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Warkworth South Plan Change:
Baseline Ecology
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Cover Illustration: SEA on southern boundary of Waimanawa Hills (a) Block.

CONTENTS

1. INTRODUCTION

Bioresearches was engaged by Osborne Hay and Tattico Limited, on behalf of their clients, to undertake an assessment of the baseline ecology within three blocks of land on either side of State Highway 1, approximately 2 – 3 km south of central Warkworth (Figure 1).

The blocks are referred to as the 'Waimanawa Valley', 'Waimanawa Hills (a)' and 'Waimanawa Hills (b)' Blocks within this report.

Waimanawa Valley Block is situated west of State Highway 1 (SH1) and is comprised of the following properties:

- 8, 30, 36, 40, 46, 83, 123 and 125 Valerie Close, Warkworth
- 1711, 1723 and 1773 State Highway 1, Warkworth
- 43, 49 and Lot 6 DP 150976 Mason Heights, Warkworth

Waimanawa Hills (a) Block is situated east of SH1 and is comprised of 1684a, 1728 and 1738 SH1, Warkworth; and Waimanawa Hills (b) Block is 1768 SH1, Warkworth.

Multiple overland flow paths are indicated on both sites and terrestrial Significant Ecological Areas (SEA-T) are associated with the south western corner of the Waimanawa Valley Block (SEA_T_2367) and the southern boundary of the Waimanawa Hills (a) Block (SEA_T_2378) (Figure 1).

This report describes the existing ecological values of the terrestrial and freshwater areas within the two property blocks.

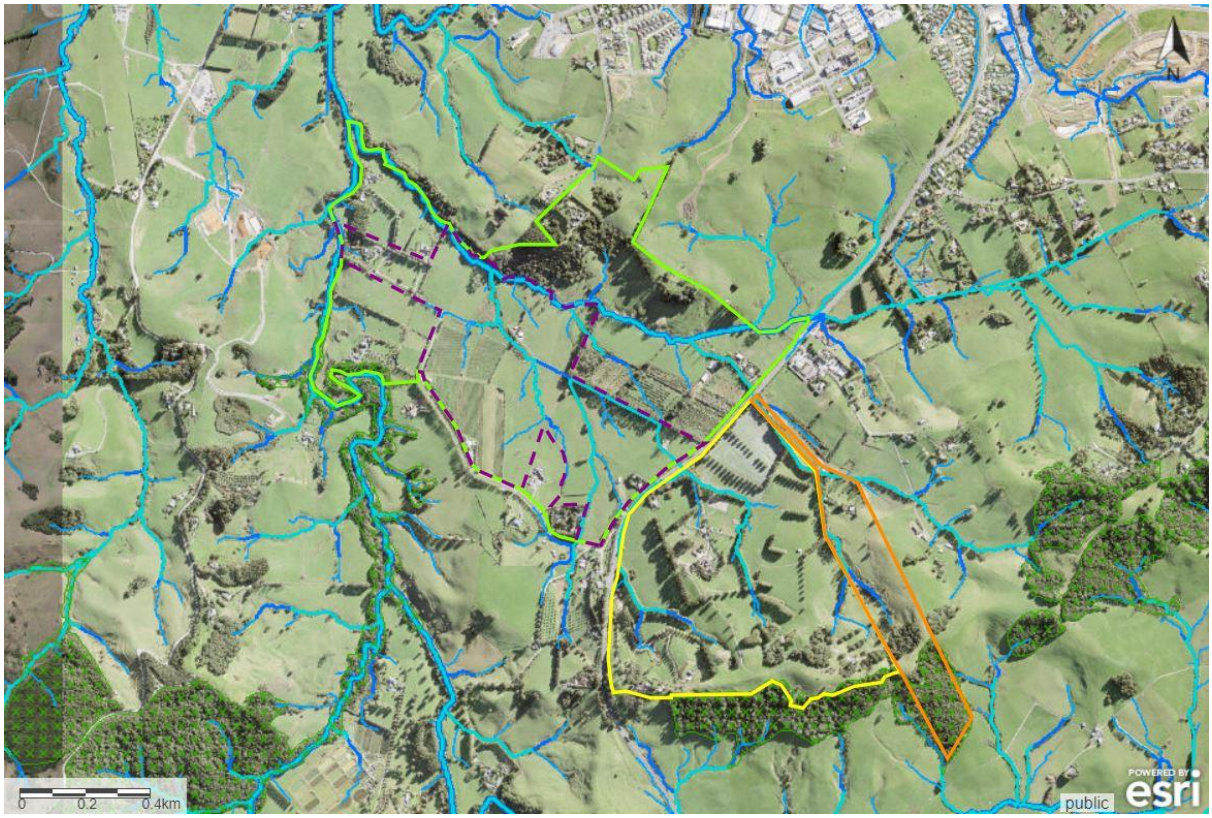

Figure 1. **Boundaries of the proposed Warkworth South Plan Change areas. Waimanawa Valley Block (green polygon), Waimanawa Hills (a) Block (yellow polygon) and Waimanawa Hills (b) block (orange polygon). The dark blue lines show the predicted overland flow paths and the green crosses show Terrestrial Significant Ecological Areas (AUP OP).**

2. METHODS

The overarching approach of this analysis and reporting is to ascertain the existing ecological values on the sites: species, communities and systems; as per the EIANZ Ecological Impact Assessment guidelines (EcIAGs) for use in New Zealand (Roper-Lindsay *et al.* 2018). This report also identifies potential constraints with respect to ecology (such as watercourses, wetlands, high value vegetation and habitats), including statutory guidelines and rules where relevant to the proposed Warkworth South Plan Change.

Using this framework, the EcIAGs describe a simple ranking system to assign value to species (Table 1) as well as other matters of ecological importance such as species assemblages and levels of organisation (Table 2).

The overall ecological value is then determined on a scale from 'Negligible' to 'Very High' (Table 3).
In addition to this assessment, all identified ecological values were assessed for significance against the Auckland Unitary Plan criteria to test ecological significance (where not already an SEA).

Table 1. Factors to be considered in assigning value to species (Roper-Lindsay *et al.* 2018).

Determining factors	Value
Nationally threatened species, found in the ZOI[1] either permanently or seasonally	Very High
Species listed as 'At-Risk' – declining, found in the ZOI, either permanently or seasonally	High
Species listed as any other category of 'At-Risk' found in the ZOI either permanently or seasonally	Moderate
Locally (ED) uncommon or distinctive species	Moderate
Nationally and locally common indigenous species	Low
Exotic species, including pests, species having recreational value	Negligible

Table 2: Attributes to be considered when assigning ecological value or importance to a site or area of vegetation / habitat / community (as per Table 4 of Roper-Lindsay *et al.* 2018).

Matters	Attributes to be considered
Representativeness	*Criteria for representative vegetation and aquatic habitats:* • Typical structure and composition • Indigenous species dominate • Expected species and tiers are present • Thresholds may need to be lowered where all examples of a type are strongly modified. *Criteria for representative species and species habitats:* • Species assemblages that are typical of the habitat • Indigenous species that occur in most of the guilds expected for the habitat type
Rarity/distinctiveness	*Criteria for rare/distinctive vegetation and habitats:* • Naturally uncommon or induced scarcity • Amount of habitat or vegetation remaining • Distinctive ecological features • National Priority for Protection *Criteria for rare/distinctive species or species assemblages:* • Habitat supporting nationally threatened or At-Risk species, or locally uncommon species • Regional or national distribution limits of species or communities • Unusual species or assemblages • Endemism
Diversity and Pattern	• Level of natural diversity, abundance and distribution • Biodiversity reflecting underlying diversity • Biogeographical considerations- pattern, complexity • Temporal considerations, considerations of lifecycles, daily or seasonal cycles of habitat availability and utilisation

[1] ZOI (Zone of Influence) in Roper-Lindsay *et al.* (2018) defines the Zone of Influence as "*the areas/resources that may be affected by the biophysical changes caused by the proposed project and associated activities.*"

Ecological context	• Site history and local environment conditions which have influenced the development of habitats and communities • The essential characteristics that determine an ecosystems integrity, form, functioning and resilience (from 'intrinsic value' as defined in RMA) • Size, shape and buffering • Condition and sensitivity to change • Contribution of the site to ecological networks, linkages, pathways and the protection and exchange of genetic material • Species role in ecosystem functioning - high level, key species identification, habitat as proxy

Table 3. Assigning value to areas (Roper-Lindsay *et al.* 2018)

Value	Determining Factors
Very High	Area rates 'High' for at least three of the assessment matters of Representativeness, Rarity/distinctiveness, Diversity and Pattern, and Ecological Context. Likely to be nationally important and recognised as such.
High	Area rates 'High' for two of the assessment matters, and 'Moderate' and 'Low' for the remainder OR area rates 'High' for one of the assessment matters and 'Moderate' for the remainder. Likely to be regionally significant and recognised as such.
Moderate	Area rates 'High' for one of the assessment matters, 'Moderate' or 'Low' for the remainder OR area rates as 'Moderate' for at least two of the assessment matters and 'Low' or 'Very Low' for the remainder. Likely to be important at the level of the Ecological District.
Low	Area rates 'Low' or 'Very Low' for majority of assessment matters, and 'Moderate' for one. Limited ecological value other than as local habitat for tolerant native species.
Negligible	Area rates 'Very Low' for three assessment matters and 'Moderate', 'Low' or 'Very Low' for the remainder.

Multiple site visits were undertaken by experienced ecologists in 2020 (23rd November), 2021, (March, April, May) and 2022 (January & February). During the visits, assessments were undertaken to:

1. Classify overland flow paths and undertake stream and wetland assessments,
2. Assess vegetation and potential fauna habitats.
3. Undertake long-tailed bat surveys

An acoustic bat survey was undertaken at the Waimanawa Hills (a) Block over April 2021 and this survey was repeated and expanded across the wider site over the summer of 2021-2022.

Prior to the field surveys, a map of the site was created from Auckland Council Geomaps GIS viewer (GIS viewer), which defined the predicted overland flow paths of the watercourses, contours of the property and any ecological overlays (Figure 1).

2.1 Terrestrial Ecology

A 'walk – through' method was employed to view, record and assess all vegetation, flora and fauna values, ascertain broad patterns of vegetation types, ages and condition.

Fauna habitats (lizards, birds, bats) were assessed qualitatively, in conjunction with database reviews (e.g. Department of Conservation's ARDs, bioweb, eBird, iNaturalist). Opportunistic fauna observations (birds seen or heard) were also recorded during the site visit.

Two acoustic bat surveys for long-tailed bats (LTB's, *Chalinolobus tuberculatus*) were undertaken:

1. At the Waimanawa Hills (a) Block from 29 March to 7 May 2021.
2. Both Waimanawa Hills (a) and Waimanawa Valley blocks from November 2021 – January 2022.

2.1.1 Acoustic bat survey

The bat surveys were undertake using Acoustic Recording devices (ARDs), set at fixed locations at the southern end of the Waimanawa Hills (a) Block (survey 1); and later across both blocks (survey 2), to identify potential edge fly-ways, foraging areas or roost trees (trees over 15 cm dbh[2] cavities, dense epiphytes) that may be used by bats over the survey period (Figure 2).

The ARDs used in this survey were the model AR4 (Department of Conservation electronics team) set 2-4 m above ground, using an extendable pole, and clear of vegetation that may interfere with recording. The ARDs were set to begin recording 30 minutes before sunset and turn off 30 minutes after sunrise, and were left in situ for 22 days.

ARDs are used to record ultrasonic echolocation calls that are produced by bats during their navigation and foraging behaviours. An ARD records the ultrasonic echolocation calls emitted by bats and converts them to frequencies that are audible to humans.

An ARD is comprised of ultrasound sensors and microphones, a sound-activated recording device, a time to turn the system on and off each day, and a rain-noise detector that turns the system off in the event of heavy, persistent rainfall. ARDs record and store data passively and remotely, and have the capacity record both long-tailed (40 kHz) and lesser short-tailed (28 kHz) bat calls, and in all directions (360^0).

2.1.1.1 Bat data analysis

ARD data were downloaded and the waveforms analysed using BatSearch 3 software (Department of Conservation, 2017). The total number of 'valid nights' was determined using climate data (CliFlo, New Zealand's National Climate Database, NIWA). Nights were considered 'valid' if the temperature remained above 10°C, and precipitation was less than 2.5 mm in the first 2 hours after dusk and there was no full moon (including nights before and after full moon).

All 'bat calls' were time (hour/minute/second) and date stamped (year/month/day) providing timing

[2] Diameter at breast height, a standard method of expressing the diameter of the trunk of a standing tree.

information for activity.

2.2 Freshwater Ecology

Watercourses were classified under the Auckland Unitary Plan Operative in Part (AUP OP) to determine, in accordance with the definitions in these plans, the ephemeral, intermittent or permanent status of these watercourses (Figure 1). The majority of watercourses were initially classified during the November 2020 site visit to provide indicative watercourse extents (Bioresearches, 2020) and confirmed during subsequent site visits. During the site assessments, the presence and extent of water was noted, reference photos were taken and freshwater habitats were marked using a handheld GPS unit. The quality of the aquatic habitat was assessed, noting ecological aspects such as channel modification, hydrological heterogeneity, riparian vegetation extent, substrate type and any fish or macroinvertebrate habitat observed. Riparian and catchment information was also reviewed.

Potential wetlands were assessed following the Ministry for the Environment's (MfE) wetland delineation protocols (Ministry for the Environment, 2020), including vegetation assessments and wetland hydrology to determine whether areas met the definition of a 'natural wetland' under the NPS-FM.

Vegetation was assessed based on the dominance and prevalence of:

- Obligate wetland vegetation (OBL) – almost always in wetlands, rarely in uplands;
- Facultative wetland (FACW) – usually occurs in wetlands but occasionally found in uplands;
- Facultative (FAC) – commonly occurs in either wetlands or uplands;
- Facultative upland (FACU) – occasionally occurs in wetlands but usually in uplands; and
- Upland (UPL) – rarely occurs in wetlands, almost always in uplands.

Where the dominance and/or prevalence tests showed unclear results, hydric soils and hydrology tests were undertaken in accordance with the associated protocols (Fraser *et al*., 2018; Ministry for the Environment., 2021)

2.2.1 Macroinvertebrates

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" (Stark *et al*., 2001). Sampling was undertaken within representative reaches, using protocol 'C2: soft-bottomed, semi-quantitative' as the streams were predominantly silt substrate. The macroinvertebrate sample was preserved in 70% ethyl alcohol (ethanol), returned to the laboratory and sorted (using protocol 'P3: full count with sub-sampling option' (Stark *et al*., 2001)). Macroinvertebrates were then identified to the lowest practicable level and counted to enable biotic indices to be calculated.

Several biotic indices were calculated, namely the number of taxa, the number and percentage of Ephemeroptera (mayflies); Plecoptera (stoneflies) and Trichoptera (caddisflies) recorded in a sample (%EPT), the Macroinvertebrate Community Index (MCI) and the Semi-Quantitative Macroinvertebrate

Community Index (SQMCI) (Stark & Maxted, 2007a). EPT are three orders of insects that are generally sensitive to organic or nutrient enrichment, but exclude *Oxyethira* and *Paroxyethira* as these taxa are not sensitive and can proliferate in degraded habitats. The MCI and SQMCI are based on the average sensitivity score for individual taxa recorded within a sample, although the SQMCI is calculated using coded abundances instead of actual scores (raw macroinvertebrate data are presented in Appendix I). For the MCI and SQMCI, respectively, scores of:

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

2.2.2 Fish Survey

To sample fish communities, single-pass electric fishing was undertaken within representative reaches. Fishing was carried out using an EFM300 backpack electric fishing machine in accordance with methodology in Joy *et al*. 2013. The electric fishing machine temporarily stuns the fish, allowing them to be caught. The species of each fish was determined, the size of each individual was estimated and the number of fish caught and fish condition (taking into account anomalies such as parasites, lesions and wounds) was recorded before fish were returned to their habitats. All fish handling was carried out by suitably qualified and experienced ecologists.

A Fish Index of Biotic Integrity (IBI) for the Auckland Region was calculated for the site based on fish species present, altitude and distance inland (Joy & Henderson, 2004). The New Zealand Freshwater Fish Database was also searched to inform whether any fish species potentially present had not been recorded during the survey.

3. EXISTING ENVIRONMENT

3.1 Overview of Fauna Values (Waimanawa Valley and Waimanawa Hills (a) Blocks)

3.1.1 Herpetofauna

Nine indigenous lizard or amphibian species have been recorded from the Rodney Ecological District, all of which are 'At Risk' or 'Threatened (Table 4). These species include some with very restricted ranges or habitat types, and would not be expected to be present within the Warkworth Area. For example, shore skink and Muriwai gecko are strictly coastal, and Hochstetter's frog are associated with forested, hard-bottom or stony streams or associated cascades within small first or second order streams that are typically free of sediment. Such environments are not present within the Waimanawa Valley or Waimanawa Hills (a) blocks, and therefore neither property has potential to support indigenous frogs.

However, six species are often recorded from regenerating forests, scrubland edges and associated ground cover and, of these, three species (forest gecko, elegant gecko and copper skink) have been recorded within 5 km of the Project areas (Waimanawa Valley and Waimanawa Hills (a) Blocks).

Table 4. Terrestrial herpetofauna of the Rodney Disctrict, corresponding NZ threat status (Hitchmough *et al.*, 2016; Burns *et al.*, 2018) and occurrence within five kilometres of the site.

	Common name	Species name	NZ threat status	Reported within 5 km of the sites	Habitat potential within Projects
Indigenous	*Mokopirirakau granulatus*	Forest gecko	At Risk – Declining	✓	✓
	Naultinus elegans	Elegant gecko	At Risk – Declining	✓	✓
	Dactylocnemis pacificus	Pacific gecko	At Risk – Relict		✓
	*Woodworthia "*Muriwai"	Muriwai gecko	Threatened- Critical		
	Oligosoma ornatum	Ornate skink	At Risk – Declining		✓
	Oligosoma moco	Moko skink	At Risk – Relict		✓
	Oligosoma smithi	Shore skink	At Risk – Naturally Uncommon		
	Oligosoma aenuem	Copper skink	At Risk – Declining	✓	✓
	Leiopelma hochstetteri	Hochstetter's frog	At Risk – Declining		
Exotic	*Lampropholis delicata*	Plague skink	Introduced & Naturalised	✓	✓
	Ranoidea aurea	Green and golden bell frog	Introduced & Naturalised		✓
	Ranoidea raniformis	Southern bell frog	Introduced & Naturalised	✓	✓

Forest gecko, elegant gecko and pacific gecko are typically arboreal (tree dwelling) and associated with regenerating scrubland and forests. Pacific and forest geckos will also inhabit clay banks and rock walls within and around such forests or scrubland.

Copper skink and ornate skink are generally found in dense ground cover or under logs or other debris around forest edge habitats. Copper skink (Not Threatened) are widespread in the Auckland Region, however ornate skinks tend to be patchily distributed, with no recognised 'hotspots' near Warkworth. Moko skinks are relatively common on offshore islands, however only have one known population in the Auckland Region at Shakespeare Sanctuary and is highly unlikely to be present.

3.1.2 Avifauna

A review of various databases (DOC fauna, inaturalist, New Zealand eBird, accessed 2 June 2021) indicates presence of a suite of common native birds throughout the Rodney Ecological District, as well as five 'At Risk' species (New Zealand Pipit; North Island fernbird; North Island kaka; North Island robin and red crowned parakeet (Robertson et al. 2016), and see Appendix 2). Coastal edges of the Ecological District support several 'At Risk' coastal bird species that are not expected to use vegetation and habitats on either the Waimanawa Valley or Waimanawa Hills (a) Blocks (the vegetation and environment does not represent the coastal habitats they use). At Risk species are discussed below:

New Zealand Pipit is 'At-Risk' (declining) on a national basis as a result of land-use intensifying (e.g. heavily grazed pasture). Pipit inhabit rough, open habitats, including farmland and could be expected to use rough, open areas of both blocks, for foraging.

North Island fernbird are often associated with wetlands, however also occur in parts of the Rodney district and beyond, in dry shrubland. Dry shrubland habitats that the species has been recorded in, within the Rodney District include Waitoki, Moirs Hill and near Puhoi. Neither of the property blocks support suitable dry scrubland habitat that fernbird could be expected to use on a permanent basis.

North Island kaka have been recorded in a few locations in Dome Valley and around Warkworth. They are considered 'rare to uncommon' on the three main islands of New Zealand but are common on many offshore islands, from which many kaka visiting the mainland commute (e.g. Great Barrier, Little Barrier, Hen & Chickens) This species is very wide ranging and is recovering (Robertson *et al.* 2017), having also benefited from the wildlife sanctuary at Tawharanui, where they are breeding, along with a few other predator-controlled mainland sites, including the Waitakere and Hunua Ranges.

Red-crowned parakeet utilise a wide variety of habitats, from heavily forested to open grasslands. However, they are largely restricted to predator free islands and pest free sanctuaries (e.g. Tawharanui) and while a few records occur for this species at Leigh and Big Omaha and the Tawharanui Peninsula, these records are likely to represent vagrants from pest-controlled sanctuaries.

North Island robin is restricted to large forest blocks in the central North Island, except where populations have been translocated. This species is not expected to occur near the site, even on an intermittent basis.

3.1.3 Long tailed bats

The Department of Conservation's National bat database identifies long-tailed bat records throughout the Rodney District, including pine forest at Riverhead Forest, between Puhoi and Warkworth and Dome Valley. Several bat records occur within 2 km of the Waimanawa Hills (a) Block, to the south and west.

Long-tailed bats are Nationally 'critical' (O'Donnell et al. 2018) and is a high priority for conservation. Their value is therefore '**Very High**' under EIANZ criteria for valuing species. However, because they have very large home ranges (c. 100 km^2), it is not uncommon for bats (often solitary individuals) to be detected flying over open areas at great distance (10 km +) from their roost or foraging habitats.

Because they are a highly mobile species, (they can travel over 10 km between roosts and foraging areas), and that there are multiple records for this species within 10 km of both the Waimanawa Valley and Waimanawa Hills (a) property blocks, it is possible that bats pass through the properties, at least intermittently.

However, long-tailed bats are also known to use different parts of their habitat within their home ranges at different times of the year. For this reason, non-detection of bats at other parts of the investigation area would not infer that these areas, or even SEA_T5349, are not of importance to bat habitat at other times of the year.

Large trees with potential roost habitat were observed at both the Waimanawa Hills (a) and Waimanawa Valley property blocks. Some of these trees, including exotic species, such as macrocarpas, support features that would be suitable for communal roosting. A communal roost would be highly significant, given such trees are a limited resource to critically endangered bats.

Survey results

No bat activity was recorded from survey 1 at the Waimanawa Hills (a) block over late summer-autumn 2021. That survey covered 18 valid survey nights, with four nights discounted from analysis due to rainfall and full moon phase. Nightly temperatures remained above 10° C.

One location at the Waimanawa Valley block recorded 17 bat passes from 59 valid survey nights during survey 2 (November 2021-January 2022, Table 5). This survey was valid for a 59 useable nights per recorder (three nights excluded for the December full moon and three nights excluded due to high rainfall). Across five ARDs, this equates to 295 total surveyed nights.

ARD, P (Photo 1) recorded 17 passes over the two-month period. This ARD was located in the south western corner of the Waimanawa Valley block along a stream Figure 2.

Table 5. Results of the two bat surveys undertaken in the Waimanawa Valley and Waimanawa Hills (a) blocks in 2021 and 2022.

Survey	ARD	Start date	End date	Total nights	Full moon nights	Rainfall over 20 mm	Useable nights	Passes
1	G	30/03/2021	11/04/2021	12	2	1	9	0
	N	30/03/2021	20/04/2021	21	2	1	18	0
2	P	22/11/2021	26/01/2022	65	3	3	59	17
	F	22/11/2021	26/01/2022	65	3	3	59	0
	J	22/11/2021	26/01/2022	65	3	3	59	0
	B	22/11/2021	26/01/2022	65	3	3	59	0
	1	22/11/2021	26/01/2022	65	3	3	59	0

Photo 1. ARD P along stream in the south western corner of the Waimanawa Valley block.

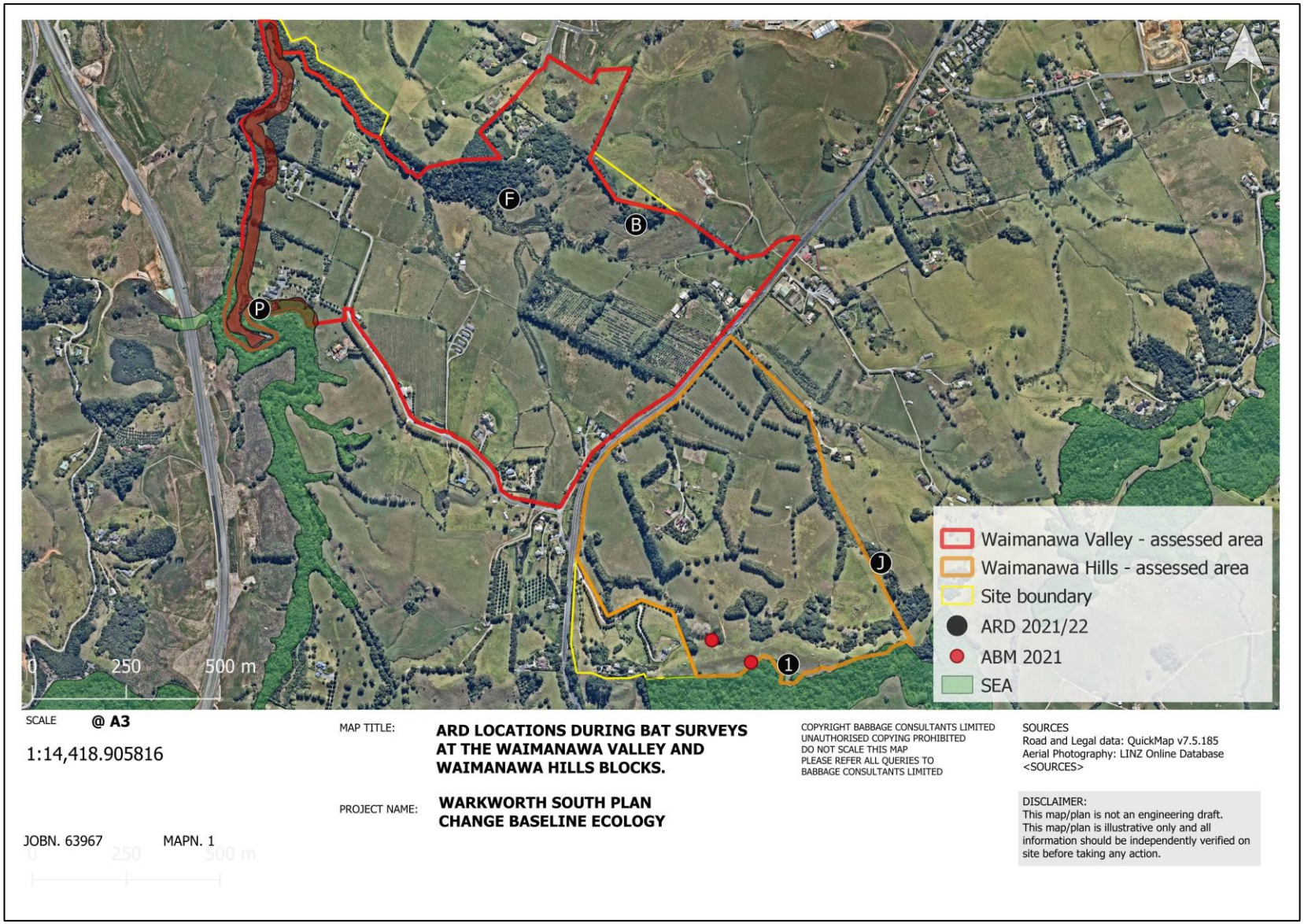

Figure 2. ARD locations of the two bat surveys in 2021 and 2022 at the Waimanawa Valley and Waimanawa Hills Blocks in Warkworth.

3.2 Waimanawa Valley Block: Background and Ecosystem Classification

Historically (pre-human), the Waimanawa Valley block would have comprised of a mixture of kauri, podocarp, broadleaved forest (WF11; Singers *et al.,* 2017) and taraire, tawa, podocarp forest ecosystem types (WF9; Singers *et al.,* 2017). These forest ecosystems are characteristic of the Rodney Ecological District, which is characterised by a hilly topography with warm, sub-humid-humid climate and generally fertile soils (favouring WF9 forest types) or leached soils, particularly on steeper hillsides (favouring WF11 forest types).

Historical aerial images show that the SEA within the site has remained largely intact over the last 55 years, and its apparent intactness in 1966 imagery (Figure 3) indicates that this vegetation, including that described as regenerating kānuka forest is probably over 100 years old in parts. However as with the surrounding landscape, much of the property is generally devoid of naturally occurring native vegetation and its current use is for agricultural purposes. Currently, the site consists of a few small dwellings, paddocks, an orchard, the scrub and the area of SEA-T vegetation.

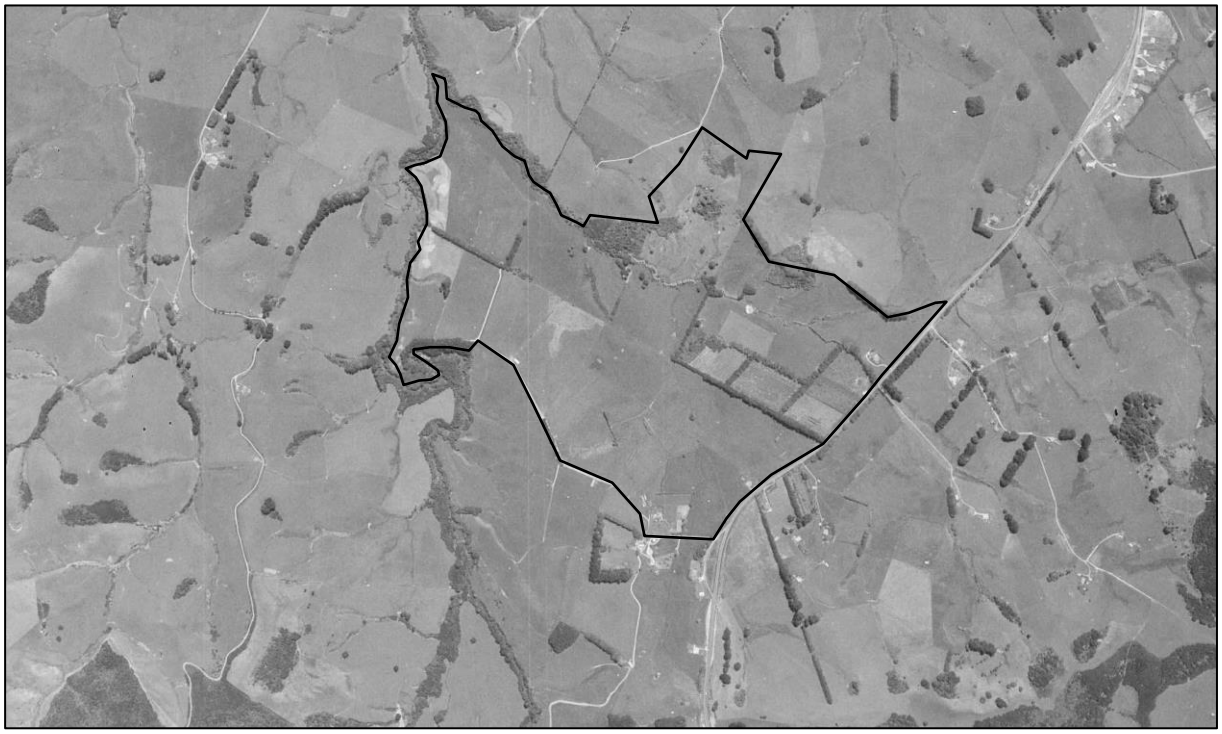

Figure 3. Historical aerial image of the Waimanawa Valley block from 1966 (black polygon), showing vegetation cover similar to what currently exists on site. Image obtained from Retrolens.

3.2.1 Vegetation cover

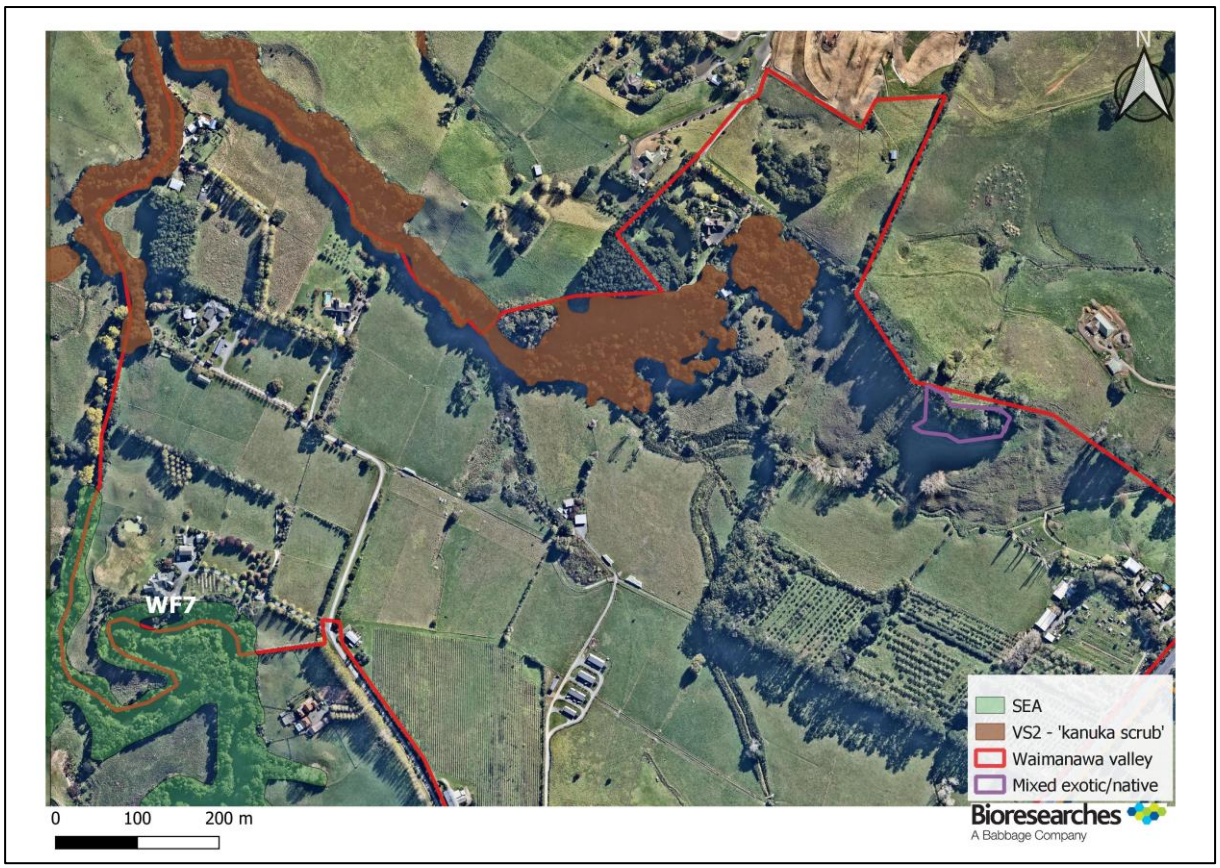

Figure 4. Indigenous vegetation cover of the Waimanawa Valley, Warkworth.

3.2.1.1 Significant Vegetation (SEA)

SEA_T_2367 is located within the south-western corner of the property and covers an area of mature, indigenous riparian vegetation along the right arm of the Mahurangi River. The ecosystem type is classified as pūriri forest (WF7) under the AUP OP, a 'Critically Endangered' ecosystem type (Singers *et al*. 2017). SEA_T_2367 triggers significance under AUP SEA criteria (Schedule 3; AUP OP) 'Representativeness', 'Threat status and rarity' and 'Diversity'. Vegetation biodiversity and abundance is predominantly indigenous throughout, and several flora species are listed as 'Threatened' or 'At Risk' (de Lange *et al.,* 2018).

The SEA supports and established canopy, comprised predominantly of mature native trees including kānuka (*Kunzea robusta*) and pōhutukawa (*Metrosideros excelsa*). The sub-canopy consists of species including karaka (*Corynocarpus laevigatus*), māpou (*Myrsine australis*) and māhoe (*Melicytus ramiflorus*) with exotic trees and shrubs common throughout. The vegetation was also subject to moderate levels of weed infestation, including several listed pest plants such as wild ginger (*Hedychium gardnerianum*) and tradescantia (*Tradescantia fluminensis*).

3.2.1.2 Other Indigenous and protected vegetation

An area of riparian vegetation along the north-western and northern boundaries of the site is classified as kānuka scrub/forest (VS2) under the AUP OP, a regenerating ecosystem with a threat status of 'Least Concern' (Singers *et al.* 2017). This vegetation extends beyond the riparian margin to cover a south-

facing hillside and of approximately 3.3 ha of the property at 49 Mason Heights, Warkworth. While this vegetation is in a regenerating state and is still predominantly a kānuka forest type, it is successional and supports emergent conifers, including kauri, kahikatea and totara, which are characteristic of a kauri, podocarp forest type that would have formerly occurred on the site.

Approximately 150 m east of this vegetation, is a smaller fragment (approx. 0.6 ha) of mature, mixed native and exotic vegetation that sits at the northern boundary of property at 1773 State Highway 1, and is fenced from stock (Photo 2). This smaller fragment supports a mixture of native podocarp and broadleaved trees, including tōtara (*Podocarpus totara*); rimu (*Dacrydium cupressinum*); kahikatea (*Dacrycarpus dacrydiodes*); pūriri (*Vitex lucens*); and kauri (*Agathis australis*). This fragment has a low level of connectivity to the larger regenerating system described above through a line of hilltop trees (pines and macrocarpa) and weedy scrub, which also feature throughout the fragment. Some of the trees, including a rimu at the edge, appear to be in very poor health.

Photo 2. Smaller fragment of native and exotic vegetation.

3.3 Terrestrial Ecology Values of Waimanawa Valley Block

This section covers areas of indigenous vegetation fragments and features; however it should be acknowledged that hedgerows, including those dominated by exotic species, may provide habitat for indigenous lizards or long-tailed bats. More comprehensive assessments are recommended to be undertaken during the summer period, when these faunas are more active.

The terrestrial ecology values of the Waimanawa Valley Block are associated with indigenous vegetation features in the SEA, regenerating kanuka forest, and the mixed native and exotic fragment. These vegetation features generally support diverse flora assemblages that are representative of the forest ecosystems that would have formerly covered the surrounding landscape. While only SEA 2367 is identified by the AUP as a mature forest ecosystem type ('critically endangered' Pūriri forest), the kānuka forest and smaller fragment clearly support components of a kauri, podocarp, broadleaved forest type (Regionally Endangered, Singers *et al.* 2017). The kānuka forest appears to be transitioning to this forest type in parts, and the smaller block, which was formerly grazed underneath, supports mature components and is recovering with weedy and indigenous regeneration beneath the canopy.

3.3.1 SEA Vegetation

Overall, the **SEA vegetation is of Very High value**, where it represents a critically endangered ecosystem, supports threatened species, and provides both riparian buffer function and important connectivity to other high value fragments through the landscape. Nationally critical long-tailed bats were recorded at the south western corner of the property, where 17 passes were recorded from 59 valid survey nights. This indicates regular, but not 'high' activity. A lack of passes elsewhere within the site (e.g. Kanuka forest along the northern edge), suggests that the location of bat activity at the edge of the site is not a major commuting corridor for bats. Historic records of bats associated throughout large areas of forest and forestry to the west of the project are known to support bat populations, from which some individuals forage along parts of the Mahurangi River, and as far as the project area. On this basis, 'representativeness', 'rarity / distinctiveness' and ecological context, as per Table 2, are all 'high' and confer an overall value of Very high (Table 3).

3.3.2 Kānuka forest

The kānuka forest is predominantly native, with the expected species of a regenerating system being present. While not surveyed, a full suite of common indigenous avifauna are expected to use this vegetation, as well as some rarer, intermittent species that are periodically recorded in the surrounding landscape, such as kaka, as the emergent conifers begin to provide food resources. 'Representativeness' is considered high.

No unusual species or communities are present, although, while this forest type is considered 'least concern' it appears to be transitioning to a podocarp forest type of higher value. It is potential habitat for a range of native lizard species, including copper and ornate skinks, as well as forest, elegant and pacific geckos, and it is likely that at least one or two of these species is present. All of these species, except copper skink, have a conservation ranking of Nationally 'At Risk'. Rarity / distinctiveness is considered to be moderate.

While a relatively small fragment in the context of other indigenous forest fragments in the surrounding landscape, the kānuka forest does provide riparian buffer and connectivity along the riparian corridor. Ecological Context is Moderate.

Overall, the **kānuka forest is assessed to have Moderate value**, and would also qualify as 'Significant' under Auckland Councils criteria for 'representativeness' and probably also 'threat status and rarity' (the vegetation does support kauri trees, and indigenous reptiles are likely to be present). The fragment also provides important landscape connectivity.

3.3.3 Mixed exotic / native species fragment

This smaller, fenced fragment of mature trees with a regenerating understory is relatively weedy and while predominantly native, is highly influenced by historic grazing, which has removed a lot of the understory and subcanopy, and with it, forest structure and edge buffer. It is a relatively small fragment with limited connectivity, and therefore 'representativeness', 'ecological context' and 'diversity / pattern' rate low for this fragment.

No unusual species or communities are present, although, while this fragment is not provided an ecosystem classification in accordance with (Singers *et al.* 2017), it is considered to be a somewhat poor quality, but recovering (endangered) kauri podocarp, broadleaved forest type. The mature native trees that make up most of the value of this feature, include 'Threatened' kauri and may be visited intermittently by 'At Risk' North Island kaka, which hold moderate value. Other 'At Risk' fauna species that may be present include forest and pacific geckos, which have 'high' and 'moderate' values, respectively, however any lizard values present are likely to represent 'relic' individuals with some low to moderate potential to recover with habitat management. Overall, rarity / distinctiveness is considered to be conservatively high, on the basis of the ecosystem type, presence of a threatened species and potential presence (intermittently or permanently) of other high value fauna.

Overall, the **mixed exotic / native species fragment is Moderate value,** on the basis of no existing fauna survey information (e.g. bats, lizards). This fragment would also qualify as 'Significant' under Auckland Councils criteria for 'threat status and rarity' on the basis of ecosystem type and presence of kauri.

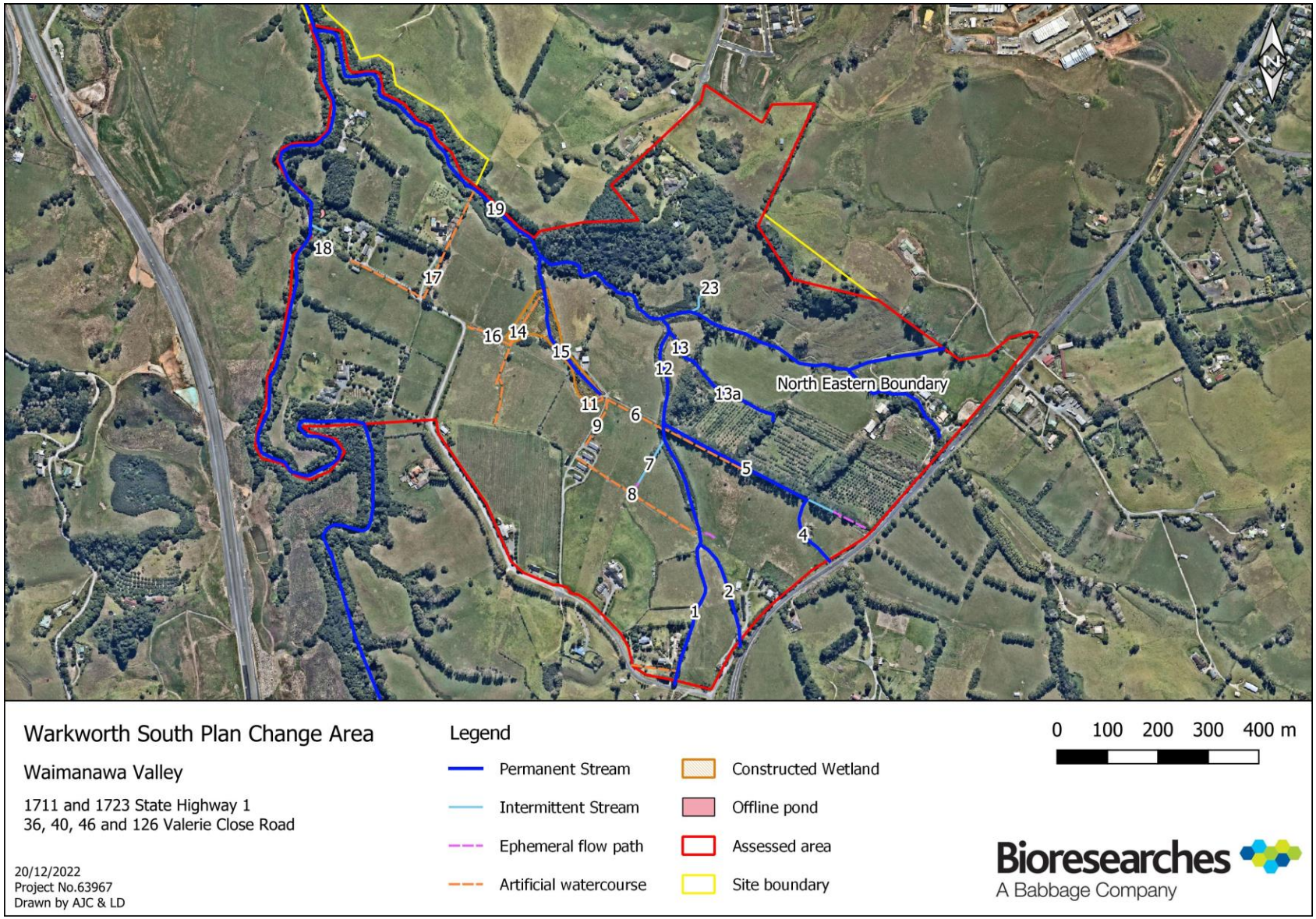

Figure 5: Ground-truthed and classified watercourses and wetlands on the Waimanawa Valley block.

3.3.4 Freshwater Ecology

The GIS viewer indicated several watercourses across the site (Figure 1). These were ground-truthed and classified during the site visits as either permanent streams, intermittent streams, ephemeral flow paths, artificial watercourses, artificial/constructed wetlands and offline ponds (Figure 5). Details of the watercourse classifications can be found in the constraints report (Bioresearches, 2020). The waterways are all tributaries of the Mahurangi River. The Mahurangi River consists of two main branches, the right branch flowing from near Pohuehue, south of the site, and the left branch flowing from the Dome Forest. The two branches converge near the north west corner of the site and then flow eastwards before discharging to the Mahurangi Harbour.

3.3.4.1 Watercourses 1, 2 and 12

The ecological values of watercourses 1, 2 and 12 are considered to be **Low**.

Watercourses 1 and 2 were both permanent flow paths that join together, approximately 250 m downstream from where they enter the site, to become watercourse 12. Watercourses 1 and 2 were relatively small, with an average width of approximately 1.08 m, and average depth of approximately 0.21 m. There were reaches that were very shallow (0.03 m deep), along with areas of deep pools and runs. Flow was generally relatively slow. Fine sediment formed the dominant substrate, however substrate also included woody debris, leaf litter and root mats. When disturbed, the sediment released a sulphurous smell indicative of an anoxic environment.

The channels were highly incised, with banks greater than 0.5 m in height. The banks also exhibited significant undercutting in a number of locations, as well as large amounts of overhanging vegetation and exposed roots. The incised banks, as well as the riparian vegetation resulted in variable levels of channel shading, ranging from almost none, to a high level of shading. Both macrophyte and periphyton coverage were low, likely due to the high level of shading. Riparian vegetation was dominated by exotic species in watercourses 1 and 2, including poplar (*Populus* spp.), caterpillar grass (*Eremochloa ophiuroides*), barberry (*Berberis* spp.), privet (*Ligustrum* spp.), pampas (*Cortaderia* spp.), ryegrass (*Lolium perenne*), buttercup (*Ranunculus repens*) and soft rush (*Juncus effusus*). Trees and shrubs grew to approximately 5 m from the stream edge, before transitioning to grazed grass.

Of note, were a number of old concrete beams that lay across the watercourse (Photo 3). These are likely to present at least a partial barrier to fish passage. Also of note were pockets of iron floc in the watercourse, suggesting an interaction with groundwater. It is highly likely the watercourse has been deepened and straightened at some stage in the past, potentially to facilitate more efficient drainage of adjacent land.

An electric fishing survey downstream of the confluence of watercourses 1 and 2 did not yield any fish (Photo 4). A macroinvertebrate sample collected from watercourse 2 contained only six individuals which is not enough to generate an accurate MCI/QMCI or other index. The six individuals included the New Zealand mudsnail *Potamopyrgus antipodarum*, and chironomids. Both species are highly tolerant of degraded habitat and water quality.

Downstream of the confluence, the watercourse became narrower and much shallower. Substrates were still predominantly fine sediment, however there were occasional small areas of small gravel. Flow was still slow, and was dominated by slow, shallow runs, with occasional deeper pools and runs. Banks remained in a similar condition to upstream and provided variable levels of shade. Low quantities of watercress (*Nasturtium officinale*) and water pepper (*Persicaria hydropiper*) were present. Riparian vegetation included harakeke (*Phormium tenax*), *Carex* sp., kānuka, as well as caterpillar grass, buttercup, blackberry, barberry, and blue morning glory.

Electric fishing near the confluence of watercourses 2, 5 and 6 (Photo 5) found one shortfin eel (*Anguilla australis*, 350mm in length). Table 6 summarises other fish species that have been found in the Mahurangi River catchment.

At the downstream extent, watercourse 12, the stream path appeared to be more natural with no obvious signs of works to deepen or straighten the flow path. The channel was less incised than upstream, however banks were still relatively steep and there was evidence of erosion and bank undercutting in some parts. Shading was much lower than upstream due to little to no canopy, and less incised banks, and as a result macrophytes were more prevalent, covering 30-100% of the channel. Macrophytes present included water pepper, parrots feather (*Myriophyllum aquaticum*), and watercress.

Riparian vegetation around watercourse 12 was contained within a fenced section, approximately 10 m from the wetted edge on both banks. The riparian yard had been recently planted and was in the early stages of succession. Species present included harakeke, cabbage trees (*Cordyline australis*), kānuka, *Carex* sp., giant rush (*Juncus pallidus*), and rank grass (Photo 6).

A macroinvertebrate sample collected from the reach contained a moderate diversity macroinvertebrate community, dominated by pollutant tolerant taxa (14 taxa, %EPT = 7%, MCI = 94 (Fair), QMCI = 3.5 (Poor)). The community was dominated by the damselfly *Xanthocnemis zealandica*, and the amphipod *Paracalliope fluviatilis*. A single EPT individual, the caddisfly *Polyplectropus puerilis* was found.

Table 6: Records of freshwater fish and large invertebrates the NZFFD for sites within the Mahurangi River catchment. Threat classification is from Dunn *et al.* 2017.

Species name	Common name	Threat classification	Recorded on site
Anguilla australis	Shortfin eel	Not Threatened	✓
Anguilla dieffenbachii	Longfin eel	At Risk - Declining	
Ctenopharyngodon idella	Grass carp	Introduced and Naturalised	
Galaxias fasciatus	Banded kōkopu	Not Threatened	
Galaxias maculatus	Īnanga	At Risk - Declining	
Gambusia affinis	Gambusia	Introduced and Naturalised	
Gobiomorphus basalis	Crans bully	Not Threatened	
Gobiomorphus cottidanus	Common bully	Not Threatened	
Gobiomorphus huttoni	Redfin bully	Not Threatened	
Echyridella spp.	Kākahi/freshwater mussel	At Risk - Declining	
Paranephrops planifrons	Kōura	Not threatened	

Photo 3: Concrete beams spanning the channel of watercourse 2.

Photo 4: Area downstream of the confluence of watercourses 1 and 2 where fishing occurred.

Photo 5: Watercourse 2 downstream of confluence with watercourse 5

Photo 6: Watercourse 12, including establishing riparian vegetation.

3.3.4.2 Watercourses 4 and 5

The ecological value of watercourses 4 and 5 is considered to be **Low**.

Watercourse 4 flows into the site from the eastern property boundary, and the adjacent Waimanawa Hills (a) Block on the opposite side of SH1. Upstream of the boundary, the stream flows through land similar to that within the site (i.e. predominantly pasture). The watercourse contained shallow, very slow flowing run habitat and the channel was approximately 0.7 m wide (Photo 7). Silt sediment dominated the stream bed and parrots feather covered 50-80% of the stream (Photo 7). The banks were highly incised, undercut, and showed evidence of collapse in a number of locations. It is likely the channel has been artificially deepened and straightened at some stage. The riparian zone was fenced to approximately two metres from the stream. Within the fenced area, vegetation was dominated by rank grass, while outside of the fenced area, grass was subject to stock grazing and a row of poplars was present in the upper reaches.

At the downstream end of watercourse 4, it flows through a culvert and into watercourse 5.

Watercourse 5 flows between a driveway and the row of shelter providing macrocarpa (*Cupressus macrocarpa*) (Photo 8). There was limited variation along its length. It had an average width of 0.87

m but reached widths of >1.3 m in parts. It was mostly very shallow, ranging in depth from 0.02 m to 0.14 m. The stream mostly consisted of slow shallow runs, however there were a small number of deeper pools present throughout. The channel has been artificially constructed to divert the waterway around the orchard that is located on the northern site boundary. Originally, the channel would have connected waterways 4 and 13 and was diverted prior to 1966 (Figure 2).

The watercourse is highly incised, and the banks are collapsing in parts. Substrate is again dominated by fine sediment, however there are rare, small patches of cobbles and gravels, potentially sourced from the driveway, or deposited during channel construction. On the true right bank, a row of macrocarpa and short grass formed the riparian vegetation. On the true left bank vegetation consisted of a narrow strip of rank grass and privet, then the gravel driveway. The macrocarpa provided a good level of shade to the stream.

An electric fishing survey of the waterway yielded no fish.

The waterway then flows into watercourse 12.

Photo 7: Watercourse 4, looking upstream. Note water flow is present beneath the macrophyte growth.

Photo 8: Watercourse 5 looking upstream.

3.3.4.3 Watercourse 13

The ecological value of watercourse 13 is considered to be **Low**.

Watercourse 13 is the historic outlet for the natural flow path between the current watercourses 4 and 13. As flow is now diverted through watercourse 5, flow within watercourse 13 is likely to be significantly less than what it was prior to diversion. The channel drains the area of orchard in the north eastern portion of the site. The watercourse was similar to watercourse 12, which was also the receiving environment. Riparian vegetation was dominated by exotic species, however there were sparse planted harakeke, cabbage tree, mānuka and kahikatea (*Dacrycarpus dacrydioides*) present along its length (Photo 9).

Upstream of watercourse 13 (13a), the banks flatten for a short section and the channel becomes wide and boggy (Photo 8).

Photo 9: Watercourse 13 viewed from the edge of the orchard, looking downstream.

Photo 10. Watercourse 13 looking upstream into the orchard.

3.3.4.4 Watercourse 13a

The ecological value of watercourse 13a is considered to be **Low**.

Watercourse 13a represents the original flow path of the what is now watercourse 5. Only part of this original flow path remains present (as indicated on Figure 5). Upstream of this area, there is a depression that indicates where the rest of the path would have been, however this is no longer considered to be a waterway in any form. The remaining channel contained areas where there was no water, however were highly incised (Photo 11), shallow and wide (3-4m in width) (Photo 12), and disconnected pools at various locations along the length. Where no water was present, buttercup and mercer grass (*Paspalum distichum*) were present.

Riparian vegetation included mixed natives and exotics including ferns, māhoe (*Melicytus ramiflorus*), privet and ivy (*Hedera spp.*), among others. Upstream of the channel, and in the paddock on the true left bank, an orchard growing apples and other fruit, occupies the area.

Photo 11: Dry, incised channel within watercourse 13a.

Photo 12: Wider shallower portion of watercourse 13a with some surface water present.

3.3.4.5 North Eastern Boundary Waterway

The ecological value of the north eastern boundary waterway is considered to be **Low**.

A watercourse forms the north eastern boundary of the site. This watercourse flows from under SH1, draining adjacent rural lifestyle properties within the Waimanawa Hills (a) Block (Photo 13). The channel was approximately one metre in width, relatively incised, and there were areas of bank undercutting and erosion along its length. The substrate was soft, and there was a reasonable amount of leaf litter and woody debris within the channel, creating fish and macroinvertebrate habitat. Shading was variable. Where there was established riparian vegetation in the lower reaches of the watercourse, shading levels were high (Photo 14), however in the upper reaches, riparian vegetation was limited to rank grass, providing limited shading. Vegetation in the lower reaches included arum lily (*Zantedeschia aethiopica*), privet, willows, gorse (*Ulex europaeus*), cabbage tree, poplars and flax, among others. Macrophytes were present in patches, including water pepper, water celery (*Apium nodiflorum*) and buttercup.

In the hills on the true right bank are a number of natural springs.

Photo 13: The true left waterway (channel on the right of the image) shows where watercourse 36 from the Waimanawa Hills (a) Block on the other side of SH1 flows into the eastern boundary watercourse.

Photo 14: The eastern boundary watercourse flowing through the vegetated area at the downstream extent.

3.3.4.6 Watercourse 23

The ecological values of watercourse 23 and the associated natural wetland area is considered to be **Low.**

At the base of the gully, an area dominated by mercer grass, with soft rush, broom rush and budding clubrush (*Isolepis prolifera*) growing sparsely throughout (Photo 15). Yorkshire fog, common bent (*Agrostis capillaris*), buttercup and were also present, predominantly on the edges of the wetland. Native vegetation biodiversity and abundance was low. A farm crossing was observed running through the area with a small culvert present (Photo 16). Aquatic habitat was limited to boggy ground among vegetation.

At the downstream end of the wetland, an intermittent stream flows under a row of mānuka trees and drains into watercourse 19. Water was very shallow (<0.05 m) and hydrological conditions consisted of a run. Substrate was predominantly silt with some small woody debris. The Riparian vegetation provided moderate shading and no macrophytes were observed in the stream. As such, aquatic habitat quality and abundance was considered very low.

Photo 15: The wetland was dominated be mercer grass.

Photo 16: The farm track split the wetland in two.

3.3.4.7 Watercourse 15

The ecological values of watercourse 15 and the associated constructed wetland area is considered to be **Moderate**.

Watercourse 15 acts as the receiving environment for a number of artificial watercourses (6, 8-11). This watercourse appeared to have a small meander and contours show that this flow path is the low point of the surrounding area, suggesting water flow through here is likely to be natural (Photo 17). Water from the channel flows into a man-made pond (Photo 18), then into a narrow, well-defined channel. Below the pond, the watercourse continued to flow through a well vegetated and shaded channel before discharging into watercourse 19 (Photo 19). The channel itself, as well as the pond, is likely to provide habitat for fish such as eels. The substrate was predominantly soft-bottomed, with runs and pools was present along its length.

The riparian area of the waterway is part of a well vegetated, constructed and fenced wetland area (Photo 20). Approximately 15 years ago, the area surrounding watercourse 15 consisted of dry pasture. A small dam was constructed on the watercourse in order to slow flow (the man-made pond is the outcome of this dam). The surrounding area was then fenced and planted with wetland vegetation. Vegetation in this area included carex (*Carex* spp.), kahikatea, flax, pampas grass (*Cortaderia selloana*), Yorkshire fog (*Holcus lanatus*), giant rush (*Juncus pallidus*), broom rush (*Juncus sarophorus*), water pepper (*Persicaria hydropiper*) and crack willow (*Salix fragilis*). Despite the constructed nature of the wetland, it provides important habitat and buffering functions to the watercourse. Despite being constructed, it is a relatively rare example of wetland habitat in an area where it would have historically been much more prevalent.

Photo 17: Watercourse 15 within the wetland area.

Photo 18: The pond at the downstream end of the constructed wetland.

Photo 19: Watercourse 15 downstream of the wetland area, before it discharges into watercourse 19.

Photo 20: Wetland area surrounding watercourse 15.

3.3.4.8 Watercourse 19

The ecological value for watercourse 19 is considered to be **Moderate**.

Watercourse 19 is the receiving environment for the majority of the watercourses within the Waimanawa Valley and Waimanawa Hills (a) Blocks. It was wide (5-10m in width), and deep enough that it was not wadeable for the entire width (Photo 21). Substrates were dominated by soft fine sediment, and there was a reasonable amount of leaf litter and woody debris. Undercut banks and erosion were present periodically throughout its length. The waterway provides good habitat for fish and macroinvertebrates, and it is considered likely that 'At Risk – Declining' longfin eel (Dunn *et al.* 2017) are present in the waterway, at least intermittently. The watercourse discharges to the north branch of the Mahurangi River, to the north west of the site.

The riparian area was predominantly well vegetated, which in turn, provided a high level of shading, riparian buffering, and filtering values. A description of the riparian vegetation for this area can be found in section 3.3.2

Photo 21: Watercourse 19, just upstream from the confluence with watercourse 15.

Photo 22. Watercourse 24, darker green vegetation indicated a hydric area.

3.3.4.1 Watercourse 24

The ecological values of watercourse 24 is considered to be **Low**.

The area was not ground-truthed, however the vegetation appeared to be hydric due to the clear colour change (Photo 20) and contained rushes (likely soft rush) and potentially a hydric grass such as mercer grass. The area was small and no aquatic habitat was observed.

3.3.4.2 Watercourse 18

The ecological value of watercourse 18 is considered to be **Negligible**.

Watercourse 18 is an intermittent waterway that flows directly into the right branch of the Mahurangi River. At the time of the site visits, no flow was present in the channel, however the presence of rooted macrophytes (water celery) throughout the channel suggests it does frequently contain water (Photo 23). A pipe discharges to the top portion of the channel and it is considered this pipe provides the main source of water (Photo 24).

Photo 23: Water celery within watercourse 18.

Photo 24: The top of watercourse 18 where a pipe discharges to the channel.

3.3.4.3 Watercourse 7

The ecological value of watercourse 7 is consider to be **Low**.

Watercourse 7 is an intermittent stream that flows into watercourse 2 through a culvert. The channel flows along the boundary of a pasture filled paddock, starting from approximately halfway along its north western boundary. The channel has been subject to pugging, and therefore is considered to be wider and shallower than it would naturally be (Photo 25). The channel contained some water during the site visit, however no flow was discernible in many places. The substrate was soft, and partially vegetated with macrophytes including starwort (*Callitriche stagnalis*), water pepper and watercress. Shading of the channel was low, except in the lower reaches were a small number of willows (*Salix* sp.) were present on the true left bank (Photo 26). The channel is unlikely to provide any fish habitat or habitat for macroinvertebrates that are not tolerant of degraded habitat conditions.

Photo 25: Watercourse 7 at the upper end showing shallow boggy ground and macrophytes.

Photo 26: Intermittent watercourse 7 at the downstream end, looking downstream.

3.3.5 Summary of Waimanawa Valley Block Freshwater Ecological Values

Table 7 provides a summary of the freshwater ecological values within the site. The values of the site ranged from Negligible to Moderate within the site.

Table 7: Summary of the freshwater ecological values on site.

Ecological Feature	Assigned ecological value	Reasoning
Watercourses 1, 2 and 12	Low	• Degraded instream habitat • Artificially straightened and deepened • Limited value riparian vegetation • Common, not threatened fish in very low numbers
Watercourses 4 and 5	Low	• Degraded instream habitat • Artificially straightened and deepened, main flow diverted into constructed channel • Limited value riparian vegetation
Watercourse 13	Low	• Short section of natural channel • Limited riparian vegetation despite indigenous species present • Degraded instream habitat
Watercourse 13a	Low	• Artificially straightened channel • Limited water present on a permanent basis • Main flow has been diverted upstream to another channel
North Eastern Boundary Waterway	Low	• Degraded instream habitat • Limited riparian vegetation
Watercourse 23	Low	• Wetland contained low indigenous vegetation biodiversity and abundance • Stock access caused degradation to stream and wetland • Minimal aquatic habitat and riparian vegetation
Watercourse 24	Low	• Wetland contained low indigenous vegetation biodiversity and abundance • Stock access caused degradation to stream and wetland • Minimal aquatic habitat and riparian vegetation
Watercourse 15	Moderate	• Relatively natural stream flow path • Fenced constructed wetland with good indigenous planting • Wetland habitat relatively uncommon in wider area
Watercourse 19	Moderate	• Relatively unmodified, moderate sized river • Good riparian vegetation including indigenous species • Good fish habitat and macroinvertebrate habitat • Likely presence of At Risk – Declining longfin eel
Watercourse 18	Negligible	• Intermittent waterway likely to have water very irregularly • No instream habitat
Watercourse 7	Low	• Highly degraded channel, with intermittent flow • Stock have access to channel • Limited riparian vegetation and no instream habitat

3.4 Waimanawa Hills (a) Block: Background and Ecosystem Classification

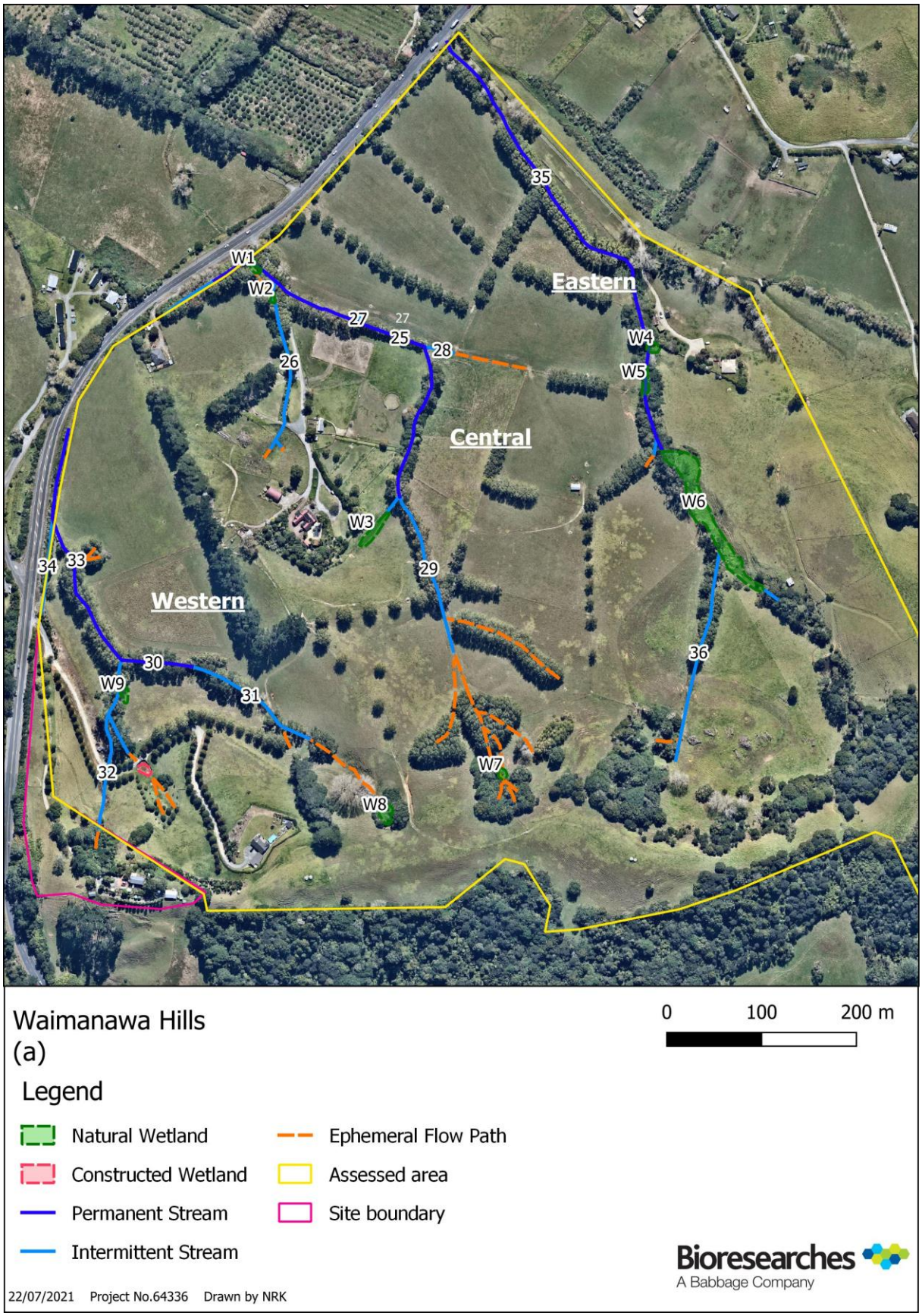

Figure 6. Ground-truthed aquatic features located within the Waimanawa Hills (a) Block.

3.4.1 Background and Existing Environment

Historically, the Waimanawa Hills (a) Block would have comprised of 'Kauri, podocarp, broadleaved forest' (WF11; Singers *et al*., 2017), which was the dominant ecosystem type over most of the Rodney Ecological District. Prior to 1970, the site was cleared of almost all native vegetation (Figure 7), and the land developed for agricultural purposes.

Currently, predominantly exotic shelter belts (e.g. macrocarpa, poplars) demarcate pasture areas while three small fragments (0.1 ha; 0.2 ha; 0.9 ha respectively) of indigenous vegetation remain at the southern end of the site.

At the southern boundary, SEA_T_2378 covers Avice Miller Scenic Reserve, a Department of Conservation managed indigenous forest fragment. The SEA overlay on the fragment extends to some 8,500m^2 of vegetation within the boundary of the Waimanawa Hills (a) Block. This vegetation is 'Kauri, podocarp, broadleaved forest' (WF11; Singers *et al*., 2017), and endangered ecosystem type (Singers *et al.* 2017).

Figure 7. Historic aerial image from 1970 showing the site to be void of native vegetation

3.4.2 Vegetation cover

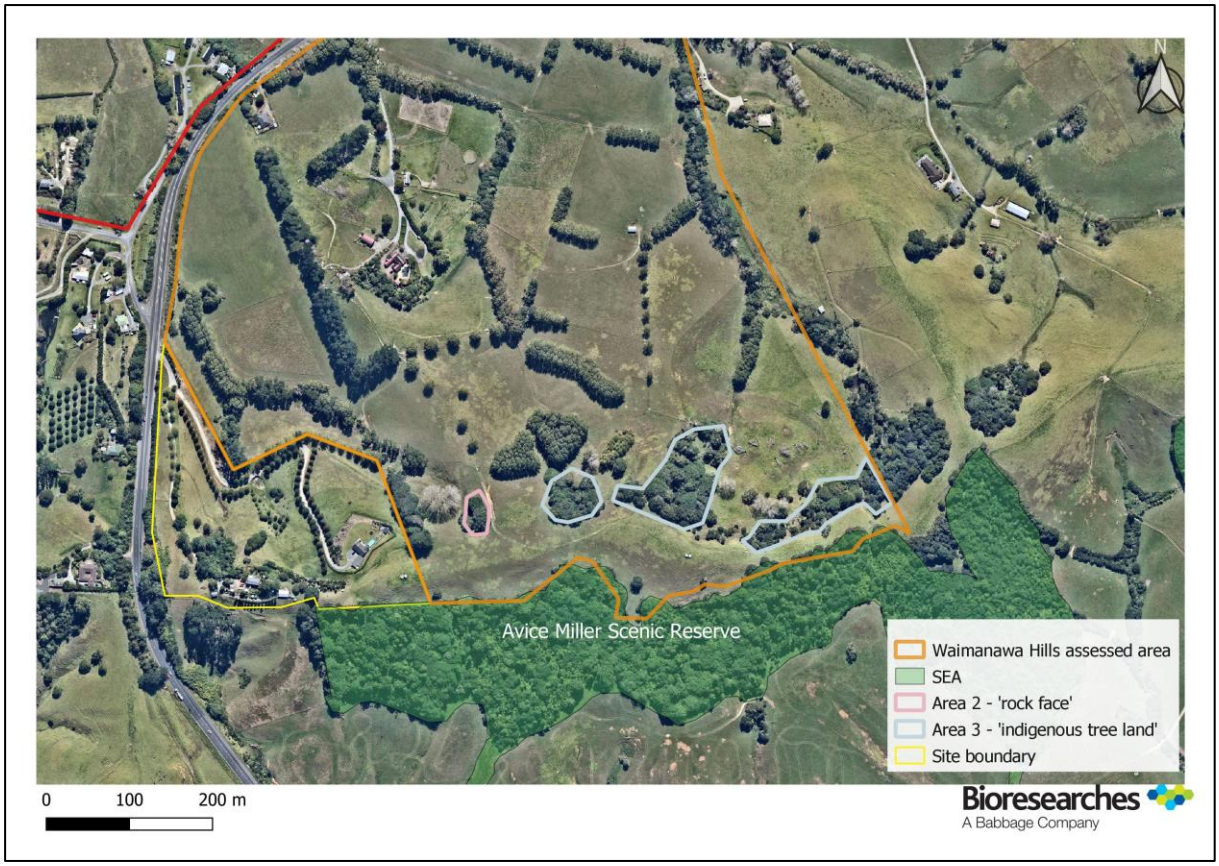

Figure 8. Indigenous vegetation cover of the Waimanawa Hills (a) Block, Warkworth.

3.5 Terrestrial Ecology Values of Waimanawa Hills (a) Block

This section covers areas of indigenous vegetation fragments and features; however it should be acknowledged that hedgerows, including those dominated by exotic species, may provide habitat for indigenous lizards or long-tailed bats. More comprehensive assessments are recommended to be undertaken during the summer period, when these faunas are more active.

3.5.1 SEA Vegetation: Southern boundary

SEA_T_2378, which covers Avice Miller Scenic Reserve and crosses the southern boundary of the Waimanawa Hills (a) Block, **is of Very High value.** Indigenous species dominate this kauri, podocarp, broadleaved forest, including characteristic podocarp trees, kauri, rimu, tōtara and kahikatea. Pūriri, taraire (B*eilschmeidia taraire*), rewarewa (*Knightia excelsa*), tānekaha (*Phyllocladus trichomanoides*), nīkau (*Rhopalostylis sapida*) and māhoe also make up a relatively diverse indigenous community along the southern boundary edge. Kauri trees were the only 'threatened' species recorded, however further survey may identify long-tailed bats (roosting or using the edge as a fly way), given the close proximity to recent records. 'At Risk' species are likely, including forest, elegant and pacific gecko, ornate skink and potentially the kauri snail, *Paryphanta busbyi* which is would represent the southern-most natural distribution limit for this species. The fragment as a whole, would also function as a relatively important link in an ecological corridor running east-west, to the south of Warkworth. Being relatively weed free, this SEA has a high level of integrity and would rank Very high (Table 3). Of note, is that

some of the kauri trees at the SEA edge are in very poor condition. One such tree is identified on Tiaki Tamaki Mākaurau GIS maps as being “with infection other than kauri dieback”.

3.5.2 Rock face fragment

This fragment of vegetation is fenced around a rock face. The fence encloses a very narrow (1 – 5 m wide) strip of predominantly indigenous vegetation around the rock face, and possibly serves to prevent stock causalities than vegetation protection (Photo 27). However, the vegetation supports mature pōhutukawa (*Metrosideros excelsa*) and pūriri, as well as māhoe, nīkau and other indigenous shrubs. The vegetation is not identified with any current ecosystem overlay on Auckland Council databases, and it probably best matches regenerating broadleaved species scrub (VS 5, Singers *et al.* 2017).

This fragment is limited in size and diversity, and is confined to a narrow edge around a rock face. It’s position near the southern boundary, and at the western end of three other ‘treeland’ fragments may lend itself to being used as a stepping stone, although the SEA along the boundary would reduce this value. The rock face itself is an interesting feature of the fragment, and the mature pōhutukawa and pūriri trees may enhance a habitat resource to fauna, potentially indigenous lizards, such as Pacific gecko that may refuge within the rock crevices. Otherwise, this fragment would rate **Low**, ecologically, on the basis of no existing fauna survey information (e.g. bats, lizards).

It should be acknowledged, however that presence of, or intermittent use by ‘Threatened’ or ‘At Risk’ fauna would qualify this fragment as significant under Auckland Councils criteria for SEAs (Threat status and rarity).

Photo 27. ‘Thin ‘ring’ of fenced vegetation around a rock face edge.

3.5.3 Indigenous tree land fragments

Three fragments of vegetation east of the rock face feature (described above) run approximately 10-50 m from, and parallel with, the SEA edge at the southern boundary (Photo 28). These fragments are entirely grazed underneath and canopy connectivity is patchy in parts (20-80%, Atkinson, 1985), but in parts the canopy is continuous. Within these fragments, tree cover is native dominated, comprising kānuka, māpou, pūriri, tōtara and kahikatea. As with the rock face vegetation described above, these vegetation fragments are not identified with any current ecosystem overlay on Auckland Council databases, and diversity is currently limited to resilient trees with little regeneration occurring beneath. Therefore, these fragments would be considered very poor-quality kauri, podocarp, broadleaved forests (WF11, Singers *et al.* 2017), which is a regionally 'endangered' ecosystem type Singers et al. 2017).

Photo 28. 'Treeland' fragments, southern Waimanawa Hills (a) Block.

These fragments rate poorly for representativeness, diversity and rarity / distinctiveness, except where it represents an 'endangered' kauri podocarp broadleaved forest ecosystem. Ecological integrity is heavily compromised by stock access, however the fragments have very good potential for recovery with seed source from the existing trees, and proximity to the adjacent SEA at the southern boundary. No 'threatened' or 'at risk' species were recorded during the site visit, however, arboreal geckos (At Risk forest gecko, elegant gecko and pacific gecko) have potential to be present. Long tailed bats were not recorded from two surveys, but have been recorded in the surrounding landscape. Overall, these

fragments would rate **Low-Moderate**, on the basis that they represent a low diversity of generally mature indigenous forest trees that are a poor representation of an endangered forest type.

3.6 Freshwater Ecology

The GIS viewer indicated several watercourses to be present throughout the site (Figure 1). Three permanent watercourses were identified within the site forming the three main systems of the Waimanawa Hills (a) block: Eastern, Central and Western. Multiple tributaries contributed to the three permanent watercourses with headwaters originating in site. Six wetlands were identified and delineated per the Ministry for the Environment wetland delineation protocol guidelines, contributing the aquatic habitat within each of the systems. The three aquatic systems present on site are major tributaries to the Mahurangi River, which enters the marine environment approximately 8.5km downstream of the site.

3.6.1 Central System

The central system of the site consisted of a permanent watercourse with multiple intermittent tributaries draining into the stream. Located around the permanent stream and tributaries, four natural wetlands were present. The central system drained in a general south to north direction, exiting the site through an undersized culvert (running under SH1) on the north-western boundary. The culvert discharges in Watercourse 4 in the Waimanawa Valley block. The individual freshwater ecosystems of the central system are described below.

3.6.1.1 Watercourse 25

The ecological values of Watercourse 25 were assessed as **Low.**

Watercourse 25 was identified as the main stem of the central system. It contained headwaters located within the centre of the site and flowed in a general south to north direction for approximately 370 m. Watercourse 25 flows through an undersized culvert under the driveway, with a vertical drop at the base of a concrete apron (Photo 29). The vertical drop would act as a partial barrier to fish passage, and it is likely only species capable of climbing (e.g. banded kōkopu, eel) would able to move upstream. Watercourse 25 was classified as a permanent stream due to the presence and depth of surface water on site and the size of the upstream catchment (13 ha). At the time of assessment, the stream was approximately 1 m wide and water depth was between 0.1 – 0.25 m deep with hydrological heterogeneity limited to runs and few pools. The banks of the stream were highly incised, with undercut steep banks and erosion evident.

The riparian vegetation of Watercourse 25 consisted of exotic vegetation, with pampas, agapanthus and poplars, providing moderate shading functions. Due to the shallow root systems of agapanthus and pampus, the filtration of groundwater and bank stability functions were expected to be very low which was evident by collapsing banks. Aquatic habitat was of moderate value with macrophytes, such as watercress and starwort growing throughout the upper catchment (Photo 30). Deep pools and undercut banks were present throughout the watercourse which would provide habitat for indigenous fish, however, oxygen reducing processes, such as anoxic sediment was present, indicating pollutant tolerant species would be more likely to inhabit the watercourse. The New Zealand Freshwater Fish database only show eels to be present within the downstream catchment, with the record located approximately 650 m downstream, within the Waimanawa Valley block, however it is likely shortfin

eel would be able to utilise the site. The ecological value of Watercourse 25 was assessed as low due to the highly degraded catchment, unnatural loading of fine sediment and low oxygen reducing processes, limiting the quality of aquatic habitat to pollutant tolerant taxa.

Photo 29. Watercourse 25 drained through a culvert with a vertical drop at the concrete apron.

Photo 30. High biomass of instream macrophytes in Watercourse 25.

3.6.1.2 Wetland 1

The ecological values of Wetland 1 were as assessed as **Low.**

Wetland 1 was located within the downstream reach and floodplain of Watercourse 25 and was approximately 93 m^2 in size. At the time of assessment, the wetland was not boggy and did not contain standing water, however it is likely that the area would contain water during wetter months. Wetland 1 contained a diverse range of exotic vegetation including, paspalum (*Paspalum dilatatum*), buttercup, umbrella sedge and soft rush, however riparian vegetation was limited to pampas grass, providing little shade functions to the wetland (Photo 31). The ecological value of Wetland 1 assessed as low due to the complete dominance of exotic vegetation and lack of riparian vegetation and aquatic habitat.

Table 8. Vegetation observed within Wetland 1.

Species	Common Name	Native/Exotic	Classification[3]	Cover (%)	Dominant
Juncus effusus	Soft rush	Exotic	FACW	20	Yes
Ranunculus spp.	Buttercup	Exotic	FAC	40	Yes
Paspalum dilatatum	Paspalum	Exotic	FACU	10	No
Persicaria hydropiper	Water pepper	Exotic	FACW	10	Yes
Cyperus eragrostis	Umbrella Sedge	Exotic	FACW	10	No
Percent of dominant species that are OBL, FACW or FAC					100%
Prevalence Index					2.6

3.6.1.3 Watercourse 26 and Wetland 2

The ecological values of Watercourse 26 and Wetland 2 were both considered **Low**.

[3] **Fidelity to or degree of affinity for wetland habitats (Clarkson et al, 2021). OBL: Obligate Wetland. Almost always is a hydrophyte, rarely in uplands (non-wetlands), FACW: Facultative Wetland. Usually is a hydrophyte but occasionally found in uplands, FAC: Facultative. Commonly occurs as either a hydrophyte or non-hydrophyte FACU: Facultative Upland. Occasionally is a hydrophyte but usually occurs in uplands, UPL: Obligate Upland. Rarely is a hydrophyte, almost always in uplands.*

One of the intermittent tributaries identified draining into Watercourse 25 was Watercourse 26. The headwaters of Watercourse 26 form a Y-confluence with ephemeral channels. The True Left arm contained no flowing water with boggy ground and puddles. Within this area, starwort was observed and occasional soft rush. The top of the channel appears to have been either recently infilled or mulch spread throughout (Photo 32) with standing puddles of water observed with mosquito larvae, however no channel was present. The True Right arm contained defined channels and water, however the upper reaches contained rooted kikuyu and water was not present.

The riparian vegetation of Watercourse 26 predominantly consisted of pampas with watercress and buttercup present on the banks and a few tall exotic trees providing organic inputs such as leaf litter. A farm track crossed over the watercourse with an overhanging culvert present acting as a complete barrier to fish passage. Water was freely flowing through the culvert. Within the lower reach of Watercourse 26, a small natural wetland (Wetland 2) was observed within the floodplain and was approximately 36 m^2 in size. Wetland 2 was dominated by water pepper (*Persicaria hydropiper*) with occasional soft rush and kikuyu established throughout. No indigenous vegetation was observed within the wetland and aquatic habitat was limited to a shallow channel.

Photo 31. Wetland 1 was dominated by exotic vegetation and lacked complex riparian vegetation.

Photo 32. Upper reach of Watercourse 26 appears to have been recently in-filled or mulched.

Table 9. Vegetation observed within Wetland 2.

Species	Common Name	Native/Exotic	Classification	Cover (%)	Dominant
Persicaria hydropiper	Water pepper	Exotic	FACW	75	Yes
Juncus effusus	Soft rush	Exotic	FACW	10	No
Ranunculus spp.	Buttercup	Exotic	FAC	5	No
Cenchrus clandestinus	Kikuyu	Exotic	FACU	10	No
Percent of dominant species that are OBL, FACW or FAC					100%
Prevalence Index					2.25

3.6.1.4 Watercourse 27

The ecological value of watercourse 27 was considered **Low.**

Watercourse 27 is a short intermittent watercourse with lotus growing within the channel. It is fed by a pipe and drains into Watercourse 25 (Photo 33). The stream was approximately 7 m long before the confluence and consisted of a shallow run, which may support tolerant fauna. Riparian vegetation was made up entirely of grazed pasture grass which did not provide any shading and likely has poor filtration capacity.

3.6.1.5 Watercourses 28 and 29

The watercourse 28 and 29 intermittent streams were assessed as **Low** ecological value.

Watercourses 28 and 29 formed the upper headwaters for Watercourse 25. Watercourse 28 was classified as an intermittent reach as it contained well-defined banks, flowing water, and had evidence of scour and deposition. A farm track was present crossing over Watercourse 28 and the stream was classified as ephemeral above this. Watercourse 29 was classified as an intermittent stream due to the presence of surface water, a well-defined channel and lack of rooted terrestrial vegetation established within the channel base. Sections of Watercourse 29 were ill-defined and dry in some places with the channel recently deepened and/or straightened (Photo 34). Riparian vegetation along Watercourse 28 and 29 was lacking, consisting solely of short grasses and a single row of exotic trees, providing low shade and filtration functions.

Watercourses 28 and 29 were assessed to be of low ecological value due to the degraded catchment, lack of complex native riparian vegetation and unnatural loading of fine sediment. Riparian functions of the intermittent streams including a low to moderate amount of shade, however ground filtration and bank stability were limited due to the shallow root systems. Additionally, several farm crossings and piped outlets/inlets were present within the intermittent streams acting as a barrier to fish passage.

Photo 33. Confluence of Watercourse 25 and small intermittent tributary of Watercourse 27

Photo 34. Intermittent channel of Watercourse 29

3.6.1.6 Wetland 3

Wetland 3 was considered of **Low** ecological value.

Wetland 3 was located at the headwaters of a small intermittent stream which drained into Watercourse 29. Wetland 3 was approximately 290 m^2 in size and hydrophytic vegetation consisted of mercer grass and soft rush. White clover (*Trifolium repens*) and buttercup was also present throughout. The area was pugged with shallow standing water retained in the pugging depressions, lacking aquatic habitat for indigenous fauna in its existing environment. No riparian vegetation was established around Wetland 3, and the surrounding area covered in pasture grass. Wetland 3 becomes more channelised and reverts to an intermittent stream, Watercourse 29, which flowed for approximately 20 m before draining into Watercourse 25. Wetland 3 was of low ecological value due to the lack of riparian vegetation and aquatic habitat in the stream, dominance of exotic hydric vegetation within the wetland and apparent access to stock within the two freshwater systems.

Table 10. Vegetation observed within Wetland 3.

Species	Common Name	Native/Exotic	Classification	Cover (%)	Dominant
Juncus effusus	Soft rush	Exotic	FACW	5	No
Ranunculus spp.	Buttercup	Exotic	FAC	20	Yes
Paspalum dilatatum	Paspalum	Exotic	FACU	5	No
Trifolium repens	White clover	Exotic	FACU	30	Yes
Paspalum distichum	Mercer grass	Exotic	FACW	30	Yes
Percent of dominant species that are OBL, FACW or FAC					66%
Prevalence Index					3.0

3.6.1.7 Wetland 7

The ecological value of Wetland 7 was considered **Low.**

Wetland 7 was located within the headwaters of the central system and was established within a depression in the ground with braided ephemeral overland flow paths around the wetland. Hydric vegetation established within the wetland consisted of buttercup and purei (*Carex secta*) with the base very boggy and highly pugged through livestock access. Within the pugging impressions, standing water was present with starwort growing throughout. Riparian vegetation groundcover around the wetland consisted of pasture grass and small herbaceous vegetation, however the sub-canopy and canopy around the wetland consisted of kahikatea, nīkau palm (*Rhopalostylis sapida*), wheki pōnga (*Dicksonia fibrosa*) and poplars providing high shading functions (Photo 35). Wetland 7 was of low ecological value due to the very small size and potentially induced nature (through pugging), low native wetland vegetation diversity and degradation due to stock access. However the native riparian vegetation provided high riparian functions such as shading and filtration.

Table 11. Vegetation observed within Wetland 7.

Species	Common Name	Native/Exotic	Classification	Cover (%)	Dominant
Ranunculus spp.	Buttercup	Exotic	FAC	64	Yes
Juncus effusus	Soft rush	Exotic	FACW	8	No
Carex secta	Purei	Exotic	FACW	25	Yes
Callitriche stagnalis	Starwort	Exotic	OBL	3	No
Percent of dominant species that are OBL, FACW or FAC					100%
Prevalence Index					2.61

Photo 35. Wetland 7 with native riparian planting established around the edges

3.6.2 Eastern System

The eastern system was formed by a permanent watercourse located on the north-eastern boundary of the site with three intermittent tributaries draining into the system. Additionally, three wetlands were present around the permanent watercourse. The eastern system drains in a general south-east to north-west direction with headwaters originating on-site. The watercourse discharges from the site through a culvert under State Highway 1 and enters the Waimanawa Valley Block to form watercourse 4.

3.6.2.1 Watercourse 35

The ecological values of watercourse 35 were assessed as **Low.**

Watercourse 35 was classified as a permanent stream due to the volume of water and large catchment size (15 ha). The watercourse had an average depth of 0.15 m and an average width of 1.5 m. The watercourse appeared to have been artificially straightened and deepened (Photo 36). The stream contained a high iron floc and hydrological heterogeneity consisted of deep pools and runs, and undercut banks which all provide habitat for indigenous fauna. The dominant substrate throughout the stream consisted of an unnatural loading of fine silt with a high volume of organic matter input such as leaf litter (from deciduous riparian vegetation) and woody debris.

Riparian vegetation consisted of rows of willow trees lining the channel banks providing good shading functions, however ground cover consisted of pasture grass with areas of the banks exposed, limiting the capacity for groundwater filtration and bank stability. A piped farm crossing intersected the stream, and the undersized culvert was clogged with debris. The ecological value of Watercourse 35 was assessed as low due to the modified nature of the stream, unnatural loading of fine sediment and lack of complex riparian vegetation.

Photo 36. Permanent stream of Watercourse 35 forming the main channel of the Eastern system.

Photo 37. Three glyceria wetlands were located within the floodplains of the Eastern system.

3.6.2.2 Wetlands 4 and 5

The ecological values of wetlands 4 and 5 were considered **Low**.

Wetland 4 was located on the True Right bank of Watercourse 35 and was approximately 133 m^2 in size. Hydric vegetation throughout the wetland was dominated by reed sweet grass (*Glyceria maxima*) with sparse buttercup, lotus and broad-leaved dock present (Photo 37). The ground of the wetland was boggy. Wetland 5 was observed to be on the floodplain of Watercourse 35 and was approximately 170 m^2 in size. The area was dominated by reed sweet grass, with occasional carex and buttercup established throughout. Riparian vegetation was limited to a row of pines and a few small shrubs established. Wetland 4 and Wetland 5 were assessed as having low ecological value due to the lack of aquatic habitat, and complete dominance of exotic vegetation, including pest plants.

Table 12. Vegetation observed within Wetland 4 and Wetland 5.

Wetland	Species	Common Name	Native/Exotic	Classification	Cover (%)	Dominant
Wetland 4	*Glyceria maxima*	Reed sweet grass	Exotic - pest	OBL	80	Yes
	Lotus pedunculatus	Lotus	Exotic	FAC	8	No
	Ranunculus spp.	Buttercup	Exotic	FAC	10	No
	Rumex obtusifolius	Broad-leaved dock	Exotic	FAC	2	No
	Percent of dominant species that are OBL, FACW or FAC					**100%**
	Prevalence Index					**1.4**
Wetland 5	*Glyceria maxima*	Reed sweet grass	Exotic - pest	OBL	70	Yes
	Carex spp.	Carex grass	-	FACW	20	No
	Ranunculus spp.	Buttercup	Exotic	FAC	10	No
	Percent of dominant species that are OBL, FACW or FAC					**100%**
	Prevalence Index					**1.4**

3.6.2.3 Wetland 6

The ecological values of wetland 6 were assessed as **Low**.

Wetland 6 is a large exotic wetland located in the wide base of the gully within the upper reaches of Watercourse 35. It is feed by two intermittent streams; one originating from the neighbouring property, and Watercourse 37. Wetland 6 was dominated by reed-sweet grass and a small channel

was observed meandering through the wetland area. Standing water was present under vegetation and was retained in pugging depressions. The ecological value of Wetland 6 was low value due to the dominance of exotic pest vegetation, livestock access and poor-quality aquatic habitat.

Table 13. Vegetation observed within Wetland 6.

Species	Common Name	Native/Exotic	Classification	Cover (%)	Dominant
Glyceria maxima	Reed sweet grass	Exotic - pest	OBL	90	Yes
Ranunculus spp.	Buttercup	Exotic	FAC	2	No
Juncus effusus	Soft rush	Exotic	FACW	8	No
Percent of dominant species that are OBL, FACW or FAC					100%
Prevalence Index					1.12

3.6.2.4 Watercourse 36

The ecological values of watercourse 36 were assessed as **Low.**

Two intermittent tributaries drained into Watercourse 35. The true right tributary is outside of the site boundaries. The True Left intermittent tributary was identified as Watercourse 36, and met the intermittent criteria due to well-defined banks, substrate sorting processes and no rooted terrestrial vegetation. Watercourse 36 contained no standing water and as such did not provide aquatic habitat at the time of assessment, however evidence of previous water flow could be seen and the channel has recently been re-contoured (Photo 39). Riparian vegetation along Watercourse 36 was lacking, with kikuyu and poplars providing moderate shading in the lower reach while the upper reach consisted of bare banks. The ecological value of Watercourse 36 was assessed to be of low ecological value due to the complete lack of aquatic habitat, low quality riparian vegetation and corresponding function (i.e. filtration, bank stability, shade) and highly modified, degraded channel.

Photo 38. Watercourse 36 lower reach, which drains into Wetland 6.

Photo 39. No water was observed in Watercourse 37, however previous flow patterns could be seen.

3.6.3 Western System

The western system of the site consisted of a permanent watercourse with multiple intermittent and ephemeral tributaries draining into the stream. The western system flowed in a general south to north direction and exited the site on the north-western boundary through a culvert under SH1, which

drained into Watercourse 2 within the Waimanawa Valley block. The freshwater ecosystems contributing to the western system are described below.

3.6.3.1 Watercourse 30

The ecological values of watercourse 30 were considered **Low.**

Watercourse 30 formed the main branch of the western system and as such was classified as a permanent stream due to the depth and presence of water within the channel and large catchment size (10 ha). Watercourse 30 had an approximate wetted width of 0.5 to 1 m and average depth of 0.1 to 0.2 m. One to two rows of poplar trees lined the stream channel. Within the floodplain, occasional mercer grass, gorse and soft rush where present. Willow trees with pampas was also located within the upper reach. The riparian vegetation would provide good stream shading in summer, however due to the lack of complex understory and shallow root systems of pampas, grasses and buttercup, filtration and banks stability functions were considered very low. The banks of Watercourse 30 were very incised and exposed, with top soil and root systems of vegetation exposed and erosion evident. The watercourse appeared to have been recently artificially deepened/cleared as large amounts of substrate were observed on the stream edges. As such, it is likely that connectivity to the floodplain is restricted (Photo 40).

Aquatic habitat available for indigenous fauna was largely limited to runs and shallow/deep pools, with hydrological heterogeneity low. Overhanging vegetation was rare due to the highly incised banks and lack of riparian vegetation. The dominant substrate within the watercourse consisted silt, and organic matter inputs into the watercourse were high (due to the deciduous riparian vegetation) which would provide some low-quality habitat for macroinvertebrates.

3.6.3.2 Watercourse 31

The ecological values of watercourse 31 were considered **Low**.

Watercourse 31 formed the upper reach and contributing headwaters of Watercourse 30 and was classified as an intermittent stream due to the presence of well-defined banks, no rooted terrestrial vegetation and some scour, however the channel had recently been straightened and deepened. Riparian vegetation was largely limited to pine trees providing low shade functions and limited filtration and bank stability capacity (Photo 41). No water was present in the channel in the upper reach, and aquatic habitat was generally limited to shallow, isolated pools containing silt and leaf litter. Watercourse 31 was considered to be of low ecological value due to the lack of aquatic habitat through much of the reach and lack of riparian vegetation.

Photo 40. Watercourse 30 contained highly incised banks and lacked complex riparian vegetation. Note substrate on banks.

Photo 41. Degraded instream habitat of the lower reach Watercourse 31.

3.6.3.3 Wetland 8

The ecological values of wetland 8 were assessed as **Low**.

Wetland 8 was located upstream of the upper reach of Watercourse 31 and was connected to the watercourse by an ephemeral overland flow path. Hydrophytic vegetation within Wetland 8 was dominated by floating sweet grass (*Glyceria fluitans*), with occasional low bulrush (*Isolepis cernua*), buttercup and mercer grass. The wetland was surrounded by a tall cliff in a semi-circle shape, and a farm track at its downstream end appeared to limit flow out of the area.

Riparian vegetation was largely limited with pasture grass, however the cliff and cliff-top vegetation provided moderate to high shading. . Hydrology within Wetland 8 consisted of standing water within pugged depressions and boggy ground under vegetation which would provide habitat to tolerant dispersal macroinvertebrates. Fish are not expected to be present as there is no aquatic connectivity to the wetland. Wetland 8 was considered to have low ecological value due to the dominance of exotic wetland vegetation, low indigenous biodiversity and low quality aquatic habitat.

Photo 42. Wetland 8 contained standing water and obligate wetland vegetation.

Photo 43. Wetland 8 was shaded by a rock cliff.

Table 14. Vegetation observed within Wetland 8.

Species	Common Name	Native/Exotic	Classification	Cover (%)	Dominant
Glyceria fluitans	Floating sweet grass	Exotic	OBL	60	Yes
Ranunculus spp.	Buttercup	Exotic	FAC	10	No
Paspalum distichum	Mercer grass	Exotic	FACW	20	Yes
Juncus effusus	Soft rush	Exotic	FACW	2	No
Isoepis crenua	Low bulrush	Exotic	OBL	2	No
Persicaria hydropiper	Water pepper	Exotic	FACW	4	No
Plantago lanceolata	Narrow-leaved plantain	Exotic	FACU	2	No
Percent of dominant species that are OBL, FACW or FAC					100%
Prevalence Index					1.52

3.6.3.4 Watercourse 32 and Wetland 9

The ecological values of watercourse 32 and wetland 9 were assessed as **Low**.

Watercourse 32 drained into Watercourse 30 and was classified as an intermittent tributary due to the presence of well-defined banks and lack of rooted terrestrial vegetation. The upper reach of Watercourse 32 formed a Y confluence, with the True Right confluence approximately 45m long, with the headwaters forming an ephemeral overland flow path. The True Left confluence of Watercourse 32 was approximately 120 m long and entered the site from the neighbouring property. Within the main stem of Watercourse 32, shallow water was present within the channel, however above a farm track crossed the stream and no water was present in a few areas of the channel (Photo 44). There was a high amount of dry leaf litter covering the channel base indicating no substantial flow had occurred for some time, despite the catchment containing water. Wetland 9 was located on the True Right bank of Watercourse 32 and was dominated by mercer grass and soft rush with occasional buttercup and lotus. Wetland 9 was approximately 125 m^2 in size and contained standing water, however the ground was highly pugged (Photo 45). Wetland 9 was considered to be of low ecological value due to the degraded habitat due to livestock access and dominance of exotic vegetation.

Photo 44. Degraded instream habitat of Watercourse 32.

Photo 45. Pugging depression observed in Wetland 9.

Table 15. Vegetation observed within Wetland 9.

Species	Common Name	Native/Exotic	Classification	Cover (%)	Dominant
Juncus effusus	Soft rush	Exotic	FACW	20	Yes
Ranunculus spp.	Buttercup	Exotic	FAC	18	No
Paspalum distichum	Mercer grass	Exotic	FACW	60	Yes
Lotus pedunculatus	Lotus	Exotic	FAC	2	No
Percent of dominant species that are OBL, FACW or FAC					100%
Prevalence Index					2.2

A constructed wetland was present near the headwaters of the True Right confluence of Watercourse 32. The constructed wetland was approximately 110 m^2 and was evident due to the rock wall surrounding the wetland edges. No water was observed within the wetland; however, the ground likely contains appropriate hydrological conditions to support hydrophytic vegetation. The constructed wetland was assessed as having **Negligible** ecological value due to the dominance of exotic wetland vegetation, artificial nature, and limited aquatic habitat.

Table 16 Vegetation observed within the Constructed Wetland.

Species	Common Name	Native/Exotic	Classification	Cover (%)	Dominant
Cyperus eragrostis	Umbrella sedge	Exotic	FACW	60	Yes
Ludwigia repens	Red leaf ludwigia	Exotic	OBL	15	No
Ranunculus spp.	Buttercup	Exotic	FAC	5	No
Poaceae spp.	Pasture grass	Exotic	FAC	20	Yes
Percent of dominant species that are OBL, FACW or FAC					100%
Prevalence Index					2.1

3.6.3.5 Watercourse 33

The ecological values of watercourse 33 were assessed as **Low**.

Watercourse 33 was a small (10 m long) intermittent tributary of Watercourse 30 and contained well-defined banks, lacked rooted terrestrial vegetation throughout the channel base and evidence of deposition within the channel banks. A shallow depression in the ground could be observed in the upper reaches of Watercourse 33, and was classified as an ephemeral overland flow path due to the ill-defined banks and lack of water or pools. With the exception of pine trees and occasional patches of pasture grass, the banks were completely bare and small roots of the pine trees were exposed. Aquatic habitat consisted of a fast-flowing, shallow (<0.03 m deep) run, which is likely to provide habitat only for pollutant tolerant macroinvertebrates.

3.6.3.6 Watercourse 34

The ecological values of watercourse 34 were assessed as **Low**.

Watercourse 34 was an intermittent watercourse located on the edge of the boundary and formed a confluence with Watercourse 30 approximately 90m prior to Watercourse 30 flowing through a roadside culvert and draining into the Waimanawa Valley block.

The stream was very narrow and aquatic habitat consisted of a shallow run. No pools or other hydrological features were observed. Shading was high, provided by a dense row of planted shrubs and weeds, and small wood and leaf litter was observed throughout.

3.7 Summary of Waimanawa Hills (a) Block Freshwater Ecological Values

Table 17 provides a summary of the freshwater ecological values within the site. The values of the site ranged from Negligible to Low within the site.

Table 17. Summary of the freshwater values within the Waimanawa Hills (a) Block site

System	Ecological Feature	Assigned Ecological Value	Reasoning
Central System	Watercourse 25	Low	• Degraded instream habitat • Unnatural loading of anoxic silt • Limited riparian vegetation
	Watercourse 26-29	Low	• Limited riparian vegetation • High loading of fine sediment • Partial barriers to fish passage present instream
	Wetland 1-2	Low	• Lack of riparian vegetation • Limited aquatic habitat on permanent bases
	Wetland 3	Low	• Degraded wetland habitat due to livestock access • No riparian vegetation
	Wetland 7	Low	• Degraded habitat due to livestock access • Dominance of exotic wetland vegetation • Common stature native riparian vegetation
Western System	Watercourse 30	Low	• Highly incised banks • Limited riparian vegetation and function • Lack of instream function
	Watercourse 32 -34	Low	• Degraded instream habitat • Limited aquatic habitat • Lack of riparian vegetation and function
	Wetland 9	Low	• Degraded habitat due to livestock access • Dominance of exotic vegetation •
	Constructed wetland	Low	• Fenced constructed wetland • No riparian vegetation and shading provided • Lack of aquatic habitat on a permanent basis
Eastern System	Watercourse 35	Low	• Lack of hydrological heterogeneity or instream habitat • Heavy loading of iron floc bacteria
	Watercourse 36	Low	• Artificially deepened with no water within the channel • No riparian vegetation and bare banks
	Wetland 4-6	Low	• Dominance of exotic pest vegetation • Limited riparian vegetation

3.8 Waimanawa Hills (b) Block: Background and Ecosystem Classification

Historically, the site would have likely comprised of the ecosystem type 'Kauri, podocarp, broadleaved forest' (WF11; Singers *et al*., 2017). Well prior to 1970 (as indicated by historical aerial photography, Figure 9) a large proportion of the site was largely cleared of indigenous native vegetation, with dense sections of native vegetation retained on the southern aspect of the property.

The southern section of the site currently supports approximately 3,000 m^2 of the recognised ecosystem type 'Kauri, podocarp, broadleaved forest', and is also subject to a Significant Ecological Area overlay, SEA_T_2378, which forms a section of Avice Miller Scenic Reserve, a Department of Conservation managed indigenous forest fragment.

Figure 9. Historic aerial image of the site from 1973 showing much of the site to be cleared of indigenous bush

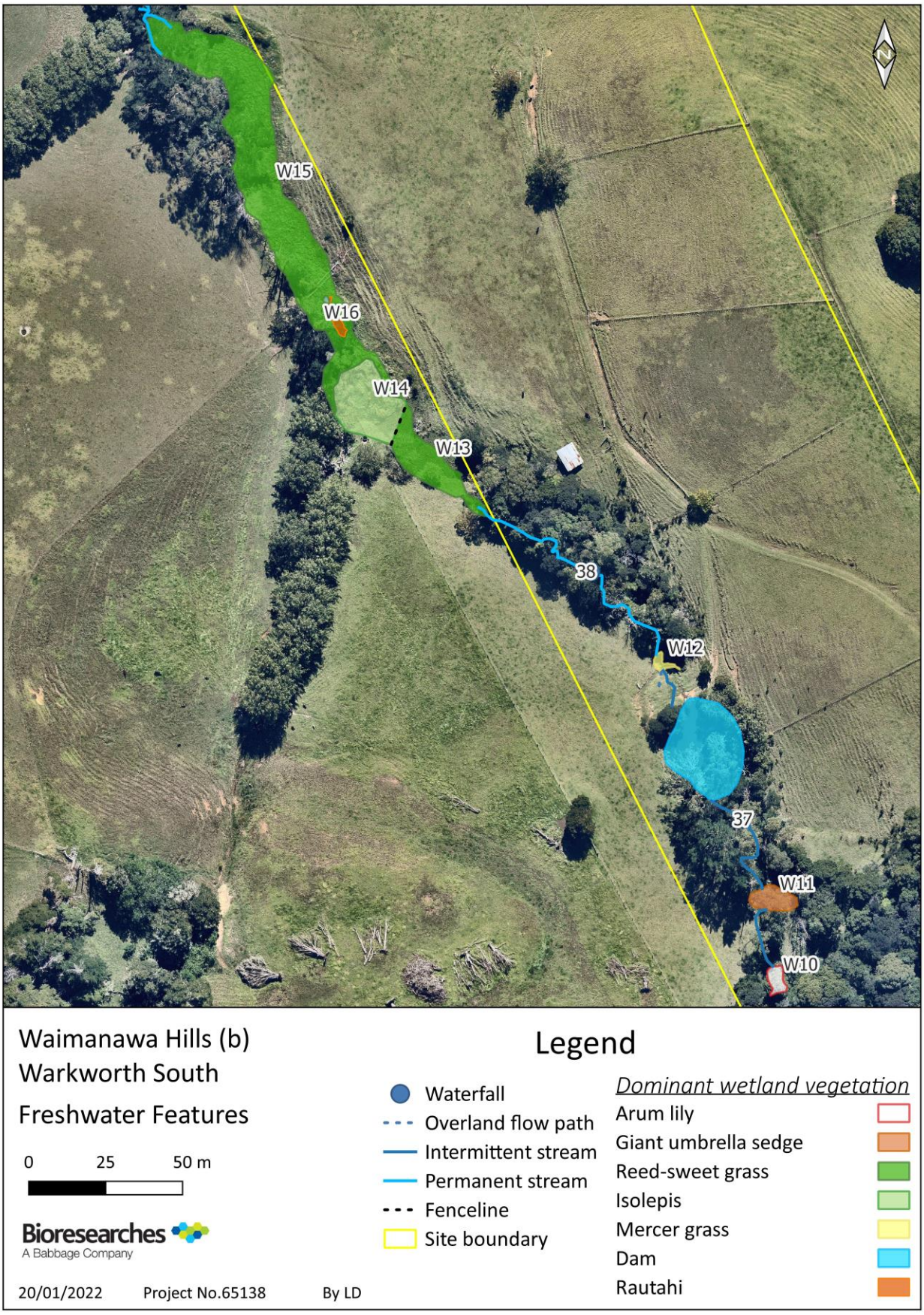

Figure 10. Ground truthed ecological features observed within Waimanawa Hills (b) block.

3.8.1 Freshwater Ecology

The Auckland Council GIS viewer indicated several watercourses to be present throughout the site. The watercourses were ground-truthed on 2 December 2021. One intermittent watercourse, forming the headwaters, was identified within the site, and transitioned to a permanent watercourse as it flowed in a general south to north direction. Seven wetlands were identified in connection to the main watercourse and were and delineated per the MfE protocol guidelines. The watercourse present within the site is a tributary to the Mahurangi River, and flows for approximately 8.5 km before entering the marine environment through a northern arm of the Mahurangi Harbour.

Wetlands 4, 5, 6 and 7 were partially delineated during the ecological baseline assessment within the Waimanawa Hills (a) Block [4] (titled W6 within Bioresearches (2021)), however due to access constraints, a complete baseline assessment was not undertaken. This report provides a full baseline assessment of Wetlands 4-7, and is to overwrite the previous baseline provided.

3.8.1.1 Watercourse 37

The ecological values of Watercourse 37 were assessed as **Low**.

Watercourse 37 was located on the southern side of the property and formed the headwaters to the stream that flows through the site. Watercourse 37 was classified as an intermittent stream as it contained standing water 48 hours after rainfall, deep pools relative to stream depth and debris on the floodplain (Photo 46). Sections of Watercourse 37 contained flattened banks and rooted terrestrial vegetation, however the stream bed had been impacted by pugging and it is likely the watercourse would contain defined banks if no livestock access had occurred. Within the watercourse, iron flocc and bacterial sheens were observed on the water surface (Photo 47). Riparian vegetation of Watercourse 37 consisted of pasture grass with tall trees such as pine (*Pinus sp.*) with ground cover largely consisting of arum lily (*Zantedeschia aethiopoca*), buttercup (*Ranunulus sp.*), and Yorkshire fog (*Holcus lantus*).

Photo 46. Watercourse 37 was classified as an intermittent watercourse.

Photo 47. Iron flocc and bacterial sheens were observed on the water surface.

[4] Bioresearches (2021). Warkworth South Plan Change: Baseline Ecology. 63588. Report for Warkworth Estate Limited & Stepping Towards Far Limited. Pp 54.

Watercourse 37 was considered to be of low ecological value due to the degraded catchment from livestock impacts and lack of complex riparian vegetation. Riparian functions of the intermittent stream included a moderate amount of shade; however, bank stability and filtration function were limited due to the lack of ground cover.

3.8.1.2 Wetland 10

Wetland 10 was considered to be of **negligible** ecological value.

Wetland 10 was located on the upstream reach of Watercourse 37 and was approximately 42 m^2 in size (Photo 48). The dominant hydric vegetation within Wetland 10 consisted of arum lily with soft rush (*Juncus effusus*) and lotus (*Lotus pedunuculatus*) present (Photo 49; Table 18). The area was pugged with shallow standing water and thick layers of fine sediments present, however the wetland lacked aquatic habitat to indigenous freshwater fauna in its existing state. Riparian vegetation around Wetland 10 largely consisted of pasture grass, however tōtara (*Podocarpus totara*) and gorse (*Ulex europaeus*) were present on the upstream extent providing limited riparian yard functions to the wetland. Wetland 10 was considered to be of negligible ecological value due to the lack of sufficient riparian vegetation, no aquatic habitat and dominance of exotic hydric vegetation.

Table 18. List of vegetation observed within Wetland 10

Species	Common Name	Native/Exotic	Classification	Cover (%)	Dominant
Zanthdeschia aethiopica	Arum lily	Exotic	FAC	60	Yes
Juncus effusus	Soft rush	Exotic	FACW	10	No
Holcus lantus	Yorkshire fog	Exotic	FAC	5	No
Blechum minus	Swamp kiokio	Native	FACW	5	No
Eleocharis acuta	Sharp spike-sedge	Native	OBL	5	No
Lotus pedunculatus	Lotus	Exotic	FAC	15	No
Percent of dominant species that are OBL, FACW, FAC					100%
Prevalence Index					2.75

Photo 48. Wetland 10 was small and contained pugging depressions.

Photo 49. Wetland 10 was dominated by arum lily with soft rush and lotus present.

3.8.1.3 Wetland 11

Wetland 11 was considered to be of **Low** ecological value.

Wetland 11 was located downstream of Wetland 10 and was approximately 95 m^2 in size, and drained into a large dam. At the time of assessment, the base of the wetland was boggy and pugged, with shallow standing water present within the pugging depressions with iron flocc and bacterial sheen observed within the pools. Wetland 8 was dominated by giant umbrella sedge (*Cyperus ustulatus*) and arum lily, with lotus and buttercup present throughout (Photo 50; Table 19). Riparian vegetation was mainly limited to pasture grass, gorse and evergreen trees (Photo 51). Wetland 11 was considered to be of low ecological value due to the low abundance of indigenous hydric vegetation, lack of riparian yard and degraded state due to stock access.

Table 19. List of vegetation observed within Wetland 11.

Species	Common Name	Native/Exotic	Classification	Cover (%)	Dominant
Zantedeschia aethiopica	Arum lily	Exotic	FAC	25	Yes
Blechum minus	Swamp kiokio	Native	FACW	7	No
Carex lessoniana	Rautahi	Native	FACW	5	No
Cyperus ustulatus	Giant umbrella sedge	Native	FACW	40	Yes
Ranunculus sp.	Buttercup	Exotic	FAC	8	No
Lotus pedunculatus	Lotus	Exotic	FAC	15	No
Percent of dominant species that are OBL, FACW, FAC					100%
Prevalence Index					2.48

Photo 50. Wetland 11 contained giant umbrella sedge and arum lily.

Photo 51. Riparian vegetation consisted of rank grass, gorse and few tall trees.

3.8.1.4 Wetland 12

Wetland 12 was considered to be of **Low** ecological value.

Wetland 12 was located downstream of the dam and was approximately 20 m^2 in size, and was dominated by exotic hydric vegetation (Photo 52). The dominant vegetation observed within Wetland 12 included mercer grass (*Paspalum distichum*) and soft rush, with spearwort (*Ranunculus flammula*), giant umbrella sedge and arum lily present (Table 20). Within Wetland 9, the ground was boggy and

occasional pools could be observed within pugging depressions (Photo 53). Wetland 12 was of low ecological value due to the low diversity of indigenous vegetation, small size and lack of riparian yard.

Photo 52. Wetland 12 was dominated by mercer grass.

Photo 53. The ground was boggy with occasional pools observed within the wetland.

On the upstream end of Wetland 12, a narrow channel, approximately 13 m, was observed, draining from the pond. Within this channel, shallow standing water and defined banks were noted and no rooted terrestrial vegetation was observed. As such, the channel was classified as a small intermittent reach. A second short channel was observed draining into Wetland 12 on the lower true right bank of the wetland. The channel contained well-defined banks, however no other intermittent criteria was met, and as such was classified as an ephemeral overland flow path.

Table 20. List of vegetation observed within Wetland 12

Species	Common Name	Native/Exotic	Classification	Cover (%)	Dominant
Paspalum distichum	Mercer grass	Exotic	FACW	40	Yes
Juncus effusus	Soft rush	Exotic	FACW	20	Yes
Zanthdeschia aethiopica	Arum lily	Exotic	FAC	10	No
Holcus lantus	Yorkshire fog	Exotic	FAC	5	No
Cyperus ustulatus	Giant umbrella sedge	Native	FACW	10	No
Blechnum novae-zelandiae	Kiokio	Exotic	FAC	2	No
Blechum minus	Swamp kokio	Native	FACW	3	No
Ranunculus flammula	Spearwort	Exotic	FACW	10	No
Percent of dominant species that are OBL, FACW, FAC					100%
Prevalence Index					2.17

3.8.1.5 Watercourse 38

Watercourse 38 was considered to be of **moderate** ecological value

Watercourse 38 was located downstream of Wetland 12 and was classified as a permanent stream due to the continuous depth of water and moderate catchment size (3.2 ha) (Photo 54). Watercourse 38 had an average width of 0.3 m and an average depth of 0.16 m with flow generally slow. The upper reach of the watercourse containing highly incised banks between 0.5 m – 1.75 m, with portions of the reach containing undercut banks. Approximately 40 m downstream of Watercourse 38 draining from

Wetland 3, the stream contained a tall drop (>2 m) with root mats trailing down the banks (Photo 55). This drop likely acts as a barrier to fish passage due to its vertical banks.

The dominant substrate throughout Watercourse 38 consisted of fine sediments with a high abundance of organic debris, root mats and leaf litter within the stream bed (Photo 56). Riparian vegetation throughout Watercourse 38 consisted of a diverse range of indigenous vegetation (Photo 57), including tōtara, kānuka (*Kunzea ericoides*), māhoe (*Meliactylus australis*) and nikau (*Rhopalostylis sapida*), with white rata (*Metrosideros albiflora*) observed growing on pōnga (*Cyathea dealbata*) trucks. The riparian vegetation and incised banks provided a high level of shading with periphyton and macrophytes low due to the high shade. Ground cover predominantly consisted of bare ground with a dense layer of leaf litter and organic debris, with occasional patches of African clubmoss (*Selaginella kraussiana*) and ground ferns.

A macroinvertebrate sample was collected from the reach and contained a low diversity macroinvertebrate community (9 taxa), dominated by moderately pollutant tolerant taxa. The community was dominated by the caddisfly *Polyplectropus puerilis* and beetle larvae (*Hydora sp.*), resulting in a moderate %EPT score (28%). The MCI was indicative of good quality habitat (102) and when the abundance of the species was taken into account the QMCI score was indicative of excellent quality habitat (6.41). No electric fishing passes were carried out throughout the reach, however two adult banded kōkopu (*Galaxias fasciatus*) were observed within the lower reach of Watercourse 2.

Photo 54. Watercourse 38 was classified as a permanent stream.

Photo 55. A tall drop was present within Watercourse 38 acting as a barrier to fish passage.

Photo 56. The dominant substrate consisted of fine sediment with high organic matter inputs.

Photo 57. The riparian margin consisted of a diverse range of indigenous vegetation.

3.8.1.6 Wetland 13

Wetland 13 was considered to be of **Low** ecological value.

Wetland 13 was located downstream of Watercourse 38, with the stream channel dissipating as it flows through the wetland. Wetland 13 was approximately 316 m^2 in size and dominated by reed-sweet grass (*Glyceria maxima*) with additional vegetation observed within the wetland consisting of soft rush, swamp millet (*Isachne globosa*) and water purslane (*Ludwigia palustris*). Within the wetland body, the ground was highly pugged and the hydric vegetation appeared to have been recently grazed. Standing water and boggy ground was observed with deep pools present within the wetland. Riparian vegetation was limited to pasture grass with sparse trees. Wetland 13 was considered of low ecological value due to the dominance of exotic hydric vegetation, an aggressive weed species, lack of riparian vegetation and impacted state due to stock access.

Table 21. List of vegetation observed within Wetland 13.

Species	Common Name	Native/Exotic	Classification	Cover (%)	Dominant
Glyceria maxima	Reed-sweet grass	Exotic	OBL	80	Yes
Juncus effusus	Soft rush	Exotic	FACW	5	No
Isachne globosa	Swamp millet	Native	OBL	5	No
Ludwigia palustris	Water purslane	Exotic	OBL	5	No
Ranunculus sp.	Buttercup	Exotic	FAC	5	No
Percent of dominant species that are OBL, FACW, FAC					100%
Prevalence Index					1.15

Photo 58. Wetland 13 was dominated by exotic vegetation.

Photo 59. Standing water and deep pools were present within the wetland.

3.8.1.7 Wetland 14

The ecological value of Wetland 14 was considered **Low**.

Wetland 14 was located immediately downstream of Wetland 13, with a wire fence dividing the two wetlands. Wetland 14 was delineated as a separate wetland due to this barrier and changes in hydric vegetation (Table 22). Wetland 5 was approximately 410 m^2 in size and dominated by budding club-rush (*Isolepis prolifera*), with additional hydric vegetation consisting of umbrella sedge, soft rush and swamp millet (Photo 60). No standing water was observed within the wetland; however, the ground was boggy, with no obvious signs of livestock impacts such as pugging depressions or grazing observed. Riparian vegetation was mainly limited to pasture grass with lines of crack willow (*Salix x fragilis*) present on the true right bank on the riparian margin providing low shading functions to the wetland area (Photo 61). The ecological value of Wetland 14 was considered to be low due to the low diversity of indigenous hydric vegetation and the lack of aquatic habitat and riparian yard.

Photo 60. Wetland 14 was dominated by budding club-rush

Photo 61. A line of willows was present on the riparian yard.

Table 22. List of vegetation observed in Wetland 14.

Species	Common Name	Native/Exotic	Classification	Cover (%)	Dominant
Isolepis prolifera	Budding club-rush	Native	OBL	60	Yes
Cyperus eragrostis	Umbrella sedge	Exotic	FACW	10	No
Blechum minus	Swamp kiokio	Native	FACW	5	No
Isachne globosa	Swamp millet	Native	OBL	5	No
Juncus effusus	Soft rush	Exotic	FACW	15	No
Paspalum distichum	Mercer grass	Exotic	FACW	2	No
Mentha spicata	Spearmint	Exotic	FAC	3	No
Percent of dominant species that are OBL, FACW, FAC					100%
Prevalence Index					1.38

3.8.1.8 Wetland 15

The ecological value of Wetland 15 was assessed to be **Low**.

Wetland 15 was present immediately downstream of Wetland 14, and was delineated as a separate wetland due to changes in hydric vegetation. Within Wetland 15, the dominant hydric vegetation consisted of reed-sweet grass, with sparse sharp spike-sedge, soft rush, and lotus present throughout (Photo 62). Within the wetland, the ground was boggy and a large pool of standing water was observed towards the downstream extent (Photo 63). Wetland 15 was approximately 1,850 m^2 in size, with the downstream portion of the wetland becoming a complete monoculture of reed-sweet grass. The riparian vegetation of Wetland 15 consisted of rank pasture grass on the true left bank, and rows of

pine (*Pinus radiata*) trees on the true right bank (Photo 64). Within the lower extent, defined channels could be observed within the wetland (Photo 65), which formed a confluence and transitioned into a permanent stream, previously described as Watercourse 35 within the Waimanawa Hills (a) Block.

Table 23. List of vegetation observed within Wetland 15.

Species	Common Name	Native/Exotic	Classification	Cover (%)	Dominant
Glyceria maxima	Reed-sweet grass	Exotic	OBL	70	Yes
Eleocharis acuta	Sharp spike-sedge	Native	OBL	15	No
Juncus effusus	Soft rush	Exotic	FACW	5	No
Lotus pedunculatus	Lotus	Exotic	FAC	10	No
Percent of dominant species that are OBL, FACW, FAC					100%
Prevalence Index					1.25

Photo 62. Wetland 15 was dominated by reed-sweet grass.

Photo 63. A large pool was observed within Wetland 15.

Photo 64. Riparian vegetation on the true right bank consisted of mature pine trees.

Photo 65. Defined channels were apparent at the downstream extent of the wetland.

3.8.1.9 Wetland 16

The ecological value of Wetland 16 was determined to be **Low**

Wetland 16 was located within Wetland 15, and was delineated as a separate wetland due to obvious changes in hydric vegetation (Table 24). Wetland 16 was approximately 30 m^2 in size and contained standing water, with a deep pool located on the northern boundary. Hydric vegetation observed within Wetland 16 included rautahi, with reed-sweet grass and Yorkshire fog (Photo 66). The riparian vegetation of Wetland 16 consisted of the hydric vegetation observed within Wetland 16, predominantly reed-sweet grass with one crack willow present (Photo 67). Wetland 16 was considered to be of low ecological value due to the small size and low diversity of indigenous hydric vegetation.

Table 24. List of vegetation observed within Wetland 16.

Species	Common Name	Native/Exotic	Classification	Cover (%)	Dominant
Cyperus eragrostis	Umbrella sedge	Exotic	FACW	3	No
Holcus lantus	Yorkshire fog	Exotic	FAC	15	No
Carex lessoniana	Rautahi	Native	FACW	57	Yes
Blechum minus	Swamp kiokio	Native	FACW	10	No
Glyceria maxima	Reed-sweet grass	Exotic	OBL	10	No

Galium aparine	Cleavers	Exotic	FACU	9	No
Percent of dominant species that are OBL, FACW, FAC					100%
Prevalence Index					2.23

Photo 66. Wetland 16 was dominated by Rautahi with swamp kiokio and Yorkshire fog.

Photo 67. Riparian vegetation consisted of one crack willow and hyric vegetation described in Wetland 16.

3.8.2 Summary of Waimanawa Hills (b) Block Freshwater Ecological Values

Table 24 provides a summary of the freshwater ecological values within the site. The values of the site range from Negligible to Moderate within the site.

Table 25. Summary of the freshwater ecological values on site.

Ecological Feature	Assigned Ecological Value	Reasoning
Watercourse 37	Low	• Highly impacted stream bed • Lack of complex riparian vegetation • Low bank stability and filtration functions
Wetland 10	Negligible	• Lack of riparian vegetation • Dominance of exotic hydric vegetation • Lack of aquatic habitat
Wetland 11	Low	• Low abundance and diversity of indigenous vegetation • Lack of riparian yard • Highly degraded and impacted state
Wetland 12	Low	• Low diversity of indigenous vegetation • Small size and low filtration functions • Lack of riparian yard
Watercourse 38	Moderate	• Permanent presence of aquatic habitat • High abundance and diversity of indigenous riparian vegetation • High MCI and QMCI scores
Wetland 13	Low	• Dominance of exotic hydric vegetation • Lack of riparian yard

		• Highly impacted and degraded state
Wetland 14	Low	• Low diversity of indigenous hydric vegetation • Lack of aquatic habitat • Lack of riparian yard
Wetland 15	Low	• Dominance of exotic hydric vegetation • Low quality riparian vegetation
Wetland 16	Low	• Small size • Low diversity of indigenous vegetation • Low quality riparian margins

4. POTENTIAL ECOLOGICAL CONSTRAINTS TO FUTURE DEVELOPMENT

4.1 Terrestrial Ecology

4.1.1 Waimanawa Valley Block

Moderate value vegetation, being the kānuka forest and mixed exotic / native fragments, both meet Auckland Council's criteria for SEAs, and should therefore be protected under the proposal.

Long-tailed bats were recorded at the south-western corner of the Waimanawa Valley block, using the Mahurangi River riparian margin. This river corridor appears to comprise part of a flight path for bats, and is of very high ecological significance (long-tailed bats, critically endangered) due to their presence. Bats were recorded at one location where the River bends at the southern end, and where there is a clearway (open space alongside or within riparian edge) along which bats were recorded flying. This riparian corridor is therefore of very high value. Although bats were not recorded beyond the clearway bend within the riparian corridor, the further northern extents of the Mahurangi River, along the western boundary of the Project area may also be used by bats, including outside the survey period. This is despite no activity being recorded to the north, particularly where it connects to the kanuka forest- an area that supports emergent podocarp trees.

Therefore, the following recommendations are provided to minimise potential disturbance associated with the Plan Change, to recorded low level bat activity:

- a minimum 20 m clear way buffer (Figure 14) should be maintained alongside (adjacent to and additional to) the eastern edge of the Mahurangi River riparian vegetation, along the western boundary of the site. The clearway buffer would be maintained alongside the riparian vegetation as open space with no building structures or permanent lighting that may otherwise disturb a bat flight path. The 20 m width recognises that intermittent bat activity is present at the southern end of the site where it is associated with the Mahurangi River riparian corridor, but reduces significantly at the northern end (where no activity was recorded to the north in Kanuka forest) of the Mahurangi River where it borders the Project area.

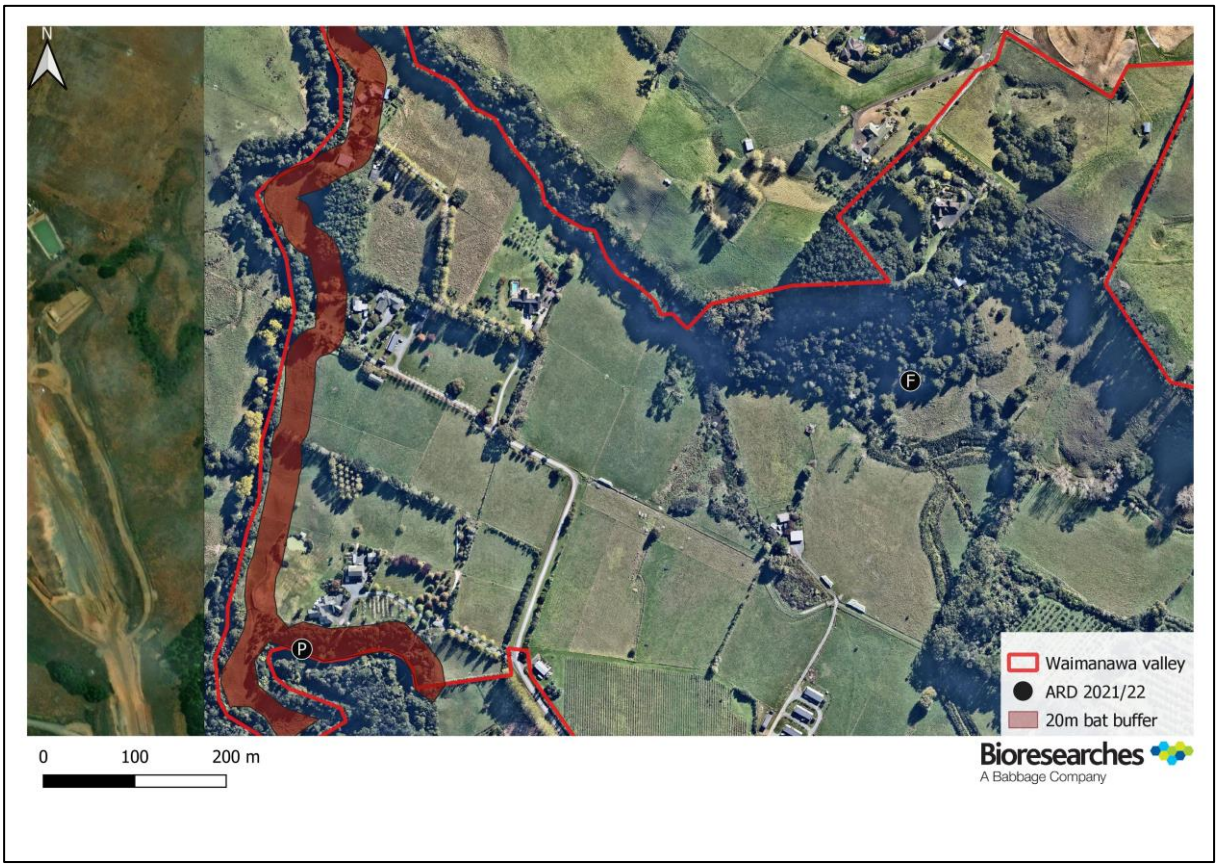

Figure 11. 20 m buffer around the area where bats were recorded in the Waimanawa Valley block.

4.1.2 Waimanawa Hills (a) Block

The southern end has the highest ecological values where the very high value SEA encroaches onto the southern boundary. This edge supports threatened kauri trees, where kauri dieback hygiene protocols would restrict development activities within 3 x their driplines (approximately 5-6 m). Auckland Council formerly required 30 m setbacks from kauri trees where possible, and this is recommended where possible, given the very high value of the vegetation.

A series of lower value indigenous vegetation fragments that run approximately 10-50 m from, and parallel with, the SEA edge at the southern boundary of the Waimanawa Hills (a) Block. These stands of mature trees represent kauri podocarp, broadleaved forest type, which is an endangered ecosystem type. These fragments are currently very degraded but have very high restoration potential. This potential could be realised through removal of stock access and enhancement planting (buffer and connectivity).

Further, protection of these fragments and maintenance of the existing open space between these fragments and Avice Miller Scenic Reserve would minimise further disturbance to kauri trees at the southern boundary as well as open space for wildlife corridors and recreation.

4.2 Freshwater Ecology

4.2.1 Waimanawa Valley, Waimanawa Hills (a) and Waimanawa Hills (b) Blocks

The current ecological values of freshwater ecosystems within the Waimanawa Valley and Waimanawa Hills Blocks were predominantly assessed as low, and ranged from negligible to moderate. The freshwater values within each site are summarised in Table 7 and Table 17. A detailed assessment of the freshwater constraints to development are within the Freshwater Constraints Analysis (Bioresearches 2020).

The proposal should apply the effects management hierarchy under the National Policy Statement for Freshwater Management 2020 (NPS-FM), where:

a) adverse effects on wetlands and streams are first avoided, where practicable; and
b) where adverse effects cannot be avoided, they are minimised where practicable; and
c) where adverse effects cannot be minimised, they are remedied, where practicable; and
d) where more than minor residual adverse effects cannot be avoided, minimised or remedied, aquatic offsetting is provided where possible; and
e) if aquatic offsetting of more than minor residual adverse effects is not possible, aquatic compensation is provided; and
f) if aquatic compensation is no appropriate, the activity itself is avoided.

Under the National Environmental Standards for Freshwater 2020 (NES-F), earthworks within wetlands that result in drainage is prohibited, unless the earthworks are for an activity that has a status such as specified infrastructure. In regards to works within and/or near streams and wetlands, the proposal should consider the objectives and policies in the NPS-FM and AUP OP, the regulations within the NES-F and the rules within E3 and E15 of the AUP OP.

An onsite meeting was held specifically looking at the Wider Western Link Road in the Waimanawa Valley Block. The diverted, straightened and deepened Watercourse 5 (Figure 6) that is present on the boundary of Morrison Heritage Orchard was assessed for a reduction in riparian width to 4 m to accommodate the link road and associated services. A 4 m riparian width on the southern side of the linear water course would still provide shading and most ecosystem services, leaf litter, woody debris, filtration, but would require maintenance to keep it weed free. The Auckland Council guidance document for Riparian Zone Management (Technical Publication 148), recommends at 10m minimum buffer as a general guideline, but also states that narrower options being considered appropriate as indicated by site constraints or opportunities. Considering the linear nature of the stream, the constraints provided by the Wider Western Link Road and amenities, and provided appropriate native species are planted and the riparian area is maintained, a 4 m buffer between the foot path and the stream is considered appropriate at this site.

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6. APPENDICES

Appendix 1. Raw Macroinvertebrate Data

					SB	SB
PHYLUM	**CLASS: Order**	**Family**	**Taxa**	**Taxa MCI sb**	**Site 12**	**Site 2**
ANNELIDA	**OLIGOCHAETA**		Oligochaeta	3.8	10	
PLATYHELMINTHES			Platyhelminthes	0.9	1	
MOLLUSCA	**GASTROPODA**	Hydrobiidae	*Potamopyrgus antipodarum*	2.1	1	4
ARTHROPODA	**CRUSTACEA: Ostracoda**		Ostracoda	1.9	1	
	Amphipoda		*Paracalliope fluviatilis*	5.5	32	
	INSECTA: Odonata	Zygoptera	*Xanthocnemis zealandica*	1.2	35	
	Trichoptera	Polycentropodidae	*Polyplectropus puerilis*	8.1	1	
	Coleoptera	Hydrophilidae	Hydrophilidae	8	1	
	Diptera	Tipulidae	*Zelandotipula* sp.	3.6	2	
		Hexatomini	*Paralimnophila skusei*	7.4	1	
		Chironomidae	*Chironomus*	3.4		2
			Polypedilum	8	1	
			Orthcladiinae	3.2	1	
			Tanypodinae	6.5	1	
	Collembola	Collembola .	Collembola	5.3	1	
		TOTALS:	**NO. TAXA**		14	2
			NO. EPT TAXA		1	0
			NO. INDIVIDUALS		89	6

Appendix 2. Terrestrial birds recorded from the wider surrounding area, from Orewa to Wellsford (Robertson *et al.* 2007; ebird; inaturalist). Data from Tawharanui Open Sanctuary excluded.

Common name	Species name	NZ Status	Recorded from site visits
Australian brown quail	*Coturnix ypsilophora australis*	Introduced	
Australian magpie	*Gymnorhina tibicen*	Introduced	✓
Barbary dove	*Streptopelia risoria*	Introduced	
Bellbird	*Anthornis melanura*	Endemic	
California quail	*Callipepla californica brunnescens*	Introduced	
Canada goose	*Branta canadensis*	Introduced	
Chaffinch	*Fringilla coelebs*	Introduced	✓
Common myna	*Acridotheres tristis*	Introduced	✓
Common pheasant	*Phasianus colchicus*	Introduced	
Common starling	*Sturnus vulgaris vulgaris*	Introduced	✓
Eastern rosella	*Platycercus eximius*	Introduced	✓
Eurasian blackbird	*Turdus merula merula*	Introduced	✓
Eurasian skylark	*Alauda arvensis*	Introduced	
European greenfinch	*Carduelis chloris*	Introduced	
Grey warbler	*Gerygone igata*	Endemic	✓
Goldfinch	*Carduelis carduelis britannica*	Introduced	
Hedge sparrow (dunnock)	*Prunella modularis*	Introduced	
House sparrow	*Passer domesticus domesticus*	Introduced	✓
Kookaburra	*Dacelo novaeguineae novaeguineae*	Introduced	
Mallard	*Anas platyrhynchos*	Introduced	✓
Morepork	*Ninox n. novaeseelandiae*	Native	
New Zealand pigeon	*Hemiphaga novaezelandiae*	Endemic	✓
New Zealand pipit	*Anthus n. novaeseelandiae*	Endemic - declining	
North Island fantail	*Rhipidura fuliginosa placabilis*	Endemic	✓
North Island fern bird	*Bowdleria punctatus*	Endemic- declining	
North Island kaka	*Nestor meridionalis septentrionalis*	Endemic - recovering	
North Island robin	*Petroica longipes*	Endemic - declining	
North Island tomtit	*Petroica macrocephala toitoi*	Endemic	
Paradise shelduck	*Tadorna variegata*	Endemic	✓
Peafowl	*Pavo cristatus*	Introduced	
Pukeko	*Porphyrio melanotus*	Native	✓
Red-crowned parakeet	*Cyanoramphus novaezelandiae*	Endemic - relict	
Redpoll	*Carduelis flammea*	Introduced	
Rock pigeon	*Columba livia*	Introduced	
Sacred kingfisher	*Todiramphus sanctus*	Native	✓
Silvereye	*Zosterops lateralis lateralis*	Native	✓
Shining cuckoo	*Chrysococcyx lucidus lucidus*	Native	
Song thrush	*Turdus philomelos*	Introduced	✓
Southern black-backed gull	*Larus dominicanus*	Native	
Spur-winged plover	*Vanellus miles novaehollandiae*	Native	✓
Swamp harrier	*Circus approximans*	Native	
Tūi	*Prosthemadera n. novaeseelandiae*	Endemic	✓
Welcome swallow	*Hirundo neoxena neoxena*	Native	✓
White-faced heron	*Egretta novaehollandiae*	Native	✓
Wild turkey	*Meleagris gallopavo*	Introduced	
Yellowhammer	*Emberiza citrinella*	Introduced	✓