report

August 2019

Waihoehoe Road Ecology Plan Change

Submitted to:
Oyster Capital Ltd

freshsolutions water
environmental consultants

Quality Assurance

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1.0 Introduction

Oyster Capital ('Oyster') is applying to Auckland Council for a Plan Change to the Auckland Unitary Plan (Operative in Part) (AUP) to rezone 48.9 hectares of Future Urban land in Drury East. The site is bound by Waihoehoe Road to the south, the KiwiRail rail corridor to the west and farmland to the north and east. It is proposed to rezone the land to a mix of residential zones (Terraced Housing and Apartment Buildings and Mixed Housing Urban) with provision for drainage reserves. The rezoning proposal provides capacity for up to 1,054 dwellings. Additionally, a precinct is proposed with trigger rules that stage the release of development capacity with the delivery of required infrastructure.

Oyster has an interest in 18.4 hectares of land on the northern side of Waihoehoe Road as shown on Figure 1. The proposed master concept plan for the site is presented in Figure 2. Oyster are experienced residential and land developers in Auckland and are currently undertaking large scale and high-quality housing developments in Whenuapai and Beachlands.

This report describes the freshwater and terrestrial ecological characteristics and values within the site. Desktop and field data were used to characterise the environment, determine ecological values and identify potential ecological constraints and opportunities for ensuring beneficial ecological outcomes for the site.

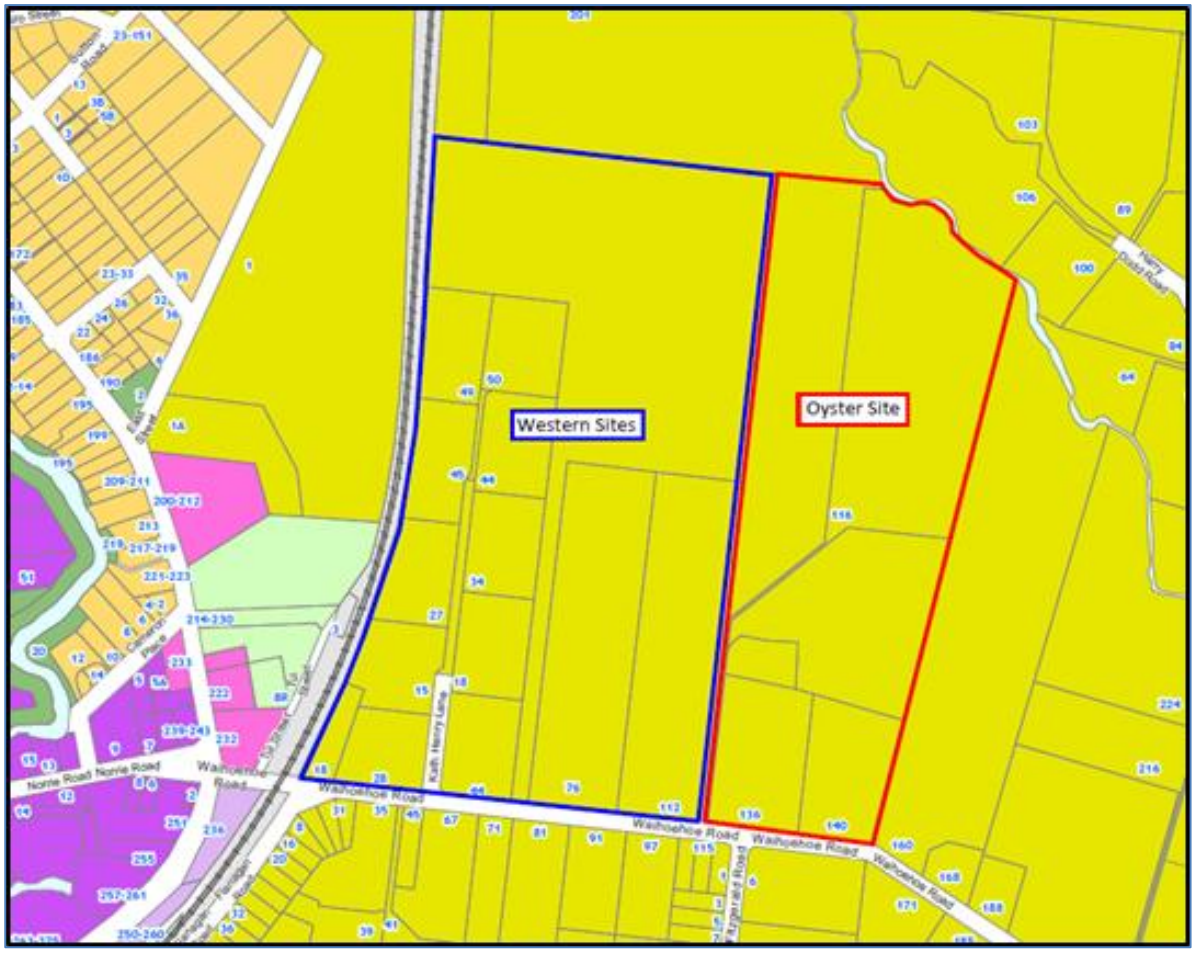

Figure 1: Plan Change Area and the Oyster Capital land holdings (shown red).

SUPER BLOCK	ZONE		LOW	MED	HIGH
		DUPHA	30	40	50
		Area	UNITS	UNITS	UNITS
SB1	THAB	29,243	88	117	146
SB2	THAB	9,572	29	38	48
SB3	THAB	26,126	78	105	131
SB4	THAB	29,914	90	120	150
SB5	THAB	10,716	32	43	54
SUB TOTAL		105,571	317	422	528

SUPER BLOCK	ZONE		LOW	MED	HIGH
		DUPHA	18	25	35
		Area	UNITS	UNITS	UNITS
SB6	MHU	6,579	12	16	23
SB7	MHU	15,845	29	40	55
SB8	MHU	18,115	33	45	63
SB9	MHU	27,969	50	70	98
SB10	MHU	14,419	26	36	50
SB11	MHU	13,460	24	34	47
SB12	MHU	44,068	79	110	154
SB13	MHU	2,125	4	5	7
SB14	MHU	5,682	10	14	20
SB15	MHU	14,401	26	36	50
SUB TOTAL		162,663	293	407	569
TOTAL		268,234	610	829	1,097

	M²	HA	%
THAB	105,571	10.6	22
MHU	162,663	16.3	33
DRAINAGE RES	166,431	16.6	34
ROAD RES	54,349	5.4	11

TOTAL AREA	489,014	48.9
Max Gross Dev Density (DUPHA)		22.4
Max Net Dev Density (DUPHA)		40.9

Figure 2: Proposed master plan for Waihoehoe Road site in Drury (supplied by HUE).

2.0 Study Methods

2.1 Introduction

A survey was completed at 116 Waihoehoe Road, which equates to approximately one third of the site (eastern bounds). Access was not available on other properties within the site.

2.2 Terrestrial Environment

A terrestrial survey was completed within 116 Waihoehoe Road on 7 February 2019. Plant and fauna species encountered were recorded and existing terrestrial habitats described. Birds identified visually and audibly were recorded across the site, including native and introduced species.

Field data collected from 116 Waihoehoe Road was used to characterise the remaining site, and was supplemented with herpetofauna records (Department of Conservation Bioweb database), bat records (Naturespace NZ), and bird records (New Zealand eBird) and a desktop review of existing literature for the site and wider Drury area.

2.3 Freshwater Environment

Stream classifications within the 116 Waihoehoe Road site were assessed via a site walkover on 30 November 2018. The classification of watercourses was assessed in accordance with criteria outlined in the Auckland Unitary Plan Operative in Part (AUP). Stream classifications in the remainder of the site were completed with reference to field information gathered from the survey of 116 Waihoehoe Road, Auckland Council GIS viewer and historical aerial imagery (Retrolens).

A more detailed survey of watercourses within the 116 Waihoehoe Road site was carried out on 7 February 2019 within the Waihoihoi Stream, as this stream held enough water to complete a stream ecological valuation (SEV), sample biological communities (invertebrates) and measure water physicochemistry (temperature, dissolved oxygen, conductivity and pH). A single macroinvertebrate sample was collected using a kick-net (mesh 0.5 mm) and following the semi-quantitative Protocol C2 (Stark et al. 2001).

The likely presence of fish within the site was discussed based on collected habitat data supplemented with New Zealand Freshwater Fisheries Database (NZFFD) records. Water physicochemistry was measured in the Waihoihoi Stream using calibrated YSI meters.

3.0 Ecological Setting

The site is located within the Manukau Ecological District which forms the southernmost portion of the Auckland Ecological Region (McEwen 1987). The Manukau Ecological District was characterised on the basis of geology and topography and encompasses low altitude flat to rolling land between the southern shores of the Manukau Harbour and the north bank of the Waikato River (McEwen 1987). The district experiences warm humid summers and mild winters with an annual rainfall of approximately 1100–1300 mm (McEwen 1987). Soils are generally well drained loam from old, strongly weathered volcanic ashes and vegetation has been highly modified by human activity particularly for farming and urbanisation (McEwen 1987).

The district comprises around 62,500 ha, but only c. 947 ha (1.5%) retains any indigenous

vegetation cover. The remaining indigenous vegetation is sparse and highly fragmented: there are 296 fragments of forest, scrub or wetland, with the majority (85%) of sites less than 5 ha in size (Emmett et al. 2000). The present isolation and scarcity of remnant vegetation patches within the district means that all areas of indigenous vegetation, no matter how small or modified, are considered important for contributing to the maintenance of biodiversity (Auckland Regional Council 2004).

Manukau Harbour together with the Firth of Thames form the most important wintering grounds for wading birds in the Southwest Pacific (McEwen 1987). The Manukau Harbour is considered to be of international significance and has been identified as a Site of Special Wildlife Interest of 'Outstanding' significance. Important wader roosting areas on the south Manukau harbour include the shell banks and adjoining pasture at Karaka, Seagrove, Waipipi, Puhinui and Pollok Spit (Emmett et al. 2000).

Historically, lowland conifer-broadleaved forest was the most common vegetation type in the ecological district, followed by mixed kauri *(Agathis australis)* forest and kauri-hard beech *(Fuscospora truncata)* forest (Emmett et al. 2000). Auckland Council Geomaps[1] biodiversity layer historically characterises vegetation within the site as a mixture of WF8 – Kahikatea, pukatea forest and WF9 – Taraire, tawa podocarp forest.

Indigenous vegetation as per the Landcover Database (version 4.1) and Significant Ecological Areas (SEAs) in the Auckland Unitary Plan Operative in Part (AUP) within the local vicinity of the site are presented on Figure 3. Most fragments of indigenous vegetation remaining within the Manukau Ecological District are located south of Paerata and only 9% of the remaining indigenous vegetation lies within protected natural areas. More than half of the protected vegetation comprises conservation covenants on private land (Auckland Regional Council 2004). No areas of indigenous vegetation occur within the site, nor do any SEA areas.

Restoration and protection of indigenous vegetation using a variety of mechanisms was seen as a priority for both the Manukau Ecological District and the neighbouring Awhitu District by former Auckland Regional Council natural heritage staff in 2004 (Auckland Regional Council 2004).

[1] https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html

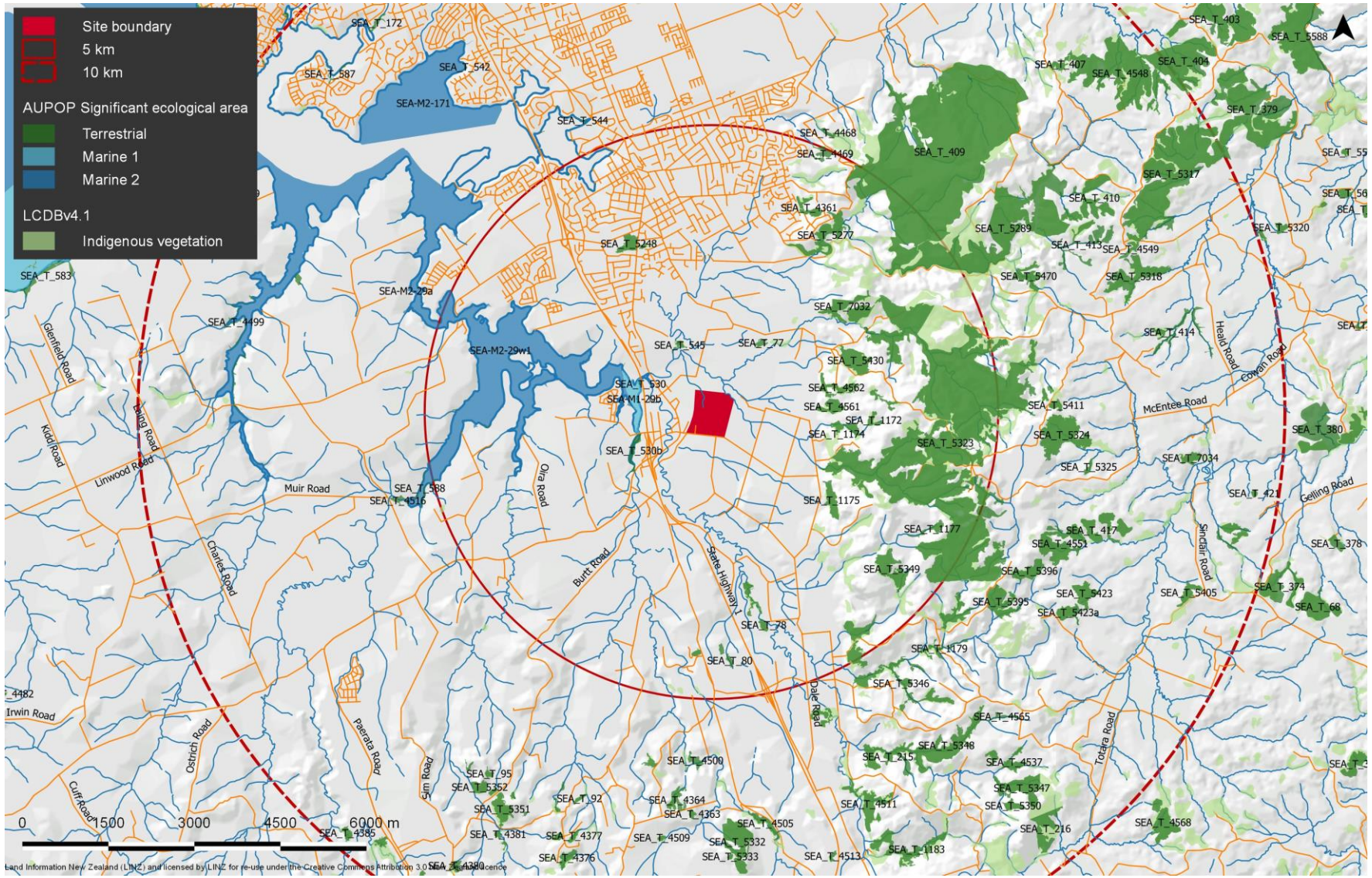

Figure 3: Significant Ecological areas (AUP) in the local vicinity of the site.

4.0 Terrestrial Habitats

4.1 Introduction

Terrestrial vegetation within the site at the time of the survey was characterised by pasture used to graze sheep and cattle with shelterbelts and amenity gardens (Figure 4). Very little indigenous vegetation was retained within 116 Waihoehoe Road (the wider site, likely to be similar) aside from occasional natives around dwellings and a small area of native planting along fence lines north and east of Pond P1.

Common species observed within 116 Waihoehoe Road included exotic shelterbelts of pine (*Pinus* sp.) and bald cypress *(Taxodium distichum),* and occasionally hedges of gorse *(Ulex europaeus),* tarata *(Pittosporum eugenioides)* and barberry *(Berberis glaucocarpa)* (Figure 5). Singular specimen trees and ornamental plants included common oak *(Quercus robusta)*, Norfolk pine *(Araucaria heterophylla),* macrocarpa (*Cupressus macrocarpa),* bead tree *(Melia azedarach),* Alder (*Alnus* sp.), *Magnolia* spp., fig *(Ficus carcia),* maple (*Acer* sp.), willow (*Salix* spp.), *Yucca* and fruit trees (i.e., *Malus*, *Citrus*, *Prunus* etc.) (Figure 6) Shrubs such as *Hydrangea*, *Alstroemeria*, flax (*Phormium* spp.), rose (*Rosa* spp.) and *Agapanthus* were common around dwellings and driveways. A similar collection of species are expected to be observed across the wider site.

Native planting along fence lines adjacent to Pond P1 included kāpuka *(Griselinia littoralis),* kōhūhū *(Pittosporum tenuifolium),* koromiko (*Veronica stricta* var. *stricta*), manuka *(Leptospermum scoparium),* kanuka *(Kunzea robusta),* cabbage tree *(Cordyline australis),* tarata, karo *(Pittosporum crassifolium),* flax and kowhai *(Sophora microphylla)* (Figure 7).

Figure 4: typical vegetation across the site.

Figure 5: Typical vegetation within the site, showing hedge of barberry and tarata.

Figure 6: Selection of fruit trees around a dwelling.

Riparian vegetation along watercourses throughout 116 Waihoehoe Road (with the exclusion of the Waihoihoi Stream) typically comprised pasture grasses and herbs such as mercer grass, paspalum *(Paspalum dilatatum),* narrow leaved plantain *(Plantago lanceolata)* and creeping buttercup *(Ranunculus repens)* with occasional gorse *(Ulex europaeus)* water pepper *(Persicaria hydropiper)* and *Juncus* rushes (Figure 8). Occasionally watercourses flowed adjacent to hedge rows of exotic tress such as pine providing some shading. A review of aerial imagery shows watercourses in the wider site are likely to have similar riparian vegetation.

The Waihoihoi Stream was overgrown with blackberry (*Rubus fruticosus* .agg) and great bind weed (*Calystegia silvatica* subsp. *disjuncta*) with occasional willow and arum lily *(Zantedeschia aethiopica)* (Figure 9). A hedgerow of pine was set back approximately 10 m on the true-right bank.

Wetland areas were heavily degraded, open to stock grazing and contained minimal native values (Figure 10). Typical vegetation included exotic rushes such as sharp fruited rush *(Juncus acuminatus),* soft rush *(J. effusus var. effusus)*, toad rush *(Juncus bufonius)* and numerous other flat leaved and leafless rushes. Other species included marsh bedstraw *(Galium palustre* subsp. *palustre),* mercer grass, creeping bent *(Agrostis stolonifera)*, spearwort *(Ranunculus flammula), Isolepis* spp., water pepper *(Persicaria hydropiper)* and starwort *(Callitriche stagnalis).*

Figure 7: Native vegetation nearing pond P1.

Figure 8: Typical riparian vegetation (February 2019).

Figure 9: Riparian vegetation along the Waihoihoi Stream (February 2019).

Figure 10: Typical wetland vegetation (February 2019).

5.0 Terrestrial Fauna

5.1 Avifauna

The bird life observed on the site (Table 1) reflects the modified state of this rural environment. Three of the five species recorded were native, and all species are considered common species, typical of urban and rural environments.

Nesting habitat for birds on the site comprises predominantly large, mature shelterbelt and amenity trees which are considered to be of reasonably low ecological value for birds.

Table 1: Bird species identified within the site.

Common name	Scientific name	NZ Status	Conservation status
Australian magpie	*Gymnorhina tibicen*	Introduced	-
Common myna	*Acridotheres tristis*	Introduced	-
Spur-wing plover	*Vanellus miles*	Native	Not Threatened
Welcome swallow	*Hirundo neoxena*	Native	Not Threatened
White faced heron	*Egretta novaehollandiae*	Native	Not Threatened

A total of 204 records of birds are listed on the eBird database[2] within 5 km of the site over the period between 1991 to 2018. Forty-seven species have been recorded, the most common include the native welcome swallow and pūkeko and the introduced common myna, Eurasian blackbird, European starling and house sparrow. A number of species of conservation interest have been identified. However, with the exception of a few, they are coastal species and are unlikely to be found as far inland as the site (particularly in the absence of a large river mouth or expanse of aquatic habitat).

Non-coastal birds within 10 km of the site include the freshwater loving New Zealand dabchick, which has been identified by a passenger on the Pukekohe-Papakura train in one of the NZ Hothouse ponds. The New Zealand dabchick is usually found in small lakes or sheltered inlets on larger lakes. Most birds inhabit freshwater lakes and ponds on the volcanic plateau, Rotorua Lakes area, Northland, Hawke's Bay and Wairarapa. The New Zealand dabchick could possibly visit the larger ponds within the site, however this would be unlikely due to their low population number and the likely presence of introduced predators within the site.

Land birds of conservation interest identified within 10 km of the site include the New Zealand falcon, which has a conservation status of 'At Risk' (Recovering) (Robertson et al. 2017). The New Zealand falcon are absent as breeders in most urban or intensive agricultural landscapes so would be unlikely to be found breeding within the site. However, juveniles are commonly observed across many landscapes in winter as they disperse from their natal territories, so there is the potential for them to be infrequent visitors to the site.

5.2 Herpetofauna

One skink was observed (not captured) during the site visit upon brief observation of logs within the 116 Waihoehoe Road site. Due to the habitat the lizard was identified in, there is the possibility it may have been a native *Oligosoma* species. The introduced rainbow skink *(Lampropholis delicata)* was also commonly observed. All lizards, except for the introduced rainbow skink are legally protected under an amendment to the Wildlife Act 1953, and their habitats by the Resource Management Act 1991 (Anderson et al. 2012). A significant component of our lizard fauna (~85%) are recognised as 'Threatened' or 'At Risk' in the latest Threat Ranking Lists (Hitchmough et al. 2015).

Herpetofauna recorded on the DOC Bioweb Herpetofauna Database in the vicinity of the site is presented on Figure 12 and include the native lizards; copper skink *(Oligosoma aeneum)*, an unidentified *Oligosoma* species, the introduced lizard rainbow skink, an introduced frog and a marine turtle. Other lizard species known to the Auckland Region include ornate skink *(Oligosoma ornatum)* gecko such as pacific gecko *(Dactylocnemis pacificus),* forest geko *(Hoplodactylus granulatus)* and the elegant geko *(Naultinus elegans)* and coastal skinks such as shore skink *(Oligosoma smithii).*

Both the native copper skink and ornate skink are adaptable ground dwelling skinks that prefer habitat such as wood and debris piles (common around dwellings), vegetated bush/shrub areas, gardens with vegetative cover and adjacent rank grass. There is a considerable amount of habitat within the site suitable for both the native copper skink and ornate skink, especially within the 116 Waihoehoe Road site, under large piles of woody debris (Figure 11). Copper skink and ornate skink can occupy areas of rank pasture when adjacent to other more suitable habitats but are unlikely to be disbursed throughout grazed pasture areas or mown lawn areas. Ornate skink are regarded as 'At Risk' (Declining) by

[2] eBird Basic Dataset. Version: EBD_relNov-2017. Cornell Lab of Ornithology, Ithaca, New York. Nov 2017.

Hitchmough et al. (2015).

Although lizards are mobile and capable of colonising sites from nearby undisturbed sites, the high level of modification and lack of remnant vegetation in the site surrounds make it less likely that native lizards will be present within the site in high numbers.

Figure 11: Large piles of woody debris suitable as lizard habitat within 116 Waihoehoe Road.

Arboreal (forest dwelling) gecko species (i.e., pacific gecko, forest gecko, elegant gecko) are unlikely to occur within the site due to an absence of suitable vegetated habitat. Shore skink is a coastal species that would be unlikely to be found as far inland as the site.

The southern bell frog *(Litoria raniformis)* has been recorded in the vicinity of the site. These species are both terrestrial and aquatic and common in farmland near water. The ponds within the site may provide habitat for these species. The southern bell frog is not protected under the New Zealand Wildlife act 1953 (noted in Schedule 5[3]). While in New Zealand these species are not protected, they are becoming less common in their country of origin Australia. The southern bell frog is considered 'Endangered' according to the 2004 International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species[4]. New Zealand is known as a stronghold for the southern bell frog.

[3] http://legislation.govt.nz/act/public/1953/0031/latest/DLM278571.html?search=sw_096be8ed815a96ef_litoria_25_se&p=1&sr=0
[4] http://www.iucnredlist.org/details/12143/0

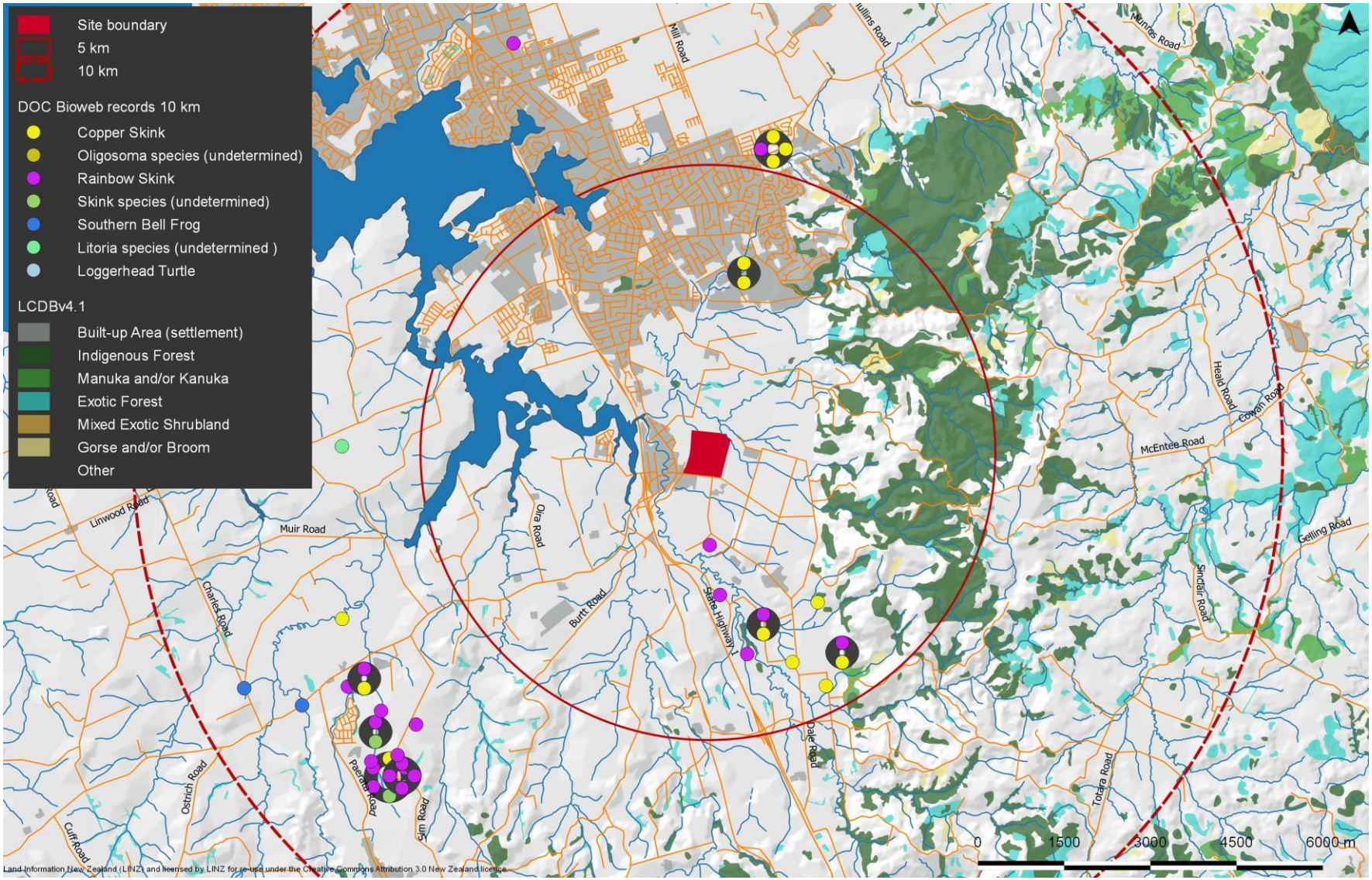

Figure 12: DOC Bioweb Herpetofauna Records in the vicinity of the site.

5.3 Bats

The site is within the ranging distance of known populations of long-tailed bat *(Chalinolobus tuberculatus)* at Point View Reserve Clevedon and the Hunua Ranges. Auckland Council complete bat monitoring regularly across the Auckland Region. Monitoring completed in nearby Redhill to the northeast of the site along Hayes Stream in 2013 has not detected bats, however bats have been detected south east of the site at Ponga Road in 2014. Auckland Council has detected low-high numbers of bats in generally forested habitat further east of the site in the Hunua Ranges, Waharau and Tapapakanga Regional Parks and Mangatangi.

Small numbers of bats have also been detected at nearby Makau, Puni, Patumahoe (Sinclair 2017, Nathan 2017). These locations are similar in character to the site (i.e., rural, lacking large tracts of native bush so are comparable to the site.

Long-tailed bats forage over farmland and urban areas favouring forest edge and riparian habitats where they feed on aquatic insects. Long-tailed bats can cover 50 km in a single night and have ranges extending up to 100 km^2. A study of long-tailed bats within the highly fragmented landscape of South Canterbury found they preferred roosting habitat that included indigenous forest, shrubland remnants and riparian zones (Sedgeley and O'Donnell 2004). Long-tailed bats usually find roosts in large old native canopy trees either beneath the bark or in cavities where they rest during the day and breed. However, they also find suitable roosts in mature exotic trees such as pine and macrocarpa.

It is possible bats are present within the site in low numbers, suitable roosts include any large mature native and exotic trees containing cavities.

Long-tailed bats in the North Island are regarded as 'Threatened' (nationally vulnerable) by O'Donnell et al. (2013). Short tailed bats are only known to be found on Little Barrier Island making their presence at the site unlikely.

6.0 Freshwater Habitats

6.1 Stream and Wetland Habitat

Watercourses and wetlands within the site are shown on Figure 13 along with their stream classifications in accordance with AUP criteria (refer to Appendix A for criteria). Historical aerial imagery of the site from 1942 is shown on Figure 14. Floodplains (100-year event) and flood prone areas (1% annual exceedance probability [AEP] extreme rainfall event) are shown on Figure 15. The 1% AEP floodplain extent is derived from Rapid Flood Hazard Mapping and simulates the 1% AEP rainfall event without climate change.

A walkover survey was carried out within 116 Waihoehoe Road on 30 November 2018. The survey was outside the recommended Auckland Council window for classifying intermittent and ephemeral watercourses (i.e., July–October). The walkover survey was carried out after 3.2 mm of rainfall within 48 hrs of the survey and 41.6 mm of rainfall over the previous 7 days at the Auckland Aero monitoring station (National Climate Database). Although the survey was not within the July-October window it was carried out during wet conditions.

All watercourses (A-J) originate within the site and are highly modified and have minimal natural character and low ecological value in their current state. Most of the watercourses within the site are located on the Drury Sand Aquifer, which is classified as a high use Aquifer Management Area and a Quality Sensitive Aquifer in the AUP.

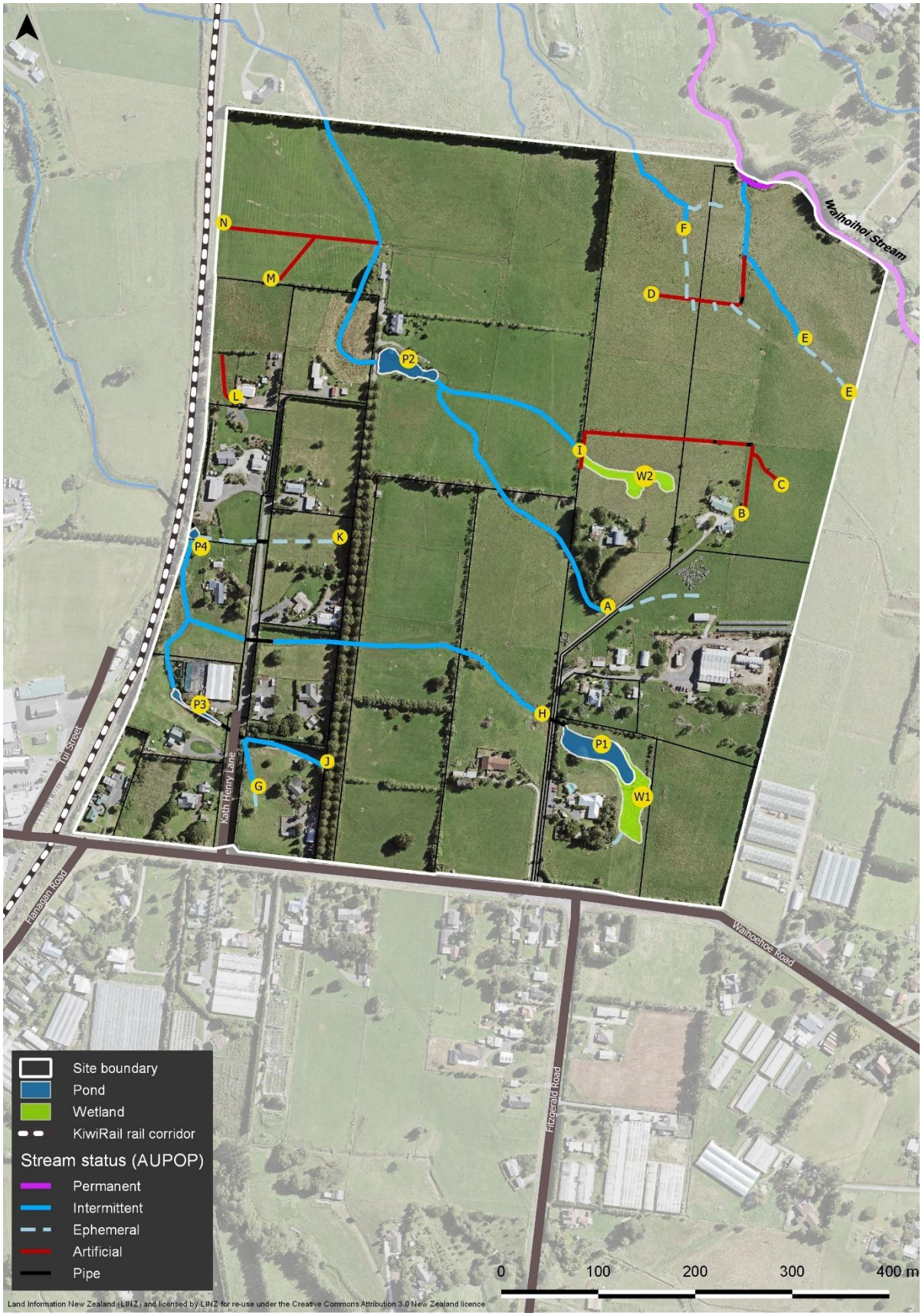

Figure 13: Stream classifications (AUP), ponds and wetlands within the site.

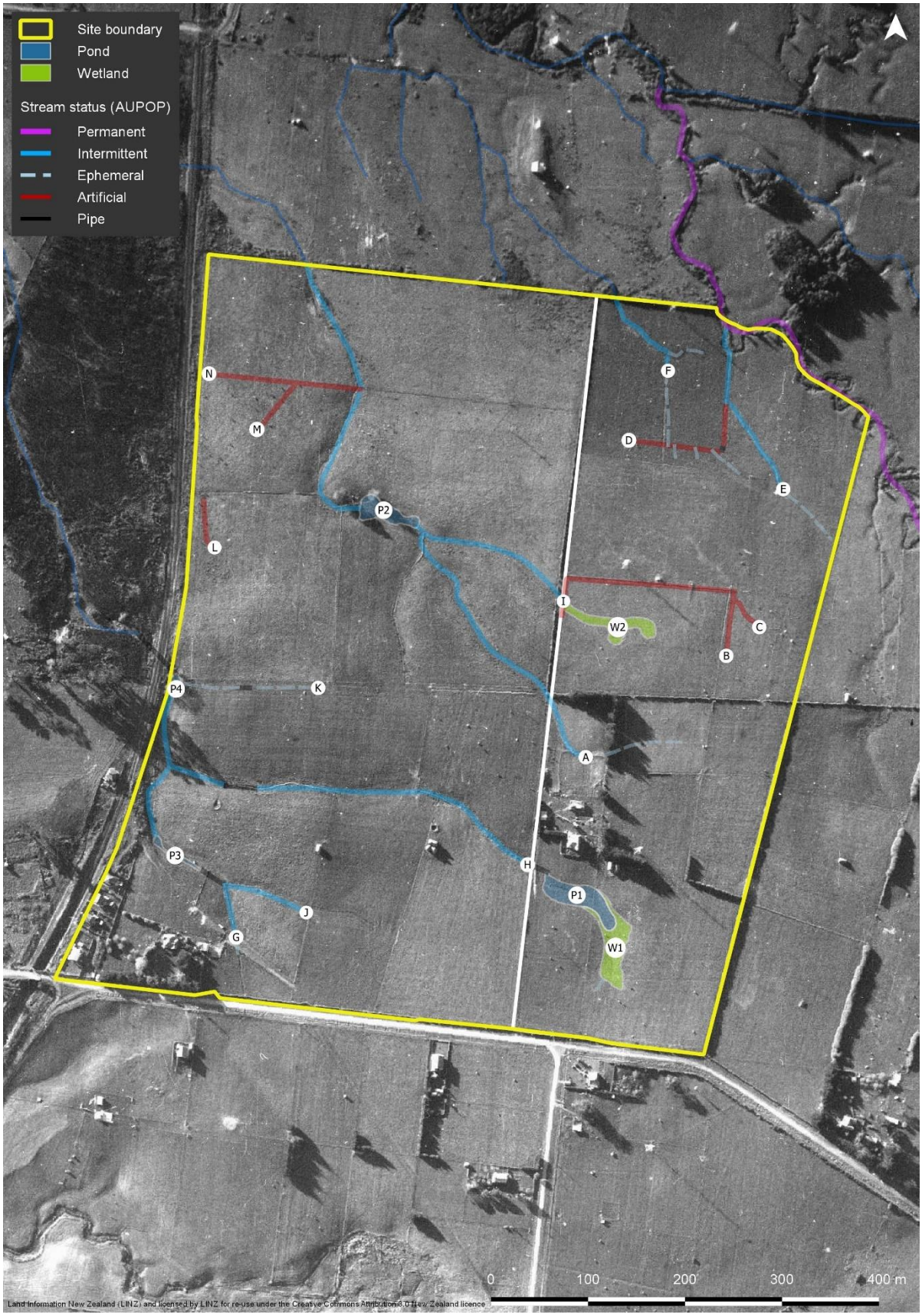

Figure 14: Historical aerial (1942) with existing streams, ponds and wetlands.

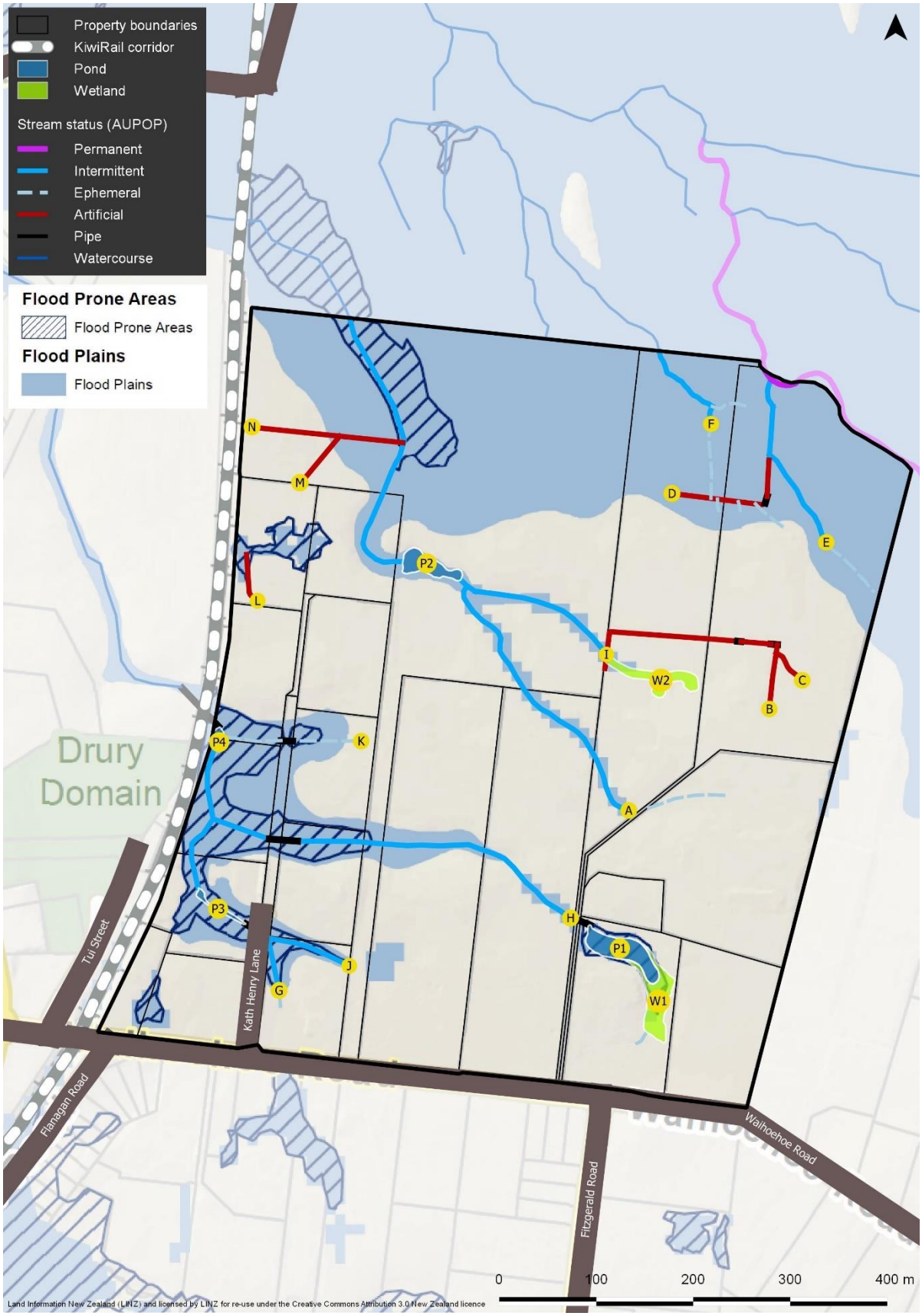

Figure 15: Floodplains and flood prone areas (Auckland Council Geomaps).

Waihoihoi Stream

There is a short section of the mainstem of the Waihoihoi Stream that drains along the north-eastern boundary of the site (Figure 16). The Waihoihoi Stream is one of four main watercourses within the Slippery Creek catchment. Slippery Creek joins Hingaia Stream to form the tidal Drury Creek at the northern end of Drury Township. The Waihoihoi Stream has a naturally meandering channel with a wetted width of 1–3 m and an average depth of 0.26 m at the time of the survey (Figure 16). The channel was incised with some connection with the floodplain during baseflow conditions. The streambed substrate was dominated by silt/sand and small gravels. Woody debris was common within the channel and increased stable aquatic habitat for invertebrates and shelter for fish. Aquatic habitat comprised mainly slow flowing run and pool habitat with occasional riffles. Riparian vegetation was dominated by exotic trees and shrubs and provided some channel shade.

Figure 16: The mainstem of the Waihoihoi Stream within the site.

Watercourse A (Ephemeral and Intermittent)

Watercourse A originates as an ephemeral flow path on 116 Waihoehoe Road and becomes an open intermittent channel surrounded by pine trees below a pipe outlet at the driveway (Figure 17 and Figure 18). The intermittent channel has been artificially widened (2–4 m) near its origin and is choked with emergent macrophytes (e.g., water pepper, starwort). The upper section held non-flowing surface water at the time of the 30 November 2018 survey but was dry during the 7 February 2019 survey. Watercourse A flows in a north-westerly direction onto 112 Waihoehoe Road over grazed pasture and feeds into Watercourse I at Pond P2. Below pond P2, Watercourse A exits the site in the north western corner where it continues downstream until it drains into Waihoehoe Stream near Drury (~150 m upstream of Slipper Creek confluence). Watercourse A within the site provides marginal aquatic habitat of poor quality for invertebrates and fish.

Figure 17: Watercourse A within the site holding surface water (November 2018).

Figure 18: Watercourse A within the site showing dry channel (February 2019).

Watercourses B, C, D, L, M and N (Artificial Watercourses)

Watercourses B, C, L, M and N were classified as artificial as they did not appear to be replacing natural drainage systems or appear as channels on the 1942 aerial photographs. Watercourse L in particular appears to have been dug recently (between 2015/16 and 2017 based on aerial imagery; Auckland Council Geomaps). Watercourse D was a straight aligned artificial channel and held water in November but was dry in February (Figure 19).

Figure 19: Watercourse D in November 2018 (top) and February 2019 (below).

All artificial watercourses surveyed had straight alignments and generally lacked riparian vegetation. Artificial watercourses within property 116 Waihoehoe Road held surface water during the November 2018 survey but were dry during the February 2019 survey. All artificial watercourses within the site represent highly modified aquatic habitats and provide very-poor quality habitat for aquatic fauna.

Watercourse E (Ephemeral and Intermittent)

Watercourse E originates in a shallow but natural depression in a grazed paddock as an ephemeral flow path. The ephemeral flow path transitions into an intermittent section that held a small amount of surface water in November 2018 but was dry in February 2019. The upper intermittent section has a wide and poorly defined channel affected by stock grazing. The channel was choked with exotic grasses including mercer grass and creeping bent and supported emergent macrophytes including water pepper and starwort in November 2018. The natural upper section discharges into a highly channelised mid-lower section that flows along a fence-line and a narrow strip of gorse before discharging into Waihoihoi Stream (Figure 20). Watercourse E represents a highly modified environment and provides marginal and seasonal aquatic habitat of poor quality for aquatic fauna.

Figure 20: Intermittent sections of Watercourse E (upper and lower sections).

Watercourse F (Ephemeral and Intermittent)

Watercourse F (Figure 21) is an intermittent stream that drains a natural shallow depression in a flat grazed paddock. The upper reach is fed by ephemeral flow paths including one that appeared t be joined with Watercourse D. The channel is grazing damaged, poorly defined, choked with pasture grasses and lacks riparian vegetation. The channel held a small amount of surface water during the November 2018 survey but was dry in February 2019. Aquatic macrophytes recorded during the November 2018 survey included water pepper and starwort. Watercourse F is highly modified intermittent stream that provides poor quality aquatic habitat in its current state.

Figure 21: Lower Watercourse F within the site (February 2019).

Watercourses G, H, I, J and K (Ephemeral and Intermittent)

It was not possible to walk over Watercourses G, H, I or J, however based on aerial imagery, these watercourses are likely to have similar characteristics to those observed in 116 Waihoehoe Road (i.e., unshaded, poorly defined, grazing damaged channels, lined with exotic grasses and herbs). A number of culverts (driveway crossings) and ponds have the potential to be acting as barriers to fish migration in Watercourses G, H, I and J.

Wetlands W1 and W2

The site contains two wetlands (W1 and W2). Wetland W1 is associated with the online Pond P1 (Figure 22). The boundary of wetland W2 was difficult to determine and was based on the presence of facultative and obligate wetland plant species (Figure 23). Rainfall in the week prior to the November 2018 survey may have resulted in wetland W2 holding more water than what would be expected. Wetland W2 did not hold surface water during the February 2019 survey and indicates it dries out after prolonged dry periods.

Wetland W1 and W2 are severely damaged through unrestricted grazing pressure and are typically lined with exotic grasses (mercer grass, *Paspalum distichum*), rushes and sedges (i.e., *Juncus* and *Isolepis*) and macrophytes such as water pepper and starwort in wetter seasons. These wetland habitats are wide, waterlogged (in winter) and lack natural defined stream channels. These wetland habitats are unlikely to support native fish due to inadequate surface water depths but may support invertebrates tolerant of degraded conditions during periods when they hold surface water.

Figure 22: Wetland W1 during November 2018 survey.

Figure 23: Wetland W2 during November 2018 survey.

Online Ponds P1, P2, P3 and P4

Four artificial ponds were identified during the survey and after reviewing aerial images. All ponds were online ponds and most were in the mid-upper reaches of intermittent tributaries. The largest pond occurs in the upper section of Watercourse H (Figure 24). Ponds are likely to be drained via perched culverts or structures that may be barriers to upstream fish passage. Artificial ponds within the site provided poor quality still water habitat and are likely to be adversely affecting downstream water physicochemistry.

Figure 24: Online Pond P1.

7.0 Water Quality and Aquatic Biota

7.1 Introduction

Water physiochemistry and invertebrate data were collected from the Waihoihoi Stream within 116 Waihoehoe Road. This reach was the only section of permanent stream (with surface water) within the 116 Waihoehoe Road site at the time of the February survey. Raw invertebrate data is presented in full in Appendix B.

7.2 Water Physiochemistry

Water temperature measured in the Waihoihoi Stream was moderate (20.0°C at 12:20 p.m.) and reflected the time of the year the survey was carried out. Dissolved oxygen was moderate (85%, 7.8 g/m^3), conductivity within the low range (92 µS/cm) and pH circum-neutral (7.2). Water physiochemistry would not have been limiting aquatic biota in the Waihoihoi Stream at the time of the survey.

7.3 Benthic Invertebrates

The Waihoihoi Stream within and immediately to the north of the site supported an invertebrate community with moderate taxa richness (25 taxa) and high abundance (2,900 individuals/m²) caused by high numbers of the snail *Potamopyrgus*. The most common taxonomic groups recorded were Mollusca (Snails), Diptera (true flies) and Platyhelminthes (Flatworms) which are typically associated with soft-bottomed streams and degraded habitat and water quality. Six water and habitat sensitive EPT taxa were recorded, including four different mayflies (*Austroclima, Deleatidium, Nesameletus* and *Zephlebia*) and two species of caddisfly (*Hydrobiosis* and *Pycnocentrodes*). No stoneflies were recorded. The MCI-sb score for the community recorded from the Waihoihoi Stream was 78 and just below the 'poor' stream health category (i.e., <80).

Other watercourses within the site are either intermittent, artificial or ephemeral and drain areas of grazed pasture without vegetated riparian margins. Watercourses are unfenced and grazing animals have direct access to streambanks and channels causing disturbance to benthic habitat and resulting in poor instream conditions for invertebrates. Although not sampled, in winter when surface water will be present, other watercourses within the site are likely to support invertebrate communities dominated by taxa that are tolerant of degraded instream conditions (e.g., ostracods, worms, dipterans, damselflies).

7.4 Freshwater Fish

Fish Fauna

Two shortfin eel measuring 500 mm and 420 mm were observed in the Waihoihoi Stream during the survey. No other fish species were observed.

The New Zealand Freshwater Fish Database (NZFFD) does not contain any records of freshwater fish within the site. There are 25 records of fish and kōura between 1980 and 2005 within the Waihoihoi catchment. Seven native fish species and kōura have been recorded from the catchment including three species of conservation interest: longfin eel, īnanga and torrentfish, which are 'At Risk' (Declining) (Dunn et al. 2017). The most commonly recorded species are kōura and banded kōkopu.

Overall, there is limited habitat for freshwater fish within the site with the exception of the Waihoihoi Stream and online ponds. All other watercourses within the site have been modified, have intermittent or ephemeral habitat characteristics, lack defined channels due to grazing damage, hold shallow surface water in winter, choked with grass and lack overhead cover and instream refugia. There are numerous barriers to fish passage within the site including culverts (pipes), bunded crossings and online ponds.

8.0 Summary of Ecological Values

8.1 Terrestrial Environment

The site is characterised by pasture, exotic shelterbelts, weeds and amenity gardens with a mixture of native and exotic species. Although vegetation within the site is of low value, given the absence of forested areas in the local landscape, shelterbelts and exotic trees and shrubs do provide a function as refuges for native fauna, while providing basic ecosystem services. No areas within the site were recognised under the AUP as having SEA status and our assessment of the site agrees with this conclusion.

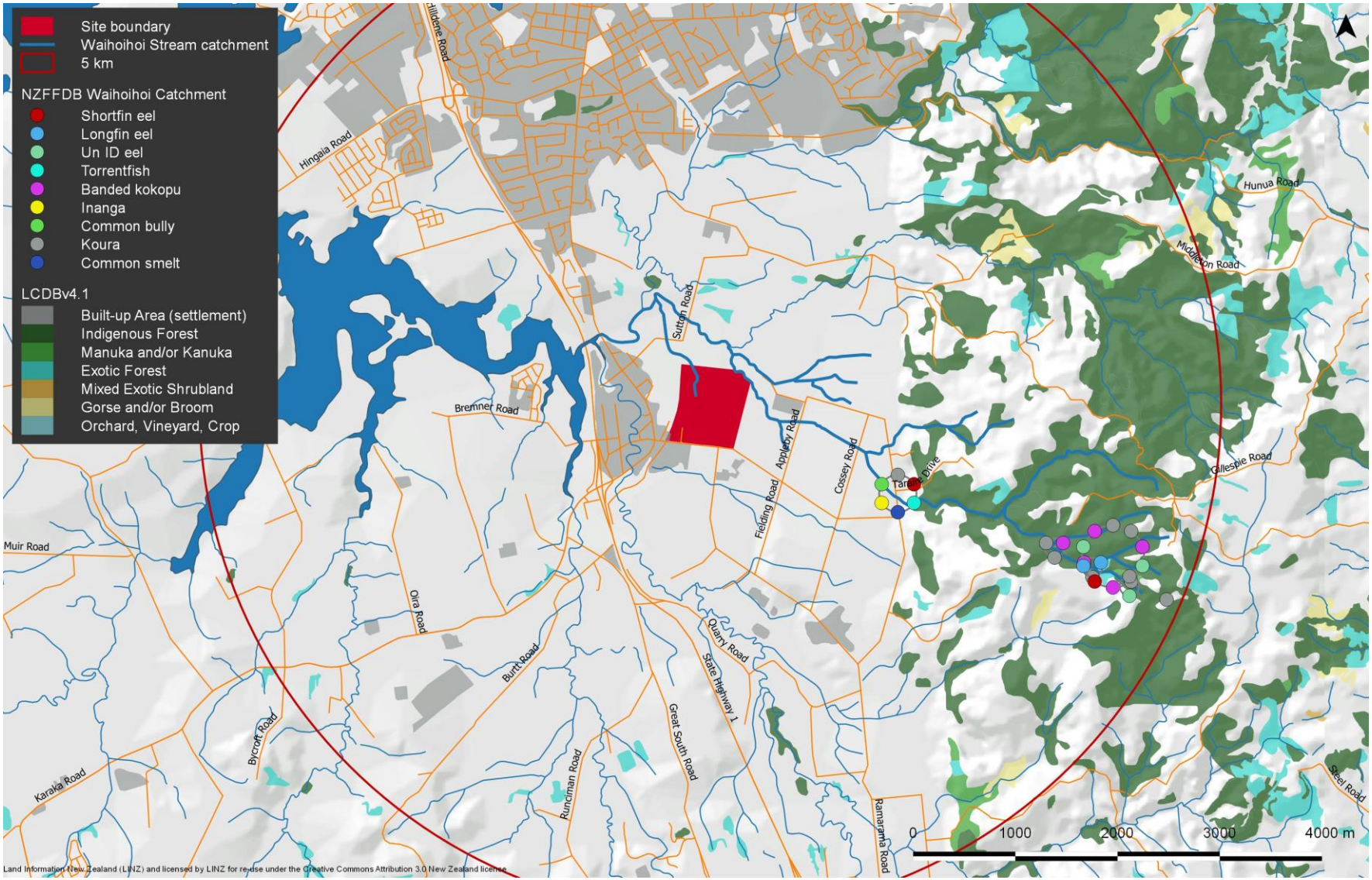

Figure 25: NZFFD fish records for the Waihoihoi Stream catchment.

Bird species identified within the site and most historic records within the local area comprise common species typical of rural and urban areas. The only species of conservation interest from within the local area are unlikely to be more than infrequent visitors to the site due to the scarcity of suitable habitat.

Native tree dwelling gecko species known to the Auckland Region are unlikely to be present within the site, due to the absences of suitable habitat. Adaptable ground dwelling species such as the native copper skink and ornate skink may be present within the site (particularly in 116 Waihoehoe Road in wood piles). All native lizard species are legally protected under an amendment to the Wildlife Act 1953 and their habitats by the Resource Management Act 1991 (Anderson et al. 2012).

A search for bat roosts was not conducted within the site. It is possible very low numbers of bats may frequent mature exotic trees (including shelterbelts) within the site that contain suitable cavities. Particularly trees lining moderately large watercourses.

8.2 Freshwater Environment

Watercourses within the site have been influenced and shaped by a long history of rural landuse practices associated with stock grazing that has resulted in clearance of riparian vegetation, disturbance of channels and damage to streambanks and streambeds.

All watercourses within the site have been modified to varying degrees and have limited natural character. The watercourses generally provide aquatic habitat of moderate to poor quality due to vegetation clearance and grazing damage. All watercourses within the site, with the exception of the Waihoihoi Stream, have low ecological value.

The Waihoihoi Stream has good baseflow and shortfin eel was observed during the survey, and it also has the potential to support other species (e.g., īnanga or banded kōkopu) in future if enhanced through riparian planting and if there are no barriers to upstream fish passage in the lower catchment.

The online ponds P1, P2, P3 and P4 are highly modified aquatic environment that provide still water habitat of low quality and ecological value. The online ponds have the potential to adversely affect downstream water quality through the discharge of water with elevated temperatures and depressed dissolved oxygen.

Freshwater wetlands within the site are highly modified and degraded, dominated by exotic species, artificially drained in places, are open to stock trampling and have minimal indigenous values and character in their current state. Nationally wetlands have been severely reduced in extent, the figure of 10% is often quoted for the area that now remains (Johnson and Gerbeaux 2004) and freshwater wetlands are a priority for protection in the Manukau Ecological District where only 0.4% of original wetlands remain. Therefore, while the wetlands within the site are highly degraded and somewhat water short, they are still regarded as valuable for their potential to be restored and function within the catchment.

The ecological and functional values of Waihoihoi Stream within and adjacent to the site was assessed using the Stream Ecological Valuation (SEV) method. SEV results are summarised in Table 1 (presented in full in Appendix D). The SEV score for the Waihoihoi Stream within and adjacent to the site was 0.531 (out of a maximum of 1.0) (Table 1). The SEV score for The Waihoihoi Stream in measured within and adjacent to the site is lower than the mean score of 0.610 (n = 19; range 0.25–0.96) for sites in Auckland Council's monitoring network across rural, native forest, exotic forest and urban land uses (Storey et al. 2011).

Table 2: SEV scores for The Waihoihoi Stream within and adjacent to the site.

Function	Function	Waihoihoi Stream
Hydraulic	Natural flow regime	0.93
	Floodplain effectiveness	0.32
	Connectivity for species migrations	1.00
	Natural connectivity to groundwater	0.96
	Hydraulic function mean score	***0.80***
Biogeochemical	Water temperature control	0.16
	Dissolved oxygen levels maintained	0.50
	Organic matter input	0.07
	In-stream particle retention	0.85
	Decontamination of pollutants	0.50
	Biogeochemical function mean score	***0.42***
Habitat Provision	Fish spawning habitat	0.55
	Habitat for aquatic fauna	0.56
	Habitat provision function mean score	***0.56***
Biodiversity	Fish fauna intact	0.23
	Invertebrate fauna intact	0.59
	Riparian vegetation intact	0.21
	Biodiversity function mean score	***0.34***
	SEV score	**0.531**

9.0 Opportunities and Constraints

9.1 Introduction

This section describes the potential ecological opportunities and constraints for the Waihoehoe Road site for the proposed plan change and makes reference to the master plan generated by HUE (Holistic Urban Environments) (Figure 26).

9.2 Terrestrial Habitat Protection and Enhancement

There is no existing terrestrial vegetation within the site that warrants specific protection nor enhancement. The AUP provides a comprehensive set of rules relating to vegetation in chapter E15 and these are considered to be appropriate to address the potential for adverse effects in the same way they already apply under the current zoning of the site.

9.3 Avifauna

Bird species identified within the site are common species typical of rural and urban areas, all of which readily habituate to disturbance so are unlikely to be especially affected by development of the site. Recommended riparian planting described in Section 9.6 and shown as drainage reserve areas on the master plan (Figure 26) will benefit current and future bird species by increasing habitat availability, diversity and food sources.

Figure 26: Proposed master plan and showing existing streams, ponds and wetlands (supplied by HUE).

While the majority of birds within the site are expected to be common species of no conservation interest, vegetation clearance (particularly of mature trees) can adversely affect native species when completed over the breeding season (September-February inclusive). Ideally vegetation clearance should occur within autumn-winter as to not impact the breeding season. If vegetation clearance occurs during the breeding season, other mitigation techniques such as avoiding trees containing nests until chicks have fledged should be employed to minimise effects.

9.4 Herpetofauna

Areas most likely to support lizards within the site include rank grass, shrubs, amenity vegetation around buildings and debris (e.g., wood and rubbish piles). Wood piles and debris are common at 116 Waihoehoe Road and support lizards. Copper skink and ornate skink can occupy areas of rank pasture when adjacent to other more suitable habitats such as wood piles but are unlikely to occur throughout grazed paddocks or mown areas.

Aside from riparian planting and enhancement that will create additional vegetated habitat for lizards (see Section 9.6 and refer to Figure 26), other opportunities for enhancement include creating habitat (i.e., installing log stacks), ensuring long rank grass areas (or dense low-growing native species) are retained along the margins of bush and scrub areas and implementing a long-term Animal Pest Control Plan to reduce predators.

The southern bell frog has been recorded in the vicinity of the site and has the potential to be present in ponds P1, P2, P3 and P4. No mitigation is required for any loss of habitat for southern bell frog as they are an exotic species. There are no native amphibians near the location so disease risk and competition with native frogs are negligible.

9.5 Bats

There is the potential for bat roosts to occur in mature trees within the site that have hollows and cavities. This will need to be assessed, and if confirmed, mitigation may need to be implemented. All mature trees, regardless if they are native or exotic, are valuable in the long-term as they age to ensure sufficient bat roosting habitat is maintained across the landscape. There is potential to consider retaining mature existing (non-invasive) trees in riparian areas (i.e., preferential roosting locations for bats) where they can be incorporated when developing the site as they have more immediate future potential to provide bat roosts given their current age.

9.6 Aquatic and Riparian Habitat Enhancement

There is significant potential to enhance streams and wetlands within the site through weed control, riparian planting, assigning suitable legal protection (i.e., covenant) and through increasing habitat connectivity and restoration of ecological corridors by minimising piping and reclamation of watercourses.

All streams within the site are currently unfenced and lack riparian vegetation. The removal of grazing stock and a programme of riparian planting will result in an increase in channel shade, woody debris inputs (e.g., potential instream habitat), improve streambank stability, encourage defined channel formation and improve overall ecological values. It is recommended that the planting of second-generation diversity forest trees of the former forest type (i.e., kahikatea, pukatea, tawa, taraire, tītoki, etc.) is included amongst pioneer species (i.e., mānuka and kānuka) to help kick-start natural forest regeneration. This will also have the added benefit of diversifying food sources for current and future lizard and

bird species within the site, and in the very long-term, provide potential suitable bat roosts.

Likewise, the restoration of wetland areas with suitable native plants and native terrestrial buffer vegetation will help to increase ecosystem diversity within the site and restore some of the valuable ecosystem functions that wetlands provide such as flood water attenuation, sustaining and balancing base flow rates and increase the filtration and removal of sediment, nutrients and other pollutants reaching watercourses.

9.7 Modification or Reclamation of Natural Watercourses and Wetlands

Any reclamation or modification of intermittent or permanent natural streams or wetlands will require offsetting through the enhancement of another section of stream or wetland within the site or offsite to ensure 'no-net-loss' of overall ecological function and values. Works in watercourses during reclamation should adhere to strict sediment control and hygiene protocols to avoid the discharge of sediment to the downstream environment and spreading aquatic weed species. Mitigation or offsetting assessments should follow recommended Auckland Council guidelines and methods (e.g., SEV and ECR) and adhere to best practice restoration guidelines (e.g., appropriate riparian widths, fish passage, etc.).

The master plan (Figure 26) shows reclamation of natural stream habitat (i.e., permanent or intermittent stream) or wetlands will be avoided or minimised with natural aquatic habitats retained in their current alignments within drainage reserves. Roads have been aligned, where practicable, with existing culverts and ponds in order to minimise the modification or loss of natural stream and wetland habitats (e.g., Wetlands W1 and W2). There may be minor modification or re-shaping of streams and wetlands to allow proposed road alignments but the vast majority of habitats within the site will be retained and enhanced.

9.8 Modification of Ephemeral Flow Paths and Artificial Channels

Ephemeral flow paths occur within the site in areas of grazed pasture. Modification or infilling of ephemeral flow paths does not require offsetting under rules in the AUP. Ephemeral flow paths can have a functional role in catchments so their retention and enhancement would be of some benefit to the catchment. The master plan (Figure 26) shows a green link for future overland flow path (e.g., swale) will be retained and will feed into a natural wetland (W2). Retaining this overland flow path will increase filtering of sediment and contaminants and enhance the downstream environment.

The AUP defines artificial watercourses as *'constructed watercourses that contain no natural portions from their confluence with a river or stream to their headwaters'*. Artificial watercourses are not included in the definition of a river under the Resource Management Act and can be modified or infilled as a permitted activity under rules in the AUP.

9.9 Removal of Artificial Ponds and Culverts

The removal of artificial ponds P1, P2, P3 and P4 has the potential to improve downstream water quality, fish passage and result in an overall enhancement of aquatic ecological values and natural character within the site by returning the ponds to a natural stream environment. Any works within ponds should adhere to sediment control and hygiene protocols to avoid the discharge of sediment to downstream aquatic environments and the spreading of aquatic weed species. Recreating stream channels in existing pond locations should be carried out in a way that returns the stream to a more natural state and draw on the characteristics of the stream in the immediate upstream and downstream environment.

There are existing culverts within the site that can be removed and the stream channel

returned to a more natural state. The removal of culverts will increase the amount of natural stream habitat and improve fish passage for native diadromous fish where culverts are blocked or perched.

9.10 Development Within Floodplains

The site is partially located on the Drury Sand Aquifer which is classified as a high use Aquifer Management Area and a Quality Sensitive Aquifer in the AUP. Watercourses within the site are likely to be aquifer fed to some extent and could be affected by a reduction in aquifer recharge if development in the catchment is not managed appropriately. Retaining natural landform and avoiding development within the floodplain will help to protect groundwater levels and remaining watercourses in the site and wider stream catchments.

10.0 References

Anderson P, Bell T, Chapman S, Corbett K. 2012. SRARNZ New Zealand Lizards Conservation Toolkit- a resource for conservation management of the lizards of New Zealand. Society for Research on Amphibians and Reptiles of New Zealand.

Auckland Regional Council 2004. Awhitu and Manukau Ecological Districts: Indigenous Vegetation Survey. Volume 1. Auckland Regional Council, Auckland 53 pp + appendices.

Dunn, N.R.; Allibone, R.M.; Closs, G.P.; Crow, S.K.; David, B.O.; Goodman, J.M.; Griffiths, M.; Jack, D.C.; Ling, N.; Waters, J.M.; Rolfe, J.R. 2018. Conservation status of New Zealand freshwater fishes, 2017. New Zealand Threat Classification Series 24. Department of Conservation, Wellington. 11 p.

Emmett, D.K., Smale, M.C., Clarkson, B.D., Leathwick, J.R., Jessen, M.R., Whaley P.T. 2000. Indigenous vegetation of the Awhitu and Manukau Ecological Districts. Unpublished contract report prepared for the Auckland Regional Council. Landcare Research, Hamilton. 181 pp.

McEwen, W.M. 1987. (Editor). Ecological Regions and Districts of New Zealand (third revised edition in four 1:500,000 maps). New Zealand Biological Resources Centre publication no. 5. Department of Conservation, Wellington.

Hitchmough R, Barr B, Monks J, Lettink M, Reardon J, Tocher M, Winkel, D.V., Rolfe, J. 2015. Conservation status of New Zealand reptiles, 2015. Department of Conservation, Wellington, New Zealand.

Johnson, P., Gerbeaux, P. 2004. Wetland types in New Zealand. Department of Conservation, Wellington.

O'Donnell, C.F.J., Christie, J.E., Lloyd, B., Parsons, S., Hitchmough, R.A. 2013: Conservation status of New Zealand bats, 2012. New Zealand Threat Classification Series 6. Department of Conservation, Wellington. 8 p.

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

Sedgeley, J.A., O'Donnell, C.F. 1999. Roost selection by the long-tailed bat, *Chalinolobus tuberculatus*, in temperate New Zealand rainforest and its implications for the conservation of bats in managed forests. Journal of Biological Conservation. Volume 88, Issue 2, May 1999, Pages 261-267.

Stark, J. D., Boothroyd, I. K. G., Harding, J. S., Maxted, J. R., Scarsbrook, M. R. 2001: Protocols for sampling macroinvertebrates in wadeable streams. Prepared for the Ministry for the Environment. November 2001.

APPENDIX A

Stream Classification Criteria (AUP)

Auckland Unitary Plan Operative in Part

River or stream

A continually or intermittently flowing body of fresh water, excluding ephemeral streams, and includes a stream or modified watercourse; but does not include any artificial watercourse (including an irrigation canal, water supply race, canal for the supply of water for electricity power generation, and farm drainage canal except where it is a modified element of a natural drainage system).

Permanent river or stream

The continually flowing reaches of any river or stream.

Intermittent stream

Stream reaches that cease to flow for periods of the year because the bed is periodically above the water table. This category is defined by those stream reaches that do not meet the definition of permanent river or stream and meet at least three of the following criteria:

a) it has natural pools
b) it has a well-defined channel, such that the bed and banks can be distinguished;
c) it contains surface water more than 48 hours after a rain event which results in stream flow;
d) rooted terrestrial vegetation is not established across the entire cross-sectional width of the channel;
e) organic debris resulting from flood can be seen on the floodplain; or
f) there is evidence of substrate sorting process, including scour and deposition.

Ephemeral stream

Stream reaches with a bed above the water table at all times, with water only flowing during and shortly after rain events. This category is defined as those stream reaches that do not meet the definition of permanent river or stream or intermittent stream.

Artificial watercourse

Constructed watercourses that contain no natural portions from their confluence with a river or stream to their headwaters.

Includes:

- canals that supply water to electricity power generation plants;
- farm drainage canals;
- irrigation canals; and
- water supply races.

Excludes: naturally occurring watercourses

APPENDIX B

Raw Invertebrate Data

	MCI-sb	Waihoehoe Road
Ephemeroptera		
Austroclima	6.5	2
Deleatidium	5.6	13
Nesameletus	8.6	1
Zephlebia	8.8	24
Trichoptera		
Hydrobiosis	6.7	2
Oxyethira	1.2	14
Pycnocentrodes	3.8	1
Hemiptera		
Microvelia	4.6	1
Coleoptera		
Elmidae	7.2	48
Diptera		
Austrosimulium	3.9	320
Corynoneura	1.7	1
Orthocladiinae	3.2	18
Polypedilum	8.0	7
COLLEMBOLA	5.3	2
Crustacea		
Amphipoda	5.5	1
Copepoda	2.4	2
Ostracoda	1.9	2
MOLLUSCA		
Lymnaeidae	1.2	1
Physella (Physa)	0.1	2
Potamopyrgus	2.1	2288
OLIGOCHAETA	3.8	48
HIRUDINEA	1.2	1
PLATYHELMINTHES	0.9	96
NEMERTEA	1.8	2
Hydra	1.6	3