

North West Redhills Riverhead Assessment of Ecological Effects

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Version 1

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Abbreviations

Acronym/Term	Description
AEE	Assessment of Effects on the Environment
ASH	Alternative State Highway
AT	Auckland Transport
AUP:OP	Auckland Unitary Plan Operative in Part
BCI	Brigham Creek Interchange
CC2W	City Centre to Westgate
FTN	Frequent Transit Network
FULSS	Future Urban Land Supply Strategy
FUZ	Future Urban Zone
NAL	North Auckland Line
NoR	Notice of Requirement (under the Resource Management Act 1991)
RMA	Resource Management Act 1991
RTC	Rapid Transit Corridor
RAMC	Regional Active Mode Corridor
RUB	Rural Urban Boundary
SG	Te Tupu Ngātahi Supporting Growth
SH16	State Highway 16
The Council	Auckland Council
Waka Kotahi	Waka Kotahi NZ Transport Agency

Glossary of Acronyms / Terms

Acronym/Term	Description
Auckland Council	Means the unitary authority that replaced eight councils in the Auckland Region as of 1 November 2010.
Primary Study Area	Comprises the area and features within the proposed designation boundary.
Redhills Riverhead Assessment Package	Two Notices of Requirement (for Don Buck Road and Coatesville-Riverhead Road) and one alteration to an existing designation (Fred Taylor Drive) for the Redhills Riverhead Package of Projects for Auckland Transport.
Secondary Study Area	Comprises the area and features within a 100 m radius boundary of the designation.
Study Areas	Primary Study Area and Secondary Study Area.

1 Executive Summary

This Ecological assessment has been prepared for the North West Local Arterial Network Notices of Requirement (**NoRs**) for Auckland Transport (**AT**) (the “Riverhead Redhills Assessment Package”). This report assesses the ecological effects of the NoRs in the North West Riverhead and Redhills Assessment Packages including: Don Buck Road, Fred Taylor Drive and Coatesville-Riverhead Highway.

As the Redhills-Riverhead package relates to proposed designations, this EclA assesses District plan matters only. Regional matters (along with Wildlife Act (1953) compliance) will be subject to a future consenting phase along with a supporting EclA. As such regional matters have not been formally assessed in this report, however the relevant matters have been screened to inform the designation boundary and future regional resource consents.

In order to inform the ecological baseline, ecological features within each Notice of Requirement (NoR) boundary were identified, mapped and their value assessed in terms of representativeness, rarity/distinctiveness, diversity/pattern and ecological context. A summary of the ecological values are provided in: for terrestrial vegetation (Table 1-1), District plan trees¹ (Table 1-2), terrestrial fauna (Table 1-3), streams (Table 1-4) and wetlands (Table 1-5).

Table 1-1 Ecological values of terrestrial vegetation types for each NoR

Vegetation Type	Abbrev.	Don Buck Road	Fred Taylor Drive	Coatesville-Riverhead Hwy
Brown Field	BF	-	-	-
Exotic Grassland	EG	Negligible	Negligible	Low
Exotic Scrub	ES	-	Low	Low
Planted Vegetation – Native (recent)	PL.1	Moderate	-	-
Planted Vegetation – Native (mature)	PL.2	-	Moderate	-
Planted Vegetation – Exotic (amenity)	PL.3	Low	Low	Moderate
Treeland – Mixed Native/Exotic	TL.2	-	Moderate	-
Treeland – Exotic-Dominated	TL.3	Low	Moderate	Moderate

¹ Only district plan vegetation (trees >4m in high and or in open space) were included as it is NoR application.

Table 1-2 Ecological values of District Plan trees for each NoR

Vegetation Type	Don Buck Road	Fred Taylor Drive	Coatesville-Riverhead Hwy
District Plan trees ²	Moderate	Low	Moderate

Table 1-3 Ecological values of terrestrial fauna for each NoR

Fauna Type	Don Buck Road	Fred Taylor Drive	Coatesville-Riverhead Hwy
Bats	-	-	Very High
Birds (Non-TAR*)	Low	Low	Low
Birds (TAR)	Very High	-	High (At Risk – Declining) Very High (Threatened – Nationally Increasing)
Lizards	High	High	High

Notes: * TAR = Threatened and At Risk.

Table 1-4 Ecological values of streams for each NoR

Stream	Site	Don Buck Road	Fred Taylor Drive	Coatesville-Riverhead Hwy
Rush Creek	R1-S1	Moderate	-	-
Tributary-Rush Creek	R1-S2	Moderate	-	-
Tributary- Brigham Creek	R3-S1	-	-	Moderate
Tributary- Brigham Creek	R3-S2	-	-	Moderate
Tributary- Brigham Creek	R3-S3	-	-	Low
Tributary Rangitopuni Creek	R3-S4	-	-	Moderate
Tributary	R3-S5	-	-	High

² Terrestrial vegetation units most likely to be relevant to the provisions of the AUP:OP relate to the treeland unit as defined by Singers et al. (2017). Units conforming to this classification (within the existing road corridor) was subject to a value and effects assessment. In addition, any notable trees were identified and included in the assessment.

Table 1-5 Ecological values of wetlands for each NoR

Wetland	NPS-FM	Don Buck Road	Fred Taylor Drive	Coatesville-Riverhead Hwy
R1-W1	Artificial	Moderate	-	-
R3-W1	Natural	-	-	High

Construction Effects

Table 1-6 to Table 1-12 provides a summary of district matter ecological effects during construction prior to any mitigation. The summary represents the level of effect for the baseline and likely future ecological environment as one, as they were found to be the same in all instances³. Where the level of effect was assessed to be **Moderate** or higher, then mitigation has been developed. Construction effects mitigation measures will include:

- A Bat Management Plan (BMP) for Coatesville-Riverhead. Details of the BMP will depend on bat habitat within the future environment and is likely to include bat habitat surveys prior to construction, siting of compounds and laydown areas to avoid bat habitat, lighting design to reduce light levels and spill from construction areas and restriction of nightworks around treeland bat habitat.
- Bird management will be required for Don Buck (stormwater upgrade in Rush Creek Reserve) and Coatesville-Riverhead (in areas where construction is adjacent to open water and wetland). Considerations for bird management will include a bird survey prior to construction to confirm Threatened or At Risk (TAR) species are not present and to provide guidance if TAR species are present, including the avoidance of the bird breeding season (September to February) during construction.

Table 1-6 Summary of ecological effects during construction prior to mitigation for district plan trees

Construction - Terrestrial vegetation (district plan vegetation only)	
NoR	Permanent loss of habitat/ecosystem, fragmentation, and edge effects due to vegetation removal (district plan vegetation only)
Don Buck (R1)	Low
Fred Taylor (R2)	Very Low
Coatesville-Riverhead (R3)	Low

Table 1-7 Summary of ecological effects during construction prior to mitigation for bats

Construction - Bats			
NoR	Disturbance and displacement to roosts and individuals (existing) due to	Loss of foraging habitat due to removal of district plan vegetation	Mortality or injury to bats due to removal of district plan vegetation

³ The effects assessment considered the baseline and the likely future environment as the construction of the road will only occur more than 20 years in the future.

Construction - Bats			
	construction activities (noise, light, dust etc.)		
Coatesville-Riverhead (R3)	Moderate	Low	Moderate

Table 1-8 Summary of ecological effects during construction prior to mitigation for birds

Construction - Birds					
NoR	Disturbance and displacement to nests and individuals (existing) due to construction activities (noise, light, dust etc.) - non-TAR birds	Disturbance and displacement to nests and individuals (existing) due to construction activities (noise, light, dust etc.) – TAR birds	Loss of foraging habitat due to removal of district plan vegetation	Nest loss due to removal of district plan vegetation	Mortality or injury to birds due to removal of district plan vegetation
Don Buck (R1)	Very Low	Moderate	Low	Low	Low
Fred Taylor (R2)	Very Low	-	Very Low	Very Low	Very Low
Coatesville-Riverhead (R3)	Low	Moderate (Threatened), High (At Risk)	Low	Low	Low

Table 1-9 Summary of ecological effects during construction prior to mitigation for lizards

Construction – Lizards	
NoR	Disturbance and displacement of individuals (existing) adjacent to construction activities (noise, dust etc.)
Don Buck (R1)	Very Low
Fred Taylor (R2)	Very Low
Coatesville-Riverhead (R3)	Very Low

The residual (post-mitigation) level of effect for all construction effects are considered **Negligible** or **Low**.

Operational Effects

Table 1-10 to Table 1-12 provides a summary of district matter operational effects due to the presence of road resulting in disturbance or loss in connectivity to bats, birds and lizards. The summary represents the level of effect for the baseline and likely future ecological environment as

one, as they were found to be the same in all instances. Mitigation has been developed where the level of effect was assessed to be **Moderate** or higher.

Operational effects mitigation measures will include a BMP. The BMP will include buffer planting along road corridors associated with stream crossings⁴, lighting design along strategic location of the road (stream crossings) and retention of large, mature trees (specifically TL.3 stands) where practicable.

Table 1-10 Summary of ecological effects during operation prior to mitigation for bats

Operation - Bats		
NoR	Disturbance and displacement of (new and existing) roosts and individuals due to lighting and noise/vibration	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
Coatesville-Riverhead (R3)	Low	Moderate

Table 1-11 Summary of ecological effects during operation prior to mitigation for birds

Operation - Birds		
NoR	Disturbance and displacement to roosts and individual birds (existing) due to the presence of the road (noise, light, dust etc.)	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
Don Buck (R1)	Very Low (Non-TAR species) ⁵	Very Low (Non-TAR species) ⁶
Fred Taylor (R2)	Very Low	Very Low
Coatesville-Riverhead (R3)	Very Low (Non-TAR species), Low (TAR species)	Very Low (Non-TAR species), Low (TAR species)

Table 1-12 Summary of ecological effects during operation prior to mitigation for lizards

Operation - Lizards		
NoR	Disturbance and displacement of existing and future lizards due to light, noise and vibration effects from the presence of the road	Loss in connectivity due to permanent habitat loss, light and noise/vibration effects from the road, leading to fragmentation of terrestrial, wetland

⁴ The extent of buffer planting is not specifically defined in this report as the requirements may change in the future. For example, stream corridors may have no or immature buffer planting under present conditions that may change in the future. The requirement to provide buffer planting and/or retain trees (that already meet the function of buffer planting) is likely to include the area between the road embankment and the designation boundary to a minimum distance of 10 m on either side of stream crossings (noting that buffer planting can occur on the road embankments).

⁵ Effects on TAR species are considered less than negligible and therefore excluded from the effect's assessment.

⁶ Effects on TAR species are considered less than negligible and therefore excluded from the effect's assessment.

Operation - Lizards		
		and riparian habitat due to the presence of the infrastructure
Don Buck (R1)	Very Low	Very Low
Fred Taylor (R2)	Very Low	Very Low
Coatesville-Riverhead (R3)	Very Low	Very Low

The residual (post-mitigation) level of effect for operational effects are considered **Low** or **Very Low**.

2 Introduction

This Ecological assessment has been prepared for the North West Redhills and Riverhead Local Arterials Notices of Requirement (NoRs) for Auckland Transport (AT) (the “Redhills Riverhead Assessment Package”). The NoRs are to designate land for future strategic and local arterial transport corridors as part of Te Tupu Ngātahi Supporting Growth Programme (Te Tupu Ngātahi) to enable the construction, operation and maintenance of transport infrastructure in the North West area of Auckland.

This report assesses the Ecological effects of the North West Redhills Riverhead Assessment Package identified in **Error! Reference source not found.** and Table 2-1.

Refer to the main Assessment of Effects on the Environment (AEE) for a more detailed project description.

Table 2-1 North West Redhills Riverhead Assessment Package – Notices of Requirement and Projects

Notice	Project
NoR RE1	Don Buck Road FTN Upgrade
NoR RE2	Fred Taylor Drive FTN Upgrade (alteration to existing designation 1433)
NoR R1	Coatesville-Riverhead Highway Upgrade

2.1 Purpose and Scope of this Report

This assessment forms part of a suite of technical reports prepared to support the assessment of effects within the Redhills Riverhead Assessment Package. Its purpose is to inform the AEE that accompanies the Redhills Riverhead Assessment Package sought by Waka Kotahi and AT.

This report considers the actual and potential effects associated with the construction, operation and maintenance of the Redhills Riverhead Assessment Package on the existing and likely future environment as it relates to Ecological effects and recommends measures that may be implemented to avoid, remedy and/or mitigate these effects.

The key matters addressed in this report are as follows:

- Identify and describe the Ecological context/baseline of the Redhills Riverhead Assessment Package area;
- Identify and describe the actual and potential ecological effects of each Project corridor, resulting from activities which relate to district matters in the AUP:OP, within the Redhills Riverhead Assessment Package;
- Recommend measures as appropriate to avoid, remedy or mitigate actual and potential ecological effects (including any conditions/management plan required) for each Project corridor within the Redhills Riverhead Assessment Package; and
- Set out ecological considerations that will need to be considered and assessed as part of a future regional resource consent;

- e) Present an overall conclusion of the level of actual and potential Ecological effects for each Project corridor within the Redhills Riverhead Assessment Package after recommended measures are implemented.

2.2 Report Structure

The report is structured as follows:

- a) Overview of the methodology used to undertake the assessment and identification of the assessment criteria and any relevant standards or guidelines;
- b) Description of each Project corridor and project features within the Redhills Riverhead Assessment Package as it relates to ecology;
- c) A discussion on area wide positive effects;
- d) An area wide desktop assessment;
- e) Identification and description of the existing and likely future ecological environment for each NoR;
- f) Description of the actual and potential adverse ecological effects of construction and operation of each NoR as they relate to district plan matters, including recommended measures to avoid, remedy or mitigate potential adverse ecological effects; and
- g) Description of potential adverse ecological effects for consideration during resource consenting;
- h) Overall conclusion of the level of potential adverse ecological effects for each NoR after recommended measures are implemented.

This report should be read alongside the AEE, which contains further details on the history and context of the Project. The AEE also contains a detailed description of works to be authorised for the Project, likely staging and the typical construction methodologies that will be used to implement this work. These have been reviewed by the author of this report and have been considered as part of this assessment of Ecological effects. As such, they are not repeated here, unless a description of an activity is necessary to understand the potential effects, then it has been included in this report for clarity.

3 Assessment Methodology

3.1 EclA Assessment

The approach followed in this study is consistent with the approach outlined in the Ecological Impact Assessment (EclA) Guidelines (EIANZ, 2018). The overarching goal of the ecological assessment is to determine the ecological effects of specific Project features or activities. The requirements for such an assessment are outlined within the EIANZ Guidelines (EIANZ, 2018) and forms the basis of this report. This process is summarised in Figure 3-1 below. Note that for the impact management (Stage 3) additional consideration was also given to the likely future ecological environment (refer Section 3.2).

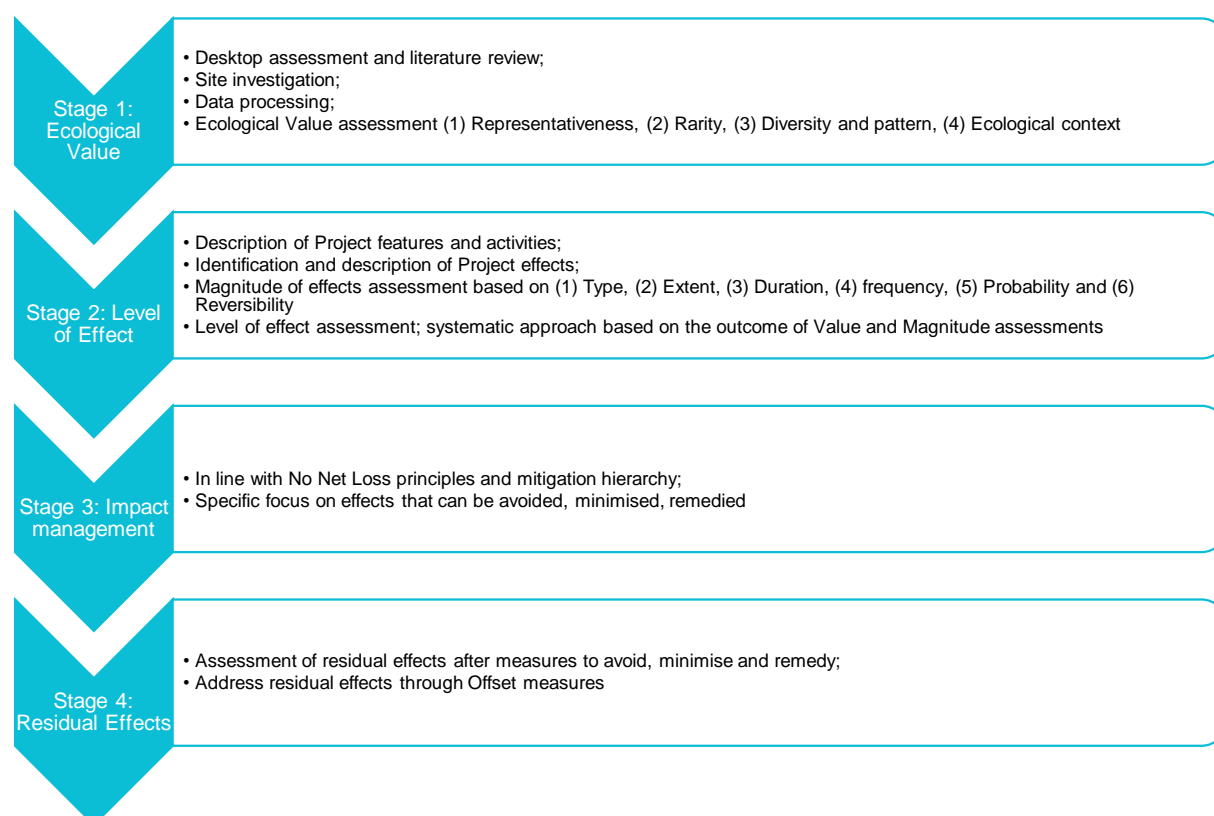


Figure 3-1: Approach process followed for this assessment

3.2 EclA and the Likely Future Ecological Environment

The EIANZ Guidelines provide guidance to assist with the assessment of the likely future ecological environment in this report. The assessment states:

“The ecologist needs to consider the permitted baseline in order to describe the potential “future ecological environment and to assess effects at that time, and should discuss this with the project planner or legal advisor if in any doubt”.

The NW Planning Team has advised of the following to inform the assessment of the likely future environment:

- The purpose of the NoRs within the Riverhead Redhills Assessment Package is to protect the transport corridors that will support the future urbanisation of Riverhead and Redhills. Construction and operation of the new and upgraded corridors will not occur until urbanization has at least been confirmed by way of a plan change or is under development. Guidance on the future urbanization can be taken from the Spatial Land Use Strategy – North West (2021);
- In addition, the AUP:OP permits activities for infrastructure, which will also change the likely future environment. These activities include vegetation clearance and the removal of trees, excluding notable trees and street trees, in Urban Zones and the Future Urban Zone (FUZ). The relevant permitted activities for ecology provisions are set out in Appendix 2;
- Given the planned urbanization of areas within Riverhead and Redhills, assessing the effects on the environment solely as it exists today (i.e. at the time of ecological site investigation / the preparation of this ecology assessment) will not provide an accurate reflection of the environment in which ecological effects, resulting from the construction and operation of each of the NoRs, will be experienced;
- The assessment of ecological effects should therefore take account of the likely future environment, which takes account of permitted activities for infrastructure and planned urbanisation within the FUZ.

A summary of the likely future environment is provided in the assessment section of each NoR (8.2, 9.2, and 10.2).

3.3 Assessment of District Plan Matters and Approach to Regional Matters

Designations are a form of 'spot zoning' over a route in a district plan. The designation authorises AT, as requiring authority, to undertake work and activity without the need for land use consent. The designated area is still subject to restrictions on land use under regional matters in the AUP:OP.

As the Redhills Riverhead Assessment Package relates to a proposed designation the ecological effects assessment assesses district plan matters only. Regional matters will be subject to a future consenting phase along with a supporting ecological impact assessment (EclA). As such regional matters have not been formally assessed in this report, however the relevant matters have been screened to inform the designation boundary and future regional resource consents and are presented in Sections 8.3.4, 9.3.4, and 10.3.4.

Appendix 3 sets out the split between District and Regional matters in the AUP:OP.

3.4 Wildlife Act Matters

The Wildlife Act (1953) includes specific provisions for activities that may disturb, injure or kill native animals. Construction and operational activities that may require consideration under the Wildlife Act are outlined in Appendix 3. The scope of this report pertains to District matters and although not required for District consents, further consideration has been given to ecological effects under the Wildlife Act in Sections 8.3.4, 9.3.4, and 10.3.4. Construction and operational activities that may require consideration under the Wildlife Act are outlined in Appendix 3.

4 Assessment Methodology

Desktop and site investigations were undertaken for ecological features within all three NoRs. Ecological features within the proposed designation boundary and a distance of approximately 100 m⁷ radius of the designation have been mapped and included onto this assessment. Vegetation, stream and wetland features were investigated and mapped to provide context for potential adjustments to the proposed designation boundary. In addition to the study area, potential habitat for native fauna was considered within the Zone of Influence (ZOI) (see Section 4.1).

4.1 Zone of Influence

The 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 native species. For example, all Significant Ecological Area’s (SEA’s) within 2 km of each Project Area has been included in the desktop review, along with their connectivity to each Project Area. This is to ensure that important habitat within the wider landscape has been taken into consideration and can be used to inform the potential for flora and fauna to be present within each of the Project Areas and also whether the Project ZOI extends out to these SEA’s.

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 Projects 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 each of the Project Areas, varying search distances were used depending on the species context.

4.2 Desktop Review

A desktop review of existing ecological records was undertaken to gain an understanding of the species and habitats that could be present within the ZOI of each of the three NoRs.

The sources of information that were reviewed to determine the likelihood of a species or habitat occurring within or adjacent to each of the NoRs include:

- Auckland Council Geomaps⁸;
- Department of Conservation (DOC) Bioweb records⁹;
- Department of Conservation Threat Classification Series¹⁰;
- Ecological Regions and Districts of New Zealand (McEwen, 1987);

⁷ The designation boundary has undergone several rounds of refinement. The ecological mapping was undertaken on the initial designation boundary and is considered sufficiently wide to provide a contingency for relatively small adjustment during refinement. The 100 m area mapping was included to provide additional context regarding the nature and extent of ecological features (including wetlands).

⁸ <https://geomapspublic.aucklandcouncil.govt.nz/viewer/index.html>

⁹ <https://www.doc.govt.nz/our-work/monitoring-reporting/request-monitoring-data/>

¹⁰ All Department of Conservation Threat Classification Documents are listed in the below webpage. When individual reports are referenced hereafter, they are referenced in-text and in Section 12. <https://www.doc.govt.nz/about-us/science-publications/conservation-publications/nz-threat-classification-system/>

- iNaturalist records¹¹ (research grade observations), records within approximately 5 km radius of the overall ZOI (including all NoRs);
- Indigenous terrestrial and wetland ecosystems of Auckland (Singers et al., 2017);
- National Institute of Water and Atmospheric Research (NIWA) freshwater fish database¹²;
- National Institute of Water and Atmospheric Research NZ River Maps¹³
- New Zealand Bird Atlas eBird database¹⁴; recorded within 10km² grid squares. Results from grid square AA66, positioned over the Redhills Riverhead area; and
- NZ River Name Lines (LINZ Data Service¹⁵)

4.3 Site Investigations

Site investigations were undertaken in order to:

- Prepare an ecological baseline of terrestrial, freshwater and wetland ecology;
- Inform the assessment of each of the NoRs against the relevant district matters (terrestrial ecology);
- Set out freshwater and wetland matters which may be considered as part of a future regional resource consent, or under relevant wildlife legislation;
- Inform the designation footprint.

4.3.1 Terrestrial Habitat

Site walkovers were undertaken between January 2022 and March 2022 to map and describe the habitats¹⁶ present within and adjacent to each of the three NoRs. 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 indigenous fauna, including birds, bats, and lizards.

The habitat assessment focused on areas of potentially significant value, such as habitat that was identified as a SEA, classified as forest habitat on Auckland Council's Geomaps – Ecosystems Current Extent (Singers et al., 2017) or appears to be wetland or forest habitat 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 NoRs.

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 grazing and foliar dieback. Vegetation surveys also included searches for any rare or threatened plant species previously recorded within the NoR boundaries.

Common plant names are predominantly used within this report. Maps showing the vegetation cover along the NoRs are provided in Appendix 5. Terrestrial ecological value assessment methodology is discussed in Section 4.4.

¹¹ <https://www.inaturalist.org/>

¹² <https://nzfdms.niwa.co.nz/search>

¹³ <https://shiny.niwa.co.nz/nzrivermaps/>

¹⁴ <https://ebird.org/atlasnz/home>

¹⁵ <https://data.linz.govt.nz/layer/103632-nz-river-name-lines-pilot/>

¹⁶ Ecosystem codes from Singers et al. (2017) were used.

4.3.2 Bat Surveys

A bat survey was undertaken for a wider study area (Appendix 11). Two bat monitors were located within 2 km of the Don Buck Road study area, three monitors were located within 2 km of the Fred Taylor Drive study area, and five bat monitors were located within 2 km of the Coatesville-Riverhead Highway study area. The bat monitors were deployed between November 2021 and January 2022. Monitoring data for 14 suitable days (weather conditions not constraining bat activity) were analysed and used for the report.

4.3.3 Freshwater Habitat

Where possible to access, streams within the three NoRs that had been identified on Auckland Council Geomaps ('Named Streams') were ground truthed and classified as permanent, intermittent or ephemeral, according to the stream definitions described by Storey and Wadhwa (2009). Any additional streams observed during site walkovers were also classified. Streams are mapped in Appendix 5.

Freshwater assessments were undertaken by ecologists on all streams identified on site. In addition to stream classifications the Rapid Habitat Assessment (RHA) protocol was implemented. The RHA provides a standardised protocol for making a quick, qualitative, site-based assessment of physical stream habitat conditions (Clapcott, 2015). Stream Ecological Valuation (SEV) assessments were not undertaken but are expected to be completed during the Resource consent phase. Macroinvertebrate and fish surveys were not undertaken as part of this assessment. However, NIWA fish records (Franklin et al., 2018) were used to inform potential ecological value of streams. Access was restricted at several locations and as such stream assessments were based solely on desktop information. Freshwater ecological value assessment methodology is discussed in Section 4.4.

4.3.4 Wetland Habitat

Potential wetland habitat areas were identified by experienced ecologists based on Auckland Council Geomaps contours and the presence of wetland vegetation on aerial maps (including a review of historical images). These areas were then ground truthed during the site investigation either through the application of the RHA where vegetation indicators were apparent or sample plots where vegetation was ambiguous. The wetland delineation followed the method outlined within the wetland delineation guidelines (Clarkson, 2018), noting limitations in terms of access and scope discussed in more detail below. Areas conforming with the delineation guidelines were mapped and described in terms of vegetation cover, soil and hydrology. Instances where wetland delineation relied on desktop assessment, due to access constraints, were noted and a more conservative delineation was adopted. Ambiguous areas were assumed to be wetlands, where these areas were not accessible. It is important to note that the scope of the specialist study, for route protection, did not provide for a detailed wetland delineation (i.e. mapping accuracy of <1:10 000). The key focus was to confirm wetland presence and approximate extent. This approach is considered practical for the purposes of route protection, while it is expected that a more detailed wetland assessment will be undertaken during the resource consenting phase.

Wetlands were assessed based on the RMA definition of a wetland¹⁷ and classified into ecosystem type based on those described in Singers et al. (2017). If the habitat present met this definition, it was then further evaluated against the provisions of the NPS-FM for natural wetlands (assessed for

¹⁷ "wetland includes 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"

potential exclusion on the basis of being artificial or pasture dominated and temporary rain derived ponding). Details regarding the wetland value assessment is outlined in Section 4.4.

4.4 Ecological Value Assessment

The ecological value of ecological features were 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. Considerations in relation to the four matters and corresponding aspects for terrestrial, freshwater and wetland features are detailed below:

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:** 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 determined in accordance with the EclA guidelines (EIANZ, 2018) and was recorded within a matrix spreadsheet for use within the ecological impact assessment (refer Appendix 9).

5 Redhills Riverhead Assessment Package Overview

A brief summary of the Redhills Riverhead Assessment Package projects is provided in

Table 5-1.

Readers should refer to the AEE for further information on these projects, including a project description, key project features and the planning context.

Table 5-1 Redhills Riverhead Assessment Package Project Summary

Corridor	NoR	Description	Requiring Authority
Don Buck Road FTN Upgrade	RE1	Upgrade of Don Buck Road corridor to a 30m wide four-lane cross-section providing bus priority lanes and separated active mode facilities on both sides of the corridor.	Auckland Transport
Fred Taylor Drive FTN Upgrade	RE2	Upgrade of Fred Taylor Drive corridor to a 30m wide four-lane cross-section providing bus priority lanes and separated active mode facilities on both sides of the corridor.	Auckland Transport
Coatesville-Riverhead Highway Upgrade	R1	Upgrading the southern section of the corridor to a 33m two-lane low speed rural arterial cross-section with active mode facilities on the western side; and Upgrading the northern section of the corridor to a 24m two-lane urban arterial cross-section with active mode facilities on both sides of the corridor.	Auckland Transport

Please refer to the AEE for further information on these projects, including a project description, key project features and the planning context.

6 Area Wide Ecological Desktop Review

This section presents the findings of an area wide desktop study. The study identifies all the habitats and species ('ecological features') present within the ZOI of each of the NoRs.

NoR specific ecological baselines have also been set out in Sections 8.2.2, 9.2.2, and 10.2.2.

6.1 Historical Ecological Context

The designations lie within the Tamaki Ecological District, which has a warm humid climate and is characterised by volcanic cones, isthmus, harbours and volcanic terrain (McEwen, 1987). Originally forested, the landscape would have been dominated by northern North Island lowland broadleaved forest with abundant taraire (*Beilschmiedia tarairi*) and puriri (*Vitex lucens*) (Singers, 2017). Now, only 7% of the native land cover; and 1% of freshwater wetlands and wetland forests remain in the Tamaki Ecological District (Auckland Regional Council, 2013). For context, a reduction to around 20% of former extent is usually considered to be significant. Reduction to below 5% is considered to be severe (Walker et al., 2008). The reductions in the Tamaki Ecological District are well below these levels.

6.2 Terrestrial Habitat and Fauna

6.2.1 Terrestrial vegetation

Where natural habitat remains, the AUP:OP has mapped and classified habitats as terrestrial or marine SEAs. SEAs which occur within 2 km of the Project Area, are presented and described in Table 6-1. A distance of 2 km was selected as potential ZOI for adverse effects of the Project given the potential receiving environment and the habitats and species present with a SEA.

Table 6-1 Significant Ecological Areas present within 2 km of the Project Area

SEA	Relevant NoR	Distance from Relevant NoR (km)	SEA Type Terrestrial/ Marine	SEA Description
SEA_T_2041	NoR RE1	0.7 km	Terrestrial	Terrestrial riparian habitat, with presence of threatened species <i>Galaxias maculatus</i> (īnanga).
SEA_T_2040	NoR RE1	0.8 km	Terrestrial	Terrestrial riparian habitat supporting a migration pathway
SEA_T_4866	NoR RE1	0.9 km	Terrestrial	Terrestrial riparian habitat supporting a migration pathway
SEA_T_2042	NoR RE1	1.0 km	Terrestrial	Terrestrial riparian habitat, with presence of threatened species <i>Galaxias maculatus</i> (īnanga).
SEA_T_2031	NoR RE1	1.1 km	Terrestrial	Terrestrial area of mānuka, kānuka scrub
SEA_T_2043	NoR RE1	1.1 km	Terrestrial	Terrestrial riparian habitat, with presence of threatened species <i>Galaxias maculatus</i> (īnanga) and threatened <i>Marattia salicina</i> (King fern).

SEA	Relevant NoR	Distance from Relevant NoR (km)	SEA Type Terrestrial/ Marine	SEA Description
SEA_T_4661	NoR RE1	1.5 km	Terrestrial	<i>Anguilla dieffenbachii</i> , <i>gobiomorphus huttoni</i> , <i>naultinus elegans</i> . Buffers an SEA
SEA_T_2034	NoR RE2	0.6 km	Terrestrial	Terrestrial riparian habitat supporting a migration pathway for threatened species <i>Galaxias maculatus</i> (Inanga).
SEA_M2_57B	NoR RE2, NoR R1	1.1 km, 0.7km	Marine	This area covers the inner Waitematā Harbour, and it contains various mudflats and mangrove-lined inlets and creeks, with a natural succession between terrestrial, freshwater and marine habitats. These habitats are an important migration corridor for indigenous freshwater fish and for coastal fringe bird species.
SEA_T_6359	NoR R1	0.3 km	Terrestrial	Area of diverse habitat, including broadleaved species scrub forest and mangrove forest and scrub.
SEA_T_6540	NoR R1	1.4 km	Terrestrial	Terrestrial habitat bordering a river, which is used as a migration pathway for species. Rare species <i>Loxosoma cunninghamii</i> (endemic terrestrial fern) present within the SEA.

6.2.2 Bats

The Department of Conservation (DOC) and SGA desktop records confirm the presence of long-tailed bats (*Chalinolobus tuberculatus*) within a 10 km radius of the three NoRs. The conservation status of this species is 'Nationally Critical' (O'Donnell et al., 2017). There are DOC records of bats within 5 km to the southwest of the Project Area, near Redhills; and approximately 2 km to the north of the Project Area in the Riverhead Forest (Figure 6-1). Previous SGA bat studies have recorded bats within 2 km to the west of Don Buck Road and southwest of Fred Taylor Drive.

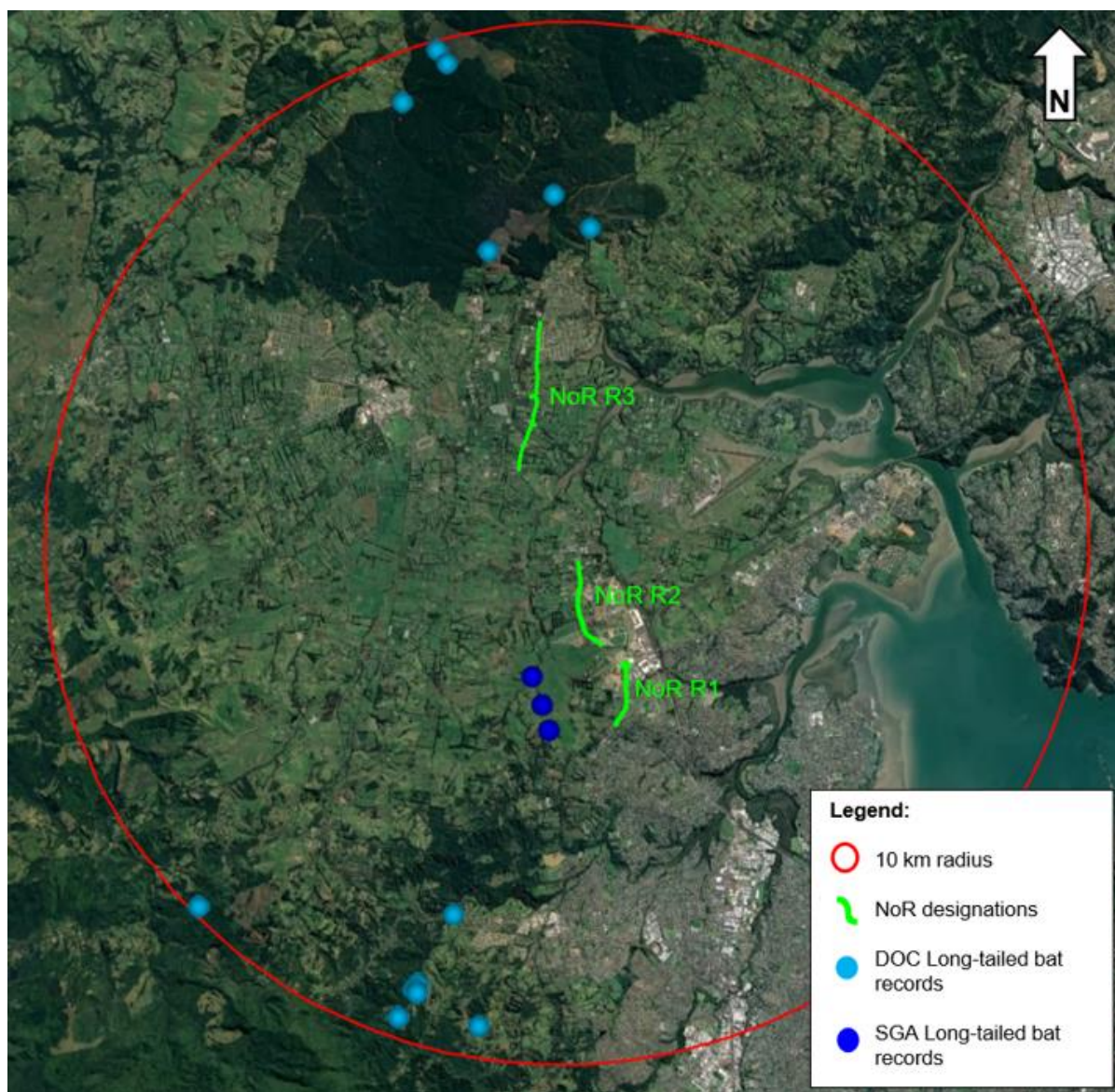


Figure 6-1 DOC and SGA historical long-tailed bat records within 10 km radius of NoR RE1, R2 and R3

6.2.3 Birds

The area wide desktop review identified 53 forest, freshwater, and coastal bird species (44 of which are indigenous) within a 5 km radius of the three NoRs. The full species list can be found in Appendix 2. This included 14 indigenous bird species which are listed as 'At Risk' or 'Threatened' (Robertson et al., 2021) (Table 6-2). The majority of these indigenous bird species are associated with coastal and marine habitats which are located < 2 km from the NoRs, while spotless crane (At Risk – Declining) and dabchick (Threatened – Nationally Vulnerable) may utilise wetland and stormwater ponds at locations within the three NoRs.

Table 6-2 Desktop study At-Risk and Threatened bird species records and their conservation status

Common Name	Māori Name	Scientific Name	Conservation Status (Robertson et al., 2021)
Black shag	Kawau	<i>Phalacrocorax carbo novaehollandiae</i>	At Risk - Naturally Uncommon

Common Name	Māori Name	Scientific Name	Conservation Status (Robertson et al., 2021)
Black-billed gull	Tarāpuka	<i>Larus bulleri</i>	Threatened - Nationally Critical
Caspian tern	Taranui	<i>Hydroprogne caspia</i>	Threatened - Nationally Vulnerable
Cook's petrel	Tītī	<i>Pterodroma cookii</i>	At Risk - Relict
Dabchick	Waiwea	<i>Poliiocephalus rufopectus</i>	Threatened – Nationally Vulnerable
Grey duck	Pāpera	<i>Anas superciliosa</i>	Threatened - Nationally Critical
Little black shag	Kawau tūī	<i>Phalacrocorax sulcirostris</i>	At Risk - Naturally Uncommon
Northern New Zealand Dotterel	Tūturiwhatu	<i>Charadrius obscurus aquilonius</i>	At Risk - Recovering
Pied shag	Kāruhiruhi	<i>Phalacrocorax varius varius</i>	At Risk - Recovering
Red-billed gull	Tarāpunga	<i>Larus novaehollandiae scopulinus</i>	At Risk - Declining
Royal Spoonbill	Kōtuku ngutupapa	<i>Platalea regia</i>	At Risk - Naturally Uncommon
South Island pied oystercatcher	Tōrea	<i>Haematopus finschi</i>	At Risk - Declining
Variable oystercatcher	Tōrea pango	<i>Haematopus unicolor</i>	At Risk - Recovering
White-fronted tern	Tara	<i>Sterna striata striata</i>	At Risk - Declining
Wrybill	Ngutuparore	<i>Anarhynchus frontalis</i>	Threatened - Nationally Vulnerable

6.2.4 Herpetofauna

A review of the DOC Bioweb database found six indigenous lizard records within a 10 km radius of the Project Area (Table 6-3). No records were found within the Project Area; however, this is likely to indicate that lizard surveys have not been completed in the local area, rather than lizards are not present. Five of the six indigenous lizard species identified in the DOC Bioweb search have a threat status of 'At Risk' (Hitchmough et al., 2021).

The At-Risk Declining copper skink is however widespread and frequently recorded within highly modified habitats such as exotic scrub and rank grassland. The closest record is less than 2 km from the Project Area (NoR R1). It is therefore highly likely to occur within and adjacent to the Project Area.

Table 6-3 Indigenous lizard species records within 10 km of the Project Area

Common Name	Scientific Name	Conservation Status (Hitchmough et al., 2021)
Auckland green gecko	<i>Naultinus elegans</i>	At Risk - Declining

Common Name	Scientific Name	Conservation Status (Hitchmough et al., 2021)
Forest gecko	<i>Mokopirirakau granulatus</i>	At Risk - Declining
Pacific gecko	<i>Dactylocnemis pacificus</i>	Not Threatened - Taxonomically indeterminate
Copper skink	<i>Oligosoma aeneum</i>	At Risk - Declining
Moko skink	<i>Oligosoma moco</i>	At Risk - Relict
Ornate skink	<i>Oligosoma ornatum</i>	At Risk - Declining

6.3 Freshwater Habitat and Fauna

A desktop review of existing ecological records was undertaken to gain an understanding of the freshwater habitat and fauna that could be present within the ZOI of each of the Projects.

6.3.1 Streams

The NIWA NZ River Maps site was used to identify any streams or rivers that may be crossed by any of the NoRs. The Don Buck NoR includes a stormwater pond on Rusk Creek. The Fred Taylor NoR will not cross, or directly impact any streams, while the Coatesville-Riverhead NoR will cross five unnamed tributary streams, which flow southeast into Brigham Creek inlet and Rangitopuni inlet (Table 6-4).

Table 6-4 Desktop assessment of streams that will be crossed Project wide (LINZ Database)

Relevant NoR	Stream Name
Don Buck	Rush Creek
Coatesville-Riverhead	Brigham creek inlet tributaries
	Rangitopuni inlet tributary

6.3.2 Fish

The NIWA freshwater fish database was reviewed for fish records within stream catchments affected by the Projects. Of the fish recorded, two species are īnanga (*Galaxias maculatus*) and longfin eel (*Anguilla australis*) are classed as 'At Risk – Declining' (Dunn et al., 2017). The desktop review results are presented in Table 6-5.

Table 6-5 Freshwater fish species recorded within the catchments affected by the Project

Common Name	Scientific Name	Conservation Status (Dunn et al., 2017)	Relevant NoR		
			RE1	RE2	R1
Banded kokopu	<i>Galaxias fasciatus</i>	Not Threatened	X	X	

Common Name	Scientific Name	Conservation Status (Dunn et al., 2017)	Relevant NoR		
			RE1	RE2	R1
Common bully	<i>Gobiomorphus cotidianus</i>	Not Threatened	X		
Crans bully	<i>Gobiomorphus basalis</i>	Not Threatened	X		
Grass carp	<i>Ctenopharyngodon idella</i>	Introduced and Naturalised			X
Īnanga	<i>Galaxias maculatus</i>	At Risk - Declining	X		
Koura	<i>Paranephrops</i>	NA	X		
Longfin eel	<i>Anguilla dieffenbachii</i>	At Risk - Declining	X	X	
Rudd	<i>Scardinius erythrophthalmus</i>	Introduced and Naturalised	X		
Shortfin eel	<i>Anguilla australis</i>	Not Threatened	X	X	
Unidentified eel	<i>Anguilla</i>	NA	X	X	X

7 Riverhead Redhills Positive Effects

The following section outlined the positive effects of the proposed alignment for each NoR in relation to specific ecological features. The statement regarding positive effects assumes that native planting will occur on the roadsides as part of the landscape management.

There is the potential for positive effects which apply to each of the NoRs. These are:

- The ability for future landscape planting within each NoR to tie into stream and riparian corridors. Most notably for the Coatesville-Riverhead NoR and its associated streams.
- All existing culverts in the Coatesville-Riverhead Highway NoR will be upgraded as part of the implementation of the Project, this upgrade will give consideration to the provisions of the NES-FM. The existing culverts are located at streams R3-S2 (located between 1352 and 1335 Coatesville-Riverhead Highway), R3-S3 (located between 1302 and 1295 Coatesville-Riverhead Highway), and R3-S5 (located between 1210 and 1229 Coatesville-Riverhead Highway).
- Net increase in green infrastructure and associated habitats within each of the NoRs. The net increases are associated with street trees, berm and stormwater plantings and planted stormwater wetlands.

8 NoR RE1: Don Buck Road FTN Upgrade

8.1 Project Corridor Features

The Don Buck Road corridor features a north-south alignment, running on a watershed between the Totara Creek catchment (to the east) and Ngongetepara Creek catchment (to the west). This corridor does not cross any watercourses or transect any area of native vegetation, with the exception of native plantings associated with Rush Creek and an existing stormwater pond on the same stream.

8.2 Existing and Likely Future Environment

8.2.1 Planning Context

The land adjacent to Don Buck Road is comprised of various business, residential and open space zoning. The following outlines the key elements of the planning context for the Don Buck Road FTN Upgrade:

- The eastern side of Don Buck Road above Westgate Drive is zoned under the AUP:OP as Business – Light Industry. To the south of Westgate Drive, the eastern side of Don Buck Road contains an Open Space – Community Zone (occupied by Massey Leisure Centre), with the remaining land zoned as Residential – Mixed Housing Urban Zone;
- The western side of Don Buck Road is within the I610 Redhills Precinct and is predominantly zoned Residential – Mixed Housing Urban, with a portion of land in the northern section of the corridor zoned Residential – Terraced Housing and Apartment Buildings Zone (**THAB**). Land further to the west of Don Buck Road forms part of the Redhills Precinct;

Table 8-1 below provides a summary of the existing and likely future environment as it relates to the Don Buck Road FTN Upgrade.

Table 8-1 Don Buck Road FTN Upgrade Existing and Likely Future Environment

Environment today	Zoning	Likelihood of Change for the environment ¹⁸	Likely Future Environment ¹⁹	Implications of Future Environment on Ecological Features
Business	Business (Industrial)	Low	Business	N/A
Residential	Residential – Mixed Housing Urban Zone Residential – Terraced Housing and Apartment Zone	Low	Residential	N/A

¹⁸ Based on AUP:OP zoning/policy direction

¹⁹ Based on AUP:OP zoning/policy direction

Environment today	Zoning	Likelihood of Change for the environment ¹⁸	Likely Future Environment ¹⁹	Implications of Future Environment on Ecological Features
Open Space	Open Space – Community Zone and Informal Recreation Zone	Low	Open Space	N/A

8.2.2 Ecological Baseline

This section presents the findings of the site and desktop investigations in relation to the terrestrial, freshwater, and wetland habitats and associated fauna species ('ecological features') currently present within the proposed Don Buck NoR.

All features within both study areas were investigated and mapped to provide context for the effects assessment and inform potential adjustments to the proposed designation boundary (Appendix 5). Based on this information, and desktop assessments, an ecological value has been calculated for each ecological feature within this NoR.

8.2.2.1 Terrestrial Habitat

Table 8-2 summarises the vegetation types and their classification (Singers et al., 2017) associated with the Don Buck NoR. Maps are presented in Appendix 5. The study area for the Don Buck NoR is dominated by brown field and exotic grasses.

Table 8-2 Vegetation types present within NoR RE1, categorised according to Singers et al. (2017)

Vegetation Type	Abbreviation	Habitat Description
Brown Field (includes cropland)	BF	This definition includes industrial hard standing concrete and unmanaged bare ground. For the purposes of mapping this has been extended to include bare ground associated with cropland, market gardens and construction sites. Consists of small areas patches of rural homesteads.
Exotic Grassland	EG	Grassland dominated by exotic species. This includes pasture and gardens.
Planted Vegetation – Native (recent)	PL.1	Native restoration plantings with <50% exotic biomass. Recently planted native scrub and forest <20 years old. PL.1 is associated with stream bank planting of Rush Creek.
Planted Vegetation – Exotic (amenity)	PL.3	Exotic amenity plantings. This includes parks and gardens and roadside vegetation dominated by exotic species.
Treeland – Exotic-Dominated	TL.3	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.

8.2.2.2 Terrestrial Fauna

Bats

Area wide bat surveys have been undertaken and include the Don Buck NoR. The results of the bat survey are detailed Appendix 11. Long-tailed bats (pekapeka) were detected within 2 km southwest and 1.5 km northwest of the NoR. However, the terrestrial habitat associated with the Don Buck NoR is considered to be of negligible value to bats and the project is occurring with an existing fragmented landscape. As such bats are not further considered for this NoR.

Birds

No dedicated bird surveys were undertaken for the Project. Incidental observations of bird species were noted, and the following birds were seen or heard throughout the NoR (Table 8-3). No TAR species were observed during site investigations, however dabchick may use the open water habitat present in the NoR. The most commonly noted birds were introduced species including blackbirds, mynas, and sparrows. Based on habitat, the stormwater pond associated with Rush Creek may provide potential habitat for dabchick (Threatened – Nationally Recovering).

Table 8-3 Incidental bird observations at the Don Buck NoR and conservation status

Common Name	Māori Name	Scientific Name	Conservation Status (Robertson et al., 2021)
Blackbird	Manu pango	<i>Turdus merula</i>	Introduced and Naturalised
House sparrow	Tiu	<i>Fringilla coelebs</i>	Introduced and Naturalised
Mallard	-	<i>Anas platyrhynchos</i>	Introduced and Naturalised
Myna	-	<i>Acridotheres tristis</i>	Introduced and Naturalised

Lizards

Indigenous lizards were not identified during opportunistic searches completed during the site walkover. Copper skink have been recorded within 3 km of the NoR. Copper skink is likely to be associated with all of the vegetation units presented in Table 8-2, where there is appropriate understorey.

8.2.2.3 Terrestrial Ecological Value

Appendix 6.1 presents the terrestrial vegetation observed within the NoR and their ecological value in accordance with the EclA Guidelines (EIANZ, 2018). Information obtained for the ecological baseline (Sections 8.2.2.1 and 8.2.2.2), as well as the area wide desktop assessment (Section 6), was used to score the matters that inform the ecological value. The ecological value of habitats ranged from **Negligible** (e.g., EG) to **Moderate** (e.g., TL.3 (District Plan))²⁰.

²⁰ The ecological value of brown fields was considered less than negligible and therefore was not assessed.

Notwithstanding the combined ecological value associated with vegetation/habitat units, specific consideration still needs to be given to individual species and their conservation significance for the following reasons (in accordance with EclA Guidelines):

- The habitat value may dilute the conservation value associated with specific species. For example, the combined value for exotic grassland is **Low**, while the value for copper skink (At Risk - Declining) is **High**. The combined value of **Low** therefore understates the conservation value of the species;
- Species may not be restricted to a single vegetation unit;
- Potential effects on species are unrelated to habitat units. For example, impact on highly mobile species (such as bats) by noise and light may be independent of the habitat loss associated with the Project footprint.

For the reasons outlined above, the ecological value assessments for individual species are considered to range from **High** to **Very High** (Table 8-4).

Table 8-4 Ecological value for terrestrial fauna (TAR species only)

Fauna type	Species within habitat	Habitat description	Conservation Status	Ecological Value
TAR Birds	Dabchick	OW	Threatened – Nationally Increasing	Very High
Herpetofauna – lizards	Copper skink	EG, PL.1, PL.3 and TL.3	At Risk - Declining	High

8.2.2.4 Freshwater Habitat

All potential streams within NoR RE1 were mapped (Appendix 5) and classified as either permanent or intermittent. Permanent or intermittent streams that were within the designation boundary were numbered and assessed.

Two stream branches were identified during the area wide desktop assessment (Section 6) and site investigations, R1-S1 and R1-S2. R1-S1 was classified as permanent as there was evidence of continuous flow, and R1-S2 was classified as intermittent as three of more of the intermittent stream criteria were met (Storey & Wadwha, 2009).

8.2.2.5 Freshwater Fauna

Fish surveys were not carried out during site investigations, however 'At Risk – Declining' species īnanga and longfin eel have been recorded within 2 km of the designation as part of the desktop review (Table 6-5).

8.2.2.6 Freshwater Ecological Value

Appendix 7 presents the ecological value for the freshwater habitats identified within the Don Buck NoR. Information obtained for the ecological baseline (Section 8.2.2.4 and 8.2.2.5) as well as the desktop assessment (Section 6), was used to score the matters that inform the ecological value. The ecological values of freshwater habitats are:

- R1-S1: Moderate

- R1-S2: Moderate

8.2.2.7 Wetland Habitat

The Don Buck NoR does not cross, or directly impact, any natural wetland habitat. However, an artificial wetland (existing stormwater pond on Rush Creek) is present off Westgate Drive (R1-W1).

8.2.2.8 Wetland Ecological Value

Appendix 7.2 presents the ecological value for the artificial wetland identified within the Don Buck NoR. The ecological value associated with the stormwater pond (artificial wetland), (R1-W1) is assessed as **Moderate**. The relatively high value associated with the feature relate to potential habitat for TAR species (dabchick) and important functional values such as flood attenuation, sediment trapping and water purification.

8.3 Assessment of Ecological Effects and Measures to Avoid, Remedy or Mitigate Actual or Potential Adverse Effects

Section 8.3 assesses the ecological effects of activities which relate to district plan matters under the AUP:OP. Refer to Section 3.3 for a discussion regarding the assumptions made for the effects assessment as it relates to permitted activities and likely future environment.

8.3.1 Construction Effects – Terrestrial Ecology

The potential construction effects (direct and indirect) to the terrestrial habitat and species within and adjacent to the Don Buck NoR (as they relate to district matters) have been identified:

- Vegetation removal subject to district controls (Appendix 5).
- Disturbance and displacement to roosts/nests and individual (existing) birds and lizards due to construction activities (noise, light, dust etc.). It is assumed that this effect will occur after vegetation clearance (subject to regional consent controls) has been implemented and is therefore likely to happen in habitats adjacent to the project footprint/designation or underneath structures such as bridges.

The following sections detail the magnitude of effect and subsequent level of effect on ecological features (further detail regarding how these were determined are provided in Appendix 1). Impact management and residual effects are also presented where the level of effect is assessed to be **Moderate** or higher.

8.3.1.1 Terrestrial Vegetation

Terrestrial vegetation to be removed that is subject to district controls is detailed in the table below. It includes native planted vegetation (PL.1) in open space (informal recreational zone) associated with Rush Creek south of Westgate Drive. The effects of district plan vegetation removal on birds (as it relates to loss in foraging habitat, and mortality and injury) is assessed in Section 8.3.1.2.

Table 8-5 Don Buck NoR: Assessment of ecological effects for terrestrial vegetation (district plan trees only) and impact management during construction

Effect Description	Permanent loss of habitat/ecosystem, fragmentation, and edge effects due to vegetation removal (district plan trees only)	
	Baseline	Likely Future Ecological Environment
Level of effect prior to impact management	<p><u>PL.1 (Open Space) (total area of 4,000 m²)</u></p> <p>The magnitude of effect is assessed as Low due to the relatively low likelihood that edge effect and additional fragmentation will occur.</p> <p>The ecological value of PL.1 is assessed to be Moderate, and the overall level of effect is assessed as Low prior to mitigation. As such no impact management is required.</p>	Same as the Baseline.
Impact management and residual level of effect	N/A	N/A
Management of residual effect	N/A	N/A

8.3.1.2 Birds

Noise, vibration and lighting disturbance caused by construction activities could potentially displace native birds from suitable nesting and foraging habitat adjacent to the Don Buck NoR. Additionally, birds may be impacted by removal of district plan vegetation through the following effects:

- Loss of foraging habitat
- Nest loss
- Mortality or injury to birds

Table 8-6 outlines the effect assessment for birds due to construction activities related to noise and light, and removal of district plan vegetation.

Table 8-6 Assessment of ecological effects for birds and impact management during construction for the Don Buck NoR

Effect Description	Disturbance and displacement to roosts and individual birds (existing) adjacent to construction activities (noise, light, dust etc.)		Effects due to removal of district plan vegetation:	
	Baseline	Likely Future Ecological Environment	Baseline	Likely Future Ecological Environment
Level of effect prior to impact management	<p><u>Non-TAR birds</u></p> <p>The magnitude of effect is assessed as Low local extent and the short duration of the effect.</p> <p>The ecological value of birds in the context of habitat features are assessed to be Low, and the overall level of effect due to construction disturbance is assessed as Very Low prior to mitigation. As such no impact management is required.</p> <p><u>TAR birds (dabchick)</u></p> <p>The magnitude of effect is assessed as Low due to the local extent and the short duration of the effect (assuming presence).</p> <p>The ecological value of these species is Very High, and the overall level of effect is assessed as Moderate prior to mitigation. As such impact management is required.</p>	Same as Baseline.	<p><u>Non-TAR birds</u></p> <p>The magnitude of effect is assessed as Low for all three effects associated with district plan tree removal.</p> <p>The ecological value of birds is assessed as Low, and the overall level of effect due district plan vegetation removal is assessed as Low prior to mitigation.</p> <p><u>TAR bird (dabchick)</u></p> <p>Will not be affected by district plan vegetation removal.</p>	Same as Baseline.

Effect Description	Disturbance and displacement to roosts and individual birds (existing) adjacent to construction activities (noise, light, dust etc.)		Effects due to removal of district plan vegetation:	
	Baseline	Likely Future Ecological Environment	Baseline	Likely Future Ecological Environment
Impact management and residual level of effect	<p>Impact management is required for dabchick.</p> <p>The Bird Management Plan should consider the following:</p> <ul style="list-style-type: none"> • Preconstruction surveys to confirm presence and guide further management • Where practical, construction works near wetland habitat (the stormwater pond) should commence prior to the bird breeding season (September to February) on order to discourage bird nesting. • Bird management should be consistent with any regional consent conditions that may be required for regional compliance. <p>The residual impact is assessed as Low post mitigation.</p>	Same as Baseline.	<p>Impact management will be required under the Wildlife Act to prevent killing or injuring of birds. As part of this management, timing of vegetation removal should be constraint, or pre-clearance inspections should be undertaken prior to vegetation removal.</p>	Same as Baseline.
Management of residual effect	N/A	N/A	N/A	N/A

8.3.1.3 Lizards

Construction effects on lizards associated with noise, light and vibration are presented in Table 8-7. Construction activity relates to the upgrade of an existing road and as such lizards are likely to be habituated to noise and vibration from the existing road. It is expected that the effects on lizards due to vegetation removal will be assessed under Regional matters and is further discussed in Section 8.3.4.3.

Table 8-7 Assessment of ecological effects for lizards and impact management during construction for the Don Buck NoR

Effect Description	Disturbance and displacement of individuals (existing) adjacent to construction activities (noise, dust etc.)	
	Baseline	Likely Future Ecological Environment
Level of effect prior to impact management	The magnitude of effect is assessed as Negligible due to the infrequent but likely probability of lizard disturbance. The ecological value of copper skink and ornate skink is assessed as High , and the overall level of effect due to construction disturbance is assessed as Very Low prior to mitigation. As such no impact management is required.	Same as Baseline.
Impact management and residual level of effect	N/A	N/A
Management of residual effect	N/A	N/A

8.3.2 Operational Effects – Terrestrial Ecology

The Project involves upgrading an existing road, therefore it is unlikely that operational effects such as fragmentation and noise and lighting will increase from the current baseline. In general, potential operational effects from the Project that relate to district plan matters are summarised below.

- Loss in connectivity to indigenous fauna (e.g. birds, herpetofauna) due to light, noise and vibration effects from the operation of the road, leading to fragmentation of habitat; and
- Disturbance and displacement of indigenous fauna and their nests/roosts (e.g., bats, birds, herpetofauna) due to light, noise and vibration effects from the operation of the road.

The following sections detail the magnitude of effect and subsequent level of effect on ecological features (further detail regarding how these were determined are provided in Appendix 1). Impact management and residual effects are also presented where the level of effect is assessed to be **Moderate** or higher.

8.3.2.1 Birds

Noise, vibration and lighting disturbance caused by the presence of the road could potentially displace native birds from suitable nesting and foraging habitat within and adjacent to the Don Buck NoR, while noise, light and vibration may also affect connectivity in the broader landscape. The stormwater pond (R1-W1) will be upgraded and reinstated after construction and therefore no operational effects are expected for TAR birds that may use the stormwater pond. Table 8-8 outlines the operational effect assessment and impact management for birds.

Table 8-8 Assessment of ecological effects for birds and impact management during operation for the Don Buck NoR

Effect Description	Disturbance and displacement to roosts and individual birds (existing) due to the presence of the road (noise, light, dust etc.)		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	
	Baseline	Likely Future Ecological Environment	Baseline	Likely Future Ecological Environment
Level of effect prior to impact management	<p><u>Non-TAR birds</u></p> <p>The magnitude of effect is assessed as Low as the Don Buck NoR is along an existing road and birds are likely to be habituated to noise, light and vibration from the road.</p> <p>The ecological value of birds in the context of habitat features are assessed to be Low, and the overall level of effect due to operational disturbance is assessed as Very Low prior to mitigation. As such no impact management is required.</p> <p><u>TAR birds (dabchick)</u></p> <p>No effect during operation.</p>	Same as Baseline.	<p><u>Non-TAR birds</u></p> <p>The magnitude of effect is assessed as Low as the Don Buck NoR is along an existing road.</p> <p>The ecological value of birds in the context of habitat features are assessed to be Low, and the overall level of effect is assessed as Very Low prior to mitigation. As such no impact management is required.</p> <p><u>TAR birds (dabchick)</u></p> <p>No effect during operation.</p>	Same as Baseline.
Impact management and residual level of effect	N/A	N/A	N/A	N/A
Management of residual effect	N/A	N/A	N/A	N/A

8.3.2.2 Lizards

Suitable habitat (EG, PL.1, PL.3 and TL.3) was identified within the NoR boundary which could potentially support native lizards. Native lizards require vegetated corridors to facilitate natural dispersal, although they are considered to be relatively resident species and do not require migration or large-scale movement to support reproduction, refuge and feeding.

The Don Buck NoR includes upgrading the existing roads, therefore it is not expected to result in the additional fragmentation of lizard habitat. Similarly, resident (existing and future) lizards are likely to be habituated to disturbance such as noise, vibration and lighting and no additional effect on lizards is expected, provided that the post-upgraded road will not result in higher levels of noise and vibration. Table 8-9 outlines the operational effect assessment and impact management for lizards.

Table 8-9 Assessment of ecological effects for lizards and impact management during operation for Don Buck NoR

Effect Description	Disturbance and displacement of existing and future lizards due to light, noise and vibration effects from the presence of the road		Further decrease in dispersal ability for existing and future lizard populations due to permanent habitat loss associated with the presence of the road	
	Baseline	Likely Future Ecological Environment	Baseline	Likely Future Ecological Environment
Level of effect prior to impact management	The magnitude of effect is assessed as Negligible as the Project is not expected to further exacerbate existing disturbance adjacent to the NoR. The ecological value of copper skinks and ornate skinks is assessed to be High , and the overall level of effect due to the presence of the road is assessed as Very Low prior to mitigation. As such no impact management is required.	Same as Baseline.	The magnitude of effect is assessed as Negligible as the Project is not expected to further exacerbate existing and future restrictions on lizard dispersal adjacent to the NoR. The ecological value of copper skinks and ornate skinks is assessed to be High , and the overall level of effect due to the presence of the road is assessed as Very Low prior to mitigation. As such no impact management is required.	Same as Baseline.
Impact management and residual level of effect	N/A	N/A	N/A	N/A
Management of residual effect	N/A	N/A	N/A	N/A

8.3.3 Conclusions

The ecological level of effects assessed as **Moderate**, **High** or **Very High** for the Don Buck NoR include:

- **Moderate** level of effect for disturbance and displacement to Dabchick (TAR species) nests and individual birds (existing) within the stormwater pond adjacent to construction activities (noise, light, dust etc) for the Baseline and Future Environment.

The post mitigation level of effect is considered to be **Negligible** for this effect.

8.3.4 Design and Future Regional Resource Consent Considerations

Ecological effects associated with activities that require regional consents and Wildlife Act Authority permits are briefly discussed in the section below. This section has informed the proposed designation boundary of the Don Buck Road NoR.

8.3.4.1 Terrestrial Ecology

Construction of the Project will result in temporary and permanent loss of vegetation within the NoRs, including suitable habitat that is potentially being used by native fauna (birds and lizards). Loss of vegetation that is subject to district plan controls is discussed in Section 8.3.1. The amounts and types of all²¹ terrestrial habitat and vegetation (including habitat used by native fauna) that could be lost as a result of the Project is presented in Table 8-10.

The terrestrial vegetation to be lost (temporary and permanent) is comprised of both native and exotic vegetation which ranges from **Negligible** to **Moderate** ecological value (Section 8.2.2.3). Some of these areas are likely to provide habitat to native fauna, as discussed in sections 8.3.4.2 and 8.3.4.3 below.

As the design develops and resource consent applications are prepared, more detailed habitat and fauna surveys may be required to inform an EclA (in line with the EIANZ Guidelines) which will be used to support future regional resource consent and wildlife permit applications (if required).

Table 8-10 Potential area of permanent terrestrial vegetation loss within the road footprint for the Don Buck NoR

Feature	Classification*	Footprint (m²)
Brown Field (includes cropland)	BF	39,766
Exotic Grassland	EG	3,826
Planted Vegetation - Native	PL.1	Adjacent to road footprint.
Planted Vegetation - Exotic	PL.3	4,667
Exotic-Dominated Treeland	TL.3	Adjacent to road footprint.

Notes: * = Classification from Singers et al. (2017)

²¹ Includes vegetation that is subject to district and regional plan controls as well as vegetation that can be removed as a permitted activity.

8.3.4.2 Birds

Native birds are likely to be present within the NoR and utilise all identified terrestrial habitats (excluding brown fields). Vegetation clearance required for construction could result in the loss of these habitats of local value to native birds. The value of these habitats ranges from **Low** to **Moderate** value and any vegetation clearance within the bird nesting season (September – February) will need to be managed in accordance with the Wildlife Act 1953. The loss of some of this habitat is already assessed because they are district plan trees.

8.3.4.3 Lizards

Native lizards are likely to be present within vegetation impacted by the Project. Therefore, there is potential that site clearance required for construction could kill or injure native lizard species and result in the removal of their habitat. Any vegetation clearance where lizards are likely to occur will also need to be managed in accordance with the Wildlife Act 1953.

8.3.4.4 Freshwater Ecology

The upgrade of the Rush Creek stormwater pond associated with the Don Buck NoR will impact two existing streams, with **Moderate** ecological value. Approximately 50 m of stream loss will be required to accommodate the Project works. The predicted permanent and intermittent stream loss for the Project is presented in Table 8-11. These calculations will require re-evaluation as part of the future regional consent process. Both streams are affected by the existing stormwater pond but reflect good native riparian planting. It is expected that details regarding the offset/compensation requirements will be addressed during the future regional resource consent application.

Table 8-11 Potential stream loss (permanent and intermittent) within the Don Buck NoR

Stream ID	Hydroperiod	Ecological Value	Active channel width (m)*	Length to be lost (m)*	Loss (m ²)*
R1-S1	Permanent	Moderate	2	25	50
R1-S2	Intermittent	Moderate	1.5	25	38

Notes: * = Some assessments were carried out at a desktop level, making it difficult to accurately delineate stream width and length. Therefore, widths, lengths and areas are indicative.

Under a future regional consent for instream works, earthworks and vegetation removal, impact management would also be required for fish salvage and relocation, sediment control and management of the riparian condition.

8.3.4.5 Wetland Ecology

The construction of the Don Buck NoR will not directly impact any natural wetlands. During construction management will be required for earthworks and potential flow modification for downstream wetland (R1-W1).

9 NoR RE2: Fred Taylor Drive FTN Upgrade

9.1 Project Corridor Features

The Fred Taylor Drive corridor features a north-south alignment, running on a watershed between the Totara Creek catchment (to the east) and Ngongetepara Creek catchment (to the west). This corridor does not cross any watercourses or transect any area of native vegetation. The majority of the area associated with this NoR is brown fields (BF) and exotic grass (EG).

9.2 Existing and Likely Future Environment

9.2.1 Planning Context

The existing Fred Taylor Drive corridor runs through a mix of residential and industrial land uses. The northern section of Fred Taylor Drive is within the Redhills North FUZ, with an area of land zoned under the AUP:OP as Open Space – Sport and Active Recreation Zone (Fred Taylor Park) adjacent the road corridor. The southern section of Fred Taylor Drive is zoned under the AUP:OP as THAB zone on the western side, and forms part of the I610 Redhills Precinct. The eastern side is zoned Business – Light Industry Zone and Business – Mixed Use Zone and forms part of the I615 Westgate Precinct. Table 9-1 below provides a summary of the existing and likely future environment as it relates to the Fred Taylor Drive FTN Upgrade.

Table 9-1 Fred Taylor Drive FTN Upgrade Existing and Likely Future Environment

Environment today	Zoning	Likelihood of Change for the environment ²²	Likely Future Environment ²³	Implications of Future Environment on Ecological Features
Business	Business (Light Industrial)	Low	Business	N/A
	Business (Mixed Use)	Low		N/A
Residential	Residential – Terraced Housing and Apartment Zone	Low	Residential	N/A
Open Space	Open Space – Sport and Active Recreation	Low	Open Space	N/A
Undeveloped greenfield areas	Future Urban	High	Urban	Dominated by exotic grassland and exotic planting likely to be

²² Based on AUP:OP zoning/policy direction

²³ Based on AUP:OP zoning/policy direction

Environment today	Zoning	Likelihood of Change for the environment ²²	Likely Future Environment ²³	Implications of Future Environment on Ecological Features
				removed during future development.

Please refer to the AEE for further information on the planning context.

9.2.2 Ecological Baseline

This section presents the findings of the site and desktop investigations in relation to the terrestrial, freshwater, and wetland habitats and associated fauna species ('ecological features') currently present within the proposed Fred Taylor NoR.

All features within the study areas were investigated and mapped to provide context for the effects assessment and inform potential adjustments to the proposed designation boundary (Appendix 5). Based on this information, and desktop assessments, an ecological value has been calculated for each ecological feature within this NoR.

9.2.2.1 Terrestrial Habitat

Table 9-2 summarises the vegetation types and their classification (Singers et al., 2017) associated with the Fred Taylor NoR. Maps are presented in Appendix 5. The study area for the Fred Taylor NoR is dominated by exotic grasses, amenity plantings and exotic treeland.

Table 9-2 Vegetation types present within the Fred Taylor NoR, categorised according to Singers et al. (2017)

Vegetation Type	Abbreviation	Habitat Description
Brown Field (includes cropland)	BF	This definition includes industrial hard standing concrete and unmanaged bare ground. For the purposes of mapping this has been extended to include bare ground associated with cropland, market gardens and construction sites. Consists of small areas patches of rural homesteads.
Exotic Grassland	EG	Grassland dominated by exotic species. This includes pasture and gardens.
Exotic Scrub	ES	Exotic secondary scrub or shrubland with >50% cover/biomass of exotic species. Generally growing along historical farm drains. Dominant species include gorse, woolly nightshade and privet species.
Planted Vegetation – Native (mature)	PL.2	Native restoration plantings with <50% exotic biomass. Planted native scrub and forest >20 years old or wetland >10 years old.
Planted Vegetation – Exotic (amenity)	PL.3	Exotic amenity plantings. This includes parks and gardens and roadside vegetation dominated by exotic species.

Vegetation Type	Abbreviation	Habitat Description
Treeland – Mixed Native/Exotic	TL.2	Tree canopy cover 20-80%. Mixed native/exotic: with 25-75% native tree cover. 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.
Treeland – Exotic-Dominated	TL.3	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.

9.2.2.2 Terrestrial Fauna

Bats

Area wide bat surveys have been undertaken and include the Don Buck NoR. The results of the bat survey are detailed in Appendix 11. Long-tailed bats (pekapeka) were detected within 2 km southwest and 1.5 km northwest of the NoR. However, the terrestrial habitat associated with the Don Buck NoR is considered to be of negligible value to bats and the project is occurring with an existing fragmented landscape. As such bats are not further considered for this NoR.

Birds

No dedicated bird surveys were undertaken for the Project. Incidental observations of bird species were noted, and the following birds were seen or heard throughout the NoR (Table 9-3). No TAR species were observed during site investigations. The most commonly noted birds were introduced species, including mynas and sparrows.

Table 9-3 Incidental bird observations at NoR RE2 and conservations status (Robertson et al., 2021)

Common Name	Māori Name	Scientific Name	Conservation Status
House sparrow	Tiu	<i>Fringilla coelebs</i>	Introduced and Naturalised
Myna	-	<i>Acridotheres tristis</i>	Introduced and Naturalised

Lizards

Indigenous lizards were not identified during opportunistic searches completed during the site walkover. However, the introduced plague skink was identified within the Fred Taylor NoR. Copper skink have been recorded within 4 km of the NoR. Copper skink is likely to be associated with all of the vegetation units presented in Table 9-2, where there is appropriate understorey.

9.2.2.3 Terrestrial Ecological Value

Appendix 6.2 presents the terrestrial vegetation observed within the Fred Taylor Drive NoR and their ecological value in accordance with the EclA Guidelines (EIANZ, 2018). Information obtained for the ecological baseline (Sections 9.2.2.1 and 9.2.2.2), as well as the area wide desktop assessment

(Section 6), was used to score the matters that inform the ecological value. The ecological value of habitats ranged from **Negligible** (e.g., EG) to **Moderate** (e.g., TL.3)²⁴.

Notwithstanding the ecological value associated with vegetation/habitat units, specific consideration still needs to be given to individual species and their conservation significance for the following reasons (in accordance with EclA Guidelines):

- The habitat value may dilute the conservation value associated with specific species. For example, the combined value for exotic grassland is **Low**, while the value for copper skink (At Risk - Declining) is **High**. The combined value of **Low** therefore understates the conservation value of the species;
- Species may not be restricted to a single vegetation unit;
- Potential effects on species are unrelated to habitat units. For example, impact on highly mobile species (such as bats) by noise and light may be independent of the habitat loss associated with the Project footprint.

For the reasons outlined above, the ecological value assessments for individual TAR species are considered to be **High** (Table 9-4).

Table 9-4 Ecological value for terrestrial fauna (TAR species only)

Fauna Type	Species within habitat	Habitat Description	Conservation Status	Ecological Value
Herpetofauna – lizards	Copper skink	EG, ES, PL.2, PL.3, TL.2, TL.3	At Risk - Declining	High

9.2.2.4 Freshwater Habitat

The Fred Taylor NoR does not cross, or directly impact, any freshwater habitat. For this reason, no freshwater surveys took place.

9.2.2.5 Freshwater Fauna

Fish surveys were not carried out during site investigations, and no species of threat classification were identified in the desktop review.

9.2.2.6 Freshwater Ecological Value

The Fred Taylor NoR does not cross, or directly impact, any freshwater streams, therefore no freshwater ecological value has been assessed for this NoR.

9.2.2.7 Wetland Habitat

The Fred Taylor NoR does not cross, or directly impact, any wetland habitat. For this reason, no wetland habitat surveys took place.

9.2.2.8 Wetland Ecological Value

The NoR does not cross, or directly impact, any wetland habitat, therefore no wetland ecological value has been assessed for this NoR.

²⁴ The ecological value of brown fields was considered less than negligible and therefore was not assessed.

9.3 Assessment of Ecological Effects and Measures to Avoid, Remedy or Mitigate Actual or Potential Adverse Effects

Section 9.3 assesses the ecological effects of activities which relate to district plan matters under the AUP:OP.

9.3.1 Construction Effects – Terrestrial Ecology

The potential construction effects (direct and indirect) to the terrestrial habitat and species within and adjacent to the Fred Taylor NoR (as they relate to district matters) were the same as for Don Buck NoR (Section 8.3.1).

9.3.1.1 Terrestrial Vegetation

Vegetation to be removed that is subject to district controls is presented in Appendix 5 and also detailed in the table below. The effects of district plan vegetation removal on fauna i.e., birds (as it related to loss in foraging habitat, and mortality and injury) is assessed in Section 9.3.1.2.

Table 9-5 Assessment of ecological effects for terrestrial vegetation (district plan trees only) and impact management during construction for NoR RE2

Effect Description	Permanent loss of habitat/ecosystem, fragmentation, and edge effects due to vegetation removal (district plan trees only)	
	Baseline	Likely Future Ecological Environment
Level of effect prior to impact management	<p><u>TL.2 (total area of 12.06 m²) & TL.3 (total area of 21.89 m²)</u></p> <p>The magnitude of effect is assessed as Negligible due to the low likelihood that the loss of these trees will result in this effect.</p> <p>The ecological value of both vegetation types was is assessed to be Moderate, and the overall level of effect is assessed as Very Low prior to mitigation. As such no impact management is required.</p>	Same as Baseline.
Impact management and residual level of effect	N/A	N/A
Management of residual effect	N/A	N/A

9.3.1.2 Birds

Noise, vibration and lighting disturbance caused by construction activities could potentially displace native birds from suitable nesting and foraging habitat adjacent to the Fred Taylor NoR. Additionally, birds may be impacted by removal of district plan vegetation through the following effects:

- Loss of foraging habitat

- Nest loss
- Mortality or injury to birds

Table 9-6 outlines the effect assessment for birds due to construction activities related to noise and light, and removal of district plan vegetation.

Table 9-6 Assessment of ecological effects for birds and impact management during construction for the Fred Taylor NoR

Effect Description	Disturbance and displacement to roosts and individual birds (existing) adjacent to construction activities (noise, light, dust etc.)		Effects due to removal of district plan vegetation:	
	Baseline	Likely Future Ecological Environment	Baseline	Likely Future Ecological Environment
Level of effect prior to impact management	<p>Non-TAR birds</p> <p>The magnitude of effect is assessed as Low due to definite presence of native birds associated with several habitat features of the NoR, and the short-term duration of the effect.</p> <p>The ecological value of birds in the context of habitat features are assessed to be Low, and the overall level of effect due to construction disturbance is assessed as Very Low prior to mitigation. As such no impact management is required.</p>	Same as Baseline.	<p>Non-TAR birds</p> <p>The magnitude for all three effects is assessed as Negligible due small extent of district plan trees that will be removed resulting in an unlikely probability</p> <p>The ecological value of birds in the context of habitat features are assessed to be Low, and the overall level of effect due to construction disturbance is assessed as Very Low prior to mitigation. As such no impact management is required.</p>	Same as Baseline.
Impact management and residual level of effect	N/A	N/A	Impact management will be required under the Wildlife Act to prevent killing or injuring of birds. As part of this management, timing of vegetation removal should be constraint, or pre-clearance inspections should be undertaken prior to vegetation removal.	Same as Baseline

Effect Description	Disturbance and displacement to roosts and individual birds (existing) adjacent to construction activities (noise, light, dust etc.)		Effects due to removal of district plan vegetation:	
	Baseline	Likely Future Ecological Environment	Baseline	Likely Future Ecological Environment
Management of residual effect	N/A	N/A	N/A	N/A

9.3.1.3 Lizards

Construction effects on lizards associated with noise, light and vibration are presented in Table 9-7. Construction activity relates to the upgrade of an existing road and as such lizards are likely to be habituated to noise and vibration from the existing road. It is expected that the effects on lizards due to vegetation removal will be assessed under Regional matters and is further discussed in Section 9.3.4.3.

Table 9-7 Assessment of ecological effects for lizards and impact management during construction for the Fred Taylor NoR

Effect Description	Disturbance and displacement of individuals (existing) adjacent to construction activities (noise, dust etc.)	
	Baseline	Likely Future Ecological Environment
Level of effect prior to impact management	The magnitude of effect is assessed as Negligible due to the infrequent but likely probability of lizard disturbance. The ecological value of copper skink and ornate skink is assessed as High , and the overall level of effect due to construction disturbance is assessed as Very Low prior to mitigation. As such no impact management is required.	Same as Baseline.
Impact management and residual level of effect	N/A	N/A
Management of residual effect	N/A	N/A

9.3.2 Operational Effects – Terrestrial Ecology

The potential operational effects (direct and indirect) to the terrestrial habitat and species within the Fred Taylor NoR (as they relate to district matters) were the same as for the Don Buck NoR (Section 8.3.2).

9.3.2.1 Birds

Noise, vibration and lighting disturbance caused by the presence of the road could potentially displace native birds from suitable nesting and foraging habitat within and adjacent to the Fred Taylor NoR, while noise, light and vibration may also affect connectivity in the broader landscape. Table 9-8 outlines the operational effect assessment and impact management for birds.

Table 9-8 Assessment of ecological effects for birds and impact management during operation for the Fred Taylor NoR (R2)

Effect Description	Disturbance and displacement to roosts and individual birds (existing) due to the presence of the road (noise, light, dust etc.)		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	
	Baseline	Likely Future Ecological Environment	Baseline	Likely Future Ecological Environment
Level of effect prior to impact management	<p><u>Non-TAR birds</u></p> <p>The magnitude of effect is assessed as Low as NoR RE2 is along an existing road and birds are likely to be habituated to noise, light and vibration from the road.</p> <p>The ecological value of birds in the context of habitat features are assessed to be Low, and the overall level of effect due to operational disturbance is assessed as Very Low prior to mitigation. As such no impact management is required.</p>	Same as Baseline.	<p><u>Non-TAR birds</u></p> <p>The magnitude of effect is assessed as Low for both effects, as NoR RE2 is along an existing road.</p> <p>The ecological value of birds in the context of habitat features are assessed to be Low, and the overall level of effect due to operational disturbance is assessed as Very Low prior to mitigation. As such no impact management is required.</p>	Same as Baseline.
Impact management and residual level of effect	N/A	N/A	N/A	N/A
Management of residual effect	N/A	N/A	N/A	N/A

9.3.2.2 Lizards

Suitable habitat (EG, ES, PL.3, PL.3, TL.2, and TL.3) was identified within the NoR boundary which could potentially support native lizards. Native lizards require vegetated corridors to facilitate natural dispersal, although they are considered to be relatively resident species and do not require migration or large-scale movement to support reproduction, refuge and feeding.

The Fred Taylor NoR includes upgrading the existing roads, therefore it is not expected to result in the additional fragmentation of lizard habitat. Similarly, resident (existing and future) lizards are likely to be habituated to disturbance such as noise, vibration and lighting and no additional effect on lizards is expected, provided that the post-upgraded road will not result in higher levels of noise and vibration. Table 9-9 outlines the operational effect assessment and impact management for lizards.

Table 9-9 Assessment of ecological effects for lizards and impact management during operation for the Fred Taylor NoR

Effect Description	Disturbance and displacement of existing and future lizards due to light, noise and vibration effects from the presence of the road		Further decrease in dispersal ability for existing and future lizard populations due to permanent habitat loss associated with the presence of the road	
	Baseline	Likely Future Ecological Environment	Baseline	Likely Future Ecological Environment
Level of effect prior to impact management	The magnitude of effect is assessed as Negligible as the Project is not expected to further exacerbate existing disturbance adjacent to the NoR. The ecological value of copper skinks and ornate skinks is assessed to be High , and the overall level of effect due to the presence of the road is assessed as Very Low prior to mitigation. As such no impact management is required.	Same as Baseline.	The magnitude of effect is assessed as Negligible as the Project is not expected to further exacerbate existing and future restrictions on lizard dispersal adjacent to the NoR. The ecological value of copper skinks and ornate skinks is assessed to be High , and the overall level of effect due to the presence of the road is assessed as Very Low prior to mitigation. As such no impact management is required.	Same as Baseline.
Impact management and residual level of effect	N/A	N/A	N/A	N/A
Management of residual effect	N/A	N/A	N/A	N/A

9.3.3 Conclusions

The Fred Taylor NoR does not present any ecological effects that are more than **Low** prior to mitigation.

9.3.4 Design and Future Regional Resource Consent Considerations

Ecological effects associated with activities that require regional consents and Wildlife Act Authority permits are briefly discussed in the section below. This section has informed the proposed designation boundary of the Fred Taylor Drive NoR.

9.3.4.1 Terrestrial Ecology

Construction of the Project will result in temporary and permanent loss of vegetation within the NoRs, including suitable habitat that is potentially being used by native fauna (bats, birds and lizards). Loss of vegetation that is subject to district plan controls is discussed in Section 9.3.1. The amounts and types of all²⁵ terrestrial habitat and vegetation (including habitat used by native fauna) that could be lost as a result of the Project is presented in Table 9-10 under the Footprint column.

The terrestrial vegetation to be lost (temporary and permanent) is comprised of both native and exotic vegetation which ranges from **Negligible** to **Moderate** ecological value (Section 9.2.2.3). Some of these areas are likely to provide habitat to native fauna, as discussed in sections 9.3.4.2 and 9.3.4.3 below.

As the design develops and resource consent applications are prepared, more detailed habitat and fauna surveys may be required to inform an EcIA (in line with the EcIA Guidelines) which will be used to support future regional resource consent and wildlife permit applications (if required).

Table 9-10 Potential area of permanent terrestrial vegetation loss within the road footprint for the Fred Taylor NoR

Feature	Classification*	Footprint (m ²)
Brown Field (includes cropland)	BF	11,066
Exotic Grassland	EG	5,698
Exotic Scrub	ES	44
Planted Vegetation - Native (mature)	PL.2	Adjacent to road footprint.
Planted Vegetation – Exotic (amenity)	PL.3	7,013
Treeland – Mixed Native/Exotic	TL.2	16
Treeland – Exotic-Dominated	TL.3	26

Notes: * = Classification from Singers et al. (2017)

²⁵ Includes vegetation that is subject to district and regional plan controls as well as vegetation that can be removed as a permitted activity.

9.3.4.2 Birds

Native birds are likely to be present within the NoR and utilise all identified terrestrial habitats (excluding brown fields). Vegetation clearance required for construction could result in the loss of these habitats of local value to native birds. The value of these habitats ranges from **Low** to **Moderate** value and any vegetation clearance within the bird nesting season (September – February) will need to be managed in accordance with the Wildlife Act 1953. The loss of some of this habitat is already assessed because they are district plan trees.

9.3.4.3 Lizards

Native lizards are likely to be present within vegetation impacted by the Project. Therefore, there is potential that site clearance required for construction could kill or injure native lizard species and result in the removal of their habitat. Any vegetation clearance where lizards are likely to occur will also need to be managed in accordance with the Wildlife Act 1953.

10 NoR R1: Coatesville-Riverhead Highway Upgrade

10.1 Project Corridor Features

Coatesville-Riverhead NoR (R3) features a north-south alignment, extending over four streams each of which flows into SEA (M2-57b) associated with Brigham Creek and Rangitopuni Stream inlets. The rural landscape provides mature exotic treeland (TL.3) which along with the five stream corridors provide potential ecological connectivity between Riverhead Forest and the SEA (M2-57b). The most notable of the stream corridors is on 1229 Coatesville-Riverhead Highway.

10.2 Existing and Likely Future Environment

10.2.1 Planning Context

The southern section of Coatesville-Riverhead Highway from SH16 to Short Road runs through rural land uses predominantly zoned under the AUP:OP as Rural – Mixed Rural Zone on both sides of the existing corridor. The northern section (close to and within the Riverhead township) runs through land zoned as Residential – Single House Zone and to the east and future urban zoned land on the west.

Table 10-1 below provides a summary of the North West existing and likely future environment as it relates to the Coatesville-Riverhead Highway Upgrade.

Table 10-1 Coatesville-Riverhead Highway Existing and Likely Future Environment

Environment today	Zoning	Likelihood of Change for the environment ²⁶	Likely Future Environment ²⁷	Implications of Future Environment on Ecological Features
Rural	Rural	Low	Rural	N/A
Residential	Residential	Low	Residential	N/A
Future Urban Zone/Undeveloped greenfield areas	Future Urban	High	Urban	Area to be developed include the upper portion of Coatesville-Riverhead Highway (1140-1200). Existing ecological features mainly include exotic grass, exotic treeland, exotic planting. No wetland or streams.

Please refer to the AEE for further information on the planning context.

²⁶ Based on AUP:OP zoning/policy direction

²⁷ Based on AUP:OP zoning/policy direction

10.2.2 Ecological Baseline

This section presents the findings of the site and desktop investigations in relation to the terrestrial, freshwater, and wetland habitats and associated fauna species ('ecological features') currently present within the proposed the Coatesville-Riverhead NoR.

All features within both study areas were investigated and mapped to provide context for the effects assessment and inform potential adjustments to the proposed designation boundary (Appendix 5). Based on this information, and desktop assessments, an ecological value has been calculated for each ecological feature within this NoR.

10.2.2.1 Terrestrial Habitat

Table 10-2 summarises the vegetation types and their classification (Singers et al., 2017) associated with the Coatesville-Riverhead NoR. Maps are presented in Appendix 5. The study area for the Coatesville-Riverhead NoR is dominated by exotic grassland with woody vegetation mostly in the form of shelterbelt and roadside planting.

Table 10-2 Vegetation types present within the Coatesville-Riverhead NoR, categorised according to Singers et al. (2017)

Vegetation Type	Abbreviation	Habitat Description
Brown Field (includes cropland)	BF	This definition includes industrial hard standing concrete and unmanaged bare ground. For the purposes of mapping this has been extended to include bare ground associated with cropland, market gardens and construction sites. Consists of small areas patches of rural homesteads
Exotic Grassland	EG	Grassland dominated by exotic species. This includes pasture, gardens for most of the NoR RE2
Exotic Scrub	ES	Exotic secondary scrub or shrubland with >50% cover/biomass of exotic species. Generally growing along historical farm drains. Dominant species include gorse, woolly nightshade and privet species.
Planted Vegetation – Exotic (amenity)	PL.3	Exotic amenity plantings. This includes parks and gardens and roadside vegetation dominated by exotic species.
Treeland – Exotic-Dominated	TL.3	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.

10.2.2.2 Terrestrial Fauna

Bats

Area wide bat surveys have been undertaken for the three NoRs (including the Coatesville-Riverhead NoR). The results of the bat survey are detailed in Appendix 11. The results of these surveys relevant to the Coatesville-Riverhead NoR is the presence of long-tailed bats (pekapeka) which were detected 2 km southwest of the NoR. Mature shelterbelt vegetation (mostly represented by TL.3) may provide bat habitat, roost potential and enable bat movement in the wider landscape.

Birds

No dedicated bird surveys were undertaken for the Project. Incidental observations of bird species were noted, and the following birds were seen or heard throughout the Coatesville-Riverhead NoR (Table 10-3). No TAR species were observed during site investigations, but spotless crane and dabchick may use wetland and open water habitat associated with the NoR. The most commonly noted birds were introduced species: including blackbirds, sparrows, and pūkeko. The structure of habitat associated with exotic shrub vegetation (ES), more mature exotic treelands (TL.3) and native plantings (PL.1) present with the NoR may provide localised value for birds.

Table 10-3 Incidental bird observations at the Coatesville-Riverhead NoR and conservations status (Robertson et al., 2021)

Common Name	Māori Name	Scientific Name	Conservation Status
Blackbird	Manu pango	<i>Turdus merula</i>	Introduced and Naturalised
Fantail	Pīwakawaka	<i>Rhipidura fuliginosa placabilis</i>	Not Threatened
House sparrow	Tiu	<i>Fringilla coelebs</i>	Introduced and Naturalised
Magpie	Makipae	<i>Gymnorhina tibicen</i>	Introduced and Naturalised
Myna	-	<i>Acridotheres tristis</i>	Introduced and Naturalised
Pūkeko	Pūkeko	<i>Porphyrio melanotus melanotus</i>	Not Threatened
Spur winged plover	-	<i>Vanellus miles novaehollandiae</i>	Not Threatened
Swamp Harrier	Kāhu	<i>Circus approximans</i>	Not Threatened
Welcome swallow	Warou	<i>Hirundo neoxena neoxena</i>	Not Threatened

Lizards

Indigenous lizards were not identified during opportunistic searches completed during the site walkover. However, the introduced plague skink was identified within the Coatesville-Riverhead NoR. Copper skink have been recorded within 2 km of the Coatesville-Riverhead NoR. Copper skink is likely to be associated with all of the vegetation units presented in Table 10-2, where there is appropriate understorey.

10.2.2.3 Terrestrial Ecological Value

Appendix 6.3 describes the terrestrial vegetation observed within the Coatesville-Riverhead NoR and their ecological value in accordance with the EclA Guidelines (EIANZ, 2018). Information obtained for the ecological baseline (Sections 10.2.2.1 and 10.2.2.2), as well as the area wide desktop

assessment (Section 6), was used to score the matters that inform the ecological value. The ecological value of habitats ranged from **Low** (e.g., EG) to **Moderate** (e.g., TL.3)²⁸.

Notwithstanding the ecological value associated with vegetation/habitat units, specific consideration still needs to be given to individual species and their conservation significance for the following reasons (in accordance with EIANZ Guidelines):

- The habitat value may dilute the conservation value associated with specific species. For example, the combined value for exotic grassland is **Low**, while the value for copper skink (At Risk - Declining) is **High**. The combined value of **Low** therefore understates the conservation value of the species;
- Species may not be restricted to a single vegetation unit;
- Potential effects on species are unrelated to habitat units. For example, impact on highly mobile species (such as bats) by noise and light may be independent of the habitat loss associated with the Project footprint.

For the reasons outlined above, the ecological value assessments for individual species are considered to range from **High** to **Very High** (Table 10-4).

Table 10-4 Ecological value for terrestrial fauna (TAR species only)

Fauna Type	Species within habitat	Habitat Description	Conservation Status	Ecological Value
Bats	Long-tailed bat	TL.3	Threatened - Nationally Critical	Very High
TAR Birds	Spotless crane	OW and EW	At Risk - Declining	High
	Dabchick	OW	Threatened - Nationally Increasing	Very High
Herpetofauna – lizards	Copper skink	EG, ES, PL.3, and TL.3	At Risk - Declining	High

10.2.2.4 Freshwater Habitat

All potential streams within the Coatesville-Riverhead NoR were mapped (Appendix 5) and classified as either permanent or intermittent. Permanent or intermittent streams that were within the designation boundary were numbered and assessed.

Stream classification, description and RHA assessment

Nine streams were identified during the desktop and site investigations within the Coatesville-Riverhead NoR. These streams are detailed in Table 10-5. Streams were assessed against the stream classification criteria developed by Storey and Wadhwa, 2009. Barriers to fish migration was assessed, to describe any fragmentation or loss of connectivity.

A total of five streams were not accessible. The ecological value for these streams were assessed at desktop level (Section 10.2.2.6).

²⁸ The ecological value of brown fields was considered less than negligible and therefore was not assessed.

All other streams were accessed during site investigations and surveyed using the RHA. The streams measured overall habitat quality scores that ranged from 'Poor' to 'Moderate' (Table 10-5). Detailed RHA results are presented in Appendix 6.

Table 10-5 Summary of streams identified in the Coatesville-Riverhead NoR

Stream Number	Classification	Barrier type	RHA Category
R3-S1	Intermittent	Partial	Poor
R3-S2*	Intermittent	Total	N/A
R3-S3*	Intermittent	Total	N/A
R3-S4	Permanent	Partial	Moderate
R3-S5	Permanent	Partial	Moderate
R3-S6*	Permanent	Partial	N/A
R3-S7	Permanent	Partial	Poor
R3-S8*	Permanent	Partial	N/A
R3-S9*	Intermittent	Total	N/A

Notes: * = Stream assessed at a desktop level

10.2.2.5 Freshwater Fauna

Fish surveys were not carried out during site investigations, however incidental sightings of eels (species unidentifiable) were made at R3-S4, R3-S5 and R3-S7. No TAR species were identified within 2 km of the designation during the desktop review (Table 6-5).

10.2.2.6 Freshwater Ecological Value

Appendix 7.2 presents the ecological value for the freshwater habitats identified within the Coatesville-Riverhead NoR. Information obtained for the ecological baseline (Section 10.2.2.4 and 10.2.2.5), as well as the area wide desktop assessment (Section 6), was used to score the matters that inform the ecological value. Of the nine streams, five of them will impacted and the ecological values of these freshwater habitats are presented in Table 10-6.

Table 10-6 Summary of freshwater ecological value identified in the Coatesville-Riverhead NoR.

Stream ID	Ecological Value
R3-S1	Moderate
R3-S2	Moderate
R3-S3	Low
R3-S4	Moderate
R3-S5	High

10.2.2.7 Wetland Habitat

One wetland within the Coatesville-Riverhead NoR was identified and assessed via desktop (R3-W1). This was conservatively classified as an NPS-FM 'natural wetland' with Exotic Wetland (EW) vegetation type.

10.2.2.8 Wetland Ecological Value

Appendix 8.1 presents the ecological value for the wetland habitat (R3-W1) identified within the Coatesville-Riverhead NoR. Information obtained for the ecological baseline (Section 10.2.2.7), as well as the desktop assessment (Section 6), was used to score the matters that inform the ecological value. The ecological value of R3-W1 was **High**.

10.3 Assessment of Ecological Effects and Measures to Avoid, Remedy or Mitigate Actual or Potential Adverse Effects

Section 10.3 assesses the ecological effects of activities which relate to district plan matters under the AUP:OP.

10.3.1 Construction Effects – Terrestrial Ecology

The potential construction effects (direct and indirect) to the terrestrial habitat and species within and adjacent to Coatesville-Riverhead NoR (as they relate to district matters) have been identified:

- Vegetation removal subject to district controls (Appendix 5).
- Disturbance and displacement to roosts/nests and individual (existing) bats, birds and lizards due to construction activities (noise, light, dust etc.). It is assumed that this effect will occur after vegetation clearance (subject to regional consent controls) has been implemented and is therefore likely to happen in habitats adjacent to the project footprint/designation or underneath structures such as bridges.

The following sections detail the magnitude of effect and subsequent level of effect on ecological features (further detail regarding how these were determined are provided in Appendix 1). Impact management and residual effects are also presented where the level of effect is assessed to be **Moderate** or higher.

10.3.1.1 Terrestrial Vegetation

Vegetation to be removed that is subject to district controls is presented in Appendix 5 and also detailed in the table below. The effects of district plan vegetation removal on fauna i.e., bats and birds (as it relates to loss in foraging habitat, and mortality and injury) are discussed in assessed in sections 10.3.1.2 and 10.3.1.3.

Table 10-7 Assessment of ecological effects for terrestrial vegetation (district plan trees only) and impact management during construction for the Coatesville-Riverhead NoR

Effect Description	Permanent loss of habitat/ecosystem, fragmentation, and edge effects due to vegetation removal (district plan trees only)	
	Baseline	Likely Future Ecological Environment
Level of effect prior to impact management	<p><u>TL.3 (total area of 4,820.2 m²)</u></p> <p>The magnitude of effect is assessed as Low due to the extent and subsequent likelihood that this effect may occur.</p> <p>The ecological value of TL.3 is assessed to be Moderate, and the overall level of effect is assessed as Low prior to mitigation. As such no impact management is required.</p>	Same as Baseline.
Impact management and residual level of effect	N/A	N/A
Management of residual effect	N/A	N/A

10.3.1.2 Bats

Bats may utilise the TL.3 habitat associated with the Coatesville-Riverhead NoR for roosting or foraging. During construction of the Project, night works may be required, and site compounds are likely to be lit overnight. Lighting at night has the potential to modify the behaviour of bats if foraging within this area or roosting in nearby isolated stands of mature trees.

Noise and vibration during construction can be an issue if bats are roosting in the immediate vicinity of the construction works. Although bat foraging has been confirmed, ABM survey at the Project scale cannot confirm roost occupation within or adjacent to the designation boundary. However, it can be assumed that bats will utilise roost sites within the Project Area based on the following assumptions:

- Confirmed habitat suitability (numerous trees with moderate to high bat roost potential, connected to linear stream corridors and wetlands);
- Confirmed foraging presence; and
- Frequent utilisation of numerous roosting sites throughout their home range (Davies et al., 2017).

Additionally, bats may be impacted by removal of district plan vegetation through the following effects²⁹:

- Loss of foraging habitat
- Mortality or injury to bats

Table 10-8 outlines the effect assessment for bats due to construction activities related to noise and light, and removal of district plan vegetation.

²⁹ Roost lost 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 NoR.

Table 10-8 Assessment of ecological effects for bats and impact management during construction for the Coatesville-Riverhead NoR

Effect Description	Disturbance and displacement to roosts and individual bats (existing) adjacent to construction activities (noise, light, dust etc.)		Effects due to removal of district plan vegetation:	
	Baseline	Likely Future Ecological Environment	Baseline	Likely Future Ecological Environment
Level of effect prior to impact management	<p>The magnitude of effect is assessed as Low due to likely probability of bats being disturbed.</p> <p>The ecological value of bats is assessed to be Very High, and the overall level of effect is assessed as Moderate prior to mitigation.</p>	Same as Baseline.	<p>Loss of foraging habitat</p> <p>The magnitude of effect is assessed as Negligible due to the relatively small contribution of district plan trees to the available foraging habitat.</p> <p>The ecological value of bats is assessed as Very High and the overall level of effect is assessed as Low prior to mitigation.</p> <p>Mortality or injury to bats</p> <p>The magnitude of effects is assessed as Low due to a higher likelihood associated with the roost potential of the district plan trees and the overall level of effect is assessed as Moderate prior to mitigation.</p>	Same as Baseline.
Impact management and residual level of effect	<p>A Bat Management Plan (BMP) should be developed to include consideration for:</p> <ul style="list-style-type: none"> • Surveys prior to construction confirm activity to confirm 	Same as Baseline.	<p>Loss of foraging habitat</p> <p>N/A</p> <p>Mortality or injury to bats</p> <p>The BMP should also include:</p>	Same as Baseline.

Effect Description	Disturbance and displacement to roosts and individual bats (existing) adjacent to construction activities (noise, light, dust etc.)		Effects due to removal of district plan vegetation:	
	Baseline	Likely Future Ecological Environment	Baseline	Likely Future Ecological Environment
	<p>presence/likely absence. Surveys to confirm bat roost locations if activity is confirmed.</p> <ul style="list-style-type: none"> Siting of compounds and laydown areas to avoid TL.3 habitat. Lighting design to reduce light levels and spill from construction areas. Restriction of nightworks around TL.3 habitat. Bat management should consider any regional consent conditions (i.e., Bat Management Plans) that may be required for bats. <p>The post mitigation level of effect can be reduced to Negligible.</p>		<ul style="list-style-type: none"> Consideration to the provisions of the Wildlife Act. Design and implementation of a vegetation removal protocol. The protocol should provide for roost potential and ABM surveys prior to vegetation removal; and timing of vegetation removal should be constrained to avoid the maternity period (vegetation removal should occur during October or between March and April). <p>The post mitigation level of effect related to mortality or injury to bats due to district plan vegetation removal can be reduced to Negligible.</p>	
Management of residual effect	N/A	N/A	N/A	N/A

10.3.1.3 Birds

Noise, vibration and lighting disturbance caused by construction activities could potentially displace native birds from suitable nesting and foraging habitat adjacent to the Coatesville-Riverhead NoR. Additionally, birds may be impacted by removal of district plan vegetation through the following effects:

- Loss of foraging habitat
- Nest loss
- Mortality or injury to birds

Table 10-9 outlines the effect assessment for birds due to construction activities related to noise and light, and removal of district plan vegetation.

Table 10-9 Assessment of ecological effects for birds and impact management during construction for the Coatesville-Riverhead NoR

Effect Description	Disturbance and displacement to roosts and individual birds (existing) adjacent to construction activities (noise, light, dust etc.)		Effects due to removal of district plan vegetation:	
	Baseline	Likely Future Ecological Environment	Baseline	Likely Future Ecological Environment
Level of effect prior to impact management	<p><u>Non-TAR birds</u></p> <p>The magnitude of effect is assessed as Moderate due to definite presence of native birds associated with several habitat features of the NoR.</p> <p>The ecological value of birds in the context of habitat features are assessed to be Low, and the overall level of effect due to construction disturbance is assessed as Low prior to mitigation. As such no impact management is required.</p> <p><u>TAR birds (spotless crane)</u></p> <p>The magnitude of effect is assessed as Moderate due to a very high probability of disturbance.</p> <p>The ecological value of these species is High, and the overall level of effect is assessed as High prior to mitigation. As such impact management is required.</p>	Same as Baseline.	<p><u>Non-TAR birds</u></p> <p>The magnitude of all three effect is assessed as Moderate due to high likelihood of these effects occurring.</p> <p>The ecological value of birds in the context of habitat features are assessed to be Low, and the overall level of effect due to construction disturbance is assessed as Low prior to mitigation. As such no impact management is required.</p> <p><u>TAR birds</u></p> <p>Unlikely to be affected by district plan vegetation removal.</p>	Same as Baseline.

Effect Description	Disturbance and displacement to roosts and individual birds (existing) adjacent to construction activities (noise, light, dust etc.)		Effects due to removal of district plan vegetation:	
	Baseline	Likely Future Ecological Environment	Baseline	Likely Future Ecological Environment
	<p><u>TAR birds (dabchick)</u></p> <p>The magnitude of effect is assessed as Moderate due to a very high probability of disturbance.</p> <p>The ecological value of these species is Very High, and the overall level of effect is assessed as Moderate prior to mitigation. As such impact management is required.</p>			
Impact management and residual level of effect	<p>Impact management is required for spotless crane and dabchick.</p> <p>The Bird Management Plan should consider the following:</p> <ul style="list-style-type: none"> • Pre-construction survey to confirm presence and further management controls. • Where practical, construction works near wetland habitat should commence prior to the bird breeding season (September to February) in order to discourage bird nesting. 	Same as Baseline.	Impact management will be required under the Wildlife Act to prevent killing or injuring of birds. As part of this management, timing of vegetation removal should be constraint, or pre-clearance inspections should be undertaken prior to vegetation removal.	N/A

Effect Description	Disturbance and displacement to roosts and individual birds (existing) adjacent to construction activities (noise, light, dust etc.)		Effects due to removal of district plan vegetation:	
	Baseline	Likely Future Ecological Environment	Baseline	Likely Future Ecological Environment
	<ul style="list-style-type: none"> Bird management should be consistent with any regional consent conditions that may be required for regional compliance. <p>The residual impact is assessed as Negligible to Low post mitigation.</p>			
Management of residual effect	N/A	N/A	N/A	N/A

10.3.1.4 Lizards

Construction effects on lizards associated with noise, light and vibration are presented in Table 10-10. Construction activity relates to the upgrade of an existing road and as such lizards are likely to be habituated to noise and vibration from the existing road. For future rural sections of the Coatesville-Riverhead Highway areas within and adjacent to riparian strips it is expected that the effects on lizards due to vegetation removal will be assessed under Regional matters and is further discussed in Section 10.3.4.4.

Table 10-10 Assessment of ecological effects for lizards and impact management during construction for the Coatesville-Riverhead NoR

Effect Description	Disturbance and displacement of individuals (existing) adjacent to construction activities (noise, dust etc.)	
	Baseline	Likely Future Ecological Environment
Level of effect prior to impact management	The magnitude of effect is assessed as Negligible due to the infrequent but likely probability of lizard disturbance. The ecological value of copper skink and ornate skink is assessed as High , and the overall level of effect due to construction disturbance is assessed as Very Low prior to mitigation. As such no impact management is required.	Same as Baseline.
Impact management and residual level of effect	N/A	N/A
Management of residual effect	N/A	N/A

10.3.2 Operational Effects – Terrestrial Ecology

The potential construction effects (direct and indirect) to the terrestrial habitat and species within and adjacent to Coatesville-Riverhead NoR (as they relate to district matters) have been identified:

- Vegetation removal subject to district controls (Appendix 5).
- Disturbance and displacement to roosts/nests and individual (existing) bats, birds and lizards due to construction activities (noise, light, dust etc.). It is assumed that this effect will occur after vegetation clearance (subject to regional consent controls) has been implemented and is therefore likely to happen in habitats adjacent to the project footprint/designation or underneath structures such as bridges.

The following sections detail the magnitude of effect and subsequent level of effect on ecological features (further detail regarding how these were determined are provided in Appendix 1). Impact management and residual effects are also presented where the level of effect is assessed to be **Moderate** or higher.

10.3.2.1 Bats

The loss of connectivity through permanent habitat loss and disturbance such as operational noise/vibration and light can lead to an overall reduction in size and quality of bat foraging habitat and can impact on bat movement in the broader landscape. Lighting spillage from street lighting could also disturb commuting and foraging bats at night and adversely affect insect prey populations. The level of effect on bats due to operational impacts associated with loss in connectivity should be assessed in the context of confirmed bat activity in the broader landscape, the existing degree of fragmentation and that of the future urban environment. Table 10-11 outlines the effects assessment for:

- Loss in connectivity due to permanent habitat loss, light and noise effects from the road, leading to additional fragmentation of terrestrial habitat due to the presence of the infrastructure.
- Disturbance and displacement of bats due to light, noise and vibration from the road.

Table 10-11 Assessment of ecological effects for bats and impact management during operation for the Coatesville-Riverhead NoR

Effect Description	Disturbance and displacement of (new and existing) roosts and individuals due to lighting and noise/vibration		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	
	Baseline	Likely Future Ecological Environment	Baseline	Likely Future Ecological Environment
Level of effect prior to impact management	<p>The magnitude of effect is assessed as Negligible due to unlikely probability low frequency and local extent of disturbance.</p> <p>The ecological value of bats is assessed to be Very High, and the overall level of effect is assessed as Low for disturbance.</p>	Same as Baseline.	<p>The magnitude of effect is assessed as Low despite unlikely probability and localised consequences of fragmentation.</p> <p>The ecological value of bats is assessed to be Very High, and the overall level of effect is assessed as Moderate for additional loss in connectivity.</p>	Same as Baseline.
Impact management and residual level of effect	N/A	N/A	<p>A Bat Management Plan should be developed to include consideration for:</p> <ul style="list-style-type: none"> • Lighting design to minimise light levels and light spill along the road corridor. • Retention of large, mature trees where practicable, to act as hop overs. <p>The implementation of the proposed impact management measures will reduce the level of effect to Low.</p>	Same as Baseline.

Effect Description	Disturbance and displacement of (new and existing) roosts and individuals due to lighting and noise/vibration		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	
	Baseline	Likely Future Ecological Environment	Baseline	Likely Future Ecological Environment
Management of residual effect	N/A	N/A	N/A	N/A

10.3.2.2 Birds

Additional noise, vibration and lighting disturbance caused by the use of the upgraded road could potentially contribute to the displacement of native birds from suitable nesting and foraging habitat within and adjacent to the Coatesville-Riverhead NoR, while noise, light and vibration may also affect connectivity in the broader landscape. Table 10-12 outlines the operational effect assessment and impact management for birds.

Table 10-12 Assessment of ecological effects for birds and impact management during operation for the Coatesville-Riverhead NoR

Effect Description	Further disturbance and displacement to roosts and individual birds (existing) due to the presence of the road (noise, light, dust etc.)		Further 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	
	Baseline	Likely Future Ecological Environment	Baseline	Likely Future Ecological Environment
Level of effect prior to impact management	<p><u>Non-TAR birds</u></p> <p>The magnitude of effect is assessed as Low for as the Coatesville-Riverhead NoR is along an existing road and birds are likely to be habituated to noise, light and vibration from the road.</p> <p>The ecological value of birds in the context of habitat features are assessed to be Low, and the overall level of effect due to operational disturbance is assessed as Very Low prior to mitigation. As such no impact management is required.</p> <p><u>TAR birds (spotless crane)</u></p> <p>The magnitude of effect is assessed as Low due to a lower probability of disturbance.</p> <p>The ecological value of these species is High, and the overall level of effect is assessed as Low prior to mitigation. As such no impact management is required.</p>	Same as Baseline.	<p><u>Non-TAR birds</u></p> <p>The magnitude of effect is assessed as Low as the Coatesville-Riverhead NoR is along an existing road.</p> <p>The ecological value of birds in the context of habitat features are assessed to be Low, and the overall level of effect due to operational disturbance is assessed as Very Low prior to mitigation. As such no impact management is required.</p> <p><u>TAR birds (spotless crane)</u></p> <p>The magnitude of effect is assessed as Low due to a lower probability of connectivity loss for this species.</p> <p>The ecological value of these species is High, and the overall level of effect is assessed as Low prior to mitigation. As such no impact management is required.</p> <p><u>TAR birds (dabchick)</u></p> <p>The magnitude of effect is assessed as Negligible due to a lower</p>	Same as Baseline.

Effect Description	Further disturbance and displacement to roosts and individual birds (existing) due to the presence of the road (noise, light, dust etc.)		Further 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	
	Baseline	Likely Future Ecological Environment	Baseline	Likely Future Ecological Environment
	<p><u>TAR birds (dabchick)</u></p> <p>The magnitude of effect is assessed as Negligible due to a lower probability of disturbance.</p> <p>The ecological value of these species is Very High, and the overall level of effect is assessed as Low prior to mitigation. As such no impact management is required.</p>		<p>probability of connectivity loss for this species.</p> <p>The ecological value of these species is Very High, and the overall level of effect is assessed as Low prior to mitigation. As such no impact management is required.</p>	
Impact management and residual level of effect	N/A	N/A	N/A	N/A
Management of residual effect	N/A	N/A	N/A	N/A

10.3.2.3 Lizards

Suitable habitat (EG, ES, PL.3 and TL.3) was identified within the NoR boundary which could potentially support native lizards. Native lizards require vegetated corridors to facilitate natural dispersal, although they are considered to be relatively resident species and do not require migration or large-scale movement to support reproduction, refuge and feeding.

The Coatesville-Riverhead NoR includes upgrading the existing roads, therefore it is not expected to result in the additional fragmentation of lizard habitat. Similarly, resident (existing and future) lizards are likely to be habituated to disturbance such as noise, vibration and lighting and no additional effect on lizards is expected, provided that the post-upgraded road will not result in higher levels of noise and vibration. Table 10-13 outlines the operational effect assessment and impact management for lizards.

Table 10-13 Assessment of ecological effects for lizards and impact management during operation for the Coatesville-Riverhead NoR

Effect Description	Disturbance and displacement of existing and future lizards due to light, noise and vibration effects from the presence of the road		Further decrease in dispersal ability for existing and future lizard populations due to permanent habitat loss associated with the presence of the road	
	Baseline	Likely Future Ecological Environment	Baseline	Likely Future Ecological Environment
Level of effect prior to impact management	The magnitude of effect is assessed as Negligible as the Project is not expected to further exacerbate existing disturbance adjacent to the NoR. The ecological value of copper skinks and ornate skinks is assessed to be High , and the overall level of effect due to the presence of the road is assessed as Very Low prior to mitigation. As such no impact management is required.	Same as Baseline.	The magnitude of effect is assessed as Negligible as the Project is not expected to further exacerbate existing and future restrictions on lizard dispersal adjacent to the NoR. The ecological value of copper skinks and ornate skinks is assessed to be High , and the overall level of effect due to the presence of the road is assessed as Very Low prior to mitigation. As such no impact management is required.	Same as Baseline.
Impact management and residual level of effect	N/A	N/A	N/A	N/A
Management of residual effect	N/A	N/A	N/A	N/A

10.3.3 Conclusions

The ecological level of effects assessed as **Moderate**, **High** or **Very High** for the Coatesville-Riverhead NoR are described in Sections 10.3.3.1 and 10.3.3.2.

10.3.3.1 Long-tailed bats

- **Moderate** level of effect for noise and light disturbance of individual bats or roosts during construction for the Baseline and Future Environment.
- **Moderate** level of effect for mortality or injury to bats during construction due to removal of district plan vegetation for the Baseline and Future Environment.
- **Moderate** level of effect for the loss in connectivity to bats due to operational effects from the presence of the road for the Baseline and Future Environment.

The post mitigation level of effect is considered to be **Negligible** for mortality or injury effects during construction, **Negligible** for construction and operational related disturbance effects and **Low** for connectivity effects.

10.3.3.2 TAR birds (spotless crane, dabchick)

- **Moderate** (for Threatened - Nationally Increasing species) and **High** (for At Risk - Declining species) level of effect for noise and light disturbance of individual birds or roosts during construction for the Baseline and Future Environment.

The post mitigation level of effect is considered to be **Negligible** and **Low** for construction related connectivity effects.

10.3.4 Design and Future Regional Resource Consent Considerations

Ecological effects associated with activities that require regional consents and Wildlife Act Authority permits are briefly discussed in the section below. This section has informed the proposed designation boundary of the Coatesville-Riverhead Highway NoR.

10.3.4.1 Terrestrial Ecology

Construction of the Project will result in temporary and permanent loss of vegetation within the NoRs, including suitable habitat that is potentially being used by native fauna (bats, birds and lizards). Loss of vegetation that is subject to district plan controls is discussed in Section 10.3.1. The amounts and types of all³⁰ terrestrial habitat and vegetation (including habitat used by native fauna) that could be lost as a result of the Project is presented in Table 10-14 under the Footprint column. For context, the extent of similar habitat features is provided for the road footprint and the designation boundary.

The terrestrial vegetation to be lost (temporary and permanent) is comprised of both native and exotic vegetation which ranges from **Negligible** to **Moderate** ecological value (Section 10.2.2.3). Some of these areas are likely to provide habitat to native fauna, as discussed in Sections 10.3.4.2 to 10.3.4.4 below.

As the design develops and resource consent applications are prepared, more detailed habitat and fauna surveys may be required to inform an EclA (in line with the EclA Guidelines) which will be used to support future regional resource consent and wildlife permit applications (if required).

³⁰ Includes vegetation that is subject to district and regional plan controls as well as vegetation that can be removed as a permitted activity.

Table 10-14 Potential area of permanent terrestrial vegetation loss within the road footprint for the Coatesville-Riverhead NoR

Feature	Classification*	Footprint (m²)
Brown Field (includes cropland)	BF	8,710
Exotic Grassland	EG	24,062
Exotic Scrub	ES	Adjacent to road footprint.
Planted Vegetation – Exotic (amenity)	PL.3	24,475
Treeland – Exotic-Dominated	TL.3	15,163

Notes: * = Classification from Singers et al. (2017)

10.3.4.2 Bats

Mature trees in suitable habitat areas (TL.3) may provide potential habitat for bat roosts and facilitate bat movement in the broader landscape. The presence of bats should be re-assessed prior to obtaining any regional resource consents for vegetation removal within 20 m of riparian strips and to support an application for a wildlife permit. The loss of some of this habitat is already assessed because they are district plan trees.

10.3.4.3 Birds

Native birds are likely to be present within the NoR and utilise all identified terrestrial habitats (excluding brown fields). Vegetation clearance required for construction could result in the loss of these habitats of local value to native birds. The value of these habitats ranges from **Low** to **Moderate** value and any vegetation clearance within the bird nesting season (September – February) will need to be managed in accordance with the Wildlife Act 1953. The loss of some of this habitat is already assessed because they are district plan trees.

10.3.4.4 Lizards

Native lizards are likely to be present within vegetation impacted by the Project. Therefore, there is potential that site clearance required for construction could kill or injure native lizard species and result in the removal of their habitat. Any vegetation clearance where lizards are likely to occur will also need to be managed in accordance with the Wildlife Act 1953.

10.3.4.5 Freshwater Ecology

The construction of the Coatesville-Riverhead NoR will impact five existing streams, with **Moderate** ecological value. Stream reclamation is estimated at approximately 370 m. The predicted permanent and intermittent stream loss for the Project along is presented in Table 8-11. These calculations will require re-evaluation as part of the future regional consent process. It is expected that details regarding the offset/compensation requirements will be addressed during the future regional resource consent application.

During the detailed design phase, stream crossing plans (i.e., bridge or culvert) will be confirmed. Under a future regional consent for earthworks, impact management would also be required to ensure sediment discharge to streams is controlled appropriately.

Table 10-15 Potential stream loss (permanent and intermittent) within the Coatesville-Riverhead NoR

Stream ID	Hydroperiod	Ecological Value	Active channel width (m)*	Length to be lost (m)*	Loss (m²)*
R3-S1	Intermittent	Moderate	1	65	65
R3-S2	Intermittent	Moderate	1	60	60
R3-S3	Intermittent	Low	1	65	65
R3-S4	Permanent	Moderate	2	113	126
R3-S5	Permanent	High	2	70	140

10.3.4.6 Wetland Ecology

The construction of the Coatesville-Riverhead NoR will impact one **High** value natural wetland (R3-W1). Approximately 200 m² of wetland loss is unavoidable. It is expected that details regarding the offset/compensation requirements will be addressed during the future regional resource consent application.

11 Conclusion

Construction Effects

Table 11-1 to Table 11-4 provides a summary of district matter ecological effects during construction prior to any mitigation. The summary represents the level of effect for the baseline and likely future ecological environment activities as one where they are the same. Construction effect mitigation measures will include:

- A Bat Management Plan (BMP) for Coatesville-Riverhead. Details of the BMP will depend on bat habitat within the future environment and is likely to include bat habitat surveys prior to construction, siting of compounds and laydown areas to avoid bat habitat, lighting design to reduce light levels and spill from construction areas and restriction of nightworks around treeland bat habitat.
- Bird management will be required for Don Buck Road (stormwater upgrade in Rush Creek Reserve – potential presence of dabchick) and Coatesville-Riverhead (in areas where construction is adjacent to open water and wetland – potential presence of dabchick/spotless crane). Considerations for bird management will include avoiding the bird breeding season (September to February) during construction (as it relates to the existing stormwater pond), or bird survey prior to construction to confirm TAR species are not present and to provide guidance if TAR species are present.

Table 11-1 Summary of ecological effects during construction prior to mitigation for district plan vegetation removal

Construction - Terrestrial vegetation (district plan vegetation only)	
NoR	Permanent loss of habitat/ecosystem, fragmentation, and edge effects due to vegetation removal (district plan vegetation only)
Don Buck (R1)	Low
Fred Taylor (R2)	Very Low
Coatesville-Riverhead (R3)	Low

Table 11-2 Summary of ecological effects during construction prior to mitigation for bats (NoR-R3 only)

Construction - Bats			
NoR	Disturbance and displacement to roosts and individuals (existing) due to construction activities (noise, light, dust etc.)	Loss of foraging habitat due to removal of district plan vegetation	Mortality or injury to bats due to removal of district plan vegetation
Coatesville-Riverhead (R3)	Moderate	Low	Moderate

Table 11-3 Summary of ecological effects during construction prior to mitigation for birds

Construction - Birds					
NoR	Disturbance and displacement to roosts and individuals (existing) due to construction activities (noise, light, dust etc.) - non-TAR birds	Disturbance and displacement to roosts and individuals (existing) due to construction activities (noise, light, dust etc.) – TAR birds	Loss of foraging habitat due to removal of district plan vegetation	Nest loss due to removal of district plan vegetation	Mortality or injury to birds due to removal of district plan vegetation
Don Buck (R1)	Very Low	Moderate	Low	Low	Low
Fred Taylor (R2)	Very Low	-	Very Low	Very Low	Very Low
Coatesville-Riverhead (R3)	Low	Moderate (Threatened), High (At Risk)	Low	Low	Low

Table 11-4 Summary of ecological effects during construction prior to mitigation for lizards

Construction – Lizards	
NoR	Disturbance and displacement of individuals (existing) adjacent to construction activities (noise, dust etc.)
Don Buck (R1)	Very Low
Fred Taylor (R2)	Very Low
Coatesville-Riverhead (R3)	Very Low

The residual (post-mitigation) level of effect for all construction effects are considered **Negligible** or **Low**.

Operational Effects

Table 11-5 to Table 11-7 provides summary of district matter operational effects due to the presence of road resulting in disturbance or loss in connectivity to bats, birds and lizards.

Operational effects mitigation measures will include a BMP. The BMP will include buffer planting along road corridors associated with stream crossings, lighting design along strategic location of the road (stream crossings) and retention of large, mature trees (specifically TL3 stands) where practicable.

Table 11-5 Summary of ecological effects during operation prior to mitigation for bats (Coatesville-Riverhead NoR only)

Operation - Bats		
NoR	Disturbance and displacement of (new and existing) roosts and individuals due to lighting and noise/vibration	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
Coatesville-Riverhead (R3)	Low	Moderate

Table 11-6 Summary of ecological effects during operation prior to mitigation for birds

Operation - Birds		
NoR	Disturbance and displacement to roosts and individual birds (existing) due to the presence of the road (noise, light, dust etc.)	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
Don Buck (R1)	Very Low (Non-TAR species), Low (TAR Species)	Very Low (Non-TAR species), Low (TAR Species)
Fred Taylor (R2)	Very Low	Very Low
Coatesville-Riverhead (R3)	Very Low	Very Low

Table 11-7 Summary of ecological effects during operation prior to mitigation for lizards

Operation - Lizards		
NoR	Disturbance and displacement to roosts and individual birds (existing) due to the presence of the road (noise, light, dust etc.)	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
Don Buck (R1)	Very Low	Very Low
Fred Taylor (R2)	Very Low	Very Low
Coatesville-Riverhead (R3)	Very Low	Very Low

The residual (post-mitigation) level of effect for operational effects are considered **Low** or **Very Low**.

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1 Appendix 1 - Ecological Impact Assessment Methodology

The standard by which this EclA was undertaken follows the guidelines published by the Environment Institute of Australia and New Zealand (EIANZ Guidelines) (EIANZ, 2018).

1.1 Assessment of Ecological Value

The first step in the EclA approach is to assess the value of ecological features in terms of Representativeness, Rarity, Diversity and Pattern, and Ecological context. Details on each matter and its associated considerations are provided in Table 12-1 for terrestrial ecological value and Table 12-2 freshwater ecological value

Table 12-1 Matters and considerations for the assessment of terrestrial ecological value

Representativeness
Typical structure and composition
Indigenous representation
Rarity/distinctiveness
Species of conservation significance
Range restricted or endemic species
Distinctive ecological values
Diversity and pattern
Habitat diversity
Species diversity
Patterns in habitat use
Ecological context
Size, shape and buffering
Sensitivity to change
Ecological networks (linkages, pathways, migration)

Table 12-2 Matters and considerations for the assessment of freshwater ecological value

Representativeness (including SEV, RHA and ecological integrity)
Extent to which site/catchment is typical of characteristic
Instream habitat modification
Riparian habitat modification

Representativeness (including SEV, RHA and ecological integrity)
Hydrological modification
Catchment conditions
Geomorphological modification
Water quality modification
Presence of alien and invasive species
Invertebrate assemblage representation
Fish assemblage representation
Rarity/descriptiveness
Pool characterisation
Species of conservation significance
Range restricted or endemic species
Stream type (rare or distinctive)
Diversity and pattern
Distinctive ecological values
Level of natural diversity
Diversity metrics
Complexity of community
Ecological context (Ecosystem services, importance sensitivity)
Stream order
Catchment size
Hydroperiod
Sensitivity to flow modification
Sensitivity water quality modification
Sensitivity to sedimentation/erosion
Connectivity and migration

1.2 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 is outlined in the following sections.

Basic impact characteristic terminology and respective descriptors are in line with the EIANZ Guidelines and are provided in Table 12-3.

Table 12-3 Magnitude of effect assessment terminology

Characteristic	Definition	Designations
Type	A descriptor indicating the relationship of the impact to the Project (in terms of cause and effect)	Direct
		Indirect
Extent	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)
		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 descriptors, the characteristics of each effect are used to assign a magnitude to the specific effect. Magnitude designations are provided in Table 12-4.

Table 12-4: Magnitude of effect designations

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
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

The magnitude of an effect is considered in relation to the ecological value of the habitat or receptor to be impacted on (Section). The ecological value of habitat or receptors are the primary focus of the ecological assessment. The ecological value of habitat or receptors are typically expressed on a local, district, regional or national scale. The ecological value designations are provided in Table 12-5.

Table 12-5: Ecological value designations

Value	Description
Very high	Area rates High for three or all the four assessment matters. Likely to be of National importance and recognised as such
High	Area rates High for two of the assessment matters, Moderate and Low for the remainder or Area rates High for 1 so the assessment matters, moderate for the remainder. Likely to be regionally important and recognised as such
Moderate	Area rates High for one matter, Moderate and Low Dortha remainder, or Area rates Moderate for 2 or more assessment matters Low or Very low for the remainder. Likely to be important at the level of the Ecological District
Low	Area rates Low or Very low for most assessment matters and Moderate for one. Limited ecological value other as local habitat for tolerant species
Negligible	Area rates Very low for three matters and Moderate, Low or Very low for the remainder

Once magnitude of effect and the ecological value of the habitat or receptor have been determined, the level of effect can be assigned for each effect using the matrix shown in Table 12-6.

Table 12-6 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

From Table 12-6, the level of effect designations are defined below:

- **Negligible:** An effect of negligible consequence is one where habitat or receptors will not be affected in any meaningful way by a Project activity or the predicted effect is indistinguishable from natural background variations;
- **Low:** An effect of minor consequence is one where habitat or receptors will experience a noticeable effect, but the effect magnitude is sufficiently small (with or without mitigation) and/or the resource/receptor is of low ecological value. In either case, the magnitude should be well within applicable standards;
- **Moderate:** An effect of moderate consequence has an effect magnitude that is within applicable standards but higher than that of a minor effect. The emphasis for moderate effects is to show that the effect has been reduced or minimised in line with the mitigation hierarchy;
- **High:** A high level of effect of is one where an accepted limit or standard may be exceeded, or moderate magnitude of effect will occur to moderate or high value habitat or receptors;
- **Very High:** A very high level of effect will occur when the magnitude and value of effects are assessed as high or very high. Typically, very high level of effects notably exceeds standard limits.

1.3 Impact Management

Informed by the level of effects suitable impact management measures are provided consistent with the mitigation hierarchy. The priority in mitigation is to first apply mitigation measures to the source of the impact (avoid) and then to address the resultant effects (reduce or minimise) of the impact.

1.4 Residual Impacts

Once mitigation measures are declared, the next step in the effect assessment process was to assign residual impact significance. This is a repeat of the impact assessment steps discussed above, considering the assumed implementation of the additional recommended mitigation measures.

1.5 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.

1.6 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 structured methods were employed to assess cumulative impacts, but where relevant descriptions of potential cumulative effects have been provided.

2 Appendix 2 – Auckland Unitary Plan Activities

The following tables specify the activity status of land use and activities relevant to the Riverhead Redhills Assessment Package as set out in the AUP:OP and any permitted standards or matters of control/discretion.

The following abbreviations are used to identify the class of activity:

Activity Class Abbreviation	Meaning
P	Permitted Activity
C	Controlled Activity
RD	Restricted Discretionary Activity
D	Discretionary Activity
NC	Non-complying Activity
Pr	Prohibited Activity

Auckland Unitary Plan – E26 Infrastructure

Table E26.4.3.1 below is relevant for considering effects and recommending mitigation in relation to tree removal. Note that, except for Trees in Roads, in Open Space Zones and Notable Trees, trees are not protected under the AUP.

Table E26.4.3.1 Activity table - Network utilities and electricity generation – Trees in roads and open space zones and the Notable Trees Overlay

Activity	Activity Status			Permitted Standards or Matters of Discretion / Control
	Trees in roads [dp]	Open space zones [dp]	Notable trees [dp]	
(A89) Tree removal of Notable Trees	N/A	N/A	D	N/A
(A90) Tree trimming, alteration or removal on roads adjoining rural zones and on roads adjoining the Future Urban Zone	P	N/A	N/A	N/A
(A91) Tree alteration or removal of any tree less than 4m in height and/or less than 400mm in girth	P	P	RD	N/A
(A92) Tree alteration or removal of any tree greater than 4m in height and/or greater than 400mm in girth	RD	RD	N/A	N/A
(A93) Tree trimming, alteration and removal not otherwise provided for	D	D	D	N/A

Auckland Unitary Plan – E26 Infrastructure

The table below is relevant for considering effects and recommending mitigation in relation to vegetation clearance. Also refer to Table E15.4.1.

Table E26.3.3.1 Activity table – Network utilities and electricity generation and vegetation management

Activity	Activity Status						Permitted Standards
	Rural zones, coastal areas and riparian areas [rp]	SEA [rp]	ONF [dp]	HNC [dp]	ONL [dp]	ONC [dp]	
(A76) Vegetation alteration or removal	P	P	P	P	P	P	Refer to E26.3.5.4. Vegetation alteration or removal for Permitted Activity Standards
(A77) Vegetation alteration or removal that does not comply with Standards E26.3.5.1 to E26.3.5.4	RD	RD	RD	RD	RD	RD	
(A78) Vegetation alteration or removal not otherwise provided for	D	D	D	D	D	D	

Note: Greyed-out boxes relate to Regional Activities which are not considered as part of the NoR and will be relevant for future Regional Resource Consents.

Auckland Unitary Plan – E15 Vegetation management and biodiversity

Table E15.4.1 below is relevant for considering effects of activities over and above those that are permitted and recommending mitigation in relation to vegetation clearance in urban and FUZ zones, and adjacent to riparian areas.

Table E15.4.1 Activity table - Auckland-wide vegetation and biodiversity management rules

Activity	Activity Status	Permitted Standards
Riparian areas (as described below)		
(A16) Vegetation alteration or removal within 20m of rural streams, other than those in Rural – Rural Production Zone and Rural – Mixed Rural Zone	RD	N/A

Activity	Activity Status	Permitted Standards
(A17) Vegetation alteration or removal within 10m of rural streams in the Rural – Rural Production Zone and Rural – Mixed Rural Zone	RD	N/A
(A18) Vegetation alteration or removal within 20m of a natural wetland, in the bed of a river or stream (permanent or intermittent), or lake	RD	N/A
(A19) Vegetation alteration or removal within 10m of urban streams	RD	N/A
All other zones and areas not covered above (i.e. Urban Zones and FUZ)		
(A22A) Vegetation alteration or removal	P	Refer to E15.6. Vegetation alteration or removal for Permitted Activity Standards
All areas		
(A23) Permitted activities in Table E15.4.1 that do not comply with one or more of the standards in E15.6	RD	N/A

Auckland Unitary Plan – E26 Infrastructure - Earthworks

The table below is relevant for considering effects of activities over and above those that are permitted and recommending mitigation in relation to earthworks.

Table E26.5.3.1 Activity table - Earthworks all zones and roads [dp]

Activity	Activity Status	Permitted Standards
(A95) Earthworks up to 2500 m ² other than for maintenance, repair, renewal, minor infrastructure upgrading	P	Refer to E26.5.5.2. General standards (District)
(A96) Earthworks up to 2500 m ³ other than for maintenance, repair, renewal, minor infrastructure upgrading	P	Refer to E26.5.5.2. General standards (District)
(A97) Earthworks greater than 2500 m ² other than for maintenance, repair, renewal, minor infrastructure upgrading	RD	
(A97A) Earthworks greater than 2500 m ³ other than for maintenance, repair, renewal, minor infrastructure upgrading	RD	

3 Appendix 3 – Regional Plan, District Plan and Wildlife Act Matters

Table 12-7 Ecological effects of road infrastructure construction broken down into AUP:OP Regional and District Plan matters

Ecological feature	Activity	Ecological Effect	AUP:OP District Plan provisions	AUP:OP Regional Plan provisions	Wildlife Act (1953)
Construction					
Terrestrial habitat	Vegetation removal (including trees) outside of roads and public spaces in: a) a rural zone b) riparian margins c) coastal areas d) SEAs This also includes other terrestrial habitat of value identified in the EclA.	Permanent loss of habitat/ecosystem, fragmentation and edge effects.		✓	
	Vegetation removal (including trees) in: a) Roads b) Public spaces c) ONFs d) ONLs e) HNCs f) ONCs	Permanent loss of habitat/ecosystem, fragmentation and edge effects.	✓		
	Earthworks – leading to invasion of bare earth surfaces with weeds and transfer of weeds (seeds and fragments) between earthworks areas.	Weed dispersal to previously unaffected areas of indigenous vegetation, reduction in terrestrial biodiversity.		✓	
Bats	Vegetation removal.	Roost loss.		✓	✓
	Vegetation removal.	Kill or injure individual.			✓
	Vegetation removal.	Loss of foraging habitat.		✓	
	Construction activities (Noise, light, dust etc.).	Disturbance and displacement to roosts and to individuals (existing).	✓		✓
Birds (native)	Vegetation removal.	Nest loss.		✓	✓
	Vegetation removal.	Kill or injure individual.			✓
	Vegetation removal.	Loss of foraging habitat.		✓	

Ecological feature	Activity	Ecological Effect	AUP:OP District Plan provisions	AUP:OP Regional Plan provisions	Wildlife Act (1953)
	Construction activities (noise, light, dust etc).	Disturbance and displacement of roosts and individuals (existing).	✓		✓
Herpetofauna (native)	Vegetation removal.	Lizard habitat loss		✓	
	Vegetation removal.	Kill or injure individual			✓
	Construction activities (noise, light, dust etc).	Disturbance and displacement of individuals (existing).	✓		✓
	Reclamation/culverting/other structures e.g., bank armouring.	Permanent loss/modification of habitat/ecosystem.		✓	
Freshwater habitat – wetland or stream (including riparian margins)	Vegetation removal.	Permanent loss of habitat/ecosystem, fragmentation and edge effects.		✓	
	Construction activities – earthworks (leading to sediment discharge), machinery use and chemical storage (leading to leaks/spills).	Uncontrolled discharge leading to habitat and water quality degradation.		✓	
	Diversion, abstraction or bunding of watercourses and water level/flow/periodicity changes.	Detrimental effects on habitats including plant composition and fauna.		✓	
Fish (native)	Reclamation/diversion/other structures e.g., bank armouring.	Loss of aquatic habitat.		✓	
	Reclamation/diversion/culverting/other structures e.g., bank armouring.	Kill or injure individual.			✓
Operation					
Terrestrial habitat	Presence of the road - use of road edges as dispersal corridors by invasive plant species.	Weed dispersal to previously unaffected areas of indigenous vegetation, reduction in terrestrial biodiversity.		✓	
	Road maintenance - increased use of herbicides.	Increased weed incursion, unintentional spray of indigenous vegetation.		✓	
Bats	Vehicle movement.	Kill or injure individual.			✓
	Presence of the road.	Loss in connectivity due to permanent habitat	✓		✓

Ecological feature	Activity	Ecological Effect	AUP:OP District Plan provisions	AUP:OP Regional Plan provisions	Wildlife Act (1953)
		loss, light and noise effects from the road, leading to fragmentation of terrestrial, wetland and riparian habitat.			
	Lighting and noise/vibration.	Disturbance and displacement of (new and existing) roosts and individuals.	✓		✓
Birds (native)	Vehicle movement.	Kill or injure individual.			✓
	Presence of the road.	Loss in connectivity due to permanent habitat loss, light and noise effects from the road, leading to fragmentation of terrestrial, wetland and riparian habitat.	✓		✓
	Lighting and noise/vibration.	Disturbance and displacement of (new and existing) nests and individuals.	✓		✓
Herpetofauna (native)	Vehicle movement.	Kill or injure individual.			✓
	Presence of the road.	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.	✓		✓
	Lighting.	Disturbance of nocturnal lizard behaviour.	✓		✓
Freshwater habitat – wetland or stream (including riparian margins)	Vehicle (cartage) movement - risk of spills of potential toxins (oil, milk, chemicals).	Temporary degradation of instream/wetland habitat and water quality.		✓	
	Presence of bridge.	Shading leading to change in ecosystem structure.		✓	
	Gradual change in hydrology from presence of the road/stormwater, including reclamations.	Effect on downstream habitat (including erosion/sediment discharge) due to change in hydrology (increase or decrease).		✓	
	Stormwater discharges - pollutants (such as heavy metals and herbicides).	Permanent degradation of wetland or instream habitat and water quality.		✓	

Ecological feature	Activity	Ecological Effect	AUP:OP District Plan provisions	AUP:OP Regional Plan provisions	Wildlife Act (1953)
Fish (native)	Presence of culvert.	Loss of connectivity due to culvert preventing fish passage up and downstream.		✓	

4 Appendix 4 - Desktop Bird Records

Table 12-8 Desktop bird records within 5 km of each NoR

Common Name	Maori Name	Scientific Name	Conservation Status	Record Source
Barbary dove	-	<i>Streptopelia risoria</i>	Introduced and Naturalised	eBird (Bird Atlas)
Black shag	Kawau	<i>Phalacrocorax carbo novaehollandiae</i>	At Risk - Naturally Uncommon	eBird (Bird Atlas)
Black-billed gull	Tarāpuka	<i>Larus bulleri</i>	Threatened - Nationally Critical	eBird (Bird Atlas)
Blackbird	Manu pango	<i>Turdus merula</i>	Introduced and Naturalised	eBird (Bird Atlas), iNaturalist
California quail	-	<i>Callipepla californica</i>	Introduced and Naturalised	eBird (Bird Atlas), iNaturalist
Canada goose	-	<i>Branta canadensis</i>	Introduced and Naturalised	eBird (Bird Atlas), iNaturalist
Caspian tern	Taranui	<i>Hydroprogne caspia</i>	Threatened - Nationally Vulnerable	eBird (Bird Atlas)
Chaffinch	Pahirini	<i>Fringilla coelebs</i>	Introduced and Naturalised	eBird (Bird Atlas), iNaturalist
Common pheasant	Peihana	<i>Phasianus colchicus</i>	Introduced and Naturalised	eBird (Bird Atlas), iNaturalist
Cook's petrel	Tītī	<i>Pterodroma cookii</i>	At Risk - Relict	eBird (Bird Atlas)
Dunnock	-	<i>Prunella modularis</i>	Introduced and Naturalised	eBird (Bird Atlas)
Eastern rosella	-	<i>Platycercus eximius</i>	Introduced and Naturalised	eBird (Bird Atlas)
Fantail	Pīwakawaka	<i>Rhipidura fuliginosa placabilis</i>	Not Threatened	eBird (Bird Atlas), iNaturalist
Goldfinch	-	<i>Carduelis carduelis</i>	Introduced and Naturalised	eBird (Bird Atlas)
Greenfinch	-	<i>Carduelis chloris</i>	Introduced and Naturalised	eBird (Bird Atlas)
Grey duck	Pārera	<i>Anas superciliosa</i>	Threatened - Nationally Critical	eBird (Bird Atlas)

Common Name	Maori Name	Scientific Name	Conservation Status	Record Source
Grey warbler	Riroriro	<i>Gerygone igata</i>	Not Threatened	eBird (Bird Atlas), iNaturalist
House sparrow	Tiu	<i>Fringilla coelebs</i>	Introduced and Naturalised	eBird (Bird Atlas)
Kingfisher	Kōtare	<i>Todiramphus sanctus vagans</i>	Not Threatened	eBird (Bird Atlas), iNaturalist
Little black shag	Kawau tūī	<i>Phalacrocorax sulcirostris</i>	At Risk - Naturally Uncommon	eBird (Bird Atlas), iNaturalist
Little pied cormorant	Kawau paka	<i>Phalacrocorax melanoleucos melanoleucos</i>	Vagrant	eBird (Bird Atlas)
Magpie	Makipae	<i>Gymnorhina tibicen</i>	Introduced and Naturalised	eBird (Bird Atlas), iNaturalist
Mallard	-	<i>Anas platyrhynchos</i>	Introduced and Naturalised	eBird (Bird Atlas), iNaturalist
Morepork	Ruru	<i>Ninox novaeseelandiae novaeseelandiae</i>	Not Threatened	eBird (Bird Atlas)
Muscovy duck	-	<i>Cairina moschata</i>	Introduced, not established	eBird (Bird Atlas), iNaturalist
Myna	-	<i>Acridotheres tristis</i>	Introduced and Naturalised	eBird (Bird Atlas), iNaturalist
New Zealand pigeon	Kereru	<i>Hemiphaga novaeseelandiae</i>	Not Threatened	eBird (Bird Atlas), iNaturalist
Northern New Zealand dotterel	Tūturiwhatu	<i>Charadrius obscurus aquilonius</i>	At Risk - Recovering	eBird (Bird Atlas), iNaturalist
Paradise shelduck	Pūtangitangi	<i>Tadorna variegata</i>	Not Threatened	eBird (Bird Atlas)
Pied shag	Kāruhiruhi	<i>Phalacrocorax varius varius</i>	At Risk - Recovering	eBird (Bird Atlas), iNaturalist
Pied stilt	Poaka	<i>Himantopus himantopus leucocephalus</i>	Not Threatened	eBird (Bird Atlas), iNaturalist
Pūkeko	Pūkeko	<i>Porphyrio melanotus melanotus</i>	Not Threatened	eBird (Bird Atlas), iNaturalist

Common Name	Maori Name	Scientific Name	Conservation Status	Record Source
Red-billed gull	Tarāpunga	<i>Larus novaehollandiae scopulinus</i>	At Risk - Declining	eBird (Bird Atlas), iNaturalist
Rock pigeon	-	<i>Columba livia</i>	Introduced and Naturalised	eBird (Bird Atlas)
Royal spoonbill	Kōtuku ngutupapa	<i>Platalea regia</i>	At Risk - Naturally Uncommon	eBird (Bird Atlas)
Shining cuckoo	Pīpīwharau	<i>Chrysococcyx lucidus lucidus</i>	Not Threatened	eBird (Bird Atlas)
Silvereye	Tauhou	<i>Zosterops lateralis lateralis</i>	Not Threatened	eBird (Bird Atlas)
Skylark	Kaireka	<i>Alauda arvensis</i>	Introduced and Naturalised	eBird (Bird Atlas)
Song thrush	-	<i>Turdus philomelos</i>	Introduced and Naturalised	eBird (Bird Atlas), iNaturalist
South Island pied oystercatcher	Tōrea	<i>Haematopus finschi</i>	At Risk - Declining	eBird (Bird Atlas), iNaturalist
Southern black-backed gull	Karoro	<i>Larus dominicanus dominicanus</i>	Not Threatened	eBird (Bird Atlas), iNaturalist
Spotted dove	-	<i>Streptopelia chinensis tigrina</i>	Introduced and Naturalised	eBird (Bird Atlas)
Spur winged plover	-	<i>Vanellus miles novaehollandiae</i>	Not Threatened	eBird (Bird Atlas), iNaturalist
Starling	-	<i>Sturnus vulgaris</i>	Introduced and Naturalised	eBird (Bird Atlas), iNaturalist
Swamp harrier	Kāhu	<i>Circus approximans</i>	Not Threatened	eBird (Bird Atlas)
Tomtit	Ngirungiru	<i>Petroica macrocephala</i>	Not Threatened	eBird (Bird Atlas)
Tūī	Tūī	<i>Prosthemadera novaeseelandiae novaeseelandiae</i>	Not Threatened	eBird (Bird Atlas), iNaturalist
Variable oystercatcher	Tōrea pango	<i>Haematopus unicolor</i>	At Risk - Recovering	eBird (Bird Atlas)
Welcome swallow	Warou	<i>Hirundo neoxena neoxena</i>	Not Threatened	eBird (Bird Atlas)

Common Name	Maori Name	Scientific Name	Conservation Status	Record Source
White-faced heron	Matuku moana	<i>Egretta novaehollandiae</i>	Not Threatened	eBird (Bird Atlas), iNaturalist
White-fronted tern	Tara	<i>Sterna striata striata</i>	At Risk - Declining	eBird (Bird Atlas)
Wrybill	Ngutuparore	<i>Anarhynchus frontalis</i>	Threatened - Nationally Vulnerable	eBird (Bird Atlas)
Yellowhammer	-	<i>Emberiza citrinella</i>	Introduced and Naturalised	eBird (Bird Atlas)

5 Appendix 5 - Riverhead Redhills Ecological Habitat Maps

5.1 NoR RE1: Don Buck Road FTN Upgrade

5.1.1 Terrestrial Vegetation

Path: P:\381\381034\TGM02 Data\1 Data Processing 550 Plus\558_Ecology_Mapping_NW_Strategic\SGA_NW_Strategic_Impacted_Habitats.aprx



LEGEND

— Route Options
□ Designation

BF
EG

PL.1
PL.3

TL.3

0 80 160
Metres

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5.1.2 Terrestrial Vegetation (District Plan Vegetation)

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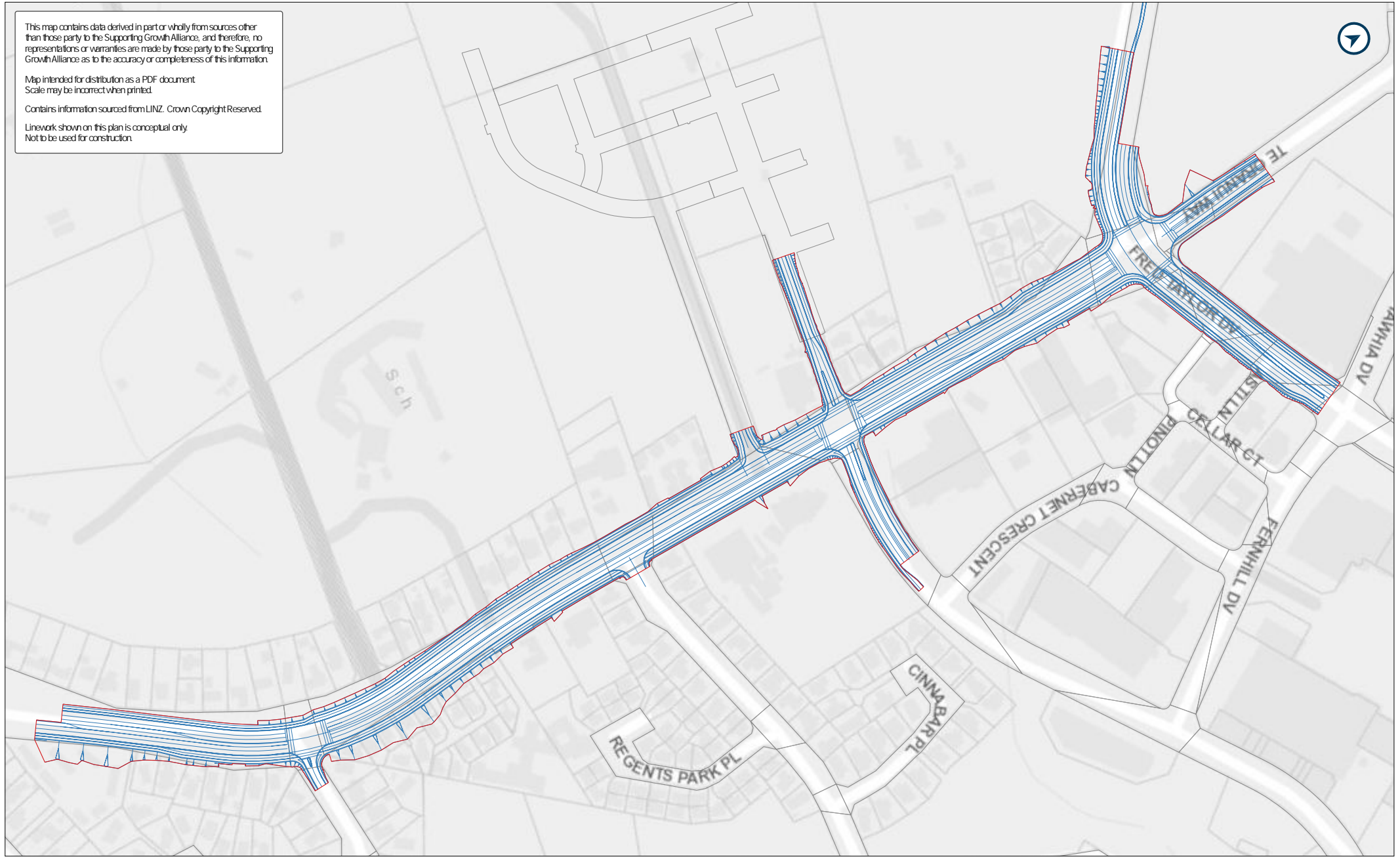
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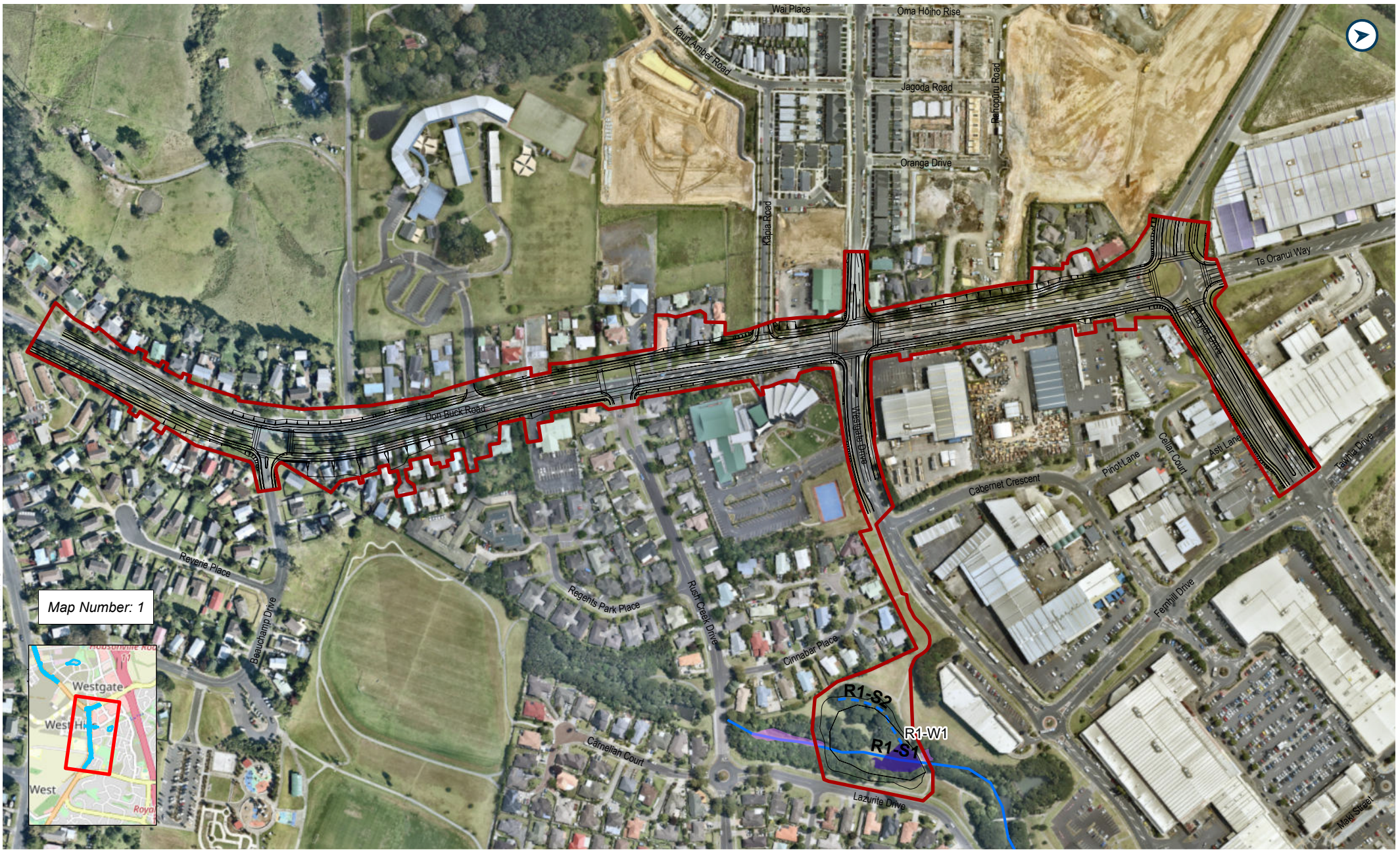


LEGEND

- Route Option
- Design Boundary
- Road

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Kilometres

5.1.3 Freshwater Streams and Wetland Habitat



Map Number: 1

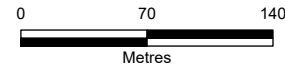


LEGEND

- Route Options
- Designation

- Intermittent
- Permanent

- EW
- OW



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5.2 NoR RE2: Fred Taylor Drive FTN Upgrade

5.2.1 Terrestrial Vegetation

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LEGEND

— Route Options
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Metres

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Map Number: 2



LEGEND

- Route Options
- Designation

BF
EG

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TL.2
TL.3

0 80 160
Metres

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5.2.2 Terrestrial Vegetation (District Plan Vegetation)

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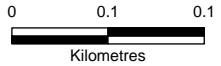


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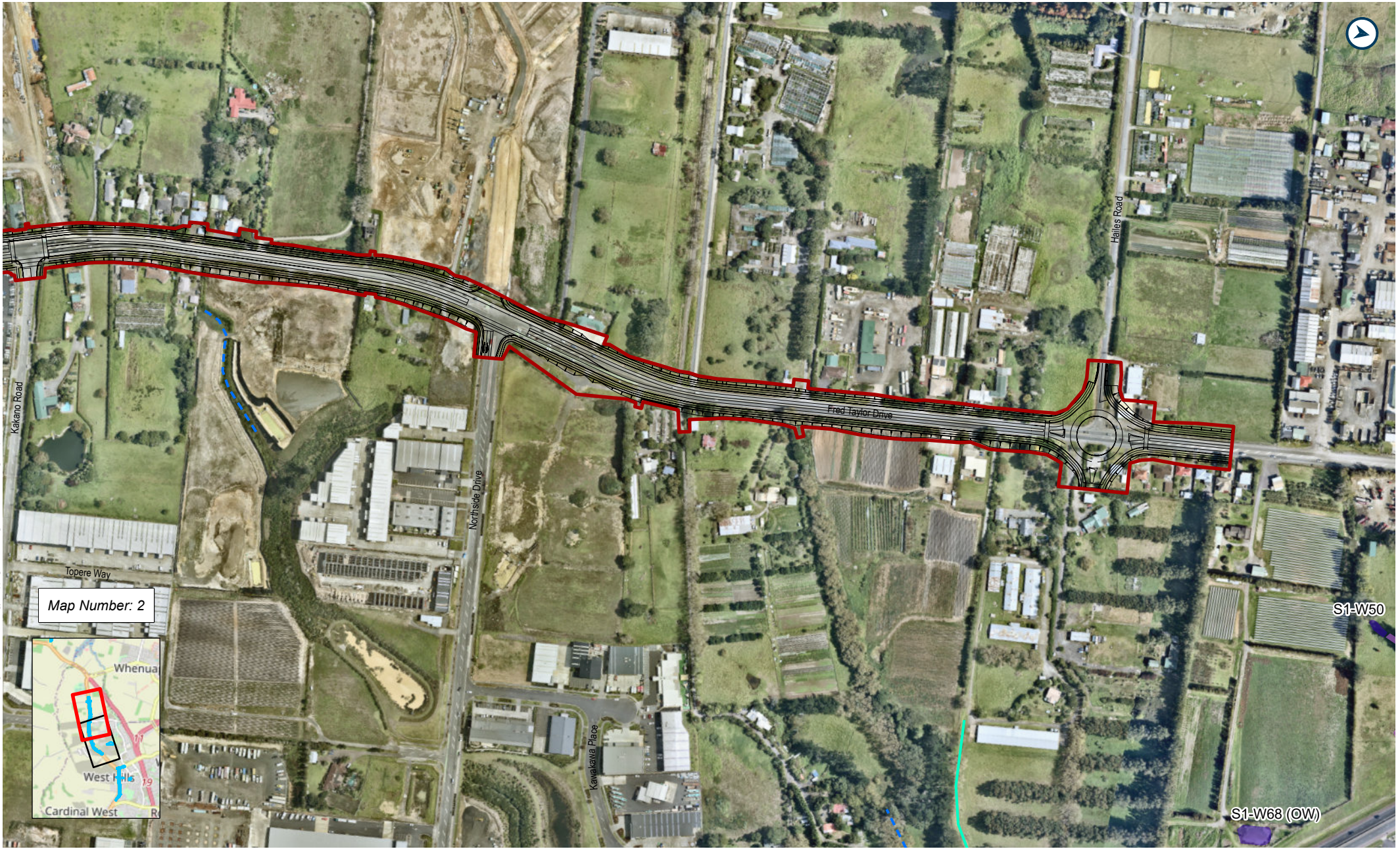
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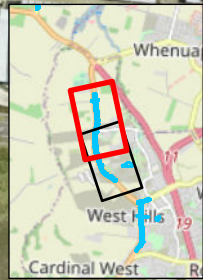
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- TL. 2_DPT
- TL. 3_DPT
- Route Option
- Design Boundary
- Road

5.2.3 Freshwater Streams and Wetland Habitat



Map Number: 2




S1-W50

S1-W68 (OW)

LEGEND

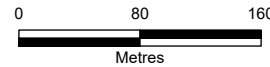
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 Designation

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 Intermittent

 EW
 OW



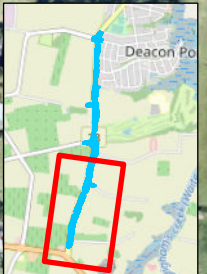
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5.3 NoR R1: Coatesville-Riverhead Highway Upgrade

5.3.1 Terrestrial Vegetation



Map Number: 1



LEGEND

- Route Options
- Designation

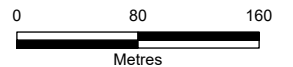
Habitat mapping

- BF

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PL3

TL3



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Path: P:\381\381034\TGM02\Detail\ Data Processing 550 Plus\558_Ecology_Mapping_NW_Strategic\SGA_NW_Strategic_Impacted_Habitats.aprx



Map Number: 2



LEGEND

— Route Options
□ Designation

Habitat mapping
□ BF

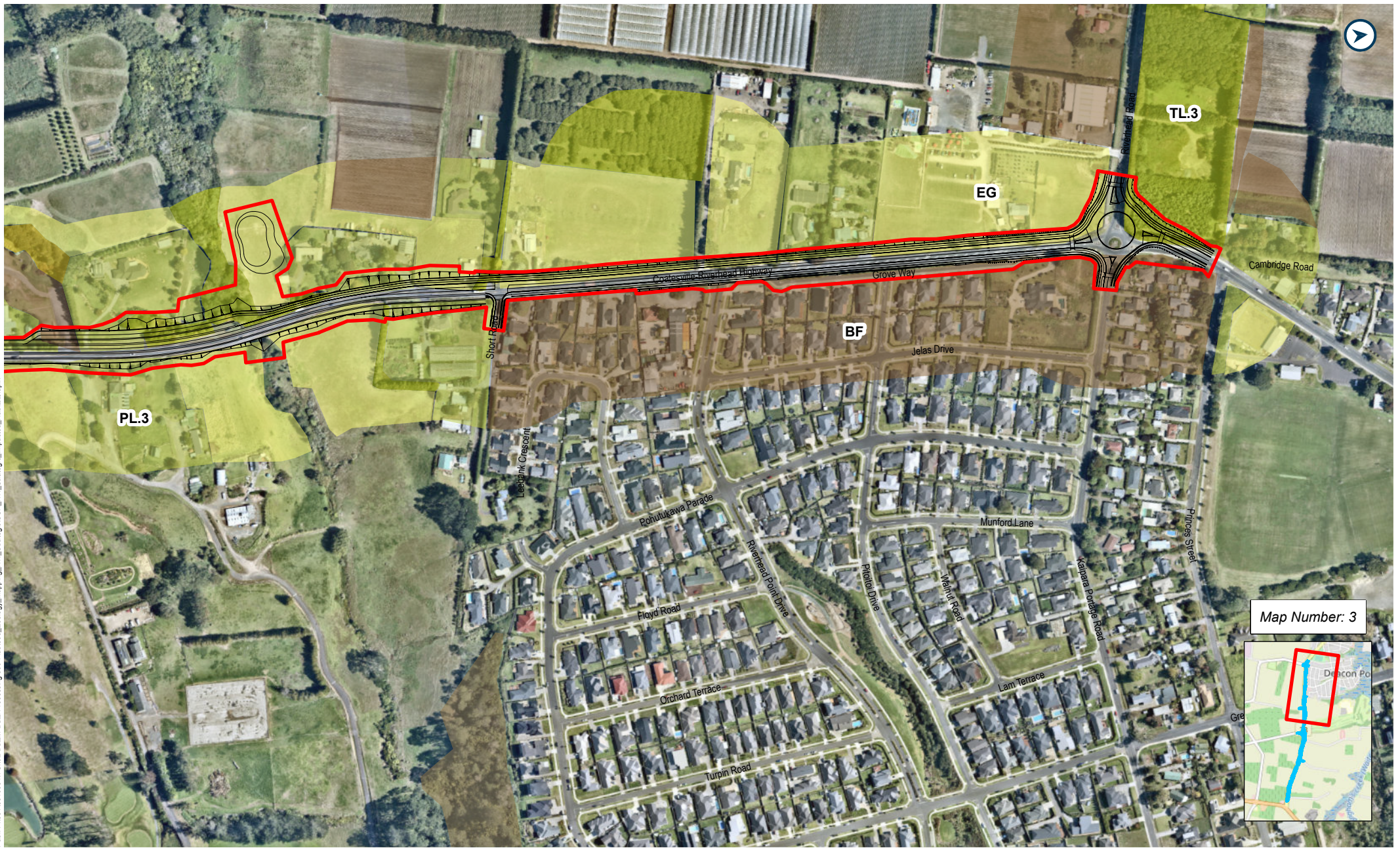
□ EG
□ ES

□ PL.3
□ TL.3

□ VS5

0 80 160
Metres

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LEGEND

— Route Options
□ Designation

Habitat mapping
□ BF

□ EG
□ ES

□ PL.3
□ TL.3

□ VS5

0 80 160
Metres

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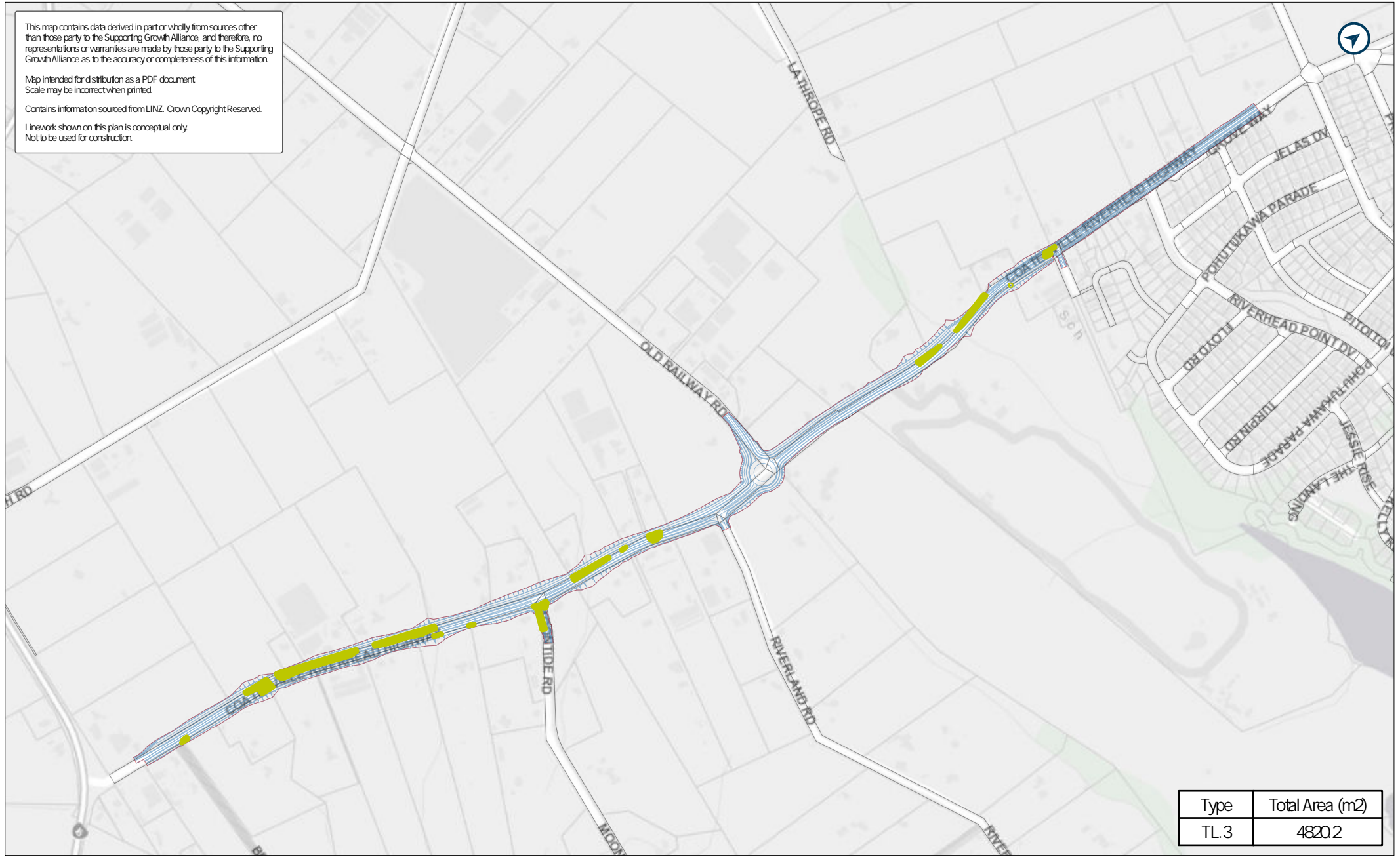
5.3.2 Terrestrial Vegetation (District Plan Vegetation)

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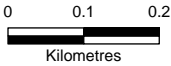
Map intended for distribution as a PDF document.
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Linework shown on this plan is conceptual only.
Not to be used for construction.



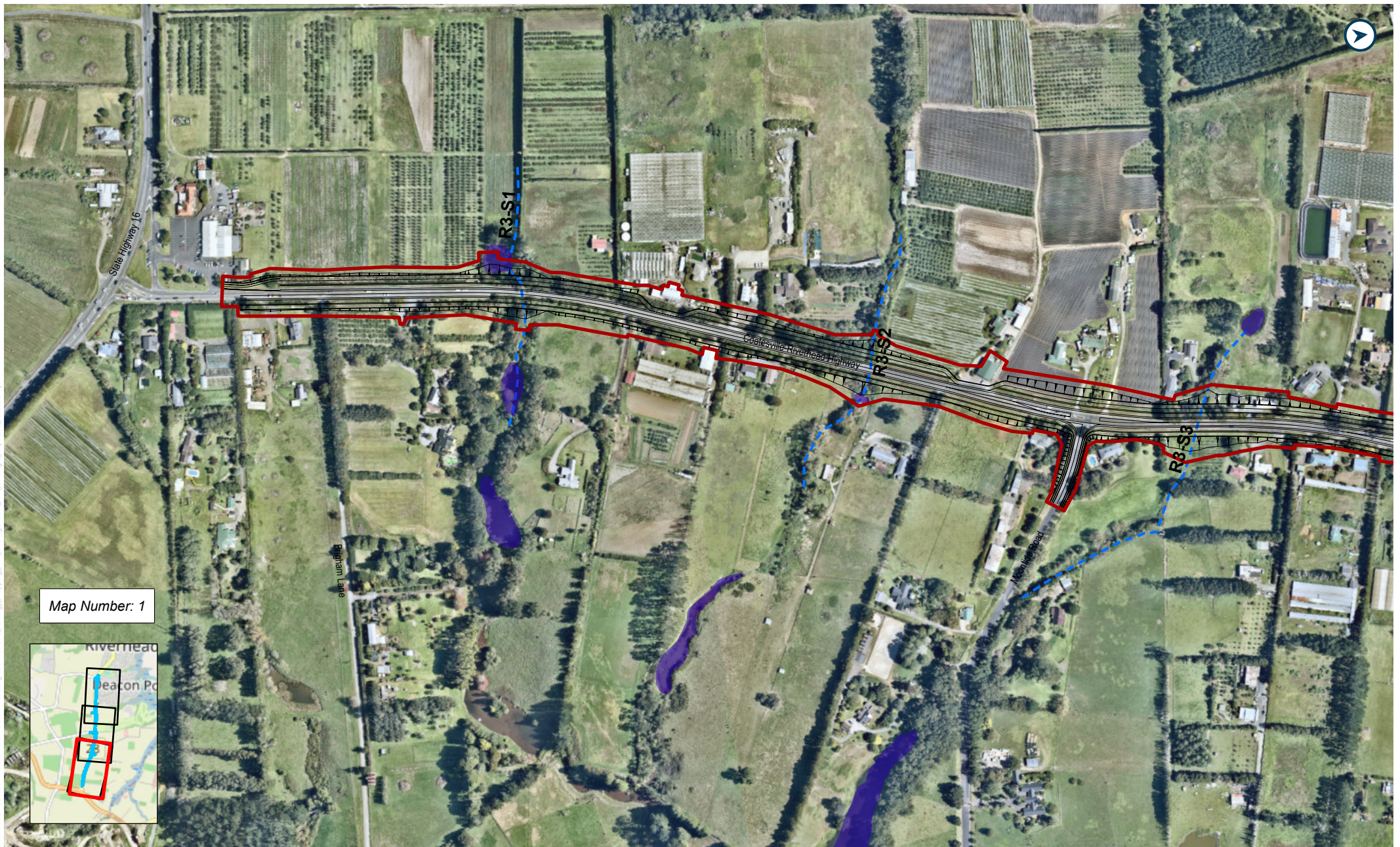
Type	Total Area (m2)
TL.3	4820.2



LEGEND

- TL.3_DPT
- Design Boundary
- Route Option
- Road

5.3.3 Freshwater Streams and Wetland Habitat



Map Number: 1

LEGEND

— Route Options

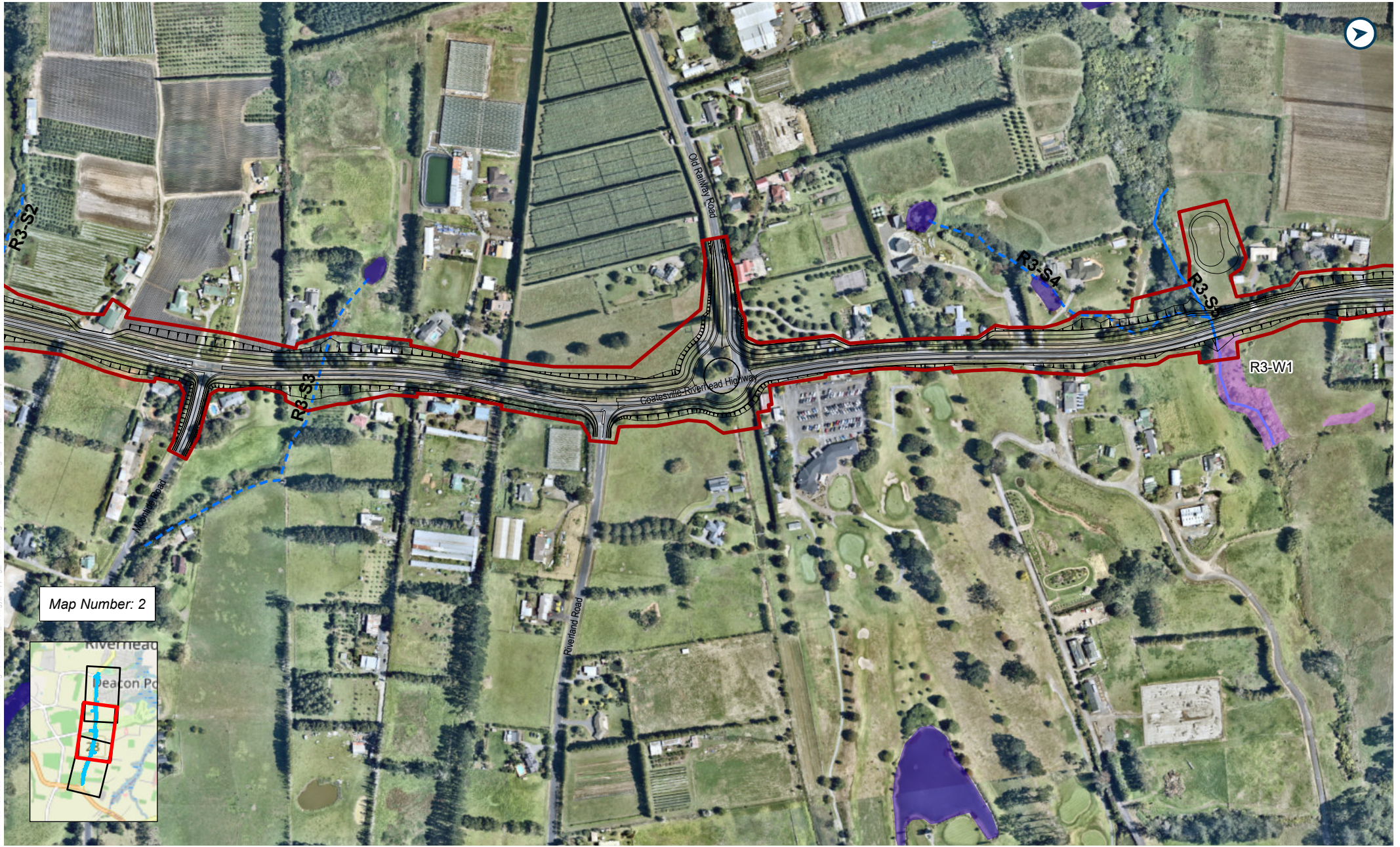
□ Designation

- - - Intermittent

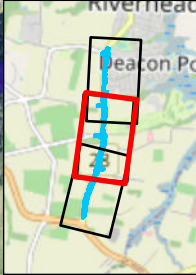
■ OW

0 80 160
Metres

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Map Number: 2



LEGEND

— Route Options

Designation

--- Intermittent

— Permanent

EW
OW

0 80 160
Metres

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6 Appendix 6 - Terrestrial Value Assessment Tables

6.1 NoR RE1: Don Buck Road FTN Upgrade

Table 12-9 Assessment of ecological value for terrestrial ecology features for NoR RE1

Attributes to be considered	R1-EG	R1-PL.3	R1-TL.3	R1-PL.1	R1-Bats	R1-Non-TAR Birds	R1-TAR Birds	R1-Lizard	R1-District Plan Trees	Justification
Representativeness	1	2	2	3	0	0	0	0	2	
Typical structure and composition	1	2	2	3	-	-	-	-	3	Generally poor for exotic dominated vegetation units, however PL.3 will provide more vertical structure and may reflect an increase in native animals. PL.1 relates to mature native planting around Rush Creek.
Indigenous representation	1	2	2	3	-	-	-	-	3	Higher scores associated with an increase in proportion of native plants and animals.
Rarity/distinctiveness	1	1	0	3	4	2	2	3	0	
Species of conservation significance (fauna only)	-	-	-	-	4	2	4	3	-	-
Species of conservation significance	-	-	-	-	-	-	-	-	-	-
Distinctive ecological values	1	1	-	3	-	-	-	-	3	Scores reflect increase value for native animals (excluding TAR species).
Diversity and pattern	1	2	2	3	0	2*	0	0	2	

Attributes to be considered	R1-EG	R1-PL.3	R1-TL.3	R1-PL.1	R1-Bats	R1-Non-TAR Birds	R1-TAR Birds	R1-Lizard	R1-District Plan Trees	Justification
Habitat diversity	1	1	2	3	-	2*	-	-	3	Score reflects the value of terrestrial habitats present.
Species diversity	1	2	2	3	-	-	-	-	3	Lowest for EG and highest for native planting around Rush Creek.
Patterns in habitat use	1	1	1	-	-	-	-	-	-	Habitat not important for lifecycle completion or periodic habitat utilisation at any scale.
Ecological context	1	2	2	3	0	2*	0	0	2	
Size, shape and buffering	1	1	2	3	-	2*	-	-	3	Scores reflect buffering value of exotic dominated vegetation, which is higher for mature native planting in Rusk Creek reserve.
Sensitivity to change	1	1	1	-	-	-	-	-	-	Habitat generally modified with no residual receptors sensitive to change.
Ecological networks (linkages, pathways, migration)	1	2	2	3	-	-	-	-	3	Woody structure of PL.3, TL.3 and PL.1 increase steppingstone value connecting other areas of ecological value. Highest for PL.1 which are associated with a stream network and wetlands around Rush Creek.
Combined value	N	L	L	M	VH	L	VH	H	M	

Notes: N = Negligible, L = Low, M = Moderate, H = High, VH = Very High. * = Scores not representative of corresponding row, scores required to produce 'Low' or 'Moderate' combined value.

6.2 NoR RE2: Fred Taylor Drive FTN Upgrade

Table 12-10 Assessment of ecological value for terrestrial ecology features for NoR RE2

Attributes to be considered	R2-EG	R2-ES	R2-PL.3	R2-PL.2	R2-TL.3	R2-TL.2	R2-Bats	R2-Birds	R2-Lizard	R2-District Plan Trees	Justification
Representativeness	1	2	2	3	2	3	0	0	0	2	
Typical structure and composition	1	1	2	3	2	3	-	-	-	2	Generally poor for exotic dominated vegetation units, however PL.3, PL.2, TL.3 and TL.1 will provide more vertical structure and may reflect an increase in native animals
Indigenous representation	1	2	2	3	2	3	-	-	-	2	Higher scores associated with an increase in proportion of native plants and animals.
Rarity/distinctiveness	1	1	1	2	3	3	4	2	3	2	
Species of conservation significance (fauna only)	-	-	-	-	-	-	4	2	3	-	-
Species of conservation significance	-	-	-	-	-	-	-	-	-	-	-
Distinctive ecological values	1	1	1	2	3	3	-	-	-	2	Scores reflect increase value for native animals (excluding TAR species).
Diversity and pattern	1	2	2	2	3	3	0	2*	0	2	
Habitat diversity	1	1	1	2	3	3	-	2*	-	2	Score reflects the value of terrestrial habitats present.
Species diversity	1	2	2	2	2	2	-	-	-	2	Lowest for EG.

Attributes to be considered	R2-EG	R2-ES	R2-PL.3	R2-PL.2	R2-TL.3	R2-TL.2	R2-Bats	R2-Birds	R2-Lizard	R2-District Plan Trees	Justification
Patterns in habitat use	1	1	1	1	1	1	-	-	-	1	Habitat not important for lifecycle completion or periodic habitat utilisation at any scale.
Ecological context	1	1	2	3	3	3	0	2*	0	1	
Size, shape and buffering	1	1	1	3	1	3	-	2*	-	1	Scores reflect buffering value of exotic dominated vegetation.
Sensitivity to change	1	1	1	1	-	-	-	-	-	-	Habitat generally modified with no residual receptors sensitive to change.
Ecological networks (linkages, pathways, migration)	1	1	2	2	3	3	-	-	-	1	Woody structure of PL.3, PL.2, TL.3 and TL.1 increase steppingstone value connecting other areas of ecological value.
Combined value	N	L	L	M	M	M	VH	L	H	L	

Notes: N = Negligible, L = Low, M = Moderate, H = High, VH = Very High. * = Scores not representative of corresponding row, scores required to produce 'Low' or 'Moderate' combined value.

6.3 NoR R1: Coatesville-Riverhead Highway Upgrade

Table 12-11 Assessment of ecological value for terrestrial ecology features for NoR R1

Attributes to be considered	R3-EG	R3-ES	R3-PL.3	R3-TL.3	R3-Bats	R3-Non-TAR Birds	R3-TAR Birds (High)	R3-TAR Birds (Very High)	R3-Lizard	R3-District Plan Trees	Justification
Representativeness	1	2	2	2	0	0	0	0	0	2	

Attributes to be considered	R3-EG	R3-ES	R3-PL.3	R3-TL.3	R3-Bats	R3-Non-TAR Birds	R3-TAR Birds (High)	R3-TAR Birds (Very High)	R3-Lizard	R3-District Plan Trees	Justification
Typical structure and composition	1	1	2	2	-	-	-	-	-	2	Exotic dominated for EG, ES, PL3 and TL.3. However, PL.3 and TL.3 may support more native species.
Indigenous representation	1	2	2	2	-	-	-	-	-	2	Lowest for EG. Native representation expected to be higher for woody habitat.
Rarity/distinctiveness	3	3	3	4	4	2	3	4	3	4	
Species of conservation significance (fauna only)	-	-	-	-	4	2	3	4	3	-	Open water associated with R3-S1. Opposite 1384 Coatesville-Riverhead HW and R3-W1 (1229 Coatesville-Riverhead HW) provide habitat for TAR birds (spotless crane, dab chick).
Species of conservation significance	3	3	3	4	-	-	-	-	-	4	Copper skink habitat associated with EG, ES and PL.3 and bat habitat associated with TL.3.
Distinctive ecological values	1	1	2	3	-	-	-	-	-	1	Scores reflect increase value for native animals (excluding TAR species). Score considers the size and location of each habitat feature.
Diversity and pattern	1	1	2	3	0	2*	0	0	0	1	
Habitat and species diversity	1	1	2	3	-	2*	-	-	-	1	Structural diversity lowest for EG and ES and higher for PL.3 and TL.3
Patterns in habitat use	1	1	1	3	-	-	-	-	-	1	TL.3 associated with stream may play an important role seasonal influenced bat behaviour. TL.3 features may also be important in controlling instream and stream margin habitat for seasonal spawners

Attributes to be considered	R3-EG	R3-ES	R3-PL.3	R3-TL.3	R3-Bats	R3-Non-TAR Birds	R3-TAR Birds (High)	R3-TAR Birds (Very High)	R3-Lizard	R3-District Plan Trees	Justification
Ecological context	3	1	3	3	0	2*	0	0	0		
Size, shape and buffering	3	1	3	3	-	2*	-	-	-	3	EG is the most abundant habitat template associated with the study area, while PL.3 and TL.3 likely provide some buffering from the existing Coatesville-Riverhead HW and surrounding rivers and streams.
Sensitivity to change	1	1	1	1	-	-	-	-	-	1	Largely modified habitat associated with pre-existing fragmentation with low or negligible residual sensitivities.
Ecological networks (linkages, pathways, migration)	1	1	1	3	-	-	-	-	-	3	More mature woody structure associated with TL.3 likely to play a role in ecological connectivity along several stream corridors.
Combined value	L	L	M	M	VH	L	H	VH	H	M	

Notes: N = Negligible, L = Low, M = Moderate, H = High, VH = Very High. * = Scores not representative of corresponding row, scores required to produce 'Low' or 'Moderate' combined value.

7 Appendix 7 - Freshwater Value Assessment Tables

7.1 NoR RE1: Don Buck Road FTN Upgrade

Table 12-12 Assessment of ecological value for freshwater ecology features for NoR RE1

Attributes to be considered	R1-S1	R1-S2	Justification
Representativeness	3	3	
Riparian habitat modification	3	3	-
Rarity/distinctiveness	3	3	
Species of conservation significance	3	3	-
Diversity and pattern	2	1	
Level of natural diversity	2	1	-
Ecological context	4	3	
Stream order	2	1	-

Attributes to be considered	R1-S1	R1-S2	Justification
Hydroperiod	4	3	-
Combined value	M	M	

Notes: N = Negligible, L = Low, M = Moderate, H = High, VH = Very High

7.2 NoR R1: Coatesville-Riverhead Highway Upgrade

Table 12-13 Assessment of ecological value for freshwater ecology features for NoR R1

Attributes to be considered	R3-S1	R3-S2	R3-S3	R3-S4	R3-S5	Justification
Representativeness	2	2	1	2	2	
Riparian habitat modification	2	2	1	2	2	All streams riparian habitat has been affected by activity. Channel shade and woody structure present for most streams (with the exception of R3-S3 and R3-S8). Downslope riparian integrity associated with R3-S3 is poor.
Rarity/distinctiveness	3	3	2	3	3	
Species of conservation significance	3	3	2	3	3	At Risk Declining species likely to be associated with most streams. Downslope connectivity associated with R3-S3 is poor.

Attributes to be considered	R3-S1	R3-S2	R3-S3	R3-S4	R3-S5	Justification
Diversity and pattern	2	2	2	3	4	
Level of natural diversity	2	2	2	3	4	All streams have moderate levels of natural diversity. Stream S2-S5 is associated with relatively large wetlands areas (including seeps and valley bottom sections with raupō).
Ecological context	3	3	3	4	4	
Stream order	2	2	2	2	2	Stream S6 is an order 2 stream, the rest are order 1.
Hydroperiod	3	3	3	4	4	Streams S4-S8 are permanent, the rest are intermittent.
Other ecological context					4	S3-S5 stream and riparian corridor connect two ecological nodes associated with VS5 vegetation (Harkin Point going into Harbour) and native vegetation, stream and wetland habitat on 1244 and 1210 Coatesville-Riverhead HW.
Combined value	M	M	L	M	H	

Notes: N = Negligible, L = Low, M = Moderate, H = High, VH = Very High

8 Appendix 8 - Wetland Value Assessment Tables

8.1 NoR R1: Coatesville-Riverhead Highway Upgrade

Table 12-14 Assessment of ecological value for wetland ecology features for NoR R1

Attributes to be considered	R3-W1	Justification
Representativeness	3	
Hydrological modification	3	Exotic wetlands, modified.
Rarity/distinctiveness	3	
Species of conservation significance	3	
Vegetation type of conservation significance	3	Portions of wetland consists of raupō.
Diversity and pattern	4	
Diversity of habitat types	4	Relatively large wetland with hillslope seeps and valley bottom features associated with seasonal and permanent wetland hydrology.
Ecological context	3	
Flood attenuation	3	Wetland is relatively large in relation to upslope catchment.
Streamflow augmentation	3	Lateral seeps and areas of permanent wetland hydrology likely to contribute to stream flows.
Sediment trapping	3	Direct catchment with moderate sediment yield.

Attributes to be considered	R3-W1	Justification
Water purification	3	Direct catchment potential source of agrichemicals and herbicide.
Combined value	H	

Notes: N = Negligible, L = Low, M = Moderate, H = High, VH = Very High

9 Appendix 9 – Impact Assessment Tables

NoR R1: Don Buck Road FTN Upgrade														
Phase	Project Activity	Resource	Ecological Value	Main Effect Description	Detailed Effect Description	Type	Extent (ZOI)	Duration	Frequency	Likelihood	Reversibility	Magnitude (pre-mitigation)	Level of Effect (pre-mitigation)	
Construction	Noise/vibration/dust	R1-Birds (Non-TAR)	Low	Construction- Birds	Disturbance and displacement to roosts and individuals (existing) due to construction activities (noise, light, dust etc.)	Direct	Local	Short-term (<5 years)	Frequently	Highly Likely	-	Low	Very Low	
Construction	Noise/vibration/dust	R1-Birds TAR	Very High	Construction- Birds	Disturbance and displacement to roosts and individuals (existing) due to construction activities (noise, light, dust etc.)	Direct	Local	Short-term (<5 years)	Frequently	Highly Likely	-	Low	Moderate	
Construction	Noise/vibration/dust	R1-Lizards	High	Construction- Herpetofauna (native)	Disturbance and displacement of individuals (existing) due to construction activities (noise, dust etc.)	Direct	Local	Short-term (<5 years)	Infrequently	Likely	-	Negligible	Very Low	
Operation	Vehicle movement/ Presence of the road	R1-Birds (Non-TAR)	Low	Operation- Birds (native)	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)	Infrequently	Likely	-	Low	Very Low	
Operation	Vehicle movement/ Presence of the road	R1-Lizards	High	Operation- Herpetofauna (native)	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)	Infrequently	Unlikely	-	Negligible	Very Low	
Operation	Vehicle movement/ Presence of the road	R1-Birds (Non-TAR)	Low	Operation- Birds (native)	Disturbance and displacement of (new and existing) nests and individuals due to lighting and noise/vibration	Direct	Local	Permanent (>25 years)	Infrequently	Likely	-	Low	Very Low	
Operation	Vehicle movement/ Presence of the road	R1-Lizards	High	Operation- Herpetofauna (native)	Disturbance of nocturnal lizard behaviour due to lighting associated with the infrastructure use	Direct	Local	Permanent (>25 years)	Infrequently	Unlikely	-	Negligible	Very Low	
Operation	Vehicle movement/ Presence of the road	R1-Birds TAR	Very High	Operation- Birds (native)	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	Direct	Local	Permanent (>25 years)	-	Unlikely	-	Negligible	Low	
Construction	Vegetation removal	R1-Trees>4m	Moderate	Construction- Terrestrial habitat	Permanent loss of habitat/ecosystem, fragmentation and edge effects due to vegetation removal	Direct	Local	Permanent (>25 years)	-	Likely	-	Low	Low	
Construction	Vegetation removal	R1-Trees>4m	Moderate	Construction- Birds	Kill or injure individual bats due to vegetation removal	Direct	Local	Temporary (days or months)	-	Unlikely	-	Negligible	Very Low	
Construction	Vegetation removal	R1-Trees>4m	Moderate	Construction- Birds	Loss of foraging habitat due to vegetation removal	Direct	Local	Permanent (>25 years)	-	Unlikely	-	Negligible	Very Low	

NoR R2: Fred Taylor Drive FTN Upgrade													
Phase	Project Activity	Resource	Ecological Value	Main Effect Description	Detailed Effect Description	Type	Extent (ZOI)	Duration	Frequency	Likelihood	Reversibility	Magnitude (pre-mitigation)	Level of Effect (pre-mitigation)
Construction	Vegetation removal	R2-Trees>4m	Low	Construction - Terrestrial habitat	Permanent loss of habitat/ecosystem, fragmentation and edge effects due to vegetation removal	Direct	Local	Permanent (>25 years)	-	Unlikely	-	Negligible	Very Low
Construction	Vegetation removal	R2-Birds	Low	Construction - Birds	Kill or injure individual due to vegetation removal	Direct	Local	Permanent (>25 years)	-	Unlikely	-	Negligible	Very Low
Construction	Noise/vibration/dust	R2-Birds	Low	Construction - Birds	Disturbance and displacement to roosts and individuals (existing) due to construction activities (noise, light, dust etc.)	Direct	Local	Short-term (<5 years)	Frequently	Highly Likely	-	Low	Very Low
Construction	Noise/vibration/dust	R2-Lizards	High	Construction - Herpetofauna (native)	Disturbance and displacement of individuals (existing) due to construction activities (noise, dust etc.)	Direct	Local	Short-term (<5 years)	Frequently	Unlikely	-	Negligible	Very Low
Operation	Vehicle movement	R2-Birds	Low	Operation - Birds (native)	Disturbance and displacement of (new and existing) nests and individuals due to lighting and noise/vibration	Direct	Local	Permanent (>25 years)	Infrequently	Likely	-	Low	Very Low
Operation	Vehicle movement	R2-Lizards	High	Operation - Herpetofauna (native)	Disturbance of nocturnal lizard behaviour due to lighting associated with the infrastructure use	Direct	Local	Long-term (15-25 years)	Infrequently	Unlikely	-	Negligible	Very Low
Operation	Vehicle movement	R2-Birds	Low	Operation - Birds (native)	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)	Infrequently	Likely	-	Low	Very Low
Operation	Vehicle movement	R2-Lizards	High	Operation - Herpetofauna (native)	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)	Infrequently	Unlikely	-	Negligible	Very Low
Construction	Vegetation removal	R2-Birds	Low	Construction - Birds	Nest loss due to vegetation removal	Direct	Local	Permanent (>25 years)	-	Unlikely	-	Negligible	Very Low
Construction	Vegetation removal	R2-Birds	Low	Construction - Birds	Loss of foraging habitat due to vegetation removal	Direct	Local	Permanent (>25 years)	-	Unlikely	-	Negligible	Very Low

NoR R3: Coatesville-Riverhead Highway Upgrade													
Phase	Project Activity	Resource	Ecological Value	Main Effect Description	Detailed Effect Description	Type	Extent (ZOI)	Duration	Frequency	Likelihood	Reversibility	Magnitude (pre-mitigation)	Level of Effect (pre-mitigation)
Construction	Vegetation removal	R3-Trees>4m	Moderate	Construction - Terrestrial habitat	Permanent loss of habitat/ecosystem, fragmentation and edge effects due to vegetation removal	Direct	Local	Permanent (>25 years)	-	Likely	-	Low	Low
Construction	Vegetation removal	R3-Bats	Very High	Construction - Bats	Kill or injure individual bats due to vegetation removal	Direct	Local	Permanent (>25 years)	-	Likely	-	Low	Moderate
Construction	Vegetation removal	R3-Birds (Non-TAR)	Low	Construction - Birds	Kill or injure individual due to vegetation removal	Direct	Local	Permanent (>25 years)	-	Highly Likely	-	Moderate	Low
Construction	Noise/vibration/dust	R3-Bats	Very High	Construction - Bats	Disturbance and displacement to roosts and individuals (existing) due to construction activities (noise, light, dust etc.)	Direct	Local	Short-term (<5 years)	Frequently	Likely	-	Low	Moderate
Construction	Noise/vibration/dust	R3-TAR Birds (Very High)	Very High	Construction - Birds	Disturbance and displacement to roosts and individuals (existing) due to construction activities (noise, light, dust etc.)	Direct	Local	Short-term (<5 years)	Continuously	Highly Likely	-	Moderate	High
Construction	Noise/vibration/dust	R3-Birds (Non-TAR)	Low	Construction - Birds	Disturbance and displacement to roosts and individuals (existing) due to construction activities (noise, light, dust etc.)	Direct	Local	Short-term (<5 years)	Frequently	Definite	-	Moderate	Low
Construction	Noise/vibration/dust	R3-Lizards	High	Construction - Herpetofauna (native)	Disturbance and displacement of individuals (existing) due to construction activities (noise, dust etc.)	Direct	Local	Short-term (<5 years)	Infrequently	Likely	-	Negligible	Very Low
Operation	Vehicle movement/ Presence of the road	R3-Bats	Very High	Operation - Bats	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)	Continuously	Unlikely	-	Low	Moderate
Operation	Vehicle movement/ Presence of the road	R3-Birds (Non-TAR)	Low	Operation - Birds (native)	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)	Continuously	Likely	-	Low	Very Low
Operation	Vehicle movement/ Presence of the road	R3-Lizards	High	Operation - Herpetofauna (native)	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	-	Negligible	Very Low
Operation	Vehicle movement/ Presence of the road	R3-Bats	Very High	Operation - Bats	Disturbance and displacement of (new and existing) roosts and individuals due to lighting and noise/vibration	Direct	Local	Permanent (>25 years)	Infrequently	Unlikely	-	Negligible	Low
Operation	Vehicle movement/ Presence of the road	R3-Birds (Non-TAR)	Low	Operation - Birds (native)	Disturbance and displacement of (new and existing) nests and individuals due to lighting and noise/vibration	Direct	Local	Permanent (>25 years)	Continuously	Likely	-	Low	Very Low
Operation	Vehicle movement/ Presence of the road	R3-Lizards	High	Operation - Herpetofauna (native)	Disturbance of nocturnal lizard behaviour due to lighting associated with the infrastructure use	Direct	Local	Long-term (15-25 years)	-	Unlikely	-	Negligible	Very Low
Construction	Noise/vibration/dust	R3-TAR Birds (High)	High	Construction - Birds	Disturbance and displacement to roosts and individuals (existing) due to construction activities (noise, light, dust etc.)	Direct	Local	Short-term (<5 years)	Continuously	Highly Likely	-	Moderate	High
Operation	Vehicle movement/ Presence of the road	R3-TAR Birds (High)	High	Operation - Birds (native)	Disturbance and displacement of (new and existing) nests and individuals due to lighting and noise/vibration	Indirect	Local	Permanent (>25 years)	Continuously	Unlikely	-	Low	Low
Operation	Vehicle movement/ Presence of the road	R3-TAR Birds (High)	High	Operation - Birds (native)	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)	Continuously	Unlikely	-	Low	Low
Operation	Vehicle movement/ Presence of the road	R3-TAR Birds (Very High)	Very High	Operation - Birds (native)	Disturbance and displacement of (new and existing) nests and individuals due to lighting and noise/vibration	Indirect	Local	Permanent (>25 years)	-	Unlikely	-	Negligible	Low
Operation	Vehicle movement/ Presence of the road	R3-TAR Birds (Very High)	Very High	Operation - Birds (native)	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	-	Negligible	Low
Construction	Vegetation removal	R3-Birds (Non-TAR)	Low	Construction - Birds	Nest loss due to vegetation removal	Direct	Local	Permanent (>25 years)	-	Highly Likely	-	Moderate	Low
Construction	Vegetation removal	R3-Birds (Non-TAR)	Low	Construction - Birds	Loss of foraging habitat due to vegetation removal	Direct	Local	Permanent (>25 years)	-	Unlikely	-	Negligible	Very Low
Construction	Vegetation removal	R3-Bats	Very High	Construction - Bats	Loss of foraging habitat due to vegetation removal	Direct	Local	Permanent (>25 years)	-	Unlikely	-	Negligible	Low

10 Appendix 10 - Rapid Habitat Assessment Results

Table 12-15 Summary of RHA values from NoR R1

Stream	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*
R3-S1	2	2	1	2	3	1	7	4	3	6	31	P
R3-S4	1	3	2	3	3	2	8	6	5	9	42	M
R3-S5	1	3	2	3	3	2	8	6	5	9	42	M
R3-S7	2	2	1	3	3	1	7	4	4	6	33	P

11 Appendix 11 – Long-Tailed Bat Acoustic Monitoring Report (2021-2022)

North West Long-Tailed Bat Acoustic Monitoring Report 2021-2022

July 2022

Version 1

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1 Executive Summary

As part of the Supporting Growth Programme, Te Tupu Ngātahi Supporting Growth (SG) is preparing Notices of Requirement (NoRs), on behalf of Waka Kotahi NZ Transport Agency (Waka Kotahi) and Auckland Transport (AT), to designate land, under the Resource Management Act 1991 (RMA), for the purpose of constructing, operating and maintaining a proposed strategic and local arterial transport network in the North West (NW) of Auckland, hereinafter referred to as the 'Project'.

Long-tailed bats (pekapeka) (*Chalinolobus tuberculatus*) are considered 'Threatened – Nationally Critical' (O'Donnell et al., 2018) and are known to be present within the Northwest of Auckland. Although desktop records confirm their presence within a 10 km radius of the Project area, the understanding of how bats use the wider landscape is limited. To gain an understanding of the habitat features that are of value to long-tailed bats it is necessary to monitor the landscape in a manner that reflects how they use it. Therefore, to establish an ecological baseline and identify if there are vegetated corridors that bats are using frequently to move through the landscape, acoustic monitoring for bats was undertaken at an areawide level.

Automatic Bat Monitors (ABM)s were deployed across the Project area in two separate survey sessions. The first (December 2021) was completed within the bat maternity period (December - February) and the second (April 2022) within the bat mating season (March - May). ABMs were placed in a network within habitats that would be affected by the Project and would provide suitable habitat for bat roosting, foraging, and commuting. Specifically, pre-determined survey locations were selected based on the current understanding of habitats that are favoured by bats.

During the December 2021 survey, seven of the 32 ABM sites (December sites #2, #11, #17, #21, #23, #25, and #27) detected bat activity. The site with the greatest number of bat passes was December site #27. No foraging calls or social calls were recorded, and no bat passes were recorded within 30 minutes of sunset or sunrise.

During the April 2022 survey, 16 of the 21 ABM sites (April sites #1, #2, #4, #5, #6, #7, #8, #9, #10, #11, #13, #14, #15, #16, #17, and #20) detected bat activity. The site with the greatest number of bat passes was April site #17 with 1370 bat passes recorded during the survey. Foraging calls were recorded at 10 of the ABM sites, with the greatest number recorded at April site #17. No social calls were recorded, and no bat passes were recorded within 30 minutes of sunset or sunrise.

The results suggest that bats are active in the North West Project area. Specifically, the results suggests that bats are active in both the Local Arterials Package area (Whenuapai Arterials, Redhills Arterials, and Riverhead Arterials), and the Strategic Projects and Kumeū Huapai Local Arterials Package area, with the highest bat activity recorded in the Alternative State Highway (ASH) NoR.

2 Introduction

2.1 Background

As part of the Supporting Growth Programme, Te Tupu Ngātahi Supporting Growth (SG) is preparing Notices of Requirement (NoRs), on behalf of Waka Kotahi NZ Transport Agency (Waka Kotahi) and Auckland Transport (AT), to designate land, under the Resource Management Act 1991 (RMA), for the purpose of constructing, operating and maintaining a proposed strategic and local arterial transport network in the North West (NW) of Auckland, hereinafter referred to as the 'Project'.

SG is preparing the NoRs for the individual projects within the NW and the projects have been split into two lodgement packages:

- **Lodgement Package 1** is the **Local Arterial Package** and consists of three area-based assessment volumes (Whenuapai, Redhills and Riverhead) (Table 2-1).
- **Lodgement Package 2** is the **Strategic and Kumeū-Huapai Package**. The assessments have been grouped based upon their strategic role, or in the case of Access and Station Road the relationship with the strategic projects (Table 2-2).

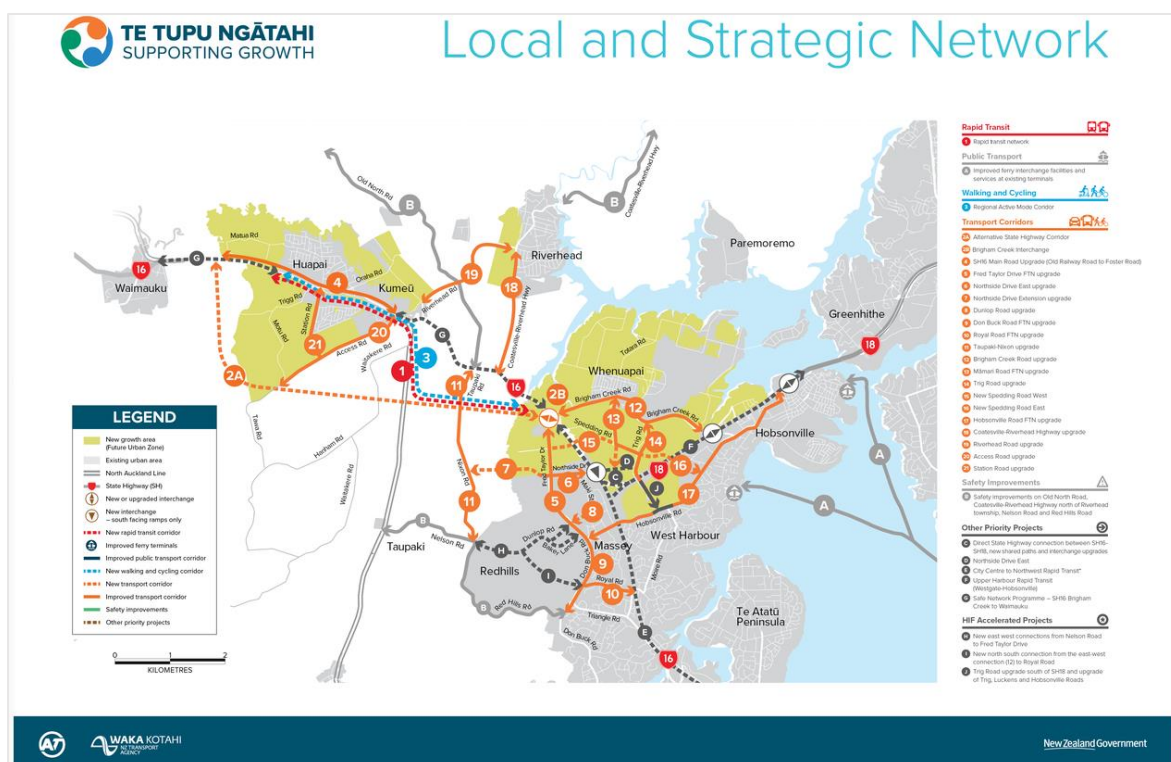


Figure 2-1 North West Growth Area Local and Strategic Network

Table 2-1 Local Arterial Package

Package	Assessment Volume	Proposed NoRs
Local Arterial Package	Whenuapai Arterials	Proposed NoRs: <ul style="list-style-type: none"> • Brigham Creek Road upgrade • Māmari Road FTN upgrade

Package	Assessment Volume	Proposed NoRs
		<ul style="list-style-type: none"> Trig Road North upgrade Spedding Road East and West
		Proposed alternations to existing designations: <ul style="list-style-type: none"> Hobsonville Road FTN upgrade
	Redhills Arterials	Proposed NoRs: <ul style="list-style-type: none"> Northside Drive East extension Don Buck Road FTN upgrade Royal Road FTN upgrade
		Proposed alternations to existing designations: <ul style="list-style-type: none"> Fred Taylor Drive Frequent Transport Network (FTN) upgrade
	Riverhead Arterials	<ul style="list-style-type: none"> Coatesville – Riverhead Highway Upgrade Riverhead Road Upgrade

Table 2-2 Strategic Package

Package	Proposed NoRs
Strategic Projects and Kumeū Huapai Local Arterials	Proposed NoRs: <ul style="list-style-type: none"> Rapid Transit Corridor (RTC), including Regional Active Mode Corridor (RAMC) Alternative State Highway (ASH), including Brigham Creek Interchange Access Road upgrade Station Road upgrade
	Proposed alternations to existing designations: <ul style="list-style-type: none"> SH16 Main Road upgrade

2.2 Acoustic Monitoring

Long-tailed bats (pekapeka) (*Chalinolobus tuberculatus*) are considered 'Threatened – Nationally Critical' (O'Donnell *et al.*, 2018) and are known to be present within the Northwest of Auckland (Waitakere Ranges, Riverhead Forest etc) (DOC, 2022). Although desktop records confirm their presence within a 10 km radius of the NoRs, the understanding of how bats use the wider landscape is limited.

To gain an understanding of the habitat features that are of value to long-tailed bats it is necessary to monitor the landscape in a manner that reflects how they use it. Therefore, to establish an ecological baseline and identify if there are vegetated corridors that bats are using frequently to move through the landscape, acoustic monitoring for bats was undertaken at an areawide level.

3 Methodology

3.1 Acoustic Monitoring

Automatic Bat Monitors (ABM)s (Song Meter SM4BAT-FS Ultrasonic Bat Detectors with SMM-U2 microphones) were deployed across the Project area. ABMs were deployed in two separate survey sessions. The first (December 2021) was completed within the bat maternity period (December - February) and the second (April 2022) within the bat mating season (March - May). The intent of surveying in two sessions was to cover any potential changes in bat activity patterns between the maternity and mating seasons.

Once deployed, ABMs were pre-set to start recording 60 minutes before sunset, and cease recording 60 minutes after sunrise (a 'night'). Each ABM was left *in-situ* for at-least 14 nights with suitable weather conditions (O'Donnell & Sedgely, 2001). For the purposes of this report suitable weather conditions have been defined as:

- Air temperatures dropped below 10°C in the first four hours after sunset.
- Mean overnight wind speed was considered 'strong breeze' on the Beaufort Scale (39-49 km/h) (Royal Meteorological Society, 2021).
- Maximum overnight wind gust exceeded 60 km/h; and/or
- Persistent heavy rain in the first two hours after sunset (heavy rain is described as >4 mm/h) (United States Geological Survey, 2016).

3.1.1 December 2021 Survey

ABMs were placed in a network within habitats that would be affected by the Project and would provide suitable habitat for bat roosting, foraging, and commuting. Specifically, pre-determined survey locations were selected based on the current understanding of habitats that are favoured by bats, drawing information from recent radio tracking that AECOM has completed on the urban fringe of the Waitakere Ranges, existing bat records (Department of Conservation and Auckland Council), and a heat map produced by Auckland Council (Crewther, 2016).

32 ABMs were left in-situ at various times during the period 17 November 2021 until 23 December 2021. The locations of the December 2021 survey sites are detailed in Table 3-1 and presented in Figure 3-1.

Table 3-1 December 2021 ABM survey locations

Site	NZTM Easting (X)	NZTM Northing (Y)
#1-Dec	1739214	5926273
#2-Dec	1740072	5926623
#3-Dec	1735355	5928284
#4-Dec	1733209	5929146
#5-Dec	1736714	5929643
#6-Dec	1734977	5929358

Site	NZTM Easting (X)	NZTM Northing (Y)
#7-Dec	1742885	5926156
#8-Dec	1738312	5927722
#9-Dec	1745935	5926209
#10A-Dec	1738213	5928889
#10B-Dec	1738211	5928832
#11-Dec	1741815	5924338
#12A-Dec	1736983	5926448
#12B-Dec	1736912	5926867
#13-Dec	1742972	5926641
#14-Dec	1741756	5931165
#15-Dec	1736431	5930302
#16-Dec	1738242	5929512
#17-Dec	1741693	5922045
#18-Dec	1735617	5930473
#19-Dec	1739393	5928689
#20-Dec	1738140	5930302
#21-Dec	1741241	5921934
#22-Dec	1741983	5926912
#23-Dec	1740244	5920178
#24-Dec	1741618	5926346
#25-Dec	1738270	5923934
#26-Dec	1738146	5928249
#27-Dec	1735631	5926833
#28-Dec	1738928	5929152
#29-Dec	1736737	5930863
#30-Dec	1734194	5928226

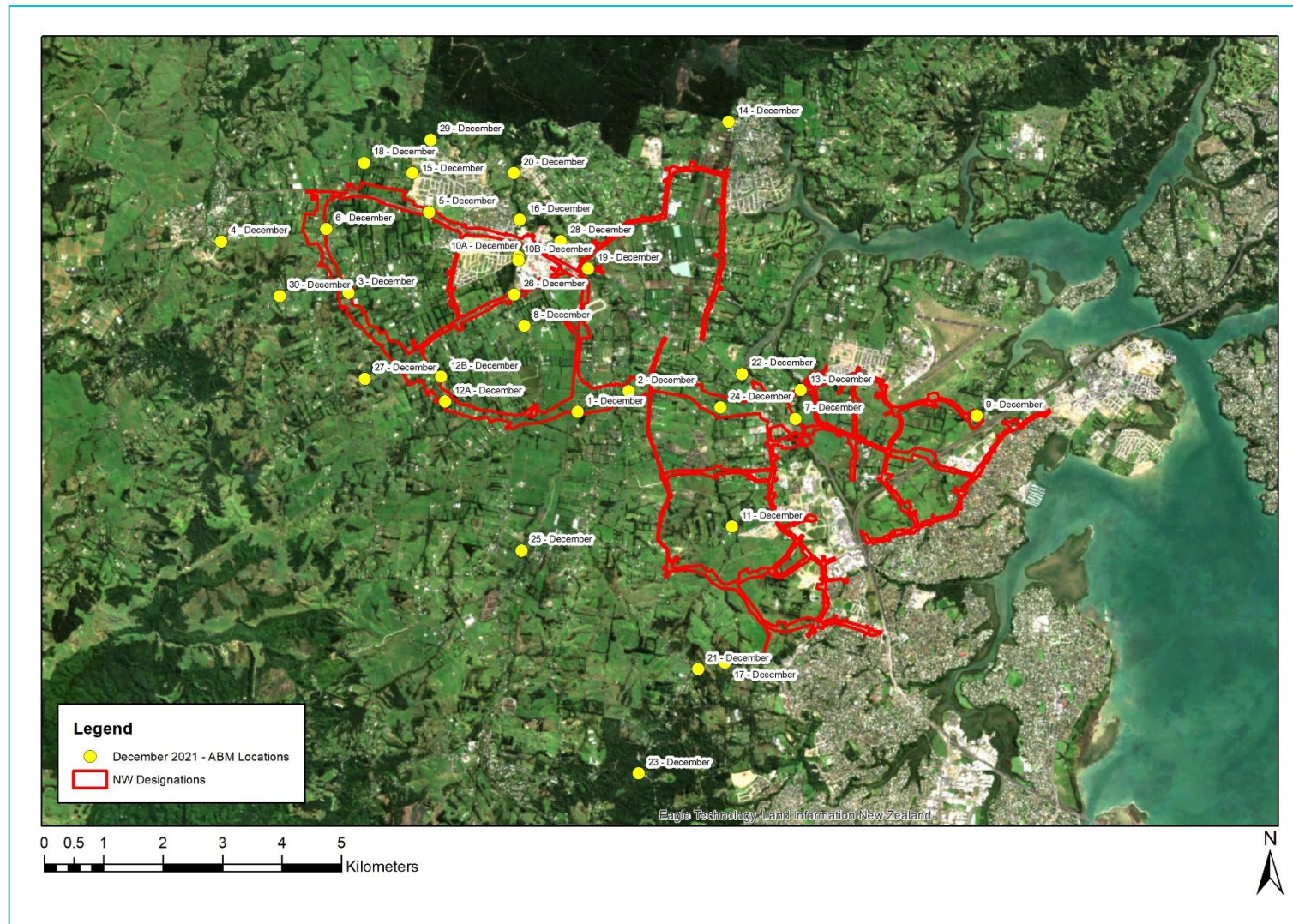


Figure 3-1 ABM locations (December 2021 survey).

3.1.2 April 2022 Survey

Based on the results of the first survey, ABMs locations were specific to the stream and river corridors associated with the proposed Strategic alignment and specifically the Alternative State Highway (ASH).

A total of 21 ABMs were left *in-situ* from 6-7 April 2022 until 3 May 2022. The locations of the April 2022 survey sites are detailed in Table 3-2 and presented in Figure 3-2.

Table 3-2 April 2022 ABM survey locations

Site	NZTM Easting (X)	NZTM Northing (Y)
#1-Apr	1741497	5926010
#2-Apr	1741627	5926348
#3-Apr	1738298	5927729
#4-Apr	1740062	5926649
#5-Apr	1739242	5926255
#6-Apr	1736563	5925866
#7-Apr	1737764	5926415
#8-Apr	1737011	5926448
#9-Apr	1738151	5928249
#10-Apr	1735633	5926835
#11-Apr	1737116	5926987
#12-Apr	1736235	5926691
#13-Apr	1736074	5927368
#14-Apr	1735449	5927854
#15-Apr	1737326	5926729
#16-Apr	1735364	5928281
#17-Apr	1735701	5928158
#18-Apr	1734931	5928655
#19-Apr	1734952	5929326
#20-Apr	1739706	5926337
#21-Apr	1739953	5926092

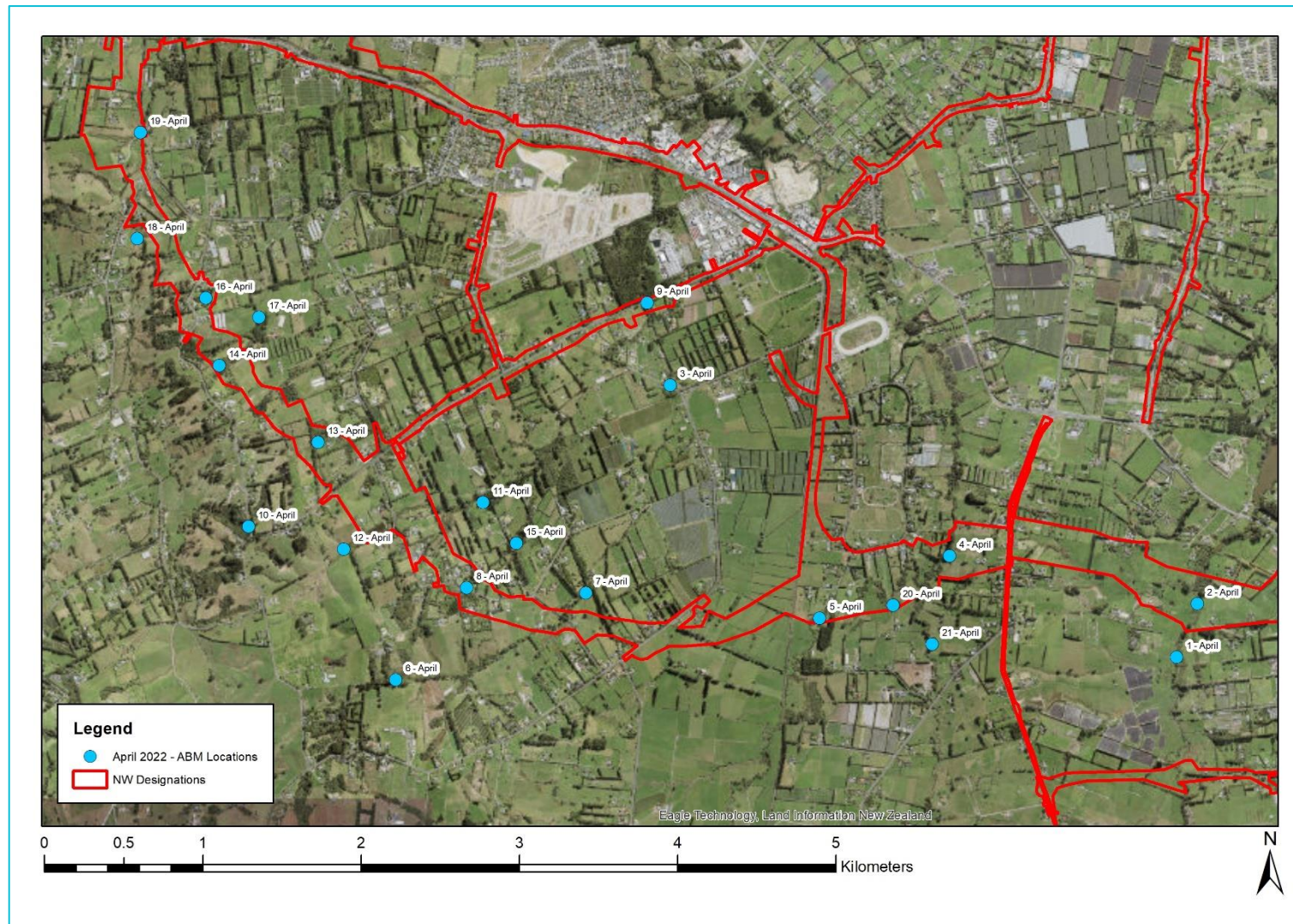


Figure 3-2 ABM locations (April 2022 survey)

3.2 Data Analysis

3.2.1 Long-tailed bat detection and behaviour

The ABM recordings were analysed by an experienced ecologist using Kaleidoscope Pro Analysis¹ software. Confirmed bat recordings (several bat echolocation calls recorded in a sound file) were further classified into:

- Echolocation calls i.e. regularly-spaced calls;
- Echolocation calls with foraging calls (feeding buzzes); and
- Echolocation calls with social calls.

The ABM data was removed from the analysis of trends if there was instrument error or weather conditions overnight were suboptimal for bat activity. Weather data for the survey period was provided by the nearest NIWA CliFlo weather station with relevant data available (North Shore Albany Ews, Agent 37852)² and the weather conditions during this period are included in Appendix 1.

3.2.2 First and Last Bat Pass

A review of the ABM data was undertaken to determine when the first and last bat pass was detected in comparison with sunset or sunrise time (data collected from the Time and Date website³). The purpose of this analysis was to gain an understanding as to whether bats could potentially be roosting in close proximity to an ABM site. Griffiths (2007) found that long-tailed bats emerged on average 30.1 ± 1.5 minutes after sunset and between January – February bats returned to their roost just before sunrise. However, by March bats were observed to be returning earlier to their roosts and by the end of May they returned as early as 40 minutes after emerging.

The following information was reviewed:

- Percentage of nights at each site where first/last bat pass is recorded within 30 minutes of sunset/sunrise;
- First and last bat pass recorded at each site during the survey period; and
- Minimum time difference between sunset/sunrise and the first/last bat pass.

¹ <https://www.wildlifeacoustics.com/download/kaleidoscope-software>.

² <https://cliflo.niwa.co.nz/>

³ <https://www.timeanddate.com>

4 Results

4.1 December 2021

Table 4-1 and Figure 2-1 present the overall results of the bat surveys completed for the North West during the December 2021 survey. Raw survey data is included in Appendix 2.

Seven of the 32 ABM sites (December sites #2, #11, #17, #21, #23, #25, and #27) detected bat activity during the survey period. The site with the greatest number of bat passes was December site #27, all other sites had similarly low numbers of bat passes (Figure 4-2). No foraging calls or social calls were recorded during the survey.

No bat passes were recorded within 30 minutes of sunset or sunrise (Appendix 3). The site with the lowest minimum time difference between sunset and first bat pass was at December site #17, with a time of one hour 37 minutes. The site with the lowest minimum time difference between sunrise and last bat pass was at December site #25, with a time of 3 hours 9 minutes.

Table 4-1 December 2021 survey results of sites with bat activity

Site	Total Number of Echolocation Calls	Total Number of Foraging Calls	Total Number of Social Calls
#2-Dec	1	0	0
#11-Dec	3	0	0
#17-Dec	2	0	0
#21-Dec	1	0	0
#23-Dec	1	0	0
#25-Dec	3	0	0
#27-Dec	42	0	0

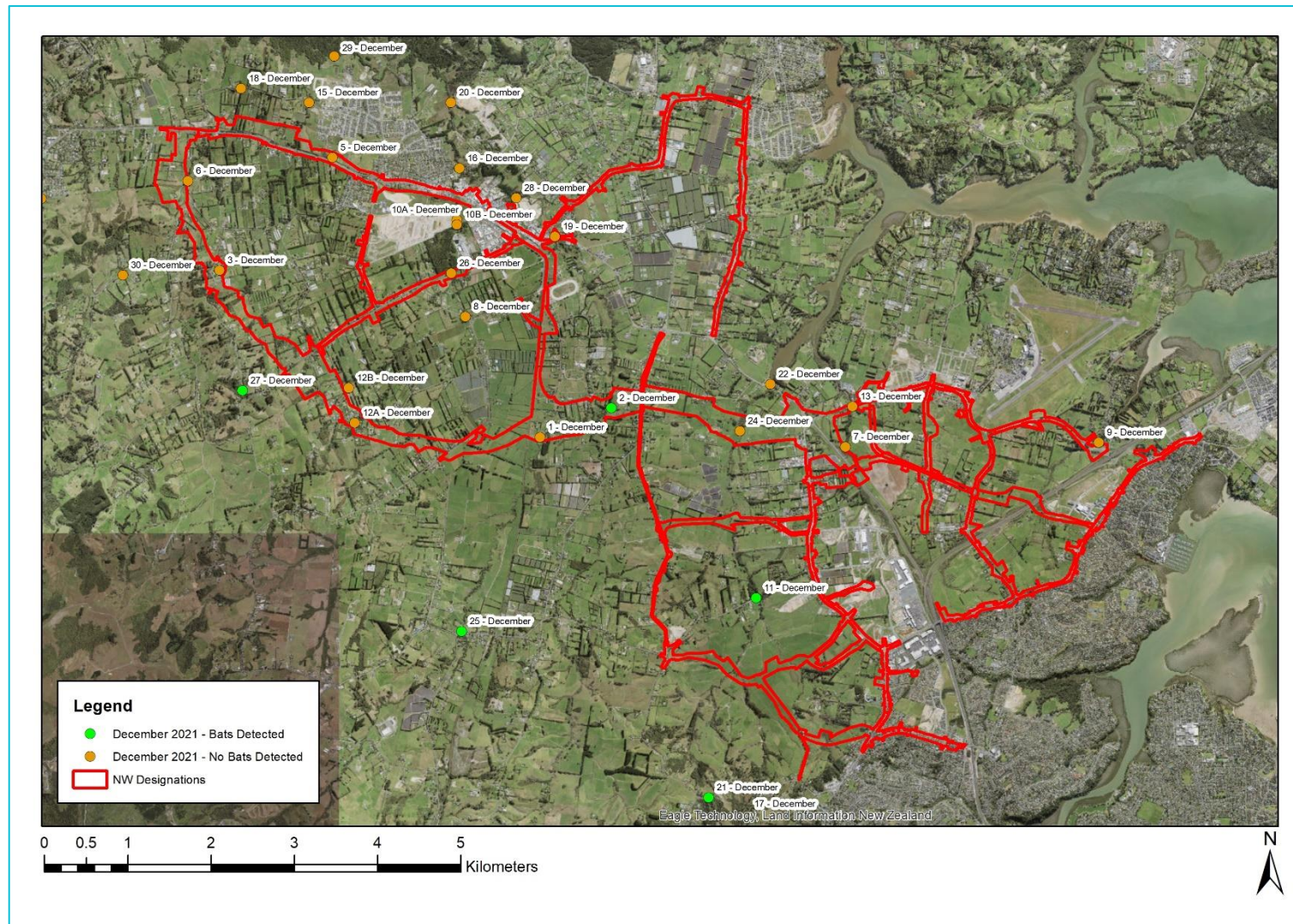


Figure 4-1 Long-tailed bat presence/absence (December 2021 survey)

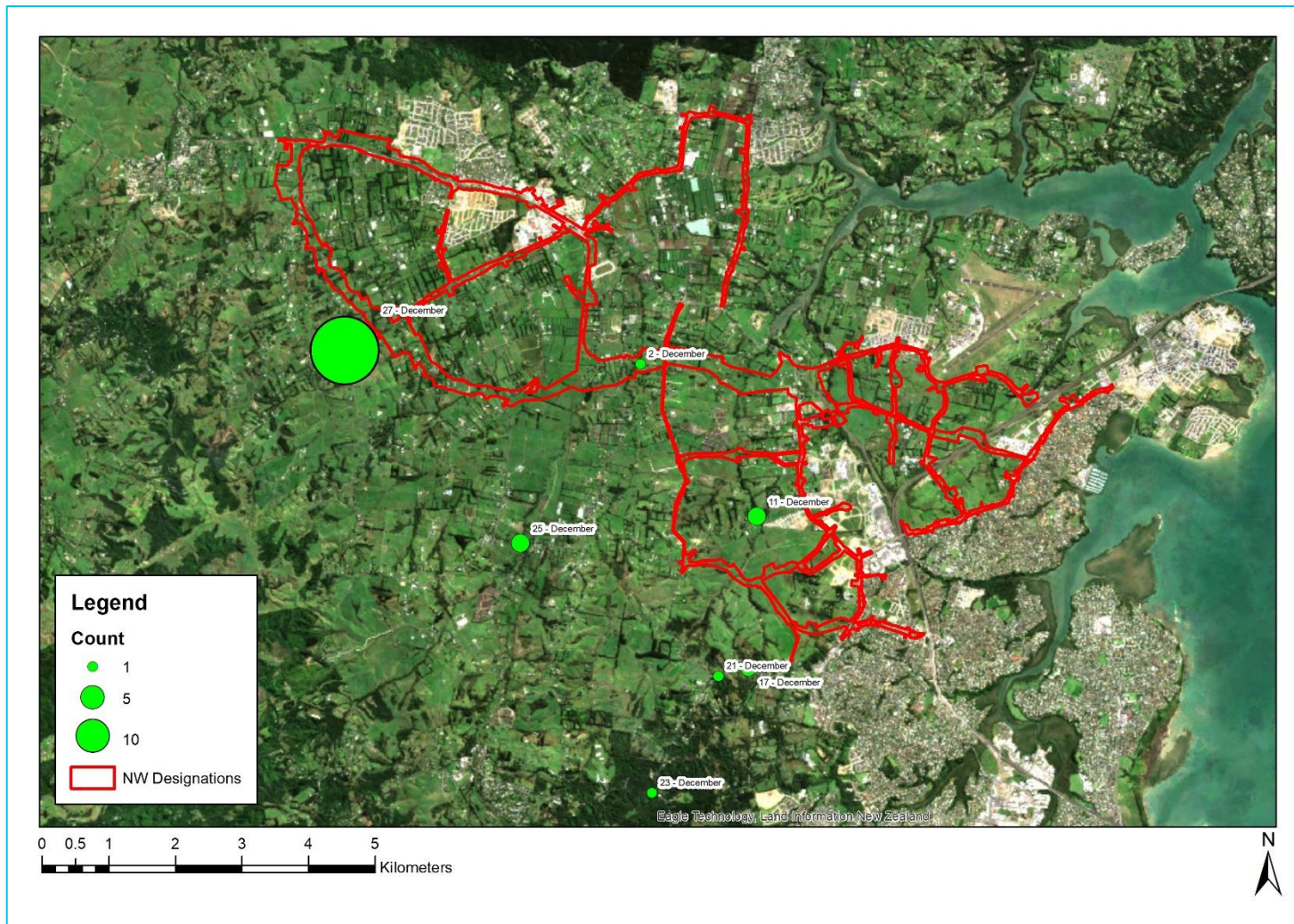


Figure 4-2 Sites with confirmed long-tailed bat presence (December 2021 survey). Proportional symbology indicates the relative proportion of bat passes in relation to the site with the highest number of bat passes (#27-December).

4.2 April 2022

Table 4-2 and Figure 4-3 present the overall results of the bat surveys completed for the North West during the April 2022 survey. Raw survey data is included in Appendix 2.

A total of 16 of the 21 ABM sites detected bat activity during the survey period (April sites #1, #2, #4, #5, #6, #7, #8, #9, #10, #11, #13, #14, #15, #16, #17, and #20). The site with the greatest number of bat passes was April site #17 with 1370 bat passes recorded during the survey (Figure 4-4). Foraging calls were recorded at 10 of the ABM sites, with the greatest number recorded at April site #17, and no social calls were recorded during the survey.

No bat passes were recorded within 30 minutes of sunset or sunrise (Appendix 3). The site with the lowest minimum time difference between sunset and first bat pass was at April site #11, with a time of 46 minutes. The site with the lowest minimum time difference between sunrise and last bat pass was at April site #17, with a time of 1 hour 2 minutes.

Table 4-2 April 2022 survey results of sites with bat activity

Site	Total Number of Echolocation Calls	Total Number of Foraging Calls	Total Number of Social Calls
#1-Apr	1	0	0
#2-Apr	2	0	0
#4-Apr	29	4	0
#5-Apr	21	2	0
#6-Apr	346	15	0
#7-Apr	103	14	0
#8-Apr	35	3	0
#9-Apr	2	0	0
#10-Apr	231	5	0
#11-Apr	162	15	0
#13-Apr	37	1	0
#14-Apr	21	1	0
#15-Apr	18	0	0
#16-Apr	5	0	0
#17-Apr	1370	265	0
#20-Apr	1	0	0

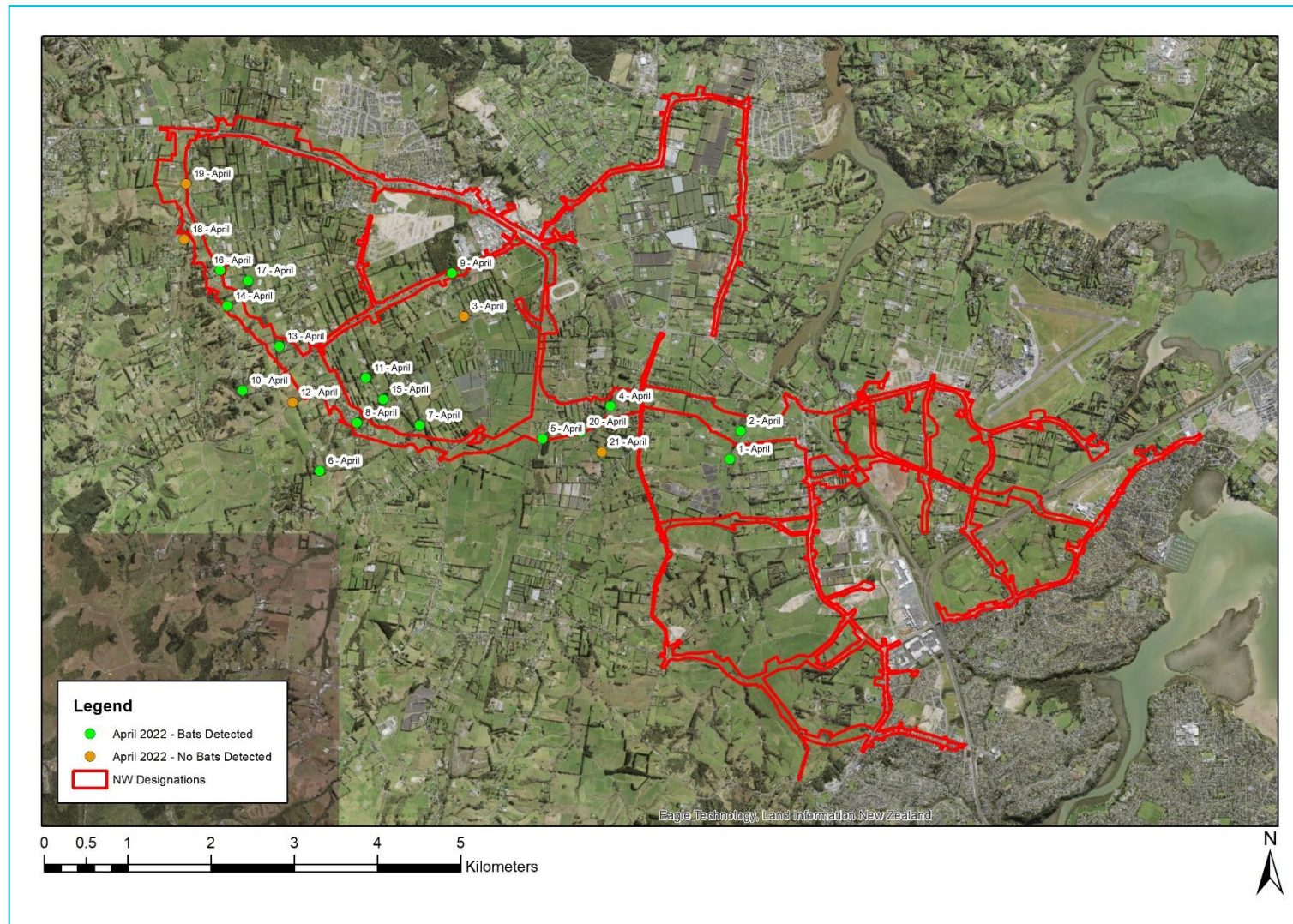


Figure 4-3 Long-tailed bat presence/absence (April 2022 survey)

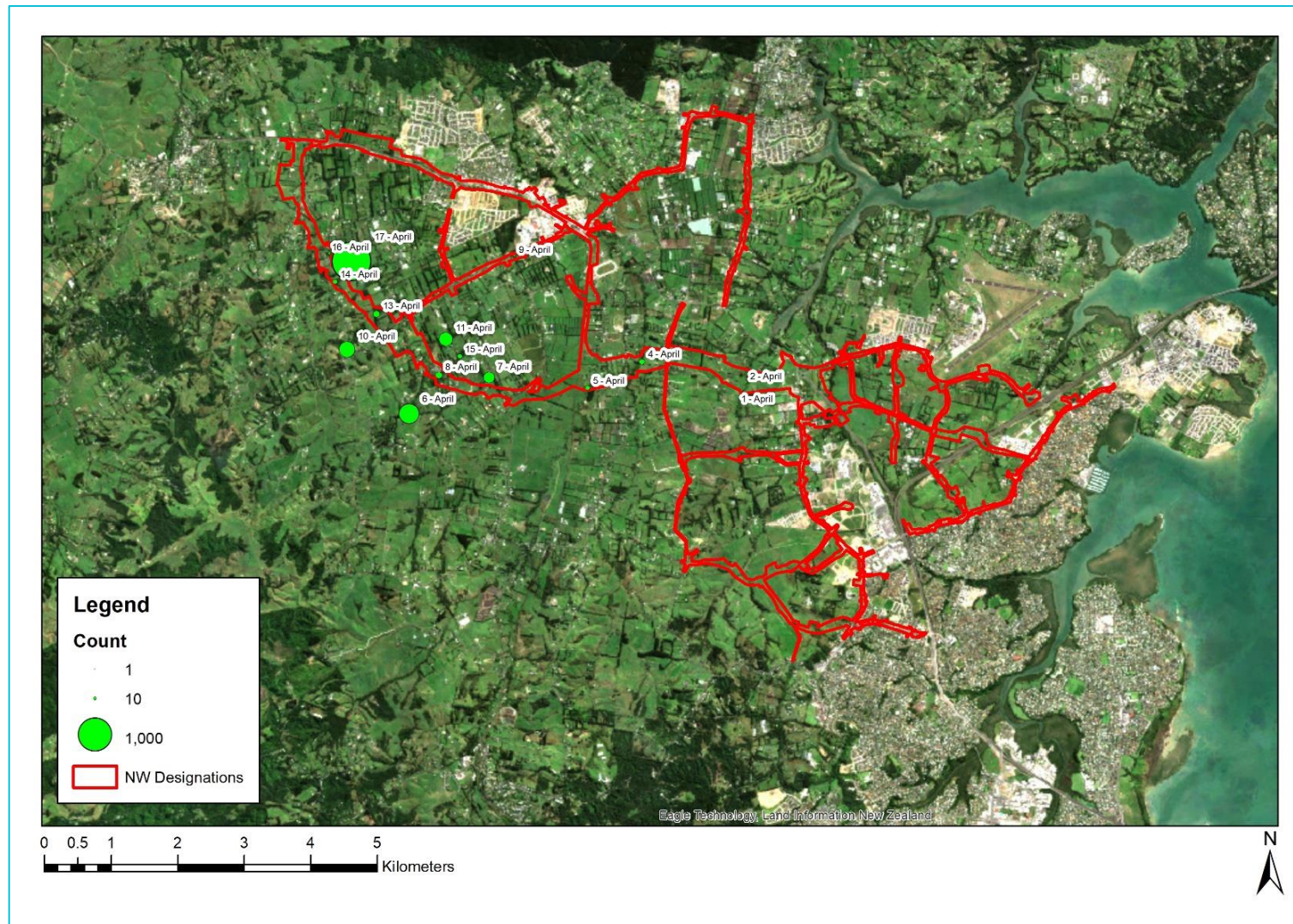


Figure 4-4 Sites with confirmed long-tailed bat presence (April 2022 survey). Proportional symbology indicates the relative proportion of bat passes in relation to the site with the highest number of bat passes (#17-April).

4.3 Survey Limitations

Some survey locations were limited by access to private property. If access was not available for a pre-determined survey location, then an alternative survey location as close as possible to the original survey site was used.

Instrument error was recorded during both the December 2021 and April 2022 surveys. An overview of when and where instrument error occurred is included in Appendix 2.

5 Conclusion

Both the December 2021 and April 2022 surveys found evidence of long-tailed bat activity in the Project area. Bats were observed to be most active during the April 2022 survey (bat mating season) with the highest mean number of 53 nightly bat passes recorded at April site #17. During the December 2021 survey, the highest mean number of bat passes was 1 nightly bat pass at December site #27.

Foraging calls were recorded during the April 2022 survey, with the highest number of foraging calls recorded at April site #17, with a total of 265 calls (19% of the total calls recorded at this site). Foraging calls were not recorded during the December 2021 survey, and social calls were not recorded during either survey.

Analysis of the first and last bat pass suggests that there are no bat roosts within the immediate vicinity of each ABM location. It is possible that bats may be roosting in the vicinity of April sites #6, #8, #11, #15, and #17 with first bat passes recorded within an hour of sunset.

Using the information obtained from the surveys, the results suggest that bats are active in the North West Project area. Specifically, the results suggests that bats are active in both the Local Arterials Package area (Whenuapai Arterials, Redhills Arterials, and Riverhead Arterials), and the Strategic Projects and Kumeū Huapai Local Arterials Package area, with the highest bat activity recorded in the Alternative State Highway (ASH) NoR.

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1 Appendix 1 - Weather Conditions

Analysis of the nightly weather against the criteria described in Section 3 led to the exclusion of data whilst the ABMs were in situ during the 2021-2022 surveys. The dates that met weather criteria and were selected for data analysis are presented in Table 1 and Table 2.

Table 1 Weather conditions during the December 2021 survey

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 Weather Conditions?
17 Nov 2021	13.7	2.62	13.0	0.0	✓
18 Nov 2021	15.8	2.57	11.1	0.0	✓
19 Nov 2021	15.5	3.08	13.2	0.0	✓
20 Nov 2021	26.3	10.3	17.4	0.0	✓
21 Nov 2021	23.4	5.92	18.9	0.0	✓
22 Nov 2021	21.6	7.01	16.6	0.0	✓
23 Nov 2021	28.4	7.76	17.0	0.0	✓
24 Nov 2021	11.9	2.88	15.0	0.0	✓
25 Nov 2021	13.0	2.58	14.4	0.0	✓
26 Nov 2021	9.4	1.66	13.2	0.0	✓
27 Nov 2021	17.3	2.77	17.0	0.0	✓
28 Nov 2021	10.8	2.03	17.3	0.0	✓
29 Nov 2021	16.6	2.23	15.4	0.0	✓
30 Nov 2021	11.2	1.80	16.4	0.0	✓
1 Dec 2021	20.2	4.09	18.7	0.3	✓
2 Dec 2021	32.8	14.56	18.9	0.0	✓
3 Dec 2021	40.0	16.56	19.6	0.0	✓
4 Dec 2021	33.1	14.81	19.2	0.3	✓
5 Dec 2021	36.4	15.45	19.7	0.0	✓
6 Dec 2021	31.7	12.96	20.3	0.0	✓
7 Dec 2021	20.2	5.37	19.8	0.0	✓
8 Dec 2021	16.2	2.53	18.6	0.0	✓

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 Weather Conditions?
9 Dec 2021	12.2	2.42	19.1	0.0	✓
10 Dec 2021	19.8	5.22	18.8	0.0	✓
11 Dec 2021	17.3	4.82	19.8	0.4	✓
12 Dec 2021	20.9	5.67	19.3	0.4	✓
13 Dec 2021	38.9	16.14	19.2	2	✓
14 Dec 2021	65.5	21.11	18.8	4.5 (did not exceed >4mm/hr)	X
15 Dec 2021	26.3	7.37	17.7	0.0	✓
16 Dec 2021	33.8	6.08	17.3	0.2	✓
17 Dec 2021	32.0	4.22	14.6	0.0	✓
18 Dec 2021	26.3	3.71	15.2	0.0	✓
19 Dec 2021	19.4	2.85	13.8	0.0	✓
20 Dec 2021	14.8	2.62	17.0	0.0	✓
21 Dec 2021	17.3	4.30	19.0	0.0	✓
22 Dec 2021	28.1	7.89	18.2	0.0	✓
23 Dec 2021	28.1	8.74	19.5	0.0	✓

Table 2 Weather conditions during the April 2022 survey

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 Weather Conditions?
6 Apr 2022	28.4	6.56	19.0	0.0	✓
7 Apr 2022	28.1	6.20	15.8	0.0	✓
8 Apr 2022	18.4	3.56	13.9	0.0	✓
9 Apr 2022	22.0	7.02	18.7	0.0	✓
10 Apr 2022	14.8	2.26	15.0	0.0	✓

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 Weather Conditions?
11 Apr 2022	31.7	12.99	19.1	0.0	✓
12 Apr 2022	32.4	11.85	18.4	0.0	✓
13 Apr 2022	31.7	8.29	17.9	0.0	✓
14 Apr 2022	28.8	4.02	12.7	0.0	✓
15 Apr 2022	14.0	2.48	14.2	0.0	✓
16 Apr 2022	16.6	4.69	16.6	0.0	✓
17 Apr 2022	54.7	24.78	19.1	0.0	✓
18 Apr 2022	55.1	26.12	17.5	0.8	✓
19 Apr 2022	41.8	15.4	19.4	4 (did not exceed >4mm/hr)	✓
20 Apr 2022	36.4	13.86	19.6	0.0	✓
21 Apr 2022	31.7	9.81	19.9	0.0	✓
22 Apr 2022	43.9	12.42	15.8	0.0	✓
23 Apr 2022	27.7	3.71	12.1	0.0	✓
24 Apr 2022	39.6	4.94	14.5	1.5	✓
25 Apr 2022	23.0	2.54	12.5	0.0	✓
26 Apr 2022	22.7	3.11	15.7	0.0	✓
27 Apr 2022	32.8	6.06	14.5	0.0	✓
28 Apr 2022	19.1	8.16	17.5	0.0	✓
29 Apr 2022	27.4	8.14	16.3	0.0	✓
30 Apr 2022	29.2	10.32	15.8	0.0	✓
1 May 2022	22.3	4.01	15.7	0.0	✓
2 May 2022	19.8	2.36	14.7	0.0	✓
3 May 2022	12.6	1.91	15.0	0.0	✓

2 Appendix 2 - Survey Results

2.1 December 2021

Date	Site																																
	#1- Dec	#2- Dec	#3- Dec	#4- Dec	#5- Dec	#6- Dec	#7- Dec	#8- Dec	#9- Dec	#10A - Dec	#10B - Dec	#11- Dec	#12A - Dec	#12B - Dec	#13- Dec	#14- Dec	#15- Dec	#16- Dec	#17- Dec	#18- Dec	#19- Dec	#20- Dec	#21- Dec	#22- Dec	#23- Dec	#24- Dec	#25- Dec	#26- Dec	#27- Dec	#28- Dec	#29- Dec	#30- Dec	
17-Nov-21	N/A	N/A	N/A	0	0	0	0	N/A	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	0	N/A	N/A	0	0	N/A	N/A	N/A	E	1	0	0	N/A	0	0	
18-Nov-21	N/A	N/A	N/A	0	0	0	0	N/A	N/A	N/A	N/A	0	0	0	N/A	N/A	N/A	0	N/A	N/A	0	0	N/A	N/A	N/A	E	0	0	0	N/A	0	0	
19-Nov-21	N/A	N/A	N/A	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	E	0	0	0	E	0	0	
20-Nov-21	N/A	N/A	N/A	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	E	0	0	0	E	0	0	
21-Nov-21	N/A	N/A	N/A	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	E	0	0	0	E	0	0	
22-Nov-21	N/A	N/A	N/A	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	E	0	0	0	E	0	0	
23-Nov-21	0	N/A	0	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	E	0	0	0	E	0	0	
24-Nov-21	0	0	0	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	E	0	0	0	E	0	0	
25-Nov-21	0	0	0	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	E	0	0	0	E	0	0	
26-Nov-21	0	0	0	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	E	0	0	0	E	0	0	
27-Nov-21	0	0	0	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	E	1	0	3	E	0	0	
28-Nov-21	0	0	0	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	E	0	0	7	E	0	0	
29-Nov-21	0	1	0	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	E	0	0	13	E	0	0	
30-Nov-21	0	0	0	0	0	0	0	0	0	0	N/A	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	E	0	0	10	E	0	0
1-Dec-21	0	0	0	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	E	0	0	
2-Dec-21	0	0	0	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	E	0	0	
3-Dec-21	0	0	0	0	0	0	0	0	0	0	N/A	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	
4-Dec-21	0	0	0	0	0	0	0	E	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	0	0	0	
5-Dec-21	0	0	0	0	0	0	0	E	E	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6-Dec-21	0	0	0	0	0	0	0	E	E	0	N/A	0	0	0	E	0	0	0	0	0	0	0	0	0	0	0	E	0	0	0	0	0	
7-Dec-21	0	0	0	0	0	0	0	0	E	N/A	0	0	0	0	E	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
8-Dec-21	0	0	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
9-Dec-21	0	0	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
10-Dec-21	0	0	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
11-Dec-21	0	0	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
12-Dec-21	0	0	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	

Date	Site																																
	#1- Dec	#2- Dec	#3- Dec	#4- Dec	#5- Dec	#6- Dec	#7- Dec	#8- Dec	#9- Dec	#10A - Dec	#10B - Dec	#11- Dec	#12A - Dec	#12B - Dec	#13- Dec	#14- Dec	#15- Dec	#16- Dec	#17- Dec	#18- Dec	#19- Dec	#20- Dec	#21- Dec	#22- Dec	#23- Dec	#24- Dec	#25- Dec	#26- Dec	#27- Dec	#28- Dec	#29- Dec	#30- Dec	
13-Dec-21	0	0	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	E	0	0	0	0	0	0	
14-Dec-21	Weather conditions unsuitable.																																
15-Dec-21	0	0	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	E	0	0	0	0	0	0	
16-Dec-21	0	0	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	E	0	0	0	0	0	0	
17-Dec-21	0	0	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	E	1	0	0	0	0	0	
18-Dec-21	0	0	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	E	0	0	0	0	0	0	
19-Dec-21	0	0	0	0	0	0	0	0	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	E	0	0	0	0	0	0	
20-Dec-21	0	0	0	0	0	0	0	E	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	E	0	0	0	0	0	0
21-Dec-21	0	0	0	0	0	0	0	E	0	N/A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	E	0	0	0	0	0	N/A	0
22-Dec-21	0	0	0	N/A	N/A	N/A	N/A	E	N/A	N/A	0	N/A	0	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0	E	N/A	N/A	0	N/A	N/A	N/A	
Total Count of Bat Passes	0	1	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	0	2	0	0	0	1	0	1	0	3	0	42	0	0	0	
# Suitable Nights Recorded	29	28	29	34	34	34	34	27	29	18	15	34	35	35	30	32	32	34	32	32	34	34	32	32	33	12	33	34	35	18	33	34	
Mean # Nightly Bat Passes	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	

Notes: N/A = ABM not deployed. E = Instrument error. Highlighted blue cells = Number of bat calls.

2.2 April 2022

Date	Site																				
	#1-Apr	#2-Apr	#3-Apr	#4-Apr	#5-Apr	#6-Apr	#7-Apr	#8-Apr	#9-Apr	#10-Apr	#11-Apr	#12-Apr	#13-Apr	#14-Apr	#15-Apr	#16-Apr	#17-Apr	#18-Apr	#19-Apr	#20-Apr	#21-Apr
6-Apr-22	N/A	0	0	N/A	0	N/A	N/A	1	0	1	N/A	Error	2	0	9	1	N/A	0	0	0	Error
7-Apr-22	1	1	0	0	0	27	15	1	0	21	0	Error	2	0	0	0	44	0	0	0	Error
8-Apr-22	0	0	0	3	1	46	58	1	0	4	4	Error	7	1	0	0	56	0	0	0	Error
9-Apr-22	0	0	0	3	3	62	3	3	0	7	1	Error	1	0	0	0	44	0	0	0	Error
10-Apr-22	0	0	0	8	0	17	3	4	2	5	7	Error	0	0	0	0	41	0	0	0	Error
11-Apr-22	0	0	0	0	0	14	0	0	0	23	26	Error	1	7	3	0	190	0	0	0	Error

Date	Site																				
	#1-Apr	#2-Apr	#3-Apr	#4-Apr	#5-Apr	#6-Apr	#7-Apr	#8-Apr	#9-Apr	#10-Apr	#11-Apr	#12-Apr	#13-Apr	#14-Apr	#15-Apr	#16-Apr	#17-Apr	#18-Apr	#19-Apr	#20-Apr	#21-Apr
12-Apr-22	0	0	0	0	0	9	0	1	0	17	4	Error	3	4	3	1	113	0	0	0	Error
13-Apr-22	0	0	0	5	0	2	0	2	0	2	7	Error	2	0	0	1	16	0	0	0	Error
14-Apr-22	0	0	0	0	0	14	0	3	0	11	3	Error	0	0	0	0	68	0	0	0	Error
15-Apr-22	0	0	0	1	0	7	0	0	0	2	3	Error	2	0	0	0	45	0	0	0	Error
16-Apr-22	0	0	0	1	5	22	0	0	0	22	43	Error	2	0	0	0	71	0	0	0	Error
17-Apr-22	0	0	0	0	0	1	0	3	0	2	0	Error	0	0	0	0	181	0	0	0	Error
18-Apr-22	0	0	0	0	0	0	0	0	0	0	0	Error	0	0	0	0	7	0	0	0	Error
19-Apr-22	0	0	0	0	0	0	0	0	0	0	0	Error	0	0	0	0	66	0	0	0	Error
20-Apr-22	0	0	0	0	0	3	0	0	0	7	2	Error	0	3	0	0	17	0	0	0	Error
21-Apr-22	0	0	0	0	0	0	0	0	0	0	0	Error	0	1	0	0	72	0	0	0	Error
22-Apr-22	0	0	0	0	0	1	0	1	0	0	0	Error	1	0	0	0	1	0	0	0	Error
23-Apr-22	0	0	0	0	3	9	0	1	0	1	1	Error	4	0	2	0	35	0	0	0	Error
24-Apr-22	0	0	0	1	0	4	0	0	0	0	1	Error	0	0	1	0	21	0	0	0	Error
25-Apr-22	0	0	0	0	0	10	3	1	0	8	3	Error	0	0	0	0	29	0	0	0	Error
26-Apr-22	0	0	0	0	2	2	0	2	0	4	5	Error	0	1	0	0	113	0	0	0	Error
27-Apr-22	0	0	0	5	7	3	0	2	0	14	15	Error	0	1	0	1	37	0	0	0	Error
28-Apr-22	0	1	0	1	0	12	0	0	0	12	18	Error	3	0	0	0	19	0	0	0	Error
29-Apr-22	0	0	0	0	0	9	0	0	0	6	0	Error	0	1	0	1	29	0	0	1	Error
30-Apr-22	0	0	0	1	0	27	10	0	0	18	10	Error	1	1	0	0	15	0	0	0	Error
1-May-22	0	0	0	0	0	25	11	2	0	34	6	Error	1	1	0	0	8	0	0	0	Error
2-May-22	0	0	0	0	0	20	0	7	0	10	3	0	5	0	0	0	32	0	0	0	Error
Total Count of Bat Passes	1	2	0	29	21	346	103	35	2	231	162	0	37	21	18	5	1370	0	0	1	N/A
# Suitable Nights Recorded	26	27	27	26	27	26	26	27	27	27	26	1	27	27	27	27	26	27	27	27	N/A
Mean # Nightly Bat Passes	0	0	0	1	1	13	4	1	0	9	6	0	1	1	1	0	53	0	0	0	N/A

Notes: N/A = ABM not deployed. E = Instrument error. Highlighted blue cells = Number of bat calls.

3 Appendix 3 - First and Last Bat Pass Results

Table 3 Times in which the first and last bat call was recorded each night, in relation to sunset and sunrise times (December 2021 survey)

Site	Sunset			Sunrise		
	First bat pass recorded during the survey period (hh:mm)	Minimum time difference between sunset and first bat pass (h:mm)	Percentage of nights where first bat pass is within 30 minutes of sunset (%)	Last bat pass recorded during the survey period (hh:mm)	Minimum time difference between last bat pass and sunrise (h:mm)	Percentage of nights where last bat pass is within 30 minutes of sunrise (%)
#2-Dec	02:14	5:50	0.00	02:14	3:40	0.00
#11-Dec	01:07	4:44	0.00	02:00	3:53	0.00
#17-Dec	01:42	1:37	0.00	01:42	4:13	0.00
#21-Dec	02:01	5:38	0.00	02:01	3:53	0.00
#23-Dec	22:26	2:13	0.00	22:26	7:32	0.00
#25-Dec	01:19	4:42	0.00	02:51	3:09	0.00
#27-Dec	23:55	3:33	0.00	02:10	3:44	0.00

Table 4 Times in which the first and last bat call was recorded each night, in relation to sunset and sunrise times (April 2022 survey)

Site	Sunset			Sunrise		
	First bat pass recorded during the survey period (hh:mm)	Minimum time difference between sunset and first bat pass (h:mm)	Percentage of nights where first bat pass is within 30 minutes of sunset (%)	Last bat pass recorded during the survey period (hh:mm)	Minimum time difference between last bat pass and sunrise (h:mm)	Percentage of nights where last bat pass is within 30 minutes of sunrise (%)
#1-April	19:26	1:20	0.00	19:26	11:11	0.00
#2-April	19:27	1:21	0.00	00:39	6:18	0.00
#4-April	18:55	1:15	0.00	23:27	7:15	0.00
#5-April	19:06	1:16	0.00	00:46	5:53	0.00
#6-April	18:35	0:53	0.00	03:43	3:00	0.00
#7-April	19:02	1:01	0.00	21:24	9:17	0.00

Site	Sunset			Sunrise		
	First bat pass recorded during the survey period (hh:mm)	Minimum time difference between sunset and first bat pass (h:mm)	Percentage of nights where first bat pass is within 30 minutes of sunset (%)	Last bat pass recorded during the survey period (hh:mm)	Minimum time difference between last bat pass and sunrise (h:mm)	Percentage of nights where last bat pass is within 30 minutes of sunrise (%)
#8-April	19:01	0:58	0.00	02:07	4:32	0.00
#9-April	19:46	1:44	0.00	19:52	10:50	0.00
#10-April	19:06	1:10	0.00	03:43	2:56	0.00
#11-April	18:26	0:46	0.00	01:38	5:03	0.00
#13-April	18:53	1:17	0.00	03:27	3:11	0.00
#14-April	19:52	2:16	0.00	02:34	4:16	0.00
#15-April	18:42	0:57	0.00	01:33	5:05	0.00
#16-April	20:18	2:19	0.00	02:51	3:53	0.00
#17-April	18:31	0:52	0.00	05:44	1:02	0.00
#20-April	19:16	1:38	0.00	19:16	11:42	0.00