APPENDIX F Ecological Impact Assessment

New Zealand Transport Agency - Waka Kotahi

BRYNDERWYN HILLS RECOVERY PROJECT

ECOLOGICAL IMPACT ASSESSMENT

15 AUGUST 2024

CONFIDENTIAL

BRYNDERWYN HILLS RECOVERY PROJECT
ECOLOGICAL IMPACT ASSESSMENT

New Zealand Transport Agency - Waka Kotahi

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REV	DATE	DETAILS
001	02/08/2024	1st Issue
002	15/08/2024	2nd Issue

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Glossary

Biodiversity compensation	A conservation outcome that meets the requirements in Appendix 4 of the National Policy Statement for Indigenous Biodiversity and results from actions that are intended to compensate for any more than minor residual adverse effects on indigenous biodiversity after all appropriate avoidance, minimisation, remediation, and biodiversity offsetting measures have been sequentially applied.
Biodiversity offset	A measurable conservation outcome that meets the requirements in Appendix 3 of the National Policy Statement for Indigenous Biodiversity and results from actions that are intended to: (a) redress any more than minor residual adverse effects on indigenous biodiversity after all appropriate avoidance, minimisation, and remediation measures have been sequentially applied; and (b) achieve a net gain in type, amount, and condition of indigenous biodiversity compared to that lost.
Brumation	The dormant period that reptiles and amphibians experience during cold months. Is a physiological state in reptiles and amphibians in the cold winter months that involves a slowing of metabolic processes, reduced activity, and minimal food intake.
Effects management hierarchy	An approach to managing the adverse effects of an activity on indigenous biodiversity.
Functional need	The need for a proposed activity to traverse, locate or operate in a particular environment because the activity can only occur in that environment.
Habitat	The area or environment where an organism or ecological community lives or occurs naturally for some or all of its life cycle, or as part of its seasonal feeding or breeding pattern; but does not include built structures or an area or environment where an organism is present only fleetingly.
Indigenous biodiversity	The living organisms that occur naturally in New Zealand, and the ecological complexes of which they are part, including all forms of indigenous flora, fauna, and fungi, and their habitats.
Indigenous vegetation	Vascular and non-vascular plants that, in relation to a particular area, are native to the ecological district in which that area is located.
Ongoing effect	An effect that is longer term than temporary construction phase effects (disturbance / displacement), including effects from short to long term, and permanent or potentially permanent effects.
Specified Highly mobile fauna	

	'Threatened' or 'At Risk' species of highly mobile fauna that are identified in Appendix 2 of the National Policy Statement for Indigenous Biodiversity.
Mitigation	For the purpose of this report, the term "mitigation" refers to the avoidance, minimisation and remedying of negative ecological effects. It specifically excludes offsetting and compensation, which are referred to as such. All derivatives, such as "mitigate" or "mitigated" should be interpreted similarly.
More than minimal	In the context of the Order in Council we have interpreted 'more than minimal' to align with what is considered a Low overall ecological effect as described in EIANZ (2018) guidelines
Natural inland wetland	Means a wetland (as defined in the Resource Management Act 1991) that is not: (a) in the coastal marine area; or (b) a deliberately constructed wetland, other than a wetland constructed to offset impacts on, or to restore, an existing or former natural inland wetland; or (c) a wetland that has developed in or around a deliberately constructed water body, since the construction of the water body; or (d) a geothermal wetland; or (e) a wetland that: (i) is within an area of pasture used for grazing; and (ii) has vegetation cover comprising more than 50% exotic pasture species (as identified in the National List of Exotic Pasture Species using the Pasture Exclusion Assessment Methodology (see clause 1.8)); unless (iii) the wetland is a location of a habitat of a threatened species identified under clause 3.8 of this National Policy Statement, in which case the exclusion in (e) does not apply
Professional Judgement	The use of accumulated knowledge and experience, as well as critical reasoning, to make an informed professional decision.
Significant Natural Area	Means: (a) any area that, is notified or included in a district plan as an SNA following an assessment of the area in accordance with Appendix 1 of the National Policy Statement for Indigenous Biodiversity; and (b) any area that, on the commencement date, is already identified in a policy statement or plan as an area of significant indigenous vegetation or significant habitat of indigenous fauna (regardless of how it is described); in which case it remains as an SNA unless or until a suitably qualified ecologist engaged by the relevant local authority determines that it is not an area of significant indigenous vegetation or significant habitat of indigenous fauna.
Species	A group of living organisms consisting of similar individuals capable of freely exchanging genes or interbreeding, including subspecies, varieties and organisms that are indeterminate.
Specified infrastructure	Means any of the following: (a) infrastructure that delivers a service operated by a lifeline utility (as defined in the Civil

	Defence Emergency Management Act 2002) (b) regionally significant infrastructure identified as such in a regional policy statement or regional plan (c) any water storage infrastructure (d) any public flood control, flood protection, or drainage works carried out: (i) by or on behalf of a local authority, including works carried out for the purposes set out in section 133 of the Soil Conservation and Rivers Control Act 1941; or (ii) for the purpose of drainage by drainage districts under the Land Drainage Act 1908 (e) defence facilities operated by the New Zealand Defence Force to meet its obligations under the Defence Act 1990.
Suitably qualified ecologist	A professional ecologist with a background, experience and expertise in conducting ecological assessments commensurate with the ecological character of the site/values.
Torpor	A period of low body temperature and metabolism lasting less than 24 hours.

Abbreviations

Above Mean Sea Level	AMSL
Acoustic Bat Monitor	ABM
Acoustic Recording Device	ARD
Artificial Cover Object	ACO
Bat Management Plan	BMP
Biosecurity Management Plan	BiMP
Department of Conservation	DOC
Ecological District	ED
Environmental Deoxyribonucleic Acid	eDNA
Freshwater Management Plan	FrMP
Geographic Information System	GIS
Habitat Management Plan	HMP
Hochstetter's Frog Management Plan	HFMP
Invertebrate Management Plan	IMP
Kilometres	km
Land Environment New Zealand – Threatened Environments (Level 4)	LENZ
Land Cover Database Version 5.0	LCDB
Land Resource Information Systems	LRIS
Lizard Management Plan	LMP
Metres	m
National Policy Statement for Indigenous Biodiversity	NPS-IB
National Threat Classification System	NZTCS
New Zealand Freshwater Fish Database	NZFFD
New Zealand Transport Agency Waka Kotahi	NZTA
Protected Natural Areas Programme	PNAP
Reconnaissance Plot	RECCE plot
Resource Management Act 1991	RMA
Severe Weather Emergency Recovery (NZTA New Zealand Transport Agency) Order 2023	WK-OIC
Significant Natural Areas	SNAs

State Highway 1	SH1
Unmanned Aerial Vehicle	UAV
Whangarei District Council	WDC
Wildlife Act 1953	WA
WSP New Zealand Limited.	WSP

Executive Summary

Recovery and resilience work, in response to damage caused by Cyclone Gabrielle in February 2023, has been undertaken on State Highway 1 (SH1) within the Northland Brynderwyn Hills (the project). WSP New Zealand Limited (WSP) was engaged by the New Zealand Transport Agency Waka Kotahi (NZTA) to prepare the Ecological Impact Assessment (EcIA) for the Project.

This report's objective is to identify and evaluate ecological features, outline potential and actual effects from these works, then address how the effects have been mitigated. Where ongoing effects cannot be reduced below "less than minor" or "less than minimal" levels by application of the proposed mitigation measures, this report also provides offset and compensation measures to account for residual effects. This EcIA will inform the application for resource consent and other WK-OIC regulatory processes as required.

The project operates under a unique regulatory framework, with the Severe Weather Emergency Recovery Order 2023 (WK-OIC) applying to the majority of the work. This order modifies the applicability of the Resource Management Act (RMA) and Wildlife Act (WA). The project is required by the WK-OIC to demonstrate minimal adverse effects on ecosystems, at-risk species, and taonga species, and ensure there are no significant effects on protected wildlife. As there are multiple regulatory frameworks that apply, an overarching holistic project assessment is provided.

Ecological features were identified using a range of databases and field surveys. The assessment of effects has been undertaken in accordance with the Ecological Impact Assessment Guidelines (EcIAG) (EIANZ 2018).

The project Site contains a wide range of terrestrial and aquatic ecological values, including the presence of nationally 'Threatened' and 'At-Risk' species. The Project's ecological values include two indigenous vegetation types, long-tailed bats, potentially short-tailed bats, many protected bird species, protected lizard species, Hochstetter's frog, terrestrial invertebrates, High value streams, longfin-eel and kōura. The presence of a Significant Natural Area (SNA) was also confirmed in line with the assessment required by the WK-OIC, and this was noted as an area of significant indigenous vegetation and significant habitats of indigenous fauna under the Protected Natural Area Programme.

Potential effects of the recovery works on these values have been avoided where possible, as set out in the Assessment of Environmental Effects. These potential project effects were further avoided, minimised and/or remedied through the development and implementation of a suite of ecological management plans. These measures centred on reducing the severity of adverse effects through vegetation or habitat clearance protocols, salvaging and relocation of 'At Risk' species including lizards, invertebrates and Hochstetter's frog.

After measures to reduce the severity of effects, the recovery works are expected to result in the permanent loss of approximately:

- 4.89 ha of high value mature indigenous native forest (kauri – podocarp – broadleaf).
- 3.47 ha of moderate value regenerating forest (kānuka – mānuka – broadleaf).

- 2.15 ha of low value recently cleared pine forest habitat that would have otherwise been replanted as pine forest.
- 322 m of High value native forest stream habitat (inclusive of 144.4 m / 156.2 m² of Hochstetter's frog habitat.

Further adverse effects on downstream aquatic receiving environments are expected to result from sedimentation and pH changes associated with concreting in addition to small scale edge effects associated with terrestrial habitat loss.

The loss of these habitats and associated terrestrial edge effects and aquatic downstream effects will also adversely affect several associated nationally Threatened, At Risk or otherwise legally protected terrestrial species including:

- Threatened or At Risk plants.
- Pekapeka / long-tailed bats, and / potentially short-tailed bats.
- Indigenous forest birds, including kiwi-nui / North Island brown kiwi.
- Pepeketua / Hochstetter's frog.
- All potentially present species of native lizard (elegant gecko, forest gecko, Pacific gecko, ornate skink and copper skink).
- Rhytid snail , peripatus, and potentially kauri snail.

However, residual effects remain (Table 1-1).

Table 1-1: Summary of residual project effects for the three assessment extents, and the total project.

Ecological Feature	Ecological Value	Magnitude of Residual Effects	Overarching Level of Residual Effect
Indigenous vegetation communities: Kauri -podocarp - broadleaf forest (WF11)	High	Moderate	Moderate
Indigenous vegetation communities: Kānuka - Mānuka - BL	Moderate	Moderate	Moderate
Exotic dominated vegetation types	Low	Negligible	Very Low
Threatened indigenous flora: Ramarama	Very High	Negligible	Very Low
Threatened indigenous flora: Kauri	Very High	Low	Moderate
Threatened indigenous flora: *Metrosideros robusta*	Moderate	Low	Low
Bats	Very High	Negligible	Very Low
Long-tailed cuckoo (locally uncommon)	Very High	Negligible	Low
Avifauna: Pīhoihoi (NZ pipit)	High	Low	Low
Avifauna: Regionally significant species	Moderate	Low	Low
Avifauna: Other Indigenous species	Low	Negligible	Very Low
Herpetofauna: At Risk - Declining lizard species including elegant gecko	High	Moderate	Moderate
Pacific gecko – locally uncommon	High	Moderate	Low
Hochstetter's frog	High	Moderate	High
Terrestrial Invertebrates: At-Risk, Declining	High	Moderate	Moderate
Terrestrial Invertebrates: Not Threatened	Low	Low	Very Low
Piroa Stream	Moderate	Low	Low
Tributaries	High	Moderate	Moderate
Wetland	Low	High	Low
Freshwater Fauna: At-Risk, Declining	High	Moderate	Moderate
Freshwater Fauna: Not Threatened	Low	Moderate	Low

Residual effects in the Low to Very Low categories after mitigation are considered acceptable. Those in the Moderate and High categories require offsetting or compensation. Where offsetting is infeasible or confidence is insufficient, compensation, (which does not directly address the effect in question but creates ecological gains by other means), may be offered.

Given that 8 ecological values were found to have experienced effects in the Moderate or High categories, offsetting and/or compensation is therefore required in terms of the EIANZ Guidelines. This involves:

- Terrestrial biodiversity values: The control of mammalian pests, wasps and weeds for a 10-year period within the proposed 78 ha Pest Management Area.
- Aquatic biodiversity values: The enhancement of planting of stream and wetland habitat.

The above contributes toward offsetting/compensating for the 'more than minor/minimal' effects. The Baber (2024) terrestrial offset report indicates that this compensates for just under half of the residual effects on Hochstetter's frog and less than half for those sensitivities with Moderate residual effects.

1. INTRODUCTION

1.1 PROJECT OVERVIEW

New Zealand Transport Agency Waka Kotahi (NZTA) has undertaken recovery and resilience works following damage to State Highway 1 (SH1) within Brynderwyn Hills, Northland, as a result of Cyclone Gabrielle in February 2023 and is lodging an application for a retrospective resource consent. SH1 within Brynderwyn Hills was severely damaged by over-slips, under-slips and rock falls. NZTA undertook immediate emergency measures to clear, secure and reopen the road to traffic. These measures were temporary, and the road remained vulnerable. NZTA has since implemented a series of interventions to stabilise and remove the slips, reinstate the road to its pre-cyclone condition and to improve resilience to reduce the likelihood of future damage, disruption and unplanned road closure. This work is referred to as the Brynderwyn Hills Recovery Works Project (BHRWP) and is being undertaken pursuant to the Severe Weather Emergency Recovery (NZTA New Zealand Transport Agency, Order 2023 (WK-OIC)).

The project Site lies along a section of SH1 and the adjacent land within the Brynderwyn Hills, Northland, New Zealand, approximately 80 km north of Auckland ('the Site'). The Site extends for approximately 2.5 km from the southern base of the Brynderwyn Hills at the boundary of Whangārei District Council and Kaipara District Council (Piroa stream bridge), northwards to the summit of the Brynderwyns/Piroa Range, near Pilbrow Hill (Figure 1-1). The Site lies within the NZTM coordinates 6011433.3 Northing and 1727470.55 Easting to coordinates 6004365.27 Northing and 1728749.67 Easting. The Project area for the purposes of this project refers to the project footprint and surrounding forest within the adjacent property titles, some 109 ha. The 'Project footprint' includes all recovery works and associated temporary and permanent infrastructure (Figure 1-2), including a construction buffer (setbacks from the physical work needed to allow for all construction activities and access).

The project activities are summarised as follows:

- Establishment of Fill Sites – Two fill sites were established to place material from the bulk earthworks. These fill sites were at the northern end of the project area (known as Fill Sites A and B).
- Stream and Gully Works – Minor widenings / extensions to the road shoulder area on the upslope side. Specific designs were developed for each gully location. This has resulted in sections of the stream extent being culverted.
    - Stream works also included receding a culturally significant waterfall adjacent to the road by cutting back into the embankment.
- Temporary Access Track – A number of work areas could not be safely accessed from the road due to steep gradients. Access to these sections could only be obtained via temporary access track. These access tracks link the work sites with Artillery Road.
- Bulk Earthworks – Major earthworks that saw the road corridor widened by cutting into the upslope hillside adjacent to the road corridor. Whist earthworks were undertaken, erosion and sediment controls were in place.
- Stormwater Drainage Works – Stormwater drainage along the entire work corridor was reassessed to conform to the changed landscape. This included a series of culvert extensions, placement of rip rap for erosion protection, installation of a new emergency overflow culvert, and associated stormwater infrastructure.

- **Downslope Stabilisation Works** – Downslope works included the installation of a series of retaining walls, and the application of shotcrete[1] and anchored nails at some sections of the downslope side of the road to stabilise the downslope embankment.
- **Riverbank Protection / Scour Protection Works** – Riverbank protection works on the bank of the Piroa Stream.
- **Temporary Access over the Piroa Stream** – Installation of a temporary culvert in the Piroa Stream to create a bridge for heavy machinery at the most southern end of the corridor. This bridge was only temporary and was removed after completion of the works.

To support design and construction activities, the project area has been split into sections or zones, from A to J (running north to south, Figure 1-2).

1.2 REPORT SCOPE

WSP has been engaged by NZTA to prepare an Ecological Impact Assessment (EcIA) associated with the BHRWP to inform the Assessment of Environmental Effects and accompany the resource consent applications. To this end, this report:

- Describes the existing terrestrial and freshwater ecological characteristics and values,
- Describes actual and potential ecological effects on these values that are expected to result from construction and operation after measures to avoid, minimise or rehabilitate adverse effects are undertaken,
- Recommends measures for addressing residual effects (where required), and
- Presents an overall conclusion on the residual level of ecological effects of the project after all recommended effects management measures have been undertaken.

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[1] Shotcrete is a highly versatile sprayed concrete mixture that is applied to vertical surfaces in order to stabilise embankments.

Figure 1-1: Site location. (Source: *https://www.topmap.co.nz*).

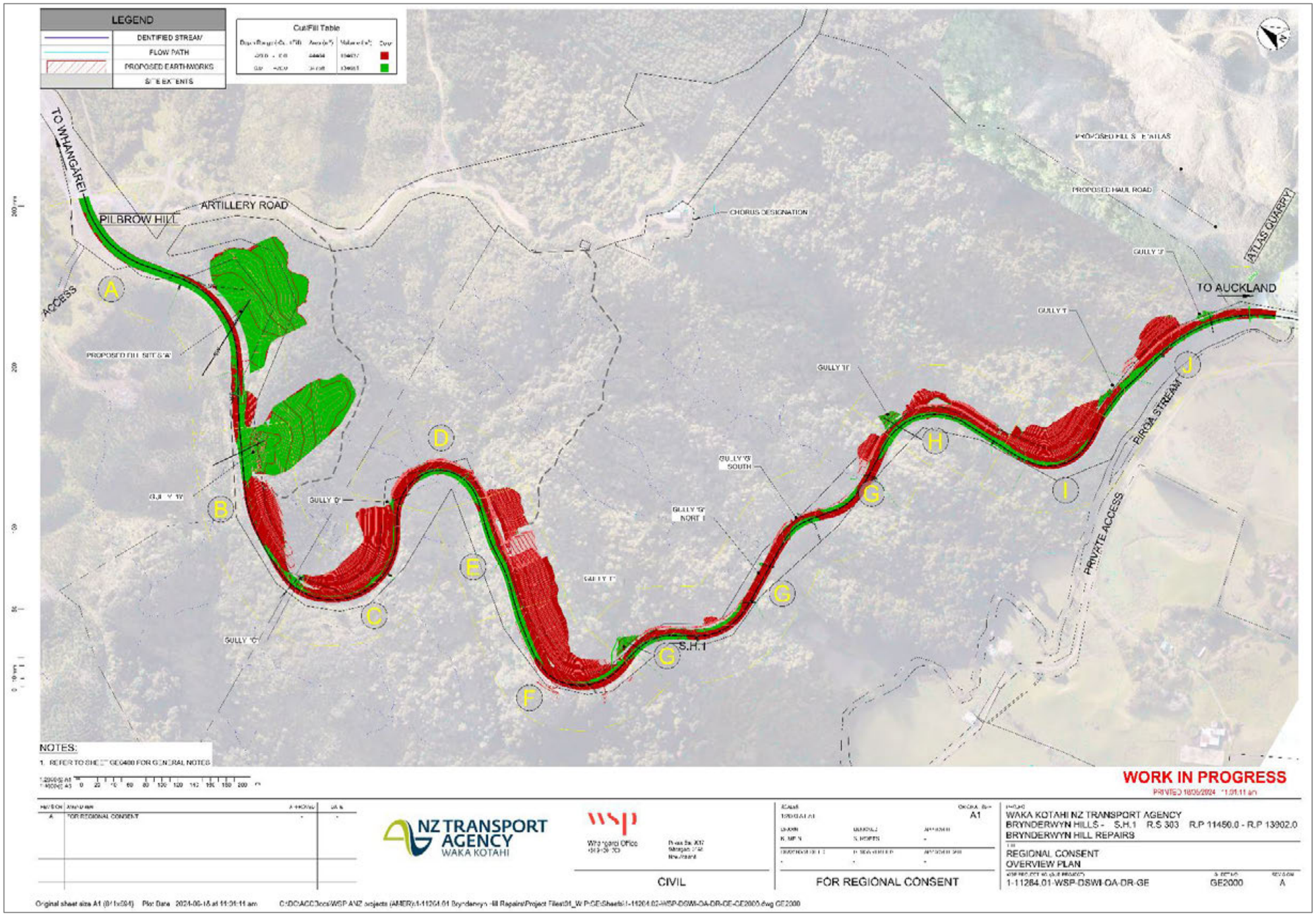


Figure 1-2: Overview of project footprint.

1.3 STATUTORY CONTEXTS

The regulatory framework applicable to the project has been modified by the Severe Weather Emergency Recovery (Waka Kotahi New Zealand Transport Agency) Order 2023 (WK-OIC) to support recovery works in response to extreme weather events. The provisions of the WK-OIC apply to the project, resulting in modified processes under the Resource Management Act (RMA) and Wildlife Act (WA) (as well as others). The modifications to both Acts has resulted in changes to the consenting and permitting processes that are to be followed.

This EcIA considers all project effects (including vegetation clearance completed as a permitted activity), specific consideration of the consent triggers has been provided in Section 5 below.

In preparing this EcIA, the following statutory matters have been considered:

- Severe Weather Emergency Recovery (Waka Kotahi New Zealand Transport Agency) Order 2023 (WK-OIC).
- Resource Management Act 1991 (RMA).
- Wildlife Act 1953 (WA).
- Freshwater Fisheries Regulations 1983 (FFR).

In addition to statutory matters, the following national direction instruments and plans have also been considered:

- The National Policy Statement for Indigenous Biodiversity (NPS-IB).
- The Resource Management (National Environmental Standards for Freshwater) Regulations 2020 (NES-F).
- The National Policy Statement for Freshwater Management (NPS-FM) 2020 (amendment Feb 2023).
- Regional Policy Statement for Northland May 2016 – updated May 2018.
- Regional Plan for Northland – Operative in Part 2024.
- Whangārei District Plan Operative in Part 2022.

The following non-statutory documents are also relevant:

- The Environment Institute of Australia and New Zealand (EIANZ) Ecological Impact Assessment Guidelines (EcIAG) (Roper Lindsay et al, 2018).
- The Wetland Delineation Protocols (WDP) (MfE, December 2022) which set out criteria for identifying and delineating wetlands. The NPS-FM requires regional councils to have regard to the WDP in cases of uncertainty or dispute about the existence or extent of a natural wetland.

1.3.1 THE WK-OIC

The WK-OIC has modified the consenting and permitting processes under the RMA and WA.

Modified Wildlife Act

The WK-OIC clause 45 (8) (b) pertaining to WA Authorities, as obtained for this project, adds the requirement to demonstrate that the project has not had "more than minimal adverse effects "on:

- Naturally uncommon ecosystems (such as wetlands),
- Indigenous "at-risk or threatened" species,
- Taonga species, and
- To demonstrate that there are no "significant adverse effects on protected wildlife".

Clause 45 (1) (a) further indicates that the WK-OIC measures relating to the WA only apply to activities within 50 m of the state highway. Therefore, the impacts of all activities falling within this extent should be assessed. This assessment extent overlaps with that required for the RMA process.

The WK-OIC contains overarching requirements which underpins the context for this EcIA. These ecological principles are outlined below.

(2) The following ecological principles must be used to guide the project design and construction (temporary and permanent works):

a) To avoid as far as practicable, and minimise:
    i. permanent habitat loss (including in coastal, terrestrial, and freshwater habitats):
    ii. loss of naturally uncommon and highly depleted ecosystem types, significant indigenous vegetation, significant habitats of indigenous fauna, and habitats for at-risk or threatened species and taonga species:
    iii. habitat fragmentation or habitat barriers (including in coastal, terrestrial, and freshwater habitats):
    iv. impacts on habitat connectivity (including coastal, terrestrial, and freshwater habitats):
    v. impacts on at-risk or threatened species and taonga species:
    vi. adverse effects on water quality (including on kaimoana and mauri) from sediment:
    vii. to the extent practicable, alteration of natural hydrology patterns.
    viii. the potential for the spread or establishment, or both, of pest plants or animals (including in coastal, terrestrial, and freshwater habitats):
    ix. impacts on habitats that play an important role in the life cycle and ecology of native species:

b) as far as practicable, to create safe habitats, especially for at-risk or threatened species and taonga species.

Modified Resource Management Act

The WK-OIC has modified the RMA and associated consenting process. Applications for resource consent for recovery works are to be processed on a non-notified basis with a controlled activity status.

Clause 7 of the WK-OIC requires that an application for resource consent for recovery works includes an assessment of the potential effects of the works, with input from appropriate experts. As part of the application, proposals to avoid, remedy or mitigate those effects are to be provided.

When considering a resource consent application for recovery works, the consent authority need not have regard to the matters in section 104(1)(b) of the RMA, which are any relevant provision of-

- A national environmental standard.
- Other regulations.
- A national policy statement.
- A New Zealand coastal policy statement.
- A regional policy statement or proposed regional policy statement.
- A plan or proposed plan.

As most of the physical works have been completed on site, an application for resource consent will be prepared on a retrospective basis (under section 330 of the RMA). As such, consent will be sought only for activities that have an ongoing adverse effect based on the applicable consent triggers.

As such, for RMA purposes, the ecological effects to be considered will relate to ongoing adverse effects.

Schedule 2 and 3 of the WK-OIC set out conditions that can be attached a decision on a resource consent application. Schedule 2 applies to regional matters, with Schedule 3 applying to district matters. For an ecological consideration, the conditions[2] require the following matters to be addressed:

- Identify any naturally uncommon ecosystems.
- Identify any at-risk or threatened species.
- Identify any taonga species that may be significantly adversely affected during or as a result of construction.
- Ecological effects assessment must be carried out in general accordance with Appendix 1 of the NPS-IB.

[2] Within Schedule 2 the relevant conditions for ecological matters are clause 18 and 19. Within Schedule 3 the relevant conditions for ecological matters are clause 11 and 12.

2. METHODOLOGY

2 DESKTOP ASSESSMENT

A desktop review of relevant literature and databases was conducted to identify the potential ecological features and species most likely to be encountered on-site or within habitats close to the site.

The information sources reviewed as part of the desktop assessment included:

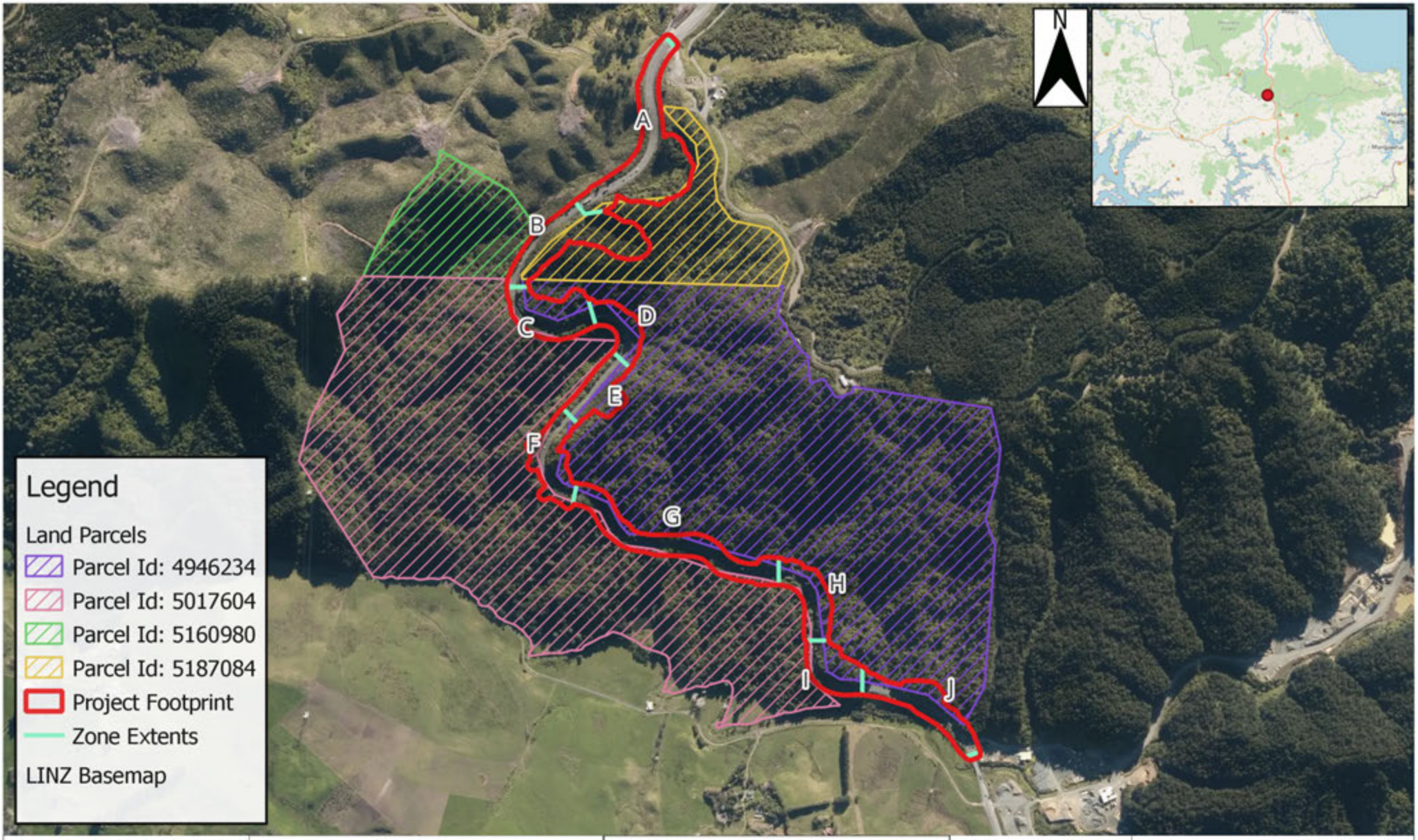
- Aerial imagery and site photographs.
- High-resolution aerial Unmanned Aerial Vehicle (UAV)/ drone imagery.
- Land Environment New Zealand – Threatened Environments (Level 4) (LENZ).
- Land cover Database Version 5.0 (LCDB).
- Land Resource Information Systems Portal (LRIS) – Potential Vegetation of New Zealand.
- OurEnvironment (Land Atlas of New Zealand) – wetland GIS datasets.
- eBird database (https://ebird.org).
- DOC Amphibian and Reptile Database.
- DOC Bat Database.
- iNaturalist Northland region database.
- Land Air and Water Aotearoa Database (LAWA).
- NIWA (2022) River Maps.
- New Zealand Topo Maps.
- New Zealand Freshwater Fish Database (NZFFD).
- Retrolens (online portal for historical aerial imagery).
- Previous ecological reports and surveys for the area, including the Waipu Ecological District Protected Natural Areas Programme survey report (Lux et al. 2007).

2.1 FIELD SURVEYS

Field investigations were undertaken to characterise the ecological values of the Project area and to inform the ecological assessment of effects and proposed effects management. These field investigations were undertaken from November 2023 to July 2024. These investigations spanned the Project footprint and its surrounding landscape. Specifically, the

four large land parcels directly adjacent to SH1 (the Survey Area), and the potential Atlas quarry fill site (Figure 2-1). This included an area of contiguous indigenous forest adjacent to SH1 and the pine plantation in which Fill Site A and B were located.

The methodology used for each of the field investigations is described in the following sections.



0 100 200 300 400 500 Meters

Project:

Brynderwyn Hills Recovery Work

Title:

Figure 2-1: Land Parcels

Project No:	Drawn:
1-11264.00	Laura van Ginkel
Date:	Checked:
2/07/24	Lisa Denmead
Scale:	Approved:
10,000 @ A4	Josh Gericke

Client:

NZ TRANSPORT AGENCY WAKA KOTAHI

Original Sheet Size: A4 [W = 297, H = 210] Plot Date: 2024-07-26 11:25:34 by van Ginkel, Laura (NZLV31597) File Ref: C:\Users\nzlv31597\OneDrive - WSP O365\QGIS Bryns.qgz

2.1.1 VEGETATION

Vegetation assessments were undertaken within the Project site and its surrounding areas. The methods used involved reconnaissance plot descriptions (RECCE plot) surveys. These were undertaken across the Site at random to understand the vegetational composition of the Site (Hurst & Allen, 2007). A total of 14 RECCE plots were undertaken across the Survey Area.

Threatened flora species present on Site were confirmed during RECCE plot surveys and incidental observations during site walkovers.

Vegetation communities and habitat type were described and mapped using aerial photographs of the site. Vegetation communities were classified using the classification and naming convention developed by Atkinson (1985).

2.2.2 CHIROPTERA (BATS)

Three local landscape scale acoustic bat surveys were undertaken in November 2023, January 2024, and April 2024 to determine the seasonal presence of bats throughout the project site. Table 2-1 details the survey period and number of valid nights of deployment, and Figure 2-2 shows the survey locations. Fifteen automated bat monitors (ABMs) were deployed in similar locations in November and January. Due to the bottleneck of tree clearance, the third deployment was delayed until April with only 13 ABMs being deployed in similar locations as the previous surveys. An additional ABM was deployed downslope from E where a significant slip had occurred on site.

Automated bat monitors were programmed to record from one hour before sunset to one hour after sunrise, on nights where weather criteria reached the following thresholds:

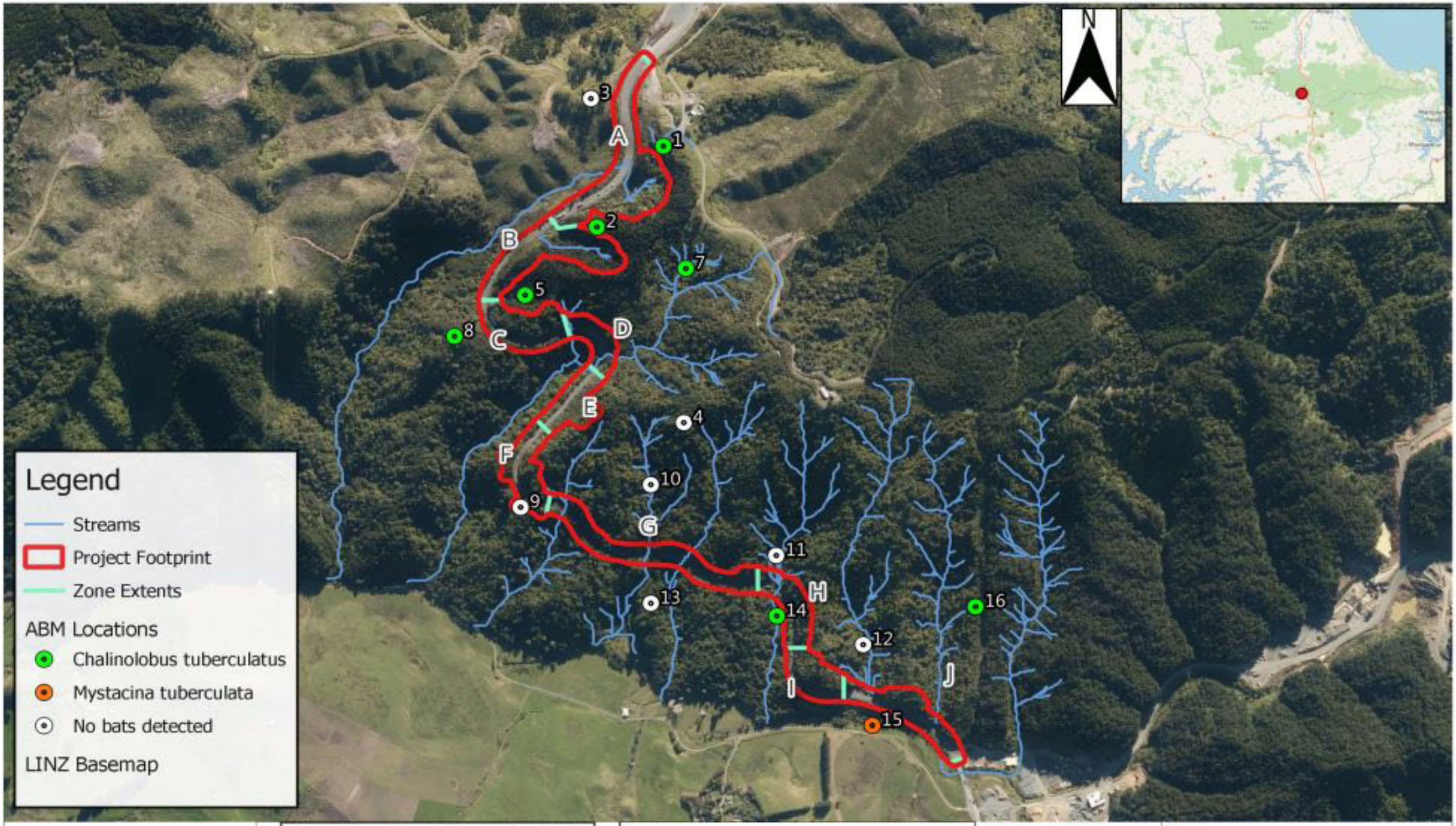
- Temperatures in the first four hours after sunset to remain 10°C or above.
- No more than 5 mm precipitation to fall in the first four hours after sunset.

For nights where weather thresholds were exceeded, data from that night was excluded from analysis.

The ABM data was processed using BatSearch3 software (Department of Conservation, 2016) to assign recorded spectrograms as either ‘non-bat’ or ‘long-tail’. Once data processing was completed. A subset of this data was then reviewed by a competent bat worker. Bat activity levels were determined by calculating the average number of bat passes per night of deployment for each ABM (total passes/valid nights).

Table 2-1: Deployment dates and number of valid nights recorded for each ABM survey. *Indicates monitors that had complete failures during the D3 survey.

SITE	DEPLOYMENT 1 (D1)	VALID NIGHTS D1	DEPLOYMENT 2 (D2)	VALID NIGHTS D2	DEPLOYMENT 3 (D3)	VALID NIGHTS D3
1	24/11/23	24	31/01/24	9	18/04/2024	0*
2	24/11/23	24	16/01/24	24	N/A	N/A
3	29/11/23	19	17/01/24	17	18/04/2024	0*
4	30/11/23	13	15/01/24	31	16/04/2024	5
5	24/11/23	24	18/01/24	18	18/04/2024	0*
7	28/11/23	21	18/01/24	32	18/04/2024	0*
8	29/11/23	14	18/01/24	54	18/04/2024	0*
9	24/11/23	24	18/01/24	22	N/A	N/A
10	28/11/23	5	15/01/24	32	16/04/2024	4
11	30/11/23	11	15/01/24	20	16/04/2024	5
12	29/11/23	20	16/01/24	34	16/04/2024	6
13	24/11/23	24	15/01/24	24	N/A	N/A
14	28/11/23	20	17/01/24	35	17/04/2024	18
15	28/11/23	20	16/01/24	56	17/04/2024	0*
16	28/11/23	20	16/01/24	25	16/04/2024	25



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Project:
Brynderwyn Hills Recovery Work

Title:
Figure 2-2: ABM deployment and bat detection locations

Project No:	Drawn:
1-11264.00	Laura van Ginkel
Date:	Checked:
23/08/24	Hannah Robinson
Scale:	Approved:
10,000 @ A4	Melanya King

Client:
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2.2.3 AVIFAUNA (BIRDS)

ACOUSTIC SURVEYS AND 5-MINUTE BIRD COUNTS

To confirm and refine the species identified as likely present from the desktop review of existing information, Department of Conservation AR4 Acoustic Recording Devices (ARDs) were deployed in the Brynderwyns Forest (in November 2023, Figure 2-3). Fifteen monitors were initially deployed for two weeks to inform the project scope ("1-11264.01 Brynderwyns Recovery Work - Scoping Survey Report 17_05_2024"). The ARDs were set to cover forest birds between sunrise and 11am, under setting 'Forest' and were set to 'Low' to cover nocturnal species from sunset to sunrise. Further repeat ARD survey data was collected in summer (January to February) and autumn (April to May).

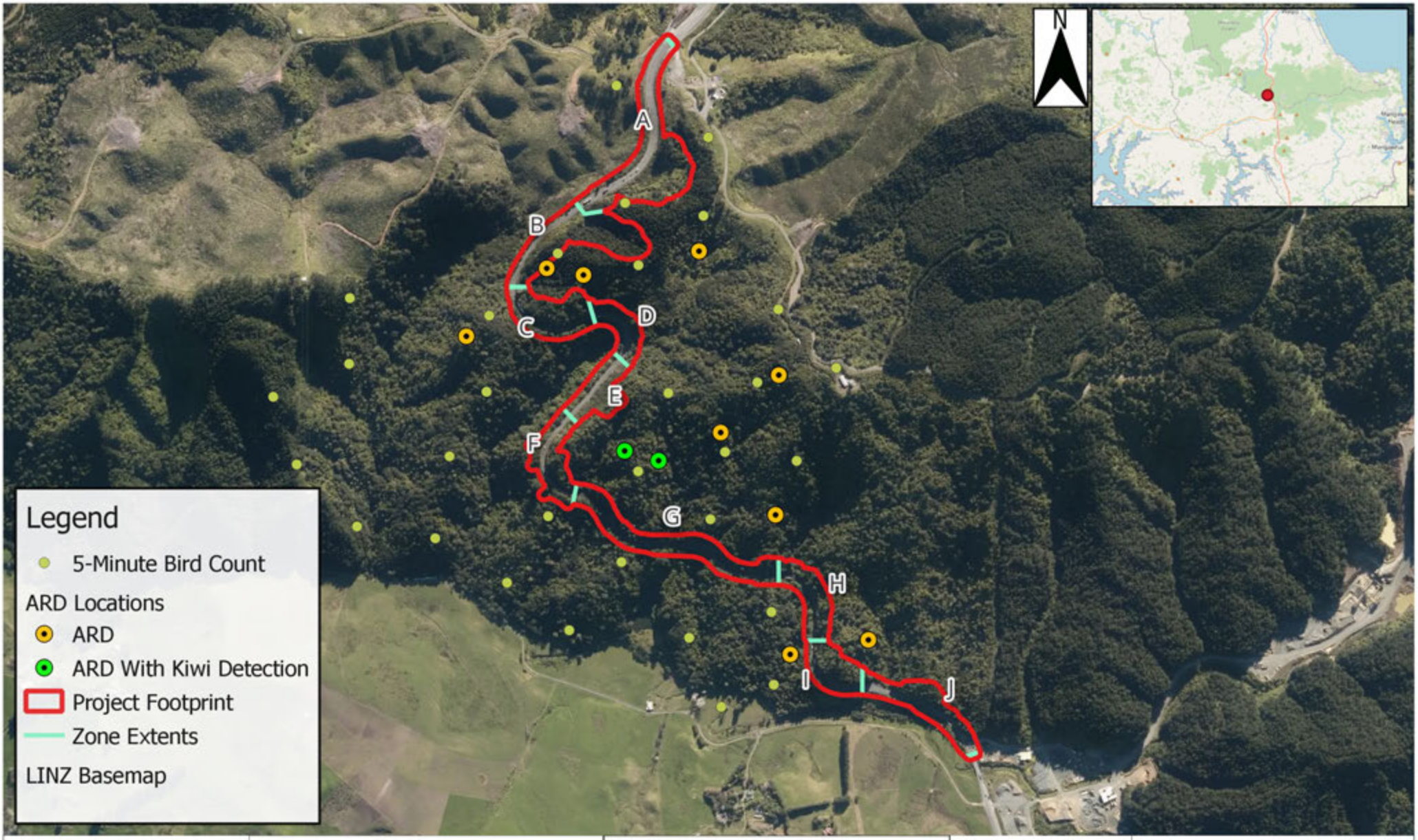
Incidental observations were also made while undertaking various site visits.

To compliment the ARD surveys five-minute bird counts were undertaken in May at 150 m intervals along ridgelines within the Brynderwyns Forest to provide a semi-quantitative complimentary survey method to the ARD survey. These counts were undertaken in fine weather conditions from shortly after sunrise until near midday, or when weather ceased being appropriate (e.g. a weather front arrived). Thirty-one bird count stations were established.

KIWI-NUI

Kiwi are known to be present within the Brynderwyn/Piroa Range. They were re-introduced through Operation Nest Egg (Piroa Conservation Trust, 2023). The closest record of kiwi is just over two kilometres from Site. As such specific survey methods were undertaken to ensure a high chance of detection should kiwi be found to be in proximity to the Site. The methods included:

- Aforementioned ARDs were set to low overnight to detect both female and male calls.
- Kiwi call survey by night listening from half an hour after sunset for two and a half hours in the central ridge location with a single listening spot over three nights.
- Five trail cameras were deployed and moved throughout the forest periodically between November 2023 and March 2024.
- A kiwi conservation dog and handler were engaged and undertook two sweeps for kiwi detection alongside the road and within the forest interior, once in February prior to main works and again in March mid-works.



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Project:

Brynderwyn Hills Recovery Work

Title:

Figure 2-3: ARD deployment locations and five minute bird count points.

Project No:	Drawn:
1-11264.00	Laura van Ginkel
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2/07/24	Lisa Denmead
Scale:	Approved:
10,000 @ A4	Josh Gericke

Client:

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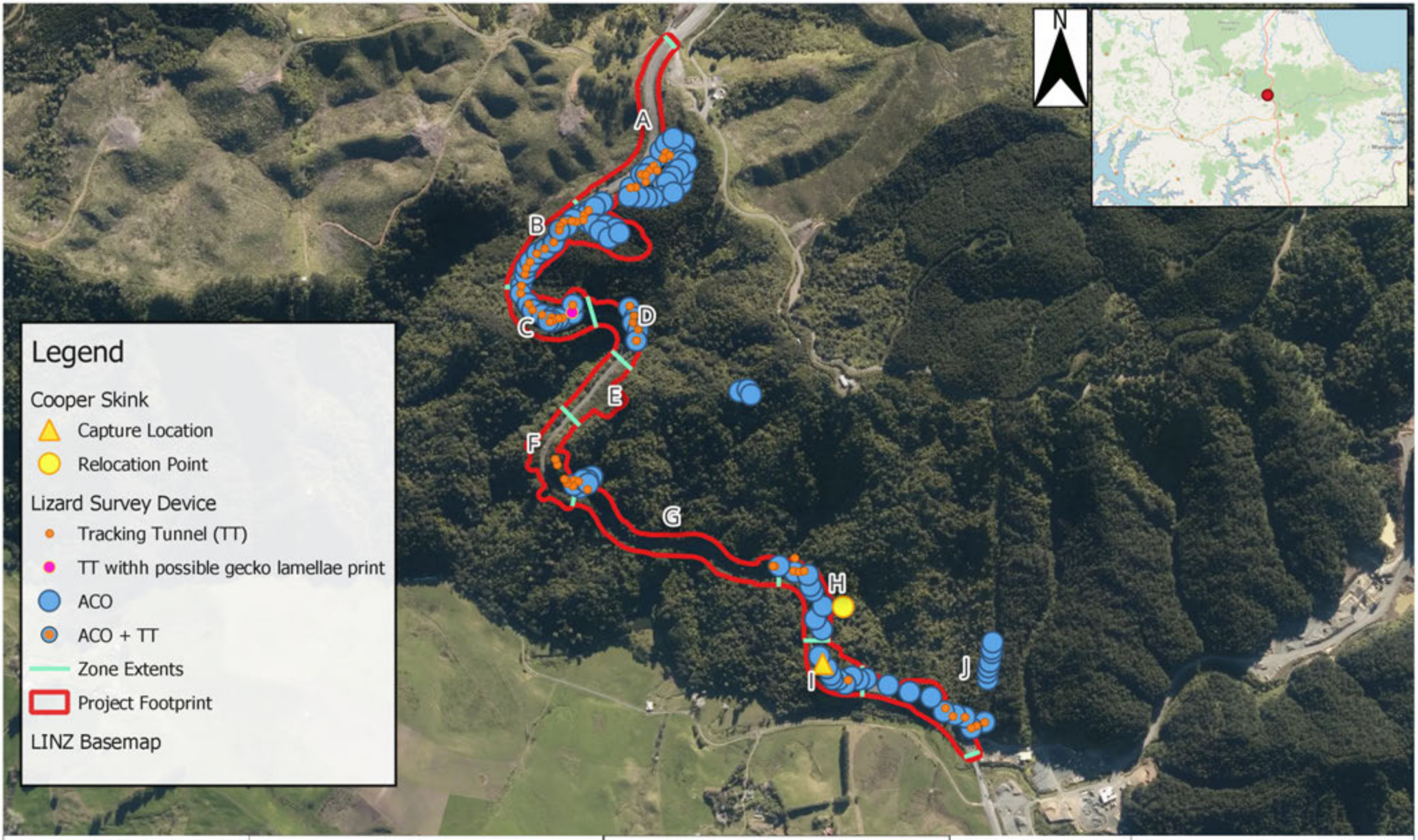
2.2.4 LIZARDS

The initial desktop review of potential species presence was informed by a qualitative assessment of habitat suitability during site walkovers in November and December 2023. All lizard surveys adhered to the Department of Conservation's Biodiversity and Monitoring toolbox protocols (Hare, 2012). Surveys were designed to maximise the likelihood of detecting lizard species likely to be present, based on desktop review and habitat availability within the project study area.

In addition to these initial habitat assessments, lizard surveys were undertaken from December 2023 to February 2024. These surveys included:

- Manual habitat searches throughout the site in suitable and accessible locations.
- Nocturnal spotlighting at fill Site A & B, Atlas fill site and downslope at Zone J. Due to health and safety concerns, nocturnal spotlighting could not be undertaken in some areas adjacent to existing SH1.
- 166 small tracking tunnels (Halema design: 50 mm diameter tube x 50 cm long) deployed both within the site and within immediately adjacent forest in tandem with the ACOs (Figure 2-4). Ink cards were baited with banana and a cat biscuit and deployed for one week in December 2023 and again in February 2024.
- 166 double stacked Artificial Cover Objects (ACOs) were deployed, with 94 of these located within the project footprint (Figure 2-4). These ACOs were deployed between 4-8 December 2023 and checked on 13-14 February 2024. Due to the urgent nature of emergency works and the time required for Wildlife Act Authorities to be approved, ACOS could not be deployed for a longer duration prior to checking.

Following approval of the project WAA (113645-FAU), additional survey efforts were undertaken including pre-vegetation clearance searches, ACO checks, destructive searches and spotlighting, as outlined in the project Lizard Management Plan.



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Project:

Brynderwyn Hills Recovery Work

Title:

Figure 2-4: Lizard survey sites, possible gecko detection, and copper skink capture and relocation locations

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2.2.5 HOCHSTETTER'S FROG

OVERVIEW

Hochstetter's Frog is classified as At risk – Declining under the New Zealand Threat Classification system and exists as a series of isolated populations across the northern half of the North Island (Fouquet *et al* 2010a, Fouquet *et al* 2010a b; Newman et al 2010).

The extant populations comprise 13 separate evolutionary significant units (ESUs) (Fouquet et al 2010a) with the Brynderwyns population constituting the northern clade (a genetically distinct clade of the Northern ESU).

Hochstetter's frogs are present throughout the Brynderwyns and have previously been recorded within local streams, including those within the Brynderwyn Recovery Footprint. (iNaturalist, DOC Bioweb). They occur primarily in habitat on the margins of stony-bottomed low-order streams and seepages with little sediment load, typically in mature native forest (Bell et al. 2004). Suitable stream habitat for Hochstetter's frogs generally includes:

- Streams with permanent or intermittent hydroperiod, less than 4m wide and predominantly shaded by native or exotic riparian margin on steep to gentle slopes.
- Streams including frog habitat refugia in the form of boulders or rocks, coarse wood and leaf packs or root mats.
- Streams were defined as having a permanent or intermittent hydroperiod, that were < 4m wide and predominately shaded by native or exotic riparian margin on steep to gentle slopes.
- Streams included frog habitat refugia in the form of boulders or rocks, coarse wood and leaf packs or root mats.

SURVEY METHODS

Hochstetter's frog surveys were undertaken in all suitable permanent and intermittent streams present within the project study area, encompassing both which included the project footprint and reference sites located upstream and downstream of this footprint. Survey methodology is set out in detail in Appendix B and summarised below.

The reference sites were selected using a randomised stratified approach to ensure selected streams were representative across the wider study area.

In total, 30 surveys, including 18 surveys within project footprint streams and 12 surveys within reference streams (see Figure 2-5), were undertaken in November and December 2023. This time-period corresponded to warmer months and under low flow conditions when frogs are inactive and under cover.

The length of each stream surveyed within project footprint streams was determined by the length of stream within the project footprint whereas all reference stream reaches surveyed were 50m in length.

Within each surveyed stream, width and GPS location was recorded at the start and end of each section, along with the dominant riparian vegetation type. Available frog habitat was quantified every metre across the 50 m transect line, recording the most dominant habitat type, comprising: 'rock', 'wood', 'vegetation/roots', 'crevices/undercut bank'.

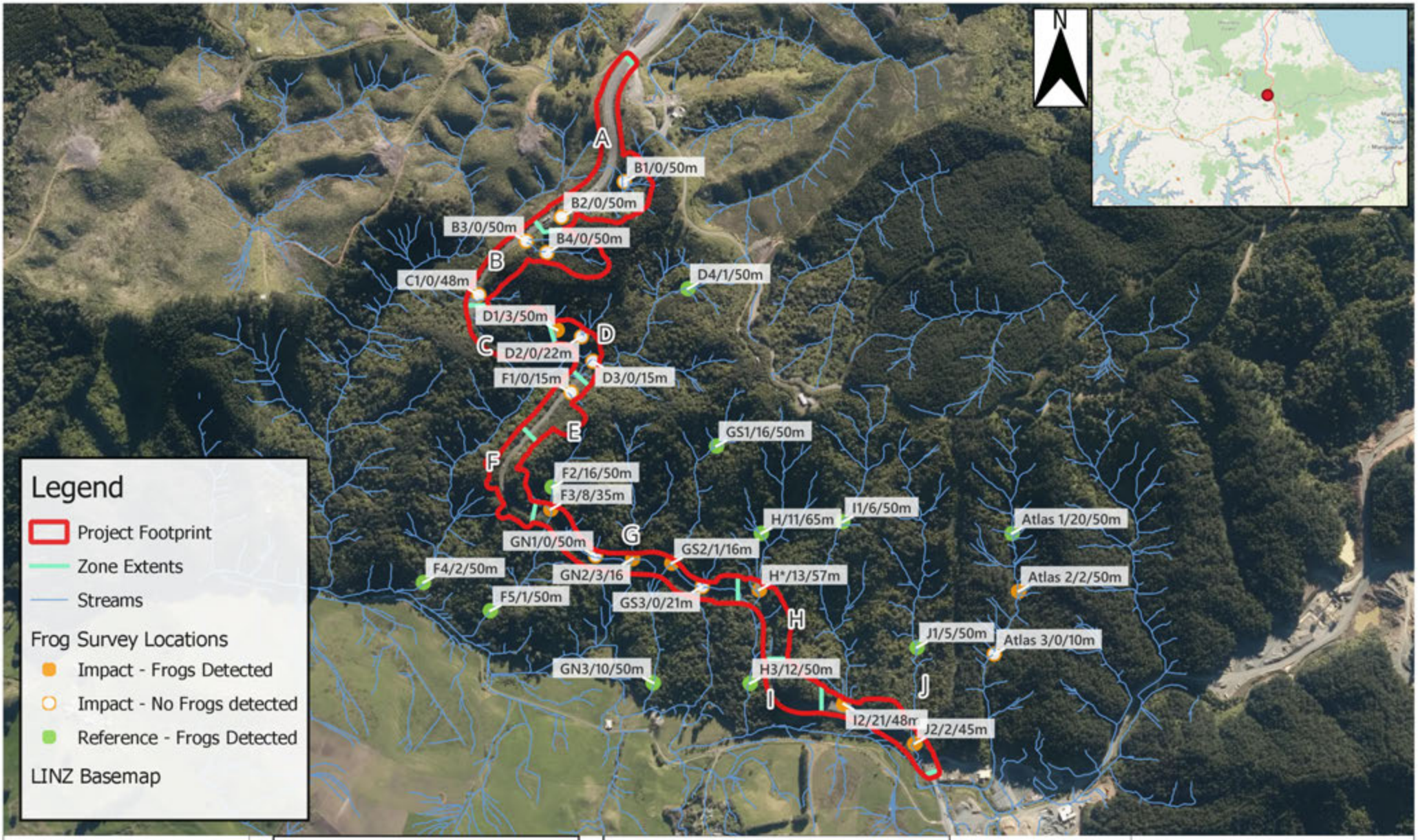
Frog relative abundance surveys were undertaken using a modified method in which two researchers (an experienced herpetologist and a trainee herpetologist) worked together to detect frogs following standard single-observer survey methods (e.g. Whitaker & Alspach 1999; Baber et al, 2009; and Longson et al. 2017). During searches, rocks or woody debris of manageable size close to stream or seepage areas were overturned, and a headlamp was used to improve the likelihood of detecting frogs. Searches were carried out in an upstream direction and searched cover objects were replaced in their original position. The following information was recorded.

- Distance of frog from water (wetted area).
- Microhabitat/refugee type.
- Snout to Urostyle Length SUL (mm),

The start and end times recorded were for the frog search (excluding the habitat assessment discussed above). Each person searched the whole transect (both banks and instream) once, one after the other, spaced 1-2 metres apart. This ensured each frog was counted only once by the team. When a frog was found, it was processed in situ, without being touched or moved during the survey. The following data was recorded for each frog:

- Position along the transect line (m)
- Distance of frog from water (wetted area)
- Microhabitat/refugia type
- Snout to urostyle length (SUL)(mm).

Photographs were taken of each frog beside a ruler when possible. If a frog could not be measured (i.e., jumped away or was deep in a crevice) its size was estimated by life stage, e.g. 'adult'.



Project:

Brynderwyn Hills Recovery Work

Title:

Figure 2-5: Location, and results of, frog scoping surveys. Survey labels show Stream name/#frogs/length searched.

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2/07/24	Lisa Denmead
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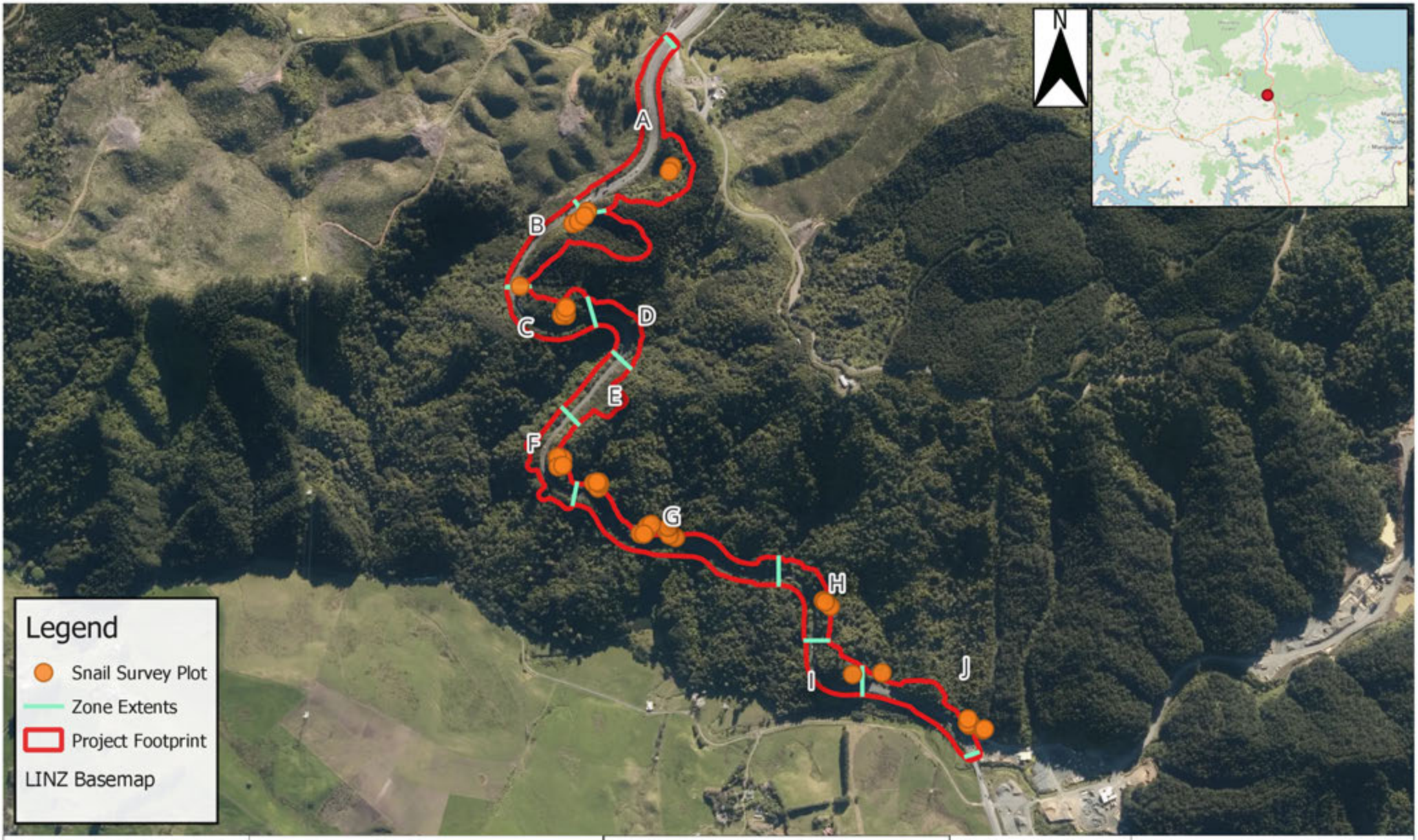
2.2.6 TERRESTRIAL INVERTEBRATES

Forty-five targeted land snail surveys were undertaken across the project footprint or in proximity to the Site (~25 m) using 1 x 1 m plots (Figure 2-6). These plots targeted suitable habitat for the 'At Risk – Declining' and protected land snail species identified as potentially present during the desktop assessment: rhytid snail (*Amborthytida dunniae*) and kauri snail (*Paryphanta busbyi*). Suitable habitats for these species included sheltered sites with high leaf litter cover. These searches were undertaken progressively with multiple passes through the same plot, searching through layers of leaf litter, topsoil, and any debris (i.e., rotting logs).

Due to the low detectability of invertebrates, significant time constraints prior to the commencement of project construction, and health and safety restrictions no further species invertebrate pre-construction surveys were undertaken.



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Project:
Brynderwyn Hills Recovery Work

Title:
Figure 2-6: Snail survey plot locations

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2/07/24	Lisa Denmead
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2.2.7 AQUATIC HABITATS AND FAUNA

Field assessments were undertaken prior to, during and post construction from September 2023 to July 2024. This included a mix of pre-construction baseline assessments, assessments as part of freshwater management measures during construction, and post construction monitoring.

CLASSIFICATION

Watercourse classification assessments were undertaken using the definitions of the Proposed Regional Plan for Northland (PRPN) and definition of a 'river' under the Resource Management Act (RMA) 1991. These definitions are used to assess whether a river or stream is permanent, intermittent, or ephemeral (see Appendix C.1).

Potential wetlands were identified and delineated in accordance with the New Zealand Wetland Delineation Protocols (MfE 2020) and updated definitions defining natural inland wetlands (MfE 2024) (see Appendix C.2).

STREAM ECOLOGICAL VALUATION

The habitat of representative stream reaches directly impacted by the Project and within the receiving environment of the project works was assessed using the Stream Ecological Valuation methodology (Storey et al., 2011; Neale et al. 2016) for permanent watercourses and for intermittent watercourses (Neale et al. 2016). The SEV methodology enables the overall function of a stream to be assessed and compared to the quality of other streams.

The SEV process involves the collection of habitat data (e.g. stream depth, substrate type, riparian cover) and sampling of fish communities and macroinvertebrates (e.g. insect larvae, snails), the latter being recognised indicators of habitat quality.

SEV assessments were generally undertaken over an approximately 50 m reach at each site. The SEV method gives a score between 0 (low quality) and 1 (high quality) for each of a number of attributes which are weighted in terms of their contribution to the overall stream value. These attributes are then combined to give an overall SEV score, also on a scale of 0 to 1. No specific Northland reference sites were available, so the standard Auckland reference sites were used which is considered justified as the streams within the project area are on the edge of the Auckland Regional boundary.

WATER QUALITY

Spot measurements of water quality parameters (temperature, dissolved oxygen & conductivity) were undertaken at representative sites using a calibrated Yellow Stone Instrument (YSI), multi-probe field meter in December 2023.

During construction, at sites impacted by high sedimentation additional surface water quality monitoring of turbidity and total suspended solids was undertaken, these samples were sent to Hills Laboratories for processing.[3]

SEDIMENT

The SEV methodology parameters (vSurf) gave an indication of silt present within transects at sites during both baseline and construction.

During construction, at sites impacted by high sedimentation, sediment assessment methods in Clapcott et. al (2011) were also used to undertake a visual estimate of the percentage of fine sediment cover (SAM 1), rapid qualitative assessment of the amount of total suspensible solids deposited on the streambed (SAM 5) and a quantitative assessment of sediment depth (SAM 6) several days after high sedimentation was observed.

MACROINVERTEBRATE COMMUNITIES

Macroinvertebrates samples were collected from instream habitats of representative sites to obtain semi-quantitative data in accordance with the Ministry for the Environment's current "Protocols for Sampling Macroinvertebrates in Wadeable Streams" (Stark et al., 2001). Sampling was undertaken using Protocol 'C1: hard bottomed, semi quantitative; or Protocol C2: soft-bottomed, semi-quantitative (e.g. kick net samples). The samples were preserved in 70% isopropyl alcohol, returned to the laboratory, and processed by Biolive using Protocol P3: full count with subsampling option (Stark et al., 2001).

This informed the value of the stream and provided a qualitative baseline. Macroinvertebrates were identified to the lowest practicable level and counted to enable biotic indices to be calculated. Biotic indices calculated were:

- The number of taxa.
- The number and percentage of Ephemeroptera (mayflies); Plecoptera (stoneflies) and Trichoptera (caddisflies) recorded in a sample (% EPT).
- The Macroinvertebrate Community Index (MCI).
- The Quantitative Macroinvertebrate Community Index (QMCI).
- The Average Score Per Metric (ASPM).

Additional information on metric and biotic indices, and interpretation of values from Stark & Maxted (2007) and NPS-FM (2024) are further discussed/illustrated in Appendix C.7.

[3] Surface water quality results were compared against Biggs et al. (2002) Stream Assessment Health Toolkit for temperature and conductivity, and NPS-FM for dissolved oxygen. Turbidity and total suspended solids sampling results were compared against the ANZG (2018) Default Guideline Values.

FISH COMMUNITIES AND OTHER KEY FRESHWATER FAUNA

A combination of Environmental Deoxyribonucleic Acid (eDNA); nocturnal spotlighting; incidental daytime discovery; trapping and electric fishing were used to survey and salvage fish communities and other freshwater fauna within the Project Area.

These methods were undertaken for a variety of purposes, outlined below:

- The eDNA sampling technique is based on the knowledge that organisms constantly shed their DNA into the surrounding environment and water from streams and wetlands can be collected, filtered, and sent to the laboratory for analysis to give a qualitative assessment of what fish, aquatic invertebrates, birds and plants may be present. This occurred at many stream sites during the baseline surveys.[4]
- Nocturnal spotlighting was undertaken using high powered head torches. This occurred at a subset of sites during baseline surveys and as part of salvage works during construction. The stream reach was surveyed from downstream to upstream by walking along the banks and scanning the stream habitat for any fish.
- Trapping consisted of deploying Gee minnow traps (1/8" mesh size) at intervals in the highest quality habitat over the length of the stream habitat for salvage works. Traps were left in place overnight and checked the following morning to recover any fish.
- Electric fishing was undertaken during salvage works using a NIWA electric fishing machine backpack. This temporarily stuns the fish allowing them to be caught without damage. Electric fishing was not undertaken in any streams where frogs were detected based on the potential adverse effects, and therefore was limited to the Piroa Stream only (where frogs were not detected).
- Incidental discovery of fish additionally occurred during all stream assessments.

Any fish or kōura observed or captured had their species and estimated size recorded before being returned to aquatic habitats. For baseline assessments, they were returned to the habitats from which they were captured, during salvage works they were relocated upstream or downstream from the works area.

An Index of Biotic Integrity (IBI) was calculated for each stream site, which compares fish presence/absence at a particular location compared to what is expected for that stream reach (MFE, 2019). This calculation was undertaken using the MFE (2024) online calculator. The fish IBI was one of many inputs used in calculating the overall SEV score.

[4] The sites were sampled using eDNA active sampling kits using 1.2 µm sized filters. Samples at each site were collected by drawing a total of approximately 0.5 L to 1 L of water through a syringe from various parts of the stream or wetland which was put through a filter as per methodology outlined by Wilder Lab (www.wilderlab.co.nz/directions). Preservative was then added to the samples, and they were sent to Wilderlab for processing. A combination of basic and comprehensive 'multiple-species analysis' were used for this assessment.

FISH PASSAGE

Fish passage through structures was assessed using eDNA samples, using results from site observations and salvage effort, and a review of design drawings and implementation of the design onsite.

Solutions for providing fish passage considered the New Zealand Fish Passage Guidelines (Franklin et al., 2018), and the Fish Passage Guidance for State Highways (NZTA, 2013) where possible. Professional judgement has also been applied. A fish passage assessment report outlines the detail of this assessment 'WSP (2024) Brynderwyn's Fish Passage Assessment'.

2.2 ECOLOGICAL SIGNIFICANCE ASSESSMENT

The vegetation and habitats present within the Project Area were assessed for significance against the ecological significance criteria listed in Appendix 1 of the National Policy Statement for Indigenous Biodiversity, as required by the WK-OIC.

2.3 ECOLOGICAL IMPACT ASSESSMENT

An assessment of ecological effects was undertaken in accordance with the EcIAG (Roper-Lindsay, et al. 2018). These guidelines provide a systematic, consistent and transparent framework for undertaking assessment of effects, while also providing for professional judgement and flexibility where appropriate.

As outlined in the following sections, the guidelines have been used to determine:

- Step 1: 'Ecological value'.
- Step 2: The 'Magnitude of Effect' of the proposed activity on the environment.
- Step 3: The overall 'Level of Effect' after recommended efforts to further avoid, remedy or mitigate for effects.

The effects of the project have then been assessed against the 'limits to offsetting' principle.

2.4.1 STEP ONE: ASSIGNING ECOLOGICAL VALUE

'Ecological values' were assigned on a scale of 'Negligible' to 'Very High' based on species and habitat values, using criteria in the EcIAG (see Appendix A, Tables A-1: A-3).

These criteria are:

- Representativeness,
- Rarity/distinctiveness,
- Diversity and pattern; and
- Ecological context.

These are also reflected in Appendix 5 of the Regional Policy Statement for Northland (Northland Regional Council, 2018).

2.4.2 STEP TWO: ASSESSING THE MAGNITUDE OF EFFECTS

The 'Magnitude of Effect' is a measure of the extent or scale of the effect of an activity and the degree of change that it will cause after measures to avoid, remedy or mitigate for effects have been undertaken.

The 'Magnitude of Effect' after efforts to avoid, remedy or mitigate for effects was scored on a scale of 'Negligible' to 'Very High' (Appendix A, Tables A-4: A-5) and was assessed in terms of:

- Spatial scale of the effect;
- Duration and timescale of the effect;
- The relative permanence of the effect;
- Timing of the effect in respect of key ecological factors; and
- Level of confidence in understanding the expected effect.

2.4.3 STEP THREE: ASSESSING THE LEVEL OF EFFECTS

An overall 'Level of Effect' (after efforts to avoid, remedy or mitigate for effects) was identified for each habitat/fauna type using a matrix approach. This approach combines the ecological values with the magnitude of effects resulting from the activity (Appendix A, Table A-6)

The matrix describes an overall 'Level of Effect' after efforts to avoid, remedy or mitigate effects on a scale from 'Very Low' to 'Very High'. This 'Level of Effect' is then used to guide the extent and nature of measures to demonstrably offset and/or compensate for residual effects.

These offsetting or compensation measures are considered necessary where the level of residual effects is assessed as 'Moderate' or higher. However, a level of effects deemed to be 'Very High' may not comply with the 'Limits to offsetting' principle.

2.4.4 ADEQUACY OF RESIDUAL EFFECTS MANAGEMENT PACKAGE

In instances where offsetting was feasible, the Biodiversity Offsets Accounting Model (Maseyk et al. 2016) was applied to determine the likelihood that No Net loss (NNL)/preferably Net Gain (NG) outcomes will be achieved via the implementation of the residual effects management package.

To sense check the degree to which the residual effects management package will achieve benefits that outweigh impacts on values that cannot be feasibly offset, Biodiversity Compensation Models (BCMs; Baber et al. 2021) were be applied.

2.4.5 ASSESSMENT AGAINST OFFSETTING AND COMPENSATION PRINCIPLES

A framework was applied to assess the degree to which project effects adheres to offsetting principles as set out in Table 13 of the EciAG (Appendix A, Table A-7), noting that there is no requirement under the WK-OIC to have regard to the offsetting and compensation principles set out Appendix 3 and 4 of the NPS-IB or Appendix 6 and 7 of the NPS-FM.

3. ECOLOGICAL CHARACTERISTICS AND VALUES

3.1 ECOLOGICAL CONTEXT

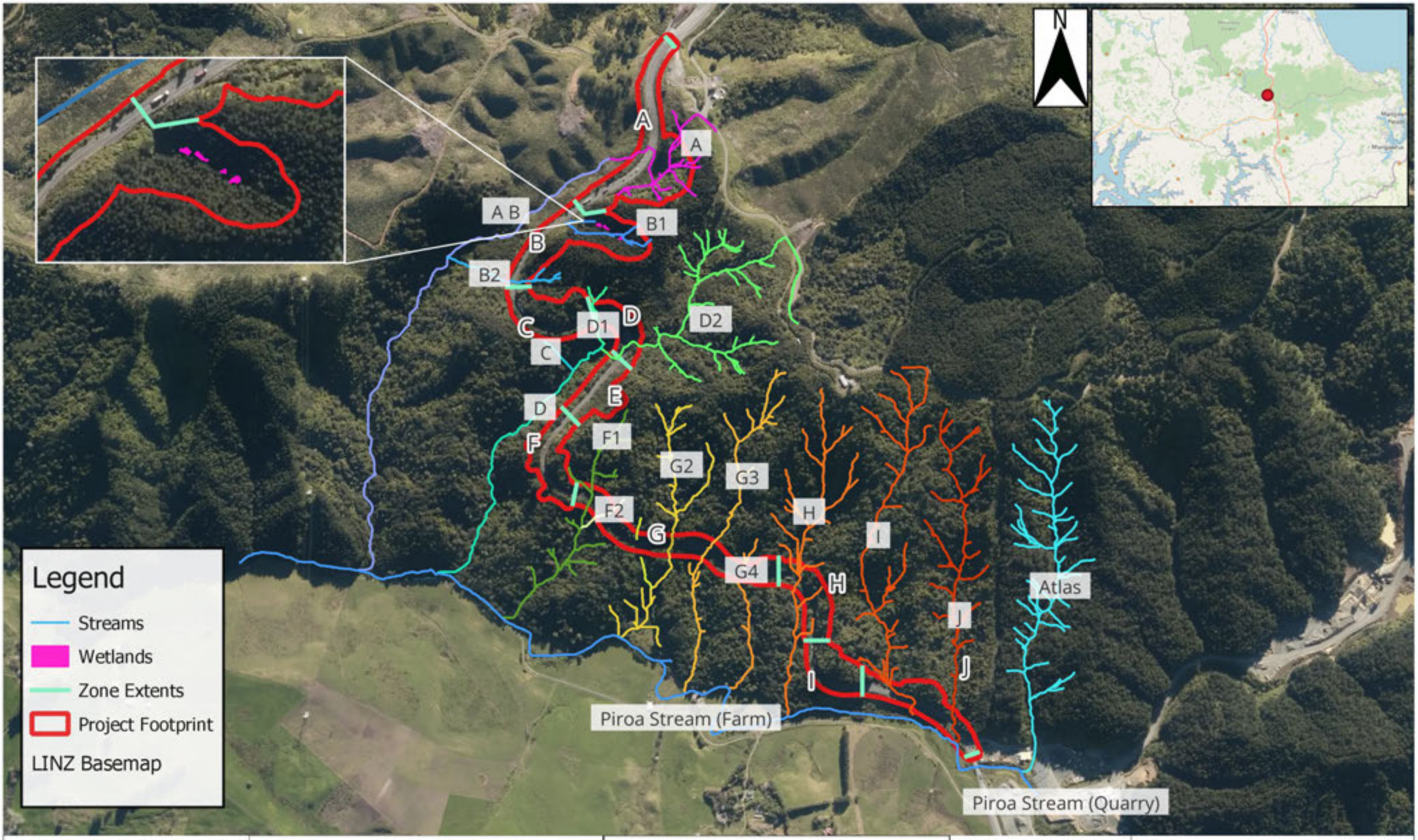
The Site is located on the southern boundary of the Waipu Ecological District (ED). The ED centres on the catchments flowing into Bream Bay, south of the Whangarei Harbour. The geology of the ED is dominated by east-west trending, moderately dissected ranges up to 400 m in elevation, with steep fault-bounded southern faces and gently sloping northern sides. Summers are warm and humid, and winters mild. Mean annual air temperatures vary from 14.0°C to 16.0°C (Lux et al, 2007).

The Waipu ED contains a mixture of low forested ranges, alluvial plains, estuaries, coastal dunelands, and coastal cliffs. Prior to human settlement, most of the ED was likely vegetated in dense forest. Extensive areas of indigenous habitat have since been cleared and modified. Lux et al (2007) recorded just 28.4% of the land cover in indigenous vegetation or habitats within this ED. These are concentrated in the inland hill country 100 m+ asl, and on the coastal dunelands and estuaries. Freshwater wetlands and floodplain forests (formerly extensive on the lowland plains) are now severely reduced in extent and in poor condition (Lux et al 2007). Of the existing 12,699 ha of forest and treeland in the ED, 3,591 ha (28.3%) is protected.

The Site is located within the Brynderwyn Hills Forest Complex (BHFC) (3,308 ha), which was identified as a Significant Natural Area (SNA), within the Protected Natural Areas Programme (PNAP) survey report (Lux, et al., 2007). The BHFC is one of several moderately large tracts of lowland indigenous forest within this ED.

The Brynderwyn/Piroa Range experiences higher rainfall than the surrounding areas and the Site itself is intersected by a network of approximately 10 high value forested tributaries that empty into the Piroa Stream (Figure 3-1). Wetland features are common along the Piroa Valley downslope of the Site, and a single hillslope seep wetland was identified within the project footprint during the ecological baseline assessment (Figure 1-4). A range of flora and faunal species, including threatened, at-risk, taonga and protected species, were identified as likely present and several were confirmed present during surveys:

- Hochstetter's frog (*Leiopelma hochstetteri*, At Risk - Declining).
- Long-tailed bats (*Chalinolobus tuberculatus*, Threatened Nationally - Critical).
- Copper skink (*Oligosoma aenum*, At Risk - Declining).
- Transitory northern brown kiwi (*Apteryx mantelli*, Not Threatened).
- Indigenous forest birds.
- Rhytid snail (*Amborhytida dunniae*).
- Threatened and At-Risk plants.
- Longfin eel (*Anguilla dieffenbachii*, At Risk – Declining), shortfin eel (*Anguilla australis*, Not Threatened) and banded kokopu (*Galaxias fasciatus*, Not Threatened).



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Project: Brynderwyn Hills Recovery Work

Title: Figure 3-1: Stream and wetland locations

Project No:	Drawn:
1-11264.00	Laura van Ginkel
Date:	Checked:
2/07/24	Mark Yungnickel
Scale:	Approved:
10,000 @ A4	Melanya King

Client: NZ TRANSPORT AGENCY WAKA KOTAHI

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3.2 TERRESTRIAL

3.2.1 VEGETATION TYPES

The Land Resource Information Systems (LRIS) potential vegetation of New Zealand database (Manaaki Whenua Landcare Research 2012) identified the Site as being entirely covered by 'kauri/taraire-kohekohe-tawa forest'. However, the field surveys identified multiple different vegetation types (Figure 3-2), which were more in line with the Waipu ED (Lux *et al*., 2007). These vegetation types were approximated as shown (Figure 3-2), this determination was based on vegetation dominance on site, and typed in general accordance with common New Zealand structural typology (Leathwick et al., 1995). The field surveys confirmed the dominant ecosystem type on Site was lowland mature and semi-mature kauri-podocarp-broadleaf forest ecosystem (WF11; (Singers et al. 2017)). Kānuka – mānuka – broadleaf forest, exotic dominated / broadleaf forest and exotic dominated scrub / grassland were also present (Figure 3-2). These vegetation types are detailed below.

3.2.2 Kauri-podocarp- broadleaf forest

The kauri-podocarp-broadleaf forest canopy consisted of mature/semi-mature stands of rimu (*Dacrydium cupressinum*), rewarewa (*Knightia excelsa*), kahikatea (*Dacrycarpus dacrydioides*), tanekaha (*Phyllocladus trichomanoides*), miro (*Pectinopitys ferruginea*), taraire (*Beilschmiedia tarairi*), kohekohe (*Didymocheton spectabilis*) and heketara (*Olearia rani var. rani*). Large mature kauri (*Agathis australis*) was occasionally present and was often observed on site on the ridges and ridge faces. Common subcanopy species found on site included species observed in the canopy, nikau (*Rhopalostylis sapida*), pigeonwood (*Hedycarya arborea*), silver fern (*Alsophila tricolor*), wheki (*Dicksonia squarrosa*), red matipo (*Myrsine australis*), kānuka (*Kunzea robusta*), mānuka (*Leptospermum scoparium var. scoparium*), and māmāngi (*Coprosma arborea*). Occasional subcanopy species included white maire (*Nestegis lanceolata*), totara (*Podocarpus totara*) and halls tōtara (*Podocarpus laetus*).

The understory was dominated by saplings from the above-mentioned native species. Other common understory species included māhoe (*Melicytus ramiflorus*), large-leaved māhoe (*Melicytus macrophyllus*), hangehange (*Geniostoma ligustrifolium*), kiekie (*Freycinetia banksii*), toropapa (*Alseuosmia spp*), crown fern (*Lomaria discolor*), cutty grass (*Gahnia lacera*). Common understory fern species included shining spleenwort (*Asplenium oblongifolium*), thread fern (*Icarus filiformis*), kiokio (*Parablechnum novae-zelandiae*). The riparian margins were dominated by parataniwha (*Elatostema rugosum*), this was often found in the wetter areas of the Site.

Large nest epiphytes such as (*Astelia spp.*) were common which highlights the maturity of this area of indigenous forest. Other common epiphytes and lianes were noted these included: drooping spleenwort (*Asplenium flaccidum*), peka-a-waka (*Earina mucronata*), supplejack (*Ripogonum scandens*), bush lawyer (*Rubus cissoides*) and various climbing rātā species (*Metrosideros diffusa, M. excelsa, M. fulgens*).

This vegetation type has been assessed to be kauri -podocarp - broadleaf forest / BL – nikau – tree fern, however for ease of reference it is named under the dominant canopy tier (Kauri – Podocarp).

3.2.3 Kānuka – mānuka – broadleaf forest

Kānuka – mānuka – broadleaf forest (VS3, Singers, 2017) was found to be a common vegetation type along the road margins from Zone A to F, Haul Road, the beginning of the E Access Track, and in other small areas throughout the Site (Figure 3-2). Kānuka was the dominant canopy species, with mānuka occasionally occurring in dense patches. Other occasional canopy species include totara, halls tōtara, māmāngi, heketara, red matipo, lancewood (*Pseudopanax crassifolius*), and other emergent podocarp species.

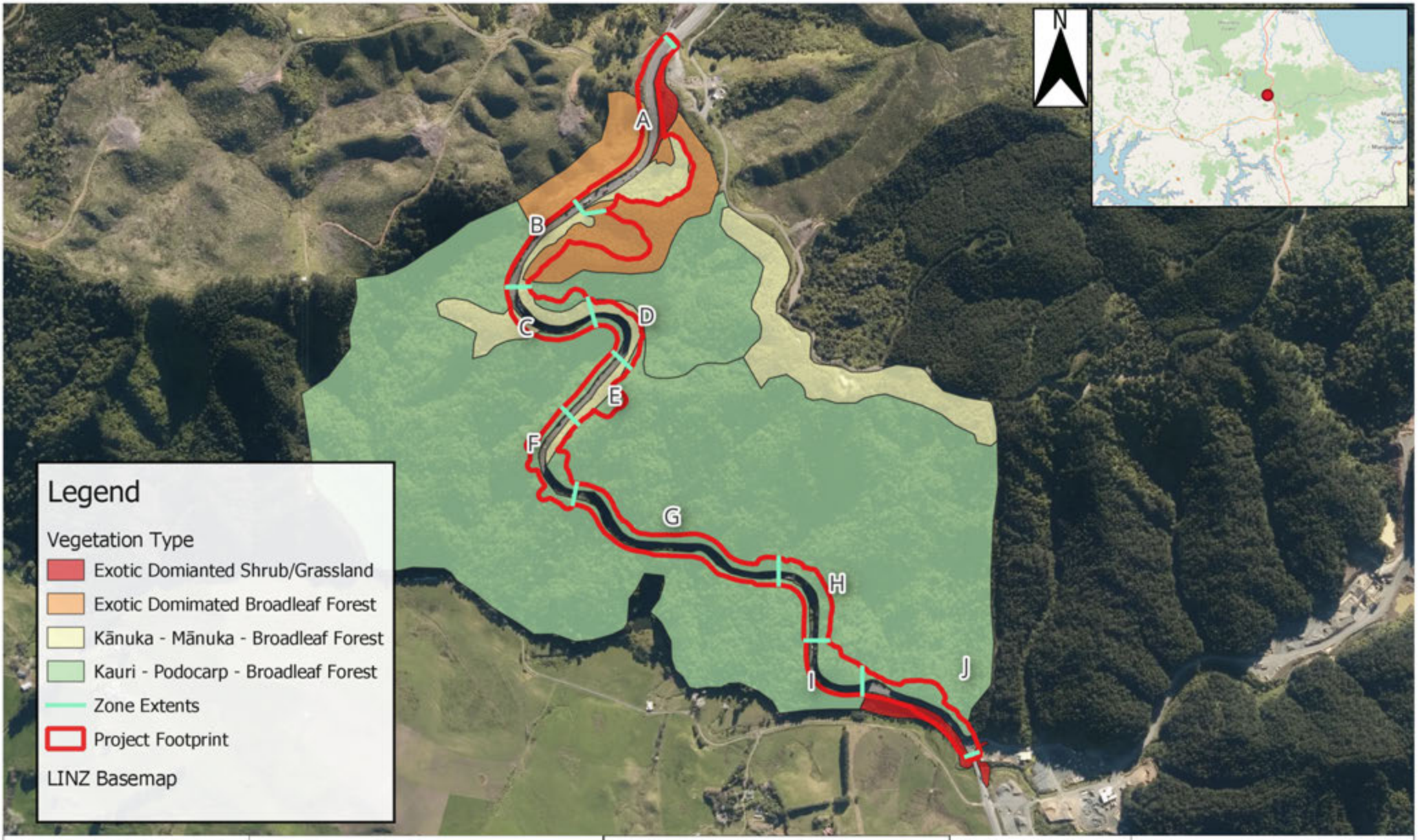
At E access track, the kānuka – mānuka – broadleaf forest community was found to be late successional with canopy and emergent species other than kānuka common. This included Halls tōtara, lancewood, rewarewa, rimu, and heketara. The subcanopy of this vegetation type was dominated by silver ferns. The understory found here was representative of the wider landscape and dominated by common native species. Occasional weed species were present when this vegetation type was observed, specifically along the roadside margins.

3.2.4 Exotic dominated / broadleaf forest

A planted area of pines (*Pinus radiata*) ('Exotic' - introduced) was noted at Fill Site A and B. The canopy was dominated by pine trees with a subcanopy consisting of a more diverse assemblage of indigenous species, largely broadleaf. Pate (*Schefflera digitata*) was the dominant subcanopy species along with the occasional silver fern and tī kōuka (*Cordyline australis*). Common understory plants included large-leaved mahoe, silver fern, wheki, hangehange, pigeonwood, and kanono (*Coprosma grandifolia*). Weed species such as khaili ginger and wandering willie (*Tradescantia fluminensis*) were noted to be at a higher density within this area compared to the areas of indigenous forest.

3.2.5 Exotic dominated scrub / grassland

Exotic dominated scrub and exotic grassland was found alongside the road margin downslope in Section J and at the northern end of Fill Site A. The exotic scrub was low-growing and was dominant of exotic species with occasional native species. Plants dominating the subcanopy/understory included a mixture of pampas (*Cortaderia selloana*), gorse (*Ulex europaeus*), silver fern, kanono, mapou and mahoe. Ground level species include seedlings of the listed subcanopy species and wandering willie, blackberry (*Rubus fruticosus*), fleabane (*Erigeron sumatrensis*), black nightshade (*Solanum nigrum*), creeping buttercup (*Ranunculus repens*) and greater bird's-foot trefoil (*Lotus pedunculatus*). The exotic climber – Hedge bindweed (*Calystegia sepium*) was noted across all strata levels. The exotic grassland tier was dominated by kikuyu (*Cenchrus clandestinus*). This vegetation type was valued as negligible and the loss of this will be insignificant, therefore this is not discussed further within this report.



0 100 200 300 400 500 Meters

Project:

Brynderwyn Hills Recovery Work

Title:

Figure 3-2: Vegetation types on-site

Project No:	Drawn:
1-11264.00	Laura van Ginkel
Date:	Checked: Andree Hickey-Elliott
2/07/24	
Scale:	Approved:
10,000 @ A4	Melanya King

Client:

NZ TRANSPORT AGENCY WAKA KOTAHI

Original Sheet Size: A4 [W = 297, H = 210] Plot Date: 2024-07-31 15:20:23 by van Ginkel, Laura (NZLV31597) File Ref: C:\Users\nzlv31597\OneDrive - WSP O365\QGIS Bryns.qgz

3.2.6 SUMMARY OF VALUES

The ecological value of vegetation types on-site was assessed using criteria from Appendix A, Table 1 & 2 and is presented below in Table 3-1.

Table 3-1: Summary of vegetation types on-site and the overall ecological value.

Ecosystem	Matter	Value	Overall Value
Kauri-podocarp-broadleaf forest (WF11)	Representativeness	High	High
	Rarity/distinctiveness	High	
	Diversity and Pattern	High	
	Ecological Context	High	
Kānuka-mānuka–broadleaf forest	Representativeness	Moderate	Moderate
	Rarity/distinctiveness	Moderate	
	Diversity and Pattern	High	
	Ecological Context	Moderate	
Exotic dominated / broadleaf forest	Representativeness	Very Low	Low
	Rarity/distinctiveness	Low	
	Diversity and Pattern	Low	
	Ecological Context	Moderate	
Exotic dominated scrub/ grassland	Representativeness	Negligible	Negligible
	Rarity/distinctiveness	Negligible	
	Diversity and Pattern	Negligible	
	Ecological Context	Negligible	

3.2.7 PLANT SPECIES

Initial desktop reviews identified ten 'Threatened' or 'At Risk' plant species (de Lange *et al.*, 2018) potentially present within the Project site. RECCE plots and incidental observations confirmed seven of those species on site as outlined below in Table 3-2.

Plant species confirmed on site that are valued as taonga include kauri, all rātā species listed in Table 3-2, rimu, kawakawa (*Piper excelsum*) and all fern species (30 species).

A full list of all plant species recorded within the site is provided in Appendix B:

Table 3-2: Summary of threatened flora confirmed on site and their associated threat status.

Scientific Name	Common Name	Threat Classification
Lophomyrtus bullata	ramarama	Threatened – Nationally Critical
Agathis australis	kauri	Threatened - Nationally Vulnerable
Kunzea robusta	kānuka	Threatened - Nationally Vulnerable
Metrosideros diffusa	white rātā	Threatened - Nationally Vulnerable
Metrosideros fulgens	climbing rātā	Threatened - Nationally Vulnerable
Metrosideros perforata	akatea	Threatened - Nationally Vulnerable
Metrosideros robusta	northern rātā	Threatened - Nationally Vulnerable / Regionally significant
Leptospermum scoparium var. scoparium	mānuka	At Risk – Declining

All species in the family *Myrtaceae* have been assigned elevated threat classifications as a precautionary measure in response to the introduction of myrtle rust (*Austropuccinia psidii*) to New Zealand. However, there is no indication to date that mānuka, kānuka and the rātā species identified on site are susceptible to myrtle rust and they are widely distributed throughout New Zealand and are relatively common species. Therefore, these species, unlike the other threatened species identified on Site, have not been assigned values in accordance with Table 5 of Roper-Lindsay *et. al*. (2018). Values for these species have been assigned based on actual current status rather than potential status should myrtle rust impact on the populations of these species i.e. these are currently common species which are not threatened.

However, this approach excludes Northern rātā' (whose threat classification is also based on myrtle rust), as this species has been identified as regionally significant in Lux *et al*. (2007). The ecological value based on its regionally significant status is Moderate and therefore it has been considered as such within the effects assessment.

3.3 BATS

3.3.1 CHARACTER

At least 18 records of long-tailed bats *(Chalinolobus tuberculatus* –'Threatened – Nationally Critical') (O'Donnell, et al., 2023) were identified from the DOC bioweb database within 3 km of the Site. The proximity of these historical long-tailed bat records informed the need for acoustic bat surveys to determine their presence and provide insight on habitat utilisation throughout the Site.

A total of 13 long-tailed bat passes and one possible short-tail bat pass were recorded throughout the Site over the three seasonal surveys that were undertaken. However, nightly activity levels were very low (<1 passes per night (ppn)), and activity peaked 2-3 hours after sunset which was indicative of foraging rather than roosting.

Bat activity was lowest during the November survey, one site recorded long-tailed bat activity upslope from Zone D (0.05 ppn), and a possible short-tailed bat pass was recorded downslope from Zone J (Figure 2-2). In contrast, five sites recorded long-tailed bat activity during the January survey with an average of 0.9 ppn (± 0.08, SD). Most of these passes were recorded between Zone A and Zone C, indicating that bats were utilising habitat directly. During the April survey one site recorded very low long-tailed bat activity upslope from Zone J, with an average of 0.12 ppn. However, a significant portion of the monitors failed during this survey which is likely to have reduced the number of overall detections.

In addition to the baseline seasonal surveys, ABMs were used onsite to support tree clearance (following best practice guidelines) prior to having all baseline surveys completed. Occasionally, these monitors did detect bat activity, at low levels, confirming the need for a Bat Management Plan (BMP) to responsibly manage the risk of tree felling harm to bats. Throughout the project vegetation clearance, a mixture of ABMs and visual roost feature inspection (via climbing) were used under the BMP Vegetation Removal Protocol (VRP). Approximately 300 trees identified as potential bat roost trees were removed, no bats were detected or seen during visual inspections.

3.3.2 SUMMARY OF VALUES

Long-tailed bats were confirmed to be utilising the site and short-tailed bats may utilise the Site. Bat activity levels were very low (<1 ppn) across the baseline surveys, and BMP VRP monitoring, this indicates that bats rarely utilised the Site. In addition, nightly activity peaked 2-3 hours after sunset, suggesting that there were no significant roost sites directly within the Site. However, long-tailed bats are classified as Threatened – Nationally Critical and northern short-tailed bats are Threatened – Nationally Vulnerable (O'Donnell et al., 2023). Both species are also noted as locally significant (Lux et al., 2007) and both bat species have been identified as taonga species. Since both species are classified as Threatened, they are assigned a Very High value as species under the criteria in Table 5 of Roper-Lindsay et. al. (2018). That stated, the activity data collected from the Site indicates it has marginal value for both species.

3.4 AVIFAUNA (BIRDS)

3.4.1 CHARACTER OF BIRD COMMUNITY

A range of indigenous forest and forest fringe bird species comprised the avifauna community found on site, with 19 indigenous species confirmed as present or likely present based on various detection methods (Table 3-3). Data from ARDs deployed for two weeks over three seasons was analysed using Avia NZ, then manually reviewed[5] using RavenLite2.0. This confirmed the presence of 12 indigenous species. An additional four indigenous species were confirmed by incidental observation whilst on-site, and three additional species were considered likely to utilise the site on occasion based on past local records and known distribution ranges.

Lux *et al*., (2007) identified tomtit (*Petroica macrocephala* – Not Threatened), bellbird (*Anthornis melanura melanura* – Not Threatened) and red-crowned parakeet as included in a draft list of significant species found being prepared by the DOC Northland Conservancy. Long-tailed cuckoo (*Eudynamys taitensis* - Threatened – Nationally Vulnerable) was heard onsite, this is a migratory species and was likely to between its wintering ground and breeding areas to the south where its host species are present. New Zealand pipit (*Anthus novaeseelandiae* - At Risk – Declining) was noted as present in small numbers in the ED (Lux et al., 2007). Two At Risk species (kaka and red-crowned parakeet) with considerable home ranges were not detected on site, however transient presence is possible. Species valued as Taonga include tomtit, kereru, tūī (*Prosthemadera novaeseelandiae* – Not Threatened), and kiwi. Table 3-3 presents the avifauna results and assigned ecological values to each based on the criteria in Table 5 of Roper-Lindsay *et. al*., (2018).

With the presence or likely presence of many protected indigenous birds it was determined that bird nest checks immediately prior to vegetation clearance were required to manage the risk of potential harm to birds. A Bird Management Plan incorporating pre-start checks was prepared and implemented during vegetation clearance. Only old inactive nests were found, including two blackbird nests and one abandoned pipit nest. Further information will be provided in the WSP (2024) Ecology Compliance Reporting (in prep).

3.4.2 NORTH ISLAND BROWN KIWI

Kiwi were known to be present within the Brynderwyn/Piroa Range, having been re-introduced through Operation Nest Egg, with a likely growing and expanding population (Piroa Conservation Trust, 2023). With the closest record of kiwi being just over two kilometres from the Site, ARDs were deployed around the road footprint within adjacent forest habitat. Listening surveys were also undertaken, and trail cameras deployed. A kiwi conservation dog and handler were engaged to undertake active searches.

Analysis of low frequency data from ARDs deployed over a two-week period detected a single female kiwi on 15 November 2023 between ARD location 6 & 7 on Figure 2-3. ARD data

[5] Every second day data was reviewed for the period from sunrise until 9 am.

was analysed using AviaNZ (Version 3.2) software (Marsland, Priyadarshani, Juodakis, & Castro, 2019) which was then reviewed by kiwi practitioners.

The results of the surveys were as follows:

- No calls were heard in any of the three nights of kiwi call listening survey, however the survey was limited to one listening location for the site due to practitioner availability.
- No kiwi were detected in the kiwi dog sitewide sweeps in February or March, indicating presence was occasional and likely limited to dispersal at this time.
- No kiwi were identified in hundreds of trail camera photographs taken over the course of the project.

Despite there only being a single call detected a precautionary approach was taken to kiwi management, as transient presence during dispersal could put individuals at risk of harm given the potential for roosting on site.

As occasional kiwi presence left uncertainty around the risk of harm posed by the project, a risk-minimising kiwi management protocol (6.3.1 Pre-Clearance Kiwi Searches) was detailed in the project Avifauna Management Plan. This required daily checks for kiwi prior to vegetation clearance commencing, which occurred throughout construction and where possible habitat remained undisturbed. No kiwi were found, however further information on preclearance searches will be provided in WSP (2024) Ecology Compliance Reporting (in prep).

3.4.3 SUMMARY OF VALUES

Ecological values ranged from Low to Very High based on species threat conservation status. Most species present or likely to be present within the Site were assigned a Low value as they were classified as Not Threatened natives. Long-tailed cuckoo was assigned a Very High value due to its Threatened status. New Zealand pipit was assigned High value due to its At Risk – Declining classification.

Bellbird and tomtit are Regional Significant species. Red-crowned parakeet and kaka are classified as At Risk, and red-crowned parakeet is also a Regionally significant species. However, the latter two species were not recorded within the Site during any of the surveys, and it is unlikely that the Site currently provides significant habitat for either of these species.

Table 3-3: Ecological values of bird species.

Scientific Name	Common Name	Māori Name	Threat Classification	Ecological Value
Eudynamys taitensis	Long-tailed cuckoo	koekoeā	Threatened - Nationally Vulnerable	Very High
Anthus novaeseelandiae	New Zealand pipit	Pīhoihoi	At Risk - Declining	High
Anthornis melanura melanura	Bellbird	Korimako	Not Threatened Regionally significant	Moderate
Apteryx mantelli	North Island brown kiwi (kiwi)	Kiwi-nui	Not Threatened – Conservation Dependent	Low
Chrysococcyx lucidus lucidus	Shining cuckoo	Pīpīwharauroa	Not Threatened	Low
Circus approximans	Australasian harrier	Kāhu	Not Threatened	Low
Gerygone igata	Grey warbler	Riorio	Not Threatened	Low
Hemiphaga novaeseelandiae	New Zealand pigeon	Kukupa / Kererū	Not Threatened – Conservation Dependent	Low
Hirundo neoxena neoxena	Welcome swallow	Warou	Not Threatened	Low
Ninox novaeseelandiae novaeseelandiae	Morepork	Ruru	Not Threatened	Low
Petroica macrocephala	Tomtit	Ngirungiru	Not Threatened Regionally significant	Moderate
Porphyrio melanotus melanotus	Australasian swamphen	Pūkeko	Not Threatened	Low
Prosthemadera novaeseelandiae	Tui	Tūī	Not Threatened	Low
Rhipidura fuliginosa	New Zealand fantail	Pīwakawaka	Not Threatened	Low
Tadorna variegata	Paradise shelduck	Pūtangitangi	Not Threatened	Low
Todiramphus sanctus vagans	New Zealand kingfisher	Kōtare	Not Threatened	Low
Zosterops lateralis lateralis	Silvereye	Tauhou	Not Threatened	Low
Nestor meridionalis	Kākā	Kākā	At Risk - Recovering	Moderate
Cyanoramphus novaezelandiae	Red-crowned parakeet	Kākāriki	At Risk – Relict Regionally significant	Moderate

3.5 LIZARDS

In total, search effort for lizards across the 10.51 ha of potential lizard habitat within the project included:

- Checking of 166 double-stacked ACOs and 166 small, baited tracking tunnels for ground-dwelling lizards.
- A total of TBC person hours of nocturnal searching for arboreal geckos in select areas within the project footprint.
- A total of TBC person hours of manual searching for ground-dwelling lizards, which included the turnover of natural and artificial cover objects.

Additionally, salvage and relocation operations associated with project activities, as detailed in the Lizard Management Plan (Assessment of Environmental Effects, Appendix F), included:

- 1,018 person-hours of pre-clearance manual and destructive searches;
- Approximately 80 person-hours of spotlighting;
- TBC hours of both day searches and spotlighting of felled vegetation stockpiles;
- Approximately 270 hours of machine-assisted searches; and
- 166 ACO checks before and on the day of vegetation clearance.

Across the survey and salvage and relocation operations, a single native copper skink was detected, along with a possible gecko footprint (lamellae print) that was recorded on a tracking card. Additionally, several exotic plague skink (*Lampropholis delicata* - Introduced) were found.

Based on results of the lizard survey coupled with the subsequent results of the lizard salvage and relocation programme, we assume that all lizard species potentially present (see Table 3-4) are present at low densities.

Table 3-4: Lizards species likely present on Site and respective ecological value.

Scientific Name	Common Name	Māori Name	Threat Classification	Ecological Value
Mokopirirakau granulatus	Forest gecko	mokopirirākau	At Risk - Declining	High
Naultinus elegans	Elegant gecko	moko kākāriki	At Risk - Declining	High
Oligosoma aeneum	Copper skink	-	At Risk - Declining	High
Oligosoma ornatum	Ornate skink	-	At Risk - Declining	High
Dactylocnemis pacificus	Pacific gecko	moko pāpā	Not Threatened – locally uncommon[6]	Moderate

[6] Pers comms. Matt Baber June 2024.

3.6 HOCHSTETTER'S FROG

Baseline Hochstetter frog surveys detected 153 Hochstetter's frogs across 19 of the 30 survey sites, which totalled 1315m in length, corresponding to an average of 0.12 frogs / m. The total time spent searching was 46.5 hours, which corresponded to 3.29 frogs per person hour of searching. Of these 153 frogs:

- One hundred frogs were detected within the 11-reference stream reaches, which totalled 550 m of stream corresponding to an average of 0.31 frogs / m of stream. The total time spent searching within reference sites was 26.3 hours, which equates to 3.8 frogs per person hour of searching within reference streams.
- Fifty-three frogs were detected within the 19 potential project footprint stream reaches, which totalled 765 m of stream equating to an average of 0.07 frogs / m of stream. The total time spent searching with reference sites was 20.2 hours, which equates to 2.62 frogs per person hour of searching within potential project footprint streams.

In general terms the higher number of frogs in the reference streams was correlated with the better-quality habitat within these streams, which were less subject to adverse effects from their immediate proximity and/or poorer habitat quality in streams adjacent to SH1 and recently felled pine forest streams as was the case for Fill Site A and B as detailed in the Hochstetter's frog salvage and relocation report (in prep).

3.6.1 SALVAGE AND RELOCATION REPORT (IN PREP)

In addition to the baseline Hochstetter's frog surveys, 150 frogs were captured and relocated during salvaging and relocation operations undertaken in accordance with the Hochstetter's frog Management Plan and Wildlife Act Authority permit. The 150 frogs were captured from a total of 144 m of impacted streams within the actual project footprint[7] in streams deemed to include suitable or potentially suitable habitat for frogs. This equated to an average of 1.04 frogs per metre.50m.

As expected, salvaging operations detected considerably higher relative abundances of frogs compared to the baseline surveys, as stream habitats were searched more thoroughly, including for example the use of crowbars to check large boulders that would not have been lifted during baseline surveys to avoid habitat disturbance.

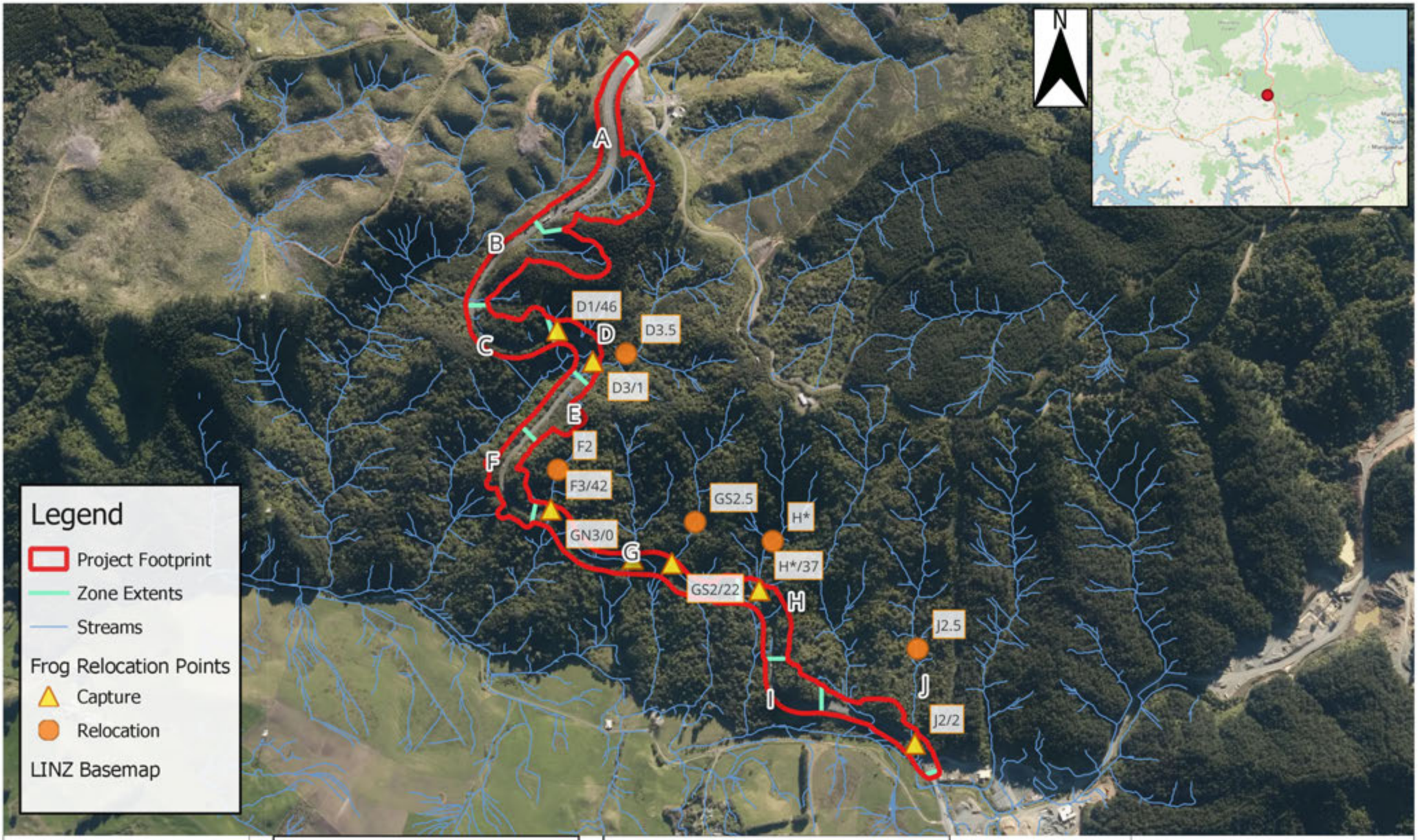
Direct comparisons of the salvaging results with the baseline frog survey results in the actual project footprint indicate a five-fold increase in the number of frogs detected during salvaging operations compared to the baseline survey (Table 3-5, below).

[7] The actual project footprint was less than the potential project footprint assumed at the time of frog baseline surveys This was because the potential project footprint assumed a worst-case scenario and was undertaken in advance of further work to avoid and minimise the quantum of effects on streams.

Table 3-5: Frog detection rate differences between baseline surveys and salvage.

Survey reach	Baseline survey no. of frogs	Total frogs salvaged
D1	3	46
D3	0	1
F3	8	42
Gn2	3	0
Gs2	1	22
H*	13	37
J2	2	2
Totals	30	150

Further details including a breakdown of findings by stream and salvage method are provided in the Hochstetter's frog salvage and relocation report (in prep). H* identifies an unnamed tributary of Stream H.



0 100 200 300 400 500 m

Project: Brynderwyn Hills Recovery Work

Title: Figure 3-3: Frog capture and relocation points

Project No:	Drawn:
1-11264.00	Laura van Ginkel
Date:	Checked:
2/07/24	Lisa Denmead
Scale:	Approved:
10,000 @ A4	Melanya King

Client: NZ TRANSPORT AGENCY WAKA KOTAHI

Original Sheet Size: A4 [W = 297, H = 210] Plot Date: 2024-08-15 13:59:20 by van Ginkel, Laura (NZLV31597) File Ref: C:\Users\nzlv31597\OneDrive - WSP O365\QGIS Bryns.qgz

3.7 TERRESTRIAL INVERTEBRATES

3.7.1 CHARACTER

INaturalist records showed two 'At Risk - Declining' snail species with known distributions that overlap the Project Site have been recorded within approximately 6 km of the Project area (Table 3-6). These species were a rhytid snail (*Amborthytida dunniae*) and kauri snail (*Paryphanta busbyi*). Kauri snails are also protected under the WA and are valued as taonga species.

Targeted snail surveys in suitable habitat across the Site identified seven shells (three confirmed empty) of the 'At Risk – Declining' *Amborhytida dunniae* (Walker et al. 2022) individuals. Manual searching during vegetation clearance for construction also identified seven shells (six confirmed empty). Final salvage details will be confirmed in 'WSP (2024) Ecology Compliance Reporting (in prep).

No 'At Risk – Declining' kauri snails (*Paryphanta busbyi*) were found during targeted surveys or manual searches. However, a single empty shell was found outside of the project footprint within proximity to the Site. Kauri snails are listed as a protected species under the Schedule 7 of the Wildlife Act (New Zealand Government, 1953). Due to the proximity of the record in which they were found to the project Site and the low detectability via survey, it has been assumed that they are also likely present with the project footprint.

The habitat within the works footprint presents potentially good quality habitat for these species (and other indigenous invertebrates). The detected snail species inhabit moist, or damp, areas of native forest and scrub. However, predation from invasive species and disturbance by introduced ungulates has likely resulted in snails being present in densities well below the carrying capacity of the ecosystem.

The distribution of a 'Not Threatened' peripatus species (*Perioatoides sympatrica*) (Trewick, Hitchmough, Rolfe, & Stringer, 2018) also overlaps with the Site. The closest peripatus observations are approximately 35 km from the Project area. These observations are likely to be *P. sympatrica* based on their known distribution. *P. sympatrica* are not protected, and therefore specific management is not required. However, this is a notable species as effects on this species are not well understood due to the limited knowledge of their taxonomy and ecology. Therefore, a precautionary approach was used for their management within the project, and they were included in the invertebrate management plan as a species for salvage during construction. Eight velvet worms (*Peripatoides*) were consequently salvaged during manual searches during construction.

3.7.2 SUMMARY OF VALUES

The two land snail species with the conservation threat classification of At Risk – Declining hold High ecological value, while other indigenous Not Threatened indigenous species hold Low ecological value (Table 3-6).

Table 3-6: Ecological value of invertebrate species.

Scientific Name	Common Name	Māori Name	Threat Classification	Ecological Value
Amborhytida dunniae	Rhytid snail	-	At Risk - Declining	High
Paryphanta busbyi	Kauri snail	pupurangi	At Risk - Declining[8]	High
Other Not Threatened species			Not Threatened	Low

3.8 AQUATIC

3.8.1 STREAM DESCRIPTION / CLASSIFICATION

Several small tributaries of the Piroa Stream are bisected by SH1 and are located within rugged hill country and native bush (Figure 3-1). They are largely characterised by their small size and steep gradient. These tributaries included a mix of ephemeral flow paths, intermittent and perennial streams. These tributaries flow into the Piroa Stream which is a larger perennial stream. Table 3-7 provides classifications for each waterway within the Project area.

These streams are part of the Waipu River Catchment. From the Site, the Piroa Stream flows into the Ahuoa River, then into the Waipu River, and Bream Bay approximately 34 km downstream. Appendix C shows representative photos of key sites for freshwater ecology.

[8] Also Protected under Schedule 7 of the Wildlife Act 1953.

Table 3-7: Stream and wetland classification of representative sites.

Freshwater Site	Classification Type
Tributaires of the Piroa Stream*	
A Upstream (Fill Site)	Intermittent
B1 Upstream (Fill Site)	Intermittent
B2 Upstream	Ephemeral
AB Downstream	Permanent
C Downstream	Ephemeral
D1 Upstream	Intermittent
D2 Upstream	Permanent
D Downstream	Permanent
F1 Upstream	Permanent
F1 Downstream	Permanent
F2 Upstream	Ephemeral
G1 Upstream	Ephemeral
G2 Upstream	Permanent
G2 Downstream	Permanent
G3 Upstream	Permanent
G3 Downstream	Permanent
G4 Upstream	Ephemeral
G4 Downstream	Permanent
H Upstream	Permanent
H Downstream	Permanent
I Upstream	Permanent
I Downstream	Permanent
J Upstream	Permanent
J Downstream	Permanent
Atlas	Permanent
Piroa Stream	
Piroa Farm	Permanent
Piroa Quarry	Permanent
Wetland	
B1 Upstream (Fill site)	Intermittent

* The “Upstream” or ‘Downstream’ indicates if the site is upstream or downstream of the state highway.

3.8.2 WETLAND DESCRIPTION / CLASSIFICATION

The only natural inland wetlands impacted by the project were present upstream of the state highway in the vicinity of the Site B fill area (Figure 3-1). This wetland complex consisted of a series of wetland habitats a total of approximately 95m² in size which were separated by sections of stream. Two representative vegetative wetland plots were assessed (in accordance with Clarkson (2013) and the MfE (2020) wetland protocols), and both passed the Dominance Test (100%) and Prevalence Index test (2.49 and 2.51 respectively) for wetland vegetation delineation. Based on the lack of surface water and the absence of pools observed in December 2023, the wetland complex was considered to be intermittent.

The wetland complex was in a degraded state based on its location amongst recently harvested exotic forest with high sediment inputs. The wetland vegetation community was mainly dominated by exotic rushes and sedges (*Juncus articulatus* – FACW; *J. effusus* – FACW; *Isolepis sepulcralis* – FAC; *I. bufonius*, - FACW), and an early native colonist of disturbed wet areas (*Juncus palnifolius* –- FACW; *Isolepis prolifera* - OBL); and consisted of a low diversity of species (Appendix C1) It exhibited some wetland hydrology which originated from seeps from groundwater at the head of the gully, which fed the intermittent stream. The wetland areas provided few functions, as they were mostly elevated above the streamflow, but might have provided some wetland function by maintaining base flow over longer periods and reducing storm peak flows. The wetland has been valued as Low for indigenous biodiversity, ecosystem health and hydrological functioning.

3.8.3 STREAM ECOLOGICAL VALUATION

Stream Ecological Valuations were carried out at representative of sites within the project area both upstream and downstream of SH1. Many of the sites scored in the vicinity of 0.8 to 0.9 indicating high scores in comparison to other streams. The highest score was recorded at Gully H downstream of the road, whereas the lowest score was recorded in the lower section of the Piroa Stream (Piroa Stream Farm). The scores were predominately affected by the presence/absence of a fully vegetated shaded riparian zone within native bush which greatly affects the temperature control, riparian vegetation intactness, and organic matter input scores. The stream ecological valuation results are presented in Appendix C4. Values for these waterways are attributed above in Section 0 taking into account the following sections.

3.8.4 WATER QUALITY

There were no LAWA long-term water quality monitoring sites within the Waipu River catchment.

Baseline spot measurements of the streams water quality generally indicated high water quality. Temperatures were generally in the range of ‘excellent’ and ‘suitable for most macroinvertebrates and periphyton’; water clarity was ‘excellent’ indicating ‘clean water’; conductivity was ‘good’ with ‘low concentrations of dissolved ions’; and dissolved oxygen varied with some streams well oxygenated where there was flowing water.

During construction, at ‘H Downstream’ and ‘F Downstream’ sites where sediment runoff from the road was observed on the 14 and 15 March, turbidity and suspended solids were significantly high and greatly exceeded guideline values. The water quality results are provided in Appendix C5.

3.8.5 SEDIMENT

During baseline surveys there was generally low cover of silt/sand within the stream beds. This is likely a result of most streams being located within native bush with fully vegetated riparian margins. The exception was the 'B1 Upstream' stream and 'B1 wetlands' and within the 'D Downstream' and 'G4 Downstream' sites which indicates ongoing effects from sedimentation from recent harvesting or semi-harvesting of exotic forest, and previous slips associated with the road.

During construction, there was a large increase in the percent cover of silt within the 'H downstream' site, and a lesser increase at the 'F Downstream' site. These are sites where sediment runoff from the road construction activities was visibly observed entering these tributaries. Additional sediment assessment protocols (SAM) 1, 5, and 6 were carried out on sediment impact sites as a baseline to track recovery after works are completed and the source/s removed. The sediment assessment results, and discussion are provided in Appendix C6.

3.8.6 MACROINVERTEBRATE COMMUNITIES

Macroinvertebrate communities were sampled at a subset of sites within the project area during summer. At most sites macroinvertebrate communities were dominated by a diverse number of sensitive taxa: mayflies, stoneflies and caddisflies (*Ephemeroptera, Plecoptera, Tricoptera*; EPT taxa) that made up a high percent of sample abundance, and a high number of sensitive taxa with individual MCI scores >8. The macroinvertebrate community index (MCI) and quantitative macroinvertebrate community index scores typically scored high (>120; >6.00 respectively) indicating the habitat quality within the streams were 'excellent' with 'clean water' and were within the A or B NPS-FM bands indicating pristine conditions or only very mild pollution. The average score per metric (ASPM) were typically within the A NPS-FM band indicating high ecological integrity. These high to very high values are indicative of streams with fully vegetated native bush riparian zones.

The exception was the Piroa Stream which had a lower score which appeared to be influenced by a lack of a vegetated riparian zone and likely water quality and sedimentation issues from upstream quarry operations. The Piroa Farm site was dominated by pollution sensitive freshwater snails *Potamopyrgus* making up 97% of the sample abundance. While the stream recorded 11 EPT taxa, they only made up 1.7% of the total sample abundance. The MCI score of 97 and QMCI score of 4.06 indicated the habitat quality within the stream was 'fair' and was within the C NPS-FM bands indicating moderate organic pollution. The ASPM was within the D NPS-FM band indicating severe loss of ecological integrity

The only species with a notable conservation status was the stonefly (*Megaleptoperla grandis*) which is 'At Risk, Naturally Uncommon', and which was found at several sites. However, there may have been other 'At Risk' taxa that were not recorded, as most taxa were only able to be identified to genus level. The macroinvertebrate results are provided in (Appendix Macroinvertebrate communities).

3.8.7 FISH COMMUNITIES AND OTHER KEY FRESHWATER FAUNA

The New Zealand Freshwater Fish Database confirmed no records from the Piroa Stream and tributaries, but four records were present from the downstream Ahuroa River and

tributaries within 5km of the site. This included five species of native fish and native freshwater crayfish, kōura.

Environmental Deoxyribonucleic Acid (eDNA) surveys were undertaken throughout the project area and confirmed the presence of 'Not Threatened' shortfin eel (*Anguilla australis*), and kōura *Paranephrops planiforms*), and 'At Risk, Declining' longfin eel (*Anguilla dieffenbachii*) and Hochstetter's frogs (*Leiopelma hochstetteri*) within the tributaries of the Piroa Stream. In addition, the Piroa Stream also recorded 'Not Threatened' banded kōkopu (*Galaxias fasciatus*) and 'At Risk, Declining' freshwater mussels, kākahi (*Echyridella menziesii*). The diversity of fish was generally low, likely due to the distance of the sites inland from the sea and steep gradients of the Piroa River tributaries.

Nocturnal spotlighting, day searches, and incidental observations while undertaking other survey work also confirmed eels, freshwater crayfish and Hochstetters frogs throughout the streams within the project area (Table 3-8). The fish and other key freshwater fauna results are presented in Appendix C8.

Table 3-8: Value of At Risk, or taonga freshwater fauna species observed.

Scientific name	Common name	Māori name	Threat Classification	Value
Anguilla australis	shortfin eel	tuna	Not Threatened	Low
Anguilla dieffenbachii	longfin eel	tuna	At Risk - Declining	High
Echyridella menziesii	freshwater mussel	kākahi	At Risk - Declining	High
Galaxias fasciatus	banded kokopu	kōkopu	Not Threatened	Low
Leiopelma hochstetteri	Hochstetter frog	Pekeketua/ pepeketua	At Risk - Declining	High
Megaleptoperla grandis	stonefly		At Risk, Naturally Uncommon	Moderate
Paranephrops planiforms	freshwater crayfish	kōura	Not Threatened	Low

During construction several streams within the vicinity of the road were affected by the Project, this included works such as culvert extensions, installing rip rap, use of concrete in or near the stream, and placement of a new culvert. Therefore, as per the freshwater and frog management plans, freshwater fauna were salvaged and relocated prior to and during construction works. This included a total of four longfin eel, three shortfin eel, one unidentified eel, 13 freshwater crayfish and 150 Hochstetter frogs, which are detailed in the 'WSP (2024) Ecology Compliance Report'. At the time of completing this report fish salvage was still to take place to remove the temporary culvert at the Piroa Quarry site.

3.8.9 FISH PASSAGE

Fish passage is discussed in detail in the 'WSP (2024) Brynderwyns Fish Passage Report'. High level fish passage assessments were undertaken on ten structures that convey stream flow. Fish and freshwater crayfish were present both upstream and downstream of SH1 in many stream sites suggesting that the existing structures provided some level of fish

passage. The streams are high-gradient and have restrictions at points where they intersect the road.

3.8.10 SUMMARY OF VALUES

The ecological value of freshwater ecology is overall considered to be High to Very High for tributaries of the Piroa Stream. Most tributaries were located within fully vegetated native bush with diverse and high instream values. The overall value of the Piroa Stream was Moderate and the wetland was Low. The Piroa Stream and the wetland were located in modified habitats, with little to no vegetated riparian zone, obvious water quality issues and high degradation as a result of land use change (Table 3-8).

There are 'At Risk' fish (Dunn et al. 2018), freshwater mussels, a stonefly (Grainger et al. 2018), and native frogs (Burns et al. 2018) present which are of high ecological value (Table 3-7). This includes several taonga species which have importance to Māori. Freshwater streams, wetlands and invertebrates are also considered taonga. The overall value for 'Not Threatened' freshwater fauna is Low and for 'At Risk, Declining' freshwater fauna is high.

Table 3-9: Aquatic Values Summary

Location	Characteristics / matters	Overall Value
Tributaries of the Piroa	Typically reference quality watercourses with negligible degradation. MCI scores were typically 120 or greater and QMCI 6.00 or greater indicating habitat quality was 'excellent'. Benthic macroinvertebrate communities had a diverse number of mainly sensitive taxa. Benthic macroinvertebrate communities had high proportions of EPT taxa. MCI were generally greater than 120 and QMCI greater than 6.00. SEV's were generally very high 0.8 to 0.9. Freshwater fauna generally consisted of 'At Risk-Declining' Hochstetter frogs, longfin eel, Not Threatened shortfin eel and koura within most tributaries. Riparian vegetation was typically well-established native vegetation with a closed canopy Stream channels were largely natural. Habitat was generally natural and unmodified. Within areas that meet the NSP-IB SNA criteria. Representative =High Rarity/distinctiveness = Very High Diversity and Pattern = High Ecological Context = High Potential: High to Very High (typically the same as the current as there is limited ability to carry out additional planting.)	High to Very High
Piroa Stream	Contains fragments of former values but Moderate to High degradation MCI score was 97 and QMCI scores 4.06 indicating habitat quality was 'fair'. Benthic macroinvertebrate communities had a mix of sensitive and pollution tolerant taxa.	Moderate

	Benthic macroinvertebrate communities had very low proportion of EPT taxa, and high proportion of pollution tolerant taxa. Obvious water quality and contaminant issues with upstream land use. SEV's were low and moderate 0.22 to 0.42 Freshwater fauna were moderately diverse and, and abundant consisting of 'At Risk-Declining' longfin eel, freshwater mussels, Not Threatened shortfin eel, banded kokopu and koura. Riparian vegetation was very limited and dominated by grass Stream channels were largely natural but modified with channel incision. Habitat was modified by retained diverse range of characteristics. Representative = Low Rarity/distinctiveness = High Diversity and Pattern = Moderate Ecological Context = Moderate Potential: Moderate (as the Piroa has the ability to be riparian planted and improve functions).	
Wetland	Representativeness: Low. The wetland is largely induced by human activities. Due to lack of connectivity and constant disturbance, the wetland lacks the flora and fauna characteristics of a robust wetland. The wetland appears to be intermittently saturated and would have likely been dry in summer months. The wetland buffer was highly disturbed. Rarity distinctiveness: Low. The wetland is a mosaic totalling 95m² and is a miniscule proportion of the wetlands in the ecological district. There are extensive areas of seepage wetlands in the landscape as evidence by the numerous seepage wetlands located at the base of the Brynderwyn Hills. No Threatened or At-Risk flora or fauna species were identified within the wetland. There was insufficient water within the wetland to support native fish. Diversity & Pattern: Low. The wetland has one dominant vegetation tier and a low species diversity, largely comprised of early colonising exotic species of wetted disturbed ground. The wetland also is very small and linear, which leaves it vulnerable to edge effects such as light, temperature, noise and wind. Ecological Context: Low. The wetland is isolated by the gully and SH1. The vegetation type was uniform throughout the wetland, with a low diversity of flora present, and a single herbaceous vegetation tier, with no trees or other structural tiers present. The wetland has no effective riparian buffer, and there is no buffering from edge effects. Potential: Low. The wetland is comprised of small patches of herbaceous vegetation located within a gully head of a commercial forest and is subject to regular commercial harvesting activities. There is no intention of protecting this habitat and it is likely that once the trees are re-established that the wetland and narrow intermittent stream will largely dry out.	Low

3.9 SIGNIFICANT NATURAL AREAS

The Survey Area was assessed against the criteria set out in Appendix 1 of the NPS-IB (Table 3-10). Based on the prior identification of areas as an SNA and data from RECCE surveys conducted on Site, these ecological values indicated a SNA was likely present. The assessment below confirms that the Site has met the criteria for SNA classification under the NPS-IB.

Table 3-10: Assessment of terrestrial vegetation values against Appendix 1 of the NPS-IB for identifying SNA's (Ministry of Environment, 2023). For key assessment principles of each criterion see Appendix C.

APPENDIX 1 OF THE NATIONAL POLICY STATEMENT – INDIGENOUS BIODIVERSITY		
Criteria	Criteria Met? (Yes/No)	Ecological Value Assessment
A) representativeness **(1) representativeness is the extent to which the indigenous vegetation or habitat of indigenous fauna in an area is typical or characteristic of the indigenous biodiversity of the relevant ecological district**	Yes – criteria met	Vegetation communities within the Site provide representative examples of an indigenous ecosystem due to the dominance of native species across all vegetation strata levels (excluding areas of fill a & b). Indigenous vegetation on-site is typical of the character of the ecological district in the present-day environment. This is further confirmed by a prior PNAP survey identifying it as a SNA of the Waipu ED (Lux et al., 2007).
B) Diversity and pattern criterion **(1) Diversity and pattern is the extent to which the expected range of diversity and pattern of biological and physical components within the relevant ecological district is present in an area**	Yes – criteria met	Vegetation communities within the Site comprise of diverse indigenous species and habitats of indigenous communities in the context of the Waipu ED. This is evident from the diversity of plant species captured in RECCE plots. Natural transition zones along environmental gradients are also persistent on-site.
C) Rarity and distinctiveness criterion **(1) Rarity and distinctiveness is the presence of rare or distinctive indigenous taxa, habitats of indigenous fauna, indigenous vegetation or ecosystems**	Yes – criteria met	Provides habitat for multiple indigenous species (flora and fauna) listed as Threatened or At Risk. Plant species and vegetation communities within the Site are significant to the Northland Region.
D) Ecological context criterion **(1) Ecological context is the extent to which the size, shape, and configuration of an area within the wider surrounding landscape contributes to its ability to maintain indigenous biodiversity or affects the ability of the surrounding landscape to maintain its indigenous biodiversity.**	Yes – criteria met	The Site provides a continuous linkage of indigenous vegetation biodiversity to the Brynderwyns Range. It is significant in size and well-buffered relative to the remaining habitat types that exist in the Waipu ED. The Site contributes to the winder surrounding landscape and provides a 'stepping stone' for any indigenous fauna species.

4. ECOLOGICAL IMPACT ASSESSMENT

This section assesses the potential effects of the project on all terrestrial and freshwater ecological values using the methodology in the EcIAG (EIANZ, 2018, Appendix A).

4.1 POTENTIAL FOR AND KNOWN ADVERSE EFFECTS

Potential (and known) adverse effects associated with the recovery works include:

Terrestrial

- Vegetation and habitat loss through vegetation clearance and earthworks. (4.89 ha of kauri-podocarp-broadleaf forest, 3.47 ha of kānuka-mānuka-broadleaf forest, and 2.15 ha of exotic dominated vegetation.
- Direct mortality or injury to species as a result of vegetation clearance, earthworks and construction activities (specifically two Hochstetter's frogs, due to water chemistry change).
- Loss of 144.4 m of Hochstetter's frog stream length, equating to an area of 156.72 m^2.
- The creation of habitat edge effects, altering the composition and health of adjacent vegetation (i.e. habitat degradation), which may affect habitat suitability for flora and fauna.
- Habitat fragmentation and isolation due to the loss and reduction of available habitat types and by reducing the ability for plants and animals to disperse across the landscape for food, shelter, and breeding purposes, i.e. severing or partially severing access to habitats that would otherwise be suitable.
- Disturbance effects from noise, vibrations, human activity, lighting or dust.
- Potential adverse effects on Hochstetter's frogs and freshwater fauna will primarily occur through habitat loss associated with stream loss, vegetation clearance, earthworks and stream culverting.

Aquatic

- For intermittent and perennial streams, this includes permanent modification / loss of a total of approximately 322 m linear length, and when including temporary affected linear length this totals approximately 497 m of streams (see Appendix C17).
- Loss of approximately 95 m^2 of natural inland wetland.
- Impacts in the aquatic receiving environment via construction are sedimentation, concrete (temperature and pH changes) and hydrocarbons.
- Impediments to fish passage through stormwater infrastructure modifications including culvert extensions, and placement of rock rip rap. This is detailed in the 'WSP (2024) Brynderwyns Fish Passage Report' and summarised in Appendix C10.

- Spread of pest plant and animal species throughout the catchment and receiving environment as a result of machinery, vehicles and other equipment which have the potential to cause ecological harm to freshwater environments (MFE, 2021).

Potential long-term effects after construction include:

Terrestrial

- Continued reduced habitat within the local landscape for both indigenous plants and terrestrial fauna due to permanent habitat loss.
- Decreased landscape and habitat connectivity through fragmentation until new habitat areas are established.
- Potential effects associated with the increased presence of people and introduced species in previously less accessible areas.
- Ongoing habitat degradation associated with edge effects and fragmentation, which permanently affect the movement of some species.
- Ongoing disturbance effects, particularly on habitat margins/edges, through noise, dust and lighting.

Aquatic

- Ongoing effects from stream habitat loss for Hochstetter's frogs and freshwater fauna.
- Ongoing effects from sediment runoff to watercourses within the receiving environment that may have adverse effects on habitat quality and aquatic fauna.
- Ongoing effects from potential changes in hydrology and stormwater quality from an increase in impervious surface and modification of stormwater infrastructure. This includes catchment hardening.

These effects relate to the potential habitat removal and modification associated with the activities within the Project footprint and ZOI.

The potential adverse ecological effects described above will vary in scale and extent and can change over time. The following section sets out the measures required to avoid, minimise or rehabilitate adverse effects.

4.2 OVERVIEW OF MEASURES TO AVOID, MINIMISE OR REMEDIATE EFFECTS

The 'WSP (2023) Brynderwyns Recovery Work: Ecological Management Plan Suite' in Appendix F outlines the measures proposed to avoid, minimise and remedy effects for vegetation, bats, birds, lizards, frogs, terrestrial invertebrates, fish and freshwater for the project. Management plans developed for the project were adaptive and updated based on the site-specific effects and constraints encountered through the project.

A summary of the measures to avoid or minimise adverse effects for the project including those outlined in the management plans include:

Terrestrial

- Avoidance of high value habitat where possible through refinement of the project footprint as described in the Assessment of Effects report. This included selection of spoil disposal sites to avoid habitat for Hochstetter's frog and other 'Threatened' or 'At Risk' species.
- Seasonal constraints on vegetation clearance. The vegetation clearance programme will be affected by specific timing restrictions to avoid or minimise effects on fauna that are legally protected under the Wildlife Act (1953). This includes avoidance of vegetation clearance:
    - Outside of earthworks season (i.e., should not be undertaken from 1 May – 1 October) when Hochstetter's frog ranges are more restricted, and erosion and sediment controls are to be in place;
    - During peak forest bird breeding season to reduce harm to eggs or chicks; and
    - Outside of winter months to improve the detectability of lizards which are more active during winter months.
- Seasonal constraints on stream works. Stream works will only occur during earthworks season, as during these drier months Hochstetter's frog ranges are more restricted.
- Implementation of a bat roost tree felling protocol in accordance with Department of Conservation standards.
- Vegetation clearance protocols, including:
    - Vegetation clearance can only occur upon completion of pre-start vegetation checks performed by a suitably qualified ecologist.
    - Vegetation only to be cleared immediately prior to construction works beginning within the project footprint to reduce habitat effects and potential for erosion and sediment generation.
    - Vegetation to be directionally felled away from the project boundary to prevent damage to vegetation immediately adjacent to the footprint, unless deemed unsafe.
    - Vegetation removal is to be site-specific and will be supervised by an ecologist.

    - Felled vegetation must be surveyed to identify, catch, and remove any native lizards and frogs, and at-risk or threatened species of invertebrates. If fauna is detected, works must stop immediately.
    - Once vegetation has been surveyed, felled woody indigenous vegetation, as far as practical, should be moved a minimal distance outside the proposed project footprint to a location of a similar environment.
    - If relocation of felled vegetation is not practical, vegetation can be mulched.
- Vegetation clearance salvage and relocation operations for nationally 'Threatened', 'At Risk' or legally protected species present or potentially present onsite. These species include Hochstetter's frog, ornate skink, elegant gecko, forest gecko, Pacific gecko, copper skink, rhytid snail and kauri snail.
- Enhancement of relocation site(s) through salvaged coarse wood or rock deployment to increase habitat abundance and planting where required to improve the likelihood of survival.
- Sediment and dust control measures.
- Measures proposed to remedy potential adverse effects are detailed in the project landscape plans and incorporate the 1.77 ha of native remediation planting.

Aquatic

- Avoidance of vegetation clearance and streamworks outside of earthworks season
- Salvage of freshwater fauna including At Risk and taonga species prior to and during instream works.
- Development and implementation of an erosion and sediment control plan
- Development and implementation of water quality protocols for concrete in or close to water courses.
- Biocontrol – check, clean and drying of vehicles, plant and equipment.
- Minimisation of habitat loss through demarcating works and buffer areas
- Refinement of the stormwater infrastructure design minimise potential scour and habitat loss.
- Construction management plan to detail refuelling procedures and contamination spillage.
- Indigenous remediation planting in gullies
- Removal of temporary culvert, reinstatement of stream and replanting of riparian zones.

4.3 MAGNITUDE AND LEVEL OF EFFECTS ASSESSMENT

The magnitude of effects on ecological values is assessed based on the extent, intensity, duration and timing of effects associated with the project. This 'Magnitude of Effects' assessment (Appendix A, Table A-4) is combined with the ecological values outlined in Section 3, using a matrix approach (Appendix A, Table A-6), to determine an overall 'Level of

Effect' (after efforts to avoid, minimise or remedy effects) on a scale from 'Very Low' to 'Very High'.

Residual effects on habitat values, individual species or species assemblages that are assessed as being 'Moderate' or higher warrant habitat restoration or enhancement measures to offset or compensate for these effects as set out in Section 6.

4.3.1 TERRESTRIAL

After avoidance, minimisation and remediation the following ecological features have a Low or Very Low overall effect:

- Exotic dominated vegetation types.
- Ramarama.
- Northern Rata.
- Bats.
- Bird species.
- Not threatened Invertebrate species.

After avoidance, minimisation and remediation the following ecological features have a Moderate or higher overall effects.

There are residual effects 'Moderate' or higher for:

- 'Kauri -podocarp - broadleaf forest' vegetation types.
- 'Kānuka - Mānuka – broadleaf forest' vegetation types.
- 'Kauri' plant species.
- 'At Risk, Declining lizards'.
- Hochstetter frogs.
- Rhytid and kauri snail.

These moderate or higher residual effects will be compensated through predator control and planting which is detailed in Section 6 and Appendix D.

Table 4-1: Terrestrial 'Magnitude of Effects' and subsequent 'Level of Effects' assessment (Appendix C, Tables 4-5).

Ecological feature	Ecological value	Project effects	Efforts to avoid, minimise or remedy adverse effects (mitigation)	Magnitude of effect after efforts to avoid, minimise or remedy effects	Level of effects category
Vegetation type					
Kauri -podocarp - broadleaf forest	High	• Direct loss of 4.89 ha from 98.90 ha of the directly adjacent/contiguous kauri-podocarp forest (~5%). <0.1% of indigenous forest cover within Waipu ED (LCDB 5). • Indirect effects on remaining vegetation include increased chance of weed species prevalence and species composition shift potential. • Access track bisects intact forest patch with resultant edge effects, incl. subsoil network fully interrupted, creation of conditions conducive to invasive species.	• 1.77 ha of indigenous remediation planting, incl. infill planting in year 2 of larger trees and 300 kauri when appropriate.	Moderate (low end)	Moderate[9]
Kānuka - Mānuka – broadleaf forest-	Moderate	• Direct loss of 3.47 ha. <0.1% of cover within Waipu ED (LCDB 5). • Indirect effects on remaining vegetation include increased chance of weed species prevalence and species composition shift potential.	• 1.77 ha of indigenous remediation planting. Kānuka and mānuka incl. outside of gullies.	Moderate (low end)	Moderate
Exotic dominated vegetation types	Negligible - Low	• Direct loss of 2.15 ha of exotic dominated forest from extensive, mostly contiguous exotic dominated forest directly adjacent to the Site.	NA	Negligible	Very Low
Species values					

[9] Overall level of effect while based on EIANZ guidelines in this instance takes into account professional judgement and the implications for overall level of effects for High value species or habitats.

Ramarama	Very High	• Only one specimen noted onsite (within proximity to access track route) which was avoided, therefore no effect due to the Project.	• Avoided specimen by design during track creation.	Negligible	Very Low
Kauri	Very High	• Permanent loss of an estimated four large specimens (> 50 cm DBH) and >10 rickers across the site, which amounts to a notable proportion of kauri and emergent trees within the local landscape. • Potential increase spread of kauri dieback.	• Avoidance of large kauri trees unless necessary (unanticipated slip was the cause of at least one tree loss). • 300 kauri seedlings will be incorporated into remediation planting. • Biosecurity Management Plan incl. site hygiene procedures.	Moderate	Moderate
Northern rata	Moderate	• Permanent loss of at least two large specimens (DBH >50 cm). Small proportion of the population of this large emergent rata within the local landscape.	• Avoidance of large trees where practicable.	Low	Low
Bats	Very High	• Permanent loss and modification of 10.69 ha of potential roosting. However, the surveys indicate that use of the site by bats is very low, and the main form of use is by foraging bats. There is therefore likely to be minimal impact on bats populations due to loss of roost trees in this locality. • The survey results indicate a low incidence of foraging by bats. Furthermore, the long-tailed bat is the only species confirmed as present. This species preferentially forages edge habitat. A similar extent of edge habitat will remain post vegetation clearance and therefore there is unlikely to be any material impact on the population of long-tailed bats due to changes in foraging habitat. • The single possible record of short-tailed bat indicates that the Site is highly unlikely to have significant value for this species and any changes in habitat that result from construction are unlikely to have any material effect on the population of this species.	• Vegetation Removal Protocols in Bat Management Plan (based on DOC bat roost protocols) for tree removal during vegetation clearance.	Negligible	Very Low
Long-tailed cuckoo/ Koekoea	Very High	• There will be a permanent loss of forest habitat potentially utilized by this species. However, this species uses this habitat transiently during migration. They are not restricted to this habitat nor reliant on it as there are extensive areas of alternative suitable habitat within the ED and Northland Region. The extent of habitat loss	• NA	Negligible	Low

		relative to available resource is extremely small therefore the effects of the project on the population of this species has been assessed as Negligible.			
NZ pipit/ Pīhoihoi	High	• Loss of 0.18 of 1.34 ha of known local habitat (14%) suitable for pipit. • Level of effect on the population at the ED level assessed as Low.	• Bird Management Plan incl. nest checks prior to Site clearance during construction. • Cut faces re-grassed providing longer term habitat pockets for pipit.	Low	Low
Regionally significant bird speciesError! Bookmark not defined.	Moderate	• Kaka and red-crowned parakeet were not recorded onsite and likely to be occasional visitors to the Site. It is likely that the habitat is of marginal importance to both species and that the loss of habitat will have Negligible effect at the population level for either species. • Bellbird is absent from most of Northland and occasional observations are likely represent birds coming from offshore islands to the east. It is unlikely the Brynderwyn's represent significant habitat for this species at the present time. Furthermore, the loss of forest habitat from this locality is unlikely to have any material effect at the population level for this species. The effect of the loss of habitat for this species has been assessed as Negligible. • Tomtit is present on-site, and the indigenous forest present will form part of the available breeding habitat for this species within the ED and Northland Region. The loss of 10.68 ha of habitat within the context of the ED and Regional is small. The magnitude of effect of this loss of habitat at the population level has therefore been assessed as Low.	• Avoidance of vegetation clearance during peak forest bird breeding season (Sept-Dec inclusive). • Bird Management Plan incl. bird nest checks.	Low	Low
Not Threatened indigenous bird species	Low	• Not Threatened bird species have large and robust populations at the ED, Regional and National level. Loss of habitat due to the project is extremely small compared to the total available resource for these species. Therefore, the effects at the population level for these species has been assessed as Negligible.	• Avoidance of vegetation clearance during peak forest bird breeding season (Sept-Dec inclusive). • Bird Management Plan incl. bird nest checks.	Negligible	Very Low
At Risk - Declining lizard species including elegant gecko	High	• Loss of approximately 8.36 ha of high-quality lizard habitat which equates to approx. 7.7% of available habitat within the immediately surrounding contiguous habitat and a smaller proportion of available habitat within the wider landscape. • Degradation of lizard habitat immediately adjacent to felled vegetation via edge effects and general disturbance.	• Vegetation Removal Protocols within Lizard Management Plan • 1.77 ha of indigenous remediation planting and cut faces re-grassed.	Moderate (low end)	Moderate[6]

		• Loss of ecological connectively between habitats in the short to intermediate term via the construction of the temporary access track vegetation. • Direct mortality or injury to lizards, noting that surveys and salvaging operation suggest that the number of lizards directly affected by habitat loss and degradation will be relatively low.	Note: Full Vegetation Removal Protocol not completed for Access Track, increased risk of individual death, and harm during construction. Also, access track not managed as agreed to minimise effects such that further fragmentation has occurred.		
Pacific gecko	Moderate	• As above, however the proportional impacts are lower in magnitude due to the lower likely implications of effects given that this species is more common nationally and is likely slightly better able to adapt to modified environments than other gecko species being both terrestrial and arboreal.	• As above	Low	Low

Hochstetter's frog/ Pepeketua	High	• Degradation of frog habitat immediately adjacent to impacted stream via edge effects and general disturbance.
		• Habitat quality degradation and associated harm to Hochstetter's frogs in up to several km of stream habitat downstream of the project via:
		  • Ongoing general contamination associated with stormwater run-off.
		  • Construction related erosion/slip/sedimentation impacts, which can result in adverse effects via clogging of refuges and interstitial space, shifts in suitability of prey and displacement. Streams particularly vulnerable to long-term sedimentation impacts due to low flows.
		• 144.4 m stream length / 156.72 m² of permanent loss of mostly high value stream habitat with high numbers of frogs. While stream habitat is of high value and the numbers of frogs are high, the loss only equates to a low proportion of (~2.4%) proportion of the approximately 6,000 m of available stream habitat in the local Brynderwyns landscape. Baseline survey habitat extents were estimated to total 6,011 m using a combination of headwater habitat sufficiency spot checks and desktop Lidar stream path and length calculations (Table B 2). Habitat quality across the sites ranged from Very High to Moderate.
		• Direct and indirect effects: disturbance, harm, kill, displacement - 150 frogs found and relocated. Low mobility significantly increases level of risk of harm.
			• Avoidance of vegetation clearance and stream works outside of earthworks season (during drier months frogs have restricted range).
			• Salvage and relocation and habitat relocation within Hochstetter's Frog Management Plan.
			• Implementation of erosion and sediment control plan.
			• Adverse effects from pH changes from concrete were observed during construction. This involved development and implementation of concrete management protocols in or close to water courses.
			• Indigenous remediation planting in gullies.
				Moderate (high end)	High

		• Concrete impacts - cement can rapidly alter pH levels to become highly alkaline and can suffocate and cause severe burns to fish and invertebrates, and likely frogs. Two deceased frogs were observed due to project caused pH imbalances. Streams particularly vulnerable based on low flows. • Sedimentation impacts – adverse effects of clogging of refuges and interstitial space, shifts in suitability of prey and displacement. Streams particularly vulnerable based on near pristine condition, high abundance of frogs and low flows.			
Rhytid and kauri snail	High	• Permanent loss of ~10 ha of potential habitat but expected to be widespread in surrounding landscape (Brynderwyn Hills Forest Complex). Habitat loss was mostly edge habitat which was likely less suitable for land snail species. • Reduction in remaining habitat quality in areas due to edge effects. • Fragmentation from access track may reduce movement of individuals between the now bisected forest and a new edge has been created along with resultant edge effects. • Increased predator abundance (temporary short- medium term) – minor increase in predation pressure. • Direct and indirect construction effects: disturbance, harm, kill, displacement (Construction effects) - Low mobility and detectability increases level of risk.	• Vegetation Removal Protocols within Invertebrate Management Plan (Low detectability during manual searches limited effectiveness). • 1.77 ha of indigenous remediation planting.	Moderate (low end)	Moderate[6]
Not threatened Invertebrate species	Low	• As above, however, proportional impacts are lower in magnitude due to the lower implications of effects given that many species are more common nationally. Also, variety of invertebrates inhabiting a larger range of habitats than At Risk species and some species have high densities, higher mobility and/or can persist in modified ecosystems.	• 1.77 ha of indigenous remediation planting.	Low	Very Low

4.3.2 AQUATIC

After avoidance, minimisation and remediation the following aquatic ecological features have a low overall effect:

- Piroa Stream.
- Not Threatened freshwater fauna.
- B1 upstream (fill site) wetland.

After avoidance, minimisation and remediation the following aquatic ecological features have a moderate overall effect:

- Piroa tributaries.
- At Risk, Declining freshwater fauna.

These moderate or higher residual effects will be offset or compensated through stream planting and enhancement of the Piroa Stream which is detailed in Section 6 and Appendix E.

Table 4-2: Aquatic 'Magnitude of Effects' and subsequent 'Level of Effects' assessment (Appendix C, Tables 4-5).

Ecological feature	Ecological value	Project effects	Efforts to avoid, minimise or remedy adverse effects (mitigation)	Magnitude of effect after efforts to avoid, minimise or remedy effects	Level of effects category
Habitat					
Piroa tributaries[10]	High to Very High	• The permanent loss/modification of stream equates to a moderate proportion (5.4%) of the approximately 6000 m of available habitat within the tributaries of the Piroa Stream that bisect the road. • Sedimentation impacts in waterways has negative impacts on aquatic environments such as the clogging of refuges and interstitial spaces for fish and macroinvertebrates, reducing the amount of oxygen in watercourses, absorption and refraction of sunlight which raises the water temperature, inundating aquatic plants, reducing light penetration, gill abrasion, burial, shifts in suitability of prey, and altering the behaviour of aquatic biota. Streams particular vulnerable based on near pristine condition, aquatic fauna present and low flows. • Concrete impacts (including unset cement, concrete dust, concrete fines and cement wash water) has the potential to have significant impacts on instream values and	• Freshwater Management Plan detailing minimisation of habitat loss and demarcating works and buffer areas. • Avoidance of vegetation clearance and stream works outside of earthworks season. • Implementation of erosion and sediment control plan following best practice guidelines such as using silt socks, silt fences, decanting bunds, and using laminar machines. Despite controls high sedimentation still remains in the 'H Downstream' site (160m of stream length /322m^2 stream area) and will be remediated by planting 176m^2 of the riparian zone of the Piroa Stream (see Appendix C6). • Adverse effects from pH changes from concrete were observed during construction. This involved development and implementation of concrete management protocols in or close to water courses. This included design changes, using precast concrete, using fast setting concrete, managing washdown areas, and flushing concrete offline. • Biocontrol – check, clean and drying of vehicles, plant and equipment prior to arriving onsite and when leaving site.	Low-Moderate	Moderate[11]

[10] * The magnitude of effect does vary between stream sub catchments for each specific effect but this specific magnitude outlines the overall magnitude expected for the streams.

[11] Based on professional judgement the overall effect has been assessed as moderate despite a higher likely short-term effect at one site.

		aquatic biota if it reaches water. Cement can rapidly alter pH levels to become highly alkaline and can suffocate and cause severe burns to fish and invertebrates. • Spills from machinery such as hydrocarbons, oils, grease and hydraulic fluids have the potential to have significant impacts on instream values. Such as affecting the development and functioning of fish and macroinvertebrates and can lead to death. • Changes to stormwater design resulting in loss of baseflow which can result in loss of habitat. • Increase in impervious surface resulting in catchment hardening (increased hydrological flow) which has potential to alter stream hydrology and morphology and increase contaminants in runoff. • Potential introduction of invasive species and associated ecological harm from machinery, vehicles and other equipment.	• Refinement of the stormwater infrastructure design and location to minimise potential scour and habitat loss such as flume outlets being located away from streams in flat areas (minimising potential scour), avoiding rip rap in stream habitats, and flumes using baffles to dissipate flow. • Machinery working from stream banks, isolating stream flows prior to instream works, and construction management plan to detail refuelling procedures and contamination spillage. • Indigenous remediation planting in gullies where habitat was lost near streams.		
Piroa Stream	Moderate	• The temporary loss of stream habitat equates to a small proportion (~0.3%).of the approximately 5500m of available habitat within the main stem of the Piroa Stream. • Sedimentation, concrete and hydrocarbon impacts (as above) but not as severe based on existing sediment and water quality issues, and the higher flow of the stream. • Catchment hardening (as above) cumulative effects on existing runoff issues in stream. • Minor geomorphological changes associated with scour protection at zone. • Potential introduction of invasive species (as above).	• As above, plus: • Removal of temporary culvert, reinstatement of stream to the same or better state than prior to installation and replanting of riparian zones with indigenous species.	Low	Low
Wetland	Low	• Permanent loss of 95m² of low value natural inland wetland habitat. This wetland mosaic was the only wetland habitat known in the	NA	High	Low

		sub catchment, but there are numerous other wetlands located at the base of the sub catchments, adjacent to the Piroa Stream.			
Species values					
At Risk Declining Freshwater Fauna	High	• Disturbance, injury or death of fish and freshwater invertebrates. • Direct effects during construction from works in streams such as diversions, reclamation, extending culverts, installing rip rap and dewatering have the potential to injure or kill native fish. • Degradation or water quality death or harm from sediment and other contaminants (as above). • Loss of habitat from road widening, culvert extensions and installing rip rap. • Fish-passage impacts through loss of available upstream habitat for native fish. This was high for some sites where high proportions of upstream habitat is potentially lost.	• Salvage of freshwater fauna including At Risk and taonga species prior to and during instream works through use of nets where possible, nocturnal spotlighting, use of hand nets and destructive searches. • Minimisation of time works occur in or near streams. • Implementation of fish passage retrofit solutions through structures for sites D2, G2, H and J to achieve or improve fish passage. This includes installation of baffles, spat rope, and void filling rip rap (see Appendix C10). • Implementation of erosion and sediment control plan (as above). • Development and implementation of concrete management protocols (as above). • Construction management plan to detail refuelling procedures and contamination spillage (as above).	Low-Moderate	Moderate[12]
Not Threatened Freshwater Fauna	Low	• As above.	• As above.	Moderate	Low

12 Based on professional judgement the overall effect has been assessed as moderate despite a higher likely short-term effect at one site.

5. PLANNING CONTEXT EFFECTS

5.1 FRAMEWORK

As noted in section 1.3 of this report, the WK-OIC has modified the consenting and permitting processes, including changes to the RMA and WA. The modifications to the RMA change the matters that the consenting authority can consider when assessing and processing an application for recovery works.

However, the WK-OIC still requires that adverse effects are identified, with proposals set out to avoid, remedy and mitigate adverse effects. The effects management hierarchy will be applied to the project.

As the application for recovery works is being provided to Northland Regional Council (NRC) on a retrospective basis (emergency works in terms of Section 330 of the RMA), only activities that relate to ongoing adverse effects are to be considered. As such, activities that do not have an ongoing adverse effect, will not be considered as part of the retrospective resource consent application.

5.1.1 WK-OIC RMA CONSIDERATIONS

A retrospective resource consent application for recovery works will be submitted to NRC based on activities that have ongoing adverse effects, based on the relevant rules of the Proposed Regional Plan for Northland (PRPN) and the National Environmental Standard for Freshwater Management (NES-FM).

Due to the modifications to the RMA by the WK-OIC, when processing an application for resource consent for recovery works, the consenting authority does not need to consider the matters outlined in Section 104(1)(b) of the RMA.

To address district consenting matters, an alteration to designation NZTA-1 (as set out in the Operative Whangārei District Plan (OWDP)) will be carried out. The alteration to the designation will extend the boundaries to ensure all additional land required for the ongoing operation and maintenance of the road are included following completion of physical works. The process to alter the designation will be as per Clause 19 of the WK-OIC.

Based on the identified consent triggers, and for matters which have an ongoing adverse effect, resource consent is required from NRC for the following reasons:

- Removal of riparian vegetation within 10 m of a watercourse.
- Diversion of a watercourse.
- Repair and extension of structures (culverts) within the bed of a stream.
- Removal of vegetation and earthworks within, or within 10 m set back from a wetland.
- Installation of structures (culverts) that does not comply with conditions stipulated in the NES-FW.

In total, 8,868.36 m^2 of riparian vegetation was removed or altered as part of the project works. Of this 548 m^2 is temporary loss of exotic dominated grassland in proximity to the Piroa stream in association with the installation of a temporary bridge. The vegetation in this instance is expected to reestablish. The riparian vegetation that was removed were within 10 m of a watercourse or wetland. Table 5-1 provides a breakdown of the vegetation types and area that were removed.

Table 5-1: Vegetation loss per type within the RMA-OIC.

Vegetation Type	Area lost (hectare)
Exotic Dominated Scrub/Grassland	0.055*
Exotic Dominated/Broadleaf Forest	0.228
Kānuka-Mānuka-Broadleaf	0.275
Kauri-Podocarp-Broadleaf Forest	0.329
Total	0.887

*Temporary loss

In addition to vegetation removal, an identified area of wetland was reclaimed as a result of the project works. The area of the impacted wetland was 95 m^2. As well as impacting the wetland, the associated vegetation and watercourse system was also impacted, with no remanent remaining.

5.1.2 WK-OIC WA CONSIDERATIONS

The WK-OIC clause 45 (8) (b) pertaining to WA Authorities, as obtained for this project, adds the requirement to demonstrate that the project has not had "more than minimal adverse effects" on:

- Naturally uncommon ecosystems (such as wetlands),
- Indigenous "at-risk or threatened" species,
- Taonga species.

It also requires that there are no "significant adverse effects on protected wildlife".

Clause 45 (1) (a) further indicates that the WK-OIC measures relating to the WA only apply to activities within 50 m of the state highway. Therefore, the impacts of all activities within this extent have been assessed. This assessment extent overlaps with what is required for the RMA process but will be assessed separately to ensure compliance with the above requirements can be demonstrated.

Note the WA does not include provision for emergency works and a WA Authority was secured prior to the relevant works commencing. The WA Authority was secured on the basis that adverse effects upon significant wildlife where managed to a 'no more than minimal adverse effect'.

5.1.3 WORKS OUTSIDE THE WK-OIC WA BOUNDARY

The WK-OIC modified provisions of the WA only apply up to 50 m from the road corridor (as per clause 45). As such, the WA Authority obtained for the project only applies to areas within 50 m of the road corridor. Some physical works have been undertaken beyond the 50 m.

Due to additional slips occurring and the unstable nature of the ground, it was necessary, from a health and safety perspective, to access sections of the upslope from above (and not from the road itself).

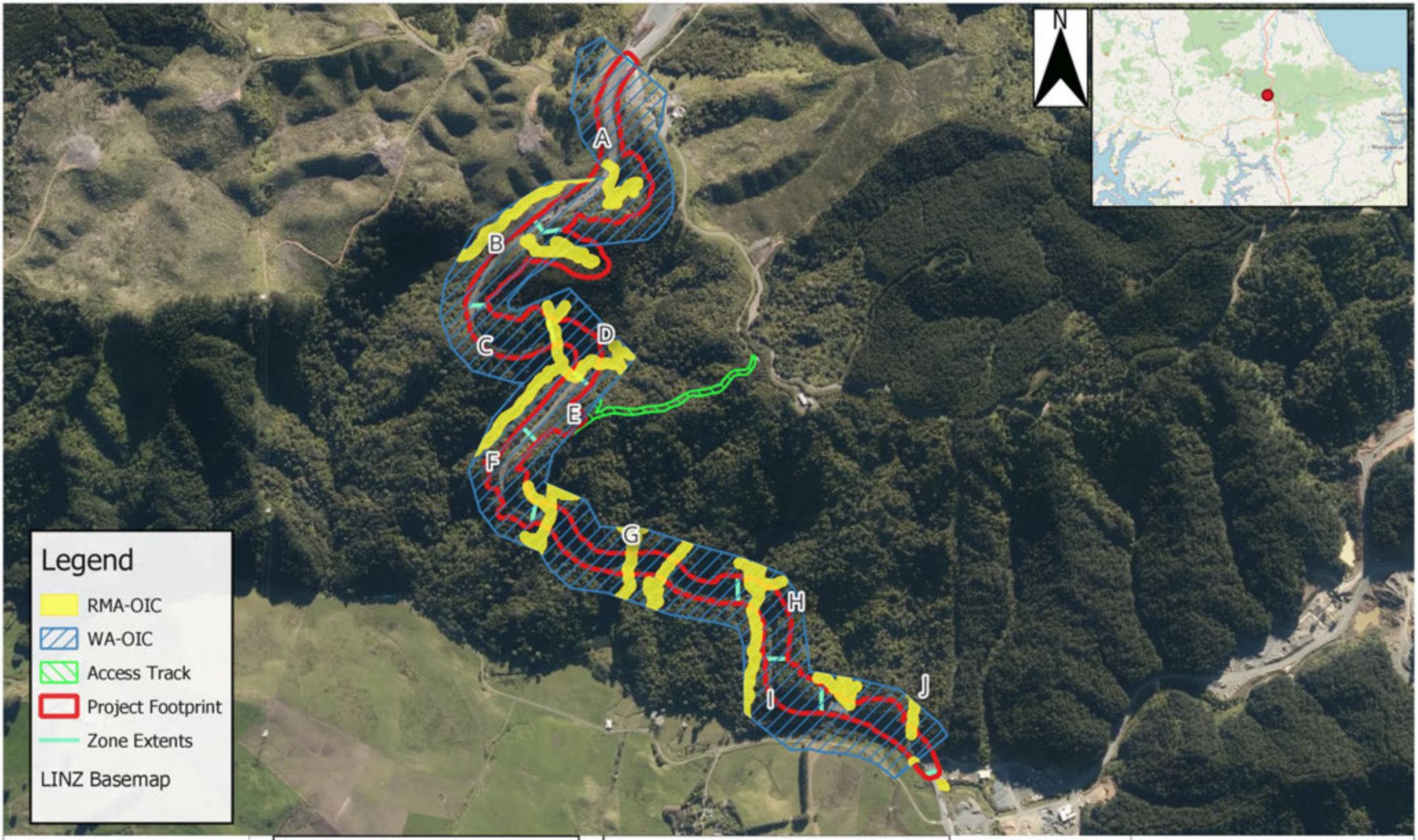
A temporary access track was established, providing access to Section E from Artillery Road, to allow construction equipment to access the Site. This track was initially formed by only undertaking minor vegetation clearance. However, further work was required to be undertaken on the track, which required the remaining vegetation to be scraped.

The works were undertaken in a fashion that reduced most of the risk of significant harm to protected wildlife, however not all measures set out the EMPs (as development for the wider project works) were completely followed.

However, due to the position of the track, being more than 10 m from a watercourse and more than 10 m from a wetland, the risk of adverse impact to significant fauna is low.

Refer to Figure 5-1 below for further clarification of the three extents that require assessment.

Additionally, NZTA provides its own requirements in the Ecological Impact Assessment Guidelines (NZTA, 2023), to which this EcIA also gives regard to.



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Project:

Brynderwyn Hills Recovery Work

Title:

Figure 5-1: WA-OIC, RMA-OIC, and access track extents

Project No:	Drawn:
1-11264.00	Laura van Ginkel
Date:	Checked:
2/07/24	Lisa Denmead
Scale:	Approved:
10,000 @ A4	Melanya King

Client:

NZ TRANSPORT AGENCY
WAKA KOTAHI

Original Sheet Size: A4 [W = 297, H = 210]

Plot Date: 2024-08-15 15:22:59 by van Ginkel, Laura (NZLV31597)

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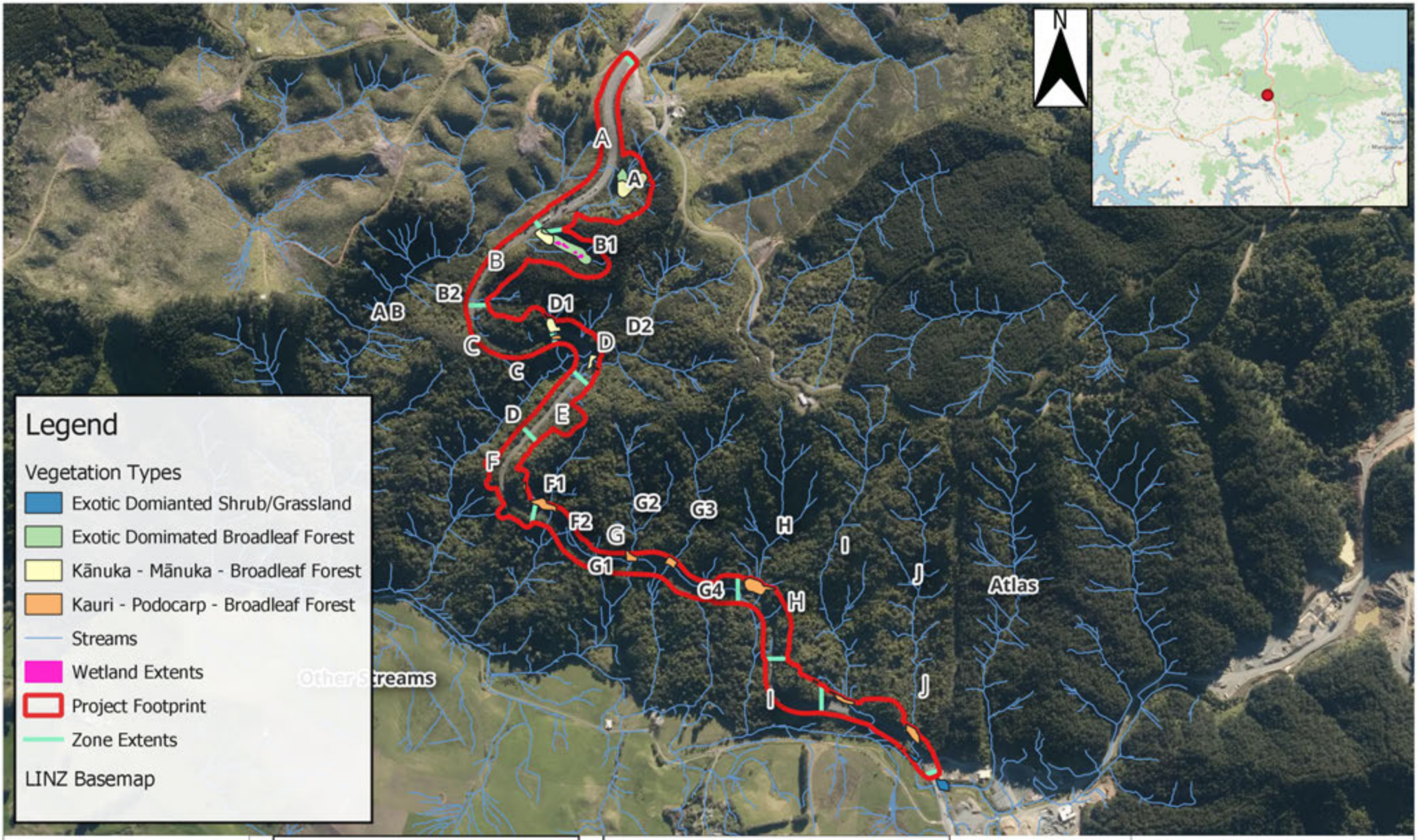
5.2 IMPLICATIONS ON EFFECTS ASSESSMENT

The implications of the planning context (NRC consenting matters) on the effects assessment is described below in Table 5-2. This covers each ecological feature and the residual effects based on the identified consent triggers, and for matters which have an ongoing adverse effect only. The overall project effects are outlined in Table 4-1 and Table 4-2 above.

Table 5-2: Assessment of residual effects under each regulatory pathway.

Ecological Feature	Residual effects: WK-OIC – RMA (NRC RC)
Indigenous vegetation communities: Kauri -podocarp - broadleaf forest (WF11)	Low
Indigenous vegetation communities: Kānuka - Mānuka - BL	Low
Exotic dominated vegetation types	Very Low
Threatened indigenous flora: Ramarama	NA
Threatened indigenous flora: Kauri	Low
Threatened indigenous flora: *Metrosideros robusta*	Very Low
Bats	Low
Long-tailed cuckoo (locally uncommon)	Low
Avifauna: Pīhoihoi (NZ pipit)	Low
Avifauna: Keystone species	Low
Avifauna: Other Indigenous species	Low
Herpetofauna: At Risk - Declining lizard species including elegant gecko	Moderate
Pacific gecko – locally uncommon	Low
Hochstetter's frog	High
Terrestrial Invertebrates: At-Risk, Declining	Low
Terrestrial Invertebrates: Not Threatened	Very Low
Piroa Stream	Low
Tributaries	Moderate
Wetland	Low
Freshwater Fauna: At-Risk, Declining	Moderate
Freshwater Fauna: Not Threatened	Low



0 100 200 300 400 500 m

Project:

Brynderwyn Hills Recovery Work

Title:

Figure 5-2: Vegetation loss within the WK RMA OIC extent by vegetation type

Project No:	Drawn:
1-11264.00	Laura van Ginkel
Date:	Checked:
2/07/24	Lisa Denmead
Scale:	Approved:
10,000 @ A4	Melanya King

Client:

NZ TRANSPORT AGENCY WAKA KOTAHI

Original Sheet Size: A4 [W = 297, H = 210] Plot Date: 2024-08-15 13:06:02 by van Ginkel, Laura (NZLV31597) File Ref: C:\Users\nzlv31597\OneDrive - WSP O365\QGIS Bryns.qgz

6. RESIDUAL EFFECTS MANAGEMENT

This section sets out:

- An overview of the residual effects that will need to be addressed (Section 6.1).
- The proposed habitat restoration or enhancement measures that will be undertaken for the purpose of addressing residual effects on terrestrial ecological values (Section 6.2).

6.1 RESIDUAL EFFECTS TO BE ADDRESSED

As assessed in Section 4.3, the project is expected to have residual adverse effects of 'Moderate' or higher (after efforts to avoid, minimise or remedy adverse effects) on several habitats and species. Specifically:

- Kauri -podocarp - broadleaf forest and kānuka – mānuka – broadleaf forest.
- Kauri.
- Keystone bird species.
- At Risk – Declining lizard species.
- Hochstetter's frog.
- Rhytid snail and Kauri snails.
- Tributaries of Piroa Stream.
- At Risk – Declining freshwater fauna.

Management of these residual effects remaining after efforts to avoid, minimise or remedy adverse impacts falls to offsetting or compensation via proposed ecological restoration and/or habitat enhancement measures.

Offsetting was initially considered for residual impacts on terrestrial biodiversity. However, no residual effects could be quantitively offset with adequate statistical rigour. This was due to limitations and constraints in collecting, interpreting and predicting outcomes based on the quantitative information collected. As such, all proposed habitat restoration and enhancement actions constitute compensation measures rather than offset measures.

Offsetting was used for residual adverse impacts on streams. The SEV / ECR methodology is a transparent, well-recognised methodology for calculating the quantum of offset required for stream loss. Although the methodology was originally developed in Auckland, it has been reviewed by NIWA for use in Wellington, Hawke's Bay and Southland, and is considered applicable without modification to most stream and river types in those regions and is applicable to this Site.

6.2 PROPOSED RESIDUAL EFFECTS MANAGEMENT PACKAGE

6.2.1 TERRESTRIAL

Measures to compensate for residual adverse ecological effects on terrestrial biodiversity values focus on the control of mammalian pests, wasps and weeds for a 10-year period within the proposed 78 ha Pest Management Area (PMA)(TBC)(See Appendix D). Details are set out in the draft Residual Effects Management Plan (see Assessment of Effects, Appendix D). NZTA will also donate a small sum toward Hochstetter's frog relocation research.

As outlined in the Biodiversity Compensation Model report (Appendix D), the proposed compensation package will partially address residual effects in the short term but will ultimately result in net loss of terrestrial biodiversity values affected by the project. Specifically the models predict that the compensation package go approximately:

- 40% of the way towards achieving net positive outcomes for residual effects on forest biodiversity values in broad terms;
- 50% of the way towards achieving net positive outcomes for residual adverse effects on Hochstetter's frogs.

Additionally, the proposed compensation package does not adhere to key principles as net gain/net positive outcomes will not be achieved, and benefits to biodiversity values will be short-lived for the project as a whole.

That said, the Biodiversity Compensation Modelling Report considers the full project extent, and not only the effects from non-permitted activities that have ongoing adverse effects. For the purposes of the regional resource consent, only the loss of riparian vegetation needs to be considered (i.e. that within 10 m of stream, or 10 m of a wetland). This amounts to less than 40% of the total value for each vegetation type (see Table 6-1 below). The proposed effects management measures for forest loss are therefore likely to be fully effective in compensating for loss within this portion of the project site. All of the Hochstetter's frog impacts are however included in the extent that requires consent, so there will still be a 50% net negative outcome for consenting purposes for this aspect.

Table 6-1: Percentage of vegetation area loss, by vegetation type, which falls within the RMA-OIC.

Vegetation type	Total loss (hectare)	Loss within the RMA-OIC (hectare)	% loss within RMA-OIC
Exotic Dominated Shrub/Grassland*	0.172	0.055	31.96%
Exotic Dominated Broadleaf Forest	1.872	0.228	12.20%
Kānuka - Mānuka - Broadleaf Forest	2.62	0.275	10.48%
Kauri - Podocarp - Broadleaf Forest	3.82	0.329	8.60%
Total	**8.488**	**0.887**	**10.45%**

*Temporary loss

6.2.2 AQUATIC

Measures to offset and compensate for residual adverse ecological effects on aquatic biodiversity values focus on the enhancement of planting of stream. Details are set out in the draft Management Plan (Appendix E).

6.3 PROPOSED BIODIVERSITY OUTCOME MONITORING PROGRAMME

The pest control plan currently under development for NZTA's 10-year plan must include development of a scientifically robust outcomes monitoring programme that assesses whether the objectives of this compensation package have been met. It must address the following (at minimum):

- Pest animal and plant control efforts over the 10-year period,
- Change in pest animal and plant population density over the period of the programme,
- Change in Hochstetter's frog, Rhytid and Kauri snail and relevant lizard population density over the 10-year period,
- Change in vegetation assemblage.

The above must be assessed at least twice during implementation of the proposed measures (at year 5 and 10).

7. CONCLUSION

The Brynderwyn Hills Recovery Works Project lies within a sensitive ecological setting. A range of sensitive species and habitat features were identified, many of which experienced negative effects as a result of the project. Mitigation measures were applied during construction, as directed by a suite of management plans, and these measures successfully avoided, minimised and remediated the majority of negative effects.

Terrestrial and aquatic habitat loss was unavoidable, with opportunity to only reinstate a minor proportion of natural habitat. The majority of the ecological effects were in the Low and Moderate categories, after mitigation. Only one feature was found to have experienced High levels of effect, related to loss of forest and stream habitat.

Residual effects in the Low to Very Low categories following mitigation are considered acceptable in regard to the WK-OIC legislation. Those in the Moderate and High categories require offsetting/compensation.

Given that eight ecological features were found to have experienced effects in the Moderate or High categories offsetting and/or compensation was determined to be required per the EIANZ Guidelines. The above contributes toward offsetting/compensating for the 'more than minor/minimal' effects. The Baber (2024) terrestrial offset report indicates that this compensates for just under half of the residual effects on Hochstetter's frog and less than half for those sensitivities with Moderate residual effects.

LIMITATIONS

This report ('Report') has been prepared by WSP New Zealand Limited ('WSP') exclusively for the New Zealand Transport Agency Waka Kotahi (NZTA - 'Client') in relation to the ecological scope for the Brynderwyn Hills Recovery Work project ('Purpose') and in accordance with the Short Form Agreement Nr. PS-8897, dated 28 June 2023 ('Agreement'). The findings in this Report are based on and are subject to the assumptions specified in the Report. WSP accepts no liability whatsoever for any use or reliance on this Report, in whole or in part, for any purpose other than the Purpose or for any use or reliance on this Report by any third party.

In preparing this Report, WSP has relied upon data, surveys, analyses, designs, plans and other information ('Client Data') provided by or on behalf of the Client. Except as otherwise stated in this Report, WSP has not verified the accuracy or completeness of the Client Data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in this Report are based in whole or part on the Client Data, those conclusions are contingent upon the accuracy and completeness of the Client Data. WSP will not be liable for any incorrect conclusions or findings in the Report should any Client Data be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to WSP.

APPENDIX A: EIANZ ECOLOGICAL IMPACT ASSESSMENT GUIDELINE TABLES

Table A-1: Ecological Values Assigned to Habitats (adapted from EIANZ, 2018).

Attributes to be considered when assigning ecological value or importance to a site or area of vegetation/habitat/community.	
Matters:	**Attributes to be considered:**
Representativeness	Attributes for representative vegetation and aquatic habitats: Typical structure and composition. Indigenous species dominant. Expected species and tiers are present. Attributes for representative species and species assemblages: Species assemblages that are typical of the habitat. Indigenous species that occur in most of the guilds expected for the habitat type.
Rarity/Distinctiveness	Attributes for rare/distinctive vegetation and habitats: Naturally uncommon, or induced scarcity. Amount of habitat or vegetation remaining. Distinctive ecological features. National priority for protection. Attributes for rare/distinctive species or species assemblages: Habitat supporting nationally threatened or at-risk species, or locally uncommon species. Regional or national distribution limits of species or community. Unusual species or assemblages. Endemism.
Diversity and Pattern	Level of natural diversity, abundance and distribution. Biodiversity reflecting underlying diversity. Biogeographical considerations – pattern & complexity. Temporal considerations, considerations of lifecycles, daily or seasonal cycles of habitat availability and utilisation.
Ecological Context	Site history, and local environmental conditions which have influenced the development of habitats and communities. The essential characteristics that determine an ecosystem's integrity, form, functioning, and resilience (from "intrinsic value" as defined in RMA (1991)). Size, shape and buffering. Condition and sensitivity to change. Contribution of the site to ecological networks, linkages, pathways and the protection and exchange of genetic material. Species role in ecosystem functioning – high level, key species identification, habitat as proxy.

Table A-2: Ecological Values Assigned to Species (adapted from EIANZ, 2018).

Value	Species Values
Very high	Nationally threatened – endangered, critical or vulnerable.
High	Nationally at risk – declining.
Moderate	Nationally at risk - recovering, relict or locally uncommon or rare.

Low	Not threatened nationally, common locally.
Negligible	Exotic species, including pests.

Table A-3: Scoring for sites or areas combining values for four matters in Table A-1.

Value	Description
Very high	Area rates high for 3 or all of the four assessment matters listed in table A-1. Likely to be nationally important and recognised as such.
High	Area rates high for 2 of the assessment matters, moderate and low for the remainder, or Area rates high for 1 of the assessment maters, moderate for the remainder. Likely to be regionally important and recognised as such.
Moderate	Area rates high for one matter, moderate and low for the 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 majority of assessment matters and moderate for one. Limited ecological value other than as local habitat for tolerant native species.
Negligible	Area rates very low for 3 matters and low or very low for remainder.

Table A-4: Criteria for describing magnitude of effect (EIANZ, 2018).

Magnitude	Description
Very high	Total loss of, or very major alteration to, key elements/features/ of the existing baseline[1] conditions, such that the post-development character, composition and/or attributes will be fundamentally changed and may be lost from the site altogether; and/or Loss of a very high proportion of the known population or range of the element/feature
High	Major loss or major alteration to key elements/features of the existing baseline conditions 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 conditions, 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 existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to 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 the 'no change' situation; and/or Having negligible effect on the known population or range of the element/feature

Table A-5: Timescale for duration of effects (EIANZ, 2018).

Timescale	Description
Permanent	Effects continuing for an undefined time beyond the span of one human generation (taken as approximately 25 years).

Long-term	Where there is likely to be substantial improvement after a 25-year period (e.g. The replacement of mature trees by young trees that need > 25 years to reach maturity, or restoration of ground after removal of a development) the effect can be termed 'long term'.
Temporary[1]	Long term (15-25 years or longer – see above). Medium term (5-15 years). Short term (up to 5 years). Construction phase (days or months).

Table A-6: Criteria for describing overall levels of adverse ecological effects (EIANZ, 2018).

Ecological value[13] Magnitude[14]	Very high	High	Moderate	Low	Negligible
Very high	Very high	Very high	High	Moderate	Low
High	Very high	Very high	Moderate	Low	Very low
Moderate	High	High	Moderate	Low	Very low
Low	Moderate	Low	Low	Very low	Very low
Negligible	Low	Very low	Very low	Very low	Very low

Table A-7: Key principles of biodiversity offsetting as applied in New Zealand (EIANZ, 2018).

Principle	Explanation
Limits to offsetting	Many biodiversity values are not able to be offset, and if they are impacted then they will be permanently lost. These situations include where: •Residual impacts cannot be fully compensated for by a biodiversity offset because of the irreplaceability or vulnerability of the biodiversity affected, and •There are no technically feasible or socially acceptable options by which to secure gains within acceptable timeframes. In either situation, an offset would be inappropriate. This principle reflects a standard of acceptability for offsetting and should not be seen as a pathway to allow uncompensated losses. The project should be redesigned wherever possible to avoid effects that cannot be offset.
No net loss	The goal of a biodiversity offset is a measurable outcome that can reasonably be expected to result in no net loss, and preferably a net gain of biodiversity. A no net loss outcome requires that at a specified point in time biodiversity values will be returned to the point they would have been if the impact and offset had not occurred. No net loss is measured by type, amount, and (in some accounting models) condition, and requires explicit statements describing: a) the elements of biodiversity for which a no net loss outcome is sought; b) the assumed background biodiversity trajectory against which no net loss is evaluated and

[13] Ecological value from Tables A-1, A-2, and A-3.

[14] Magnitude of effect from Table A-4, considering the timescale in Table A-5.

	c) the time horizon within which a no net loss outcome is to be achieved.
Landscape context	The design of a biodiversity offset should consider the landscape context of both the impact site and the offset site, taking into account interactions between species, habitats, and ecosystems, spatial connections, and system functionality. Consideration of landscape context is captured in the assessment of ecological equivalence across space and time.
Additionality	A biodiversity offset must achieve gains in biodiversity above and beyond gains that would have occurred anyway in the absence of the offset. This requires evaluating the change in biodiversity value under both a 'with offset' and a 'without offset' scenario to estimate the amount of additional gain that can be attributable to the offset action. Some aspects of an offset proposal may meet additionality rules, while other proposed actions may not. In such cases, only the amount of gain that can be demonstrated to be additional should count towards the overall offset.
Permanence	The biodiversity benefits at an offset site should be managed with the objective of securing outcomes that last at least as long as the impacts, and preferably in perpetuity. To achieve or sustain gains long term requires a well-designed monitoring and reporting programme and an adaptive management approach to adjust management as necessary.
Ecological Equivalence	Ecological equivalence describes the degree to which the biodiversity gain attributable to an offset is balanced with the biodiversity losses due to development across type, space, and time; and therefore, whether the exchange achieves no net loss. Assessing ecological equivalence requires the biodiversity at both the impact and the offset site to be described and measured to quantify losses and gains. Demonstrating ecological equivalence differentiates biodiversity offsetting from environmental compensation.

APPENDIX B: TERRESTRIAL ADDITIONAL INFORMATION

B.1 FLORA

Table B-1: Flora species present or potentially present on site, and their threat classifications (de Lange et al., 2018).

Scientific name	Common name	Māori name	Threat Classification	Detection method
Lophomyrtus bullata	ramarama	ramarama	Threatened – Nationally Critical	Incidental observation
Agathis australis	kauri	kauri	Threatened – Nationally Vulnerable	RECCE
Kunzea robusta	kānuka	kānuka	Threatened – Nationally Vulnerable	RECCE
Metrosideros carminea	carmine rātā	carmine rātā	Threatened – Nationally Vulnerable	Desktop assessment
Metrosideros excelsa	pōhutukawa	pōhutukawa	Threatened – Nationally Vulnerable	Desktop assessment
Metrosideros diffusa	white rātā	rātā	Threatened – Nationally Vulnerable	RECCE
Metrosideros fulgens	climbing rata	rātā	Threatened – Nationally Vulnerable	RECCE
Metrosideros perforata	akatea	akatea	Threatened – Nationally Vulnerable	RECCE
Metrosideros robusta	northern rātā	rātā	Threatened – Nationally Vulnerable	Incidental observation
Leptospermum var scoparium	mānuka	mānuka	At Risk - Declining	RECCE
Mida salicifolia	maire	maire taiki	At Risk - Declining	Desktop assessment
Abrodictyum elongatum	bristle fern	-	Not Threatened	RECCE
Acianthus sinclairii	heart-leaved orchid	-	Not Threatened	RECCE
Ackama rosafolia	makamaka	makamaka	Not Threatened	Incidental observation
Ageratina adenophora	mexican devil	-	Not applicable	Incidental observation
Alseuosmia banksii var. banksii	-	-	Not Threatened	RECCE
Alseuosmia macrophylla	toropapa	-	Not Threatened	RECCE
Alseuosmia quercifolia	oak-leaved toropapa	-	Not Threatened	RECCE
Alsophila tricolor	silver fern	ponga	Not Threatened	RECCE
Asplenium bulbiferum	hen and chicken fern	pikopiko	Not Threatened	RECCE
Asplenium flaccidum	drooping spleenwort		Not Threatened	RECCE
Asplenium oblongifolium	shining spleenwort	huruhuruwhenua	Not Threatened	RECCE

Asplenium polyodon	sickle spleenwort	-	Not Threatened	RECCE
Astelia hastata	tank lily	-	Not Threatened	RECCE
Astelia solandri	perching lily	kōwharawhara	Not Threatened	RECCE
Austroblechnum lanceolatum	lance fern	rereti	Not Threatened	RECCE
Beilschmiedia tarairi	taraire	taraire	Not Threatened	RECCE
Beilschmiedia tawa	tawa	tawa	Not Threatened	RECCE
Brachyglottis repanda	bushman's toilet paper	rangiora	Not Threatened	RECCE
Bulbophyllum pygmaeum	pygmy tree orchid	-	Not Threatened	Incidental observation
Calystegia sepium subsp. roseata	pink bindweed	-	Not Threatened	Incidental observation
Carex uncinata	bastard grass	kamu	Not Threatened	RECCE
Carpodetus serratus	marbleleaf	putaputawētā	Not Threatened	RECCE
Cenchrus clandestinu	kikuyu grass	-	Not applicable	Incidental observation
Centella uniflora	centella	-	Not Threatened	Incidental observation
clematis forsteri	Forster's clematis	-	Not Threatened	RECCE
Coprosma arborea	tree coprosma	māmāngi	Not Threatened	RECCE
Coprosma grandifolia	large-leaved coprosma	kanono	Not Threatened	RECCE
Coprosma lucida	shining karamū	karamū	Not Threatened	RECCE
Coprosma rhamnoides	twiggy coprosma	-	Not Threatened	RECCE
Coprosma spathulata subsp. spathulata	-	-	Not Threatened	Incidental observation
Cordyline australis	cabbage tree	tī kōuka	Not Threatened	RECCE
Cordyline banksii	forest cabbage tree	tī ngahere	Not Threatened	Incidental observation
Cortaderia selloana	pampas grass	-	Not applicable	Incidental observation
Corynocarpus laevigatus	karaka	karaka	Not Threatened	RECCE
Crocosmia ×crocosmiiflora	montbretia	-	Not Threatened	RECCE
Dacrycarpus dacrydioides	white pine	kahikatea	Not Threatened	RECCE
Dacrydium cupressinum	red pine	rimu	Not Threatened	RECCE
Dendroconche scandens	fragrant fern	mokimoki	Not Threatened	RECCE
Dianella nigra	New Zealand blueberry	turutu	Not Threatened	Incidental observation
Dicksonia squarrosa	rough tree fern	wheki	Not Threatened	RECCE

Didymocheton spectabilis	New Zealand mahogany	kohekohe	Not Threatened	RECCE
Diploblechnum fraseri	miniature tree fern	maukurangi	Not Threatened	Incidental observation
Dracophyllum latifolium	spider wood	neinei	Not Threatened	RECCE
Earina mucronata	bamboo orchid	peka-a-waka	Not Threatened	RECCE
Elaeocarpus dentatus var. dentatus	hīnau	hīnau	Not Threatened	RECCE
Elatostema rugosum	New Zealand begonia	parataniwha	Not Threatened	RECCE
Epilobium rodtuinfioium	round-leaved willowherb	-	Not Threatened	Incidental observation
Erigeron sumatrensis	broad-leaved fleabane	-	Not Threatened	RECCE
Freycinetia banksii	kiekie	kiekie	Not Threatened	RECCE
Fuschsia kotukuku	tree fuchsia	kōtukutuku	Not Threatened	Incidental observation
Gahnia lacera	cutty grass	-	Not Threatened	RECCE
Geniostoma ligustrifolium var. ligustrifolium	hangehange	hangehange	Not Threatened	RECCE
Griselinia lucida	puka	puka	Not Threatened	RECCE
Hedycarya arborea	pigeonwood	porokaiwhiri	Not Threatened	RECCE
Histiopteris incisa	water fern	mātātā	Not Threatened	RECCE
Hymenophyllum demissum	drooping filmy fern	ririrangi	Not Threatened	RECCE
Hymenophyllum dilatatum	filmy fern	matua mauku	Not Threatened	RECCE
Hymenophyllum nephrophyllum	kidney fern	raurenga	Not Threatened	Incidental observation
Hypochaeris radicata	catsear	-	Not applicable	Incidental observation
Icarus filiformis	thread fern	pānoko	Not Threatened	RECCE
Knightia excelsa	New Zealand honeysuckle	rewarewa	Not Threatened	RECCE
Lastreopsis hispida	hairy fern	-	Not Threatened	RECCE
Leptopteris hymenophylloides	crepe fern	heruheru	Not Threatened	RECCE
Leucanthemum vulgare	oxeye daisy		Not applicable	RECCE
Leucopogon fasciculatus	mingimingi	mingimingi	Not Threatened	RECCE
Libertia micrantha	native iris	mikoikoi	Not Threatened	RECCE
Libocedrus bidwilii	NZ cedar	kaikawaka	Not Threatened	Incidental observation
Lindsaea trichomanoides	-	-	Not Threatened	RECCE

Lomaria discolor	crown fern	petipeti	Not Threatened	RECCE
Lotus pedunculatus	lotus	-	Not applicable	Incidental observation
Lygodium articulatum	mangemange	mangemange	Not Threatened	RECCE
Melicytus macrophyllus	large-leaved māhoe	māhoe	Not Threatened	RECCE
Melicytus ramiflorus subsp. ramiflorus	māhoe	whiteywood	Not Threatened	RECCE
Microlaena avenacea	bush rice grass	-	Not Threatened	RECCE
Modiola caroliniana	creeping mallow	-	Not applicable	Incidental observation
Myrsine australis	red matipo	mapou	Not Threatened	RECCE
Nertera depressa	bead plant	-	Not Threatened	RECCE
Neslia paniculata subsp. paniculata	ball-mustard	-	Not Threatened	RECCE
Nestegis cunninghamii	black maire	maire	Not Threatened	RECCE
Nestegis lanceolata	white maire	maire	Not Threatened	RECCE
Olearia furfuracea	akepiro	-	Not Threatened	Incidental observation
Olearia rani var. rani	heketara	heketara	Not Threatened	RECCE
Oplismenus hirtellus subsp. imbecillis	basket grass	-	Not Threatened	RECCE
Pakau pennigera	gully fern	piupiu	Not Threatened	RECCE
Parablechnum novae-zelandiae	kiokio	kiokio	Not Threatened	RECCE
Parapolystichum glabellum	smooth shield fern	-	Not Threatened	RECCE
Parsonsia heterophylla	New Zealand jasmine	Kaihua	Not Threatened	RECCE
Pectinopitys ferruginea	brown pine	miro	Not Threatened	RECCE
Phyllocladus trichomanoides	celery pine	tānekaha	Not Threatened	RECCE
Pinus radiata	monterey pine	-	Not applicable	Incidental observation
Piper excelsum subsp. excelsum	kawakawa	-	Not Threatened	RECCE
Pittosporum tenuifolium	black matipo	kōhūhū	Not Threatened	RECCE
Podocarpus laetus	hall's tōtara	tōtara	Not Threatened	RECCE
Podocarpus totara	tōtara	tōtara	Not Threatened	RECCE
Polyphlebium venosum	veined bristle fern	-	Not Threatened	Incidental observation
Prumnopitys taxifolia	black pine	mataī	Not Threatened	RECCE

Pseudopanax arboreus	five finger	whauwhaupaku	Not Threatened	RECCE
Pseudopanax crassifolius	lancewood	horoeka	Not Threatened	RECCE
Pseudopanax lessonii	houpara	houpara	Not Threatened	RECCE
Pteris macilenta	sweet fern	-	Not Threatened	RECCE
Pterostylis banksi	greenhood	tutukiwi	Not Threatened	RECCE
Pyrrosia elaeagnifolia	leather-leaf fern	ota	Not Threatened	RECCE
Quintinia serrata	quintinia	tāwheowheo	Not Threatened	RECCE
Ranunculus repen	buttercup	-	Not applicable	Incidental observation
Rhabdothamnus solandri	New Zealand gloxinia	taurepo	Not Threatened	Incidental observation
Rhopalostylis sapida	nīkau	nīkau	Not Threatened	RECCE
Ripogonum scandens	supplejack	kareao	Not Threatened	RECCE
Rubus cissoides	bush lawyer	tātarāmoa	Not Threatened	RECCE
Rubus fruticosus agg.	blackberry	-	Not applicable	Incidental observation
Schefflera digitata	seven-finger	patē	Not Threatened	RECCE
Solanum mauritianum	woolly nightshade	-	Not applicable	Incidental observation
Solanum nigrum	black nightshade	-	Not applicable	Incidental observation
Sphaeropteris medullaris	black tree fern	mamaku	Not Threatened	RECCE
Sticherus cunninghami	umbrella fern	waekura	Not Threatened	RECCE
Syzygium smithii	lilly pilly	-	Not Threatened	RECCE
Tmesipteris sigmatifolia	fossil fern	-	Not Threatened	RECCE
Ulex europaeus	gorse	-	Not applicable	Incidental observation
Veronica macrocarpa var. macrocarpa	hebe	-	Not Threatened	RECCE
Zealandia pustulata subsp. pustulata	hound's tongue	kōwaowao	Not Threatened	RECCE

B.2 FROG HABITAT AVAILABILITY

Table B-2: Estimated available frog habitat available within Brynderwyns local forest.

Stream Reach	Frog habitat stream length (m)
D 1-3 confluence & downstream	663
D 1	131
D3 & upstream	721
F	454
Gn	603
Gs above the road	657
Gs below the road	241
H	713
I	754
J	755
Atlas tributary	319
Total	6,011

B.3 BASELINE FROG SURVEY RESULTS

Table B-3 Pre-construction baseline control and impact frog survey results

STREAM SITE (REF TO MAP FIGURE 2-5)	NO OF FROGS	SURVEY LENGTH (M)	SEARCH TIME (MINS)	EFFORT (MAN HOURS)	CATCH RATE (FROGS / HOUR)	RELATIVE DENSITY (FROGS/ M)	RELATIVE DENSITY EFFORT WEIGHTED (FROGS / M / HR)
D1	3	50	60	1	3	0.06	0.02
D4	1	50	85	1.42	0.71	0.02	0.03
F2	16	50	199	3.32	4.82	0.32	0.07
F3	8	35	143	2.38	3.36	0.23	0.07
F4	2	50	75	1.25	1.6	0.04	0.025
F5	1	50	60	1	1	0.02	0.02
Gn2	3	16	73	1.22	2.47	0.19	0.08
Gn3	10	50	155	2.58	3.87	0.2	0.05
Gs2	1	16	60	1	1	0.06	0.06
Gs1	16	50	265	4.42	3.62	0.32	0.09
H	11	65	60	1	11	0.17	0.02
H*	13	57	167	2.78	4.67	0.23	0.05
H3	12	50	265	4.42	2.72	0.24	0.08
I1	6	50	125	2.08	2.88	0.12	0.04
I2	21	48	325	5.42	3.88	0.44	0.11
J1	5	50	120	2	2.5	0.1	0.04
J2	2	45	45	0.75	2.67	0.04	0.02
Atlas1	20	50	170	2.83	7.06	0.4	0.06
Atlas2	2	50	40	0.67	3	0.04	0.01
Total	153	882	2492	41.53	3.68	0.17	0.05

H* is a tributary of H.

APPENDIX C: AQUATIC ADDITIONAL INFORMATION

C.1 WATERCOURSE AND WETLAND DEFINITIONS

Resource Management Act 1991

River: means a continually or intermittently flowing body of fresh water; and includes a stream and modified watercourse; but does not include any artificial watercourse (including an irrigation canal, water supply race, canal for the supply of water for electricity power generation, and farm drainage canal). Proposed Northland Regional Plan.

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.

Proposed Regional Plan for Northland

Ephemeral river or stream: Reaches with a natural bed level above the water table at all times, with water only flowing during and shortly after rain events, and which do not meet the definition of an intermittently flowing river.

Intermittently flowing river or stream: A river that is naturally dry at certain times of the year and has two or more of the following characteristics:

1) It has natural pools, and

2) It has a well-defined channel, such that the bed and banks can be distinguished, and

3) It contains surface water more than 48 hours after a rain event which results in river flow, and

4) Rooted terrestrial vegetation is not established across the entire cross-sectional width of the channel, and

5) It appears as a blue line on topographical maps at 1:50,000 scale.

Permanently flowing river or stream: There is no specific definition for a permanently flowing river or stream in the PRPN. However, a coastal river, small river or large river that is not an intermittently flowing river or stream and is not an ephemeral river or stream is permanent. The definition defaults to the RMA 1991 definition.

Coastal river: A river in the Coastal River water quantity management unit.

Small river: A river in the Small River water quantity management unit.

Large river: A river in the Large River water quantity management unit.

Artificial Watercourse: A man-made channel constructed in or over land for carrying water and includes an irrigation canal, roadside drains and water tables, water supply race, canal for the supply

of water for electricity power generation and farm drainage canals. It does not include a channel constructed in or along the path of any historical or existing river, stream or natural wetland.

Nationally Policy Statement for Freshwater Management

The National Policy Statement for Freshwater 2020 (MFE, 2023) defines 'Natural inland wetlands' which are a subset of 'wetlands' defined in the RMA 1991 as:

'A natural wetland (as defined in the Act) that is not:

(a) In the coastal marine area; or

(b) A deliberately constructed wetland, other than a wetland constructed to offset impacts on, or to restore, an existing or former natural inland wetland; or

(c) A wetland that has developed in or around a deliberately constructed water body, since the construction of the water body; or

(d) A geothermal wetland; or

(e) A wetland that:

(i) Is within an area of pasture used for grazing; and

(ii) Has vegetation cover comprising more than 50% exotic pasture species (as identified in the National List of Exotic Pasture Species using the Pasture Exclusion Assessment Methodology (see clause 1.8)); unless

(iii) The wetland is a location of a habitat of a threatened species identified under clause 3.8 of this National Policy Statement, in which case the exclusion in (e) does not apply.

C.2 WETLAND DELINEATION PROCEDURE

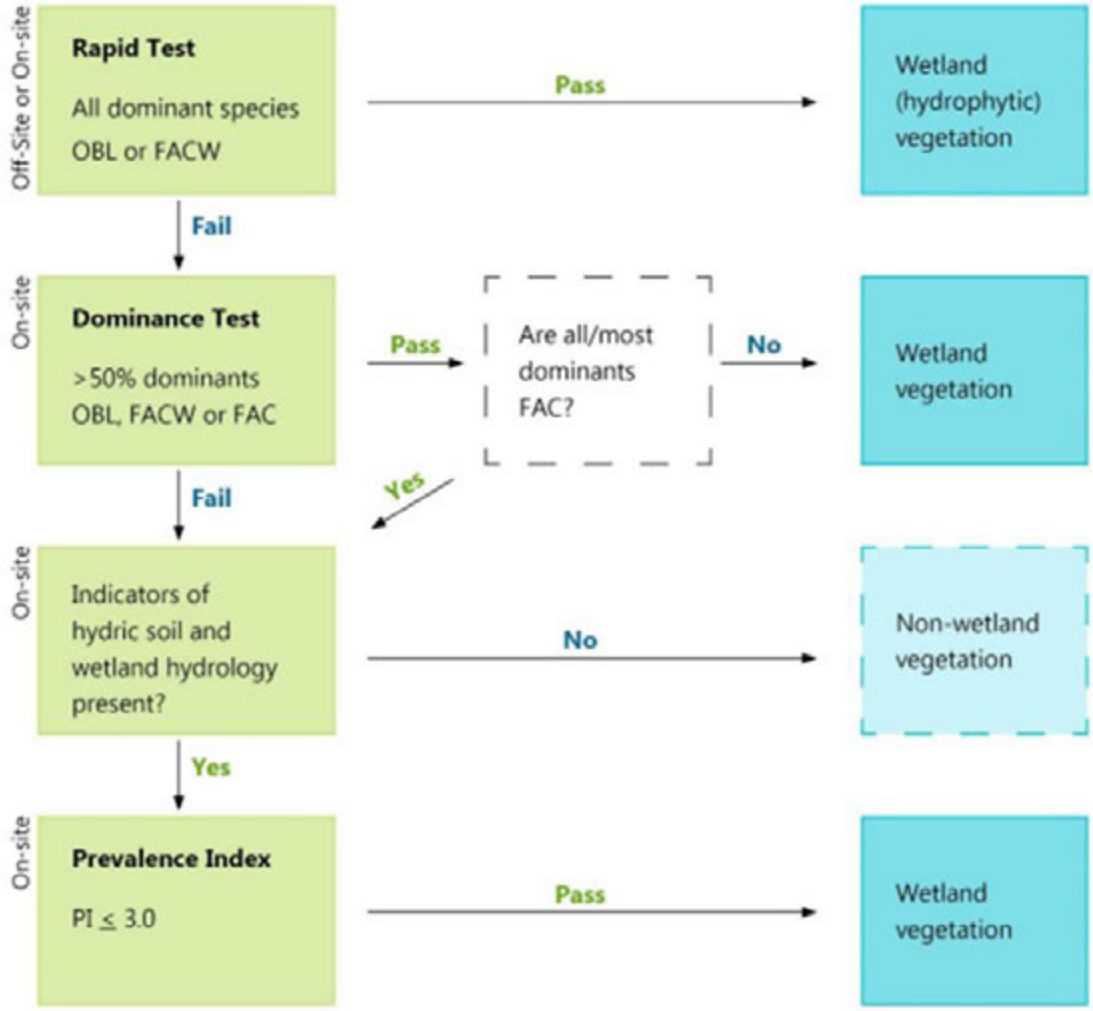


Figure C-1: Assessing 'Natural Wetland' and 'Natural Inland Wetland' status under the NPS-FM using hydrophytic vegetation, hydric soils and wetland hydrology tools. delineation procedure.

Vegetation Class:

Facultative (FAC): equally likely to occur in wetlands or non-wetlands (34–66%).

Facultative wetland (FACW): occurs usually in wetlands (67–99%).

Obligate wetland (OBL): occurs almost always in wetlands (estimated probability >99% in wetlands).

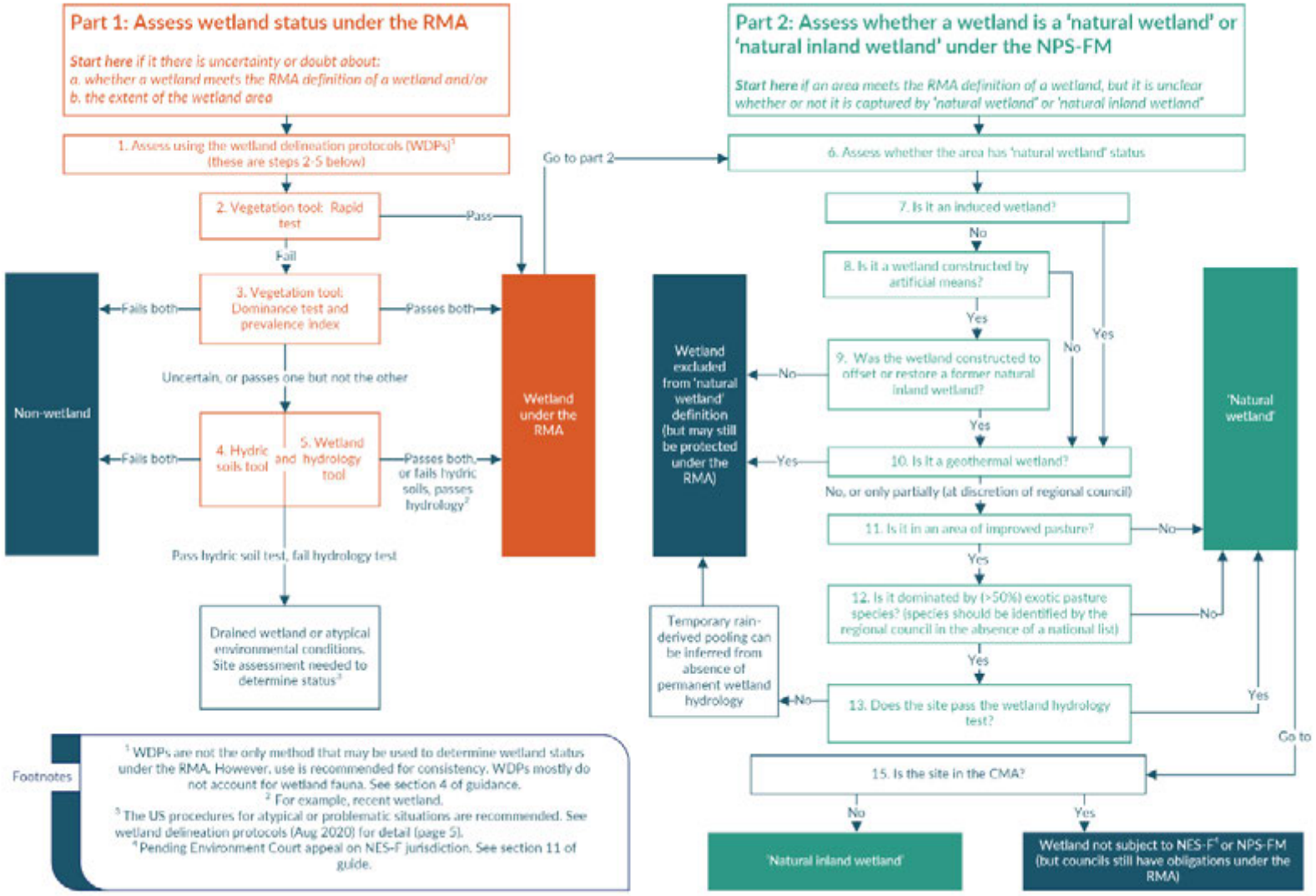


Figure C-2: Assessing 'Natural Wetland' and 'Natural Inland Wetland' status under the NPS-FM using hydrophytic vegetation, hydric soils and wetland hydrology tools. delineation procedure.

Table C-4: *Results from rapid, dominance, and prevalence tests from vegetation plots within the Site B1 Upstream (Fill Site) wetland.*

Wetland Complex B1 (Fill Site)				Quadrat (% cover)	
Plot & stratum type				1	2
Species	Common name	Class	Native / Exotic		
Isolepis sepulcralis	-	FAC	Exotic	50*	25*
Juncus planifolius	grass-leaved rush	FACW	Native	10	20*
Juncus bufonius	toad rush	FACW	Exotic	5	10
Lotus pedunculatus	-	FAC	Exotic	5	-
Isolepis prolifera		OBL	Native	20*	-
Juncus effusus	soft rush	FACW	Exotic	-	25*
Digitalis purpurea	foxglove	UPL	Exotic	-	5
Anagallis arvensis	scarlet pimpernel	FACU	Exotic	1	-
Schefflera digitata	pate	FACU	Native	5	2
Dominance test				100	100
Prevalence test				2.49	2.51
Do any exclusions apply?				No	No
Hydric soils / wetland hydrology tools				NA	NA
Natural Wetland (yes/ no)				Yes	Yes

Class = Obligate (OBL): occurs almost always in wetlands (estimated probability >99% in wetlands); Facultative Wetland (FACW): occurs usually in wetlands (67–99%); Facultative (FAC): equally likely to occur in wetlands or non-wetlands (34–66%); Facultative Upland (FACU): occurs occasionally in wetlands (1–33%); Upland (UPL): rarely occurs in wetlands (<1%), almost always in 'uplands' (non-wetlands). * = dominant.

C.3 SITE PHOTOS

Tributaries of the Piroa Stream

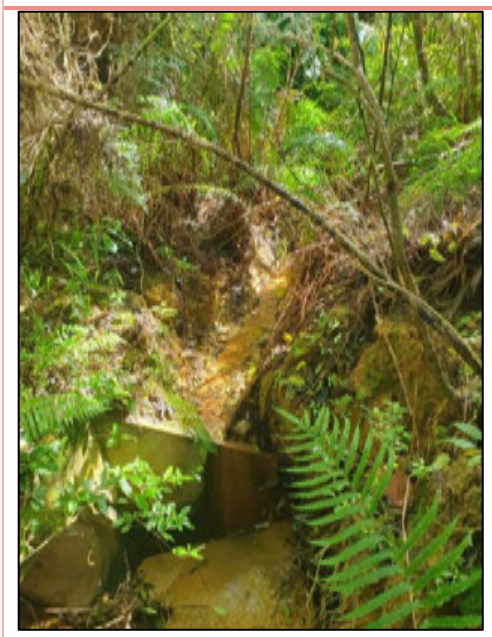


Photo 1: Site A Upstream: Section of stream directly upstream of culvert upstream of the road prior to construction in October 2023. This section of stream was completely reclaimed by fill area A.

Photo 2: Site A Upstream: Section of stream upstream of the road during construction in December 2023.. This section of stream was completely reclaimed by fill area A.

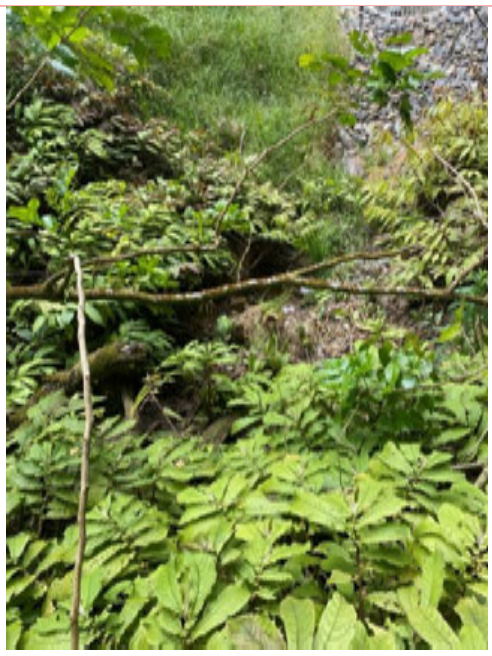


Photo 3: Site D1 Upstream: Stream upstream of the road in December 2023 prior to construction. This section of stream was partially modified with a pipe extention and placement of rip rap.

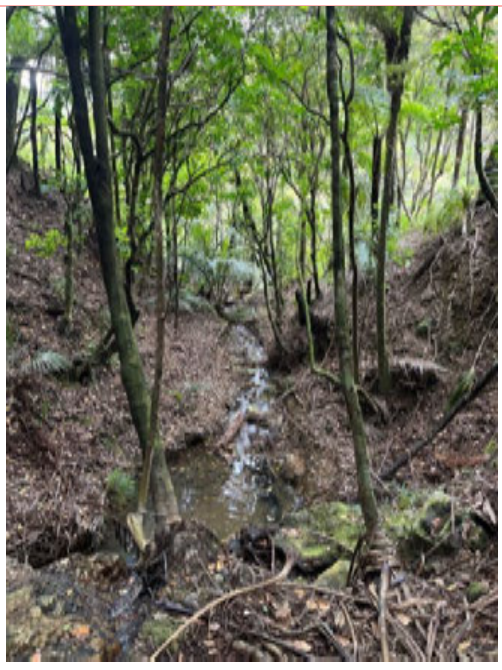


Photo 4: Site D2 Upstream: Stream upstream of the road in December 2023 prior to construction. Part of this stream was modified with a pipe extention.

Photo 5: Site F1: Upstream Stream upstream of the road in December 2023 prior to construction. This lower section of stream was modified with a pipe extention and placement of rip rap.

Photo 6: Site G4 Downstream: Stream downstream of the road after construction in April 2024. This section of stream was not directly impacted but is within the receiving environment from the road.

Photo 7: Site H1 Upstream: Stream upstream of the road during construction in Febuary 2024. This section of stream had a pipe extention and placement of rip rap.

Photo 8: Site H Downstream: Stream habitat downstream of the road during construction in April 2024. This section of stream was not directly impacted but was within the receiving environment of the road.

Photo 9: Site I Upstream: Stream habitat upstream of the road during construction in April 2024. This section of stream was not directly impacted.

Photo 10: Site J: Stream habitat upstream of the road during construction in April 2024. Part of the section of stream was modified with a pipe extention and palcement of rip rap.

Piroa Stream

Photo 11: Site Piroa Stream Quarry: Stream habitat upstream of the road bridge within Atlas Quarry. The ripairan vegetation was removed and a temporary culvert was installed.

Photo 12: Site Piroa Stream Farm: represnative section of stream habitat downstream of the road. This site was not directly impacted by the works.

Photo 13: Site B1 Upstream: Wetland and stream upstream of the road prior to construction in December 2024. This wetland complex and stream habitat was completely reclaimed by fill area B.

Photo 14: Site B1 Upstream: Wetland and stream upstream of the road prior to construction in December 2024. This wetland complex and stream was completely reclaimed by fill area B.

Photo 15: Site B1 Upstream: Wetland and stream upstream of the road prior to construction in December 2024. This shows the recenlty semi-felled exotic forest. This wetland complex and stream habitat was completely reclaimed by fill area B.

Photo 16: Site B1 Upstream: The wetland complex and stream during construction in April 2024. This has been completely reclaimed by fill area B.

C.4 STREAM ECOLOGICAL VALUATION

Table C-5: Stream SEV evaluations.

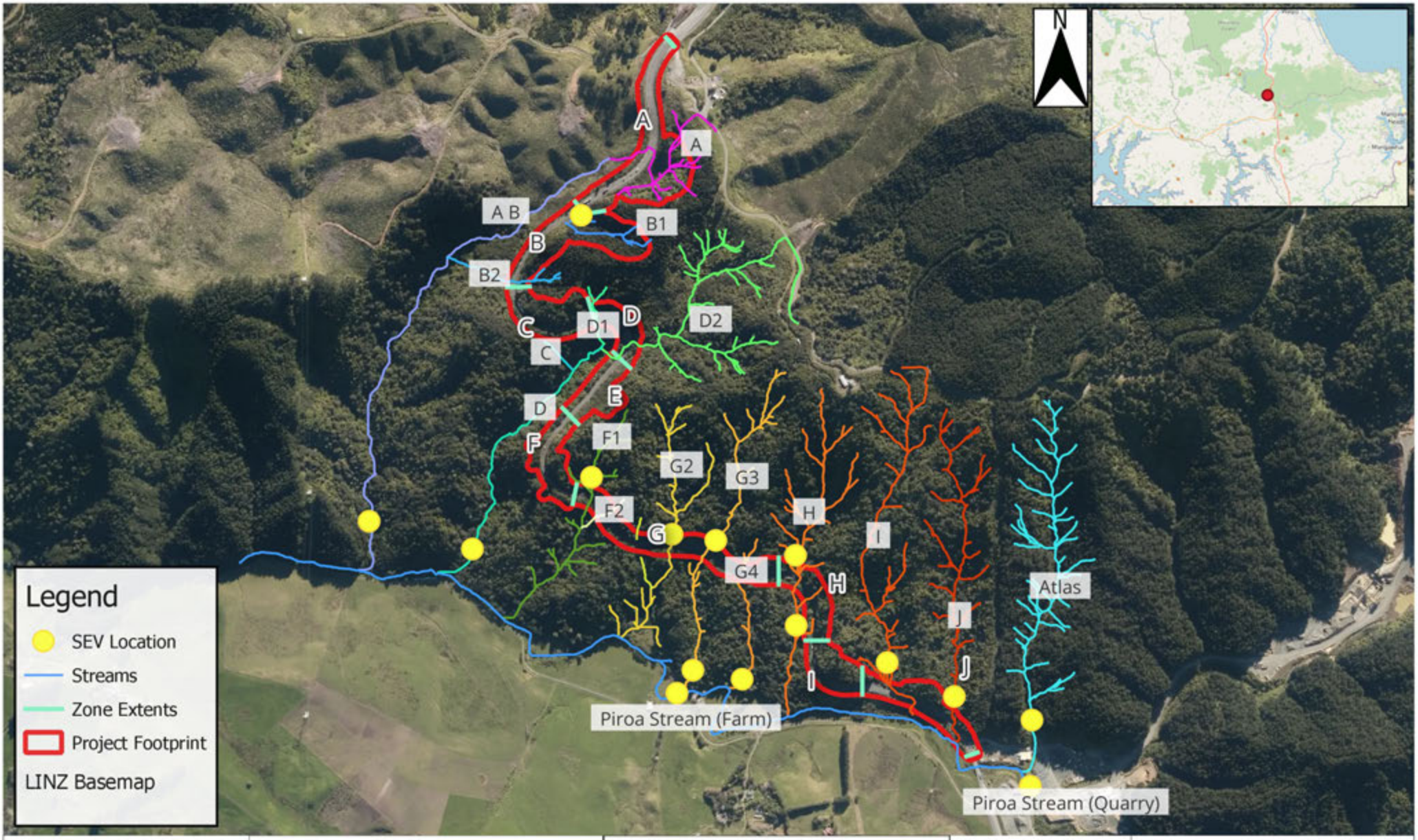
Stream Location	Tributaries of Piroa Stream														Piroa Stream	
Stream Reach	A Upstream	B1 Upstream	Site AB Downstream	D2 Upstream	D Downstream	F1 Upstream	G2 Upstream	G3 Upstream	G3 Downstream	G4 Downstream	H1 Upstream	H Downstream	I Upstream	J Upstream	Atlas Quarry	Piroa - Farm	Piroa - Quarry
Stream Classification ▲	I	I	P	P	P	P	P	P	P	P	P	P	P	P	P	P	P
Average Wetted width (m)	0.40	0.25	-	0.31	-	0.24	0.76	0.62	-	-	0.44	-	0.70	1.10	-	-	1.9
Average Width of the bank (m)	-	-	-	-	-	1.70	1.13	-	-	-	3.60	-	1.90	2.20	-	-	2.6
Hydraulic	0.78	0.45	1.00	0.83	0.95	0.70	1.00	0.99	1.00	0.99	1.00	1.00	0.99	1.00	0.42	0.55	0.47
1. Natural flow regime	0.86	0.82	0.99	1.00	0.93	0.93	0.99	0.98	1.00	0.98	0.99	1.00	0.99	0.99	0.53	0.46	0.13
2. Floodplain effectiveness	1.00	0.16	1.00	1.00	1.00	0.60	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.020.2	0.07	0.04
3. Connectivity for migrations ¤	0.30	0.00	1.00	0.30	1.00	0.30	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.000	1.00	1.00
4. Connectivity to groundwater	0.95	0.83	0.99	1.00	0.87	0.98	0.99	0.96	1.00	0.96	0.99	0.99	0.98	0.99	0.940.94	0.66	0.72
Biogeochemical	0.89	0.37	0.91	0.92	0.73	0.87	0.96	0.90	0.91	0.95	0.90	0.92	0.89	0.92	0.40	0.4	0.37
5. Water temperature control	1.00	0.04	0.84	0.80	0.84	0.66	0.98	0.70	0.82	0.96	0.74	0.86	0.84	0.86	0.16	0.08	0.3
6. Dissolved oxygen maintained	1.00	0.68	1.00	1.00	0.23	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.60	0.68	0.68
7. Organic matter input	1.00	0.01	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.50	0.30	0.3
8. Instream particle retention	0.84	0.84	1.00	1.00	1.00	0.92	0.98	0.95	1.00	1.00	0.93	1.00	0.96	1.00	0.24	0.56	0.20
9. Decontamination of pollutants	0.63	0.3	0.73	0.79	0.60	0.77	0.87	0.87	0.73	0.77	0.85	0.74	0.66	0.77	0.49	0.39	0.37
Habitat Provision	0.46	0.43	0.52	0.75	0.43	0.60	0.54	0.73	0.69	0.51	0.50	0.75	0.63	0.76	0.49	0.420	0.28
10. Fish spawning habitat	0.05	0.50	0.10	0.54	0.10	0.40	0.10	0.50	0.43	0.05	0.05	0.55	0.29	0.54	0.50	0.40	0.05
11. Habitat for aquatic fauna	0.86	0.36	0.93	0.96	0.76	0.81	0.97	0.95	0.95	0.96	0.96	0.96	0.98	0.98	0.485	0.45	0.51
Biodiversity	0.65	0.04	0.7	0.70	0.68	0.55	0.63	0.40	0.73	0.28	0.75	0.74	0.69	0.74	0.48	0.40	0.31
12. Fish fauna intactness	0.50	0.00	0.40	0.40	0.40	0.40	0.40	0.00	0.33	0.40	0.40	0.40	0.33	0.40	0.40	0.40	0.50

13. Invertebrate fauna intactness	*	*	*	*	0.80	*	0.68	*	0.87	*	0.89	0.82	0.78	0.81	0.91	0.64	0.39
14. Riparian vegetation intact	0.80	0.0.07	1.00	1.00	0.85	0.70	0.80	0.80	1.00	0.15	0.96	1.00	0.95	1.00	0.14	0.17	0.03
Overall mean value SEV score ■	0.75 (0.77)	0.0.38 (0.38)	0.84 (0.88)	0.83 (0.87)	0.74 (0.76)	0.73 (0.76)	0.84 (0.89)	0.82 (0.89)	0.87 (0.91)	0.79 (0.82)	0.84 (0.87)	0.88 (0.92)	0.84 (0.89)	0.88 (0.93)	0.44 (0.40)	0.45 (0.43)	0.37 (0.36)

▲ Stream Classification: P = perennial stream ; I = intermittent stream;

■ The SEV scores in brackets exclude the FFI and IFI data which are not included in ECR calculations;

* Macroinvertebrate data was not gathered for some sites so the IFI has not been included in the overall SEV score.



0 100 200 300 400 500 Meters

Project: Brynderwyn Hills Recovery Work

Title: Figure C-3: SEV Locations

Project No:	Drawn:
1-11264.00	Laura van Ginkel
Date:	Checked:
2/07/24	Mark Yungnickel
Scale:	Approved:
10,000 @ A4	Melanya King

Client: NZ TRANSPORT AGENCY WAKA KOTAHI

Original Sheet Size: A4 [W = 297, H = 210] Plot Date: 2024-07-31 11:25:13 by van Ginkel, Laura (NZLV31597) File Ref: C:\Users\nzlv31597\OneDrive - WSP O365\QGIS Bryns.qgz

C.5 WATER QUALITY

Table C-6: Baseline Spot Water Quality Sampling.

Stream Reach	A Upstream	B1 Upstream	F1 Upstream	G2 Upstream	G3 Upstream	H Upstream	I Upstream	J Upstream	Piroa - Quarry
Date	14 Dec 23	14 Dec 23	14 Dec 23	14 Dec 23	14 Dec 23	14 Dec 23	14 Dec 23	14 Dec 23	14 Dec 23
Time	10:25	11:10	12:40.	13:40	14:10	15:35	16.40	17:15	17:40
Temperature (°C)	15.4	15.8	14.7	14.5	14.4	14.5	14.8	14.7	18.2
Dissolved Oxygen (%)	14.7	81.3	71.5	89	97.7	92.4	86.9	85.2	90.9
Dissolved Oxygen (mg/l)	1.4	8.1	7.2	9.1	9.8	9.4	8.8	8.6	8.6
Conductivity (µs/cm)	159	171	122	122	118	120	118	91	146
Water colour	Clear and uncoloured	Clear and uncoloured	Clear and uncoloured	Clear and uncoloured	Clear and uncoloured	Clear and uncoloured	Clear and uncoloured	Clear and uncoloured	Slightly milky

Table C-7: Results from Hills Laboratory Testing: during Construction after Sedimentation.

Site	Impact or Control	Date	Turbidity (NTU)*	Total Suspended solids (g/m³)*
H Upstream	Control	14 Mar 24	**8.1**	15
H Downstream	Impact	14 Mar 24	**192**	**170**
H Downstream	Impact	15 Mar 24	**71**	**83**
F Upstream	Control	15 Mar 24	**4.8**	<5
F Downstream	Impact	15 Mar 24	**650**	**800**
H Downstream	Impact	29 Apr 24	**5.7**	<30
F Downstream	Impact	3 May 24	3.5	<3
Guideline (Letters marked in bold are above the ANZECC guideline levels)			ANZG (2018) Guideline Values 4.1 Upland Rivers 5.6 lowland rivers	ANZG (2018) Guideline Values <40

*Bold numbers exceed guideline values.

C.6 SEDIMENT

Additional Information for Effects Assessment

Erosion and Sediment control measures were developed and implemented across the project area to minimise sediment reaching the stream habitat. Sediment control across the Site generally worked during the construction of the project but some degree of sedimentation downslope along most of the road was observed during the project's construction, potentially due to severe weather events.

Particular sites which were impacted the worst were site 'H Downstream' and to a lesser degree 'F Downstream'. On the 14 March and 11 April 2024 at site 'H Downstream', sediment laden runoff was observed and water within the entire wetted width of the stream was light brown, heavily laden with sediment with 0m of clarity. Spot measurement found that the bed of the main stream had 100% fine sediment cover which was several millimetres thick. This was further verified by high turbidity and suspended solids readings which exceeded guideline values on the 14 and 15 March 2024. The outlet to Site H drains a fairly large stretch of road to a single point. Previous sedimentation events (from cyclone Gabrielle) have caused sedimentation of streams downstream of the road.

The sedimentation initially had had a large impact on stream habitat quality. The affected portions of instream habitat have changed from nearly pristine habitat to fairly poor habitat in the worst affected pools. This will likely have impacted stream fauna in the following ways:

- The sedimented areas will likely exhibit a large change in invertebrate species assemblage. Loss of EPT and other sensitive taxa.
- The direct impact on fish is likely to be limited as they are mobile, although they are likely to avoid these areas and move to unaffected reaches.
- The long-term effects of sediment on frogs is not known, however, they are not found in streams with high sediment cover. Several days after the initial 11 April sediment runoff observations, initial surveys during construction found that the majority of the frogs in the worst affected portions of the stream had moved to areas of better habitat.

Approximately, 160m of stream length within the 'H Downstream' site was affected (when this is combined with an average wetted with of 1.1m this equates to 176m^2). This equates to approximately a third of the sub-catchment and is also the section of stream with the highest ecological values resulting in a moderate magnitude of effect for this stream.

The scale of the impact is likely restricted spatially and temporally. Periodic checks of the 'H downstream' in April, June and July 2024 found that much of the sediment was still present within this stream, particularly within the pools and likely has had limited flushing based on the low flow within the stream.

The source of sediment from the road has been removed and the project upgrade works will minimise continued slips and sediment inputs to the downslope stream reaches. The 'H downstream' was periodically checked for the remainder of construction and high sediment cover was still present. The sediment in the 'H Downstream' is likely to flush over time into the Piroa Stream. Periodic checks of The duration of this effect is not known but this could recover as early as 1 or 2 years without intervention. Macroinvertebrate communities are already showing signs in May 2024 of recolonising the site from unaffected upstream habitats, and fish and freshwater crayfish will likely move back into the affected portions of stream. Little is known about the effects of

sediment on frogs and continued monitoring and confirming these effects have been addressed in the 'Hochstetter Frog Assessment Report'.

The extent and duration of effect on the larger Piroa Stream is expected to be of a low magnitude of effect, as the stream is a larger system already subject to water quality issues including sedimentation from upstream land use and no freshwater mussels were observed in the lower section at the discharge point which are sensitive to sedimentation.

Management

The sedimentation observed at site 'H Downstream' is higher than that accounted for in the overall estimate of impact significance for the project. There are considered to be ongoing effects on freshwater habitats and fauna from the project from sedimentation at site "H downstream'. The full impact and duration of effect will need to be monitored and reassessed next summer to confirm the duration of this effect on habitats and freshwater fauna.

The additional impact and residual effects from sedimentation at site 'H Downstream' will be accounted for through compensation. Via planting an additional stream area of the Piroa Stream at a 1:1 ratio (e.g. 176m^2 on habitat on the Piroa will be planted).

Table C-8: Silt/Sand bed cover based on Vsurf in SEV assessment from baseline and during construction.

Freshwater Site	Silt/sand <2mm Bed cover (from SEV vsurf)	
Tributaries of the Piroa Stream	BASELINE (OCT / NOV 2023)	DURING CONSTRUCTION (APR / MAY 2024)
A Upstream (Fill Site)	NA	NA
B1 Upstream (Fill Site)	62	NA
AB Downstream	8	NA
D1 Upstream	NA	NA
D2 Upstream	14	NA
D Downstream	54	NA
F1 Upstream	19	NA
F1 Downstream	NA	15
G2 Upstream	16	NA
G2 Downstream	NA	NA
G3 Upstream	6	17
G3 Downstream	15	11
G4 Downstream	50	NA
H Upstream	27	29
H* Upstream	NA	NA
H Downstream	16	41
I Upstream	33	NA
I Downstream	NA	NA
J Upstream	9	NA
J Downstream	NA	NA
Atlas Upstream	72	NA
Piroa Stream		
Piroa Farm	18	NA
Piroa Quarry	32	NA
Wetland		
B1 Upstream (Fill site)	70*	NA

NA = not assessed; * = estimate

Table C-9 SAM 1: Bankside visual estimate of the percentage of fine sediment cover during construction (May 2024).

Location/Stream	Habitat	Habitat length (m)	% sediment
F Downstream	Riffle	15	22
	Run	22	65
	Pool	3	60
H Downstream	Riffle	27	50
	Run	45	80
	Pool	28	92

Table C-10 SAM 5: Rapid qualitative assessment of the amount of total suspensible solids deposited on the streambed during construction (May 2024).

Location/ Stream		sample	Water depth (m)	water velocity	score*
F Downstream	Impact	1	0.081	Medium	1
		2	0.095	Slow	3
		3	0.12	Slow	3
H Downstream	Impact	1	0.04	Slow	3
		2	0.062	Medium	3
		3	0.044	Slow	4

* 1 = little sediment to 5 = excessive sediment.

Table C-11 SAM 6: Quantitative assessment of sediment depth during construction (May 2024).

Location/ Stream	Depth (mm)	Transect 1	Transect 2	Transect 3	Transect 4	Transect 5
F Downstream	Section 1	1	2	3	1	1
	Section 2	1	1	2	1	1
	Section 3	1	1	3	1	2
	Section 4	2	2	2	2	1
H Downstream	Section 1	1	1	2	1	1
	Section 2	1	1	1	1	1
	Section 3	1	2	1	1	3
	Section 4	2	2	3	2	2

C.7 MACROINVERTEBRATE COMMUNITIES

Additional Methodology

Several metrics and indices commonly used in interpreting macroinvertebrate community surveys have been considered.

Ephemeroptera, Plecoptera and Trichoptera (EPT) taxa are three orders of insects that are generally sensitive to organic or nutrient enrichment but exclude Oxyethira sp., Paroxyethira sp. and Hydroptilidae caddisfly larvae as these taxa are not sensitive and can proliferate in degraded habitats.

Macroinvertebrate Community Index (MCI) is based on the average sensitivity score for individual taxa recorded within a sample. Sensitivity scores for taxa in hard bottomed streams were used in streams dominated by gravels and cobble, and soft bottomed streams dominated by either macrophytes, wood, overhanging vegetation, and/or any gravel/cobble substrate was largely covered by a thick layer of silt (Stark & Maxted, 2007). Taxon scores are between 1 and 10, 1 representing species highly tolerant to organic pollution (e.g., worms and some dipteran species) and 10 representing species highly sensitive to organic pollution (e.g., most mayflies and stoneflies).

A site score is obtained by summing the scores of individual taxa and dividing this total by the number of taxa present at the site. These scores can be interpreted in comparison with national standards (see Table C-9 below). For example, a low site score (e.g., 40) represents 'poor' conditions and a high score (e.g., 140) represents 'excellent' conditions (Stark & Maxted, 2007).

Quantitative MCI (QMCI) is similar to MCI (based on sensitivity scores) but weights each taxon score based on how abundant the taxa is within the community. As for MCI, the QMCI scores can be interpreted in the context of the national standards (Stark & Maxted, 2007).

Average Score Per Metric (ASPM) is the average of three metrics standardised to a scale of 0 to 1 with the top of the scale representing reference conditions. The component metrics are: EPT taxa richness, %EPT taxa; and the MCI. When normalising scores for the ASPM, the following minimums and maximums were used: %EPT-abundance (0-100), EPT-richness (0-29), MCI (0-200) (Collier, 2008). These scores can be interpreted in comparison with national standards (see table below).

Table C-12: *Interpretation of macroinvertebrate community index values from Stark & Maxted (2007) and NPS-FM (2020).*

Stark & Maxted (2007)	Excellent	Good	Fair	Poor
MCI score	> 120	100– 119	80– 99	<80
QMCI score	> 6.00	5.00– 5.99	4.00– 4.99	< 4.00
NPS-FM NOF (2020)	**A**	**B**	**C**	**D**
MCI range	>130	>130– <110	>100– <90	<90
QMCI range	>6.00	>5.00– <5.99	>4.00– <4.99	<4.00
ASPM range	> 0.6	<0.6 - >0.4	<0.4 - >0.3	<0.3
MCI and QMCI band narrative descriptions	Macroinvertebrate community indicative of pristine condition with almost no organic pollution or nutrient enrichment.	Macroinvertebrate community indicative of mild organic pollution or nutrient enrichment.	Macroinvertebrate community indicative of moderate organic pollution. There is a mix of taxa sensitive and insensitive to organic pollution/nutrient enrichment.	Macroinvertebrate community indicative of severe organic pollution or nutrient enrichment. Communities are largely composed of taxa insensitive to (in)organic pollution/nutrient enrichment.
ASPM band narrative descriptions	Macroinvertebrate communities have high ecological integrity, similar to that expected in reference conditions	Macroinvertebrate communities have mild-to-moderate loss of ecological integrity.	Macroinvertebrate communities have moderate-to-severe loss of ecological integrity.	Macroinvertebrate communities have severe loss of ecological integrity.

*NPS-FM has stricter criteria that is assessed against the median of five years of annual samples which is not available.

Result of Surveys

Table C-13: *Summary of macroinvertebrate metrics during baseline.*

Site Location	Tributaries of the Piroa Stream								Piroa Stream
Site Name	Site D2: Upstream	Site G2: Upstream	Site G3: Downstream	Site H1: Upstream	Site H: Downstream	Site I: Upstream	Site J: Upstream	Atlas Quarry	Piroa Farm
Date Collected	15-Dec-23	12-Dec-23	12-Dec-23	14-Dec-23	12-Dec-23	14-Dec-23	15-Dec-23	12-Dec-23	15-Dec-23
Substrate Type	Hard	Hard	Hard	Hard	Hard	Hard	Hard	Soft	Hard
No of Individuals	1624	747	579	1071	808	582	814	272	16806
No of Taxa	29	26	36	30	38	26	31	32	26
No of EPT taxa	14	9	15	16	15	11	13	9	11
% EPT taxa	68.9	68.3	67.0	79.0	70.2	81.6	77.9	36.4	1.7
MCI HB score	126	123	128	135	116	126	132		97
QMCI HB score	7.79	7.09	6.90	7.48	6.89	7.30	7.50		4.06
MCI SB score								120.5	
QMCI SB score								5.59	
ASPM score	0.60	0.54	0.61	0.67	0.60	0.61	0.63	0.40	0.29
MCI Stark & Maxted (2007)	Excellent	Excellent	Excellent	Excellent	Good	Excellent	Excellent	Excellent	Fair
QMCI Stark & Maxted (2007	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent	Good	Fair
MCI NPS-FM band	B	B	B	A	B	B	A	B	C
QMCI NPS-FM band	A	A	A	A	A	A	A	B	C
ASPM NPS-FM band	A	B	A	A	A	A	A	B	D

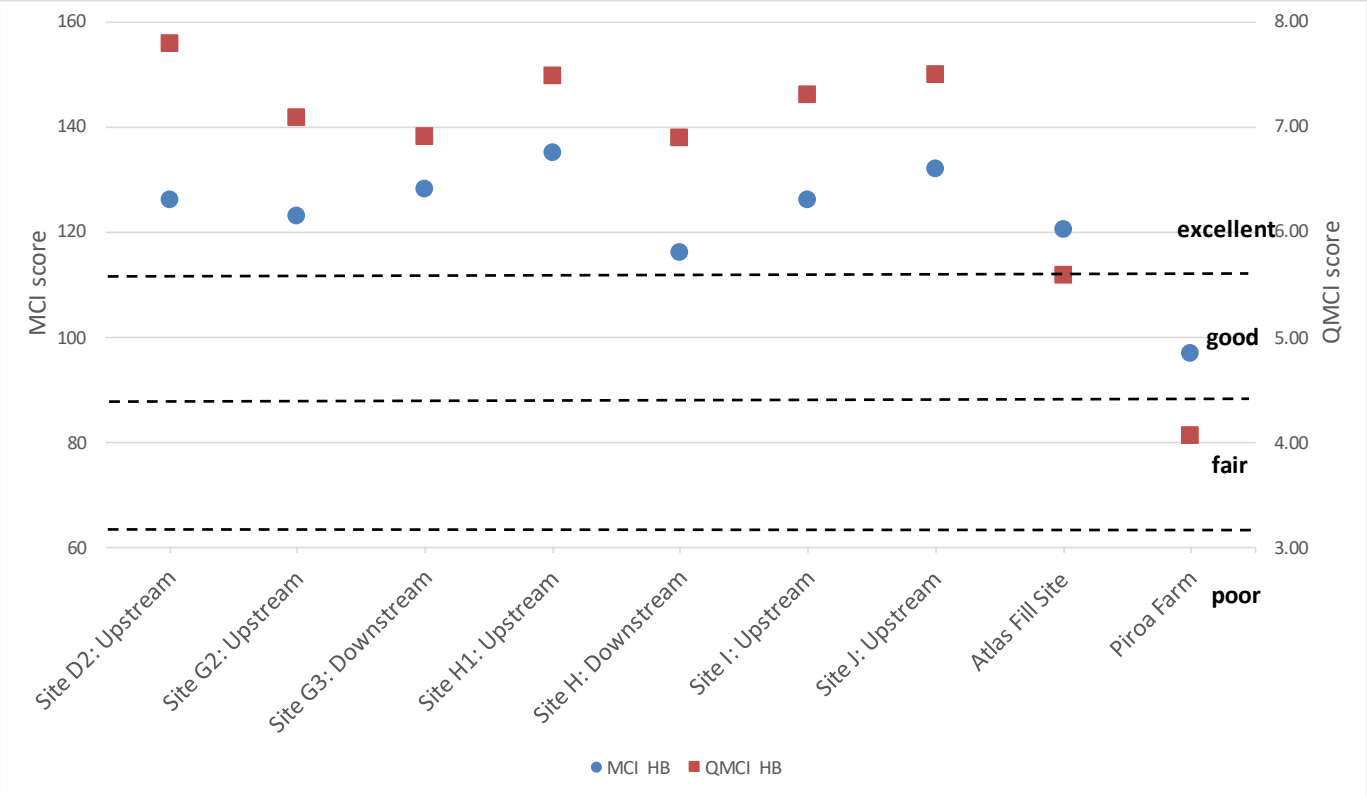


Figure C-4: *MCI and QMCI scores for sampled sites during baseline surveys.*

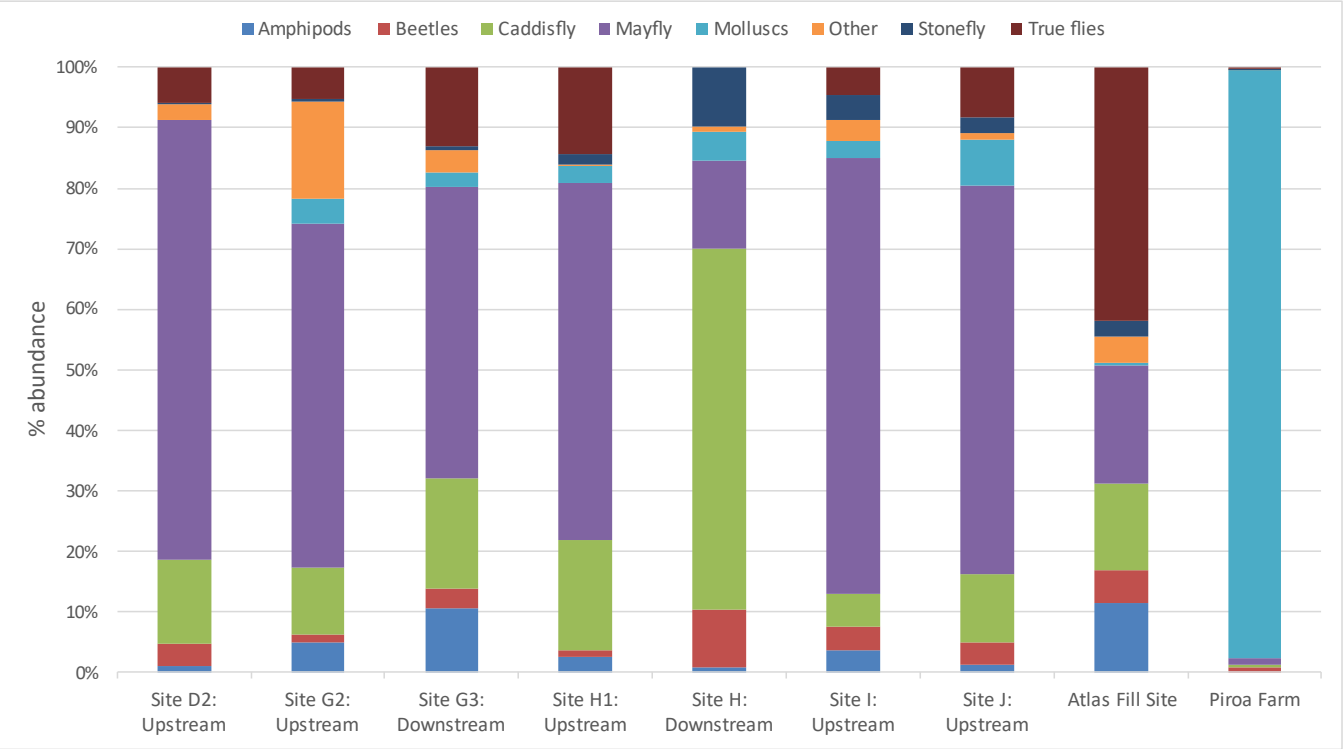


Figure C-5: *Composition of macroinvertebrate assemblages at sites sampled during baseline surveys.*

Table C-14: *Macroinvertebrate results during baseline*

General Group	Taxa	Common Name	MCI Score HB	MCI Score SB	Site D2: Upstream	Site G2: Upstream	Site G3: Downstream	Site H1: Upstream	Site H: Downstream	Site I: Upstream	Site J: Upstream	Atlas Fill Site	Piroa Farm
Platyhelminthes	*Platyhelminthes*	Flat Worm	3	0.9			1		1				
Nematoda	*Nematoda*	Roundworm	3	3.1								1	
Gastropoda	*Austropeplea sp. (lymnaeidae)*	Snail (freshwater)	3	1.2					19				
Gastropoda	*Latia sp.*	Freshwater limpet	3	6.1						1			
Gastropoda	*Potamopyrgus antipodarum*	Estuarine snail	4	2.1		31	14	31	99	15	62	1	16315
Oligochaeta	*Oligochaeta*	Oligochaete worms	1	3.8	6		9	1	29	17	6	8	22
Isopoda	*Isopoda*	Isopods	5	4.5							1		
Isopoda	*Oniscoidea*	Isopods Terestrial	5	4.5		1							
Amphipoda	*Corophiidae*	Amphipod (family)	5	5.5								5	
Amphipoda	*Paraleptamphopidae*	Amphipod	5	5.5		9	17						
Amphipoda	*Talitridae*	Amphipod (family)	5	5.5	17	28	44	27		21	11	26	
Decapoda	*Paranephrops*	freshwater crayfish (koura)	5	8.4		4	6		2		2	1	
Ostracoda	*Ostracoda*	Ostracods	3	1.9									4
Copepoda	*Copepoda*	Copepods	5	2.4									1
Ephemeroptera	*Austroclima sp.*	Mayfly larvae	9	6.5	125	41	22	82	34	24	78	14	
Ephemeroptera	*Coloburiscus humeralis*	Mayfly larvae	9	8.1	286	180	23	262	151	29	145	4	
Ephemeroptera	*Deleatidium*	Mayfly larvae	8	5.6	472	59	131	114	160	254	203	27	192
Ephemeroptera	*Ichthybotus*	Mayfly larvae	8	7.1			1	2	2				
Ephemeroptera	*Nesameletus sp.*	Mayfly larvae	9	8.6			1		1		1		
Ephemeroptera	*Zephlebia sp.*	Mayfly larvae	7	8.8	298	144	101	170	134	112	95	8	5
Plecoptera	*Stone Fly Larvae (Juvenile)*	Stone fly larvae (unid)	5	5									2
Plecoptera	*Austroperla cyrene*	Stone fly larvae	9	8.4	3	1	1	4		23	4		
Plecoptera	*Megaleptoperla grandis*	Stone fly larvae	9	7.3	1		2		3	1	10		10
Plecoptera	*Spaniocerca*	Stone fly larvae	8	8.8			1	2	2				
Plecoptera	*Stenoperla prasina*	Stone fly larvae	10	9.1		1		11			6		
Plecoptera	*Zelandobius sp.*	Stone fly larvae	5	7.4					1			7	
Plecoptera	*Zelandoperla sp.*	Stone fly larvae	10	8.9				2					
Hemiptera	*Microvelia macgregori*	Waterskaters	5	4.6		109			5		1		
Coleoptera	*Elmidae Larvae*	Riffle Beetle	6	7.2			1		1	5		1	77
Coleoptera	*Elmidae Beetle*	Beetle Freshwater	0	7.2									16
Coleoptera	*Hydraenidae Larvae*	Beetle Freshwater	8	6.7	13	6	1			10			
Coleoptera	*Hydraenidae Beetle*	Beetle	8	6.7				5	1		6	1	25
Coleoptera	*Hydrophilidae Indet.*	Freshwater Beetle	5	8								5	
Coleoptera	*Ptilodactylidae*	Freshwater Beetle	8	7.1	45	1	5	2	5	5	12	2	
Coleoptera	*Staphylinidae*	Rove beetle	5	6.2		1	11	4			10	1	4
Coleoptera	*Antiporus sp.*	diving beetle	5	3.5								3	
Coleoptera	*Lancetes sp. (Dytiscidae)*	diving beetle	5	5								1	
Coleoptera	*Paracymus sp. (Hydrophilidae)*	Beetle	5	5		1	1			3	1	1	
Diptera	*Empididae*	dance fly	3	5.4	6	7	6		2			10	1
Diptera	*Eriopterini*	crane fly	9	7.5	6		8	2	2	1	1	6	
Diptera	*Muscidae*	Fly larvae	3	1.6								1	
Diptera	*Orthocladiinae*	midges	2	3.2	1				1			74	7
Diptera	*Psychodidae*	moth fly	1	6.1					1				
Diptera	*Tabanidae*	horse fly	3	6.8	1				19				
Diptera	*Tanypodinae*	midges	5	6.5	1	6	1	1	1	5	1	3	
Diptera	*Tanytarsini*	non-biting midges	3	4.5									14
Diptera	*Austrosimulium*	sandflies	3	3.9					12				24
Diptera	*Chironomus spp.*	non-biting midges	1	3.4									5
Diptera	*Hexatomini*	Crane fly larvae	5	6.7		1	2	2	1	6	4	7	
Diptera	*Mischoderus sp.*	Fly larvae	4	5.9			1		1				
Diptera	*Molophilus sp.*	crane fly	5	6.3	16		3	21	2		11		1
Diptera	*Nothodixa*	dixid midges	4	9.3	7	1	33			2	8		
Diptera	*Paradixa sp.*	dixid midges	4	8.5	2	13		1	4	2	3	5	
Diptera	*Paralimnophila skusei*	crane fly	6	7.4	1		3	1	12		22		
Diptera	*Podochlus sp. (Podonominae)*	non-biting midges	8	8									1
Diptera	*Polypedilum*	non-biting midges	3	8	54	12	18	125	22	11	18	8	
Trichoptera	*Hydroptilidae*	Instar without case	2	2									6
Trichoptera	*Aoteapsyche sp.*	net-spinning caddis	4	6								2	10
Trichoptera	*Costachorema*	free-living caddis	7	7.2				1					
Trichoptera	*Hydrobiosella*	Free-living caddis	9	7.6			15				22		
Trichoptera	*Hydrobiosis gollanis*	Free-living caddis	5	6.7	3			1		2			
Trichoptera	*Hydrobiosis parumbripennis*	Free-living caddis	5	6.7									44
Trichoptera	*Hydrobiosis sp. (juveniles)*	Free-living caddis	5	6.7	12			1	1			8	
Trichoptera	*Hydrochorema*	free-living caddis	9	9	2			3					
Trichoptera	*Oeconesus sp.*	Case caddis	9	6.4			1				1		
Trichoptera	*Orthopsyche*	net-spinning caddis	9	7.5	181	46	54	179	46	14	30		7
Trichoptera	*Oxyethira albiceps*	Axe-head caddis	2	1.2									4
Trichoptera	*Plectrocnemia*	Caddis fly	8	6.6	13				1	5			
Trichoptera	*Polyplectropus sp.*	Free-living caddis	8	8.1	3		26		26	2			
Trichoptera	*Psilochorema nemorale*	Free-living caddis	8	7.8	10	2	8	9	1	9	19	29	1
Trichoptera	*Pycnocentria sp.*	sandy cased caddis	7	6.8	3	36	1	3			20		
Trichoptera	*Pycnocentrodes*	stony cased caddis	5	3.8									2
Trichoptera	*Tarapsyche olis*	Case caddis	9	6.4					1				
Trichoptera	*Triplectides*	Case caddis larvae	5	5.7									6
Arachnida	*Acarina*	Mites	5	5.2	36	6	6	2	2	3		1	
Arachnida	*Dolomedes aquaticus*	water spider	5	6.2								1	

C.8 FISH COMMUNITIES AND OTHER KEY FAUNA

Table C-15: *Freshwater Fish species and other key freshwater fauna recorded within the project area at each site during field investigations and those assumed to be present.*

Stream/Wetland Sites	Fish IBI ■	Presence/Absence (size in mm where recorded)					
		Shortfin eel	Longfin eel	Banded kōkopu	Freshwater crayfish	Hochstetter Frogs	Freshwater mussels
Tributaries of the Piroa Stream (upstream or downstream of the highway)							
Site A Upstream			△				
Site B Upstream (stream & wetland)							
Site AB Downstream							
Site D1 Upstream							
Site D2 Upstream		*					
Site D Downstream							
Site F1 Upstream							
Site F1 Downstream		*	*		*	*	
Site G2 Upstream							
Site G2 Downstream		*	*		*	*	
Site G3 Upstream							
Site G3 Downstream							
Site H Upstream							
Site H Downstream							
Site I Upstream							
Site I Downstream		*	*		*	*	
Site J Upstream							
Site J Downstream		*	*		*	*	
Atlas Quarry							
Piroa Stream							
Piroa Quarry Upstream					*		
Piroa Farm Downstream							

△ there is potential there was cross contaminations as other samples taken from this site so may not be present.
* no eDNA samples were taken but assumed to be present based on the habitat and results of sampling at other sites.

C.9 HABITAT MODIFICATION / LOSS

Table C-16: *Summary of temporary and permanent freshwater habitat loss/modification within the Project Footprint.*

LOCATION/STREAM	APPROXIMATE EXTENT OF STREAM LENGTH AFFECTED (M)		APPROXIMATE WETTED WIDTH OF STREAM AREA AFFECTED (M)	APPROXIMATE EXTENT OF TEMPORARY STREAM (M) / WETLAND AREA AFFECTED (M^2)	APPROXIMATE EXTENT OF PERMANENT STREAM (M) / WETLAND AREA AFFECTED (M^2)	IMPACT TYPE
	INCLUDES TEMPORARY BUFFER AND PERMANENT MODIFICATION/LOSS[15]	INCLUDES PERMANENT MODIFICATION/LOSS ONLY				
Tributaries of the Piroa Stream						
A Upstream (fill site)	NA*	100	0.40	NA	40.0	Reclamation
B1 Upstream (fill site)	NA*	117	0.25	NA	29.3	Reclamation
D1 Upstream	20.3	15.3	0.31	6.3	4.7	Culvert extension and rip rap
D2 Upstream	15	9	0.75	11.3	6.8	Culvert extension and rip rap
F1 Upstream	25.8	20.8	0.24	7.2	5.0	Culvert extension and rip rap
G2 Upstream	13.4	3.6	0.76	10.2	2.7	Rip rap
G3 Upstream	12.6	NA	NA	NA	NA	Modification of manhole
H Upstream (Culvert 17)	11.7	8	0.55	6.4	4.4	Culvert extension and rip rap
H* Upstream (Culvert 18)	41.7	36.7	0.3	12.5	11.0	Culvert extension and rip rap
J Upstream	16	11.5	1.10	17.6	12.7	Culvert extension and rip rap
Piroa Stream						
Piroa Stream Atlas	19*	NA	1.90	30.4	NA	Temporary Culvert
Wetland						
B1 Upstream (fill site)	NA*	NA	NA	NA	95.2	Reclamation

* no frogs were present.
H* is a tributary of H stream.

[15]Fish fences were put in place which included an approximately 5m buffer to ensure there was enough room to enable works; this included salvage of freshwater fauna and removal of habitat as part of destructive salvage effort; in some instances permanent modification/loss went beyond this area.

C.10 FISH PASSAGE

Additional Information for Effects Assessment

The majority of fish species recorded within the Project Area are diadromous and need to move between the sea and freshwater to complete their lifecycle. When assessed at the sub catchment scale, effects of the Project on freshwater fauna, in relation to fish passage, scored Very Low to Low for many sites, which broadly equates to being not 'more than minimal', in accordance with the wording used in the WK-OIC. However, some sites were considered to have High effects where there was extensive suitable upstream habitat for fish.

Therefore, based on the results of this assessment instream structures at sites 'A upstream', 'B1 Upstream', 'D1 upstream', 'F1 Upstream' and 'G3 Upstream' and are considered eligible to be exempt from providing for the passage of fish under the WK-OIC.

Project effects at the remaining sites 'D2 Upstream', 'G2 Upstream', 'H Downstream' and 'J Upstream' can be minimised by retrofitting fish pass devices to structures to achieve or improve fish passage. Site 'I Upstream' is not impacted by the works so is not eligible for a fish passage exemption. However, the structure currently restricts fish passage and is at risk of getting an abatement notice so will be remediated to improve fish passage.

Management

Some of the structures, installed during emergency works, may be retrofitted with fish passage solutions to enhance the passage of indigenous fish with good climbing ability, such as eels. However, fish habitat upstream of SH1 is limited in many streams, either due to being intermittent, the steep gradient of the natural stream or being lost as part of historic weather events. Proposed works were limited to culvert extensions, placement of rip rap and maintenance repair. While there were changes to the stormwater design, no structures were replaced which convey streams.

Retrofit fish passage solutions have been proposed and have/will be applied where feasible to maintain or improve passage for species found to be using upstream habitats and present within downstream habitats where suitable upstream habitat is also present (Table 4-2; WSP, 2024 Fish Passage Report).

APPENDIX D: TERRESTRIAL RESIDUAL EFFECTS

August 2024

Alliance Ecology™

Biodiversity Compensation Modelling Report

Brynderwyn Hills Recovery Project

Prepared for WSP Ltd

alliance ecology.co.nz

Table of Contents

1 Introduction

1.1 Background

Recovery and resilience work has been undertaken on State Highway 1 (SH1) within the Northland Brynderwyn Hills (the project) in response to damage caused by Cyclone Gabrielle in February 2023.

WSP New Zealand Limited (WSP) was engaged by the New Zealand Transport Agency Waka Kotahi (NZTA) to prepare the project Ecological Impact Assessment (EcIA) to inform the application for resource consent and other Severe Weather Emergency Recovery Order 2023 (WK-OIC) regulatory processes as required.

As set out in the EcIA (WSP, August 2024), project activities are expected to have residual adverse effects on several terrestrial values that cannot be avoided, minimised or remedied. The level of residual effects was assessed as:

- High for Hochstetter's frog
- Moderate for
    - Kauri -podocarp - broadleaf forest
    - Kauri
    - Kānuka – mānuka – broadleaf forest
    - Keystone bird species
    - Lizard species
    - Rhytid snail and Kauri snails.

Measures to compensate for residual adverse ecological effects on terrestrial biodiversity values focus on the control of mammalian pests, wasps and weeds for a 10-year period within the proposed 78 ha Pest Management Area (PMA). Financial compensation ($200,000) for Hochstetter's frog research is also included in the proposed compensation package.

1.2 Report Purpose and Scope

Alliance Ecology Ltd has been engaged by WSP to prepare a Biodiversity Compensation Modelling (BCM) report to sense-check the adequacy of the residual effects management package proposed in the EcIA. To that end, this report:

- Applies the BCM to help determine the type and quantum of proposed habitat restoration and enhancement measures needed to achieve net positive outcomes, as predicted by the model, and address residual adverse effects.
- Assesses the proposed residual effects management package against biodiversity offsetting principles, set out in Table 13 of the Ecological Impact Assessment Guidelines (Roper-Lindsay et al. 2018).

2 Application of Models

2.1 Background

The development of a Biodiversity Offset Accounting Model (BOAM) was commissioned by the Department of Conservation (DOC) (Maseyk et al. 2015)). This model provides a transparent and structured means of assessing an offset proposal in instances where data inputs yield quantifiable and demonstrable measures of effects associated with impacts and measures of projected gains at the proposed offset sites. Based on data inputs, the model calculates whether net positive outcomes will be achieved, accounting for uncertainty and the time lag between losses occurring at impact sites and gains being generated at offset sites. Net positive outcomes are defined as outcomes for which benefits associated with restoration and enhancement activities are expected to outweigh adverse residual effects associated with the project.

While offsetting is preferable, in the context of large infrastructure projects, many residual adverse effects of project activities cannot be demonstrably offset with adequate certainty. Where this is the case, compensation measures may be proposed. This occurs in instances where proposed restoration and habitat enhancement sites have not been secured or cannot be accessed, where the collection of quantitative data is technically difficult to measure, or where the project impacts and/or benefits associated with proposed offsetting are simply unclear (Baber et al. 2021b).

Commonly, the quantum of compensation is determined through the application of multipliers or Environmental Compensation Ratios that are used to indicate the magnitude of habitat restoration or enhancement measures relative to the magnitude of impact. However, the use of multipliers to determine the magnitude of compensation has increasingly been challenged due to a lack of transparency and the often ad-hoc nature of their application. Overall, this approach generates high variability in the type and management of compensation across projects relative to the type and level of residual effects.

To address the above issues of transparently and consistently, the BOAM has recently been adapted to help determine the type and magnitude of proposed habitat and restoration measures that are considered likely to achieve net positive outcomes. These adaptations are termed Biodiversity Compensation Models (BCMs) and are an improvement on the status quo for determining compensation requirements. The BCMs follow the same approach as the BOAM but are based in part on qualitative information derived from expert assessment and available literature where quantitative data is not available.

2.2 Limitations and constraints

In applying any biodiversity offset or compensation model, it is important to acknowledge the limitations, constraints and uncertainties associated with such models. Most notably and particularly with respect to the BCMs, these limitations, constraints and uncertainties

have the potential to generate false positives, i.e. instances where the models generate net positive outcomes when the converse is true. This occurs when:

- A biodiversity value that is not explicitly accounted for is lost in the trade, e.g., a tree-dwelling beetle that is not known to occur or not measured at the impact site, does not self-colonise the offset or compensation site or does not benefit from proposed restoration or enhancement measures at those sites; and
- Data inputs or assumptions are incorrect and indicate that the level of effects at the impact site(s) are lower than they are and/or the benefits associated with the proposed habitat restoration or enhancement at the offset or compensation site(s) are greater than they actually are.

The likelihood or risk of a false positive is higher when:

- Affected habitat types have high biodiversity value or are more complex (often a feature of more mature habitat types);
- Models quantify or capture only a subset of biodiversity values (e.g. only quantify plant biodiversity values within an ecosystem type and do not account for fauna values);
- Models aggregate biodiversity values (e.g. lump all the biodiversity values associated with an ecosystem type into a single measure such as 'biodiversity condition' or 'ecological integrity'); and
- Models rely heavily or exclusively on expert opinion, inaccurate data or incorrect assumptions.

Despite these limitations and constraints of BCMs or other models, the risk of a 'false positive' can be reduced in large part by:

- Including a representative diversity of biodiversity value measures in the models (e.g. vegetation and fauna biodiversity values);
- Conservatism with respect to the likelihood of achieving the expected benefits at the habitat restoration and enhancement sites;
- Providing an adequate 'Net Benefit' buffer through the type and quantum of habitat restoration or enhancement measures proposed; and
- The development and implementation of a biodiversity outcome monitoring programme that enables the conversion of compensation models into offset models through substitution of qualitative information for quantified data.

Equally, it is important to recognise that while there are limitations and constraints with the development and application of the BCM and other biodiversity models, the BCM constitutes a recognised improvement over the status quo. That is, this approach is transparent and robust, and provides a validation process for determining compensation requirements to address residual adverse effects.

The BCMs and other models are therefore appropriately used as a decision support tool to help identify compensation measures that are expected to result in tangible net positive outcomes for affected biodiversity values. As is the case for this Project, BCMs rely upon

expert knowledge and experience to determine the data inputs and also the appropriateness and validity of the proposed compensation measures.

3 Biodiversity Compensation Models (BCMs)

3.1 Overview

For the Brynderwyn Hills Project, BCMs have been used to help determine the type and magnitude of effort that is expected to achieve net positive outcomes for affected biodiversity values that cannot (at this stage) be demonstrably offset.

BCMs were run for native forest biodiversity values as a whole, and for Hochstetter's frog. These values were considered key priorities for residual effects addressment. The BCMs assess the likelihood of achieving net positive outcomes for these biodiversity values based on:

- Available information on the areal extent of both impact and proposed habitat restoration and enhancement site(s).
- Expert assessment, supported by a review of relevant literature or data (where quantitative data is unavailable), on:
    - The reduction in habitat value or population/assemblage at the impact site(s) as a result of the project activities; and
    - The increase in habitat value or population/assemblage that can be directly attributed to compensation actions at the habitat restoration and enhancement compensation site(s) within a fixed time period.
- The expected benefit attributed to the proposed habitat restoration and enhancement measures
- An assigned percentage confidence (i.e. 50 to < 75 %, 75 to < 90 %, and ≥ 90 %) that those offset actions would achieve the expected benefit.
- Assigned time discount rate of 3 % to account for the time lag between when an impact is likely to occur and when the offset benefit is likely to be achieved.

The BCMs predict that the type, quantum and duration of the proposed compensation package is insufficient to achieve net positive outcomes for overall forest biodiversity or Hochstetter's frogs.

Sections 4 and 5 below describe the data inputs for both BCMs, and summarise modelling inputs and data outputs. Data inputs are informed by the detailed desktop and field investigations described in the EcIA.

4 Native forest terrestrial BCM

4.1 Overview

The native forest BCM relates to the permanent loss of 8.36 ha of native forest terrestrial biodiversity, including 4.89 ha of kauri-podocarp-broadleaved forest (WF11) and 3.47 ha of Kānuka - mānuka – broadleaved forest (VS2). This modelled value includes edge and disturbance-related adverse effects on adjacent native habitats.

The level of residual effects was assessed as 'High' for kauri-podocarp-broadleaved forest (WF11) and 'Moderate' for Kānuka-mānuka–broadleaved forest (VS2).

Measures to compensate for residual adverse ecological effects on native forest terrestrial biodiversity include the control of mammalian pests, wasps and weeds for a 10-year period within the proposed 78 ha Pest Management Area (PMA).

4.2 BCM

Table 4.1 below describes the data inputs into the BCM. Table 4.2 provides a data input and output summary.

In conclusion, the BCM indicates that net positive outcomes for effects on native terrestrial forest will not be met through the proposed compensation actions. The compensation score is 58.4% lower than the impact score, indicating a greater extent of compensation is required.

Table 4.1 Native forest terrestrial BCM data inputs (see Appendix A for a detailed explanation of model inputs)

General model descriptor inputs	
Model inputs	**Explanation**
Biodiversity type	Native forest terrestrial biodiversity (aggregated)
Technical expert input(s)	Matt Baber
Benchmark	A benchmark of 5 equates to high-value mature native forest that has been subject to long-term pest and weed control and supports a full complement of associated species that are at carrying capacity.
How many habitat types OR sites are impacted	2
Number of proposed compensation measures	2

Net positive target	0% (i.e. the compensation score equals the impact score) While a 10% Net positive target is generally considered appropriate as set out in the User Guide (Appendix A), the target has been set at 0% given the nature of the emergency works.
Impact model inputs and descriptions	
Habitat/site impacted	Kauri-podocarp-broadleaved forest (WF11)
Impact contingency (risk)	High risk/High value (calculated impact score is multiplied by 1.1 (+10%)) This habitat/vegetation type was assessed in the EcIA as having 'High' ecological value under the EcIAG criteria (Roper Lindsay et al. 2018).
Impact contingency (uncertainty)	Moderate uncertainty (calculated biodiversity impact score is multiplied by 1.1 (+10%)) Project Impacts on this habitat type are generally understood but uncertainties remain, particularly in relation to the presence or abundance of some species.
Areal extent of impact (ha)	Approximately 4.89 ha, as well as associated edge or disturbance-related effects on adjacent habitat.
Value score prior to impact	Data input score: 3.75 Explanation: Kauri-podocarp-broadleaved forest (WF11) within the project footprint has been assigned a score of 3.75 relative to the benchmark of 5, e.g., it is considered to equate to 75 % the value of benchmark habitats. This assessment directly aligns with the assessment of ecological value of high (high range) in the EcIA which was based on desktop and field investigations, applying professional judgement.
Value score after impact	0.001 There will be a permanent and complete loss of habitat within the footprint (noting that the formula cannot work with 0).
Habitat/site impacted	Kānuka-mānuka–broadleaved forest (VS2)
Impact contingency (risk)	Moderate risk/Moderate value (calculated impact score is multiplied by 1.05 (+5%))
Impact contingency (uncertainty)	Moderate uncertainty (calculated biodiversity impact score is multiplied by 1.1 (+10%)) Project Impacts on this habitat type are generally understood but uncertainties remain, particularly in relation to the presence or abundance of some species.

Areal extent of impact (ha)	3.47 ha
Value score prior to impact	Data input score: 2.5 Explanation: Kānuka-mānuka–broadleaved forest (VS2) within the project footprint has been assigned a score of 2.5 relative to the benchmark of 5, e.g., it is considered to equate to 50 % the value of benchmark habitats. This assessment directly aligns with the assessment of ecological value of moderate (mid-range) in the EcIA which was based on desktop and field investigations and using professional judgement
Value score after impact	0.001 There will be a permanent and complete loss of habitat within the footprint (noting that the formula cannot work with 0).
Compensation model inputs	
Compensation type 1	**Native revegetation (0.6 ha of riparian planting + 1.77 ha of remediation planting)**
Discount rate	+3 % (the default discount score as per Maseyk et al. (2015); Baber et al. (2021a). The discount rate addresses the temporal time lag between the impact occurring and the biodiversity gains being generated by the conservation action(s).
Finite end-point	35 years after impact (life of consent)
Compensation contingency (confidence)	High confidence (75 – 90%).
Areal extent (ha) of compensation type	2.37 ha
Value score prior to compensation measure (relative to benchmark)	Data value input: 0.25 Explanation: These sites are currently in pasture which has been assigned a score of 0.25, relative to the benchmark, i.e. it is considered to equate to 5% of the benchmark habitat (pasture can provide habitat for some native species such as long-tailed bats or copper skink and several invertebrates) This assessment directly aligns with the assessment of ecological value of Negligible (low range) in the EcIA which is based on desktop and field investigations, applying professional judgement.
Value score after compensation	**2.5** (i.e. relative to the benchmark, a 45% gain in value).

measure (relative to benchmark)	This assessment directly aligns with the assessment of ecological value of Moderate (mid-range) in the EcIA based on professional judgement and experience.
Compensation type 2	**Control of mammalian pests, wasps and weeds for a 10-year period within the proposed 78 ha Pest Management Area (PMA).**
Discount rate	+3 % (the default discount score as per Maseyk et al. (2015); Baber et al. (2021a). The discount rate addresses the temporal time lag between the impact occurring and the biodiversity gains being generated by the conservation action(s).
Finite end-point	1: The finite point represents the time between impact and assessment of biodiversity gain at the compensation site(s). This is assumed to be 1 because the majority of biodiversity benefits associated with pest control happen almost immediately after pest reduction targets have been achieved.
Compensation contingency (confidence)	Moderate confidence (50 – 75%). While there is high confidence that the proposed pest control would generate notable benefits for native terrestrial biodiversity, there is less confidence around the rate at which these benefits diminish over 25 years.
Areal extent (ha) of compensation type	78 ha
Value score prior to compensation measure (relative to benchmark)	Data value input: 3.5 Explanation: Most of the proposed compensation area comprises kauri-podocarp-broadleaved forest (WF11) with a smaller proportion of Kānuka - Mānuka – broadleaved forest (VS2). This assessment aligns with the assessment of ecological value of High (moderate-range) in the EcIA which is based on desktop and field investigations, and applying professional judgement.
Value score after compensation measure (relative to benchmark)	Data value input: 3.75 (i.e. relative to the benchmark, a 5% gain in value). It is expected that the proposed compensation would elevate the ecological value of the native forest terrestrial biodiversity by 20% after 1 year which would equate to a score of 4.5 relative to the benchmark. However, these gains would diminish once pest control is terminated at 10 years and by 35 years would be predicted to drop to a 5% gain.

Table 4.2: BCM input/output summary table.

This table indicates a Net Loss outcome in that the model predicts that the proposed compensation will go just over two-fifths of the way (-41.6%) towards achieving a no net loss outcome based on the compensation score being 58.4% less than the impact score.[1]

Model Inputs		
Input descriptors	**Input data**	
Project/reference name	Brynderwyn Emergency	
Biodiversity type	Native forest	
Technical expert(s) input	Matt Baber	
Benchmark	5	
How many habitat types OR sites are impacted	2	
Number of proposed compensation actions	2	
Net gain target	0%	
Habitat/Site Impact(s)	**WF11 kau-pod-bro forest**	**VS2 kan-man-bro forest**
Impact risk contingency:	3	2
Impact uncertainty contingency:	2	2
Areal extent of impact (ha):	4.89	3.47
Value score prior to impact:	3.75	2.5
Value score after impact:	0.001	0.001
Compensation Action(s)	**Pest control 10 years**	**Native rev (rip + rem)**
Discount rate:	3.0%	3.0%
Finite end point (years):	1	35
Compensation confidence contingency:	3	2
Areal extent (ha) of compensation type:	78	2.37
Value score prior to compensation:	3.5	0.25
Value score after compensation:	3.75	2.5

Model outputs			
	Total impact score	**WF11 kau-pod-bro forest**	**VS2 kan-man-bro forest**
Impact score	**-6.43962**	-4.43649	-2.00312
	Total compensation score	**Pest control 10 years**	**Native rev (rip + rem)**
Compensation score	**2.67919**	2.36650	0.31269
Net gain outcome	**-58.4%**		

[1] The absolute (+) impact score.

5 Hochstetter's frog BCM

5.1 Overview

The Hochstetter's frog BCM relates to:

- The loss of 144 metres of permanent stream habitat within the Project footprint, assessed as having High value for Hochstetter's frog, and
- A reduction in habitat value for 1000 metres of permanent stream downstream of the Project footprint, assessed as currently having Very High value for Hochstetter's frog.

Measures to compensate for residual adverse effects associated with this loss include the control of mammalian pests and wasps for a 10-year period within the proposed 78 ha Pest Management Area (PMA).

Financial compensation of $200,000 for Hochstetter's frog research is also included in the proposed compensation package. However, this type of compensation is excluded from the model because it will not generate tangible biodiversity benefits that directly address impacts.

5.2 BCM

Table 5.1 Hochstetter's frog BCM data inputs (see Appendix A for a detailed explanation of model inputs)

General model descriptor inputs	
Model inputs	**Explanation**
Biodiversity type	Hochstetter's frog habitat
Technical expert input(s)	Matt Baber
Benchmark	A benchmark of 5 equates to high value mature native forest hard bottomed streams with high abundance and diversity of refugia (e.g. boulders, crevices, coarse wood and leaf packs) and subject to long-term intensive mammalian pest management with frogs at carrying capacity.
How many habitat types OR sites are impacted	2
Number of proposed compensation measures	1

Net positive target	0% (i.e. the compensation score equals the impact score) While a 10% Net positive target is generally considered appropriate as set out in the User Guide (Appendix A), the target has been set at 0% given the nature of the emergency works.
Impact model inputs and descriptions	
Habitat/site impacted	Project footprint streams
Impact contingency (risk)	High risk/high value (calculated impact score is multiplied by 1.1 (+10%)) Hochstettter's frog is classified as nationally At Risk (Declining) which equates to a 'high' ecological value under EcIAG (Roper Lindsay et al. 2018).
Impact contingency (uncertainty)	Low uncertainty (calculated biodiversity impact score is multiplied by 1.05 (+5%)). There is low uncertainty because the extent of actual loss is known with high precision.
Extent of impact (metres)	144 m of permanent stream habitat loss
Value score <u>prior to</u> impact	Data input score: 3.5 Explanation: Stream habitat within the project footprint has been assigned a score of 3.5 relative to the benchmark of 5, e.g., it is considered to equate to 70 % the value of benchmark habitats. This assessment directly aligns with the assessment of ecological value of High (mid-range) in the EcIA which was based on desktop and field investigations, applying professional judgement.
Value score <u>after</u> impact	0.001 There will be a permanent and complete loss of habitat within the footprint (noting that the formula cannot work with 0).
Habitat/site impacted	Streams below project footprint which are impacted by sedimentation and ph changes associated with project activities
Impact contingency (risk)	High risk/high value (calculated impact score is multiplied by 1.1 (+10%)) Hochstettter's frog is classified as nationally At Risk (Declining) which equates to a 'high' ecological value under EcIAG (Roper Lindsay et al. 2018).
Impact contingency (uncertainty)	High uncertainty (calculated biodiversity impact score is multiplied by 1.20 (+20%)). The extent and intensity of adverse effects on frogs in affected streams below the footprint is relatively uncertain.
Extent of impact (metres)	1000 m of stream habitat degradation

Value score prior to impact	Data input score: 4 which equates to Very High value (lowest-range) Explanation: Stream habitat downstream of the project footprint has been assigned a score of 4 relative to the benchmark of 5, e.g., it is considered to equate to 80 % the value of benchmark habitats. This score is based largely on field investigations that included quantification of stream habitat characteristics and frog relative abundance within 5 reference sites (50m reaches) that were located downstream of the project footprint.
Value score after impact	Data input score 3 which equates to High value (lowest range): Explanation: This score is largely based on observations of downstream habitats after sediment and the degree and extent of this project-induced sedimentation in the streams. High levels of sediment are expected to stay in the streams in the long-term and thus effects will be ongoing.
Compensation model inputs	
Compensation type 1	**Control of mammalian pests and wasps for a 10-year period within the proposed 78 ha Pest Management Area (PMA).**
Discount rate	+3 % (the default discount score as per Maseyk et al. (2015); Baber et al. (2021a). The discount rate addresses the temporal time lag between the impact occurring and the biodiversity gains being generated by the conservation action(s).
Finite end-point	Data input score 1: Explanation: The finite point represents the time between impact and assessment of biodiversity gain at the compensation site(s). This is assumed to be 1 because the majority of biodiversity benefits associated with pest control happen almost immediately after pest reduction targets have been achieved.
Compensation contingency (confidence)	Moderate confidence (50-75%)
Extent (m) of stream subject to compensaton	Data input: 6011 m This is the calculated length of stream within the 78 ha of forest subject to the proposed pest control programme.
Value score prior to compensation measure (relative to benchmark)	Data input score: 4 which equates to Very High value (lowest-range) Explanation: Stream habitat downstream of the project footprint has been assigned a score of 4 relative to the benchmark of 5, as it is considered to equate to 80 % the value of benchmark habitats.

	This score is based largely on field investigations that included quantification of stream habitat characteristics and frog relative abundance within 11 reference sites (50m reaches) that were located downstream of the project footprint.
Value score <u>after</u> compensation measure (relative to benchmark)	Data value input: 4.25 (i.e. relative to the benchmark, a 5% gain in value). It is expected that the proposed compensation would elevate the ecological value of the stream by 15% due to an increase in the abundance of frogs after 1 year. This would equate to a near benchmark score of 4.75, or Very high value (high range). However, these gains would diminish once pest control is discontinued after 10 years and 35 years after commencement of pest control, the gain is predicted to drop from 15% to 5%

Table 5.2: BCM input/output summary table.

This table indicates a Net Loss outcome for Hochstetter's frog values. The model predicts that proposed compensation will go just under half-way (47.9%) towards achieving a No Net loss outcome, based on the compensation score being 52.1% less than the impact score.[2]

[2] The absolute (+) impact score.

Model Inputs		
Input descriptors	**Input data**	
Project/reference name	Brynderwyn Emergency	
Biodiversity type	Hochstetter's frog pop	
Technical expert(s) input	Matt Baber	
Benchmark	5	
How many habitat types OR sites are impacted	2	
Number of proposed compensation actions	1	
Net gain target	10%	
Habitat/Site Impact(s)	**Impact footprint**	**Downstream of impact**
Impact risk contingency:	3	3
Impact uncertainty contingency:	1	3
Areal extent of impact (ha):	144	1000
Value score prior to impact:	3.5	4
Value score after impact:	0.001	3
Compensation Action(s)	**Pest control**	
Discount rate:	3.0%	
Finite end point (years):	1	
Compensation confidence contingency:	3	
Areal extent (ha) of compensation type:	6011	
Value score prior to compensation:	4	
Value score after compensation:	4.25	

Model outputs			
	Total impact score	**Impact footprint**	**Downstream of impact**
Impact score	**-380.39074**	-116.39074	-264.00000
	Total compensation score	**Pest control**	
Compensation score	**182.37257**	182.37257	
Net gain outcome	**-52.1%**		

6 Assessment against EcIAG biodiversity offsetting principles

In line with the assessment of ecological effects under the EcIAG, the proposal has been further evaluated against the 'key principles of biodiversity offsetting' set out in that document. While not a statutory requirement, adherence to EcIAG methodology—including assessment against these principles — is considered good practice.

The EcIAG does not include compensation principles. However, compensation principles generally align with offsetting principles, except the emphasis is net positive outcomes in which the goal is for benefits to outweigh impacts, rather than no net loss.

This assessment is provided in Table 6.1 below.

Table 6.1: Assessment against Biodiversity Offset Principles set out in Table 13 of the EcIAG

Principle	EcIAG Explanation	Assessment
Limits to offsetting	*Many biodiversity values are not able to be offset, and if they are impacted then they will be permanently lost. These situations include where:* • *Residual impacts cannot be fully compensated for by a biodiversity offset because of the irreplaceability or vulnerability of the biodiversity affected, and* • *There are no technically feasible or socially acceptable options by which to secure gains within acceptable timeframes.* *In either situation, an offset would be inappropriate. This principle reflects a standard of acceptability for offsetting and should not be seen as a pathway to allow uncompensated losses. The project should be redesigned wherever possible to avoid effects that cannot be offset.*	We consider this principle likely to be met
No net loss	*The goal of a biodiversity offset is a measurable outcome that can reasonably be expected to result in no net loss, and preferably a net gain in biodiversity. A no net*	We consider this principle unlikely to be met

Principle	EcIAG Explanation	Assessment
	loss outcome requires that at a specified point in time biodiversity values will be returned to the point they would have been if the impact and offset had not occurred. No net loss is measured by type, amount, and (in some accounting models) *condition, and requires explicit statements describing:* *a) the elements of biodiversity for which a no net loss outcome is sought;* *b) the assumed background biodiversity trajectory against which no net loss is* *evaluated and* *c) the time horizon within which a no net loss outcome is to be achieved.*	
Landscape context	*The design of a biodiversity offset should consider the landscape context of both the impact site and the offset site, taking into account interactions between species, habitats, and ecosystems, spatial connections, and system functionality.* *Consideration of landscape context is captured in the assessment of ecological equivalence across space and time.*	We consider this principle likely to be met
Additionality	*A biodiversity offset must achieve gains in biodiversity above and beyond gains that would have occurred anyway in the absence of the offset. This requires evaluating the change in biodiversity value* *under both a 'with offset' and a 'without offset' scenario to estimate the amount of additional gain that can be attributable to the offset action.* *Some aspects of an offset proposal may meet additionality rules, while other proposed actions may not. In such cases, only the amount of gain that can be demonstrated to*	We consider this principle likely to be met

Principle	EcIAG Explanation	Assessment
	be additional should count towards the overall offset.	
Permanence	*The biodiversity benefits at an offset site should be managed with the objective of securing outcomes that last at least as long as the impacts, and preferably in perpetuity. To achieve or sustain gains long term requires a well-designed monitoring and reporting programme and an adaptive management approach to adjust management as necessary.*	We consider this principle unlikely to be met
Ecological equivalence	*Ecological equivalence describes the degree to which the biodiversity gain attributable to an offset is balanced with the biodiversity losses due to development across type, space, and time; and therefore, whether the exchange achieves no net loss. Assessing ecological equivalence requires the biodiversity at both the impact and the offset site to be described and measured to quantify losses and gains. Demonstrating ecological equivalence differentiates biodiversity offsetting from environmental compensation*	We consider this principle likely to be met

7 References

Baber, M, Dickson, J, Quinn, J, Markham, J, Ussher, G, Heggie-Gracie, S, and Jackson, S. (2021a). *A Biodiversity Compensation Model for New Zealand* – A User Guide (*Version 1*). Prepared by Tonkin & Taylor Limited. Project number 1017287.0000P.

Baber, M, Christensen, M, Quinn, J, Markham, J, Ussher, G and Signal-Ross, R. (2021b): The use of modelling for terrestrial biodiversity offsets and compensation: a suggested way forward. Resource Management Journal, Resource Management Law Association (April 2021)

Baber, M, Dickson, J, Quinn, J, Markham, J, Ussher, G, Heggie-Gracie, S, and Jackson, S. (2021c). Biodiversity Compensation Model for New Zealand– Excel Calculator Tool (*Version 1*). Prepared by Tonkin & Taylor Limited. Project number 1017287.0000P.

Maseyk, F., Maron, M. Seaton, R. and Dutson, G. (2015). A Biodiversity Offsets Accounting System for New Zealand. Contract report prepared for the Department of Conservation, Hamilton Service Centre Private Bag 3072 Hamilton New Zealand.

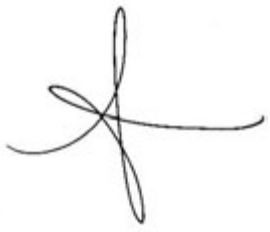
Roper-Lindsay, J., Fuller S.A., Hooson, S., Sanders, M.D., Ussher, G.T. (2018). Ecological impact assessment. EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd edition.

WSP, 2024 (in prep). Brynderwyn Hills Recovery Project Ecological Impact Assessment prepared for New Zealand Transport Agency Waka Kotahi. August 2024.

8 Applicability

This report has been prepared for the exclusive use of our client RS Sand Ltd, with respect to the particular brief given to us and it may not be relied upon in other contexts or for any other purpose, or by any person other than our client, without our prior written agreement.

Report prepared by:



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Matt Baber

Principal Ecologist/ Director

Alliance Ecology Ltd

Appendix A: BCM input descriptions

(Table 3.1 Baber et al. 2021a)

Model inputs	Description
Project reference/ name	**Instruction** Manually type project reference as applicable.
Biodiversity type	**Instruction** Manually type in the biodiversity type to which the BCM relates, e.g., terrestrial vegetation, kahikatea swamp forest, raupō wetland, indigenous fauna assemblage, lizard assemblage, kānuka or Australasian bittern. **Explanation** Models can be applied to broad habitat types (e.g. forest habitat or wetland habitat) for which impact scores for several specific forest or wetland habitat types can be independently determined (e.g. exotic wetland versus a raupō wetland). This approach is often taken when the same compensation action or actions are proposed for different impacts on different habitat types. For example, for a long-tailed bat BCM, native revegetation may be proposed as a common compensation measure to address effects associated with the loss of three habitat types (exotic plantation forest, exotic scrub and pasture).
Technical expert input(s)	**Instruction** Manually type in the names of all technical experts involved in contributing to and agreeing data inputs. **Explanation** Determining data inputs with maximum accuracy requires the involvement of experts, likely a team, including those experienced in implementing, monitoring and reporting on management actions. Evaluating the outputs of the BCM will equally benefit from interpretation by a representative team of suitability qualified and experienced experts.
Benchmark	**Instruction** Manually type in **5** (the benchmark is always 5). **Explanation** The benchmark of 5 is a reference measure score which constitutes a hypothetical but realistic potential state. Typically, this would include a large, contiguous, native-dominated terrestrial or wetland ecosystem type that has

	been subject to intensive mammalian pest control over the long-term with the full suite of indigenous flora and fauna present at or near carrying capacity. This habitat would generally be of such high quality that compensation actions would provide negligible additional ecological gain. The benchmark is always 5 so that it aligns with the Ecological Impact Assessment Guidelines (EcIAG, Roper-Lindsay *et al.* 2018). In broad terms the following numerical scores for ecological value align with the following ecological value categories: < 1 = Negligible 1 - <2 = Low 2 - <3 = Moderate 3 - <4 = High 4 - <5 = Very High 5 = Benchmark
How many habitat types OR sites are impacted	**Instruction** Select from the drop-down menu the number of different habitat type or sites/locations impacted. Up to 5 different habitat types or sites can be selected. **Explanation** When the affected biodiversity value constitutes a broad habitat type (e.g. native forest) there may be different habitat types that are impacted. For example, the biodiversity type 'native forest' may include pūriri forest, kānuka forest, and kauri forest. Each of these specific habitat types will likely require different impact contingencies and have different ecological value scores and should therefore be considered separately. When an affected biodiversity value includes a specific habitat type that is impacted at different sites or locations, considering these as separate may be warranted if the ecological value or the type of impacts differ across sites or locations. For example, a project may have different types and magnitude of impacts on a single 0.4 ha of kauri forest, (including 0.1 ha of total habitat loss through vegetation clearance and 0.3 ha of habitat degradation through edge effects and general disturbance associated with land use change). In this situation, the impacts on this kauri forest fragment could be separated out because the type and magnitude of effects differs. Equally though, the areas could be assessed as one, provided the impacts are appropriately captured in the assessment. If there are more than 5 habitat types or sites/locations impacted, a new BCM can be created, and the overall impact scores added.
Number of proposed	**Instruction**

compensation actions	Select from the drop-down menu the number of different compensation actions proposed. Up to 5 different compensation actions can be selected. **Explanation** Where compensation actions differ AND are undertaken in different locations or sites, or the spatial extent of the compensation action is different, then each action must be assessed independently. In some instances, different compensation actions in the same location can be lumped into a single compensation action (e.g. native revegetation and weed control), provided appropriate justification is given. Similarly, it may be appropriate to combine the same compensation action at different locations into a single compensation action, with appropriate explanation.
Net positive target	**Instruction** Manually type in the desired net positive target as a percentage, e.g., if the number 20 is typed, this will be converted to 20%. **Explanation** In general terms, the greater the assigned net positive outcome target, the greater the likelihood that net positive outcomes will be achieved. For compensation a net positive outcome target of 20% is considered by the authors to be generally appropriate. This equates to a 20% exceedance of No Net Loss, i.e. the Compensation Score is 20% higher than the Impact Score. However, the selected net positive outcome target will need to be justified and should be assigned on a case-by-case basis.
Habitat/site impacts	**Instruction** Manually type the name of the habitat(s) or site(s) impacted. The number of named habitat(s) or site(s) will need to match the number of proposed compensation actions specified above.
Impact risk contingency	**Instruction** Select from the drop-down menu: 1 = Negligible or low risk/ Negligible or low value (calculated impact score is multiplied by 1.0 (+0%)) 2 = Moderate risk/Moderate value (calculated impact score is multiplied by 1.05 (+5%)) 3 = High risk/High value (calculated impact score is multiplied by 1.1 (+10%)) 4 = Very high risk/Very high value (calculated impact score is multiplied by 1.2 (+20%)) **Explanation** The impact risk contingency addresses the increased likelihood that adverse effects will result in the permanent and irreplaceable loss of significant biodiversity values when impacting on habitats or species that are of higher

	ecological value. The assigned ecological value is based on the EcIAG ecological value assessment. The risk contingency percentage multiplier is commensurate with the EcIAG assigned ecological value with the multiplier assigned to each ecological value category based on testing under a range of scenarios[3]. For avoidance of doubt, the impact risk contingency relates to the biodiversity type. For example: If the model biodiversity type is 'long-tailed bat' then the impact risk contingency relates to the assigned ecological value for long-tailed bat and would therefore be the same across the different long-tailed bat habitat types that are impacted and included in the model (e.g. pasture versus shelterbelts, versus mature forest). If the model biodiversity type is a broad habitat type, e.g. 'native forest', and the impacts relate to more specific habitat types that differ in their ecological value, then the impact risk contingency for each habitat type will be different (e.g. kauri forest versus young regenerating kānuka forest).
Impact uncertainty contingency	**Instruction** Select from the drop-down menu: 1 = Low uncertainty (calculated impact score is multiplied by 1.05 (+5%)) 2 = Moderate uncertainty (calculated impact score is multiplied by 1.1 (+10%)) 3 = High uncertainty (calculated impact score is multiplied by 1.2 (+20%)) 4 = Very high uncertainty (the model will not work if this option is selected) **Explanation** By providing for a greater margin of error, the impact uncertainty contingency addresses the increased risk of permanent or irreplaceable biodiversity loss when impacting on more complex habitats, or on species for which there is less information regarding species-specific impacts associated with an effect. The rationale for category selection will need to be justified on ecological grounds. Where very high uncertainty exists in relation to adverse effects, this constitutes a limit to the use of the BCM model; project redesign or avoidance of effects should instead be considered. The percentage multipliers used for the impact uncertainty contingency levels have been assigned based on testing different multipliers under a range of scenarios.[4]

[3] In general terms, the application of higher percentage multipliers was difficult to justify and generated predicted Net Loss outcomes when the converse would be expected. Similarly, the use of lower multipliers undermined confidence that predicted Net Gain model outputs would be achieved.
[4] In general terms, the application of higher percentage multipliers for each level of uncertainty category was difficult to justify and generated predicted Net Loss outcomes when the converse would be expected. Similarly, the use of lower percentage multipliers for each level of uncertainty category undermined confidence that predicted Net Gain model outputs would be achieved.

Areal extent of impact (ha)	**Instruction** Manually type in the areal extent of impact in hectares with respect to the value being considered (incorporating both direct and indirect effects). **Explanation** If there is more than one habitat type or more than one site of the same habitat type, then impact (ha) will relate to that specific habitat or site. However, the total habitat loss (ha) will be automatically summed and factored into the impact score calculations.
Value prior to impact	**Instruction** Manually type in a numerical score between 0 and 5 that relates to the value score prior to impact relative to the benchmark value score of 5. **Explanation** The assigned value score in all instances must relate explicitly to the biodiversity type that the model relates to. Adequate detail must be provided to justify the assigned ecological value score based on desktop and field investigations. This enables an understanding of the adequacy and certainty surrounding the assessment and should include an explanation of why the value score was neither higher nor lower. **Habitat value scores:** For habitats, the ecological value prior to impact relates to the representativeness, rarity and distinctiveness, diversity and pattern, and ecological context associated with the habitats/vegetation types within a project footprint as assessed against the benchmark. Refer to Section 5.2 and Table 4 of the Ecological Impact Assessment Guidelines (EcIAG, Roper-Lindsay *et al.* 2018), the detail of which would be provided in the Assessment of Ecological Effects report for the Project. In broad terms: < 1 = Negligible 1 - <2 = Low 2 - <3 = Moderate 3 - <4 = High 4 - <5 = Very High 5 = Benchmark NB: In some instances, consideration of loss of 'potential value' may be required for impact values (e.g. for natural inland wetlands under the National Policy Statement for Freshwater Management 2020 (NPS FM)). This should be considered in the context of the value affected and the potential value if it were restored (using best practice, reasonable efforts). Ensure that the reporting

	outputs are clear as to whether the 'existing' or 'potential' values were used to quantify the compensation measures. The EcIAG (Roper-Lindsay *et al.* 2018) assessment of ecological value does not assess the contribution that a particular habitat type may make to ecological functioning or the provision of ecosystem services. We recommend that these factors are also considered when assessing the value of impacted habitats. **Species or species assemblage value scores:** The EcIAG (Roper-Lindsay *et al.* 2018) does not include criteria for determining habitat suitability for a given species. Since habitat suitability is a key component of a magnitude of effects assessment, this will ideally be addressed in subsequent versions of the EcIAG. In the interim we set out proposed criteria below: 0 = Habitat not suitable. < 1 = Marginal habitat that may be used but is not important for any part of the species or species assemblage life-cycle(s). 1 - <2 = Relatively low value habitat that provides some but not all of a species or species assemblages life-history requirements and/or the habitat is of low quality and the relative abundance within the habitat is low compared to other habitat types. 2 - <3 = Relatively moderate value habitat that provides for most, if not all, of a species or species assemblage's life-history requirements and/or the habitat quality is of moderate quality and the relative abundance within the habitat is moderate compared to other habitat types. 3 - <4 = Relatively high value habitat that would typically provide for all species or species assemblage life-history requirements and/or provides a critical resource or resource(s) for life-history requirements. The habitat quality is high and the relative abundance within the habitat is, or is likely to be, high compared to other habitat types. 4 - <5 = Relatively very high value habitat that provides for all species or species assemblage life-history requirements and/or provides a critical resource or resource(s) needed for life-history requirements. The habitat quality is very high and the relative abundance within the habitat is or is likely to be very high compared to other habitat types. Likely to be a local hotspot for that species. 5 = Highest quality habitat and/or relative abundance for a given species or species assemblage, likely to be a regional hotspot or benchmark with the species or species assemblage at carrying capacity. As with habitat scores, adequate detail must be included from desktop and field investigations to provide transparent justification for each value score. The reader needs to understand the adequacy and certainty surrounding the assessment and requires an explanation of why the score was neither higher nor lower. The model assumes a static rather than temporally dynamic biodiversity baseline at the impact site. The predicted NNL/NG outcome is therefore relative to pre-impact values.

	In instances where population densities or relative abundance appear higher in seemingly less suitable habitats than in more suitable habitats, this will need to be addressed and reflected in the relative value scores.
Value after impact	**Instruction** Manually type in a numerical score between 0 and 5 that relates to the value score after the impact relative to the benchmark value score of 5. **Explanation** The explanation for determining the habitat or species scores after impact is the same as the method for determining these scores prior to impact except that the assessment value score relates to the impact site after the impact has occurred. NB: The drop in ecological value relates to the magnitude of impact based on the EcIAG, which is a function of the extent, intensity, frequency and permanence of the impact. It is important to factor in all types of impacts associated with the project which may range from earthworks, vegetation and sedimentation to increased exposure to artificial lighting or noise, or domestic mammalian predators. The model does not accept a value score of 0 as the formula will not work, but it does allow for a score of 0.001 (virtually zero).
Compensation action(s)	**Instruction** Manually enter the compensation action proposed. The number of different compensation measures (habitat(s) or site(s)) will need to match the number of proposed compensation actions specified above. **Explanation** The compensation action relates to each type of habitat creation, restoration, or enhancement activity that is proposed, e.g., native revegetation into existing pasture and/or weed and mammalian pest control in existing forest. As long as it is explained, it is appropriate to lump different compensation types where they are applied as a total package within a particular habitat or site (e.g. bush retirement coupled with weed control and mammalian pest control).
Discount rate	**Instruction** Manually enter a discount rate. **Explanation** The discount rate addresses the temporal time lag between the impact occurring and the biodiversity gains being generated by the conservation action(s). A discount rate of 3% is recommended. This is the same as the discount rate recommended in the BOAM user guide (Maseyk *et al.* 2015), which is informed by research in Gibbons *et al.* 2015. That said, we note that a discount rate of 3% rewards benefits that deliver faster than those that take longer but provide

	greater ecological outcomes in the longer term, i.e. it punishes the tortoise and rewards the hare). For example, revegetation may deliver greater biodiversity gains in the long term for habitats than mammalian pest control, but all else being equal, a discount rate of 3% will favour mammalian pest control over revegetation because gains would be predicted to occur almost immediately after commencement of pest control operations.
Finite end-point	**Instruction** Manually enter the number of years between impact and assessment of biodiversity gain at the compensation site(s) resulting from compensation actions. **Explanation** The finite end-point is the time period (years) over which to calculate NPBV. This equates to the time between the commencement of proposed compensation action(s) and an assessment of the associated benefits for the affected biodiversity value (e.g. native revegetation at 20 years). For pest control this time period would be short because biodiversity gains occur almost immediately after commencement of pest control operations. However, these biodiversity gains will diminish once the pest control is terminated, and this needs to be addressed when applying the model. The finite end-point should generally be tied to the duration of the biodiversity management and monitoring programmes that are used to verify that the benefits at compensation sites have been achieved. For instance, if the finite end point is set at 10 years from commencement of compensation, then the biodiversity management and monitoring programme should be undertaken for 10 years (but possibly longer if predicted biodiversity gains are not achieved and adaptive management or contingency measures are required).
Compensation confidence contingency	**Instruction** Select from the drop-down menu: 1 = Very high confidence (>90%) 2 = High confidence (75%-90%) 3 = Moderate confidence (50-75%) 4 = Low confidence (< 50%) (The model will not work if this option is selected). **Explanation** The approach used to assign compensation confidence contingency is aligned with the approached used in Maseyk *et al.* (2015) except that the term 'offset' has been changed to 'compensation'. The compensation confidence contingency relates to the level of confidence in the likely success of the proposed compensation measures and methodology (see above). This reflects that even well-established management methods sometimes fail to achieve targets for a multitude of reasons. The model does not

	consider confidence in the implementer of the proposed compensation. Nor does it consider likelihood of abandonment of the project post-impact but prior to the implementation of compensation actions. Very high confidence: The proposed compensation measure uses methods that are well tested and repeatedly proven to achieve intended biodiversity gains; evidence-based expert opinion is that success is very likely. Likelihood of success is > 90%. Calculated biodiversity gain is multiplied by 0.925. High confidence: The proposed compensation measure uses methods that are well known, often implemented, and which have been proven to succeed greater than 75% of the time. However, complicating factors and/or expert opinion precludes greater confidence in this compensation measure. Likelihood of success is greater than 75% but less than 90%. Calculated biodiversity gain is multiplied by 0.825. Moderate confidence: The proposed compensation measure uses methods that have either been successfully implemented in New Zealand or in the situation and context relevant to the compensation site but infrequently, or the outcomes of the proposed compensation measures are not well proven or documented, or success rates elsewhere have been shown to be variable. Likelihood of success is > 50% but < 75%. Calculated biodiversity gain is multiplied by 0.625. Low confidence: Should not use the compensation measure and the model will not work if this option is selected on the basis that uncertainty is too high.
Areal extent (ha) of compensation action	**Instruction** Manually enter the areal extent (ha) of the proposed compensation action.
Value score prior to compensation action	**Instruction** Manually type in a numerical value score between 0 and 5 that relates to the value score at the compensation site(s) prior to implementation of compensation action(s). **Explanation** Adequate detail must be provided to justify the assigned ecological value score based on desktop and field investigations and assessed using EcIAG (Roper-Lindsay *et al.* 2018 or an updated version). This enables an understanding of the adequacy and certainty surrounding the assessment and should include an explanation of why the value score prior to the implementation of the compensation action(s) was neither higher nor lower. The EcIAG (Roper-Lindsay *et al.* 2018) assessment of ecological value does not include an assessment of value in relation to ecological functioning or the provision of ecosystem services. We recommend that these factors are also considered when assessing the habitat value associated with a compensation action(s).

	Note that the model does not accept a value score of 0 as the formula will not work, but it does allow for a score of 0.001 (virtually 0).
	Instruction Manually type in a numerical value score between 0 and 5 that relates to the value score at the compensation site(s) after implementation of compensation action(s) as assessed at the finite end point (years). **Explanation** Adequate detail must be provided to justify the assigned ecological value score after implementation of compensation actions based on desktop and field investigations and assessed using EcIAG (Roper-Lindsay *et al.* 2018 or an updated version). This enables an understanding of the adequacy and certainty surrounding the assessment and should include an explanation of why the compensation value score after implementation of the compensation action(s) was neither higher nor lower. The EcIAG (Roper-Lindsay *et al.* 2018) assessment of ecological value does not include an assessment of value in relation to ecological functioning or the provision of ecosystem services. We recommend that these factors are also considered when assessing the habitat value associated with a compensation action(s).

APPENDIX E: AQUATIC RESIDUAL EFFECTS

Memorandum

Bioresearches
A Babbage Company

To:	**WSP**	**Date:**	12 August 2024
Attention:	Joshua Gericke / Mark Yungnickel	**Ref:**	67045
Subject:	**Brynderwyns Potential Aquatic Offset**		

Introduction – Residual Effects Management for Stream and Wetlands

The State Highway 1 improvements over the Brynderwyn Hill have resulted in residual adverse effects i.e. more than minimal effects, on aquatic habitats that could not be reasonably avoided, minimised, remedied or mitigated (in accordance with the RMA and with the effects management hierarchy).

This memorandum provides an outline of the process for addressing 'more than minimal' residual adverse effects on aquatic habitat of the site works.

The aquatic ecological values and impacts of the works on those values is assessed and detailed in the Ecological Impact Assessment Report (EcIA) (WSP, 2024[1]).

The loss/modification (loss) of the stream habitats within the works footprint are assessed as residual adverse effects, and their impacts are required to be offset, or if unable to be offset, then compensated.

The extent of permanent stream loss through fill sites and culvert extensions is approximately 322 linear metres, equating to 117 m² of stream bed loss (refer to EcIA Appendix C17).

Stream ecological valuation (SEV) assessments were carried out on streams in the works areas, prior to the works commencing. A summary of the stream valuations; magnitude and level of impact (in accordance with the EIANZ Ecological Impact Assessment Guidelines) (Roper-Lindsay et al, 2018); the SEV scores prior to works; SEV scores 'potential' prior to works; and impact of the proposed works is presented as Table 1 and **Error! Reference source not found.**.

Table 1. Brynderwyn Stream ecological valuations and permanent habitat loss or modification. (EcIA, WSP (2024)).

Stream number	Classification Type	SEV 'current'	SEV 'potential'	Impact type	SEV 'Impact'
A Upstream (Filll Site A)	Intermittent	0.77	0.77	Reclamation	0
B1 Upstream (Fill Site B)	Intermittent	0.38	0.60	Reclamation	0
D1 Upstream	Intermittent	0.76△	0.76	Culvert extension	0.2
D2 Upstream	Permanent	0.87	0.87	Culvert extension	0.2
F1 Upstream	Permanent	0.76	0.76	Culvert extension	0.2
G2 Upstream	Permanent	0.89	0.89	Culvert extension	0.2

[1] WSP (2024). Brynderwyn Hills Recovery Project. Ecological Impact Assessment. Report New Zealand Transport Agency - Waka Kotahi

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Website: www.Bioresearches.co.nz

H1 Upstream	Permanent	0.87	0.87	Culvert extension	0.2
H2 Upstream	Intermittent	0.87△	0.87	Culvert extension	0.2
H Downstream	Permanent	0.92	0.92	Culvert extension	0.2
J Upstream	Permanent	0.93	0.93	Culvert extension	0.2

△ no SEV obtained from site so SEV was assumed based on an SEV from another similar site (A Upstream: F1 Upstream; D1 Upstream: D2 Upstream; H2 Upstream: H1 Upstream)

Table 2. Extent of permanent stream loss or modification (From EcIA, Table C17).

Stream number / name	Approximate extent of length affected (m)	Average wetted width (m)	Area (m^2)
A Upstream (Filll Site A)	100	0.4	40.0
B1 Upstream (Fill Site B)	117	0.25	29.3
D1 Upstream	15.3	0.31	4.7
D2 Upstream	9	0.75	6.8
F1 Upstream	20.8	0.24	5.0
G2 Upstream	3.6	0.76	2.7
H1 Upstream	8	0.55	4.4
H2 Upstream	36.7	0.3	11.0
J Upstream	11.5	1.1	12.7
Total	**322**	-	**117**
Mitigation of sediment effects			
H Downstream	160	1.1	176

Principles of Aquatic Offsetting

The loss/modification of the 322 m of streams to the State Highway 1 improvement works over the Brynderwyn Hills are:

- 'more than minimal' residual adverse effects;
- a Moderate Level of effect under the EcIA guidelines (Roper-Lindsay *et al*., 2018); and
- would require aquatic offset or aquatic compensation.

Guidance on, and the principles for, good practice aquatic biodiversity offsetting or compensation is provided by the Ministry for the Environment (2014), and in Appendix 6 and 7 of the National Policy Statement for Freshwater Management (NPS-FM; MfE, 2023) and have been applied in this assessment. The NPS-FM requires that the applicant has complied with Offset / Compensation principles 1 to 6, and has regard to the remaining principles, as appropriate.

Stream Loss Offset - Environmental Compensation Ratio (ECR) Methodology

Storey *et al.* (2011) provides the Stream Ecological Valuation (SEV) methodology combined with the calculation of the Environmental Compensation Ratio (ECR) for stream offset. It is a transparent, well-recognised methodology for calculating the quantum of offset required for stream loss. Although the methodology was originally developed in Auckland, it has been reviewed by NIWA for use in Wellington,

Hawke's Bay and Southland, and is considered applicable without modification to most stream and river types in those regions (Storey *et al.,* 2011).

The SEV methodology (Storey *et al.,* 2011) enables the overall function of the streams to be assessed and compared to the quality of other streams in the region. The SEV procedure involves the collection of habitat data (e.g. stream depth, substrate type, riparian cover), and sampling of fish communities and macroinvertebrates (e.g. insect larvae, snails), the latter being recognised indicators of habitat quality. SEV data are then entered into a SEV calculator to calculate an averaged SEV value.

For permanent and intermittent streams, SEV scores can be utilised to calculate environmental compensation (stream offset) for loss or modification to natural stream habitat by using the Environmental Compensation Ratio (ECR; Storey *et al.*, 2011). The ECR considers the SEV values of both the affected or impacted stream/s and the proposed restoration site stream/s, and determines any differential between the scores to provide a ratio for offset which will result in "no net loss of area weighted stream function" (Storey *et al*., 2011). The SEV score used in the ECR calculation does not include two biotic functions relating to fish and macroinvertebrates due to the difficulty of predicting changes to these communities (Storey *et al*., 2011).

The ECR equation is calculated as follows:

$$ECR = [(SEVi\text{-}P – SEVi\text{-}I) / (SEVm\text{-}P – SEVm\text{-}C)] \times 1.5$$

Where:

- SEVi-P and SEVi-I are the potential SEV value and SEV value after impact, respectively, for the site to be impacted.
- SEVm-C and SEVm-P are the current and potential SEV values, respectively, for the site where the environmental compensation (offset) works are to be applied.
- 1.5 is a multiplier that allows for the delay in achieving offset benefits.

The ECR calculations are, unavoidably, carried out using a number of assumptions. The 'Potential' SEV scores are calculated by altering parameter scores assuming best practice riparian restoration of the stream has taken place and is well established to a level providing at least 70% shade to the stream bed.

For the streams within the project area that have full shading riparian cover, no additional 'potential' will be added to the SEV score. Calculation of the 'Potential' score for the impact sites has assumed native riparian restoration of a 20m margin (10m either side of the watercourse). Calculation of the 'Impact' SEV scores assumes an outcome as proposed, with the section of the stream either being completely lost to the works (reclamation) so the SEV 'impact' is set as zero, or modification but not complete loss (culvert extensions) resulting in function loss, so the SEV 'impact' is set at the anticipated reduced function.

Following calculation of the ECR, the area of stream impacted (based on length and width of the stream) is multiplied by this value to determine the stream area required for remediation works. If the ECR calculations result in less offset length than the length lost, additional length will be added to the offset to achieve a minimum of 1:1 length, as per the methodology.

A detailed restoration planting plan and weed management plan will need to be prepared for the stream riparian site by a qualified plant ecologist to ensure good quality native habitat is created. A minimum of

a five-year defects and maintenance contract would be required for the restoration planting to ensure vegetative cover is achieved, weed control is maintained and to ensure the proposed offset is achieved over the medium term.

Stream offset site

No landowner agreements have been reached, but the proposed stream offset site for the stream loss is the Piroa Stream (Photo 2 and Photo 2).

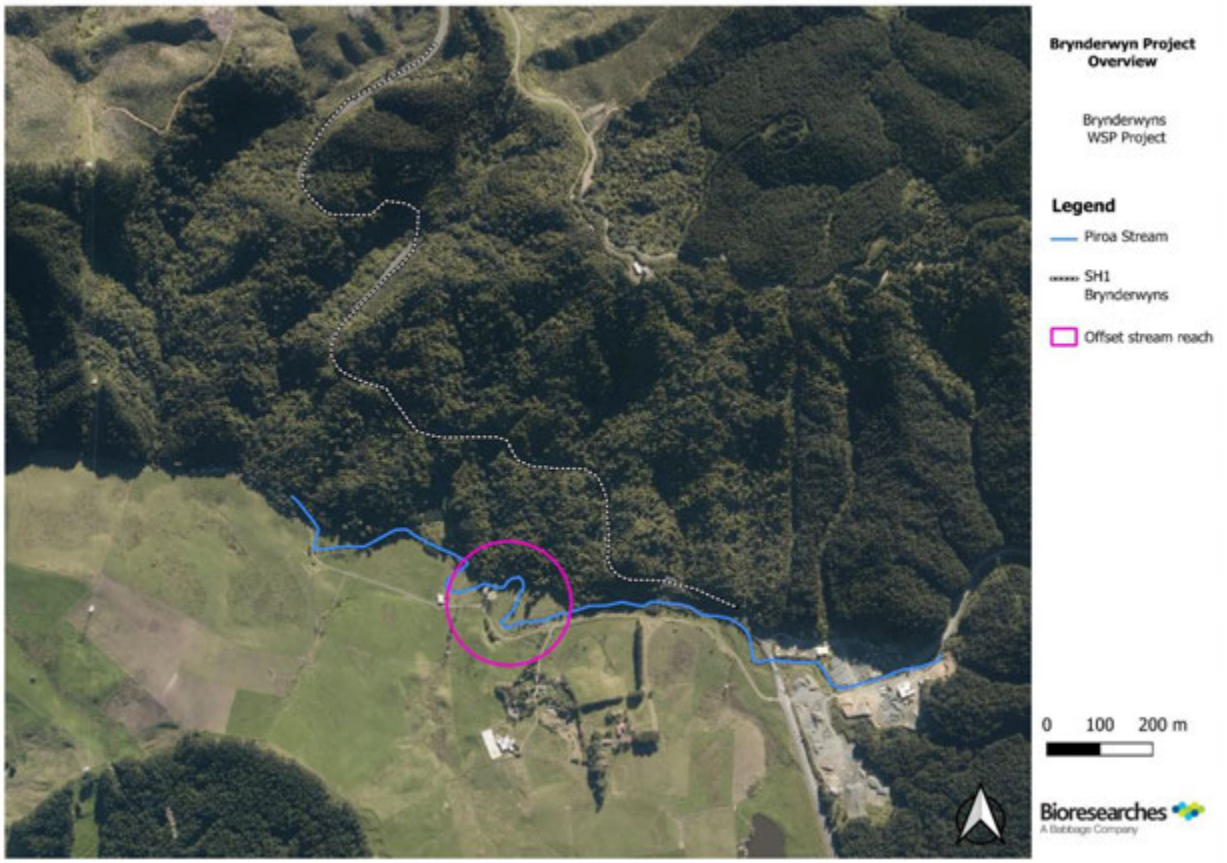

Figure 1. Piroa Stream proposed offset site and SH1 Brynderwyn Hills.

Photo 1. Piroa Stream proposed offset site.

Photo 2. Piroa Stream proposed offset site, located at the base of the Brynderwyn Hills (background).

A desktop survey was undertaken to locate headwater streams within close proximity to the works site that would be suitable for stream offset. Almost all of the surrounding catchment was native bush or commercial forestry (at various stages of development and harvest), and no offset streams were located, and therefore alternative streams in close proximity to the impact site were assessed for suitability for stream offset.

The Piroa Stream is located immediately downstream of the project site, and all of the project streams drain to the Piroa Stream. The Piroa Stream flows from the Atlas Quarry catchment, under SH1 and then through farmland along the western foot of the Brynderwyn Hills. The stream is a permanent stream and wider than the streams lost/modified to the SH1 works. However, given the current lack of vegetated riparian vegetation within the current stream, the proximity of the offset stream, the connection to the impact streams and their riparian zones, and that it is the immediate receiving environment of the impact streams makes it a suitable offset site.

The northern side of the Piroa Stream is Crown Land but the southern side of the Piroa Stream is under private ownership. No agreements have been reached with the landowner for this proposed offset site site, and although this site is highly recommended, it is indicative only, and subject to engagement with the landowner.

The Piroa Stream within the SEV reach was assumed to be approximately an average of 1.9m wide and 0.3m deep, with incised banks, and a riparian zone dominated by pasture, with areas of pampas. Occasional patches of mature trees were present within the wider riparian zone, but shading to the stream was very low. The substrate was dominated by cobbles and gravels with areas of silt. The current SEV of the Piroa Stream within the farm was 0.43, and with the restoration of the riparian zone, and reaching a potential SEV score of 0.69.

The exposure draft document for the National Policy Statement for Freshwater Management (NPS-FM) (MfE, 2023) sets out eleven principles that underpin the concept of aquatic biodiversity offsetting. These principles are identified in Table 3 with a brief explanation of how the proposed aquatic habitat offset for the Brynderwyn works will satisfy them.

Table 3. Principles of aquatic biodiversity offsetting and how these will be achieved for Brynderwyn SH1 improvement stream loss and the Piroa Stream Offset Site.

	Brynderwyns Site
1. Adherence to effects management hierarchy	Assessments prior to offset using the Ecological Impact Assessment Guidelines (EcIAG) for use in New Zealand, published by EIANZ (Roper-Lindsay *et al*. 2018). Avoidance / minimisation of ecological effects through design has been proposed wherever this has been practicable /possible. Redesign and avoidance of stream loss by minimising the length of the culvert extensions. Minimisation of ecological effects through native fish recovery and relocation; where more than minor residual adverse effects cannot be avoided, minimised, or remedied, aquatic offsetting is provided

2. When aquatic offsetting is not appropriate	Offset can achieve the conservation outcomes specified in the NPS-FM. Specifically, there is no net loss of irreplaceable habitat; there is adequate certainty about the success of the proposed offset measures; and it is the most technically feasible option to address the residual effects after application of the initial steps of the effects management hierarchy.
3. No net loss and preferably a net gain	Like-for-like with streams offset by streams. Permanent and intermittent stream lengths are to be offset with permanent streams, which provide stream habitat values (connection; macroinvertebrates; fish habitat) throughout the year. Accounting using the SEV and ECR methodology for stream loss/modification, provides for no net loss.
4. Additionality	There are no current or future plans to undertake any of the proposed revegetation and restoration actions on the Piroa Stream. Replacement plantings will be protected where they currently have no protections.
5. Leakage	The aquatic offset will avoid displacing harm to this location, and will ensure that potential harm to existing biodiversity will be mitigated and temporary.
6. Long term outcomes	Offsets will comprise revegetation along both sides of the stream bank where possible, linking back to the same stream systems that have been impacted and connecting existing riparian vegetation downstream of the offset site. It is recommended that legal protection of offset sites, such as with a covenant or encumbrance, occurs. Verification is needed that stream restoration is functioning as an offset e.g. planting is successful and achieves the gains expected.
7. Landscape context	The offset will occur within 150 - 900 m of the impact sites, and in a hydrologically connected area i.e. immediately downstream of the impact streams, all draining to the same catchment and receiving environment. All restoration actions should be legally protected in perpetuity (e.g. encumbrance or covenant), and monitored for a minimum 5 years to ensure offset targets are achieved. The riparian restoration planting will link to wetland areas and forested areas, and will link the new riparian areas and to adjacent high value habitats.
8. Time lags	The planting and restoration activities will likely be established a year after most of the loss. Even so, the SEV/ECR model has a time lag component incorporated within the methodology, providing a 1.5 multiplier to account for the time delay between the stream loss and the development of the riparian vegetation at the offset site.
9. Science and mātauranga Māori	The design of the biodiversity offset will be based on established and proven methods for vegetation management and restoration. The biodiversity offset will provide careful consideration for opportunities for maximising ecological outcomes as well as providing for interests of the land owners and NZTA stakeholders, including tangata whenua.
10. Tangata whenua or Stakeholder participation	NZTA is active with community engagement, has long-term relationships that are built on dialogue and collaboration. The project to date has included consultation with local iwi, who have been an integral part of the ecological work on the site.

11. Transparency	Accounting using the SEV and ECR methodology for stream loss/modification, as recommended as good practice, as well as the EIANZ guidelines for assigning ecological values. Calculations and summary tables are provided in this report. Site-specific planting plans for the stream habitats are proposed to be developed, success monitoring of the restoration activities is recommended; and regular maintenance and monitoring reports will be provided to Council and (where appropriate) other stakeholders.

Table 4. Proposed Piroa Stream offset site SEV current and potential values.

Stream number	SEV 'current'	SEV 'potential'	Stream Width (m)
Piroa - Farm	0.43	0.69	1.9

The ECR calculations are presented as a rolling calculation table in Appendix B, and in summary as Table 5. Biodiversity gains at the offset site would be achieved through the enhancement and restoration of the existing habitat to improve its condition and by fencing the area from stock. The restoration of the Piroa Stream will include planting of a 10 m riparian zone on each bank, or infill planting where existing native vegetation is present, and fencing on the true left bank. The restoration planting will provide aquatic ecological benefits by replacing pasture grass and/or weed species with native shrubs and trees in the riparian zone (providing temperature control and reduction of nuisance growth of aquatic vegetation through shading); woody debris in the stream (increasing habitat and refuges for invertebrates and fish); stabilisation of channel banks and channel shape; and reduction of nutrient and sediment inputs into the stream.

Table 5. Impact Stream Environmental Compensation Ratio for offset on the Piroa Stream in the farm.

Stream number	ECR
A Upstream (Filll Site A)	4.85
B1 Upstream (Fill Site B)	3.46
D1 Upstream	3.63
D2 Upstream	3.12
F1 Upstream	2.42
G2 Upstream	3.58
H1 Upstream	3.92
H2 Upstream	3.69
J Upstream	5.08

The quantum of offset for the stream loss to the SH1 improvement works, using the SEV/ECR methodology and enhancement of restoration of the riparian zone of the Piroa Stream is 322 m, equating to 612 m² of bed area (Figure 2). Although the quantum of bed area offset is achieved on 251 m of the Piroa Stream,

the SEV/ECR methodology requires that minimum stream length offset is equivalent to the stream length lost. This results in a 1: 1 ratio for stream length at this site, as required by the SEV methodology, but provides a 1 : 5.3 gain for stream bed area, resulting in a Net biodiversity gain.

The restoration of the degraded stream habitats, immediately downstream and adjacent to the Brynderwyns works area will provide positive aquatic ecological benefits, habitat creation, biodiversity gains and restore riparian connectivity between the part of the Piroa Stream to the Brynderwyn Hills and the downstream catchments of the impact streams. The wording around the sediment offset - needs to be pulled back to recommended, but outside of scope of current consenting requirements. And the location for this is 'indicative' and if this site is deemed unsuitable/land owner access unobtainable then a comparable site will be determined.

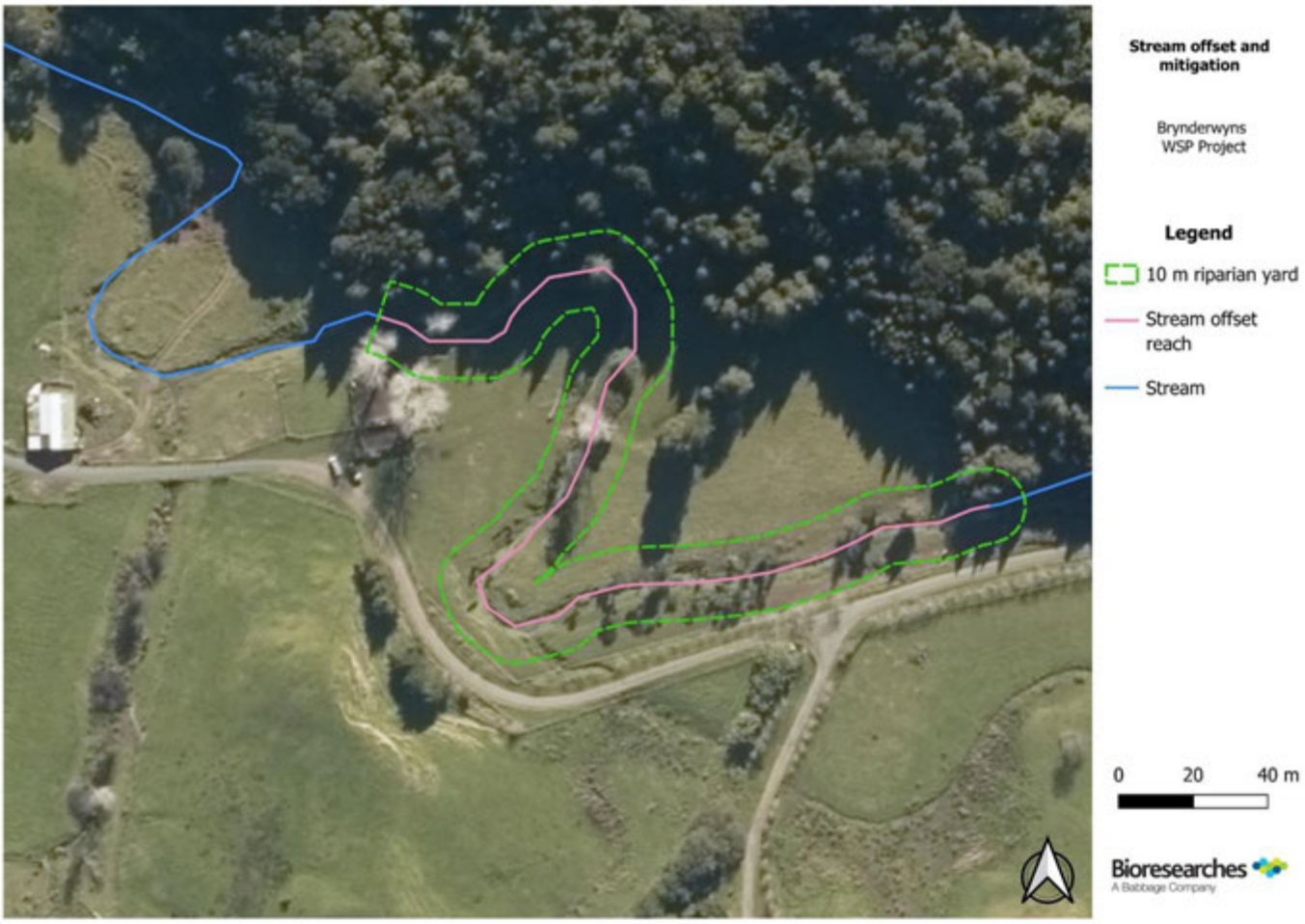

Figure 2. Indicative Area for Proposed Stream Offset (332m) on the Piroa Stream (subject to landowner engagement).

Summary

The SH1 works on the Brynderwyn Hills will result in the loss/modification of 322m of stream length. The loss or modification of these aquatic habitats was assessed by the high-level Ecological Impact Assessment (WSP, 2024) as requiring offset or compensation for their loss.

A suitable offset site is present on the Piroa Stream, immediately downstream of the impact area. Although the northern side of the recommended offset site stream is under Crown ownership, the southern side is under private ownership, and therefore the offset proposal is subject to engagement with the landowner.

The SEV/ECR methodology was used to determine the quantum of offset required to demonstrate no net loss and preferably a net gain in biodiversity, for the stream loss, at the proposed Piroa Stream site.

The stream loss would be offset by enhancing and restoring the riparian area on 330 m of the Piroa Stream, a length equating to the stream length lost to permanent works. The application of the SEV/ECR methodology shows a 1:1 loss to offset ratio for stream length, as required by the methodology, but a 1: 5.2 ratio for stream bed area, resulting in a net gain.

Regards

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REFERENCES

Ministry for the Environment (2014) Guidance on Good Practice Biodiversity Offsetting in New Zealand. Ministry for the Environment. August 2014. 44pp.

Ministry for the Environment (2023). National Policy Statement for Freshwater Management 2020, amended 2023. Available from https://environment.govt.nz/assets/publications/National-Policy-Statement-for-Freshwater-Management-2020.pdf

Roper-Lindsay, J., Fuller S.A., Hooson, S., Sanders, M.D., Ussher, G.T. (2018). Ecological impact assessment. EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd edition. Environmental Institute of Australia and New Zealand: Melbourne, Australia. Available from https://www.eianz.org/document/item/4447

Storey, R. G., Neale, M.W., Rowe, D.K., Collier, K.J., Hatton, C., Joy, M.K., Maxted, J.R., Moore, S., Parkyn, S.M., Phillips, N., Quinn, J.M., (2011). Stream Ecological Valuation (SEV): a method for assessing the ecological function of Auckland streams. *Auckland Council Technical Report 2011/009*. 66p.

Appendix A. SEV potential assumptions table.

		Potential SEV Score – Assumptions
	Impact Streams	Off-set Stream
Function and Variable		
Hydraulic		
Vchann	No change.	Some naturalisation with increase in roughness, no instream structure resulting in ponding, and provision of riparian vegetation.
Vlining	No change.	Some decrease in heavy load of silt, no artificial lining.
Vpipe	No change.	No change.
Vbank	No change.	No change.
Vrough	No change.	Changed to reflect riparian margins, with regenerating indigenous vegetation to 10m on both banks and fencing on the true left bank. Restoration of understory under mature trees.
Vbarr	No change.	No change.
Vchanshape	No data entry required.	No data entry required.
Biogeochemical	No change.	
Vshade	No change.	Increased to reflect change in riparian margins.
Vdod	No change.	Increase with stock restricted and reduction in macrophytes.
Vveloc	No change.	Reduction in stagnant areas with reduction in macrophytes.
Vdepth	No change.	No change.
Vripar	No change.	Changed to reflect riparian margins 10 m on each bank, but connecting to existing bush on the SH1 side of the stream in places.
Vdecid	No change.	No change, no deciduous
Vmacro	No change.	Reduction in macrophytes with increased shading
Vretain	No data entry required.	No data entry required.
Vsurf	No change.	Increase in leaf litter but reduction of macrophytes.
Vripfilt	No change.	Changed to reflect riparian margins.
Habitat provision	No change	
Vgalspwn	No change.	No change due to topography.
Vgalqual	No change.	Increase with shading.
Vgobspawn	No data entry required	No data entry required
Vphyshab	No change.	Increase in parameters associated with riparian planting.
Vwatqual	No change.	No change.
Vimperv	No change.	No change.
Biodiversity		
Vfish	Removed for ECR.	Removed for ECR.
Vmci	Removed for ECR.	Removed for ECR.
Vept	Removed for ECR.	Removed for ECR.
Vripcond	No data entry required.	No data entry required
Vinvert	Removed for ECR.	Removed for ECR.
Vripconn	No change.	Changed to reflect riparian margins.

Appendix B. Rolling ECR Table.

		Impact					Compensation/Offset							ECR		Compensated	Residual
Stream ID	Impact type	SEVi-P	SEVi-I	Length (m)	Average width (m)	Streambed area (m2)	Stream ID	Compensaton method *	SEVm-P	SEVm-C	Average width (m)	Length available (m)	Steambed area available (m2)	ECR	Strembed area compensation required (,m2)	Proportion of impact reach compendated	Compensation stream bed area still available (m2)
Site A (Filll Site A)	Reclamation	0.84	0	100	0.4	40.00	Piroa	Enhancement	0.69	0.43	1.9	322	*611.8*	4.85	193.85	3.16	418.0
B1 (Fill Site B)	Reclamation	0.6	0	117	0.25	29.25	Piroa	Enhancement	0.69	0.43	1.9		418.0	3.46	101.25	4.13	316.7
D1	Culvert extension	0.83	0.2	15.3	0.31	4.74	Piroa	Enhancement	0.69	0.43	1.9		316.7	3.63	17.24	18.37	299.5
D2	Culvert extension	0.74	0.2	9	0.75	6.75	Piroa	Enhancement	0.69	0.43	1.9		299.5	3.12	21.03	14.24	278.4
F1 Gully (formally C	Culvert extension	0.62	0.2	20.8	0.24	4.99	Piroa	Enhancement	0.69	0.43	1.9		278.4	2.42	12.10	23.02	266.3
G2 South	Culvert extension	0.82	0.2	3.6	0.76	2.74	Piroa	Enhancement	0.69	0.43	1.9		266.3	3.58	9.79	27.22	256.6
H (permanent)	Culvert extension	0.88	0.2	8	0.55	4.40	Piroa	Enhancement	0.69	0.43	1.9		256.6	3.92	17.26	14.86	239.3
H (intermittent)	Culvert extension	0.84	0.2	36.7	0.3	11.01	Piroa	Enhancement	0.69	0.43	1.9		239.3	3.69	40.65	5.89	198.6
J Gully	Culvert extension	0.88	0	11.5	1.1	12.65	Piroa	Enhancement	0.69	0.43	1.9		198.6	5.08	64.22	3.09	134.4
				322		**117**							71	m			
													322	**Total offset length**			

APPENDIX F: MANAGEMENT PLANS

New Zealand Transport Agency Waka Kotahi

BRYNDERWYN HILLS RECOVERY PROJECT

ECOLOGICAL MANAGEMENT PLAN SUITE

2 AUGUST 2024

CONFIDENTIAL

BRYNDERWYN HILLS RECOVERY PROJECT ECOLOGICAL MANAGEMENT PLAN SUITE

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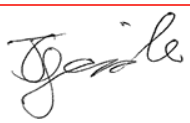
REV	DATE	DETAILS
2	15 Dec. 23	Reviewed
3	19 Dec. 23	Final

	NAME	DATE	SIGNATURE
Habitat Management Plan			
Prepared by:	Abbey Macredie	6/12/23	
Reviewed by:	Wayne Teal	6/12/23	
Approved by:	Friso Roest	8/12/23	
Bat Management Plan			
Prepared by:	Hannah Robinson	6/12/23	
Reviewed by:	Caitlin Dodunski	6/12/23	
Approved by:	Friso Roest	8/12/23	
AVIFAUNA MANAGEMENT PLAN			
Prepared by:	Caitlin Dodunski	6/12/23	
Reviewed by:	John Turner	6/12/23	
Approved by:	Friso Roest	8/12/23	
FRESHWATER MANAGEMENT PLAN			
Prepared by:	Micah Madsen	6/12/23	
Reviewed by:	Joshua Gericke	6/12/23	
Approved by:	Friso Roest	8/12/23	

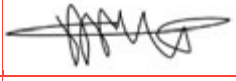
LIZARD MANAGEMENT PLAN			
Prepared by:	Andree Hickey-Elliott	8/12/23	
Reviewed by:	Matt Baber	8/12/23	
Approved by:	Friso Roest	8/12/23	
HOCHSTETTER'S MANAGEMENT PLAN			
Prepared by:	Josh Gericke	8/12/23	
Reviewed by:	Matt Baber	8/12/23	
Approved by:	Friso Roest	8/12/23	
INVERTEBRATE MANAGEMENT PLAN			
Prepared by:	Laura van Ginkel	7/12/2023	
Reviewed by:	Lisa Denmead	7/12/2023	
Approved by:	Friso Roest	8/12/2023	
BIOSECURITY MANAGEMENT PLAN			
Prepared by:	Wayne Teal	6/12/23	
Reviewed by:	Cindy Hempsall	6/12/23	
Approved by:	Friso Roest	7/12/2023	

Table of Contents

Acronyms and Glossary

SPECIFIC TERMS	
ACO	Artificial Cover Objects
AEE	Assessment of Environmental Effects
ARD	Automated Recording Device (DOC v4.0)
DBH	Diameter at Breast Height
DOC	Department of Conservation
ECR	Environmental Compensation Ratio
EcIA	Ecological Impact Assessment – 'Ecology Scoping Report' term in the OIC
EIANZ	The Environment Institute of Australia and New Zealand
ENVMP	Environmental Management Plan and any subplans
ESC	Erosion and Sediment Control
HFMP	Hochstetter's Frog Management Plan
HIMP	Habitat Impact Management Plan
LMP	Lizard Management Plan
MCM	Maintenance Contract Manager
MEP	Māori engagement plan
NRC	Northland Regional Council
NSMA	Natural Stream Management Area
NZTCS	National Threat Classification System
OIC	Severe Weather Emergency Recovery (NZTA New Zealand Transport Agency) Order 2023
PM	Project Manager
RMA	Resource Management Act 1991
SEA	Significant Ecological Area
SEV	Stream Ecological Valuation
SH1	State Highway 1
SQP	Suitable Qualified Professional
Territorial authorities	Whangarei District Council, Kaipara District Council & Northland Regional Council
VES	Visual Encounter Surveys

1 Introduction

1.1 Project Background

The portion of the State Highway 1 (SH1) between the Atlas Quarry and Artillery Road in the Brynderwyn Hills, Northland, New Zealand was severely damaged by slips and rock falls during Cyclone Gabrielle in February 2023. New Zealand Transport Agency Waka Kotahi (NZTA) undertook immediate emergency measures to clear, secure and reopen the road to traffic. These measures were temporary. The road remains vulnerable. NZTA has planned a series of interventions to stabilise and remove slips, reinstate the road to its pre-cyclone condition and to improve resilience beyond that point to reduce the likelihood of future unplanned closures and disruption.

As part of slip stabilisation, a variety of interventions are planned within the road corridor and immediate upper and lower slopes.

In order to carry out slip stabilisation it is proposed to widen SH1 to allow construction traffic to move up and down the works area outside of the live SH1 traffic lanes. This will be achieved by slope cutting along the majority of the affected portion of the road.

This process will produce a large volume of spoil. NZTA has selected fill sites alongside the road to allow soil from the northern portion of the site to remain within the northern portion of the works area. The same process has similarly occurred for the southern portion of the works area; fill areas have been selected primarily in areas that have been previously disturbed.

The usable fill areas are low-lying gullies and include small streams or overland flow paths. Freshwater management (and aquatic ecology) is a consideration at most of the fill sites (with the exception for Fill sites A and B where there are no watercourses).

WSP New Zealand Limited (WSP) and Fulton Hogan have been undertaking the required recovery and resilience work. Full details of the proposed Brynderwyn Hills Recovery work ("the Project") is included in the overarching application document that this suite of management plans is appended to. An overview of the project footprint is provided in Figure 1 (see section 1.2 below).

1.2 Project Location and Extent

The Project is located in the Brynderwyn Hills in Northland, New Zealand, approximately 80 km north of Auckland. The project footprint extends upslope along SH1 from the entrance to the Atlas quarry site at the southwestern extent to the intersection with Artillery Road at the top of Pilbrow Hill. The project site rises 162 m from 118 m to 280 m above mean sea level (amsl). An overview of the project footprint is included in Figure 1.

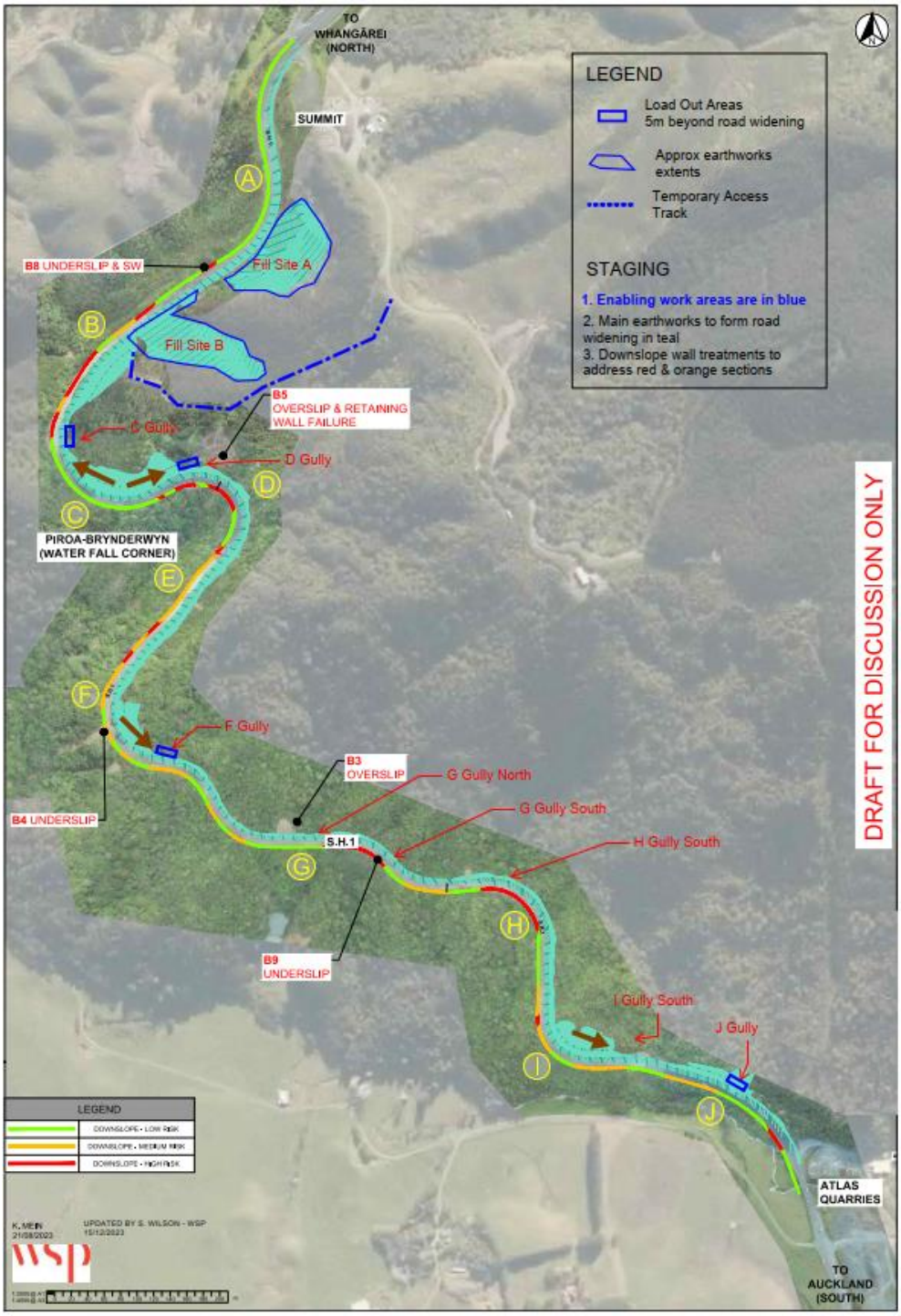


Figure 1 Overview of the project footprint

1.3 Purpose and Objectives

The Ecological Management Plans (EMPs) are intended for implementation prior to, during, and following completion of all physical work undertaken as part of the Project. The EMPs aim to set out measures to avoid and mitigate the actual and potential impacts on native wildlife associated with the proposed works.

The majority of the work falls within the portion of the SH1 to which the Severe Weather Emergency Recovery (Waka Kotahi New Zealand Transport Agency) Order 2023 (OIC) applies. The OIC alters the application of the Resources Management Act 1991 RMA), the Wildlife Act 1953 (WA) and other acts within areas specified within the OIC. All portions of the Project area have been included in this management plan, although separate application processes may apply.

These EMPs are required to manage effects on wildlife for the duration of site work. They are also required as part of the application for Wildlife Authority in terms of section 53 of the WA and under the provisions of the OIC.

The ecological sensitivities identified and addressed by each of the management plans are:

- Terrestrial Habitats
- Bats
- Avifauna
- Lizards
- Frogs
- Freshwater habitats and fauna
- Invertebrates
- Pathogens and biosecurity

The site is complex, and ecological surveys are ongoing for all sensitivities. Detailed design is also not yet complete for the Project. These EMPs have therefore been drafted conservatively, in line with the precautionary principle and the ecological principles set out in section 18(2) and clause 5(2) of Schedule 4 of the OIC. Going forward, they will be regularly updated as new information becomes available and will become more detailed over time. Further on-site adaptive management may be required, depending on site conditions, species encountered, or other unforeseen circumstances. Any changes to the Project, construction methodologies or timing of works that could impact any habitats or species will only be conducted with prior consultation and approval in writing by, the project ecologist.

Should new information arise that significantly changes the expected potential or actual magnitude of effects or the management approach in relation to indigenous wildlife and their habitats, DOC will be consulted to determine whether a formal amendment to the conditions of the Wildlife Authority will be required.

This EMP must be implemented in respect of all of the sensitivities outlined in the following management plans. It is important to note that there may be overlapping survey requirements for

different species that must all be undertaken and cleared of any risk, and all plans must be referred to for each stage of construction.

The plans have been prepared in accordance with Schedule 4 of the OIC and the conditions as specified in the OIC have all been incorporated into these Management Plans.

A summary of the information required in Management Plans as listed in Schedule 4 of the OIC, and where this information is captured in the Management Plans, are indicated in the table below. Condition 6(6) of schedule 4 notes that "a wildlife management plan must include measures to ensure compliance with clauses 8-12 (general conditions)" and these provisions are included in the table below.

Clause in Schedule 4 of the OIC		Section in the Management Plan addressing the matter
General Conditions		
8	Procedure for incidental discovery of significant wildlife	
	(1) The Agency must have a procedure for incidental discovery, including as of indigenous woody vegetation management, of significant wildlife not identified in the ecological scoping survey or the ecological effects assessment.	Accidental discovery protocols for are included in Sections 4, 5, 6, 7 and 8. Incidental discovery of bats is addressed by application of the DOC (2021) Protocols for minimising the risk of felling bat roosts (Bat Roost Protocols (BRP)) Version 2 (Appendix A)
	(2) The procedure for incidental discovery must include—	
	(a) immediately notifying the Department of Conservation of the discovery, and compliance with any advice given, or obligations imposed, by the Department; and	
	(b) appointment of a suitably qualified and experienced expert approved by the Department of Conservation to develop a management plan for the discovered species, if required by the Department; and	
	(c) an application for authority or consent in respect of the species, if applicable.	
9	Salvage, capture, handling, and relocation of native lizards and frogs, and at-risk or threatened invertebrates	
	(1) The Agency may only release a native lizard or frog, and an at-risk or threatened species of invertebrate, into a release site—	Addressed in subsections 4.3.2, 5.2.2 and 8.2.2.
	(a) of similar or better habitat than the source location, and capable of supporting that lizard, frog, or invertebrate; and	
	(b) that is within 500 m of the project footprint (or other release sites if approved by the Department of Conservation); and	
	(c) where the habitat for that lizard, frog, or invertebrate has been enhanced and approved by the Department of Conservation before relocation.	
	(2) The Agency must ensure that salvage, capture, handling, and relocation of native lizards and frogs, and at-risk or threatened species of invertebrates, is undertaken in a manner and at a time determined to be appropriate by suitably qualified and experienced experts.	Addressed in subsections 4.3.1, 5.2.1 and 8.2.1.

Clause in Schedule 4 of the OIC		Section in the Management Plan addressing the matter
	(3) The Agency must ensure (except where the native lizard or frog, or at-risk or threatened species of invertebrate, is identified under the incidental discovery protocol) that the suitably qualified and experienced experts referred to in subclause (2) are at the on-site induction before construction work commences.	Addressed in subsections 4.2, 5.2 and 8.2
10	Salvage, capture, handling, and relocation of native lizards and frogs, and at-risk or threatened invertebrates	
	Salvage reporting for lizards, frogs, and invertebrates relocated under clause 9	
	(1) The Agency must submit to the Department of Conservation each year for the duration of the project, a salvage report for any lizards, frogs, and invertebrates that are relocated under clause 9.	Addressed in subsections 4.5, 5.5 and 8.3
	(2) The salvage report must include— (a) the species, and number of each species, of lizards, frogs, and invertebrates captured and released; and (b) the GPS location, or a detailed map, or both, of the collection points and release points; and (c) copies of any permits for those species; and (d) results of all surveys and monitoring.	
	(3) The Agency must send completed amphibian and reptile distribution system (ARDS) cards for all herpetofauna sightings and captures to the Department of Conservation, within 1 week of the sighting or capture.	Addressed in subsections 5.2.4 and 4.5.3.
11	Injury and euthanasia of significant wildlife	
	(1) If any significant wildlife is injured in the course of the project, the Agency must take all reasonable steps to— (a) immediately address the injury; and (b) rehabilitate the wildlife, in consultation with the Department of Conservation.	Addressed in Section 2.
	(2) The Agency must not euthanise an injured animal that is significant wildlife unless— (a) a veterinarian recommends euthanasia on animal welfare grounds; or (b) the Agency euthanises the animal under direction of the Department of Conservation.	
	(3) Despite subclause (2), a bat may be euthanised only by a veterinarian.	
	(4) The Agency must notify the Department of Conservation within 48 hours of euthanising significant wildlife.	

Clause in Schedule 4 of the OIC		Section in the Management Plan addressing the matter
	(5) The notification must include details of the species euthanised and the personnel involved in the euthanising.	
12	Death of protected wildlife during course of project	
	(1) If any protected wildlife is killed during the course of the project, the Agency must—	Addressed in Section 3.3.8, 4.4.3, 5.2.3
	(a) inform the Department of Conservation within 24 hours; and	Addressed Section 3.3.8, 4.4.3, 5.2.3, 6.4, 8.2.3.
	(b) comply with any requirements imposed by the Department, for example, — (i) chilling the body if it can be delivered for necropsy within 72 hours: (ii) freezing the body if delivery for necropsy will take longer than 72 hours: (iii) ceasing the project for a period agreed by the Department and the Agency, after reasonable discussions, but in any event not exceeding 3 months.	Addressed Section 3.3.8, 4.4.3, 5.2.3, 6.4, 8.2.
13	Indigenous woody vegetation management	
	(1) When indigenous woody vegetation is felled, the Agency must, as far as practicable, move the vegetation a minimal distance outside the proposed project footprint to a location of similar indigenous woody habitat.	Addressed Section 2.2.4
	(2) Before mulching felled indigenous woody vegetation, the Agency must, as far as practicable, identify, catch, and remove any native lizards and frogs, and at-risk or threatened species of invertebrates, that are within the vegetation	Addressed Section 2.2.4
Frog Management Plan		
16	(2) The frog management plan must include-	
	(a) capture, handling, containment, and release techniques; and	Addressed Section 4.4.1 - Capture, handling, and transport
	(b) actions to prevent and mitigate frog habitat damage; and	Addressed Section 4.2 - Effects Management
	(c) details for any frog salvage operation, which must include provision for—	
	(i) the approved herpetologist to be on site for any salvage operation; and	Addressed Section 5.2 - Monitoring salvage success

Clause in Schedule 4 of the OIC		Section in the Management Plan addressing the matter
	(ii) a frog survey and salvage relocation to be undertaken no earlier than 2 weeks before construction works begin; and	Addressed Section 4.3.2 - Salvaging protocol (Phase 1)
	(iii) a second frog survey and salvage relocation the day before construction works begin; and	Addressed Section 4.3.2 - Salvaging protocol (Phase 3)
	(iv) the use of drift or exclusion fences to deter frogs from re-entering the project footprint, if appropriate; and	Addressed Section 4.3.2 - Salvaging protocol (Phase 1)
	(v) minimisation of trampling and disturbance of frogs and their habitat outside the project footprint by— (A) using the same marked access routes for access to and from survey and release sites; and (B) avoiding habitats that could easily be crushed or collapse (for example, stream seepages that could collapse if disturbed); and (C) releasing frogs using a system that avoids the risk of released frogs being disturbed or trampled.	Addressed Section 4.2 - Effects Management
Lizard Management Plan		
17	(2) The lizard management plan must include—	
	(a) Capture and handling techniques, including processes for- (i) Using live capture traps; and (ii) Sterilisation of instruments; and (iii) Temporary containment of lizards; and	Addressed Section 5.2.2 - Relocation Protocol
	(b) Actions to prevent and mitigate lizard habitat damage; and	The project has been designed in a way to minimise the damage done to lizard habitat.

Clause in Schedule 4 of the OIC			Section in the Management Plan addressing the matter
	(c) Details for any lizard salvage operations, including-		Details of any lizard salvage operations will be finalised after consultation with DOC and Mana Whenua and the Management Plans will be updated accordingly.
		(i) the proposed relocation release site; and	
		(ii) management of the proposed relocation release site, including provisions for protection of relocated lizards; and	
		(iii) timing of relocation; and	
		(iv) how post-release monitoring will be undertaken; and	
		(v) actions to be followed if threatened lizard species are found within the project footprint; and	
		(vi) habitat enhancement; and	
		(vii) pest management.	
Bat Management Plan			
18	(2) The bat management plan must include—		
	(a) capture, handling, containment, and release techniques; and		Section 3.3.8 - Bat Injury or Mortality
	(b) actions to prevent and mitigate bat habitat damage, including that—		
		(i) bat maternity roosts must not be felled; and	Section 3.3.6 - Confirmed Roost Procedures
		(ii) trees must be searched for bats before felling	Section 3.3.5 - Reporting
Specific conditions: native frogs			
19	(2) The Agency must prevent the spread of chytrid fungus and other pathogens to, within, and between capture and release sites for native frogs.		Section 4.4.1 - Capture, handling, and transport
	Destructive habitat searches (3) Where vegetation is to be removed or the ground physically disturbed, the Agency must ensure that the vegetation or ground is searched by hand using destructive habitat searches to locate Hochstetter's frogs or Archey's frogs.		Section 4.3.2 - Salvaging protocol (Phase 1)

Clause in Schedule 4 of the OIC		Section in the Management Plan addressing the matter
	(5) Any Hochstetter's frogs that are located must be released within 24 hours of capture into a suitable habitat in a nearby stream corridor that is unaffected by the project.	Section 4.4.1 - Capture, handling, and transport
	Native frog injuries and euthanasia (6) If any frogs are found injured during the project, the Agency must take all reasonable steps to immediately address the injury.	Section 4.4.3 - Inadvertent Hochstetter's frog injury or mortality
	(7) The Agency may euthanise an injured frog if that is recommended by the Department of Conservation-approved herpetologist or a veterinarian.	Section 4.4.3 - Inadvertent Hochstetter's frog injury or mortality
	Native frog injuries and euthanasia (8) The Agency must submit a report to the Department of Conservation within 3 months after any frog salvage is completed. (9) The report must include- (a) The Agency and a description and map of the location and project; and (b) The relevant authorisation number; and (c) A summary of all frog surveys and salvage operations, including frog survey and salvage methodologies; and (d) The species and number of frogs observed, collected, and released; and (e) the GPS location of the collection points and release points for each frog; and (f) the results of all surveys, and salvage relocations, including date, weather conditions, search effort, frog age class (sub-adult, adult), and habitat type at capture and release points; and (g) any difficulties encountered with capture and handling of frogs; and (h) records of any frogs injured, euthanised, or killed.	Section 4.5.3 - Wildlife Act Authority Permit Reporting
Specific conditions: native lizards		
20	*Destructive habitat searches* (2) Where vegetation is to be removed or the ground physically disturbed as part of the project, the Agency must ensure that the vegetation or ground is searched for lizards by hand using destructive habitat searches.	Section 5.2.1.1.2 - Manual Day Searching

Clause in Schedule 4 of the OIC		Section in the Management Plan addressing the matter
	(3) Any lizard species identified in a destructive habitat search must be salvaged and relocated, in accordance with the lizard management plan, to similar habitat at least 100 m outside the project footprint.	Section 5.2.2 - Relocation Protocol
	Lizard salvage reporting (4) The Agency must submit a report on lizard salvage to the Department of Conservation each year during the project. (5) The lizard salvage report must include— (a) the authorisation number; and (b) the species and number of any lizards captured alive and released; and (c) the species and number of any lizards found dead; and (d) results of all monitoring; and (e) a description of how the lizard management plan was implemented, including— (i) any difficulties encountered with capture of live lizards; and (ii) post-release monitoring; and (iii) details of any contingency actions undertaken.	Section 5.3.2 - Wildlife Act Reporting
Specific conditions: bats		
21	*Vegetation felling* (2) Where vegetation is to be removed as part of the project, the Agency must ensure that all tree felling is undertaken in accordance with the tree felling protocol at doc-bat-roost-protocol-nz-Oct 2021.pdf	Section 3.3.6 - Confirmed Roost Procedures
	Bats found during course of project (3) If bats are found during the course of the project, or if any bat is killed or injured during the course of the project, the Agency must— (a) immediately stop the construction works; and (b) review the bat management plan in conjunction with the Department of Conservation and, before recommencing construction works, agree with the Department a process to prevent or minimise any further killing of or injury to bats; and (c) take any injured bat to a veterinarian in accordance with subclause (4); and (d) report any bat death or injury to the Department of Conservation within 48 hours.	Section 3 - Bat Management Plan Section 3..3.8

Clause in Schedule 4 of the OIC		Section in the Management Plan addressing the matter
	Injured bats (4) The Agency must ensure that any injured bat is taken to a veterinarian approved by the Department of Conservation.	
	(5) If the veterinarian determines that the bat is in a healthy condition, a chiropterologist approved by the Department of Conservation and appointed by the Agency may immediately release the bat.	
	Bat release (6) The Agency must ensure that when bats are released, they are released— (a) outside the project footprint; and (b) into appropriate habitat (as determined by the chiropterologist) at least 1 hour after dusk and before midnight; and (c) in approximate environmental conditions (little to no rain with temperatures above 12 degrees Celsius).	
	Bat monitoring report (7) The Agency must provide a report of all bat monitoring data to the Department of Conservation- (a) at the conclusion of the tree felling; and (b) at any reasonable time during the tree felling, on request by the Department.	
Specific conditions: certain birds		
22	*Kiwi* (2) The Agency must ensure that all projects undertaken in areas where kiwi are present or possibly present are undertaken in accordance with the kiwi best practice manual available at https://www.doc.govt.nz/globalassets/documents/science-and-technical/sap262entire.pdf	Section 6.3.1 - Pre-Clearance Kiwi Searches
	(3) The Agency must ensure that kiwi are only captured using the assistance of a contracted and certified kiwi dog handler.	Section 6.3.1 - Pre-Clearance Kiwi Searches
	Kōkako (4) If nesting kōkako or kōkako nests are observed in the project area, the Agency must— (a) immediately stop all construction works; and	NA – kōkako are not present on site.

Clause in Schedule 4 of the OIC		Section in the Management Plan addressing the matter
	(b) immediately notify the Department of Conservation; and (c) resume construction works only when authorised to do so by the Department of Conservation.	
Specific conditions: biosecurity		
23	(2) The Agency must prevent the spread of the pest organism Phytophthora taxon Agathis, to the extent reasonably practicable.	Section 9.2.2 - Kauri Dieback Disease (PA) Management
	(3) The Agency must ensure that all vehicles and equipment, including clothing, are thoroughly cleaned of all visible soil and that footwear once cleaned is sprayed with SteriGENE solution before they enter, and when they move between, areas where there are kauri.	Section 9.2.2.2.1 to 9.2.2.2.5.6 - Summary of Site protocols
	(4) The Agency must prevent the spread of myrtle rust, to the extent reasonably practicable.	Section 9.2.1 - Myrtle Rust Management
	(5) Before starting construction works, the Agency must appoint a suitably qualified and experienced expert to complete a scoping survey to identify— (a) whether plants that can be affected by myrtle rust are present; and (b) whether any of those plants are affected by myrtle rust.	Section 9.2.1 - Myrtle Rust Management
	(6) If plants that can be affected by myrtle rust are identified in the scoping survey, the Agency must ensure that all personnel on the project site are familiar with plants affected by myrtle rust and able to identify myrtle rust signs.	Section 9.2.1 - Myrtle Rust Management
	(7) If plants that are affected by myrtle rust are identified in the scoping survey or during the project, the Agency must— (a) contact MPI to report the discovery of myrtle rust, and comply with any requirements imposed by MPI; and (b) immediately bag any clothing or materials that have come into contact with the affected plant or plants; and (c) avoid any disturbance or handling of the affected plant or plants (including sample collection).	Section 9.2.1 - Myrtle Rust Management

2 General Provisions

2.1 Accidental discovery

An ecologist must be on site during all site works. The ecologist must be alerted to any wildlife discovery to take appropriate action. All significant wildlife should be relocated by the ecologist in accordance with the corresponding provisions in the individual management plans. Any new significant species noted within the site should be brought to DOC's attention within one week of discovery.

2.2 Injury to and euthanasia of wildlife

Should wildlife become injured during construction, the onsite ecologist must be immediately notified. The onsite ecologist will immediately address the injury and rehabilitate the wildlife in accordance with advice from the DOC.

Animals may only be euthanised by the onsite ecologist under instruction the DOC or under the direction of a veterinarian on animal welfare grounds. Bats may only be euthanised by a veterinarian. The DOC must be notified within 48 hours of any euthanasia and the notification must include the species euthanised and the personnel involved in the euthanasia.

3 Habitat Impact Management Plan

This Habitat Impact Management Plan (HIMP) has been developed to manage and mitigate the impacts to vegetation associated with the project. The HIMP is a requirement of, and has been developed in accordance with, the ecological principles and guidelines outlined within the Severe Weather Emergency Recovery (NZTA New Zealand Transport Agency) Order 2023 (OIC) to avoid and minimise loss of significant indigenous vegetation, significant habitat of indigenous fauna, and habitats for at-risk or threatened species and taonga species.

The full extent of vegetation to be impacted and/or removed is yet to be confirmed, as such this is an indicative plan. Any changes to the project that could further impact vegetation on-site must only be conducted with the engagement of and approval from the Project Ecologist.

The Brynderwyn Hills ('the site') is located within Waipu Ecological District (ED). There are significant natural areas, identified within the Protected Natural Areas Programme (PNAP) survey report (Department of Conservation, 2007). Whangārei District Council (WDC) have not yet mapped the district's Significant Natural Areas (SNA).

Kauri dieback disease (*Phytophthora agathidicida)* and myrtle rust (*Austropuccinia psidii*) Management is outlined in the biosecurity section within the Biosecurity Section of this EMP.

3.1 Key Species

The site is broadly dominated by 'Indigenous Forest', 'Broadleaved Indigenous Hardwoods', and 'Mānuka and/or Kānuka', with small pockets of deciduous hardwoods, harvested forest, and low producing grassland.

Key significant indigenous vegetation that are 'Threatened' or 'At-Risk' identified on-site and their threat classifications are provided in Table 3-1 below.

Table 3-1: Key significant indigenous vegetation that are 'Threatened' or 'At Risk' on-site

Scientific name	Common name	Māori name	Threat Classification[1]
Agathis australis	kauri	kauri	Threatened – Nationally Vulnerable
Kunzea ericoides	kānuka	kānuka	Threatened – Nationally Vulnerable
Leptospermum aff. Scoparium	mānuka	mānuka	Threatened – Nationally Vulnerable
Metrosideros carminea	carmine rātā	carmine rātā	Threatened – Nationally Vulnerable
Metrosideros excelsa	pōhutukawa	pōhutukawa	Threatened – Nationally Vulnerable

[1] Lange, P. J, Rolfe, J. R., Barkla, J. W., Courtney, S. P., Champion P. D., Perrie, L. R., Beadel, S.M., Ford, K. A., Breitwieser, I., Schönberger, I., Hindmarsh-Walls, R., Heenan, P.B., Ladley, K. (2017) Conservation status of New Zealand indigenous vascular plants. New Zealand Threat Classification Series 22. Department of Conservation.

Metrosideros robusta	northern rātā	northern rātā	Threatened – Nationally Vulnerable
Metrosideros fulgens	*climbing rata*	*pōhutukawa*	*Threatened – Nationally Vulnerable*
Metrosideros perforata	*akatea*	*akatea*	*Threatened – Nationally Vulnerable*
Mida salicifolia	*Maire*	*Maire taiki*	*Threatened – At Risk and Declining*

3.2 Management

Potential adverse effects associated with this key infrastructure project will primarily occur through habitat loss associated with vegetation clearance and earthworks. Potential adverse ecological effects will be avoided, remedied, or mitigated through:

- Refinement of the project footprint through detailed design and construction methodology, avoidance measures (where possible);
- Seasonal constraints on vegetation clearance;
- Vegetation clearance protocols; and
- Pre-vegetation clearance surveys or salvage operations for nationally 'Threatened', 'At Risk', taonga species, or legally protected species (including bats, birds, lizards, frogs, invertebrates, and fish).

3.2.1 Physical Delineation

All vegetation areas within and adjoining the project footprint must be identified during the design process, and physically delineated. Individual mature native trees or bat roosts trees in proximity, but outside, the project footprint will also be identified by a suitably qualified ecologist and marked by flagging tape or fencing to avoid inadvertent clearance and to minimise potential damage to branches and roots.

3.2.2 Seasonal Constraints on Clearance of High Value Vegetation

Vegetation clearance will be affected by specific timing restrictions for each fauna type (bats, birds, lizards, invertebrates, fish) identified as being present or likely to be present by pre-clearance fauna surveys. Table 3-2provides a summary of seasonal vegetation clearance for each taxa type.

Vegetation clearance is planned to take place from January to April, which is outside of the winter season when erosion risks are significant.

Clearence of vegetation within Kauri Hygiene Areas (KHA) is to be avoided) during wet conditions to avoid potential transfer of Kauri Dieback disease (PA) to outside areas and beyond the site.

Table 3-2: Seasonal vegetation clearance for each taxa. Blue cells = no constraints. Grey cells = constraints.

Taxa	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Constraints
Bats													High risk trees or contiguous groups of high-risk trees clearance to occur between 1 October and 30 April, inclusive, when weather is warmer, and bats are likely to be more active (therefore bat roosts are more likely to be detected if present).
Birds													Vegetation clearance to occur outside of peak bird breeding season (1 September to 30 February), inclusive) to avoid and minimise potential direct mortality or injury to eggs, nesting chicks, and fledglings.
Lizards													Vegetation clearance to occur between 1 October to 30 April, inclusive, during these warmer month's lizards, frogs, and invertebrates are more likely to be active, easier to detect and more likely to survive relocation.
Frogs													
Invertebrates													
Fish													

3.2.3 Avoidance

Avoidance of negative effects on wildlife is a key objective in the ecological principles indicated in clause 5(2) of the OIC and should be the first measure applied as far as possible, before minimisation and other forms of mitigation are applied. Avoidance of significant indigenous vegetation, significant habitat of indigenous fauna, and habitats for at-risk or threatened species and taonga species must therefore be considered in the detailed design and construction methodologies, as they progress, to minimise the need for removal of vegetation.

The construction site impact area should be minimised, by avoiding the removal of vegetation (including ground cover), to minimise the risk of sediment and erosion. Removal of vegetation can expose soil making it more prone to erosion, resulting in increased sedimentation into streams. Where possible, avoid the removal of felled tree root masses (i.e.: within the construction zone but outside excavation area). Retained root masses will maintain soil stability, reducing the risk of erosion on-site.

Avoiding unnecessary vegetation removal will also reduce remediation requirements on-site, post construction. Where avoidance of indigenous vegetation cannot be avoided, hand felling or trimming of arborescent vegetation is recommended.

3.2.4 Vegetation Clearance

Vegetation clearance must only commence after all pre-start management measures have been undertaken or in place, and approval of works is approved by Project Ecologist.

During vegetation clearance, construction methodology must be refined, and maintenance of physical delineation barriers will be ongoing. If wildlife is encountered during vegetation clearance, incidental salvaging and relocation of fauna will be required.

Methodologies to further reduce potential effects during and after vegetation clearance include:

- Vegetation will only be cleared immediately prior to construction works beginning. Within the project footprint. This will reduce habitat effects and potential for erosion and sediment generation.
- Vegetation will be directionally felled away from the physically marked edge (project boundary). This is to prevent damage to vegetation immediately adjacent to the footprint, unless deemed unsafe.
- Vegetation removal will be site specific, and will commonly include an excavator, grapple, and chainsaw on suitable land. Tree felling must be undertaken by an experience arborist under supervision by a suitably qualified ecologist. All vegetation removal will be supervised by a suitably qualified ecologist.
- Felled vegetation must be surveyed to identify, catch, and remove any native lizards and frogs, and at-risk or threatened species of invertebrates. If fauna is detected, works must stop immediately.
- Once vegetation has been surveyed, felled woody indigenous vegetation, as far as practical, should be moved a minimal distance outside the proposed project footprint to a location of a similar environment, in accordance with Condition 13(1) of Schedule 4 of the OIC.

If relocation of felled indigenous vegetation is not practical, vegetation can be mulched, in accordance with Condition 13(2) of Schedule 4 of the OIC.

3.2.5 Site Rehabilitation and Monitoring

Post construction monitoring is essential to ensure appropriate site rehabilitation. In accordance with Condition 15(4) of Schedule 4 of the OIC, a rehabilitation plan must be developed, as part of the earthworks and construction management plan, to include ecologically appropriate vegetation cover and habitat, pest and weed control, and other specific actions required to rehabilitate the site and its wildlife habitat (New Zealand Government, 2023).

The Project team have engaged and will be working extensively with Mana Whenua partners around revegetation considerations, including seed collection, eco-sourcing from the maunga targeting species identified during the ecological scoping, and ongoing assessments.

The site rehabilitation plan must be provided and certified by the Department of Conservation (DOC) before construction works are completed.

3.3 Reporting

A vegetation management completion report shall be issued upon completion of the project. The report is to be provided to the client, and relevant stakeholders, detailing the vegetation management employed including:

- Detailed preclearance monitoring report outlining an updated project footprint and ecological constraints maps that illustrates site specific vegetation clearance management measures. Detailing physical delineation of vegetation within project footprint and immediately adjacent
- Incident based report during construction (if required), detailing unscheduled event associated with vegetation clearance (e.g., notable compliance failure that results in adverse ecological effects)
- Post-clearance compliance and completion report. This report will include confirmation of the vegetation clearance effects management activities that were undertaken in accordance with this HIMP. This will also include specific site rehabilitation required and any recommendations for future similar projects. The completion report must outline post-completion monitoring frequencies, vegetation establishment and survivorship and reporting requirements to ensure appropriate site rehabilitation.

4 Bat Management Plan

This Bat Management Plan (BMP) sets out measures for avoiding or mitigating impacts on long-tailed bats within affected vegetation associated with the Brynderwyn Hills Recovery works on behalf of NZTA.

This BMP is indicative and may require revision through consultation with contractors based on construction methodologies and site conditions. Further on-site, adaptive management may be required depending on site conditions, or other unforeseen circumstances and site supervision by an ecologist during construction adjacent to or directly impacting potential bat habitat will be in place to recognise and address these eventualities.

Prior to commencement of works this BMP must be understood by all relevant construction site-works contractors and site project construction staff. This BMP requires implementation and oversight by a suitably qualified ecologist and should be implemented in conjunction with the other management plans included within this Ecological Management Plan.

The potential effects of the project on bats include:

- Habitat loss from felling of potential roost trees, foraging habitat, and commuting flyways;
- Injury or death as a result of vegetation clearance and construction activities; and
- Temporary construction effects such as noise, and light.

Potential ongoing effects include:

- Decreased landscape and habitat connectivity through fragmentation until new habitat areas are established; and
- Mortality or injury on roads through bat strike with vehicles.

This BMP has been drafted to avoid, minimise, and mitigate the potential effects of Injury or death as a result of vegetation clearance and construction activities. The BMP has been written on the assumption that bats roost within the project footprint. Any changes to the project, construction methodologies or timing of vegetation clearance that could impact bat habitat can only be conducted with prior consultation and written approval from the project ecologist.

4.1 Long-tailed Bats

There are at least 18 records of long-tailed bats[2] *(Chalinolobus tuberculatus)* within 3 km of the project. Long-tailed bats are classified as "Threatened – Nationally Critical"[3] (O'Donnell, et al., 2022). They roost in mature native and exotic trees that provide sufficient shelter, including but not limited to cavities, damaged branches and trunks, epiphytes, and dead skirting on tree ferns.

[2] Department of Conservation. Bat BioWeb database. March 2023.

[3] O'Donnell, C. F., Borkin, K. M., Christie, J. E., Parsons, Davidson-Watts, I., Dennis, G., Pryde, M., Michel, P. (2022) Conservation status of bats in Aotearoa New Zealand. New Zealand Threat Classification Series 41. Department of Conservation

Due to the suitable bat roost habitat present within the site, and the proximity of bat records to the site, it is necessary to employ bat management as outlined in the following sections, particularly with respect to tree clearance protocols, to avoid any accidental injury or mortality to bats during vegetation clearance works.

4.2 Baseline Bat Monitoring

Four baseline bat activity surveys will be undertaken at sites within or near the Project footprint from December 2023 to March 2024 (Figure 4-1). Acoustic Bat Monitors (ABMs) will be deployed for two weeks at a time with at least four weeks in between each deployment. The aim of these surveys is to collect data on habitat use with seasonality and bat lifecycle factors taken into account for the purposes of informing management of residual effects.

Figure 4-1. Proposed locations of ABMs for baseline surveys within or near the zone of impact.

4.3 Tree Clearance Protocols & Procedures

These protocols are project specific and incorporate all required steps outlined in the Bat Roost Protocols[4] (Appendix A). The protocols provide procedures that are to be followed prior to, during, and after the removal of all trees and vegetation to be cleared for the project, with the goal of avoiding mortality or injury to long-tailed bats.

[4] Department of Conservation Bat Recovery Group. (2021, October). Protocols for minimising the risk of felling bat roosts (Bat Roost Protocols (BRP)) Version 2. Wellington: Department of Conservation.

Implementation of these protocols must be undertaken by a bat ecologist(s) certified as competent in undertaking "High risk activities – roost felling" (Competency 3.1 - 3.3), as described in the DOC Bat handling competencies authorisation[5]. A bat ecologist certified to Competency 2 (handling bats) should also be available in the event that bats are found injured during clearance works.

4.3.1 Avoidance

- Options to avoid removal of any high-risk trees should be explored, particularly if confirmed as a roost tree.
- Prior to the commencement of works, the project footprint should be clearly demarcated on-site to ensure all trees within the proposed construction zone are risk-rated in advance. This ensures that no more vegetation than necessary, is removed.
- To minimise the effects of habitat loss, tree clearance must be kept to a minimum. Trees must only be removed when absolutely necessary.
- Removal of maternity roosts (if identified while undertaking the tree clearance protocols below) must be avoided as they are critical to the survival of the species. No trees confirmed as maternity roosts can be removed without consultation and written approval from the DOC.

4.3.2 Risk Rating Vegetation

All vegetation to be removed must first be assessed by a bat ecologist for presence of roost features. Vegetation identified as potential bat roosts have one or more of the following attributes:

- Cracks, crevices, cavities, knot holes, fractured limbs, or other deformities, large enough to support roosting bat(s);
- Sections of loose flaking or peeling bark large enough to support roosting bat(s);
- A hollow trunk, stem, or broken branches;
- Epiphytes, dead skirting on tree ferns; and/or
- Deadwood in canopy or stem of sufficient size to support roost cavities or hollows.

If all areas of the tree cannot be observed due to foliage cover or other constraints, that tree should be treated as high-risk.

4.3.3 Low-Risk Vegetation & Removal constraints

Trees or vegetation with no potential bat roost features can be rated as low-risk and do not require any further bat management or implementation of pre-felling monitoring and inspection procedures as outlined in Section 4.3.5.

All vegetation that is identified as low-risk may be removed at any time without a bat ecologist present on-site, provided operations do not disturb any adjacent high-risk trees, or the vegetation does not require other management as per the other plans within this suite of EMPs.

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[5] Department of Conservation, Bat Recovery Group. (2021). Bat Handling competencies authorisation, Version 2..

4.3.4 High-Risk Vegetation & Removal Constraints

Trees or vegetation with potential roost features present (or where all extents of the tree cannot be observed) are deemed as high-risk (see Section 4.3.2).

All high-risk trees must be clearly marked and labelled by nailing a conspicuous marker to the tree and by using flagging tape to ensure it is obvious for any contractors that will be working on-site. Roost feature notes must be recorded to ensure that correct future surveillance occurs prior to felling.

During periods of cold weather, predominantly winter, long-tailed bats enter torpor. Torpor is a state of decreased physiological activity similar to hibernation. Consequently, monitoring and inspection techniques are ineffective. Therefore, **felling of high-risk vegetation can only occur between 1st October and 31st May** and when the temperature at official dusk the night prior to works is at least 10°C or above.

All high-risk trees must be subject to pre-felling monitoring as outlined in Section 4.3.5.

4.3.5 Pre-felling monitoring and inspection procedures

For all vegetation assessed as high-risk, monitoring and/or inspection must be undertaken to ensure there are no roosting bats immediately prior to removal. One, or a combination of the techniques outlined below may be used to determine occupancy (or lack thereof) and at the discretion of the bat ecologist.

4.3.5.1 Acoustic Bat Monitoring

- All high-risk vegetation will be acoustically monitored for at least two consecutive "valid" survey nights immediately prior to felling. A "valid" survey night requires the following overnight weather conditions:
    - Air temperature remains above 10°C until four hours after official dusk.
    - Rainfall of < 2.5mm in the first two hours after official dusk, and <5 mm in the first four hours after official dusk.
    - Where a night of monitoring is lost to adverse weather, or monitor failure, further monitoring will take place until two consecutive nights of monitoring is achieved.
- ABMs must be deployed in appropriate locations and no more than 50 m apart within the target vegetation. This may require numerous ABMs to be deployed for sufficient site coverage.
- Monitors will be programmed to detect activity from one hour before official dusk until one hour after official dawn.
- If no bat activity is detected at any time for a minimum of two consecutive valid survey nights, all high-risk trees within the survey area can be removed on the day immediately after the valid survey nights without any further monitoring. The procedures in Section 4.3.5 should then be implemented.
- Any trees not able to be felled on that day will require additional bat monitoring prior to felling. Additional monitoring may be one extra night of no bat activity.
- If bat activity is detected, monitoring must continue until two consecutive nights without bat activity are observed.

- If bat activity is consistent in the area and two nights with zero bat passes cannot be obtained, another bat monitoring method (see below) must be implemented.

4.3.5.2 Visual Inspections

If consistent activity is detected via acoustic monitoring, then the extent of all potential roost features will need to be inspected for presence of bats, if safe to do so.

- All vegetation identified as high-risk as a roost tree may be inspected to confirm occupancy by roosting bats. As bats are less likely to be active over colder periods, climbing to check whether bats are present in potential roost features must take place between October 1st and April 30th and when the temperature are >10°C at official dusk on the night prior to inspection.
- If roost features are low enough the bat ecologist will undertake the inspection. However, if they cannot be reached, or the full extent of the vegetation cannot be seen from the ground, then arborists/qualified tree climbers will be required to climb and inspect the tree under supervision of the bat ecologist.
- The bat ecologist will appropriately train the tree climber in the use of inspection equipment (handheld detector and borescope), methods and bat evidence (guano, grease staining or bats themselves). The bat ecologist will advise the tree climber on where the identified features of the tree are located that require inspection and each feature must be inspected thoroughly to the satisfaction of the bat ecologist.
- The arborist and bat ecologist will also check for signs of roosting bats using a handheld bat detector (to detect social (25 kHz) and echolocation (40 kHz) calls from roosting bats).
- The tree climber will relay any potential evidence of bats (e.g., guano) verbally and by photographs for review by the bat ecologist.
- If potential roosts are located within tree ferns or other 'delicate' vegetation, climbing will only be undertaken if it is safe to do so for the climber, and if this will not damage the roost or disturb potentially roosting bats at the time of inspection. All climbing must take place under the careful supervision of the bat ecologist to prevent roost damage or disturbance/injury to roosting bats.
- A thermal camera may also be used from the ground to inspect any roost features at the time of tree inspections. This technique is useful when a particular branch or tree cannot be climbed to provide certainty that a tree is unoccupied.
- If bats are observed to be present within a roost, the tree climber will carefully descend, and the procedures in Section 4.3.6 will be implemented.
- If no bats are identified and the bat ecologist determines the vegetation can be removed, the inspected tree(s) must be felled on the day of inspection prior to dusk. The procedures in Section 4.3.7 should then be implemented.

4.3.5.3 Emergence/Re-entry Roost Watches

- This method will be used if potential roosts cannot be ruled out using acoustic and/or visual inspection techniques and/or a tree cannot be climbed. In this instance, the following methodology should be implemented.
- The bat ecologist must be present at each of the roost watch sessions.

- Roost emergence and re-entry watches[6] must be undertaken for two consecutive valid nights (see Section 4.3.5.1) and in conjunction with ABM use. ABM data must be analysed for the night of the roost watch. Where a night of monitoring is lost to adverse weather, further monitoring will take place until two consecutive nights of monitoring is achieved.
- Each tree must be watched from prior to official dusk until it becomes too dark to see by people observing all potential exit points. Bats begin to leave their roosts while there is still light outside therefore there is potential to observe bats without the aid of cameras or video equipment.
- The tree shall then be watched the following morning to determine if bats return to the tree(s), at a minimum, two hours prior to official dawn, or two hours prior to when the last passes were recorded on ABMs on previous nights.
- If no bats are observed entering or exiting the potential roost tree(s) for two consecutive nights of emergence/re-entry watches and the bat ecologist is confident that no bats are roosting within the subject tree(s), then it can be removed. Removal must occur on the same day following roost watches (i.e., if the survey ends in the morning, the tree must be felled the same day. If the tree is not able to be felled entirely and there is residual risk (roost features still present), then roost watches must continue (if other methods remain unsuitable).
- If bats are observed exiting a tree at either dusk or dawn, it is a confirmed roost tree and must not be felled. Procedures in Section 4.3.6 should then be implemented.

4.3.6 Confirmed Roost Procedures

If bats are confirmed to be roosting within a tree, it must not be felled. The following actions will be taken:

- Roost trees will be clearly marked, and the immediate area will be cordoned off with safety fencing and signage erected in a 10 m radius around the roost, alerting any person approaching the area that a bat roost is present and to stay clear.
- All relevant Project staff will be briefed to ensure the tree is not removed. The bat ecologist will determine whether all tree clearance works should be suspended or whether inspections and clearance can continue away from the roost.
- An emergence roost watch will then need to be undertaken on the tree (the same night it was discovered) to determine the number of bats roosting (i.e., identify if it is a solitary or maternity/communal roost).
- DOC must be notified within 48 hours of when the occupied bat roost was discovered and be provided with relevant information such as photos, location, date(s), tree species, roost type and methods used to confirm bat presence. No roost tree shall be removed until consultation and written approval from DOC.

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[6] Two sessions required per "valid survey night" i.e., one emergence watch, and one re-entry watch per night until two consecutive nights with no roosting bat activity is observed.

- If removal of the roost tree is approved, further monitoring must continue until the bat ecologist can confirm that no bats are roosting within.
- If removal of a maternity roost is approved, removal works shall be scheduled to only occur within the period 1 March to 30 April inclusive, and only after the appropriate pre-felling monitoring.
- All options to avoid the removal of the roost tree must be explored by relevant project staff. The bat ecologist will review whether it is possible to relocate the roost into an area that would remain of value to bats. For example, could the hollow be kept and attached to another tree as an artificial roost? Could the tree be relocated as standing dead timber? Therefore, preventing the loss of the roost through careful repositioning.
- Removal of a confirmed bat roost should be avoided as far as possible.4.4

4.3.7 Felling & Post-felling Procedures

- Upon approval from the bat ecologist that bats are not roosting within the tree(s), removal must occur on the same day the pre-felling monitoring and/inspections were undertaken. If this is not possible then monitoring and/or repeat inspection of roost features must be continued until there is no residual risk of bats roosting.
- The bat ecologist must be onsite to supervise all vegetation clearance operations and to advise staff should bats be detected (either leaving trees or injured).
- If bats are detected at any stage of the process, felling must stop (if it is safe to do so) to allow any uninjured bats to escape. Attempts should be made to capture any observed bats (those that don't fly away) by the bat ecologist for assessment. If any bats are found, Section 2.2.6 shall be implemented.
- DOC must then be notified immediately and a review of the bat management plan in conjunction with DOC must be undertaken before recommencing felling works, to agree to a process to prevent or minimise any further killing of, or injury to bats.
- Every effort should be made to relocate the section of the trunk/branch where the bats were roosting before felling may recommence.
- All high-risk vegetation shall be thoroughly inspected immediately after felling with the aid of a handheld detector by the bat ecologist, to check for any roosting bats remaining within the tree.

4.3.8 Bat Injury or Mortality

In the event of finding a dead or injured bat(s) the following procedures will be implemented, in accordance with Conditions 11, 12 and 21 of Schedule 4 of the OIC:

- All captured bats will be placed in a dark material-lined bag and put in a dark, quiet place at ambient (or slightly warmer temperatures. A maximum of two bats should be kept in one bag.
- Injured bats will then be taken immediately to a veterinarian approved by the DOC for assessment/treatment. The vet will make an assessment whether to euthanise the bat, or if its injuries/lack thereof will allow rehabilitation and return to the wild.
- Any bats that are not euthanised or obviously injured must be kept for three days under observation and kept out of torpor during this time.

- DOC must be notified within 48 hours of any incident regarding injury or death to bats.
- If the vet decides that the bat can be rehabilitated, the ecologist and the vet will contact DOC on emergency hotline [0800 DOC HOT (0800 362 468)] for advice on the most appropriate rehabilitation measures.
- For all bats able to be released, this will be undertaken by an approved bat ecologist, and must be released:
    - Outside of the project footprint; and
    - Into appropriate habitat (as determined by the bat ecologist) at least 1 hour after dusk and before midnight; and
    - In suitable environmental conditions (minimal precipitation, temperatures above 12°C)
- If the animal is dead or euthanised by the vet, it will be taken to the local DOC office (Whangarei Office: 09 470 3300) as soon as practicable. The bat(s) must be stored in a fridge at less than 4°C.

4.4 Post-felling management

If a confirmed roost cannot be avoided and must be removed, and where possible to do so, relocate the section of the tree with the roost feature (should be done by an arborist) and install on a suitable adjacent tree unaffected by the works. This should be predator proofed using aluminium banding above and below the roost feature.

4.5 Reporting

A bat management completion report shall be issued within 12 weeks of the conclusion of tree felling. This report is to be provided to the client, DOC, and any relevant stakeholders, detailing the results of the acoustic surveys, management employed during vegetation clearance, and any recommended further management required.

5 Hochstetter's Frog Management

This Hochstetter's Frog Management Plan (HFMP) sets out measures for avoiding or mitigating impacts on Hochstetter's frogs within affected watercourses associated with the Brynderwyn Hills Recovery works. This HFMP has been developed in accordance with, the ecological principles and guidelines outlined within the Severe Weather Emergency Recovery (NZTA New Zealand Transport Agency) Order 2023 (OIC). The plan describes measures to avoid or salvage and relocate Hochstetter's frogs that would otherwise be adversely affected by the recovery works. Measures to address residual effects on Hochstetter's frogs will be addressed as part of the detailed AEE within the retrospective resource consent applications.

Hochstetter's frog is legally protected under the Wildlife Act 1953 and classified as 'At Risk – Declining'[7,8] under the Department of Conservation National Threat Classification System (NZTCS). This HFMP is a sub-plan of the EMP. Prior to being finalised the HFMP will be further updated and developed in consultation with mana whenua and the DOC.

The frog management measures detailed below are deemed to be appropriate for the species most likely on-site and their estimated abundances. The Conservation status of New Zealand amphibians[9] has been used to assign frog values and subsequent management requirements.

5.1 Hochstetter's Frog

The Hochstetter's frog is a terrestrial, semi-aquatic species, residing alongside and within seepages and streams located within indigenous forest. Hochstetter's frog prefer streams and seepages with an abundance of vegetation, rocky and organic debris, and crevices. Hochstetter's frog are a nocturnal species but may be occasionally observed during the day. The watercourses in the subject site provide suitable habitat for Hochstetter's frog.

Numerous previous observational records of Hochstetter's frog exist within and immediately surrounding the project footprint, with the most recent record from the DOC amphibian and reptile data base being 2009. The population in this area represents the northern clade of the northern Evolutionary Significant Unit.

Suitable habitat for Hochstetter's frogs exists within all indigenous forest streams across the project footprint, where substantial seasonal or permanent flow occurs and generally where indigenous riparian vegetation is present. Frog surveys have detected frogs in all these stream reaches apart from those at Fill Sites A and B (due to the ephemeral flows), both within and upstream and downstream of the project footprint.

[7] New Zealand Government. (1953). Wildlife Act. Wellington, New Zealand.

[8] Department of Conservation. (2017). Conservation status of New Zealand amphibians (New Zealand Threat Classification Series 25).

[9] Burns, R., Bell, B., Haigh, A., Bishop, P., Easton, L., Wren, S., . . . & Makan, T. (2017). Conservation status of New Zealand amphibians, 2017. Wellington: Department of Conservation.

5.2 Effects Management

Potential adverse effects on frogs that are associated with the construction and operation of the project will primarily occur through habitat loss associated with stream loss, vegetation clearance, earthworks, and stream culverting. Potential adverse ecological effects will be avoided, remedied, or mitigated through:

- Vegetation clearance protocols (detailed in the HIMP);
- Minimisation of trampling and disturbance of frogs and their habitat outside the project footprint by:
    - using the same marked access routes for access to and from survey and release sites; and
    - avoiding habitats that could easily be crushed or collapse (for example, stream seepages that could collapse if disturbed); and
    - releasing frogs using a system that avoids the risk of released frogs being disturbed or trampled.
- Seasonal constraints on vegetation clearance and streamworks (only during earthworks season during these drier months when frog ranges are more restricted and less widespread);
- Repeat salvage operations prior to earthworks; and
- Enhancement of relocation site(s) through rock pile deployment (rocks sourced from impacted habitats) to increase habitat abundance (as set out in this HFMP) and planting where required to improve the likelihood of survival[10]. DOC will be consulted on a case-by-case basis, in line with the requirements of Clause 9 (1)(C) of Schedule 4 of the OIC.
- Ensuring that an ecologist provides a briefing at the onsite induction to ensure that the measures indicated in this management plan are implemented correctly.

Concrete Management:

Wet concrete can introduce a variety of chemicals to watercourses that may be very harmful to aquatic organisms. This includes increased pH due to release of hydroxyl ions. The latter phenomenon may continue after concrete has set. Manage risk of concrete contamination at culvert sites and any other locations within 50 m of a watercourse.

- Minimise use of concrete in or within 50m of a stream as far as possible.
- Use pre-cast concrete wherever possible to maximise drying time before use. Ideally all precast should be at least a week old before installation.
- Flush or hose off the pre-cast concrete off-site prior to installation in a location where the runoff does not cause ecological harm.

[10] Mammalian pest control will serve to mitigate potential adverse effects by increasing the likelihood of survival for relocated individuals.

- Concrete structures poured in-situ need to be isolated to dry thoroughly before flow is allowed to return. They may be kept wet (ideally) or dry, but must be isolated from the stream and from frogs & fish. Where concrete is within a stream course (e.g. a culvert), it may need to be separated by physical barrier, but this should be as directed by the relevant on-site ecologist tasked for the purpose. It is assumed that over-pumping forms a key part of this process.
- All concrete structures within 30 m of a watercourse must be flushed with locally abstracted water with a verified pH of between 7 and 7.6. The area affected by the flushing must be, to the satisfaction of the on-site ecologist, free from frogs, fish and other vulnerable wildlife. The outlet of the structure or group of structures must be closed such that water cannot flow into the stream downslope. The flushing water should be pumped out and disposed of safely, offsite.
- A small amount of water (volume simulating normal streamflow) will be put through the structure/structures and then the pH measured where it collects at the closed outlet immediately after it has collected (to simulate through flow). If the pH is between 7 and 7.8, the culvert may be opened. If not, the culvert must be flushed as many times as required for the pH to stabilise.
- Once the pH falls within the target bracket, the culvert may be opened, keeping the over-pumping live. Inflowing and outflowing pH must be measured after opening. If the outflowing pH still falls within the desired range, the over-pumping may be deactivated and the related temporary infrastructure may be removed.

5.3 Hochstetter's Frog Salvaging Protocols

The protocols for frog salvaging and relocation are specified below.

5.3.1 Hochstetter's frog salvage

Frog salvaging is proposed to reduce mortality or injury prior to streamworks and vegetation clearance. Salvaging will be undertaken within all stream habitat within the project footprint, where earthworks are proposed during December to April inclusive. Work will be prioritised in accordance with site construction schedule. Frogs are expected to be relatively easy to locate during drier months when the flows are lower.

Frog salvaging will be undertaken using methodologies described below. Site specific methodologies will be guided by the Project amphibian ecologist based on their assessment of the frog habitat.

The Project amphibian ecologist has discretion to include or exclude areas based on the type and quality of habitat being cleared and must be present onsite during salvaging operations until he/she deems salvaging ecologists to be adequately trained.

5.3.2 Salvaging protocol

The protocols for frog salvaging and relocation specified below are consistent with standard methodologies from DOC's Inventory and Monitoring Toolbox: Herpetofauna.[11] The methodology has been adapted for local site conditions.

Manual destructive salvage protocol for Hochstetter's frog populations is to search all available retreats along the streambed and streambanks during the day when the frogs are mostly inactive and under cover.

Salvaging will typically extend between the stream banks up to 1 m from the water's edge but will not include sites beneath water level. All available refugia such as loose stones, logs, vegetative matter, undercut banks and crevices will be searched for frogs. Salvaging and relocation efforts will be staged as follows:

- Phase 1 salvage and relocation will commence a minimum of 2 weeks prior to vegetation clearance/earthworks and include:
    - Daytime searching and capture using two-person teams in which all suitable and accessible refugia will be searched, with the exception of large boulders or deep crevices that cannot feasibly be searched. Crow-bars or similar equipment will be used to enable searching under larger boulders or coarse wood (e.g., downed logs) and tools will also be required to remove frogs from crevices or undercover retreats (where feasible). Head lamps will be used to increase the likelihood of detection.
    - Relocation of all potential refugia (suitable rocks, coarse wood, and vegetative matter (e.g. leaf packs) out of the stream and up on the bank once searched. This will reduce stream habitat availability for frogs. Any frogs that are present but not detected, e.g. juveniles in leaf packs, are expected to move back into the stream.
    - Re-deployment of suitable rocks once the length of stream has been searched. These will be along the stream edges to provide optimal refugia for displaced frogs that were undetected during phase 1 salvaging or for mobile Hochstetter's frogs that colonise the stream after Phase 1 searching.
    - Fish exclusion barriers will be placed upstream and downstream of the impacted stream reaches to reduce the likelihood of uncaptured frogs or frogs from elsewhere moving into the stream after salvaging and prior to impacts.
    - Relocation of frogs and suitable refugia to frog relocation sites (see Section 5.4.25.4.2 below).

- Phase 2 salvage will commence a minimum of 5 days prior to vegetation clearance/earthworks and will include nocturnal searching using two-person teams (with headlamps) to capture frogs not detected during Phase 1 salvaging. This method is not always employed for health and safety reasons; however, for this project, the length of stream impacted is generally small and impacted streams are immediately adjacent to the existing road and are therefore readily accessible.

[11]Adams, M. (2012). Department of Conservation Inventory and Monitoring Toolbox: Herpetofauna. Department of Conservation, Wellington

- Phase 3 salvage will commence immediately prior to earthworks and will include a final search and capture of frogs within impacted streams and under judas rocks after which these rocks will be moved to relocation sites (see Section 5.4.2 below).
- Phase 4 salvage will be undertaken during earthworks and where feasible will involve the use of machinery to remove and capture frogs under large cover objects that could not be removed via manual salvaging.

5.3.2.1 Data collection

Each individual Hochstetter's frog that is captured will be assigned a number and the following information will be recorded:

- Date and time of capture and weather conditions;
- Capture methodology;
- Capture location with GPS coordinates;
- Capture major habitat type and micro habitat type;
- Species, sex (reproductive status for females), age class, size Snout to Urostyle (SUL), and overall health and condition; and
- A minimum of one representative photograph.

5.4 Relocation Protocols

5.4.1 Capture, handling, and transport

The following steps will be undertaken by the Project amphibian ecologist to ensure appropriate handling of frogs occurs. The transportation of all frogs will comply with the Animal Welfare (Transport within New Zealand) Code of Welfare[12].

To minimise any possible spread of chytrid fungus (*Batrachochytrium dendrobatidis)* and other pathogens to, within and/or between monitoring sites, the highest level of hygiene protocol will be implemented following the current national Frog Hygiene Protocol.

Capture, handling, and relocation of frogs will be undertaken in accordance with the following methodologies:

Site hygiene:

- All footwear, packs, rainwear, and gaiters must be cleaned, disinfected with Trigene, and dried between sites;
- All clothing must be freshly laundered using hot water or Trigene (including outer clothing) between sites;
- All frog handling/measuring equipment must be disinfected between sites;

[12] Ministry for Primary Industries (2018). Code of Welfare: Transport within New Zealand. MPI, Regulation and Assurance Branch, Wellington 6140

- Footwear and gaiters must be cleaned and disinfected at the point of entry to a frog field site; and
- Wherever a chemical disinfectant is used (e.g. Trigene, bleach, F10) this must be rinsed off after the disinfection time (Ethanol can be air dried).

Frog handling hygiene:

- A new glove(s) must be used for catching and handling each frog (the same glove can be re-used on the same frog if that glove remains isolated from other frogs and/or their body fluid);
- Each frog must be held in a separate moist plastic bag (one plastic bag is used per capture and then disposed of);
- Each frog must be weighed and measured in the plastic bag;
- If frogs are too small to be measured, then callipers should be disinfected between frogs using alcohol wipes (air dry before measuring next frog);
- Salvaged frogs will be transported in a ventilated and wet darkened plastic container (to maintain a dark environment). Care will be taken to keep the plastic containers at a constant ambient temperature and out of direct sunlight;
- Salvaged frogs will be placed in plastic containers for no longer than 5 hours for transportation before being released to the relocation site;
- Minimise handling time to reduce stress and to avoid side effects of stress; and
- Sick or dead frogs should be collected and held separately from all other frogs until delivered to the appropriate recipient. All equipment should be thoroughly cleaned and disinfected after use.

5.4.2 Relocation site

Key aspects of the Hochstetter's frog relocation site(s) are:

- Frogs will be relocated into suitable indigenous forested stream habitat that is either upstream or downstream of the same stream from which they were captured.
- The relocation site(s) will occur along stream headwaters and tributaries under native-dominated forest and will be subject to mammalian pest and wasp control to improve the likelihood of relocation success.
- Salvaged frogs will be relocated into suitable micro-habitat in the relocation site(s) that has been enhanced with rock refuges salvaged from the Project footprint. Individual frogs will be placed a minimum of 5 m apart along a relocation stream. However, if more than one frog is captured in the same refugia and/or appears to be part of the same cohort (e.g., several juvenile frogs of the same size that are captured in the same area), then these frogs will be relocated together.

For each Hochstetter's frog released, the following information will be recorded upon release:

- Date and time of release and weather conditions;
- Release location including GPS coordinates;
- General habitat description and microhabitat type; and

- Release photograph(s) of the frog and the release habitat.

5.4.3 Inadvertent Hochstetter's frog injury or mortality

The following steps will be implemented if any injured or dead frogs are found during frog salvage as per Wildlife Act Authority Permit (once issued):

- The Environmental Manager and relevant representatives of DOC and Council will be notified at the earliest opportunity within 24 hours after an injured or dead frog is found;
- Any Hochstetter's frog death shall be sent to Massey University Wildlife Postmortem Service for necropsy. The body is to be chilled if it can be delivered within 24 hours, or frozen if longer than 24 hours to deliver.
- Appropriate measures shall be undertaken to minimise further frog deaths;
- Injured frogs found during salvage will be taken to a suitably qualified vet as soon as possible for assessment and treatment. Injured frogs will be kept in an appropriate portable enclosure (i.e., a clean, well-ventilated plastic container) under the direction of the Project amphibian ecologist to ensure the animal is handled appropriately until the frog(s) can be assessed and treated;
- Frogs assessed by the vet or alternative specialist as uninjured, or otherwise in suitable condition for release, will be transported to the frog relocation site(s) in the portable enclosure and released into habitat suitable for the species being relocated; and
- Euthanasia of an injured frog shall only be undertaken under direction from DOC.

5.5 Monitoring and reporting

5.5.1 Compliance monitoring report

A compliance monitoring report will be submitted to Council within three months following completion of the frog salvages.

This report shall include:

- Confirmation that frog salvaging and relocation operations were undertaken in accordance with this HFMP and associated consent conditions;
- Salvage and relocation results; and
- Recommendations for potential changes to improve the effectiveness of frog management in relation to the HFMP scope.

Notable changes to salvage and relocation protocol will be undertaken in consultation with Council, DOC, iwi, and/or stakeholders (as required). Resulting changes and updates to this HFMP, following consultations, will be effective upon confirmation with all respective groups.

The compliance monitoring report shall also include representative photos showing:

- The salvaging methodologies; and
- Frogs captured including salvage site photos and relocation site photos.

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5.5.2 Monitoring salvage success

We will be unable to determine salvaging success as it is not proposed to individually mark frogs. This is on the assumption that mana whenua and other stakeholders would be averse to toe clipping, which constitutes the only viable technique for distinguishing between relocated and resident frogs at the relocation site. However, verification of net positive outcomes[13] for Hochstetter's frogs will be achieved through monitoring the response of Hochstetter's frogs to habitat enhancement operations (including at the relocation sites).

5.5.3 Wildlife Act Authority Permit Reporting

Reporting requirements outlined in Wildlife Act Authority Permit and of Schedule 4, Condition 19 (9) of the OIC will be adhered to. Hochstetter's frog capture and relocation data will also be compiled, summarised, and submitted to DOC's national data repository for frog records (the Bioweb Herpetofauna database) annually. As a minimum, the report will include the following information:

- The Agency and a description and map of the location and project; and
- DOC Wildlife Act Authority number and Project name and location;
- A summary of the species, numbers and age/sex classes of frog captured;
- GPS location and habitat type of salvage and release sites of each frog captured; and
- The results of all surveys, and salvage relocations, including date, weather conditions, search effort, frog age class (sub-adult, adult), and habitat type at capture and release points and success; and.
- Any difficulties encountered with capture and handling of frogs
- Records of any frogs injured, euthanised, or killed.

In addition, all sightings must be reported to DOC via the ARD card system within 1 week of discovery.

[13] Net positive outcomes result from an increase in frog abundance in offset/compensation sites that is expected to exceed the loss of frogs at impact sites, based on biodiversity outcome monitoring.

5.6 Site Map

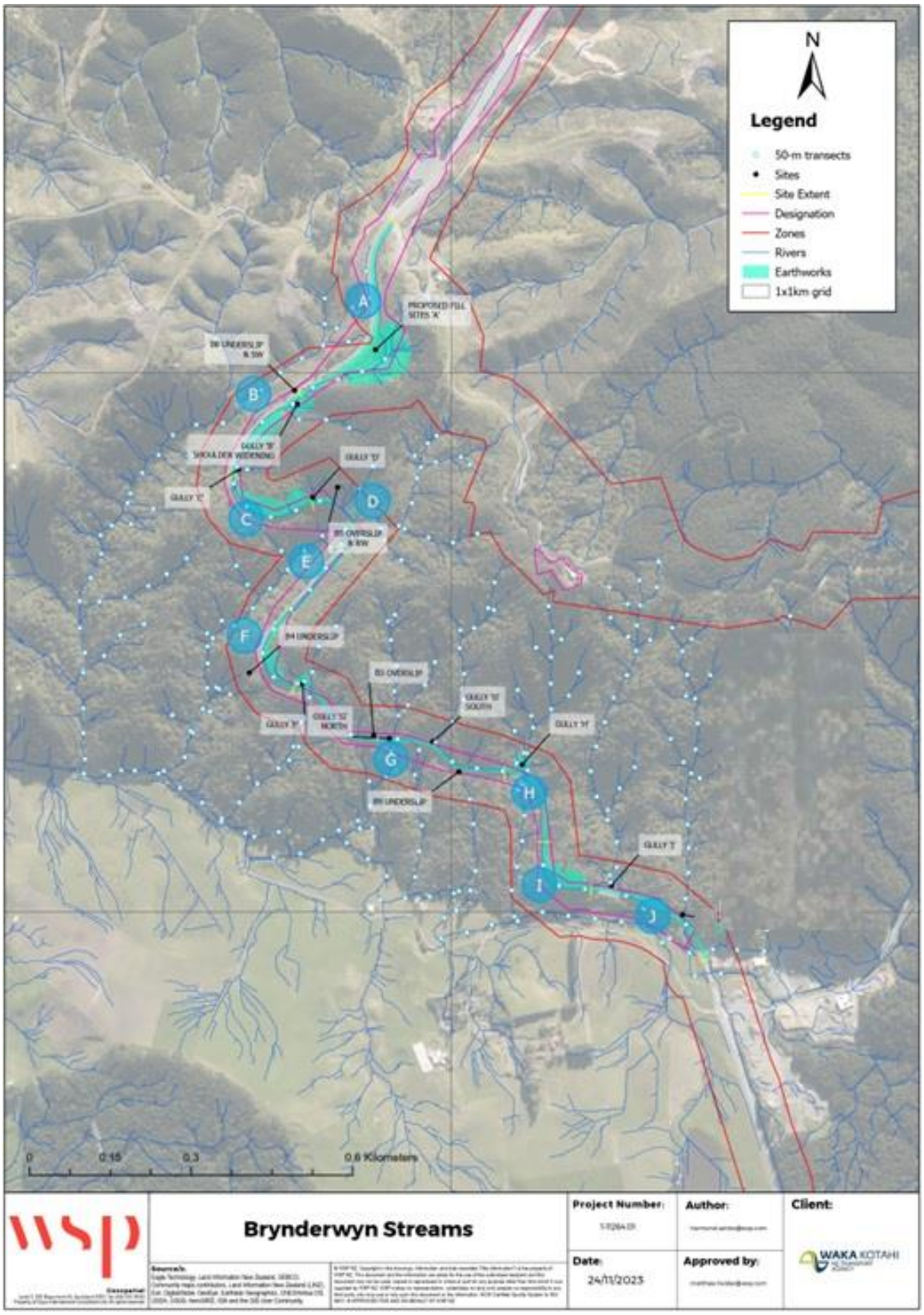

Figure 5-1 Map of the site including 50 m transects where frog searches were undertaken.

6 Lizard Management Plan

This Lizard Management Plan (LMP) has been developed to manage the actual and potential impacts caused by works associated with the Brynderwyn Hills Recovery work project.

This LMP is a living document and may require revision through consultation with contractors based on construction methodologies and site conditions. Further on-site, adaptive management may be required depending on site conditions, species encountered, or other unforeseen circumstances and site supervision by an ecologist during construction adjacent to or directly impacting potential lizard habitat will be in place to recognise and address these eventualities.

Prior to commencement of works this LMP must be understood by all relevant construction site-works contractors and site project construction staff. This LMP requires implementation and oversight by a suitably qualified ecologist and should be implemented in conjunction with the other management plants included within this Ecological Management Plan.

The potential effects on lizards relate to the potential habitat removal and modification associated with the recovery works and all associated temporary and permanent infrastructure. This includes a construction buffer (setbacks from the physical work needed to allow for all construction activities and access) (Project footprint).

The potential effects of the project on lizards include:

- Habitat loss and degradation of adjacent habitats via fragmentation, isolation, disturbance (noise, light, and dust) and edge effects (altered bio-physical conditions); and
- Injury or death as a result of vegetation clearance and construction activities and deposition of fill (copper skink only).

Potential ongoing effects include:

- Decreased landscape and habitat connectivity through fragmentation until new habitat areas are established;
- Mortality or injury on roads through lizard strike or road kill;
- Potential effects associated with the increased presence of people and introduced species in previously less accessible areas; and
- Lost opportunities for creating wildlife corridors.

This management plan has been drafted to avoid, minimise, and mitigate these potential impacts. Any changes to the project, construction methodologies or timing of vegetation clearance that could impact lizard habitat can only be conducted with prior consultation with, and written approval from, the project ecologist.

6.1 Key Lizard Species

Five native lizard species (Table 6-1) are known or expected to be present within the project area based on a qualitative assessment of habitat values for native lizards (skinks and geckos) during site walkovers in November and December 2023, past records (iNaturalist and DOC Bioweb) and their known distributions.

Indigenous native forested habitat within the project footprint and surrounds was deemed highly suitable for all native lizard species, while cleared pine forest habitat was deemed suitable for copper skink only.

All native lizards are protected under the Wildlife Act 1953 and aside from Pacific gecko, which is 'Not Threatened', all species potentially present on site have a threat status of nationally 'At Risk-Declining'[14].

Table 6-1: Native lizard species likely of potentially present on site and included within this LMP for management.

Scientific name	Common name	Māori name	National Threat Classification
Mokopirirakau granulatus	forest gecko	mokopirirākau	At Risk - Declining
Naultinus elegans	elegant gecko	kākāriki	At Risk - Declining
Oligosoma aeneum	copper skink	-	At Risk - Declining
Oligosoma ornatum	ornate skink	-	At Risk - Declining
Dactylocnemis pacificus	Pacific gecko	-	Not Threatened

Quantitative lizard surveys were not undertaken due to:

- The considerable level of effort required to confirm species presence and relative abundance within the time available, e.g., insufficient time to deploy and bed in Artificial Cover Objects;
- Difficulties in undertaking nocturnal surveys along a state highway due to site accessibility and health and safety constraints; and
- Low detectability of geckos when surveying under canopy, as opposed to along forest edges since they are cryptic and often located high in the canopy.

To address survey constraints and limitations and in alignment with the precautionary principle, this LMP conservatively assumes that:

- All lizards that are potentially present are present, albeit at low to moderate densities; and
- Lizard populations are considerably lower than maximum carrying capacity due to the ongoing impacts of introduced mammalian predators.

In summary, if present, the species listed in Table 6-1 are expected to be directly impacted by the loss of approximately ~4.275 ha of indigenous forest and 1.5840 ha of lower quality regenerating forest, along with a lower risk that copper and possibly ornate skink will also be impacted by the additional loss of approximately 0.8 ha of harvested pine[15]. Indirect edge effects may be experienced over an additional approximately 4.4 ha area.

[14] Hitchmough, R., Barr, B., Knox, C., Lettink, M., Monks, J. M., Patterson, G. B., Reardon, J. T., van Winkel, D., Rolfe, J., Mchel, P. (2021). Conservation status of New Zealand reptiles, 2021. New Zealand Threat Classification Series 35. Department of Conservation, Wellington. 15 p.

[15] These numbers are an estimate as designs are being finalised. They will be confirmed in the next version of the management plan and in the effects assessment.

6.2 Lizard Salvage and Relocation

Lizard salvaging is proposed to reduce mortality or injury during vegetation clearance. A high-level assessment of lizard habitat has already been undertaken and assessed all indigenous forest within the footprint as potential lizard (skink and gecko) habitat and all cleared pine forest as potential copper skink habitat. All vegetation clearance within indigenous forest and clear pine forest will require implementation of the salvage and relocation protocols as described below.

The protocols for lizard salvaging and relocation specified below are consistent with standard methodologies from DOC's Inventory and Monitoring Toolbox: Herpetofauna[16] and are commonly used on many construction projects. The methodologies have been adapted in this LMP for local site conditions and programming constraints. Ensure that an ecologist provides a briefing at the onsite induction to ensure that the measures indicated in this management plan are implemented correctly.

6.2.1 Lizard Salvage Protocol

Salvaging will include a range of methods as described below and will be undertaken only during the warmer months (1 October – 30 April inclusive) when lizard species are more active and therefore more likely to be detected during salvaging operations.

The specific salvage methodologies will be guided by the project herpetologist (lizard ecologist) based on their assessment of the lizard habitat. The project herpetologist has discretion to include or exclude areas based on the type and quality of habitat being cleared and must be present onsite during salvaging operations until s/he deems salvaging ecologists to be adequately trained.

6.2.1.1 Pre-construction salvaging

Prior to commencement of vegetation/habitat clearance activities, artificial cover objects (ACOs) will be deployed, and manual habitat and nocturnal searching will be undertaken.

6.2.1.1.1 ARTIFICIAL COVER OBJECTS (ACOS) AND LIZARD TUNNELS

ACOs can be used to monitor and/or capture native lizards within potential lizard habitat. Each ACO will consist of two stacked onduline sheets measuring approximately 500 mm x 500 mm.

Approximately 200 ACOs (ca. ~20 ACOs per ha) will be deployed for a minimum of eight weeks prior to vegetation removal within the approximately 10 ha area[17]. Each ACO will be deployed in suitable microhabitat and spaced a minimum of 5 m apart. To optimise the likelihood of lizard use, ACOs will predominately be situated along the forest margins or in more open habitats.

Checking of ACOs will commence immediately prior to vegetation clearance. Each ACO will be checked once a minimum of three days prior to vegetation clearance and during appropriate weather conditions. The single check prior to vegetation clearance reflects time constraints and

[16]Adams, L. (2019). Key principles for lizard salvage and transfer in New Zealand. Department of Conservation Lizard Technical Advisory Group, Wellington.

[17] This number is an estimate, final numbers TBC. Further details of ACO deployment (including a map) will be included in the next version of the management plan.

the need for ACOs to adequately 'bed in' prior to checking. This limitation will be countered to the extent possible by deploying a high number and density of ACOs.

6.2.1.1.2 MANUAL DAY SEARCHING

Systematic manual searching will be undertaken in combination with ACO checks a minimum of three days prior to vegetation clearance and during appropriate weather conditions. Manual searches and destructive habitat searches before vegetation clearance will include:

- Turning over or pulling apart cover objects by hand (e.g., coarse woody debris or rocks);
- Raking of leaf litter or ground cover (e.g., pampas or tradescantia); and
- Habitat searches by hand of low growing epiphytes, dense low-growing vegetation, loose tree bark, fern skirts and woody debris.

6.2.1.1.3 NOCTURNAL SPOTLIGHING

Nocturnal spotlight searching for geckos will commence a minimum of 5 nights prior to clearance of indigenous forest. Nocturnal spotlighting will be limited to forest margin habitat where geckos can be readily detected. A minimum of 10 person hours spotlighting will be required across approx. 1 km of forest margin with an additional four person hours required for every gecko detected (to a maximum of 40 person hours searching). Nocturnal searches will be undertaken using powerful torches (minimum 1000 lumens) and binoculars to 'spotlight' and capture lizards. Nocturnal searches will focus on forest and shrubland edges, which provide suitable habitat for lizards and in which lizards are most readily detected. Nocturnal salvaging will also be undertaken in habitat away from the forest edge where this is considered by the project herpetologist to be suitable for salvaging. Spotlighting will include both visual detection of lizards and detection of lizard eye shine using binoculars.

6.2.1.1.4 EXCEPTIONS

In areas that are not dominated by indigenous vegetation cover, only manual searches and nocturnal spotlighting will be undertaken as per the above protocol. Use of ACOs and tracking traps will be implemented only to the extent that time allows. Additional urgent sites may be added to this list in consultation with DOC. For each site that is added, the magnitude of the residual effect on herpetofauna will be re-evaluated for the project to reflect any significant increase in the likely negative effects.

6.2.1.2 Construction-assisted Salvaging

On the morning of, but prior to any vegetation clearance, ACOs will be re-checked. During habitat clearance, construction (machinery) assisted salvaging during vegetation clearance activities will be undertaken in conjunction with:

- Clearance of low stature non-woody vegetation;
- Removal of large cover objects that cannot be searched manually (e.g., large decomposing logs); and

- Searching of all felled vegetation and associated epiphytes[18].

6.2.1.3 Pre-mulching Salvage

Felled vegetation once removed must be relocated nearby and organised into small windrows (no more than 3 m high) adjacent to existing standing vegetation (where possible) to enable geckos to disperse into remaining habitat. The stockpiles must be left undisturbed and visually day-searched once a week for three weeks before mulching if it is not possible to leave in-situ.

In any instances/locations where stockpiling is not feasible, potential lizard vegetation will be hand searched for geckos immediately after felling and prior to mulching, in accordance with Condition 13(2) of Schedule 4 of the OIC.

6.2.1.4 Data Collection

Each individual lizard salvaged will be assigned a number and the following information will be recorded:

- Date and time of capture and weather conditions;
- Capture methodology;
- Capture location (GPS coordinates), capture methodology, habitat type;
- Species, sex (reproductive status for females), age class, Snout to Vent Length (SVL), tail status (regenerating versus original tail), and overall health and condition; and
- A minimum of one photograph of each captured lizard will be taken, including at least one photograph showing the dorsal surface clearly.

6.2.2 Relocation Protocol

6.2.2.1 Capture, Handling and Transport

The following steps will be undertaken by the project herpetologist to ensure appropriate handling of lizards occurs. The transportation of all lizards will comply with the Animal Welfare (Transport within New Zealand) Code of Welfare[19].

Capture, handling, and relocation of lizards will be undertaken in accordance with the following methodologies:

- All field equipment that indigenous lizards may come into contact with (e.g., plastic enclosures, collection bags, scales, etc.) will be sterilised;
- Hand sterilisation will be undertaken;

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[18] As detailed in the Habitat Impact Management Plan (HIMP), typically, to minimise mortality and injury to indigenous lizard not detected during the above salvaging operations, felled trees deemed to be suitable for indigenous lizards would be stockpiled at the edge of remaining native vegetation for a minimum of one month, or until all foliage has fallen off. However, this is not a viable option due to the lack of available space for stockpiling.

[19] Ministry for Primary Industries (2018). Code of Welfare: Transport within New Zealand. MPI, Regulation and Assurance Branch, Wellington 6140

- Salvaged lizards will either be transported in cloth bags (only during salvage), or in suitable ventilated plastic containers (during transportation). Care will be taken to keep the bags and containers at a constant ambient temperature, and vegetation/leaf litter will be added to plastic containers to shelter and protect lizards during transportation;
- Where practical, lizards will be placed into ventilated two litre plastic containers for no longer than eight hours for transportation and relocation to the relocation site; and
- Salvaged lizards will be released into appropriately prepared habitat suitable for the species being relocated, in consultation with DOC.

6.2.2.2 Relocation Site

(To be discussed with DOC, Council, and mana whenua)

Lizards will be relocated into forest adjacent to the project footprint (at least 100 m but no more than 500 m from the project footprint) and into suitable species-specific micro-habitats that have been enhanced via:

- Mammalian pest and wasp control to improve the likelihood of relocation success; and
- Deployment of felled or fallen coarse wood that has been salvaged from the project footprint (specifics to be determined); to provide additional habitat for relocated lizards.

For each lizard, the following information will be recorded upon release:

- Date and time of release and weather conditions;
- Release location (GPS coordinates), habitat type; and
- Release photograph(s). For geckos this will include photographs to enable individual identification of relocated lizards.

6.2.3 Inadvertent Lizard Injury or Death

The following steps will be implemented if any injured or dead lizards are found during lizard salvage, in accordance with Conditions 11 and 12 of Schedule 4 of the OIC:

- The project herpetologist will notify DOC at the earliest opportunity within 24 hours after an injured or dead lizard is found;
- Any lizard death of Threatened, At Risk, or Data Deficient species shall be sent to Massey University Wildlife Postmortem Service for necropsy:
- The body is to be chilled if it can be delivered within 24 hours, frozen if longer than 24 hours to deliver.
- Appropriate measures shall be undertaken to minimise further lizard deaths;
- Injured lizards found during salvage will be taken to a suitably qualified vet as soon as possible for assessment and treatment. Injured lizards will be kept in an appropriate portable enclosure (i.e., a clean, well-ventilated plastic container) under the direction of the project herpetologist to ensure the animal is handled appropriately until the lizard(s) can be assessed and treated;
- Lizards assessed by the vet or alternative specialist as uninjured, or otherwise in suitable condition for release, will be transported to the lizard relocation site in the portable enclosure and released into habitat suitable for the species being relocated; and

- Euthanasia of an injured lizard shall only be undertaken under direction from DOC.

6.2.4 *Accidental Discovery Protocol*

All personnel working on site are responsible for alerting the Project herpetologist and the site manager in the discovery of any 'At Risk' or 'Threatened' herpetofauna not otherwise identified in this management plan on the same working day as the discovery.

Any 'At Risk' or 'Threatened' not identified in this management plan will be reported to the DOC Local Area Manager and Mana Whenua. All discoveries are to be recorded in a database with an incident register and log of actions taken for each discovery. All sightings must be reported to DOC via the ARD card system within 1 week of discovery.

6.3 Reporting

6.3.1 *Compliance Report*

A HIMP and this LMP will be provided to Council prior to the construction commencement date. The plan will be prepared by an appropriately qualified and experienced ecologist.

In accordance with Conditions 20(4) and (5), a lizard salvage report will be submitted to Council within three months of completion of salvaging and relocation operations.

This report shall include:

- Confirmation that lizard salvaging and relocation operations were undertaken in accordance with this LMP and associated consent conditions;
- Salvage and relocation results; and
- Representative photos showing:
    - The salvaging methodologies;
    - Lizards captured; and
    - Relocation site photos.

It is not proposed to monitor relocation success for lizards due to the inherent difficulties associated with assessing the success of relocation due to low sample sizes and difficulties with marking and discerning relocated animals from resident animals.

6.3.2 *Wildlife Act Reporting*

In accordance with Conditions 20(4) and (5) of Schedule 4 of the OIC, a lizard salvage report will be submitted to DOC within three months of completion of salvaging and relocation operations. Any additional reporting requirements outlined in the Wildlife Act Authority Permit (Authorisation TBC) will be adhered to. Lizard capture and relocation data will also be compiled, summarised, and submitted to DOC's national data repository for lizard records (the Bioweb Herpetofauna database) annually (by 30 June each year). As a minimum, the report will include the following information:

- DOC Wildlife Act Authority number and Project name and location;
- A summary of the species, numbers and age/sex classes of lizards captured alive or dead;
- Locations of lizards captured; and

- Summary of survey and salvage methodologies, effort, and success.
- Any difficulties encountered with capture of live lizards, any contingency actions undertaken and, if required, monitoring.

7 Avifauna Management Plan

This Draft Avifauna Management Plan (AMP) sets out measures for avoiding or mitigating actual or potential impacts on avifauna within vegetation associated with SH1 Brynderwyn Hills Recovery works.

This AMP is indicative and may require revision through consultation with contractors based on construction methodologies and site conditions. Adaptive management may be required depending on site conditions, or other unforeseen circumstances and site supervision by an ecologist during construction adjacent to or directly impacting potential bird habitat will be in place to recognise and address these eventualities.

Prior to commencement of works this AMP must be understood by all relevant construction site-works contractors and site project construction staff. This AMP requires implementation and oversight by a suitably qualified ecologist and should be implemented in conjunction with the other management plants included within this Ecological Management Plan.

The potential effects of the project on birds include:

- Habitat loss from felling of nesting trees;
- Injury or death as a result of vegetation clearance and construction activities.

Potential ongoing effects include:

- Decreased landscape and habitat connectivity through fragmentation until new habitat areas are established.

This management plan has been drafted to avoid, minimise, and mitigate these potential impacts. Any changes to the project, construction methodologies or timing of vegetation clearance that could impact bird habitat can only be conducted with prior consultation with, and written approval from, the project ecologist.

7.1 Key Species

All native birds, and their nests, regardless of their conservation status, are protected under the Wildlife Act. It is important that the procedures presented in this AMP are followed to avoid the risk of harm to native bird species during vegetation clearance and any relevant site establishment work where bird nests may be compromised.

A review of the eBird database[20] and iNaturalist provided a number of native and introduced species recorded in proximity to the project area. Observations on site and Acoustic Recordings Devices (ARDs) have also confirmed the presence of some of these species. One species is classified as “At Risk-Declining”, New Zealand pipit (Table 7-1). This AMP has been developed for protected birds most likely to be affected by the Project as listed in Table 7-1.

20 NZ Bird Atlas. (2023). Retrieved from the eBird database: https://ebird.org/atlasnz/home

Table 7-1: Key bird species that may require management on-site.

Scientific name	Common name	Māori name	Threat Classification
Anthus novaeseelandiae	New Zealand pipit	Pīhoihoi	At Risk - Declining
Apteryx mantelli	North Island brown kiwi	Kiwi-nui	Not Threatened
Circus approximans	Australasian harrier	Kāhu	Not Threatened
Chrysococcyx lucidus lucidus	Shining cuckoo	Pīpīwharauroa	Not Threatened
Gerygone igata	Grey warbler	Riroriro	Not Threatened
Hemiphaga novaeseelandiae	New Zealand pigeon	Kererū	Not Threatened
Hirundo neoxena neoxena	Welcome swallow	Warou	Not Threatened
Petroica macrocephala	Tomtit	Ngirungiru	Not Threatened
Prosthemadera novaeseelandiae novaeseelandiae	Tui	Tūī	Not Threatened
Rhipidura fuliginosa	New Zealand fantail	Pīwakawaka	Not Threatened
Todiramphus sanctus vagans	New Zealand kingfisher	Kōtare	Not Threatened
Zosterops lateralis lateralis	Silvereye	Tauhou	Not Threatened

7.2 Habitats

The habitats utilised by key bird species for nesting include predominantly arborescent vegetation, forest floor and stream beds/wetted areas (

Table 7-2). The clearance and project activities across these habitats may disturb, injure, or kill protected birds if occurring during nesting and fledging seasons. Where avoidance of key species' nesting periods cannot occur, pre-start nest checks by a suitably qualified ecologist, must be undertaken (Section 7.3).

Table 7-2: Months in which key species are known to lay eggs, based on habitat type on-site (NZ birds online, 2023)

Common name	Months												Nest type
	J	F	M	A	M	J	J	A	S	O	N	D	
Arborescent/forest vegetation													
North Island brown kiwi	■					■	■	■	■	■	■	■	Burrow, rock crevice, hollow tree, or log.
grey warbler								■	■	■	■	■	Enclosed dome
New Zealand kingfisher	■									■	■	■	Nests in single entrance tree cavities or burrows in banks
shining cuckoo										■	■	■	Grey warbler nest
New Zealand fantail	■							■	■	■	■	■	Nests in vegetation of trees, woven cup
Welcome swallow	■	■						■	■	■	■	■	Mud and grasses, typically on manmade structures
tui	■								■	■	■	■	Canopy or subcanopy, bulky structure of sticks and twigs
silvereye	■	■							■	■	■	■	Outermost branch of trees, shrubs and ferns, delicate woven cup
tomtit	■								■	■	■	■	Well concealed in thick vegetation or cavities
kereru	■	■	■	■	■	■	■	■	■	■	■	■	Platform of dead twigs, canopy
Open country													
Australasian harrier										■	■	■	Nest on ground in long grass or wetlands, or in low bushes and scrub
pipit	■	■						■	■	■	■	■	Woven cup of grass under tussocks, partly or fully covered with vegetation

■ = Egg laying

7.3 Pre-Clearance Nest Checks

It is best practice to avoid undertaking vegetation clearance within the general forest bird breeding season, September-February (inclusive). However, given the additional constraints with respect to bats and lizards, avoidance of vegetation clearance during the peak bird breeding season cannot be achieved, therefore pre-clearance checks for bird nests must be carried out.

Up to 48 hours prior to any ground disturbance or vegetation clearance, a visual inspection of the vegetation must be undertaken by a suitably qualified ecologist, to identify active nests. This timeframe is provided as an appropriate period in which it is unlikely for birds to create an active nest.

If no native bird's nests are discovered the Project Ecologist shall:

- Provide written authority for habitat clearance to commence including the following:

- The date in which the survey was conducted.
- A clear demarcation of habitats surveyed/approved habitat clearance area: preferably by a high-resolution map and or on-site demarcation, to ensure contractors are fully aware of the allowable clearance area.
- The date in which clearance works must be completed by (within two days).
- If the habitat surveyed is not cleared within two days, another nest survey must be conducted of remaining habitat.

If an inactive nest is identified during surveys, the Project Ecologist shall:

- Confirm the nest status as inactive by undertaking visual checks inside the nest, monitoring of the nest for up to 30 minutes to ensure no birds return to the nest, and listening for chicks inside the nest. Details of the nest are to be recorded including species, photos, vegetation type, GPS location, the method by which the next was confirmed inactive, and the assessing ecologist's name.
- Notify the contractor immediately and arrange for habitat clearance the same day. Following completion of all other required pre-clearance checks. If clearance the same day is not possible, then an additional pre-clearance survey immediately prior to disturbances or habitat clearance at the site will be required.

If an active nest is identified during surveys, the Project Ecologist shall:

- Clearly identify the site with flagging tape and notify the contractor immediately. Define and demarcate an appropriate buffer (10m for arborescent nests, 20m for ground nests), to be determined by the Project Ecologist, around the nest.
- Conduct a visual survey to identify bird species. Record the nest found, species, photos, vegetation type, GPS location, and assessing ecologist's name.
- Provide a high-resolution map clearly defining the buffer zone within three working days, to the contractor, where no project related disturbances may occur.
- Provide in writing an estimated nesting period and stand down time until chicks have successfully fledged.
- Follow up surveys must be undertaken to confirm that chicks have fledged. Once the Project Ecologist is confident and has provided written authority that there is no residual risk of harm to birds, clearance for that area may recommence.

7.3.1 Pre-Clearance Kiwi Searches

There is a known Piroa kiwi population and in 2023 the Piroa Conservation Trust completed an extensive ARD survey across the Piroa-Brynderwyn Range. The closest detection in the survey was within three kilometres of the project site (Wilson, T. 2023). At least one female kiwi has since been detected by two acoustic devices placed approximately 83 and 130 m upslope of the site, but, as juvenile and subadult kiwi do not call and can disperse many kilometres from nests we cannot be certain of the numbers present in the area. ARD, trail cam and night listening and soliciting surveys are being implemented within and in proximity to the Project Footprint to assist with detection of kiwi onsite.

Presence of kiwi within the project site will be assumed to manage the risk and the project will be undertaken in accordance with the kiwi best practice manual[21], as required by Condition 22(2) of Schedule 4 of the OIC. Due to the small areas of vegetation removal to be undertaken on a daily basis, manual destructive searches overseen by accredited kiwi handlers will be undertaken to confirm no kiwi are present prior to construction works proceeding in a given day; works may only proceed on same day as kiwi manual searches have occurred. Should it not be possible to confirm absence due to complex underground hollows, a certified kiwi dog will be required to sweep the feature to confirm absence prior to works proceeding, until such time as our confidence from the ARD, trail cam and night listening and soliciting indicates absence.

Should a resident kiwi population be confirmed present from ARDs, kiwi call listening/soliciting and trail camera use, a full kiwi management plan will be developed and enacted. Should young dispersing non-territorial kiwi be detected, the manual daily search requirement immediately prior to vegetation clearance will continue.

If kiwi are detected DOC will be informed immediately with 24 hours of detection confirmation.

7.4 Accidental Bird Injury or Mortality

In the event of finding a dead or injured native bird during clearance works, or any phase of the project, the following procedures must be followed:

- If not on-site at the time, the project ecologist must be notified immediately and be informed of the circumstances in which the bird was found or injured.
- Injured native birds should be placed in a cool, dark material lined box or bag and must be taken immediately to the nearest veterinarian for assessment.
- The local DOC office of DOC hotline must be notified within 48 hours of any incident regarding injury or death to native birds.
- The veterinarian will make an assessment as to whether the bird is able to be rehabilitated, and a plan for its rehabilitation and release should be discussed in conjunction with a DOC representative and the project ecologist.
- Any bird dead or euthanised by the vet will be taken to the local DOC office.
- A review should be undertaken to determine why the incident occurred and this management plan should be updated, to ensure no further incidents of the same nature.

7.5 Reporting

An avifauna management completion report shall be submitted to the client, Councils, DOC, and mana whenua within three months of completion of avifauna management. The completion

[21] Colbourne, R., Bean, E., Coad, N., Ruchs, R., Graham, I., Robertson, H., & Scrimgeour, J. (2020). *Kiwi Best Practise Manual*. Department of Conservation, Wellington.

report shall detail the management employed on-site throughout the project and a compilation of the records kept.

8 Freshwater Management Plan

This Freshwater Management Plan (FMP) sets out measures for avoiding or mitigating actual or potential impacts on freshwater habitats and fauna within affected watercourses and wetlands associated with State Highway 1 (SH1) Brynderwyn Hills Recovery works.

This FMP is based on best practice guidelines[22]. It is indicative and may require revision through consultation with contractors based on construction methodologies and site conditions. Further on-site, adaptive management may be required depending on site conditions, species encountered, or other unforeseen circumstances and site supervision by an ecologist during construction adjacent to or directly impacting freshwater systems will be in place to recognise and address these eventualities.

Prior to commencement of works this FMP must be understood by all relevant construction site-works contractors and site project construction staff. This FMP requires implementation and oversight by a suitably qualified ecologist and should be implemented in conjunction with the other management plants included within this suite of Ecological Management Plans.

The proposed work area along the SH1 road corridor is traversed by a number of streams and overland flow path. The potential effects of the proposed recovery works relate to trenching and excavation of stream beds and banks, temporary bunding of watercourses, post-construction reinstatement and permanent infilling of watercourses, along with disturbance of sediment within stream catchments during cutting, filling, and excavation. The streams and proposed earthworks areas are indicated in Figure 8-1 below.

The potential effects of these activities on freshwater systems include:

- Possible loss of wetland values or extent;
- Direct loss of stream habitat in infilled areas.
- Sedimentation from earthworks in the streams and their catchment, which could impact instream habitat quality;
- Geomorphological impacts (bank collapse, disturbance of the bed) from earthworks in stream areas;
- Direct disturbance or death of freshwater fauna in the construction zone;
- Loss of fish passage in infilled areas; and
- Disturbance of fish spawning and migration.

This management plan has been drafted to avoid, minimise, and mitigate these potential impacts. Any changes to the project, construction methodologies or timing of in-stream works that could

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22

Ministry for the Environment. (2021). *National works in waterways guideline. Best practice guide for civil infrastructure works and maintenance.* Wellington: Ministry for the Environment.

impact freshwater habitat or fauna can only be conducted following prior consultation with, and written approval from, the project ecologist.

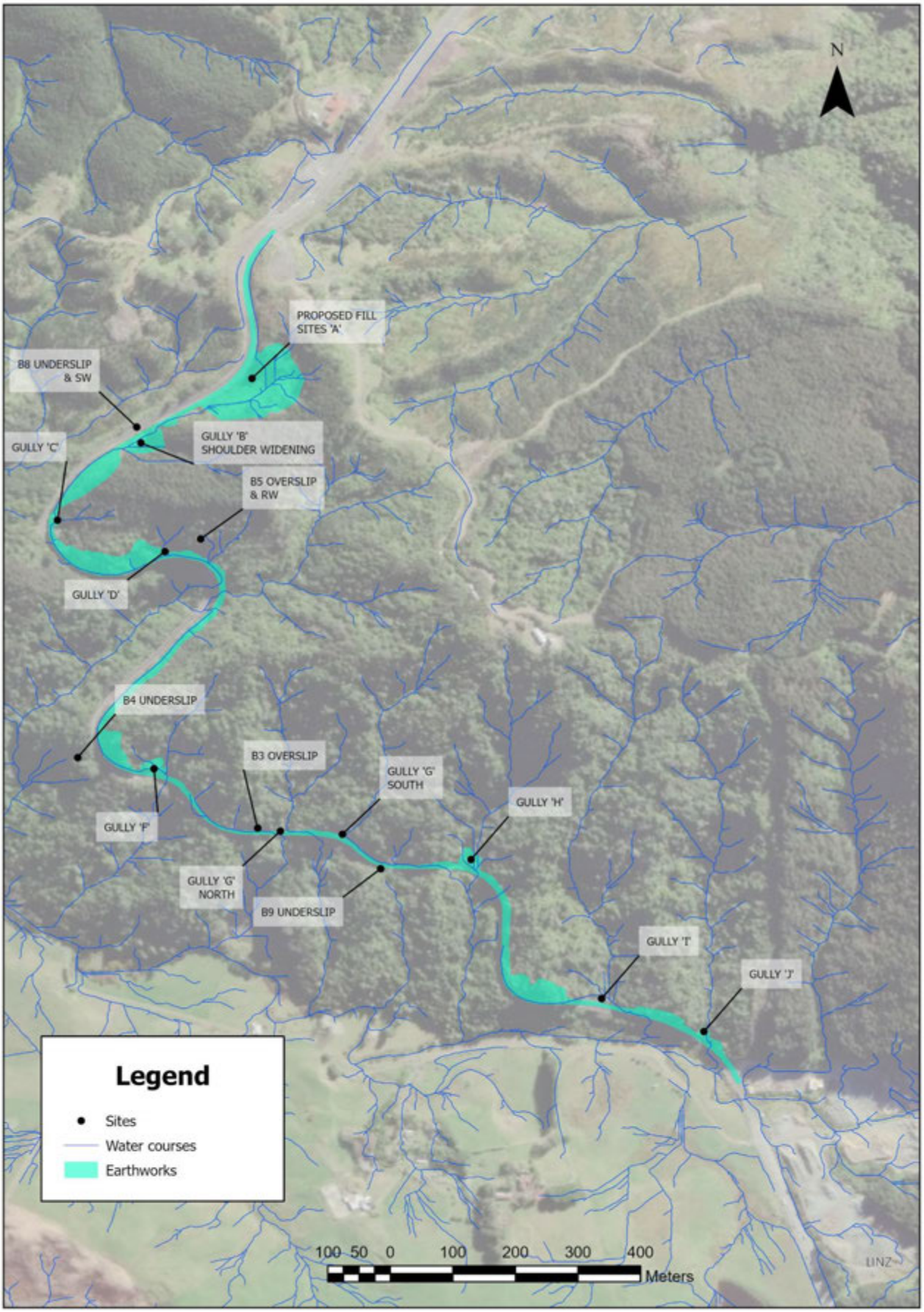

Figure 8-1: Overview of the project footprint, with streams and planned earthworks indicated.

8.1 Wetlands

Only one wetland has been identified within the Project Footprint. The wetland is located within fill site B and is an intermittent seepage wetland. The potential wetland does not exhibit surface water and aquatic fauna is not a consideration, although it feeds the small, seasonal stream that flows through fill site B.The following protocol will be applied to the identified wetland and to any other wetlands, in the event of accidental discovery.

- All potential wetlands must be delineated following the wetland delineation protocols[23]. ecologist.
- Where practicable, the wetland and a 20 m buffer around the perimeter must be physically designated as a no-go-zone using danger tape or fencing and excluded from construction activities. The wetland at fill site B cannot be avoided and will be entirely lost to infilling.
- An assessment of effects must be completed for any works within 100 m of any wetland that will be retained, along with a baseline assessment of wetland condition. .
- If wetland lies within or directly downslope of a work area that cannot be modified to avoid impacts on the wetland and buffer, a detailed wetland assessment must be completed, sufficient to inform offsetting and/or compensation.Where the wetland values will be impacted, but not extent, a supplementary management and monitoring plan must be drafted and attached to this management plan which details the avoidance, minimisation and remediation actions .
- Where the wetland extent will be lost due to infilling, hydrological changes or any other factor, the value and extent of wetland lost must be documented.

8.2 Stream Habitat

The streams that traverse the proposed site are generally in good condition. Pre-existing impacts include presence of invasive plant species in the riparian zone, litter near the road, and historical geomorphic impacts from road construction.

The planned activities on the site include earthworks within the catchments and streams, along with infilling of several stream reaches. The most significant areas of stream impact include infilling at:

- A 140 m stream reach at fill site A, along with several additional small overland flow paths,
- Two 25 m stream reaches at gullies F and G.

Small areas of infilling will also occur at each stream that crosses the road at each gully site (refer to Figure 8-1).

The following avoidance, minimisation and remediation measures must be implemented:

[23] Ministry for the Environment. 2022. Wetland delineation protocols. Wellington: Ministry for the Environment.

- Demarcate each stream and a 20 m buffer around each stream, where these fall within 50 m of the general work area.
- Demarcate any required work areas (including access routes) within the stream and buffer zone. These work areas must cover the smallest footprint that is practically possible to undertake the required work.
- Designate all stream and buffer areas outside of the required work areas as no-go zones where vehicle/machinery access, stockpiling, clearing or other activities that may impact streams, vegetation, soil, or wildlife are prohibited.
- Ensure that effective sediment controls are implemented in line with the requirements of Schedule 2 of the OIC.
- Ensure that aquatic fauna is managed in accordance the provisions set out below.
- All streams that will be lost or otherwise impacted must be surveyed by means of the Stream Ecological Valuation protocol to record the baseline value.
- Post-construction SEV surveys must be undertaken to document stream recovery and quantify the residual effect.

Concrete Management

Wet concrete can introduce a variety of chemicals to watercourses that may be very harmful to aquatic organisms. This includes increased pH due to release of hydroxyl ions. The latter phenomenon may continue after concrete has set. Manage risk of concrete contamination at culvert sites and any other locations within 50 m of a watercourse.

- Minimise use of concrete in or within 50m of a stream as far as possible.
- Use pre-cast concrete wherever possible to maximise drying time before use. Ideally all precast should be at least a week old before installation.
- Flush or hose off the pre-cast concrete off-site prior to installation in a location where the runoff does not cause ecological harm.
- Concrete structures poured in-situ need to be isolated to dry thoroughly before flow is allowed to return. They may be kept wet (ideally) or dry, but must be isolated from the stream and from frogs & fish. Where concrete is within a stream course (e.g. a culvert), it may need to be separated by physical barrier, but this should be as directed by the relevant on-site ecologist tasked for the purpose. It is assumed that over-pumping forms a key part of this process.
- All concrete structures within 30 m of a watercourse must be flushed with locally abstracted water with a verified pH of between 7 and 7.6. The area affected by the flushing must be, to the satisfaction of the on-site ecologist, free from frogs, fish and other vulnerable wildlife. The outlet of the structure or group of structures must be closed such that water cannot flow into the stream downslope. The flushing water should be pumped out and disposed of safely, offsite.
- A small amount of water (volume simulating normal streamflow) will be put through the structure/structures and then the pH measured where it collects at the closed outlet immediately after it has collected (to simulate through flow). If the pH is between 7 and 7.8, the culvert may be opened. If not, the culvert must be flushed as many times as required for the pH to stabilise.

- Once the pH falls within the target bracket, the culvert may be opened, keeping the over-pumping live. Inflowing and outflowing pH must be measured after opening. If the outflowing pH still falls within the desired range, the over-pumping may be deactivated and the related temporary infrastructure may be removed.

8.3 Key Freshwater Fauna Species

A desktop assessment of the New Zealand Freshwater Fish Database NZFFD was undertaken, and the potential fish and crustacean species identified are presented in the table below. Of these, only one crayfish and two eel species (in bold) were noted by means of EDNA sampling. Longfin eel (*Anguilla dieffenbachii*) is listed as “At Risk – Declining”. An array of other freshwater invertebrates were also identified, but no threatened species were noted.

Table 8-1: Freshwater fish and crustacean species identified in the NZFFD assessment. Species confirmed on site with eDNA are indicated in bold.

Scientific name	Common name	Māori name	Threat classification
Anguilla dieffenbachii	longfin eel	tuna	At Risk - Declining
Anguilla australis	shortfin eel	tuna	Not Threatened
Galaxias fasciatus	banded kokopu	kōkopu	Not Threatened
Gobiomorphus basalis	Cran's bully	titikura	Not Threatened
Gobiomorphus cotidianus	common bully	toitoi	Not Threatened
Gobiomorphus huttoni	redfin bully	tīpokopoko	Not Threatened
Paranephrops planifrons	northern freshwater crayfish	kēkēwai	Not Threatened
Paratya curvirostris	freshwater shrimp	kōuraura	Not Threatened

8.4 Avoidance

Where practicable, instream works should avoid the spawning periods for indigenous fish and crayfish present. A summarised spawning calendar[24], including known peak spawning periods for those present within the site and those potentially present downstream, is provided below in Table 8-2 below. Of these, the bullies and crayfish tend to breed during the summer months, while banded kokopu tend to breed primarily in midwinter. There is no period during which the catchments are likely to be free of spawning activity. The northern freshwater crayfish is the only known species present on site that could spawn within the stream. However, the potential disruption to crayfish spawning activity in the localised work areas is likely to be of lesser impact than that caused by sedimentation if work were completed in winter to avoid their spawning season. It is therefore recommended that work proceed during the summer months.

Table 8-2: Spawning periods for indigenous freshwater species present within the site and those potentially be present downstream.

	Summer			Autumn			Winter			Spring		
Species	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
Banded kōkopu												
Cran's bully												
common bully												
redfin bully												
northern freshwater crayfish												

8.5 Sedimentation Management

An appropriate Erosion and Sedimentation Control Plan must be drafted and implemented in line with the provisions of Schedule 2, Condition 8 of the OIC (as required for the later resource consent

[24] Smith, J. (2014). Freshwater Fish Spawning and Migration Periods—Prepared for Ministry for Primary Industries. National Institute of Water & Atmospheric Research Ltd.

application). The provisions of Condition 8 of Schedule 2 of the OIC are sufficient that no further management measures will be required to address wildlife impact.

8.6 Fish Passage

Culverts have the potential to restrict fish passage to upstream habitats if constructed poorly. Where practicable, culverts will be constructed in accordance with New Zealand fish passage guidelines[25]. Culvert design will consider the order of preference outlined in the New Zealand fish guidelines (Figure 8-2).

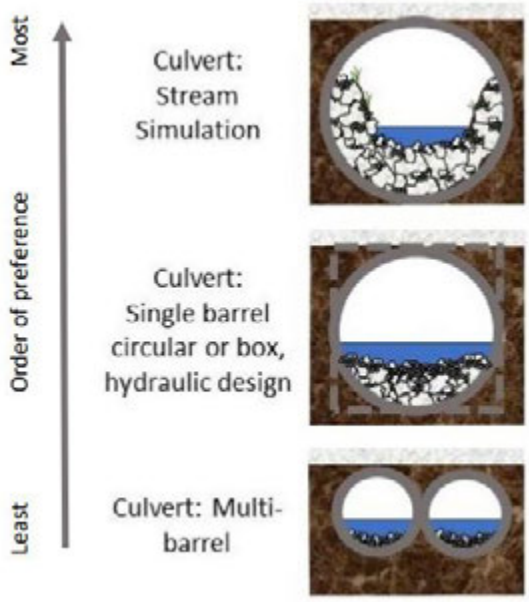

Figure 8-2: Order of preference for culvert design, based on the degree of connectivity each design facilitates.

Where culverts cross minor tributaries that do not presently exhibit fish passage, these do not need to comply with the fish passage requirements. These will be confirmed on site by the project freshwater ecology lead.

Eels are excellent climbers and seldom require the full scope indicated in the fish passage guidelines. Should there be any culverts carrying streams where eels are present (as indicated by eDNA or other sampling results), but where it is not feasible to comply with all the requirements of the fish passage guidelines, the culvert must be designed in consultation with a freshwater ecologist, such that fish passage for eels is maintained.

8.7 Freshwater Fauna Salvage Protocols

The proposed dewatering and infilling of the streams is likely to result in death of aquatic fauna. Implementing these freshwater fauna salvage protocols will minimise the likelihood of freshwater fish and freshwater crayfish death.

A combination of fish salvage methods will be applied, and site-specific implementation of the methods will be at the discretion of the project ecologist, based on the assessment of

[25] Franklin, P., Gee, E., Baker, C., Bowie, S (2018) New Zealand fish passage guidelines for structures up to four metres. National Institute of Atmosphere and Water. NIWA Client Report No. 2018019HN

microhabitats and the likelihood of freshwater fauna presence within each watercourse. Adaptive management may be required due to site conditions, seasonal timing, construction activities or other unforeseen circumstances.

The project ecologist has discretion to include or exclude areas of salvage based on human health and safety, quality of in-stream habitat and suitability to conduct these methods within a given watercourse.

8.7.1 Salvage Footprint

Fish will be salvaged at every location where significant earthworks, particularly infilling, will take place within a stream. Refer to Figure 8-2 above.

8.7.2 Worksite Isolation

Prior to any fish salvage methods being employed, fish exclusion barriers must be installed upstream of the construction area, isolating the area, and preventing freshwater fauna from entering the construction area. The locations of the fish exclusion barriers will be agreed upon by the contractors and the project ecologist, to avoid the need for barrier removal and re-installation during construction.

Earth bunds must be installed in any watercourse requiring dewatering to isolate the area.

8.7.3 Trapping

As the watercourses are largely headwater streams and tributaries, water levels are likely to vary greatly between dry and rainfall periods, and between each watercourse. As such, the exact number of traps will be determined by the water level, and subsequent available habitat at the time of salvage. As the objective is to remove all fish present, trap densities will likely be much higher than monitoring recommendations [26].

Due to restrictions imposed by the watercourses (narrow channel width and depth) gee minnow funnel traps will be the only effective trapping method.

The fish trapping methodology is as follows:

- Trapping will occur for a minimum of three nights within each watercourse prior to the commencement of in-stream works;
    - If indigenous freshwater fauna with a threat classification of 'At Risk -Declining' are captured during the first three nights, trapping will continue until no more 'At Risk – Declining' freshwater fauna are captured during a single night.
    - If, on the third night of trapping, the quantity of 'Not Threatened' freshwater fauna exceeds 50% of that of the first night's results, additional trapping may be required. Additional salvage efforts will be at the discretion of the project ecologist and the method used will be based on the species trapped on that night. For example, if freshwater crayfish are the predominant species captured, additional gee minnow

[26] Joy, M., David, B., & Lake, M. (2013). *New Zealand Freshwater Fish Sampling Protocols, Part 1—Wadeable Rivers & Streams*. The Ecology Group - Institute of Natural Resources.

funnel traps will be the most productive method while if kōkopu are the predominant species captured (although unlikely as they have not been recorded by eDNA), spotlighting will be the most productive method.

- Traps shall be installed to target species within varying habitats.
- Gee minnow funnel traps will be distributed throughout the watercourses at a minimum density of four per 10 m.
- Gee minnow funnel traps shall be baited with cat biscuits and will be installed in areas adjacent to undercut banks, and within habitats such as riffles.
- All traps must be installed in such a way to minimise mortality of fish (e.g., in areas of low flow, ensuring the top of the trap remains above the surface of the water to allow fish to gulp air).
- Efforts will be made, where possible, to install traps in such a way that encourages fish to enter them (e.g., placing traps in riffles).
- Traps must be checked daily. Daily baiting and redeployment will occur for the duration of the trapping phase for each watercourse. Traps may be redeployed in the same locations or redistributed based on the results of trapping and/or incidental fish observations.

8.7.4 Spotlighting

Spotlighting is an effective way to identify and capture species that may otherwise evade other salvage methods and will be implemented if these species are observed or recorded. Multi-pass fish salvage methods have been proven to catch a higher proportion of freshwater fauna present. As such, multi-pass spotlighting surveys will be implemented in conjunction with trapping efforts.

Watercourses will be assessed for their suitability to conduct spotlighting during daytime installation and/or checking of traps. Watercourses may be omitted from spotlighting efforts based on the likelihood of fish presence, watercourse condition or for health and safety reasons.

If spotlighting is undertaken, the spotlighting methodology will be as follows:

- Spotlighting must begin a minimum of 45 minutes after sunset.
- Using a minimum of two people, slowly walk upstream either side of the watercourse, being careful not to spook any freshwater fauna or stir up sediment within the watercourse. To further prevent disturbing or spooking any freshwater fauna, avoid spotlighting more than 1-2 metres ahead.
- A minimum of three passes of spotlighting effort per watercourse must be implemented.
- Two hand / dip nets should be used to salvage any freshwater fauna located. One net is placed in front of the fish and remains stationary. The other net is used to guide the fish from behind and spook it into the first net.

8.7.5 Construction Supervision

The project ecologist will release the site for construction once they are satisfied sufficient trapping and spotlighting efforts have been undertaken. Works cannot begin until the project ecologist has provided authority to do so.

Some freshwater fauna may avoid trapping. As such, certain construction activities, such as dewatering and mucking out, will require supervision by a suitably qualified ecologist to ensure any freshwater fauna at risk of injury, death or becoming stranded are salvaged.

The edges of banks, and other areas likely to dry out must be monitored during the dewatering process. All soft sediment and bank material removed from the work site must be carefully removed and spread out in an appropriate location on-site for ecologists to survey. Any fauna observed during the dewatering and mucking out stages shall be salvaged and released as detailed below in Sections 8.8 and 8.9 below.

8.8 Freshwater Fauna Holding and Handling

Following capture, all fauna will be held in a lidded bucket with an appropriate volume of clean stream water. If necessary, an air stone fitted to a battery powered air pump will be added to buckets to increase surface diffusion. Fauna will be separated into different containers based on size and the potential for predation during the temporary holding process to ensure welfare is not compromised. Fauna will be transferred to the release sites regularly to avoid high densities of fauna within the buckets as conditions dictate (i.e., daily temperature).

Manual handling of fauna will be kept to a minimum. All fauna must be handled with wet hands during the identification and measuring process immediately prior to release.

Pursuant to Special Permit (SP775) (ref) the following information will be recorded for all salvaged fauna:

- Date of capture
- Species
- Size (mm) of all individuals
- Number caught
- Capture method
- Capture and release locations (GPS coordinates)
- Fate of all fauna taken

8.9 Freshwater Fauna Relocation and Release Sites

Pursuant to NFT355, all salvaged freshwater fauna must be released at the nearest suitable location outside the construction site and zone of influence (ZOI). The project ecologist must ensure that all salvaged fauna are released in a distributed manner within the release sites, particularly when releasing a large quantity of freshwater fauna at one time. This will reduce the risk of predation or overstocking at a single release site.

Freshwater fauna release sites must contain suitable habitat for those species being released. Release sites may vary, depending on salvage timing and possible migration patterns for the species captured. Upstream sites should be selected wherever possible to minimise exposure to sedimentation during construction. Efforts will be made to release freshwater fauna within the watercourse they were salvaged from, but all freshwater fauna will be released within the appropriate catchment as per NFT355. GPS locations of each release site will be recorded by the project ecologist.

9 Invertebrate Management Plan

This Invertebrate Management Plan (IMP) sets out measures for avoiding or mitigating actual or potential impacts on native invertebrates within affected vegetation associated with the Brynderwyn Hills Recovery works.

This IMP is indicative and may require revision throughout consultation with contractors based on the construction methodologies and site conditions. Further on-site adaptive management may be required depending on site conditions, species encountered, and/or other unforeseen circumstances. Site supervision by an ecologist during construction adjacent to or directly impacting potential invertebrate habitat will be in place to recognise and address these eventualities.

Prior to commencement of works this IMP must be understood by all relevant construction site-works contractors and site project construction staff. This IMP requires implementation and oversight by a suitably qualified ecologist and should be implemented in conjunction with the other management plants included within this Ecological Management Plan.

The potential effects of the project on invertebrates from construction include:

- Habitat loss and degradation of adjacent habitats via fragmentation, isolation, disturbance (noise, light, and dust) and edge effects (altered bio-physical conditions); and
- Injury or death as a result of vegetation clearance and construction activities and deposition of fill.

Potential ongoing effects from the project include:

- Decreased landscape and habitat connectivity through fragmentation until new habitat areas are established;
- Potential effects associated with the increased presence of people and introduced species in previously less accessible areas, due to ongoing wildlife management, particularly near monitored or managed fauna release sites.

This management plan has been drafted to avoid, minimise, and mitigate these potential impacts. Any changes to the project, construction methodologies or timing of vegetation clearance that could impact invertebrate habitat can only be conducted with prior consultation with, and written approval from, the project ecologist.

9.1 Key Invertebrate Species

A desktop assessment was conducted to identify threatened and protected invertebrate species which are likely to be, or could potentially be, present within the site's footprint and the surrounding area. This assessment included a review of the iNaturalist database[27] and relevant literature.

[27] iNaturalist, "iNaturalist," n.d., accessed November 20, 2023.

Two At Risk species have known distributions which overlap the project site and have iNaturalist records within ~6 km of the project area; rhytid snail[28] (*Amborhytida dunniae*) and kauri snail (*Paryphanta busbyi*) (Table 9-1). One potential rhytid snail shell (identification was not confirmed) has also been found within the project area. Kauri snails are legally protected under the Wildlife Act 1953[29] and both species are classified as At Risk-Declining[30].

The distribution of a 'Not Threatened' peripatus species, *Perioatoides sympatrica*[31] also overlaps with the project area. Though the closest peripatus observations are ~ 35 km from the project area. These observations are likely to be *P. sympatrica* based on the known distributions of peripatus species. *P. sympatrica* is not threatened or protected and therefore specific management is not required. However, effects on this species are not well understood due to the limited knowledge of their taxonomy and ecology. Therefore, a precautionary approach should be applied regarding their management for construction works.

Based on the desktop assessment outcomes described in this section, this IMP has been developed to avoid, minimise, and remedy actual and potential impacts to the invertebrate species outlined in Table 9-1. Any reference to invertebrates in this IMP is specifically referring to the three species listed.

Table 9-1: Invertebrate species potentially present within the project area that will be managed by this IMP.

Scientific Name	Common Name	Māori Name	National Threat Classification	Protected (Schedule 7)
Amborhytida dunniae	rhytid snail	-	At Risk - Declining	-
Paryphanta busbyi	kauri snail	pupurangi	At Risk - Declining	Yes
Peripatoides sympatrica	peripatus	ngaokeoke	Not Threatened	-

Quantitative invertebrate surveys have not been undertaken to date:

- The considerable level of effort required to confirm species presence in the time available;
- Difficulties in undertaking nocturnal surveys along a state highway due to site accessibility and health and safety constraints; and
- Low detectability of invertebrates.

To address survey constraints and limitations and in alignment with the precautionary principle, this IMP conservatively assume that:

[28] Both *Paryphanta busbyi* and *Amborthytida dunniae* are within the Rhytidae family (i.e., both "rhytids"), however, Amborthytida dunniae has no common name so in this report is referred to as 'rhytid snail'.

[29] New Zealand Government, "Wildlife Act" (Wellington, New Zealand, 1953).

[2] Mahlfeld, K., Brook, F. J., Roscoe, D. J., Hitchmough, R. A., Stringer, I. 2012: The conservation status of New Zealand terestrial Gastropoda excluding Powelliphanta. New Zealand Entomologist 35(2): 103–109

[31] Trewick, S., Hitchmough, R., Rolfe, J., Stringer, I. 2018: Conservation status of New Zealand Onychophora ('peripatus' or velvet worm), 2018. New Zealand Threat Classification Series 26. Department of Conservation, Wellington. 3 p

- All invertebrates that are potentially present are present, albeit at low to moderate densities; and
- Invertebrate populations are considerably lower than maximum carrying capacity due to the ongoing impacts of introduced mammalian predators.

9.2 Invertebrate Salvage and Relocation

Invertebrate salvaging is proposed to reduce mortality or injury during vegetation clearance. A high-level assessment of invertebrate habitat has already been undertaken and assessed all forest within the Project Footprint as potential invertebrate (snail and peripatus) habitat. Therefore, all vegetation clearance within forests will require the implementation of the salvage and relocation protocols as described below.

The protocols for invertebrate salvage and relocation specified below have been prepared in accordance with best practice and have taken into consideration protocols as described in the DOC inventory and monitoring toolbox for invertebrates[32]. The methodologies have been adapted in this IMP for local site conditions and programming constraints. Ensure that an ecologist provides a briefing at the onsite induction to ensure that the measures indicated in this management plan are implemented correctly.

9.2.1 Invertebrate Salvage Protocols

For the purposes of salvages and relocations, manual habitat searches must take place for invertebrates, including the empty shells of snail species, immediately prior to, and following, vegetation clearance in all indigenous forest habitats. These searches are to take place at the same time and in conjunction with lizard salvage protocols as described in the Lizard Management Plan (LMP).

Salvaging will be completed using methods as described below and must take place during the period of October 1st to April 30th inclusive. The suitable seasonal conditions during this period result in greater activity levels from invertebrates, increasing the probability of detection. Invertebrate species may be less active during periods of dry weather and therefore less detectable, making searches less effective.

The specific salvage methodologies will be guided by the project ecologist based on their assessment of the vegetation to be removed. The project ecologist has discretion to include or exclude areas based on the type and quality of habitat being cleared, and must be present onsite during salvaging operations until s/he deems salvaging ecologists to be adequately trained.

9.2.1.1 PRE-CONSTRUCTION SALVAGING

MANUAL DAY SEARCHING

[32] Evans, A. (2016). *Inventory and monitoring toolbox: Invertebrates*. Department of Conservation, Wellington.

Systematic manual and destructive searches during daylight hours will be conducted for both live invertebrate specimens, and for snail shells before vegetation clearance. Searches will take place systematically, with an initial site walk over to identify microhabitats with the most suitable habitat. Suitable habitats are those with moist soils, abundant leaf litter, rotting logs and debris, and/or low growing vegetation. Searches may include:

- Turning over or pulling apart cover objects by hand (e.g. coarse woody debris or rocks);
- Raking of leaf litter or ground cover (e.g. pampas or tradescantia); and
- Habitat searches by hand of low growing epiphytes, dense low-growing vegetation, loose tree bark, fern skirts and woody debris.

NOCTURNAL SPOTLIGHTING

Several snail species, including kauri snails (*P. busbyi*), are known to burrow into soft soils during the day[33]. This behaviour may result in failure to detect kauri snails in surveys undertaken during daylight hours. Therefore, where it is safe to do so, nocturnal spotlight searching for snails will commence a minimum of five days prior to clearance of indigenous forest (alongside nocturnal spotlighting for lizards as outlined in the LMP).

9.2.1.2 Construction Assisted Salvaging

Construction (machinery) assisted salvaging during vegetation clearance activities will be undertaken in conjunction with:

- Clearance of low stature non-woody vegetation;
- Removal of large cover objects that cannot be searched manually (e.g. large decomposing logs); and

9.2.1.3 Data Collection

For all individual invertebrate salvaged the following data must be collected for reporting purposes:

- Date and time of collection, including weather conditions;
- Photographs of salvage site, photograph of the invertebrate specimen, length measurement and species identification of all individuals collected; and
- GPS coordinates for where which each individual specimen was captured, and relocated to.

9.2.2 Relocation Protocols

Any individuals which are found during before and during vegetation clearance searches are to be relocated from the works area. Empty snail shells will also be relocated to provide calcium for relocated snails.

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[33] Gruijters, T. (2018). *Predation at a snail's pace. What is needed for a successful hunt?* https://doi.org/10.1101/420042

9.2.2.1 Capture, Handling, and Transport

All capture and handling must be done under the supervision of the lead project ecologist. All assisting staff on-site, including contractors, shall be provided appropriate briefing by the project ecologist (or ecologists s/he deems to be adequately trained) to ensure handling and transport protocols are followed.

For the capture, handling, and transport of any snails and peripatus the following protocols must be implemented:

- All equipment that may come into contact with the invertebrates during fieldwork (e.g., plastic enclosures, collection bags, scales, etc.) will undergo sterilisation.
- All persons involve with any salvage and translocation work are required to sterilise their hands.
- Salvaged invertebrates will be transported in well-ventilated plastic containers, ensuring that the containers are maintained at a cool temperature. A minimum of 30 mm of moist vegetation/leaf litter will be added to provide shelter and protection during transportation.
- Whenever possible, invertebrates will be placed in ventilated two litre plastic containers for a duration not exceeding eight hours during transportation to the relocation site.
- Salvaged invertebrates will be released into appropriately prepared and protected habitats suitable for the specific species being relocated.
- Snail shells will be transported to the relocation site in a plastic bag or container.

9.2.2.2 Relocation Sites

(To be discussed with DOC, council, and mana whenua)

Invertebrates will be relocated into forest adjacent to the project footprint (at least 100 m but no more than 500 m from the project footprint) and into suitable species-specific micro-habitats that have been enhanced via:

- Riparian planting (where required) to maximise habitat quality at release sites.
- Deployment of felled or fallen coarse wood that has been salvaged from the project footprint (specifics to be determined); to provide additional habitat.

For each snail, the following information will be recorded upon release:

- Date and time of release and weather conditions;
- Release location (GPS coordinates), habitat type; and
- Photographs of release site

9.2.3 Inadvertent Invertebrate Death

The following steps will be implemented if any snails are killed due to salvage or construction activities as per Wildlife Act Authority Permit (Authorisation no. TBC):

- The project ecologist will notify DOC at the earliest opportunity within 24 hours after the snail is killed;

- Ascertain from DOC whether the specimen is required for research purposes or whether it should be taken to the translocation site (note that this will depend on the quality of the specimen);
- Photograph the snail; and
- Undertake appropriate measures to minimise further snail deaths.

9.2.4 Accidental Discovery Protocol

All personnel working on site are responsible for alerting the lead Project ecologist and the site manager in the event of discovery of any 'At Risk' or 'Threatened' invertebrates not otherwise identified in this management plan on the same working day as the discovery.

Any 'At Risk' or 'Threatened' species not identified in this management plan will be reported to the DOC Local Area Manager and Mana Whenua. All discoveries are to be recorded in a database with an incident register and log of actions taken for each discovery.

9.3 Reporting

9.3.1 Compliance Report

A compliance monitoring report will be submitted to Council within three months of completion of salvaging and relocation operations.

This report will include:

- Confirmation that invertebrate salvaging and relocation operations were undertaken in accordance with this IMP and associated consent conditions;
- Salvage and relocation results including:
    - The species and number of any invertebrates captured alive or any empty snail shell released;
    - The species and number of any invertebrates found dead;
    - The GPS location and/or a detailed map of the collection and release points; and
    - The authorisation number and copies of any permits for those species; and
- Representative photos showing:
    - The salvaging methodologies;
    - Invertebrates captured; and
    - Relocation site photos.

It is not proposed to monitor relocation success for invertebrates due to the inherent difficulties associated with assessing the success of relocation. The invertebrate species being managed are cryptic and therefore there are inherent difficulties associated with detection. Not detecting the invertebrates during any post-salvage monitoring would not necessarily indicate that salvages have been unsuccessful.

9.3.2 Wildlife Act Reporting

Reporting requirements outlined in Wildlife Act Authority Permit (Authorisation no. TBC) will be adhered to. Invertebrate capture and relocation data will also be compiled, summarised, and submitted to DOC's national data repository for invertebrate records (the Bioweb Invertebrate database) annually (by 30 June each year). As a minimum, the report will include the following information:

- DOC Wildlife Act Authority number and Project name and location;
- A summary of the species and numbers of invertebrates captured;
- Locations of invertebrates captured; and
- Summary of salvage methodologies, effort, and success.

10 Biosecurity Management Plan

10.1 Introduction

The purpose of this Biosecurity Management Plan (BMP) is for all the project team members, partners involved in the Brynderwyn Hills Recovery project to be aware of and implement procedures and protocols that will minimise the likelihood of introduction, establishment, and dispersal of invasive organisms as a result of project related- activities.

Mammalian pest and invasive pest plant species, will be required to be managed where the project is likely to encourage, introduce or create opportunity for these species, with ecological scoping and baseline conditions establishment currently underway at the time of writing. These assessments and findings with be required to be workshopped with project partners and actions agreed and provided once scoping assessments have satisfied baseline information requirements. Presently there is minimal coordinated pest control efforts undertaken through this part of the Brynderwyn Forest Complex – Part A.

This BMP contains four sections, each sets out the monitoring requirements and protocols for managing biosecurity for the project.

- Section 9.2: Plant Pathogen Management
    - Section 9.2.1: Myrtle Rust Management
    - Section 9.2.2: Kauri Dieback (PA) Management
- Section 9.3: Pest Plants Management
- Section 9.4: Pest Animal Management

10.2Plant Pathogen Management

10.2.1 Myrtle Rust Management

Myrtle rust *(Austropuccinia psidii)* is a wind-borne fungal disease that can infect Taonga species found across the Brynderwyn Range. Myrtle rust is an 'unwanted organism' under the Biosecurity Act 1993. The rust attacks plants of the Myrtaceae family which include mānuka (*Leptospermum scoparium*), kānuka (*Kunzea sp.),* pōhutukawa (*Metrosideros excelsa*), Northern rātā *(Metrosideros robusta)* and their variants (MPI, 2019).

Myrtle rust was first detected in mainland New Zealand in 2017. MPI lead a response with the DOC and the support of regional councils. By August of 2018, the disease had spread and was found across most climatically suitable areas of the North Island and northern areas of the south. It became apparent that eradication or containment responses were not feasible, and efforts were scaled back to surveillance and management activities.

To reduce the risk of spread of myrtle rust myrtle species sourced as part of procurement activities must follow standard procedures set out by the New Zealand Plant Producers Incorporated (NZPPI) Biosecurity declaration. – Myrtle Rust Registration process when sourcing plants of Myrtaceae for revegetation activities. This certifies the respective nurseries have implemented the Myrtle Rust Nursery Management Protocol of which evidence of this should be supplied prior to delivery of any species to site.

Signs of Myrtle Rust have not been detected within the project site to date. Ecologists will continue to monitor myrtle species throughout the project. Below is a table of host species observed on site which have the potential to be affected by the pathogen.

Table 2 Host species with potential for myrtle rust onserved at the project site

Scientific name	Common name	Māori name	Threat classification	Ecological Value[6]
Kunzea robusta	kānuka	kānuka	Threatened – Nationally Vulnerable	Very High
Leptospermum aff. Scoparium	mānuka	mānuka	Threatened – Nationally Vulnerable	Very High
Metrosideros carminea	carmine rātā	carmine rātā	Threatened – Nationally Vulnerable	Very High
Metrosideros excelsa	pōhutukawa	pōhutukawa	Threatened – Nationally Vulnerable	Very High
Metrosideros robusta	northern rātā	northern rātā	Threatened – Nationally Vulnerable	Very High
Metrosideros fulgens	climbing rata	pōhutukawa	Threatened – Nationally Vulnerable	Very High
Metrosideros perforata	akatea	akatea	Threatened – Nationally Vulnerable	Very High

10.2.2 Kauri Dieback Disease (PA) Management

Kauri dieback disease *(Phytophthora agathidicida)* (PA for short) is a soil-borne pathogen that infects kauri (*Agathis australis*) via the tree's root system and restricts the trees' ability to transport water and nutrients internally, eventually starving the tree (Tiakina Kauri, 2023).

PA can infect kauri of any age with symptoms taking many years to visibly manifest, often by this late stage there is little that can be done to arrest the trees death (Tiakina Kauri, 2023).

Being soil-borne the pathogen can be easily spread by coming into contact with contaminated soil and / or plant material which is then transferred to other locations. Rain and storm events can trigger slips and instability and the downstream environment can receive PA by sedimentation to water bodies (Tiakina Kauri, 2023).

Preventing the movement of soil and plant material is fundamental for the protection of kauri. Practicing strict hygiene measures around footwear, equipment plant, machinery and vehicles is vital. Contractors and specialists involved in the project from the initial emergency response to the initiation of the Brynderwyn Hills Recovery project were experienced in the risk PA poses and are familiar with hygiene procedures required when undertaking soil removal activities and entering forest areas (Tiakina Kauri, 2023).

10.2.2.1 The National Pest Management Plan (NPMP)

The National Pest Management Plan (NPMP) is a biosecurity regulation made under the Biosecurity Act 1993. The NPMP is a legal framework that establishes clear national objectives and a consistent approach to managing the risk and impact of PA to New Zealand kauri forests, culture, communities, and economy. The NPMP provides access to powers under the Act to require specific actions of people that use or come into contact with kauri trees and forests.

Tiakina Kauri/Kauri Protection is the management agency established for the NPMP which is a unit of Biosecurity New Zealand. The agency is tasked with leading and coordinating efforts between Government councils, Mana Whenua, and non-governmental organisations with the shared goal of protecting kauri.

The National Plan for Kauri has introduced 10 Rules to help protect and conserve kauri. These rules can be found in Table 3with a comment on their applicability to the project.

10.2.2.1.1 REQUIREMENT FOR KAURI DIEBACK MANAGEMENT PLAN

Kauri *(Agathis australis)* is present across the Brynderwyn range and including in the Recovery works project footprint (Figure 10-1). There are several trees identified which are in proximity to areas instability and potentially at risk of further slipping. Kauri dieback is indicated as being found on the Brynderwyn Forest Complex from previous testing and maps online via (Figure 10-1, Tiakinna Kauri – Kauri Protection, 2023). The Project has requested further information regarding higher resolution mapping or spatial data to best appreciate the level of risk across the project site. Following receipt of this spatial information it will be incorporated into the project understanding and documentation.

Prior to receipt of detailed spatial PA information, a precautionary approach is taken and assumes PA presence.

Activities associated with the project that require management to limit the risk of exacerbating the risk include:

- Topsoil removal, slip removal, stockpiling, and bulk earthworks over a 2.4km of State Highway 1 SH1 with the wider area of influence over c.116 hectares of The Brynderwyn Forest Complex..
- Restoration planting as a result of storm damage, site works, buffer areas and re-vegetation of cleared areas.

10.2.2.1.2 TE URI O HAU NGA TAPU ENVIRONS ASSESSMENT

An assessment was undertaken by Mana Whenua to assess a kauri grove and individual trees on a ridge crest in an area known as E section 0n the 20 November 2023. The experienced team brought a matauranga Te Ao Māori perspective to tree assessment. A report provided by Nga Maunga Tapu suspected PA infection (Nga Maunga Tapu Environs 1, 2023).

PA testing and further health assessments have been undertaken by a specialist biosecurity team on the 7 December 2023. Comprehensive sampling has occurred with results to be confirmed by February 2024. Current opinion, to be confirmed by the testing is that the trees do not appear to show signs consistent with PA infection.

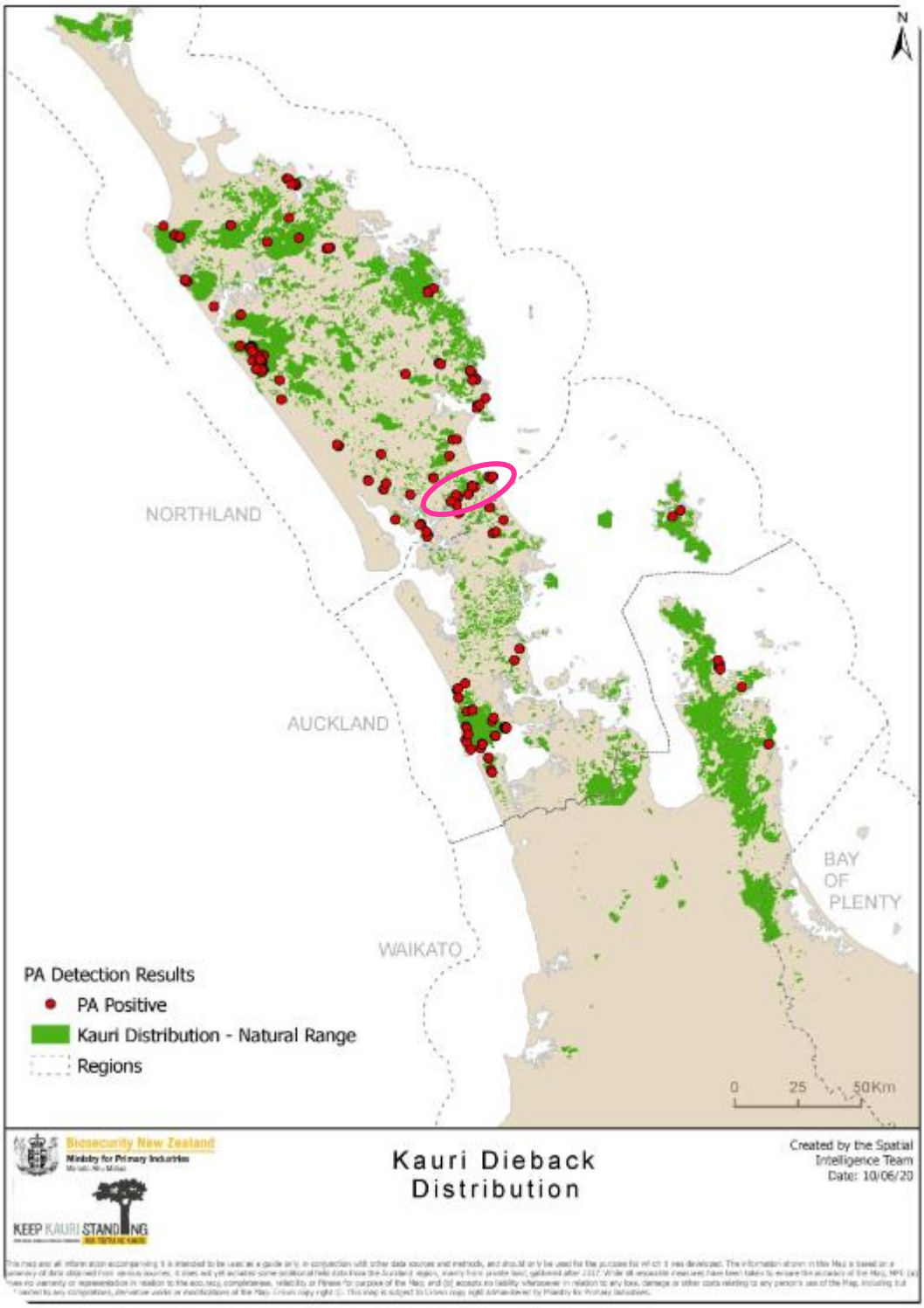

Figure 10-1: PA distribution map showing PA positive locations. Area circled pink is the Brynderwyn Ranges and Project Site[34].

[34] Figure 10-1 Sourced from Beauchamp, A. 2017 Best Practice Guidelines for Land Disturbance activities (including earthworks) around Kauri.

10.2.2.1.3 MANAGEMENT PLAN APPROACH

10.2.2.1.4 OBJECTIVE

Kauri dieback disease (PA) is known from the Brynderwyn range. Requests for information on the presence and location of positive testing have been requested and specialist ecological testing has been actioned to understand the status from known trees within the project footprint.

The Purpose of this Kauri Dieback Management Plan (KDMP) is to minimise the risk of spreading PA within and beyond the site through the course of project works and during ongoing maintenance and restoration tasks, and use of the site.

The key potential risk is transfer both within and the beyond the site. Effective containment of works in proximity of kauri where there is high PA potential (The Kauri Hygiene Area; or KHA; shown in Figure 10-2) will reduce the chances of contacting and transfer of the pathogen in the undertaking of works activities.

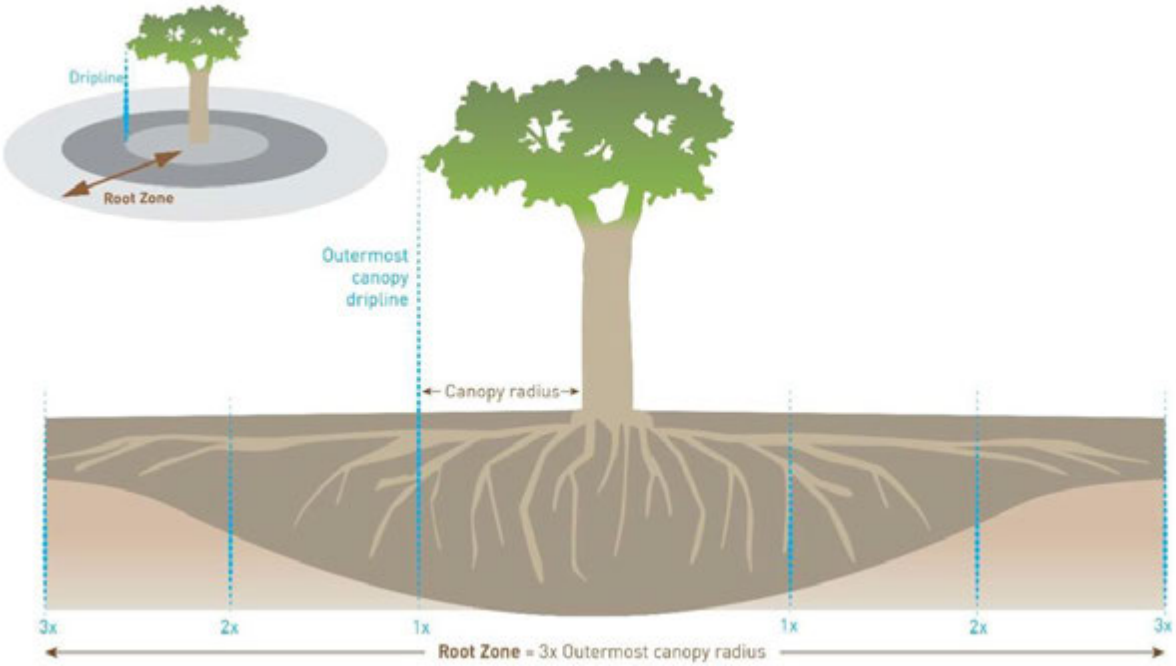

Figure 10-2: [35] The Kauri Hygiene Area (KHA) including the indicative root zone of kauri (approximately 3 times the radius of the outermost canopy dripline) Kauri roots can be in close proximity to the surface and can easily be disturbed.

This KDMP employs a risk management approach that assumes PA presence and associated risk is highest in vicinity of Kauri trees, and places more stringent controls on activities in these locations. In other areas on the site, is likely to be patchy and inconsistent to not present in its potential distribution. Management primarily focuses on maintaining good hygiene practices to minimise the likelihood of spreading the PA within and offsite.

[35] Figure 10-2 Sourced from Beauchamp, A. 2017 Best Practice Guidelines for Land Disturbance activities (including earthworks) around Kauri.

10.2.2.1.5 MANAGEMENT PLAN APPROACH

Experience in the management of Phytophthora type dieback diseases (Colquhoun & Hardy, 2000) demonstrates that effective disease management procedures can be achieved through Recognising contamination risk pathways and following appropriate working practices that minimise the risk of spreading the pathogen. While activities including earthworks within KHA cannot be avoided, the proposed approach is otherwise consistent with best practice guidelines for Land disturbance activities (including earthworks) around Kauri. Important risk management principles include:

- Understanding where the pathogen is present.
- Restricting the movement of material from contaminated to non-contaminated areas
- Practice good hygiene measures following activities in contamination confirmed areas.
- Prevent the mixing of both contaminated and non-contaminated soils and associated material.
- Prevention of water draining from contamination areas to non-contamination areas
- Training of all staff, including contractors and field personnel, site supervisors and managers
- Ensure that any person who has access to the site understands requirements of their individual efforts to limit the spread of PA.
- Monitoring to enable procedural improvements when there is evidence that the programme is not proving to be effective.

Management of PA risk for this site has the following components:

- Works specifications will minimise the risk that any potentially infected material is moved offsite in an uncontrolled manner. This includes measures to contain overland flow paths of storm water, and spoil disposal within the project site, as appropriate for the level of infection risk.
- Containment and wash facilities and hygiene protocols to prevent site workers machinery and plant moving soil offsite and between works areas.
- Hygiene facilities and protocols for the ongoing maintenance and use of the Site

10.2.2.2 Summary of Site protocols

PA transfer and movement occurs through contamination of soil and or surface water Consequently, the applicable management functions are those that control and/or mitigate the movement of soil and surface water during construction and operation of the site.

Containment measures to be followed at each stage of works are as follows;

10.2.2.2.1 PRIOR TO SITE WORKS/GENERAL

- Washdown facilities (vehicle and personnel) installed at site entry/exit.
- Training of all contractors and staff in PA hygiene requirements at site induction.
- Physical delineation of Kauri Hygiene Areas (KHA)

- Establishment of stabilised entry points and washdown/hygiene facilities installed at KHA access points.

10.2.2.2.2 TOPSOIL, VEGETATION REMOVAL AND BULK EARTHWORKS

- Routine maintenance of access points and wash down facilities. Wash water should be collected and contained onsite until it can be sterilized or disposed of.
- Control of runoff to avoid moving high-risk material to non-KHA sites; localized. sediment controls installed prior to bulk earthworks with downstream surface water containment.
- Disposal of all soil and organic material from within KHAs on-site, and if required to be placed in specified disposal locations with appropriate controls within designated fill sites.

10.2.2.2.3 OPERATIONAL PHASE

The Site Manager will be responsible for overseeing implementation of Kauri Dieback management protocols.

- Strict hygiene protocols will apply during maintenance works within soil disposal site(s), ensuring all tools, clothes and footwear are cleaned or bagged for transport to a cleaning facility prior to moving out of the KHA.
- Strict hygiene protocols will apply during planting and maintenance works around isolated kauri trees and where kauri occur on the margins of forest remnants.

10.2.2.3 Detailed Specifications

10.2.2.3.1 PRIOR TO SITE WORKS

The following actions must be undertaken before any vegetation clearance, earthworks or heavy plant and machinery is to be undertaken.

1. The expectation of contractors and all parties arriving on site bringing with them plant, machinery and equipment is that it arrives to site clean, clear of soil, vegetation, and debris.
2. The Site manager should inspect arrivals of plant machinery and equipment new to site for obvious signs of uncleanliness.
3. A wash facility for vehicles, machinery, equipment should be established to treat the above items should the site manager be unsatisfied with the state of cleanliness/hygiene.
4. All footwear, tools and equipment must be soil free when entering the worksite. This extends to equipment entering the site and areas of the Brynderwyns Forest Complex Part A (including all footwear) should be cleaned and sprayed with SteriGENE® 2% solution disinfectant (or equivalent) when departing the site.
5. KHA encompassing the rule of at least 3 times the canopy drip zone will be delineated. Project ecologists, arborists will determine and mark out the actual extent of the root zone (site specific) for each KHA. Contractors in conjunction with Engineers, Ecologists and or Arborists and a Mana whenua representative the required operational extent of proposed works.
6. In KHA areas protective booties over footwear are required to be worn and are to be fitted outside of KHA and then removed and bagged for disposal for the walk out of these areas

10.2.2.3.2 CONSTRUCTION PHASE

The bulk earthworks associated with The Brynderwyn Hills Recovery Project will cover c. 29,067 m^2 (approximate) of land of varying slopes and stability and consists of up to 130,000 m^3 of cut to fill activities over an area adjacent to State Highway 1 (SH1).

Figure 10-3: The Brynderwyn Forest Complex - Part A

10.2.2.3.3 SITE WIDE HYGIENE SPECIFICATIONS

The following controls will be implemented throughout the construction period.

- All soil is to be treated as potentially infected.
- Wash facilities for vehicles, machinery, equipment, and footwear is to be provided at entry/exit location.
- All footwear, tools and equipment must be totally soil-free when entering and exiting the Site. Equipment (including footwear) should be cleaned and sprayed with SteriGENE® 2% solution disinfectant (or equivalent).
- Earthworks are to be staged to limit the extent of open works. As far as possible, works are to be undertaken in dry weather to reduce soil adhering to vehicles and equipment.
- Any damage or failure of silt fences will be remedied promptly.
- Wash water is to be collected and contained onsite until it can be appropriately treated an or sterilised.
- Runoff and stormwater from project site to be directed away from KHAs.

10.2.2.3.4 KAURI HYGIENE AREA (KHA) SPECIFIC MEASURES

A site plan showing the details of earthworks and construction management within KHA is provided in Figure 10-4. The following specific controls will apply in these areas KHA.

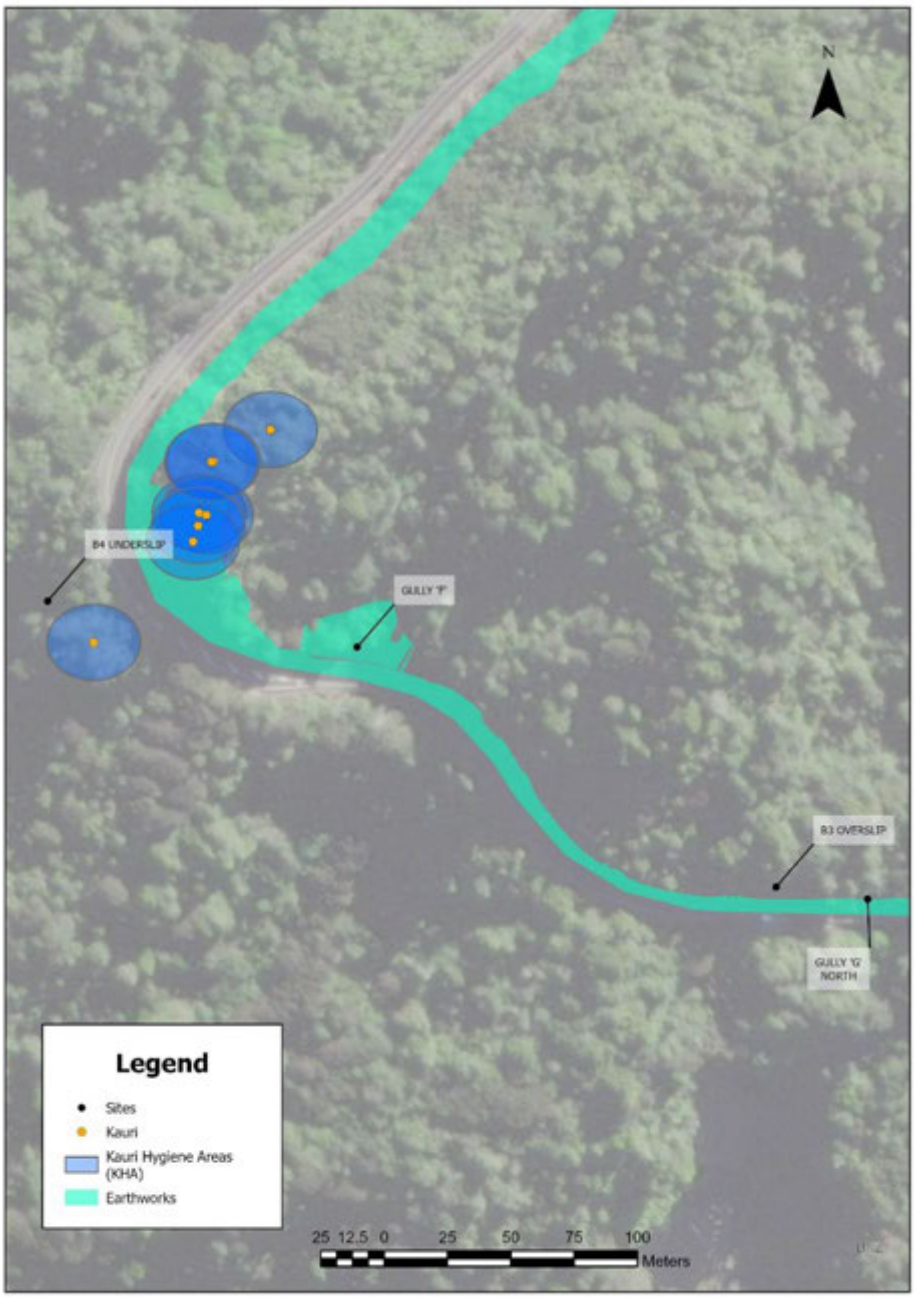

Figure 10-4: Kauri and respective Kauri Hygiene Areas (KHA) in E Section where specific controls apply.

- Avoid construction activities in wet conditions.
- Control of runoff to avoid moving high-risk material to non-KHA sites; localised sediment controls installed prior to bulk earthworks with downstream surface water. Containment This could be by way of a topsoil isolation bund or silt fence where practical.
- Establish associated hygiene stations, refuelling locations, materials stockpiles outside of KHA.
- Following the above being completed, machinery or plant required inside of KHA will be established and remain until completion of KHA works.

- All works to be completed with localised stormwater and sediment control. During the process of topsoil removal, surface flows are to be directed away from the works areas.
- Cleaning of footwear and equipment used to occur within the KHA. Soil attached to machinery that has operated within a KHA must be removed prior to exiting the KHA, and then further cleaned at wash down facility prior to exiting the project Site.

Figure 10-5 Cleaning of footwear. Left image is unacceptable, Right image is acceptable.

Source Northland Regional Council

10.2.2.4 Roles and Responsibilities

10.2.2.4.1 SITE MANAGER

It is the Site Manager's responsibility to:

- Ensure all contractors, consultants and staff are informed of the relevant protocols included in this document.
- Ensure that contractors, consultants, and staff understand that entry into and exit from the project site triggers kauri dieback control protocols.
- Undertake ongoing monitoring and repairs of the exclusion and silt fences, which will be installed as part of the site preparation.
- Carry out and document daily and 'inclement weather' inspections of sediment and runoff controls around the works site and remediate issues identified.
- Oversee contractors, consultants, and staff to ensure compliance with the work protocols specified in this management plan.

10.2.2.4.2 PROJECT ENGINEER

It is the project Engineer's responsibility to:

- Review and assist the contractor in designing and maintaining compliant earthworks controls in accordance with the KDMP and consent conditions.
- Carry out inspections to the installed control measures to ensure compliance.
- Provide instruction and oversight to ensure adequate hold points are stipulated and observed so that the Kauri Dieback Management plan principles are achieved.

10.2.2.4.3 PROJECT ECOLOGIST / ARBORIST

It is the project Ecologist / Arborist's responsibility to:

- Identify the driplines and root zones of all large kauri in the vicinity of the works footprint.
- Confirm final location of and supervise installation of KHA fencing and signage.
- Supervise earthworks within KHA to ensure damage to the root zone of kauri is avoided. (This role can also be undertaken by kaitiaki who are suitably trained, and it is safe to do so).

10.2.2.4.4 COMMUNICATIONS
10.2.2.4.5 TRAINING AND INDUCTION

Ensuring all contractors, consultants and partners are aware of the potentially severe impacts of PA, how it is spread, and effective measures are critical to promoting the compliance of this Brynderwyns Kauri Dieback Management Plan.

The site manager is to induct all contractors, consultants, and partners upon their first entry to the. The following points should be included in all site inductions:

1. Background information of PA, the organism and how it infects Kauri.
2. PA is present on the maunga, and the locations it has be observed (To be Confirmed). As a result, a precautionary approach is taken ensuring strict hygiene protocols.
3. The Impact of PA and the wider forest ecosystem
4. How the disease is spread, noting that the tiniest soil particles can spread the disease.
5. That there is currently no known cure and if PA is introduced to an ecosystem that it is not currently possible to eradicate
6. Detail the Hygiene procedures each site worker is to undertake and how these procedures will help keep the work site and surrounds free of PA.

Training in undertaking hygiene procedures will be provided as part of the induction process for new personnel entering the project site. It will emphasize both individual and collective responsibilities for ensuring all plant machinery and equipment is clean of soil and cover the necessary entry and exit procedures, so they are clear and understood.

10.2.2.4.6 SIGNAGE

Signage shall be displayed around the project site including site office, hygiene, and wash stations to highlight procedures outlined in the training as part of the induction (Figure 5).

All KHA to be appropriately indicated with signage which should alert personnel to the KHA and required protocols.

Figure 10-6 Example signage for placement around the Project Site

10.2.2.5 Monitoring, Surveillance and Management

10.2.2.5.1 DURING SITE WORKS
10.2.2.5.2 ENTRY AND EXIT FROM SITE

The Site Manager will be responsible for ensuring that all vehicles, equipment plant and machinery are being appropriately washed with SteriGENE® 2% solution (or equivalent) upon entry into the Project Site, and that wash/hygiene stations are kept clean, maintained and in working order.

10.2.2.5.3 EROSION SEDIMENT CONTROLS

The Site manager is responsible for daily inspections to ensure the effectiveness of containment and erosion control measures (bunds, geotextile covers, wood chip, brush fascines, etc) implemented around both the active works area and treated areas during the process of topsoil stripping. The Site Manager is responsible for ensuring any issues identified are immediately remedied and documented with photographs.

10.2.2.5.4 WEATHER EVENTS

Weather forecasting is to be undertaken through the course of the project. Forecasts are to be closely monitored and if work within a KHA can be achieved or is appropriate given the conditions. This would also likely apply to health and safety considerations when machinery or plant can operate and or presence of ecologists or kaitiaki monitors. Bunds and Erosion and sedimentation controls downslope of active works are to be inspected during rain events in the course of vegetation and topsoil removal, and immediately rectified if breaches are detected.

10.2.3 Post Construction

10.2.3.1 Hygiene, Wash Stations, Signage

Hygiene and wash facilities at the completion of the project are to be dismantled and disestablished where they are no longer required and recycled where possible. Generally, the project site is not accessible to the public under normal road operating conditions. The site office and project facilities will return to their pre project state.

10.2.3.2 Management Plan Review

As knowledge and understanding of PA evolves so too does the approach and management protocols established in this management plan. The above management plan represents a detailed approach based on the most recently available information and research. As new

information or procedures are developed this management plan will be amended and updated in accordance with the established current best practice to prevent the spread of PA.

10.2.4 Appendices

Table 3: Tiakina Kauri/Kauri Protection - 10 Rules to help protect and conserve kauri.

	Rule	Intent	Applicable to the Project
1	Obligation to report	Kauri which appears unhealthy, displays symptoms of PA require you to advise Tiakina Kauri, a biosecurity inspector or an authorised person	Yes- report any signs of Kauri tree poor health and condition
2	Provision of Information	Tiakina Kauri, a biosecurity inspector or an authorised person may request information that helps manage the disease caused by the PA pathogen and movement of risk items	Yes, comply with request or state the reason why you cannot
3	Restriction on the Movement of Kauri	Nurseries growing kauri plants/trees for moving to and/or re-planting at a different location, there is a set of hygiene practices you need to follow to ensure you don't inadvertently spread the PA pathogen. A production plan detailing these practices needs to be filled out and followed in order for kauri to be moved safely. The production plan is based on existing New Zealand Plant Producers Inc (NZPPI) standards. This rule applies to any kauri grown after 2 August 2022.	Yes, if mitigation / compensation plans call for provision of nursery supplied kauri plants/trees for moving to or re-planting at a different location
4	PA Risk Management Plans	This rule means that areas that are infected, at risk of becoming infected, or creating a risk of spreading the PA pathogen to other properties may need to have a kauri risk management plan	Yes, and included in the document
5	Earthworks PA risk management plan	From 2 August 2023, if you want to undertake any earthworks within a 'kauri hygiene zone' (3x the radius of the dripline of a kauri tree canopy) you may need to submit an earthworks PA risk management plan.	Yes, and included in the document
6	Stock exclusion notice	This rule requires stock to be excluded from areas in which their movement poses a high risk of spreading the PA pathogen, e.g., where PA has been detected in a kauri forest within 500m from where the stock can access that forest. For other high-risk situations, stock exclusion notices may be made on a case-by-case basis.	No stock are present in areas identified within the project as having Kauri. However, farms surround the southern extent of the project site. If this changes kauri protection will be notified
7	Restriction on release of animals	This rule prohibits the release of animals into kauri forest areas, building on the existing legislative prohibition on the release of animals into public forests. There are some exceptions, for example to allow the transfer of animals under a DOC permit. This rule does not restrict bringing dogs or companion animals into kauri forest areas but does require that dogs be in close	Non-applicable

		contact and care of a person, as well as being free of visible soil and organic matter before entering - and after being in - the forest.	
8	Obligation to clean items before entering or exiting kauri forest	If you are going off track in a kauri forest area, or onto a track where you will touch the forest floor, this rule means that anything that comes into contact with the ground (e.g., shoes, walking sticks, tyres) must be clean before you enter, and when you exit, the area	Yes, and as per this document
9	Obligation to use cleaning stations	If you see a hygiene station in a kauri forest area, e.g., at the start or end of a track, you need to use it. Most commonly, the hygiene station will require you to clean your footwear using items such as brushes or sprays that have been provided.	Yes, and as per this document
10	Open tracks and roads in kauri forest	Introduces minimum requirements for publicly accessible tracks and roads that go through kauri forest areas. Farm roads or tracks that are not open to the public are not affected by this rule.	Non-applicable

10.3Pest Plant Management

10.3.1 Purpose

The purpose of this section is to:

- Provide Background information on pest plant species present within and in proximity to the Brynderwyn Hills Recovery project;
- Describe how pest plant may affect the Ecological value of the project area;
- Describe actions to be undertaken as part of the project to minimise the likelihood of pest plants spreading and invading; and,
- Recommended actions in case of new pest incursions

10.3.2 Adverse effects

Pest plants or weeds as they are commonly known continue to occupy, invade, and spread across the countryside. Humans are the key vector in their distribution and transfer both intentionally and unintentionally.

In Northland, the subtropical climate has facilitated their spread with numerous species from around the world have taken advantage of the relatively warm and humid conditions (Roy, et al, 2004). Outside of their ecological niches and in the absence of predators, diseases and natural environmental controls exotic species have thrived. With the onset of climate change, it is predicted that the rate of pest naturalisation will only increase (Keen et al, 2015).

Construction and maintenance of roads and in this case, proactive and reactive earthwork related activities from extreme weather events result in loss of indigenous cover, habitat fragmentation and edge effects, increase plant machinery and personnel movements provide numerous opportunities for invaders to take hold (Keen et al, 2015).

Once established pest plants have the potential to smother, shade or outcompete indigenous species, dominating and changing both terrestrial and freshwater environments and communities.

10.3.3 Brynderwyn Hills Recovery Project

The Brynderwyn Hills Recovery project is located in an area of high ecological value, noted as having a high-level of ecological diversity and complexity (NRC, 2023). The range is home to 10 threatened, 5 regionally significantly species (NRC, 2023). Despite these high biodiversity values there is very minimal pest control activities undertaken in the Project Site footprint.

10.3.4 Key pest species at Brynderwyn Forest Complex – Part A.

The current site footprint is dominated with indigenous forest, with pine forest and pine harvested areas to the north, east and to the south pastoral farms. These adjacent areas provide the front at which exotic pests species have the potential to invade and establish along forest margins, edges, and exposed slip areas (Figure 10-7).

Northern areas which interface with forestry to north are subject incursions. Pampas *(Cortaderia jubata and Cortaderia selloana) and gorse (Ulex europeaus)* which dominate forest and road margins. Japanese Honey suckle *(Lonicera japonica)* through recent site surveys have been seen to be gaining a foothold across ridge lines and the vicinity of the Chorus communications tower along Artillery Road.

Kahili ginger (*Hedychium gardnerianum)* has established in damp gullies to the north and has encroached via the Artillery Road facing section of the forest. Other gullies which extend down through the site are subject to a range of species which include wandering jew *(Tradescantia fluminensis), Jasmine* (*Jasminum polyanthum*), cotoneaster (*Cotoneaster glaucophyllus*). Mexican Devil *(Ageratina adenophora*) can be seen to dominate some well-lit gullies and in one instance large steep rocky faces in the section known to the project as E section. Other known species are less frequent include woolly nightshade *(Solanum mauritianum)* privet (*Ligustrum lucidum*).

Gorse is a common species encountered throughout the Project Site and is most evident in the Atlas fill site. It is the pre-eminent species coming through following the harvest. Pampas while present has received treatment as part of post-harvest and pre-planting for further rotations.

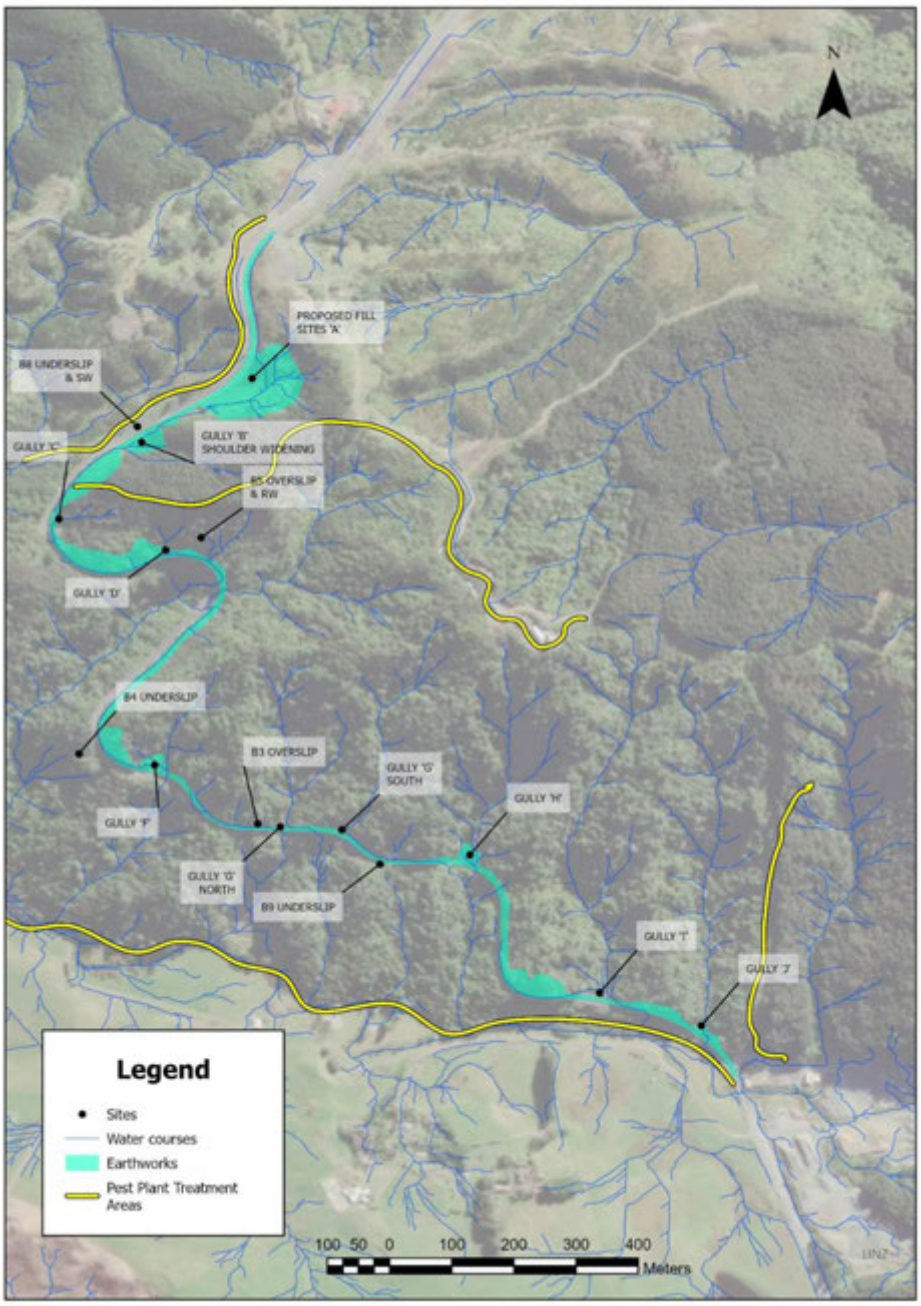

Figure 10-7: Incursion fronts surround the Project Site key locations to undertake pest plant control

10.3.5 General Management

To ensure pest plant control and mitigation is undertaken safely and effectively, the following general guidelines are to be adhered.

- All pest plant management shall be carried out by a suitable qualified professional.
- Application of any herbicides to be undertaken during fine weather low wind conditions
- Label rates and applications methods must be adhered.
- Care must be taken around any new restorative plantings; marker die to indicate spray coverage.
- Appropriate PPE to be used during herbicide application.
- Herbicides not to be applied over water except those approved for this purpose.
- Pest plants are to be disposed of onsite (buried at depth in fill sites on nominated disposal areas)

10.3.5.1 Pest Plant prevention measures

Pest plants shall be controlled to prevent their spread and to prevent any new introductions of pest plants. Along the Project alignment, pest plants will be prevented as far as practicable in order to maintain a clean edge especially considering the earthworks cut proposals on the upper slopes. For the balance of the project area, pest plants will be controlled to low levels, including future mitigation planting areas where progressive stabilisation options such as Hydroseeding (with a native seed mix) cannot be achieved. Prevention is more effective than control once species have established, hence the emphasis of preventative measures.

Some pest plants (e.g., *tradescantia*) can spread by fragments, pampas (wind), privet (birds), gorse (soil movement), therefore prevention measures must standup to different methods of movement. Preventative actions are covered Table 1.

Table 10-4: Potential Vectors and hygiene protocols to be adhered to mitigate the establishment and spread of pest plants through the project alignment.

Potential Vectors	Actions and Procedures
Inductions	• All personnel to be inducted on cleaning protocols and the importance of cleaning gear to prevent the spread of weeds
Vehicles and machinery	• Provision of vehicle wash-down facilities at Project site entry/exit locations to be used by all vehicles entering and leaving the Project site to remove any soil and plant material. • Soil and plant material to be removed from vehicles when exiting or entering the work site. • Where excavators and other construction vehicles are required to move between sites, soil and plant material must be cleaned off
Personnel and equipment	• Provision of wash facilities, foot wash stations at entry exit points for cleaning and hygiene of equipment of soil and plant matter when moving within site locations
Mulch, topsoil, and growing mixes	• There is a probability that site sourced soil may contain pest species. E.g.: Tradescantia, gorse • An appropriate pre-emergent herbicide is recommended for soil taken from infestation areas. • Breaking up existing soils may also release dormant seeds. Where gorse is present soil should be treated with the appropriate herbicides

	• All weed species that germinate in any placed mulch or topsoil shall receive with appropriate herbicides treatment
Design controls	• Design of an interface area between roadside barriers, swales and chip seal area that minimizes weed growth. • Swales and drainage, sediment traps to be treated with pre-emergent herbicide. • Where possible swales shall be lined, rocks concrete asphalt or similar to reduce the need for herbicide application. The Project Alignment and project related plantings will be managed for pest plants through construction phase. Treatments will require to extended beyond the completion of construction works

10.3.5.2 Working around or in proximity to waterways

For personnel undertaking works around waterways, all equipment and gear (which can extend to boots, waders, and any nets) shall be cleaned (SteriGENE® 2%) and checked for plant material and dry before and post access.

10.3.5.3 Pest Plant Control

Pest plant control is achieved by both of chemical and physical control. Chemical control

relates to the use of herbicides to control pest plants. This is usually the most effective method for controlling pest plants; however, overuse of herbicides may have adverse impacts on the environment including spray drift to non-target species, impacts to sensitive species.

Chemical control can be achieved by a number of methods:

Physical control refers to using physical means to remove pest plants, such as:

1. Shading;
2. Manual weeding;
3. ring barking;
4. grubbing;
5. felling; and,
6. mulching.

Each method of chemical control may be suitable for different species/age classes.

Control of pest plants shall follow best practice for the species in question, as well considering effects on the local environment (e.g., some herbicides are persistent in soil and can inhibit future growth). Some species (such as ginger) may require a combination of chemical and physical control approaches to be effective (NRC, 2023).

10.3.5.4 New Incursions

Monitoring of the site will be on going through the Project works by ecologists, who as part of the continuing ecological work will be vigilant in observing for signs of new pest species incursions.

In the instance of a discovery of a novel pest plant the following protocols are to be followed:

7. Once an identification is confirmed a notification will be provided to the Project manager who will inform the wider team as required.
8. Locations shall be GPS with coordinates taken to pinpoint the area/s of concern
9. Species cross checked with the Regional Pest Management and Marine Pathways Plan (Northland Regional Council) to determine its pest status and method for control.
10. Eradication undertaken (if practical and feasible)

11 Monitoring and further control in the event of further discovery. Suggested periodic inspections, scaling back after assuming no new infestations

The Northland Regional Councils Regional Pest Management and Marine Pathways Plan has a chapter on organisms declared as pests in Northland and an indicative management programme. Programme approaches extend to progressive containment, sustained control, exclusion, and eradication species.

10.3.5.5 Restorative Mitigation Plantings Maintenance

New plantings in areas outside of forest areas can become overrun with pest plants and growth and viability impacted. To ensure successful establishment of any plantings and prevent adverse effects of pest plants, sites for mitigation planting (to be determined) will be prepared, planted, and maintained in accordance with the Landscape and Vegetation Management Plan.

Sites to be planted are likely to be highly variable; from harvested forestry sites to engineered fill. Weed control regimes will need to incorporate timelines for site preparations to take into account any likelihood of re-infestation.

10.4 Pest Animal Management

10.4.1 Purpose

The purpose of this section is to

- Provide Background context on pest animal situation within and in proximity to the Brynderwyn Hills Recovery project.
- Describe how pest animals may affect the Ecological Value of the project area.
- Describe actions to be undertaken as part of the project to minimise effects on significant wildlife.
- Recommended actions in case of new pest incursions

10.4.2 Brynderwyn Hills Recovery Project

The Brynderwyn Hills Recovery project is located in an area of high ecological value, noted as having a high-level of ecological diversity and complexity (NRC, 2023). The range is home to 10 threatened, 5 regionally significantly species. Despite these high biodiversity values there is very minimal pest animal control activities undertaken within the Project Site Footprint.

10.4.3 Key pest species at Brynderwyn Forest Complex – Part A.

There is limited information of the pest animal species from the direct project site, but conclusions can be made from the efforts of Landcare groups from neighbouring part of the Brynderwyns Forest Complex. The following species in the table below can be expected in significant numbers across the Project site.

Table 10-5: Pest species expected to be present in significant numbers across the project site.

Common name	Scientific
Rats	*Rattus rattus*
Common mouse	*Apodemus sylvaticus*

Possum	*Trichosurus vulpecula*
Stoats	*Mustela nivalis*
Weasels	*Mustela erminea*
Ferrets	*Mustela furo*
European hedgehog	*Erinaceus europaeus*
Feral cats	*Felis catus*
German wasps	*Vespula germanica*
Asian paper wasp	*Polistes chinensis*
Wild pigs	*Sus scrofa*
Wild goats	*Capra hircus*

10.4.4 Pest Herpetofauna

Plague Skink (*Lampropholis delicata*), a native of Australia first recorded in Auckland 1950s potentially as a result of the importation hardwood sleepers. It has since worked its way around the upper Northland and has become extremely abundant especially on roadsides, railway corridors urban situations and have been observed and abundant across the project site (Teal pers. comm).

Plague skink are highly mobile animals and are also easily transported by human activity. For example, in household items, mail, personal effects and shipping containers. Plants and potting mix from nurseries have also been found harbouring skinks and eggs.

Care must be taken when relocating equipment, plant and machinery and bulk items from Plague skink areas to areas that a plague skink free.

This is especially pertinent with nurseries and plants transported to and from sites. Potting mix in potted plants is a favoured medium and breeding habitat. Check these items for any small white eggs. Whilst they are present on site all efforts should be maintained to prevent new introductions and dispersal from the Project Site.

10.4.5 Argentine Ants

Argentine ants (*Linepithema humile*) are an introduced ant species. The Global Invasive species database lists Argentine Ants as one of the world's worst invasive species (IUCNGISD.org, 2023).

There current distribution includes Northland. They spread by the transfer of queens and nests, often in potted plants and soil or plant machinery or vehicles. Argentine ants pose a significant to native invertebrates, and other significant fauna. To date this species has not been observed At the Project Site but there is a high potential to invertedly introduce them from project related procurement movements.

10.4.6 Prevention of Pest Animal Incursions

Table 10-6: Actions and procedures to prevent the spread of pest animals

Potential Vectors	Actions and Procedures
Inductions	• All personnel to be inducted on cleaning protocols and the importance of checking and cleaning plant machinery, gear to prevent the spread of Pest animals
Importation of soil with restoration plantings	• Potting/soil mix is one of the most frequent vectors of pest species.

	• Restoration planting should be sourced from nurseries that are subject to regular biosecurity inspections to ensure that plant distribution is spreading pest species. • Upon receipt of plants at the Project an inspection should be undertaken for any unusual species, ants, and eggs.

11 Limitations

This Management Plan ('Report') has been prepared by WSP New Zealand Limited ('WSP') exclusively for NZTA ('Client') in accordance with the Short Form Agreement with the Client dated 28 June 2023 ('Agreement').

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business opportunity, site depredation costs, business interruption or economic loss) of any kind whatsoever, suffered on incurred by a third party.

12 References

Adams, L. (2019). *Key principles for lizard salvage and transfer in New Zealand*. Department of Conservation Lizard Technical Advisory Group, Wellington

Beauchamp A., (2017). *Land Disturbance Activities (including earth works around Kauri) Best Practice guidelines.* Department of Conservation, Wellington.

Burns, R., Bell, B., Haigh, A., Bishop, P., Easton, L., Wren, S., . . . & Makan, T. (2017). *Conservation status of New Zealand amphibians, 2017.* Department of Conservation, Wellington.

Colbourne, R., Bean, E., Coad, N., Ruchs, R., Graham, I., Robertson, H., & Scrimgeour, J. (2020). *Kiwi Best Practise Manual*. Department of Conservation, Wellington.

Colquhoun, I. J., & Hardy, G. E. St. J. (2000). *Managing the Risks of Phytophthora Root and Collar Rot During Bauxite Mining in the Eucalyptus marginata (Jarrah) Forest of Western Australia*. Plant Disease, 84(2), 116–127. https://doi.org/10.1094/PDIS.2000.84.2.116

Department of Conservation (2023). *Bat BioWeb database.* Department of Conservation, Wellington. Accessed March 2023.

Department of Conservation (2022). *Bat handling comptencies authorisation*. Version 2, July 2022. Department of Conservation: Bat Recovery Group, Wellington (provided in Appendix A).

Department of Conservation(2021). *Protocols for minimising the risk of felling bat roosts (Bat Roost Protocols (BRP)) Version 2.* Department of Conservation: Bat Recovery Group, Wellington. (Provided in Appendix A)

Department of Conservation. (2017). *Conservation status of New Zealand amphibians (New Zealand Threat Classification Series 25).* Department of Conservation, Wellington

Eda, A. R. A. R., Bishop, P. J., Altobelli, J. T., Godfrey, S. S., & Stanton, J. (2023). *Screening for Batrachochytrium dendrobatidis in New Zealand native frogs: 20 years on.* New Zealand Journal of Ecology, *47*(2), 1-10.

Evans, A. (2016). *Inventory and monitoring toolbox: Invertebrates.* Department of Conservation, Wellington.

Franklin, P., Gee, E., Baker, C., Bowie, S (2018) *New Zealand fish passage guidelines for structures up to four metres. National Institute of Atmosphere and Water*. NIWA Client Report No. 2018019HN

Gruijters, T. (2018). *Predation at a snail's pace. What is needed for a successful hunt?* Preprint: https://doi.org/10.1101/420042

Global Invasive Species Database (2024) *100 of the world's worst invasive Alien Species.* [Accessed Nov 2023 from http://www.iucngisd.org/gisd/100_worst.php on 01/12/2023].

Hitchmough, R., Barr, B., Knox, C., Lettink, M., Monks, J. M., Patterson, G. B., Reardon, J. T., van Winkel, D., Rolfe, J., Mchel, P. (2021). *Conservation status of New Zealand reptiles, 2021. New Zealand Threat Classification Series 35.* Department of Conservation, Wellington. 15 p.

iNaturalist. (n.d.). *iNaturalist.* Accessed Nov 2023. [https://inaturalist.nz/]

Joy, M., David, B., Lake, M. (2013). *New Zealand Freshwater Fish Sampling Protocols, Part 1—Wadeable Rivers & Streams*. The Ecology Group - Institute of Natural Resources.

Keen, J., M., Eckehard G. Brockerhoff, S. V. Fowler, Gerard J., Logan, D., P., Mullan, B., A., Sood, A., Tompkins, D., M, Ward, D., F. (2015) *Effects of climate change on current and potential biosecurity pests and diseases in New Zealand*. Ministry for Primary Industries

Mahlfeld, K., Brook, F. J., Roscoe, D. J., Hitchmough, R. A., Stringer, I. 2012: *The conservation status of New Zealand terrestrial Gastropoda excluding Powelliphanta*. New Zealand Entomologist 35(2): 103–109

Melzer, S., and Bishop, P.J. (2010). *Skin peptide defences of New Zealand frogs against chytridiomycosis.* Animal Conservation, 13: 44-52. https://doi.org/10.1111/j.1469-1795.2009.00340.x

Ministry for the Environment. (2021). *National works in waterways guideline. Best practice guide for civil infrastructure works and maintenance.* Wellington: Ministry for the Environment

Ministry for Primary Industries, 2023 Tiakina Kauri Protection National Biosecurity New Zealand

Ministry for Primary Industries, 2019 New *Zealand Myrtle Rust strategy 2019-2023*

Ministry for Primary Industries (2018). *Code of Welfare: Transport within New Zealand.* MPI, Regulation and Assurance Branch, Wellington 6140

New Zealand Plant Producers Incorporated (NZPPI), website https://nzppi.co.nz/ [Accessed 20 November 2023]

Northland Regional Council, 2023 Kauri Protection [Accessed from https://www.nrc.govt.nz/environment/weed-and-pest-control/biosecurity-programmes/kauri-protection/ on 20/11/2023]

Northland Regional Council, 2023 Piroa/ *Brynderwyn (Mangawhai/ Waipū)* [Accessed from https://www.nrc.govt.nz/environment/weed-and-pest-control/biosecurity-programmes/high-value-areas/piroabrynderwyn-mangawhaiwaipu/ on 15/011/2023

Northland Regional Council, 2017 *Northland Regional Pest and Marine Pathways Management Plan 2017-2027.* Northland Regional Council.

New Zealand Government. (1953). *Wildlife Act*. New Zealand Government, Wellington, New Zealand.

NZ Bird Atlas. (2023). Retrieved from the eBird database: https://ebird.org/atlasnz/home

NZ Birds Online. (2023). Retrieved from New Zealand Birds Online The digital encyclopedia of New Zealand birds: https://nzbirdsonline.org.nz/

O'Donnell, C. F., Borkin, K. M., Christie, J. E., Parsons, Davidson-Watts, I., Dennis, G., Pryde, M., Michel, P. (2022) *Conservation status of bats in Aotearoa New Zealand. New Zealand Threat Classification Series 41.* Department of Conservation

O'Donnell, C. F. (2004). *Roost use by long-tailed bats in South Canterbury: Examining predictions of roost-site selection in a highly fragmented landscape.* New Zealand Journal of Ecology, 19

Roy, B., Popay, I., Champion, P., James, T., Rahman, (2004) A. *Common Weeds of New Zealand*. New Zealand Plant Protection Society Second Edition

Shaw, S.D., Berger, L., Bell, S., Dodd, S., James, T.Y., Skerratt, L.F., Bishop, P.J., & Speare, R. (2014*). Baseline cutaneous bacteria of free-living New Zealand native frogs* (*Leiopelma archeyi* and *L. hochstetteri*) *and implications for their role in defence against the amphibian chytrid* (batrachochytrium dendrobatidis). J Wildl Dis. 50 (4): 723–732. https://doi.org/10.7589/2013-07-186

Sheppard, C. S., Burns, B. R., & Stanley, M. C. (2016). *Futureproofing weed management for the effects of climate change: is New Zealand underestimating the risk of increased plant invasions?* New Zealand Journal of Ecology, 40(3), 398-405.

Smith, J. (2014). *Freshwater Fish Spawning and Migration Periods.* Prepared for Ministry for Primary Industries. National Institute of Water & Atmospheric Research Ltd.

Trewick, S., Hitchmough, R., Rolfe, J., Stringer, I. 2018: *Conservation status of New Zealand Onychophora ('peripatus' or velvet worm).* New Zealand Threat Classification Series 26. Department of Conservation, Wellington. 3 p

Ward DF, Toft R 2011 *Argentine ants in New Zealand*. http://argentineants.landcareresearch.co.nz/ (accessed 01/12/2023).

REFERENCES

ANZG (2018). Australian and New Zealand Water Quality Guidelines for Fresh and Marine Water Quality. Australian and New Zealand Environment and Conservation Council. Published 1 August 2018.

Atkinson I.A.E. 1985: Derivation of vegetation mapping units for an ecological survey of Tongariro National Park, North Island, New Zealand. New Zealand Journal of Botany 23: 361-378.

Burns, R. J., Bell, B. D., Haigh, A., Bishop, P., Easton, L., Wren, S., . . . Makan, T. (2017). *Conservation status of New Zealand amphibians.* Wellington: Department of Conservation.

Clapcott, J., Young, R., Harding, J., Matthaei, C., Quinn, J., Death, R. (2011) Sediment Assessment Methods: Protocols and Guidelines for Assessing the Effects of Deposited Fine Sediment on In-Stream Values. Nelson, New Zealand. Cawthron Institute.

Clarkson, B. (2013). A vegetation tool for wetland delineation in New Zealand. Prepared for Meridian Energy Limited. Hamilton: Manaaki Whenua Landcare Research.

de Lange, P. J., Rolfe, J. R., Barkla, J. W., Courtney, S. P., Champion, P. D., Perrie, L. R., . . . Ladley, K. (2018). *New Zealand Threat Classification Series 22. Conservation status of New Zealand indigenous vascular plants, 2017.* Wellington: Department of Conservation.

Department of Conservation Bat Recovery Group. (2021, October). Protocols for minimising the risk of felling bat roosts (Bat Roost Protocols (BRP)) Version 2. Wellington: Department of Conservation.

Dunn, N.R., Allibone, R.M., Closs, G.P, Crow, S.K., David, B.O., Goodman, J.M., Griffiths, M., Jack, D.C., Ling, N., Waters, J.M. and Rolfe, J.R. (2018). Conservation status of New Zealand freshwater fishes, 2017. New Zealand Threat Classification Series 24. Department of Conservation. 15pp.

Grainger,N., Harding, j., Drinan, T., Collier,K., Smith, B., Death, R., Makan, T. Rolfe, J. (2018). Conservation status of New Zealand freshwater invertebrates. New Zealand Threat Classification Series 28. 25 p

Hitchmough, R., Barr, B., Knox, C., Lettink, M., Monks, J. M., Patterson, G. B., . . . Michel, P. (2021). *New Zealand Threat Classification Series 35. Conservation status of New Zealand reptiles, 2021.* Wellington: Department of Conservation.

Hurst, J. M., Allen, A. B., & Fergus, A. J. (2022). *The Recce Method for Describing New Zealand Vegetation - Expanded Manual Version 5.* Landcare Research Ltd. 2022.

iNaturalist. (2024, 03 22). *iNaturalist Obeservations*. Retrieved from iNaturalist: https://www.inaturalist.org/observations

Land Information New Zealand. (2023, 12 08). *Browse GIS Data - Mapping Tool*. Retrieved from Land Information New Zealand: https://data.linz.govt.nz/data/

Leathwick, J., Morgan, F., Wilson, G., Rutledge, D., McLeod, M., & Johnston, K. (2002). *Land Environments of New Zealand: A Technical Guide.* Ministry for the Environment.

Lux, J., Martin, T., & Beadel, S. (2007). *Natural areas of Waipu Ecological District.* Whangarei: Department of Conservation.

Mahlfeld, K., Brook, F. J., Roscoe, D. J., Hitchmough, R. A., & Stringer, I. (2012). The conservation status of New Zealand terrestrial Gastropoda excluding Powelliphanta. *New Zealand Entomologist, 35*(2), 103-109.

Manaaki Whenua Landcare Research. (2012). Potential Vegetation of New Zealand GIS Layer. Manaaki Whenua Landcare Research.

Manaaki Whenua Landcare Research. (2020). Land Cover Database Version 5.0, Mainland New Zealand. Manaaki Whenua Landcare Research.

Marsland, S., Priyadarshani, N., Juodakis, J., & Castro, I. (2019). AviaNZ: A future-proofed program for annotation and recognition of animal sounds in long-time field recordings. *Methods in Ecology and Evolution, 10*(8), pp. 1189-1195.

Ministry for Primary Industries. (1993). *Biosecurity Act 1993.* Wellington: Ministry for Primary Industries.

Ministry for Primary Industries. (2019). *New Zealand Myrtle Rust Strategy 2019-2023.* Wellington: Ministry for Primary Industries.

Ministry for Primary Industries. (2023). *Tiakina Kauri Protection National Biosecurity New Zealand.* Wellington: Ministry for Primary Industries.

Ministry for the Environment. (2009). Threatened Environments of New Zealand Land Environments New Zealand Level 4 Polygons GIS layer.

Ministry for the Environment. (2023). *National Policy Statement for Indigenous Biodiversity.* Wellington: Minister for the Environment.

Ministry for the Environment. (2023). *National Policy Statement for Indigenous Biodiversity.* Wellington: Ministry for the Environment.

Ministry for the Environment. (2024). *National Policy Statement for Freshwater Management 2020.* Wellington: Minister for the Environment.

Ministry for the Environment (2020). Wetland Delineation Protocols. Wellington: Ministry for the Environment.

National Institute of Water and Atmospheric Research. (2024, 03 25). *NZ Freshwater Fish Database*. Retrieved from NIWA Taihoro Nukurangi: https://nzffdms.niwa.co.nz/

Neale, M. W., Storey, R. G., and Quinn, J. L. (2016) Stream Ecological Valuation: Application to Intermittent Streams. Auckland Council Technical Report, TR2016/023. 38pp.

New Zealand Bird Atlas. (2024, January 31). *NZ Bird Atlas Effort Map*. Retrieved from eBird: https://ebird.org/atlasnz/effortmap

New Zealand Government. (1953). *Wildlife Act 1953.* Wellington: New Zealand Government.

New Zealand Herpetological Society. (2023, 05 17). *New Zealand Herpetological Society*. Retrieved from New Zealand Herpetological Society: https://www.reptiles.org.nz/

New Zealand Herpetological Society. (2024, 5 30). *Native Herpetofauna Index*. Retrieved from Reptiles.org.nz: https://www.reptiles.org.nz/herpetofauna/native-index

Northland Regional Council. (2024, 05 14). *Wetlands open data*. Retrieved from Open data site - Northland Region Council: https://data-nrcgis.opendata.arcgis.com/datasets/NRCGIS::wetlands-open-data/explore?layer=1&location=-36.066804%2C174.443261%2C13.70

NZTA. (2023). *Ecological Impact Assessment Guidelines* . Wellington: NZTA.

O'Donnell, C. F., Borkin, K. M., Christie, J., Davidson-Watts, I., Dennis, G., Pryde, M., & Michel, P. (2023). *New Zealand Threat Classification Series 41. Conservation*

status of bats in Aotearoa New Zealand, 2022. Wellington: Department of Conservation.

Piroa Conservation Trust. (2023). *Kiwi Survey.* Piroa Conservation Trust.

Purdie, S. (2022). *Reptiles & Amphibians of New Zealand.* Oxford, England: John Beaufoy Publishing Lts.

Robertson, H. A., Baird, K. A., Elliot, G. P., Hitchmough, R. A., McArthur, N. J., Makan, T. D., . . . Michel, P. (2021). *New Zealand Threat Classification Series 36. Conservation status of birds in Aotearoa New Zealand, 2021*. Wellington: Department of Conservation.

Roper-Lindsay, J., Fuller, S. A., Hoosan, S., Sanders, M. D., & Ussher, G. T. (2018). *Ecological Impact Assessment (EcIA). EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd EDITION.* Melbourne: EIANZ.

Roper-Lindsay, J., Fuller, S., Hooson, S., & Sanders, M. (2018). *Ecological Impact Assessment (EcIA). EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd EDITION.* Melbourne: EIANZ.

Roper-Lindsay, J., Fuller, S., Hooson, S., Sanders, M. D., & Usher, G. T. (2018). *Ecological impact assessment. EIANZ guidelines for use in New Zealand terrestrial and freshwater ecosystems. 2nd edition.* Melbourne: EIANZ.

Stark, J. D., Boothroyd, I. K. G., Harding, J. S., Maxted, J. R. and Scarsbrook, M. R., (2001). Protocols for sampling macroinvertebrates in wadeable streams, For: the Ministry for the Environment, 57p.

Stark, J. D. and Maxted, J. R., (2007). A user guide for the Macroinvertebrate Community Index. Cawthron Institute for the Ministry for the Environment, 58p.

Singers, N. J., & Rogers, G. M. (2014). A classification of New Zealand's terrestrial ecosystems. *Science for Conservation 325*, 88-pp.

Storey, R. G., Neale, M.W., Rowe, D.K., Collier, K.J., Hatton, C., Joy, M.K., Maxted, J.R., Moore, S., Parkyn, S.M., Phillips, N., Quinn, J.M., (2011). Stream Ecological Valuation (SEV): a method for assessing the ecological function of Auckland streams. Auckland Council Technical Report 2011/009. 66p

Townsend, A. J. (2008). *New Zealand Threat Classification System manual.* Department of Conservation .

Trewick, S., Hitchmough, R., Rolfe, J., & Stringer, I. (2018). Conservation status of New Zealand Onychophora ('peripatus' or velvet worm). *New Zealand Threat Classification Series 26*.

Walker, S., Cieraad, E., & Barringer, J. (2015). *The Threatened Environment Classification for New Zealand 2012: a guide for users.* Landcare Research Manaaki Whenua.

West Coast Regional Council. (2020). *West Coast Regional Policy Statement.* Greymouth: West Coast Regional Council.

Westland District Council. (2002). *Westland District Plan.* Westland District Council.

Wilson, T. (2023). *Kiwi Survey.* Piroa Conservation Trust.