Whenuapai Wastewater Servicing Scheme Package 2 – Massey Connector and Northern Interceptor Phase 2

Ecological Impact Assessment

Prepared for Watercare Services Ltd
Prepared by Beca Limited

29 August 2023

Contents

Appendices

Appendix 1 – Ecological Impact Assessment (EIANZ methodology)

Appendix 2 – Potential Wetlands and Plot Locations

Appendix 3 – Wetland Delineation Plot Results

Appendix 4 – Borehole 1 and 2 Logs

Appendix 5 – Ecological Constraints Assessment

Revision History

Revision Nº	Prepared By	Description	Date
1	Kimberley D'Souza	Draft for Internal Review	21/07/2023
2	Kimberley D'Souza	Draft for Client Review	26/07/2023
3	Kimberley D'Souza	Final for Lodgement	30/08/2023

Document Acceptance

Action	Name	Signed	Date
Prepared by	Kimberley D'Souza		30/08/2023
Reviewed by	Claire Webb		30/08/2023
Approved by	Jenny Vince		30/08/2023
on behalf of	Beca Limited		

Executive Summary

The Whenuapai Wastewater Servicing Scheme is required to accommodate growth in the North West region of Auckland. The scheme will be delivered in three service packages to match the growth in the area.

This Ecological Impact Assessment (EcIA) has been prepared to support the resource consent application(s) for Whenuapai Wastewater Servicing Scheme Package 2 – Massey Connector and Northern Interceptor Phase 2 (the Project). Package 2 relates to the installation of an approximately 4 km of wastewater pipeline between 32 Mamari Road, Whenuapai and the existing Hobsonville Pump Station at 2A Buckley Avenue, Hobsonville.

The Package 2 project corridor is located within the Whenuapai and Hobsonville areas. Several watercourses are located within the project corridor, including the upper section and tributaries of the Waiarohia Stream. The Waiarohia Stream has a relatively large catchment area, at approximately 280 ha, and is a permanent channel fed by several named and unnamed tributaries. The main Waiarohia Stream channel, as well as some of the tributaries, have undergone significant modifications as a consequence of rural and urban land use change. Additionally, several low-value wetlands have been identified across the project area, this includes several riverine wetlands associated with the Waiarohia Stream, Trig Stream, and an overland flow pathway, as well as a palustrine marsh wetland with the farmland at the location of the Break Pressure Chamber (BPC).

The Project will be constructed by trenchless methods via a Tunnel Boring Machine (TBM) and will include temporary works to install the pipeline as well as the construction of additional shafts to launch or receive the TBM (in addition to the three permanent shafts and BPC), construction yards/laydown areas at each shaft site, and a temporary access road.

The key potential adverse ecological effects of the proposed works relate primarily to construction activities and includes:

- Degradation of riverine and palustrine wetland systems.
- Potential effects on wetland and stream hydrology from temporary groundwater depletion.
- Degradation of aquatic habitat quality during construction.
- Potential disturbance, injury, and/or mortality of native fauna.
- Removal of riparian vegetation to enable construction.

Within this report, various measures have been recommended during the construction phase to avoid and mitigate adverse effects. With these measures in place, the overall ecological effect of the project is assessed as **Low**, with no residual effects anticipated. The recommendations include:

- The implementation of sediment and erosion control measures during construction in general accordance with GD05.
- Vegetation clearance to occur outside of the bird nest season (August to January) as far as practicable.
- An initial pre-survey for herpetofauna within areas of vegetation clearance, including groundcover clearance. Depending on the findings of the survey, lizard salvage and relocation guided by a Lizard Management Plan may be required.
- An initial tree risk roost survey and pre-survey for long-tailed bats within areas of tree clearance. Should bat activity be detected, a Bat Management Plan will be required.
- Re-vegetation of riparian margins of watercourses and wetlands with eco-sourced native species, appropriate to the site.

1 Introduction

Watercare Services Ltd (Watercare) are currently designing and implementing the Whenuapai Wastewater Servicing Scheme. The scheme is required to accommodate growth in the North West region of Auckland and will be delivered in three service packages to match the growth in the area.

This Ecological Impact Assessment (EcIA) has been prepared by Beca Ltd (Beca) to support the resource consent application(s) for the Whenuapai Wastewater Servicing Scheme Package 2 – Massey Connector and Northern Interceptor Phase 2 (the Project). Package 2 involves the installation of approximately 4 km of wastewater pipeline between 32 Mamari Road, Whenuapai and the existing Hobsonville Pump Station at 2A Buckley Avenue, Hobsonville.

1.1 Purpose and Scope

In October 2021, Beca carried out a high-level Ecological Constraints Assessment to identify ecological features within 100 m of the works area and potential ecological constraints for the Package 2 works (Appendix 5).

The purpose of this EcIA is to build on the Constraints Assessment and provide an assessment to determine the values and potential ecological effects of project works and sets out methods to manage adverse ecological effects. The scope of tasks undertaken includes:

- A desk-based review of previous documentation and publicly accessible records/reports/information.
- A site walkover of the pipeline alignment and site surveys of previously identified ecological features within the constraints report. Site surveys included investigations of potential wetland areas and stream classifications.
- An assessment of ecological values in the works area.
- An assessment of the ecological effects of the proposed project activities.
- To identify and recommend management measures to avoid and/or minimise adverse ecological effects.

1.2 Project Purpose and Description

The Package 2 project (the Project) involves the installation of approximately 4 km of wastewater pipeline between 32 Mamari Road, Whenuapai and the existing Hobsonville Pump Station at 2A Buckley Avenue, Hobsonville. This pipeline will provide additional wastewater servicing capacity to accommodate growth in the North West region of Auckland.

The Project includes the following four key components (see Figure 1):

1. A **break pressure chamber (BPC)** located on the corner of Mamari and Spedding Roads which connects to the Package 1 works[1].
2. The **Massey Connector,** a gravity pipeline (approximately 1km long and 1800mm in diameter) between the BPC and the Northern Interceptor at 27 Trig Road, Whenuapai.
3. Phase 2 / Stage 1 of the **Northern Interceptor**, comprising of a new gravity tunnel (approximately 2.8km long and 2100mm in diameter), which will run adjacent to SH18 between 27 Trig Road, Whenuapai, and 2 Buckley Avenue, Hobsonville.

[1] The location of the BPC chamber has been influenced by the alignment of Package 1 works and has therefore been designated as part of the Package 1. Detailed design for the BPC has been completed as part of 'Package 2' and therefore regional resource consents are sought as part of this consenting package.

4. A **pump station connection** (approximately 40 m in length, and 800 mm in diameter), between the Northern Interceptor and the Hobsonville Pump Station
5. **Three permanent shafts** along the Northern Interceptor alignment.

For the purposes of this assessment, the Project also includes construction activities for, three temporary shafts (in addition to the three permanent shafts and BPC), construction yards/laydown areas at each shaft site, and a temporary access road. The alignment of the Northern Interceptor, pump station connection, all shaft sites and construction yards, and the majority of the access road are located within Designation 9377 (North Harbour No. 2 Watermain and Northern Interceptor Shared Corridor). The Massey Connector, and two portions of access road which connect to Westpoint Drive, will be located outside of the designation.

This report assesses the effects in relation to the ecological features present within and within proximity to the proposed works.

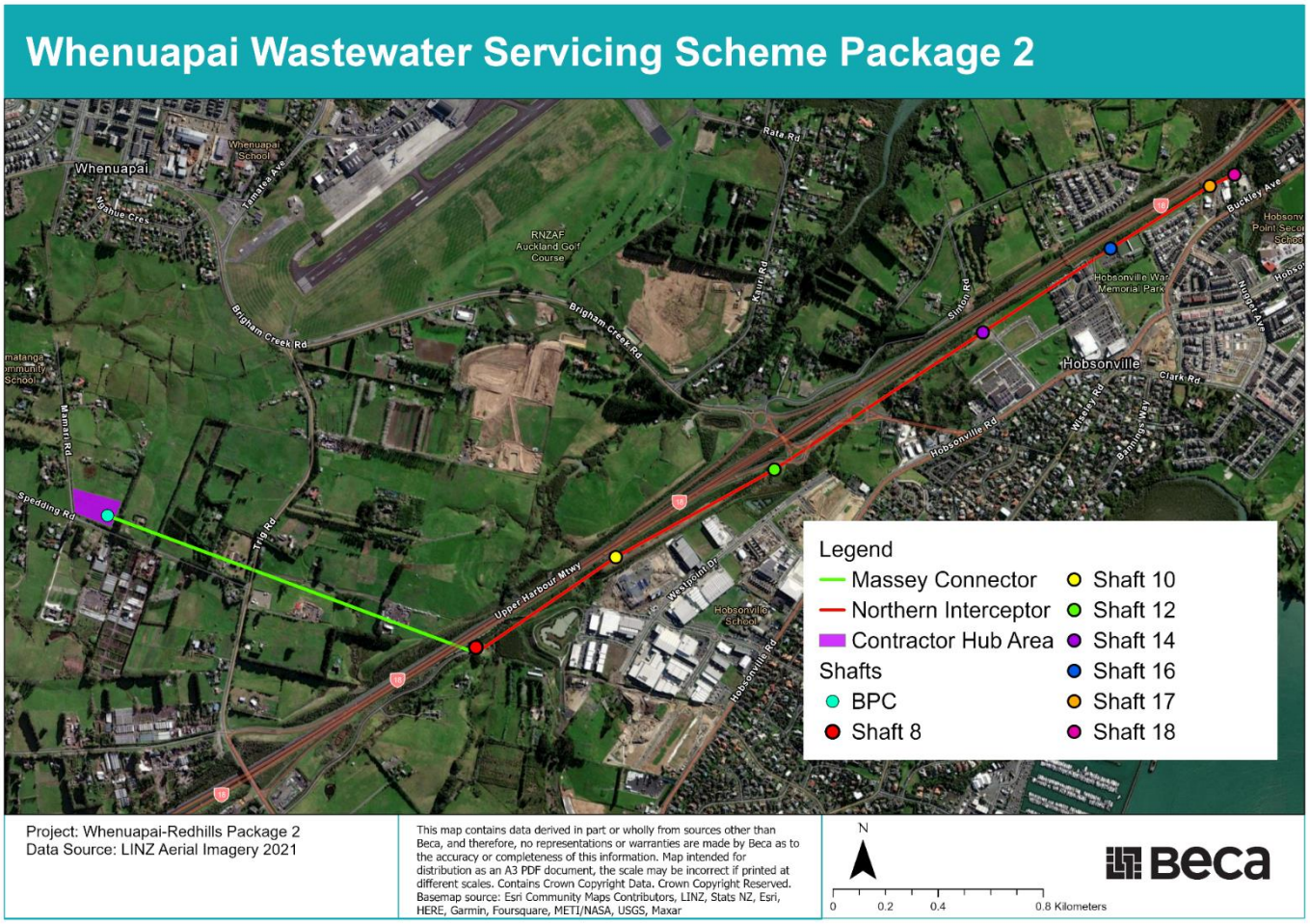


Figure 1. The Whenuapai Wastewater Servicing Scheme Package 2 overview.

2 Methodology

2.1 Desktop Review

A desk-based study was undertaken using ecological information from the following sources:

- Auckland Council Geomaps: aerial photography (2022), and geospatial layers including Significant Ecological Areas, current ecosystem extent, catchment, and hydrology.
- New Zealand Freshwater Fish Database (NZFFD): (McDowall & Richardson, 1983).
- eBirds: (Sullivan et al., 2009).
- The Tree Consultancy Company, 2022. *Arboricultural Assessment of Effects at 27 Trig Road Whenuapai and 19 Westpoint Drive Hobsonville.* Prepared for Beca Limited.
- Mott MacDonald, 2022. *Northern Interceptor Phase 2 Westgate to Hobsonville: Geotechnical Interpretive Report Massey Connector Section (Geotechnical Interpretive Report).*
- Beca Limited, 2021. *Whenuapai-Redhill's Package 2 – Ecological Constraints Assessment*.
- Tonkin & Taylor, 2023. *Groundwater and Settlement Effects Assessment.*
- iNaturalist and Department of Conservation (DOC) records for avifauna, herpetofauna, and bats.

2.1.1 Potential wetland identification

Desktop screening for areas of 'potential wetlands' was undertaken using ecological information from the following sources:

- Google Earth and LINZ aerial photography
- Auckland Council geospatial layers
- Retrolens historical imagery
- Freshwater Ecosystems of New Zealand (FENZ) historic wetland typology geospatial layer (Leathwick et al., 2010)

The topography and underlying geology across the pipeline alignment was first examined using contours, modelled overland flow paths and S-Map to understand where 'wet' areas might be located. The site was then examined for any predicted (prehuman arrival) wetland extents as modelled by Ausseil et al., 2008 and shown in FENZ geospatial layers (Leathwick et al., 2010). Subsequently, recent aerial imagery from Google Earth and Retrolens were visually inspected for wetland features. The photography was analysed for hydrophytic plant communities using visual cues such as colour, shape, texture, and location. Particular attention was also paid to low stature vegetation which may be indicative of rushlands, and sharp changes in vegetation composition. The aerial imagery was also explored for any evidence of inundation (a primary indicator of wetland hydrology), and soil saturation (a secondary indicator of wetland hydrology).

This information is used to inform the scope of field investigations needed to confirm wetland characteristics and condition to enable an assessment of ecological values and fulsome description of wetland ecosystem types.

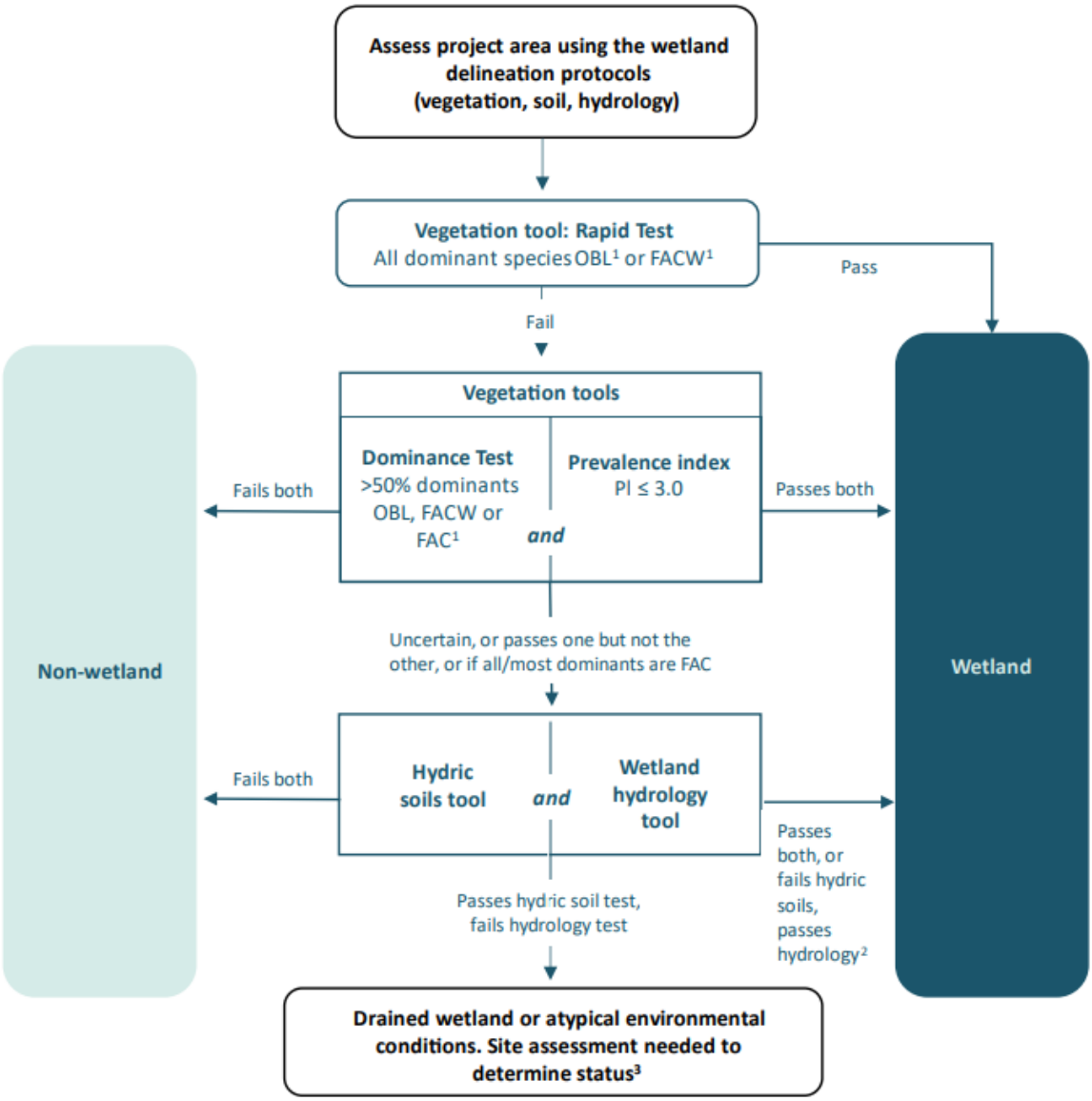


Figure 2. Wetland delineation protocols for determining hydrophytic vegetation (Ministry for the Environment, 2022b).

2.1.2 Stream identification

Potential watercourses within proximity to the pipeline alignment were screened using the catchment and hydrology layers on Auckland Council Geomaps. This included examining the contours, rivers and permanent streams, and overland flow pathway layers.

Once these potential watercourses were identified, they were examined in more detail to confirm their location. This was done using historical aerial imagery from Retrolens and Auckland Council Geomaps. Particular attention was paid to the presence of water flow pathways, defined channels within the landscape, and visual cues of water present.

This information is used to inform the scope of field investigation needed to confirm stream characteristics and condition to enable an assessment of ecological values and a fulsome description of each watercourse.

2.2 Field Investigations

Following the desktop review, the first site visit was undertaken on 22nd September 2022 to conduct freshwater and terrestrial habitat assessments including assessing and delineating areas of potential wetlands (refer to Ecological Constraints Assessment – Appendix 5), identifying, and classifying watercourses, as well as surveying and evaluating other ecological features. Weather during the site visit was cloudy and sunny, and there was approximately 9.3 mm of rainfall within the previous 72 hours.

Following this, a second site visit was undertaken on 17th July 2023 to undertake a wetland delineation survey at only Shaft 8, where a potential natural inland wetland was identified due to the high rainfall events experienced in Auckland over the last 7-8 months. Weather during the site visit was sunny, and there had been approximately 75 – 80 mm of rainfall in the month prior (Auckland Council, 2023). This rainfall record is considered to be normal over the winter and generally wetter season, however, the high rainfall events recorded earlier in 2023 are not considered normal conditions.

Location of Ecology Surveys

For the purpose of this report, the pipeline alignment route has been separated into four different areas where ecological surveys were carried out. These areas were identified from the information gathered in the Ecological Constraints Assessment (Appendix 5).

These four locations are stated below and are shown on Figure 3:

1. BPC (32 Mamari Road).
2. Shaft 8 (27 Trig Road);
3. Shaft 12 (motorway shoulder adjacent to 19 Westpoint Drive); and
4. Shaft 14 (4 Sinton Road)

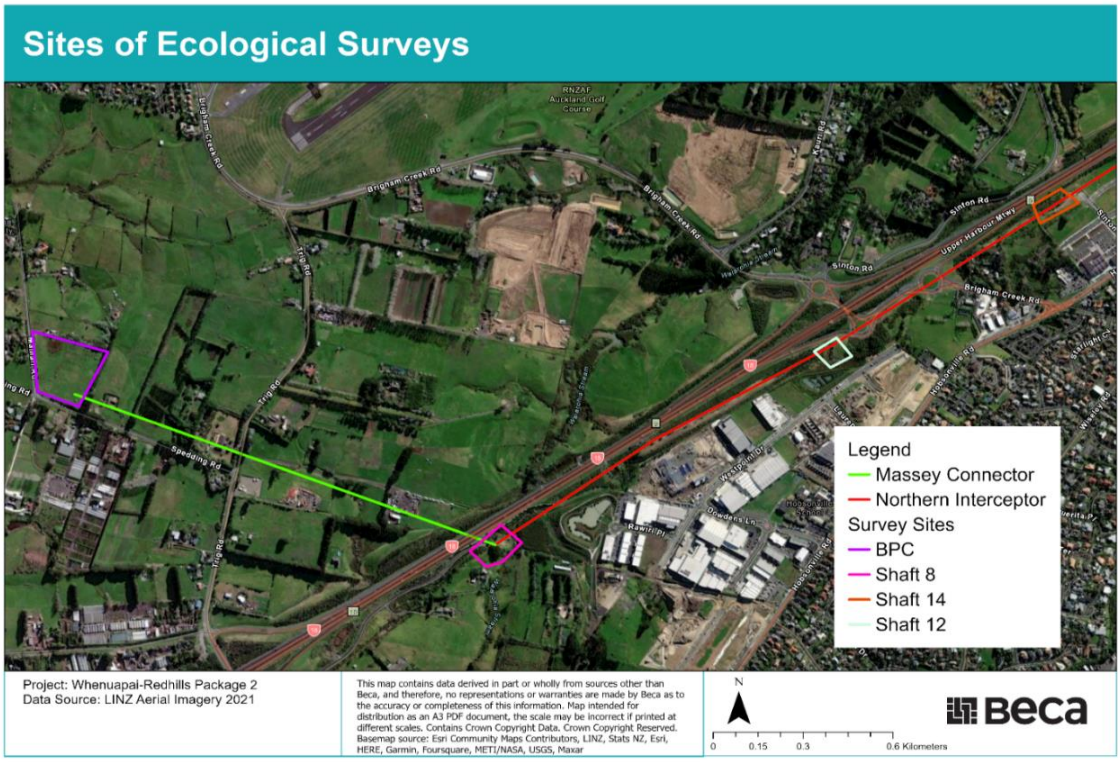


Figure 3. Locations of the ecological surveys along the Northern Interceptor and Massey Connector route.

2.2.1 Wetland Delineation

During both site visits an assessment of any potential wetland areas within 100 m of proposed earthworks was undertaken in accordance with the New Zealand Wetland Delineation Protocols and current Ministry for the Environment guidance in order to classify wetlands and delineate extent where necessary (Clarkson, 2018; Ministry for the Environment, 2022b). The location of the wetland plots can be seen in Appendix 2.

Detailed investigations were not deemed necessary where an area was dominated by pasture species (> 50%) and/or only contained a few very scarce rushes amongst pasture vegetation. More detailed investigations were undertaken where non-pasture vegetation was identified, which includes facultative, facultative wetland, and obligate vegetation types, covered an area greater than 2m x 2m and where there were other landscape clues (such as minor depressions in the landscape) that could suggest that wetland hydrology could be present. To delineate the wetland boundary adjacent to the works area, a suspected boundary was determined using visual clues such as changes in topography and vegetation. Where boundaries were unclear, several sample plots were established to help substantiate the boundary location where possible.

Vegetation assessment

Topography across the pipeline alignment remains relatively flat. Where areas of wetland vegetation were identified, and the area did not pass the rapid test, several vegetation plots were established both within and on the estimated extent of the wetland. Within the wetland areas, vegetation plots were deployed in areas of representative vegetation types to determine the dominance of hydric vegetation as well as to provide a representative sample of vegetation composition.

Due to the time constraints of the field surveys quick visual assessments were generally relied upon in areas that were very clearly dry pasture or had no wetland vegetation. Where vegetation was inconclusive and there were signs of wetland hydrology (i.e., ponding/pugging), wetland delineation protocols were applied.

Soil samples and hydrological assessment

Soil test pits were dug to ~30 – 50cm depth at all the locations of the vegetation plots. Soil composition/type (i.e. sand, clay), and presence of mottles or other features of note were recorded and interpreted in accordance with Fraser et al. (2018).

Presence of surface water, soil saturation and presence of ground water in test pits, as well as other hydrology indicators were recorded at each plot in line with the Wetland Delineation Hydrology Tool for Aotearoa New Zealand (Clarkson, 2018; Ministry for the Environment, 2022a).

2.2.2 Watercourse classification

During the site visits, an assessment of watercourse and catchment characteristics was undertaken to classify the watercourse present within proximity to the proposed pipeline route. This classification was undertaken in accordance with the Auckland Unitary Plan Practice and Guidance Note – River/Stream Classification document (Auckland Council, 2021). Watercourse classifications are best undertaken during the wet season, between July and October, when ecological function difference between ephemeral and intermittent streams can be most accurately assessed (Auckland Council, 2021).

The definitions of rivers or streams is considered to be:

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

Table 1. AUP:OP criteria for permanent, intermittent, and ephemeral watercourses (Auckland Council, 2021).

Criterion	Definition
Permanent river or stream	
1	Evidence of continuous flow
Intermittent river or stream,	
Ceases to flow when bed is above water table. To be intermittent, a river must exhibit at least three of the following	
1	Evidence of natural pools
2	Well defined channel. Banks and bed can be distinguished
3	Surface water present (more than 48hrs after a rain event)
4	Rooted terrestrial vegetation not present across the entire cross-sectional width of channel
5	Organic debris present in floodplain
6	Evidence of substrate sorting processes, including scour and deposition
Ephemeral stream	
1	Stream bed above the water table at all times.
2	Water present only during and shortly after rain fall

2.2.3 Vegetation assessments

Terrestrial habitat assessments were undertaken to capture the species composition and ecological value of terrestrial vegetation across the project site, as well as the suitability of vegetation to support habitat for terrestrial fauna.

2.3 Analysis of Field Data

2.3.1 Wetland data analysis

The analysis of the data collected during the wetland surveys was undertaken using the New Zealand Wetland Delineation Protocols and Ministry for the Environment Wetland delineation protocols (Clarkson, 2018; Ministry for the Environment, 2022b).

When applying the vegetation tests, a dominance test score of 50% and a prevalence index value of 2.9 –3.1 is considered to be marginal, and the assessment is considered along with other indicators of wetland conditions such as soil and hydrology. Where hydric soils and hydrological indicators were present in proximity to the vegetation plot and there were no notable gradient changes, then the marginal vegetation results are interpreted as a positive for a wetland.

2.3.2 Wetland extent and boundary mapping

Where possible, a preliminary feature boundary was determined using current vegetation extents on using aerial photography (Google Earth and Auckland Council Geomaps). The preliminary feature boundary is then ground-truthed during the site visit using visual clues such as changes in topography, vegetation, soil and hydrological indicators.

The preliminary feature boundary is refined based on contours, vegetation plots (where appropriate), soils and hydrology information gathered during field investigations and represents the spatial extent of wetland ecosystem.

The wetland boundary is not an exact surveyed extent as wetlands exhibit a gradation in vegetation, hydrology and soils and the precise location of the boundary occurs within a margin of approximately 10 m depending on topography The wetland boundary may be further refined to represent the spatial extent of the wetland ecosystem that meets the NPS-FM definition of a natural inland wetland (if any) (Ministry for the Environment, 2020).

2.3.3 Wetland description and classification

Wetland characteristics, composition, function and condition are described in accordance with relevant ecological literature. Wetland class and type are determined using Johnson and Gerbeaux classification guidelines (Johnson & Gerbeaux, 2004a). This provides ecological context regarding significance and value of wetland ecosystems.

2.4 Assessment Methodology

An assessment of ecological effects was undertaken in accordance with Ecological Impact Assessment (EcIA) EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems.

The EIANZ guidelines set out a methodology to assign ecological value to species and ecosystems based on four assessment criteria which are consistent with significance assessment criteria set out in the Proposed National Policy Statement for Indigenous Biodiversity (2019) Appendix 1: Criteria for identifying significant indigenous vegetation and significant habitat of indigenous fauna. These are reproduced in this report as Appendix 1: Tables 1.1-1.4. In summary:

- Attributes are considered when considering ecological value or importance. They relate to matters such as representativeness, the rarity and distinctiveness, diversity and patterns, and the broader ecological context.
- Determining Factors for valuing terrestrial species; terrestrial species span a continuum of very high to negligible, depending on aspects such as whether species are native or exotic, have threat status, and their abundance and commonality at the site impacted.
- Ecological Values are scored based on an expert judgement, qualitative and quantitative data collected.

Once ecological values have been identified and valued, the severity of potential impacts is assessed by determining the change from baseline ecological values likely to occur as a result of the proposal along the lines of a magnitude of effect as determined by the criteria set out in Appendix 1:Table 1.5.

Finally, once these two factors have been determined (the ecological value and the magnitude of effect), an overall level of effect on each of the identified ecological values is determined by applying the matrix shown in Appendix 1:Table 1.6.

3 Wetland Classification and Delineation

Modelling of the wider Auckland area indicates that there are very few wetland classes present within the region and mainly consists of swamps. This is largely due to the significant land use modification that has occurred across the Auckland region, which has reduced wetland to just 4.6% of its historic extent (Ausseil et al., 2008a) The Hobsonville and Whenuapai area have undergone significant land modification and were originally mainly used for agricultural and horticulture. In the historical aerial imagery of the surrounding area distinct watercourse pathways can be identified, however, in the present day it is likely that a majority of these watercourses have been converted for rural and/or residential use.

A desk-based review of publicly available ecological information identified the presence of several potential *natural inland wetland* under the NPS:FM (2022) within 100 m of the proposed alignment route (refer to Appendix 2).

The following two sections details the survey findings from the wetland delineations carried out at the location of the BPC and Shaft 8 (Refer to Appendix 2 for location of proposed wetlands and survey plot locations, and Appendix 3 for survey plot data).

3.1 Break Pressure Chamber Site

During the first site visit (22/09/2022) wetland delineation surveys were conducted at the BPC site where a temporary construction area, a shaft, and the permanent BPC are proposed for construction.

3.1.1 Historic land-use and landforms

Within the BPC site, historical imagery indicates the land has been converted for rural use since at least 1940 and surveying of these images identified no defining features that would indicate that there are historic wetlands or watercourses (Figure 4 and Figure 5). Aerial imagery from Auckland Council Geomaps database indicates that between 2015 to 2017 the land was utilised for crop growth and harvesting, however, presently the land appears to be unused.

Figure 4. Aerial imagery of the BPC site from 1963. Yellow outline is the property boundary (Source: Retrolens).

Figure 5. Aerial imagery of the BPC site from 1940. Yellow outline is the property boundary (Source: Retrolens).

3.1.2 Vegetation

Vegetation within the BPC site is highly modified and comprises of mainly exotic grasses and rushes.

Vegetation surveys were carried out as part of the Wetland Delineation Protocol (Ministry for the Environment, 2022a) (WDP). The vegetation was relatively similar within the northern section and the southern section (refer to Appendix 2 for outline of Northern and Southern Sections) but varied considerably between these two sections. As such, five vegetation plots were conducted across the site, and survey plots were chosen based on their overall representativeness of the wider section.

Within the plots carried out across the wider site, only one hydrophytic species was identified, soft rush (*Juncus effusus*), which was scattered in variable cover percentages. Some of these patches of soft rush were localised in slightly lower-lying areas, where ponding occurred during rainfall events. No other facultative wetland or obligate species were observed within the potential wetland areas and the wetland plot surveyed (Appendix 2 and 3).

Vegetation extents are expected to expand, and contract based on seasonal variations and land use practices. Therefore, during the drier summer months, vegetation communities on the site could differ compared to the wetter winter months.

There is a distinctive change in vegetation between the northern and southern sections. These changes are described in more detail below. Details from the vegetation plot are included in Appendix 2.

Northern Section (Plot 1)

The northern section of the site is located in a slightly lower-lying area in comparison to the southern section (approximately 1 m) as indicated in the available topographic desktop map. As a result of this, it is likely that the northern section will receive more surface water flows during high precipitation events. This slight change in elevation is expected to be the main factor in vegetation differences observed between the northern and southern portion of the property. The northern portion of the property had overall lower species diversity with mainly creeping buttercup (*Ranunculus repens*) and soft rush present, with areas of bare and boggy ground (likely due to recent rainfall) (Figure 6).

Southern Section (Plots 2 – 5)

The southern section of the property has a more diverse range of flora, in comparison to the northern section (Figure 7). Vegetation included pampas (*Cortaderia selloana*), kikuyu (*Cenchrus clandestinus*), Yorkshire fog (*Holcus lanatus*), willowherb (*Epilobium hirtigerum*), greater birdsfoot trefoil (*Lotus corniculatus*), red clover (*Trifolium pratense*), creeping buttercup, and soft rush. Aside from soft rush, which is a facultative wetland (FACW) species, the rest of the species identified are either facultative (FAC) or facultative upland (FACU) species and as such, are tolerant to a variety of soil and hydrological conditions arising from seasonal patterns.

Vegetation Plots Summary

The vegetation plot results indicate that all plots within the site failed the rapid test, passed the dominance test except for Plot 1, and fell within the range of uncertainty for the prevalence test (Appendix 3). This uncertainty is likely due to the dominance of facultative species across the site (mainly creeping buttercup and Yorkshire fog) which are tolerant of a range of seasonal fluctuations. As the topography of the site is relatively flat, with only a small change in elevation between the northern and southern site, it is expected that the lower-lying region of the northern site increases water ponding during high rainfall events from surface water runoff from the southern site. In addition to this, it is likely that the groundwater table is closer to the surface. This also explains the dominance of creeping buttercup and general absence of facultative

wetland and obligate vegetation types within the northern site. As during the winter periods, higher rainfall events would result in more surface ponding, which was observed during the site visit, whilst during the warmer seasons, the lack of rainfall would see the area remain relatively dry. This seasonal variability has likely limited the ability for more wetland-suitable vegetation to establish and successfully survive.

Therefore, as the vegetation test for Plots 2 – 5 was uncertain and failed for Plot 1 (see Appendix 3 for overall results), following the hierarchy of the WDP, soil tests and hydrology tests were undertaken at the BPC site.

Figure 6. Vegetation communities identified within the northern section of the BPC site (22/09/2022).

Figure 7. Vegetation communities identified within the southern section of the BPC site (22/09/2022).

3.1.3 Soils

Shallow soil investigations were carried out as part of the WDP throughout the site and results found typically non-hydric soils (high chroma, high organic content, and silt-sand based), which is typical for pasture-dominated landscapes (refer to Figure 8).

To support the assessment of soils, geological information was sourced from the Geotechnical Interpretive Report for 32 Mamari Road (Mott MacDonald, 2022). This report indicates that the Whenuapai and Hobsonville area consist of Puketoka Formation, which is a relatively early formation and is comprised of "*pumiceous riverine and estuarine deposits with interbedded lenses of alluvial pumiceous mud, sand and gravel derived from volcanic ash and tuff, with muddy peat and lignite (estuarine). Main soil types of Puketoka Formation are generally silts and clays, and silty/clayey sands for which the density and thickness can vary considerably across the region. Organic soils and coarse-grained deposits represent lesser but still significant portions of Puketoka Formation"* (Mott MacDonald, 2022).

Northern Section

Soils within the northern section of the property were highly saturated and a high-water table was observed upon digging the test pit, which immediately filled with water (Figure 8). This is likely indicative of either a high or perched groundwater table, which is expected during the winter season (Mott MacDonald, 2022). Soil composition is mainly comprised of sandy silt with minor clay components and a high chroma. The highly saturated soils observed during the soil investigations is likely due to the moderate rainfall events experienced during the days prior, as well as due to the generally high rainfall events experienced throughout the Auckland region over the 2022 winter period.

The soil investigations carried out within the northern section of the BPC site did not uncover any soils that would typically be considered hydric. However, while the soil consistency was fluid and saturated this is likely due to the recent rainfall as well as heavier rainfall periods that have occurred in the weeks prior. It is highly likely that during the summer season this area would become highly dry.

Southern Section

Soil properties within the wetland plots from the southern section of the property were similar to the northern section. Surveys from the southern section identified soils which were largely indicative of non-hydric properties including high chroma, silt/sand based with some orange deposits (Figure 8). The soil was moist however, not saturated and the slight wetness is likely due to recent rainfall.

Bore-hole logs from within the southern section of the BPC (Figure 9) indicate that between 0 – 2.7 m below ground soil types consist of mainly silt, silty-clay, and sandy-silt. The soil is described as moist within the first 2.7 m and transitions from high chroma to lighter orange/brown to depths of 1.5 m. The reason for this transition is:

- A Beca Geologist was consulted for further professional input. They note that the silty base is porous and therefore holds more water. However, as the layer has adequate drainage properties, the water is not retained for an extended period of time.
- At around 0.4 m deep, the soil properties change to silty clay, which is more fine-grained and less permeable. This layer has higher water retention capacity and a slower drainage period, which can lead to groundwater perching.

Given the soil characteristics outlined above, and taking into consideration the wet winter of 2022, we would expect to see highly saturated/wet soils within the silty clay layer. However, this was not observed during the soil surveys. As a result, it is unlikely that the silty-clay layer is influencing the root zone within the soil horizon to a point that would encourage the growth of hydrophytic vegetation types, and this is seen within the vegetation plots where the plant communities identified were FAC and FACU species.

Therefore, soil investigations of the southern section of the BPC site did not uncover any soils that would typically be considered hydric or meet the indicators of the WDP Hydric Soil Tool.

Hydric Soils Summary

Taking into consideration the geological information and borehole assessments from the site as well as the soil investigations conducted as part of the WDP, the BPC site did not uncover any soils that would typically be considered hydric or meet the indicators of the WDP Hydric Soil Tool.

Figure 8. Typically soils identified in the northern section (left) and the southern section (right) where a seasonal perched water table was observed.

Figure 9. Borehole assessment carried out at the southern section of the BPC site. Results displayed to a depth of 2.7 m.

3.1.4 Hydrology

Northern Section

The property, on a local scale, has a relatively flat topography, however, the northern section is very slightly inclined in comparison to the southern section, and it is likely this area receives greater input of surface water flows, from the upgradient southern section. This was observed during the site visit, where surface water was observed in the northern section of the property, but not the southern section. Within Auckland Council Geomaps (Auckland Council, n.d.), there are several overland flow pathways mapped through the site, however, distinct flow pathways or minor depressions were not observed during the site visit.

As the site visit was completed during a period following moderate rainfall, some surface water and soil saturation is expected. Within the northern section of the property, the area met 3 primary and 1 secondary hydrology indicators as follows (as outlined in the Wetland Hydrology Tool, Ministry for the Environment 2021):

- 1A: presence of surface water that indicates a high-water table.
- 1B: presence of groundwater.
- 1C: soil saturation.
- 4B: presence of localised geomorphology that indicates water accumulation potential.

These hydrology indicators were only observed in the northern section, which is in a slightly lower lying area compared to the southern section.

Information sourced from the *Northern Interceptor Phase 2 Westgate to Hobsonville: Geotechnical Interpretative Report Massey Connector Section* (dated January 2022), which assesses the local groundwater conditions, noted that groundwater within and surround ding the site is consistent with both perched and regional regimes and during the winter period, perched groundwater can be present at "*near surface levels,*" and is mainly influenced by sea levels of the Waitematā Harbour and nearby watercourses. This report identified that the groundwater level is approximately 2 m below ground level (Mott MacDonald, 2022). Therefore, it is highly likely that the surface water pooling observed within the northern portion of the site is mainly due to temporary rain-derived pooling after the recent rainfall events, and the water observed during the soil investigation was likely due to a perched water table, which is expected during the winter – early spring season.

Southern Section

The southern section has a high density of pasture vegetation cover with thick grasses and is located at a slightly higher elevation compared to the northern section. This has limited wetland hydrology features, and the area did not meet any of the indicators of the Wetland Hydrology Tool.

Hydrology Test Summary

Hydrology tests undertaken at the BPC indicates that the southern section of the site did not have wetland hydrology features. Regarding the northern section of the site, as the area met four of the hydrology indicators of the WDP Hydrology Tool, this area is considered to have wetland hydrology features. However, due to the rainfall events within the previous 48 hours (9.3 mm), there is potential that some of this may be temporary saturation.

3.1.5 Overall Conclusion for the BPC

Results of the wetland investigations are summarised in Table 2 and results confirm the presence of one wetland system within 100 m of the proposed works. These surveys were undertaken using the three

components of the WDP – vegetation, soil, and hydrology. Where the tests resulted in uncertainties, professional judgement was applied to provide classifications.

Table 2. Summary of Wetland Delineation Protocol tests from northern and southern section of the BPC.

Sites	Northern Section	Southern Section
Vegetation Test	• Fails rapid test. • Passes dominance test. • Passes prevalence test. • Fails pasture test. Vegetation results remain uncertain for northern section.	• All plots fail rapid test. • Plot 1 fails the dominance test, all other plots pass. • Plot 1 fails the prevalence test; all other plots remain uncertain. • Plot 1 passes the pasture test; all other plots fail. Vegetation test result remains uncertain for southern section.
Soil Test	• Soils are highly saturated, likely due to recent rainfall. • No hydric soil features identified in accordance with the Hydric Soil Tool. Section fails the hydric soils test.	• No hydric soil features identified in accordance with the Hydric Soil Tool. Section fails the hydric soils test.
Hydrology Test	The area met three primary hydrology indicators and one secondary indicator of wetland hydrology according to the Wetland Hydrology Tool. Section passes the hydrology test.	No hydrology features identified in accordance with the Wetland Hydrology Tool.
Summary	The northern section is considered to be a wetland that meets the NPS-FM (2020) criteria for a 'natural wetland.'	The southern section is considered non-wetland.

Overall, the southern section of the site is assessed to be non-wetland.

The northern section of the site failed the hydric soil test, but passed the hydrology test, and is considered a wetland under the Resource Management Act (1991) and a "natural inland wetland" under the NPS-FM (2022) flowchart (Figure 2). The extent of this wetland is shown in Figure 10. The wetland is considered to be a highly modified palustrine marsh wetland located within a lower-lying depression in the land (Johnson & Gerbeaux, 2004b). Palustrine marsh wetland systems are described as (Johnson & Gerbeaux, 2004b):

"*All freshwater wetlands fed by rain, groundwater, or surface water, but not directly associated with estuaries, lakes, or rivers. The term palustrine derives from the Latin, palus = marsh. Most wetlands are palustrine, and it is this hydrosystem that includes the greatest range of wetland classes and vegetation types.*

A mainly mineral wetland, having moderate to good drainage, fed by groundwater or surface water of slow to moderate flow, and characterised by moderate to great fluctuation of water table or water level. Marshes are often periodically inundated by standing or slowly moving water. They are usually mesotrophic to eutrophic, and slightly acid to neutral in pH. Marshes differ from swamps by having better drainage, a generally lower water table, a usually more mineral substrate, and a higher pH. Marshes occur mainly on slight to moderate slopes, especially on valley margins, valley floors, and alongside water bodies such as rivers and lakes. Vegetation is most often rushland, grassland, sedgeland, or herbfield."

Taking into consideration the results of the vegetation, soil, and hydrology tests, the wetland system is considered to be ephemeral or intermittent, and it is likely that seasonal variation in rainfall leads to ponding

in the lower lying sections of the landscape during the wetter months and completely dries out during the drier months (Johnson & Gerbeaux, 2004b).

Figure 10. Delineation and extent of the palustrine marsh wetland identified on the northern area of the BPC site.

3.2 Shaft 8 Site

Two site visits were undertaken at Shaft 8. During the first site visit (22/09/2022) there was no evidence of wetland or wetland-like features in the proposed location for the shaft. However, following notification from the project team that a potential wetland maybe present, a second site visit was undertaken (17/07/2023), which confirmed that the area had significantly changed over the last 10 months.

Therefore, during the second site visit (17/07/2023), wetland delineation surveys were undertaken at Shaft 8, which is the proposed location for the largest diameter shaft and will accommodate the future Western Wastewater Connection. Once built, the shaft will be permanent and accessed as required by Watercare staff.

3.2.1 Historic land-use and landforms

At the Shaft 8 site location there has been significant land modification in the last 60 year (Figure 11). Aerial imagery from 1959 indicates that this area (and the surrounding landscape) had been cleared of native vegetation and primarily utilised for agriculture. Within the imagery, there are two watercourses clearly outlined on the eastern and western boundary of the site. The site was further modified in 2000 with the development of a private residence and driveway (Figure 11: 2000). The placement of a culvert within the watercourse on the north-western boundary resulted in the development of a ponded/potential wetland area north of the residence (Figure 11: 2008). The surrounding landscape is again modified in 2010/11, as the Upper Harbour Highway is developed. In 2017, the private residence was removed, and the land has since been left unused. Investigation of the aerial imagery over the last 60 years shows no indication of (naturally occurring) wetland features within the site.

3.2.2 Vegetation

Vegetation across Shaft 8 is highly modified and only exotic and commonly found native species were identified. As the site was small in extent four vegetation plots were conducted, in representative vegetation types (Appendix 2).

The species with the highest percentage cover was jointed rush (*Juncus articulatus*). Other species identified in much smaller percentage cover and scattered throughout included umbrella sedge (*Cyperus eragrostis*), creeping bent (*Agrostis stolonifera*), and spearwort (*Ranunculus flammula*) (Figure 12).

Vegetation surrounding this depressed area (the slope) comprised of primarily kikuyu (*Cenchrus clandestinus*), pampas (*Cortaderia selloana*), gorse (*Ulex europaeus*), and scattered areas of *Coprosma* seedlings / saplings. In one location along the slope a small patch of *Isolepsis prolifera* was found which is an obligate wetland species – this was the only spot this species was identified in.

The vegetation test results indicate that Plot 6 passed both the dominance and prevalence tests, Plots 7 and 8 both didn't pass the dominance test and had marginal prevalence scores (3.27 and 3.38, respectively), and Plot 9 passed the dominance test and had a marginal prevalence score of 2.54.

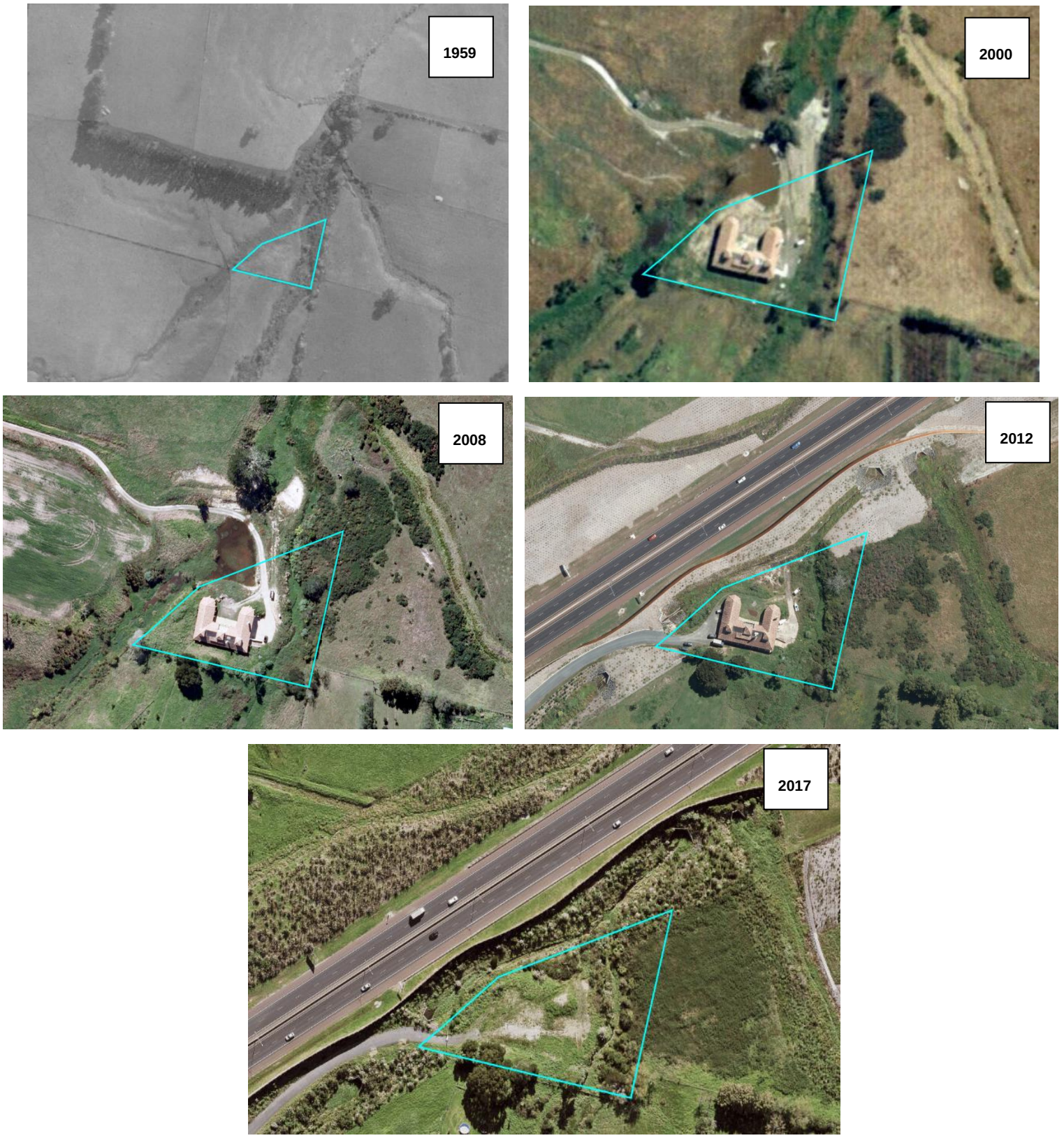


Figure 11. Aerial imagery over the last 60 years of 27 Trig Road (location of Shaft 8), which indicates significant modification and land-use changes over this time (Sourced from Auckland Council Geomaps).

Vegetation plot summary

These marginal scores are likely due to the dominance of facultative species which can be found in a wide range of environments and generally tolerant to seasonal fluctuations and changing weather patterns (refer to Appendix 3).

As the topography of the site is within a depressed area, surrounded on all sides by higher ground, it is surmised that this area receives surface water runoff during periods of high rainfall and water accumulates and ponds within this area.

Therefore, as only Plot 6 passes all the WDP tests, and Plots 7-9 are uncertain, following the WDP hierarchy, soil test and hydrology tests were undertaken which are described in the following sections.

Figure 12. Vegetation and ponded water identified within the depressed zone at Shaft 8.

3.2.3 Soils

Soil investigations were attempted at the site, however, due to the ponded water within the depressed area soil plots were unable to be undertaken. While there had been little rainfall in the previous 24 – 72 hours, there had been between 75- 80 mm over the last month (Auckland Council, 2023), which has resulted in soils becoming highly saturated with limited drainage potential. This, therefore, has resulted in ponded water throughout this area. An inspection of the soils indicated that there was a high silt content.

Soil test summary

As the site visit indicated the soils were highly saturated and surface water was present throughout, hydric soil testing was unable to be undertaken in this instance. Therefore, soil logs from boreholes collected in 2021 are used here to determine whether hydric soils were previously present at this location.

The Ground Contamination Detailed Site Investigation (Tonkin & Taylor Ltd, 2023b) describes borehole investigations undertaken within the proposed location for Shaft 8 (refer to Appendix 4 for locations). The borehole undertaken within proximity to the potential wetland (# WSL-21-BH102 – referred to as Borehole 1) indicates the top 1.35 m is primarily fill material comprising of gravelly silt that is non-plastic, permeable and dry in texture. From 1.35 m to 3.2 m the material comprises of clayey silt and sandy silt as well as fine sand and gravels, of medium plasticity. A borehole survey was also undertaken west of Borehole 1, and away from the potential wetland (# WSL-21-BH101, referred to as Borehole 2). In comparison to Borehole 1, Borehole 2 has varying soil characteristics with the top 30 m being fill material comprising of silt which is low plasticity. Between 0.5 m to 0.9 m the material shifts to being clayey silt that was moist, with medium to high plasticity, and then transitions to silt with minor clay components of medium plasticity (Tonkin & Taylor Ltd, 2023b) (refer to Appendix 4 for borehole log photos).

As such, Borehole 1 indicates higher permeability, within the top 1.35 m of the soil, with a transition to lower permeability material from > 1.35 m. This indicates that the soil has good drainage abilities, and, under normal seasonal conditions, surface water run of, and direct rainwater received by this area should be adequately drained. Borehole 2 has lower permeability within the top 1 m of material indicating less adequate drainage ability, potentially leading to surface water running off and into lower elevation areas.

Therefore, the soil logs indicate that the soils within this area (Borehole 1) are non-hydric, and, under normal seasonal circumstances, the soils would not support a permanent wetland to occur here.

3.2.4 Hydrology

The wider area of Shaft 8 is relatively flat, with sloping areas leading to the two watercourses along the eastern and northern boundary of the site. The area surveyed however, is located within a depression in the wider landscape and is surrounding, on all sides, by higher areas (between 1.5 – 2 m difference). During the second site visit, surface water was observed within this depressed area, with the surrounding areas appearing much drier in comparison. No distinct overland flow pathways were identified within the site. This area is located adjacent to the Trig Stream; however, it is unlikely that it is hydrologically connected as the stream water level sits > 1.5 m below the land area of the potential wetland, and even during high flow periods, the water level is unlikely to overtop the densely vegetation banks. This also indicates that the water table is likely to be low and disconnected to the surface.

Therefore, within Shaft 8, the area meets 2 primary and 1 secondary hydrology indicator and includes:

- 1A: presence of surface water
- 1C: soil saturation in top 30 cm
- 4B: geomorphic position

The first site visit (22/09/2022) was undertaken during a period with lower rainfall in the preceding 72 hours, however, was undertaken following a wetter winter period. This was clear within the BPC location where ponded water was evident in the flatter Southern Section, however, during that same site visit, Shaft 8 was completely dry.

Hydrology test summary

Hydrology tests undertaken at Shaft 8 indicates that this area passes three indicators of the WDP Hydrology Tool, therefore this area is considered to have wetland hydrology features.

However, due to the high rainfall events recorded for the entire Auckland region over the last 6 – 7 months, the hydrology tests are considered to be unreliable, especially when comparing these results to the observations made onsite during the first site visit. As such, professional judgement has been applied here and it is highly likely that the wetland hydrology features observed during the second site survey has been influenced by the recent high rainfall events, and as such, is not considered to be "normal conditions" of this area.

3.2.5 Overall Conclusion for Shaft 8

As this site was visited twice in the last 10 months, this allows for comparisons to be made over two different seasons. Rainfall data indicates that during July 2022 average rainfall within this location was approximately 540 mm, increasing to 1040 mm in September 2022 (at the time of the first site visit) compared to 2023, where rainfall data has averaged approximately 960 mm in May and almost 1500 mm by the end of June 2023 (Auckland Council, 2023). Additionally, the wider Auckland and Northland regions have experienced one of the wettest summer and winter seasons to date, with high rainfall rates recorded since January 2023.

As such, the identification of any *natural inland wetlands* at Shaft 8 have been made with guidance from the Wetland Delineation Protocols according to the U.S Army Corps of Engineers (Harper, 2020; Ministry for the Environment, 2022b) for *atypical situations*, which are described as:

"*positive indicators of hydrophytic vegetation, hydric soils, and/or wetland hydrology could not be found due to effects of recent human activities or natural events.*"

Therefore, to determine this, soil logs from boreholes collected in 2021 are used to determine whether hydric soils were previously present at this location. Soils have been identified as the key factor due to vegetation communities frequently adapting to changing weather patterns, therefore, are unreliable, and due to the topographical location of this area, within a depressed area.

The topographical location of the potential wetland means that this area has been receiving high inputs of surface water, and direct rainwater during the recent high rainfall events, and despite the adequate drainage properties of the soil, due to the volume of water inputs, this has led to the soils becoming highly saturated resulting in ponding. This has created an ecological niche in this location, allowing for the establishment and dispersal of wet-adapted species, which are mainly facultative and known to inhabit a wide range of environments as they are highly tolerant to seasonal changes (Figure 13). The soil logs indicate that the soils within this area are non-hydric, and, under normal seasonal circumstances, the soils would not support a permanent wetland to occur her. This is also supported by the aerial imagery, where no natural wetland features can be identified over the last 60 years (Figure 11).

Given this information, professional judgment has been applied to the potential wetland identified at Shaft 8, which is considered to not meet the conditions of a *natural inland wetland* as defined by the NPS:FM (2022).

Table 3. Summary of Wetland Delineation Protocol test at Shaft 8.

Tests	Shaft 8
Vegetation Test	• Only Plot 6 and 9 passes both the dominance and prevalence tests. • Plots 7 and 8 fail dominance test and marginal scores for prevalence test. Vegetation pattern is considered to be highly influenced by topography and hydrology with facultative wetland species dominate in areas where surface water collects in low-lying areas
Soil Test	• The site visit indicated the soils are highly saturated, likely due to recent rainfall; therefore, soil pits were unable to be conducted. • Soil logs undertaken in 2021 indicate that soils within this area have higher permeability, therefore, high drainage abilities, so are unlikely to support a permanent wetland occurring here. Soils are determined to be non-hydric.
Hydrology Test	The area met three primary hydrology indicators and one secondary indicator of wetland hydrology according to the Wetland Hydrology Tool. However, hydrology is surmised to be influenced by recent high rainfall events, and therefore, are unreliable.
Summary	The potential wetland at Shaft 8 is considered to have formed following *atypical situations* (weather patterns) and as such, is not considered a *natural inland wetland* under the NPS:FM.

Figure 13. Comparisons of Shaft 8 between September 2022 and July 2023 indicates the site has been highly influenced by the high rainfall events experienced throughout the Auckland (particularly north Auckland) region since January 2023.

3.3 Riverine Wetland Systems

Within proximity to the project works, three riverine wetlands have been identified that meet the NPS-FM (2020) definition of 'natural inland wetland,' and are associated with an overland flow pathway and Trig Stream and Waiarohia Stream. Vegetation within these wetlands were dominated by obligate and facultative wetland species, therefore passed the rapid vegetation test.

Riverine wetland systems are described as (Johnson & Gerbeaux, 2004b):

"*Wetlands associated with rivers, streams, and other channels, where the dominant function is continually or intermittently flowing freshwater in open channels. The riverine hydrosystem includes open flowing waters and both the beds and margins (riparian zones) of channels. It embraces natural waterways and artificial ones such as canals, irrigation channels, and drains . . .* "

The location of these riverine wetland systems can be found in Figure 17.

3.4 Summary

Wetland surveys undertaken across the project site, in proximity to the proposed works for the Northern Interceptor and the Massey Connector indicate the presence of several wetlands that meet the criteria for 'natural inland wetland' under the NPS-FM (2022). These comprise of a palustrine marsh at the BPC and several riverine wetlands associated with watercourse channels along the Northern Interceptor, in Whenuapai (Figure 14 and Figure 17).

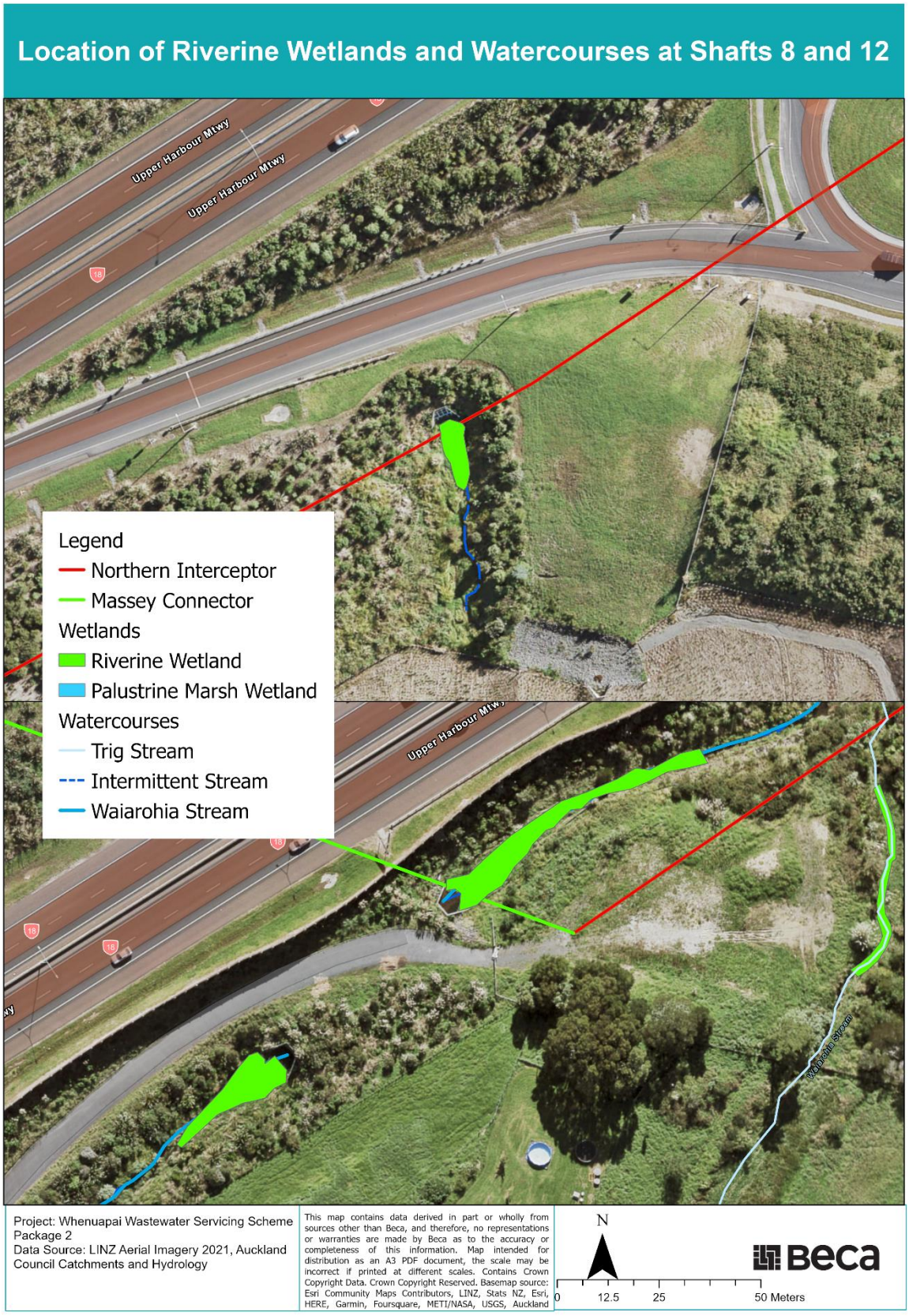


Figure 14. Location of watercourses and riverine wetlands at Shaft 12 (top) and Shaft 8 (bottom).

4 Watercourse Classification

The desk-based assessment identified three watercourses located within proximity to the pipeline alignment. These were subsequently surveyed and classified during the field survey. This classification was undertaken in accordance with the Auckland Unitary Plan Practice and Guidance Note – River/Stream Classification document (Auckland Council, 2021) (see Section 2.2.2).

4.1 Watercourse Assessment

Prior to the site visit, desktop assessments of the watercourses were undertaken. Reviewing of the contour, hydrology, and catchment layers from Auckland Council Geomaps identified the presence of one overland flow pathway and one permanent stream system at Shaft 8 and an overland flow pathway at Shaft 12.

A site survey was undertaken to confirm these findings, which is detailed in the below sections.

4.1.1 Shaft 8 Watercourses

At Shaft 8 there are two watercourses identified within the site and adjacent to the site. One of these watercourses is classified as permanent named stream (Trig Stream) by Auckland Council and runs along the eastern boundary of the site. This classification was verified during the site visit.

The other watercourse is currently identified and mapped as an overland flow pathway by Auckland Council and flows along the north western boundary of the site. During the site visit it was noted that several elements of the watercourse indicated that it more than likely meets the definitions of a permanent stream under the AUP:OP. This includes the historical evidence that identified the presence of a distinct watercourse in this area dating back to 1996 and 1959 (Figure 15). Whilst land use changes in the Whenuapai area have resulted in this channel being significantly modified, which included the installation of two culverts, this watercourse is still present. In addition to this, the presence of *Glyceria maxima* indicates that the watercourse has continually flowing water, as this species is generally found in slow flowing water.

As such, this watercourse is classified as a permanent stream and mapped and named as Waiarohia Stream on LINZ database (*New Zealand River Name Lines*, 2019).

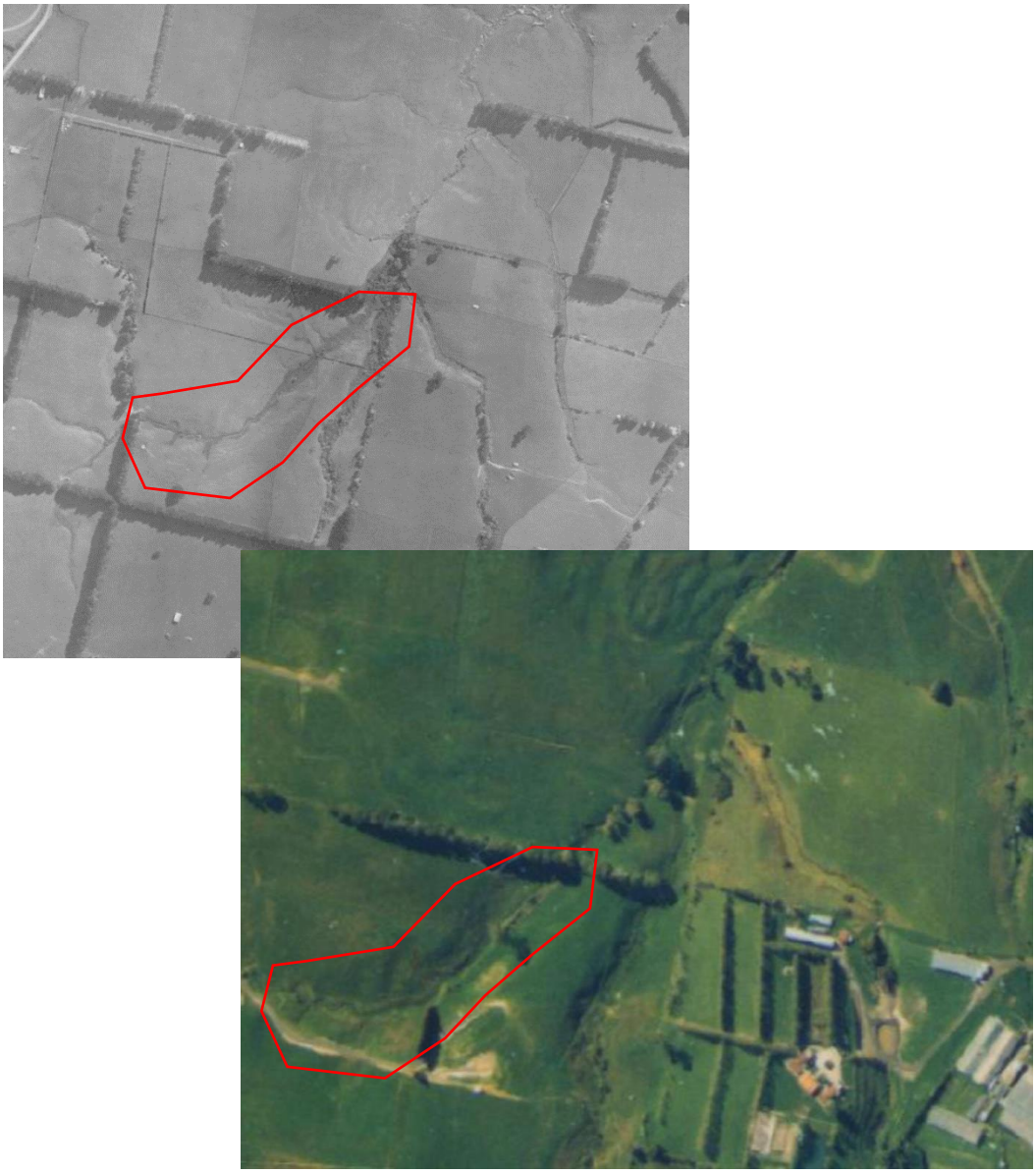


Figure 15. Upper section of the Waiarohia Stream (near the proposed location for Shaft 8) from 1959 (top) to 1996 (bottom).

4.1.2 Shaft 12 Watercourse

An overland flow path (OLP AC geospatial layer) is mapped next to Shaft 12. The watercourse flows through a piped culvert system and under the Upper Harbour Motorway before merging with the Waiarohia Stream. A watercourse classification was carried out at this watercourse and the findings are detailed in Table 4.

Table 4. Watercourse classification for the watercourse on the northern boundary of Shaft 12.

Watercourse Assessment at Shaft 12	
Intermittent river or stream, or ephemeral stream – cases to flow when bed is above water table. To be an intermittent, a river must exhibit at least 3 of the following	
Criteria	Observation
1. Evidence of natural pools	Yes – natural pools were observed within the watercourse channel itself. The watercourse was overgrown with *Carex* sp.
2. Well defined channel. Banks and bed can be distinguished.	No – the banks and bed of the channel were not fully distinguishable. Additionally, the riparian area alongside the channel has been planted.
3. Surface water is present (more than 48 hrs after a rainfall event).	Yes – surface water was observed within the channel, however, there was approximately 9.3 mm of rainfall 72 hours prior to the site visit.
4. Rooted terrestrial vegetation is not present across the entire cross-sectional width of the channel.	No – there was some terrestrial vegetation identified within the channel itself.
5. Organic debris present in the floodplain.	Yes – there was some organic debris identified within the riparian margins.
6. Evidence of substrate sorting processes, including scour and deposition.	Uncertain – due to the overgrowth of vegetation within the channel, this observation was unable to be made.

The findings from the River and Stream Classification Criteria indicate that the watercourse passed at least 3 of the criteria for an intermittent stream. Based on this, the watercourse is classified as an intermittent stream system.

The location of all watercourses identified at Shaft 8 and 12 are shown on Figure 14.

5 Ecological Features and Values

5.1 Site Location and Ecological Context

The pipeline alignment is located in the Tāmaki Ecological District (ED), on the north-western shore of the Waitematā Harbour (McEwen, 1987) (Figure 16). The Tāmaki ED has undergone significant land clearance and modification since early human settlement, with original forest cover comprising of North Island lowland types including taraire and pūriri (McEwen, 1987). These forests would have supported a diverse range of native terrestrial fauna species. Vegetation clearance over time has resulted in significant habitat loss, reducing the diversity of terrestrial fauna populations in this area. Characteristics of this district include low hills, isthmuses, and harbours. The pipeline alignment primarily follows the southern edge of a section of State Highway 18, and is surrounded by a mix of residential, rural, and industrial land.

Within the project area is the upper section and tributaries of the Waiarohia Stream. The Waiarohia Stream catchment is relatively large, at approximately 280 ha, and is a permanent channel fed by several named and unnamed tributaries, including Trig Stream and Rawiri Stream. The headwaters of the stream are located in farmland near Westpoint Drive and Trig Road, where is flows in a north-east direction under the Upper Harbour Motorway, through farmland and urban settlements near Brigham Creek, before discharging into the Waiarohia Inlet and the Waitematā Harbour. The main Waiarohia Stream channel as well as some of the tributaries have undergone significant modifications as a consequence of rural and urban land uses. This included some areas unfenced from stock, little to no riparian vegetation cover, stream culverting, and the creation of irrigation and ornamental ponds. Overtime, this has led to significant degradation of water and habitat quality from stream bank erosion and direct contamination from livestock access, Additionally, instream barriers have restricted fish passage into the upper sections of the channel.

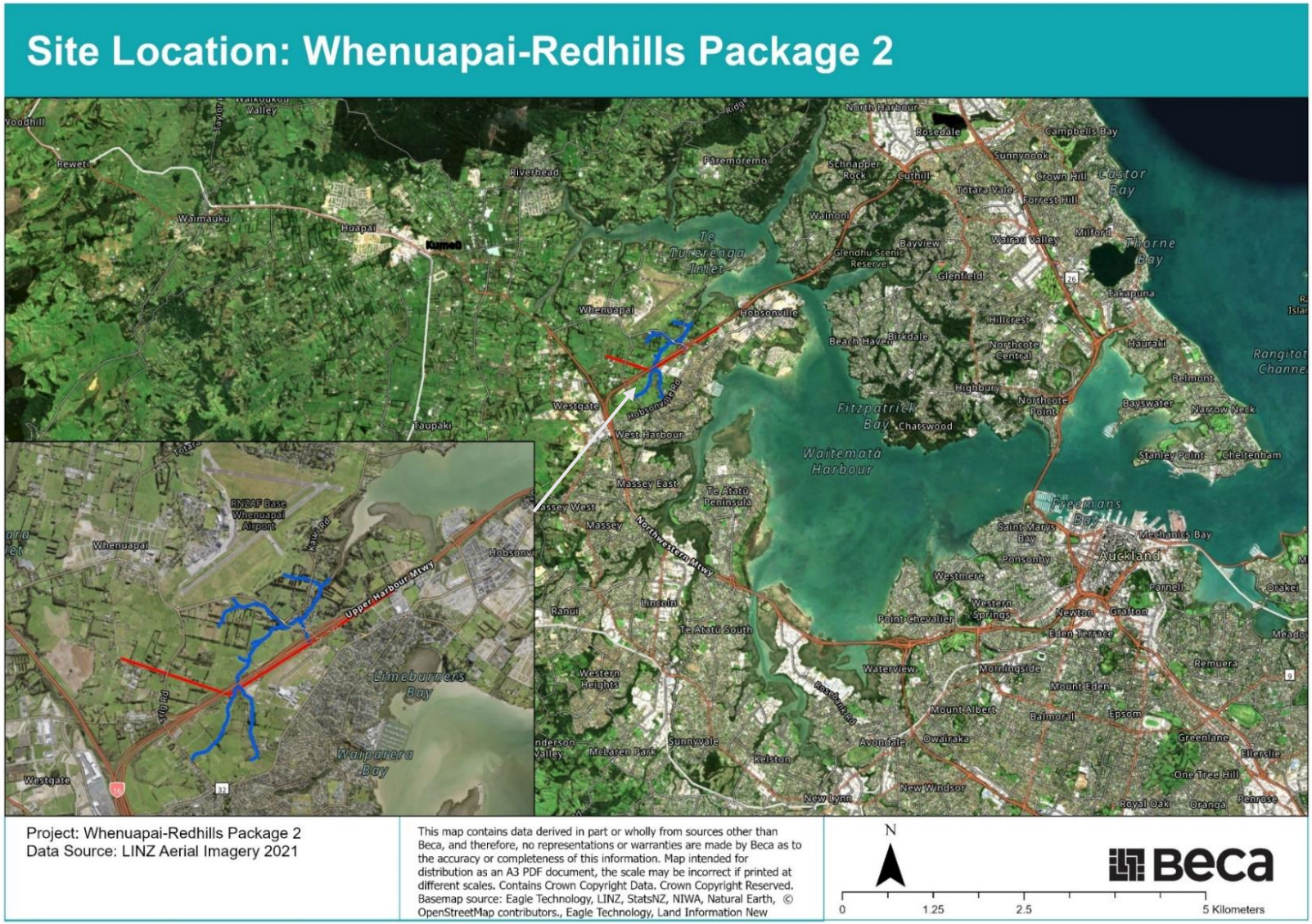


Figure 16. Location of the Whenuapai Wastewater Servicing Scheme Package 2, in relation to surrounding landscape.

5.2 Ecological Features within the BPC, Shaft 8, and Shaft 12.

The ecological features located at the BPC, Shaft 8, and Shaft 12 are illustrated in Figure 17, and discussed in detail in Sections 5.3 to 5.5 below.

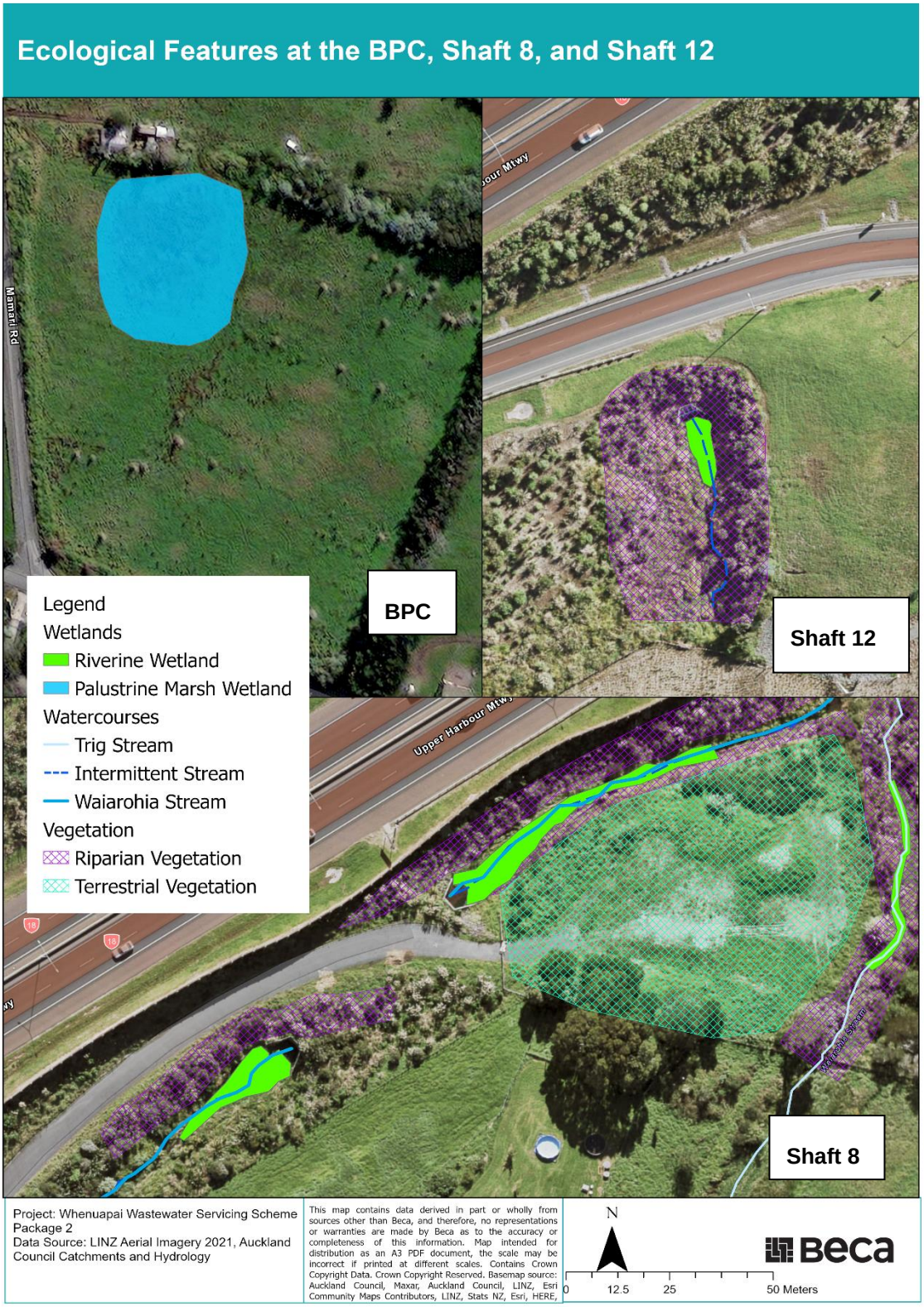


Figure 17. Ecological features identified and surveyed at the BPC, Shaft 8, and Shaft 12.

5.3 National Policy Statement for Indigenous Biodiversity

The National Policy Statement for Indigenous Biodiversity (NPS-IB, 2023), which came into effect on 7th August 2023, seeks to maintain indigenous biodiversity across New Zealand so that there is at least no overall loss in indigenous biodiversity. The NPS-IB highlights the need for a cautionary approach to considering effects on indigenous biodiversity both within and beyond Significant Natural Areas (SNAs) and including areas supporting highly mobile fauna. Increased indigenous vegetation cover in urban and non-urban environments is promoted, as is information gathering and monitoring of indigenous biodiversity (Ministry for the Environment, 2023).

At the same time, the NPS-IB sets out a need to recognise and allow for activities which contribute to New Zealand's social, economic, cultural, and environmental wellbeing. The NPS-IB provides a consenting pathway for specified infrastructure which provides significant national or regional public benefit. The NPS-IB provides criteria for identifying significant indigenous vegetation or significant habitats of indigenous fauna in a specific area and this includes representativeness, diversity and pattern, rarity and distinctiveness, and ecological context.

Within the project footprint vegetation comprises of primarily exotic grass cover, exotic trees, and scattered areas of recently planted native trees. A significance assessment is provided in accordance with Appendix 1 NPS: IB in Table 5. This has been informed by the ecological descriptions and values of features within the project footprint (Section 5.4 to 5.6).

Table 5. Significance assessment of ecological features within the project footprint .

Criteria for SNA	Significant Assessment and Reasoning
Representativeness: *An area that qualifies as an SNA under this criterion has at least one of the following attributes:* *(a) indigenous vegetation that has ecological integrity that is typical of the character of the ecological district:* *(b) habitat that supports a typical suite of indigenous fauna that is characteristic of the habitat type in the ecological district and retains at least a moderate range of species expected for that habitat type in the ecological district.*	Vegetation within the project footprint does not meet either (a) or (b). There is overall limited indigenous vegetation within the project footprint, that has been highly modified from urban development, and impacted the ecological integrity of the remaining native vegetation. Vegetation is expected to provide habitat for primarily exotic avifauna and only commonplace native avifauna and limited habitat for bats.
Diversity and pattern: *An area that qualifies as an SNA under this criterion has at least one of the following attributes:* *(a) at least a moderate diversity of indigenous species, vegetation, habitats of indigenous fauna or communities in the context of the ecological district:* *(b) presence of indigenous ecotones, complete or partial gradients or sequences*	Vegetation within the project footprint does not meet either (a) or (b). Overall low diversity of biological components within the project footprint. No indigenous ecotones or sequences within the project footprint.
Rarity and distinctiveness: *An area that qualifies as an SNA under this criterion has at least one of the following attributes:* *(a) provides habitat for an indigenous species that is listed as Threatened or At Risk (declining) in the New Zealand Threat Classification System lists:* *(b) an indigenous vegetation type or an indigenous species that is uncommon within the region or ecological district:* *(c) an indigenous species or plant community at or near its natural distributional limit:*	Vegetation within the project footprint is does not meet criteria (a) to (h). While there are potential bat roosting trees are limited to isolated patches of vegetation, with little connectivity to any contiguous forest areas. Threatened species is limited to the planted mānuka and kānuka near Shaft 8. Both species are common throughout the wider Tāmaki ED and the Auckland region.

(d) indigenous vegetation that has been reduced to less than 20 per cent of its prehuman extent in the ecological district, region, or land environment: *(e) indigenous vegetation or habitat of indigenous fauna occurring on naturally uncommon ecosystems:* *(f) the type locality of an indigenous species:* *(g) the presence of a distinctive assemblage or community of indigenous species:* *(h) the presence of a special ecological or scientific feature.*	No presence of special ecological or scientific features, or distinctive assemblages or indigenous species.
Ecological context: *An area that qualifies as an SNA under this criterion has at least one of the following attributes:* *(a) at least moderate size and a compact shape, in the context of the relevant ecological district:* *(b) well-buffered relative to remaining habitats in the relevant ecological district:* *(c) provides an important full or partial buffer to, or link between, one or more important habitats of indigenous fauna or significant natural areas:* *(d) important for the natural functioning of an ecosystem relative to remaining habitats in the ecological district.*	Vegetation within the project footprint is does not meet criteria (a) to (d). There are no linkages or ecological corridors that allow for movement of highly mobile fauna. Potential bat roosting habitat is limited to isolated trees with no connectivity to contiguous forest areas.

Overall, there are no areas of vegetation within the project that meet the criteria of an SNA. However, consideration has been given within this report to the potential presence of highly mobile species as outlined within Appendix 2 of the NPS-IB. This is limited to long-tailed bat (*Chalinolobus tuberculatus*) (see Section 5.4.2), and appropriate mitigation measures have been recommended in Section 7.3.3.

5.4 Terrestrial Features

5.4.1 Terrestrial Vegetation

Exotic grasses cover a majority of the terrestrial landscape across the Package 2 route, with some areas of mainly exotic species and small patches of native species scattered throughout as well as along the riparian margins.

Terrestrial vegetation assessments were conducted at only one of the four sites, Shaft 8, where there was a mix native and exotic vegetation present. No vegetation surveys were conducted at the BPC, where vegetation comprises primarily of exotic groundcover grasses; Shaft 14, which consists of mainly gorse; or Shaft 12, where vegetation was only present in the riparian margin (and is discussed in Section 5.2.4).

Site: Shaft 8

Vegetation at Shaft 8 comprised of a row of Tasmania blackwood (*Acacia melanoxylon*), a singular Lawson cypress (*Chamaecyparis lawsoniana*), wattle (*Acacia* sp.)(pest plant), sapling karamū (*Coprosma robusta*) scattered throughout the area as well as a dense area of mānuka (*Leptospermum scoparium*), kānuka (*Kunzea robusta*), and karamū in the proposed carpark area (Figure 18).

Therefore, the ecological value of vegetation at Shaft 8 is assessed as **Low** due to low ratings for representativeness, diversity and pattern, and ecological context and a moderate rating for rarity/distinctiveness (Table 6).

Table 6. Scoring and justification for assigned ecological value for terrestrial vegetation at Shaft 8.

Matter	Rating	Justification
Representativeness	Low	Land modification has resulted in vegetation types being uncharacteristic in the structure and composition that would have previously existed, which would have been characteristic of northern North Island lowland types including taraire and pūriri. Vegetation types are dominated by exotic and pest plants, with small, scattered areas of native species.
Rarity/Distinctiveness	Moderate	Mānuka and kānuka (both Threatened – Nationally Vulnerable) identified within proximity to works area at 27 Trig Road.
Diversity and Pattern	Low	Land modifications has resulted in low levels of natural diversity within and within proximity to the project area. Distribution of biological components across the landscape does not reflect underlying natural physical patterns – prior to human activity.
Ecological context	Low	Vegetation types likely provide minimal suitable habitat for indigenous terrestrial fauna. Vegetation areas are fragmented throughout the landscape and provides inadequate movement corridors for highly mobile (birds and bats) terrestrial fauna. Vegetation areas are small in extent and in a degraded condition.
		Overall value: **Low**

Figure 18. Terrestrial vegetation identified at Shaft 8.

5.4.2 Bats

Bat data sourced from the Department of Conservation (DOC) identifies the presence of long tailed bats (Threatened – Nationally Critical) within 1 km of the BPC within the last 3 years. There are no records of long tailed bats in proximity to the rest of the pipeline alignment. Long tailed bats are known to forage within riparian corridors with less-dense vegetation and more open space (Dixon, 2020).

Trees within proximity to the BPC that may provide roosting habitat for long tailed bats are mainly limited to a shelter belt of pine on the eastern side of the property (which aren't proposed to be cleared). Across sites Shaft 8, 12, and 14 there is expected to be some, albeit minimal, suitable roosting habitat, due to the low availability of larger and more mature exotic and native trees. However, as roost trees are characterised as trees with a trunk diameter of > 15 cm and have cracks, crevices, cavities, hollows, and epiphytes clumps, there is potential for trees within and within proximity to the project corridor to have suitable roosting characteristics.

As long tailed bats have a home range of 100 km and there are some suitable habitats present within and within proximity to the project area, there is potential for utilisation of these habitats may occur. Additionally, there is record of long-tailed bats within proximity to the Projects corridor. Therefore, a conservative approach has been taken and the bat values are assessed as **High**.

5.4.3 Herpetofauna habitat

Within the wider Tāmaki ED there are 5 confirmed species of native herpetofauna including pacific gecko (*Dactylocnemis*), forest gecko (*Mokopirirakau granulatus*), elegant gecko (*Naultinus elegans*), ornate skink (*Oligosoma ornatum*), and copper skink (*Oligosoma aeneum*) (Bell & Wiles, 2015). However, of these species, there is likely to only be ornate skink and copper skink (both At Risk – Declining) potentially residing within and within proximity to the project sites due to their known ability to thrive and persist within highly modified suburban Auckland environments.

No lizard surveys were undertaken due to project time constraints and a habitat assessment is used to determine the likelihood of lizards occurring across the project corridor. Three key factors are considered namely, recent species records demonstrating presence, availability of moderate to high quality habitat that meets species requirements, and the magnitude of landscape modification at the site and surrounding areas (adopted from Ussher, 2015).

There are no records of any herpetofauna species identified in proximity to or within the site area. Additionally, information sourced from Department of Conservation's Bioweb Herpetofauna database identifies the presence of no native herpetofauna species within 1 km of the project sites.

Copper and ornate skinks both make use of thick, overgrown exotic grass cover as well as dense weedy species such as pampas, logs, rotting vegetation, and other fallen debris (Department of Conservation, n.d.-a, n.d.-b). There is considered to be suitable lizard habitat across the BPC and Shafts 8, 12, and 14. This comprises of modified thick grassy growth within the northern section of the BPC, and the riparian and terrestrial environment (including pampas, gorse, and rank grasses) of Shafts 8, 12, and 14 (Knox et al., 2019).

A review of historic aerial imagery of the wider landscape indicates a history of ongoing modification beginning with conversion to pasture in the early 1940s. Over the last 60 – 70 years the wider area has been further developed with the ongoing development of residential dwellings and industrial buildings, as well as the Upper Harbour Motorway in 2010-11. More recently (5 – 10 years), these sites (the BPC, Shaft 8, 12, and 14) appear to have been left largely unmaintained, which has allowed exotic grassy and shrubby vegetation to over grow.

Based on this evidence, it is about likely as not that copper and ornate skinks may be present across these sites. This provides a reasonable level of confidence that At Risk herpetofauna species could be present, supporting a values assessment of **High**.

5.4.4 Avifauna

Records on various databases including eBirds (Sullivan et al., 2009) and iNaturalist within 1 km of the site for the last 10 years include only commonly found Not Threatened native avifauna and exotic species. Most of the Northern Interceptor alignment is situation near a highway and as such, this is likely to result in

continuous disturbance and noise to fauna in the area. However, there are some constructed pond habitats near Shaft 12 which may provide some habitat for waterfowl and wetland species.

Therefore, due to the presence of only Not Threatened and exotic avifauna within proximity to the project area and limited habitat availability, the potential species value is assessed as **Low**.

5.5 Aquatic Features

5.5.1 Watercourses

There are several permanent and intermittent watercourses identified within proximity to the pipeline alignment. These watercourses are located at Shaft 8 and Shaft 12 and are discussed and valued in the below sections.

Site: Shaft 8

a. Trig Stream

Trig Stream is a permanent, headwater stream that originates near Trig Road in Hobsonville, runs along the eastern boundary of the works area, then feeds into the Waiarohia Stream at the north eastern corner of the site. The stream channel is naturally meandering with a minimum water depth of approximately 30 cm, with some areas of deeper pools. Instream habitat comprised of pool and run habitat, undercut banks, and some instream vegetation, albeit this was limited to introduced weeds. A majority of the terraced bank is overgrown with reed sweet grass (*Glyceria maxima*), which forms the riverine wetland area.

In 2016, Morphum Environmental Ltd assessed the Waiarohia Stream (and tributaries) as being within the 'moderate' ecological value range (stream ecological valuation score 0.3 - 0.7) for fish and macroinvertebrates, and having 'poor' water quality (Auckland Council Healthy Waters, 2017; Morphum Environmental Limited, 2016). Past Macroinvertebrate Community Index (MCI) scores for the Waiarohia Stream Catchment, from 1997 – 2009 have generally ranged between 60 – 72, which indicates poor water quality (Auckland Council Healthy Waters, 2017; Maxted & Stark, 2007). In comparison with the AUP:OP, MCI guideline value for rural land use adopted for the Auckland region (MCI of 94), also indicated that the Waiarohia Stream and tributaries are degraded below that typically associated with rural land uses in Auckland (Auckland Council Healthy Waters, 2017).

Riparian vegetation along the channel length comprises of a mix of native and introduced species, which provides limited stream shading due to the low stature of the vegetation. Species include mānuka, kānuka, karamū, wattle (pest), pampas (pest), flax, and cabbage trees.

Therefore, the ecological value of this section of the Trig Stream channel is assessed as **Low** due to low ratings for representativeness, rarity/distinctiveness, and diversity and pattern, and a moderate rating for ecological context (Table 7).

Table 7. Scoring and justification for assigned ecological value to Trig Stream.

Matter	Rating	Justification
Representativeness	Low	Water quality and MCI values recorded as poor to moderate due to significant catchment influences and ongoing degradation. Large culvert system located under SH18 connecting the main channel of the Waiarohia Stream to Trig Stream. Trig Stream represents the headwaters of the Waiarohia Stream.
Rarity/Distinctiveness	Low	Waiarohia Stream has limited fish and macroinvertebrate diversity, however, key īnanga spawning site has been identified downstream.
Diversity and Pattern	Low	Distribution of biological components does not reflect natural underlying physical patterns due to significant land modifications. Low to moderate habitat availability including pool and run systems, with areas of undercut banks.
Ecological context	Moderate	Trig Stream represents the headwaters of the Waiarohia Stream. Wider catchment has been extensively modified for rural and urban use.

Matter	Rating	Justification
		Poor water quality within the main Waiarohia Stream channel and nearby tributaries – including Trig Stream. Riparian vegetation provides poor stream shading, however, is expected to provide some buffering and erosion control services. Low to moderate instream habitat for freshwater fish and macroinvertebrates.
		Overall value: **Low**

b. Waiarohia Stream

The stream channel is a permanent headwater stream and is a pool-run system with a narrower channel width. Substrata within the stream comprises of primarily sandy-silt and an overgrowth of brown-orange algae was noted within the channel. Water depth varied throughout the channel but range from deeper pools (10-15 cm) to shallow runs (5 – 10 cm). A majority of the channel is overgrown with reed sweet grass, which forms the riverine wetland area, to a point where the stream channel is not visible in some sections. Additionally, plastic rubbish was observed scattered in the water during both site visits.

Riparian vegetation was limited to numerous pest species including black wattle (*Acacia mearnsii*), Sydney gold wattle (*Acacia longifolia*), Chinese privet (*Ligustrum sinense*), woolly nightshade (*Solanum mauritanum*), gorse, and pampas (*Cortaderia selloana*). Native species were limited to juvenile karamū. Groundcover vegetation comprised of exotic grasses, montbretia (*Crocosmia X crocosmiiflora*)(pest), and juvenile tree ferns.

Therefore, the assigned ecological value of this section of the Waiarohia Stream channel is assessed as **Low** due to low ratings for representativeness, rarity/distinctiveness, and diversity and pattern, and a moderate rating for ecological context (Table 8).

Table 8. Scoring and justification for assigned ecological value for the section of the Waiarohia Stream within the project works area.

Matter	Rating	Justification
Representativeness	Low	Water quality and MCI values recorded as poor to moderate due to significant catchment influences and ongoing degradation. Large culvert system located under SH18 connecting the main channel of the Waiarohia Stream to Trig Stream. Represents the headwaters of the Waiarohia Stream. A large culvert located within the channel to accommodation the road, with a concrete area that is expected to limit fish passage for species with low climbing abilities during low flow periods.
Rarity/Distinctiveness	Low	Waiarohia Stream (main channel) has limited fish and macroinvertebrate diversity, however, key īnanga spawning site has been identified downstream.
Diversity and Pattern	Low	Distribution of biological components does not reflect natural underlying physical patterns due to significant land modifications. Low to moderate habitat availability including pool and run systems, with areas of undercut banks.
Ecological context	Moderate	Wider catchment has been extensively modified for rural and urban use. Poor water quality within the main Waiarohia Stream channel and nearby tributaries. Riparian vegetation provides poor stream shading, however, is expected to provide some buffering and erosion control services. Low to moderate instream habitat for freshwater fish and macroinvertebrates. Stream banks overgrown with exotic pest plant – sweet reed grass.
		Overall value: **Low**

Site: Shaft 12

The intermittent stream channel represents the headwaters of the Waiarohia Stream and flows through a large culvert under the Upper Harbour Motorway. The stream system and the surrounding land has been largely modified for rural and residential use and there is now a large stormwater pond located south of the watercourse, and potentially discharges within or within proximity to the watercourse.

The stream channel is overgrown with hydrophytic vegetation including umbrella sedge (*Cyperus ustulatus*) and exotic grasses, as well as flax (*Phormium tenax*), pampas, and blackberry (*Rubus fruticosus*). The stream had above-ground water present with some areas of deeper pools, and the sediment base was unable to be identified due to the overgrowth of vegetation, however, is expected to be soft sediments. Riparian vegetation along the banks has been planted in 2012 and comprises of a kānuka, mānuka, rimu (*Dacrydium cupressinum*), kahikatea (*Dacrycarpus dacrydiodes*), kōwhai (*Sophora microphylla*) and karamū, with an understorey growth of tree ferns, flax, and blackberry. However, due to the wide stream channel and low stature of the vegetation, the plantings are unlikely to provide suitable shading to the watercourse (at this stage). The stream channel is expected to provide some suitable habitat for tolerant macroinvertebrate species, however, limited habitat to a range a native fish, due both to the overgrowth of vegetation as well as the large culvert, which may potentially be a barrier to fish passage.

Therefore, the ecological value of the intermittent stream is assessed as **Low** due to low ratings for all four subject matters (Table 9).

Table 9.Scoring and justification for the assigned ecological value for the intermittent stream.

Matter	Rating	Justification
Representativeness	Low	Intermittent stream channel, where flows are likely to vary depending on rainfall events. Generally shallow depth.
Rarity/Distinctiveness	Low	Riparian margins have been planted with a range of native vegetation. Shading is limited due to wider width of channel and low stature of vegetation.
Diversity and Pattern	Low	Distribution of biological components does not reflect natural underlying physical patterns due to significant land modifications. Instream habitat comprises of primarily shallow pool sections.
Ecological context	Low	Wider catchment has been extensively modified for rural and urban use. Riparian vegetation provides limited stream shading, however, is expected to provide some buffering and erosion control services. Low instream habitat for freshwater fish and macroinvertebrates due to overgrowth of vegetation and periods of low to no flow. Large culvert connecting the channel to Waiarohia Stream under the Upper Harbour Motorway. Culvert is potentially a barrier to fish migration.
		Overall value: **Low**

5.5.2 Freshwater Fish

Within the wider Waiarohia Stream catchment area there are only a few species of native freshwater fish identified based on records collated within NZFFD. A total of two native species have been identified in the lower stream catchment in the last 10 years, with the most recent records from 2021. These species include īnanga (*Galaxias maculatus*) (At Risk - Declining) and redfin bully (*Gobiomorphus huttoni*) (Not Threatened). Additionally, īnanga spawning has been confirmed downstream of the project footprint area near 164 Brigham Creek Road.

As many of New Zealand's juvenile native fish develop at sea and migrate into river habits, where they grow into adults, the movement of these species between the marine and freshwater environment can be hindered by instream structures and barriers. This includes īnanga, which are also a species with low climbing abilities.

Shaft 8 is located approximately 1.8 km inland and 47 m above sea level. New Zealand's freshwater fish fauna distribution is generally influenced by elevation and distance from the coast. Previous studies indicate that whilst elevation remains within the 0 – 200 m, there are generally higher numbers of species found within the stream system (Joy et al., 2015). As such, the Waiarohia Stream is considered to provide an adequate pathway for migratory diadromous native freshwater fish species, which would reside, for a part of their lifestyle, within suitable areas in the upper reaches of this stream. However, within the Waiarohia

Stream catchment there has been numerous historic modifications to allow for urban expansion, including the installation of two culverts within the stream, with one being near 162 Brigham Creek Road and the other being within the project area. Artificial instream barriers can often act as barriers to migration, especially for species with low climbing abilities. Therefore, both the Waiarohia Stream and Trig Stream are expected to provide suitable habitat for some native freshwater fish, especially longfin eel (*Anguilla dieffenbachii*) (At Risk - Declining) and/or shortfin eel (*Anguilla australis*).

As a result, given the confirmed presence of native freshwater fish within the wider stream catchment, and the potential presence within the watercourses in the project site, the fish values within the project area are assessed as **Moderate**.

5.6 Wetlands

Wetlands were identified at the following locations; the BPC, Shaft 8, and Shaft 12 (Figure 17). These all meet the definition of a 'natural inland wetland' under the NPS-FM (2022), therefore are subject to regulation under the NES FW (2022) and are described in more detail in the below sections.

5.6.1 Palustrine Marsh Wetland

a. BPC

The marsh wetland is located within a slight topographical depression in the local landscape and despite wetlands being a threatened ecosystem type (Clarkson et al., 2013), this wetland is considered to be highly modified and degraded from previous land uses. The area is dominated by exotic vegetation types including creeping buttercup and soft rush and is low in diversity, complexity and representativeness.

As such, this wetland is of **Low** ecological value based on low ratings for all four subject matters (Table 10).

Table 10. Scoring and justification for assigned ecological value to the palustrine marsh wetland at the BPC.

Matter	Rating	Justification
Representativeness	Low	Wetland is dominated by exotic grass species, with only two main vegetation types identified.
Rarity/Distinctiveness	Low	No At Risk or Threatened species identified. No distinct features - vegetation types identified are tolerant to a variety of soil and hydrological conditions as well as changes in seasonal patterns. Wetland habitat is reduced in extent both regionally and nationally.
Diversity and Pattern	Low	Low diversity and complexity of vegetation types – only two vegetation types identified. Discrete site, not connected to other natural areas or ecotones.
Ecological context	Low	Isolated site within a catchment dominated by rural and urban use. Minimal provisioning of ecosystem services associated with typical wetland ecosystems.
		Overall value: **Low**

5.6.2 Riverine Wetlands

There are two riverine wetlands identified within the works area of the Northern Interceptor alignment, and are associated with the Waiarohia Stream, Trig Stream, and intermittent stream.

Site: Shaft 8

There are several moderate-sized sections of riverine wetland associated with both the Waiarohia and Trig Stream channels. The flowing watercourse has allowed for the establishment of reed sweet grass alongside the Waiarohia Stream channel and within the channel, as well as along the terraced bank of Trig Stream. This species is an exotic obligate wetland species found in aquatic habitats including drains and slow flowing waterbodies. Additionally, this species is a pest plant in Auckland and is known to aggressively grow and spread, often forming dense mats in nutrient rich areas and limiting the growth of native macrophytes and providing limited habitat to native aquatic fauna (Figure 19).

Site: Shaft 12

This wetland is associated with the intermittent stream system and is connected to a large, piped watercourse that moves under the Upper Harbour motorway and connects to the Waiarohia Stream. At the time of the site visit, the watercourse was not fully visible under the dense growth of vegetation including pampas (pest), *Coprosma* sp., and umbrella sedge. Umbrella sedge can tolerate a wide range of habitats, however, prefer frequently wet environments including wetland and river margins (Figure 19).

Overall ecological value of the riverine wetlands

The riverine wetlands at Shaft 8 and Shaft 12 are considered to have **Low** ecological values based on low ratings for all four subject matters (Table 11).

Table 11. Scoring and justification for assigned ecological value to the riverine wetlands.

Matter	Rating	Justification
Representativeness	Low	The wetland at Shaft 8 is dominated by exotic sweet reed grass, whilst the wetland at Shaft 12 comprises a mix of native and exotic species. Wetland vegetation at Shaft 8 is dominated by an aggressively growing introduced species. Species particularly common in slow moving, overland flow watercourse.
Rarity/Distinctiveness	Low	No At Risk or Threatened species identified. Commonly found hydrophytic vegetation species identified. Wetland habitat is reduced in extent both regionally and nationally.
Diversity and Pattern	Low	Low diversity and complexity of vegetation types.
Ecological context	Low	Catchment dominated by rural and urban use. Wetland vegetation fed by stormwater and surface water runoff. Minimal provisioning of ecosystem services associated with typical wetland ecosystems.
		Overall value: **Low**

Figure 19. Riverine wetland systems identified within the project area at Shaft 8 (top) and Shaft 12 (bottom).

5.7 Potential Ecological Value

The NPS-FM (2022) requires that both the current ecological value and potential ecological value of freshwater systems is considered. When considering the potential value of the watercourses and wetlands in context of their current condition and in regard to restoration actions that could reasonably be undertaken at the site.

With respect to the permanent streams at the site, it is assumed that the riparian margins can be restored through fencing, replanting, and weed control . As the permanent streams have exiting riparian vegetation of low to moderate value currently providing woody debris inputs, habitat heterogeneity, scour and erosion protection, the additional restoration benefits are likely to result in a modest improvement resulting in no more than a moderate potential value.

Regarding the wetlands, as the palustrine and riverine hydrosystems are assessed to be of low value, restoration actions include fencing, weed control, and planting would result in modest improvements that are constrained by the ecological context of the sites and as such the potential value of the wetlands will be no more than moderate.

6 Ecological Impact Assessment

Ecological effects are associated with the temporary and permanent effects arising from the project works required to pipeline and tunnel installation for the Whenuapai Wastewater Servicing Scheme Package 1 works.

The assessment of ecological effects was undertaken in accordance with the EIANZ guidelines (2018). Level of effects are assessed as the product of **magnitude** (determined according to the duration of effects, the degree of change that will be caused and the extent of potential impact), and the ecological values impacted. The effects assessed are described in detail below.

The NPS-FM (2022) requires that both the current ecological value and potential ecological value of freshwater systems is considered. When considering the potential value of the watercourses and wetlands in context of their current condition and in regard to restoration actions that could reasonably be undertaken at the site[2]. As such, the effect of the proposed works on the potential ecological value of the wetlands and watercourses is also provided here.

An overall level of effect assessment and recommended management measures is provided in Table 12.

6.1 Overview of Proposed Works

The proposed works to construct Package 2 is expected to take approximately 36 months.

The Massey Connector pipeline, Northern Interceptor tunnel and pump station connection will be constructed using trenchless methods and will utilise an earth pressure balancing tunnel boring machine (TBM). At each of the seven shafts a construction yard will be built with the sizes varying across the areas. Vegetation clearance and earthworks are expected at each of the shaft locations to build the construction yards as well as construct the access road. Additionally, dewatering will be required for the construction of the shafts, but not during the operational period of the shafts. Refer to the AEE for drawings showing the location and construction area for each shaft.

6.2 Key Ecological Effects Overview

The key ecological effects are all expected during the construction phase of works and are considered to be temporary in nature. No long term (operational) effects are anticipated. The key (construction) effects include:

- Temporary degradation of riverine and palustrine wetland systems
- Potential effects on wetland and stream hydrology from temporary groundwater depletion activities
- Temporary degradation of aquatic habitat quality
- Potential disturbance, injury, and/or mortality of native fauna
- Temporary and permanent loss of riparian and terrestrial vegetation

6.3 Magnitude of Effects (unmitigated)

6.3.1 Temporary degradation of riverine and palustrine wetland systems

BPC

The proposed works at the BPC are expected to cover approximately 8,000 m^2 of the property. The construction and installation of the BPC will be a permanent structure; however, the site offices and

[2] Reasonable restoration actions can include fencing, indigenous re-planting, and weed management.

establishment of the construction yard will be temporary fixtures but will be within 100 m of the palustrine wetland system. There are two key effects identified that could cause degradation of the marsh wetland; the alteration of hydrology due to the installation of hardstand, and the smothering of the wetland from sediment runoff during earthworks.

In regard to the installation of hardstand, this will comprise of stripping the topsoil and replacing it with geotextile and compacted GAP65. The use of GAP65 is expected to provide for the permeability and filtration of water, and geotextiles can be used for filtration (range of grades and sizes). As such, the construction of the hardstand area at the BPC is expected to allow for the permeation and filtration of water into the ground although not to the same scale as the current grassy state.

Therefore, in regard to degradation of wetland hydrology, the proposed installation of the hardstand is not expected to result in any discernible changes to the hydrological input, therefore is assessed as a **Low** magnitude of effect, with an overall **Very Low** level of adverse effect.

However, in regard to sediment runoff, despite the works being temporary, without appropriate management measures the uncontrolled discharge of sediment has the potential to smother wetland vegetation. As such, the magnitude of effect is assessed as **Moderate**, with an overall **Low** level of effect.

When considering the potential value of the marsh wetland following reasonable restoration, this is expected to be no more than moderate. Therefore, the temporary degradation of the marsh wetland with a moderate ecological value, is expected to result in overall **Low to Moderate** level of effect.

Shaft 8

The proposed earthworks at the site have the potential to result in sediment runoff directly into the natural riverine wetland and potentially smothering wetland vegetation.

However, despite any sediment runoff during the construction phase being temporary, without appropriate management measures the uncontrolled discharge of sediment has the potential to smother wetland vegetation. As such, the magnitude of effect is assessed as **Moderate**, with an overall **Low** level of effect.

The potential value of the riverine wetland following reasonable restoration can be expected to be no more than moderate. As such, the effect of sediment runoff from temporary earthworks on the potential ecological value is assessed as **Moderate**.

Shaft 12

The construction of Shaft 12, which is within 100 m of the riverine wetland, is a temporary structure only and will require access roads to be formed to allow for the movement for heavy vehicles. The works at Shaft 12 are occurring within approximately 20 m of the riverine wetland and there is a narrow band of riparian vegetation between the shaft location and the wetland.

However, despite any sediment runoff during the construction phase being temporary, without appropriate management measures the uncontrolled discharge of sediment has the potential to smother wetland vegetation. As such, the magnitude of effect is assessed as **Moderate**, with an overall **Low** level of effect.

The potential value of the riverine wetland following reasonable restoration can be expected to be no more than moderate. As such, the effect of sediment runoff from temporary earthworks on the potential ecological value is assessed as **Moderate**.

6.3.2 Potential effects on wetland and stream hydrology from temporary groundwater depletion activities

The BPC and Shaft 8 will be permanent structures, whilst Shaft 12 will be a temporary structure (refer to AEE). The installation and establishment of these shafts will require dewatering activities including pumping out groundwater and discharging it into the surrounding environment (area undetermined yet).

The assessment provided within the Tonkin + Taylor *Groundwater and Settlement Effects Assessment* (dated June 2023) notes that dewatering across Shafts 8 and 12 as well as the BPC will not "*significantly impact upon groundwater hydrological conditions*" (Tonkin & Taylor Ltd, 2023a). Furthermore, it has been stated that "*No change in hydrological function and negligible, if any effect to surface groundwater level (top 2-3 meters) is expected to occur at adjacent waterbodies as a result of dewatering activities."*

Therefore, given the assessment provided by Tonkin + Taylor (2023), the dewatering activities undertaken at the BPC, Shaft 8, and Shaft 12 is expected to have a **Negligible** magnitude of effect, with an overall **Very Low** level of adverse effect on the existing value of the natural inland wetlands and watercourses located across Shaft 8, 12, and the BPC. As a result, no further management is deemed necessary.

Regarding the potential value of the wetlands and watercourses, additional restoration benefits are likely to result in a modest improvement resulting in no more than a moderate potential value. As such, the dewatering activities undertaken near the BPC and Shafts 8 and 12 are expected to have **Very Low** levels of effect on wetland and stream hydrology.

6.3.3 Temporary degradation of aquatic habitat quality within the watercourses

The proposed earthworks, and clearance of vegetation from within the riparian areas of Shaft 8 and 12, which are required to establish the contractor yards and construct the shafts has the potential to disturb soil and generate sediment that may discharge into the nearby watercourses. In regard to Shaft 8, this includes the Waiarohia and Trig Stream channels, and the intermittent stream at Shaft 12.

Sediment laden water generated during the construction phase may impact the ecological health of streams downstream of the project area. This includes reducing water clarity and light attenuation, smothering benthic organisms, reducing visibility for fish, and clogging the gills of fish.

Therefore, given the temporary timescale of the construction phase works and the short area of open stream adjacent to the project works area, the magnitude of effect is **Moderate**, with an overall **Low** level of effect. To minimise the uncontrolled release of sediment into nearby waterways, managed measures through erosion and sediment controls have been recommended in Section 7.

Regarding the potential value of the watercourses, the effect of sediment discharge on the Waiarohia Stream, Trig Stream, and the intermittent stream is expected to have an overall **Moderate** level of effect.

6.3.4 Potential disturbance, injury, and/or mortality of native terrestrial fauna

Terrestrial and riparian vegetation clearance is proposed across the sites for the establishment of contractor areas and is comprised of a mix of exotic and native species.

The proposed works across the Package 2 route is not expected to require any instream works. As such, there is no expectation for the direct injury and/or mortality of native freshwater species, and this has not been further discussed in this report.

Avifauna

Avifauna within proximity to the site are limited to commonly found native species and introduced species. Vegetation clearance of taller trees has the potential to cause disturbance to roosting species may cause them to disperse to nearby suitable habitats however, it is possible that clearance will result in the direct loss of nesting adults, eggs, and juveniles. Temporary noise and vibration disturbances from the construction phase of works are expected to have minimal effects on avifauna species and as such, this is assessed as a **Low** magnitude of effect, with an overall **Very Low** level of effect.

As some species of avifauna are protected under the Wildlife Act (1953) measures to avoid injury and mortality to nesting adults, eggs, and chicks will be required.

Herpetofauna

Any potential adverse impact on herpetofauna populations is expected to be associated with the direct injury and/or mortality on individuals should they be present, from vegetation clearance.

A majority of vegetation clearance for the installation of the shafts and accessway roads is mainly required at the BPC, Shaft, 8, 12, and 14, which comprises of low to moderate habitat quality for ground-dwelling ornate and copper skinks. The total vegetation clearance across these four sites is estimated to be 30,000 m^2. These areas have been outlined as areas of unmaintained areas with thick grassy vegetation, and areas of densely growing shrubby vegetation (native and exotic).

A majority of the surrounding landscape is highly modified and disturbed, however, as both ornate and copper skinks are known to reside with backyards and disturbed areas it is anticipated that there is suitable lizard habitat outside of these areas.

Given that the loss of potentially suitable lizard habitat along the pipeline route is limited to fragmented areas of modified vegetation and exotic shrubby areas, this is considered to have a low to moderate magnitude of effect, therefore a **Low to High** overall level of effect on the site's potential lizard population. Overall, a precautionary approach is recommended as all native herpetofauna are absolutely protected under the Wildlife Act (1953), therefore measures to avoid injury and/or mortality will be required.

Bats

Clearance of high-risk roost trees could potentially lead to the injury and/or mortality of individuals or colonies of bats by crushing them during tree felling, causing lethal levels of stress, or forcing them out of their roosts and exposing them to diurnal predators. The terrestrial vegetation proposed for clearance along the pipeline route is limited to few tall trees at Shaft 8,12, and 14 that are disconnected from any other areas of mature vegetation. Additionally, these areas comprise of primarily juvenile trees, with few mature native/exotic trees that may provide some, albeit limited, roosting habitat to bats.

Currently, bat information has been sourced from online database, and no site-specific surveys have been carried out. As such, a precautionary approach has been applied, and the magnitude of effect is assessed as **Moderate**, and the overall level of effect is **High.**

Nevertheless, as bats are absolutely protected under the Wildlife Act (1953), measures to avoid injury/mortality will be required. Recommendations for management and mitigation have been made to address these issues in Section 7.

6.3.5 Temporary and permanent loss of riparian vegetation

Some riparian vegetation clearance will be required to construct the shafts and associated structures (parking areas, access roads, etc.). It is anticipated that some this vegetation will be permanent as it is associated with permanent shafts and access roads.

A total of approximately 2,300 m^2 of riparian vegetation is proposed for clearance at Shafts 8, of this 330 m^2 is expected to be permanent. This comprises of primarily exotic species and pest plants.

At Shaft 12 there is expected to be temporary clearance of 150 m^2. The clearance comprises of plants that were planted at these locations between 10 -12 years ago, as well as grassy ground over vegetation and pest plants. The riparian vegetation is expected to provide some benefits to the stream including buffering against runoff from the surrounding environment, stream shading and organic inputs (leaf litter) into the stream, and bank stability.

Therefore, considering the small area of riparian clearance proposed, the relatively low diversity of vegetation within the works areas and dominance of grass and exotic plants, this is assessed to be a

Moderate magnitude of effect, with an overall **Low** level of effect. Recommendations to address permanent loss have been provided in Section 7.

6.3.6 Temporary and permanent loss of terrestrial vegetation and habitat

Terrestrial vegetation clearance will be required to construct the shafts and associated structures (parking areas, access roads, etc.). It is anticipated that some of this vegetation will be permanent where it is associated with permanent shafts, whilst most areas will be reinstated following completion of works.

A majority of the terrestrial vegetation is proposed for the BPC and Shafts 8, 12, and 14, and amounts to approximately 30,000 m^2. A majority of this vegetation comprises of thick exotic grassy cover, some mixed native and exotic trees, and exotic shrubby growth (pampas and gorse).

The terrestrial vegetation has low ecological value and there are expected to be limited ecological benefits provided by the primarily exotic and grassy vegetation cover. For this reason, clearance is assessed as a **Low** magnitude of effect with an overall **Very Low** level of effect, and no ecological management is considered necessary.

7 Effects Management Recommendations

The below sections provide recommendations for ecological management to remedy or mitigate the potential effects outlined in Section 6. The effects which meet the threshold for management are outlined below:

- Temporary degradation of riverine and palustrine wetland systems
- Temporary ddegradation of aquatic habitat quality
- Potential disturbance, injury, and/or mortality of native terrestrial fauna
- Removal of riparian vegetation habitat

A summary of the mitigated and unmitigated level of effects, and subsequent management measures is provided in Table 12.

7.1 Erosion and Sediment Control Plan

A Sediment and Erosion Control Plan has been prepared (Beca, 2023) which will be implemented to prevent sediment laden runoff entering watercourses. This has been prepared in accordance with industry best practice guidelines following the Auckland Council GD05: 'Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland. Additionally, it is recommended the works are carried out, as far as practicable, during the appropriate earthworks season.

7.2 Riparian Planting

A total of approximately 2,300 m^2 of riparian vegetation is proposed for clearance at Shaft 8, of which 330 m^2 is permanent, with 150 m^2 of temporary loss at Shaft 12. The clearance comprises of plants that were planted at these locations between 10 -12 years ago, as well as grassy ground over vegetation and pest plants. No vegetation is proposed for clearance within or within 10 m of the palustrine marsh wetland.

Where loss is expected to be permanent, it is recommended that compensation planting be undertaken of an equal value in terms of area of vegetation lost. This area of planting can be undertaken along the riparian margins of the streams at the site upon completion of works. This will increase the indigenous dominance in the local landscape, reduce the undergrowth of weedy vegetation through increased shading, and provide habitat for terrestrial native fauna.

This planting should be informed by a Riparian Planting Guide which will outline the implementation and maintenance programme for a minimum of five years, as well as a detailed planting methodology (which includes suitable plant species, spacing, time of planting, and plant numbers). This Plan should also specify post-planting maintenance activities and compliance monitoring to ensure the longevity of the planting.

7.3 Fauna Management

7.3.1 Avifauna

The clearance of mature trees and riparian vegetation will directly remove some habitat for native birds. Due to their high mobility, it is likely that direct impacts on adult birds will be largely avoided as they are expected to disperse to nearby suitable habitats during vegetation clearance activities. Potential impacts on nesting adult native birds, and both their eggs and unfledged chicks should be avoided by timing vegetation clearance to avoid nesting season where this is practicable (August to January inclusive).

If vegetation clearance during the peak of the bird breeding season is unavoidable, then in order to meet the requirements of the Wildlife Act (1953), vegetation should be checked by a suitably qualified ecologist for nesting birds immediately prior to vegetation removal and, if any active nests (i.e. one or more viable eggs or

live chicks are present) are detected, vegetation clearance in the immediate vicinity of the nest (e.g., within a 20m radius) should be delayed until a suitably qualified ecologist confirms that any nests present are no longer active.

7.3.2 Herpetofauna

Native herpetofauna are protected under the Wildlife Act (1953) and construction stage activities may disrupt herpetofauna species if present.

To meet the requirements of the Wildlife Act (1953), it is recommended a lizard survey is undertaken prior to vegetation clearance within suitable habitat areas and should be conducted by a suitably qualified herpetologist.

Should the survey identify native herpetofauna within the site, a Lizard Management Plan (LMP) will need to be developed and implemented by a DOC-permitted herpetologist, and prior to vegetation clearance activities, the risk of mortality or injury to native herpetofauna present at the site will need to be mitigated by relocating them to protected, suitable habitat. Should lizard salvage and relocation be required, typical actions are expected to be the capture and release by an experienced herpetologist, outside of winter months and in accordance with Department of Conservation Wildlife Authority requirements. A lizard release site will need to be secured and should be under pest control both prior to and following relocation. The release site should also be monitored for lizard presence, abundance and habitat suitability outside of winter months.

7.3.3 Bats

Despite the lack of bat data currently available within the wider area of the site there is likely some suitable bat habitat within or within proximity to the site. Additionally, long-tailed bats are known to utilise watercourses as movement corridors and mature canopy trees for roosting and foraging.

To meet the requirements of the Wildlife Act (1953), it is recommended that an initial bat survey and tree risk roost assessment be conducted by an appropriately qualified ecologist prior to the commencement of works. If any bat activity is detected, a Bat Management Plan (BMP) should be developed and implemented. The BMP will outline roost tree management, tree felling protocol, and appropriate mitigation for loss of roost trees.

7.4 Overall Level of Ecological Effects and Proposed Management

Table 12. Overall level of ecological effects and proposed management recommended.

Impact	Ecological Feature	Current Ecological Value	Potential Ecological Value	Unmitigated Level of Effect (towards current and potential ecological value)	Effects Management	Mitigated Level of Effect
Degradation of riverine and palustrine wetland systems	Palustrine and riverine wetlands	Low	Moderate	**Current:** Very Low to Low **Potential:** Low to Moderate	Erosion and Sediment Controls	Low to Very Low
Potential effects on wetland and stream hydrology from groundwater depletion activities	Palustrine and riverine wetlands	Low	Moderate	**Current:** Very Low **Potential:** Very Low	None	N/A
	Streams (Shaft 8 and 12)	Low	Moderate	**Current:** Very Low **Potential:** Very Low	None	N/A
Degradation of aquatic habitat quality	Streams (Shaft 8 and 12)	Low	Moderate	**Current:** Low **Potential:** Moderate	Erosion and Sediment Controls	Low to Very Low
Potential disturbance, injury, and/or mortality of native fauna	Avifauna	Low	Low	Low	Working outside of the peak bird nesting season, if possible.	Very Low
	Lizard	High	High	Low to High	Initial risk assessment for lizards and LMP if lizards are identified.	Low
	Bats	High	High	High	Initial bat survey and tree roost risk assessment, and BMP if bats are detected.	Low
Loss of vegetation	Riparian vegetation (streams and wetlands)	Low	Low	Moderate	Re-planting of riparian margins informed by a Riparian Planting Guide	Very Low
	Terrestrial vegetation	Low	Low	Very Low	None	Very Low

8 Conclusion

The Whenuapai Wastewater Servicing Scheme Package 2 project is part of the wider Whenuapai Wastewater Servicing Scheme, which aims to upgrade and improve the wastewater infrastructure to accommodate growth in the North West region of Auckland. However, due to the proximity of the Package 2 works in relation to sensitive ecological features, the range of construction activities proposed are expected to result in adverse ecological effects, if not properly addressed and managed.

However, with the implementation of the recommended management measures, the adverse effects can be managed so they are **Low to Very Low**, with no residual effects expected.

Effects management include:

- The implementation of sediment and erosion control measures during construction in general accordance with GD05.
- Vegetation clearance to occur outside of the bird nest season (August to January) as far as practicable.
- An initial pre-survey for herpetofauna within areas of vegetation clearance, including groundcover clearance. Depending on the findings of the survey, lizard salvage and relocation guided by a Lizard Management Plan may be required.
- An initial tree risk roost survey and pre-survey for long-tailed bats within areas of tree clearance. Should bat activity be detected, a Bat Management Plan will be required.
- Re-vegetation of riparian margins of watercourses and wetlands with eco-sourced native species, appropriate to the site.

Overall, a majority of the key ecological effects are expected to be temporary in nature and no significant long-term effects are anticipated.

9 References

Auckland Council. (n.d.). *Auckland Council Geomaps*. https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html

Auckland Council. (2021). *Auckland Unitary Plan - Practice and Guidance note for River / Stream Classification*. *17*(July), 1–23.

Auckland Council. (2023). *Auckland Council Environmental Data Portal*. https://environmentauckland.org.nz/Data/Location/Summary/Location/649818/Interval/Latest

Auckland Council Healthy Waters. (2017). Whenuapai 3 Precinct: Stormwater Management Plan. In *Auckland Council* (Issue September).

Ausseil, A.-G., Gerbeaux, P., Chadderton, W. ., Stephens, T., Brown, D., & Leathwick, J. (2008a). Wetland ecosystems of national importance for biodiversity: Criteria, methods and candidate list of nationally important inland wetlands. *Landcare Research Report*, *January*.

Ausseil, A.-G., Gerbeaux, P., Chadderton, W. L., Stephens, T., Brown, D., & Leathwick, J. (2008b). *Wetland ecosystems of national importance for biodiversity: Criteria, methods and candidate list of nationally important inland wetlands. Landcare Research Contract Report LC0708/158*. *June 2016*.

Bell, T., & Wiles, A. (2015). Describing lizard and frog distribution and species assemblages using the Ecological Districts framework. In *BioGecko* (Vol. 3).

Clarkson, B. (2018). *Wetland Delineation Protocols. Contract Report: LC3354.*

Clarkson, B., Ausseil, A.-G., & Gerbeaux, P. (2013). Wetland Ecosystem Services. *The Wetland Book: I: Structure and Function, Management, and Methods*, 323–333. https://doi.org/10.1007/978-90-%0A481-9659-3_66

Department of Conservation. (n.d.-a). *Atlas Species Information - Copper Skink.* https://www.doc.govt.nz/our-work/reptiles-and-frogs-distribution/atlas/atlas-details/?SpeciesID=13167

Department of Conservation. (n.d.-b). *Ornate Skink*. https://www.doc.govt.nz/nature/native-animals/reptiles-and-frogs/lizards/skinks/ornate-skink/

Dixon, O. (2020). *Spatial distribution survey of long-tailed bats (Chalinolobus tuberculatus) north of Hamilton City.* https://www.waikatoregion.govt.nz/assets/WRC/WRC-2019/survey-of-long-tailed-bats-Hamilton-City.pdf

Fraser, S., Singleton, P., & Clarkson, B. (2018). *Hydric soils - field identification guide* (Issue June).

Harper, I. H. W. (2020). *U . S . Army Corps of Engineers – Wetland Delineation Protocol Corps of Engineers* (Vol. 438).

Johnson, P., & Gerbeaux, P. (2004a). *Wetland Types in New Zealand*. *2*, 20–39.

Johnson, P., & Gerbeaux, P. (2004b). *Wetland Types in New Zealand*. *1*, 11–19.

Joy, M., Henderson, I. M. (Ian M., & Roygard, J. (2015). *A fish index of biotic integrity (IBI) for Horizons Regional Council : report and user guide for use with the Horizons Fish IBI excel macro*. *June*, 19.

Knox, C., Wairepo, J., Rate, S., & Shaw, W. (2019). *Guidance on methods to improve lizard protection and management during land use and development in the Wellington Region*. 32.

Leathwick, J. R., West, D., Gerbeaux, P., Kelly, D., Robertson, H., Brown, D., Chadderton, W., & Ausseil, A.-G. (2010). *Freshwater ecosystems of New Zealand (fenz) geodatabase. Users guide*. 57.

Maxted, J. R., & Stark, J. D. (2007). *A user guide for the Macroinvertebrate Community Index. Cawthron Report No. 1166.*

McDowall, R. M., & Richardson, J. (1983). *The New Zealand freshwater fish survey: a guide to input and output.* https://niwa.co.nz/freshwater-and-estuaries/nzffd/catchment-number-dictionary

McEwen, M. (1987). *Ecological regions and districts of NZ* (Vol. 5, Issue 5).

Ministry for the Environment. (2020). National Policy Statement for Freshwater Management 2020. *Publication Reference ME 1155 34p*.

Ministry for the Environment. (2022a). *Wetland delineation protocols*.

Ministry for the Environment. (2022b). *Wetland Delineation Protocols*. https://www.ptonline.com/articles/how-to-get-better-mfi-results

Ministry for the Environment. (2023). *National Policy Statement for Indigenous Biodiversity*. https://environment.govt.nz/assets/publications/biodiversity/National-Policy-Statement-for-Indigenous-Biodiversity.pdf

Morphum Environmental Limited. (2016). *Watercourse Assessment Report: Whenuapai Structure Plan Area.*

Mott MacDonald. (2022). *Northern Interceptor Phase 2 Westgate to Hobsonville: Geotechnical Interpretive Report Massey Connector Section* (Issue January).

New Zealand River Name Lines. (2019). https://data.linz.govt.nz/layer/103632-nz-river-name-lines-pilot/

Sullivan, B. L., Wood, C. L., Iliff, M. J., Bonney, R. E., Fink, D., & Kelling, S. (2009). eBird: a citizen-based bird observation network in the biological sciences. *Biological Conservation*, *142*, 2282–2292. https://science.ebird.org/en/atlasnz/use-ebird-data/citation

Tonkin & Taylor Ltd. (2023a). *Groundwater and Settlement Effects Assessment* (Issue 1015506).

Tonkin & Taylor Ltd. (2023b). *Whenuapai to Redhills Wastewater Servicing Package 2 Ground Contamination Detailed Site Investigation* (Issue 1015506).

1

Appendix 1 – Ecological Impact Assessment (EIANZ methodology)

Appendix 1: Ecological Impact Assessment Guidelines

Assigning Ecological Value

Freshwater and terrestrial habitat

The ecological values of freshwater and terrestrial systems (riparian vegetation, habitats and species present) potentially impacted by the works were assessed against the following attributes:

- Representativeness;
- Rarity or distinctiveness;
- Diversity or pattern; and
- Ecological context.

These attributes are described in Table 1.1 and Table 1.2 below.

Table 1.1. Matters that may be considered when assigning ecological value to a freshwater site or area.

Matters	Attributes to be assessed
Representativeness	Extent to which site/catchment is typical or characteristic. Stream order Permanent, intermittent or ephemeral waterway Catchment size Standing water characteristics
Rarity/distinctiveness	Supporting nationally or locally threatened, at risk or uncommon species National distribution limits Endemism Distinctive ecological features Type of lake/pond/wetland/spring
Diversity and pattern	Level of natural diversity Diversity metrics Complexity of community Biogeographical considerations - pattern, complexity, size, shape
Ecological context	Stream order Instream habitat Riparian habitat Local environmental conditions and influences, site history and development Intactness, health and resilience of populations and communities Contribution to ecological networks, linkages, pathways Role in ecosystem functioning – high level, proxies

Table 1.2. Attributes to be considered when assigning ecological value or importance to a site or area of vegetation/ habitat/community.

Matters	Attributes to be assessed
Representativeness	Criteria for representative vegetation and aquatic habitats: Typical structure and composition Indigenous species dominate Expected species and tiers are present Thresholds may need to be lowered where all examples of a type are strongly modified Criteria for representative species and species assemblages: Species assemblages that are typical of the habitat Indigenous species that occur in most of the guilds expected of the habitat type
Rarity/distinctiveness	Criteria for rare/ distinctive vegetation and habitats: Naturally uncommon, or induced scarcity Amount of habitat or vegetation remaining Distinctive ecological features National priority for protection Criteria for rare/ distinctive species or species assemblages: Habitat supporting nationally Threatened or At Risk species, or locally uncommon species Regional or national distribution limits of species or communities Unusual species or assemblages Endemism
Diversity and pattern	Level of natural diversity, abundance, and distribution Biodiversity reflecting underlying diversity Biogeographical considerations, considerations of lifecycles, daily or seasonal cycles of habitat availability and utilisation
Ecological context	Site history, and local environmental conditions which have influenced the development of habitats and communities The essential characteristics that determine an ecosystem's integrity, form, functioning, and resilience (form "intrinsic value" as defined in RMA) Size, shape and buffering Condition and sensitivity to change Contribution of the site to ecological networks, linkages, pathways and the protection and exchange of genetic material Species role in ecosystem functioning – high level, key species identification, habitat as proxy

The freshwater habitat features were assessed considering each of the attributes in Table 1.1, and terrestrial habitat features were assessed considering attributes in Table 1.2. Features of interest were subjectively given a rating on a scale of 'Very Low' to 'High' for each attribute and assigned a value in accordance with the description provided in Table 1.3.

Table 1.3. Rating system for assessing ecological value of terrestrial and freshwater systems (Roper-Lindsay et al. 2018)

Value	Description
Negligible	Feature rates Very Low for at least three assessment attributes and Low to Moderate for the remaining attribute(s).
Low	Feature rates Very Low to Low for most assessment attributes and moderate for one. Limited ecological value other than providing habitat for introduced or tolerant indigenous species.
Moderate	Feature rates High for one assessment attribute and Low to Moderate for the remainder, OR the project area rates Moderate for at least two attributes and Very Low to Low for the rest. Likely to be important at the level of the Ecological District.
High	Feature rates High for at least two assessment attributes and Low to Moderate for the remainder, OR the project area rates High for one attribute and Moderate for the rest. Likely to be regionally important.
Very High	Feature rates High for at least three assessment attributes. Likely to be nationally important.

Species

The EIANZ provides a method for assigning value (Table 1.4) to species for the purposes of assessing actual and potential effects of activities.

Table 1.4. Criteria for assigning ecological values to species

Ecological Value	Species
Very High	Threatened (Nationally Critical, Nationally Endangered, Nationally Vulnerable)
High	At Risk (Declining)
Moderate	At Risk – Recovering and At Risk – Naturally Uncommon
Low	Nationally and locally common indigenous species

Assigning Magnitude of Impacts

The magnitude of impacts is determined by the scale (temporal and spatial) of potential impacts identified and the degree of ecological change that is expected to occur as a result of the proposed activity (Roper-Lindsay *et al*. 2018).

Based on the assessor's knowledge and experience, the magnitude of identified impacts on the ecological values within the project area and zone of influence were assessed and rated on a scale of 'Very High' to 'Negligible' based on the description provided in Table 1.5.

Table 1.5. Criteria for describing the magnitude of effects (Roper-Lindsay et al. 2018)

Magnitude	Description
Very high	Total loss or very major alteration to key features of existing conditions, such that the post-development attributes will be fundamentally changed and may be lost altogether; and/or loss of a very high proportion of the known population or range of the feature.
High	Major loss or alteration of key features of existing conditions, such that post-development attributes will be fundamentally changed; and/or loss of a high proportion of the known population or range of the feature.
Moderate	Loss or alteration to one or more key features of the existing condition, such that post-development attributes will be partially changed; and/or loss of a moderate proportion of the known population or range of the feature.
Low	Minor shift away from existing conditions. Change arising from the loss/alteration will be discernible, but underlying attributes will be similar to pre-development circumstances; and/or having a minor effect on the known population or range of the feature.
Negligible	Very slight change from existing conditions. Change barely distinguishable, approximating “no change”; and/or having negligible effect on the known population or range of the feature.

Assessment also considered the temporal scale at which potential impacts were likely to occur:

- Permanent (>25 years).
- Long-term (15-25 years).
- Medium-term (5-15 years).
- Short-term (0-5 years).
- Temporary (during construction)

Assessing the Level of Effects

The overall level of effect on each ecological feature identified within the zone of influence were determined by considering the magnitude of impacts and the values of impacted ecological features (Roper-Lindsay *et al*. 2018).

Results from the assessment of ecological value and the magnitude of identified impacts were used to determine the level or extent of the overall impacts on identified ecological features within the project area and zone of influence using the matrix described in Table 1.6.

Table 1.6. Matrix combining magnitude and value for determining the level of ecological impacts (Roper-Lindsay et al. 2018).

Effect Level		Ecological and/or Conservation Value				
		Very High	**High**	**Moderate**	**Low**	**Negligible**
	Very High	Very High	Very High	High	Moderate	Low
Magnitude	**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

Results from the matrix were used to determine the type of responses that may be required to mitigate potential direct and indirect impacts within the project area and within the zone of influence, considering the following guidelines (Roper-Lindsay *et al*. 2018):

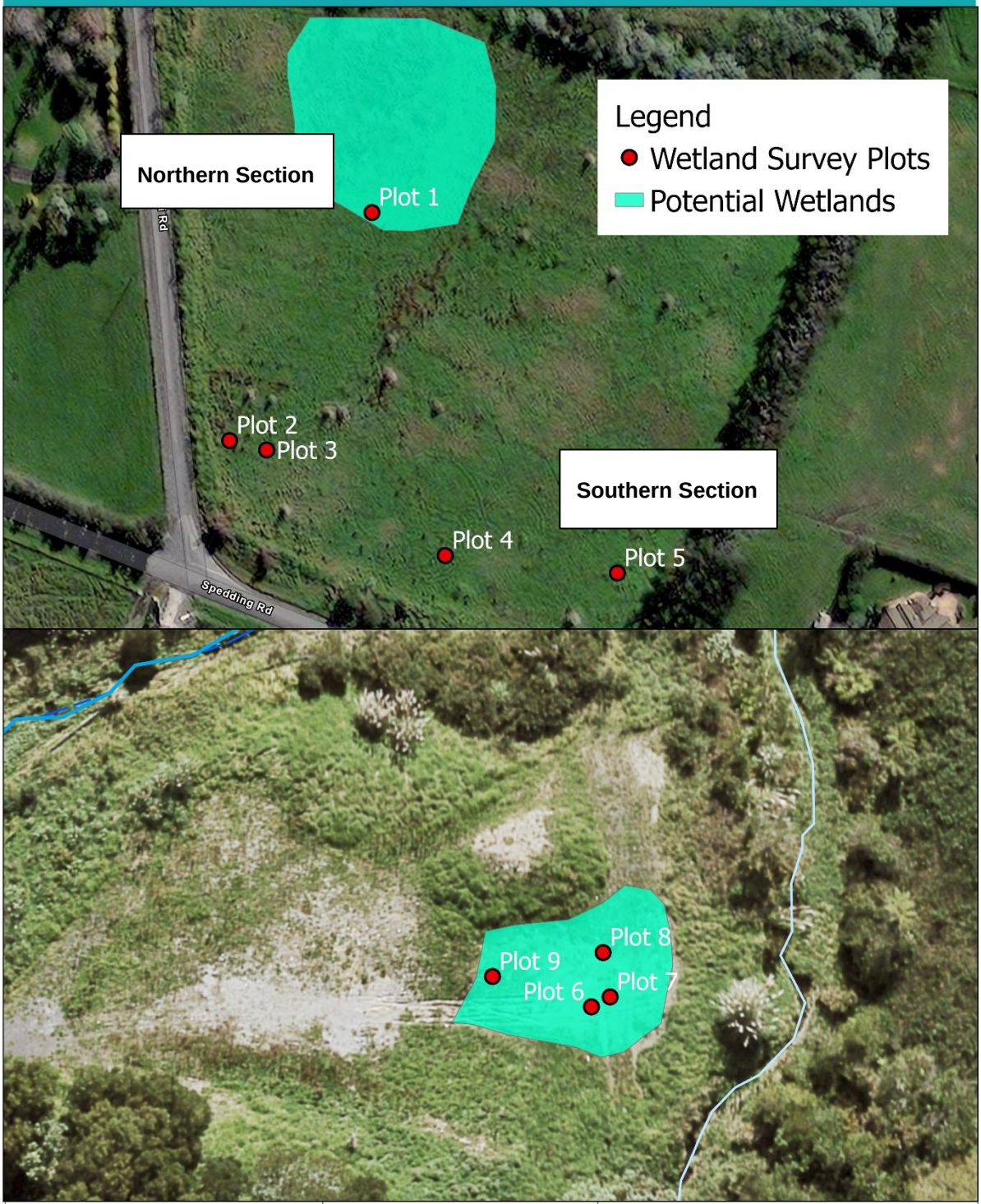
- A ‘Low’ or ‘Very Low’ level of impact is not normally of concern, though design should take measures to minimise potential effects.
- A ‘Moderate’ to ‘High’ level of impact indicates a level of impact that qualifies careful assessment on a case-by-case basis. Such activities could be managed through avoidance (revised design) or appropriate mitigation. Where avoidance is not possible, no net loss of biodiversity values would be appropriate.

A ‘Very High’ level of impact is unlikely to be acceptable on ecological grounds alone and should be avoided. Where avoidance is not possible, a net gain in biodiversity values would be appropriate.

2

Appendix 2 – Potential Wetlands and Plot Locations

Potential Wetlands and Survey Plots



Project: Whenuapai-Redhills Wastewater Servicing Scheme
Data Source: LINZ Aerial Imagery 2021

N

0 20 40 80 Meters

3

Appendix 3 – Wetland Delineation Plot Results

Site	Plot	Rapid Test	Pasture Test	Dominance Test	Prevalence Test	Vegetation Test	Hydric Soil Test	Hydrology	Classification	Justification
					BPC					
Southern Section	1	Fail	Pass	Fail	3.58	Fail	Not hydric	No hydrology features	Non – wetland	Fails both dominance and prevalence test.
	2	Fail	Fail	Pass	3.19	Uncertain	Not hydric	No hydrology features	Non – wetland	Passes dominance test and sits in the range of uncertainty for the prevalence test. Soils are clearly not hydric and there were no hydrology features observed.
	3	Fail	Fail	Pass	3.05	Uncertain	Not hydric	No hydrology features	Non – wetland	Passes dominance test and sits in the range of uncertainty for the prevalence test. Soils are clearly not hydric and there were no hydrology features observed.
	4	Fail	Fail	Pass	3.06	Uncertain	Not hydric	No hydrology features	Non – wetland	Passes dominance test and sits in the range of uncertainty for the prevalence test. Soils are clearly not hydric and there were no hydrology features observed.
Northern Section	5	Fail	Fail	Pass	2.88	Uncertain	Not hydric	Features met: 1A, 1B, 1C, 4B	Wetland	Passes dominance test and sits in the range of uncertainty for the prevalence test. Soils were highly saturated, and the area met features of the hydrology test. Area meets the criteria for a “natural wetland” under the

										NPS -FM. However, this area is likely heavily influenced by the recent rainfall.
Shaft 8										
	6	Fail	Fail	Pass	2.26	Pass	Non - wetland	Features met: 1A, 1C, 4A, 4B	Non-wetland	Vegetation, soil, and hydrology of the site are considered to be influenced by high rainfall in recent months and so, are the site is considered not representative of normal conditions.
	7	Fail	Fail	Fail	3.27	Uncertain	Non - wetland	Features met: 1A, 1C, 4A, 4B	Non-wetland	Same as Plot 6
	8	Fail	Pass	Fail	3.38	Uncertain	Non - wetland	Features met: 1A, 1C, 4A, 4B	Non-wetland	Same as Plot 6
	9	Fail	Fail	Pass	2.54	Uncertain	Non - wetland	Located on a slope	Non-wetland	Same as Plot 6

4

Appendix 4 – Borehole 1 and 2 Logs

Figure 4.1. Borehole logs from the proposed location for Shaft 8, including Borehole 1 (bottom) and Bore hole 2 (top).

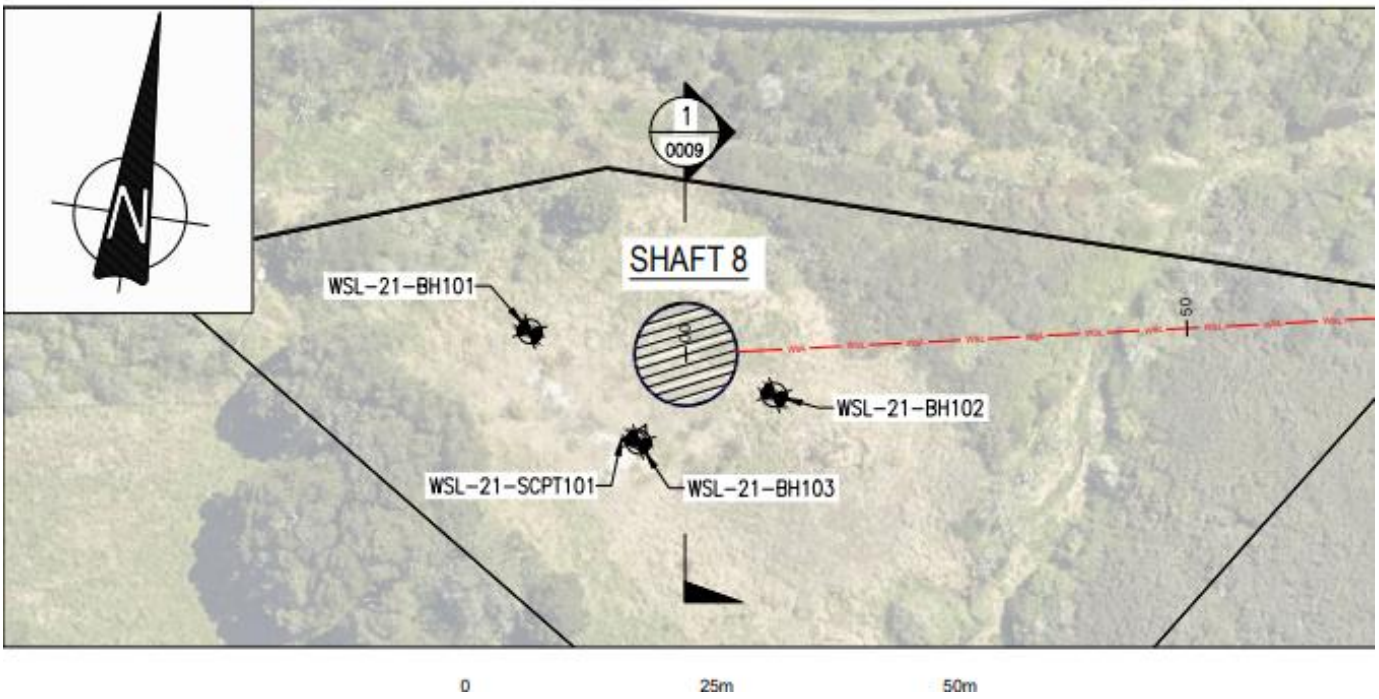


Figure 4.2. Location of boreholes collected at Shaft 8 in 2021.

5

Appendix 5 – Ecological Constraints Assessment