Whenuapai Business Park Private Plan Change

Ecological Impact Assessment

Prepared for: Neil Construction Limited

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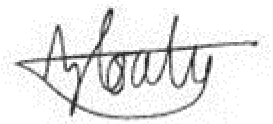
Author(s)	
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Cover photo: Mixed landuses within the site with permanent waterway 2 in the background, Brigham Creek Road, September 2023.

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1 INTRODUCTION

Neil Construction Limited is applying to Auckland Council for a Private Plan Change (PPC) to rezone the land at 141-159 Brigham Creek Road and 69, 71, 73, 94, 96 and 96a Trig Road, Whenuapai ('the site'; Figure 1). The PPC seeks to rezone approximately 47 ha of land from Future Urban Zone to Business - Light Industry Zone in an integrated and comprehensive manner.

This report describes the existing ecological values of the site, including terrestrial and freshwater features, and assesses the potential effects of the proposed PPC on those values.

An ecological assessment of the site and neighbouring environment identified the presence of permanent and intermittent waterways, natural inland wetlands, and one small area of planted indigenous vegetation.

The plan change will enable the transition of land within the site from semi-rural land use to a light industrial business area, in an integrated and comprehensive. Precinct provisions will be provided with the plan change. The Precinct will facilitate the establishment of infrastructure to support development and ensure it is integrated into, and enables, future urban development of the wider area. Infrastructure upgrades include new internal roading connections, new and upgraded intersections, and an upgrade to Brigham Creek Road and Trig Road.

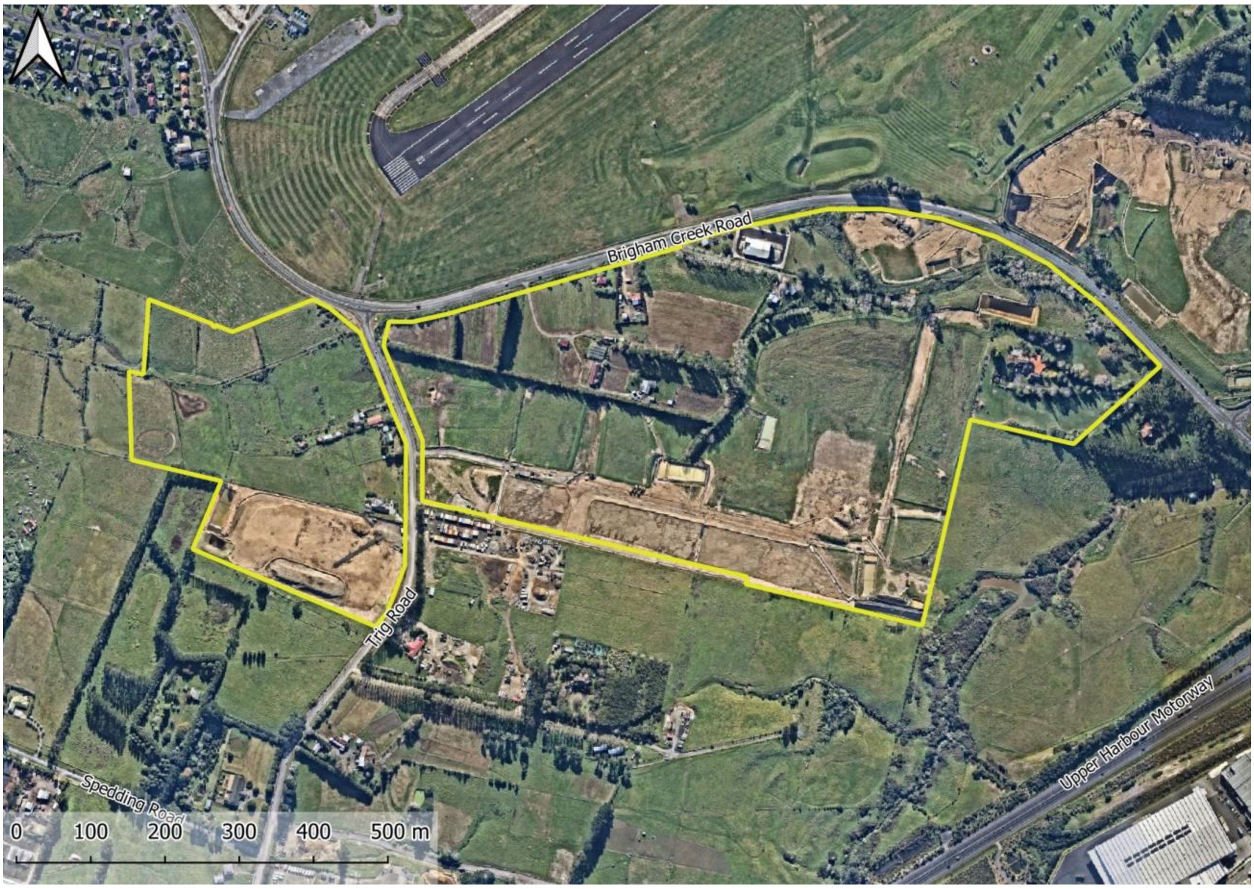

Figure 1. Site boundary for the Whenuapai PPC

2 METHODOLOGY

2.1 Overview

The assessment included a desktop review and site visit, undertaken by a suitably qualified ecologist. The desktop review involved an examination of current and historical aerial imagery of the site, during which factors such as changes in vegetation and surface water were noted. A review of data on Auckland Council's Geomaps (such as current biodiversity layers, predicted watercourses and site topography) was also undertaken.

Site assessments were undertaken in September 2023, during which the presence and extent of freshwater and terrestrial features within the property and surrounding area were recorded and the quality of associated habitat (if any) was visually assessed, in accordance with the methodology detailed in Sections 2.2 through 2.3, below.

2.2 Terrestrial Ecology

The vegetation within the property was assessed during the site visit. The botanical value of both exotic and native vegetation was recorded, and the quality, extent and connectivity of vegetation was considered. Terrestrial fauna habitat was assessed qualitatively, in conjunction with database reviews (e.g., Department of Conservation's ARDs, Bioweb, eBird and iNaturalist) and considered indigenous lizards, birds, and bats. A desktop review of local bat and herpetofauna records from specific databases was undertaken. Opportunistic sightings of avifauna were recorded, and the conservation status of the species, as defined in Robertson et. al. (2021), was noted.

The ecological value of terrestrial features were determined in accordance with the methodology prescribed in the EIANZ guidelines (refer Section 2.4).

2.3 Freshwater Ecology

During the site assessment, the presence and extent of streams and wetlands on site (if any) were noted and the quality of any freshwater habitat was visually assessed. Watercourses were classified as per the Auckland Unitary Plan Operative in Part (AUP-OP) definitions to determine, in accordance with the definitions in this plan, the ephemeral, intermittent or permanent status of the watercourse. Freshwater 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 and the NIWA New Zealand Freshwater Fish Database (NZFFD) was examined for fish species potentially present within the site.

Where appropriate, potential wetland areas were assessed in accordance with wetland delineation protocols (MfE 2022a, Clarkson 2014) and pasture exclusion methodology (MfE 2022b), to determine if an area met the regulatory definition of 'natural inland wetland' (NPS-FM 2020). Potential wetland areas were assessed based on the prevalence of certain vegetation species and their indicator status ratings, as defined in Clarkson et. al. (2021):

- Obligate wetland (OBL) vegetation, which almost always is a hydrophyte (a plant which only grows in wet environments), rarely found in uplands (non-wetland areas).
- Facultative wetland (FACW) vegetation, which usually is a hydrophyte but can occasionally be found in uplands.
- Facultative (FAC) vegetation, which is commonly either a hydrophyte or non-hydrophyte.

- Facultative upland (FACU) vegetation, which is occasionally a hydrophyte but is usually found in uplands.
- Upland (UPL) vegetation, which is rarely a hydrophyte and is almost always found in uplands.

Where the dominance or prevalence tests showed unclear results, hydric soils and hydrology tests were undertaken in accordance with methodology outlined in MfE (2022) and Clarkson (2014).

Wetland assessments also included identifying native and exotic vegetation species, examining the structural tiers within wetland areas, and assessing the quality and abundance of aquatic habitats. Signs of wetland degradation such as pugging and grazing from stock access, structures such as culverts impeding hydrological function, and weed infestation were also noted.

The ecological value of freshwater features were determined in accordance with the methodology prescribed in the EIANZ guidelines (refer Section 2.4).

2.4 Ecological Impact Assessment

The overarching approach of this analysis and reporting is to ascertain the existing ecological values on the site and determine the impact of the proposed works on those values.

The ecological value of the site, relating to species, communities and systems, were determined as per the EIANZ Ecological Impact Assessment guidelines (EcIAG) for use in New Zealand (Roper-Lindsay et. al. 2018). This report also identifies statutory guidelines and regulation with respect to ecology (such as watercourses, wetlands, high value vegetation and habitats) where relevant to the proposed development. Using this framework, the EcIAG describes a simple ranking system to assign value to species as well as other matters of ecological importance such as species assemblages and levels of organisation. The overall ecological value is then determined on a scale from '*Negligible*' to '*Very High*'.

Criteria for describing the magnitude of effects are given in Chapter 6 of the EcIAG. The level of effect can then be determined through combining the value of the ecological feature/attribute with the score or rating for magnitude of effect to create a criterion for describing level of effects (Table 1). A moderate level of effect requires careful assessment and analysis of the individual case. For moderate levels of effects or above, measures need to be introduced to avoid through design, or appropriate mitigation needs to be addressed (Roper-Lindsay et al. 2018).

Table 1. Criteria for describing the level of effects (from Roper-Lindsay et al. 2018).

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

Notes: Where text is italicised, it indicates 'significant effects' where mitigation is required..

3 SITE DESCRIPTION

3.1 Background

The site is situated in the Tāmaki Ecological District of the Auckland Region. The district is characterised by harbours and coastal areas with a strong influence from historic volcanic activity. Significant vegetation clearance has occurred, and the district is now dominated by urban areas. Historically (pre-human), the site would have likely contained the ecosystem type 'Kahikatea, pūriri forest' (WF7-3).

Native flora characteristic of this ecosystem type would have included pūriri (*Vitex lucens*) with occasional kahikatea (*Dacrycarpus dacrydioides*), kohekohe (*Didymocheton spectabilis*) and nīkau (*Rhopalostylis* spp.), which could support a diverse community of invertebrates, amphibians, reptiles, birds and bats (Singers et. al. 2017). However, a review of historical aerial imagery indicates that the site, and much of the surrounding landscape, was cleared over 80 years ago for agricultural purposes (Appendix 1).

Currently, the site contains several residential dwellings and associated outbuildings, the Whenuapai Cable Landing Station (owned by Spark and located at 153 Brigham Creek Road), and the Royal New Zealand Air Force (RNZAF) Base Auckland runway approach lighting (which traverses the northwestern corner of 96 Trig Road). Land use within the site is currently dominated by agriculture and horticultural activities. Large areas of the site have current earthworks consents, with earthworks at various stages of completion (Figure 2). The wider area is largely rural, with the RNZAF Base Auckland on the opposite side of Brigham Creek Road.

There are no Significant Ecological Areas (SEA) within the site. The closest SEA is located approximately 300m to the east of the site and encompasses the terrestrial head of the Waiarohia Inlet. The key ecological features on site and the surrounding landscape are presented in Figure 3.

3.2 Terrestrial Ecology

3.2.1 Vegetation

The ecological and botanical value of the vegetation within the site is low.

Vegetation within the site can be characterised as garden and amenity planting, shelterbelts, and riparian vegetation (Figure 4, Figure 5a). Grazed/managed pasture and daffodil cultivation were the dominant vegetation types (Figure 5b, Figure 6). Vegetation other than grass and daffodils was not common throughout the site and was generally concentrated around the riparian yard of waterways 2-5 and the houses in the easter part of the site.

Where vegetation other than pasture was present it was dominated by exotic species. Exotic species observed on site included bamboo, Norfolk island pine (*Araucaria heterophylla*), pine (*Pinus* spp.), willow (*Salix* spp.), wattle (*Accacia* spp.), sheoak (Casuarina cunninghamiana), camphor (*Cinnamomum camphora*), ivy (*Hedera* spp.), tree privet (*Ligustrum lucidum*), Chinese privet (*Ligustrum sinense*), *Agapanthus* sp., arum lily (*Zantedeschia aethiopica*), gorse (*Ulex europaeus*), woolly nightshade (*Solanum mauritianum*), *Camelia* sp., moth plant (*Araujia hortorum*), bottle brush (*Banksia* spp.), redwood (*Sequoia sempervirens*), lillypilly (*Acmena smithii)* and pampas (*Cortaderia selloana*) among others.

Indigenous vegetation was generally focused around the amenity planting within two small pockets (300 m2 and 950 m2) in the northeast of the site (Figure 3), and scattered species elsewhere. Native species were generally relatively small and had likely been planted in the last approximately 20 years. Native species observed included *Coprosma repens*, totara (*Podocarpus totara*), lacebark (*Hoheria populnea*), cabbage tree (*Cordyline australis*), kauri (*Agathis australis*), flax (*Phormium tenax*), *Pittosporum* spp., tree ferns, karaka (*Corynocarpus laevigatus*), and rimu (*Dacrydium cupressinum*).

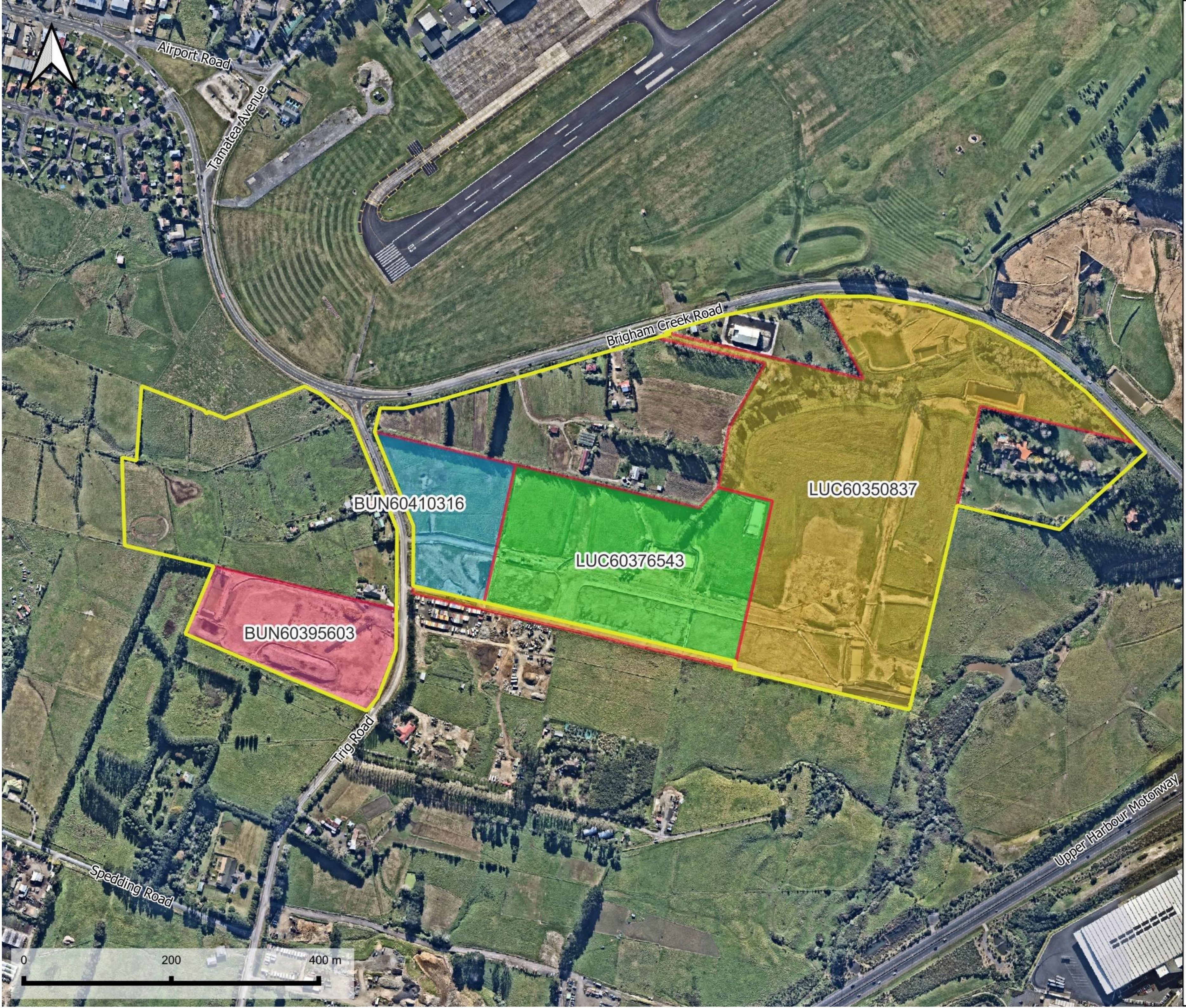

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Figure 2 - Existing earthworks consents

Site boundary

SOURCES
Nearmap.com 2023

DISCLAIMER: This map/plan is not an engineering draft. This map/plan is illustrative only and all information should be independently verified on site before taking any action.

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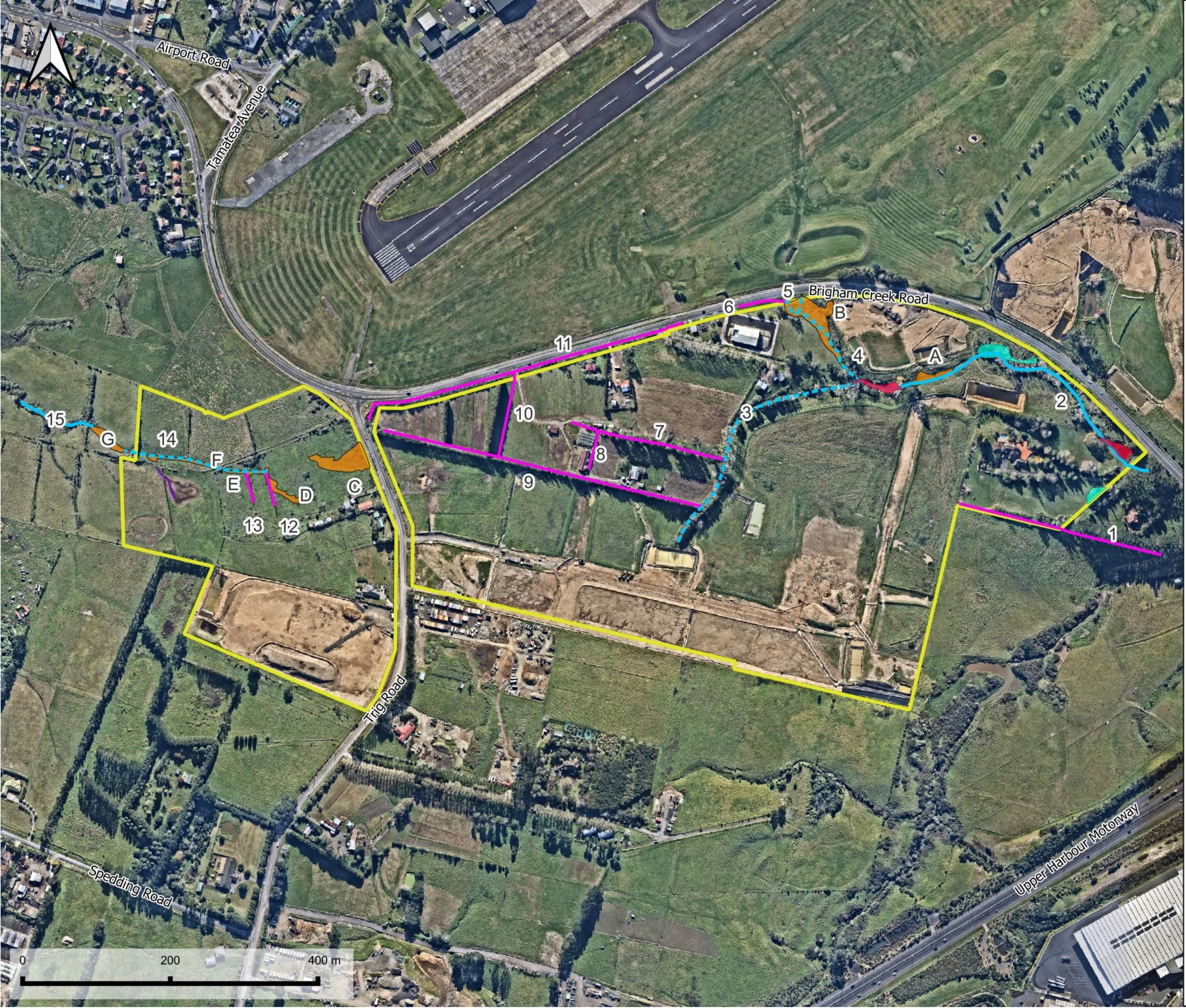

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Figure 3 - Ecological Features, Whenuapai PPC

- Site boundary
- Permanent waterway
- Intermittent waterway
- Artificial waterway
- Natural Wetlands
- Induced Wetland
- Constructed Pond
- Native dominant vegetation

SOURCES
Nearmap.com 2023

DISCLAIMER: This map/plan is not an engineering draft. This map/plan is illustrative only and all information should be independently verified on site before taking any action.

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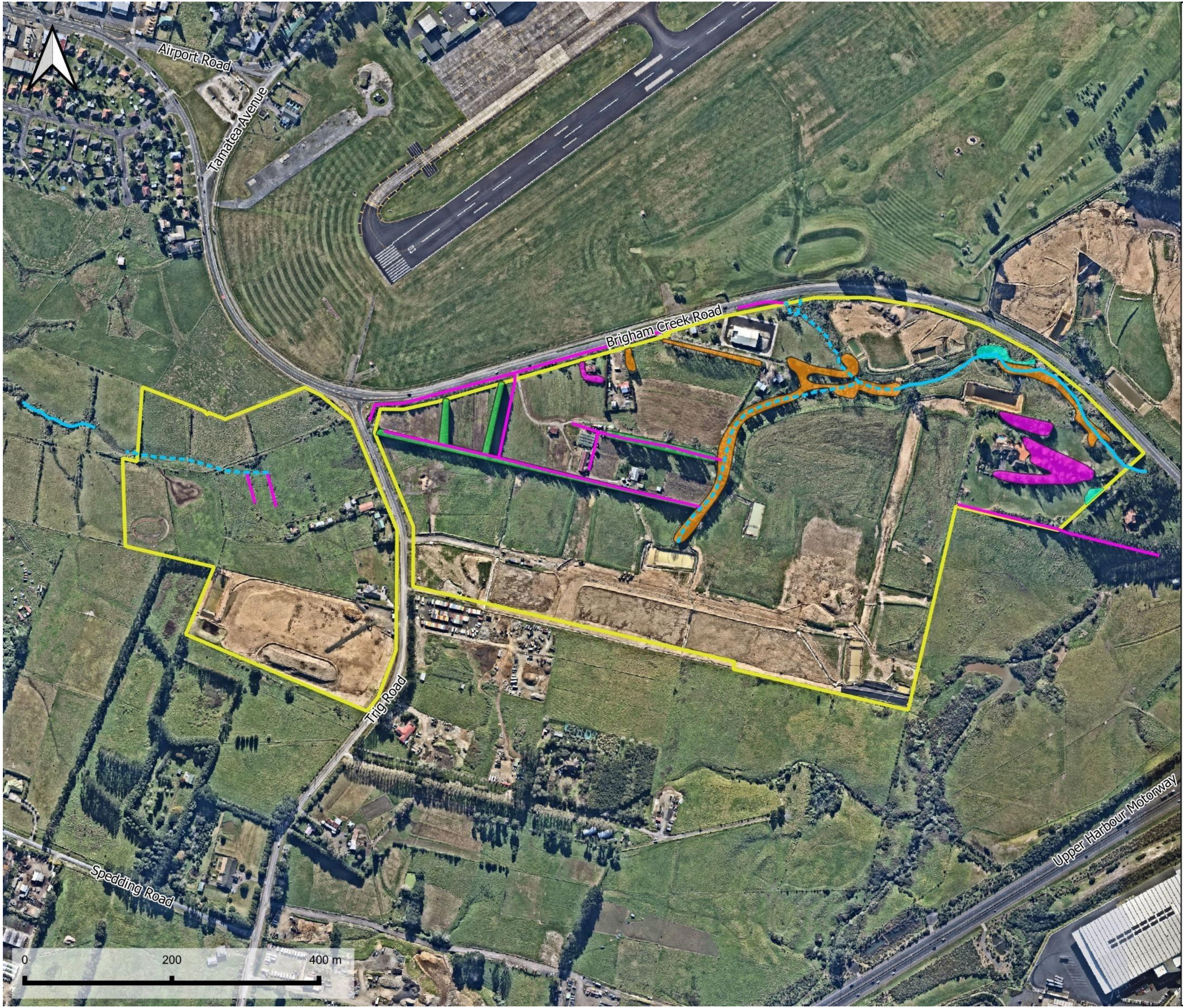

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Figure 4 - Main areas of vegetation

Site boundary

Waterways

Permanent waterway

Intermittent waterway

Artificial waterway

Vegetation

Exotic

Exotic shelterbelt

Garden/amenity planting

Native dominant vegetation

SOURCES
Nearmap.com 2023

DISCLAIMER: This map/plan is not an engineering draft. This map/plan is illustrative only and all information should be independently verified on site before taking any action.

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a) b)

Figure 5. a) Stand of native vegetation within the site and b) Un-earthworked areas dominated by lawn.

a) b)

Figure 6. a) Pasture that has not been earthworked and b) Remnant daffodil farm.

3.2.2 Connectivity and ecological function

The connectivity and ecological functioning values of the site were considered to be low.

Connectivity between areas of vegetation is important to facilitate ecological function. Edge communities are heavily influenced by increased exposure to light, drying winds, and competitive weeds. This ‘edge effect’ restricts some native flora and fauna to forest interiors. Patch fragmentation increases the edge effect and decreases the availability of habitat for interior species. Loss of ecological connectivity can also impair reproductive function for both flora and fauna.

There were only small areas of vegetation, both exotic and native, present within the site and these were generally long and narrow. As a result, all vegetation within the site is subject to very high edge effects and as such the functioning of the vegetated area and its ability to persist and resist the effects of adverse weather and weed invasion are significantly reduced. The more mature areas are likely to provide some level of connectivity for highly mobile fauna such as birds as they move between other small, vegetated areas in the wider vicinity of the site.

The vegetated margins of the waterways within the site act to provide freshwater ecological functions. These include shading, bank stability, organic input, and surface water filtration. Functions are limited to the reaches of waterway where riparian vegetation is present.

3.2.3 Avifauna

The ecological value of the site for avifauna was considered to be moderate due to the potential presence of an At Risk – Declining species.

No formal bird survey was undertaken on the site. Opportunistic observations, with records retrieved from ebird.org has provided a list of species likely present in the wider area (Table 2). The avifauna community is expected to be dominated by common native and exotic species. There is a possibility the At Risk – Declining NZ pipit is present within the site, or wider area. NZ pipits can be found in farmland and around wetlands and have been recorded in the rural areas around west Auckland. New Zealand pipits are protected under the Wildlife Act 1953, irrespective of whether the PPC proceeds or not.

The existing vegetation provides nesting, roosting, and foraging habitat for native birds within the site however, the value is limited due to low botanical values of the site. The lack of complect, diverse vegetation significantly limits the ability of the site to provide high value habitat.

Table 2. Bird species potentially present within the site.

Common name	Species name	Conservation status
Pūkeko	*Porphyrio melanotus melanotus*	Not Threatened
Spur winged plover	*Vanellus miles novaehollandiae*	Not Threatened
Kingfisher	*Todiramphus sanctus vagans*	Not Threatened
Eastern rosella	*Platycercus eximius*	Introduced and Naturalised
Tui	*Prosthemadera novaeseelandiae novaeseelandiae*	Not Threatened
Magpie	*Gymnorhina tibicen*	Introduced and Naturalised
Fantail	*Rhipidura fuliginosa placabilis*	Not Threatened
Skylark	*Alauda arvensis*	Introduced and Naturalised
Welcome swallow	*Hirundo neoxena neoxena*	Not Threatened
Silvereye	*Zosterops lateralis lateralis*	Not Threatened
Common myna	*Acridotheres tristis*	Introduced and Naturalised
Thrush	*Turdus philomelos*	Introduced and Naturalised
Blackbird	*Turdus merula*	Introduced and Naturalised
Sparrow	*Passer domesticus*	Introduced and Naturalised
Paradise shelduck	*Tadorna variegata*	Introduced and Naturalised
Grey warbler	*Gerygone igata*	Not Threatened
Kereru	*Hemiphaga novaeseelandiae*	Not Threatened
Pheasant	*Phasianus colchicus*	Introduced and Naturalised
Australasian harrier	*Circus approximans*	Not Threatened
NZ pipit	*Anthus novaeseelandiae novaeseelandiae*	At Risk - Declining

3.2.4 Herpetofauna

The ecological value of the site for herpetofauna was considered to be moderate due to the likely presence of At Risk – Declining copper skink.

Herpetofauna (reptiles and amphibians) comprise a significant component of New Zealand's terrestrial fauna. There is currently 104 endemic herpetofauna taxa recognised in New Zealand (Hitchmough et al., 2016) and more than 80% are considered 'Threatened' or 'At Risk'. All indigenous reptiles and amphibians are legally protected under the Wildlife Act 1953, and vegetation and landscape features that provide significant habitat for native herpetofauna are protected by the Resource Management Act 1991 (RMA). Statutory obligations require management of resident reptile and amphibian populations where they or their habitats are threatened by disturbance such as land development.

No formal lizard survey was undertaken. Review of records from the wider Whenuapai area show that five species have been recorded in the wider area (Table 3). The habitat present within the site is generally too highly modified to support native lizards, with the exception of copper skink. The stands of mixed vegetation were too open to provide any significant arboreal lizard habitat, and the lack of connection to existing stands of native vegetation means geckos are unlikely to be able to colonise the site even if habitat is suitable. Copper skink are known to inhabit areas of long pasture and rank grass. Ornate skinks are unlikely to be present. They are generally found in forested areas and shrubland, amongst dense leaf litter, low foliage, thick rank grass and under rocks or logs. Habitat such as this was not present on site.

Table 3. Lizards present in the wider Whenuapai area.

Common name	Species name	Conservation status	Likelihood of presence
Pacific gecko	*Dactylocnemis pacificus*	Not Threatened	Unlikely
Elegant gecko	*Naultinus elegans*	At Risk - Declining	Unlikely
Forest gecko	*Mokopirirakau granulatus*	At Risk - Declining	Unlikely
Copper skink	*Oligosoma aeneum*	At Risk - Declining	Likely
Ornate skink	*Oligosoma ornatum*	At Risk - Declining	Unlikely

3.2.5 Bats

The ecological value of the site for bats has conservatively been considered to be high.

Long-tailed bats (LTBs; *Chalinolobus tuberculatus*) are classified as 'Nationally Vulnerable' in the North Island (O'Donnell et al., 2023). This classification is given the qualifier "Data Poor" which indicates that there is low confidence in the rating due to poor data available on the species populations and distribution (Townsend et al., 2008). LTBs have large home ranges.

No formal survey for LTBs was completed as part of the investigations for this report. However, LTBs are known to occur throughout the Auckland area, including around Whenuapai and west Auckland. Therefore, the site is within the flight range of known LTB habitat.

The large pines present within the site present potential roosting and/or nesting habitat (cavities, large sections of flaking bark). The site and surrounding area was not considered to be optimal for bats due to the dominance of agriculture with scattered suitable areas of vegetation. However, bats are known to utilise waterways as forage and commuting corridors and the proximity of the site to the Brigham Creek and Waiarohia Stream catchments mean there is a possibility bats forage in the area. It is therefore considered LTBs may periodically be present in the area, and potentially within the site, however the habitat is not expected to support regular visits or communal roosts. Specific provisions to manage effects on LTBs are not required in the PPC because they are already legally protected by the Wildlife Act 1953.

3.3 Freshwater Ecology

3.3.1 Permanent waterways (2 and 15)

The ecological value of the permanent waterways was considered to be moderate.

Waterway 2 is an unnamed tributary of the Waiarohia Stream. It originates within the site as an intermittent channel, discussed below, and flows in a generally easterly direction before joining Waiarohia Stream just to the east of the site. Waterway 2 contained a fine sediment substrate and limited habitat heterogeneity, with the reach characterised as a run. Riparian vegetation was present along part of Waterway 2, including an area of native dominant vegetation (Figure 7a). Where vegetation was present, shading was relatively high and good inputs of organic matter are expected. The remainder of the waterway generally only contained rank grass as riparian vegetation (Figure 7b).

There are no records in the NZFFD for the waterways within the site. However, review of records for nearby waterways suggests the stream could support various native species, providing there are no barriers to fish passage downstream of the site (Table 4). Currently there is a significant barrier to fish passage in the form of a perched culvert located under the access of both 159 and 161 Brigham Creek Road, although it is possible fish with climbing abilities such as eels will still be able to navigate it. As it is possible At Risk – Declining species including longfin eels and īnanga are present within the site, the value of the waterway was conservatively considered to be moderate. While the waterway may have a moderate ecological value, it is important to note that all permanent and intermittent streams are protected by existing rules and standards in the AUP and therefore any proposal to disturb these habitat areas would be assessed through a future resource consent application.

Waterway 15 is not within the site, this information is provided for context purposes. It has been conservatively classified based on aerial images, and the upstream nature of the channel. It has a catchment size of approximately 55 ha, based on the upstream most reach being the downstream point of wetland G. Review of aerial images shows riparian vegetation, likely willows, and it is therefore considered to be well shaded and have good organic matter inputs and filtration functions. It is conservatively considered to be moderate, again due to the likelihood it supports At Risk – Declining fish species.

Regardless of their classification, all watercourses within the site would be required to be reassessed at resource consent stage prior to future development.

Table 4. Fish species potentially present within the site (records retrieved from the NZFFD).

Common name	Species name	Conservation status
īnanga	*Galaxias maculatus*	At Risk – Declining
Longfin eel	*Anguilla dieffenbachii*	At Risk – Declining
Shortfin eel	*Anguilla australis*	Not Threatened
Banded kōkopu	*Galaxias fasciatus*	Not Threatened
Redfin bully	*Gobiomorphus huttoni*	Not Threatened
Common bully	*Gobiomorphus cotidianus*	Not Threatened

3.3.2 Intermittent waterways (3, 4, 5 and 14)

The ecological values of the intermittent waterways were considered to be conservatively moderate, due to the potential presence of At Risk – Declining longfin eels.

Waterways 3, 4 and 5 form the upper reaches of permanent waterway 2. Waterway 3 is currently partially fed by a sediment detention pond consented under LUC60376543. In the past it has been significantly deepened and straightened in parts to provide better drainage. Review of aerial images suggests prior to earthworks commencing it originated in essentially the same location and was likely fed by a combination of land drainage from the artificial channels and overland flow. Exotic riparian vegetation was present for much of its length (Figure 8). It discharges to an online pond at its confluence with waterway 4.

Waterways 4 and 5 flow into the site from Brigham Creek Road. They appear to be partially fed by roadside drainage, as well as stormwater management from RNZAF Base Auckland. The majority of these channels within the site flow through a natural inland wetland, discussed further below (Figure 9a).

Waterway 14 flows generally west within the property at 96 Trig Road. The majority of waterway 14 forms a natural inland wetland with a channel flowing through it, as discussed below (Figure 9b). It flows into another natural wetland just west of the site's western boundary before becoming permanent waterway 15.

All intermittent waterways have been conservatively valued at moderate. When water is present, they have the potential to support the fish species listed in Table 4, including At Risk – Declining fish species, specifically longfin eels.

a)

b)

Figure 7. a) Waterway 2 with mixed native and exotic riparian vegetation, and b) pasture dominant riparian vegetation on waterway 2.

a)

b)

Figure 8. a) Waterway 3 mid reaches and b) Upper reaches of waterway 3.

a)

b)

Figure 9. a) Waterway 4 at the downstream point of wetland B and b) Waterway 14.

3.3.3 Artificial drains (1, 6-13)

The ecological value of the artificial drains was considered to be low. These waterways have been classified as artificial based on a number of criteria including alignment with natural topography, absence of an historical natural channel, catchment size and artificial characteristics such as unnaturally deep and straight channels.

Waterway 1 flows along the southern boundary of the property at 159 Brigham Creek Road. It appears to be dry and likely only contains water during significant rainfall (Figure 10). It discharges to Waiarohia Stream to the east of the site.

Waterways 6 and 11 are roadside drains along Brigham Creek Road (Figure 11a). Both appear to be dry, and likely only contain water following rainfall significant enough to flow off the road. Waterway 6 discharges to waterway 5 and wetland B, while waterway has no obvious outlet and water likely infiltrates directly to ground.

Waterways 7-10 form a drainage network in approximately the middle of the site associated with the daffodil farm. Water was intermittently present in waterways 7, 9 and 10 however where present, it was stagnant and not flowing. All channels were artificially straight and present either adjacent to, or underneath an exotic shelterbelt (Figure 11b, Figure 12a). Review of historical aerial images suggests waterway 7 has been present for the longest and appears to be present in some form since prior to 1940 however there is no evidence there was ever a natural channel present and the catchment for waterway 7 is very small (~2000 m2). The others appear to be more recent, though the presence of shelterbelts makes it difficult to determine exactly when they were constructed. Regardless, there is no evidence of a natural waterway in the area throughout the historical aerial image record (Appendix 1), therefore all were considered to be artificial in nature.

Waterways 12 and 13 discharge into intermittent waterway 14. Both were artificially straight, with waterway 12 flowing along paddock fencing, and waterway 13 flowing parallel, but within the paddock (Figure 12b). While water was present, the topography of the site was such that not enough energy could be generated to naturally scour out a channel and the channels were therefore likely to have been formed intentionally. Review of historic aerial images shows these appear to have been constructed between 1958 and 1963.

It is possible fish may be present in the drains if water is present, however due to the compromised habitat quality, only tolerant species such as shortfin eels are expected to be present.

a)

b)

Figure 10. a) Artificial channel, waterway 1.

a)

b)

Figure 11. a) Waterway 11 adjacent to Brigham Creek Road and b) Waterway 7.

a)

b)

Figure 12. a) Waterway 9 and b) Waterway 12 with wetland E.

3.3.4 Wetlands

The ecological values of the wetlands ranged from low to moderate.

Wetland A was located within the floodplain of waterway 2 (Figure 13a). Wetland A passed the rapid test and contained indictors of wetland hydrology including standing water and soil saturation. It was contained only exotic species and it provided low quality habitat for flora and fauna. The ecological value of wetland A was considered to be low.

Wetland B was located near the northern boundary of the site. It included almost the entire lengths of waterways 4 and 5 and occupied the floodplain of these waterways. Wetland B passed the rapid test and contained indictors of wetland hydrology including standing water and soil saturation. It contained wetland vegetation on both the herbaceous level, and subcanopy level, and included native species such as cabbage tree, kiokio (*Parablechnum novae-zelandiae*) and mānuka (*Leptospermum scoparium*). However, weeds were also prevalent in the wetland and in the terrestrial area around it (Figure 13b, Figure 14a). The value of wetland B has been conservatively assessed as moderate owning to the diversity of structure and presence of native species.

Wetland C was located on the western side of Trig Road, within a grazed paddock. It was dominated by exotic pasture weeds including buttercup and *Juncus effuses* (Figure 14c). Review of aerial images does not suggest the presence of wetland conditions (i.e. no evidence of rushes, no changes in vegetation colour, no standing water). It appears that as Trig Road has been upgraded, the drainage of the area has been interrupted and an induced wetland has formed. The area was conservatively considered to be a natural inland wetland as per the definition in the NPS-FM due to the presence of wetland hydrology indicators including standing water. However, Auckland has experienced a significantly wetter than average year, and therefore the conditions at the time of the assessment my not be considered to be 'normal circumstances'. As a result, future assessments, including hydric soil tests, may provide a different result. As it stands, the ecological value of Wetland C was considered to be low.

Wetlands D, E and F, while delineated separately, are all connected, and therefore they are discussed her collectively. All were associated with waterways 12-14 and were characterised by exotic pasture weeds such as buttercup and *Juncus effuses*. Standing water was present, however the abnormally wet year made assessments of wetland hydrological conditions difficult, therefore the areas were conservatively considered to contain wetland hydrological indicators. Due to the almost complete dominance of FAC species (e.g. buttercup) and the lack of soft rush (FACW) outside the delineated wetland area, soil assessments were completed at two points outside the area. No hydric soils were encountered. Soils were described as being moderately well drained, with 0-30 cm (topsoil) being medium brown clayey silt derived topsoil with low plasticity and minor rootlets (10YR 4/50); and 30-100 cm (clay) being yellow/grey silty clay with high plasticity (10YR 7/4). Beyond the wetland boundaries, wetland hydrology was absent. The areas have conservatively been identified as natural inland wetlands as per the NPS-FM, however future investigations may alter the status, or alter the boundaries if conducted under normal climatic conditions. The ecological values of wetlands D, E and F were considered to be low.

Wetland G was located beyond the boundaries of the site. At its closes point it is approximately 7 m from the site's western boundary. As a result, it has not been directly assessed, rather it was viewed from within the site, and using aerial images. It appeared to be dominated by *Juncus effuses* (FACW) and therefore met the dominance test. Review of historical aerial images does not suggest the presence of a wetland, rather only a channel is present. It is therefore considered the wetland has been induced over time, likely as a result of stock pugging the intermittent waterway, resulting in conditions suitable for hydrophytic vegetation. The ecological value of wetland G was considered to be low.

Regardless of their classification, all watercourses within the site would be required to be reassessed at resource consent stage prior to future development, in the event that a future development encroached within a riparian margin setback area.

Additional information regarding how the wetlands were delineated can be found in Appendix B.

3.3.5 Induced wetland

One area of induced wetland was located in the north-western region of the site, within a shallow gully. The current landowner, whose family has managed the property since the late 1960s, advised that this portion of the site was previously utilised as a feeding pad for livestock (Current landowner, Carl Laurie, pers. comm., April 2023). In recent years, the area has been converted and managed as pasture.

During various site visits, the area showed no hydrological indicators (e.g., saturated ground) during one visit, but saturated ground was present during a second visit. The feature was dominated by common exotic pasture species which are recognised under a nationally derived pasture exclusion list (MFE 2022c), therefore meeting the Rapid Pasture Test (>50% of the area contained Italian rye grass - Lolium multiflorum, UPL (MFE 2022b). Scattered soft rush (Juncus effusus, FACW) was observed within the area in lower densities. Based on vegetation assessments, the area does not meet the definition of a natural inland wetland, however, an assessment of hydric soils and wetland hydrology was undertaken to confirm or exclude wetland conditions.

The assessment dug 30 test pits in and around the area (WWLA 2023). Three yielded hydric soils and two of these also demonstrated wetland hydrology indicators. As a result, part of the area was considered to be an induced wetland, limited to a drainage channel in the general area. Induced wetlands are considered to be natural inland wetlands under the NPS-FM. The ecological value of the induced wetland was considered to be low. Additional information regarding the induced wetland can be found in Appendix B.

a) **b)**

Figure 13. a) Wetland A and b) Wetland B at the Brigham Creek Road end.

a) **b)**

Figure 14. a) Wetland B at the downstream end as it transitions to waterway 4 and b) Wetland C.

3.3.6 Constructed ponds

The ecological value of the constructed ponds was considered to be moderate, due to the potential for At Risk – Declining fish to be present.

There are two constructed ponds within the site. Both ponds are associated with the unnamed tributary of Waiarohia Stream, with one pond being at the eastern most point of the site just before the stream flows out of the site (Figure 15), and the second being at the point where waterways 3 and 4 converge into waterway 2. Riparian vegetation of both ponds was dominated by exotic species, with short, maintained lawn. It is expected the ponds would support native fish, particularly eels. Due to the potential presence of longfin eels, the ecological value was conservatively considered to be moderate. Any works in riparian areas, ponds, wetlands, or streams will be subject to existing AUP rules that will enable careful consideration of effects on fish when a resource consent application is sought.

Figure 15. The eastern most constructed pond.

4 ASSESSMENT OF ECOLOGICAL EFFECTS

The PPC seeks to rezone approximately 47 ha of land from Future Urban Zone under the Auckland Unitary Plan to Business – Light Industry Zone. No additional provisions are proposed as part of this PPC. All Auckland-wide and Business – Light Industry Zone provisions of the AUP will apply to the rezoned land and will enable Council to exert control over subdivision development. Where relevant, national environmental standards and legislation (such as the Wildlife Act 1953) will also apply to development activities.

The main threats to the long-term viability of ecosystems in Auckland include habitat destruction, fragmentation, edge effects and invasion by pest plants and animals. These threats are often augmented through an increase in urban development.

This section assesses the potential effects of the proposed private plan change on the current and potential ecological values within the Site and the associated wider landscape..

4.1 Vegetation and terrestrial ecological connectivity and function

Vegetation values within the site were significantly limited due to the dominance of exotic vegetation. The only area of native dominant vegetation was small and had been planted no more than approximately 20 years ago. No SEAs were present within the site. The significant amount of vegetation within the site was located within the riparian yard of permanent or intermittent waterways, and is therefore protected from removal through riparian yard rules.

Rezoning the site will result in low adverse effects on the existing vegetation. It is expected vegetation beyond the riparian yard will be removed, namely the shelterbelts, however this can already be removed as a permitted activity. The majority of the native vegetation is located within 10 m of the unnamed waterway, and therefore will be subject to riparian yard rules under a Business – Light Industry Zone. There will be landscaping and amenity planting included in any development of the site which will be required by the proposed precinct provisions. This includes landscaped frontage (within the Light Industrial zoned area) along the road network and a 5 m open space buffer along the eastern boundary of 69 Trig Road and 159 Brigham Creek Road, and the southern boundary of 94 Trig Road. Street trees will be planted along the internal road network to increase canopy cover. Generally, landscaping will provide species diversity and periodic areas of vegetation, similar to what is currently present on site. The wetlands and permanent waterways within the site will be planted, creating a corridor of vegetation through the site. Landscape connectivity is particularly relevant given the location of the site in relation to the North West Wildlink. The proposed street trees, planting and landscaping will assist in achieving the vision of the North West Wildlink, in creating a safe, connected and healthy habitat for native wildlife across Auckland..

4.2 Pest animals

Rezoning the site from Future Urban to Business – Light Industry is expected to increase human population density in the area, at least during daylight hours. An increase in human population density often brings an increase in rat and mice abundance, however it is also expected there will be an increase in pest control where currently it is limited. The pest animal abundance within the Site will likely currently be at carrying capacity so no increase effect is expected within these areas

No significant increases in domestic cat numbers are expected due to the limited residential properties present within and around the site, and the fact that domestic cats are generally associated with residential development, not industrial development as proposed by the PPC.

It is not expected that possum, mustelid, hedgehog, and rabbit abundance would increase as a result of the re-zoning, in fact there may be a decrease due to a likely increase in trapping and/or poisoning from the increased human population.

Overall, it is considered that the rezoning of the site will result in a negligible increase of pest animal effects.

4.3 Terrestrial indigenous fauna

Due to the low adverse effects on vegetation and the negligible effects of pest animals, it is considered that the re-zoning will result in a low adverse effect on native terrestrial habitat. There is the potential for a loss of low quality bat habitat through the removal of exotic shelterbelts and garden/amenity planting, however roosting habitat is expected to remain within vegetation within the stream and wetland riparian yards.

Any potential direct adverse effects on native terrestrial fauna as a result of subsequent development works (e.g. earthworks) would be assessed at the resource consenting phase and can be appropriately mitigated through the implementation of fauna management plans, if considered appropriate noting that bulk earthworks have been undertaken across the majority of the site. It should be noted that, any subsequent site works resulting from any rezoning of the Future Urban Zone will result in the same or similar potential adverse effects on native fauna due to the change from rural to urban land use required by the policy framework.

4.4 Freshwater ecology

The permanent and intermittent waterways within the site were considered to be of moderate ecological value. The waterways are already subject to existing Auckland wide AUP rules, policies and rules.

The main threats to freshwater ecology as a result of a change to Business – Light Industrial Zone are:

- The decrease in riparian yard setback
- The potential for increased impervious surfaces as a result of industrial development
- The potential increase in contaminant runoff as a result of industrial development

All threats can be effectively managed during development with appropriate controls such as erosion and sediment control plans, appropriate design and riparian planting and management. It is expected that any specific potential adverse effects resulting from future development will be addressed and managed during future consenting processes, including through detailed design (e.g. for culverts and outfalls) and through mitigation such as planting.

Activities in relation to development near intermittent and permanent streams (e.g., riparian yard infringements, riparian vegetation clearance, stream reclamation) will require assessment at the resource consent stage. It is considered that the effects management hierarchy will be appropriate for managing adverse effects of future proposals and mitigating/offsetting where required. As such, the proposed rezoning is not anticipated to result in residual adverse effects on the freshwater values of the site.

It is expected the artificial drains will be reclaimed during future works or incorporated into onsite stormwater management. Artificial channels are not subject to protection or management rules under either Future Urban or Business – Light Industry Zones and therefore no change in effects is anticipated.

Industrial activities are often associated with elevated contaminants such as heavy metals and hydrocarbons. Contaminants can have detrimental effects on aquatic flora and fauna. Industrial and Trade Activities will require site and activity specific controls and specific consents in accordance with the AUP, and as such, effects will be addressed during future consenting processes. Changing from an urban land use is likely to result in a decrease in certain contaminants such as those associated with stock effluent runoff.

4.5 Riparian margins

The proposed change from Future Urban Zone to Business – Light Industry will decrease the riparian yards setback from 20 m to 10 m. One of the main purposes of riparian yard setbacks is to provide a buffer to the stream to increase ecological values through filtration of overland flow, provision of shade and organic matter and contribute to fish and invertebrate habitat. Currently, the riparian yards are of limited ecological value and comprise of narrow strips of exotic vegetation, and pasture. Subdivision and development of areas adjacent to waterways will include planting of the full 10 m riparian yard which will be a significant improvement from what is currently present. There is limited proven scientific evidence as to what width of riparian yard is most effective, with the general consensus being any yard is better than none, and wider yards tend to be more self-sustaining and require less intervention to manage weeds. While greater setback distances allow more space for riparian planting and therefore a corresponding increase in the ecological benefit derived from such planting, 10 m is consistent with the zoning provision and a 10 m riparian yard is considered to be appropriate.

The rezoning is expected to result in an increase in the riparian vegetation quality of the plan change area overall.

4.6 Wetlands

There are six wetlands, one within 10 m of the sites boundaries and one induced wetland within the site. The location of all wetlands is shown on the precinct plan. The precinct provisions require a 10m riparian yard from the wetland to be planted within native vegetation. There is the potential for wetlands to be affected by future land use changes, in the same manner as waterways. Wetlands are also protected from development by the AUP (Chapter E3) and the NES-F and any future earthworks within 100 m of any wetland, or works or vegetation removal within or within 10 m of a wetland will be subject to a resource consent application. Identification of the wetlands at this stage allows future development to be designed around the wetlands and their catchments to ensure no complete or partial drainage occurs.

It should be noted that as the zoning is currently Future Urban Zone, it is a prohibited activity to reclaim natural inland wetlands under the NES-F. The urban rezoning will provide a consenting pathway for wetland reclamation under Regulation 45C of the NES-F. Compliance with relevant NES-F regulations in relation to natural inland wetlands will be required for subsequent development following rezoning, and it is considered that any adverse effects on natural inland wetlands will be able to be assessed and managed appropriately at future resource consent stage.

Regardless of their current classification, all wetlands and potential within the site would be required to be reassessed at resource consent stage prior to future development.

4.7 Stormwater

The proposed zone change is expected to result in an increased coverage of impervious surfaces from development such as buildings, roads and carparks. Increased levels of impervious surfaces have the potential to result in increased adverse stormwater effects on the receiving environment such as scouring, erosion, and increased levels of contamination.

A stormwater management plan has been prepared by Cato Bolam (2023). Stormwater will be directed from hard surfaces to retention tanks and bioretention devices for treatment and/or controlled release, before being discharged to the public stormwater network. Treatment shall be provided within the future individual lots for all impervious areas (excluding clean roof runoff) by water quality devices designed in accordance with GD01/TP10 for the relevant contaminants. Riparian planting 10m either side of the stream will also provide the filtration of surface runoff to assist with the reduction of contaminants and sediment entering waterways

4.8 Relevant Plans and Policies

4.8.1 National Policy Statement for Indigenous Biodiversity 2023

The National Policy Statement for Indigenous Biodiversity (NPS-IB) sets out objectives, policies and implementation requirements to manage natural and physical resources to maintain indigenous biodiversity under the RMA. It outlines a system for the management of biodiversity outside of public conservation land.

There is no significant indigenous biodiversity within the site and no areas that meet the definition of a Significant Natural Area as per the NPS-IB Appendix 1. The effects management heirachy will be applied to manage residual ecological effects. The PPC will provide opportunities to increase indigeous cover through planting and enhancements of riparian areas and wetlands.

A 10 metre riparian margin will be provided around all permanent and intermittent waterways as well as the wetlands. This margin will be planted with appropriate native species. Further planting will be provided on the parts of the site that abut future recreation reserves. It is considered that the plan change is in accordance with the NPS – IB.

4.8.2 National Policy Statement for Freshwater Management 2020

The NPS-FM provides national direction for decisions regarding water quality and quantity, and the integrated management of land, freshwater and coastal environments under the RMA. The NPS-FM contains national objectives for protecting ecosystems, indigenous species and the values of outstanding water bodies and wetlands.

All streams and wetlands will remain and be enhanced through provision of a 10 metre planted riparian buffer around all features. A proposed stream crossing will be designed and constructed in line with NPS-FM criteria.

Future resource consents required for the development of the site will require compliance with relevant NES-F regulations in relation to natural inland wetlands, noting that a consenting pathway is provided for urban development (refer Regulation 45C).

4.8.3 Auckland Unitary Plan – Operative in Part 2016

The AUP-OP sets out a number of policies and objectives that gives effect to the RMA to promote the sustainable management of natural and physical resources. This section addresses the objectives and policies set out in the AUP-OP pertaining to ecology.

Chapter B7 – Natural Resources

In line with the objectives and policies in this chapter, areas of significant indigenous biodiversity value and freshwater environments have been identified. Freshwater habitat will be protected from inappropriate adverse effects of subdivision use and development, or otherwise the effects management hierarchy applied to manage ecological effects. A 10 metre planted riparian margin will be provided around all freshwater environments which will provide significant benefit to both terrestrial ecological values and stream and wetland functioning.

Chapter E1 – Water Quality and Integrated Management

Consistent with Chapter E1, the development of the site will provide opportunities for the appropriate integrated management of water discharges, subdivision and greenfield development to maintain and/or enhance water quality, flows, intermittent/permanent streams and associated riparian margins.

A stormwater management plan has been prepared. The plan details methods to be put in place to manage both quality and quantity of stormwater generated within the site.

Chapter E3 – Lakes, Rivers, Streams and Wetlands

All potential streams, rivers and wetland have been identified within the sites in line with Chapter E3. Additionally, significant adverse effects can be avoided though retaining all intermittent and permanent streams where practicable, and where avoidance cannot be achieved, through implementation of the effects management hierarchy.

Chapter E15 – Vegetation Management and Biodiversity

Consistent with Chapter E15, the vegetation and biodiversity values of the site have been identified. Development of the site will provide opportunities to maintain and enhance ecosystem services and indigenous biodiversity values, particularly in sensitive environments, and areas of contiguous indigenous vegetation cover, while providing for appropriate subdivision, use and development.

4.3.3 Auckland Plan 2050

The Auckland Plan is a long-term spatial plan that aims to ensure Auckland grows in a sustainable way that supports people and the local environment and ecosystems. When considering environmental outcomes, the plan seeks to preserve, protect, and care for the natural environment, and use development as an opportunity to do so, as well as future-proof Auckland’s infrastructure.

The Precinct Plan aligns with the Auckland Plan, through incorporation of ecological and active mode/green corridors into the design, to connect Aucklanders to their environment. It will also incorporate sustainable infrastructure, while providing for appropriate development.

Consistent with the Auckland Plan 2050, the PPC provides opportunity to restore degraded ecosystems where appropriate, while providing for appropriate development.

4.8.4 Parks and Open Spaces Strategic Action Plan 2013

Auckland Council's Parks and Open Spaces Strategic Action Plan 2013 seeks to conserve Auckland's rich natural heritage through parks and open spaces. The Plan further states that parks and open spaces can protect ecosystems that make Auckland unique, such as our streams.

Consistent with the Parks and Open Spaces Strategic Action Plan, the PPC provides an opportunity to create an open space that protects the streams and site.

4.3.4 Auckland's Urban Ngahere (Forest) Strategy 2018

Auckland's Urban Ngahere (Forest) Strategy aims to promote the protection, expansion, management, and education around the network of vegetation within current and future urban Auckland. The includes remaining forest fragments, native trees, natural stormwater assets, community gardens and parks, and private gardens.

The vegetation within the PPC sites has been identified and classified, and the development of the site provides opportunities that align with the strategy's nine principles: Right tree in the right place; Preference for native species; Ensure urban forest diversity; Protect nature, healthy trees; Create ecological corridors and connections; Access for all residents; Management urban forest on public and private land; and deploy regulatory and non-regulatory tools.

The Precinct Plan proposes increased canopy cover through stream and wetland riparian revegetation, improved ecological linkages and corridors, a dominance of indigenous planting in landscaped areas, incorporation of plants for ecological revegetation areas that suit the ecological district and environmental conditions.

5 SUMMARY AND RECOMMENDATIONS

Neil Construction Limited are applying to Auckland Council for a PPC to rezone the land at 141-159 Brigham Creek Road and 69, 71, 73, 94, 96 and 96a Trig Road, Whenuapai from Future Urban Zone to Business – Light Industry Zone under the Auckland Unitary Plan.

The existing terrestrial and freshwater ecological values of the site have been identified and assessed. It is considered the PPC is appropriate for the area from an ecological perspective and can protect and enhance indigenous biodiversity values of the site in accordance with the outcomes of relevant plans and policy documents, while providing for efficient development.

Overall, it is considered that the proposed PPC can effectively manage any adverse effects of industrial development on the natural environment through the existing planning provisions and policy framework within the AUP. Any potential adverse effects can be adequately mitigated through appropriate stormwater design, fauna management plans, restoration and riparian planting, and detailed design.

REFERENCES

Cato Bolam. 2023. Whenuapai Business Park Private Plan Change, Whenuapai, Auckland: Stormwater Management Plan. Prepared for Neil Construction Ltd, 21 November 2023

Clarkson BR 2014. A vegetation tool for wetland delineation in New Zealand. Landcare Research Contract Report LC1793 for Meridian Energy Limited.

Clarkson BR, Fitzgerald NB, Champion PD, Forester L, Rance BD 2021. New Zealand wetland plant list 2021. Manaaki Whenua - Landcare Research contract report LC3975 for Hawke's Bay Regional Council.

MfE 2022a. Wetland delineation protocols. Wellington: Ministry for the Environment. Ministry for the Environment. 2020.

MfE 2022b. Pasture exclusion assessment methodology. Wellington: Ministry for the Environment. Ministry for the Environment. 2022.

MfE 2022c. National list of exotic pasture species. Wellington: Ministry for the Environment. Ministry for the Environment. 2022.

O'Donnell CFJ, Borkin KM, Christie J, Davidson-Watts I, Dennis G, Pryde M, Michel P 2023. Conservation status of bats in Aotearoa New Zealand, 2022. New Zealand Threat Classification Series 41. Department of Conservation, Wellington. 18 p

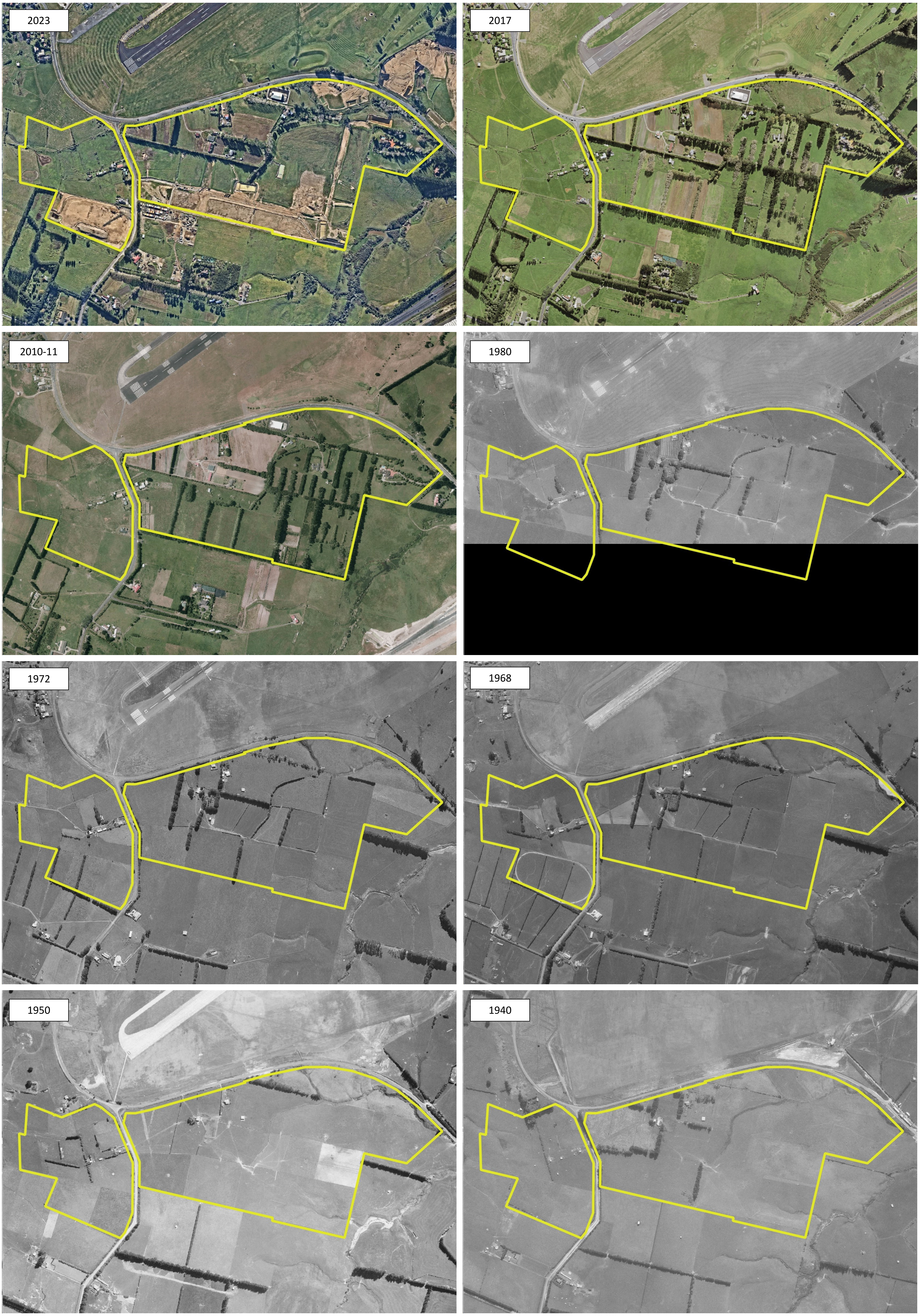
Robertson H A, Baird, KA, Elliott G, Hitchmough R, McArthur N, Makan T, Miskelly C, O'Donnell CF, Sagar PM, Scofield RP, Michel P 2021. Conservation status of birds in Aotearoa New Zealand, 2021. Department of Conservation, Te Papa Atawhai. 2021.

Roper-Lindsay J, Fuller SA, Hooson S, Sanders MD, Ussher GT 2018. Ecological impact assessment. EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd edition.

Singers N, Osborne B, Lovegrove T, Jamieson A, Boow J, Sawyer J, Hill K, Andrews J, Hill S, Webb C 2017. Indigenous terrestrial and wetland ecosystems of Auckland. Auckland Council.

WWLA. 2023. 96a Trig Road, Hydric Soil & Hydrology Tool Assessment. Williamson Water and Land Advisory. Prepared for PMG Funds Limited, 22 November 2023

Appendix A
Historical Aerial Images


2023
2017
2010-11
1980
1972
1968
1950
1940

Appendix B
Clause 23 Request for Further Information Response

TO:	Todd Elder Auckland Council	Date:	1 March 2024
COPY TO:	Matt Ashworth, Trevor Canty (Neil Group Ltd)	Document No:	10139-002-1
FROM:	Annabelle Coates		

WHENUAPAI BUSINESS PARK PPC – Clause 23 ECOLOGY RESPONSE

Neil Construction Limited is applying to Auckland Council for a Private Plan Change (PPC) to rezone the land at 141-159 Brigham Creek Road and 69, 71, 73, 94, 96 and 96a Trig Road, Whenuapai ('the site'). The PPC seeks to rezone approximately 47 ha of land from Future Urban Zone to Business - Light Industry Zone in an integrated and comprehensive manner.

Auckland Council have requested further information under clause 23 or Schedule 1 of the Resource Management Act (1991). The contents of this memo are intended to address questions specific to ecology.

Can the applicant please provide the wetland data points used in the wetland delineation and classification assessments.

Due to the dynamic nature of these types of wetlands, wetland extents can alter over time due to natural seasonal variations or a change in the wider contributing catchment. There are no timeframes for when a resource consent may be applied for, this could be a matter of months or years. As such, all wetlands within the site will be required to be reassessed if a resource application is applied for.

Wetland A passed the rapid test and contained indictors of wetland hydrology including standing water and soil saturation. No data points were generated for Wetland A. The boundaries were delineated by clear changes in topography and vegetation, i.e. where vegetation communities changed from OBL and FACW dominant to UPL and FACU dominant.

Wetland B passed the rapid test and contained indicators of wetland hydrology including standing water and soil saturation. No data points were generated for Wetland B. The boundaries were delineated by clear changes in topography and vegetation.

Wetland C passed the rapid test. It contained an area entirely dominated by buttercup (FAC) and soft rush (FACW). It was delineated based on clear and obvious changes in vegetation, i.e. where buttercup was not present. As discussed in the EcIA, the provenance of this area is not certain as no hydrological indicators were present and aerial images do not suggest a wetland or wetland vegetation has been present in this location historically. As this area was delineated following a significantly wetter than average year t is expected this area will reduce in size or revert to pasture once 'normal circumstances' reestablish.

Wetlands D, E and F all passed the rapid test, but not the FAC neutral test due to the heavy dominance of FAC buttercup. They were delineated conservatively based on hydrological indictors and where the FACW soft rush abundance clearly decreased. To support the delineation, soil test pits were dug beyond delineated areas. No hydric soils were found. Soils were described as being moderately well drained, with 0-30 cm (topsoil) being medium brown clayey silt derived topsoil with low plasticity and minor rootlets (10YR 4/50); and 30-100 cm (clay) being yellow/grey silty clay with high plasticity (10YR 7/4). The locations of the soil test pits are illustrated in Figure 1.

Due to the uncertainty (i.e., potential vegetation alteration) around the classification of the induced wetland (i.e., the wetland associated with the feeding pit), it was delineated by hydrological specialists using both the hydrology tool and hydric soils tool[1]. Hydric soils were identified at points 114, 201, and 205. Hydrological indicators were observed at points 114, and 205 which were located in the thalweg of an overland flow path. No other point yielded hydric soils or hydrological indicators, as such, the induced wetland was delineated based on this. The report providing these results is appended to this memorandum.

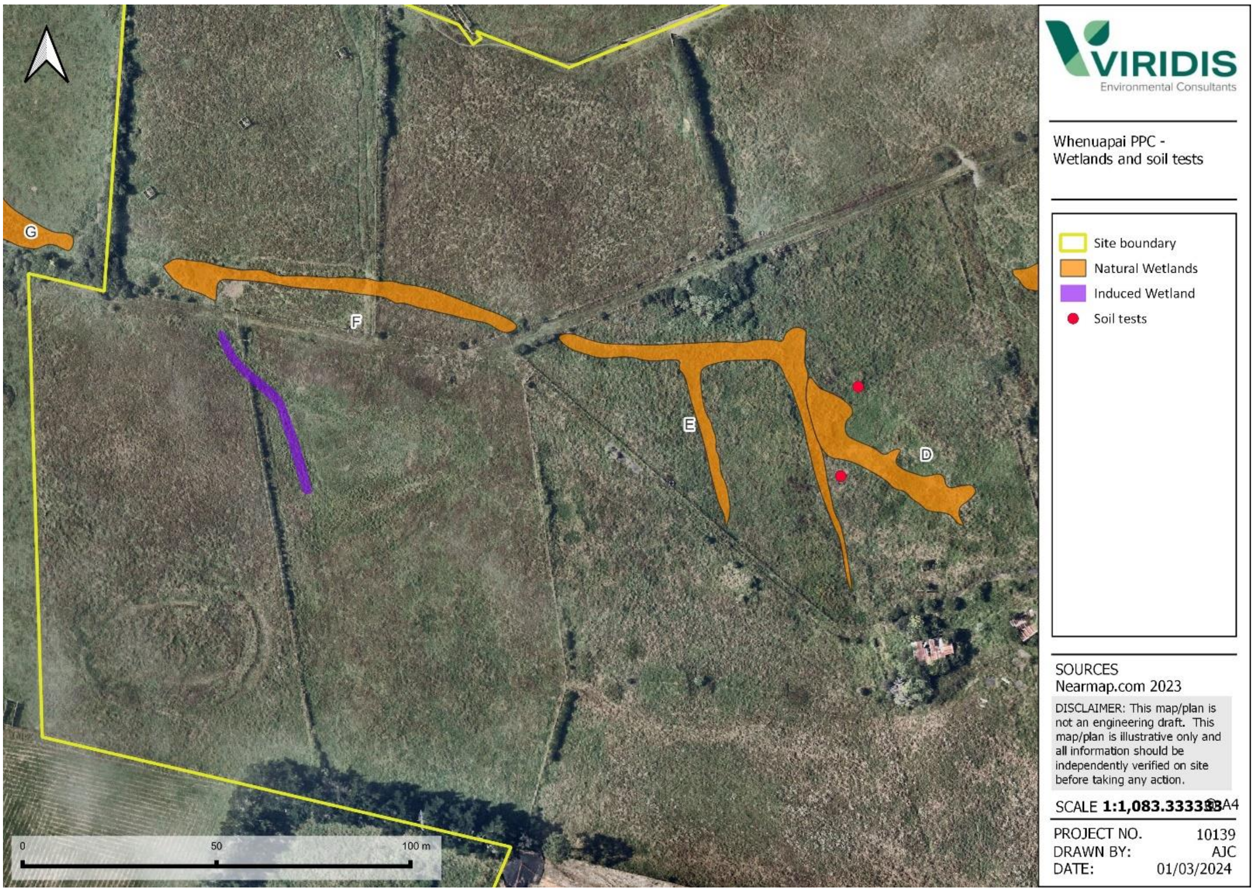


Figure 1. Location of soil test pits around wetlands D, E and FI

[1] WWLA. 2023. 96a Trig Road, Hydric Soil & Hydrology Tool Assessment. Williamson Water and Land Advisory. Prepared for PMG Funds Limited, 22 November 2023

Appendix A – WWLA Report

96a Trig Road

Hydric Soil & Hydrology Tool Assessment

PMG FUNDS LIMITED

WWLA1006 | Rev. 2

22 November 2023

WWLA

Exploration & Production Bore Drilling

Project no:	WWLA1006
Revision:	2
Date:	22 November 2023
Client name:	PMG Funds Limited
Project manager:	Jon Williamson
Author(s):	Jaide Derbyshire and Alistair Bradford
File name:	G:\Shared drives\Projects\PMG Funds Ltd\WWLA1006_96a Trig Rd Wetland Assessment\Deliverables\Reports\WWLA Report_96a Trig Road Wetland Assessment_v2.docx

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Document history and status

Rev	Date	Description	By	Review	Approved
1	14 November 2023	First draft	Jaide Derbyshire and Alistair Bradford	Jon Williamson	Jon Williamson
2	22 November 2023	Second draft	Jon Williamson	Jon Williamson	Jon Williamson

Distribution of copies

Rev	Date issued	Issued to	Comments
1	14 November 2023	Matt Doughney (Euroclass)	Draft for client review
2	22 November 2023	Matt Doughney (Euroclass)	Updated draft after second sampling

Executive Summary

Williamson Water & Land Advisory (WWLA) were commissioned by PMG Funds Ltd in October 2023 to undertake a Hydric Soil and Wetland Hydrology Tool Assessment on the property at 96a Trig Road. The work was required following uncertain outcome in Step 1 and Step 2 of the RMA wetland identification process relating to hydrophytic plant identification undertaken by Mark Delaney (Viridis Consultants Limited).

The following summarises the key findings:

Project Objectives	The specific objective of the assessment was to: • Confirm the presence or absence of hydric soil and hydrology indicators of natural inland wetlands; and • Map the possible wetland extent based on the findings of the field assessment.
Methods	All investigations were undertaken in accordance with the Landcare Research (2018) and MfE (2021) guidelines for hydric soil and hydrology assessment for natural inland wetlands. The work was undertaken in November after a short period of fine weather. Weather had been wet the week prior, hence ground conditions were slightly moist, but not saturated. A total of 20 initial sites and 10 secondary sites within the key area of concern were investigated to achieve a representative spread of results in and around the area regularly known to pond. The scale of the investigation was initially 1:800, which can be considered detailed mapping. Following the addition of the secondary sites, the scale of investigation was approximately 1:500. In the first phase of investigation, test pits were dug to 400 mm and hand-augured further to 1,000 mm, with key lithological and morphological characteristics logged as the depth of investigation progressed. Each was measured, photographed and backfilled following investigation. In the second phase of investigation, test pits were dug to between 450 mm and 750 mm, with a focus on the topsoil in the key area of interest.
Summary of Results	In summary: • Soils on site were uniformly represented across the site, comprising between 200-300 mm of topsoil underlain by Tauranga Group Alluvium. • Soils across the site were generally well drained. • Two (2) sites displayed properties indicative of hydric soils within as displayed by primary indicators of wetlands.
Key Conclusions	The assessment of potential wetland areas within 96a Trig Road using the hydric soil and hydrology delineation tools confirmed the presence of two locations (sites 114(201) and 205) where hydric soils and/or primary hydrology indicators of wetland are present. The presence of wetland is very localised to the drainage channel in that general area, as marked in Figure 1. All other twenty-eight (28) test locations showed no sign of primary or secondary hydric soils or hydrology characteristics, due principally to their position within the landscape on slightly higher ground. It was also noted that several areas, particularly away from the old drain (e.g. around 204, 206) appear to be quite modified by prior activities. There is evidence of fill (clay within topsoil) and also tyres from a silage pit. It is suspected (but not confirmed) that the farmer used the elevated race to the north to bring silage or topsoil for storage into this area. We are not sure whether the bunker was natural or cut out for silage operations, but either way the area is already heavily modified. The large scale of Retrolens photos at decadal intervals from 1940 to 1990 are not of any assistance in addressing this.

Contents

Appendices:

1. Introduction

Williamson Water & Land Advisory (WWLA) were commissioned by PMG Funds Ltd to undertake Hydric Soil and Wetland Hydrology Tool Assessments in accordance with the guidance in Landcare Research (2018)[1] and MfE (2021)[2].

Previous investigations by Mark Delaney (Viridis Consultants Limited) involved Step 1 and Step 2 of the RMA wetland identification process, which focusses on hydrophytic vegetation, with the outcome being uncertain. This has led to the requirement of this Hydric Soil and Wetland Hydrology Tools Assessment.

The report structure is as summarised in **Table 1**.

Table 1. Report structure.

Section	Heading	Description
1	Introduction	Project overview and background.
2	Field Investigation Methodology	Describes when and how the work was undertaken, along with key general observations of the site..
3	Environmental Setting	Climate, Topography and Drainage, Soils and Geology.
4	Hydric Soil Tool Assessment	Tool methodology, Site specific considerations implementation.
5	Hydrology Tool Assessment	Tool methodology, Site specific considerations and implementation.
6	Conclusions	Results of study and development implications.

[1] Landcare Research, 2018. Hydric soils – field identification guide. Consultancy report prepared for Tasman District Council under Envirolink Grant: C09X1702. June 2018.

[2] MfE, 2021. Wetland delineation hydrology tool for Aotearoa New Zealand. Published in July 2021 by the Ministry for the Environment. ISBN: 978-1-99-003362-9. Publication number: ME 1575.

2. Field Investigation Methodology

2.1 Overview

The assessment was undertaken in two stages, with soil testing and inspection performed at twenty primary sites on 6 November 2023 and ten secondary sites 20 November 2023, within the 1.56 ha key area of interest, as shown in **Figure 1**.

The primary investigation was conducted by two WWLA environmental scientists, and the secondary investigation by a Principal Hydrologist from WWLA (Jon Williamson) and Principal Ecologists from Viridis Ltd (Mark Delaney).

The weather conditions and ground conditions at the time of the survey were:

- ***6 November*** - fine with patchy cloud. The ground conditions were moist due to recent rain, but not saturated, except in some low lying areas where beef cattle pugging (which currently graze the property) had retained surface water.
- ***20 November*** – sunny and very hot / humid conditions following clearing of the very heavy rainfall that occurred over the weekend.

The investigations for the primary sites were undertaken at a mapping scale of approximately 1:800 and 1:500 overall. For context, most national scale soil maps and land use classification maps are developed at 1:50,000. Detailed farm or orchard planning typically requires mapping at 1:3,000 scale, hence the scale used in this investigation can be considered detailed.

2.2 Methodology

The field investigation methodology undertaken at each of the primary sites involved:

- Hand excavation of a 400 x 400 mm hole to a depth of 400 mm, followed by hand auger of a 60 mm core to a depth of 1,000 mm;
- Describing the soil in accordance with the NZ Geotechnical Society guidelines for soil and rock description, and the requirements for hydric soil identification provided in Section 5 of the Hydric Soils Identification Guide[1], which included:
  - Munsell Soil Colour Book 2009;
  - New Zealand Hydric Soils – Field Identification Guide Sheet; and
  - copies of the wetland soil data form.
- Recording the hydrological indicators of the site.

For the secondary sites, the investigation focused largely on the topsoil and top of the subsoil to depth of between 450 mm to 650 mm. Recording of the hydrological indicators was not performed for the secondary sites.

2.3 Overview of the Wetland Assessment Tools

The key objective of wetland hydric soil and hydrology tools is to aid in identifying and delineating wetlands, and are two of the three component suite of tools for conducting this type of wetland assessment, including:

1) Hydrophytic vegetation;
2) Hydric soils; and
3) Hydrology.

These tools are based on the US Army Corps of Engineers Wetlands Delineation manual for the USA originally developed in 1987 and refined through the 1990's. Since 1991, this document has been a mandatory requirement for permitting activities that potentially impact on wetlands (amongst other things) under Section 404 of the USA Clean Water Act (CWA). The use of this document is a legislative requirement of the National Policy Statement for Freshwater Management 2022 update.

The wetland hydrology tool outlines assessment procedures for primary and secondary hydrology indicators. To confirm the presence of wetland hydrology, positive identification of the following are required:

- One primary indicator, or
- Two secondary indicators.

There is an overlap in the guidelines between the hydric soil and hydrology tools, hence the guideline suggests the hydrology tool should be concurrently with the hydric soils tool. For this reason, this assignment completes both tasks in both the wetland hydric soil and hydrology tools.

Map Title:
Site Overview

Project:
Hydric Soil & Hydrology Tools Assessment

Client:
PMG Funds Ltd

Legend

- **Road**
- **1 m Topo Contours**
- **Primary Sites**
- **Secondary Sites**
- **Wetland Outline**
- **Property Boundary**

Data Provenance
Aerial imagery and land parcels from Land Information New Zealand

Drawn by: Jaide Derbyshire
22/11/2023

Layout Name
Fig 1. Overview

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Figure 1.

3. Environmental Setting

3.1 Climate

Historic climate data was obtained from NIWA's Climate station sites. The following data was used:

- Whenuapai Aero, Auckland #1410 (rainfall and evaporation) from 1943 – 1993; and
- Henderson North, Auckland #1423 (rainfall) 1993 – 2023.

The Cliflo data was not available for recent years in Whenuapai, therefore, the dataset was completed with the rainfall data from Henderson North. Average annual rainfall and evaporation over this period was 1,369 mm and 383 mm, respectively.

Mean monthly rainfall and evaporation is displayed in **Figure 2**.

This shows on average that monthly evaporation exceeds monthly rainfall (i.e., a moisture deficit) during the months November to February. Conversely, outside of these months' rainfall typically exceeds evaporation. This pattern follows the typical dry summer and wet winter trend observed across the northern North Island.

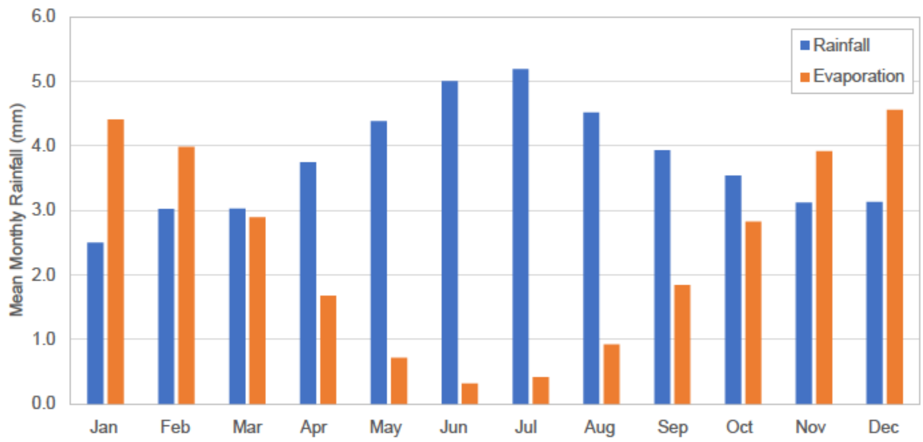


Figure 2. Mean monthly rainfall and evaporation.

A 3-month moving average residual mass rainfall analysis was undertaken over the last 10 years to provide an indication as to rainfall conditions leading up to the Hydric Soil and Hydrology Tool Assessment (**Figure 3**). This shows that climatic conditions have been significantly wetter than average since mid-2022.

The investigation was planned to take place at the start of November, however rain delayed this with four days of dry weather required prior to the primary investigation commencing on 6 November.

Ground conditions, whilst not saturated, were wetter than normal, this means that the assessment is conservative (i.e., any uncertainty in finding wetland conditions would be diminished, compared to performing the testing after drier than normal conditions).

During the secondary investigation, ground consitio0ns were surprising dry given the heavy rainfall over the preceding two day, which tends to suggest the soils have a moderate permeability.

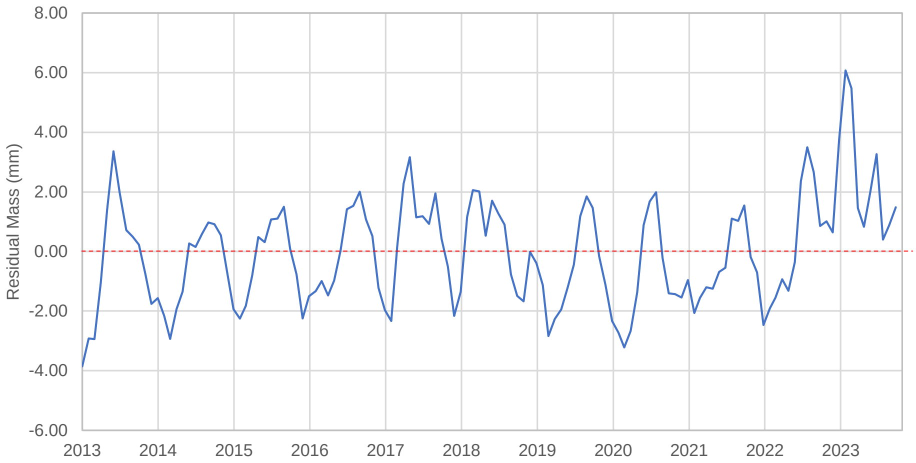


Figure 3. Three-month daily moving average rainfall residual mass plot.

3.2 Topography and Drainage

The topography across 96a Trig Road was interpolated from high-resolution local radar and is shown in **Figure 1**. The topography of the investigation area is fairly flat with a gentle slope to the north/north-west, with elevation ranging from around 35.5 mAMSL to 29 m AMSL. The lower elevation acts as a surface water drain for the investigation area and surroundings, particularly the adjected property to the south.

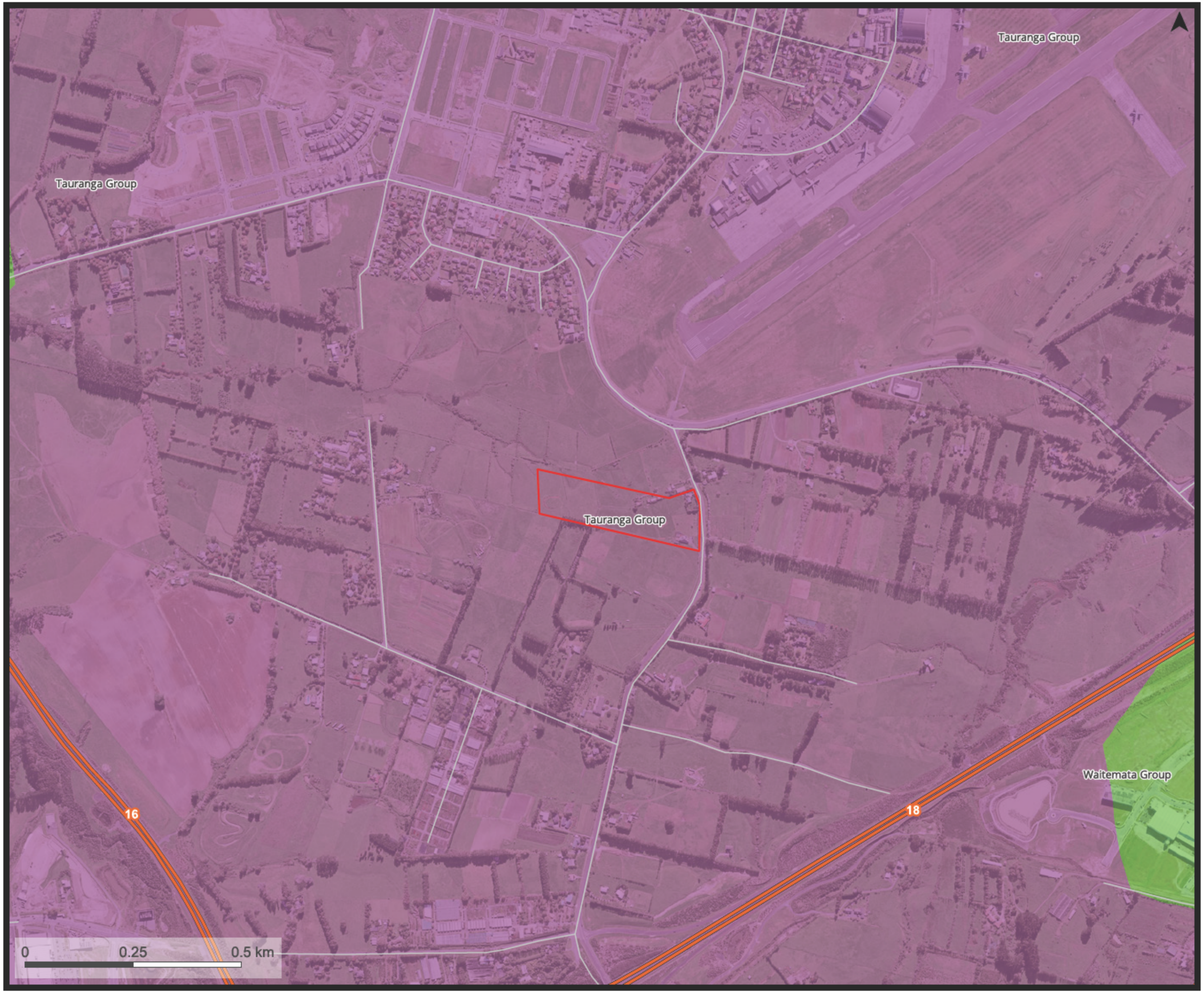
3.3 Soils and Geology

According to the New Zealand Soil Classification (NZSC), the soils are classified as Impeded Allophanic (LI) Soils. The soils typically consist of very dark brown or black topsoils and a yellow-brown subsoil. These soils are usually very porous, low density with weak strength. The topsoils crumble easily and are followed by hard, or slowly permeable layers which was evident at this site.

The soil order is derived based on variation in factors such as drainage status, parent material, chemical and physical properties.

The soils and sub-surface lithology was highly consistent across the entire investigation area, with between 200-300 mm of topsoil underlain by grey and/or orange/brown plastic clay in each test location (refer **Table 2, Appendix B**).

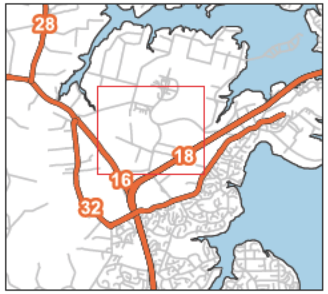
Geology for the property is uniform indicating that the site is underlain by Tauranga Group Alluvium (**Figure 5**).



Map Title:
Geology

Project:
Hydric Soil & Hydrology Tools Assessment

Client:
PMG Funds Ltd



Legend

Road

96a Trig Road

Regional geology (main rock)

Tauranga Group

Waitemata Group

Data Provenance
Aerial imagery and land parcels from Land Information New Zealand

Drawn by: Jaide Derbyshire
13/11/2023

Layout Name
Fig 5. Geology

WILLIAMSON WATER & LAND ADVISORY

Figure 4.

4. Hydric Soil Tool Assessment

As discussed in **Section 1**, the hydric soil assessment undertaken in this report was undertaken using the Landcare Research (2018) field guide.

'Hydric soils' is a general term for soils that are poorly or very poorly drained and have a water table above, at, or near the surface long enough during the growing season to develop anaerobic conditions in the upper layers. Gley and Organic soils are the two main orders of hydric soils.

- Gley soils have pale subsoils often with reddish mottles. These colours are indicators of saturated low oxygen conditions.
- Organic soils are also formed in saturated conditions and have at least 30 cm of peaty material.

Generally hydric soils are peaty or humic or have pale light grey subsoil colours caused by saturation and a lack of oxygen. Blotches (mottles) of redder colour can occur in the topsoil or subsoil where air can get into the soil and oxidises iron minerals to form redder colours.

4.1 Indicators

The procedure for hydric soil testing involved examining various soil characteristics indicative of hydric soils including the following:

- ***Field observations and soil colour***: This provided valuable information about soil characteristics that can indicate wetland conditions, including the presence of gleyed colours (grey or bluish-grey), and presence of mottling (speckled, low chroma colours).
- ***Soil morphology***: Morphological features seen in the soil profile can provide details about potentially hydric conditions such as mottling, oxidised root channels, accumulation of organic matter, and presence of iron or manganese concretions can indicate perennial or prolonged wet conditions in the growing season.
- ***Soil structure and texture****:* Proportions of sand, silt, and clay influence water-holding capacity, drainage, and aeration potential. Hydric soils are often characterised by finer textures such as silty or clayey soils with poor drainage.
- ***Soil moisture***: Hydric soils typically exhibit saturated or ponded conditions for a significant portion of the year, resulting in anaerobic conditions that do not require oxygen for growth.
- ***Soil chemistry***: Chemical indicators such as iron and manganese reduction, accumulation of organic matter, and low redox potential, can suggest hydric soil conditions.

Soil colour[3] is one of the key defining feature for identification of hydric soils because the presence of water within the soil profile will affect the colour of soils, depending on the duration of anaerobic conditions. Soils that are subject to prolonged anaerobic conditions with the matrix iron reduced tend to have matrix with low chroma colours. The low chroma colour are typical of hydric soils, as shown in **Figure 5**. Note that dark topsoil colour values of 3 or less are not good indicators of hydric soils as many topsoils have colours in this range.

[3] Describing a colour requires three components: hue, value, and chroma. Hue refers to the colour (e.g. red, orange, yellow), value describes how light or dark the colour is, and chroma rates how bright or vibrant the colour is.

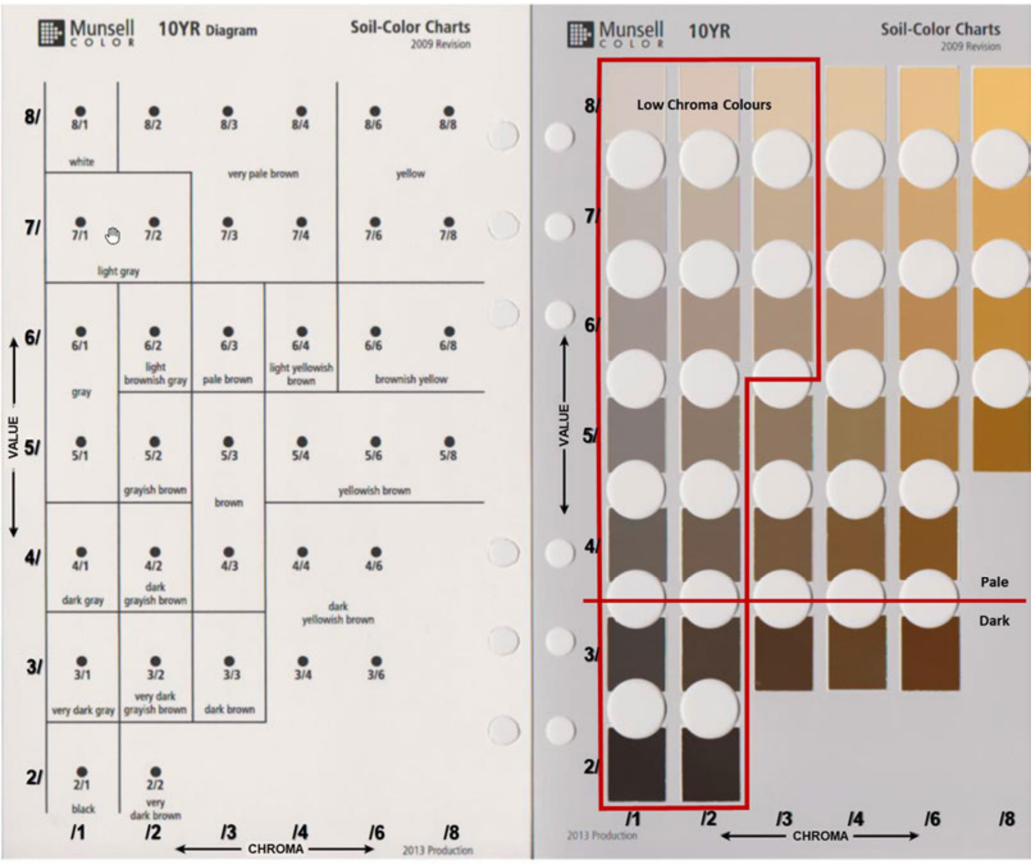


Figure 5. 10YR hue page from a soil colour chart.

A simple indicator for hydric soils is provided in Landcare Research (2018), which is reproduced in **Figure 6**.

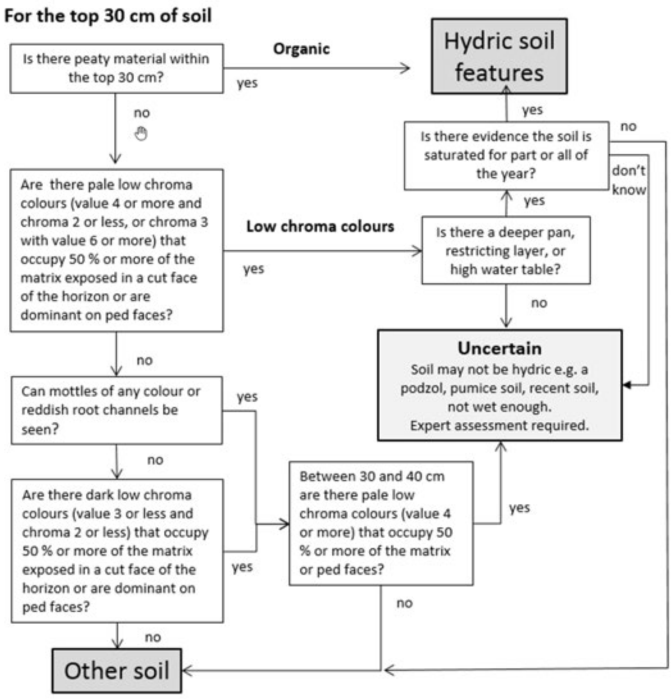


Figure 6. Simple key to identifying hydric soils.

4.2 Results

Details of the observations made at each site are summarised in **Table 2** and provided in full in **Appendix B.** The range in soil colour (value/chroma) is presented in **Figure 7.**

Table 2. Summary of hydric soil tests.

Site #	Soil Description Summary		Hydric Soil? (Yes/No)
	Lithology	**Hydric Soil Indicators**	
101	0-22 cm Clayey SILT: Medium Brown. Loose, dry. Minor rootlets. (Topsoil) 22-100 cm Clayey SILT: Brown/orange. High plasticity (Puketoka Formation)	Drainage – Well drained. Matrix Colour (10YR - Value/Chroma): • Topsoil – 4/3 • Clay – 7/4 & 6/2	N
102	0-20 cm Clayey SILT: Medium Brown. Moist. Minor rootlets. (Topsoil) 20-100 cm Clayey SILT: Orange. High plasticity (Puketoka Formation)	Drainage – Well drained. Matrix Colour (10YR - Value/Chroma): • Topsoil – 5/3 • Clay – 7/6	N
103	0-25 cm Clayey SILT: Medium Brown. Moist. Minor rootlets. (Topsoil) 25-100 cm Clayey SILT: Orange diffusing to grey. High plasticity (Puketoka Formation)	Drainage – Well drained. Matrix Colour (10YR - Value/Chroma): • Topsoil – 4/3 • Clay – 6/6	N
104	0-20 cm Clayey SILT: Medium Brown. Moist. Minor rootlets. (Topsoil) 20-100 cm Clayey SILT: Orange/grey. High plasticity (Puketoka Formation)	Drainage – Well drained. Matrix Colour (10YR - Value/Chroma): • Topsoil – 4/4 • Clay – 7/5	N
105	0-20 cm Clayey SILT: Medium Brown. Moist. Minor rootlets. (Topsoil) 20-100 cm Clayey SILT: Orange diffusing to grey. High plasticity (Puketoka Formation)	Drainage – Well drained. Matrix Colour (10YR - Value/Chroma): • Topsoil – 3/3 • Clay – 7/3	N
106	0-20 cm Clayey SILT: Medium Brown. Loose, dry. Minor rootlets. (Topsoil) 20-100 cm Clayey SILT: Orange diffusing to grey. High plasticity (Puketoka Formation)	Drainage – Well drained. Matrix Colour (10YR - Value/Chroma): • Topsoil – 4/4 • Clay – 7/6 & &/3	N
107	0-18 cm Clayey SILT: Medium Brown. Loose, dry. Minor rootlets. (Topsoil) 18-100 cm Clayey SILT: Orange diffusing to grey. High plasticity (Puketoka Formation)	Drainage – Well drained. Matrix Colour (10YR - Value/Chroma): • Topsoil – 3/4 • Clay – 7/6 & 8/3	N
108	0-20 cm Clayey SILT: Medium Brown. Loose, dry. Minor rootlets. (Topsoil) 20-100 cm Clayey SILT: Orange diffusing to grey. High plasticity (Puketoka Formation)	Drainage – Moderately well drained. Matrix Colour (10YR – Value/Chroma) • Topsoil – 3/3 • Clay – 7/3	N
109	0-23 cm Clayey SILT: Medium Brown. Loose, dry. Minor rootlets. (Topsoil) 23-100 cm Clayey SILT: Orange diffusing to grey. High plasticity (Puketoka Formation)	Drainage – Moderately well drained Matrix Colour (10YR – Value/Chroma) • Topsoil – 3/3 • Clay – 7/6 & 6/1	N
110	0-27cm Clayey SILT: Medium Brown. Moist. Minor rootlets. (Topsoil)	Drainage - Well drained.	N

Site #	Soil Description Summary		Hydric Soil? (Yes/No)
	Lithology	Hydric Soil Indicators	
	27-100 cm Clayey SILT: Orange diffusing to grey. High plasticity (Puketoka Formation)	Matrix Colour (10YR – Value/Chroma) • Topsoil – 4/3 • Clay – 6/2	
111	0-25 cm Clayey SILT: Medium Brown. Loose, dry. Minor rootlets. (Topsoil) (Topsoil) 25-100 cm Clayey SILT: Orange diffusing to grey. High plasticity (Puketoka Formation)	Drainage – Moderately well drained. Matrix Colour (10YR – Value/Chroma) • Topsoil – 3/3 • Clay – 6/2	N
112	0-18 cm Clayey SILT: Medium Brown. Moist. Minor rootlets. (Topsoil) 18-100 cm Clayey SILT: Orange diffusing to grey. High plasticity (Puketoka Formation)	Drainage - Well drained. Matrix Colour (10YR – Value/Chroma) • Topsoil – 3/3 • Clay – 6/4	N
113	0-23 cm Clayey SILT: Medium Brown. Moist. Minor rootlets. (Topsoil) 23-100 cm Clayey SILT: Grey. High plasticity (Puketoka Formation)	Drainage - Well drained. Matrix Colour (10YR – Value/Chroma) • Topsoil – 4/3 • Clay – 7/3	N
14	0-10 cm Clayey SILT: Dark Brown. Moist. Minor rootlets. (Topsoil) 10-80 cm SOIL: Black. Moist. Minor rootlets. (Topsoil) 80-100 cm Clayey SILT: Grey. High plasticity (Puketoka Formation)	Drainage – Poorly drained. Matrix Colour (10YR – Value/Chroma) • Topsoil – 3/2 • Subsoil – 8/1 • Clay – 6/1	Y
115	0-28 cm Clayey SILT: Medium Brown. Loose, dry. Minor rootlets. (Topsoil) 28-100 cm Clayey SILT: Orange/grey. High plasticity (Puketoka Formation)	Drainage - Well drained. Matrix Colour (10YR – Value/Chroma) • Topsoil – 3/3 • Clay – 7/4	N
116	0-20 cm Clayey SILT: Orange/brown. Loose, dry. Minor rootlets. (Topsoil) 20-70 cm Clayey SILT: Orange/brown. High plasticity. (Puketoka Formation) 80-100 cm Clayey SILT: Grey. High plasticity (Puketoka Formation)	Drainage – Well drained. Matrix Colour (10YR – Value/Chroma) • Topsoil – 3/4 • Subsoil – 6/6 • Clay – 5/6	N
117	0-20 cm Clayey SILT: Medium Brown. Loose, dry. Minor rootlets. (Topsoil) 20-100 cm Clayey SILT: Grey. High plasticity (Puketoka Formation)	Drainage – Moderately well drained. Matrix Colour (10YR – Value/Chroma) • Topsoil – 4/3 • Clay – 6/3	N
118	0-23 cm Clayey SILT: Medium Brown. Loose, dry. Minor rootlets. (Topsoil) 23-100 cm Clayey SILT: Grey. High plasticity (Puketoka Formation)	Drainage – Moderately well drained. Matrix Colour (10YR – Value/Chroma) • Topsoil – 5/4 • Clay – 6/4	N
119	0-24 cm Clayey SILT: Medium Brown. Loose, dry. Minor rootlets. (Topsoil) 24-100 cm Clayey SILT: Grey. High plasticity (Puketoka Formation)	Drainage – Moderately well drained. Matrix Colour (10YR – Value/Chroma) • Topsoil – 4/3 • Clay – 6/1	N
120	0-18 cm Clayey SILT: Medium Brown. Loose, dry. Minor rootlets. (Topsoil) 18-100 cm Clayey SILT: Grey. High plasticity (Puketoka Formation)	Drainage – Moderately well drained. Matrix Colour (10YR – Value/Chroma)	N

Site #	Soil Description Summary		Hydric Soil? (Yes/No)
	Lithology	Hydric Soil Indicators	
		• Topsoil – 3/3 • Clay – 6/2	
201	[duplicate of site 114] 0-10 cm Clayey SILT: Dark Brown. Moist. Soft and fibrous. (Topsoil) 10-450 cm Organic TOPSOIL: Black. Moist. Minor rootlets. (Topsoil)	Drainage – Poorly drained. Matrix Colour (10YR – Value/Chroma) • Topsoil – 2/1	Y
202	0-45 cm. TOPSOIL: Dark yellowish brown. Clayey Silt. 45-55 cm. CLAY: Light yellowish brown / orange grey clay. Moderately Mottled.	Drainage – Moderately well drained. Matrix Colour (10YR – Value/Chroma) Topsoil – 4/4 Clay – 6/4	N
203	0-50 cm. TOPSOIL: Dark brown clayey silt. 50 cm. CLAY: Grey lightly mottled.	Drainage – Moderately well drained. Matrix Colour (10YR – Value/Chroma) Topsoil – 3/3 Clay – 6/1	N
204	0-30 cm. TOPSOIL: Dark yellowish brown clayey silt, with clay fill nodules (100 mm). Disturbed ground. Dry.	Drainage – Moderately well drained. Matrix Colour (10YR – Value/Chroma) Topsoil – 4/3	N
205	0-10 cm. TOPSOIL. Very dark brown. Spongy and fibrous. 10-750 mm. SOIL. Dark brown-black silty organic rich soil. Water table encountered at 650 mm – rapid seepage.	Drainage – Moderately well drained to shallow groundwater table at 650 mm. Matrix Colour (10YR – Value/Chroma) Topsoil – 2/2	Y
206	0-30 cm. TOPSOIL. Dark yellowish brown clayey silt.	Drainage – Moderately well drained. Matrix Colour (10YR – Value/Chroma) Topsoil – 4/4	N
207	0-30 cm. TOPSOIL. Dark brown clayey silt.	Drainage – Moderately well drained. Matrix Colour (10YR – Value/Chroma) Topsoil – 3/3	N
208	0-30 cm. TOPSOIL. Brown clayey silt.	Drainage – Moderately well drained. Matrix Colour (10YR – Value/Chroma) Topsoil – 4/3	N
209	0-30 cm. TOPSOIL. Dark brown clayey silt.	Drainage – Moderately well drained. Matrix Colour (10YR – Value/Chroma) Topsoil – 3/3	N
210	0-30 cm. TOPSOIL. Dark brown clayey silt.	Drainage – Moderately well drained. Matrix Colour (10YR – Value/Chroma) Topsoil – 3/3	N

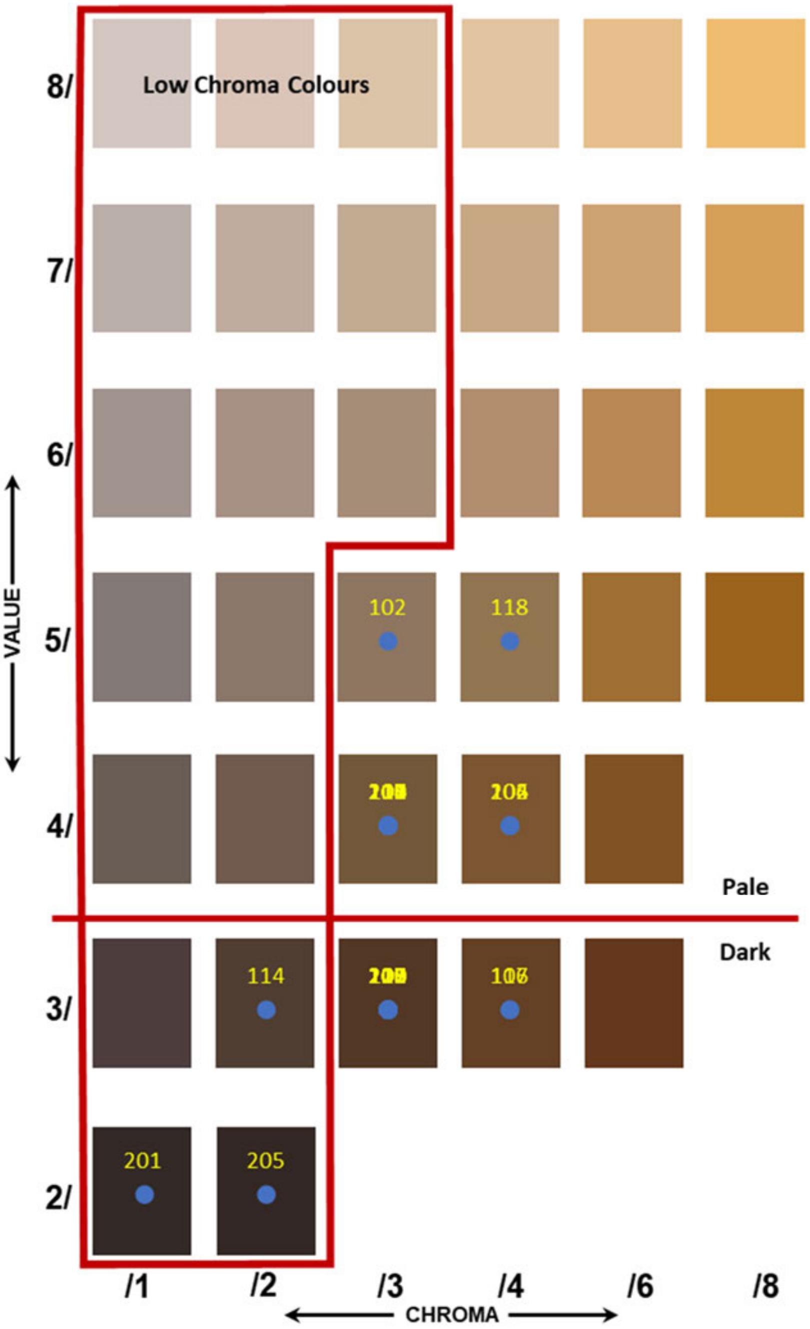


Figure 7. Summary of soil chroma range.

5. Hydrology Tool Assessment

Wetland hydrology can be defined as encompassing all hydrological characteristics of areas that are periodically inundated or have soils saturated to, or near, the surface during a portion of the growing season (based on US Army Corp of Engineers - Environmental Laboratory, 1987). To meet the standard for wetland hydrology, an area must be:

- Inundated for at least seven consecutive days during the growing season in most years (50 per cent probability of recurrence); or
- Saturated at or near the surface for at least 14 consecutive days during the growing season in most years (50 per cent probability of recurrence, for example, 5 years in 10).

1. Soils may be considered saturated if the water table is within:

- 15 cm of the surface for sands
- 30 cm of the surface for all other soils.

5.1 Indicators

Hydrology indicators are one-off observations that identify the presence or absence of a wetland in areas where hydrophytic vegetation and hydric soils are present or uncertain. Wetland delineation using the hydrology tool should be undertaken during periods of 'normal rainfall'. Because hydrology indicators can be highly transient, a follow-up visit may be required during normal and wetter periods of the growing season.

2. There are four indicator groups identified in the guidelines:

- Observation of flooding or groundwater;
- Evidence of flooding or ponding;
- Soil saturation; and
- Landscape, vegetation and soil observations (which may overlap with the vegetation and hydric soil tools).

Group 1 are primary indicators and Groups 2 to 4 have a mix of primary and secondary indicators. The presence of one primary indicator, or two secondary indicators, confirms the presence of a wetland. The full suite of 26 hydrology indicators are summarised in **Table 3**.

Table 3. Summary of wetlands hydrology indicators.

Indicator	Primary	2ndary	Observation Description ("observed in the area of interest during the growing season")
Group 1: Observation of flooding or groundwater			
1A: Surface water	✓		Surface water can be observed in the form of either flooding or ponding.
1B: Groundwater	✓		A high water table is observed within 30 centimeters of the soil surface as determined by soil pit, auger hole or shallow monitoring well.
1C: Soil saturation	✓		Soil saturation is observed in the top 30 centimeters of the soil profile. Indicated by 'water glistening on the surfaces and broken interior faces of the soil samples removed from a pit or auger hole'. Pg 19.
Group 2: Evidence of flooding or ponding			
2A: Water marks	✓		Water marks (discoloration or staining) are seen on trees, rocks, fences or other fixed objects. Lichen may also be absent below the flooding level.
2B: Sediment deposits	✓		Thin layers or coatings of fine mineral material (e.g., silt or clay) or organic matter (e.g., pollen) are seen on trees, rocks or other fixed objects.
2C: Drift deposits	✓		Debris (e.g., branches, leaves, plastic fragments) are seen deposited on the ground surface or entangled in vegetation or other fixed objects.

Indicator	Primary	2ndary	Observation Description ("observed in the area of interest during the growing season")
2D: Agal mat or crust	✓		An algal mat or crust is seen on or near the soil surface after the water has drained away.
2E: Iron deposits	✓		A thin orange or yellow crust or gel or oxidised iron is seen on or near the soil surface or as a sheen on standing water.
2F: Surface soil cracks	✓		Surface soil cracks are seen where mineral or organic sediment dry and shrink to form a network of cracks or polygons.
2G: Inundation visible on aerial imagery	✓		Inundation is seen on one or more recent aerial or satellite images.
2H: Sparsely vegetated concave surface	✓		A lack of vegetation (less than 5 per cent coverage) is seen on concave land surfaces resulting from prolonged ponding.
2I: Salt crust	✓		Hard or brittle deposits of salts are seen on the ground surface, usually in depressions, seeps or lake fringes, after evaporation of saline surface water.
2J: Aquatic invertebrates	✓		Numerous live or dead aquatic invertebrates, including diapausing eggs, remains of aquatic invertebrates, such as aquatic snails or crustaceans, are seen on the soil surface or plants or other emergent objects.
2K: Water-stained leaves	✓	✓	Water-stained grey or black leaves are visible due to long periods of saturation during the growing season
2L: Drainage patterns		✓	Areas that have recently experienced overland water flow may show soil erosion, low vegetation bent in the direction of water flow, or absence of leaf litter or small woody debris.
Group 3: Evidence of current or recent soil saturation			
3A: Hydrogen sulphide odour	✓		Hydrogen sulphide odour, similar to rotten eggs, is detected from the top 30 centimeters of the soil profile. Hydrogen sulphide is produced in soils only when saturation has been prolonged.
3B: Oxidised rhizospheres along living roots	✓		A soil horizon with greater than or equal to 2 per cent iron-oxide (orange coating) can be seen on the surfaces of living roots or soil pores immediately surrounding the roots within the top 30 centimeters of the soil profile.
3C: Reduced iron	✓		A soil layer containing reduced iron in the top 30 centimeters of the soil profile can be seen where the soil changes colour upon air exposure.
3D: Recent iron reduction in tilled soils	✓		A soil layer containing greater than or equal to 2 per cent redox concentrations (mottles) is visible in pore linings of masses in a soil that has been tilled less than two years ago within the tillage zone or the top 30 centimeters of the soil profile, whichever one is shallower.
3E: Dry-season water table		✓	A water-table depth between 30 centimeters and 60 centimeters of the soil profile can be seen during the normal dry season or a drier-than-normal period of the year.
3F: Saturation visible on aerial imagery		✓	Visual assessment of one or more aerial or satellite images can identify sites where soil saturation corresponds to depressions, drainage patterns, crop management, field verified hydric soils or other evidence of a seasonally high water table during the growing season
Group 4: Evidence from other site conditions or data			
4A: Stunted or stressed plants	✓		It can be seen that most plants in cultivated or planted wetland areas are smaller, less vigorous or appear more stressed compared with neighbouring non-wetland areas
4B: Geomorphic position		✓	The possible wetland may be seen in a localised depression, swale, drainage system, concave position in a floodplain, at the toe of a slope, on extensive flatland, the low-elevation fringe of a pond or waterbody, or groundwater discharge zone.
4C: Shallow aquitard		✓	A semi-permeable–impermeable layer is confirmed within 60 centimeters of the soil surface, which decreases movement of groundwater and causes a perched water table

Indicator	Primary	2ndary	Observation Description ("observed in the area of interest during the growing season")
			within 30 centimeters of the soil surface. This semi-permeable–impermeable layer can be composed of clay or non-porous rock.
4D: Facultative-neutral test		✓	Plant test – normally done by ecologists.
4E: Frost-heave hummocks		✓	Frost-heave hummocks are produced as water-logged soils undergo freeze–thaw processes. Exclude livestock pugging hummocks.

5.2 Results

Full test data sheets and a table summarising the findings are provided in **Appendix A**.

With respect to the aforementioned assessment parameters, the presence of one primary indicator, or two secondary indicators confirms the presence of a wetland.

In summary, the key findings are as follows:

- ***Primary Indicators*** **–** Two (2) sites (site 114/201, and 205) displayed primary indicators.
- ***Secondary Indicators*** **–** No sites displayed any secondary indicators.

Hydrology indicator 3F requires analysis of recent aerial imagery to ascertain soil saturation. It is best to view the imagery during prolonged dry times or drought because true wetlands will remain wetter than surrounding land and therefore maintain a deeper/darker hue of green representative of wetland vegetation. In comparison, vegetation on adjacent land that has significant soil moisture deficits will display progressively lighter hues of green to yellow to yellow-tan, reflecting moisture stressed vegetation.

Figure 8 provides an aerial photograph taken in December 2017. Aerial imagery was limited for the site due to the low quality of some images. December 2017 shows general dryness throughout the area. The key features observed are:

- Dried areas across the paddocks used for grazing.
- Green vegetation in and immediately adjacent to drains in the lowest elevation areas, and hedgerows. A triangular area of approximately 1,400 m^2 appears to be retaining moisture more so than the adjacent paddocks in the northwest of the property.
- Overall, the analysis using the 3F secondary indicator suggests that the majority of the property is not being maintained by wet land, however a small low lying area of approximately 1,400 m^2 is being maintained by wetter land during this drought period.

Overall, the hydrology tool assessment indicates a presence of two (2) locations displaying either hydric soils or primary indicators for wetland (refer **Appendix A**).

Map Title:
Drought February 2019 Aerial Imagery

Project:
Hydric Soil & Hydrology Tools Assessment

Client:
PMG Funds Ltd

Legend

Road

Property Boundary

Data Provenance
Aerial imagery and land parcels from Land Information New Zealand

Drawn by: Jaide Derbyshire
22/11/2023

Layout Name
Fig 8. Historic Aerial Imagery

WILLIAMSON WATER & LAND ADVISORY

Figure 8.

6. Conclusions

The assessment of potential wetland areas within 96a Trig Road using the hydric soil and hydrology delineation tools confirmed the presence of two locations (sites 114(201) and 205) where hydric soils and/or primary hydrology indicators of wetland are present. The presence of wetland is very localised to the drainage channel in that general area, as marked in **Figure 1**.

All other twenty-eight (28) test locations showed no sign of primary or secondary hydric soils or hydrology characteristics, due principally to their position within the landscape on slightly higher ground. It was also noted that several areas, particularly away from the old drain (e.g. around 204, 206) appear to be quite modified by prior activities.

There is evidence of fill (clay within topsoil) and also tyres from a silage pit. It is suspected (but not confirmed) that the farmer used the elevated race to the north to bring silage or topsoil for storage into this area. We are not sure whether the bunker was natural or cut out for silage operations, but either way the area is already heavily modified. The large scale of Retrolen photos at decadal intervals from 1940 to 1990 are not of any assistance in addressing this.

7. References

Landcare Research, 2018. Hydric soils – field identification guide. Consultancy report prepared for Tasman District Council under Envirolink Grant: C09X1702. June 2018.

MfE, 2021. Wetland delineation hydrology tool for Aotearoa New Zealand. Published in July 2021 by the Ministry for the Environment. ISBN: 978-1-99-003362-9. Publication number: ME 1575.

Edbrooke, S. W. (compiler), 2011. Geology of the Auckland area. Institute of Geological and Nuclear Sciences 1:250,000, geological map 3.

Appendix A. Hydric Soil and Hydrology Tool Test Sheets

Table A1. Summary of hydrology tool site findings.

Indicator		Group 1: Observation of flooding or groundwater			Group 2: Evidence of flooding or ponding												Group 3: Evidence of current or recent soil saturation						Group 4: Evidence from other site conditions or data				
		1A: Surface water	1B: Ground-water	1C: Soil saturation	2A: Water marks	2B: Sediment deposits	2C: Drift deposits	2D: Agal mat or crust	2E: Iron deposits	2F: Surface soil cracks	2G: Inundation visible on aerial imagery	2H: Sparsely vegetated concave surface	2I: Salt crust	2J: Aquatic invert-ebrates	2K: Water-stained leaves	2L: Drainage patterns	3A: Hydrogen sulphide odour	3B: Oxidised rhizo-spheres along living roots	3C: Red-uced iron	3D: Recent iron reduction in tilled soils	3E: Dry-season water table	3F: Saturation visible on aerial imagery	4A: Stunted or stressed plants	4B: Geo-morphic position	4C: Shallow aquitard	4D: Facul-tative-neutral test	4E: Frost-heave humm-ocks
	Prim.	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓			✓				
Site	Sec.														✓	✓					✓	✓		✓	✓	✓	✓
101		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
102		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
103		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
104		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
105		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
106		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
107		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
108		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
109		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
110		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
111		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
112		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
113		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
114		×	✓	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×	×	×
115		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
116		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
117		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
118		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
119		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
120		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
201		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
202		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
203		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
204		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
205		×	✓	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	✓	×	×	×
206		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
207		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
208		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
209		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×
210		×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×	×

Appendix B. Soil Logs and Photos

Soil Description	Test Pit
101 0-22cm Clayey SILT: Medium Brown. Loose, dry. Minor rootlets. (Topsoil) 10YR Topsoil – 4/3	
22-100cm Clayey SILT: Brown/orange. High plasticity (Puketoka Formation) 10YR Clay – 7/4 & 6/2	

102 0-20cm Clayey SILT: Medium Brown. Moist. Minor rootlets. (Topsoil) 10YR Topsoil – 5/3	
20-100cm Clayey SILT: Orange. High plasticity (Puketoka Formation) 10YR Clay – 7/6	

103 0-25cm Clayey SILT: Medium Brown. Moist. Minor rootlets. (Topsoil) 10YR Topsoil – 4/3	
25-100cm Clayey SILT: Orange diffusing to grey. High plasticity (Puketoka Formation) 10YR Clay – 6/6	

104 0-20cm Clayey SILT: Medium Brown. Moist. Minor rootlets. (Topsoil) 10YR Topsoil – 4/4	
20-100cm Clayey SILT: Orange/grey. High plasticity (Puketoka Formation) 10YR Clay – 7/5	

105 0-20cm Clayey SILT: Medium Brown. Moist. Minor rootlets. (Topsoil) 10YR Topsoil – 3/3	
20-100cm Clayey SILT: Orange diffusing to grey. High plasticity (Puketoka Formation) 10YR Clay – 7/3	

106 0-20cm Clayey SILT: Medium Brown. Loose, dry. Minor rootlets. (Topsoil) 10YR Topsoil – 4/4	
20-100cm Clayey SILT: Orange diffusing to grey. High plasticity (Puketoka Formation) 10YR Clay – 7/6 & &/3	

107 0-18cm Clayey SILT: Medium Brown. Loose, dry. Minor rootlets. (Topsoil) 10YR Topsoil – 3/4	
18-100cm Clayey SILT: Orange diffusing to grey. High plasticity (Puketoka Formation) 10YR Clay – 7/6 & 8/3	

108 0-20cm Clayey SILT: Medium Brown. Loose, dry. Minor rootlets. (Topsoil) 10YR Topsoil – 3/3	
20-100cm Clayey SILT: Orange diffusing to grey. High plasticity (Puketoka Formation) 10YR Clay – 7/3	

109 0-23cm Clayey SILT: Medium Brown. Loose, dry. Minor rootlets. (Topsoil) 10YR Topsoil – 3/3	
23-100cm Clayey SILT: Orange diffusing to grey. High plasticity (Puketoka Formation) 10YR Clay – 7/6 & 6/1	

110 0-27cm Clayey SILT: Medium Brown. Moist. Minor rootlets. (Topsoil) 10YR Topsoil – 4/3	
27-100cm Clayey SILT: Orange diffusing to grey. High plasticity (Puketoka Formation) 10YR Clay – 6/2	

111 0-25cm Clayey SILT: Medium Brown. Loose, dry. Minor rootlets. (Topsoil) (Topsoil) 10YR Topsoil – 3/3	
25-100cm Clayey SILT: Orange diffusing to grey. High plasticity (Puketoka Formation) 10YR Clay – 6/2	

112 0-18cm Clayey SILT: Medium Brown. Moist. Minor rootlets. (Topsoil) 10YR Topsoil – 3/3	
18-100cm Clayey SILT: Orange diffusing to grey. High plasticity (Puketoka Formation) 10YR Clay – 6/4	

113 0-23cm Clayey SILT: Medium Brown. Moist. Minor rootlets. (Topsoil) 10YR Topsoil – 4/3	
23-100cm Clayey SILT: Grey. High plasticity (Puketoka Formation) 10YR Clay – 7/3	

114 0-10cm Clayey SILT: Dark Brown. Moist. Minor rootlets. (Topsoil) 10YR Topsoil – 3/2 Subsoil – 8/1	
10-80cm SOIL: Black. Moist. Minor rootlets. (organic rich soil) 80-100cm Clayey SILT: Grey. High plasticity (Puketoka Formation) 10YR Clay – 6/1	

115 0-28cm Clayey SILT: Medium Brown. Loose, dry. Minor rootlets. (Topsoil) 10YR Topsoil – 3/3	
28-100cm Clayey SILT: Orange/grey. High plasticity (Puketoka Formation) 10YR Clay – 7/4	

116 0-20cm Clayey SILT: Orange/brown. Loose, dry. Minor rootlets. (Topsoil) 10YR Topsoil – 3/4	
20-70cm Clayey SILT: Orange/brown. High plasticity. (Puketoka Formation) 80-100cm Clayey SILT: Grey. High plasticity (Puketoka Formation) 10YR Clay – 5/6	

117 0-20cm Clayey SILT: Medium Brown. Loose, dry. Minor rootlets. (Topsoil) 10YR Topsoil – 4/3	
20-100cm Clayey SILT: Grey. High plasticity (Puketoka Formation) 10YR Clay – 6/3	

118 0-23cm Clayey SILT: Medium Brown. Loose, dry. Minor rootlets. (Topsoil) 10YR Topsoil – 5/4	
23-100cm Clayey SILT: Grey. High plasticity (Puketoka Formation) 10YR Clay – 6/4	

119 0-24cm Clayey SILT: Medium Brown. Loose, dry. Minor rootlets. (Topsoil) 10YR Topsoil – 4/3	
24-100cm Clayey SILT: Grey. High plasticity (Puketoka Formation) 10YR Clay – 6/1	

120 0-18cm Clayey SILT: Medium Brown. Loose, dry. Minor rootlets. (Topsoil) 10YR Topsoil – 3/3	
18-100cm Clayey SILT: Grey. High plasticity (Puketoka Formation) 10YR Clay – 6/2	

201 [duplicate of site 114] 0-10 cm Clayey SILT: Dark Brown. Moist. Soft and fibrous. (Topsoil) 10-450 cm Organic TOPSOIL: Black. Moist. Minor rootlets. (Topsoil) – 2/1	
202 0-45 cm. TOPSOIL: Dark yellowish brown. Clayey Silt. 45-55 cm. CLAY: Light yellowish brown / orange grey clay. Moderately Mottled. 10YR – Topsoil – 4/4 Clay – 6/4	

203 0-50 cm. TOPSOIL: Dark brown clayey silt. 50 cm. CLAY: Grey lightly mottled. 10YR – Topsoil – 3/3 Clay – 6/1	No photo
204 0-30 cm. TOPSOIL: Dark brown clayey silt, with clay fill nodules (100 mm). Disturbed ground. Dry. 10YR - Topsoil – 4/3	

205 0-10 cm. TOPSOIL. Very dark brown. Spongy and fibrous. 10-750 mm. Dark brown-black silty organic rich soil. Water table encountered at 650 mm – rapid seepage. 10YR – Topsoil – 2/2	

206 0-30 cm. TOPSOIL. Dark yellowish brown clayey silt. Clay nodule inclusions. Disturbed ground (potential fill). 10YR – Topsoil – 4/4	
207 0-30 cm. TOPSOIL. Dark brown clayey silt. 10YR – Topsoil – 3/3	

208 0-30 cm. TOPSOIL. Brown clayey silt. 10YR – Topsoil – 4/3	
209 0-30 cm. TOPSOIL. Dark brown clayey silt. 10YR – Topsoil – 3/3	

210 0-30 cm. TOPSOIL. Dark brown clayey silt. 10YR – Topsoil – 3/3	

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