Project Number: 3-WW021.02

Eastern Hills Reservoir

Ecological Impact Assessment

EASTERN HILLS RESERVOIR RECREATION ASSESSMENT

Wellington Water

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REV	DATE	DETAILS
1	14/09/23	For external legal review
2	22/11/23	Edited to address legal review feedback
3	28/02/24	Revised to include Offsetting Management Plan

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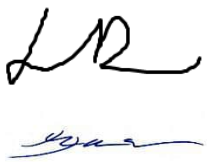
Reviewed by:	Lisa Denmead Mark Hansen	28/02/24	
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Executive Summary

A new potable water reservoir is proposed next to the existing Naenae reservoir in the Eastern Hills, Fairfield. The Eastern Hills reservoir is a key infrastructure project required to provide current customers with reliable services and to accommodate predicted future population growth.

WSP was engaged to perform an Ecological Impact Assessment for consenting purposes. A combination of desktop assessments and site surveys were conducted to inform the Ecological Impact Assessment. The Environment Institute of Australia and New Zealand Ecological Impact Assessment Guidelines were followed to assess the value of all ecological features on-site and within the zones of influence. Government Acts, National Policy Statements, Regional and District plans were considered regarding the proposed activity, biodiversity, and significance as well as regional and threat classifications for features and species. Actual and potential impacts, and their duration on ecological features were considered to determine magnitude of effects. The effects management hierarchy was applied to pre-mitigated levels of effect to inform management, appropriate for the size and scale of the effect and the feature or species impacted. When residual levels of effect were more than minor e, offsetting these effects has been proposed to ensure biodiversity Net Gains are achieved, pursuant to the National Policy Statement for Indigenous Biodiversity.

Although the site has experienced significant impacts and is fundamentally changed from a pre-1840 state, many features still hold high ecological values on-site and within the zones of influence. A mix of indigenous and exotic vegetation is present on-site and will need to be removed to construct the reservoir and associated infrastructure. Proposed site remediation will result in a variety of temporal impacts, including the permanent loss and alteration of vegetation character, such that offsetting for effects on vegetation is required. Off-site exotic weed control and indigenous vegetation replacement will be required to offset for the loss of vegetation due to the project. Indigenous birds and lizards, and their habitat, will also suffer a variety of temporal impacts, including, habitat loss, disturbance, and the risk of mortality during habitat clearance, must be managed, pursuant to the effects management hierarchy under the National Policy Statement for Indigenous Biodiversity and the Wildlife Act 1953. Post construction remediation and offsetting for the permanent effects on vegetation will enhance habitat for indigenous lizards and birds and will result in an ecological Net Gain for terrestrial features and values within proximity to the site.

Aquatic features on-site and within the zone of influence have similarly experienced significant impacts and are fundamentally changed from pre-human conditions, though again, still retain high levels of ecological value. Waiwhetū Stream provides habitat for several regionally 'Threatened' and 'At Risk' species and the zone of influence includes spawning and migration zones for a number of these and other species of indigenous freshwater fauna. First-order tributaries of the Waiwhetū Stream are present adjacent to the site and fall within the zone of influence for proposed construction activities. Tributaries provide habitat for keystone species and transfer terrestrial organic matter energy to natural inland wetlands adjacent to the site and the Waiwhetū Stream. All natural inland wetlands within the Wellington Region hold significance, as such project design and associated vegetation clearance avoids direct impacts to within 10 m of wetland boundaries. Indirect impacts may affect all aquatic ecosystems within the zone of influence, however mitigation measures, proposed remediation on-site and additional restoration off-site will all act to reduce the effects such that residual levels of effect will be less than minor.

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Abbreviations

Abbreviation/acronym	Term
ABMs	Acoustic Bat/Bird Monitoring Devices
ACO	Artificial Cover Object
ADP	Accidental Discovery Protocol
AEE	Assessment of Environmental Effects
BMP	Bird Management Plan
CLHDP	City of Lower Hutt District Plan
DOC	Department of Conservation
EcIA	Ecological Impact Assessment
ED	Ecological District
eDNA	Environmental Deoxyribonucleic Acid
EIANZ	Environment Institute of Australia and New Zealand
ER	Ecological Region
ESCP	Erosion and Sediment Control Plan
FFMP	Freshwater Fauna Management Plan
FMU	Freshwater Management Unit
GIS	Geographic Information System
ha	hectares
km	kilometres
LCDB	Landcover Database
LENZ	Land Environment New Zealand
LG	Low gradient
LMP	Lizard Management Plan
m	metres
MCI	Macroinvertebrate Community Index
MfE	Ministry for the Environment
MHS	Manual Habitat Search
mm	millimetres
NCO	Natural Cover Object
NPS-FM	National Policy Statement for Freshwater Management
NPS-IB	National Policy Statement for Indigenous Biodiversity
NZFFD	New Zealand Freshwater Fish Database
PMP	Pest Management Plan
ppm	parts per million
REC	River Environment Classification
RMA	Resource Management Act 1991

Abbreviation/acronym	Term
BOAM	Biodiversity Offset Accounting Model
BV	Biodiversity value
OMP	Offsetting Management Plan
PAA	Pipe Alignment Assessment (WSP, 2023a)
SNA	Significant Natural Area
SNR12	Significant Natural Resource Area 12
TL	True left
TR	True right
UAV	Unmanned Aerial Vehicle
VMP	Vegetation Management Plan
WRPS	Wellington Regional Policy Statement
WWL	Wellington Water Limited
ZOI	Zone of Influence

1 Introduction

1.1 Background

For Wellington Water Limited (WWL) to provide reliable services to customers and accommodate future population growth, a new water reservoir is proposed next to the existing Naenae reservoir at the top of Summit Road, Fairfield, Lower Hutt.

The Eastern Hills reservoir ('the Reservoir') is proposed to be an above ground, circular reservoir with a 55 m diameter. Water supply to the reservoir will be from the Waterloo Water Treatment Plant which utilises the existing DN750 bulk network pipeline on Summit Road. A connection point exists on this pipeline at the intersection of Summit Road and Farrelly Grove. The reservoir will supply water via a new 1.1 km long DN750 delivery pipeline which will run north down the side of the hill, crossing below Waiwhetū Stream at the end of Balgownie Grove. A new overflow / scour pipeline will run parallel to the delivery pipeline down the side of the hill, before discharging into Waiwhetū Stream. The Naenae No. 1 reservoir overflow will also be connected to this line. The reservoir valves and control equipment will be housed in a new valve house connected to the reservoir.

WSP was engaged to perform this Ecological Impact Assessment (EcIA) to support the resource consent applications and Notice of Requirement for the proposed reservoir.

1.2 Site Location, Description and Ecological Context

The proposed location for the reservoir is in Hutt Valley's Eastern Hills (Eastern Hills) at the top of Summit Road, Fairfield, Lower Hutt ('the site'). The site falls within the Wellington Ecological District (ED) of the Sounds-Wellington Ecological Region (ER) (Figure 1). The entirety of the site is located within the 670 hectare (ha) Significant Natural Resource area 12 (SNR12) (Chapter 14E, City of Lower Hutt District Plan) (Hutt City Council, 2022)) (Figure 2).

Legend

- Wellington Ecological District
- Sounds - Wellington Ecological Region

Aerial Imagery Basemap

CLIENT: Wellington Water

wsp
Christchurch Ecology
+64 3 373 2028
PO Box 1482
Christchurch 8140
New Zealand

DRAWN	APPROVED
M. HANSEN	J. Lucas
SHEET NUMBER	SCALE
1 of 1	1:250,000

PROJECT
Client Name: Wellington Water
Location: Naenae, Lower Hutt
Project Title: Eastern Hills Reservoir

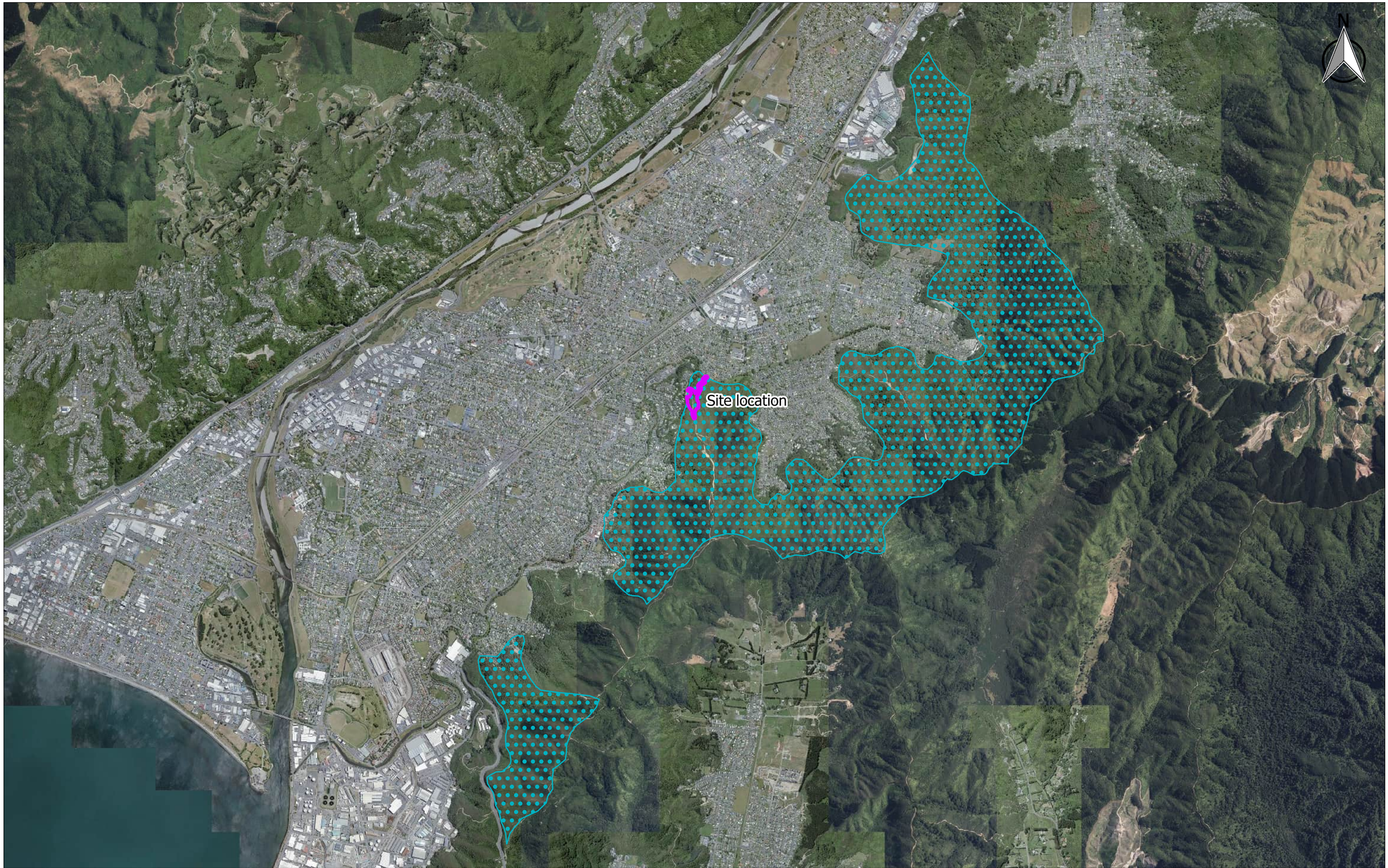
SHEET
Figure 1: Site location

PROJECT NUMBER	REVISION DATE	REVISION
3-WW021.02	24/08/2023	R1

Original Sheet Size: A3 [W = 420, H = 297]

Plot Date: 2023-08-24 16:25:37 by Hansen, Mark (NZMH30142)

File Ref: U:\ProjectsNZ\3w\3-WW021.02 Naenae No.2 Reservoir\Home\500 Work in Progress\Ecology\GIS\0 Naenae EcIA.qgz



Legend

- Project site boundary
- SNR12

Aerial Imagery Basemap

CLIENT

Wellington Water

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New Zealand

DRAWN	APPROVED
M. HANSEN	J. Lucas
SHEET NUMBER	SCALE
1 of 1	1:30,000

PROJECT

Client Name: Wellington Water
Location: Naenae, Lower Hutt
Project Title: Eastern Hills Reservoir

SHEET

Figure 2: Significant Natural Resources Area 12

PROJECT NUMBER	REVISION DATE	REVISION
3-WW021.02	24/08/2023	R1

Original Sheet Size: A3 [W = 420, H = 297]
Plot Date: 2023-08-24 16:24:37 by Hansen, Mark (NZMH30142)
File Ref: U:\ProjectsNZ\3w\3-WW021.02 Naenae No.2 Reservoir\Home\500 Work in Progress\Ecology\GIS\0 Naenae EcIA.qgz

The Wellington ED retains relatively large expanses of natural and regenerating indigenous vegetation. Historically, the Eastern Hills would have likely been covered in dense indigenous beech forests intermixed with podocarps on the lower slopes. However, much of the vegetation in the Eastern Hills was felled for timber through the 19th and 20th Centuries. The foothills now comprise a mix of regenerating mānuka and kānuka, broadleaved indigenous hardwoods, lowland beech, kamahi, scattered arborescent exotic vegetation and areas of gorse, broom and other noxious weeds. Wildfires have also impacted the Eastern Hills. Subsequently, firebreaks have been constructed along many of the spurs, significantly reducing the number of fires in recent years (Boffa Miskell, 2012).

The site comprises approximately 1.9 ha of regenerating indigenous and exotic vegetation, typical of the Eastern Hills landscape. The site, intersected by a firebreak, can broadly be defined as an Eastern Hills spur, entirely bordered by contiguous vegetation, consistent with the wider Eastern Hills area. Residential properties are within proximity to the western boundary while Waiwhetū Stream intersects the north end of the site (Figure 3).

Legend

- Project site boundary
- NZ Topo 1-50k 20m Contours
- NZ Topo 1-50k Topo Tracks
- NZ Topo 1-50k Topo Rivers

Aerial Imagery Basemap

CLIENT

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DRAWN	APPROVED
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SHEET NUMBER	SCALE
1 of 1	1:2,000

PROJECT

Client Name: Wellington Water
Location: Naenae, Lower Hutt
Project Title: Eastern Hills Reservoir

SHEET

Figure 3: Site overview

PROJECT NUMBER	REVISION DATE	REVISION
3-WW021.02	24/08/2023	R1

Original Sheet Size: A3 [W = 420, H = 297]

Plot Date: 2023-08-24 16:29:12 by Hansen, Mark (NZMH30142)

File Ref: U:\ProjectsNZ\3w\3-WW021.02 Naenae No.2 Reservoir\Home\500 Work in Progress\Ecology\GIS\0 Naenae EcIA.qgz

2 Proposed Project

2.1 Proposed Activity

As outlined in Section 1.1 the proposed activity comprises the construction of a 55 m above ground, circular reservoir and associated pipelines; the water supply network pipeline from Summit Road and delivery pipeline which will run north down the spur, crossing below Waiwhetū Stream and an overflow / scour pipeline parallel to the delivery pipeline, which will discharge onto gabion baskets on the bank edge within Waiwhetū Stream. An overview of the proposed project is provided in Figure 4.

This assessment is based on the draft construction methodology appended to the Notice of Requirements and resource consent application. This methodology was prepared in consultation with prospective contractors HEB and Fulton Hogan. Due to the uncertainty around exact earthworks methodologies and ground stability a designation has been provided for consent application which is slightly larger than the project boundary (Figure 5). Construction is anticipated to take 2.5 years to complete and will include the following activities:

- Site establishment.
- Vegetation clearance for construction activities (Figure 3)[1] (approximately 1.9 ha in total, of which 1.32 ha is indigenous).
- The removal of 90,000 m^3 (un-bulked) material from site to construct a platform for the reservoir and install the pipelines down the hill.
- The installation of delivery and overflow / scour pipelines, including clearance of a 14 m wide strip of vegetation leading north from the reservoir down to Waiwhetū Stream.
- The piped Waiwhetū Stream crossing.
- Construction of the reservoir and valve house which will involve four working nights for the base slab concrete pour and roof concrete pour.
- Valve house fitout.
- Reservoir testing and commissioning.
- Site remediation including contouring, reinstating the firebreak, and planting.

[1] Refer to drawing 3-WW021.02_W010 in the AEE for a detailed earthworks boundary.

BURIED STREAM CROSSING. (NOTE 5)
ROCK SWALE
BUBBLE UP CHAMBER
CONNECTION POINT REFER NOTE 2
VALVE CHAMBER
(B)
BALGOWNIE GRV
WAIWHETU STREAM
SUMMIT RD
DN500 OVERFLOW / SCOUR PIPE (NOTE 4)
CONNECTION TO EXISTING DN300 NAENAE RESERVOIR OVERFLOW/SCOUR PIPE (NOTE 4)
CONNECTION TO EXISTING DN750 BULK WATER MAIN
FARRELLY GRV
DN300 NAENAE RESERVOIR OVERFLOW/SCOUR PIPE CONNECTION (NOTE 4)
DN750 DELIVERY PIPE (NOTE 3)
DN500 DELIVERY PIPE CROSS CONNECTIONS (NOTE6)
CONNECTION TO EXISTING NAENAE RESERVOIR DN450 DELIVERY PIPE
EXISTING NAENAE RESERVOIR 11.3ML
(A)
DN750 RESERVOIR INLET
VALVE HOUSE
EASTERN HILLS RESERVOIR 15ML
N
SCALE 1:750 AT ORIGINAL SIZE
0 10 20 30 40 50m

NOTES:

1. DO NOT SCALE OFF DRAWINGS.
2. CONNECTION POINT FOR URBAN DELIVERY ALIGNMENT
3. DELIVERY PIPE LONG SECTION SHOWN ON 3-WW021.02_W012
4. EXISTING DN300 EW FARRELLY GR, DN300 NAENAE SCOUR PIPE CONNECTION AND DN55 OVERFLOW/ SCOUR LONG SECTIONS SHOWN ON 3-WW021.02_W013
5. DELIVERY PIPE BURIED STREAM CROSSING SHOWN ON 3-WW021.02_W004 AND 3-WW021.02_W005
6. SITE PIPELINES FOR FARRELLY GRV AND SUMMIT ROAD SHOWN ON 3-WW021.02_W007
7. WATER STOPS WITH SUBSOIL DRAINS TO BE INSTALLED IN THE SHARED TRENCH FROM POINT (A) TO (B). REFER TO 3-WW021.02_W012 AND W013 FOR FURTHER DETAIL.

WW SERVICES LEGEND

NEW WATER MAIN	W
EXISTING WATER MAIN	W
NEW STORMWATER	SW
EXISTING STORMWATER	SW
NEW SEWER	SS
EXISTING SEWER	SS
NEW POWER LINE	400V
VALVE NEW OR EX / REDUNDANT	V V
HYDRANT NEW OR EX /REDUNDANT	FH FH
NEW SW MANHOLE	
EXISTING SW MANHOLE	

A1 REPRODUCTION SCALE 0mm 10 20 40 60 80 100
A3 REPRODUCTION SCALE 0mm 10 20 30 40 50

FOR INFORMATION
NOT FOR CONSTRUCTION

No.	Revision	By	Chk	Appd	Date
3	UPDATED POST INDEPENDENT REVIEW	G.H.	J.L.	J.L.	29/09/23
2	ISSUED FOR INFORMATION	G.H.	J.L.	J.L.	18/08/23
1	ISSUED WITH CONCEPT DESIGN - FINAL	G.H.	G.B.	J.L.	03/03/23
0	ISSUED FOR INFORMATION	C.Y.	G.B.	J.L.	07/12/22

Drawing Originator: Connect Water
a+ WSP
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Wellington 6144
T 64 4 471 7000

Original Scale (A1) 1:750	Design	L.H.	29/09/23
	Drawn	G.H.	08/09/23
Reduced Scale (A3) 1:1500	Dsg Verifier	J.L.	29/09/23
	Dwg Check	L.H	29/09/23

Approved For Construction* -
Date-
* Refer to Revision 1 for Original Signature

Client: Wellington Water

Project: WELLINGTON WATER
EASTERN HILLS RESERVOIR

Title: SITE PIPELINES
GENERAL LAYOUT

Discipline: CIVIL
Drawing No.: 3-WW021.02_W001
Rev.: 3

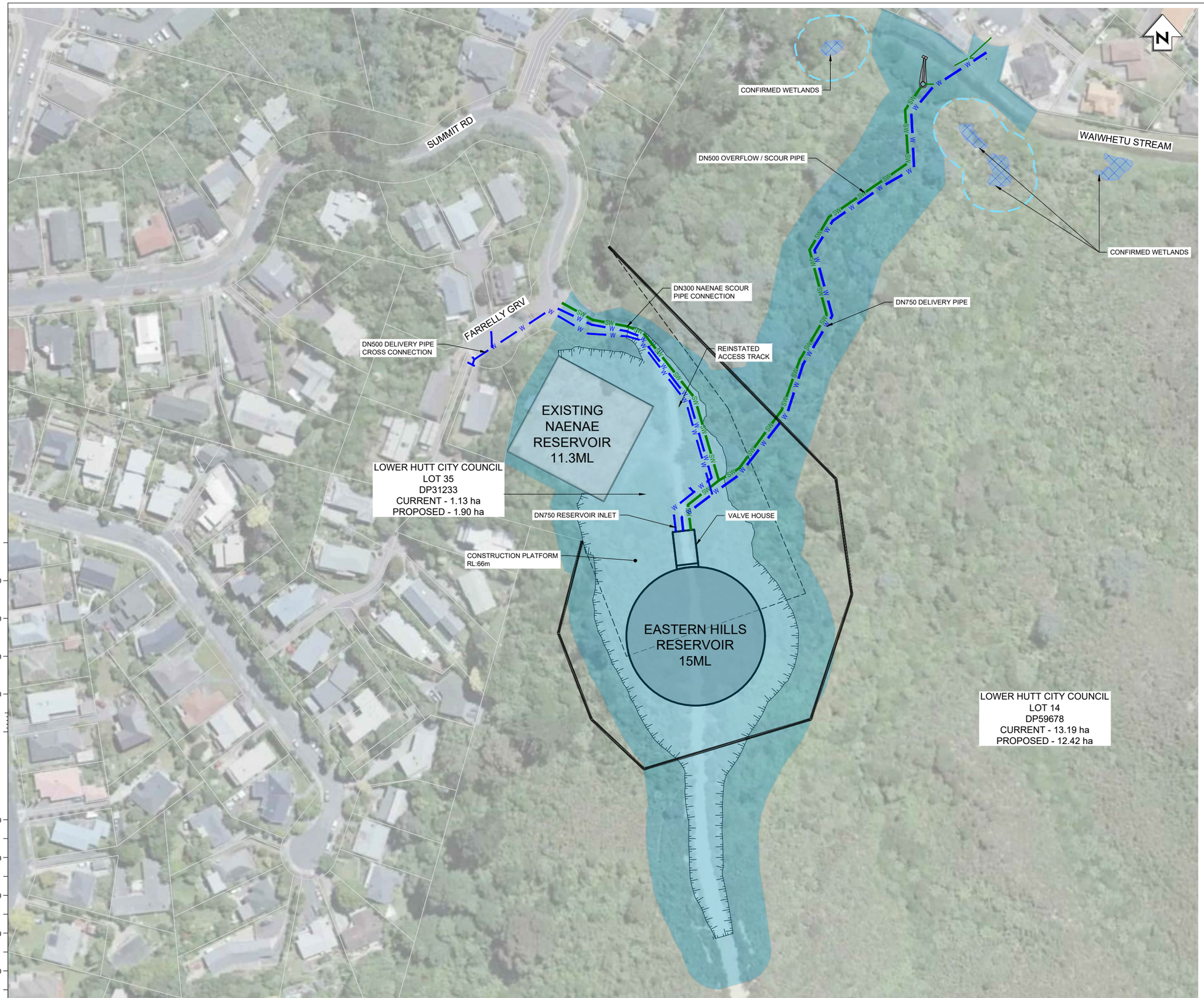
DO NOT SCALE - IF IN DOUBT ASK

PLOTTED BY: PIETERSEN, RIAAN

DRAWING PLOTTED: 18-Jul-23

DOCUMENT PATH: \\CORP\ANZ\PROJECTS\NZ03\W3-WW021.02 NAENAE NO.2 RESERVOIR\HOME\700 DRAWINGS

DOCUMENT NO: 3-WW021.02_W001.DWG



NOTES:

1. DO NOT SCALE OFF DRAWINGS.

LEGEND

- PROPERTY BOUNDARY
- PROPERTY BOUNDARY, TO BE ADJUSTED
- PROPOSED NEW PROPERTY BOUNDARY
- 10m WETLAND BUFFER
- DELIVERY / INLET PIPE (W)
- OVERFLOW / SCOUR DISCHARGE PIPE (SW)
- DESIGNATION BOUNDARY
- WETLAND (CONFIRMED)

A1 REPRODUCTION SCALE: 0mm 20 40 60 80 100

A3 REPRODUCTION SCALE: 0mm 10 20 30 40 50

0 5 10 15 20 25 30 35
SCALE 1:750 AT ORIGINAL SIZE

FOR INFORMATION
NOT FOR CONSTRUCTION

DOCUMENT PATH: \\CORP\ANZ\PROJECTS\NZ3\W3-WW021.02 NAENAE NO.2 RESERVOIR\HOME\700 DRAWINGS

DOCUMENT NO: 3-WW021.02_C008.DWG

No.	Revision	By	Chk	Appd	Date
1	UPDATED POST INDEPENDENT REVIEW	G.H.	L.H.	J.L.	29/09/23
0	ISSUED FOR INFORMATION	G.H.	L.H.	J.L.	18/08/23

Drawing Originator: Connect Water
c/- WSP
PO Box 12-003 Thorndon
Wellington 6144
T 64 4 471 7000

Original Scale (A1) 1:750
Reduced Scale (A3) 1:1500

Design	L.H.	29/09/23	Approved For Construction*
Drawn	G.H.	29/09/23	-
Dsg Verifier	J.L	29/09/23	
Dwg Check	J.L.	29/09/23	Date-

* Refer to Revision 1 for Original Signature

Client: Wellington Water

Project: WELLINGTON WATER
EASTERN HILLS RESERVOIR

Title: RESERVOIR AND PIPELINES
CONSENT DESIGNATION

Discipline: CIVIL

Drawing No.: 3-WW021.02_C008

Rev.: 1

DO NOT SCALE - IF IN DOUBT ASK

PLOTTED BY: PIETERSEN, RIAAN

DRAWING PLOTTED: 29-MAY-23

2.2 Project Effects

2.2.1 Zones of Influence

The zone of influence (ZOI)[2] will vary depending upon the impact and the ecological feature it may influence. The ZOI may extend well beyond the site boundary (e.g., sediment impacts downstream within a watercourse), while in other instances, the impact will be restricted to within the site boundary (e.g., vegetation clearance).

The ZOI for indigenous birds will vary depending on the species, and their utilisation of the site and immediately adjacent habitats. Birds foraging or traversing above the site are likely to bypass operations unaffected, while common species on-site and in the immediately area adapted to human presence, are unlikely to experience significant disturbance and may even benefit from activities during construction. The ZOI for these birds has been assessed as within 20 m of construction during their breeding and nesting periods. Birds averse to humans, are likely to be only slightly affected by construction activities. The ZOI for these birds has been assessed as within 50 m of construction.

The ZOI for herpetofauna will be restricted to habitats immediately adjacent (within 5 m) to construction activities on-site, as lizards are largely unaffected by such disturbances.

The ZOI for Waiwhetū Stream will be dependent on the impact, weather conditions and flow rates at the time. The site largely comprises clay, as such should unmanaged runoff from site occur water quality impacts and sedimentation may extend many kilometres, reaching the Hutt River confluence / outflow into the Wellington harbour. The ZOI for freshwater fauna will include all affected areas of Waiwhetū Stream.

The ZOI for construction activities relevant to ground water may extend to adjacent natural inland wetlands, east of the site (WSP, 2023b). Modelling has shown a potential ground water drawdown of up to 0.3 m beneath only the nearest wetland, while dewatering associated with the pipeline trench during installation, is likely to be discharged within the natural inland wetlands.

2.2.2 Duration

The site and ZOI will experience a number of temporal effects ranging from 'temporary – construction phase' to 'permanent' (Roper-Lindsay, Fuller, Hooson, & Sanders, 2018). Timescales for the duration of effects, caused by the proposed project, are provided below in Table 1. This has been reproduced from Table 9 of the EIANZ guidelines (Roper-Lindsay, Fuller, Hooson, & Sanders, 2018).

Table 1: Timescales for duration of effects (modified from *(Roper-Lindsay, Fuller, Hooson, & Sanders, 2018)*).

Permanent	Effects continuing for an undefined time beyond the span of one human generation (taken as approximately 25 years)
Long-term	15 – 25 years or longer where there is likely to be a substantial improvement after a 25 year period (e.g.: the replacement of mature trees by young trees that need > 25 years to reach maturity.
Medium-term	5 – 15 years
Short-term	After construction completion, up to 5 years
Temporary	Construction phase (days or months)

2.2.3 Actual and Potential Project Impacts

Actual or potential impacts, expected to be caused by the proposed project are listed below.

- Temporary (construction phase) increase in human activity which may disturb protected wildlife.
- Temporary (construction phase) increase in dust, noise, and vibration.

[2] ZOI is defined as "the areas/resources that may be affected by the biophysical changes caused by the proposed project and associated activities' (Roper-Lindsay, Fuller, Hooson, & Sanders, 2018)

- Temporary (construction phase) to short-term increase in erosion and sedimentation.
- Temporary (construction phase) dewatering of Waiwhetū Stream and associated interruption of fish movements.
- Temporary (construction phase) discharge to Waiwhetū stream from dewatering.
- Temporary (construction phase) reduction of ground water to adjacent natural inland wetlands.
- Temporary (construction phase) increase in artificial lighting at night during 24-hour concrete pours.
- Short-term loss of Waiwhetū Stream riparian vegetation.
- Short to medium-term loss of vegetation.
- Medium to long-term loss of bird habitat.
- Medium to long-term loss of lizard habitat.
- Short to long-term loss of invertebrate habitat.
- Permanent loss of vegetation.
- Permanent loss of bird habitat.
- Permanent loss of lizard habitat.
- Potential death of protected wildlife (indigenous birds and lizards).

3 Impact Assessment Methodology

3.1 Overview

The Environmental Institute of Ecology for Australia and New Zealand (EIANZ) guidelines for undertaking an ecological impact assessment (Roper-Lindsay, Fuller, Hooson, & Sanders, 2018) were used to assess the ecological impacts of the project. These industry standard guidelines provide a transparent stepwise approach to evaluate the ecological value of features on-site, determine the magnitude of effect from the proposed activity on those features and describe an overall level of effect based on a matrix combination of values and magnitude of effects.

3.2 Ecological Values Assessment

The criteria by which the value of ecological features are identified with respect to ecosystems and/or indigenous biodiversity are outlined within the EIANZ guidelines (Roper-Lindsay, Fuller, Hooson, & Sanders, 2018). Criteria for determining significant indigenous vegetation and habitat for indigenous fauna include 'Representativeness', 'Rarity and Distinctiveness', 'Diversity and Pattern', and 'Ecological Context'. A range of attributes are considered when assigning a value for each of the four matters. Once attributes are assessed, a value of 'Very Low', 'Low', 'Moderate', 'High' or 'Very High' is assigned to each matter. The four matters and associated attributes have been reproduced in Table 28 and Table 29 (Appendix A) from the EIANZ guidelines for describing the ecological value of terrestrial and freshwater sites, respectively.

When considering the importance of plant and animal species, values are assigned based on the species description in the New Zealand Threat Classification System (Townsend, 2008). The information in this system contributes to the assessment of the 'Rarity/distinctiveness' matter of this EcIA. Table 5 of (Roper-Lindsay, Fuller, Hooson, & Sanders, 2018) identifies factors to consider when assessing species value and has been reproduced as Table 30 (Appendix A).

The Very High, High, Moderate, Low, Very Low and Negligible values assigned to each ecological feature for each matter (based on Table 28 and Table 29) then feed into a scoring system to give an overall ecological value for that feature within the assessed site. Table 6 of (Roper-Lindsay, Fuller, Hooson, & Sanders, 2018) provides a broad guide on how a combined overall ecological value score could be determined from the four individual matter scores. Table *31* of Appendix A reproduces the guide to combining values for each of the four matters.

3.3 Levels of Effects Assessment

3.3.1 Magnitude of Effect

Using information on the actual and/or potential impacts of an activity on any given ecological feature, the extent of effects on that feature can be quantified using the same Negligible to Very High scale previously mentioned. When determining the pre-mitigated magnitude of effect, consideration is given to the scale of impacts, the extent of proportion of habitat loss verse local availability, the duration of impacts and the intensity of pre-mitigated effects. Table *32* of Appendix A outlines the criteria for describing the magnitude of effect and Table 1 provides guidance on the timescale potential effects must be considered.

3.3.2 Pre-Mitigated Level of Effect

To determine the pre-mitigated level of effect on an ecological feature, the assessed ecological value is combined with the pre-mitigated magnitude of effect. This overall 'pre-mitigated' level of effect is determined prior to any avoidance, minimisation, or remediation measures being implemented. As ecological values and magnitude of effects lie on a continuum (Negligible to Very High), matrices assist in clarifying what the pre-mitigated level of effect on the ecological feature will be. This assessment framework allows for pre-mitigated level of effects to be rated on

a gradient of 'Very Low' to 'Very high' and includes scenarios where an ecological 'Net Gain' is achieved. Positive effects are considered in the assessment framework as many projects offer, as part of their design, positive environmental outcomes. The pre-mitigated level of effect provides justification for avoidance, minimisation, remediation, offsetting, or compensation requirements as appropriate. When determining the pre-mitigated level of effect on a given ecological feature, Table 10 of (Roper-Lindsay, Fuller, Hooson, & Sanders, 2018) was used and has been reproduced as Table 33 of Appendix A.

3.3.3 Management of Effects

The effects management hierarchy, as defined by the EIANZ guidelines and in the National Policy Statement for Indigenous Biodiversity (NPS-IB) and National Policy Statement for Freshwater Management (NPS-FM) begins with avoidance. Some project effects are unavoidable, as such mitigation is required. Minimisation of actual or potential project impacts must occur, followed by remedying impacts or effects through reinstatement or restoration of the affected site. The level of restorative effort needed for the site is guided by the significance of ecological values adversely affected, level of ecological effects, and feasibility of implementation. The likelihood of success of any imposed impact management must also be considered.

3.3.4 Post-Mitigated Level of Effect

Following the identification of a project's pre-mitigated level of effect on any given ecological feature, options are recommended to avoid, minimise, and remedy ecological impacts. A post-mitigated level of effect (residual effect) is then established (Table 33; Appendix A) which accounts for the on-site actions (avoidance, minimisation, and/or remediation) implemented to address the actual and potential impacts of the project.

If, following avoidance, minimisation, and remediation more than minor effects remain (moderate level of effect or above), biodiversity offsetting must be provided and finally, if offsetting is not possible, biodiversity compensation is provided. These final two measures are the least favourable management measures and effort should always be given to at least mitigating impacts where practicable.

Finally, considering all effects management (avoidance, minimisation, remediation, offsetting, and compensation), the residual level of effect is assessed is derived using Table 33 (Appendix A).

4 National Policy Statements

4.1 National Policy Statement for Indigenous Biodiversity

The NPS-IB applies to indigenous biodiversity in the terrestrial environment throughout Aotearoa New Zealand (Ministry for the Environment, 2023). The objective of the NPS-IB is to maintain indigenous biodiversity across Aotearoa New Zealand so that there is at least no overall loss. The NPS-IB came into force on 4 August 2023.

The NPS-IB requires the effects management hierarchy to be applied to any adverse effects on a Significant Natural Area (SNA) (3.10 (3)). The site is within SNR12 (Section 1.2 and Section 6), which is consistent with being an SNA under the NPS-IB. The Ecological Assessment (Section 7) outlines proposed methods to avoid, minimise, remedy, offset or compensate the effects on indigenous biodiversity in accordance with the effects management hierarchy. Where biodiversity offsetting is required, a biodiversity Net Gain outcome must be achieved. Key polices from the NPS-IB that are relevant to the proposed activity are as follows:

Policy 1: Indigenous biodiversity is managed in a way that gives effect to the decision-making principles and takes into account the principles of the Treaty of Waitangi.
Policy 3: A precautionary approach is adopted when considering adverse effects on indigenous biodiversity.
Policy 7: SNAs are protected by avoiding or managing adverse effects from new subdivision, use and development.
Policy 8: The importance of maintaining indigenous biodiversity outside SNAs is recognised and provided for.
Policy 10: Activities that contribute to New Zealand's social, economic, cultural, and environmental wellbeing are recognised and provided for as set out in this National Policy Statement.
Policy 13: Restoration of indigenous biodiversity is promoted and provided for.
Policy 14: Increased indigenous vegetation cover is promoted in both urban and non-urban environments.
Policy 15: Areas outside SNAs that support specified highly mobile fauna are identified and managed to maintain their populations across their natural range, and information and awareness of highly mobile fauna is improved.

4.2 National Policy Statement for Freshwater Management

The NPS-FM applies to freshwater environments throughout Aotearoa New Zealand (Ministry for the Environment, 2022). The objective of the NPS-FM is to ensure that natural and physical resources are managed in a way that prioritises the health and well-being of waterbodies and freshwater ecosystems. The NPS-FM came into force on 3 September 2020.

The NPS-FM requires the effects management hierarchy to be applied to any loss of extent or values of rivers (streams) (Clause 3.24) and natural inland wetlands (Clause 3.22). This Ecological Assessment (Section 7) outlines proposed methods to avoid, minimise, remedy, offset or compensate the effects on freshwater streams and wetlands in accordance with the effects management hierarchy.

Key polices from the NPS-FM that are relevant to the proposed activity are as follows:

2.2 Policies

Policy 1: Freshwater is managed in a way that gives effect to Te Mana o te Wai.
Policy 3: Freshwater is managed in an integrated way that considers the effects of the use and development of land on a whole-of-catchment basis, including the effects on receiving environments.
Policy 5: Freshwater is managed (including through a National Objectives Framework) to ensure that the health and well-being of degraded water bodies and freshwater ecosystems is improved, and the health and well-being of all other water bodies and freshwater ecosystems is maintained and (if communities choose) improved.
Policy 6: There is no further loss of extent of natural inland wetlands, their values are protected, and their restoration is promoted.
Policy 9: The habitats of indigenous freshwater species are protected.
Policy 10: The habitat of trout and salmon is protected, insofar as this is consistent with Policy 9.

The NPS-FM provides five compulsory values that must be considered when determining ecosystem health. In combination with the four matters and associated attributes outlined by EIANZ guidelines (Section 3.2), the five compulsory values outlined by the NPS-FM will be

considered, where possible, when assessing freshwater habitats on-site. The five compulsory values are outlined below.

Appendix 1A – Compulsory values
1. Ecosystem health
This refers to the extent to which an FMU [Freshwater Management Unit] or part of an FMU supports an ecosystem appropriate to the type of water body (for example, river, lake, wetland, or aquifer).

There are 5 biophysical components that contribute to freshwater ecosystem health, and it is necessary that all of them area managed. They are:

1) Water quality – the physical and chemical measures of the water, such as temperature, dissolved oxygen, pH, suspended sediment, nutrients and toxicants

2) Water quantity – the extent and variability in the level or flow of water

3) Habitat – the physical form, structure, and extent of the water body, its bed, banks and margins; its riparian vegetation; and its connections to the floodplain and to groundwater

4) Aquatic life – the abundance and diversity of biota including microbes, invertebrates, plants, fish and birds

5) Ecological processes – the interactions among biota and their physical and chemical environment such as primary production, decomposition, nutrient cycling and trophic connectivity.

In a healthy freshwater ecosystem, all 5 biophysical components are suitable to sustain the indigenous aquatic life expected in the absence of human disturbance or alteration (before providing for other values).

5 Wellington Regional Policy Statement

The Wellington Regional Policy Statement (WRPS) (Wellington Regional Council, 2013) outlines several objectives and related policies for the protection of indigenous biodiversity in terrestrial and freshwater ecosystems. Objectives and policies relevant to the project are outlined below. Of particular importance is Policy 23 which outlines criteria for identifying indigenous ecosystems and habitats with significant indigenous biodiversity values. This policy is useful for identifying significant values more generally as it uses the same four matters that are considered in the EIANZ guidelines.

Objective 12: The quantity and quality of freshwater:
a) Meet the range of uses and values for which water is required;
b) Safeguard the life supporting capacity of water bodies; and
c) Meeting the reasonably foreseeable needs of future generations.

Policy 12: Management purposes for surface water bodies – regional plans
Regional plans shall include policies, rules and/or methods that:
a) require that water quality, flows and water levels, and the aquatic habitat of surface water bodies are to be managed for the purpose of safeguarding aquatic ecosystem health; and
b) manage water bodies for other purposes identified in regional plans.

Policy 14: Minimising contamination in stormwater from new development – regional plans
Regional plans shall include policies, rules and/or methods that protect aquatic ecosystem health by minimising ecotoxic and other contaminants in stormwater that discharges into water, or onto or into land that may enter water, from new subdivision and development.

Policy 15: Minimising the effects of earthworks and vegetation clearance – district and regional plans.
Regional and district plans shall include policies, rules and/or methods that control earthworks and vegetation disturbance to minimise:
a) erosion; and
b) silt and sediment runoff into water, or onto land that may enter water, so that aquatic ecosystem health is safeguarded.

Policy 40: Safeguarding aquatic ecosystem health in water bodies – consideration
When considering an application for a resource consent, notice of requirement, or a change, variation or review of a regional or district plan, particular regard shall be given to:
a) requiring that water quality, flows and water levels and aquatic habitats of surface water bodies are managed for the purpose of safeguarding aquatic ecosystem health;
b) requiring, as a minimum, water quality in the coastal marine area to be managed for the purpose of maintaining or enhancing aquatic ecosystem health; and
c) managing water bodies and the water quality of coastal water for other purposes identified in regional plans.

Policy 41: Minimising the effects of earthworks and vegetation disturbance – consideration.
When considering an application for a resource consent, notice of requirement, or a change, variation or review of a regional or district plan, particular regard shall be given to controlling earthworks and vegetation disturbance to minimise:
a) erosion; and
b) silt and sediment runoff into water, or onto or into land that may enter water, so that healthy aquatic ecosystems are sustained

Objective 13: The region's rivers, lakes and wetlands support healthy functioning ecosystems.

Policy 18: Protecting aquatic ecological function of water bodies – regional plans.
Regional plans shall include policies, rules and/or methods that:
a) promote the retention of in-stream habitat diversity by retaining natural features – such as pools, runs, riffles, and the river's natural form;
b) promote the retention of natural flow regimes – such as flushing flows;
c) promote the protection and reinstatement of riparian habitat;
d) promote the installation of off-line water storage;
e) discourage the reclamation, piping, straightening or concrete lining of rivers;
f) discourage stock access to rivers, lakes and wetlands;
g) discourage the diversion of water into or from wetlands – unless the diversion is necessary to restore the hydrological variation to the wetland;

h) discourage the removal or destruction of indigenous plants in wetlands and lakes; and
i) maintain fish passage.

Policy 19: Managing amenity, recreational and indigenous biodiversity values of rivers and lakes – regional plans.
Regional plans shall include policies, rules and/or methods that:
a) maintain or enhance the amenity and recreational values of rivers and lakes, including those with significant values listed in Table 15 of Appendix 1; and
b) protect the significant indigenous ecosystems and habitats with significant indigenous biodiversity values of rivers and lakes, including those listed in Table 16 of Appendix 1.

Policy 43: Protecting aquatic ecological function of water bodies – consideration.
When considering an application for a resource consent, notice of requirement, or a change, variation or review of a district or regional plan, particular regard shall be given to:
a) maintaining or enhancing the functioning of ecosystems in the water body;
b) maintaining or enhancing the ecological functions of riparian margins;
c) minimising the effect of the proposal on groundwater recharge areas that are connected to surface water bodies;
d) maintaining or enhancing the amenity and recreational values of rivers and lakes, including those with significant values listed in Table 15 of Appendix 1;
e) protecting the significant indigenous ecosystems and habitats with significant indigenous biodiversity values of rivers and lakes, including those listed in Table 16 of Appendix 1;
f) maintaining natural flow regimes required to support aquatic ecosystem health;
g) maintaining fish passage;
h) protecting and reinstating riparian habitat, in particular riparian habitat that is important for fish spawning;
i) discouraging stock access to rivers, lakes and wetlands; and
j) discouraging the removal or destruction of indigenous wetland plants in wetlands.

Policy 64: Supporting a whole of catchment approach – non-regulatory.
Take a whole of catchment approach that recognises the inter-relationship between land and water, and support environmental enhancement initiatives to restore and enhance:
a) coastal features, ecosystems and habitats;
b) aquatic ecosystems and habitats; and
c) indigenous ecosystems and habitats.

Objective 16: Indigenous ecosystems and habitats with significant biodiversity values are maintained and restored to a healthy functioning state.

Policy 23: Identifying indigenous ecosystems and habitats with significant indigenous biodiversity values – district and regional plans.
District and regional plans shall identify and evaluate indigenous ecosystems and habitats with significant indigenous biodiversity values; these ecosystems and habitats will be considered significant if they meet one or more of the following criteria:
a) Representativeness: the ecosystems or habitats that are typical and characteristic examples of the full range of the original or current natural diversity of ecosystem and habitat types in a district or in the region, and:
i. are no longer commonplace (less than about 30% remaining); or
ii. are poorly represented in existing protected areas (less than about 20% legally protected).
b) Rarity: the ecosystem or habitat has biological or physical features that are scarce or threatened in a local, regional or national context. This can include individual species, rare and distinctive biological communities and physical features that are unusual or rare.
c) Diversity: the ecosystem or habitat has a natural diversity of ecological units, ecosystems, species and physical features within an area.
d) Ecological context of an area: the ecosystem or habitat:
i. enhances connectivity or otherwise buffers representative, rare or diverse indigenous ecosystems and habitats; or
ii. provides seasonal or core habitat for protected or threatened indigenous species.
e) Tangata whenua values: the ecosystem or habitat contains characteristics of special spiritual, historical or cultural significance to tangata whenua, identified in accordance with tikanga Māori

Policy 24: Protecting indigenous ecosystems and habitats with significant indigenous biodiversity values – district and regional plans.
District and regional plans shall include policies, rules and methods to protect indigenous ecosystems and habitats with significant indigenous biodiversity values from inappropriate subdivision, use and development.
Table 16 in Appendix 1 identifies rivers and lakes with significant indigenous ecosystems and habitats with significant indigenous biodiversity values by applying criteria taken from policy 23 of rarity (habitat for threatened indigenous fish species) and diversity (high macroinvertebrate community health, habitat for six or more migratory indigenous fish species).

Policy 47: Managing effects on indigenous ecosystems and habitats with significant indigenous biodiversity values – consideration.

When considering an application for a resource consent, notice of requirement, or a change, variation or review of a district or regional plan, a determination shall be made as to whether an activity may affect indigenous ecosystems and habitats with significant indigenous biodiversity values, and in determining whether the proposed activity is inappropriate particular regard shall be given to:

a) maintaining connections within, or corridors between, habitats of indigenous flora and fauna, and/or enhancing the connectivity between fragmented indigenous habitats;
b) providing adequate buffering around areas of significant indigenous ecosystems and habitats from other land uses;
c) (c) managing wetlands for the purpose of aquatic ecosystem health;
d) avoiding the cumulative adverse effects of the incremental loss of indigenous ecosystems and habitats;
e) providing seasonal or core habitat for indigenous species;
f) protecting the life supporting capacity of indigenous ecosystems and habitats;
g) remedying or mitigating adverse effects on the indigenous biodiversity values where avoiding adverse effects is not practicably achievable; and
h) the need for a precautionary approach when assessing the potential for adverse effects on indigenous ecosystems and habitats.

Policy 64: Supporting a whole of catchment approach – non-regulatory.
Take a whole of catchment approach that recognises the inter-relationship between land and water, and support environmental enhancement initiatives to restore and enhance:
a) coastal features, ecosystems and habitats;
b) aquatic ecosystems and habitats; and
indigenous ecosystems and habit

6 City of Lower Hutt District Plan

The City of Lower Hutt District Plan (CLHDP) contains policies relating to the identification and protection of Significant Natural Resources. Resources relevant to this report include habitats and wetlands.

The site is identified within the CLHDP as SNR12 (Section 1.2), which meets the definition of an SNA under the NPS-IB (Section 4.1). SNR12 has been considered as an SNA for the purposes of this EcIA.

Section 1.1 of Chapter 14E states Significant Natural Resources will be identified using the following factors:

14E 1.1 Protection of Significant Natural, Cultural and Archaeological Resources
Objective:
To identify and protect significant natural, cultural and archaeological resources in the City from inappropriate subdivision, use and development.
Policy
a) That a schedule of significant natural, cultural and archaeological resources within the City be compiled.
b) That it be recognised that new significant natural, cultural and archaeological resources may be discovered, and added to the schedule of significant resources.
c) That any activity or site development shall not modify, damage or destroy a significant natural, cultural or archaeological resource.
d) That any activity or site development shall not compromise the natural character or visual amenity values of a significant natural, cultural or archaeological resource.
e) All buildings, structures and activities shall preserve the natural character, visual amenity values and landscape values of the significant natural, cultural or archaeological resources including the identified coastal environment.
f) The scale, height, location and design of all buildings and structures shall protect the amenity values, especially landscape values, of the identified coastal environment.
g) That any activity or site development will take into account new findings of significant natural, cultural and archaeological resources.
h) That the cultural significance of these natural resources be recognised and protected.
i) That any activity or site development shall not modify, damage or destroy the intrinsic values of the ecosystems of a significant natural, cultural or archaeological resource.
Factors such as the following will be taken into account when considering resources for future inclusion in the schedule of significant natural resources:
a) Representativeness
- *Contains an ecology that is unrepresented or unique in the ecological district.*

b) Rarity
- *Contains threatened ecosystems.*
- *Contains threatened species.*
- *Contains species that are endemic to the ecological district.*

c) Diversity
- *Diversity of ecosystems/species/vegetation.*

d) Distinctiveness
- *Contains large/dense population of viable species.*
- *Largely in its natural state or restorable.*
- *Uninterrupted ecological sequence.*

Contains significant landforms.
e) Continuity and Linkage within Landscape
- *Provides, or has potential to provide, corridor/buffer zone to an existing area.*

f) Cultural Values
- *Traditionally important for Māori.*
- *Recreational values.*
- *Significant landscape value.*
- *Protection of soil values.*
- *Water catchment protection.*
- *Recreation or tourism importance.*
- *Aesthetic coherence.*

g) Ecological Restoration
- *Ability to be restored.*
- *Difficulty of restoration.*

- *Cost/time.*

h) *Landscape Integrity*

- *Significance to the original character of the landscape.*
- *Isolated feature, does it stand out or blend in.*
- *Does it have a role in landscape protection.*

i) *Sustainability*

- *Size and shape of the area.*
- *Activities occurring on the boundaries which may affect its sustainability.*
- *Adjoins another protected area.*
- *Links.*
- *Easily managed.*

7 Ecological Assessment

A desktop review of relevant literature and databases was conducted to determine the potential ecological features and species most likely to be present on-site or within respective zones of influence.

Desktop reviews included:

- Aerial imagery databases (Google Earth/GIS).
- High resolution aerial UAV/drone imagery.
- Land Environment New Zealand – Threatened Environments (Level 4) (LENZ).
- Land Cover Database Version 5.0 (LCDB).
- OurEnvironment (Land Atlas of New Zealand) – wetland GIS datasets.
- eBird NZ Bird Atlas.
- Department of Conservation (DOC) bat[3] and herpetofauna[4] databases.
- DOC Official Information Act request for relevant information
- New Zealand Freshwater Fish Database (NZFFD).
- Hutt City District Plan Map.
- Greater Wellington Regional Council Map – Natural Resources Plan.

On-site assessments were performed by WSP ecologists between early March and mid-June 2023. A range of ecological features were identified on-site and within the ZOI. Fine level flora and fauna surveys, watercourse mapping and wetland delineations were all performed during optimal season conditions. Off-site field surveys were also conducted within proximity to the site and provide further context for the rarity of ecological features found on-site. A summary of field assessment effort is provided below in Table 2.

Table 2: Summary of field assessment effort.

Date	Activity
7 – 8 March 2023	• Initial site walkover • Incidental vegetation surveys • Installation of long-term nocturnal and diurnal high and low frequency bird monitoring devices (AR4s) • Incidental bird surveys • Installation of long-term bat monitoring devices (AR4 Acoustic recorders) • Nocturnal hand-held bat monitoring • Installation of long-term passive lizard monitoring devices (Artificial Cover Objects (ACOs) and tracking tunnels • Lizard surveys (manual habitat searches and nocturnal spotlighting) • High-level watercourse identifications • Identification of potential natural inland wetlands • Installation of long-term pest animal monitoring devices (trail cameras and tracking tunnels) • Incidental pest animal observations
17 – 20 April 2023	• Vegetation surveys • Collection of bird AR4s • Incidental bird surveys • Collection of bat AR4s • Lizard surveys (monitoring of ACOs, manual habitat searches and nocturnal spotlighting) • Installation and collection of baited lizard tracking tunnel ink cards (pear and apple puree) • Watercourse mapping • Wetland delineations • Collection of eDNA samples from watercourses on-site and within ZOI • Collection of macroinvertebrates samples on-site and within ZOI

[3] DOC Bat GIS Layer (as of May 2021)
[4] DOC Herpetofauna GIS Layer (2020)

Date	Activity
	• Collection of trail cameras • Installation and collection of baited pest animal tracking tunnel ink cards (peanut butter & chicken) • Installation and collection of pest animal monitoring chew cards (aniseed) • Incidental pest animal observations
19 – 20 June 2023	• Wetland delineations

7.1 Avifauna - Birds

7.1.1 Bird Values

A desktop review of the eBird database (New Zealand Bird Atlas, 2023) identified 37 bird species previously recorded within proximity of site (Table 35; Appendix B). Of the 21 indigenous birds, two are 'Threatened' and five are 'At Risk' based on their regional threat classifications (Greater Wellington Regional Council, 2020a).

Long-term bird monitoring on-site was conducted using two AR4 acoustic bird monitoring devices (ABMs) (Figure 6). One was set to record at a high frequency, from one hour before sunrise (06:10 am) until one hour after sunset (09:10 pm) targeting diurnal species, while the other at a low frequency from one hour before sunset (06:40 pm) and until one hour after sunrise at (07:25 am) targeting nocturnal species (Figure 7). The high frequency diurnal ABM functioned until 16 March 2023 when the SD card was full while the low frequency nocturnal ABM remained operational until 5 April 2023.

Figure 6: ABM installed to record diurnal birds

N

Legend

Long-term monitoring devices

ABM12 Bird high day

ABM9 Bird low night

Project site boundary

ESRI Satellite

CLIENT

Wellington Water

WSP

Christchurch Ecology

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M. HANSEN	J. Lucas
SHEET NUMBER	SCALE
1 of 1	1:2,000

PROJECT

Client Name: Wellington Water
Location: Naenae, Lower Hutt
Project Title: Eastern Hills Reservoir

SHEET

Figure 7: Bird ABM locations

PROJECT NUMBER	REVISION DATE	REVISION
3-WW021.02	11/09/2023	R1

Original Sheet Size: A3 [W = 420, H = 297]

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Eighteen bird species were confirmed either through ABM surveys, environmental DNA (eDNA) sampling of Waiwhetū Stream or incidentally (heard or seen) during site visits. North Island brown kiwi (*Apteryx mantelli)* and North Island rifleman (*Acanthisitta chloris granti*) are highly unlikely within the Eastern Hills area. Of the 16 confirmed, likely, or possible, indigenous bird species within on or within proximity to the site, bush falcon (*Falco novaeseelandiae ferox*) is 'Threatened - Regionally Critical' (Greater Wellington Regional Council, 2020a) and was observed traversing above the site. Bush falcon range widely across the landscape and were observed traversing the site. They may forage 'on-site' and could potentially utilise suitable arborescent vegetation for nesting. Kererū (*Hemiphaga novaeseelandiae*) were observed within mature bush immediately adjacent to the (Figure 8). Although nationally 'Not Threatened' (Robertson, et al., 2021), within the Wellington Region they are 'At Risk – Recovering' (Crisp, 2020), as with the bush falcon kererū may nest on-site. Pursuant to Policy 3 of the NPS-IB and EIANZ guidelines, where there is risk or uncertainty, a precautionary approach must be taken, and therefore 'Rarity / distinctiveness' of the site for birds, must be assessed as 'Very High'.

Figure 8: Kereru within 'Broadleaved Indigenous Hardwoods' immediately adjacent to the site.

A summary of birds, their regional threat classification, and likelihood of presence on-site is provided in Table 35 (Appendix B).

The ecological value of birds on-site has been assessed against the four matters outlined in Section 3.2 and described in Table 28 (Appendix A). The 'Rarity / distinctiveness' value of birds has also been assessed based on their threat classification (Table 30; Appendix A). The ED was used as an appropriate scale by which ecological values were considered. Attributes relevant to each matter pursuant to the site are provided along with assigned values in Table 3. The four values were then combined as outlined in Table 31 (Appendix A) for an overall value. The overall ecological value of birds on-site is **Moderate**.

Table 3: Summary of bird attributes and the overall ecological value.

Matters	Attributes	Ecological value	Overall ecological value
Representativeness	• Greater than half of the 37 species within proximity to the site are indigenous. Although, vast majority are 'Not Threatened' or 'Introduced and Naturalised'. • Bird community highly likely to be significantly altered from pre-1840. • Species assemblage / richness is typical for the habitats on-site and within the ZOI.	Low	**Moderate**
Rarity / distinctiveness	• Regionally 'Threatened' and 'At Risk' species may utilise the site.	Very High	

Matters	Attributes	Ecological value	Overall ecological value
Diversity and pattern	• Surrounding environment likely supports daily and seasonal lifecycles (e.g., foraging and nesting) of bird species.	Moderate	
Ecological context	• Urbanised local environment has likely played a role in shaping bird community on-site. • Site boundary is a small proportion of the overall SNR and bird species on-site will likely be able to utilise adjacent habitats.	Low	

7.1.2 Levels of Effects Assessment

The actual or potential impacts to birds caused by the proposed project include the temporary (construction phase) disturbance/displacement during construction, short-term to permanent loss of nesting and foraging habitats (refer Section 7.6.2) and the potential death of protected species during vegetation clearance. Mobile adult birds are highly unlikely to be killed, however immobile eggs and chicks in the nest are at risk.

The clearance of all vegetation on-site will result in a short-term to permanent loss of habitat on-site for birds. There will be a short-term loss in foraging habitat for some species and an increase in foraging habitat for others more adapted to disturbed areas and human activity such as fantail (*Rhipidura fuliginosa placabilis*). The expected loss of foraging habitat is due to the time required for replanted vegetation to mature to flower and fruit while the loss of nesting habitat is negligible when considering the expansive adjacent habitat. No carrying capacity constraints are expected in adjacent habitats based on the species and few numbers of those birds that may be displaced. Of the vegetation that is replanted within the 'Indigenous Broadleaved Hardwood' areas (Figure 50) nesting habitat will be replaced within the long-term. The pipeline alignment remediation will be fundamentally altered, permanently losing mature vegetation, however it is proposed this area is planted in shrubs suitable for the site and SNR. Areas unable to be replanted such as the reservoir and carpark hardstand will suffer a permanent loss.

Vegetation clearance on-site has the potential to kill birds' eggs and chicks in nests, while eggs and chicks within the ZOI could also be impacted if the adult birds abandon the nest.

Using the ED as the scale, the magnitude of effect has been assessed as **Low**. This is because there is likely to be only a minor shift away from existing habitat and foraging baseline conditions. The change arising from the loss/alteration to habitats on-site will be discernible but will only have a minor effect on the known population of birds given the surrounding SNR. Using Table 33 (Appendix A) to combine the Low magnitude of effect with the moderate overall ecological value, the pre-mitigated level of effect is **Low**.

7.1.3 Measures to avoid, minimise and/or remedy effects on avifauna.

Although the pre-mitigated level of effect has been assessed as Low, the effects management hierarchy must be applied pursuant to Clause 3.10 (2) of the NPS-IB. Furthermore, all indigenous birds observed on-site, except southern black-backed gull, and their nesting habitat are 'protected' under the Wildlife Act 1953 (New Zealand Government, 1953).

A Bird Management Plan (BMP) must be developed by a suitably qualified ecologist to avoid disturbance and death to indigenous birds during site works. The BMP must define the nesting and fledging seasons and the ZOI for all species on-site, methodologies to determine if active nests are present prior to vegetation removal and construction activities and management actions should nests be discovered during checks (e.g., exclusion zones). The measures outlined to avoid, minimise, and remedy impacts on vegetation as outlined in Section 7.6.3 will also contribute to avoiding, minimising and remediating avifauna effects as the vegetation provides suitable bird habitat.

Implementing these management actions will result in a **Negligible** post-mitigated magnitude of effect, resulting in a **Very Low** overall level of effect for bird populations on-site. A Very Low level

of residual effect is not 'more than minor', therefore, in accordance with the effects management hierarchy, offsetting and compensation do not need to be considered for avifauna.

However, the pest animal control required as part of lizard mitigation (Section 7.3.3) and vegetation offsetting requirements (Section 7.6.3) defined in the Offsetting Management Plan (OMP) (Appendix C) will provide additional benefits and result in an overall Net Gain for bird populations. A summary of the impact assessment for birds is provided below in Table 4.

Table 4: Impact assessment summary for birds present on-site and within the ZOI.

Value	Magnitude of effect	Pre-mitigated level of effect	Mitigation requirements	Post-mitigated magnitude of effect	Residual level of effect
Moderate	Low	Low	Avoid • A BMP (including methodologies for nest checks and management actions) must be developed and implemented by a suitably qualified ecologist, specific to the site and species. • Avoid the removal of, or impacts to, indigenous vegetation where practicable. • Avoid vegetation removal, where practicable, during bird breeding seasons for bird species most likely on-site. Minimise • Minimise the extent of indigenous vegetation removed where possible. • Stage vegetation removal to minimise impacts on the birds inhabiting the vegetation on site. Remediation • Remediation of vegetation on-site, where practicable, with eco sourced indigenous plants (see Section 7.6.3 for details).	Negligible (Positive with mitigation and offsetting provided for vegetation and lizards)	Very Low (Net Gain with mitigation and offsetting provided for vegetation and lizards)

7.2 Chiropteran - Bats

7.2.1 Bat Values

The DOC Bat Database of previous surveys was reviewed to within 25 km of site, pursuant to the protocols to minimise the risk of felling roosts (Department of Conservation Bat Recovery Group, 2021) (Figure 9). A total of 437 previous surveys exist within 25 km, three of which are either very old (1980) or an unreliable observation (Pers. Comm. A. van Meeuwen-Dijkgraff). A 2022 record from DOC tier 1 monitoring recorded three passes of the 'Threatened – Nationally Increasing' central lesser short-tailed bat (*Mystacina tuberculata rhyacobi*) (O'Donnell, et al., 2023) approximately 15 km east of the site.

Legend

DOC Bat bioweb data (2023) within 25 km of site

Mystacina tuberculata

No bat species detected

25km radius from site

Project site boundary

ESRI Satellite

CLIENT

Wellington Water

wsp
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SHEET NUMBER	SCALE
1 of 1	1:210,000

PROJECT

Client Name: Wellington Water
Location: Naenae, Lower Hutt
Project Title: Eastern Hills Reservoir

SHEET

Figure 9: Bat database records within proximity to site

PROJECT NUMBER	REVISION DATE	REVISION
3-WW021.02	11/09/2023	R1

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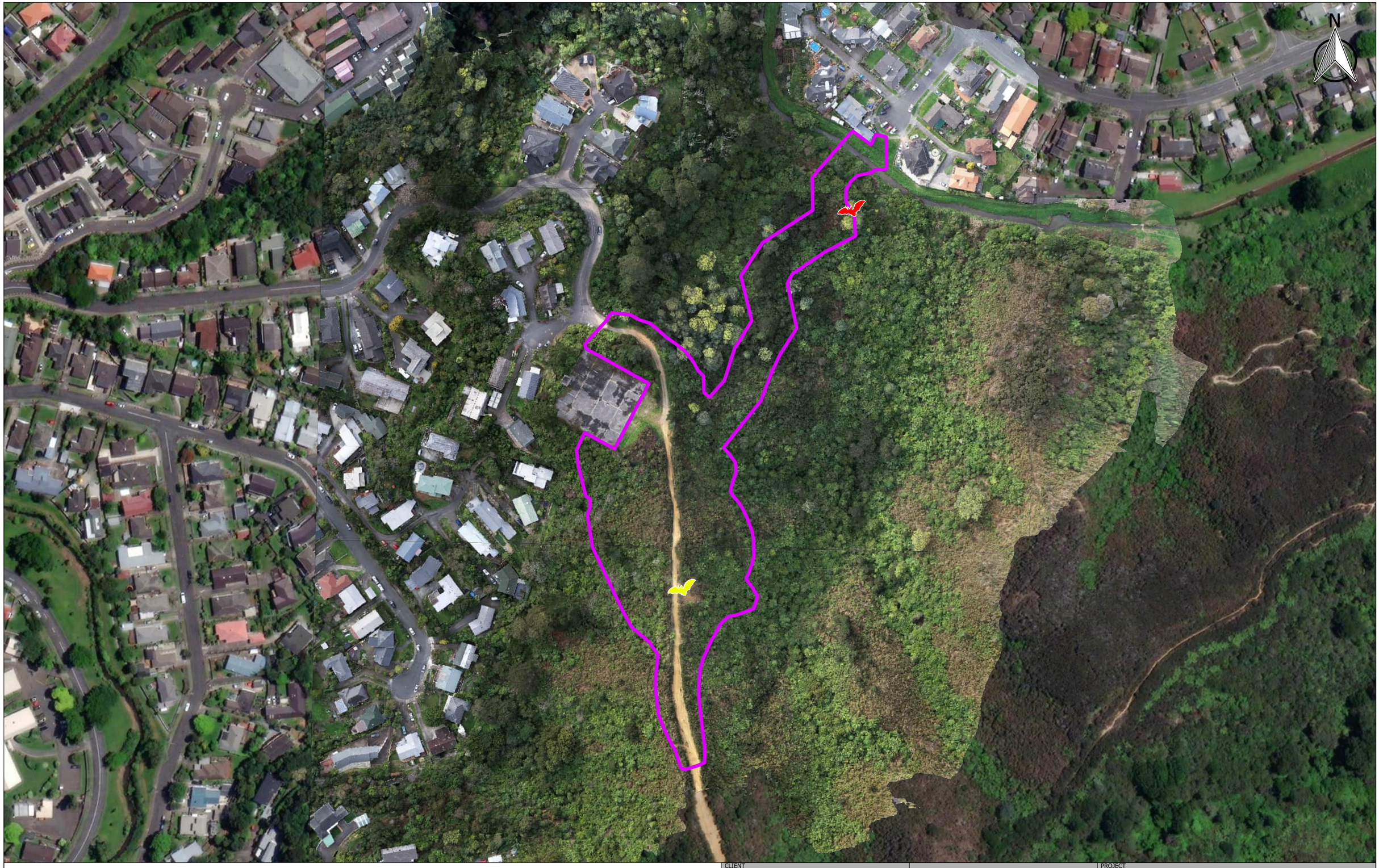
Two ABMs were deployed across the site on 7 March 2023. One ABM was set to target Waiwhetū Stream, while the other was set to target bats traversing the site (Figure 10 & Figure 11). The ABMs were set to record from one hour before sunset (06:40 pm) until one hour after sunrise (07:27 am). One ABM was operational for 20 nights, the other 30 nights. During optimal seasonal and weather conditions on 7 March 2023, a hand-held bat monitor was carried during nocturnal surveys to monitor for the presence of foraging bats. Over two hours of monitoring occurred immediately after dusk with no bats detected.

Figure 10: ABM installed to record for bats



Legend

Long-term monitoring devices

Project site boundary

ESRI Satellite

ABM1

ABM8

CLIENT

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1 of 1	1:2,000

PROJECT

Client Name: Wellington Water
Location: Naenae, Lower Hutt
Project Title: Eastern Hills Reservoir

SHEET

Figure 11: Bat ABM locations

PROJECT NUMBER	REVISION DATE	REVISION
3-WW021.02	11/09/2023	R1

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Plot Date: 2024-02-28 15:01:39 by Hansen, Mark (NZMH30142)

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Of the 30 nights of ABM monitoring, 25 nights were 10°C or above for four hours after official sunset with no precipitation, therefore valid nights for bat monitoring. No bats were detected during the ABM survey or with the handheld monitor. Based on only a single positive record 15 km from the site for the central lesser short-tailed bat from substantial bat surveys within 25 km of the site and the fact that the site and wider Eastern Hills area provides no suitable central lesser short-tailed bat habitat, it can be assumed no bats are present or utilise the site. Overall, the site has been assessed as having **no value** for bats.

7.3 Herpetofauna – Lizards and Frogs

7.3.1 Herpetofauna Values

A review of relevant literature revealed the site falls within the geographic range of eight indigenous lizard species and two introduced frog species (Table 36; Appendix B) (Purdie, 2022). The DOC herpetological database confirms all these species have previously been recorded within 10 km of the site. Of the eight indigenous lizards, six are regionally 'Threatened' and two are regionally 'At Risk' (Greater Wellington Regional Council, 2023a). DOC bioweb records of the northern spotted skink (*Oligosoma kokowai*) were from 1980 and 1995, with the records from the northern side of the Hutt River, a significant geographic barrier. Additionally, in most cases, records of the northern spotted skink are associated with coastal areas, therefore, it is highly unlikely for northern spotted skinks to be found on-site.

Suitable habitat for indigenous lizards exists across the entire site. As no Wildlife Act Authority was held for the active trapping, catching, and handling of indigenous lizards, passive surveillance techniques were used including artificial cover objects (ACOs) (Figure 12 & Figure 13), baited tracking tunnels (Figure 14 & Figure 15), manual habitat searches (MHS) and nocturnal spotlighting. These survey techniques were deemed most appropriate to determine herpetofauna presence and provide an indicative distribution of indigenous lizards on-site. Four transects were deployed on and off-site, each containing 10 ACOs approximately 10 m apart on 7 March 2023 (Figure 16). Transects were deployed targeting the various habitat types on-site including the scrub/track edge habitat and indigenous bush. Individual ACOs within transects targeted high-quality microhabitats, such as natural cover objects (NCOs) (branches/logs) dense shrubs dense leaf litter to encourage lizard utilisation. ACOs were found to be utilised by skinks along the firebreak track within one day on 8 March 2023 however ACOs were left to 'naturalise' in the environment for approximately six weeks prior to surveys. Four tracking tunnels were deployed on and off-site on 7 March 2023 and left to naturalise in the environment for approximately six weeks prior to baited ink card installations (Figure 16).

Figure 12: ACO installed along the firebreak track edge

Figure 13: ACO installed within bush off-site

Figure 14: Tracking tunnel installed on-site

Figure 15: Baited ink card

N

Legend

Long-term monitoring devices

- ACO transect 1
- ACO transect 2
- ACO3 transect 3
- ACO transect 4
- Lizard tracking tunnel
- Project site boundary

ESRI Satellite

CLIENT: Wellington Water

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1 of 1	1:1,500

PROJECT
Client Name: Wellington Water
Location: Naenae, Lower Hutt
Project Title: Eastern Hills Reservoir

SHEET
Figure 16: Passive lizard suervey devices

PROJECT NUMBER	REVISION DATE	REVISION
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ACOs were inspected three times during suitable weather conditions on 17, 18 and 20 April 2023. Inspections were conducted mid-morning to late afternoon when lizard activity is typically highest. ACOs were approached quietly to minimise disturbance prior to inspection. Transect inspection order was varied to reduce temperature and time influences on lizard detections. Approximately 20 northern grass skinks were observed during the four days of ACO inspections, and all observations were restricted to the firebreak track edge (Figure 17 & Figure 18). Ink cards baited with pureed fruit were installed in the tracking tunnels on 17 April and collected on 20 April 2023. Tracking tunnels did not detect the presence of herpetofauna on-site. ACO survey results are provided in Figure 21.

Figure 17: Northern grass skink basking on an ACO

Figure 18: Northern grass skink on the firebreak track edge

Nocturnal spotlighting surveys were performed by two ecologists on 7 March 2023 and four ecologists on 17 and 18 April 2023. The Weather conditions were optimal for surveys and a summary of survey time and results are provided in Table 5.

Table 5: Nocturnal lizard survey effort

Date	Weather	Staff	Survey time	Total survey effort
7 March 2023	Fine, calm, warm (16-17°C)	2	21:00 – 23:10	4 hours 20 minutes
17 April 2023	Fine, calm, warm (14-16°C)	4	18:45 – 22:30	15 hours
18 April 2023	Fine, calm, warm (18-19°C)	4	19:00 – 21:30	10 hours
				29.3 hours

No lizards were observed on-site during nocturnal spotlighting surveys (Figure 19). A single barking gecko (*Naultinus punctatus*) was observed off-site (Figure 20). Nocturnal survey effort and results are provided in Figure 22. Although not observed on-site, the connectivity of suitable contiguous habitat means it must be assumed barking gecko could be present within the site boundary. Barking gecko are nationally 'At Risk – Declining' (Hitchmough, et al., 2021), however, using the SNR as a suitable scale for the Threatened – Regionally Vulnerable' conservation status must be used to assign value to the site (Greater Wellington Regional Council, 2023a)

Figure 19: Nocturnal spotlighting on-site

Figure 20: Barking gecko found off-site

Legend

- 08 March 2023 Skink Observations
- 18 April 2023 Skink Observations
- Project site boundary
- ESRI Satellite
- 17 April 2023 Skink Observations
- 20 April 2023 Skink Observations

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1 of 1	1:1,500

PROJECT

Client Name: Wellington Water
Location: Naenae, Lower Hutt
Project Title: Eastern Hills Reservoir

SHEET

Figure 21: Skink observations

PROJECT NUMBER	REVISION DATE	REVISION
3-WW021.02	29/09/2023	R1

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N

Legend

Survey tracks

- 7 March 2023 nocturnal survey
- 17 April 2023 nocturnal survey
- 18 April 2023 nocturnal survey

17 April 2023 barking gecko

Project site boundary

ESRI Satellite

CLIENT

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1 of 1	1:3,250

PROJECT

Client Name: Wellington Water
Location: Naenae, Lower Hutt
Project Title: Eastern Hills Reservoir

SHEET

Figure 22: Nocturnal arboreal gecko survey results

PROJECT NUMBER	REVISION DATE	REVISION
3-WW021.02	28/09/2023	R1

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A summary of herpetofauna, their regional threat classifications, and likelihood of presence on-site is provided in Table 36 (Appendix B).

The ecological value of herpetofauna on-site has been assessed against the four matters outlined in Section 3.2 and described in Table 28 (Appendix A). The 'Rarity / distinctiveness' value of herpetofauna has also been assessed based on their threat classification (Table 30; Appendix A) SNR12 was used as an appropriate scale by which ecological values were considered. Attributes relevant to each matter pursuant to the site are provided along with assigned values in Table 6. The four values were then combined as outlined in Table 33 (Appendix A) for an overall value. The overall ecological value for lizards on-site is **High**.

Table 6: Summary of herpetofauna attributes and the overall ecological value.

Matters	Attributes	Ecological value	Overall ecological value
Representativeness	• Expected herpetofauna assemblages are likely changed from a pre-1840 state but are typical of the current SNR.	Moderate	High
Rarity / distinctiveness	• Habitat on-site must be assumed to support regionally 'Threatened' herpetofauna.	Very High	
Diversity and pattern	• Abundance of herpetofauna on-site is likely very low for 'regionally 'Threatened' or 'At Risk' species and moderate to high for 'Not Threatened' species. • Diversity of lizards on-site likely to be limited for only few of the potential range of species known from the mainland Wellington region.	Low	
Ecological context	• Site provides high quality habitat and connectivity to high quality habitat for lizards. • natural diversity and offer carry capacity that supports healthy populations of herpetofauna.	Very High	

7.3.2 Levels of Effects Assessment

The actual or potential impacts to herpetofauna caused by the proposed project the temporary (construction phase) disturbance/displacement during construction, short-term to permanent loss of habitat and the potential for death of protected species during habitat clearance.

There is significant risk of death to northern grass skink on-site resulting from vegetation clearance and contact with construction machinery. This temporary risk can be extended to known herpetofauna in the wider area given their likely utilisation of the site.

Construction activities and habitat clearance will disturb herpetofauna. The ground dwelling northern grass skinks, confirmed within scrub on-site, are more able to disburse away from impacts. Arboreal geckos, if present, are less mobile and often restricted to a single tree's canopy, as such while still susceptible to disturbance they are less likely to be able to disburse very far and may not evade vegetation impacts.

Clearance of scrub along the firebreak track edge will result in the loss of approximately 0.2 ha of northern grass skink habitat. As proposed plantings of kānuka scrub (Figure 50), suitable for northern grass skink will remediate habitat and be able to be recolonised within five years, this is a short-term effect.

Long-term to permanent loss of regenerating kānuka and mature broadleaved indigenous hardwoods may affect the arboreal barking and ngahere geckos, if present on-site. Arborescent vegetation could take up to 25 years to grow to a size where they become usable habitat for these species. The proposed remediation of the pipeline (Figure 50) excludes trees suitable for barking and ngahere geckos which will result in the permanent loss of habitat.

The magnitude of effect, when considering SNR12 as an appropriate spatial scale, has been assessed as **Low**. This is because there is likely to be only a minor effect on the known population of herpetofauna. Even if the entirety of the 1.9 ha on-site was suitable indigenous lizard habitat, when compared to available habitat within the 671 ha SNR12, the loss of habitat on-site is less than 0.3%, as such is of a negligible proportion. Using Table 33 (Appendix A) to combine the Low magnitude of effect with the high overall ecological value, the pre-mitigated level of effect is **Low**.

7.3.3 Measures to avoid, minimise and/or remedy effect on herpetofauna.

Although the pre-mitigated level of effect has been assessed as Low, the effects management hierarchy must be applied pursuant to Clause 3.10 (2) of the NPS-IB. Furthermore, all indigenous lizards confirmed or possible on-site, are 'protected' under the Wildlife Act 1953 (New Zealand Government, 1953).

A Lizard Management Plan (LMP) will be developed and implemented by a suitably qualified herpetologist to avoid and minimise the risk to protected lizards. This must outline avoidance measures. Impacts to lizard habitat are unable to be avoided, However, during vegetation clearance efforts will be made to avoid the extent removed where practicable. Vegetation removal within lizard habitat will also be avoided from May to September, inclusive, when lizards are likely to be in brumation and therefore at higher risk of injury or death. Vegetation removal will be staged to minimise impacts on lizards inhabiting the vegetation on site.

The LMP will outline lizard salvage methodologies (e.g., ACOs, trapping, habitat searches and supervised habitat clearance) and an Accidental Discovery Protocol (ADP) to minimise impacts to lizards encountered on-site. The LMP must adhere to the key principles for lizard salvage and transfer (Department of Conservation, 2019) and be carried out under a valid lizard salvage permit. To minimise impacts to lizards salvaged during the works, lizards will be transferred off-site to suitable habitat within SNR12 (and possibly Matiu/Somes Island) where predator control has been implemented as detailed in LMP.

On-site mānuka and/or kānuka scrub will be remediated (approximately 0.26 ha, Section 7.6.3) and will result in approximately 1:1 replacement of lost northern grass skink habitat. On-site remediation of 'Broadleaved Indigenous Hardwoods' (approximately 0.62 ha, Section 7.6.3) will also provide arboreal gecko habitat.

Implementing these management actions will result in a **Negligible** post-mitigated magnitude of effect, resulting in a **Very Low** level of effect for lizard populations on-site. A Very Low level of residual effect is not 'more than minor', therefore, in accordance with the effects management hierarchy, offsetting and compensation do not need to be considered for herpetofauna.

However, the vegetation offsetting requirements (Section 7.6.3) defined in the OMP (Appendix C) will provide additional benefits and result in an overall **Net Gain** for indigenous lizard populations on-site. A summary of the impact assessment for lizards is provided below in Table 7.

Table 7: Impact assessment summary for lizards on-site.

Value	Magnitude of effect	Pre-mitigated level of effect	Mitigation requirements	Post-mitigated magnitude of effect	Residual level of effect
High	Low	Low	Avoid • Development and implementation of a LMP by a suitably qualified herpetologist, including vegetation removal protocols. • Avoid the removal of, or impacts to, indigenous vegetation where practicable. • Avoid vegetation removal during May-Sept due to lizard brumation. Minimise • Minimise the extent of indigenous vegetation removed where possible. • LMP must include an ADP. • LMP must include pest animal control, suitable for lizards known or likely to be relocated and must occur prior to salvage within proposed release sites.	Negligible (Positive with offsetting provided for vegetation)	**Very Low (Net Gain** with offsetting provided for vegetation)

Value	Magnitude of effect	Pre-mitigated level of effect	Mitigation requirements	Post-mitigated magnitude of effect	Residual level of effect
			• Pest animal control must be elevated within release site if certain thresholds for each species are exceeded during the salvage operation. Remedy Remediate the site with vegetation appropriate for skink and gecko habitat as proposed in Section 7.6.3.		

7.4 Terrestrial Invertebrates

7.4.1 Invertebrate Values

Terrestrial invertebrates on-site were assessed through opportunistic observations, MHS of NCOs (logs and other debris) and tracking tunnel ink cards. Observations were made during both diurnal and nocturnal (spotlighting) surveys. Relatively high abundances of common invertebrates including Anostostomatidae (wētā) (Figure 23 & Figure 24), Blattidae (cockroaches), Cicadidae (cicada) (Figure 25), Lepidoptera (moths) (Figure 26), Mantidae (New Zealand mantis; *Orthodera novaezealandiae*) (Figure 27), Phasmatidae (stick insects) (Figure 28 & Figure 29), and Tettigoniidae (katydids) (Figure 30).

Figure 23: Tree wētā

Figure 24: Wētā

Figure 25: Cicada

Figure 26: Noctuid moths

Figure 27: New Zealand mantis

Figure 28: Stick insect

Figure 29: Stick insect

Figure 30: Katydid

A peripatus or velvet worm (*Peripatoides novaezelandiae*) was a notable find during MHS, though is 'Not Threatened'. A wide variety of spiders (Araneidae), beetles (Coleoptera) and detritus invertebrates such as slaters (Armadillidiidae) were also observed on-site, all of which indicate a relatively high species richness and ecosystem health. Based on the 'Representativeness', 'Rarity / distinctiveness', 'Diversity and pattern', and 'Ecological context' matters outlined in Section 3.2 and reproduced in Table 28 (Appendix B), the overall ecological value of terrestrial invertebrates on-site is **Moderate**.

7.4.2 Level of Effects Assessment

The actual or potential impacts to terrestrial invertebrates caused by the proposed project primarily relate to the temporary (construction) risk of death or injury and the short-term to permanent loss of suitable habitat. The ZOI for terrestrial fauna is restricted to habitats immediately adjacent (within 5 m) to construction activities on-site.

Construction activities associated with habitat clearance pose a risk of death to terrestrial invertebrates. Vegetation clearance will also result in short-term impact to terrestrial invertebrate habitat loss. Site remediation and offsetting requirements for birds and lizards will result positive effect for terrestrial invertebrates.

The magnitude of effect has been assessed as **Negligible**. This is because there is likely to be only a very slight change from the existing terrestrial invertebrate baseline condition. Using Table 33 (Appendix A) to combine the Negligible magnitude of effect with the Moderate overall ecological value, the pre-mitigated level of effect is **Very Low.**

Nonetheless, effects on invertebrates will be avoided and minimised where practicable through the implementation of the Vegetation Management Plan (VMP) as outlined in Section 7.6.3. Furthermore, the pest animal control required as part of lizard mitigation (Section 7.3.3) and offsetting requirements outlined for vegetation (Section 7.6.3) will provide additional benefits to terrestrial invertebrates and likely result in a, Positive post-mitigated level of effect and **Net Gain** residual level of effect for terrestrial invertebrate populations, as such it is not necessary to consider additional offsetting measures.

7.5 Mammalian Pests

7.5.1 Mammalian Pest Values

A desktop review of the DOC mammalian pest database (Department of Conservation, 2007) and subsequent field surveys revealed 11 mammalian pest species that were either have known distributions that include SNR12 (Table 37; Appendix B). Trail cameras (Figure 32) were deployed on and off-site on 8 March 2023 and set to photograph movement 24 hours a day, while tracking tunnels were installed on and off-site and left to naturalise in the environment like those for lizards. On 17 April 2023, eight aniseed chew cards were installed on and off-site (Figure 33), while tracking tunnels received baited ink cards. Four tracking tunnels were baited with peanut butter to attract omnivores such as rodents and four baited with raw chicken to attract predators such as mustelids (stoats, ferrets, and weasels). Chew cards and ink cards were collected after three

nights on 20 April 2023. Figure 31 provides an overview of all pest animal monitoring equipment installed on-site.

Legend

- Chew cards
- Pest tracking tunnels
- Trail Cameras
- Project site boundary
- ESRI Satellite

CLIENT

Wellington Water

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1 of 1	1:1,500

PROJECT

Client Name: Wellington Water
Location: Naenae, Lower Hutt
Project Title: Eastern Hills Reservoir

SHEET

Figure 31: Mammalian pest monitoring devices

PROJECT NUMBER	REVISION DATE	REVISION
3-WW021.02	11/09/2023	R1

Original Sheet Size: A3 [W = 420, H = 297]

Plot Date: 2024-02-28 15:21:17 by Hansen, Mark (NZMH30142)

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Figure 32: Trail camera set on-site

Figure 33: Aniseed chew card installed on-site.

Results of pest animal monitoring confirmed the presence of cats (*Felis catus*) (Figure 34), although other predators may be present in low densities within the SNR and transient on-site, such as hedgehog (*Erinaceus europaeus*) and stoat (*Mustela erminea*). Pig (*Sus scrofa*) rooting, and scat was observed on-site while trail cameras also confirmed their presence (Figure 35). Possums (*Trichosurus vulpecula*) were observed during nocturnal spotlighting, and confirmed on-site through browse damage, chew cards, tracking tunnels and trail cameras (Figure 36). Norway rat (*Rattus norvegicus*) and black ship rat were confirmed through eDNA and chew card detection (Figure 37), while only very minor mouse (*Mus musculus*) tracking was recorded on one ink card. Red deer (*Cervus elephus*) were confirmed on-site through extensive tracking, clusters of scat, antler thrash, eDNA and trail cameras (Figure 38 & Figure 39). Deer are the likely cause of the significant lack of palatable species within the understory on and off-site and will be impacting the recruitment and regeneration of some canopy species.

Figure 34: Cat on-site captured using trail cameras.

Figure 35: Feral pig on-site captured using trail cameras.

Figure 36: Brushtail possums on-site captured using trail cameras.

Figure 37: Chew card confirming rat presence.

Figure 38: red stag on-site.

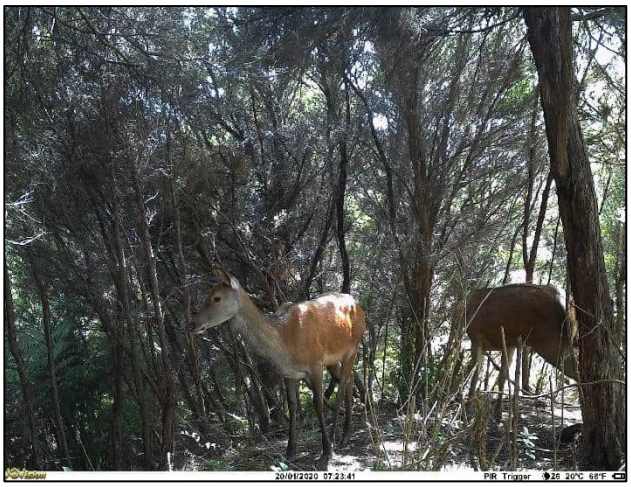

Figure 39: red hinds.

Table 37 (Appendix B) summarises mammalian pest species, their threat type and likelihood on-site.

7.5.2 Negative Effects

Mammalian pest species found on-site and in adjacent habitats are having a negative effect on indigenous flora and fauna, and ecosystem functioning. The site provides territorial habitat for a few mammalian pest species, such as brushtail possum, which will be displaced into adjacent habitat during the construction phase of this project. Mammalian pests such as domestic cat, feral pig and red deer will be largely unaffected by construction activities and their domestic or transient behaviour will have no additional effect on adjacent habitats, flora, or fauna.

Herbivorous and omnivorous pest animal species on-site may jeopardize the successful establishment of indigenous vegetation planted to remediate the site post construction.

7.5.3 Mammalian Pest Management

Current baseline conditions regarding pest animal presence and abundance will not be altered as a result of the proposed development. The VMP should include methods to protect newly established plants. The VMP must define a suitable monitoring and maintenance schedule to ensure appropriate site remediation within the short-term (within five years). Pest animal management is also proposed as part of remediation and offsetting for vegetation effects which will be outlined in a Pest Management Plan (PMP) and as part of lizard mitigation as outlined in the LMP. The PMP and LMP will outline pest animal management methods, trap or bait station densities and maintenance duration, appropriate to the site and impacts. Pest animal management required for indigenous fauna and flora mitigation and offsetting will contribute to a short-term **Net Gain** in indigenous biodiversity on-site and within the immediate vicinity of the site.

7.6 Flora - Vegetation

7.6.1 Vegetation Values

Desktop assessments included reviews of the Land Environments New Zealand (LENZ) threatened environments level 4 (LENZ) (Ministry for the Environment, 2009) and landcover database (V5.0) (LCDB) (Manaaki Whenua Landcare Research, 2020) Geographic Information System (GIS) layers. Following desktop assessments, Unmanned Aerial Vehicle (UAV) drone imagery and on-site surveys were conducted to identify vegetation assemblages on-site.

A review of the LENZ GIS information revealed the environment types (Leathwick, et al., 2002) and corresponding categories (Walker, Cieraad, & Barringer, 2015) present on-site shows almost entirety of the site falls within the environment type F1.4b (Figure 40). A small area associated with the urban area north of Waiwhetū Stream falls within environment C2.1. For the purposes of

this assessment only Environment F1.4 has been considered. Environment F1.4 has suffered moderate levels of indigenous vegetation losses since human arrival in New Zealand, with 20 - 30% indigenous cover remaining nationally. This environment type elevates the value of indigenous vegetation on-site. A summary of this environment type and its national context is provided in Table 8.

Environment F1
Environment F1 is the largest and most geographically diverse of the Level II environments. It is most extensive in the North Island where it includes old volcanic cones of southern Waikato, extensive dissected Tertiary hills of inland Taranaki and northern Manawatu, and low to mid-elevation hills in Wellington and Wairarapa. Smaller areas in the northern South Island include dissected low elevation hills in the Marlborough Sounds and in Golden Bay. The climate is mild with high solar radiation and slight annual water deficits. Predominant parent materials include Tertiary sandstones, mudstones and argillites with some volcanic material in the north and greywacke in Wellington and Wairarapa. Soils are well-drained and of low natural fertility ***(Leathwick, et al., 2002)***

Table 8: Threatened environments on-site and national context.

Environment	LENZ category and criteria	Site area (ha)	National area (ha)	Site context (5)
F1.4	3 : 20–30% indigenous cover left	1.87	290,292	0.0009%

A review of the LCDB shows the site to be almost entirely comprised of either 'Broadleaved Indigenous Hardwoods' or 'Gorse and/or Broom'. A summary of the LCDB is provided in Table 9 and shown in Figure 41.

Table 9: Landcover database types on-site

Landcover	Site area (ha)	Site percentage (%)
Built-up Area	0.0914	5%
Broadleaved Indigenous Hardwoods	0.7848	41%
Gorse and/or Broom	1.0152	53%

Legend

LENZ Level 4

- C2.1a
- C2.1b
- F1.4b

Project site boundary

ESRI Satellite

CLIENT: Wellington Water

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PROJECT
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Location: Naenae, Lower Hutt
Project Title: Eastern Hills Reservoir

SHEET
Figure 40: Threatened Environments on-site

PROJECT NUMBER	REVISION DATE	REVISION
3-WW021.02	11/09/2023	R1

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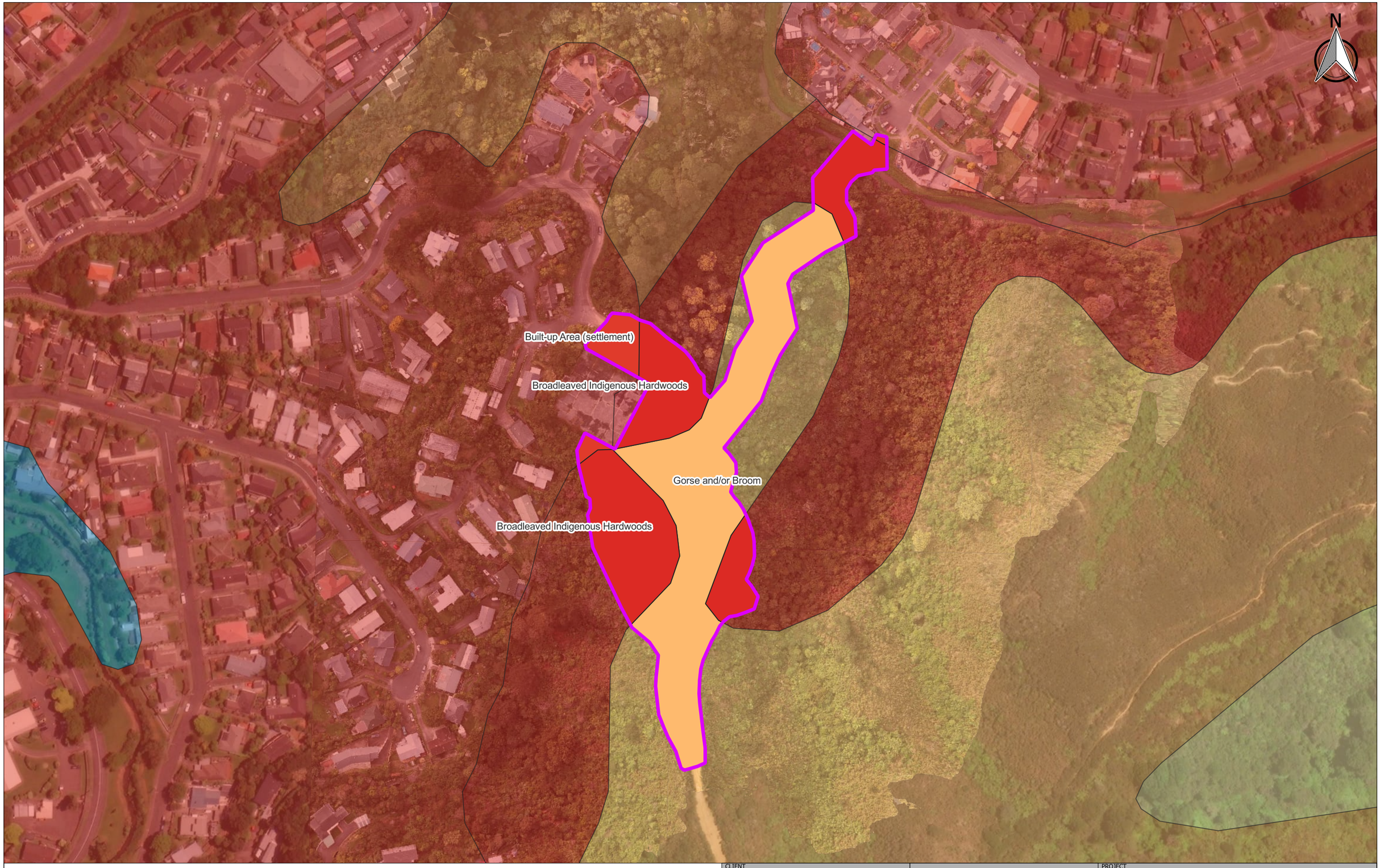

Legend

Landcover Database V5.0

- Gorse and/or Broom
- Built-up Area (settlement)
- Broadleaved Indigenous Hardwoods
- Project site boundary

ESRI Satellite

CLIENT: Wellington Water

Christchurch Ecology
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Project Title: Eastern Hills Reservoir

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Figure 41: Landcover database landcover types on-site

PROJECT NUMBER	REVISION DATE	REVISION
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UAV drone imagery and on-site assessments confirmed vegetation species and assemblages on-site. Areas of 'Gorse and/or Broom' were overestimated while additional land cover types were confirmed, including 'River', 'Gravel and/or Rock', 'High Producing Grassland', 'Exotic Forest' and 'Mānuka / Kānuka'. A summary of confirmed land cover types and their site context is provided in Table 10 and shown in Figure 42.

Table 10: Confirmed land cover types on-site

Landcover	Site area (ha)	Site percentage
River	0.008	0.4%
Gravel and/or Rock	0.1133	6.0%
High Producing Grassland	0.0274	1.4%
Broom and/or Gorse	0.2347	12.4%
Exotic Forest	0.1103	5.8%
Mānuka / Kānuka	0.3512	18.5%
Broadleaved Indigenous Hardwoods	0.9656	50.8%

N

Legend

- River
- Gravel or Rock
- High Producing Exotic Grassland
- Gorse and or Broom
- Exotic Forest
- Manuka and or Kanuka
- Broadleaved indigenous hardwoods
- Project site boundary

ESRI Satellite

CLIENT

Wellington Water

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PROJECT

Client Name: Wellington Water
Location: Naenae, Lower Hutt
Project Title: Eastern Hills Reservoir

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Figure 42: Confirmed land cover types on-site

PROJECT NUMBER	REVISION DATE	REVISION
3-WW021.02	11/092023	R1

Original Sheet Size: A3 [W = 420, H = 297]

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The area of 'Gorse / Broom' was considerably smaller than indicated in the LCDB and primarily occurred in the highly disturbed habitats immediately adjacent to the firebreak track (Figure 43).

Figure 43: Gorse and other weeds adjacent to the firebreak

The negligible area of 'High Producing Grassland' is restricted to the highly maintained park area on the north side of Waiwhetū Stream (Figure 44) and around the Naenae No 1 reservoir.

Figure 44: Highly maintained grass park north of Waiwhetū Stream

'Exotic Forestry', in the form of pine (*Pinus radiata*) and silver wattle (*Acacia dealbata*) was clustered across the site (Figure 45) and species occurring in the understory was dominated by gorse, and other regenerating natives similar to the 'Broadleaved Indigenous Hardwoods' vegetation type.

Figure 45: Site overview showing pine and wattles

Within the 'Mānuka / Kānuka' vegetation areas, kānuka (*Kunzea* sp.) dominated, while few scattered mānuka (*Leptospermum scoparium* var. *scoparium)* were restricted to the areas immediately adjacent to the firebreak (Figure 46). Mature and regenerating kānuka extended down the spur towards the northern end of the site. The understory was often sparse (Figure 47) but included hangehange (*Geniostoma ligustrifolium* var. *ligustrifolium*), bracken (*Pteridium esculentum*), gorse (*Ulex europaeus*), blackberry (*Rubus fruticosus*) and pampus (*Cortaderia jubata*).

Figure 46: kānuka along the firebreak

Figure 47: Sparce understory within 'Mānuka / Kānuka' vegetation type

Mānuka and kānuka are nationally 'Threatened' however regionally they are not listed as 'Threatened' or 'At Risk' (Greater Wellington Regional Council, 2020b). Nationally, these species were changed from 'Not Threatened' to 'Threatened' as a precautionary approach in the most recent threat classification document (de Lange, et al., 2018) due to the arrival of myrtle rust into New Zealand. To date, myrtle rust has not been found infecting wild populations of these species, as such for the purposes of this impact assessment, the regional threat classification for these species has been used.

Within the 'Broadleaved Indigenous Hardwoods', the canopy was dominated by black tree fern (*Cyathea medullaris*) māhoe (*Melicytus ramiflorus* subsp. *ramiflorus*), *Pseudopanax* spp. with scattered wild cherry (*Prunus avium*) (Figure 48). The understory and groundcover tiers consisted of sparse, unpalatable species including hangehange, rangiora (*Brachyglottis repanda*) and red matipo (*Myrsine australis*) silver fern (*Alsophila tricolor*) and bracken.

Figure 48: Overview of 'Broadleaved Indigenous Hardwoods' canopy species.

Table 38 (Appendix B) summarises vegetation recorded on-site and their national and regional threat classification.

Comparing the indigenous vegetation land cover types on-site to the LCDB for SNR12 as an appropriate scale, 'Broadleaved Indigenous Hardwoods' on-site make up only 0.3% of SNR12. 'Mānuka / Kānuka' does not feature within the LCDB for SNR12, although site surveys confirmed

relatively large areas of this vegetation type within the Eastern Hills area (Figure 49). A summary of indigenous land cover types and comparison to SNR12 is provided in Table 11.

Figure 49: An off-site spur dominated by 'Mānuka and/or Kānuka'.

Table 11: Indigenous land cover types on-site relative to SNR12

Landcover	Site area (ha)	Site percentage	SNR12 area (ha)	Site context in SNR
Mānuka / Kānuka	0.3512	18.5%	0	Indeterminable
Broadleaved Indigenous Hardwoods	0.9656	50.8%	342.6	0.3%

Vegetation on-site is consistent with the wider Eastern Hills, having suffered extensive impacts since human occupation and being fundamentally changed from a pre-1840 state. Predicted pre-human vegetation of the site and much of the Eastern Hills is believed to have consisted of a mixed podocarp beech complex including rimu (*Dacrydium cupressium*), miro (*Prumnopitys ferruginea*), kamahi (*Pterophylla racemosa*), red beech (*Nothofagus fusca*), hard beech (*N. truncata*), kahikatea (*Dacrycarpus dacrydioides*) and, pukatea (*Laurelia novae-zelandiae*) (Manaaki Whenua Landcare Research, 2012). The confirmed area of 'Broadleaved Indigenous Hardwoods' on-site only makes up 0.3% of the LCDB area of 'Broadleaved Indigenous Hardwoods' within the SNR, and although the LCDB shows no 'Mānuka / Kānuka' within the SNR, observations confirmed this landcover type to be relatively abundant throughout the SNR. The site's vegetation provides suitable habitat for some regionally 'Threatened' and 'At Risk' bird species, though none were observed utilising the site during surveys and are likely transient. Although no arboreal geckos were found within vegetation on-site, regionally 'Threatened' and 'At Risk' lizards may be present on-site.

The ecological value of vegetation on-site has been assessed against the four matters outlined in Section 3.2 and described in Table 28 (Appendix A). The threat classifications of plant species on-site has also been assessed with regard to their rarity (Table 30; Appendix A). SN12 was used as an appropriate scale by which ecological values were considered. Attributes relevant to each matter pursuant to the site are provided along with assigned values in Table 12. The four values were then combined as outlined in Table 31 (Appendix A) for an overall value. The overall value of vegetation on-site is **High**.

Table 12: Summary of vegetation attributes and the overall ecological value.

Matters	Attributes	Ecological value	Overall ecological value
Representativeness	• The site is fundamentally changed from a natural state pre-1840 state. • Considering the Eastern Hills and SNR12, the site comprises a typical structure and composition, though some aspects are lacking (e.g.: emergent and ground cover tiers). • The site is largely dominated by indigenous species.	High	High
Rarity / distinctiveness	• The indigenous species found on-site are typical of the SNR. • Nationally 'Threatened' but regionally 'Not Threatened' myrtaceae (mānuka/kānuka) are present on-site. • The site is comprised almost entirely of a moderately threatened environment type with only 20-30% of vegetation remaining nationally. • Site provides habitat for regionally 'Threatened' and 'At Risk' fauna (birds and lizards).	Very High	
Diversity and pattern	• The diversity and pattern of vegetation types on-site is low, dominated by indigenous species, of which species richness is moderate.	Moderate	
Ecological context	• The ecosystem services that the vegetation on-site provides are rare considering the surrounding urban catchment.	Moderate	

7.6.2 Levels of Effects Assessment

Construction of the proposed reservoir could potentially involve the complete removal of all vegetation on-site (approximately 1.9 ha, of which approximately 1.32 ha is indigenous vegetation). Post-construction, the site is proposed to be remediated with indigenous vegetation consistent with SNR12, therefore areas will suffer different temporal impacts based on the vegetation maturity lost and proposed site remediation. Fast growing and regenerating vegetation will experience a short-term loss, mature vegetation will experience a long-term loss while some areas will be permanently lost due to infrastructure, such as the reservoir and carpark areas. The loss of vegetation on-site is not restricted to indigenous plants, as approximately 20% of the site comprises exotic plants and weeds.

When assessed against SNR12, as an appropriate scale, the magnitude of effect has been assessed as **Very high**. This is due to the loss or major alteration of vegetation on-site, such that the composition and character will be fundamentally changed. Using Table 33 (Appendix A) to combine the Very high magnitude of effect with the High value, the pre-mitigated level of effect is **Very high**.

7.6.3 Measures to avoid, minimise and/or remedy effects on vegetation.

Opportunities to avoid or minimise impacts on vegetation (and associated values) have been considered in developing the project, including as discussed in the Eastern Hills Reservoir Pipe Alignment Assessment (PAA) (WSP, 2023a).

While the option of constructing the delivery pipeline and scour pipeline down Summit Road (rather than down the vegetated hillside to Balgownie Grove) was considered, this was ultimately not practicable for the reasons set out in the PAA. In addition, the reservoir site and construction area has reduced in size through detailed design and is the minimal practicable size.

During vegetation clearance further efforts will be made to avoid or minimise the extent removed where possible. Also, vegetation removal will be staged to minimise impacts on the indigenous fauna inhabiting the vegetation on site.

Vegetation remediation will occur across the site where practicable. The pipeline alignment shall be replanted in suitable low growing indigenous shrubs, eco-sourced from the ED and consistent with the site and SNR12. Riparian areas impacted must be remediated with suitable bank and riparian vegetation to promote bank stability and provide suitable shading and freshwater fauna

habitat. Areas adjacent to the newly formed firebreak and the north facing hillslope behind the reservoir must be replaced in a 'Mānuka / Kānuka' vegetation type to replace this vegetation and skink habitat lost during site clearance (see Section 7.3). Remaining areas must be planted in a suitable suite of indigenous species congruent with lost 'Broadleaved Indigenous Hardwoods', and the SNR. Vegetation must be eco-sourced indigenous plants suitable for the site conditions and the wider SNR. Remediation will occur as soon as practicable within the appropriate planting season. An indicative plan of the proposed site remediation is provided in Figure 50. Remediation will revegetate 0.61 ha of the 1.32 ha of indigenous vegetation removed (Table 8).

Table 13: Indicative areas of vegetation impacts, remediation, and loss

Vegetation type	On-site area (potential indigenous vegetation removal)	On-site remediation	Potential indigenous vegetation loss (removal – remediation)
Mānuka / Kānuka	0.35 ha	0.26 ha	0.09 ha
Broadleaved Indigenous Hardwoods	0.97 ha	0.35 ha	0.62 ha

N

Legend

- Kānuka scrub
- Broadleaved Indigenous Hardwoods
- Low growing shrubs
- Riparian planting
- Project site boundary

ESRI Satellite

CLIENT

Wellington Water

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1 of 1	1:2,000

PROJECT

Client Name: Wellington Water
Location: Naenae, Lower Hutt
Project Title: Eastern Hills Reservoir

SHEET

Figure 50: Indicative site remediation vegetation overview.

PROJECT NUMBER	REVISION DATE	REVISION
3-WW021.02	16/10/2023	R1

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Plot Date: 2024-02-28 15:42:44 by Hansen, Mark (NZMH30142)

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A VMP must be developed by a suitably qualified ecologist or have technical input by a suitably qualified ecologist. The VMP must outline measures to avoid, minimise and remediate vegetation lost on-site. The VMP must include actual areas of indigenous vegetation types lost during site clearance and areas remediated on-site to determine the offsetting areas required (as detailed below). Monitoring and maintenance of the planted vegetation must be outlined in the VMP to ensure canopy closure and plant survivorship.

It has been assessed that implementing the above measures to minimise and remediate effects on vegetation will results in a **Moderate** post-mitigated magnitude of effect resulting in an overall High residual level of effect on vegetation. A summary of the impact assessment for vegetation is provided below in Table 14.

Table 14: Impact assessment summary for vegetation present on-site.

Value	Magnitude of effect	Pre-mitigated level of effect	Mitigation requirements	Post-mitigated magnitude of effect	Residual level of effect
High	High	Very High	• Development of a VMP to avoid, minimise and remediate vegetation where practicable. Avoid • Avoid the removal of, or impacts to, indigenous vegetation where practicable. Minimise • Minimise the extent of indigenous vegetation removed where possible. • Staged vegetation removal to minimise impacts on the indigenous fauna inhabiting the vegetation on site. Remediation • Remediation of vegetation where practicable on-site with eco sourced indigenous plants.	Moderate	**High**

Following remediation, more than minor adverse effects on vegetation will remain (Table 14) as overall approximately 0.71 ha of High value indigenous vegetation is likely to be permanently lost (due to the reservoir footprint) (Table 13), and the vegetation above the pipeline alignment will be fundamentally changed. Also, there will be a time lag between vegetation removal and remediation planting and then when the remediation planting will be of sufficient quality / age to provide habitat and resources for native fauna. Pursuant to the effects management hierarchy under the NPS-IB (Ministry for the Environment, 2023), where more than minor residual effects cannot be avoided, minimised, or remediated biodiversity offsetting is required.

The total loss of indigenous vegetation will not be confirmed until post-clearance therefore, the total amount of offsetting required cannot be confirmed at this stage. However, the Biodiversity Offset Accounting Model (BOAM) has been utilised to inform the approximate extent of offsetting required by the project. The proposed offset actions are removal of off-site 'Gorse / Broom' and 'Exotic Forest' (pine & wattle) in proximity to the site, replacing them with indigenous vegetation and completing pest animal control within the restored areas. Exotic weed replacement and pest animal control will enhance and expand existing habitats for indigenous fauna and improve habitat connectivity (Section 7.1). Control of exotic vegetation species and pest animals may also allow indigenous vegetation species to naturally regenerate. There is sufficient exotic vegetation within proximity to the site to accommodate offsetting requirements. The

replacement offsetting will comply with NPS-IB by meeting the 11 principles for biodiversity offsetting and via promoting the restoration of biodiversity and indigenous vegetation cover in urban environments (Policy 13 and 14). The OMP is included within Appendix C and further details will be included in the VMP. The VMP will include final offset calculations, confirmed locations of offsetting and a Pest Management Plan (PMP). The PMP will outline pest animal management methods, trap or bait station densities and maintenance duration, appropriate to the site and impacts. Due to the Net Gain requirements for Offsetting, as defined in the NPS-IB, the residual level of effect following offsetting will be 'Positive', and in accordance with the effects management hierarchy, compensation will not need to be considered for vegetation.

7.7 Waiwhetū Stream

7.7.1 Waiwhetū Stream Values

A desktop assessment of Waiwhetū Stream included a review of the Ministry for the Environment (MfE) River Environment Classification 2010 (REC) database (Ministry for the Environment, 2023). Waiwhetū Stream characteristics obtained from the REC database and definitions are provided in Table 15.

Table 15: Summary of Waiwhetū Stream characteristics.

Characteristic	Category	Definition (Snelder, Biggs, & Weatherhead, 2012)
Stream order	4	Fourth-order stream.
Climate	Warm-wet	Warm: mean annual temperature >12°C. Wet: mean annual effective precipitation 500 - 1500 mm.
Source-of-flow	Low elevation	Very marked seasonal flow patterns: high in winter, low in summer. Low sediment supply. Stable, Low-Gradient, entrenched channels with low flow velocity and silty-sandy substrates. Flood flow velocities are low due to low channel slope.
Geology	Hard-sedimentary	Infiltration of rainfall is variable. Where geology is fractured, infiltration is high, resulting in infrequent floods but sustained base flow. Low natural nutrient concentration. Low suspended sediment. Relatively coarse substrates (cobble, gravel, sands) depending on local morphology.
Landcover	Urban	Flood peaks are very 'peaky' and recessions return quickly to base flow. Base flows are very low. High concentration of many contaminants. High suspended sediment load during development and typically low afterward. Fine substrates (silts and mud) relative to natural Land-Cover categories.
Network position	Middle order	Tributaries (Stream order 3 and 4)
Valley-landform	Low gradient	Low-Gradient channels. For given higher order classes, LG categories are characterised by relatively greater meandering, greater depth relative to width and lower water velocities.
Catchment Area	8.78 km^2	

Waiwhetū Stream is a permanent, low gradient, fourth-order stream. The site encompasses approximately 25 m of Waiwhetū Stream (Figure 51). Within the project boundary, the stream is characterised by moderately flowing runs and riffles with streambed substrate consisting mainly of gravels, cobbles, and organic debris (Figure 52 and Figure 53). Riparian vegetation can be broadly defined as high quality on the true left[5](TL) including arborescent indigenous and exotic vegetation, rank grass, and exotic weeds, while the true right (TR) is of poor quality and consists of a highly modified urban environment dominated with rank grass. There is little to no shading of the stream on-site (Figure 51). Stormwater infrastructure, in the form of a culvert outflow, is present within the site boundary. A weir is present approximately 750 m downstream of site (Figure 54 & Figure 55). Upstream of the site, Waiwhetū Stream drains approximately 700 ha of Eastern Hills foothills and urban residential land upstream of the site. Waiwhetū Stream is highly modified with artificial channelling while culverting underneath residential housing is also present.

Figure 51: The reach of Waiwhetū Stream set on-site.

Figure 52: Waiwhetū streambed on-site.

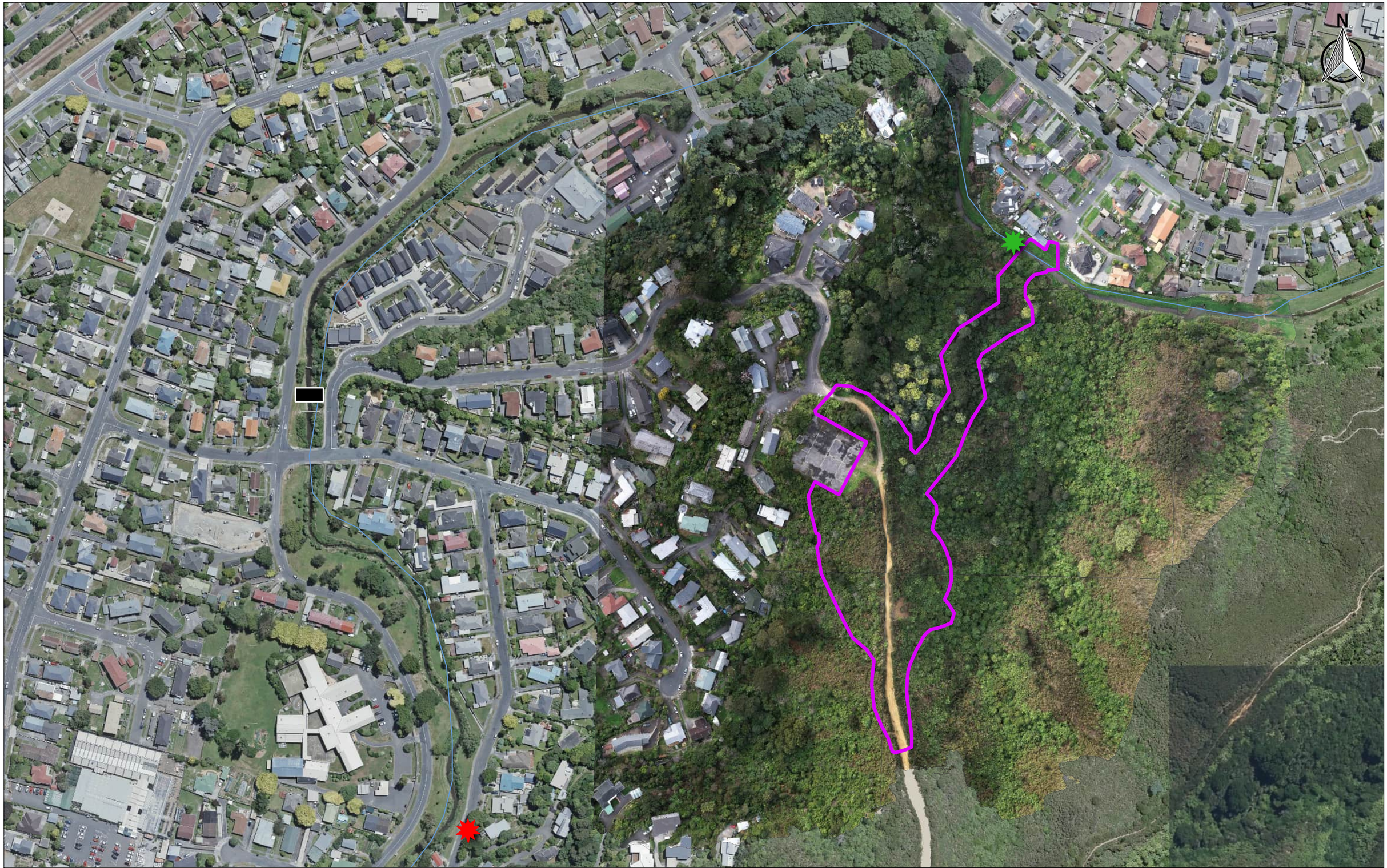
[5] 'True right' or 'true left' refers to the side of the steam when you are facing downstream.

Figure 53: Organic debris within Waiwhetū Stream.

Figure 54: Weir located downstream of site.

The freshwater fauna of Waiwhetū Stream is discussed in detail in Section 7.10, however, the communities that Waiwhetū Stream support are indicative of the quality of habitat provided, as such are briefly reviewed here. The New Zealand Freshwater Fish Database (NZFFD) revealed four 'At Risk' freshwater fish previously recorded within the Waiwhetū Stream catchment. It is possible for Waiwhetū Stream to support freshwater fish that exist in the wider Hutt River Catchment. Reviewing the Hutt River Catchment of the NZFFD, revealed two 'Threatened – Regionally Vulnerable' and eight 'At Risk – Declining' fish species.

Aquatic invertebrates are routinely assessed in stream biomonitoring throughout NZ to provide an indication of ecological stream health. The Macroinvertebrate Community Index (MCI) (Stark & Maxted, 2007) is an invertebrate stream health metric commonly used in NZ that weighs invertebrate species according to their tolerance of pollution. *Ephemeroptera* (mayfly), *Plecoptera* (stonefly) and *Trichoptera* (caddisfly), collectively known as EPT, are sensitive to pollution and their presence and abundance is an indication of ecological stream health. A total of four macroinvertebrate kick samples were taken from Waiwhetū Stream to determine overall stream health. Loosely following DOC methodologies, two samples were taken on-site (one targeting hardbottom riffle habitat (Gray, 2013), and the other soft bottom muddy substrate (Gray, 2013a) and two downstream (again one targeting hard bottom and one softbottom habitats (Figure 55). A summary of macroinvertebrate stream health metrics is provided below in Table 16.



Legend

- NZ Topo 1-50k Topo Rivers
- Macroinvertebrate downstream kicksample
- Macroinvertebrate on-site kicksample
- Weir
- Project site boundary
- Aerial Imagery Basemap

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SHEET NUMBER	SCALE
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PROJECT
Client Name: Wellington Water
Location: Naenae, Lower Hutt
Project Title: Eastern Hills Reservoir

SHEET
Figure 55: Macroinvertebrate sample locations

PROJECT NUMBER	REVISION DATE	REVISION
3-WW021.02	11/09/2023	R1

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Plot Date: 2023-09-11 16:28:54 by Hansen, Mark (NZMH30142)
File Ref: \\corp.pbwan.net\ANZ\ProjectsNZ\3w\3-WW021.02 Naenae No.2 Reservoir\Home\500 Work in Progress\Ecology\GIS\0 Naenae EcIA.qgz

Table 16: Summary of macroinvertebrate stream health metrics.

Site	MCI score	MCI category[6]	MCI description	%EPT abundance	%EPT richness
Riffle habitat on-site	82	Fair	Probably moderate pollution	3	40
Muddy habitat on-site	82	Fair	Probably moderate pollution	4	15
Riffle habitat downstream	87	Fair	Probably moderate pollution	2	25
Muddy habitat downstream	67	Poor	Probably severe pollution	0	0

MCI scores, and the lack of sensitive EPT taxa, indicate Waiwhetū Stream is likely at least moderately polluted. These findings are consistent with the surrounding urban environment which has likely contributed to the lower aquatic invertebrate scores. Waiwhetū Stream is also a part of a wider ecological monitoring program in the Wellington Region. Waiwhetū Stream at Whites Line East has been monitored to assess stream ecological health using MCI scores. Although the site falls below the national bottom line for MCI scores (<90; Attribute band D), which is a nationally-set minimum acceptable state (Ministry for the Environment, 2022), ecological stream health, as determined by MCI scores, is likely improving (LAWA, 2023).

The ecological value of Waiwhetū Stream has been assessed against the four matters outlined in Section 3.2 and described in Table 29 (Appendix A). Furthermore, the five biophysical values outlined in the NPS-FM (Section 4.2) have also been considered when assigning value to Waiwhetū Stream. The ED was used as an appropriate scale by which ecological values were considered. Attributes relevant to each matter pursuant to the site are provided along with assigned values in Table 17. The four values were then combined as outlined in Table 31 (Appendix A) for an overall ecological value of **High**.

Table 17: Summary of Waiwhetū Stream attributes and overall ecological value.

Matters	Attributes	Ecological value	Overall ecological value
Representativeness	• Waiwhetū catchment is typical of the wellington region, having varying states of modification across its reach. • Middle-order stream within a modified urban environment. However, indigenous riparian vegetation likely buffers stream reach on-site. • Permanently flowing.	Moderate	High
Rarity / distinctiveness	• Waiwhetū Stream provides habitat for four 'At Risk' species. • Two 'Threatened' and eight 'At Risk' species known to the wider catchment and could utilise Waiwhetū Stream habitat on-site.	High	
Diversity and pattern	• Waiwhetū Stream supports a diverse freshwater fish community. • Low invertebrate diversity on-site. • Waiwhetū Stream is highly channelised, often artificially, meandering stream with alternating hydrological components (e.g., riffles, runs).	Moderate	
Ecological context	• Waiwhetū stream provides varied instream habitat, ranging from gravels to cobbles and including undercut banks and organic debris. • Riparian vegetation varies with urban parkland and Eastern Hills bush and consists of a mix of indigenous and exotic vegetation. Riparian vegetation often provides little to no shading but does offer instream habitat through overhanging vegetation and protection from contaminants entering the watercourse in some locations along the waterway. • Urban land-use has likely contributed to lower aquatic invertebrate scores. • Waiwhetū Stream provides migration pathways, but to a limited extent as instream infrastructure may impact fish migrations such as weirs (for non-climbing fish) and significant culverting / channelising (flow / darkness).	High	

[6] Interpreted from quality classes in (Stark & Maxted, 2007) which is reproduced as Table 34 in Appendix A.

Matters	Attributes	Ecological value	Overall ecological value
	• Upstream reaches of stream flowing through urban environments likely accumulating pollutants. • Water quality at routinely monitored downstream site is more degraded (although likely improving) than the Waiwhetū Stream reach on-site. Suggests stream reach on-site could be buffered from surrounding urban environment.		

7.7.2 Levels of Effects Assessment

Actual or potential impacts to Waiwhetū Stream from the proposed activity will include temporary construction phase and short-term negative effects, related to the open trenching through the stream and associated loss of riparian vegetation for the delivery pipeline and rock armouring/riprap for scour protection installation.

The construction methodology required to install the delivery pipeline across Waiwhetū Stream will be open trenching. Open trenching will result in the temporary (construction phase) disturbance of the Waiwhetū streambed and riparian margins. Use of temporary earth bunds or sheet piling to isolate the worksite, and a by-pass pump or carrier pipe to maintain water flow will be implemented to facilitate dewatering of the worksite. Works within the waterway are expected to take no more than 2 weeks. Dewatering of the construction zone will result in a temporary loss of habitat for freshwater fauna and restrict movement or migration, depending on the time of year and fish affected. The size of the construction zone is unknown, however can be expected to extend several metres either side of the pipeline. For this effects assessment, it is assumed the construction zone is confined by the site boundary (Figure 3). Water from the trench dewatering will be treated through a lamella settling tank or a decanting earth bund to remove sediment and then discharged to Waiwhetū Stream downstream of the works site.

Installation of rock rip rap may require temporary disturbance of the streambed of Waiwhetū Stream. The size of the construction zone is unknown but may extend several metres either side of the rock rip rap. Potential effects of these activities include temporary (construction phase) to permanent loss of existing habitat, and a temporary (construction phase) increase in sediment. The loss of habitat is expected to be negligible due to the size of the site compared to the Waiwhetū catchment.

The loss of vegetation combined with construction activities associated with the delivery pipe installation and reservoir will likely result in a temporary (construction phase) to short-term increased risk of erosion and sediment. Sediment from the construction site may become mobilised during rain events and enter Waiwhetū Stream. The risk for erosion and sedimentation is likely to be up to five years until remediation planting is established on-site.

The pre-mitigated magnitude of effect has been assessed as **High** due to the potential major alteration that Waiwhetū Stream could face, during construction if erosion and sediment control and open trenching through Waiwhetū Stream are not managed. Using Table 33 (Appendix A) to combine the High magnitude of effect with the High overall ecological value, the pre-mitigated level of effect is **Very high**.

7.7.3 Measures to avoid, minimise and/or remedy effects on Waiwhetū Stream

The potential pre-mitigated level of effect to Waiwhetū Stream is Very High, as such the effects management hierarchy must be applied (Clause 3.24, NPS-FM).

Opportunities to avoid or minimise impacts on Waiwhetū Stream (and associated values) have been considered in developing the project, including as discussed in the PAA.

The option to install the delivery pipe stream crossing above ground i.e. using a pipe bridge, was considered but was ultimately not practicable for the reasons described in the Preliminary Design Report (Connect Water, 2023). The deck of any pipe bridge would need to be located at a

height above the 100-year flood level which would result in an un-safe and visually intrusive asset. Deep piles to support the bridge, would also result in disturbance of the stream and potentially impact groundwater.

Management actions listed here as well as within the Freshwater Fauna Management Plan (FFMP), discussed in Section 7.10.3 will minimise and remedy the effects where practicable.

During construction work efforts will be made to avoid or minimise the extent of riparian vegetation removed where possible. This will reduce the risk of Waiwhetū Stream habitats, and their freshwater fauna communities, from potential increases in sediment loss from construction works on-site via overland flow. An Erosion and Sediment Control Plan (ESCP) will be developed by a suitably qualified professional and implemented during construction to avoid sediment transfer during dewatering and minimise soil loss during construction activities. Reducing the amount of exposed soil, especially during seasons where heavy rain events are more likely is also highly recommended. The ESCP will ensure the water treatment devices (lamella settling tank and decanting earth bund) deployed to treat water during the dewatering process are sufficient to avoid sediment transfer from the trench to the stream. Multiple levels of erosion and sediment control may be required to minimise soil loss during construction activities depending on topography and season to ensure erosion and sediment control can manage effects during adverse weather events. Reducing sediment accumulation on-site will help prevent overland flow into the Waiwhetū Stream during periods of rain.

Ecologist input on the design and installation rock riprap is recommended to ensure in-stream habitat for freshwater fauna is promoted and impacts are minimised.

Reinstatement of the Waiwhetū streambed must occur to remedy the effects of construction, using appropriate substrate to remediate the stream bed and will be detailed in the FFMP (Section 7.10.3). Riparian remediation of any exposed areas post-construction using appropriate indigenous vegetation will be completed and will be detailed in the Vegetation Management Plan (Section 7.6.3). Ecologist input regarding species selection is recommended to ensure not only bank stability but to promote stream health and indigenous fish habitat improvements. Eco-sourced plants, suitable for the site conditions and SNR must be used.

Implementing the above management actions addresses the actual and potential effects on Waiwhetū Stream through the effects management hierarchy and will ensure in a **Low** post-mitigated magnitude of effect, resulting in a **Low** overall level of effect. A Low level of residual effect is 'less than minor', therefore, in accordance with the effects management hierarchy, offsetting does not need to be considered for Waiwhetū Stream. However, the project also proposes to complete indigenous riparian planting along both the TL and TR banks of Waiwhetū stream (details to be included within the VMP) which will provide additional benefits to Waiwhetū stream values and result in an overall **Net Gain**. A summary of the impact assessment for Waiwhetū Stream is provided below in Table 18.

Table 18: Impact assessment summary for Waiwhetū Stream.

Value	Magnitude of effect	Pre-mitigated level of effect	Mitigation requirements	Post-mitigated magnitude of effect	Residual level of effect
High	Moderate	High	Avoid: • Avoid the removal of, or impacts to, vegetation in the riparian zone where practicable. Minimise: • Develop and implement an ESCP. • Minimise the extent of riparian vegetation removed where possible. • Minimise exposed soil during works where possible.	Low (Positive with additional riparian planting)	**Low** (**Net Gain**) with additional riparian planting)

Value	Magnitude of effect	Pre-mitigated level of effect	Mitigation requirements	Post-mitigated magnitude of effect	Residual level of effect
			• Develop and implement a FFMP (see Section 7.10.3). • Ensure ecologist input on the design and installation of riprap. Remedy: • Remediate Waiwhetū Stream bed post-construction. • Remediate Waiwhetū stream riparian on-site with appropriate vegetation.		

7.8 Waiwhetū Stream Tributaries

7.8.1 Tributary Values

Three unnamed tributaries of Waiwhetū Stream are present on-site, all of which appear to be partially intermittent or permanent. These tributaries meet the definition of a river under the Greater Wellington Regional Policy Statement (Wellington Regional Council, 2013) and the Resource Management Act (Ministry for the Environment, 1991). A measure of stream or river size is defined by the degree of branching in a drainage system (e.g.: first-order streams have no tributaries, second-order streams have at least two first-order tributaries and a third-order stream must have at least two second-order tributaries.

For the purposes of this report, all tributaries identified are second order streams, when considering the Waiwhetū catchment and will be referred to as tributaries 1, 2 and 3. First order tributaries of these will be classified with the number of the second order tributary, followed by a letter, e.g., tributary 1a (Figure 56). All tributaries are within the ZOI and have the potential to be affected by project related impacts.

N

Legend

Tributary 1
- 1
- Stormwater discharge

Tributary 2
- 1a
- 1

Tributary 3
- 3
- 3a

3b

Natural inland wetlands

NZ Topo 1-50k Topo Rivers

Project site boundary

Aerial Imagery Basemap

CLIENT

Wellington Water

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SHEET NUMBER	SCALE
1 of 1	1:2,000

PROJECT
Client Name: Wellington Water
Location: Naenae, Lower Hutt
Project Title: Eastern Hills Reservoir

SHEET
Figure 56: Delineated tributaries of the Waiwhetū Stream

PROJECT NUMBER	REVISION DATE	REVISION
3-WW021.02	12/09/2023	R1

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Plot Date: 2023-09-12 08:45:43 by Hansen, Mark (NZMH30142)

File Ref: U:\ProjectsNZ\3w\3-WW021.02 Naenae No.2 Reservoir\Home\500 Work in Progress\Ecology\GIS\0 Naenae EcIA.qgz

Tributary 1 is the western most second-order stream and is within a gully west of the proposed delivery pipe alignment. Tributary 1 is characterised by riffles, runs (Figure 57), cascades and pools. The streambed consists of fine sediment, gravel, scattered woody debris and leaf litter. The riparian zone is undefined with contiguous vegetation and is primarily 'Broadleaved Indigenous Hardwoods' providing substantial instream shading (Figure 58). A natural inland wetland is present in the lower reaches of this tributary. An ephemeral flow path exists on the true left associated with stormwater discharge. A gabion basket has been installed in the attempt to mitigate erosion (Figure 59 & Figure 60).

Figure 57: Lower reach of tributary 1, facing downstream.

Figure 58: Tributary 1, facing upstream.

Figure 59: Stormwater discharge during no flow.

Figure 60: Ephemeral flow from stormwater discharge

Tributary 2 has a short reach and is relatively undefined in the topography of the area. Tributary 2 provides surface water to two natural inland wetlands to the east of the delivery pipe alignment. This tributary is characterised by runs and riffles and the bed comprises fine sediment, gravel, scattered woody debris and leaf litter. A short first order tributary is present on the true right and has the same characteristics. The riparian zone is undefined with contiguous vegetation and is primarily 'Broadleaved Indigenous Hardwoods' providing substantial instream shading. Downstream of the wetlands, no surface flow or defined channel exists (Figure 61).

Figure 61: Downstream of wetlands where surface water stops.

Tributary 3 is the eastern most second-order stream and drains the gully east of the site. The upper catchment is a steep gradient, fast-flowing stream with cascades, riffles and runs, with heavily incised and scoured banks (Figure 62). The upper reach streambed is solely dominated by exposed clay and scattered organic matter (Figure 63). The middle reach has defined banks and the bed comprises a mix of gravels and clay (Figure 64), while the lower reaches lack banks, is dominated by organic leaf matter (Figure 65) or gravel (Figure 66) and provides surface water to a natural inland wetland dominated by raupō before entering Waiwhetū Stream (Figure 67). The riparian zone consists mixed indigenous vegetation provides substantial instream shading. A natural inland wetland is present immediately to tributary 3 entering Waiwhetū Stream.

Figure 62: The upper reach of tributary 3 showing incised banks.

Figure 63: Upper reach of tributary 3 showing clay streambed

Figure 64: Middle reach of tributary 3 showing gravel bed.

Figure 65: Lower reach of tributary 3 lacking defined banks.

Figure 66: Gravel and sediment bed in the lower reaches of tributary 3

Figure 67: Raupō wetland June 2023.

Many headwater streams (first through third order) are heavily influenced by riparian vegetation and rely on the input of terrestrial organic matter as an energy source (Vannote, Minshall, Cummins, Sedell, & Cushing, 1980). Therefore, these smaller headwater streams form an important component of the wider river system by providing terrestrially sourced energy (e.g., leaf litter, woody debris etc) to downstream reaches. Detected through eDNA sampling, tributary 3 serves as a refuge for kōura and shortfin eel. Kōura are considered a keystone species[7] in freshwater ecosystems because they have various ecological functions, acting as shredders, detritivores, and predators which in turn influences other freshwater fauna communities (NIWA, 2023). In the tributaries on-site, kōura are likely contributing to the processing of terrestrially derived organic material.

The ecological value of the Waiwhetū Stream tributaries have been assessed against the four matters outlined in Section 3.2 and described in Table 29 (Appendix A). Furthermore, the five biophysical values outlined in the NPS-FM (Section 4.2) have also been considered when assigning value to Waiwhetū Stream. The ED was used as an appropriate scale by which ecological values were considered. Attributes relevant to each matter pursuant to the site are provided along with assigned values in Table 19. The four values were then combined as outlined in Table 31 (Appendix A) for an overall value of **Moderate.**

Table 19: Summary of Waiwhetū Stream tributary values and overall ecological value.

Matters	Attributes	Ecological value	Overall ecological value
Representativeness	• All tributaries are assumed to be permanent or partially intermittent. • Tributaries have riparian vegetation and habitats that are typical and characteristic of what would be expected from headwater streams.	Moderate	Moderate
Rarity / distinctiveness	• Keystone invertebrate species present.	Moderate	
Diversity and pattern	• Supports a basic freshwater community as eDNA sampling only detected kōura and shortfin eel (*Anguilla australis*).	Very Low	
Ecological context	• Tributaries are a part of an important sub-catchment of Waiwhetū Stream given their intact headwater characteristics (i.e., dense riparian margins and subsequent transfer of terrestrial organic matter /energy sources) and the lack of these pristine tributaries in the wider catchment. • Tributaries on-site could be serving as important sources of terrestrial organic matter. Riparian vegetation is depositing terrestrial matter into tributaries which likely serves as a source of terrestrial organic matter for downstream reaches. • Riparian vegetation almost entirely of indigenous vegetation, providing almost complete canopy closure. • Relatively simple instream habitat, limited to fine sediments and gravels, and organic matter.	High	

[7] Keystone species – a species that has a disproportionately large influence on an ecosystem due to the ecological functions it provides.

7.8.2 Levels of Effects Assessment

Impacts directly affecting permanent or intermittent reaches of all tributaries are avoided, however, the upper reach of an ephemeral flow path associated with tributary 3 will be within the construction zone of the reservoir (Figure 56). All tributaries are within the ZOI for construction works where vegetation removal may increase the risk of erosion and sediment impacts and construction activities may alter surface and ground water flow.

Clearance of adjacent vegetation may result in the medium-term loss of terrestrial organic matter sources to tributaries Although difficult to quantify, this is likely to result in a reduction in energy transfer from terrestrial sources to tributaries and downstream receiving environments. The duration of this reduction in terrestrial inputs is due to the proposed site remediation and expected planting to reinstate those terrestrial energy sources between five and 10 years.

Vegetation clearance associated with the project will increase the risk of erosion and sediment and may result in the suitability of tributaries to support indigenous freshwater fauna including keystone species. An important food source for kōura is organic matter that is derived from terrestrial sources (e.g., leaf litter).

The pre-mitigated magnitude of effect has been assessed as Moderate due to the current baseline conditions of the tributaries and the potential alteration that may result in a partially changed character or attributes, during construction. Using Table 31 (Appendix A) to combine the Moderate magnitude of effect with the Moderate overall ecological value, the pre-mitigated level of effect is Moderate.

7.8.3 Measures to avoid, minimise and/or remedy Waiwhetū stream tributaries.

The potential pre-mitigated level of effect to tributaries of the Waiwhetū Stream is Moderate, as such the effects management hierarchy must be applied (Clause 3.24, NPS-FM).

Direct impacts to permanent or intermittent reaches of all tributaries are avoided by the project (no instream works), however indirect impacts may occur, and the management actions described here will minimise and remedy the effects where practicable.

The ESCP outlined in Section 7.7.3 will include the tributaries. Where practicable, construction work should avoid impacts to vegetation within 10 m of any permanent, intermediate, or ephemeral tributary. This will ensure tributaries, and their freshwater fauna communities, are naturally buffered from potential increases in sediment loss from construction works on-site via overland flow. However, vegetation removal adjacent to tributaries 1 and 2 associated with the delivery pipeline installation may result in the loss of 'Broadleaved indigenous Hardwoods' within 10 m, that provide stream shading and terrestrial energy sources. Where vegetation removal occurs slash management of removed vegetation must be implemented to minimise the impacts from vegetation removal. Stockpiling slash, between sediment control fences and tributaries will allow the long-term breakdown of foliage to retain terrestrial energy sources for keystone species. This will appropriately mitigate the potential medium-term effect loss of terrestrial energy sources. Slash must be stockpiled in a manner that poses no risk to Waiwhetū Stream during an adverse weather event. Indicative areas for slash stockpiling are provided in Figure 68; this must be confirmed in the VMP prior to clearance, with input from an ecologist.

Legend

- Indicative slash stockpile areas
- Indicative sediment control fences
- Tributary 1
  - 1
  - Stormwater discharge
- Tributary 2
  - 1
  - 1a
- Tributary 3
  - 3
- Project site boundary
- NZ Topo 1-50k Topo Rivers
- Aerial Imagery Basemap

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1 of 1	1:500

PROJECT
Client Name: Wellington Water
Location: Naenae, Lower Hutt
Project Title: Eastern Hills Reservoir

SHEET
Figure 68: Indicative slash stockpile areas

PROJECT NUMBER	REVISION DATE	REVISION
3-WW021.02	12/09/2023	R1

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Plot Date: 2023-09-12 11:07:48 by Hansen, Mark (NZMH30142)

File Ref: U:\ProjectsNZ\3w\3-WW021.02 Naenae No.2 Reservoir\Home\500 Work in Progress\Ecology\GIS\0 Naenae

Following completion of site work, site remediation through indigenous vegetation planting impacted with eco-sourced plants suitable for the site and SNR12 will be completed as detailed in the VMP (Section 7.6.3). Actual and potential impacts associated with the loss of 'Broadleaved Indigenous Hardwoods' to tributaries are expected to be remediated within five to 10 years.

Implementing management actions is best practice and will effectively mitigate adverse effects to tributaries resulting in a **Negligible** post mitigated magnitude of effect, and **Very Low** residual level of effect. A Very low level of residual effect is not 'more than minor', therefore, in accordance with the effects management hierarchy, offsetting and compensation do not need to be considered for the Waiwhetū Stream tributaries A summary of the impact assessment for Waiwhetū Stream tributaries is provided below in Table 20.

Table 20: Impact assessment summary for Waiwhetū Stream tributaries.

Value	Magnitude of effect	Pre-mitigated level of effect	Mitigation requirements	Post-mitigated magnitude of effect	Residual level of effect
Moderate	Moderate	Moderate	Avoid • No instream works will occur within the tributaries. • Avoid the removal of, or impacts to indigenous vegetation adjacent to the tributaries where practicable. Minimise • Develop and implement a ESCP. • Minimise exposed soil during works where possible. • Implement slash stockpiles between sediment fences and tributaries, so long as this poses no risk to Waiwhetū Stream during adverse weather. Remedy • Remediate the site with indigenous vegetation.	Negligible	Very Low

7.9 Wetlands

7.9.1 Wetland Values

Desktop assessments included reviews of the pre-human predicted wetlands GIS layer (Manaaki Whenua Landcare Research, 2023), OurEnvironment current wetlands GIS layer (Manaaki Whenua Landcare Research, 2023) and high-resolution aerial imagery. Desktop assessments revealed the site to be found to be within an area of predicted pre-human swamp wetland (Figure 69), predisposing the area to wetland features.

2.5.3 Swamp
A wetland that receives a relatively rich supply of nutrients and often also sediment via surface runoff and groundwater from adjacent land. Swamps usually have a combination of mineral and peat substrates. Leads of standing water or surface channels are often present, with gentle permanent or periodic internal flow, and the water table is usually permanently above some of the ground surface, or periodically above much of it. Swamps usually occur in basins, and on valley floors, deltas, and plains. Vegetation cover is often sedge, rush, reed, flax, tall herb, or scrub types, often intermingled, and also forest.

Legend

Pre-human predicted wetlands

- Fen
- Swamp
- Project site boundary

Aerial Imagery Basemap

CLIENT

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SHEET NUMBER	SCALE
1 of 1	1:30,000

PROJECT

Client Name: Wellington Water
Location: Naenae, Lower Hutt
Project Title: Eastern Hills Reservoir

SHEET

Figure 69: Predicted pre-human wetlands

PROJECT NUMBER	REVISION DATE	REVISION
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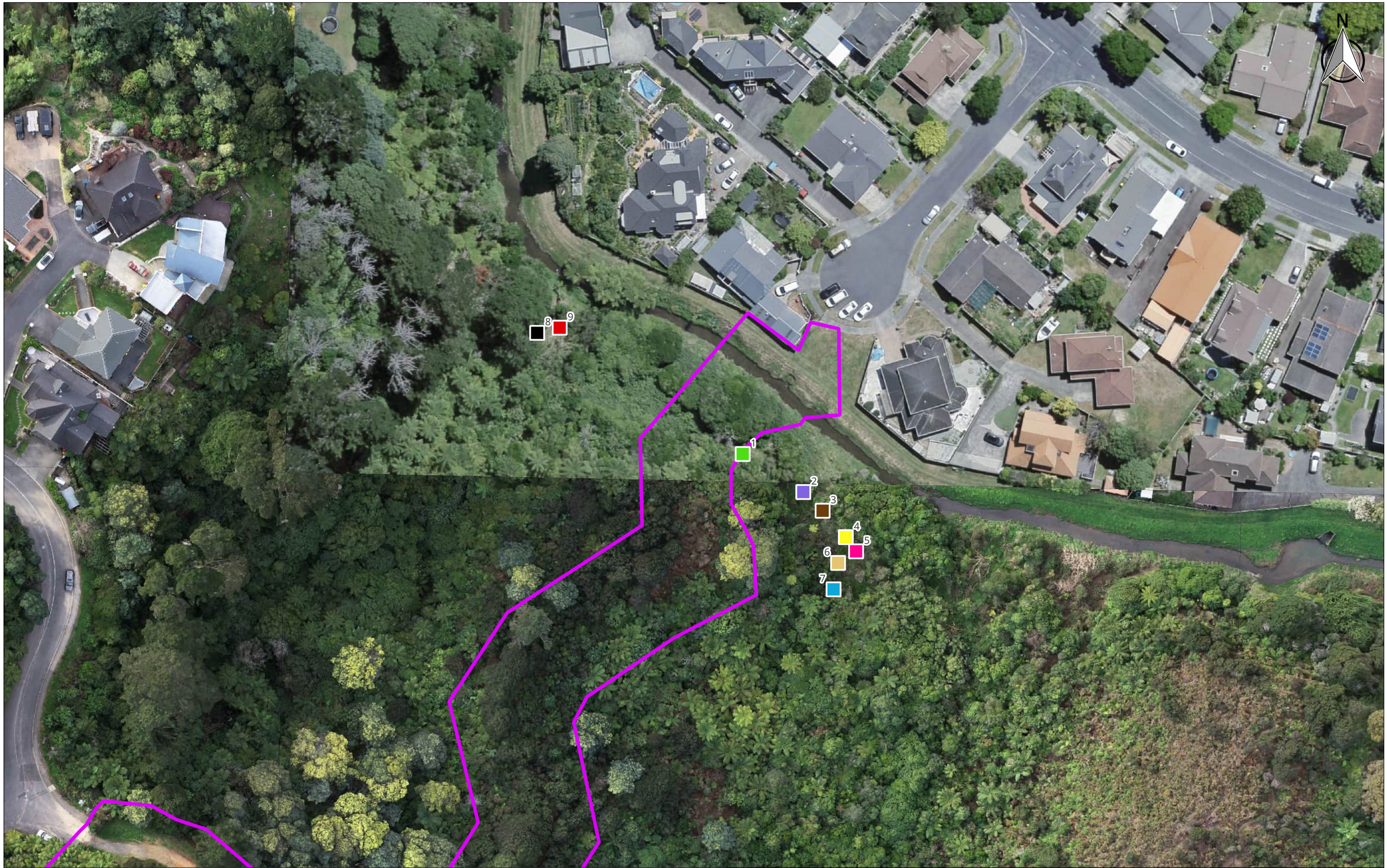
Areas within 100 m of construction works associated with the project were surveyed for the actual or potential presence of natural inland wetlands, for consenting purposes. During site visits in March 2023, areas were identified that required wetland delineation. All areas were associated with the flood plain of Waiwhetū Stream. Nine wetland vegetation plot assessments were conducted randomly within estimated wetland areas (Figure 70). Plots 1 to 7 were performed in April 2023, while plots 8 and 9 were performed in June 2023. All wetland assessments were conducted utilising 2 m x 2 m plots and were performed in accordance with the Wetland Delineation Protocols (Ministry for the Environment, 2022). Using the Vegetation Tools within the Protocols, an area is classified as a wetland under the RMA if it passes the dominance test (50% of dominant species are facultative, facultative wetland, or obligate wetland species), and the prevalence index is equal to or less than 3 (Ministry for the Environment, 2020). If the outcome is uncertain, the Hydric Soils and Wetland Hydrology Tool must be used to provide supporting evidence and supplement the Vegetation Tools (Ministry for the Environment, 2020).



Legend

Wetland delineation plots

1
2
3
4
5
6
7
8
9

Project site boundary

Aerial Imagery Basemap

CLIENT

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1 of 1	1:750

PROJECT

Client Name: Wellington Water
Location: Naenae, Lower Hutt
Project Title: Eastern Hills Reservoir

SHEET

Figure 70: Wetland delineation plot locations

PROJECT NUMBER	REVISION DATE	REVISION
3-WW021.02	12/09/2023	R1

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Wetland delineation Plot 1 (Figure 71) failed both the dominance and prevalence index tests, therefore did not qualify as a wetland.

Figure 71: Wetland delineation Plot 1.

Plots 2 and 3 (Figure 72 & Figure 73) achieved 100% dominance of vegetation indicative of a wetland, and received prevalence index values of 1.5 and 1.7 respectively, passing the hydrophytic vegetation determination and qualifying as a wetland. This area is defined as Wetland 2, and functions as a delta for tributary 2 (Figure 81).

Figure 72: Wetland delineation Plot 2.

Figure 73: Wetland delineation Plot 3.

Plot 4 (Figure 74) failed both the dominance and prevalence index tests, therefore did not qualify as a wetland.

Figure 74: Wetland delineation Plot 4.

Plots 5, 6 and 7 all failed the dominance test with 25%, 50% and 16% respectively, however they all passed the prevalence index with values of 2.7 for both Plots 5 & 6 and 1.9 for Plot 7. Due to the uncertain come, the Hydric Soils and Wetland Hydrology Tool was utilised. Saturated soil conditions resulted in the confirmation of this site meeting the definition of a wetland. This area is defined as Wetland 3 and functions as a delta of tributary 3 (Figure 81).

Figure 75: Wetland delineation Plot 5.

Figure 76: Wetland delineation Plot 6.

Figure 77: Wetland delineation Plot 7.

Plots 8 and 9 (Figure 78 & Figure 79) had 100% dominance of vegetation indicative of a wetland and an index value of 2.5, thus passing the hydrophytic vegetation determination, and qualifying as a wetland. This area, defined as Wetland 1, loosely functions as a floodplain / delta for tributary 1 (Figure 81).

Figure 78: Wetland delineation Plot 8.

Figure 79: Wetland delineation Plot 9.

A rapid visual assessment was conducted of a raupō dominated area where tributary 3 meets Waiwhetu Stream. No delineation plots were required due to the obvious dominance of raupō (*Typha orientalis*). This area is defined as Wetland 4.

Figure 80: Wetland 4 overview.

Defining attributes, including landform, vegetation, and structural classes, resulted in all wetlands meeting the definition of swamps, consistent with pre-human predictions of the area. Furthermore, no wetlands on-site were dominated by pasture species, nor grazed, therefore, all wetlands on-site are considered 'natural inland wetlands' under the NPS-FM. All natural wetlands within the Wellington Region are deemed to be sites of significant biodiversity value (Greater Wellington Regional Council, 2022a). Pursuant to Policy P31 and Policies P38-41 natural wetlands must be protected (Greater Wellington Regional Council, 2022a). A summary of wetland delineation plots and findings are provided in Table 21, while delineated natural inland wetlands are shown in Figure 81.

Table 21: Wetland delineation plot results

Plot	Dominance	Prevalence	Hydrology indicators	Natural inland wetland	Type
1	0% - Fail	3.7 - Fail	-	No	
2	100% - Pass	1.5 - Pass	N/A	Yes	Swamp
3	100% - Pass	1.7 - Pass	N/A	Yes	Swamp
4	50% - Fail	3.2 - Fail	-	No	
5	25% - Fail	2.7 - Pass	Soil saturation	Yes	Swamp
6	50% - Fail	2.7 - Pass	Soil saturation	Yes	Swamp
7	16% - Fail	1.9 - Pass	Soil saturation	Yes	Swamp
8	100% - Pass	2.5 - Pass	N/A	Yes	Swamp
9	100% - Pass	2.5 - Pass	N/A	Yes	Swamp

Legend

Natural inland wetlands

Project site boundary

Aerial Imagery Basemap

CLIENT

Wellington Water

Christchurch Ecology
+64 3 373 2028
PO Box 1482
Christchurch 8140
New Zealand

DRAWN	APPROVED
M. HANSEN	J. Lucas
SHEET NUMBER	SCALE
1 of 1	1:750

PROJECT

Client Name: Wellington Water
Location: Naenae, Lower Hutt
Project Title: Eastern Hills Reservoir

SHEET

Figure 81: Confirmed natural inland wetlands

PROJECT NUMBER	REVISION DATE	REVISION
3-WW021.02	12/09/2023	R1

Original Sheet Size: A3 [W = 420, H = 297]

Plot Date: 2023-09-12 15:19:13 by Hansen, Mark (NZMH30142)

File Ref: U:\ProjectsNZ\3w\3-WW021.02 Naenae No.2 Reservoir\Home\500 Work in Progress\Ecology\GIS\0 Naenae EcIA.qgz

All delineated wetlands within proximity to the site provide the same ecological function, are of similar size and all equally provide little in the way of habitat for 'Threatened' or 'At Risk' fauna. As such for the purposes of this EcIA, all wetlands have been considered in a single value assessment. The Waiwhetū Stream catchment was used as an appropriate scale by which the ecological values for these wetlands were considered. Due to the predisposition of the Eastern Hills area to wetlands, based on the predicted pre-human wetland extents (Figure 69), and the confirmed wetlands within proximity to site, it can be assumed similar wetlands exist throughout the Waiwhetū Catchment, where lowland flood plains of tributaries exist. Although unable to be quantified, it is highly likely numerous wetlands of similar size, function and quality exist.

The ecological value of wetlands within proximity to the site have been assessed against the four matters outlined in Section 3.2 and described in Table *29* (Appendix A). Furthermore, the five biophysical values outlined in the NPS-FM (Section 4.2) have also been considered when assigning value to the wetlands. The overall ecological value of wetlands is **Moderate**. Attributes relevant to each matter pursuant to the site are provided along with assigned values in Table *22*. The four values were then combined as outlined in Table *31* (Appendix A) for an overall value.

Table 22: Summary of wetland attributes and the overall ecological value.

Matters	Attributes	Ecological value	Overall ecological value
Representativeness	• Four natural inland wetlands were confirmed within proximity to the site and are classified as swamps, consistent with the predicted pre-human wetland on-site. • All wetlands are associated with minor but permanent first-order tributaries of the Waiwhetū Stream. • Wetlands are fed by both surface and ground water. • Wetlands provide ecological function prior to tributary discharge into Waiwhetū Stream. • Species compositions are characteristic of modified / regenerating wetlands. • Species assemblage consists native and exotic species.	Moderate	Moderate
Rarity / distinctiveness	• Wetlands are the most threatened national ecosystem, and all natural inland wetlands are significant in the Wellington Region. • Naenae has been significantly developed from its natural state into residential property, very few wetland areas remain which elevates the value of these wetlands. • These wetlands provide no habitat for regionally or nationally 'Threatened' or 'At Risk' fauna.	High	
Diversity and pattern	• Species assemblage consists largely of perennial species, reducing seasonal habitat availability. • While some surface ponding does occur, it is in small volumes and unlikely to sustain any significant populations of aquatic fauna. • The combined area of the wetlands is very small; and species composition is largely consistent between all. As such wetlands on-site are only capable of providing low levels of habitat diversity. • Wetlands pattern, complexity, size, and shape are of low quality.	Low	
Ecological context	• Site is regenerating from previous land-use impacts. • The wetlands provide significant function within the tributary-catchments they are located within, but do not provide ecological context within the wider Waiwhetū Stream catchment. • Only 8% of wetlands remain in the Greater Wellington Region elevating the value of ecological function provided by these wetlands. • The wetlands provide low value habitat for indigenous flora and negligible value habitat for indigenous fauna.	Low	

7.9.2 Levels of Effects Assessment

Direct vegetation impacts and construction activities within 10 m of all confirmed natural inland wetlands are avoided by project activities. However, construction and installation of the delivery pipelines has the potential to impact the wetlands adjacent to the site. The loss of vegetation on-site increases the risk of erosion and sediment while construction works associated with the delivery pipeline installation will impact ground water (WSP, 2023b).

Vegetation clearance on-site may indirectly impact wetlands adjacent to the site. Surrounding arborescent vegetation contributes terrestrial organic material to all wetlands via the three tributaries adjacent to the site, as outlined in Section 7.8.1. The loss of adjacent vegetation may have a short-term indirect impact to wetland habitat quality for aquatic fauna. Additionally, the loss of vegetation on-site will expose bare earth, increasing the risk for sedimentation of wetlands during periods of rain via overland flow. Without mitigation, this would have the potential to smother wetlands which could cause a major loss or major alteration to the wetlands, fundamentally changing their character, composition, or attributes.

Dewatering of the trench associated with installing the delivery pipeline through the riparian zone and Waiwhetū Stream is required. A dewatering assessment has been completed by WSP hydrogeologists and a conservative modelling approach was employed (WSP, 2023b). Dewatering was found to have a reduction of no more than 0.3 m of groundwater to wetland 2 (WSP, 2023b). The dewatering impact to groundwater is likely to be less, however a precautionary approach must be taken where risk or uncertainty exists (Roper-Lindsay, Fuller, Hooson, & Sanders, 2018). Construction will be temporary and as recommended within the dewatering assessment, must not exceed two weeks. Should construction exceed two weeks, mitigation recommendations outlined within the dewatering assessment must be implemented. Waiwhetū Stream.

The magnitude of effect on all wetlands adjacent to the site could be **High**, resulting in a major alteration to key features of the baseline conditions, such that post-development attributes could be fundamentally changed. Using Table 31 (Appendix A) to combine the Moderate magnitude of effect with the Very high overall ecological value, the pre-mitigated level of effect is **Moderate**.

7.9.3 Measures to avoid, minimise and remedy effects on wetlands

The potential pre-mitigated level of effect to wetlands within the ZOI is Moderate, as such the effects management hierarchy must be applied (Clause 3.22, NPS-FM).

Direct impacts to the wetlands and vegetation removal within 10 m of wetlands have been avoided through design, however indirect impacts to wetlands may occur and will be managed to minimise and remedy the effects where practicable.

Erosion and sediment controls must be implemented to minimise sediment impacts to wetlands during construction activities, as outlined in Sections 7.7.3 & 7.8.3 above.

Groundwater impacts to wetland 2 will be temporary, however, to minimise impacts on wetland 2, dewatering is planned to not exceed two weeks. If more than two weeks is required, effects will be minimised by adhering to recommendations listed below that were included within the dewatering assessment (WSP, 2023b):

- Ensure no single excavation is open for longer than 14 days;
- Allow groundwater levels to recover before starting on next excavation;
- Groundwater can be monitored through the use of monitoring wells

Following the completion of the pipeline installation, wetlands are expected to quickly revert to natural conditions (WSP, 2023b).

Implementing the above mitigation recommendations is expected to achieve a **Low** post-mitigated magnitude of effect resulting in a **Low** residual level of effect. A Low level of residual effect is not 'more than minor', therefore, in accordance with the effects management hierarchy,

offsetting and compensation do not need to be considered for wetlands. The project also proposes remediation across the site and additional riparian planting along Waiwhetū stream which is expected to improve site and wetland conditions. Offsetting requirements for vegetation impacts outlined in Section 7.6.3 regarding exotic weed control, if performed within and adjacent to wetlands, will further improve the post-development values of wetlands to the site and likely lead to an overall Net Gain for wetlands. A summary of the wetland impact assessment is provided in Table 23 below.

Table 23: Impact assessment summary for wetlands adjacent to the site.

Value	Magnitude of effect	Pre-mitigated level of effect	Mitigation recommendations	Post-mitigated magnitude of effect	Residual level of effect
Moderate	High	Moderate	Avoid • Construction activities, including vegetation clearance have been avoided within 10 m of the natural inland wetlands through design. Minimise • ESCP must be developed and implemented. • Dewatering will be limited to a maximum of two weeks. • Further management actions have been proposed to minimise effects if dewatering need to exceed two weeks. Remedy • Following completion of dewatering, wetlands will recover quickly to natural conditions (no further remediation required).	Low (Positive with additional riparian planting and vegetation remediation and offsetting)	**Low (Net Gain** with additional riparian planting and vegetation remediation and offsetting)

7.10 Freshwater Fauna

7.10.1 Freshwater Fauna Values

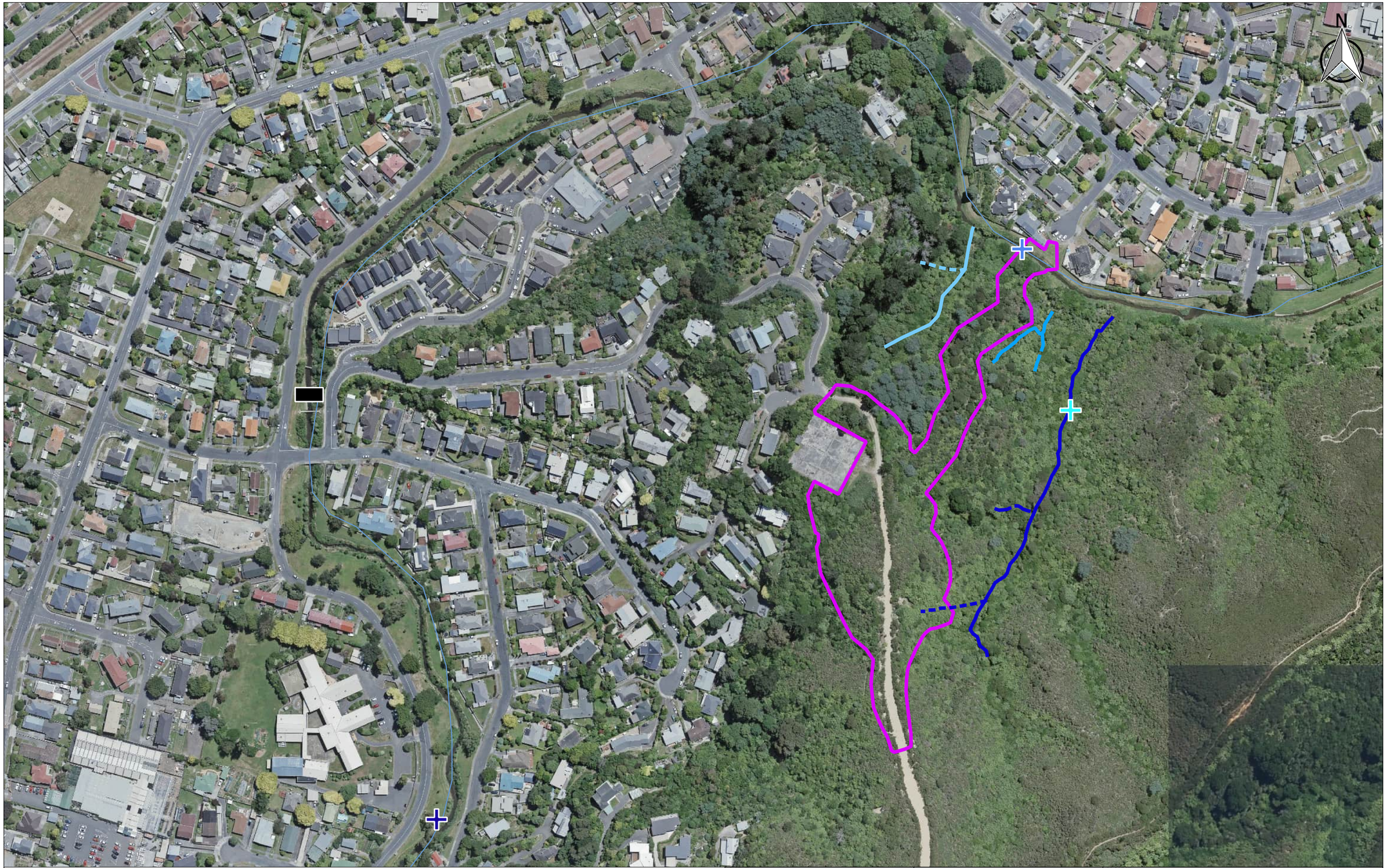
A review of the NZFFD for Waiwhetū Stream and the wider Hutt River catchments identified nineteen species of freshwater fauna. Two species are regionally 'Threatened', and eight are regionally 'At Risk' (Greater Wellington Regional Council, 2022b) (Table 39; Appendix B).

A review of the Greater Wellington Natural Resources Plan Map (Greater Wellington Regional Council, 2023b) revealed Waiwhetū stream provides īnanga spawning habitat in its lower reaches while the reach on-site falls within the īnanga migration zone (Greater Wellington Regional Council, 2023b) and is therefore an ecosystem with significant indigenous biodiversity values. The site is approximately 7.8 km from the coast, and well upstream of spawning areas for īnanga typically spawning in coastal or brackish water (LAWA, 2023).

During site assessment a weir was found to be present approximately 700 m downstream of the site (Figure 82). This weir is likely to be a barrier, impeding the upstream migration of fish that are poor climbers or unable to climb.

Figure 82: Weir downstream of site within Waiwhetū Stream

The use of eDNA surveys allows the detection of numerous species upstream of the survey points due to shedding DNA into the watercourse. This technique provides an assessment of species presence within the wider catchment upstream of the sample location, rather than that of merely trapping, which only surveys the immediate area. Three eDNA samples were taken during site visits in April 2023. eDNA was collected from a variety of locations within watercourses on-site and within the ZOI to determine the freshwater communities present. Two eDNA samples were taken from Waiwhetū Stream and one from tributary 3 (Figure 83). eDNA samples from Waiwhetū Stream were collected within the site boundary and 780 m downstream of the site, below the weir. This was to determine if the weir was acting as a barrier to fish and to identify species both on-site and within the ZOI. The eDNA collected from tributary 3 provided evidence of freshwater fauna values within the potential receiving environment adjacent to the site. Samples were sent to Wilderlab for analysis. eDNA sampling detected the presence of nine fish species and one aquatic invertebrate in total. Species composition at the two Waiwhetū Stream sampling locations were largely identical, which suggests the downstream weir is not a significant fish barrier for most fish but is preventing fish passage upstream for species least able to climb. One regionally 'Threatened' and three regionally 'At Risk' species were detected on or upstream of the site. In addition to the aforementioned species, another 'At Risk' species was identified in the downstream sample, while only 'Not Threatened' species were detected within tributary 3. Table 39 (Appendix B) summarises eDNA results from the three sampling locations. Both of the Waiwhetū Stream samples detected nine marine fish species; likely a result of fish frames being dumped into the stream, while the downstream site detected two species of tropical freshwater fish potentially due to a recent aquarium water dumping by residents. The introduced peach blossom jellyfish (*Craspedacusta sowerbii*) was detected in both Waiwhetū Stream samples. Of the ten freshwater fauna species identified through eDNA sampling, half were either regionally 'Threatened' or regionally 'At Risk'.



Legend

- Waiwhetu Stream downstream eDNA
- Waiwhetu Stream on-site eDNA
- Tributary 3 eDNA
- Weir
- Tributary 1
  - 1
- Stormwater discharge
- Tributary 2
  - 1
  - 1a
- Tributary 3
  - 3
  - 3a
  - 3b
- NZ Topo 1-50k Topo Rivers
- Project site boundary

Aerial Imagery Basemap

CLIENT: Wellington Water

wsp
Christchurch Ecology
+64 3 373 2028
PO Box 1482
Christchurch 8140
New Zealand

DRAWN	APPROVED
M. HANSEN	J. Lucas
SHEET NUMBER	SCALE
1 of 1	1:2,500

PROJECT
Client Name: Wellington Water
Location: Naenae, Lower Hutt
Project Title: Eastern Hills Reservoir

SHEET
Figure 83: eDNA sample locations

PROJECT NUMBER	REVISION DATE	REVISION
3-WW021.02	13/09/2023	R1

Original Sheet Size: A3 [W = 420, H = 297]
Plot Date: 2023-09-13 19:05:15 by Hansen, Mark (NZMH30142)
File Ref: U:\ProjectsNZ\3w\3-WW021.02 Naenae No.2 Reservoir\Home\500 Work in Progress\Ecology\GIS\0 Naenae EcIA.qgz

Aquatic macroinvertebrate results, outlined in Table 16 above, indicate ecological stream health is mostly 'Fair'. Invertebrates form a key part of the freshwater food chain and are an important component of freshwater fish diets. Few EPT taxa were detected, and overall invertebrate richness was low (number of taxa ranged from 9 – 13). These findings are indicative of the surrounding urban environment which is known to have negative effects on stream invertebrate communities. However, ecological stream health is likely improving from a degraded state in Waiwhetū Stream (LAWA, 2023), and stream invertebrate richness and abundance can be expected to improve over time. This will likely benefit already important freshwater fish communities in Waiwhetū Stream.

The ecological value of freshwater fauna on-site have been assessed against the four matters outlined in Section 3.2 and described in Table 29 (Appendix A). The 'Rarity / distinctiveness' value of freshwater fauna has also been assessed based on their threat classification (Table *30*; Appendix A). Where applicable, the five biophysical values outlined in the NPS-FM (Section 4.2) have also been considered when assigning value to freshwater fauna on-site. The Waiwhetū Stream catchment was used as an appropriate scale by which ecological values were considered. The overall ecological value of freshwater fauna is **Very High**. Attributes relevant to each matter pursuant to the site are provided along with assigned values in Table 24. The four values were then combined as outlined in Table 31 (Appendix A) for an overall value.

Table 24: Summary of freshwater fauna attributes and the overall ecological value.

Matters	Attributes	Ecological value	Overall ecological value
Representativeness	• Although the Waiwhetū Stream catchment has experienced a high level of impacts historically, and moderately changed from a pre-1840 state, indigenous fish diversity and species richness remains high, and all guilds are occupied (up to apex predators). • All nine species of freshwater fauna confirmed on-site are indigenous. • The species assemblage is typical of the Waiwhetū Stream catchment and microhabitats available.	High	**Very High**
Rarity / distinctiveness	• One regionally 'Threatened' and four regionally 'At Risk' fish confirmed on-site or within the ZOI. • Kōura, confirmed on or upstream of the site within Waiwhetū Stream and within tributary 3 adjacent to the site, are a keystone species regarding freshwater ecosystem health.	Very High	
Diversity and pattern	• Indigenous fish species richness is high, indicating good level of fish community pattern and complexity. • High diversity of indigenous fish, likely utilise the site and ZOI year-round.	High	
Ecological context	• Waiwhetū Stream catchment although moderately changed supports a complex fish community. • The site location is within the īnanga migration area of Waiwhetū Stream, and lower catchment which falls within the ZOI includes īnanga spawning habitat. The site location likely falls within the migration area for one regionally 'Threatened' and three regionally 'At Risk' species. • The food web on-site reaches the apex predator stage (i.e., eels).	High	

7.10.2 Levels of Effects Assessment

Actual or potential impacts to freshwater fauna from the proposed activity primarily relate to instream construction works for the delivery pipeline installation, risk of sediment entering Waiwhetū Stream due to the loss of vegetation on-site and exposure to chlorine from the reservoir that may cause death to freshwater fauna.

As outlined previously, there is a short-term risk of sediment impacts to Waiwhetū Stream and the fish communities due to vegetation removal on-site and works adjacent to the waterway.

Instream works associated with installation of the delivery and overflow / scour pipelines and associated infrastructure (rock riprap) will pose a temporary (construction phase) risk to indigenous fish. Instream works will include the installation of temporary earth bunds, dewatering of the work site and open trenching through the stream bed, removal of bank habitat and the installation of rock riprap, all of which has the potential to kill regionally 'Threatened' and 'At Risk' fish. The size, scale, and duration of the instream works is expected to affect only a very small number of indigenous fish resulting in a negligible effect on the known populations of these fish within the Hutt River catchment. Once installed, rock riprap within the stream bank is likely to provide habitat for a range of species.

After reservoir construction is complete, there will be the risk for chlorinated water to kill freshwater fauna when released from the reservoir during maintenance. Chlorine is toxic to most aquatic life at concentrations of 0.1 – 0.3 parts per million (ppm). Drainage of chlorinated drinking water from reservoirs is permitted under the Greater Wellington Proposed Natural Resources Plan, provided chlorine concentration does not exceed 0.3 ppm (Greater Wellington Regional Council, 2022c). Therefore, if discharge of chlorinated water during routine maintenance exceeds the defined threshold, there is the potential for large-scale death of aquatic life within the ZOI, which may extend some several hundred meters downstream of the site.

The pre-mitigated magnitude of effect has been assessed as **High**, due to the potential loss of a high proportion of the population of freshwater fish within Waiwhetū Stream, downstream of the site, should chlorine enter the waterway. Using Table 33 (Appendix A) to combine the High magnitude of effect with the Very high overall ecological value, the pre-mitigated level of effect is **Very high**.

7.10.3 Measures to avoid, minimise and remedy effects on Freshwater Fauna

The potential pre-mitigated level of effect to freshwater fauna within Waiwhetū Stream is Very High, as such the effects management hierarchy must be applied (Clause 3.24, NPS-FM).

Impacts to freshwater fauna cannot be avoided during construction works within Waiwhetū Stream (as outlined in Section 7.7.3). However, fish management, pursuant to best practice guidelines (Ministry for the Environment, 2021), and pursuant to the NPS-FM as well as the mitigation actions outlined in Section 7.7.3 and 7.8.3 will minimise and remedy effects where practicable. . Where practicable, construction work should avoid impacts to riparian vegetation. This will ensure watercourse habitats on-site, and their freshwater fauna communities, are naturally buffered from potential increases in sediment loss from construction works on-site via overland flow.

To avoid effects of chlorinated water discharge during commissioning, water must be treated to remove all chlorine prior to being discharged into Waiwhetū Stream.

An ESCP must be implemented to minimise sediment impacts to freshwater fauna during construction activities, as outlined in Sections 7.7.3 & 7.8.3 above.
To minimise project impacts on freshwater fauna, a FFMP must be developed by a suitably qualified ecologist, appropriate for the construction works, methodology, site conditions and species likely affected. Guidance on the timing of construction works should be defined within the FFMP and ecological supervision must occur during high-risk construction work. Avoiding impacts during spawning and migration periods of indigenous fauna is recommended and will be outlined within the FFMP. The FFMP will also outline any fish salvage work required prior to and during construction work.

Ecologist input and supervision on the design and installation of rock riprap is recommended to ensure in-stream habitat for freshwater fauna is promoted and impacts are minimised.

Reinstatement of the Waiwhetū streambed and riparian remediation of any exposed areas post-construction will be completed (as in Section 7.7.3) and will be detailed in the Vegetation Management Plan (Section 7.6.3).

Implementing these mitigation recommendations is expected to achieve a **Negligible** post-mitigated magnitude of effect resulting in a **Low** residual level of effect on freshwater fauna. A Low level of residual effect is not 'more than minor', therefore, in accordance with the effects management hierarchy, offsetting and compensation do not need to be considered for freshwater fauna. Riparian planting is proposed post-construction (Section 7.7.3). Planting the site with eco-sourced indigenous vegetation suitable for the site conditions and SNR12 is expected to improve Waiwhetū Stream riparian conditions and provide additional benefits for freshwater fauna. A summary of freshwater fauna impact assessment is provided in Table 25 below.

Table 25: Impact assessment summary for freshwater fauna on-site and within the ZOI.

Value	Magnitude of effect	Pre-mitigated level of effect	Mitigation recommendations	Post-mitigated magnitude of effect	Residual level of effect
Very high	High	Very high	Avoid • Avoid the removal of, or impacts to, indigenous vegetation in the riparian zone where practicable. • Treat any chlorinated water prior discharge to ensure levels are below requirements to avoid the risk of freshwater fauna mortality. • Avoid instream works during peak spawning and migration periods for 'Threatened' and 'At Risk' indigenous fauna if possible. Minimise: • Develop and implement an ESCP. • Minimise exposed soil during works where possible. • Develop and implement a FFMP. • Consider ecologist input on the design and installation of riprap. Remedy: • Remediate Waiwhetū stream riparian zone on-site with appropriate vegetation. • Remediate Waiwhetū Stream post-construction.	Negligible	**Low**

8 Summary of recommendations to avoid, minimise and remedy ecological effects

Provided the following recommended measures to mitigate the actual and potential adverse ecological effects are implemented, the overall level of effects is expected to be 'Very Low' or 'Low' for birds, lizards, terrestrial invertebrates, streams, wetlands, and freshwater fauna, but 'High' for vegetation.

8.1 Project Management and Construction Works

- Ensure all areas/habitats on and off-site, likely to be impacted by any aspect of the project, are well defined to allow ecological guidance and appropriate management.
- Ensure clear communication and collaboration between all contractors and consultants with construction methodology and ecological management requirements.
- Ensure construction methodologies are developed and implemented to reduce overall project timeframes and reduce ecological impacts where possible.
- Ensure plant working in and around the tributaries on-site, the Waiwhetū Stream or wetland is clean from biosecurity and contaminant risks and is low risk of oil/hydraulic fluid spills (modern machines or recently serviced).

8.2 Terrestrial flora and fauna

- Develop and implement a BMP by a suitably qualified ecologist.
- Develop and implement a LMP by a suitably qualified herpetologist.
- Develop and implement a VMP by a suitably qualified ecologist, or landscape architects with ecological input.
- Develop a PMP by a suitably qualified ecologist and ensure implementation of the PMP occurs.
- Revise and update the OMP (Appendix C) once vegetation impacts on-site have been completed.
- Implement the OMP.
- Ensure all management plans consider and incorporate relevant elements of other management plans, including aquatic management plans.

8.2.1 Avoid

- Avoid the removal of, or impacts to, indigenous vegetation where practicable.
- Avoid nesting and fledging seasons for protected bird species most likely on-site if practicable.
- Ensure the BMP includes methodologies to determine if active nests are present prior to vegetation removal and construction activities and management actions should nests be discovered during checks (e.g., avoidance zones).
- Ensure the BMP defines nesting and fledging seasons for all species possible on-site as well as defines the ZOI for each species to avoid disturbance of nests, pursuant to the Wildlife Act 1953.
- Avoid impacts to lizard habitat May – August when lizards are likely to be in brumation and at higher risk of injury or death.

8.2.2 Minimise

- Minimise the extent of indigenous vegetation removed where possible.
- Stage vegetation removal to minimise impacts on the fauna inhabiting the vegetation on site.
- Ensure the LMP is appropriate for the species mostly likely on-site.

- Ensure the LMP includes an ADP for regionally 'Threatened' or 'At Risk' species that may be encountered on-site.
- Ensure the LMP identifies pest animal control requirements at release sites.
- Quantify areas of 'Mānuka and/or Kānuka' and 'Broadleaved Indigenous Hardwoods' lost during vegetation clearance to accurately calculate and inform the OMP.

8.2.3 Remedy

- Remediation of vegetation where practicable on-site.
- Ensure plants used for site remediation are consistent with the site conditions and SNR12 and are eco-sourced.
- Remediation plantings should be appropriate for bird and lizard species mostly likely on-site.
- Remediate areas of vegetation clearance within the first available planting season. Where future works are planned, or significant delays before planting can occur, temporary hydroseeding or biodegradable coir matt covering of areas must be implemented to manage erosion and sediment risk.
- Ensure the VMP defines appropriate planting plan for prompt 'canopy closure' and clearly defines monitoring and maintenance of plantings to ensure mortality replacement for 'canopy closure'.
- Ensure pest animal protection for newly established plants, based on herbivorous mammalian pests confirmed on-site.

8.3 Aquatic Ecosystems and Freshwater Fauna

- Develop and implement an ESCP appropriate for the site and receiving environments, including but not limited to Waiwhetū Stream, tributaries, and wetlands adjacent to the site.
- Development and implementation of a FFMP by a suitably qualified ecologist.
- Ensure all management plans consider and incorporate relevant elements of other management plans, including terrestrial management plans.

8.3.1 Avoid

- Avoid the removal of, or impacts to, indigenous vegetation in the riparian zone where practicable.
- Construction activities, including vegetation clearance have been avoided within 10 m of the natural inland wetlands through design.
- Avoid works within Waiwhetū Stream during peak spawning and migration periods for regionally 'Threatened' and 'At Risk' species likely to utilise the site, if practicable.

8.3.2 Minimise

- Ensure the FFMP provides robust construction methodology guidance to reduce the risk to indigenous freshwater fauna and their habitats within Waiwhetū Stream, the Waiwhetū Stream tributaries, and wetlands.
- Minimise exposed soil during works where possible.
- Ensure ecologist input on the design and ecologist supervision during the installation of riprap.
- Implement slash stockpiles between sediment fences and tributaries, in areas where there is no risk of slash ending up in Waiwhetū Stream during adverse weather.
- Dewatering of Waiwhetū Stream for instream works will be limited to a maximum of two weeks.

8.3.1 Remedy

- Reinstate the effected riparian areas and streambed of Waiwhetū Stream to as close to natural state as possible.
- Reinstate any effected Waiwhetū Stream tributaries to as close to natural state as possible.
- Ensure restoration planting along the Waiwhetū Stream riparian and adjacent to/within wetlands is suitable for the site conditions and SNR12, plants are eco-sourced, and planted to stabilise banks, improve watercourse quality, and promote fish habitat.

9 Summary of Assessment

9.1 Key Ecological Features

The key ecological features and elements observed on-site or within the ZOI requiring mitigation, management, or offsetting to reduce adverse effects as a result of this project are provided in Table 26.

Table 26: Key ecological features to be considered.

High Value ecosystems	Status
Indigenous vegetation	20-30% indigenous cover remains / Site is within an SNA
natural inland wetlands	regionally significant
High Value Avifauna	**Threat classification status**
bush falcon	Threatened – Regionally Critical
New Zealand pigeon	Regionally At Risk - Recovering
High Value Herpetofauna	**Threat classification status**
barking gecko	Threatened - Regionally Vulnerable
ngahere gecko	At Risk - Declining
Threatened / High Value Freshwater Fauna	**Threat classification status**
giant kōkopu	Threatened – Regionally Vulnerable
longfin eel	At Risk – Declining
kōaro	At Risk – Declining
whitebait	At Risk – Declining
giant bully	At Risk – Declining

9.2 Summary of the overall level of effect

Assuming appropriate mitigation, detailed in Section 8 of this report, is implemented, it is considered that there will be an overall 'Very Low' or 'Low' (i.e.: 'less than minor') effect on, birds, lizards, terrestrial invertebrates, streams, wetlands, and freshwater fauna. While an overall 'High' (i.e.: 'more than minor') effect on vegetation requires offsetting (Table 27). An overall Net Gain must be achieved for vegetation after offsetting has been implemented and the offsetting requirements will also provide additional benefits for birds, lizards, terrestrial invertebrates, and freshwater ecosystems.

Table 27 Overall mitigated level of effects for each ecological feature.

Ecological feature	Ecological value	Mitigated magnitude of effect	Mitigated level of effect	Offsetting required	Level of effect provided mitigation and offsetting (including for other ecological features) is implemented
Birds	Moderate	Negligible	Very Low	No	Net Gain[8]
Bats	No value	N/A	N/A	N/A	N/A
Lizards	High	Negligible	Very Low	No	Net Gain[8]
Terrestrial invertebrates	Moderate	Negligible	Very Low	No	Net Gain[8]
Vegetation	High	Moderate	High	Yes	Net Gain
Waiwhetū Stream	High	Low	Low	No	Net Gain[9]
Waiwhetū Stream tributaries	Moderate	Low	Very Low	No	Very Low
Wetlands	Moderate	Low	Low	No	Net Gain[8]
Freshwater fauna	Very High	Negligible	Low	No	Low

10 Conclusion

The construction of the Eastern Hills reservoir is regionally significant infrastructure required to provide reliable potable water supply to current customers and ensure the predicted future population growth in the Wellington region can be accommodated. This ecological impact assessment has undertaken a thorough evaluation of the ecological features on-site. Impacts associated with the proposed project were assessed to determine their risk to ecological features

[8] Due to vegetation offsetting and Net Gain requirements
[9] Due to voluntary riparian enhancement off-site

on-site and within the respective zones of influence. Where necessary, recommendations to avoid, minimise and remedy effects have been provided to reduce any actual or potential adverse effects and to align with the NPS-IB and NPS-FM. The proposed mitigation requirements seek to maintain indigenous biodiversity on-site and, in some cases, improve upon current baseline conditions. Management is also recommended to avoid disturbance and death of protected wildlife, and impacts to protected wildlife habitats, pursuant to the Wildlife Act 1953.

The avoidance of, or minimising the impacts to, ecological features through project design, the implementation of required management plans, and ecological input to construction methodologies, will reduce any actual or potential residual effects caused by the proposed project to a maximum of Low, but mostly resulting in an ecological Net Gain.

11 Limitations

This report ('Report') has been prepared by WSP New Zealand Limited ('WSP') exclusively for Wellington Water ('Client') in relation to this Eastern Hills Reservoir Ecological Impact Assessment ('Purpose') and in accordance with the Wellington Water Consultant Project Engagement form dated 10th March 2023] ('Agreement'). The findings in this Report are based on and are subject to the assumptions specified in the Report and Offer of Services dated 10th March 2023. 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 the 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 the 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 in relation to 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.

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Appendix A

Relevant EIANZ Tables

Table 28: 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	Criteria for representative vegetation and aquatic habitats: • Typical structure and composition • Indigenous species dominate • Expected species and tiers are present • Thresholds may need to be lowered where all examples of a type are strongly modified Criteria for representative species and species assemblages: • Species assemblages that are typical of the habitat • Indigenous species that occur in most of the guilds expected for the habitat type
Rarity/distinctiveness	Criteria for rare/distinctive vegetation and habitats: • Naturally uncommon, or induced scarcity • Amount of habitat or vegetation remaining • Distinctive ecological features • National priority for protection Criteria for rare/distinctive species or species assemblages: • Habitat supporting nationally Threatened or At Risk species, or locally uncommon species • Regional or national distribution limits of species or communities • Unusual species or assemblages • Endemism
Diversity and pattern	• Level of natural diversity, abundance and distribution • Biodiversity reflecting underlying diversity • Biogeographical considerations – 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) • 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 29: Matters that may be considered when assigning ecological value to a freshwater site or area.

Matters	Attributes to be considered
Representativeness	Criteria for representative vegetation and aquatic habitats: • Typical structure and composition • Indigenous species dominate • Expected species and tiers are present • Thresholds may need to be lowered where all examples of a type are strongly modified Criteria for representative species and species assemblages: • Species assemblages that are typical of the habitat • Indigenous species that occur in most of the guilds expected for the habitat type
Rarity/distinctiveness	Criteria for rare/distinctive vegetation and habitats: • Naturally uncommon, or induced scarcity • Amount of habitat or vegetation remaining • Distinctive ecological features • National priority for protection Criteria for rare/distinctive species or species assemblages: • Habitat supporting nationally Threatened or At Risk species, or locally uncommon species • Regional or national distribution limits of species or communities • Unusual species or assemblages • Endemism
Diversity and pattern	• Level of natural diversity, abundance and distribution • Biodiversity reflecting underlying diversity • Biogeographical considerations – pattern, complexity • Temporal considerations, considerations of lifecycles, daily or seasonal cycles of habitat availability and utilisation

Matters	Attributes to be considered
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) • 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 30: Factors to consider in assigning species value for EcIA.

Determining factors	Ecological value
Nationally Threatened species, found in the ZOI either permanently or seasonally	Very High
Species listed as At Risk – Declining, found in the ZOI, either permanently or seasonally	High
Species listed as any other category of At Risk, found in the ZOI either permanently or seasonally	Moderate
Locally (ED) uncommon or distinctive species	Moderate
Nationally and locally common indigenous species	Low
Exotic species, including pests, species having recreational value	Negligible

Table 31: Scoring for sites or areas combining values for four matters from Table 28 or Table 29.

Value	Description
Very High	Area rates High for 3 or all of the four assessment matters listed in Table 28 or Table 29. 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 Moderate, Low or Very Low for remainder.

Table 32: Criteria for describing magnitude of effect.

Magnitude	Description
Very High	Total loss of, or very major alteration to, key elements/features/ of the existing baseline conditions, such that the post-development character, composition and/or attributes will be fundamentally 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 to the 'no change' situation; and/or Having negligible effect on the known population or range of the element/feature

Table 33: Criteria for describing levels of effects.

Ecological Value ▸ Magnitude ▾	Very High	High	Moderate	Low	Negligible
Very High	Very High	Very High	High	Moderate	Low
High	Very High	Very High	Moderate	Low	Very low
Moderate	High	High	Moderate	Low	Very low
Low	Moderate	Low	Low	Very low	Very low
Negligible	Low	Very low	Very low	Very low	Very low
Positive	Net Gain	Net Gain	Net Gain	Net Gain	Net Gain

MCI Quality Classes

Table 34: Interpretation of MCI biotic indices adapted from *(Stark & Maxted, 2007)*.

Quality Class	Descriptions	MCI
Excellent	Clean water	>119
Good	Doubtful quality or possible mild pollution	100 – 119
Fair	Probable moderate pollution	80 – 99
Poor	Probable severe pollution	<80

Appendix B

Species tables

Avifauna

Table 35: Birds known from the Wellington region and their likelihood on-site or within the ZOI.

Scientific name	Common name	Māori name	Regional Threat classification	Likelihood on-site
Apteryx mantelli	North Island brown kiwi	kiwi	Threatened - Regionally Critical	Highly unlikely
Falco novaeseelandiae ferox	bush falcon	kārearea	Threatened - Regionally Critical	**Confirmed -** observed
Acanthisitta chloris granti	North Island rifleman	tītitipounamu	At Risk - Declining	Highly unlikely
Cyanoramphus novaezelandiae novaezelandiae	red-crowned parakeet	kākāriki	At Risk - Recovering	Unlikely
Hemiphaga novaeseelandiae	New Zealand pigeon	kererū	At Risk - Recovering	**Confirmed -** observed
Nestor meridionalis septentrionalis	North Island kākā	kākā	At Risk - Recovering	Unlikely
Eudynamys taitensis	long-tailed cuckoo	koekoeā	At Risk – Naturally Uncommon	Unlikely
Anthornis melanura melanura	bellbird	korimako	Not Threatened	**Confirmed -** ABM
Chrysococcyx lucidus lucidus	shining cuckoo	pīpīwharauroa	Not Threatened	Possible
Circus approximans	Australasian harrier	kāhu	Not Threatened	Likely
Gerygone igata	grey warbler	riorio	Not Threatened	**Confirmed –** observed / ABM
Hirundo neoxena neoxena	welcome swallow	warou	Not Threatened	**Confirmed -** observed
Mohoua albicilla	whitehead	pōpokatea	Not Threatened	Possible
Ninox novaeseelandiae novaeseelandiae	morepork	ruru	Not Threatened	**Confirmed –** observed / ABM
Petroica macrocephala toitoi	North Island tomtit	hōmiromiro	Not Threatened	**Confirmed –** observed / ABM
Porphyrio melanotus melanotus	Australasian swamphen	pūkeko	Not Threatened	**Confirmed –** observed / eDNA / ABM
Prosthemadera novaeseelandiae novaeseelandiae	tui	tūī	Not Threatened	**Confirmed –** observed / ABM
Rhipidura fuliginosa placabilis	North Island fantail	pīwakawaka	Not Threatened	**Confirmed –** observed / ABM
Todiramphus sanctus vagans	New Zealand kingfisher	kōtare	Not Threatened	Likely
Zosterops lateralis lateralis	silvereye	tauhou	Not Threatened	**Confirmed –** observed / eDNA / ABM
Larus dominicanus dominicanus	southern black-backed gull	karoro	Not Threatened*	**Confirmed –** observed / eDNA / ABM
Alauda arvensis	Eurasian skylark		Introduced and Naturalised	Unlikely
Anas platyrhynchos	mallard		Introduced and Naturalised	**Confirmed –** observed / eDNA / ABM
Callipepla californica	California quail		Introduced and Naturalised	**Confirmed –** observed
Carduelis carduelis	goldfinch		Introduced and Naturalised	**Confirmed –** observed / eDNA
Carduelis chloris	greenfinch		Introduced and Naturalised	Likely
Carduelis flammea	common redpoll		Introduced and Naturalised	Unlikely
Columba livia	rock pigeon		Introduced and Naturalised	Possible
Emberiza citrinella	yellowhammer		Introduced and Naturalised	Unlikely
Fringilla coelebs	chaffinch		Introduced and Naturalised	**Confirmed –** observed / eDNA / ABM
Gymnorhina tibicen	Australian magpie		Introduced and Naturalised	Possible
Passer domesticus	house sparrow		Introduced and Naturalised	**Confirmed** – eDNA

Scientific name	Common name	Māori name	Regional Threat classification	Likelihood on-site
Platycercus eximiu	eastern rosella		Introduced and Naturalised	Likely
Prunella modularis	dunnock		Introduced and Naturalised	Possible
Sturnus vulgaris	starling		Introduced and Naturalised	**Confirmed –** observed / eDNA
Turdus merula	blackbird		Introduced and Naturalised	**Confirmed –** observed / eDNA / ABM
Turdus philomelos	song thrush		Introduced and Naturalised	**Confirmed** – eDNA

*** =** Species not protected under the Wildlife Act 1953 (Schedule 5).

Herpetofauna

Table 36: Herpetofauna known from the mainland Wellington region and their likelihood on-site.

Scientific name	Common name	Māori name	Regional (Mainland) Threat classification	Likelihood on-site
Oligosoma kokowai	northern spotted skink	mokomoko	Threatened - Regionally Endangered	Highly unlikely
Naultinus punctatus	barking gecko	moko kākāriki	Threatened - Regionally Vulnerable	Highly likely (**Confirmed –** off-site)
Oligosoma aeneum	copper skink	mokomoko	Threatened - Regionally Vulnerable	Possible
Oligosoma ornatum	ornate skink	mokomoko	Threatened - Regionally Vulnerable	Possible
Mokopirirakau "southern North Island"	ngahere gecko	moko piri-rakau	At Risk - Declining	Possible
Oligosoma zelandicum	glossy brown skink	mokomoko	At Risk - Declining	Possible
Oligosoma polychroma	northern grass skink	mokomoko	Not Threatened	**Confirmed** – on-site
Woodworthia maculata	raukawa gecko	moko pāpā	Not Threatened	Possible
Litoria ewingii	brown (whistling) tree frog		Introduced and Naturalised	Possible
Ranoidea raniformis	southern bell frog		Introduced and Naturalised	Unlikely

Mammalian Pests

Table 37: Mammalian pests known from the mainland Wellington region and their likelihood on-site.

Scientific name	Common name	Threat type	Likelihood on-site
Erinaceus europaeus	hedgehog	Predator	Highly likely (Confirmed via eDNA on-site within Waiwhetū Stream)
Felis catus	cat	Predator	**Confirmed** – Trail camera, eDNA on-site within Waiwhetū Stream
Mustela erminea	stoat	Predator	Likely
Mustela nivalis	weasel	Predator	Possible
Mustela putorius furo	ferret	Predator	Possible
Sus scrofa	feral pig	Omnivore	**Confirmed** – Tracks, scat, rooting observations / Trail camera / ABM / eDNA on-site within Waiwhetū Stream
Mus musculus	house mouse	Omnivore	**Confirmed** – observed within Waiwhetū Stream on-site
Rattus norvegicus	Norway rat	Omnivore	Highly likely -Chew card / eDNA on-site within Waiwhetū Stream
Rattus rattus	black ship rat	Omnivore	Highly likely - eDNA on-site within tributary 3
Trichosurus vulpecula	brushtail possum	Omnivore	**Confirmed** – Scat, browse damage and visually observed / Trail camera / ABM / eDNA on-site within Waiwhetū Stream and tributary 3
Cervus elephus	red deer	Herbivore	**Confirmed** – Tracks, scat, browse damage / Trail camera / ABM / eDNA on-site within Waiwhetū Stream and tributary 3

Vegetation

Table 38: Vegetation species confirmed on-site.

Scientific name	Common name	Māori name	Regional threat classification
Alectryon excelsus subsp. *excelsus*	New Zealand ash	tītoki	Not Threatened
Alsophila tricolor	silver fern	ponga	Not Threatened
Aristotelia serrata	wineberry	makomako	Not Threatened
Asplenium bulbiferum	hen and chicken's fern	pikopiko	Not Threatened
Astelia fragrans	bush flax	kakaha	Not Threatened
Beilschmiedia tawa	tawa	tawa	Not Threatened
Brachyglottis repanda	bushman's friend	rangiora	Not Threatened
Carex sp.	hook grass		Not Threatened
Coprosma autumnalis	large-leaved coprosma	kanono	Not Threatened
Coprosma colensoi	-	-	Not Threatened
Coprosma robusta	glossy karamū	karamū	Not Threatened
Cordyline australis	cabbage tree	tī kōuka	Not Threatened
Corynocarpus aevigatus	karaka	karaka	Not Threatened
Dianella nigra	New Zealand blueberry	turutu	Not Threatened
Elaeocarpus dentatus	hīnau	hīnau	Not Threatened
Fuchsia excorticata	tree fuchsia	kotukutuku	Not Threatened
Gahnia setifolia	razor sedge	māpere	Not Threatened
Geniostoma ligustrifolium var. *ligustrifolium*	New Zealand privet	hangehange	Not Threatened
Hedycara arborea	pigeonwood	porokaiwhiri	Not Threatened
Icarus filiformis	thread fern	pānako	Not Threatened
Knightia excelsa	New Zealand honeysuckle	rewarewa	Not Threatened
Kunzea robusta	kānuka	kānuka	Not Threatened*
Laurelia novae-zelandiae	pukatea	pukatea	Not Threatened
Leptospermum scoparium var. *scoparium*	mānuka	mānuka	Not Threatened**
Melicytus ramiflorus subsp. *ramiflorus*	whiteywood	māhoe	Not Threatened
Microsorum pustulatum subsp. *pustulatum*	Hound's tongue	kowaowao	Not Threatened
Muehlenbeckia australis	large-leaved muehlenbeckia	pōhuehue	Not Threatened
Myrsine australis	red matipo	māpou	Not Threatened
Parsonsia heterophylla	New Zealand jasmine	kaihua	Not Threatened
Phormium tenax	flax	harakeke	Not Threatened
Piper excelsum subsp. *excelsum*	pepper tree	kawakawa	Not Threatened
Pittosporum eugenioides	lemonwood	tarata	Not Threatened
Pittosporum tenuifolium	black matipo	kōhūhū	Not Threatened
Pseudopanax arboreus	fivefinger	puahou	Not Threatened
Pteridium esculentum	bracken	rarauhe	Not Threatened
Pterophylla racemosa	kamahi	kāmahi	Not Threatened
Rubus australis	bush lawyer	tātarāmoa	Not Threatened
Schefflera digitata	seven-finger	patatē	Not Threatened

Scientific name	Common name	Māori name	Regional threat classification
Sphaerropteris medullaris	black tree fern	mamaku	Not Threatened
Veronica salicifolia	hebe	koromiko	Not Threatened
Acacia dealbata	silver wattle		Introduced and Naturalised
Anthoxanthum odoratum	sweet vernal		Introduced and Naturalised
Cirsium vulgare	scotch thistle		Introduced and Naturalised
Cortaderia selloana	pampas grass		Introduced and Naturalised
Cotoneaster glaucophyllus	large-leaved cotoneaster		Introduced and Naturalised
Cyperus eragrostis	umbrella sedge		Introduced and Naturalised
Cytisus scoparius	common broom		Introduced and Naturalised
Erica arborea	tree heath		Introduced and Naturalised
Holcus lanatus	Yorkshire fog		Introduced and Naturalised
Ilex aquifolium	holly		Introduced and Naturalised
Leycesteria formosa	Himalayan honeysuckle		Introduced and Naturalised
Lonicera japonica	Japanese honeysuckle		Introduced and Naturalised
Pinus radiata	radiata pine		Introduced and Naturalised
Prunus avium	wild cherry		Introduced and Naturalised
Ranunculus repens	creeping buttercup		Introduced and Naturalised
Rubus fruticosus agg.	blackberry		Introduced and naturalised
Senecio angulatus	Cape ivy		Introduced and Naturalised
Syzygium smithii	lilly pilly		Introduced and Naturalised
Tradescantia fluminensis	wandering willie		Introduced and Naturalised
Ulex europaeus	gorse		Introduced and Naturalised

* = 'Threatened – Nationally Vulnerable', ** = Nationally 'At Risk – Declining'

Freshwater Fauna

Table 39: Freshwater fauna records from within proximity to the site and their likelihood on-site or within the ZOI.

					eDNA Waiwhetū Stream		
Scientific name	Common name	Māori name	Regional Threat classification	Likelihood on-site	downstream	on-site	eDNA (tributary 3)
Geotria australis	lamprey	piharau	Threatened - Regionally Vulnerable	Unlikely			
Galaxias argenteus	giant kokopu	kōkopu	Threatened - Regionally Vulnerable	**Confirmed**	✓	✓	
Anguilla dieffenbachii	longfin eel	tuna	At Risk - Declining	**Confirmed**	✓	✓	
Echyridella menziesii	mussel	kākahi	At Risk - Declining	Unlikely			
Galaxias brevipinnis	koaro	kōaro	At Risk - Declining	**Confirmed**	✓	✓	
Galaxias divergens	dwarf galaxias	-	At Risk - Declining	Unlikely			
Galaxias maculatus	whitebait	īnanga	At Risk - Declining	**Confirmed**	✓	✓	
Gobiomorphus hubbsi	bluegill bully	tīpokopoko	At Risk - Declining	Highly unlikely			
Gobiomorphus gobioides	giant bully	māruru	At Risk - Declining	Unlikely	✓		
Retropinna retropinna	common smelt	īnanga papa	At Risk - Declining	Highly unlikely			
Anguilla australis	shortfin eel	tuna	Not Threatened	**Confirmed**	✓	✓	✓

Galaxias fasciatus	banded kokopu	kōkopu	Not Threatened	**Confirmed**	✓	✓	
Gobiomorphus basalis	Cran's bully	titikura	Not Threatened	Possible			
Gobiomorphus cotidianus	common bully	toitoi	Not Threatened	**Confirmed**	✓	✓	
Gobiomorphus huttoni	redfin bully	tīpokopoko	Not Threatened	Possible			
Paranephrops planifrons	northern freshwater crayfish	kēkēwai	Not Threatened	**Confirmed**	✓	✓	✓
Paratya curvirostris	shrimp	kōuraura	Not Threatened	Possible			
Anguilla reinhardtii	Australian longfin eel		Regional Coloniser	**Confirmed**		✓	
Salmo trutta	brown trout		Introduced and Naturalised	Highly unlikely			

Appendix C

Offsetting Management Plan

1 Introduction

1.1 Purpose and Scope of this Plan

The Ecological Impact Assessment (EcIA) has applied the effects management hierarchy by attempting to avoid, minimise, and remedy adverse effects associated with the proposed reservoir development. The residual level of effect, caused by the permanent loss of terrestrial vegetation is High and therefore offsetting is required. The residual level of effects for all other terrestrial and freshwater ecological features were Low or Very Low (i.e. less than minor adverse effects). As the site falls within a Significant Natural Area, defined as Significant Natural Resource 12 (SNR12[10]), offsetting requirements must ensure a biodiversity net gain is achieved, pursuant to the National Policy Statement for Indigenous Biodiversity (Ministry for the Environment, 2023).

This Offsetting Management Plan (OMP) has used the Biodiversity Offset Accounting Model (BOAM; (Maseyk, et al., 2015)) as a decision support tool to assist in transparently designing the offset for the vegetation loss. This OMP presents an assessment of vegetation loss expected for the proposed Eastern Hills reservoir and the requirements to offset those impacts.

1.2 Biodiversity Offsetting

1.2.1 Overview

The purpose of biodiversity offsetting is to counter-balance residual adverse effects that development activities have on biodiversity after first avoiding, minimising (mitigating) and remedying any adverse effects (New Zealand Government, 2014). Offsetting residual adverse effects is a way to ensure that development causes no net loss and preferably net gain, as in this case, of targeted biodiversity elements, by delivering sufficient biodiversity gains elsewhere.

The National Policy Statement for Indigenous Biodiversity 2023 (NPS-IB) (1.6 (1)) defines **biodiversity offsetting** as:

a measurable conservation outcome that meets the requirements in Appendix 3 [Principles for biodiversity offsetting, see 2.1.3 below] 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.*

1.2.2 Principles of Offsetting

There is variation between the number and stated principles for biodiversity offsetting in biodiversity offsetting guidance documents[11], the National Policy Statement for Freshwater Management 2020 (NPS-FM, which relate to aquatic offsetting only) and the NPS-IB. The 11 NPS-IB principles of biodiversity offsets for adverse effects on indigenous biodiversity have been used

[10] As described in Section 1 of the Ecological Impact Assessment (Site Location, Description and Ecological Context).
[11] (New Zealand Government, 2014; Maseyk, Ussher, Kessels, Christensen, & Brown, 2018; Greater Wellington Regional Council, 2022c),

for this OMP, as this relates to terrestrial vegetation impacts only. The NPS-IB requires that the applicant has complied with principles 1 to 6 and has had regard to the remaining principles.

National Policy Statement for Indigenous Biodiversity; Appendix 3: Principles for biodiversity offsetting.

(1) ***Adherence to effects management hierarchy:*** *A biodiversity offset is a commitment to redress more than minor residual adverse effects and should be contemplated only after steps to avoid, minimise, and remedy adverse effects are demonstrated to have been sequentially exhausted.*

(2) ***When biodiversity offsetting is not appropriate:*** *Biodiversity offsets are not appropriate in situations where indigenous biodiversity values cannot be offset to achieve a net gain. Examples of an offset not being appropriate include where:*

(a) residual adverse effects cannot be offset because of the irreplaceability or vulnerability of the indigenous biodiversity affected:

(b) effects on indigenous biodiversity are uncertain, unknown, or little understood, but potential effects are significantly adverse or irreversible:

(c) there are no technically feasible options by which to secure gains within an acceptable timeframe.

(3) ***Net gain:*** *This principle reflects a standard of acceptability for demonstrating, and then achieving, a net gain in indigenous biodiversity values. Net gain is demonstrated by a like-for-like quantitative loss/gain calculation of the following, and is achieved when the indigenous biodiversity values at the offset site are equivalent to or exceed those being lost at the impact site: (a) types of indigenous biodiversity, including when indigenous species depend on introduced species for their persistence; and (b) amount; and (c) condition (structure and quality).*

(4) ***Additionality:*** *A biodiversity offset achieves gains in indigenous biodiversity above and beyond gains that would have occurred in the absence of the offset, such as gains that are additional to any minimisation and remediation undertaken in relation to the adverse effects of the activity.*

(5) ***Leakage:*** *Biodiversity offset design and implementation avoids displacing harm to other indigenous biodiversity in the same or any other location.*

(6) ***Long-term outcomes****: A biodiversity offset is managed to secure outcomes of the activity that last at least as long as the impacts, and preferably in perpetuity. Consideration must be given to long-term issues around funding, location, management and monitoring.*

(7) ***Landscape context:*** *Biodiversity offsetting is undertaken where this will result in the best ecological outcome, preferably close to the impact site or within the same ecological district. The action considers the landscape context of both the impact site and the offset site, taking into account interactions between species, habitats and ecosystems, spatial connections, and ecosystem function.*

(8) ***Time lags:*** *The delay between loss of, or effects on, indigenous biodiversity values at the impact site and the gain or maturity of indigenous biodiversity at the offset site is minimised so that the calculated gains are achieved within the consent period or, as appropriate, a longer period (but not more than 35 years).*

(9) ***Science and mātauranga Māori:*** *The design and implementation of a biodiversity offset is a documented process informed by science and mātauranga Māori.*

(10) ***Tangata whenua and stakeholder participation:*** *Opportunity for the effective and early participation of tangata whenua and stakeholders is demonstrated when planning biodiversity offsets, including their evaluation, selection, design, implementation, and monitoring.*

(11) ***Transparency:*** *The design and implementation of a biodiversity offset, and communication of its results to the public, is undertaken in a transparent and timely manner.*

An explanation of how each principle has been addressed by this OMP is provided in Section 5 (Adherence to Offsetting Principles).

1.3 The Biodiversity Offset Accounting Model

The BOAM (Maseyk, et al., 2015) was developed as part of a New Zealand Government-funded project to investigate biodiversity offsetting within the New Zealand context. Key outputs from the project included the development of the Guidance on Good Practice Biodiversity Offsetting in New Zealand (Offsetting Guidance) (New Zealand Government, 2014), supporting resources, and the BOAM. The Offsetting Guidance was a collaborative document developed by several Government organisations.

The methodology in the BOAM, driven by the Offsetting Guidance, is consistent with the World Bank Offsets Guide. The BOAM has also undergone peer review in its development and again via the publication (Maseyk, et al., 2016). The BOAM is therefore appropriate for use in calculating biodiversity offsets for this Project.

An introduction to the operation of the BOAM is set out in the following subsection, then in more specific detail for the Project in Section 2 (Application of the BOAM) below.

1.3.1 Introduction to the Operation of the BOAM

The BOAM is an accounting model that uses a currency as determined by the condition of an area[12] to calculate the value of biodiversity. The calculation is completed for each biodiversity attribute that requires an offset.

The BOAM includes two sub-models:

1. The 'impact model': calculates the biodiversity value at the impact site (ISBV) for each biodiversity attribute entered into the BOAM. The ISBV is determined by calculating the difference in the condition (compared to a benchmark) of each biodiversity attribute at the impact site pre and post impact and multiplying this change by the area of impact.
2. The 'offset model': calculates the biodiversity value at the offset site (OSBV) for each biodiversity attribute entered into the BOAM. The OSBV is determined by calculating the difference in the condition (compared to the same benchmark) of each biodiversity attribute at the offset site pre and post offset measures, applying a multiplier to adjust this value based on the confidence in the proposed offset action to achieve the anticipated gains, further adjusting the condition value to account for time lag, and then multiplying the discounted condition value by the area of the offset.

The Net Present Biodiversity Value (NPBV) is then calculated by subtracting the ISBV from the OSBV at both the biodiversity attribute and biodiversity component levels. The NPBV is used to evaluate whether a no net loss exchange is likely from the proposed offset. Negative NPBV values demonstrate a net loss, positive values demonstrate a net gain (Maseyk, et al., 2016).

2 Application of the BOAM

This section provides a step-by-step guide to the application of the BOAM.

2.1 Impact Model

The first stage in the BOAM is to apply the impact model. This determines the ISBV (i.e., the area impacted within the Project footprint) for each biodiversity attribute included in the model (see 2.1.1 below). This is determined through the following stages.

[12]Area by condition currencies measure the area of each biodiversity type and multiply this by a condition score relative to an agreed ecological benchmark.

2.1.1 Calculating Loss

The impact model requires the classification and quantification of biodiversity impacted by the Project. There is a three-tiered classification system for biodiversity:

1. **Biodiversity types:** the high-level classification of the key biodiversity features of concern. Can be either ecosystems, habitats or species;
2. **Biodiversity components**: describes what makes up the biodiversity type. Can respond differently to both impact and offset proposals;
3. **Biodiversity attributes**: elements of the biodiversity component. Attributes are the measured values balanced within the BOAM to demonstrate no net loss.

The biodiversity type considered in this report is indigenous vegetation, made up of two biodiversity components: 1) Broadleaved Indigenous Hardwoods and 2) Mānuka / Kānuka as defined in the Landcover Database Version 5.0 (LCDB) (Manaaki Whenua Landcare Research, 2020). During the site visits, all vegetation within the site was mapped and categorised into LCDB categories.

Following this, the BOAM requires the calculation of areas of each biodiversity component to be lost due to the Project. After these areas of loss have been determined, the BOAM requires an assessment of each 'biodiversity attribute'. Percentage cover of all native species within each biodiversity component has been used as the biodiversity attribute. Percentage cover was determined using the recce method (Hurst & Allen, 2007).

2.1.2 Setting a Benchmark for Each Ecosystem Type

The BOAM requires the condition of ecosystem types to be measured against a 'benchmark' (such as typical percentage cover of native species, or a reference site).

The benchmark value represents the 'best defensible' measure available for that attribute (Maseyk, et al., 2015). The benchmark provides a mechanism to weight the loss of attributes of different biodiversity values at the impact site (i.e., within the Project footprint). This weights attributes of higher biodiversity value greater than attributes of lower biodiversity value. It is important to understand that reaching the same quality as the benchmark sites is not the same as no net loss.

As the site is consistent with the wider SNR12, from a biodiversity value perspective, it was chosen as a defensible location for the baseline surveys. Therefore, the native cover values measured in the RECCE plots on-site were also used as the benchmark values for the BOAM.

2.1.3 Output from Impact Model

The impact model for this Project assumes that no biodiversity will remain within the impact site of the Project due to vegetation clearance for construction (i.e. native vegetation cover after impact will be zero). The impact model quantifies the loss in biodiversity attribute value due to the impact, as such the output from the impact model is a negative attribute BV number. The attribute BVs, calculated in the impact model, are then used within the offset model when calculating the difference between BVs at the impact and offset sites.

2.2 Offset Model

The offset model takes the biodiversity attribute of both the impact site and the potential offsetting site(s) (as in, where it is anticipated offsetting would occur) and evaluates if the proposed offsetting area is sufficient. Therefore, appropriate offset sites and associated offset actions are required to accurately complete the offset model. The following sections outline the proposed offset actions and offset sites used in the BOAM.

2.2.1 Apply the Discount Rate

A discount rate is applied to the offset model to address the time lag between the loss (from the Project) and the subsequent gains (certain loss now in exchange for an uncertain gain in the future). The notion of applying a discount rate is comparable to adding 'interest' to the calculation to account for this time lag and is based on principles in social equity (New Zealand Government, 2014). Discount rates are typically between 0 and 4%. We have used a discount rate of 3% to align with best practice.

2.2.2 Offset Actions

The amount of indigenous vegetation loss within the Project footprint has been calculated as 0.09 hectares (ha) of 'Mānuka and/or Kānuka' and 0.62 ha of 'Broadleaved Indigenous Hardwoods'.

Offsetting options include creation of new forests and/or restoring an existing area of forest, to improve native dominance and ecosystem health. The latter approach is proposed for this Project through exotic weed and mammalian pest animal control and native planting. There are areas of 'Gorse and/or Broom' and 'Exotic Forest' within proximity to the site, within SNR12 where these exotic species can be removed and replaced, or enhanced, with indigenous vegetation. Indigenous vegetation replacing exotic weed species will also enhance habitats for indigenous fauna.

An area of 'Gorse and/or Broom' along a ridgeline close to the Project site will be targeted for 'Mānuka and/or Kānuka' restoration (0.51 ha) and areas of 'Gorse and/or Broom' on the hillsides and in the gullies will be targeted for 'Broadleaved Indigenous Hardwoods' restoration (1.8 ha). Adjacent to the pipeline and near the reservoir 'Exotic Forestry' in the form of silver wattle (*Acacia dealbata*) and pine (*Pinus radiata)* will also be targeted for 'Broadleaved Indigenous Hardwoods' restoration (0.48 ha). Areas identified for exotic weed control and replacement planting is provided in Figure 84. Indigenous plants used for planting will be eco-sourced from the ecological district and consistent with the vegetation type required for offsetting, the site conditions and SNR12. Due to the high number of deer within SNR12, the palatability of plant species will need to be considered when completing the planting plan to ensure successful establishment and survivorship of the plantings.

Pest animal control (mouse, rat, and possum) will be completed within 18 ha, including all offset sites, for 10 years. This will ensure the offset planting has established sufficiently to provide equivalent functionality as the habitat that has been lost. This will allow the planted vegetation to establish and fauna to colonise the sites without pest animal pressure. Pest animal control will also improve the wider ecosystem function within that 18 ha area. Pest animal control would not be effective if only completed within the patchy areas where exotic weed control is being completed, furthermore pest animal control is required as part of the lizard management for the Project. Therefore, pest animal control will be completed across the whole area, encompassing the site remediation planting, offset sites, lizard release site and all habitat in between (Figure 85). Pest animal control will be completed using a bait station network. Pest animal control will be maintained for 10 years after the final indigenous planting has been completed (see Section 4 (Offsetting Implementation) for monitoring and contingency details.

Maintenance of the planting (e.g., exotic weed control, browse damage, mortality & replacement planting) is required annually for a minimum of five years after completion (see Section 4 (Offsetting Implementation) for monitoring and contingency details) and will be detailed in the Vegetation Management Plan.

N

Legend

- Project site boundary
- Offsetting Broadleaved Indig. Hardwoods Exotic Forest Control Areas (c. 0.47 ha)
- Offsetting Broadleaved Indig. Hardwoods Gorse Control Areas (c. 1.8 ha)
- Offsetting Manuka Kanuka Gorse Control Areas (c. 0.51 ha)

ESRI Satellite

CLIENT

Wellington Water

wsp
Christchurch Ecology
+64 3 373 2028
PO Box 1482
Christchurch 8140
New Zealand

DRAWN	APPROVED
M. Hansen	J. Lucas
SHEET NUMBER	SCALE
1 of 1	1:2,000

PROJECT

Client Name: Wellington Water
Location: Naenae, Lower Hutt
Project Title: Eastern Hills Reservoir

SHEET

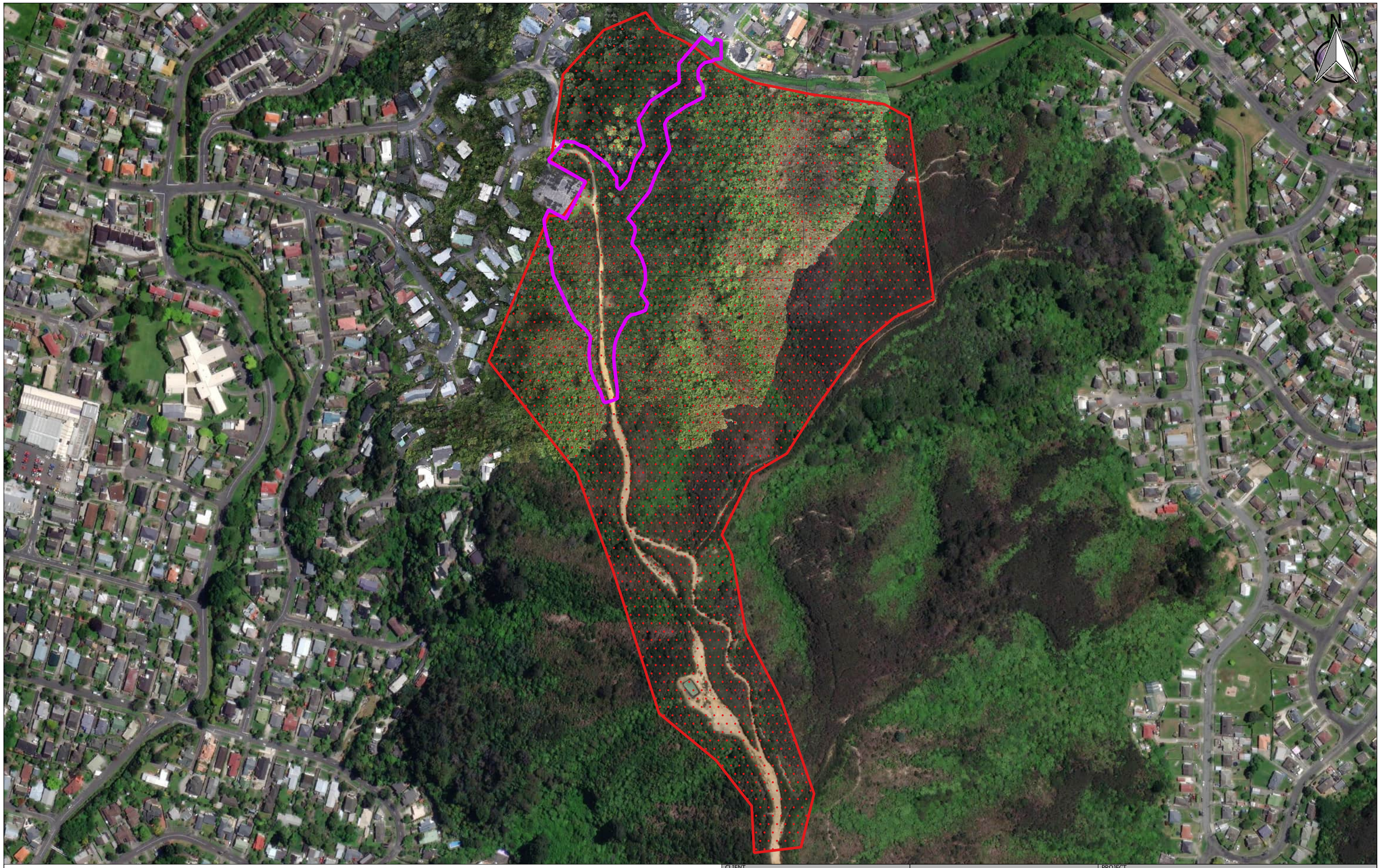
Figure 84: Areas for exotic weed control and indigenous replacement offsetting.

PROJECT NUMBER	REVISION DATE	REVISION
3-WW021.02	22/11/2023	R1

Original Sheet Size: A3 [W = 420, H = 297]

Plot Date: 2024-02-27 22:46:50 by Hansen, Mark (NZMH30142)

File Ref: U:\ProjectsNZ\3w\3-WW021.02 Naenae No.2 Reservoir\Home\500 Work in Progress\Ecology\GIS\0 Naenae EcIA.qgz



Legend

- Offsetting Pest Control Area (c. 18.2 ha)
- Project site boundary

ESRI Satellite

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Christchurch 8140
New Zealand

CLIENT		PROJECT		
Wellington Water		Client Name: Wellington Water Location: Naenae, Lower Hutt Project Title: Eastern Hills Reservoir		
DRAWN	APPROVED	SHEET		
M. Hansen	J. Lucas	Figure 85: Area for pest animal control.		
SHEET NUMBER	SCALE	PROJECT NUMBER	REVISION DATE	REVISION
1 of 1	1:3,500	3-WW021.02	22/11/2023	R1

Original Sheet Size: A3 [W = 420, H = 297]
Plot Date: 2024-02-27 22:58:21 by Hansen, Mark (NZMH30142)
File Ref: U:\ProjectsNZ\3w\3-WW021.02 Naenae No.2 Reservoir\Home\500 Work in Progress\Ecology\GIS\0 Naenae EcIA.qgz

2.2.3 *Evaluating the Proposed Offset*

The offset model compares the BV of both the impact site and the offset sites. Therefore, a cover value was determined for each attribute prior to offset (current indigenous cover value at the offset sites) and after offset (predicted value once the offsetting actions have been applied). A 'time until endpoint' is also required for the BOAM, predicting the anticipated number of years until the offset action is expected to achieve the offset goal. The time until endpoint used in this Project is five years for 'Mānuka/Kānuka' and 10 years for 'Broadleaved Indigenous Hardwoods'.

The difference between the Offset BV and the Impact BV is calculated to derive the NPBV at both the biodiversity attribute and biodiversity component levels. The NPBV evaluates if the anticipated gains from the proposed offset actions are enough to balance losses (NPBV>0)

3 BOAM Results

The component and attribute NPBVs calculated for the proposed offset are positive, demonstrating a net gain. The results of the offset calculations from the BOAM are outlined in Table 40.

Table 40: BOAM results

Biodiversity attribute	Biodiversity component	Area lost (ha)	Exotic vegetation for removal	Offset area (ha)	Impact site BV	Offset site BV	Attribute NPBV	Component NPBV
Indigenous vegetation cover	Broadleaved Indigenous Hardwoods	0.62	Wattle	0.48	-0.05	0.06	0.01	0.02
			Gorse	1.80	-0.57	0.60	0.03	
	Mānuka and/or Kānuka	0.09	Gorse	0.51	-0.09	0.13	0.04	0.04

3.1 Assumptions

The inputs and subsequent results of the BOAM are based on the following assumptions:

- The Project will result in a loss of 0.09 ha of 'Mānuka/Kānuka' and 0.62 ha of 'Broadleaved Indigenous Hardwoods' on-site.
- The average indigenous cover value at the 'Mānuka/Kānuka' offset sites will be at least 125% after five years and at least 169% after 10 years at the 'Broadleaved Indigenous Hardwoods' offset sites ('Offsetting targets').
- Offsetting actions (Section 2.2.2 (Offset Actions)) will occur within the sites indicated in Figure 84 and Figure 85.
- Palatability to ungulates will be considered when choosing plant species for the offsetting sites.

If the Offsetting targets are not reached within the relevant timeframes, contingency actions will be triggered (see Section 4 (Offsetting Implementation) below).

If offsetting cannot be completed within the sites indicated in Figure 84 the BOAM may need to be re-run.

3.2 Limitations

It is important to recognise that the BOAM has limitations, specifically in the limited manner in which it addresses uncertainty. Its role is to help understand the rationale and justification for determining offsetting that are expected to result in tangible outcomes. Certainty of the outcomes will require a targeted monitoring programme to verify offsetting outcomes, as well as

contingency management actions, should offsetting outcomes not be achieved. These should be captured in resource consent conditions.

4 Offsetting Implementation

In order to achieve require outcomes and a biodiversity net gain, the following must be implemented.

4.1 Management

Offsite exotic weed control, detailed in Figure 84, must be implemented at the same time as Project commencement. This minimises the risk of time-lags, while also minimising predator impacts to fauna that may be displaced during exotic weed control and on-site construction works.

Pest animal control must be implemented across the 18 ha, shown in Figure 85, at least one month prior to Project commencement, to align with the lizard management plan. The reduction in pest animals on-site prior to works will reduce the risk of any indigenous fauna stress which may predispose it to being preyed upon. Pest animal control must be implemented for 10 years.

Offsite exotic weed control and or pest control could be implemented prior to Project commencement and would further reduce time-lags. This would then reduce the area required for offsetting; however, this would require offsetting areas to be recalculated.

4.2 Monitoring

Monitoring and maintenance, including exotic weed control, browse damage of plantings and the replacement of dead plants, of all on-site remediation plantings and all offsetting locations is required annually for a minimum of five years after completion. Monitoring and maintenance is required to ensure plant survivorship and prompt canopy closure. Annual monitoring must be completed in autumn to allow plant sourcing and planting during the planting season (winter). Monitoring and maintenance details will be included in the Vegetation Management Plan.

Verification that restored vegetation has established adequately so that the offset has been achieved is required. RECCE plots must be completed within the offset sites to demonstrate confirm indigenous vegetation cover meets or exceeds the required levels. Within the ‘Mānuka/Kānuka’ offset site RECCE plots must be performed no more than five years after planting is complete and representative ‘Broadleaved Indigenous Hardwoods’ offset sites must be performed no more than 10 years after planting. RECCE plots can be performed prior to the five- and ten-year requirements if vegetation appears to be well established. If the RECCE plot data indicates the offsetting targets have been met, the offsets will be deemed successful. If Recce plots are performed prior to the five- and ten-year requirements and fail to confirm offsetting has been achieved, RECCE plots must be repeated.

If the monitoring outcomes determine the offsetting targets have not been met at the respective five- and ten-year timeframes, interstitial plantings of understory species are required and pest animal control may be required to continue beyond the 10 year minimum, until the average indigenous cover value reaches the relevant target. This outcome will also trigger additional contingencies to compensate for the additional time lag, such as additional offsetting, or compensation, such as funding an off-site conservation Project to benefit indigenous vegetation within Eastern Hills.

4.3 Reporting

Annual reporting must be provided to the consenting authority. Reporting must detail the remediation and offsetting planting monitoring performed and what maintenance is required, if any.

Annual reporting must include a minimum of the following:

- Date of monitoring.
- Name of ecologist who performed the monitoring.
- Locations of monitoring (remediation site, offsetting site with a unique identifier Gorse 1, Wattle 2 etc)
- Mortality encountered.
    - Plant species.
    - Number of plants affected.
    - Location(s) of mortality.
    - Cause, if known (wet feet, drought, pest animal damage etc).
- Browse damage encountered.
    - Plant species.
    - Number of plants affected.
    - Location(s) of browse impacts.
    - Pest animal species, if possible (possum, deer etc).
- Recommendations
    - The number and species to replace plants suffering mortality.
    - Suggested plant species changes if mortality is related to site conditions.
    - Additional plant protection or pest management if browse damage may impact offsetting achievements.
    - When RECCE plots may be able to be performed, if ahead of the five- and 10-year requirements.

As RECCE plots must be performed within the 'Mānuka/Kānuka' and 'Broadleaved Indigenous Hardwoods' location prior to, or no later than, five and ten years respectively. RECCE plot Reporting must be completed upon completion.

RECCE plot reporting must include a minimum of the following:

- Date of monitoring.
- Name of ecologist who performed the monitoring.
- Locations of monitoring (Offsetting site with a unique identifier Gorse 1, Wattle 2 etc)
- RECCE plot locations within the sites (GPS locations)
- RECCE plot data
- Confirmation of passing or failing offset requirements
    - 'Mānuka/Kānuka' offset sites must be at least 125% after five years
    - 'Broadleaved Indigenous Hardwoods' offset sites must be and at least 169% after 10 years.
- Recommendations
    - Monitoring and maintenance can stop if offsetting has been achieved.
    - If offsetting targets have not been met, further offsetting requirements or compensation must be clearly outlined.

5 Adherence to Offsetting Principles

Table 1: The NPS-IB Principles for biodiversity offsetting and how these have been addressed in the Project.

NPS-IB – Principles for biodiversity offsetting	Justification / Project context
1. Adherence to effects management hierarchy: A biodiversity offset is a commitment to redress more than minor residual adverse effects and should be contemplated only after steps to avoid, minimise, and remedy adverse effects are demonstrated to have been sequentially exhausted.	The effects management hierarchy has been adhered to as per Section 7 of the Ecological Impact Assessment (Ecological Assessment). Impacts on vegetation are unable to be avoided by the Project, however, during vegetation clearance, efforts will be made to avoid the extent removed where practicable. Vegetation removal will be staged to minimise impacts on the indigenous vegetation, and fauna inhabiting the vegetation on-site. Vegetation remediation will occur across the site where practicable post construction. Remediation will revegetate approximately 0.61 ha of the 1.32 ha of indigenous vegetation removed. After avoidance, minimisation, and remediation, a 'more than minor' residual level of effect remains, as such offsetting is required. This OMP has been developed to detail this and to achieve a net gain within SNR12, pursuant to the NPS-IB. A vegetation management plan will be developed to detail the implementation of avoidance, minimisation, and remediation measures.
2. When biodiversity offsetting is not appropriate: Biodiversity offsets are not appropriate in situations where indigenous biodiversity values cannot be offset to achieve a Net Gain. Examples of an offset not being appropriate include where: (a) residual adverse effects cannot be offset because of the irreplaceability or vulnerability of the indigenous biodiversity affected: (b) effects on indigenous biodiversity are uncertain, unknown, or little understood, but potential effects are significantly adverse or irreversible: (c) there are no technically feasible options by which to secure gains within an acceptable timeframe.	The presence of introduced mammalian pest animals (e.g. deer, pigs, possums rodents) throughout SNR12 threatens the success of remediation and offsetting planting. Possum and rodent control has been included within the offset actions, however, ungulate control would not be feasible, due to the size and scale of the adjacent habitat. Therefore, plant species selections will consider palatability to deer. Offsetting is expected to be appropriate, however if the use of unpalatable species is not appropriate, compensation options may be required.
3. Net gain: This principle reflects a standard of acceptability for demonstrating, and then achieving, a Net Gain in indigenous biodiversity values. Net gain is demonstrated by a like-for-like quantitative loss/gain calculation of the following, and is achieved when the indigenous biodiversity values at the offset site are equivalent to or exceed those being lost at the impact site: (a) types of indigenous biodiversity, including when indigenous species depend on introduced species for their persistence; and: (b) amount; and (c) condition (structure and quality).	Offset calculations for this Project use the BOAM (Maseyk, et al., 2015), as detailed in this offset plan. The NPBV for each biodiversity component in the model is positive (i.e. a no net loss biodiversity exchange is demonstrated), indicating a potential net gain. This plan includes detailed monitoring requirements to ensure the expected net gain outcomes are achieved.
4. Additionality: A biodiversity offset achieves gains in indigenous biodiversity above and beyond gains that would have occurred in the absence of the offset, such as gains that are additional to any minimisation and remediation undertaken in relation to the adverse effects of the activity.	Biodiversity offsets must deliver conservation gains beyond those that would be achieved by ongoing or planned activities that are not part of the offset. 1. For offsets that intend to strengthen the protection and management of existing protected areas, the question of additionality is particularly relevant. Existing protected areas with low threat levels and adequate funding are unlikely to be suitable for biodiversity offsets as it would be difficult to demonstrate much additionality. 2. However, protected areas that are underfunded, lack adequate management, or face significant threats

NPS-IB – Principles for biodiversity offsetting	Justification / Project context
	may benefit substantially from the additional support provided by offsets (Ledec & Johnson, 2016). The proposed offsets for this Project fall under the second category. The offsetting will be within SNR12, where no exotic weed management is currently being undertaken (or planned to be) in and around the site. As such, exotic weed species are present throughout. For example, approximately 20% of the site comprises of exotic vegetation. Some ungulate (deer) control has recently been implemented by the Hutt City Council, though the level of effort, outcome objectives and duration are unknown. No rodent or possum control is currently being undertaken in and around the site. To offset for permanent indigenous vegetation loss, off-site exotic vegetation within SNR12 (Figure 84) will be removed and replaced with indigenous vegetation and pest animal control will be completed across the restored areas as well as the remediated site and the proposed lizard release area, required pursuant to the lizard management plan.
5. Leakage: Biodiversity offset design and implementation avoids displacing harm to other indigenous biodiversity in the same or any other location.	In theory, the removal of exotic vegetation has the potential to adversely affect indigenous species that utilise that exotic vegetation. However, indigenous vegetation will provide higher quality habitat for indigenous fauna. Exotic vegetation is abundant in SNR12, therefore it is not considered that a net loss of exotic vegetation will cause leakage. Native lizards may utilise gorse, therefore, lizard management is required when removing gorse for offsetting to minimise risk to native lizards. Gorse must be hand felled and left on-site to allow geckos to move into adjacent vegetation Protected birds may nest within arborescent vegetation, therefore bird management is required when removing trees such as wattle and pine.
6. Long-term outcomes: A biodiversity offset is managed to secure outcomes of the activity that last at least as long as the impacts, and preferably in perpetuity. Consideration must be given to long-term issues around funding, location, management.	The Project will result in permanent vegetation and fauna habitat loss and or change in character on-site. Offsets will therefore need to be permanent. The offset sites are within SNR12 and as such have protection under the City of Lower Hutt District Plan and the NPS-IB. Furthermore, the offset sites will have pest animal control that will continue until the offset planting has established sufficiently to provide habitat for native fauna (10 years). This will allow the vegetation to establish and fauna to colonise the sites without pest animal pressure. Verification is needed that planted vegetation is functioning as an offset and, if not, that appropriate contingency actions are triggered. Contingencies such as additional offsetting is considered (see section 4 (Offsetting Implementation)) or compensation such as funding an off-site conservation project.
7. Landscape context: Biodiversity offsetting is undertaken where this will result in the best ecological outcome, preferably close to the impact site or within the same ecological district. The action considers the landscape context of both the impact site and the offset site, taking into account interactions between species, habitats and ecosystems, spatial connections, and ecosystem function.	The offset actions will be to remove 'Gorse / Broom' and 'Exotic Forest' close to the Project site and within SNR12 (Figure 84), replacing it with indigenous vegetation and completing pest animal control across the restored areas, remediated site and lizard release area comprising 18 ha (Figure 85). Indigenous vegetation replacing exotic weed species and pest animal control will enhance and expand existing habitats for indigenous fauna and improve habitat connectivity.

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8. Time lags: The delay between loss of, or effects on, indigenous biodiversity values at the impact site and the gain or maturity of indigenous biodiversity at the offset site is minimised so that the calculated gains are achieved within the consent period or, as appropriate, a longer period (but not more than 35 years).	The time lag is accounted for in the BOAM calculations. However, offsetting in advance of construction would provide better outcomes for biodiversity by providing greater certainty that anticipated biodiversity outcomes will be achieved and securing gains before losses. The reduction in time lag between losses and gains will also reduce the discount rate applied to expected gains (i.e. reduce the amount of offsetting needed to achieve no net loss). Therefore, offsetting in advance of construction will be considered.
9. Science and mātauranga Māori: The design and implementation of a biodiversity offset is a documented process informed by science and mātauranga Māori.	The offsetting will use a combination of restoration ecology and offset calculations that includes pertinent mātauranga Māori as provided by tangata whenua and/or mana whenua (see Principle 10).
10. Tangata whenua and stakeholder participation: Opportunity for the effective and early participation of tangata whenua and stakeholders is demonstrated when planning biodiversity offsets, including their evaluation, selection, design, implementation, and monitoring.	Wellington Water Ltd (on behalf of Hutt City Council) is committed to engaging with key stakeholders on the Project. The key stakeholders were identified as: Hutt City Council, Greater Wellington Regional Council, and mana whenua partners. The Department of Conservation has also been consulted regarding the lizard salvage and transfer permit required for lizard management at the site. Taranaki Whānui provided feedback during the site selection process for the reservoir (multi-criteria analysis (MCA)). Their preferred site for the Project was the site selected through the MCA process (Naenae). Taranaki Whānui have also been provided the opportunity to have input into the EcIA and this offsetting plan and will have the opportunity to review and provide input into the Vegetation Management Plan
11. Transparency: The design and implementation of a biodiversity offset, and communication of its results to the public, is undertaken in a transparent and timely manner.	Conditions will be included in the Resource Consent for the Project that will ensure the design and implementation of the biodiversity offsetting is undertaken in a transparent and timely manner. Use of the BOAM improves transparency of loss-gain calculations and evaluation of adequacy of proposed offset actions. This offsetting plan contributes to transparency as well as efforts to address Principle 10.