TE TUPU NGĀTAHI
SUPPORTING GROWTH

Trig Road Corridor Upgrade

Assessment of Ecological Effects

December 2022

Version 1

WAKA KOTAHI NZ TRANSPORT AGENCY

AT

New Zealand Government

Document Status

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Glossary of Defined Terms and Acronyms

Acronym/Term	Description
AEE	Assessment of Environmental Effects
ABM	Automatic Bat Monitor
AT	Auckland Transport
AUP:OP	Auckland Unitary Plan: Operative in Part
EcIA	Ecological Impact Assessment
EIANZ	Environment Institute of Australia and New Zealand
Impact Management	Includes the full range of actions taken to address adverse effects on indigenous biodiversity and ecosystems. This includes: • Avoid • Remedy (remediate, restore, rehabilitate, reinstate) • Mitigate • Offset • Compensate
NPS	National Policy Statement
NPS:FM	National Policy Statement on Freshwater Management 2020
NPS:IB	National Policy Statement for Indigenous Biodiversity 2019 (Draft)
NG	Net Gain
NNL	No Net Loss
NoR	Notice of Requirement
Project	Trig Road Corridor Upgrade Project
Project Area	Area that is located within the designation footprint
RMA	Resource Management Act 1991
SEA	Significant Ecological Area
TAR	Threatened or At Risk
Te Tupu Ngātahi	Te Tupu Ngātahi Supporting Growth Alliance
Waka Kotahi	Waka Kotahi New Zealand Transport Agency
ZOI	Zone of Influence

1 Executive Summary

Assessment Methodology

This assessment of effects on ecology has been undertaken in accordance with the Ecological Impact Assessment (EcIA) Guidelines, published by the Ecological Institute of Australia and New Zealand (Roper Lindsay et al., 2018) (hereinafter referred to as the EIANZ Guidelines) and best practice methodology. It utilises EIANZ Guidelines ecological value ratings (Very High, High, Moderate, Low, Very Low, and Negligible) to classify ecological features (i.e., aquatic, wetland and terrestrial habitats and their fauna), for the purposes of making an ecological assessment of Project impacts (Appendix 2). This is based on a relative scale and indicates the level of intactness or modification/damage to a feature or system. The aim of this approach is to protect the highest value features and to highlight more degraded systems where there is the potential for enhancement and restoration (if possible, within the Project scope or as part of possible compensation/offset proposals). Where features are unavoidable, this approach also allows prioritisation of features of greater value.

This report does not include an assessment of effects on Māori cultural values, Māori cultural matters may encompass a wider range of values than those covered in the report. This assessment does not denote the habitat or features of cultural value to Mana Whenua, and such assessments should only be made by Mana Whenua.

A desktop study was completed to identify existing records of native species and habitats that could be present within and adjacent to the Project Area and associated zone of influence (ZOI). These findings guided field assessment/effort, which included a high-level site walkover to classify habitats using Singers et al., 2017. A bat survey was completed to determine the presence or likely absence of long-tailed bats in the Project Area. No dedicated surveys were completed for native lizards and birds, however incidental site observations and habitat suitability appraisal was made. Where wetland habitat occurred, wetlands were delineated using the MfE (2020b) Wetland Delineation Protocols. Using the EIANZ Guidelines, ecological value was assigned, and assessment of the magnitude of effects was made, based on predicted impacts for construction and operation stages of the Project. Except where legislation or policy dictates the requirement for impact management, impact management was recommended where the overall level of effect (value x magnitude) was considered to be **Moderate** or greater. Where residual effects remain, these have been addressed through offset/compensation.

Ecological Baseline

Aquatic, wetland, and terrestrial features were described based on desktop and site investigations. A summary of ecological features and their value within the Project Area are provided in Table 1-1.

Table 1-1 Summary of ecological features and their value for aquatic, wetland and terrestrial habitat and associated fauna within the Project Area

Ecological Feature	Ecological Value
Aquatic Ecology	
TR-S1 (associated with TR-W3) TR-S2 (associated with TR-W1)	Low

Ecological Feature	Ecological Value
TR-S3 (associated with TR-W4) W5-S2 (associated with TR-W7)	
Wetland Ecology	
TR-W1, TR-W2, TR-W3, TR-W7	Low
TR-W4, TR-W5&W6	Moderate
Terrestrial Ecology (Flora)	
Brown Field (BF) Exotic Grassland (EG)	Negligible
Planted Vegetation – Native (recent) (PL.1) Planted Vegetation – Exotic/Native (amenity) (PL.3) Treeland – Exotic Dominated (TL.3)	Low
Terrestrial Ecology (Fauna)	
Long-tailed bat	Very High
Non-TAR bird	Low
North Island fernbird	High
Copper skink	High

Assessment of Ecological Effects and Impact Management

The overall level of effect from the construction and operation of the Project to aquatic, wetland and terrestrial habitats and associated fauna was calculated (prior to and after impact management) as per the EIANZ Guidelines.

Terrestrial Ecology

The terrestrial vegetation within the Project site is of **Negligible** to **Low** ecological value. There are no construction or operational effects for terrestrial ecology where the level of effect was assessed to be **Moderate** or higher, however habitat is provided to native fauna including:

- Long-tailed bats (**Very High** ecological value)
- Non-TAR native birds (**Low** ecological value)
- North Island fernbird (**High** ecological value)
- Copper skink (**High** ecological value)

During vegetation removal there is the potential to kill/injure native fauna. All native fauna is protected by the Wildlife Act 1953; therefore, this effect will need to be avoided and mitigated.

Aquatic Ecology

All works (excluding minor stormwater outfall works) will be outside the riparian setback and therefore no instream works will occur. Therefore, potential effects on instream habitat due to hydrology and water quality impacts during construction and operation have been assessed for the corresponding wetland.

Wetland Ecology

Where possible the Project has minimised impacts on wetlands, however, the reclamation of the upper portions of TR-W1 and TR-W4 during construction is unavoidable. The loss of TR-W4 is considered a **Moderate** level of effect therefore impact management is required, however, the loss of TR-W1 and TR-W4 also requires impact management as a result of the NPS:FM requirements. The loss of these wetlands can be sufficiently offset through wetland habitat restoration and wetland margin planting of the lower portions of the respective wetlands within the Project designation. The proposed wetland offset areas will allow the Project to achieve No Net Loss in ecological value.

2 Introduction

2.1 Background

Auckland's population is growing rapidly; driven by both natural growth (more births than deaths) and migration from overseas and other parts of New Zealand. The Auckland Plan 2050 anticipates that this growth will generate demand for an additional 313,000 dwellings and require land for approximately 263,000 additional employment opportunities.

In response to this demand, the Auckland Unitary Plan Operative in Part (AUP:OP) identifies 15,000 hectares of predominantly rural land for future urbanisation. To enable the urban development of greenfield land, appropriate bulk infrastructure needs to be planned and delivered.

The Supporting Growth Programme is a collaboration between Auckland Transport (AT) and Waka Kotahi NZ Transport Agency to investigate, plan and deliver the transport network needed to support Auckland's future urban growth areas over the next 30 years.

2.2 Purpose and Scope of this Report

Trig Road, Whenuapai has been identified in the Supporting Growth Programme as a future arterial corridor that is needed to support the urban development of Whenuapai.

This report has been prepared to support AT's notice of requirement (NoR) and application for resource consents for the Trig Road Corridor Upgrade (the Project). The NoR under the Resource Management Act 1991 (RMA) is to designate land for the construction, operation and maintenance of the Project.

Funding for the upgrade of Trig Road between Hobsonville Road and State Highway 18 (SH18) has been made available through the Housing Infrastructure Fund[1]. As there is funding available for construction, AT are also applying for the necessary resource consents under the RMA, concurrently with the NoR process.

This report provides an assessment of ecological effects associated with the construction, operation and maintenance of the Project. This assessment has been prepared to inform the Assessment of Environmental Effects (AEE) for the NoR and resource consent application.

The key matters addressed in this report are as follows:

(a) Identify and describe the existing and potential ecological environment and associated ecological values;

(b) Describe the actual and potential adverse ecological effects associated with construction and operation of the Project;

(c) Recommend measures as appropriate to avoid, remedy or mitigate actual and potential adverse ecological effects (including any conditions/management plan(s) required);

[1] See North West Housing Infrastructure Fund Assessment of Environmental Effects for further detail regarding the Housing Infrastructure Fund.

(d) Recommend measures to offset or compensate for any residual effects that cannot be avoided, remedied or mitigated (including any conditions/management plan(s) required); and

(e) Present an overall conclusion of the level of actual and potential adverse ecological effects of the Project after recommended measures are implemented.

3 Project Description

The Project consists of the widening and upgrade of Trig Road between the SH18 off-ramps and Hobsonville Road. The widening has capacity to provide for a two-lane arterial standard corridor including new footpaths on both sides of the road and a cycleway which is indicatively shown as a dedicated bi-direction cycleway on the eastern side of the corridor. The Project will upgrade the current rural standard corridor to an urban standard, which is appropriate to support the soon to be urban environment on either side of Trig Road.

To tie into the existing road network, the Project also includes the signalisation of the intersections at Trig Road/Hobsonville Road and Luckens Road/Hobsonville Road and upgrade of Hobsonville Road between these intersections. This will require some localised widening of the road corridor along Hobsonville Road.

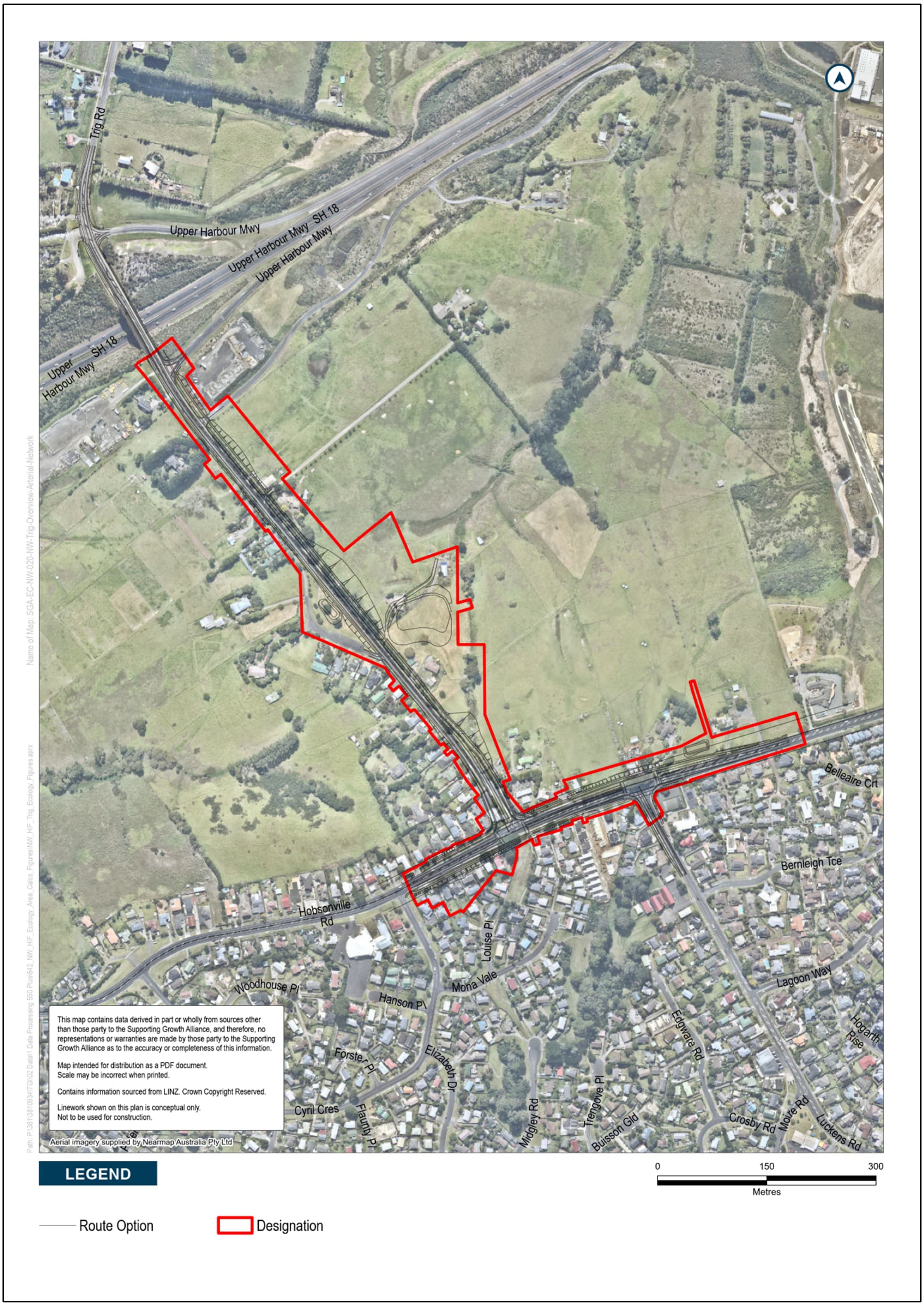


Figure 3-1 Overview of Trig Road Corridor Upgrade

3.1 Project Features

The features of the Project that have the potential to impact on ecological values include:

- The widening of the existing road corridor by 4 m, including a cycleway and footpath;
- Construction of a dry stormwater retention pond;
- Culverting/piping of a wetland, and associated disturbance that may result in the loss of wetland habitat;
- Construction machinery and earthworks within the Project area;
- Street lighting; and
- Upgrades to existing culverts.

3.2 Indicative Construction Methodology

An indicative construction methodology has been prepared to inform the assessment of the Project and while subject to change, assists in determining the envelope of effects. An overview of the indicative construction methodology is set out in the AEE. The final construction methodology for the Project will be confirmed during detailed design phase and finalised once a contractor has been engaged for the work.

A summary of the key components of the indicative construction methodology that are relevant to this report are outlined in the sub-sections below.

3.2.1 General Construction Overview

The total construction phase of the Project is expected to take approximately 18 to 24 months. It is anticipated that the works will be broken down into separate construction zones based on the type of works required and the nature of the work environment. These anticipated zones are:

- Zone 1: Trig Road North of the SH18 bridge
- Zone 2: Trig Road South including the SH18 bridge
- Zone 3: Hobsonville Road

3.2.2 Construction Methodology

Each zone has different construction activities depending on the type of work to be done and the surrounding environment. In all cases the general sequence of construction is likely to be:

1. Divert or remove services
2. Construct permanent and temporary stormwater drainage and controls
3. Move traffic away from works longitudinally
4. Construct earthworks and any retaining structures
5. Construct new longitudinal drainage
6. Construct new pavement to half of the road
7. Move traffic onto newly constructed pavement
8. Complete longitudinal drainage
9. Complete pavement and median
10. Move traffic to new alignment
11. Complete footpath and cycleway

4 Statutory Context

4.1 Notice of Requirement

This assessment has been prepared to support the NoR process for the Project. Section 171 of the RMA sets out the matters that must be considered by a territorial authority in making a recommendation on a NoR. This includes consideration of the actual or potential effects (including positive effects) on the environment of allowing the requirement.

4.2 Resource Consent Application

AT are also seeking regional resource consents under the AUP:OP and resource consents under the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health and National Environmental Standard for Freshwater.

Overall, the application is assessed as a Discretionary Activity

5 Receiving Environment

5.1 Approach to the Receiving Environment

A key objective of the Supporting Growth Programme is to protect land now to ensure that the transport networks required to support growth areas in the future, around Auckland, can be provided in an efficient and co-ordinated manner. This Project supports the development of housing in the immediate vicinity of Trig Road and has funding to be constructed in the near future.

In the context of an RMA assessment process, considering the environment as it exists today will not be a true reflection of the real-world environment in which the transport corridor will operate. Accordingly, when considering the environment within which the effects of the construction and operation of the transport corridor are likely to occur, this assessment considers both the existing environment and the likely future environment for the Project Area.

The following outlines the key elements of the planning context for the Project:

- The existing corridor for Trig Road is approximately 20 m wide and zoned 'Road' under the AUP:OP.
- The proposed designation will be wider than the existing corridor to provide for the construction and operation of a 24 m wide transport corridor cross section, and additional space for construction activities and mitigation.

Table 5-1 sets out the likely future receiving environment of the Project. This rezoning signals a high probability of land use change over time for the majority of the Project Area from the current mostly rural character to higher density urban development. This 'likely future receiving environment' has been used to inform this assessment.

Table 5-1 Whenuapai – Trig Road Corridor Upgrade Likely Receiving Environment

Whenuapai – Trig Road Corridor Upgrade Likely Receiving Environment	
Residential – Mixed Housing Urban Zone	• 'Reasonably high-intensity zone enabling greater intensity of development than previously provided for'. • Development 'typically up to three storeys in a variety of sizes and forms including detached dwellings, terraced housing and low-rise apartments'.
Residential – Terraced Housing and Apartment Building Zone	• 'A high-intensity zone…providing for urban residential living in the form of terraced housing and apartments…with the greatest density, height and scale of development of all the residential zones'. • Buildings enabled up to five, six or seven storeys. • 'Predominantly located around metropolitan, town and local centre zones and the public transport network', also providing for a range of non-

Whenuapai – Trig Road Corridor Upgrade Likely Receiving Environment	
	residential activities within an 'urban residential character'.

5.2 Existing and Future Environment Specific Context

The existing environment within the Project area is mostly highly modified rural land uses. The intersection of Trig Road and Hobsonville Road is an existing urban environment, with housing extending up the lower portion of the western side of Trig Road.

Remaining habitat in the locality of the Trig Road corridor within the Project Area is limited to small patches of remnant native forest and scattered native and exotic trees, streams and freshwater wetlands, dominated by exotic plant species. The Project Area is in relatively close proximity (approximately 1-2 km away), but not directly abutting, estuarine and harbour ecosystems.

It is anticipated that the Project will be constructed before or at the same time as urban development begins to occur in the vicinity. As such the effects of the road development and urbanisation on the natural environment may be cumulative rather than independent from each other.

This assessment assesses the construction impacts on the existing mostly rural environment, through which the construction will occur and the operational impacts on a future urbanised environment within which the Project will operate.

Historically in Auckland the Ministry for the Environment has observed that as land use changes from rural to urban the condition of streams has declined and there has been a loss of remaining native vegetation. However, the AUP:OP and NES:FW/NPS:FW place greater emphasis on the protection and enhancement of existing watercourses and require that these are accommodated within the future urban environment. Accordingly, it is assumed that in a future urbanised scenario stream corridors and areas of indigenous vegetation will be largely retained. It is also assumed that where practicable stormwater design will be integrated into the green network and sediment and pollutants will be controlled at source.

6 Assessment Methodology

This ecological impact assessment has been undertaken in general accordance with the EIANZ Guidelines and best practice methodology. It utilises EIANZ Guidelines ecological value ratings (Very High, High, Moderate, Low, Very Low, and Negligible) to classify ecological features (i.e., aquatic, wetland and terrestrial habitats and their fauna), for the purposes of making an ecological assessment of Project impacts (Appendix 2). This is based on a relative scale and indicates the level of intactness or modification/damage to a feature or system. This approach aims to protect the highest value features and to highlight more degraded systems where there is the potential for enhancement and restoration (if possible, within the Project scope or as part of possible compensation/offset proposals). Where features are unavoidable, this approach also allows prioritisation of features of greater value.

This report does not include an assessment of effects on Māori cultural values, Māori cultural concerns may encompass a wider range of values than those covered in the report. This assessment does not denote the habitat or features of cultural value to Mana Whenua, and such assessments should only be made by Mana Whenua.

6.1 Preparation for this Report

A desktop review was also undertaken to inform this report (Section 6.5) and field surveys were completed by AECOM Ecologists in December 2019, and September 2022. Full details on survey methodologies are provided in Section 6.6 to 6.8. These surveys formed the basis for the results which are presented in the 'Ecological Baseline' in Section 7.1.

6.2 Relevant Standards and Guidelines

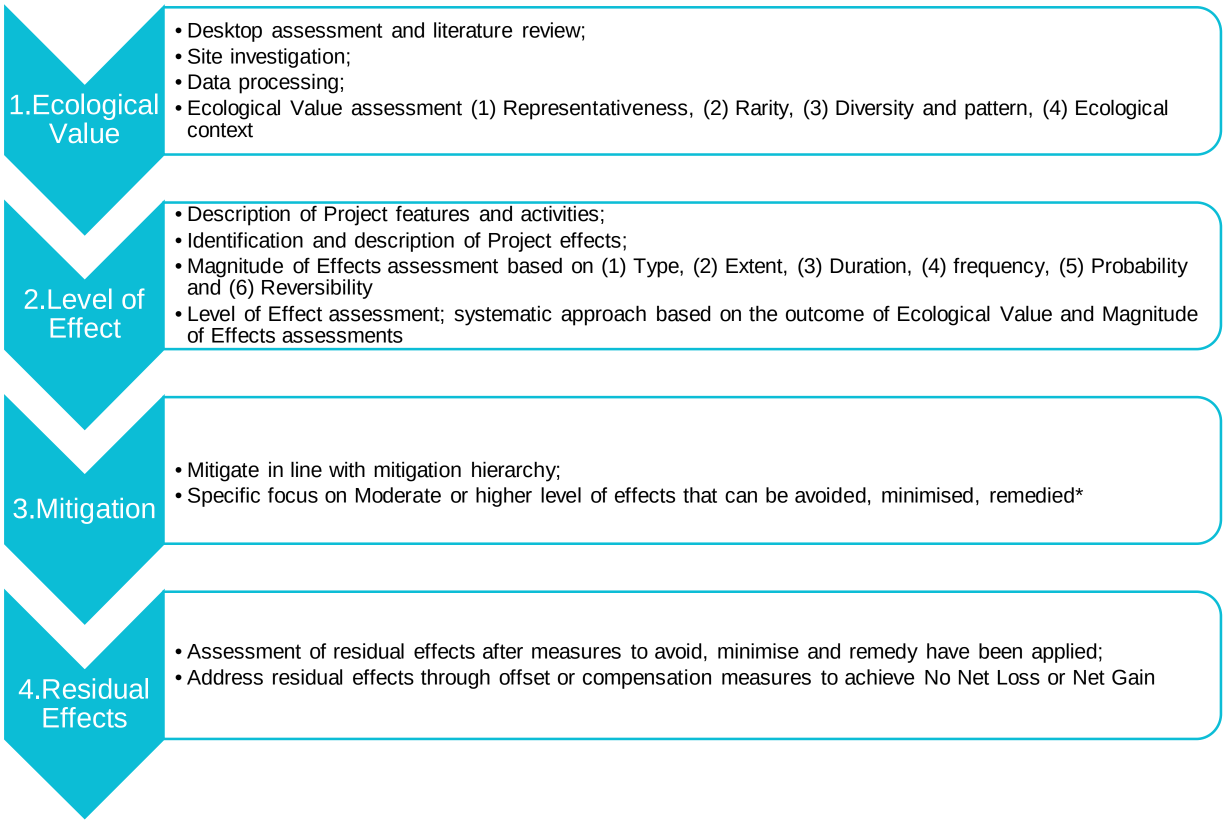
A list of relevant legislation, policy, plans and strategies for this assessment are presented below. A more detailed summary is provided in Appendix 1:

- Resource Management Act 1991;
- Wildlife Act 1953;
- National Policy Statement for Freshwater Management (Ministry for the Environment, 2020a);
- Auckland Unitary Plan Operative in Part 2016 (Auckland Council, 2016);
- New Zealand Biodiversity Strategy (Department of Conservation & Ministry for the Environment, 2000);
- Protecting Our Places (Department of Conservation & Ministry for the Environment, 2007);
- Auckland Conservation Management Strategy 2014-2024 (Department of Conservation, 2014);
- Auckland Council Indigenous Biodiversity Strategy (Auckland Council, 2012);
- New Zealand's Fish Passage Guidelines (Franklin, et al., 2018); and
- EcIA Ecological Institute of Australia and New Zealand (EIANZ) guidelines for use in New Zealand: Terrestrial and freshwater ecosystems (Roper Lindsay et al., 2018).

6.3 Ecological Impact Assessment Approach

The approach followed for this ecological impact assessment (EcIA) for Project activities is consistent with the methodology outlined in the EIANZ Guidelines.

The EcIA approach is represented in Figure 6-1 and is summarised in Appendix 2.



* The Wildlife Act 1953 must be complied with, as such management measures must always be implemented to ensure that Project activities do not injure or kill native wildlife.

Figure 6-1 EcIA approach followed for this assessment (Appendix 2)

6.4 Project Area and Zone of Influence

The Project has been described in Section 3. ‘Project Area’ has been used within this report as a term to describe the area that is located within the designation footprint.

The Zone of Influence (ZOI) of the Project relates to an area occupied by habitats and species that are adjacent to and may go beyond the boundary of the Project Area. It is defined in the EIANZ Guidelines as “the areas/resources that may be affected by the biophysical changes caused by the proposed Project and associated activities.” The distance of the ZOI and type of effect from the Project can be different for different species and habitat types. ZOI is used throughout this report to describe the impacts of the Project (construction and operation) on adjacent or connected terrestrial, freshwater and wetland habitats and associated (often highly mobile) native species. This includes indirect effects on sensitive receiving environments and the potential for protected fauna and flora to be present within or adjacent to the Project Area.

The ZOI of the Project on different species differs depending on how they use their environment e.g., mobile species such as long-tailed bats have a larger home range and more diverse habitat requirements compared to lizards and threatened plant species which may be restricted to a small area or specific habitat type. This affects how a species could be impacted by the Project and this was taken into consideration during the desktop review and site investigations. To reflect the likelihood of a species occurring or dispersal ability within the Project Area, varying search distances were used depending on the species context. The size of this search area is stated alongside any species or habitat records identified within the relevant sections of this report. ZOI is also relevant to habitats, as indirect impacts on the receiving environment such as sedimentation of waterbodies could affect habitats far beyond the Project Area. Similarly, habitats which require permanent or intermittent inundation such as wetlands could be negatively impacted by changes to hydrology as a result of Project design.

6.5 Desktop Review

A desktop review of existing ecological records was undertaken to gain an understanding of the aquatic, wetland[2] and terrestrial habitats and species that could be present within the ZOI of the Project Area.

The sources of information that were reviewed to determine the likelihood of a species or habitat occurring within or adjacent to the Project Area included:

- Auckland Council Geomaps[3];
- Department of Conservation (DOC) Bioweb records[4];
- Department of Conservation Threat Classification Series[5];
- Ecological Regions and Districts of New Zealand (McEwen, 1987);
- iNaturalist records[6], within approximately 5 km radius from each NoR. GPS coordinates are 'obscured' for Threatened species which may affect the accuracy of records within the study area;
- Indigenous terrestrial and wetland ecosystems of Auckland (Singers et al., 2017);
- National Institute of Water and Atmospheric Research (NIWA) freshwater fish database;
- New Zealand Bird Atlas eBird database[7]; recorded within 10 km^2 grid squares;
- Supporting Growth Alliance (SGA) – North West – Assessment of Ecological Effects (SGA, 2022a; SGA, 2022b).

6.6 Aquatic Ecology Assessment Methodology

6.6.1 Site Investigations

Field surveys were completed in December 2019 and September 2022 for watercourses associated with the Project Area. Section 6.6.2 outlines the specific methodology employed to determine baseline

[2] The RMA defines wetland as including *'permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions'*.

The NPS:FM excludes wetlands which do not meet its definition of '*natural wetlands'* as:

a) a wetland constructed by artificial means (unless it was constructed to offset impacts on, or restore, an existing or former natural wetland); or b) a geothermal wetland; or c) any area of improved pasture that, at the commencement date, is dominated by (that is more than 50% of) exotic pasture species and is subject to temporary rain derived water pooling.

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

[4] https://www.doc.govt.nz/our-work/monitoring-reporting/request-monitoring-data/

[5] All Department of Conservation Threat Classification Documents are listed in the below webpage. When individual reports are referenced hereafter, they are referenced in-text. https://www.doc.govt.nz/about-us/science-publications/conservation-publications/nz-threat-classification-system

[6] https://www.inaturalist.org/

[7] https://ebird.org/atlasnz/home

conditions and ecological value. A short summary of the freshwater field assessments is provided below. For a detailed methodology refer to Appendix 3.

- General notes on the stream and river including name, catchment, hydrological regime, channel morphology, cross-sectional features, and REC classification based on the River Environment Classification (REC) (Snelder et al., 2004);
- Stream classification as per Storey and Wadhwa (2009) into ephemeral, intermittent and permanent hydroperiods (Appendix 3, Section 3.1);
- No streams are directly impacted by the Project. Therefore, the Rapid Habitat Assessment methodology (Clapcott, 2015) was used for streams to inform ecological condition to understand indirect effects. In the Project Area, streams are associated with wetland complexes (and the hydrology is mainly wetland). The reference state is likely to be inconsistent with what is presumed within the Stream Ecological Valuation (SEV) model, and the hydrology was mainly wetland.

6.6.2 Assessing Aquatic Ecological Value

The different aquatic ecological assessment methods were applied to inform the ecological value (ranging from **Negligible** to **Very High**) of rivers and streams within the ZOI and are consistent with the EIANZ Guidelines. This was done by using all or selected parts of different methods (Table 6-1) to inform matters influencing the ecological importance and sensitivity of the receiving environment (Figure 6-1). Each EcIA 'Matter' and corresponding method/s used to inform the matter are summarised in Table 6-1. To help inform the effects assessment, fish have been assigned a separate ecological value which corresponds to the ecological value of the river/stream it likely occupies.

Table 6-1 Summary of how different methods of assessment have been applied to inform aquatic ecological value

EcIA Matter	Rapid Habitat Assessment	Fish community (desktop assessment)
Matter 1 Representativeness	✓	✓
Matter 2 Rarity/distinctiveness		✓
Matter 3 Diversity and pattern	✓	
Matter 4 Ecological context		✓

6.7 Wetland Ecology Assessment Methodology

6.7.1 Site Investigation

Wetlands were delineated in September 2022 as per the MfE (2020b) Wetland Delineation Protocols. This included reference to Clarkson (2018), Fraser et al. (2018) and MfE's Hydrology Tool (2021). Wetland habitats were initially classified based on Singers et al. (2017), to describe the wetland habitats present based on vegetation assemblage within and adjacent to the Project Area.

Potential wetlands were identified and delineated on desktop prior to field verification. All wetlands within 100 m of the Project designation were delineated. Wetlands potentially affected by the project activities were included within the field verification. For the field verification the wetland delineation was based on sampled quadrats, within and across vegetation types. Representative vegetation plots were sampled for each plant community observed, using a 2m × 2m quadrat. Estimate % cover was recorded for each species within each quadrats.

Wetland extent was then delineated based on the dominance of hydrophytic plants according to Clarkson (2018). This classifies plant species, according to fidelity to wetland soil conditions, into the following groups: obligate wetland (OBL: occurs almost always in wetlands), facultative wetland (FACW: occurs usually in wetlands), facultative (FAC: equally likely in wetlands or non-wetlands), facultative upland (FACU: usually in no wetlands) or obligate upland (UPL: almost always in non-wetlands). The dominance and prevalence of OBL, FACW and FAC species are then assessed through the Dominance Test (i.e., wetland plant species >50%) and Prevalence Index. In instances where the Dominance Test mainly consists of FAC species, the presence of hydric soils was used to inform the Prevalence Index. A Prevalence Index score below 3 confirmed the presence of a wetland. For vegetation plots where results are ambiguous, the delineation then relied on wetland soil and hydrology characteristics.

The vegetation quadrats were also used to inform NPS:FM exclusions, for exotic pasture species. Potential exclusion from an NPS:FM natural wetland was tested where pasture species[8] were dominant (>50%) and rain derived soil saturation was considered temporary. Additionally, where a wetland was identified to be constructed by artificial means this was also excluded (Appendix 1, Section 1.2.1).

All wetlands delineated were subject to a wetland condition assessment to inform ecological value. This was done using the method outlined by Clarkson et al. (2004) and augmented with a wetland condition classification adopted from Kleynhans (2007) (Appendix 3, Table 9-7) which assesses direct modification to the wetland (Appendix 3, Table 9-7) and impacts within its wider catchment (Appendix 3, Table 9-8). The functional importance of wetlands was also assessed through the application of Brinson's (1993) hydrogeomorphic (HGM) classification, while the functional value of each HGM (in terms of flood attenuation, stream flow regulation, water quality enhancement and carbon storage) was inferred from Kotze et al. (2007). The different HGM types and associated functional values are provided in Appendix 3.

6.7.2 Assessing Wetland Ecological Value

The different wetland assessment methods described in Section 6.7.1 were applied to inform the ecological value (ranging from **Negligible** to **Very High**) of wetland habitat associated with the Project Area and were consistent with the EIANZ Guidelines. This was done by using all or selected parts of different methods employed to inform matters influencing the ecological importance and sensitivity of the receiving environment (Figure 6-1). Each ecological EcIA 'Matter' and corresponding method/s used to inform the matter are summarised in Table 6-2.

[8] Technical guidance for the determination of natural wetlands under Greater Wellington's proposed Natural Resources Plan. Available: http://www.gw.govt.nz/assets/Biodiversity/Wetland-Technical-Determination.pdf

Table 6-2 Summary of how different methods of assessment have been applied to inform wetland ecological value

EcIA Matter	Vegetation type (Singers et al., 2017)	Functional value[9] (Kotze et al., 2007)	Wetland Condition Index (Clarkson et al., 2004)
Matter 1 Representativeness			✓
Matter 2 Rarity/distinctiveness	✓		
Matter 3 Diversity and pattern	✓	✓	
Matter 4 Ecological context		✓	

6.8 Terrestrial Ecology Assessment Methodology

6.8.1 Site Investigation

6.8.1.1 Vegetation Communities and Habitats

Site walkovers were undertaken in December 2019, and September 2022 by experienced ecologists to map and describe the habitats[10] present within and adjacent to the Project Area. Habitats were classified into ecosystem type based on those described in Singers et al. (2017). The habitats were also assessed as to their potential to support native fauna, including birds, bats, lizards, fish and macroinvertebrates.

Habitat assessment focused on areas of potentially significant value, such as stream corridors and areas of vegetation (trees, scrub) based on aerial photos and during site investigation. Species records from relevant literature and biodiversity databases were utilised to focus search efforts on certain areas within the Project Area.

Broad indigenous vegetation communities were mapped on recent aerial photography and incorporated into the Project's GIS database. The vegetation assessment included recording the dominant or characteristic species present and the general quality described, including structure, maturity, presence of weeds and evidence of disturbance.

6.8.1.2 Terrestrial Fauna

Incidental observations of any native species seen during site walkover were recorded. For lizard species, this included incidental searches of natural/artificial refugia, such as turning over logs/wood/corrugated iron on the ground. For birds, incidental observations were made during other field surveys for forest or wetland bird species.

[9] Functional wetland values were informed by generic wetland functions including flood attenuation, stream flow regulation, sediment trapping, water purification, erosion control and carbon storage associated with different HGM units based on Kotze et al. (2007)

[10] Ecosystem codes from Singers et al. (2017) were used to describe the habitats encountered on site.

To determine the presence or likely absence of long-tailed bats in the Project Area, two Automatic Bat Monitors (ABMs) (SM4BAT FS with SMM-U2 microphone) were placed along vegetated linear features, where bats were most likely to be foraging (in accordance with recommendations from Borkin and Parsons 2009 and O'Donnell et al., 2006). The ABMs were left on site for a minimum of 14 nights, during weather conditions when bats would be active[11] (Sedgeley, 2012). The locations of these ABMs are illustrated in Figure 6-2.

[11] ABM data was excluded from the analysis if conditions would affect bat activity (O'Donnell & Sedgeley, 1999);

- Air temperatures dropped below 10°C overnight
- Mean overnight wind speed exceed 20km/h, maximum overnight wind gust exceeded 60km/h; and / or
- Persistent heavy rain through the night.

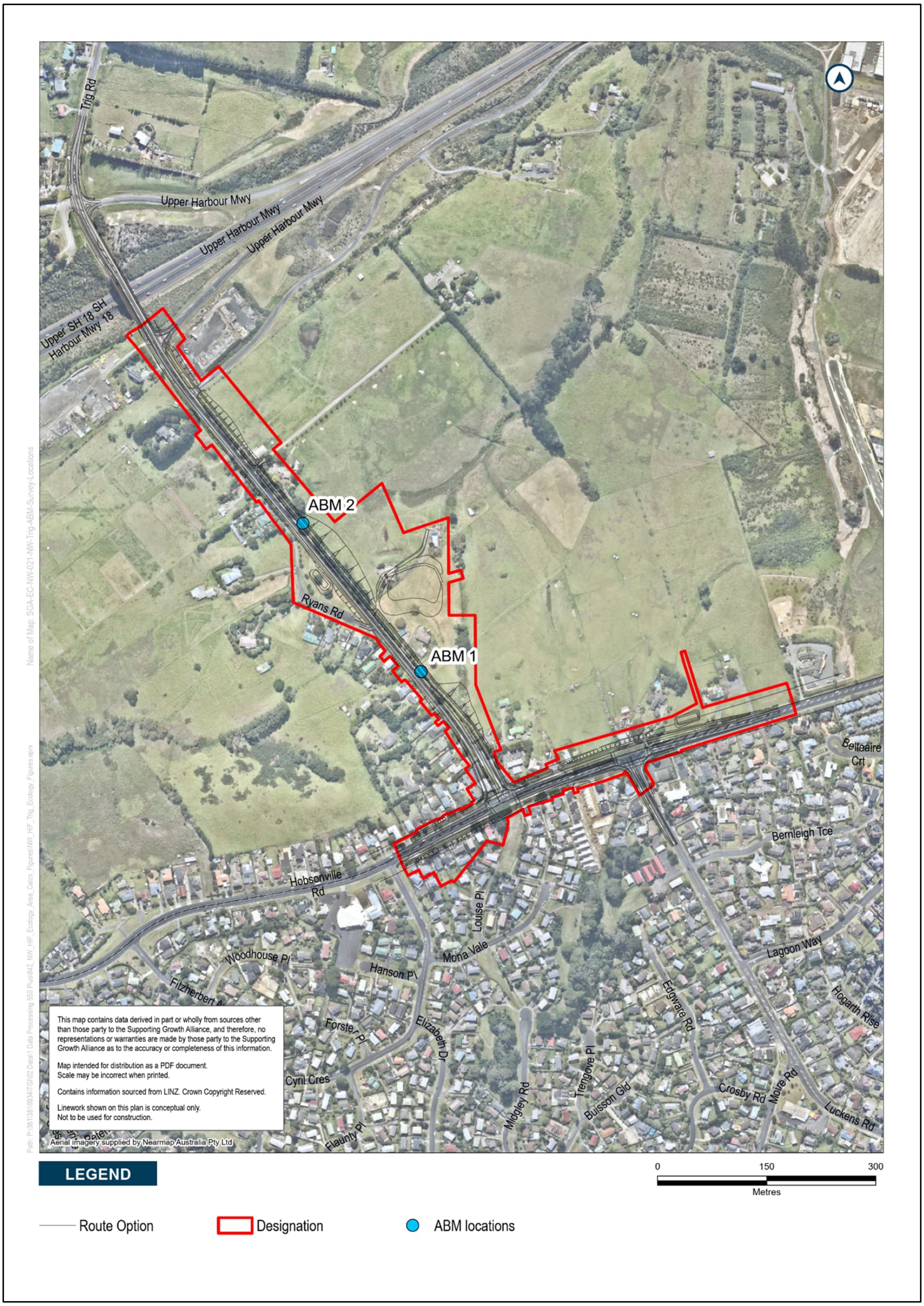


Figure 6-2 ABM survey locations

6.8.2 Assessing Terrestrial Ecological Value

The different terrestrial assessment methods were applied to inform the ecological value (ranging from **Negligible** to **Very High**) of terrestrial habitat associated with the Project Area and were consistent with the EIANZ Guidelines. This was done by using all or selected parts of different methods employed to inform matters influencing the ecological importance and sensitivity of the receiving environment. Each ecological EcIA 'Matter' and corresponding method(s) used to inform the matter are summarised in Table 6-3.

Table 6-3 Summary of how different methods of assessment have been applied to inform terrestrial ecological value

EcIA Matter	Habitat description (Singers et al., 2017)	Presence of TAR species or habitats
Matter 1 Representativeness	✓	✓
Matter 2 Rarity/distinctiveness	✓	✓
Matter 3 Diversity and pattern	✓	
Matter 4 Ecological context	✓	

In accordance with the EIANZ Guidelines, assigning ecological value at the species level considers the current threat status of a species (in accordance with the NZ Threat Classification system) that is present in areas potentially impacted by the Project (refer Appendix 2). For example, exotic species are assigned a **Negligible** ecological value and Native Threatened (Nationally Critical/Endangered/Vulnerable) species are assigned a **Very High** ecological value.

7 Assessment of Effects

7.1 Ecological Baseline

This section presents the findings of the desktop study (which includes a review of the documents listed in Section 6.5) and site investigations for all of the habitats and species (‘ecological features’) present within the Project Area. Based on this information, an ecological value has been calculated for each ecological feature using the assessment method outlined in Sections 6.6.2, 6.7.2 and 6.8.2.

7.1.1 Historic Ecological Context

The Project lies within the Tāmaki Ecological District, which has a warm, humid climate and is characterised by volcanic cones, isthmus, harbours and volcanic terrain (McEwen, 1987). Historically, the terrestrial portions of the Project Area would have been forested, and composed of species including pūriri (*Vitex lucens*), tōtara (*Podocarpus totara*), mataī (*Prumnopitys taxifolia*), kahikatea (*Dacrycarpus dacrydioides*) and tītoki (*Alectryon excelsus subsp. excelsus*), kōwhai (*Sophora sp.*) and taraire (Singers et al., 2017).

7.1.2 Terrestrial Ecology (Flora)

7.1.2.1 Desktop Review

Aerial imagery shows that the historical habitats described in Section 7.1.1 had been cleared prior to 1959 (earliest available aerial image). The habitats within the Project Area currently comprises grazed pasture, residential gardens, and native road plantings (Upper Harbour Motorway) (Appendix 5). No naturally occurring shrubland or forested habitat is currently present within the Project footprint.

Aerial imagery (Auckland Council, 2022) shows the presence of three terrestrial Significant Ecological Areas (**SEA**s) within 2 km of the Project Area (there are no SEAs located within the Project Area) and early route selection work sought to avoid these areas. These SEAs are identified in AUP:OP and include:

- SEA_T_2040: 1.0 km southwest of the Project Area.
- SEA_T_4661: 0.98 km south of the Project Area.
- SEA_T_4733: located within the wider stream catchment, approximately 2 km northeast of the Project Area, adjacent to the Waiarohia Stream. Tributaries to the Waiarohia Stream flow through from the Project Area.

7.1.2.2 Site Investigation

The Project Area is dominated by hard standing (existing roads and a footpath on the southern part of the western side), grazed exotic grasses, planted native and exotic trees consisting of mostly mature pines (*Pinus radiata*) and exotic garden species.

The surveys identified the presence of kānuka (*Kunzea robusta*) and mānuka (*Leptospermum scoparium*) within areas of native planting (< 20 years old) along the Upper Harbour Motorway and Trig Road, and pōhutukawa (*Metrosideros excelsa*) surrounding a pump station located at the junction between Trig Road and Hobsonville Road. These species are listed as ‘Threatened – Nationally Vulnerable’ because of the spread of myrtle rust within New Zealand and the risk that this poses to all Myrtaceae species. These species are currently common throughout the Tāmaki Ecological District and, in addition, the individuals within the Project Area are all newly planted and either immature or semi-mature. Therefore, the presence of these Threatened species has not altered the valuation of the habitats within which they occur (Table 7-1). A detailed list of vegetation species observed during the site investigations is included in Appendix 0.

Table 7-1 below describes the habitats identified within the Project Area through site investigations and their value in accordance with EIANZ guidelines (Appendix 2). The extent of these habitats, in relation to the Project Area, is presented in Appendix 5.

Table 7-1 Terrestrial habitats in the Project Area

Classification (Singers et al., 2014)	Vegetation Type	Description
BF	Brown Field (includes cropland)	This definition includes Industrial zones, metaled carparks, rail corridors, unmanaged or managed land within urban settings, road median strips, pavements, cracks in concrete. Substrate includes metal (stone chip) and concrete surfaces. largely exotic herbfield (weeds) and occasional exotic or native woody species.
EG	Exotic Grassland	Grassland dominated by exotic species. This includes pasture, and garden lawns.
PL.1	Planted Vegetation – Native (recent)	Native restoration plantings with <50% exotic biomass. Recently planted native scrub and forest <20 years old.
PL.3	Planted Vegetation – Exotic/Native (amenity)	Amenity plantings. This includes planted native and/or exotic vegetation within parks, amenity areas and private gardens.
TL.3	Treeland – Exotic-Dominated	Tree canopy cover 20-80%: <25% native with exotic tree cover dominant. For the purposes of mapping this includes planted and wilding exotic vegetation and mature shelterbelts. This includes mature riparian vegetation and scattered or discontinuous canopy of mature trees within gardens, farms and amenity areas.

7.1.2.3 Ecological Value

The terrestrial habitats within the Project Area are dominated by exotic grasslands (EG) (managed cut grassland), which is of **Negligible** ecological value. The Project Area also includes planted amenity areas or self-seeded (scrub), which are entirely or predominantly exotic habitats (exotic scrubland, (ES), exotic treeland (TL.3) and planted vegetation (PL.1 and PL.3). These habitats are considered to be of **Low** ecological value due to their low botanical diversity (lack of native species) and predominance of pest species.

These exotic vegetation types although of limited value botanically provide some value in terms of ecosystem function, such as, bank stability and stream shading of the adjacent streams. In addition, they may provide habitat utilised by long-tailed bat (Threatened – Nationally Critical), non-TAR birds, and copper skink (At Risk – Declining):

- Long-tailed bat potential habitat: TL.3
- Non-TAR bird potential habitat: PL.1, PL.3, TL.3
- Copper skink potential habitat: EG, PL.1, PL.3, TL.3 (with appropriate understorey)

These habitat provisioning aspects of ecological value have been considered in the overall assessment of terrestrial habitats presented in Table 7-2. A detailed justification for the value assessment is outlined in Appendix 4 and ecological habitat maps are provided in Appendix 5.

Table 7-2 Terrestrial habitat ecological value assessment associated with Trig Road

Ecological Feature	Ecological Value
BF	Negligible
EG	Negligible
PL.1	Low
PL.3	Low
TL.3	Low

7.1.3 Terrestrial Ecology (Fauna)

7.1.3.1 Bats

Desktop Review

Existing records (Department of Conservation, 2022; Supporting Growth Alliance, 2022a) confirm the presence of long-tailed bats (*Chalinolobus tuberculatus*) in the wider landscape (Figure 7-1). The conservation status of this species is ‘Threatened - Nationally Critical’ (O’Donnell et al., 2017). The nearest record is approximately 1.5 km north of the Project Area (Figure 7-2).

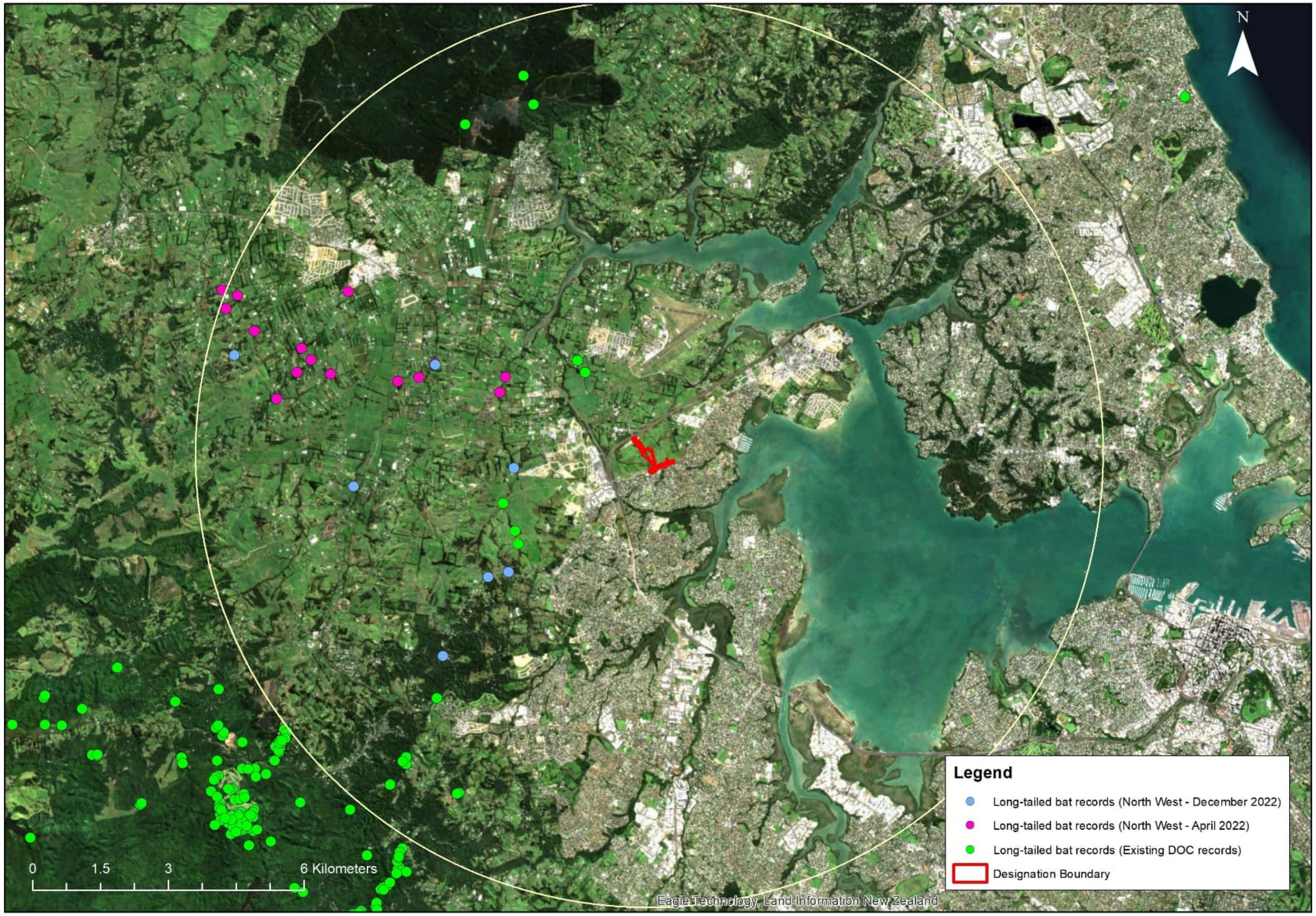


Figure 7-1 Existing long-tailed bat records within a 10 km radius of the Project Area (Department of Conservation, 2022; Supporting Growth Alliance, 2022a)

Figure 7-2 Existing long-tailed bat records within a 5 km radius of the Project Area (Department of Conservation, 2022; Supporting Growth Alliance, 2022a)

Site Investigation

Two ABMs were placed in the Project Area within linear vegetation located at the headwaters of Trig Stream for 17 nights between 1 November and 18 November 2019. No bat activity was recorded at either ABM during the monitoring period. Weather conditions were suitable during the monitoring period for bats to be active on 12 nights (Appendix 4 presents weather data from the monitoring period).

The habitat surrounding the Project Area is not considered to be optimal for bats (being agricultural fields and residential gardens) and the wetland/stream areas are dominated by pasture grass with only scattered stands of exotic trees. The standing dead timber around wetland TR-W4 did contain cracks, splits and rot holes within which bats could roost if present. However, bats would need to be foraging and commuting through this area to be able to identify these trees for roosting.

Survey information suggests that the habitat quality for long-tailed bats is poor and that they are not regularly present within the Project Area. However, as long-tailed bats are known to be present in the wider landscape, it is not possible to completely exclude the potential for bat presence.

Ecological Value

The conservation status of long-tailed bats is 'Threatened – Nationally Critical' (O'Donnell et al., 2017), therefore the ecological value of long-tailed bats is **Very High**.

7.1.3.2 Birds

Desktop Review

The New Zealand Bird Atlas[12] and iNaturalist identified 40 bird species within 2 km of the Project Area (Appendix 0). This included 21 native bird species, which are listed as 'At Risk' or 'Threatened' (TAR) species (Table 7-3). These species are predominantly coastal, excluding kākā (*Nestor meridionalis septentrionalis*) and New Zealand pipit (*Anthus novaeseelandiae novaeseelandiae*). Most of these species would be very unlikely to utilise habitats within the Project Area, apart from occasional flyovers, or to occasionally feed within the pasture wetland areas.

Table 7-3 Threatened or At Risk (TAR) native bird species recorded within 2 km of the Project Area

Common Name	Māori Name	Scientific Name	Conservation Status (Robertson et al., 2021)	Record Source
Banded dotterel	Pohowera	*Charadrius bicinctus*	At Risk - Declining	Desktop record - eBird (Bird Atlas)
Banded rail	Mioweka	*Gallirallus philippensis assimilis*	At Risk - Declining	Desktop record - iNaturalist/eBird (Bird Atlas)
Black shag	Māpunga	*Phalacrocorax carbo*	At Risk - Relict	Desktop record - iNaturalist

12 https://birdatlas.co.nz/

Common Name	Māori Name	Scientific Name	Conservation Status (Robertson et al., 2021)	Record Source
Caspian tern	Taranui	*Hydroprogne caspia*	Threatened - Nationally Vulnerable	Desktop record - iNaturalist/eBird (Bird Atlas)
Bar-tailed godwit	Kuaka	*Limosa lapponica bauer*	At Risk - Declining	Desktop record - iNaturalist/eBird (Bird Atlas)
Black-billed gull	Tarāpuka	*Larus bulleri*	At Risk - Declining	Desktop record - iNaturalist
Dabchick	Weweia	*Poliocephalus rufopectus*	Threatened – Nationally Increasing	Desktop record - iNaturalist/eBird (Bird Atlas)
Lesser knot	Huahou	*Calidris canutus rogersi*	At Risk - Declining	Desktop record - eBird (Bird Atlas)
Little black shag	Kawau tūī	*Phalacrocorax sulcirostris*	At Risk – Naturally Uncommon	Desktop record - iNaturalist
New Zealand pipit	Hīoi	*Anthus novaeseelandiae novaeseelandiae*	At Risk – Declining	Desktop record - iNaturalist
North Island fernbird	Mātātā	*Poodytes punctatus*	At Risk – Declining	Desktop record - iNaturalist/eBird (Bird Atlas)
North Island kākā	Kākā	*Nestor meridionalis septentrionalis*	At Risk – Recovering	Desktop record - iNaturalist
Northern New Zealand dotterel	Tūturiwhatu	*Charadrius obscurus aquilonius*	At Risk - Recovering	Desktop record - eBird (Bird Atlas)
Pied shag	Kāruhiruhi	*Phalacrocorax varius*	At Risk – Recovering	Desktop record - iNaturalist/eBird (Bird Atlas)
Red-billed gull	Tarāpunga	*Larus novaehollandiae scopulinus*	At Risk - Declining	Desktop record - iNaturalist/eBird (Bird Atlas)
Lesser knot	Huahou	*Calidris canutus rogersi*	At Risk - Declining	Desktop record - iNaturalist/eBird (Bird Atlas)
Royal spoonbill	Kōtuku ngutupapa	*Platalea regia*	At Risk – Naturally Uncommon	Desktop record - iNaturalist/eBird (Bird Atlas)

Common Name	Māori Name	Scientific Name	Conservation Status (Robertson et al., 2021)	Record Source
South Island pied oystercatcher	Tōrea	*Haematopus finschi*	At Risk - Declining	Desktop record - iNaturalist/eBird (Bird Atlas)
Variable oystercatcher	Tōrea pango	*Haematopus unicolor*	At Risk - Recovering	Desktop record - eBird (Bird Atlas)
White-fronted tern	Tara	*Sterna striata*	At Risk - Declining	Desktop record - eBird (Bird Atlas)
Wrybill	Ngutu parore	*Anarhynchus frontalis*	Threatened – Nationally Increasing	Desktop record - iNaturalist

Site Observations

Formal bird surveys for wetland or forest bird species were not completed within the Project Area, as limited habitat was present for TAR species. However, during site visits, birds were recorded incidentally, the full list is presented in Appendix 0. Table 7-4 lists the native species observed within the Project Area, all of which are Not Threatened. The native species recorded are typical of a modified agricultural landscape with areas of open water and residential gardens.

Table 7-4 Native bird species recorded incidentally during site walkover

Common Name	Māori Name	Scientific Name	Conservation Status (Robertson et al., 2021)
Australasian harrier	Kāhu	*Circus approximans*	Not Threatened
Grey warbler	Riroriro	*Gerygone igata*	Not Threatened
Pūkeko	Pūkeko	*Porphyrio melanotus melanotus*	Not Threatened
Tūī	Tūī	*Prosthemadera novaeseelandiae novaeseelandiae*	Not Threatened
Welcome swallow	Warou	*Hirundo neoxena*	Not Threatened
White-faced heron	Matuku moana	*Ergretta novaehollandiae*	Not Threatened

Ecological Value

The desktop review and site investigations identified 21 TAR bird species within 2 km of the Project Area. These bird species included coastal, freshwater and forest species. There is the potential that several of these species could stop to feed or rest within the areas of open farmland that surround the Project Area (e.g., black-billed and red-billed gulls) and that these species could occasionally fly over the Project Area (e.g., kākā). New Zealand pipit has been recorded in the local area and can use areas of long grass along field margins to nest, but within the Project Area this habitat type is impacted by intensive stock grazing minimising cover and likely disturbance from the existing road network, and it is considered suboptimal for this species. North Island fernbird are associated with wetland habitats in the Project Area and are likely to be present and considered to be a transient visitor to the wetlands.

If any of the habitats surrounding the Project Area were to be used by TAR bird species, this would most likely be infrequently and not during critical stages of their lifecycle (e.g., nesting) (with the exception of North Island fernbird). Non-TAR native bird species would most likely forage and nest within vegetation within residential gardens that line the existing road network.

Table 7-5 Ecological value for TAR bird species

Common Name	Scientific Name	Conservation Status (Robertson et al., 2021)	Ecological Value
Non-TAR birds	-	Not Threatened	Low
North Island fernbird/ Mātātā	*Poodytes punctatus*	At Risk - Declining	High

7.1.3.3 Herpetofauna

Desktop Review

A desktop review confirmed eight herpetofauna records within 2 km of the Project Area (Appendix 0). No herpetofauna records were found within the Project Area. This does not confirm that herpetofauna are not present in the Project Area, but most likely that the habitat is too modified to be suitable for the majority of these species. Of the six native herpetofauna records, only copper skink is likely to be found within the Project Area based on habitat preference (Table 7-6).

Table 7-6 Native lizard species recorded within 2 km of the Project Area

Common Name	Scientific Name	Threat Class (Hitchmough et al., 2021; Burns et al., 2017)	Record Source	Likelihood of Presence
Pāpā/Pacific gecko	*Dactylocnemis pacificus*	At Risk – Not Threatened	iNaturalist	Unlikely
Hochstetter's frog	*Leiopelma hochstetteri*	At Risk - Declining	iNaturalist	Unlikely
Elegant gecko	*Naultinus elegans*	At Risk – Declining	DOC Bioweb	Unlikely

Common Name	Scientific Name	Threat Class (Hitchmough et al., 2021; Burns et al., 2017)	Record Source	Likelihood of Presence
Moko pirirākau/Forest gecko	*Mokopirirakau granulatus*	At Risk – Declining	iNaturalist	Unlikely
Mokomoko/Copper Skink	*Oligosoma aeneum*	At Risk – Declining	iNaturalist	Likely
Ornate skink	*Oligosoma ornatum*	At Risk – Declining	iNaturalist	Unlikely

Site Investigation

Habitats within the Project Area were assessed for their potential to support native lizards. This was completed during the site walkover along with consideration of lizard presence from desktop records. Where present, suitable refugia were inspected (i.e., logs, rocks etc) for the presence of lizards.

Although no lizards were identified during the site walkover, it was concluded that the rank grassland that is present along the existing road margins, and areas of leaf litter beneath exotic trees and native plantings could support copper skink (At Risk – Declining). Potential copper skink habitat that was observed during the site walkover (approximately 6195 m^2) is presented in Figure 7-3.

The exotic trees within the Project Area are unlikely to support geckos due to their open form and lack of connectivity to established stands of native vegetation. The closely grazed pasture (without any refugia e.g., log piles) provide suboptimal habitat for native lizards. The Project Area potentially include habitats where ornate skink ('At Risk – Declining') could be present, however it is not connected to indigenous habitat that would support a population and as such they are considered unlikely to be present within the Project Area.

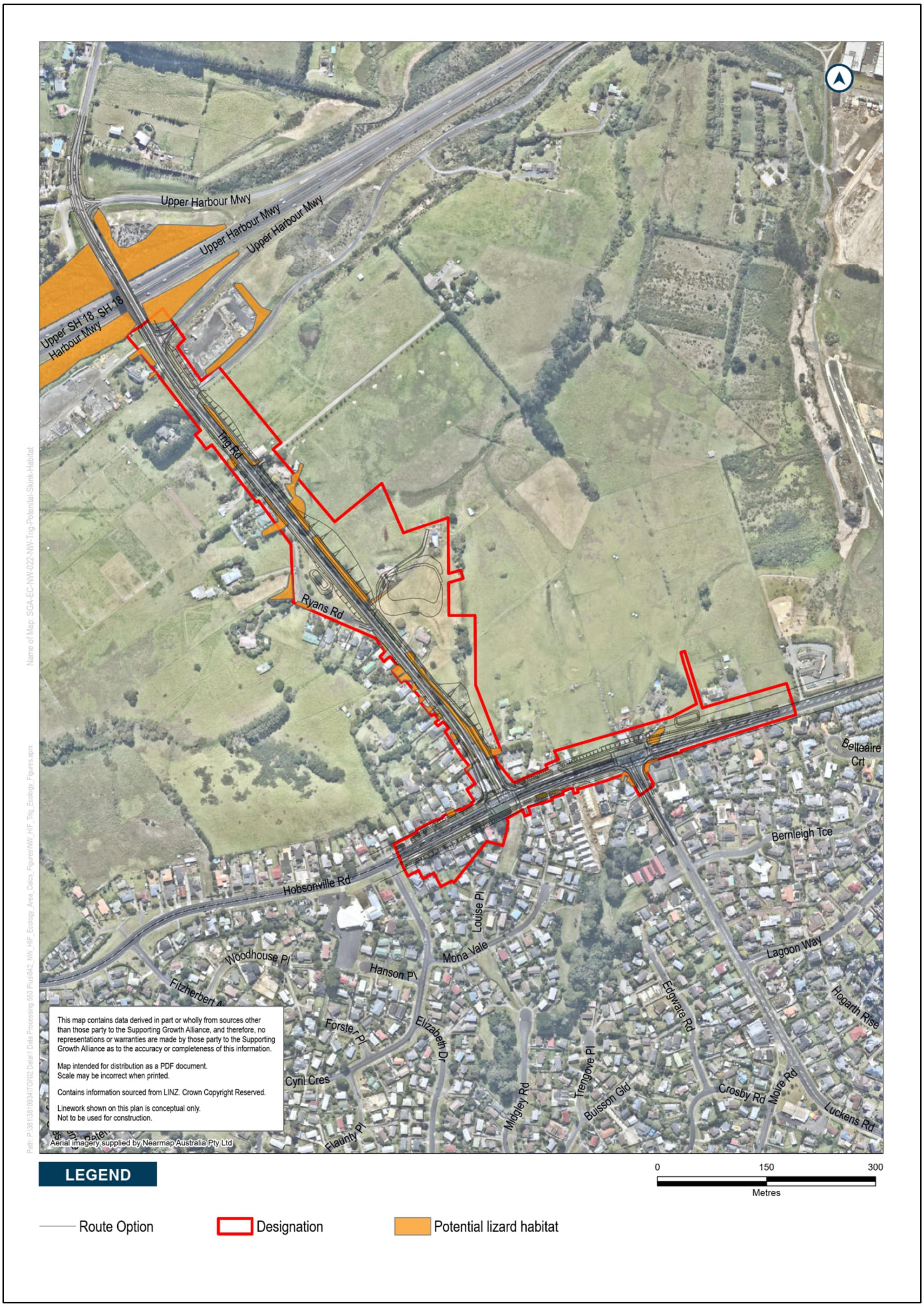


Figure 7-3 Potential copper skink habitat within and adjacent to the Project Area

Ecological Value

The conservation status of copper skink is ‘At Risk – Declining’ (Hitchmough et al., 2021), therefore the ecological value of copper skink is **High**.

7.1.4 Aquatic Ecology

7.1.4.1 Desktop Review

One stream (Trig Stream) was identified within the Project Area using Auckland Council Geomaps ‘rivers and permanent streams’ layer (Auckland Council, 2022). Stream habitats within the Project Area were assessed for their potential to support native fish and a desktop review of existing records was completed. The desktop review identified the presence of six native fish species in Waiarohia Stream (Table 7-7). There is the potential for eel species to be present within the upper stream and wetland reaches, and there is a low probability for longfin eel due to poor habitat. A detailed list of fish species identified in the desktop review is included in Appendix 0.

Table 7-7 Native fish species recorded within 2 km of the Project Area

Common Name	Scientific Name	Threat class (Dunn et al., 2018)	Record source
Shortfin eel	*Anguilla australis*	Not Threatened	NIWA, iNaturalist
Longfin eel	*Anguilla dieffenbachii*	At Risk - Declining	NIWA, iNaturalist
Banded kokopu	*Galaxias fasciatus*	Not Threatened	NIWA, iNaturalist
Īnanga	*Galaxias maculatus*	At Risk – Declining	NIWA, iNaturalist
Common bully	*Gobiomorphus cotidianus*	Not Threatened	NIWA, iNaturalist
Giant bully	*Gobiomorphus gobioides*	At Risk – Naturally Uncommon	iNaturalist

7.1.4.2 Site Investigation

Stream Classification

The four streams identified within the Project Area were classified according to their Hydroperiod Classification (Appendix 4, Table 9-10). The results are described in Table 7-8, with all streams classified as intermittent. All streams were associated with valley head seep wetlands and are generally dominated by wetland hydrology (lateral soil seepage). Where present, stream channels were poorly defined but seasonally intercept the saturated soils and are therefore classified as intermittent streams.

Table 7-8 Description of hydrogeomorphic features for streams TR-S1 to TR-S3 and W5-S2

Stream ID	Hydroperiod	Channel Morphology	Substrate Dominance
TR-S1	Intermittent	Soft bottom	Silt, mud and clay (>75% of reach)

Stream ID	Hydroperiod	Channel Morphology	Substrate Dominance
TR-S2	Intermittent	Soft bottom	Silt, mud and clay (>75% of reach)
TR-S3	Intermittent	Soft bottom	Silt, mud and clay (>75% of reach)
W5-S2	Intermittent	Soft bottom	Silt, mud and clay (>75% of reach)

Rapid Habitat Assessment

All streams were surveyed using the Rapid Habitat Assessment protocol (Clapcott, 2015). The streams measured overall habitat quality scores that were considered 'Poor' (Table 7-9). Detailed RHA results are presented in Appendix 4. The RHA category was included within the ecological value assessment for each of the streams where it was applied.

Table 7-9 RHA results for streams TR-S1 to TR-S3 and W5-S2

Stream ID	RHA Score	RHA Category
TR-S1	18	Poor
TR-S2	16	Poor
TR-S3*	18	Poor
W5-S2*	18	Poor

Notes: * = Stream assessed at a desktop level due to property access constraints.

7.1.4.3 Ecological Value

Based on the overall freshwater assessment, all four streams are associated with wetland complexes and were assessed to have **Low** ecological value (Table 7-10). A detailed justification for the value assessment is outlined in Appendix 4 and ecological habitat maps are provided in Appendix 5.

Table 7-10 Aquatic ecological features and overall ecological value

Ecological Feature	Ecological Value
TR-S1 (associated with TR-W3)	Low
TR-S2 (associated with TR-W1)	Low
TR-S3 (associated with TR-W4)	Low
W5-S2 (associated with TR-W7)	Low

7.1.5 Wetland Ecology

7.1.5.1 Site Investigation

Seven wetlands potentially affected by the Project have been identified, five within the Project Area (TR-W1, TR-W2, TR-W3, TR-W4, and TR-W5) and two directly adjacent (TR-W6 and TR-W7) to the

Project Area. All seven wetland areas were described as Exotic Wetland (EW) (Singers et al., 2017), due to the dominance of exotic hydrophytic plant species. Wetland descriptions and analysis are presented in Table 7-11 and the results of vegetation plots, Dominance Test, Prevalence Index, wetland condition assessment and wetland function assessment have been included in Appendix 4.

Based on results of the site investigation all wetlands have been classified as NPS:FM natural wetlands because they do not meet the NPS:FM exclusions that are outlined in Appendix 1, Section 1.2.1.

Table 7-11 Wetland description and analysis

Reference No. and location	Hydrogeomorphic type	Vegetation	Wetland condition	Wetland description in relation to NPS:FM
TR-W1	Seasonally saturated hillslope seep (headwater seep) connected to a channelled valley bottom	Exotic grass and sedges (>50% exotic pasture species)	Largely modified	Natural wetland
TR-W2	Seasonally saturated hillslope seep connected to a channelled valley bottom	Exotic grass and sedges (>50% exotic pasture species)	Largely modified	Natural wetland
TR-W3	Seasonal channelled valley bottom system	Exotic grass and sedges (>50% exotic pasture species)	Largely modified	Natural wetland
TR-W4	Permanently to seasonally saturated hillslope seep connected to stream network	Exotic grass and shrubs (>50% exotic pasture species)	Largely modified	Natural wetland
TR-W5&6	Channelled valley bottom system with permanent zone associated with channel and seasonal zone adjacent hillslopes	Exotic grass and sedges (>50% exotic pasture species)	Largely modified	Natural wetland
TR-W7	Seasonally saturated hillslope seep connected to stream network	Exotic grass and shrubs (>50% exotic pasture species)	Largely modified	Natural wetland

7.1.5.2 Ecological Value

Wetland habitats present within the Project Area are dominated by exotic plant species, degraded vegetation removal, artificial drainage and grazing and pugging from livestock. Alongside the wetland delineation process, the wetland condition was also assessed, and a value given based on the four "Matters": representativeness, rarity/distinctiveness, diversity and pattern, and ecological context. Although highly modified, taking into consideration the retained ecological functionality of these systems for attenuation of stormwater and nutrient removal, the ecological value of these exotic wetlands is considered to be **Low** to **Moderate (**Table 7-12**)**. A detailed justification for the value assessment is outlined in Appendix 4 and ecological habitat maps are provided in Appendix 5.

Table 7-12 Wetland ecological features and overall ecological value

Ecological Feature	Ecological Value
TR-W1	Low
TR-W2	Low
TR-W3	Low
TR-W4	Moderate
TR-W5&W6	Moderate
TR-W7	Low

7.1.6 Summary of Ecological Value

Table 7-13 summarises the ecological values of the ecological features (aquatic, wetland and terrestrial) present within the Project Area.

Table 7-13 Summary of ecological values for aquatic, wetland and terrestrial habitat and species within the Project Area

Ecological Feature	Ecological Value
Habitats	
Aquatic Ecology	
TR-S1	Low
TR-S2	Low
TR-S3	Low
W5-S2	Low
Wetland Ecology	
TR-W1	Low

Ecological Feature	Ecological Value
TR-W2	Low
TR-W3	Low
TR-W4	Moderate
TR-W5&W6	Moderate
TR-W7	Low
Terrestrial Ecology (Flora)	
Brown Field (BF)	Negligible
Exotic Grassland (EG)	Negligible
Planted Vegetation – Native (recent) (PL.1)	Low
Planted Vegetation – Exotic/Native (amenity) (PL.3)	Low
Treeland – Exotic-Dominated (TL.3)	Low
Terrestrial Ecology (Fauna)	
Long-tailed bats	Very High
Native birds (Non-TAR)	Low
North Island fernbird	High
Native herpetofauna	High

7.2 Assessment of Ecological Effects

7.2.1 Positive Effects

Wetland compensation within the Project designation will occur, which will include wetland planting and wetland buffer planting. As this will significantly enhance the existing, largely exotic (weed dominated) vegetation, this will in turn provide improved habitat for any remaining or recolonising native bird species and herpetofauna.

Additionally, further positive ecological outcomes and enhancement opportunities will be developed during detailed design. When implemented, these will include:

- Opportunities for green infrastructure and habitats within the Project Area. For example, planting native street trees, and planting native vegetation rather than grass, on roadside berms and around stormwater wetlands.
- Landscape planting that enhances existing retained habitat (e.g., underplant retained exotic treeland with native understorey vegetation and replace exotic scrub habitat with native species).

7.2.2 Assessment of Construction Effects

The proposed construction activities (described in Sections 7.2.2.1 to 0) have the potential to cause impacts on ecological features (aquatic, wetland and terrestrial) within and adjacent to the Project Area, without appropriate construction impact management. The effects assessment has considered the current ecological baseline only, under the assumption that the likely future ecological environment (considering permitted activities) will not change substantially.

7.2.2.1 Terrestrial Ecology (Flora)

Table 7-14 lists the potential effects to the terrestrial vegetation within the Project Area and their magnitude of effect. This is then used to calculate an overall level of effect to each ecological feature, prior to impact management. A detailed justification for the ecological value assessment and the magnitude of effect assessment that has resulted in the level of effect as per the EIANZ Guidelines is presented in Appendix 4.

Table 7-14 Magnitude of effects and subsequent level of effect (without impact management) of the Project upon terrestrial ecology (flora) during construction

Ecological Feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
Brown Fields (BF) (18,600 m^2) Exotic Grassland (EG) (17,302 m^2)	Negligible	Vegetation removal: Permanent loss of habitat/ecosystem, fragmentation and edge effects due to vegetation removal.	High	Effect is direct, local, permanent, and definite.	Very Low
Planted Vegetation – Native (recent) (PL.1) (149 m^2) Planted Vegetation - Amenity (PL.3) (3846 m^2) Treeland – Exotic-Dominated (TL.3) (3991 m^2)	Low	Vegetation removal: Permanent loss of habitat/ecosystem, fragmentation and edge effects due to vegetation removal.	High	Effect is direct, local, permanent, and definite.	Low
Exotic Grassland (EG) Planted Vegetation – Native (recent) (PL.1) Planted Vegetation - Amenity (PL.3) Treeland – Exotic-Dominated (TL.3)	Negligible - Low	Earthworks: Weed dispersal to previously unaffected areas of indigenous vegetation, reduction in terrestrial biodiversity.	Negligible	Effect is direct, local and short-term (<5 years). The effect is considered to be infrequent and unlikely.	Very Low

7.2.2.2 Terrestrial Ecology (Fauna)

Table 7-15 lists the potential effects to the fauna within the Project Area and their magnitude of effect. This is then used to calculate an overall level of effect to each ecological feature, prior to impact management. A detailed justification for the ecological value assessment and the magnitude of effect assessment that has resulted in the level of effect as per the EIANZ Guidelines is presented in Appendix 4.

Long-tailed bats

Table 7-15 Magnitude of effects and subsequent level of effect (without impact management) of the Project upon terrestrial ecology (long-tailed bats) during construction

Ecological Feature	Ecological Value	Effects Description*	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
Long-tailed bats	Very High	Disturbance and displacement to roosts and individuals (existing) due to construction activities (noise, light, dust etc).	Negligible	Effect is indirect, local, short term (<5 years) and unlikely. The effect will have a periodic frequency and is totally reversible.	Low
		Vegetation removal: Loss of foraging and breeding habitat, fragmentation of habitat, causing adverse effects on population dynamics.	Negligible	Effect is direct, local and permanent (>25 years). However, long-tailed bat habitat in the context of the Project Area is small, isolated, and adjacent to an existing road, therefore loss of habitat is considered unlikely.	Low
		Vegetation removal: Potential to kill/injure long-tailed bat, causing adverse effects on population dynamics.	Negligible	Effect is direct, local, and short term (<5 years). Although long-tailed bats are known to be in the wider landscape, no moderate or high roosting potential was identified in the Project Area, therefore the likelihood of the effect is considered unlikely. As long-tailed bat presence cannot be excluded in the future, the requirements of the Wildlife Act 1953 will need to be adhered to during vegetation removal.	Low **WA 1953 requirements** (refer Section 7.3.1.1)

Notes: * = Roost loss has been considered but discounted as an effect as the consequence of roost loss (if it does occur at all) is considered less than Negligible in the context of this Project.

Birds

Table 7-16 Magnitude of effects and subsequent level of effect (without impact management) of the Project upon terrestrial ecology (birds) during construction

Ecological feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
Non-TAR birds	Low	Disturbance and displacement to roosts and individuals (existing) due to construction activities (noise, light, dust etc).	Low	Effect is indirect, local, short term (<5 years) and highly likely. The effect will have a periodic frequency and is totally reversible.	Very Low
		Vegetation removal: Nest loss.	Low	Effect is direct, local, short term (<5 years) and is considered highly likely.	Very Low
		Vegetation removal: Loss of foraging and breeding habitat, fragmentation of habitat, causing adverse effects on population dynamics.	High	Effect is direct, local, permanent and the likelihood is considered definite due to the definite presence of native bird habitat in the Project Area.	Low
		Vegetation removal: Potential to kill/injure non-TAR birds, causing adverse effects on population dynamics.	Negligible	Effect is direct, local, and short term (<5 years). Although native birds are definitely present in the Project Area, an effect on population dynamics is considered unlikely. However, as all native birds are protected under the WA 1953, requirements of the WA 1953 will need to be adhered to during vegetation removal.	Very Low **WA 1953 requirements** (refer Section 7.3.1.1)
North Island fernbird	High	Disturbance and displacement to roosts and individuals (existing) due to construction activities (noise, light, dust etc).	Negligible	Effect is indirect, local, short term (<5 years) and unlikely. The effect will have a periodic frequency and is totally reversible.	Very Low
		Vegetation removal: Nest loss.	Negligible	Effect is direct, local, and short term (<5 years). However, North Island fernbird potential nesting habitat in	Very Low

Ecological feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
				the Project Area is suboptimal, therefore nest loss in considered unlikely.	
		Vegetation removal: Loss of foraging and breeding habitat, fragmentation of habitat, causing adverse effects on population dynamics.	Negligible	Effect is direct, local, and permanent. However, North Island fernbird habitat is already isolated and surrounded by pasture, therefore the effect is considered unlikely.	Very Low
		Vegetation removal: Potential to kill/injure birds, causing adverse effects on population dynamics.	Negligible	Effect is direct, local, and short term (<5 years) and considered unlikely. However, as all native birds are protected under the WA 1953, requirements of the WA 1953 will need to be adhered to during vegetation removal.	Very Low **WA 1953 requirements** (refer Section 7.3.1.1)

Herpetofauna

Table 7-17 Magnitude of effects and subsequent level of effect (without impact management) of the Project upon terrestrial ecology (herpetofauna) during construction

Ecological feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
Copper skink	High	Disturbance and displacement to individuals (existing) due to construction activities (noise, light, dust etc).	Negligible	Effect is indirect, local, short term (<5 years) and unlikely. The effect will have a periodic frequency and is totally reversible.	Very Low
		Vegetation removal: Loss of foraging and breeding habitat, fragmentation	Low	Effect is direct, local, and permanent. Copper skink are anticipated to be utilising all terrestrial features in the	Low

		of habitat, causing adverse effects on population dynamics.		Project Area (excluding Brown Fields). Approximately 6195 m^2 of potential copper skink habitat will be removed, therefore the effect is considered likely. Additionally, a project specific Wildlife Act Permit (WAP) will be required for lizard salvage. The current expectations of Department of Conservation are that habitat restoration to address residual effects (of habitat loss and salvage) is required to issue a WAP. This will need to be considered.	**Wildlife Act Permit (WAP)** (refer Section 7.3.1.1)
		Vegetation removal: Potential to kill/injure copper skink, causing adverse effects on population dynamics.	Negligible	Effect is direct, local, and short term (<5 years) and considered unlikely. However, as all native herpetofauna are protected under the WA 1953, requirements of the WA 1953 will need to be adhered to during vegetation removal.	Very Low **WA 1953 requirements** (refer Section 7.3.1.1)

7.2.2.3 Aquatic Ecology

All works (excluding minor stormwater outfall works) will be outside the stream riparian setback and therefore no instream works will occur. Additionally, all streams are associated with wetland complexes. The main hydrological maintenance of these complexes is associated with wetland hydrology. Therefore, potential effects on instream habitat due to hydrology and water quality impacts during construction have been assessed in Section 0 for the corresponding wetlands.

7.2.2.4 Wetland Ecology

Table 7-18 lists the potential construction effects (direct and indirect) to the wetland ecology within the Project Area and their magnitude of effect. This is then used to calculate an overall level of effect to each habitat, prior to impact management. A detailed justification for the ecological value assessment and the magnitude of effect assessment that has resulted in the level of effect as per the EIANZ Guidelines is presented in Appendix 4.

The effects assessment is based on the following assumptions and embedded mitigation being delivered as part of the Project:

- A provisional Erosion and Sediment Control Plan has been prepared for the Project which describes how the effects of sedimentation from construction earthworks will be managed. As such, it is assumed that issues related to sediment generation will be adequately mitigated and will not lead to adverse ecological effects. This includes the potential effects on the downstream receiving environment as it has been assumed that it can be acceptably managed as part of project delivery.
- Stormwater generated from the construction area will be treated through industry standard best practice measures, to remove or reduce contaminants to acceptable levels prior to discharge into any waterway within or adjacent to the proposed works area. It is assumed that the hydrology of the receiving wetlands will be maintained through the stormwater controls.

Table 7-18 Magnitude of effects and subsequent level of effect (without impact management) of the Project on wetland ecology during construction

Ecological Feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
TR-W1	Low	Vegetation removal/reclamation: Road embankment will result in the permanent loss of approximately 1000 m^2 (0.1 ha) of a 3,700 m^2 (0.37 ha) hydrogeomorphic unit (HGM) of natural wetland associated with TR-W1 (approximately 27% of the hydrogeomorphic unit).	High	Permanent, irreversible loss of wetland habitat that will definitely occur. Although the level of effect is considered low, offset is required under the NES-FW due to loss in wetland extent.	Low **NES-FW requirements** (refer Section 7.3.2)
TR-W4	Moderate	Vegetation removal/reclamation: Road embankment will result in the permanent loss of approximately 780 m^2 (0.078 ha) of a 2,800 m^2 (0.28 ha) HGM unit of natural wetland associated with TR-W4 (approximately 29% of the hydrogeomorphic unit).	High	Permanent, irreversible loss of wetland habitat that will definitely occur. Level of effect is **Moderate** and offset is required. This is also required under the NES-FW due to a loss in wetland extent.	**Moderate** **NES-FW requirements** (refer Section 7.3.2)
TR-W1, TR-W2	Low	Earthworks: Detrimental effects on habitats including plant composition and fauna due to diversion,	Moderate	Regardless of embedded controls, earthworks for all wetlands have potential of affecting the hydrology of the receiving environment through disrupting soil-water pathways.	Low

Ecological Feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
		abstraction or bunding of watercourses and water level/flow/periodicity changes.		TR-W1: TR-W1 is a seasonal wetland and therefore has a reduced likelihood of this effect occurring relative to other wetlands. TR-W2: Earthworks for this wetland is mainly associated with the dry pond construction.	
TR-W3	Low		Low	Wetland TR-W3 is located further away from construction and the upslope hydrology is more ephemeral, resulting in a lower likelihood of this impact occurring.	Very Low
TR-W4	Moderate		Low	Wetland TR-W4 is potentially spring fed. Earthworks will occur within a portion of this wetland, therefore posing a risk of disrupting soil-water pathways.	Low
TR-W5&W6	Moderate		Low	Wetland not directly associated with earthworks and maintained through multiple sub-catchments therefore reducing the likelihood.	Low
TR-W7	Low		Negligible	TR-W7 is approximately 37 m away from the relatively small stormwater outfall construction. Earthwork related flow disruption is unlikely due to the distance and the large additional catchment maintaining TR-W7.	Very Low
TR-W1, TR-W2, TR-W3	Low	Earthworks: Uncontrolled discharge leading to habitat and water quality degradation.	Low	Uncontrolled discharge from construction stormwater possible (therefore allocated 'Likely' probability) despite embedded controls.	Very Low

Ecological Feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
TR-W4, TR-W5&W6	Moderate		Low	Uncontrolled discharge from construction stormwater possible (therefore allocated 'Likely' probability) despite embedded controls.	Low
TR-W7	Low		Negligible	Uncontrolled discharge from construction stormwater unlikely due to distance to wetland and scale of construction (therefore allocated 'Unlikely' probability) despite embedded controls.	Very Low

7.2.3 Assessment of Operational Effects

The operation of the Project has the potential to cause impacts on ecological features (terrestrial and wetland) within and adjacent to the Project Area, without impact management. Section 7.2.3.2 to 7.2.3.4 details the magnitude of effect and subsequent level of effect on ecological features (further detail regarding how these were determined are provided in Appendix 2). The effects assessment has considered the current ecological baseline only, under the assumption that the likely future ecological environment (considering permitted activities) will not change substantially.

7.2.3.1 Terrestrial Ecology (Flora)

Operational effects on terrestrial ecology include weed dispersal to previously unaffected areas of indigenous vegetation due to presence of the infrastructure, and increased weed incursion and unintentional spray of indigenous vegetation due to maintenance. This is detailed further in Table 7-19.

Table 7-19 Magnitude of effects and subsequent level of effect (without impact management) of the Project upon terrestrial ecology (flora) during operation

Ecological Feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
Exotic Grassland (EG)	Negligible	Presence of the infrastructure: Weed dispersal to previously unaffected areas of indigenous vegetation, reduction in terrestrial biodiversity due to the presence of the infrastructure, use of infrastructure edges as dispersal corridors by invasive plant species.	Negligible	Effect is direct, local, permanent, and is considered infrequent and unlikely.	Very Low
Planted Vegetation – Native (recent) (PL.1) Planted Vegetation - Amenity (PL.3) Treeland – Exotic-Dominated (TL.3)	Low	Presence of the infrastructure: Weed dispersal to previously unaffected areas of indigenous vegetation, reduction in terrestrial biodiversity due to the presence of the infrastructure, use of infrastructure edges as dispersal corridors by invasive plant species.	Negligible	Effect is direct, local, permanent, and is considered infrequent and unlikely.	Very Low
Exotic Grassland (EG)	Negligible	Maintenance: Increased weed incursion, unintentional spray of indigenous vegetation due to maintenance, increased use of herbicides.	Low	Effect is direct, local, permanent, and is considered likely with a periodic frequency.	Very Low
Planted Vegetation – Native (recent) (PL.1) Planted Vegetation - Amenity (PL.3) Treeland – Exotic-Dominated (TL.3)	Low	Maintenance: Increased weed incursion, unintentional spray of indigenous vegetation due to maintenance, increased use of herbicides.	Low	Effect is direct, local, permanent, and is considered likely with a periodic frequency.	Very Low

7.2.3.2 Terrestrial Ecology (Fauna)

The loss of connectivity through permanent habitat loss due to the presence of the road, and disturbance such as operational noise/vibration and light can lead to an overall reduction in size and quality of habitat and can impact bats, birds, and herpetofauna. This is detailed further in Table 7-20 to Table 7-22.

Long-tailed bats

Table 7-20 Magnitude of effects and subsequent level of effect (without impact management) of the Project upon terrestrial ecology (long-tailed bats) during operation

Ecological Feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
Long-tailed bats	Very High	Disturbance and displacement of (new and existing) roosts and individuals due to lighting and noise/vibration.	Negligible	Effect is indirect, local, and permanent. However, due to the restricted bat habitat within the Project Area, the effect is considered unlikely.	Low
		Loss in connectivity due to permanent habitat loss, light, and noise effects from the road, leading to fragmentation of terrestrial habitat and influencing bat movement in the broader landscape.	Negligible	Effect is indirect, local, and permanent. However, due to the restricted bat habitat and existing fragmentation within the Project Area, the effect is considered unlikely.	Low

Birds

Table 7-21 Magnitude of effects and subsequent level of effect (without impact management) of the Project upon terrestrial ecology (birds) during operation

Ecological feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
Non-TAR birds	Low	Disturbance and displacement to roosts and individual birds (existing) due to the presence of the road (noise, light, dust etc).	Moderate	Effect is indirect, local, permanent, and is considered highly likely due to the definite presence of native birds in the Project Area.	Low
		Loss in connectivity due to permanent habitat loss, light and noise effects from the road, leading to fragmentation of terrestrial, wetland and riparian habitat due to the presence of the infrastructure.	Negligible	Effect is indirect, local, permanent, and is considered unlikely due to the existing fragmentation of the habitat.	Very Low

North Island fernbird	High	Disturbance and displacement to roosts and individual birds (existing) due to the presence of the road (noise, light, dust etc).	Negligible	Effect is indirect, local, and permanent. However, due to the restricted North Island fernbird habitat within the Project Area, the effect is considered unlikely.	Very Low
		Loss in connectivity due to permanent habitat loss, light and noise effects from the road, leading to fragmentation of terrestrial, wetland and riparian habitat due to the presence of the infrastructure.	Negligible	Effect is indirect, local, and permanent. However, due to the restricted North Island fernbird habitat and existing fragmentation within the Project Area, the effect is considered unlikely.	Very Low

Herpetofauna

Table 7-22 Magnitude of effects and subsequent level of effect (without impact management) of the Project upon terrestrial ecology (herpetofauna) during operation

Ecological feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
Copper skink	High	Disturbance and displacement of existing and future copper skink due to light, noise and vibration effects from the presence of the road.	Negligible	Effect is indirect, local, permanent and is considered unlikely.	Very Low
		Loss in connectivity due to permanent habitat loss, light and noise/vibration effects from the road, leading to fragmentation of terrestrial, wetland and riparian habitat due to the presence of the infrastructure.	Negligible	Effect is indirect, local, permanent and is considered unlikely due to the existing fragmentation of copper skink habitat within the Project Area.	Very Low

7.2.3.3 Aquatic Ecology

All works (excluding minor stormwater outfall works) will be outside the stream riparian setback and therefore no instream works will occur. Therefore, potential effects on instream habitat due to hydrology and water quality impacts during operation have been assessed in Section 7.2.3.4 for the corresponding wetlands.

7.2.3.4 Wetland Ecology

Table 7-23 lists the potential operational effects (direct and indirect) to the wetland ecology within the Project Area and their magnitude of effect. This is then used to calculate an overall level of effect to each habitat, prior to impact management. A detailed justification for the ecological value assessment and the magnitude of effect assessment that has resulted in the level of effect as per the EIANZ Guidelines is presented in Appendix 4.

Table 7-23 Magnitude of effects and subsequent level of effect (without impact management) of the Project upon wetland ecology during operation

Ecological Feature	Ecological Value	Effects Description	Magnitude of Effect	Justification of Magnitude	Level of Effect (without impact management)
TR-W1, TR-W2, TR-W3	Low	Change in hydrology: Effect on downstream habitat (including erosion/sediment discharge) due to change in hydrology (increase or decrease) due to gradual change in hydrology from the presence of the infrastructure/stormwater, including reclamations.	Negligible	Wetland water budget (volume and timing) will be maintained through stormwater management. No increase in flood frequency post development relative to baseline.	Very Low
TR-W4	Moderate		Low	Groundwater management will convey the constant groundwater feed out of the fill embankment footprint where the spring seepage occurs for Wetland TR-W4. This control is considered sufficient to address operational changes to the hydrology of the receiving environment. However, the probability classes have conservatively been adjusted one class up	Low
TR-W5&W6	Moderate		Negligible	Wetland water budget (volume and timing) will be maintained through stormwater management. No increase in flood frequency post development relative to baseline.	Very Low
TR-W1, TR-W2, TR-W3	Low	Stormwater discharge: Permanent degradation of wetland habitat and water quality due to stormwater discharges - pollutants (such as heavy metals and herbicides).	Negligible	All stormwater from the road pavement will be directed to the kerb channels and treated through the proposed stormwater treatment dry pond.	Very Low
TR-W4, TR-W5&W6	Moderate		Negligible	All stormwater from the road pavement will be directed to the kerb channels and treated through the proposed stormwater treatment dry pond.	Very Low

7.3 Impact Management

In accordance with the EIANZ Guidelines, measures to avoid, remedy or mitigate effects is focused on ecological features where the level of effect was assessed to be **Moderate** or higher. There were no construction or operational effects (except for the unavoidable loss of wetland TR-W4) that were assessed as **Moderate** or higher. However, there are construction related effects for fauna that requires impact management as a result of the Wildlife Act 1953 requirements, and construction related effects for wetlands that requires impact management as a result of the NPS:FM requirements. This is detailed further in Section 7.3.1 to 7.3.2.

7.3.1 Terrestrial Ecology

There are no construction or operational effects for terrestrial ecology where the level of effect was assessed to be **Moderate** or higher. However, all native fauna is protected by the Wildlife Act 1953, therefore requirements of this legislation will need to be adhered to. These requirements are detailed further in Section 7.3.1.1.

7.3.1.1 Wildlife Act 1953

Long-tailed bats

As long-tailed bat presence cannot be excluded in the future, the requirements of the Wildlife Act 1953 will need to be adhered to during vegetation removal of exotic-dominated treeland (TL.3) in the Project Area. This should include the implementation of vegetation removal protocols (including pre-felling surveys).

Birds

The Project Area is likely to contain native birds. Any vegetation clearance within the bird nesting season (September to February) will need to be managed to avoid harm to native bird species and their nests e.g., programming vegetation clearance to avoid bird nesting season or else undertaking nesting bird checks.

Herpetofauna

The Project Area is likely to contain copper skink. Methods to manage effects should be detailed in a Lizard Management Plan (LMP) and should address the following (as appropriate):

- Credentials and contact details of the ecologist/herpetologist who will implement the plan.
- Timing of the implementation of the LMP.
- A description of methodology for survey, trapping and relocation of lizards rescued including but not limited to salvage protocols, translocation protocols (including method used to identify suitable relocation site(s)), nocturnal and diurnal capture protocols, supervised habitat clearance/transfer protocols, artificial cover object protocols, and opportunity relocation protocols.
- A confirmation of the translocation site. Potential sites identified include:
  - 100 Hobsonville Road - TEMP (20 metre riparian corridor of Rawiri Stream)
  - Trig Reserve (located off Ryans Road)
  - Suitable habitat within Project Area
- For the confirmed translocation site, a discussion of:
  - Provision for additional refugia, if required e.g., depositing salvaged logs, wood or debris for newly released skinks that have been rescued.

- Any protection mechanisms (if required) to ensure the relocation site is maintained (e.g.) covenants, consent notices etc.
- Any weed and pest management to ensure the relocation site is maintained as appropriated habitat.

- Monitoring methods, including but not limited to the following: baseline surveying with the site, baseline surveys outside the site to identify potential release sites for salvaged lizard populations and lizard monitoring sites, ongoing annual surveys to evaluate translocation success, pre- and post-translocation surveys, and monitoring of effectiveness of pest control and/or any potential adverse effects on lizards associated with pest control.
- A post-vegetation clearance search for remaining lizards.
- Details of lizard habitat restoration to compensation for the loss of lizard habitat (approximately 6195 m^2) within the Project Area and to address residual effects of lizard salvage. It is recommended that restoration is accommodated within the designation as part of the Landscape Restoration Plans.

In order to implement the LMP, a project specific Wildlife Authority Permit (WAP) under the Wildlife Act 1953 is required and should be held by a suitably experienced Herpetologist (to handle or translocate indigenous wildlife and/or to destroy their habitat) which is administrated by the Department of Conservation. Permits can take several months to obtain and should be programmed appropriately prior to commencing vegetation/site clearance.

7.3.2 Wetland Ecology

The wetland ecology features that require mitigation are presented in Table 7-24. Although the level of effect for the permanent loss of TR-W1 was considered **Low**, offset is required under the NES-FW due to the loss in wetland extent.

Table 7-24 Wetland ecology features requiring mitigation

Ecological Feature	Effects Description	Level of Effect, Without Impact Management	Mitigation
TR-W1	Vegetation removal/reclamation: Road embankment will result in the permanent loss of approximately 1000 m^2 (0.1 ha) of a 3,700 m^2 (0.37 ha) hydrogeomorphic unit (HGM) of natural wetland associated with TR-W1 (approximately 27% of the hydrogeomorphic unit).	Low **NES-FW requirements**	The loss of wetland habitat at TR-W1 and TR-W4 cannot be mitigated 'at the point of impact'; therefore, this effect is considered further in Section 7.3.2.1.
TR-W4	Vegetation removal/reclamation: Road embankment will result in the permanent loss of approximately 780 m^2 (0.078 ha) of a 2,800 m^2 (0.28 ha) HGM unit of natural wetland associated with TR-W4 (approximately 29% of the hydrogeomorphic unit).	**Moderate** **NES-FW requirements**	

7.3.2.1 Residual Effects

The loss of wetland habitat at TR-W1 and TR-W4 cannot be mitigated 'at the point of impact' (due to unavoidable loss of wetland); therefore, offsetting is required. The proposed location for this offset is within the downslope areas of the remaining portions of wetland habitat associated with both wetlands (TR-W1 and TR-W4). The proposed designation boundary provides sufficient room for this offset to be finalised at detailed design stage.

Based on the current design, the area of wetland enhancement/planting required has been calculated using a Biodiversity Offset Accounting Model to ensure No Net Loss in ecological value. Appendix 8 presents an Indicative Wetland Offset/Compensation Restoration Plan and outlines the results of the offset modelling to identify the amount and type of wetland enhancement required. The model shows that restoring the downslope portions of the HGMs associated with TR-W1 (2,700 m^2) and TR-W4 (1,000 m^2) will result in a No Net Loss outcome.

It is recommended that the Biodiversity Offset Accounting Model, set out in Appendix 8, be re-calculated at the time of detailed design (if design changes effects on wetlands) and form the basis of a detailed Wetland Restoration and Enhancement Plan, which shall as a minimum include a methodology for the wetland enhancement and restoration.

8 Conclusions

Terrestrial Ecology

The terrestrial vegetation within the Project site is of **Negligible** to **Low** ecological value. There are no construction or operational effects for terrestrial ecology where the level of effect was assessed to be **Moderate** or higher, however habitat is provided to native fauna including:

- Long-tailed bats (**Very High** ecological value)
- Non-TAR native birds (**Low** ecological value)
- North Island fernbird (**High** ecological value)
- Copper skink (**High** ecological value)

During vegetation removal there is the potential to kill/injure native fauna. All native fauna is protected by the Wildlife Act 1953; therefore, this effect will need to be avoided and mitigated at the start of construction.

Aquatic Ecology

All works (excluding minor stormwater outfall works) will be outside the stream riparian setback and therefore no instream works will occur. Therefore, potential effects on instream habitat due to hydrology and water quality impacts during construction and operation have been assessed for the corresponding wetland.

Wetland Ecology

Where possible the Project has minimised impacts on wetlands, however, the reclamation of the upper portions of TR-W1 and TR-W4 during construction is unavoidable. The loss of TR-W4 is considered a **Moderate** level of effect therefore impact management is required, however, the loss of TR-W1 and TR-W4 also requires impact management as a result of the NPS:FM requirements. The loss of these wetlands can be sufficiently offset through wetland habitat restoration and wetland margin planting of the lower portions of the respective wetlands within the Project designation. The proposed wetland offset areas will allow the Project to achieve No Net Loss in ecological value.

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1 Appendix 1 – Regulatory Assessment

1.1 Legislation

1.1.1 Resource Management Act 1991

The purpose of the RMA is to achieve sustainable development of natural and physical resources. Important elements of this are the maintenance of indigenous biodiversity and protection of significant indigenous vegetation and habitats. These elements are given effect in Sections 5, 6 and 7, and Schedule 4 sets out the requirements for effects assessments.

1.1.2 Wildlife Act 1953

The Wildlife Act 1953 provides statutory protection for all indigenous lizard, frog, bat and bird species, and for the control of those species listed in Schedules 1 to 6. This includes a number of invertebrates (terrestrial and freshwater) and marine animals.

1.1.3 Conservation Act 1987

The Conservation Act 1987 provides for the protection of New Zealand's natural and historic resources. This includes protection of resources within public conservation land, including marginal strips and specially protected areas. Part 5B sets out protection for indigenous freshwater fish, including spawning habitat and individuals, and requirements regarding fish translocation.

1.2 National Policy Statements

1.2.1 National Policy Statement for Freshwater Management 2020

The National Policy Statement for Freshwater Management (MfE 2020a) provides national direction for decisions regarding water quality and quantity, and integrated management of land, freshwater and coastal environments under the RMA. The National Policy Statement for Freshwater Management contains national objectives that specify what local authorities, in their governance and management roles, must do to help achieve those objectives and policies.

The NPS:FM excludes wetlands which do not meet its definition of '*natural wetlands*' as:

a) *a wetland constructed by artificial means (unless it was constructed to offset impacts on, or restore, an existing or former natural wetland); or*

b) *a geothermal wetland; or*

c) *any area of improved pasture that, at the commencement date, is dominated by (that is more than 50% of) exotic pasture species and is subject to temporary rain derived water pooling.*

1.3 Auckland Unitary Plan Operative in Part 2016

The AUP:OP sets out the direction and rules for land, water, air and coastal use activities and development in the region and provides measures to protect natural and physical resources.

The AUP:OP became operative in part on 15 November 2015, replacing most district and regional plans in the Auckland Region.

1.4 Additional Planning Guidance

1.4.1 New Zealand's Fish Passage Guidelines 2018

This guidance document sets out recommended practice for the design of instream infrastructure to provide for fish passage. The intent of these guidelines is to set the foundation for the improvement of fish passage management in New Zealand.

1.4.2 New Zealand Biodiversity Strategy

The New Zealand Biodiversity Strategy (DOC and MfE 2000) was prepared in response to the state of decline of New Zealand's indigenous biodiversity and establishes a strategic framework for the conservation, sustainable use and management of New Zealand's biodiversity. This includes indigenous biodiversity and 'important' introduced species.

1.4.3 Protecting our Places

Protecting our Places (DOC & MfE, 2007) forms part of a Department of Conservation (DOC) and Ministry for the Environment (MfE) programme and intends to provide a framework for decision making regarding biodiversity management on private land. It is an important document for managing biodiversity under the RMA and its key provisions have been incorporated into the Proposed National Policy Statement for Biodiversity (refer to Sections 3.1.1 and 3.2.2).

It is supported by the 'Statement of National Priorities for protecting rare and threatened indigenous biodiversity on private land' and includes the provision of identifying rare and threatened environments and ecosystems in New Zealand:

National Priority 1: To protect indigenous vegetation associated with land environments (defined by Land Environments of New Zealand at Level IV), that have 20% or less remaining in indigenous cover.

National Priority 2: To protect indigenous vegetation associated with sand dunes and wetlands; ecosystem types that have become uncommon due to human activity.

National Priority 3: To protect indigenous vegetation associated with 'originally rare' terrestrial ecosystem types not already covered by priorities 1 and 2.

National Priority 4: To protect habitats of acutely and chronically threatened indigenous species.

1.4.4 Auckland Conservation Management Strategy 2014 to 2024

The Auckland Conservation Management Strategy (DOC, 2014) describes the conservation values present in Auckland and provides guidance for conservation work in the Auckland region. The purpose of the Auckland Conservation Management Strategy is to implement DOC's general policies and establishes objectives and milestones for integrated management of the region's natural and historic resources. A priority of the strategy is the maintenance and enhancement of ecosystems, habitats and species vulnerable to the adverse effects of human activities.

1.4.5 Auckland Council's Indigenous Biodiversity Strategy 2012

The Council's Indigenous Biodiversity Strategy (Auckland Council, 2012) provides an approach for managing indigenous biodiversity in the region and gives guidance for the development of statutory plans, while upholding the Council's statutory obligations to biodiversity under the RMA and the Proposed National Policy Statement for Biodiversity.

It provides objectives and performance measures for:

- Conserving Auckland's indigenous ecosystems;
- The Long-term recovery of threatened species;
- The maintenance and enhancement of ecosystem services;
- Sustaining and protecting cultural values; and
- Improving understanding biodiversity, collaboration and implementation of statutory responsibilities.

2 Appendix 2 – Summary of Ecological Impact Assessment Methodology

A1. Assessment of Ecological Value

The first step in the Ecological Impact Assessment (EcIA) approach is to assess the value of ecological features identified as part of the ecological baseline in terms of Representativeness, Rarity, Diversity and Pattern, and Ecological context.

The ecological value of terrestrial, freshwater and wetland ecological features was assessed by assigning a score of 0 (None), 1 (Low), 2 (Moderate), 3 (High) or 4 (Very High) based on professional judgement (with justification) to aspects associated with each of the four ecological matters (1) Representativeness 2) Rarity/distinctiveness 3) Diversity and pattern 4) Ecological context) including:

Terrestrial Ecology

1) **Representativeness**: Typical structure, species composition and indigenous representation
2) **Rarity/distinctiveness**: Species of conservation significance, distinctive ecological values
3) **Diversity and pattern**: Habitat diversity, species diversity and patterns in habitat use
4) **Ecological context**: Size, shape and buffering function, sensitivity to change, ecological networks (linkages, pathways, migration)

Freshwater Ecology

1) **Representativeness**: RHA score for accessible sites and riparian habitat modification based on desktop stream and catchment assessments
2) **Rarity/distinctiveness**: Species of conservation significance informed by the potential occurrence of Threatened and At-Risk (TAR) fish species
3) **Diversity and pattern**: Level of natural diversity informed by the habitat diversity subsection of the RHA. Stream order, slope and hydroperiod were applied as desktop proxies to judge the likely habitat diversity for streams where access was constraint
4) **Ecological context**: Stream order and hydroperiod

Wetland Ecology

1) **Representativeness**: Informed by wetland condition assessment. Hydrological modification based on observations of drains, ponds and catchment land use. Native vegetation informed by site visit and review of landcover information;
2) **Rarity/distinctiveness**: Wetland type (rare or distinctive); distinctive ecological values (ecosystem services) in a larger catchment context;
3) **Diversity and pattern**: Representation of different hydroperiods (permanent, seasonal or temporary) and the structural complexity of vegetation cover
4) **Ecological context**: flood attenuation, streamflow regulation, sediment trapping, water purification, connectivity and migration

The score for each matter was constrained to the highest score for each aspect (for example a High score allocated to a wetland for flood attenuation will result in a High score for the Ecological context matter). The combined ecological value score (ranging from **Very High** to **Negligible**), for the four matters, was then determined in accordance with the EIANZ Guidelines.

Species

Assigning value at the terrestrial species level considers the current threat status of a species (in accordance with the NZ Threat Classification system) that is present in areas potentially impacted by the Project. The ecological value of the species is assigned in accordance with the table below.

Table 9-1 Attributes to consider when assessing ecological value of terrestrial species

Threat Class	Threat Sub-class	Value
Exotic: Introduced and Naturalised	-	Negligible
Indigenous: Common/not threatened	-	Low
Indigenous: Locally uncommon or distinctive species	-	Moderate
Indigenous: At Risk	Naturally uncommon Relict Recovering	Moderate
	Declining	High
Indigenous: Threatened	Nationally Critical Nationally Endangered Nationally Vulnerable	Very High

A2. Assessment of ecological effects

The ecological effects assessment includes several steps that collectively assess the way the Project will interact with elements of the physical and biological, environment to produce effects to habitat and receptors. The method for determining the level of effect are outlined in the following sections.

Magnitude of effect

The magnitude of effects from a Project is firstly determined by the characteristics in the following table.

Table 9-2 Magnitude of effect characteristics

Characteristic	Definition	Designations
Type	A descriptor indicating the relationship of the impact to the Project (in terms of cause and effect)	Direct
		Indirect
Extent[13]	The “reach” of the impact (e.g., confined to a small area around the Project Footprint, projected for several kilometres, etc.)	Local
		Regional
		National
Duration	The time period over which a resource/receptor is affected	Temporary (days or months)
		Short-term (<5 years)
		Long-term (15-25 years)

[13] Extent for streams and wetlands differs. The extent is as follows: score of 1 = <10% of reach length, 2 = 10-20% of stream length, 3 = 20-40% of stream length, 4 = 40-70% of stream length, 5 = >70% of stream length. Downstream flow/water quality effects are as follows: (a score of 1 is not appropriate in this context), score of 2 = stream reach 100-500 m, 3 = stream reach 500 m – 1 km, 4 = stream reach 1 – 10 km, 5 = stream reach >10 km.

Characteristic	Definition	Designations
		Permanent (>25 years)
Frequency	A measure of the constancy or periodicity the receptor will be affected	Infrequently
		Periodically
		Frequently
		Continuously
Likelihood	The probability of an effect occurring if it is unplanned	Highly Unlikely
		Unlikely
		Likely
		Highly Likely
		Definite
Reversibility	The degree to which the ecological effect can be reversed in a reasonable time scale through natural processes or mitigation	Totally
		Partially
		Irreversible
		Not applicable

Based on the above-mentioned characteristics, a magnitude is assigned for each Project effect and are defined in the table below

Table 9-3 Magnitude of effect – levels

Magnitude	Description
Very High	Total loss of, or very major alteration to, key elements/features of the existing baseline conditions, such that the post-development character, composition and or attributes will be fundamentally changes and may be lost from the site altogether; and/or loss of very high proportion of the known population or range of the elements/features
High	Major loss or major alteration to key elements/features of the existing baseline such that the post-development character, composition and/or attributes will be fundamentally changed; and/or loss of a high proportion of the known population or range of the element/feature
Moderate	Loss or alteration to one or more key elements/features of the existing baseline such that the post-development character, composition and/or attributes will be partially changed; and/or loss of a moderate proportion of the known population or range of the element/feature
Low	Minor shift away from the existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline conditions will be similar or pre-development circumstances or patterns; and or having a minor effect on the known population or range of the element/feature

Magnitude	Description
Negligible	Very slight change from the existing baseline condition. Change barely distinguishable, approximating to the 'no change' situation; and/or having negligible effect on the known population or range of the element/feature

Level of effect

Once the magnitude of effect and the ecological value of the feature have been determined, the level of effect on that feature, can be assigned for each effect, using the matrix shown in the table below

Table 9-4 Ecological effect matrix

		Ecological Values				
		Very High	High	Moderate	Low	Negligible
Magnitude	Very High	Very High	Very High	High	Moderate	Low
	High	Very High	Very High	Moderate	Low	Very Low
	Moderate	High	High	Moderate	Low	Very Low
	Low	Moderate	Low	Low	Very Low	Very Low
	Negligible	Low	Very Low	Very Low	Very Low	Very Low
	Positive	Negligible	Negligible	Negligible	Negligible	Negligible

A3. Impact Management

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:

- 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 Hig**h' level of impact is are 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.

Residual impact

Once impact management measures are declared, the next step in the effects assessment process was to assign determine whether any residual effects remain and to implement further mitigation, offset or compensation measures to reduce the effect. This is a repeat of the impact assessment steps discussed above (until an acceptable level of effect remains – usually **Low/Very low/Negligible**), considering the implementation of the additional recommended impact management measures.

Managing uncertainty

Biophysical impacts are difficult to predict with certainty, but uncertainty stemming from on-going development of the Project design and implementation is inevitable, and the environment is variable over time. If uncertainties are relevant to the effect assessment, they were stated and approached conservatively, to identify a range of likely residual effects and relevant mitigation measures.

Cumulative effects

Cumulative impacts and effects are those that arise because of an impact and effect from the Project interacting with those from another activity to create an additional impact and effect. These are termed cumulative impacts and effects. No structed methods were employed to assess cumulative impacts, but where relevant descriptions of potential cumulative effects have been provided.

3 Appendix 3 – Aquatic and Wetland Methodologies

3.1 Storey & Wadha (2009) Stream Classification Methodology

During the site walkovers detailed in Section 7.1.4.2, all streams within the Project Areas identified on Auckland Council Geomaps were ground truthed and classified as permanent, intermittent or ephemeral, according to the stream definitions described by Storey and Wadhwa (2009), which are presented in Table 9-5. Any additional streams observed during site walkovers were also classified and where appropriate artificial swales, ditches and piped flow paths were also recorded.

Table 9-5 Stream classification criteria (Storey and Wadhwa, 2009)

Criteria	Definition
Permanent stream	
1	Evidence of continuous flow
Intermittent or ephemeral stream*	
1	Evidence of natural pools
2	Well defined banks and bed
3	Retains surface water present more than 48 hours after a rain event
4	Rooted terrestrial vegetation not established across channel
5	Organic debris from flooding present on floodplain
6	Evidence of substrate sorting, including scour and deposition
*If three or more of the six assessment criteria can be met with confidence, the watercourse is considered intermittent. If at least three criteria cannot be met, the watercourse is considered ephemeral.	
Ephemeral	
Stream reach with a bed above the water table at all times. Concentrated flow for short periods of time during and/or after rainfall. Not confined within a defined channel.	

3.2 Rapid Habitat Assessment

Freshwater assessments were undertaken on all streams identified on site and included the implementation of the Rapid Habitat Assessment (RHA) protocol either onsite or at a desktop level (Clapcott, 2015) (Figure 9-1). The RHA provides a standardised protocol for making a quick, qualitative, site-based assessment of physical stream habitat conditions.

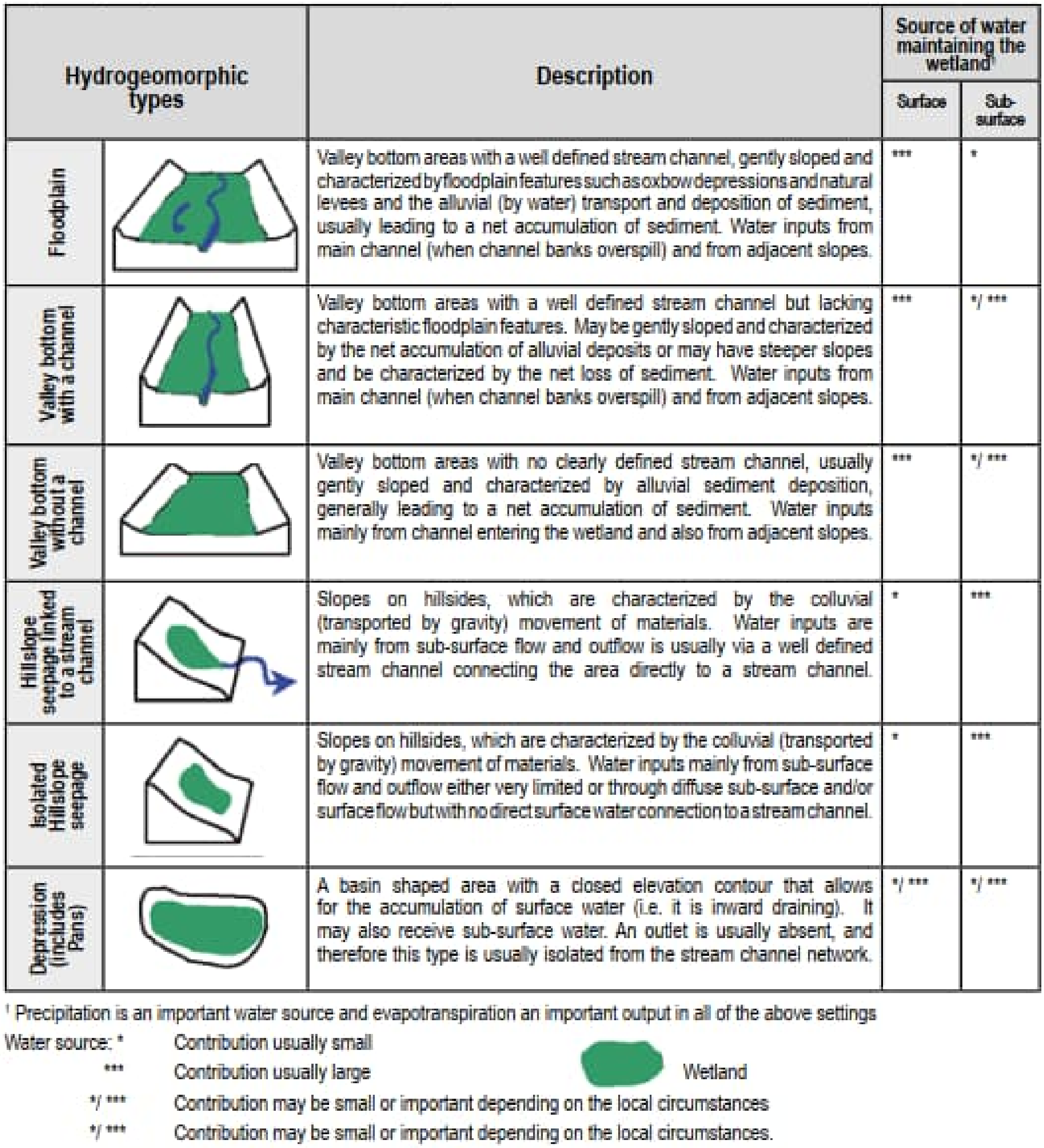
Habitat parameter	Condition category										SCORE
1. Deposited sediment	*The percentage of the stream bed covered by fine sediment.*										
	0	*5*	*10*	*15*	*20*	*30*	*40*	*50*	*60*	*≥ 75*	
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
2. Invertebrate habitat diversity	*The number of different substrate types such as boulders, cobbles, gravel, sand, wood, leaves, root mats, macrophytes, periphyton. Presence of interstitial space score higher.*										
	≥ 5	*5*	*5*	*4*	*4*	*3*	*3*	*2*	*2*	*1*	
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
3. Invertebrate habitat abundance	*The percentage of substrate favourable for EPT colonisation, for example flowing water over gravel-cobbles clear of filamentous algae/macrophytes.*										
	95	*75*	*70*	*60*	*50*	*40*	*30*	*25*	*15*	*5*	
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
4. Fish cover diversity	*The number of different substrate types such as woody debris, root mats, undercut banks, overhanging/encroaching vegetation, macrophytes, boulders, cobbles. Presence of substrates providing spatial complexity score higher.*										
	≥ 5	*5*	*5*	*4*	*4*	*3*	*3*	*2*	*2*	*1*	
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
5. Fish cover abundance	*The percentage of fish cover available.*										
	95	*75*	*60*	*50*	*40*	*30*	*20*	*10*	*5*	*0*	
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
6. Hydraulic heterogeneity	*The number of of hydraulic components such as pool, riffle, fast run, slow run, rapid, cascade/waterfall, turbulance, backwater. Presence of deep pools score higher.*										
	≥ 5	*5*	*4*	*4*	*3*	*3*	*2*	*2*	*2*	*1*	
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
7. Bank erosion	*The percentage of the stream bank recently/actively eroding due to scouring at the water line, slumping of the bank or stock pugging.*										
Left bank	*0*	*≤ 5*	*5*	*15*	*25*	*35*	*50*	*65*	*75*	*> 75*	
Right bank	*0*	*≤ 5*	*5*	*15*	*25*	*35*	*50*	*65*	*75*	*> 75*	
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
8. Bank vegetation	*The maturity, diversity and naturalness of bank vegetation.*										
Left bank AND Right bank	*Mature native trees with diverse and intact understorey*		*Regenerating native or flaxes/sedges/tussock > dense exotic*			*Mature shrubs, sparse tree cover > young exotic, long grass*			*Heavily grazed or mown grass > bare/impervious ground.*		
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
9. Riparian width	*The width (m) of the riparian buffer constrained by vegetation, fence or other structure(s).*										
Left bank	*≥ 30*	*15*	*10*	*7*	*5*	*4*	*3*	*2*	*1*	*0*	
Right bank	*≥ 30*	*15*	*10*	*7*	*5*	*4*	*3*	*2*	*1*	*0*	
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
10. Riparian shade	*The percentage of shading of the stream bed throughout the day due to vegetation, banks or other structure(s).*										
	≥ 90	*80*	*70*	*60*	*50*	*40*	*25*	*15*	*10*	*≤ 5*	
SCORE	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	
TOTAL	(Sum of parameters 1-10)										

Figure 9-1 Rapid Habitat Assessment (RHA) protocol (Clapcott, 2015)

3.3 Wetland Assessment Methodology

3.3.1 Hydrogeomorphic Unit

Conceptual model for different HGM units as applied within this assessment (Figure 9-2).



Hydrogeomorphic types		Description	Source of water maintaining the wetland[1]	
			Surface	Sub-surface
Floodplain		Valley bottom areas with a well defined stream channel, gently sloped and characterized by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*
Valley bottom with a channel		Valley bottom areas with a well defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterized by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.	***	*/ ***
Valley bottom without a channel		Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterized by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.	***	*/ ***
Hillslope seepage linked to a stream channel		Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well defined stream channel connecting the area directly to a stream channel.	*	***
Isolated Hillslope seepage		Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow either very limited or through diffuse sub-surface and/or surface flow but with no direct surface water connection to a stream channel.	*	***
Depression (includes Pans)		A basin shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent, and therefore this type is usually isolated from the stream channel network.	*/ ***	*/ ***

[1] Precipitation is an important water source and evapotranspiration an important output in all of the above settings

Water source: * Contribution usually small

*** Contribution usually large

*/ *** Contribution may be small or important depending on the local circumstances

*/ *** Contribution may be small or important depending on the local circumstances.

Wetland

Figure 9-2 The HGM classification according Brinson (1993) and adopted from Kotze et al. (2007)

3.3.2 Wetland Functional Value

The matrix outlining the likely presence of specific wetland functions associated with different wetland types is presented in Table 9-6.

Table 9-6 Likely presence of different functional wetland values associated with different HGM units (wetland types)

	Early wet season Flood attenuation	Late wet season Flood attenuation	Stream flow regulation	Erosion control	Sediment trapping	Phosphate removal	Nitrate removal	Toxicants
Depression	Likely	Likely	Unlikely	Unlikely	Unlikely	Unlikely	Likely	Likely
Hillslope seep (isolated)	Likely	Unlikely	Unlikely	Very likely	Unlikely	Unlikely	Very likely	Likely
Hillslope seep (connected)	Likely	Unlikely	Likely	Very likely	Unlikely	Unlikely	Very likely	Very likely
Unchanneled valley bottom	Likely	Likely	Unlikely	Very likely	Very likely	Likely	Likely	Very likely
Channelled valley bottom	Likely	Unlikely	Likely	Very likely	Likely	Likely	Likely	Likely
Floodplain	Very likely	Likely	Unlikely	Very likely	Very likely	Very likely	Likely	Likely

3.3.3 Wetland Condition

Based on Clarkson et al. (2004) handbook for monitoring wetland condition, to assess a range of external pressures which can lead to a decline in the health or condition of the wetland. For example, changes in hydrology, water pollution, nutrient enrichment, and invasion by weeds and pests can lead to biodiversity loss and impaired wetland functioning (Table 9-7). The wetland condition score was interpreted through wetland condition categories proposed by Kleynhans (2007) (Table 9-7). These conditions where used to value the functional integrity of the wetland habitat and therefore provide a way to value the system with regards to the EIANZ Guidelines.

Table 9-7 Summary of aspects and components considered within the wetland condition assessment (Clarkson et al., 2004). The degree of modification was assessed using the following scoring: 5=very low/none, 4=low, 3=medium, 2=high, 1=very high and 0=extreme

Impact indicator	Indicator components
Hydrological integrity	Impact of manmade structures
	Water table depth
	Dryland plant invasion
Physico-chemical parameters	Fire damage
	Degree of sedimentation
	Nutrient levels
	Von Post index
Change in ecosystem intactness	Loss in area of original wetland
	Connectivity barriers
Change in browsing, predation and harvesting regimes	Damage by domestic or feral animals
	Introduces predator impacts on wildlife
	Harvesting levels
Change in dominance of native plants	Introduced plant canopy cover
	Introduced plant understory cover
Total wetland condition index/25	

Table 9-8 Key wetland pressures assessed within the catchment of the wetland (Clarkson et al., 2004). Pressure scores were assigned as follows:5=very high, 4= high, 3=medium, 2=low, 1=very low, 0=none

Pressure
Modification to catchment hydrology
Water quality within the catchment
Animal access
Key undesirable species

Pressure
% catchment introduced vegetation
Other
Total catchment pressure index/30

Table 9-9 Wetland condition categories and associated descriptions used within this assessment

Category Wetland Condition	Description	%
Unmodified	Unmodified/ natural	100%
Largely natural	Largely natural with a few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota have taken place	80-100%
Moderately	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	60-80%
Largely	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred	40-60%
Seriously	Seriously modified. The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable	20-40%
Critically	Critically modified. Modifications have rich a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota	<20%

4 Appendix 4 – Aquatic, Wetland and Terrestrial Ecology Results

4.1 Aquatic Ecology Results

4.1.1 Stream Hydroperiod Classification

Table 9-10 Stream classification results, based on Storey and Wadhwa (2009)

Stream	Stream classification	Criteria met based on Storey and Wadhwa (2009) – refer Appendix 3, Section 3.1
TR-S1	Intermittent	Evidence of natural pools, defined banks and bed, rooted vegetation not established across channel. Riverbed seasonally intercepting the saturated soil zone
TR-S2	Intermittent	Evidence of natural pools, defined banks and bed, rooted vegetation not established across channel. Riverbed seasonally intercepting the saturated soil zone
TR-S3	Intermittent	Evidence of natural pools, defined banks and bed, rooted vegetation not established across channel. Riverbed seasonally intercepting the saturated soil zone
W5-S2*	Intermittent	Evidence of natural pools, well defined banks and bed, rooted vegetation not established across channel.

Notes: * = Desktop assessment.

4.1.2 Rapid Habitat Assessment

Table 9-11 Summary of RHA values

Stream ID	Deposited Sediment	Invertebrate habitat diversity	Invertebrate habitat abundance	Fish cover diversity	Fish cover abundance	Hydraulic heterogeneity	Bank erosion	Bank vegetation	Riparian width	Riparian shade	RHA Habitat Quality Score	Corresponding Habitat Value*
TR-S1	1	1	1	1	1	1	9	1	1	1	**18**	**Poor**
TR-S1	1	1	1	1	1	1	7	1	1	1	**16**	**Poor**
TR-S1	1	1	1	1	1	1	9	1	1	1	**18**	**Poor**
W5-S2	1	1	1	1	1	1	9	1	1	1	**18**	**Poor**

Notes:

* = Corresponding habitat values for each habitat quality score

P = Poor (Score 10-40)

M = Moderate (Score 41-60)

G = Good (Score 61-80)

E = Excellent (Score 81+)

4.1.3 Aquatic Ecology - Value Assessment

Table 9-12 Ecological value assessment for aquatic ecological features

Attributes	Ecological Feature				Justification
	TR-S1	TR-S2	TR-S3	W5-S2*	
Representativeness (including SEV, RHA and ecological integrity)	**1**	**1**	**1**	**1**	**-**
Instream habitat modification	1	1	1	-	Poor RHA scores for all streams.
Riparian habitat modification	1	1	1	1	Poor RHA scores for all streams.
Invertebrate assemblage representation	-	-	-	-	-
Fish assemblage representation	1	1	1	-	Habitat is largely unsuitable or inaccessible for potential assemblage.
SEV scores relative to potential score	-	-	-	-	-
RHA score relative to potential score	-	-	-	-	-
Rarity/distinctiveness	**3**	**3**	**3**	**1**	**-**
Range restricted or endemic species	-	-	-	-	-
Species of conservation significance	3	3	3	1	Desktop review: Potential for longfin eel (At Risk - Declining).
Stream type (rare or distinctive)	1	1	1	-	-
Distinctive ecological values (ecosystem services)	-	-	-	-	-
Diversity and pattern	**0**	**0**	**0**	**1**	**-**
Level of natural diversity	-	-	-	1	-
Species diversity	-	-	-	-	-
Complexity of community	-	-	-	-	-

Attributes	Ecological Feature				Justification
	TR-S1	TR-S2	TR-S3	W5-S2*	
Ecological context (Ecosystem services, importance and sensitivity)	**3**	**3**	**3**	**3**	**-**
Stream order	1	2	2	1	TR-S1: Zero order TR-S2: Order 1 TR-S3: Zero order
Hydroperiod	3	3	3	3	TR-S1: Intermittent stream TR-S2: Intermittent stream TR-S3: Intermittent stream
Sensitivity to flow and water quality modification	1	1	1	-	Habitat already significantly altered by human activities, therefore less easily affected by anthropogenic changes.
Connectivity and migration	-	-	-	-	Habitat is not important in terms of connectivity for the survival of any species at any scale.
Protected status	-	-	-	-	Streams do not fall within any category of protected status.
Ecological Value	**Low**	**Low**	**Low**	**Low**	**-**

Notes: * = Ecological value assessment as per draft Assessment of Ecological Effects for North West – Whenuapai (Supporting Growth, 2022b).

4.2 Wetland Ecology Results

4.2.1 Wetland Vegetation Plots

A site plan showing the location of the wetland vegetation plots is presented in Figure 9-3 and further detail is provided in Table 9-13.

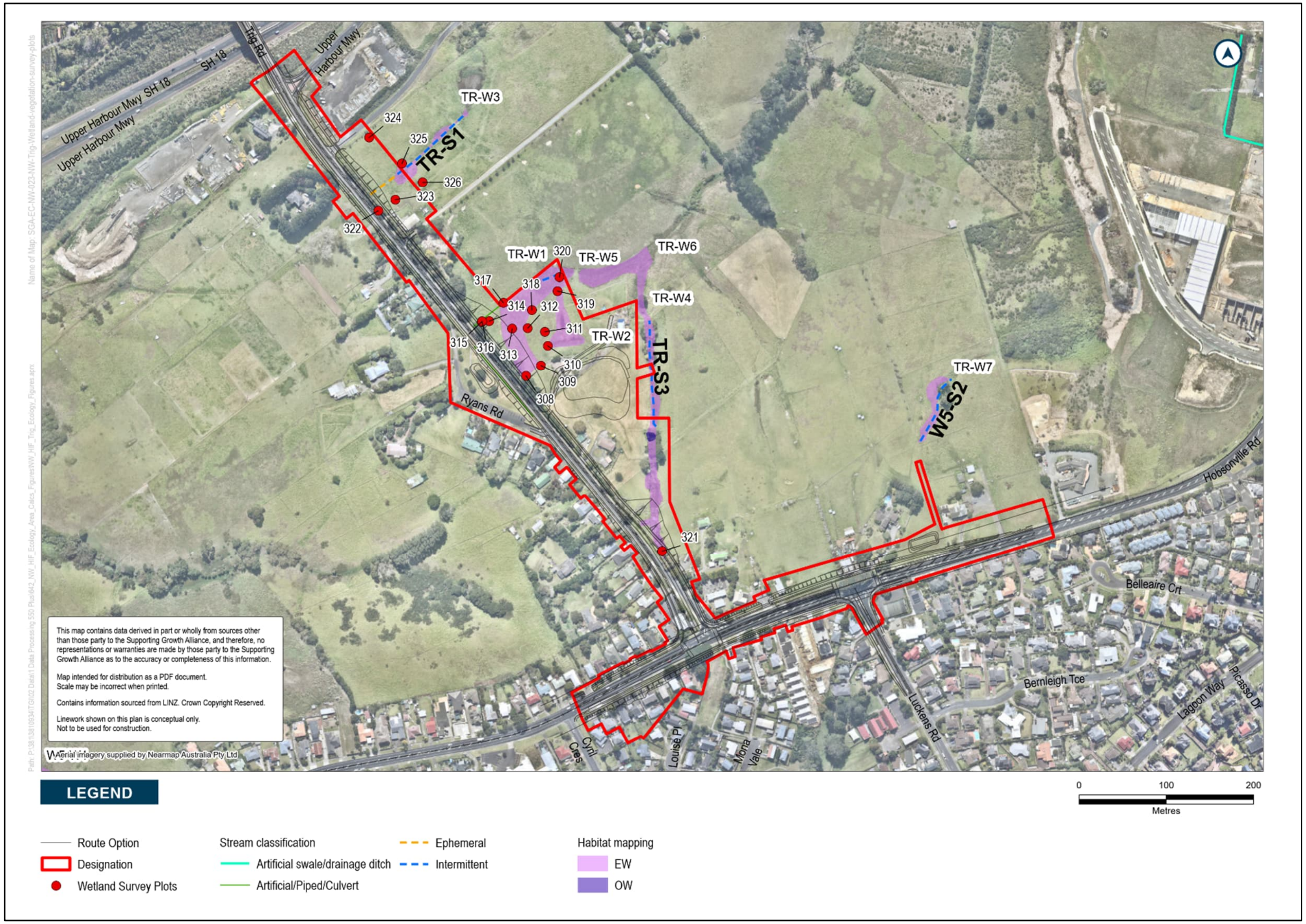


Figure 9-3 Trig Road wetland vegetation survey plots

Table 9-13 Wetland vegetation plots, dominance test (Dom T) and Prevalence Index (PI)

Plot ID	Index	Common Name	Scientific Name	Cover (%)*	Rating	Exotic/Native	Pasture Dom (>50%) T	Wetland Dom T	PI
Plot 308	**45**	Kikuyu grass	*Cenchrus clandestinus*	20	FACU	Exotic	No	Yes	Yes (3.0)
	54	Creeping buttercup	*Ranunculus repens*	70	FAC	Exotic			
	28	Soft rush	*Juncus effusus*	20	FACW	Exotic			
Plot 309	**43**	Mercer grass	*Paspalum distichum*	40	FACW	Exotic	No	Yes	Yes (2.8)
	54	Creeping buttercup	*Ranunculus repens*	40	FAC	Exotic			
	45	Kikuyu grass	*Cenchrus clandestinus*	20	FACU	Exotic			
Plot 310	**43**	Mercer grass	*Paspalum distichum*	25	FACW	Exotic	No	Yes	Yes (2.5)
	54	Creeping buttercup	*Ranunculus repens*	50	FAC	Exotic			
	28	Soft rush	*Juncus effusus*	25	FACW	Exotic			
Plot 311	**43**	Mercer grass	*Paspalum distichum*	40	FACW	Exotic	Yes	No	No (3.3)
	45	Kikuyu grass	*Cenchrus clandestinus*	80	FACU	Exotic			
	54	Creeping buttercup	*Ranunculus repens*	20	FAC	Exotic			
	67	White clover	*Trifolium repens*	10	FACU	Exotic			
Plot 312	**43**	Mercer grass	*Paspalum distichum*	50	FACW	Exotic	No	Yes	Yes (2.3)
	54	Creeping buttercup	*Ranunculus repens*	20	FAC	Exotic			
Plot 313	**45**	Kikuyu grass	*Cenchrus clandestinus*	90	FACU	Exotic	Yes	No	No (3.7)
	54	Creeping buttercup	*Ranunculus repens*	20	FAC	Exotic			
	43	Mercer grass	*Paspalum distichum*	10	FACW	Exotic			
Plot 315	**45**	Kikuyu grass	*Cenchrus clandestinus*	70	FACU	Exotic	Yes	No	No (3.5)

Plot ID	Index	Common Name	Scientific Name	Cover (%)*	Rating	Exotic/Native	Pasture Dom (>50%) T	Wetland Dom T	PI
	54	Creeping buttercup	*Ranunculus repens*	40	FAC	Exotic			
	28	Soft rush	*Juncus effusus*	10	FACW	Exotic			
Plot 316	**45**	Kikuyu grass	*Cenchrus clandestinus*	100	FACU	Exotic	Yes	No	No (3.8)
	54	Creeping buttercup	*Ranunculus repens*	20	FAC	Exotic			
Plot 317	**54**	Creeping buttercup	*Ranunculus repens*	100	FAC	Exotic	No	Yes	No (3.2)
	45	Kikuyu grass	*Cenchrus clandestinus*	30	FACU	Exotic			
Plot 318	**43**	Mercer grass	*Paspalum distichum*	50	FACW	Exotic	No	Yes	Yes (2.9)
	45	Kikuyu grass	*Cenchrus clandestinus*	30	FACU	Exotic			
	54	Creeping buttercup	*Ranunculus repens*	30	FAC	Exotic			
	67	White clover	*Trifolium repens*	10	FACU	Exotic			
Plot 319	**43**	Mercer grass	*Paspalum distichum*	50	FACW	Exotic	No	Yes	Yes (2.9)
	45	Kikuyu grass	*Cenchrus clandestinus*	40	FACU	Exotic			
	54	Creeping buttercup	*Ranunculus repens*	30	FAC	Exotic			
Plot 320	**28**	Soft rush	*Juncus effusus*	70	FACW	Exotic	No	Yes	Yes (2.3)
	54	Creeping buttercup	*Ranunculus repens*	30	FAC	Exotic			
	43	Mercer grass	*Paspalum distichum*	10	FACW	Exotic			
Plot 321	**28**	Soft rush	*Juncus effusus*	80	FACW	Exotic	No	No	Yes (2.4)
	45	Kikuyu grass	*Cenchrus clandestinus*	20	FACU	Exotic			
Plot 322	No property access. Review of previous field assessment and roadside observation, determined as wetland.								
Plot 323	**45**	Kikuyu grass	*Cenchrus clandestinus*	100	FACU	Exotic	Yes	No	Yes (3.8)

Plot ID	Index	Common Name	Scientific Name	Cover (%)*	Rating	Exotic/Native	Pasture Dom (>50%) T	Wetland Dom T	PI
	54	Creeping buttercup	*Ranunculus repens*	20	FAC	Exotic			
Plot 324	**45**	Kikuyu grass	*Cenchrus clandestinus*	95	FACU	Exotic	Yes	No	No (3.9)
	54	Creeping buttercup	*Ranunculus repens*	10	FAC	Exotic			
Plot 325	**45**	Kikuyu grass	*Cenchrus clandestinus*	40	FACU	Exotic	No	No	Yes (3.0)
	43	Mercer grass	*Paspalum distichum*	30	FACW	Exotic			
	67	White clover	*Trifolium repens*	5	FACU	Exotic			
Plot 326	**45**	Kikuyu grass	*Cenchrus clandestinus*	100	FACU	Exotic	Yes	No	No (4.0)

Notes: * - Absolute % cover for each species is estimated as the vertical projection (natural spread) of the above ground live biomass for each species irrespective of the position of other vegetation. Individual species cover cannot be more than 100% but total vegetation cover can >100%.

Plate 1 – Wetland TR-W1: General area of TR-W1.

Plate 2 – Wetland TR-W1: Plot 312 dominated by *Paspalum distichum* (FACW). *Ranunculus repens* (FAC) also present.

Plate 3 – Wetland TR-W3: General area of TR-W3.

Plate 4 – Wetland TR-W3: Plot 323 dominated by *Paspalum distichum* (FACW). *Ranunculus repens* (FAC) also present.

Plate 5 – Wetland TR-W4: General area of TR-W4.

Plate 5 – Wetland TR-W4: General area of TR-W4.

Figure 9-4 Wetland delineation observations

4.2.2 Wetland Condition Assessment

The condition of wetlands TR-W1 to TR-W7 were assessed using Clarkson et al., 2004 and the results of the assessment are provided in Table 9-14. A value of 1 corresponds to a very high degree of modification and a value of 5 corresponds to a very low degree of modification.

The overall condition scores ranged between 7/25 and 11/25 which translate to a **Largely Modified** state (a large change in ecosystem processes and loss of natural habitat and biota has occurred) or **Seriously Modified** state (the change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable).

Table 9-14 Wetland condition scores for impact indicators and indicator components for TR-W1 to TR-W7

Impact Indicator	Indicator Components	TR-W1 Impact Score	TR-W2 Impact Score	TR-W3 Impact Score	TR-W4 Impact Score	TR-W5&6 Impact Score	TR-W7 Impact Score
Hydrological integrity	Impact of manmade structures	4	3	2	4	4	4
	Water table depth	-	-	-	-	-	-
	Dryland plant invasion	-	-	-	-	-	-
Mean Score		**4.0**	**3.0**	**2.0**	**4.0**	**4.0**	**4.0**
Physico-chemical parameters	Fire damage	-	-	-	-	-	-
	Degree of sedimentation	-	-	-	-	-	-
	Nutrient levels	2	1	1	2	1	1
	Von Post index	-	-	-	-	-	-
Mean score		**2.0**	**1.0**	**1.0**	**2.0**	**1.0**	**1.0**
Change in ecosystem intactness	Loss in area of original wetland	3	3	2	3	3	3
	Connectivity barriers	-	-	-	-	-	-
Mean score		**3.0**	**3.0**	**2.0**	**3.0**	**3.0**	**3.0**
Change in browsing, predation and harvesting regimes	Damage by domestic or feral animals	1	1	1	1	1	1
	Introduces predator impacts on wildlife	-	-	-	-	-	-
	Harvesting levels	-	-	-	-	-	-
Mean score		**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**

Impact Indicator	Indicator Components	TR-W1 Impact Score	TR-W2 Impact Score	TR-W3 Impact Score	TR-W4 Impact Score	TR-W5&6 Impact Score	TR-W7 Impact Score
Change in dominance of native plants	Introduced plant canopy cover	1	1	1	1	1	1
	Introduced plant understory cover	-	-	-	-	-	-
Mean score		**1.0**	**1.0**	**1.0**	**1.0**	**1.0**	**1.0**
Average condition score		**11.0**	**9.0**	**7.0**	**11.0**	**10.0**	**10.0**
Average condition %		**44.00%**	**36.00%**	**28.00%**	**44.00%**	**40.00%**	**40.00%**
Condition index category		**Largely**	**Seriously**	**Seriously**	**Largely**	**Largely**	**Largely**

Notes: 1 = Very high degree of modification to 5 = Very low degree of modification.

The catchment pressure assessment resulted in total overall catchment pressure scores of 18/25 (Table 9-15). This score reflects a High degree of catchment modification. A score of 0 corresponds to no catchment modification, and a score of 5 corresponds to a very high degree of catchment modification.

Table 9-15 Catchment impact score for TR-W1 to TR-W7

Catchment Pressure	TR-W1 Impact Score	TR-W2 Impact Score	TR-W3 Impact Score	TR-W4 Impact Score	TR-W5&W6 Impact Score	TR-W7 Impact Score
Modification to catchment hydrology	2	2	2	2	2	2
Water quality within the catchment	4	4	4	4	4	4
Animal access	5	5	5	5	5	5
Key undesirable species	2	2	2	2	2	2
% catchment introduced vegetation	5	5	5	5	5	5
Total catchment pressure index/25	**18.0**	**18.0**	**18.0**	**18.0**	**18.0**	**18.0**
Total catchment pressure (%)	**28.00%**	**28.00%**	**28.00%**	**28.00%**	**28.00%**	**28.00%**

Catchment Pressure	TR-W1 Impact Score	TR-W2 Impact Score	TR-W3 Impact Score	TR-W4 Impact Score	TR-W5&W6 Impact Score	TR-W7 Impact Score
Degree of modification	**High**	**High**	**High**	**High**	**High**	**High**

Notes: 0 = No catchment modification to 5 = Very high degree of catchment modification

4.2.3 Wetland Function Assessment

Likely functional values were assigned based on wetland type. TR-W1, TRW2, TR-W4, and TR-W7 represents a hillslope seep wetland connected to the stream network. Likely functional values associated with connected hillslope seep systems are provided in Table 9-16.

TR-W3 and TR-W5/W6 mostly represent channelled valley bottom wetlands. Likely functional values associated with channelled valley bottom systems are provided in Table 9-17. Given the catchment pressures outlined in Table 9-15, all wetlands can provide these functional services, albeit with an impaired capacity due to the degree of modification. The residual functional value for each wetland informed the ecological context score under "Matter 4" of the EIANZ Guidelines. This was achieved through relating the probability score outlined in Table 9-16 to a value score under Matter 4 (Table 9-18), while considering the wetlands size and slope in relation to its catchment.

Table 9-16 The likelihood of different functional wetland values generically associated with Hillslope seep wetlands connected to the stream network (Kotze et al., 2007)

Hydrological/Functional Importance			Description	Probability
Regulating & supporting benefits		**Flood attenuation**	The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream	Likely
Regulating & supporting benefits		**Streamflow regulation**	Sustaining streamflow during low flow periods	Likely
Regulating & supporting benefits	Water Quality Enhancement	**Sediment trapping**	The trapping and retention in the wetland of sediment carried by runoff waters	Unlikely
Regulating & supporting benefits	Water Quality Enhancement	**Phosphate assimilation**	Removal by the wetland of phosphates carried by runoff waters, thereby enhancing water quality	Unlikely
Regulating & supporting benefits	Water Quality Enhancement	**Nitrate assimilation**	Removal by the wetland of nitrates carried by runoff waters, thereby enhancing water quality	Very likely
Regulating & supporting benefits	Water Quality Enhancement	**Toxicant assimilation**	Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters, thereby enhancing water quality	Very likely
Regulating & supporting benefits	Water Quality Enhancement	**Erosion control**	Controlling of erosion at the wetland site, principally through the protection provided by vegetation.	Very likely
Regulating & supporting benefits		**Carbon storage**	The trapping of carbon by the wetland, principally as soil organic matter	
			TOTAL OVERALL SCORE AND CONFIDENCE:	

Table 9-17 The likelihood of different functional wetland values generically associated with channelled valley bottom wetlands (Kotze et al., 2007)

Hydrological/Functional Importance			Description	Probability
Regulating & supporting benefits		Flood attenuation	The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream	Likely
		Streamflow regulation	Sustaining streamflow during low flow periods	Likely
	Water Quality Enhancement	Sediment trapping	The trapping and retention in the wetland of sediment carried by runoff waters	Likely
		Phosphate assimilation	Removal by the wetland of phosphates carried by runoff waters, thereby enhancing water quality	Likely
		Nitrate assimilation	Removal by the wetland of nitrates carried by runoff waters, thereby enhancing water quality	Likely
		Toxicant assimilation	Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters, thereby enhancing water quality	Likely
		Erosion control	Controlling of erosion at the wetland site, principally through the protection provided by vegetation.	Very likely
	Carbon storage		The trapping of carbon by the wetland, principally as soil organic matter	
			TOTAL OVERALL SCORE AND CONFIDENCE:	

4.2.4 Wetland Ecology - Value Assessment

Table 9-18 Ecological value assessment for wetland ecological features

Attributes	Ecological Feature						Justification
	TR-W1	TR-W2	TR-W3	TR-W4	TR-W5 & TR-W6	TR-W7	
Representativeness (Wetland condition assessment)	**2**	**2**	**2**	**2**	**2**	**2**	**-**
Hydrological modification	-	-	-	-	-	-	-
Physico-chemical modification	-	-	-	-	-	-	-
Sediment and geomorphological modification	-	-	-	-	-	-	-
Biota	-	-	-	-	-	-	-
Wetland Condition Index Score	2	2	2	2	2	2	Wetland condition assessment consistent with large digression from benchmark for all wetlands. Hydrological integrity and wetland extent is generally retained, but wetland condition mainly affected by changes in water quality, browsing pressure and dominance of exotic species.
Rarity/distinctiveness	**1**	**1**	**1**	**3**	**2**	**1**	**-**
Species of conservation significance	-	-	-	-	-	-	-
Range restricted or endemic species	-	-	-	-	-	-	-
Wetland type (rare or distinctive)	1	1	1	3	2	1	All wetland types (except for TR-W4) common at any scale. TR-W4 likely spring fed.
Distinctive ecological values (ecosystem services) larger context	-	-	-	-	-	-	-
Diversity and pattern	**2**	**2**	**1**	**3**	**2**	**2**	**-**
Diversity of habitat types	2	2	1	3	2	2	Wetlands are > 500 m^2 in size, permanent, temporary, seasonal areas of saturation present for TR-W1, W2 and

Attributes	Ecological Feature						Justification
	TR-W1	TR-W2	TR-W3	TR-W4	TR-W5 & TR-W6	TR-W7	
							W4, W5 and W6. TR-W3 mainly seasonally saturated, while the relatively large proportion of W4 is represented by permanent saturation
Species diversity	1	1	1	1	1	1	Species diversity is not significant at any scale (exotic wetland).
Ecological context (ecosystem services, importance, and sensitivity)	**3**	**3**	**3**	**3**	**3**	**2**	**-**
Sensitivity to change in floods	-	-	-	-	-	-	-
Sensitivity to change in baseflows (low flows)	-	-	-	-	-	-	-
Sensitivity to change in water quality	1	1	1	1	1	1	No sensitivity to change in water quality.
Flood attenuation	2	2	2	3	3	1	Frequency with which stormflows are spread across the wetlands are estimated to be >1 per year and therefore frequently plays a role in flood attenuation. Variation in scores reflect differences in the ratio between catchment size and wetland size as well as wetland slopes.
Streamflow regulation	2	2	1	3	3	2	TR-W1 and W2: Permanent & seasonal zones both present but collectively <30%. TR-W4, W5 and W6: Seasonal & permanent zone both present & collectively 30-60% of wetland (likely spring fed). TR-W3: Seasonal zone present but permanent zone absent.
Sediment trapping	3	3	2	1	3	1	All wetlands in the study area are associated with sediment yielding landuse. Differences in scores relate to wetland slope (TR-W4 approximately 9%) and more affectively drained wetlands (TR-W3).
Phosphate assimilation	-	-	-	-	-	-	-
Nitrate assimilation	3	3	3	3	3	2	Majority of local catchment associated with nutrient producing landuse. All the wetlands within the study area

Attributes	Ecological Feature						Justification
	TR-W1	TR-W2	TR-W3	TR-W4	TR-W5 & TR-W6	TR-W7	
							have the capacity to perform nutrient treatment functions. TR-W7 drains the larges catchment relative to the wetlands size.
Toxicant assimilation	-	-	-	-	-	-	-
Erosion control	-	-	-	-	-	-	-
Carbon storage	-	-	-	-	-	-	-
Connectivity and migration	-	-	-	-	-	-	-
Protected status of the wetland	-	-	-	-	-	-	-
Ecological Value	**Low**	**Low**	**Low**	**Moderate**	**Moderate**	**Low**	

4.2.5 Wetland Ecology - Magnitude of Effect and Level of Effect Assessment

Table 9-19 Wetland ecology – magnitude of effect and level of effect assessment in terms of the EIANZ Guidelines

Phase	Wetland	Effect	Type	ZOI	Duration	Frequency	Likelihood	Reversibility	Magnitude (pre-mitigation)	Level of Effect (pre-mitigation)
Construction	TR-W1	Permanent loss/modification of habitat/ecosystem due to reclamation/culverting/other structures (e.g., bank armouring)	Direct	3	Permanent (>25 years)	-	Definite	-	High	Low
	TR-W4		Direct	3	Permanent (>25 years)	-	Definite	-	High	**Moderate**
	TR-W1	Detrimental effects on habitats including plant composition and fauna due to diversion, abstraction or bunding of watercourses and water level/ flow/ periodicity changes.	Direct	4	Temporary (days or months)	-	Highly Likely	-	Moderate	Low
	TR-W2		Direct	4	Temporary (days or months)	-	Highly Likely	-	Moderate	Low
	TR-W3		Direct	4	Temporary (days or months)	-	Likely	-	Low	Very Low
	TR-W4		Direct	4	Temporary (days or months)	-	Highly Likely	-	Low	Low
	TR-W5&W6		Direct	4	Temporary (days or months)	-	Likely	-	Low	Low

Phase	Wetland	Effect	Type	ZOI	Duration	Frequency	Likelihood	Reversibility	Magnitude (pre-mitigation)	Level of Effect (pre-mitigation)
	TR-W7		Direct	1	Temporary (days or months)	-	Unlikely	-	Negligible	Very Low
	TR-W1	Uncontrolled discharge leading to habitat and water quality degradation due earthworks (leading to sediment discharge), machinery use and chemical storage (leading to leaks/spills).	Direct	4	Temporary (days or months)	Frequently	Likely	-	Low	Very Low
	TR-W2		Direct	4	Temporary (days or months)	Frequently	Likely	-	Low	Very Low
	TR-W3		Direct	4	Temporary (days or months)	Frequently	Likely	-	Low	Very Low
	TR-W4		Direct	4	Temporary (days or months)	Frequently	Likely	-	Low	Low
	TR-W5&W6		Direct	4	Temporary (days or months)	Frequently	Likely	-	Low	Low
	TR-W7		Direct	1	Temporary (days or months)	-	Unlikely	-	Negligible	Very Low
Operation	TR-W1	Effect on downstream habitat (including erosion/sediment	Direct	3	Permanent (>25 years)	-	Unlikely	-	Negligible	Very Low

Phase	Wetland	Effect	Type	ZOI	Duration	Frequency	Likelihood	Reversibility	Magnitude (pre-mitigation)	Level of Effect (pre-mitigation)
	TR-W2	discharge) due to change in hydrology (increase or decrease) due to gradual change in hydrology from the presence of the infrastructure/stormwater, including reclamations.	Direct	3	Permanent (>25 years)	-	Unlikely	-	Negligible	Very Low
	TR-W3		Direct	3	Permanent (>25 years)	-	Unlikely	-	Negligible	Very Low
	TR-W4		Direct	3	Permanent (>25 years)	-	Likely	-	Low	Low
	TR-W5&W6		Direct	3	Permanent (>25 years)	Infrequently	Unlikely	-	Negligible	Very Low
	TR-W1	Permanent degradation of wetland habitat and water quality due to stormwater discharges - pollutants (such as heavy metals and herbicides)	Direct	2	Permanent (>25 years)	Infrequently	Unlikely	-	Negligible	Very Low
	TR-W2		Direct	2	Permanent (>25 years)	Infrequently	Unlikely	-	Negligible	Very Low
	TR-W3		Direct	2	Permanent (>25 years)	Infrequently	Unlikely	-	Negligible	Very Low
	TR-W4		Direct	2	Permanent (>25 years)	Infrequently	Unlikely	-	Negligible	Very Low
	TR-W5&W6		Direct	2	Permanent (>25 years)	Infrequently	Unlikely	-	Negligible	Very Low

4.3 Terrestrial Ecology Results

4.3.1 ABM Weather Data

Table 9-20 Ecological value assessment for terrestrial ecological features (flora)

Date	Maximum overnight wind gust (km/h)	Average Nightly Windspeed (km/h)	Minimum temperature in first four hours after sunset (°C)	Total rainfall in first two hours after sunset (mm)	Suitable for ABM data to be used
1-Nov	36.0	13.7	9.2	0.0	No
2-Nov	23.8	9.2	11.0	0.0	Yes
3-Nov	22.3	7.8	8.7	0.0	No
4-Nov	18.0	5.8	11.0	0.0	Yes
5-Nov	17.3	5.1	7.7	0.0	No
6-Nov	15.5	2.6	14.8	0.0	Yes
7-Nov	23.8	5.7	14.6	0.0	Yes
8-Nov	23.8	7.6	18.1	0.0	Yes
9-Nov	41.8	14.7	17.0	0.0	Yes
10-Nov	45.7	16.7	13.1	4.2	No
11-Nov	33.8	12.5	11.3	0.0	Yes
12-Nov	29.2	7.0	5.4	0.0	No
13-Nov	18.4	4.1	11.4	0.0	Yes

Date	Maximum overnight wind gust (km/h)	Average Nightly Windspeed (km/h)	Minimum temperature in first four hours after sunset (°C)	Total rainfall in first two hours after sunset (mm)	Suitable for ABM data to be used
14-Nov	46.8	13.6	13.2	0.0	Yes
15-Nov	39.6	9.4	7.1	0.0	No
16-Nov	19.8	6.3	13.0	0.0	Yes
17-Nov	19.4	6.7	16.5	0.0	Yes
18-Nov	26.6	7.3	10.0	0.2	Yes

4.3.2 Terrestrial Ecological - Value Assessment

Table 9-21 Ecological value assessment for terrestrial ecological features (flora)

Attributes to be considered	BF	EG	PL.1	PL.3	TL.3	Justification
Representativeness	1	1	4	2	2	
Typical structure and composition	1	1	2	1	1	BF, EG, ES, PL.3, TL.3: Habitats have been significantly altered by human activities (exotic dominated). PL.1: Habitat and species have been affected by human activities.
Indigenous representation	1	1	4	2	2	BF, EG: <10% of the species are indigenous. PL.3, TL.3: 10-50% of the species are indigenous. PL.1: >90% of the species are indigenous.
Rarity/distinctiveness	**0**	**3**	**3**	**3**	**4**	

Attributes to be considered	BF	EG	PL.1	PL.3	TL.3	Justification
Range restricted or endemic species	-	-	1	-	-	PL.1: One population (or taxon) judged to be unique at a local scale.
Species of conservation significance	-	3	3	3	4	Long-tailed bat (Threatened – Nationally Critical, value score of 4) potentially using ecological features associated with the Project Area (TL.3). Bats were not detected within Project Area, however bats are present in wider landscape, therefore TL.3 likely to only provide infrequent stepping-stone habitat for bats. Non-TAR bird species expected to utilise EG, PL.1, PL.3, TL.3. No terrestrial TAR bird species expected to be reliant on terrestrial ecological features (BF, EG, PL.1, PL.3, TL.3) associated with the Project Area. Copper skink (At Risk - Declining, value score 3) likely to utilise ecological features within the Project Area (EG, PL.1, PL.3, and TL.3 (with appropriate understorey)).
Distinctive ecological values	-	-	1	1	1	PL.1, PL.3, TL.3: Habitat playing an important role in provisional or regulatory ecosystem services typically on Local scale.
Diversity and pattern	**0**	**0**	**1**	**0**	**1**	
Habitat diversity	-	-	1	-	1	Increased habitat diversity in areas with indigenous species present: PL.1 Increased habitat diversity in areas with late succession: TL.3
Species diversity	-	-	1	-	1	Increased species diversity in areas with indigenous species present: PL.1

Attributes to be considered	BF	EG	PL.1	PL.3	TL.3	Justification
						Increased species diversity in areas with late succession: TL.3
Patterns in habitat use	-	-	-	-	-	All habitats are not significant for lifecycle completion or periodic habitat utilisation on any scale.
Ecological context	**0**	**0**	**0**	**0**	**1**	
Size, shape, and buffering	-	-	-	-	-	All terrestrial ecology features are represented by small (or isolated) patches of habitat surrounded by pasture.
Sensitivity to change	-	-	-	-	-	Largely modified habitats.
Ecological networks (linkages, pathways, migration)	-	-	-	-	1	TL.3 likely to provide infrequent stepping-stone habitat for long-tailed bats.
Protected status	-	-	-	-	-	-
Ecological Value	**Negligible**	**Negligible**	**Low**	**Low**	**Low**	

Table 9-22 Ecological value assessment for terrestrial ecological features (fauna)

Attributes to be considered	Long-tailed bat	Non-TAR bird	North Island fernbird	Copper skink	Justification
Representativeness	**0**	**2***	**0**	**0**	
Typical structure and composition	-	2*	-	-	-
Indigenous representation	-	-	-	-	-
Rarity/distinctiveness	**4**	**2**	**3**	**3**	
Range restricted or endemic species	-	-	-	-	-

Attributes to be considered	Long-tailed bat	Non-TAR bird	North Island fernbird	Copper skink	Justification
Species of conservation significance	4	2*	3	3	NZ Conservation Status: Long-tailed bat: Threatened - Nationally Critical Copper skink: At Risk - Declining North Island fernbird: At Risk - Declining
Distinctive ecological values	-	-	-	-	-
Diversity and pattern	**0**	**2***	**0**	**0**	
Habitat diversity	-	2*	-	-	-
Species diversity	-	-	-	-	-
Patterns in habitat use	-	-	-	-	-
Ecological context	**0**	**2***	**0**	**0**	
Size, shape, and buffering	-	2*	-	-	-
Sensitivity to change	-	-	-	-	-
Ecological networks (linkages, pathways, migration)	-	-	-	-	-
Protected status	-	-	-	-	-
Ecological Value	**Very High**	**Low**	**High**	**High**	

Notes: * = Scores not representative of corresponding row, scores required to produce ‘Low’ combined value.

4.3.3 Terrestrial Ecology - Magnitude of Effect and Level of Effect Assessment

Table 9-23 Impact assessment for terrestrial ecological features (flora)

Phase	Ecological Feature	Effect	Type	ZOI	Duration	Frequency	Likelihood	Reversibility	Magnitude of Effect (pre-mitigation)	Level of Effect (pre-mitigation)
Construction	BF	Vegetation removal: Permanent loss of habitat/ecosystem, fragmentation and edge effects due to vegetation removal.	Direct	Local	Permanent (>25 years)	-	Definite	-	High	Very Low
	EG		Direct	Local	Permanent (>25 years)	-	Definite	-	High	Very Low
	PL.1		Direct	Local	Permanent (>25 years)	-	Definite	-	High	Low
	PL.3		Direct	Local	Permanent (>25 years)	-	Definite	-	High	Low
	TL.3		Direct	Local	Permanent (>25 years)	-	Definite	-	High	Low
	EG	Earthworks: Weed dispersal to previously unaffected areas of indigenous vegetation, reduction in terrestrial biodiversity.	Direct	Local	Short-term (<5 years)	Infrequently	Unlikely	-	Negligible	Very Low
	PL.1		Direct	Local	Short-term (<5 years)	Infrequently	Unlikely	-	Negligible	Very Low
	PL.3		Direct	Local	Short-term (<5 years)	Infrequently	Unlikely	-	Negligible	Very Low
	TL.3		Direct	Local	Short-term (<5 years)	Infrequently	Unlikely	-	Negligible	Very Low

Phase	Ecological Feature	Effect	Type	ZOI	Duration	Frequency	Likelihood	Reversibility	Magnitude of Effect (pre-mitigation)	Level of Effect (pre-mitigation)
Operation	EG	Presence of the infrastructure: Weed dispersal to previously unaffected areas of indigenous vegetation, reduction in terrestrial biodiversity due to the presence of the infrastructure, use of infrastructure edges as dispersal corridors by invasive plant species.	Direct	Local	Permanent (>25 years)	Infrequently	Unlikely	-	Negligible	Very Low
	PL.1		Direct	Local	Permanent (>25 years)	Infrequently	Unlikely	-	Negligible	Very Low
	PL.3		Direct	Local	Permanent (>25 years)	Infrequently	Unlikely	-	Negligible	Very Low
	TL.3		Direct	Local	Permanent (>25 years)	Infrequently	Unlikely	-	Negligible	Very Low
	EG	Maintenance: Increased weed incursion, unintentional spray of indigenous vegetation due to maintenance, increased use of herbicides.	Direct	Local	Permanent (>25 years)	Periodically	Likely	-	Low	Very Low
	PL.1		Direct	Local	Permanent (>25 years)	Periodically	Likely	-	Low	Very Low
	PL.3		Direct	Local	Permanent (>25 years)	Periodically	Likely	-	Low	Very Low
	TL.3		Direct	Local	Permanent (>25 years)	Periodically	Likely	-	Low	Very Low

Table 9-24 Impact assessment for terrestrial ecological features (fauna)

Phase	Ecological Feature	Effect	Type	ZOI	Duration	Frequency	Likelihood	Reversibility	Magnitude (pre-mitigation)	Level of Effect (pre-mitigation)
Construction	Long-tailed bats	Disturbance and displacement to roosts and individuals (existing) due to construction activities (noise, light, dust etc).	Indirect	Local	Short-term (<5 years)	Periodically	Unlikely	Totally	Negligible	Low
		Vegetation removal: Loss of foraging and breeding habitat, fragmentation of habitat, causing adverse effects on population dynamics.	Direct	Local	Permanent (>25 years)	-	Unlikely	-	Negligible	Low
		Vegetation removal: Potential to kill/injure long-tailed bat, causing adverse effects on population dynamics.	Direct	Local	Short-term (<5 years)	Infrequently	Unlikely	Irreversible	Negligible	Low
	Non-TAR birds	Disturbance and displacement to roosts and individuals (existing) due to construction activities (noise, light, dust etc).	Indirect	Local	Short-term (<5 years)	Periodically	Highly Likely	Totally	Low	Very Low
		Vegetation removal: Nest loss.	Direct	Local	Short-term (<5 years)	-	Highly Likely	-	Low	Very Low

Phase	Ecological Feature	Effect	Type	ZOI	Duration	Frequency	Likelihood	Reversibility	Magnitude (pre-mitigation)	Level of Effect (pre-mitigation)
		Vegetation removal: Loss of foraging and breeding habitat, fragmentation of habitat, causing adverse effects on population dynamics.	Direct	Local	Permanent (>25 years)	-	Definite	-	High	Low
		Vegetation removal: Potential to kill/injure non-TAR birds, causing adverse effects on population dynamics.	Direct	Local	Short-term (<5 years)	-	Unlikely	Irreversible	Negligible	Very Low
	North Island fernbird	Disturbance and displacement to roosts and individuals (existing) due to construction activities (noise, light, dust etc).	Indirect	Local	Short-term (<5 years)	Periodically	Unlikely	Totally	Negligible	Very Low
		Vegetation removal: Nest loss.	Direct	Local	Short-term (<5 years)	-	Unlikely	-	Negligible	Very Low
		Vegetation removal: Loss of foraging and breeding habitat, fragmentation of habitat, causing adverse effects on population dynamics.	Direct	Local	Permanent (>25 years)	-	Unlikely	-	Negligible	Very Low
		Vegetation removal: Potential to kill/injure birds,	Direct	Local	Short-term (<5 years)	-	Unlikely	Irreversible	Negligible	Very Low

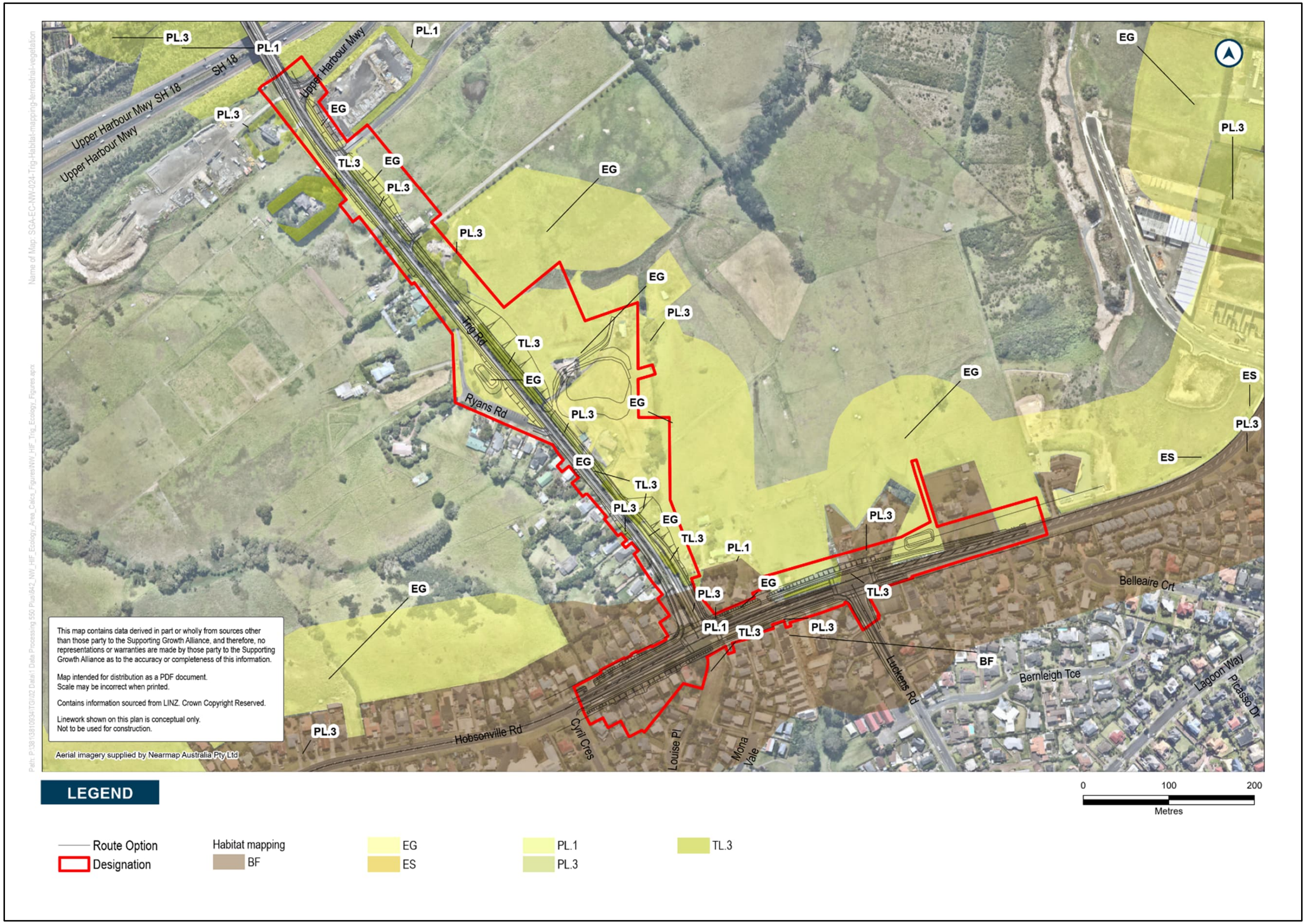
Phase	Ecological Feature	Effect	Type	ZOI	Duration	Frequency	Likelihood	Reversibility	Magnitude (pre-mitigation)	Level of Effect (pre-mitigation)
		causing adverse effects on population dynamics.								
	Copper skink	Disturbance and displacement to individuals (existing) due to construction activities (noise, light, dust etc).	Indirect	Local	Short-term (<5 years)	Periodically	Unlikely	Totally	Negligible	Very Low
		Vegetation removal: Loss of foraging and breeding habitat, fragmentation of habitat, causing adverse effects on population dynamics.	Direct	Local	Permanent (>25 years)	-	Likely	-	Low	Low
		Vegetation removal: Potential to kill/injure copper skink, causing adverse effects on population dynamics.	Direct	Local	Short-term (<5 years)	-	Unlikely	Irreversible	Negligible	Very Low
Operation	Long-tailed bats	Disturbance and displacement of (new and existing) roosts and individuals due to lighting and noise/vibration.	Indirect	Local	Permanent (>25 years)	-	Unlikely	Irreversible	Negligible	Low
		Loss in connectivity due to permanent habitat loss, light, and noise effects	Indirect	Local	Permanent (>25 years)	-	Unlikely	Irreversible	Negligible	Low

Phase	Ecological Feature	Effect	Type	ZOI	Duration	Frequency	Likelihood	Reversibility	Magnitude (pre-mitigation)	Level of Effect (pre-mitigation)
		from the road, leading to fragmentation of terrestrial habitat and influencing bat movement in the broader landscape								
	Non-TAR birds	Disturbance and displacement to roosts and individual birds (existing) due to the presence of the road (noise, light, dust etc.)	Indirect	Local	Permanent (>25 years)	-	Highly Likely	Irreversible	Moderate	Low
		Loss in connectivity due to permanent habitat loss, light and noise effects from the road, leading to fragmentation of terrestrial, wetland and riparian habitat due to the presence of the infrastructure.	Indirect	Local	Permanent (>25 years)	-	Unlikely	Irreversible	Negligible	Very Low
	North Island fernbird	Disturbance and displacement to roosts and individual birds (existing) due to the presence of the road (noise, light, dust etc.)	Indirect	Local	Permanent (>25 years)	-	Unlikely	Irreversible	Negligible	Very Low
		Loss in connectivity due to permanent habitat loss, light and noise effects from the road, leading to	Indirect	Local	Permanent (>25 years)	-	Unlikely	Irreversible	Negligible	Very Low

Phase	Ecological Feature	Effect	Type	ZOI	Duration	Frequency	Likelihood	Reversibility	Magnitude (pre-mitigation)	Level of Effect (pre-mitigation)
		fragmentation of terrestrial, wetland and riparian habitat due to the presence of the infrastructure.								
	Copper skink	Disturbance and displacement of existing and future copper skink due to light, noise and vibration effects from the presence of the road.	Indirect	Local	Permanent (>25 years)	-	Unlikely	Irreversible	Negligible	Very Low
		Loss in connectivity due to permanent habitat loss, light and noise/vibration effects from the road, leading to fragmentation of terrestrial, wetland and riparian habitat due to the presence of the infrastructure.	Indirect	Local	Permanent (>25 years)	-	Unlikely	Irreversible	Negligible	Very Low

5 Appendix 5 – Ecological Habitat Maps

5.1 Terrestrial Habitat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Upper Harbour Mwy
SH 18
Upper Harbour Mwy
Trig Rd
Ryans Rd
Hobsonville Rd
Cyril Cres
Louise Pl
Mona Vale
Luckens Rd
Belleaire Crt
Bernleigh Tce
Lagoon Way
Picasso Dr
PL.1
PL.3
EG
ES
TL.3
BF
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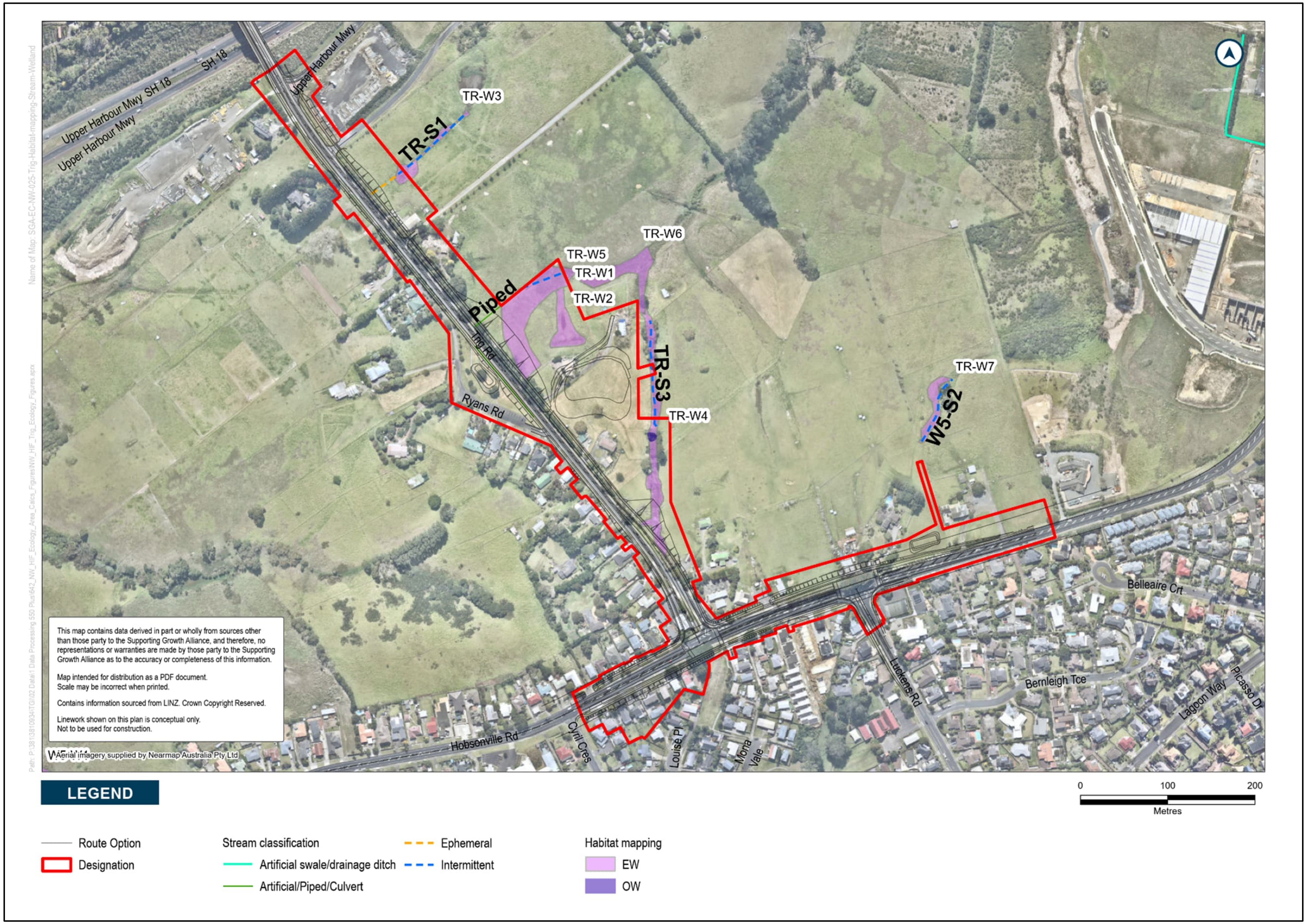
Aerial imagery supplied by Nearmap Australia Pty Ltd
LEGEND
0
100
200
Metres
Route Option
Designation
Habitat mapping
BF
EG
ES
PL.1
PL.3
TL.3

5.2 Stream and Wetland Habitat


Upper Harbour Mwy SH 18
SH 18
Upper Harbour Mwy
Upper Harbour Mwy
TR-W3
TR-S1
TR-W6
TR-W5
TR-W1
TR-W2
Piped
Trig Rd
TR-S3
TR-W4
Ryans Rd
TR-W7
W5-S2
Belleaire Crt
Bernleigh Tce
Lagoon Way
Picasso Dr
Luckens Rd
Mona Vale
Louise Pl
Cyril Cres
Hobsonville Rd
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0
100
200
Metres
LEGEND
Route Option
Designation
Stream classification
Artificial swale/drainage ditch
Artificial/Piped/Culvert
Ephemeral
Intermittent
Habitat mapping
EW
OW

6 Appendix 6 – Desktop and Incidental Fauna Records

Table 9-25 Desktop bird records within 2 km of the Project Area

Common Name	Māori Name	Scientific Name	Conservation Status (Robertson et al., 2021)	Record Source
Banded dotterel	Pohowera	*Charadrius bicinctus*	At Risk - Declining	Desktop record - eBird (Bird Atlas)
Banded rail	Mioweka	*Gallirallus philippensis assimilis*	At Risk - Declining	Desktop record - iNaturalist/eBird (Bird Atlas)
Barbary dove	-	*Streptopelia risoria*	Introduced and Naturalised	Desktop record - iNaturalist/eBird (Bird Atlas)
Bar-tailed godwit	Kuaka	*Limosa lapponica bauer*	At Risk - Declining	Desktop record - iNaturalist/eBird (Bird Atlas)
Black shag	Māpunga	*Phalacrocorax carbo*	At Risk - Relict	Desktop record - iNaturalist
Black-billed gull	Tarāpuka	*Larus bulleri*	At Risk - Declining	Desktop record - iNaturalist
Blackbird	Manu pango	*Turdus merula*	Introduced and Naturalised	Desktop record - iNaturalist/eBird (Bird Atlas)
Canada goose	-	*Branta canadensis*	Introduced and Naturalised	Desktop record - eBird (Bird Atlas)
Caspian tern	Taranui	*Hydroprogne caspia*	Threatened - Nationally Vulnerable	Desktop record - iNaturalist/eBird (Bird Atlas)
Chaffinch	Pahirini	*Fringilla coelebs*	Introduced and Naturalised	Desktop record - iNaturalist/eBird (Bird Atlas)
Common pheasant	Peihana	*Phasianus colchicus*	Introduced and Naturalised	Desktop record - iNaturalist/eBird (Bird Atlas)
Dabchick	Weweia	*Poliocephalus rufopectus*	Threatened – Nationally Increasing	Desktop record - iNaturalist/eBird (Bird Atlas)

Common Name	Māori Name	Scientific Name	Conservation Status (Robertson et al., 2021)	Record Source
Domestic duck	-	*Anas platyrhynchos domesticus*	Introduced and Naturalised	Desktop record - iNaturalist
Dunnock	-	*Prunella modularis*	Introduced and Naturalised	Desktop record - eBird (Bird Atlas)
Goldfinch	-	*Carduelis carduelis*	Introduced and Naturalised	Desktop record - eBird (Bird Atlas)
Greenfinch	-	*Carduelis chloris*	Introduced and Naturalised	Desktop record - iNaturalist
Greylag goose	Kuihi	Anser anser	Introduced and Naturalised	Desktop record - eBird (Bird Atlas)
House sparrow	Tiu	*Fringilla coelebs*	Introduced and Naturalised	Desktop record - iNaturalist/eBird (Bird Atlas)
Lesser knot	Huahou	*Calidris canutus rogersi*	At Risk - Declining	Desktop record - eBird (Bird Atlas)
Lesser knot	Huahou	*Calidris canutus rogersi*	At Risk - Declining	Desktop record - iNaturalist/eBird (Bird Atlas)
Little black shag	Kawau tūī	*Phalacrocorax sulcirostris*	At Risk – Naturally Uncommon	Desktop record - iNaturalist
Magpie	Makipae	*Gymnorhina tibicen*	Introduced and Naturalised	Desktop record - iNaturalist/eBird (Bird Atlas)
Mallard	-	*Anas platyrhynchos*	Introduced and Naturalised	Desktop record - iNaturalist/eBird (Bird Atlas)
Muscovy duck	-	*Cairina moschata*	Introduced, not established	Desktop record - eBird (Bird Atlas)
Myna	-	*Acridotheres tristis*	Introduced and Naturalised	Desktop record - iNaturalist/eBird (Bird Atlas)
New Zealand pipit	Hīoi	*Anthus novaeseelandiae novaeseelandiae*	At Risk – Declining	Desktop record - iNaturalist
North Island fernbird	Mātātā	*Poodytes punctatus*	At Risk – Declining	Desktop record - iNaturalist/eBird (Bird Atlas)

Common Name	Māori Name	Scientific Name	Conservation Status (Robertson et al., 2021)	Record Source
North Island kākā	Kākā	*Nestor meridionalis septentrionalis*	At Risk – Recovering	Desktop record - iNaturalist
Northern New Zealand dotterel	Tūturiwhatu	*Charadrius obscurus aquilonius*	At Risk - Recovering	Desktop record - eBird (Bird Atlas)
Pied shag	Kāruhiruhi	*Phalacrocorax varius*	At Risk – Recovering	Desktop record - iNaturalist/eBird (Bird Atlas)
Red-billed gull	Tarāpunga	*Larus novaehollandiae scopulinus*	At Risk - Declining	Desktop record - iNaturalist/eBird (Bird Atlas)
Rock pigeon	-	*Columba livia*	Introduced and Naturalised	Desktop record - eBird (Bird Atlas)
Royal spoonbill	Kōtuku ngutupapa	*Platalea regia*	At Risk – Naturally Uncommon	Desktop record - iNaturalist/eBird (Bird Atlas)
Song thrush	-	*Turdus philomelos*	Introduced and Naturalised	Desktop record - iNaturalist/eBird (Bird Atlas)
South Island pied oystercatcher	Tōrea	*Haematopus finschi*	At Risk - Declining	Desktop record - iNaturalist/eBird (Bird Atlas)
Spotted dove	-	*Streptopelia chinensis tigrina*	Introduced and Naturalised	Desktop record - iNaturalist/eBird (Bird Atlas)
Variable oystercatcher	Tōrea pango	*Haematopus unicolor*	At Risk - Recovering	Desktop record - eBird (Bird Atlas)
White-fronted tern	Tara	*Sterna striata*	At Risk - Declining	Desktop record - eBird (Bird Atlas)
Wrybill	Ngutu parore	*Anarhynchus frontalis*	Threatened – Nationally Increasing	Desktop record - iNaturalist
Yellowhammer	-	*Emberiza citrinella*	Introduced and Naturalised	Desktop record - iNaturalist/eBird (Bird Atlas)

Table 9-26 Incidental bird species identified in the Project Area during the site investigation

Common Name	Māori Name	Scientific Name	Conservation Status (Robertson et al., 2021)
Australasian harrier	Kāhu	*Circus approximans*	Not Threatened
Blackbird	Manu pango	*Turdus merula*	Introduced and Naturalised
Canada goose	-	*Branta canadensis*	Introduced and Naturalised
Chaffinch	Pahirini	Fringilla coelebs	Introduced and Naturalised
Common pheasant	Peihana	*Phasianus colchicus*	Introduced and Naturalised
Eastern rosella	Kākā uhi whero	*Platycercus eximius*	Introduced and Naturalised
Goldfinch	Kōurarini	*Carduelis carduelis*	Introduced and Naturalised
Grey warbler	Riroriro	*Gerygone igata*	Not Threatened
Mallard	Rakiraki	*Anas platyrhynchos*	Introduced and Naturalised
Myna	Maina	*Acridotheres tristis*	Introduced and Naturalised
Pūkeko	Pūkeko	*Porphyrio melanotus melanotus*	Not Threatened
Skylark	Kairaka	*Alauda arvensis*	Introduced and Naturalised
Song thrush	Manu-kai-hua-rakau	*Turdus philomelos*	Introduced and Naturalised
Tūī	Tūī	*Prosthemadera novaeseelandiae novaeseelandiae*	Not Threatened
Welcome swallow	Warou	*Hirundo neoxena*	Not Threatened
White-faced heron	Matuku moana	*Ergretta novaehollandiae*	Not Threatened

Table 9-27 Desktop herpetofauna records within 2 km of the Project Area

Common Name	Māori Name	Scientific Name	Conservation Status (Hitchmough et al., 2016)	Record Source
Elegant gecko	Moko kākāriki	*Naultinus elegans*	At Risk – Declining	DoC
Copper skink	-	*Oligosoma aeneum*	At Risk – Declining	iNaturalist
Forest gecko	Moko pirirākau	*Mokopirirakau granulatus*	At Risk – Declining	iNaturalist
Green and golden bell frog	Poraka	*Litoria aurea*	Introduced and Naturalised	iNaturalist
Ornate skink	-	*Oligosoma ornatum*	At Risk - Declining	iNaturalist
Pacific gecko	Teretere	*Dactylocnemis pacificus*	Not Threatened	iNaturalist
Plague skink	-	*Lampropholis delicata*	Introduced and Naturalised	DoC, iNaturalist
Hochstetter's frog	Peketua	*Leiopelma hochstetteri*	At Risk - Declining	iNaturalist

Table 9-28 Desktop freshwater fish records

Common Name	Scientific Name	Conservation Status (Dunn et al., 2017)	Record Source
Shortfin eel	*Anguilla australis*	Not Threatened	NIWA, iNaturalist
Longfin eel	*Anguilla dieffenbachii*	At Risk - Declining	NIWA, iNaturalist
Grass carp	*Ctenopharyngodon idella*	Introduced and Naturalised	NIWA
Koi carp	*Cyprinus rubrofascus*	Introduced and Naturalised	iNaturalist
Banded kokopu	*Galaxias fasciatus*	Not Threatened	NIWA, iNaturalist
Īnanga	*Galaxias maculatus*	At Risk – Declining	NIWA, iNaturalist
Mosquito fish	*Gambusia affinis*	Introduced and Naturalised	NIWA, iNaturalist
Common bully	*Gobiomorphus cotidianus*	Not Threatened	NIWA, iNaturalist

Common Name	Scientific Name	Conservation Status (Dunn et al., 2017)	Record Source
Giant bully	*Gobiomorphus gobioides*	At Risk – Naturally Uncommon	iNaturalist
Freshwater shrimp	*Paratya curvirostis*	Not Threatened	NIWA

Table 9-29 Vegetation species identified during site investigation

Common Name	Scientific Name	Threat Class (de Lange et al., 2017)
Agapanthus	*Agapantus praecox*	Introduced
Bent grass	*Agrostis* spp.	Introduced
Titoki	*Alectryon excelsus*	Not Threatened
Sweet vernal	*Anthoxanthum odoratum*	Introduced
Oioi	*Apodasmia similis*	Not Threatened
Climbing asparagus	*Asparagus scandens*	Introduced
Bottlebrush	*Callistemon citrinus*	Introduced
Swamp oak	*Casuarina glauca*	Introduced
Karamu	*Coprosma robusta*	Not Threatened
Tī kōuka / cabbage tree	*Cordyline australis*	Not Threatened
Cotoneaster	*Cotoneaster glaucophyllus*	Introduced
Japanese cedar	*Cryptomeria japonica*	Introduced
Bermuda grass	*Cynodon dactylon*	Introduced
Umbrella sedge	*Cyperus ustulatus*	Not Threatened
Whekī	*Dicksonia squarrosa*	Not Threatened
Broadleaf	*Griselinia littoralis*	Not Threatened
Yorkshire fog	*Holcus lanatus*	Introduced
Soft rush	*Juncus effusus*	Introduced
Kānuka	*Kunzea robusta*	Threatened – Nationally Vulnerable
Mānuka	*Leptospermum scoparium* var. *scoparium*	Threatened – Nationally Vulnerable
Chinese privet	*Ligsustrum sinense*	Introduced

Common Name	Scientific Name	Threat Class (de Lange et al., 2017)
Tree privet	*Ligustrum lucidum*	Introduced
Ryegrass	*Lolium perenne*	Introduced
Pohutukawa	*Metrosideros excelsa*	Threatened – Nationally Vulnerable
Māpou	*Myrsine australis*	Not Threatened
Watercress	*Nasturtium officinale*	Introduced
Brush wattle	*Paraserianthes lophantha*	Introduced
Ironwood	*Parrotia persica*	Introduced
Water pepper	*Persicaria hydropiper*	Introduced
Harakeke	*Phormium tenax*	Not Threatened
Pine	*Pinus radiata*	Introduced
Karo	*Pittosporum crassifolium*	Not Threatened
Lemonwood	*Pittosporum eugenioides*	Not Threatened
Ribwort	*Plantago lanceolata*	Introduced
Totara	*Podocarpus totara*	Not Threatened
Poplar	*Populus* sp.	Introduced
Turkey oak	*Quercus cerris*	Introduced
Buttercup	*Ranunculus repens*	Introduced
Rose	*Rosa* spp.	Introduced
Curled dock	*Rumex crispus*	Introduced
Wooly nightshade	*Solanum mauritianum*	Introduced
Kowhai	*Sophora microphylla*	Not Threatened
Windmill palm	*Trachycarpus fortunei*	Introduced
Red clover	*Trifolium pratense*	Introduced
White clover	*Trifolium repens*	Introduced
Arum lily	*Zantedeschia aethiopica*	Introduced

7 Appendix 7 – Site Photographs (2019)

Plate 1 – Exotic treeland (TL.3) present in the Project Area.

Plate 2 – Amenity garden planting (PL.3) present in the Project Area.

Plate 3 – Potential copper skink habitat present in the Project Area.

Plate 4 – Potential long-tailed bat roost habitat present in the Project Area.

Figure 9-5 Site photographs (2019)

8 Appendix 8 – Wetland Offset & Conceptual Restoration Design

TE TUPU NGĀTAHI
SUPPORTING GROWTH

Memorandum

To:	Bridget O'Leary
From:	Michiel Jonker (Author) and Fiona Davies (Reviewer)
CC:	Fiona Davies
Date:	3 November 2022
Subject:	Trig Road Corridor Upgrade – Wetland Offset & Conceptual Restoration Design

1 Background

As part of the Assessment of Ecological Effects for the proposed Trig Road Corridor Upgrade notice of requirement (NoR) and application for resource consents, four modified wetlands were identified within the designation footprint (Figure 1). All four wetlands are dominated by exotic facultative wetland plant species and retain reasonably intact hydrological functionality so that they can be defined as wetlands. The Assessment of Ecological Effects identifies that construction of Trig Road will result in the permanent loss of 0.1 ha (1000 m^2) of wetland TR-W1 and 0.078 ha (780 m^2) of wetland TR-W4. Mitigation cannot be undertaken at the point of impact. As such, this results in a Low and Moderate residual level of effect respectively (owing to the differences in value between the two wetlands) that cannot be avoided, remedied, or mitigated. The policy direction (NES-FW) is for no loss in wetland extent, therefore both wetlands are included within this offset memo.

This memo presents offset modelling to identify the amount and type of wetland enhancement required to address the wetland loss at both wetlands. It also presents a conceptual restoration design.

It is expected that this memo shall provide guidance to the NoR and resource consent conditions and to the detailed Wetland Restoration and Enhancement Plan (WREP). The WREP shall, provide confirmation in detailed design that the wetland hydrological system allows for a wide range of indigenous wetland plants to establish and become a self-sustaining native wetland system.

Figure 1 Location and classification of TR-W1 and TR-W4

2 Ground rules for applying biodiversity offsetting and compensation

Biodiversity offsetting is defined by Maysek et al. 2018 as:

A measurable conservation outcome resulting from actions designed to compensate for residual adverse biodiversity effects arising from activities after appropriate avoidance, remediation, and mitigation measures have been applied. The goal of a biodiversity offset is to achieve no-net-loss and preferably a net-gain of indigenous biodiversity values[1].

Biodiversity compensation provides an option to address residual biodiversity losses that are not or cannot be offset, although it generally should be explored as a last resort. Although compensation does not require the same numerical rigour as biodiversity offsetting, outcomes can be improved by implementing offsetting principles and rules as a guideline when designing compensation packages.

The document 'Guidance on Good Practice Biodiversity Offsetting in New Zealand' provides a detailed and comprehensive account of the theory and possible application of the use of biodiversity offset mitigation in NZ (New Zealand Government et al., 2014). However, in the absence of clear over-arching policy and lack of practitioner consensus as to how biodiversity offsetting is defined and fits into the RMA context, ambiguity over how biodiversity offsetting should be implemented, monitored, and enforced is commonplace.

In New Zealand, offset models have generally only been used for large developments (e.g., wind farms, dams, and mines) where biodiversity matters are broad-ranging and offset models are correspondingly complex. However, a disaggregated condition-area model template has been developed for the Department of Conservation (Maseyk et al., 2015) which provides a more accessible, transparent, flexible, and structured means of assessing an offset proposal than those previously used in New Zealand for terrestrial and wetland ecosystems (Maseyk et al., 2016). The actual Accounting Model is a non-prescriptive, flexible 'empty shell' Microsoft Excel spreadsheet that the user populates by entering biodiversity measures, estimates, and discount rates[2]. As stated in the User Guide, in summary the Accounting Model:

- Accounts only for 'like for like' biodiversity trades aimed at demonstrating no net loss (the model does not address 'like for unlike' exchanges);
- Relies on three hierarchical levels to categorise biodiversity (1: biodiversity types; 2: biodiversity components; 3: biodiversity attributes);
- Uses a disaggregated area/condition currency;
- Calculates net present biodiversity value (NPBV) for individual biodiversity attributes and average NPBV across the range of attributes representing a biodiversity component (as defined by Overton et al., 2013);
- Uses NPBV to estimate whether no net loss is achieved in the exchange with project level no net loss being demonstrated when all components demonstrate no net loss;
- Incorporates the use of a discount rate;
- Increases transparency of input values;
- Adjusts for uncertainty of success regarding the proposed offset actions; and

[1] ND: This definition differs slightly from that within the Good Practice Guidance as the terminology used in this definition has been altered to align with that of the RMA. The meaning and intent of the two definitions is the same.

[2] Biodiversity offsets accounting system - Microsoft Excel template accessed 1 November 2022. Retrieved from: https://www.doc.govt.nz/about-us/our-policies-and-plans/guidance-on-biodiversity-offsetting/biodiversity-offsets-accounting-system/

- Includes in-model explanations to assist the user.

3 Application of a Biodiversity Offset Accounting Model for wetland loss

3.1 Model definitions and parameters

The Biodiversity Offset Accounting Model (BOAM) as developed by Maseyk et al. (2015) has been used to determine if no net loss of biodiversity values for wetlands TR-W1 and TR-W4 is likely to be achieved through downslope restoration of the remaining portions of wetland habitat associated with both wetlands. Section 4 outlines the conceptual restoration design.

The model is an accounting system/mathematical framework used to balance the losses at the impact site with the predicted gains at the offset site by comparing the value of biodiversity lost at the impact site (biodiversity value post-impact minus biodiversity value pre-impact) with the predicted value of biodiversity gained at the offset site (biodiversity value post-offset minus biodiversity value pre-offset).

The BOAM comprises an Impact Model and an Offset Model. Both need to be used to calculate the Net Present Biodiversity Value of each Biodiversity Attribute (NPBV) following the proposed Offset Action.

In this case the model has been used to calculate the NPBV for wetland condition attributes based on Clarkson et al. (2003) for TR-W1 and TR-W4 respectively. Condition attributes assessed included[3]:

- Hydrological integrity;
- Physico-chemical integrity;
- Ecosystem intactness;
- Browsing, predation and harvesting regimes;
- Dominance of native plants.

For each wetland the condition assessment was completed for the following scenarios:

- Impact Site - Before Impact: condition of the wetland under baseline (current) conditions;
- Impact Site - Potential: condition of the wetland given theoretical potential state. This assessment assumed current legal provisions for natural wetlands which mainly relate to stock exclusion;
- Impact Site - After Impact: condition of the wetland after the impact occurred;
- Offset Site - Baseline: The baseline condition of the wetland earmarked for restoration;
- Offset Site - After Offset: the condition of the wetland after restoration.

A detail justification of the condition assessment is presented in **Attachment 2**. To simplify the use of the BOAM the wetland extent and condition for both wetlands were combined and averaged respectively. This was considered appropriate due to the similarities in wetland type and condition. The combined extent and average wetland condition scores are also presented in **Attachment 2** (Table 7) while the definitions and biodiversity attributes used are detailed in **Attachment 3.**

3.2 Impact Model results

Table 1 presents the output of the Impact Model as Biodiversity Value loss scores (expressed as five Biodiversity Attributes of Wetland Condition) resulting from 0.178 ha of wetland loss (TR-W1 = 0.1 ha

[3] The catchment impact module for the wetland condition assessment has not been included in the condition assessment for purposes of the BOAM model. This is because the restoration actions mainly pertains to the wetland area.

and TR-W4 = 0.078 ha combined). **Attachment 3** (Table 8), provides detail on the definitions and justifications for each of the attribute cells.

Table 1 shows that within the 0.178 ha of proposed reclaimed wetlands, three of the five Biodiversity Attributes will be reduced to 0. Note that the measure score prior to impact represents the potential value of the wetlands. Thus, the Biodiversity Value is correspondingly reduced to a net negative value as shown in the last column of Table 1. These represent the residual adverse effects which require offsetting, as this loss cannot be directly avoided, remediated, or mitigated.

For 'Browsing pressure' and 'Dominance of native vegetation' no change in condition is predicted or shown in the Impact Model, as the decrease in the extent of the wetlands due to the road upgrades will not influence these attributes. Conversely, 'Ecosystem intactness' best represents the loss in wetland extent, while 'Hydrological integrity' and 'Physico-chemical parameters' have also been scored zero to account for the loss of wetland habitat within the condition assessment[4]. Refer to stormwater report for details on the groundwater treatment design.

The most ecologically intact state of wetland condition is expressed as a maximum value of 5 for each Biodiversity Attribute as shown in the Benchmark column, which is assessed against the current degraded (potential) state of for each wetland and then averaged for input into the Impact Model (**Attachment 3**). This benchmark becomes the aspirational restoration state, which is inputted into the Offset Model (discussed further below).

Table 1 Results of Impact Model where 0.178 ha of wetland habitat is reclaimed

	This section captures which elements of biodiversity, and over what area, will be impacted by the proposal					This section is where the change in measure of each Biodiversity Attribute due to the proposed Impact is quantified, and Attribute Biodiversity Value calculated. Inputs are derived from direct measures, existing data or models where available, or expert estimated predictions			
	Biodiversity Component	Biodiversity Attribute		Measurement Unit	Area of Impact (ha)	Benchmark	Measure prior to Impact	Measure after Impact	Biodiversity Value
1.1	Habitat quality	1.1a	Hydrological integrity	Condition Rating	0.178	5	4	0	-0.14
		1.1b	Physico-chemical parameters	Condition Rating	0.178	5	3	0	-0.11
		1.1c	Ecosystem intactness	Condition Rating	0.178	5	3	0	-0.11
		1.1d	Browsing and predation	Condition Rating	0.178	5	4	4	0.00
		1.1e	Dominance of native plants	Condition Rating	0.178	5	2	0	-0.07

3.3 Offset Model results

Table 2 presents the results of the Offset Model. This assumes that a total of 0.37 ha (0.27 ha for TR-W1 and 0.1 ha for TR-W4) associated with the unaffected downstream portions of each wetland, is restored within the NoR designation (Figure 2)[5], which is shown in the Offset Area column of the model. The detailed definitions of the Offset Model are shown in **Attachment 3** (Table 9).

[4] Embedded controls (stormwater management and erosion and sediment controls) mitigate for the loss functional wetland values as they relate to the receiving environment including, flood control, water treatment and erosion control. Therefore, there is no 'indirect' effect on the condition of wetland habitat outside of the portion of each wetland that will be permanently reclaimed.

[5] Buffer planting has not been presented on the figure. It is expected to be a 10 metre buffer planting around the offset areas (where possible within the designation boundary).

The Offset Model takes across the Biodiversity Value at the Impact Site and Benchmark scores from the Impact Model.

An NPBV discount rate of 3% has been applied to this restoration project in consideration of the time delay of the restoration being successfully realised. Further detail on how this rate was determined is provided in the User Manual (Maseyk et al., 2015).

Biodiversity Attribute measures prior to the Offset have been taken from the scores presented in condition assessment in the Measure prior to Offset column of the model. The likely improvement of wetland condition score has been provided for each Biodiversity Attribute in the Measure after Offset column of the model.

Benefits associated with planting, pest plant control and stock exclusion are expected to accrue within five years. This is expressed for each Biodiversity Attribute in the Time till endpoint column of the Offset Model.

The model determines the Biodiversity Value at the Offset Site for each Biodiversity Attribute and presents an Attribute Net Present Biodiversity Value for each of these attributes.

The final output of the Offset Model shows that the five key Biodiversity Attributes measuring wetland condition are improved through restoration and hence a Component Net Present Biodiversity Value of 0.00 is achieved after five years (Table 2).

This is a neutral NPBV value indicating that, if successfully implemented, restoration of 0.37 ha of unaffected downstream portions of TR-W1 and TR-W4 will offset the loss of 0.178 ha of the upstream portions of the same wetlands associated with the construction and operation of the Trig Road Corridor Upgrade.

Table 2 Results of Offset Model where 0.37 ha (consisting of 0.27 ha for TR-W1 and 0.1 ha for TR-W4) is restored as an offset (with a 3% discount rate applied)

	This section captures which elements of biodiversity are to be accounted for, and the benchmark value for the Attribute. The information matches that in the Impact Model					These cells provide information about the proposed Offset Actions			Calculations can be made for a finite end point, or at five yearly time-steps over 35 years. Indicate preference in Column K and Follow the instructions in Column L		This section is where the marginal change in the measure of Biodiversity Attribute due to the Offset Action is quantified. Inputs are derived from direct measure, existing data or models where available, or expert estimated predictions. Attribute Biodiversity Value at the Offset Site is compared to the Attribute Biodiversity Value at the Impact Site to calculate the Net Present Biodiversity Value for each Attribute						This is the average Net Present Biodiversity Value for the Biodiversity Component
	Biodiversity Component	Biodiversity Attribute		Measurement Unit	Benchmark	Proposed Offset Actions	Offset area (ha)	Confidence in Offset Actions			Measure prior to Offset	Measure after Offset	Time till endpoint (years)	Biodiversity Value at Offset Site	Biodiversity Value at Impact Site	Attribute Net Present Biodiversity Value	Component Net Present Biodiversity Value
1.1	Habitat quality	1.1a	Hydrological integrity	Condition Rating	5	Hydrology for offset wetlands will be maintained	0.37	Confident 75-90%	Finite end point	Continue to Column M	4	4	5	0.00	-0.14	-0.14	0.00
		1.1b	Physico-chemical parameters	Condition Rating	5	Stock exclusion, fencing ,10 m buffer planting and wetland planting will improve Physico-	0.37	Confident 75-90%	Finite end point	Continue to Column M	2	4	5	0.11	-0.11	0.00	
		1.1c	Ecosystem intactness	Condition Rating	5	Offset wetland extent will remain the same as baseline	0.37	Very confident >90%	Finite end point	Continue to Column M	3	3	5	0.00	-0.11	-0.11	
		1.1d	Browsing and predation	Condition Rating	5	Stock will permanently be excluded	0.37	Confident 75-90%	Finite end point	Continue to Column M	1	5	5	0.21	0.00	0.21	
		1.1e	Dominance of native plants	Condition Rating	5	Replant with native wetland plants including 10 m native buffer planting and a 5 year	0.37	Low confidence >50% <75%	Finite end point	Continue to Column M	1	4	5	0.12	-0.07	0.05	

Figure 2 Indicative location and extent of the proposed offset wetland areas

4 Conceptual restoration design

The proposed offset wetlands will be situated within the downslope portions of TR-W1 and TR-W4 (Figure 2). The BOAM demonstrated that a net gain (NPBV of 0.01) in wetland condition will be achieved through restoration of 0.37 ha of wetland habitat. This extent does not include an additional 10 m native buffer planting where practicable.

Subject to further ground survey, and detailed design in accordance with the final WREP, the following steps will be required to recreate wetland habitat in these locations:

i. Confirmation in detailed design that the wetland hydrological system allows for a wide range of wetland plants to establish and become a self-sustaining native wetland system;
ii. Measures to protect the wetland so it is protected in perpetuity and excludes stock;
iii. Initial and ongoing plant pest control for a period of five years from establishment to minimise exotic plant cover in the wetland; and
iv. Initial and infill planting of an array of wetland and wetland edge native plants to achieve a minimum 80% native wetland plant cover five years from establishment.

4.1 Hydrology

The final layout of the offset wetlands will be undertaken during detailed design by a suitably experienced and qualified ecologist in conjunction with the design engineers. Achieving an optimal hydrological regime in the wetland is critical to the success of the wetland plantings.

4.2 Plantings

The offset wetlands will contain a mosaic of permanently submerged wetland vegetation and low-growing shrubby species with thick, strong root systems that tolerate sediment deposition and frequent periods of inundation (Figure 3). This vegetation shall naturally establish or be planted. These plants will provide ideal wetland bird feeding habitat as well as preventing bank erosion and slowing down surface water flows. Along the margins riparian tree and shrub species will dominate. These trees will provide shade over the water, and habitat protection for wildlife.

Two benchmark wetland types are recommended to be re-created within the proposed offset area of TR-W1 and TR-W4:

i. *Carex - Machaerina* swampland: The majority of the wetland area should be planted with the aim of establishing a vegetation assemblage dominated by *Carex* and *Machaerina* sedges with harakeke, tī kōuka, manuka and *Coprosma* species interspersed throughout. This type of vegetation association is likely to have been present prior to European habitation of the area and subsequent drainage and clearance for farming. Target vegetation communities should therefore be dominated by native wetland species more suited to high levels of nutrients. Other species to plant include giant umbrella sedge, *Machaerina sinclarii, Astelia grandis,* raupō, and *Schoenoplectus tabernaemontani.*
ii. Kahikatea-dominated swamp forest: Along the less saturated and riparian margins planting is intended to be restored to kahikatea-dominated swamp forest. As well as kahikatea, species such as tī kōuka, toetoe, koromiko, putaputaweta, manuka, pukatea, and swamp maire should be utilised. Kahikatea can be planted at relatively high density but should be part of a mix which includes fast-growing small trees and shrubs which will provide some shelter to the larger trees when they are young. Kahikatea forest has a diverse understorey and groundcover flora which

includes small-leaved shrub species such as *Coprosma rigida, C. rotundifolia, Melicytus micranthus, Raukaua anomalus*, and *Melicope simplex* as well as a range of lianes, sedges, and fern species.

The dry, upper slopes of the wetlands will be somewhat restricted in plant selection by the presence of the road and other safety and landscape design restrictions. The target vegetation type here should be dominated by plantings of smaller flowering tree and species such as small-leaved kōwhai, wineberry, and koromiko, as well as occasional pūriri and tītoki where they are unlikely to pose a long-term hazard to the road.

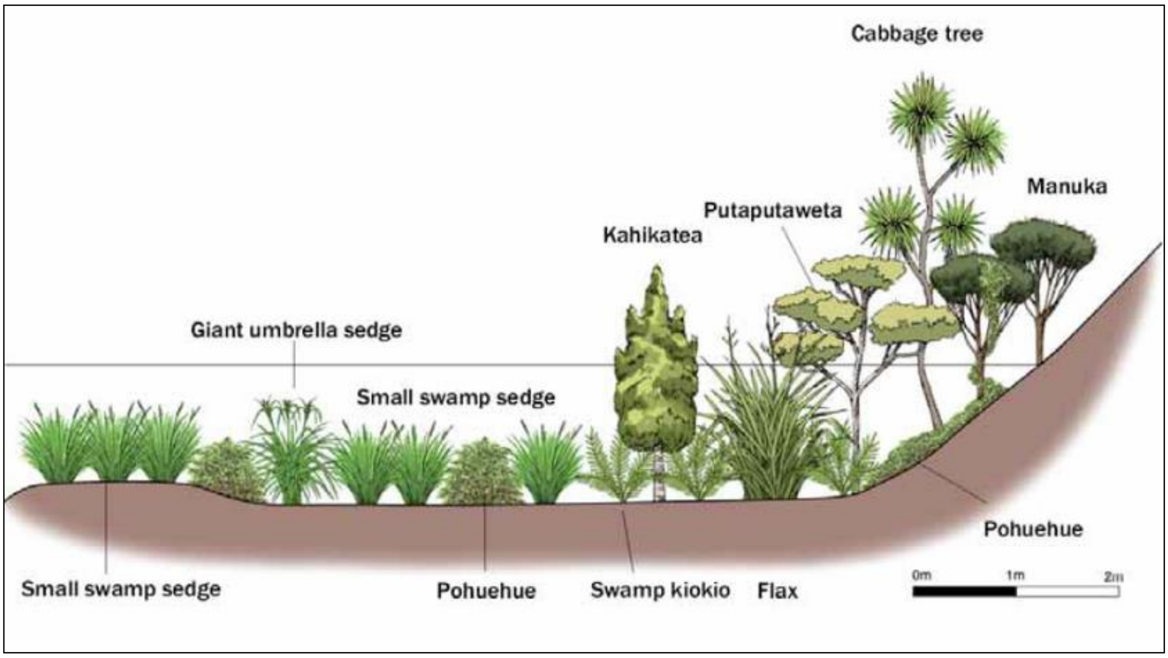

Figure 3 Generalised wetland planting cross-section (Auckland Regional Council, 2001)

Planting schedules and species appropriate for planting in each wetland benchmark community type will be required during detailed design. The planting schedules will need to specify those species that are suitable for initial plantings in each zone and will ensure a relatively fast canopy closure which will assist with weed control. The schedules will also need to include the proportion of the overall mix that each species should contribute to achieving the benchmark wetland communities, along with the recommended grade of plant.

In order to maintain the genetic integrity of the local area all plants used for the wetland project should be grown from seed of naturally occurring species growing in the locality or from other nearby sources within the Auckland Ecological District.

4.3 Maintenance and Pest Control

It is recommended that the wetland is maintained for a minimum period of five years following construction from the date planted to achieve at least 80% cover (over all strata) of indigenous species, with no more than 5% total cover of exotic species in any tier. The species shall be appropriate for all tiers found in a mature habitat, and shall include ground cover, sub canopy and canopy species (where applicable). If monitoring shows that 80% cover has not been achieved after five years of maintenance, the maintenance period shall be extended until that is achieved.

5 References

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6 Limitations

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1 Attachment 1 - Figures

Figure 4 Location and classification of TR-W1 and TR-W4

Figure 5 Indicative location and extent of the proposed offset areas

2 Attachment 2 – Wetland Condition Assessment

Table 3 Wetland condition scores for impact indicators and indicator components for TR-W1 (impact site and offset site)

Impact Indicator	Indicator Components	Impact Site: Before Impact (0.1 ha)	Impact Site: Potential (0.1 ha)	Impact Site: After Impact (0.1 ha)	Offset Site: Before Offset (0.27 ha)	Offsite Site: After Offset (0.27 ha)	Justification
Hydrological integrity	Impact due to manmade structures/drains /changes in water budget and changes to runoff characteristics	4	4	0	4	4	The hydrological integrity of TR-W1 remains largely intact with no observable changes to abstraction, impoundments, changes in hydroperiod (timing, duration, frequency), volumes, inundation of wetland habitats or groundwater changes to the wetland. A small change hydrology due to increased runoff from agricultural land and existing road is reflected in the impact score. Under the potential scenario (fencing and stock exclusion) no material improvement in wetland hydrology is expected. A very high degree of modification to hydrology is expected for post-impact scenario as the wetland will be occupied by the new road embankment. A small extent (<10%) of the offset wetland is affected by a farm pond but overall hydrological integrity remains similar to the impact wetland. The post-offset hydrological integrity expected to improve slightly due to increased surface roughness associated with buffer planting but likely to remain in the same score range.
	Water table depth	-	-	-	-	-	-
	Dryland plant invasion	-	-	-	-	-	-
Mean Score		**4.0**	**4.0**	**0.0**	**4.0**	**4.0**	-
Physico-chemical parameters	Fire damage	-	-	-	-	-	-
	Degree of sedimentation	-	-	-	-	-	-
	Nutrient levels	2	3	0	2	4	Point and diffuse sources of nutrients from agricultural landuse and road runoff. The potential wetland health can improve through stock exclusion.

Impact Indicator	Indicator Components	Impact Site: Before Impact (0.1 ha)	Impact Site: Potential (0.1 ha)	Impact Site: After Impact (0.1 ha)	Offset Site: Before Offset (0.27 ha)	Offsite Site: After Offset (0.27 ha)	Justification
							Nutrient levels for the offset wetland is similar to the impact wetland as it drains the same catchment. The post-offset nutrient levels are expected to improve notably due to stock exclusion and additional filtration through buffer planting.
	Von Post index	-	-	-	-	-	-
Mean Score		**2.0**	**3.0**	**0.0**	**2.0**	**4.0**	-
Change in ecosystem intactness	Loss in area of original wetland	3	3	0	3	3	Moderate increase in runoff due to surface roughness changes associated with agriculture likely resulted in some reduction in wetland extent relative to benchmark. No notable increase in wetland extent is considered achievable under the potential scenario (fencing of the wetland). Changes in wetland extent for the offset wetland (prior to actual offset) is similar to that of the impact wetland (prior to impact) as the offset wetland is an extension of the impact wetland. Offset action will not result in a notable increase in wetland extent and is therefore allocated the same impact score.
	Connectivity barriers	-	-	-	-	-	-
Mean Score		**3.0**	**3.0**	**0.0**	**3.0**	**3.0**	-
Change in browsing, predation, and harvesting regimes	Damage by domestic or feral animals	1	4	4	1	5	Baseline wetland condition notably affected by grazing pressure. Stock exclusion through fencing under the potential scenario will improve wetland condition (although fencing alone will not prevent grazing by introduced pests such as possum, rabid and hare). Grazing pressure (under the impact scenario) scored the same for the pre-impact wetland as impact will not increase grazing pressure (therefore further deteriorating wetland habitat quality).

Impact Indicator	Indicator Components	Impact Site: Before Impact (0.1 ha)	Impact Site: Potential (0.1 ha)	Impact Site: After Impact (0.1 ha)	Offset Site: Before Offset (0.27 ha)	Offsite Site: After Offset (0.27 ha)	Justification
	Introduced predator impacts on wildlife	-	-	-	-	-	-
	Harvesting levels	-	-	-	-	-	-
Mean Score		**1.0**	**4.0**	**4.0**	**1.0**	**5.0**	-
Change in dominance of native plants	Introduced plants	1	2	0	1	4	The baseline cover for the wetland to be impacted is exotic grasses and shrubs with no native species contingent. Therefore, the highest (most severe) impact score is allocated). The wetland potential scenario presumes fencing which by itself will not increase the representation of native species. However, some native recruitment is likely through stock exclusion alone and a slightly higher category impact score is allocated for the potential wetland. The impact is not going to increase the representation of introduced species and is therefore allocated the same impact score as the baseline for the impact wetland. The offset wetland (prior to offset) have the same dominance of introduced plants as the impact wetland. Successful implementation of the restoration plan will result in native plant dominance. The Impact score reflects some contingency for resilient introduced plants.
	Introduced plant understorey cover	-	-	-	-	-	-
Mean Score		**1.0**	**2.0**	**0.0**	**1.0**	**4.0**	-
Total Wetland Condition Index/25		**11.0**	**16.0**	**2.0**	**11.0**	**20.0**	-
Condition Index (%)		**44.00%**	**64.00%**	**16.00%**	**44.00%**	**80.00%**	-
Condition Index Category		**Largely**	**Moderately**	**Critically**	**Largely**	**Largely natural**	-

Table 4 BOAM input summary for TR-W1

Impact Indicator	Impact Site TR-W1: Before Impact (0.1 ha)	Impact Site TR-W1: Potential	Impact Site TR-W1: Before Impact (0.1 ha)	Impact Site TR-W1: Potential	Impact Site TR-W1: Before Impact (0.1 ha)
Hydrological integrity	4	4	0	4	4
Physico-chemical parameters	2	3	0	2	4
Ecosystem intactness retained	3	3	0	3	3
Browsing, predation and harvesting regimes	1	4	4	1	5
Dominance of native plants	1	2	0	1	4

Table 5 Wetland condition scores for impact indicators and indicator components for TR-W4 (impact site and offset site)

Impact Indicator	Indicator Components	Impact Site: Before Impact (0.1 ha)	Impact Site: Potential (0.1 ha)	Impact Site: After Impact (0.1 ha)	Offset Site: Before Offset (0.27 ha)	Offsite Site: After Offset (0.27 ha)	Justification
Hydrological integrity	Impact due to manmade structures/drains /changes in water budget and changes to runoff characteristics	4	4	0	4	4	The hydrological integrity of TR-W4 remains largely intact with no observable changes to abstraction, impoundments, changes in hydroperiod (timing, duration, frequency), volumes, inundation of wetland habitats or groundwater changes to the wetland. A small change hydrology due to increased runoff from agricultural land and existing road is reflected in the impact score. Under the potential scenario (fencing and stock exclusion) no material improvement in wetland hydrology is expected. A very high degree of modification to hydrology is expected for post-impact scenario as the wetland will be occupied by the new road embankment. A small extent (<10%) of the offset wetland affected by a farm pond but overall hydrological integrity similar to the impact wetland. The post-offset hydrological integrity expected to improve slightly due to increased surface roughness associated with buffer planting but likely to remain in the same score range.

Impact Indicator	Indicator Components	Impact Site: Before Impact (0.1 ha)	Impact Site: Potential (0.1 ha)	Impact Site: After Impact (0.1 ha)	Offset Site: Before Offset (0.27 ha)	Offsite Site: After Offset (0.27 ha)	Justification
	Water table depth	-	-	-	-	-	-
	Dryland plant invasion	-	-	-	-	-	-
Mean Score		**4.0**	**4.0**	**0.0**	**4.0**	**4.0**	-
Physico-chemical parameters	Fire damage	-	-	-	-	-	-
	Degree of sedimentation	-	-	-	-	-	-
	Nutrient levels	2	3	0	2	4	Point and diffuse sources of nutrients from agricultural landuse and road runoff. The potential wetland health can improve through stock exclusion. Nutrient levels for the offset wetland is similar to the impact wetland as it drains the same catchment. The post-offset nutrient levels are expected to improve notably due to stock exclusion and additional filtration through buffer planting.
	Von Post index	-	-	-	-	-	-
Mean Score		**2.0**	**3.0**	**0.0**	**2.0**	**4.0**	-
Change in ecosystem intactness	Loss in area of original wetland	3	3	0	3	3	Moderate increase in runoff due to surface roughness changes associated with agriculture likely resulted in some reduction in wetland extent relative to benchmark. No notable increase in wetland extent is considered achievable under the potential scenario (fencing of the wetland). Changes in wetland extent for the offset wetland (prior to actual offset) is similar to that of the impact wetland (prior to impact) as the offset wetland is an extension of the impact wetland.

Impact Indicator	Indicator Components	Impact Site: Before Impact (0.1 ha)	Impact Site: Potential (0.1 ha)	Impact Site: After Impact (0.1 ha)	Offset Site: Before Offset (0.27 ha)	Offsite Site: After Offset (0.27 ha)	Justification
							Offset action will not result in a notable increase in wetland extent and is therefore allocated the same impact score.
	Connectivity barriers	-	-	-	-	-	-
Mean Score		**3.0**	**3.0**	**0.0**	**3.0**	**3.0**	-
Change in browsing, predation, and harvesting regimes	Damage by domestic or feral animals	1	4	4	1	5	Baseline wetland condition notably affected by grazing pressure. Stock exclusion through fencing under the potential scenario will improve wetland condition (although fencing alone will not prevent grazing by introduced pests such as possum, rabid and hare). Grazing pressure (under the impact scenario) scored the same for the pre-impact wetland as impact will not increase grazing pressure (therefore further deteriorating wetland habitat quality).
	Introduced predator impacts on wildlife	-	-	-	-	-	-
	Harvesting levels	-	-	-	-	-	-
Mean Score		**1.0**	**4.0**	**4.0**	**1.0**	**5.0**	-
Change in dominance of native plants	Introduced plants	1	2	0	1	4	The baseline cover for the wetland to be impacted is exotic grasses and shrubs with no native species contingent. Therefore, the highest (most severe) impact score is allocated). The wetland potential scenario presumes fencing which by itself will not increase the representation of native species. However, some native recruitment is likely through stock exclusion alone and a slightly higher category impact score is allocated for the potential wetland. The impact is not going to increase the representation of introduced species and is therefore allocated the same impact score as the baseline for the impact wetland.

Impact Indicator	Indicator Components	Impact Site: Before Impact (0.1 ha)	Impact Site: Potential (0.1 ha)	Impact Site: After Impact (0.1 ha)	Offset Site: Before Offset (0.27 ha)	Offsite Site: After Offset (0.27 ha)	Justification
							The offset wetland (prior to offset) have the same dominance of introduced plants as the impact wetland. Successful implementation of the restoration plan will result in native plant dominance. The Impact score reflects some contingency for resilient introduced plants.
	Introduced plant understorey cover	-	-	-	-	-	-
Mean Score		**1.0**	**2.0**	**0.0**	**1.0**	**4.0**	-
Total Wetland Condition Index/25		**11.0**	**16.0**	**2.0**	**11.0**	**20.0**	-
Condition Index (%)		**44.00%**	**64.00%**	**16.00%**	**44.00%**	**80.00%**	-
Condition Index Category		**Largely**	**Moderately**	**Critically**	**Largely**	**Largely natural**	-

Table 6 BOAM input summary for TR-W4

Impact Indicator	Impact Site TR-W4: Before Impact (0.078 ha)	Impact Site TR-W4: Potential (0.078 ha)	Impact Site TR-W4: After Impact (0.078 ha)	Offset Site TR-W4: Before Offset (0.1 ha)	Offset Site TR-W4: After Offset (0.1 ha)
Hydrological integrity	4	4	0	4	4
Physico-chemical parameters	2	3	0	2	4
Ecosystem intactness retained	3	3	0	3	3

Impact Indicator	Impact Site TR-W4: Before Impact (0.078 ha)	Impact Site TR-W4: Potential (0.078 ha)	Impact Site TR-W4: After Impact (0.078 ha)	Offset Site TR-W4: Before Offset (0.1 ha)	Offset Site TR-W4: After Offset (0.1 ha)
Browsing, predation and harvesting regimes	1	4	4	1	5
Dominance of native plants	1	2	0	1	4

Table 7 BOAM input summary for combined extent and averaged scores for TR-W1 and TR-W4

Impact Indicator	Impact Site TR-W1 & TR-W2	Impact Site TR-W1 & TR-W4: Potential (0.178 ha)	Impact Site TR-W1 & TR-W4: After Impact (0.178 ha)	Offset Site TR-W1 & TR-W4: Before Offset (0.37 ha)	Offset Site TR-W1 & TR-W4: After Offset (0.37)
Hydrological integrity	4	4	0	4	4
Physico-chemical parameters	2	3	0	2	4
Ecosystem intactness retained	3	3	0	3	3
Browsing, predation and harvesting regimes	1	4	4	1	5
Dominance of native plants	1	2	0	1	4

3 Attachment 3 - Definition and attribute justifications for the Biodiversity Accounting Model

Table 8 Impact Model - data inputs used to determine an overall biodiversity loss score at the impact site

Model Inputs	Explanation (Maseyk et al., 2016)	Application for Trig Road Corridor Upgrade
Biodiversity Type	*Biodiversity Type describes the key biodiversity features of concern found at the Impact Site and can include ecosystems, habitats, or species. Examples include: Lowland podocarp-hardwood forest, or a river and riparian ecosystem. Threatened and iconic species and rare or special features may also be listed as Biodiversity Types.*	Palustrine wetland has been used as our biodiversity type, as this is the overarching hydro system classification of the wetlands.
Biodiversity Component	*Identify and input Biodiversity Components to help describe what makes up the Biodiversity Type. Examples of components include: vegetation tiers, habitat types, related groups of indigenous species, or functional roles (insectivore/predator, nectarivore/pollinator and frugivore/seed disperser).*	Wetland habitat quality has been used as the biodiversity component. Habitat quality is based on attribute categories that are aligned at both the impact and offset sites (Clarkson et al., 2003).
Biodiversity Attribute	*Identify and input Biodiversity Attributes as measures of the condition or the quantity of the Biodiversity Component. The Biodiversity Attributes are the measures balanced in this accounting system to demonstrate no net loss.*	Attribute categories (based on Clarkson et al., 2003) included: – Change in hydrological integrity. – Change in physicochemical parameters. – Change in ecosystem intactness. – Change in browsing, predation and harvesting regimes. – Change in dominance of native plants. These index scores have been directly inserted in the Input Model of the BOAM as suitable "Biodiversity Attributes" which are measures of the condition and the quantity of the wetlands Biodiversity Attributes.
Measurement Unit	*Enter measurement Units for each Biodiversity Attribute. For example, if the Attribute is 'number of adults' the Measurement Unit would be a count. If the Attribute is 'spatial extent of a vegetation tier', the Measurement Unit might be percent. For each attribute, the same measurement units must be used in the Impact and Offset Models.*	Impact scores for each attribute were as per Clarkson et al. (2004): Degree of modification in wetland: **Descriptor** — **Score** Very High — 1 High — 2 Medium — 3 Low — 4 Very Low — 5
Area of Impact (ha)	*Measure and input the extent of habitat or area (ha) supporting the Biodiversity Type and over which the Biodiversity Attribute*	Area of impact assumes the permanent loss of a portion of wetlands TR-W1 (0.1 ha) and TR-W4 (0.078 ha). Embedded

Model Inputs	Explanation (Maseyk et al., 2016)	Application for Trig Road Corridor Upgrade
	will be impacted by the proposal. For example, if the Biodiversity Type is a threatened plant species, the area of Impact is the total area (ha) of the vegetation community supporting that species that will be affected by the proposed impact, not just the summed area occupied by individual plants.	controls for stormwater management and erosion and sediment control during construction and operation mitigate for the 'indirect' effects associated with potential hydrology and water quality effects. Similarly, embedded controls also compensate for the loss of functional wetland services related to flood attenuation, sediment control and water purification. The area of impact is therefore limited to the permanent loss of wetland habitat directly associated with the construction footprint.
Benchmark	*Input Benchmark values specific to each Biodiversity Attribute. Measurements of ecological condition or quality require reference to a benchmark state that reflects a 'natural' or 'pristine' or other desirable condition.Benchmarks are ideally measured, from a real site of the same vegetation community type of the Impact and Offset Site, and be a site that has been under sustained conservation management or be of the highest possible condition value.*	Benchmark state equates to best possible examples of wetland ecosystem types currently present and the restoration potential of the site, e.g., a future state of mature indigenous wetland ecosystem types with the full potential complement of indigenous species. To be consistent with the Clarkson et al. (2003) wetland impact score, a benchmark score of 5 has been applied and represents a Very Low impact state.
Measure <u>prior to</u> Impact	*Measure and input the measured value of the Biodiversity Attribute at the Impact Site prior to the proposed Impact occurring. This is the measure of biodiversity loss in the loss/gain calculation. The value is expressed in the stated Measurement Unit (Column F), using the same method of measurement as for the Benchmark. If the Impact to the Attribute is total loss, enter a value of zero.*	Assessment of **<u>potential</u>** wetland habitat condition against the benchmark condition. This is a theoretical condition assessment based on expected improvements in wetland condition if stock is excluded from the wetland through fencing.
Measure <u>after</u> Impact	Estimate and input the predicted value of the Attribute at the Impact Site following the proposed Impact. The value is expressed in the stated Measurement Unit (Column F), using the same method of measurement as for the Benchmark. The quantum of Impact may be derived from the Assessment of Environmental Effects, or predictive models may be needed to inform this value. Experts with expertise relevant to each Biodiversity Attribute may be able to confidently estimate post Impact values.	Assumes the value of each condition attribute within the development footprint will be reduced to zero with total removal in the impact footprint. Attributes that will not be affected by the road construction (for example 'Browsing pressure' and 'Dominance of native plants' in the wetland have the same post impact scores).
Biodiversity value	This is the calculated value of the Biodiversity Attribute at the Impact Site following the Impact. Attribute biodiversity value is the measure of the Attribute after the Impact, relative to the measure prior to the Impact, and adjusted in proportion to the Benchmark. Any Attribute value greater than the Benchmark value is truncated to 1 within the equation. This	As per the output of the model's calculation.

Model Inputs	Explanation (Maseyk et al., 2016)	Application for Trig Road Corridor Upgrade
	change in biodiversity value is then multiplied across the area of proposed Impact.	

Table 9 Offset Model - data inputs used to determine an overall biodiversity gain at the restoration site

Model Inputs	Explanation (Maseyk et al., 2016)	Application for Trig Road Corridor Upgrade
Biodiversity Type	*The Offsets Model will auto populate this cell with the text entered the Impact Model.*	No deviation from model explanation.
Discount Rate	*Enter a discrete discount rate before any other values are entered into the Offset Model. The same discount rate applies to all Biodiversity Types, Components, and Attributes in the Offset Model. For more discussion on discount rates see the Good Practice Guidance.*	A discount rate of 3% has been applied. This rate is considered appropriate given the risk and uncertainty associated with this specific offset.
Biodiversity Component	The Offsets Model will auto populate this cell within the text entered in the Impact Model.	No deviation from model explanation.
Biodiversity Attribute		
Measurement Unit		
Benchmark		
Proposed Offset Actions	*Define and Input brief detail of the action(s) (management intervention) proposed to Offset Impact. Further detail can be provided in supporting documentation.*	Broad restoration measures are presented in the memo and will be detailed in a WREP as part of the NoR/resource consent condition requirements. However, it is assumed that proposed offset actions include but are not limited to stock exclusion through fencing, native revegetation, or native enrichment plantings, weed pest control for five years (limited to invasive weeds and shrubs in accordance with commonly applied targets) and 10 m buffer planting around each wetland where practicable to do so.
Offset area (ha)	Input the area (in hectares) over which the Offset activity related to this Biodiversity Attribute will be implemented. The same Offset activity, and therefore the same area over which the Offset activity is to be implemented, can apply to more than one Attribute.	Offset reach: TR-W1 - 0.27 ha Offset reach: TR-W4 - 0.1 ha Combined area applied in the BOAM - 0.37 ha
Confidence in Offset Actions	*Estimate and input the likelihood that the proposed Offset Action (Column H) will be successful within the specified time estimate (Column O). This reflects that even with proven management techniques some uncertainty around*	Confidence levels were congruent with the likely success of the proposed offset and the time till endpoint: The following confidence levels were applied:

Model Inputs	Explanation (Maseyk et al., 2016)	Application for Trig Road Corridor Upgrade
	outcomes is always present e.g., restoration plantings may fail due to unanticipated drought or pest pressures, or possum control targets may not be met due to bait interference by an unexpectedly high rat population. This confidence level does not include risk of default or failing to implement the proposed Offset Actions. *Choose a confidence rating from the dropdown list, as follows:* ***Low confidence**: The proposed Offset Action uses methods that have either been successfully implemented in New Zealand or in the situation and context relevant to the Offset Site but infrequently, or the outcomes of the proposed Offset Action are not well proven or documented, or success rates elsewhere have been shown to be variable. Likelihood of success is > 50% but < 75%.* ***Confident**: The proposed Offset Action uses well known and often implemented methods which have been proven to succeed greater than 75% of the time although enough complicating factors and/or expert opinion exists to not have greater confidence in this Offset Action. Likelihood of success is greater than 75% but less than 90%.* ***Very confident**: The proposed Offset Action uses methods that are well tested and repeatedly proven to be very reliable for the situation and context relevant to the Offset Site; evidence-based expert opinion is that success is very likely. Likelihood of success is > 90%.*	Confidence 75-90% assigned to hydrological integrity, physico-chemical improvements and browsing pressure within five years. Residual uncertainty relates to other browsing pressure other than stock and the wetland vegetation response to stock exclusion Confidence >90% assigned to ecosystem intactness as it is relatively certain the the existing extent of the wetland will remain approximately the same. Confidence >50<75% assigned to dominance of native plants within a five year period.
Time period over which to calculate NPBV	Decide whether to run calculations across five yearly time-steps for 35 years, or at a finite, user defined end point. The time-step calculation is limited to 35 years to reflect the maximum life of a resource consent. The finite end point is not time restricted. It is important to consider that management required to maintain the Offset over the long-term may be necessary beyond the time taken to demonstrate no net loss.	Finite end point.
Measure <u>prior to</u> Offset	*Measure and input the value of the Biodiversity Attribute at the Offset Site prior to the proposed Offset Action being implemented, expressed in the Measurement Unit (Column F). The methods/models used to measure the Attribute at the Offset Site need to be identical to those used to measure the same Attribute at the Impact Site.*	Based on the average attribute condition scores (baseline) for the offset wetlands as per the condition assessment for each attribute.

Model Inputs	Explanation (Maseyk et al., 2016)	Application for Trig Road Corridor Upgrade
Measure <u>after</u> the Offset	*Estimate and input the value of the Biodiversity Attribute at the Offset Site following the proposed Offset Action at the finite end point — the time at which the Offset Action is anticipated to have achieved the stated objective (Column O), expressed in the Measurement Unit (Column F). Predictive models may be needed to inform this measure. Experts with expertise relevant to each Biodiversity Attribute may be able to estimate future measures.*	Based on the theoretical condition assessment for each of the attributes give the implementation of the proposed restoration plan.
Time till end point (years)	*Predict and input the anticipated number of years (from the time of implementing the Offset Action) until the Offset Action is expected to achieve the Offset goal.*	Time till endpoint (time between restoration action and biodiversity value realized) was allocated as five years.
Biodiversity Value at Offset Site	*This is the difference between the future value of the Attribute after the Offset action (Column N) and the current value of the Attribute at the Offset Site prior to the Offset being implemented (Column M). This change in Attribute value is calculated as a proportion of the Benchmark (Column G). Any Attribute value greater than the Benchmark is truncated to 1. The proportional raw gain is adjusted to the level of confidence in the Offset Actions succeeding, by multiplying the raw gain by the midpoint of the confidence range (Column J). This calculation also incorporates the time preference discount rate (cell E11) and the time taken to reach the stated objective for the Offset Action (Column O). The gain in value is multiplied across the Offset Area (Column I) to give a final Attribute value.*	No deviation in approach from model explanation.
Biodiversity Value at Impact Site	*This value is imported from the corresponding Impact Model and feeds into the Offset Model spreadsheet (Column R).*	
Attribute Net Present Biodiversity Value	*The Net Present Biodiversity Value (NPBV) is determined for each Attribute by calculating the difference between the Attribute biodiversity value at the Offset Site and at the Impact Site to give the net change in biodiversity value over time. A no net loss biodiversity exchange is demonstrated when this value is equal to or greater than zero. Negative values demonstrate a net loss, positive values demonstrate a net gain.* *Where the five yearly time-step option is chosen (Offset Model_5 yearly), this cell is populated with the Attribute NPBV value at the point that is equal or greater than zero or, when a equal or greater than*	

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Model Inputs	Explanation (Maseyk et al., 2016)	Application for Trig Road Corridor Upgrade
	zero NPBV is not reached, the NPBV at Year 35.	
Component Net Present Biodiversity Value	*The NPBV for each component is calculated by averaging the NPBV of all the Attributes used to account for the Biodiversity Component (whether they were calculated using a finite end point or a five yearly time-step). All Biodiversity Attributes are equally weighted.*	