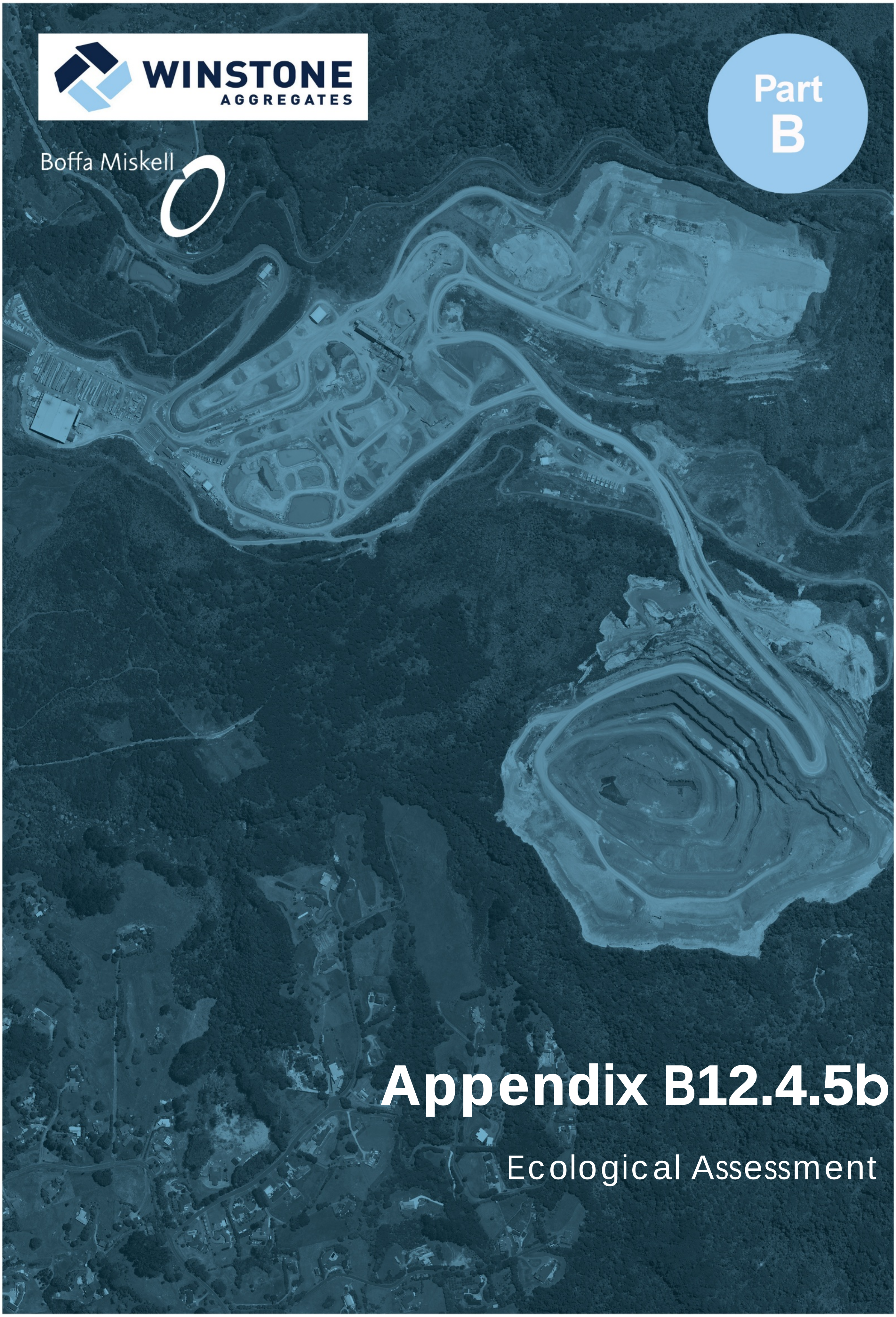

WINSTONE AGGREGATES

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Part B

Appendix B12.4.5b

Ecological Assessment

File Ref: U:\2025\BM250767_NPo_Project_Mahitahi\GIS\ BM250767_02_Ecology.aprx BM250767_FocusArea1_Offset_A3L2:34 pm

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Data Sources: Auckland Council – Environmental Strategy and Policy – Natural Heritage (2013), Lynker Analytics
Auckland Council: Healthy Waters, Geospatial, Eagle Technology, LINZ
Projection: NZGD 2000 New Zealand Transverse Mercator

LEGEND

- Offset sites
- Quarry Development Area
- The Site
- Existing vegetation areas to be protected, infilled or replaced
- Proposed Native Revegetation Areas
- Native revegetation areas
- OBDA Planting Areas
- Stream planting (10m buffer)
- Significant Ecological Areas
- Existing Scrub/Shrub
- Existing Indigenous Forest

HUNUA QUARRY DEVELOPMENT

Focus Area 1: Hunua Quarry and Adjacent Properties

Date: 27 March 2026 | Revision: 0

Plan prepared for Winstone Aggregates by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: HCo | Checked: IBo

File Ref: U:\2025\BM250767_NPo_Project_Mahitahi\GIS\ BM250767_02_Ecology.aprx BM250767_MeremereOffset_A3L1:00 pm

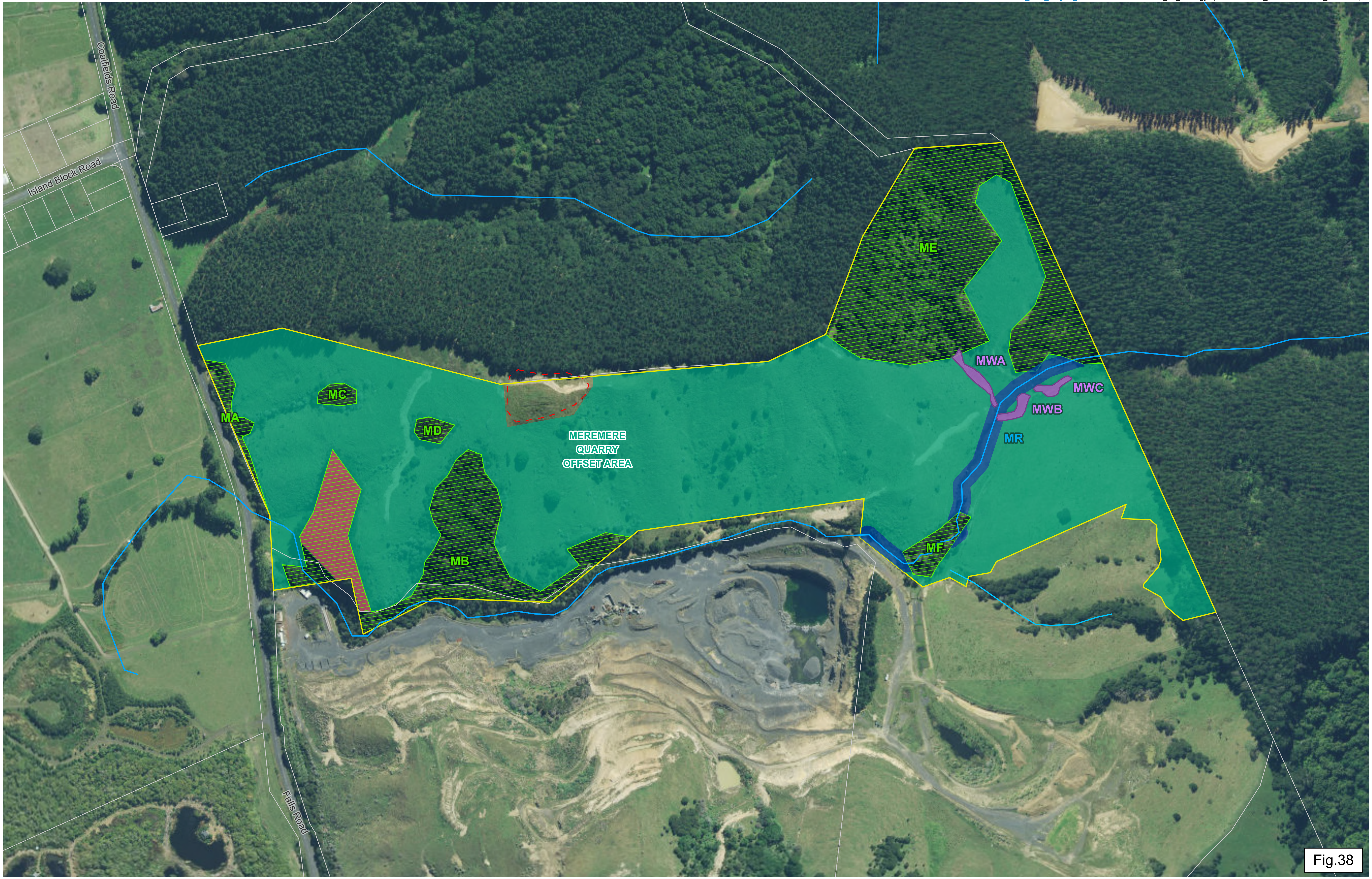

Fig.38

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Data Sources: Eagle Technology, LINZ

Projection: NZGD 2000 New Zealand Transverse Mercator

LEGEND

- Streams (LINZ)
- Meremere Offset Site Boundary
- Existing vegetation
- Approximate existing wetland areas
- Plantation forest
- Offset area
- Riparian margin
- Site of Significance to Maaori
- Parcels (LINZ)

Label key

M: Meremere
W: Wetland
R: Riparian
A-F: Existing vegetation area

HUNUA QUARRY DEVELOPMENT

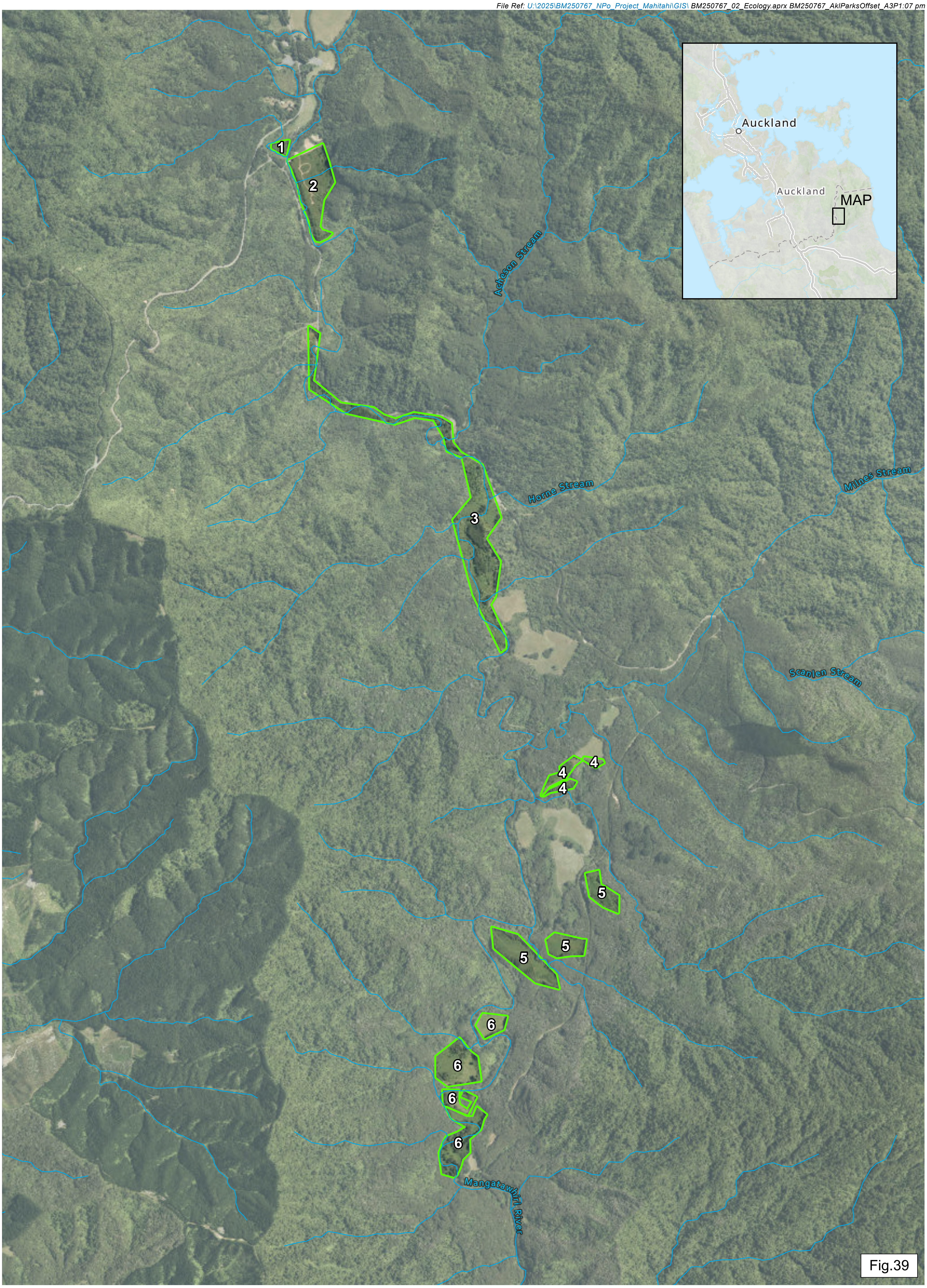
Focus Area 2: Meremere Quarry

Date: 27 March 2026 | Revision: 3

Plan prepared for Winstone Aggregates by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: HCo | Checked: IBo

File Ref: U:\2025\BM250767_NPo_Project_Mahitahi\GIS\ BM250767_02_Ecology.aprx BM250767_AklParksOffset_A3P1:07 pm



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Data Sources: Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors, Eagle Technology, LINZ, StatsNZ, NIWA, Natural Earth, © OpenStreetMap contributors., Eagle Technology, Land Information New Zealand

Projection: NZGD 2000 New Zealand Transverse Mercator

LEGEND

Streams (LINZ)

Auckland Parks Offset Areas

HUNUA QUARRY DEVELOPMENT

Focus Area 3: Hunua Regional Park Sites

Date: 27 March 2026 | Revision: 0

Plan prepared for Winstone Aggregates by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: HCo | Checked: IBo

9.6 Offsetting and Compensation Principles

The purpose of biodiversity offsetting / compensation is to counterbalance the unavoidable residual impacts (i.e., adverse ecological effects that cannot be avoided, remedied, or minimised) of development activities on biodiversity by enhancing the state of biodiversity elsewhere (Maseyk et al., 2018).

The NPS-FM and NPS-IB include principles to be used when applying offsetting and compensation mechanisms to balance the loss of extent or values of natural inland wetlands and streams, and for the loss of indigenous terrestrial biodiversity, respectively. The principles articulated in the NPS-FM and NPS-IB are the same, notwithstanding minor differences in phrasing and explanatory examples in the respective descriptions of each principle.

Table 23 **and** Table 24 set out amalgamated versions of offsetting and compensation principles that incorporates the text from both versions, with a summary assessment of the proposed offset/ compensation package for the Project with respect to each of the specified principles. Where the proposed offset does not fully satisfy offsetting principles, compensation is required, and the proposal is evaluated against compensation principles.

Table 23: Principles for biodiversity offsetting (derived from NPS-IB Appendix 3 and NPS-FM Appendix 6) [13]

Principle	Description	Terrestrial outcome	Freshwater
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.	Satisfied	Satisfied
When biodiversity offsetting is not appropriate	Biodiversity offsets are not appropriate in situations where indigenous biodiversity values cannot be offset to achieve no net loss/ net gain[14], e.g. because of irreplaceability or vulnerability; uncertainty; or because no technically feasible options exist to secure gains within acceptable timeframes.	Satisfied	Satisfied
No net loss/ net gain[1]	No net loss/ net gain is demonstrated by like-for-like quantitative loss/gain calculations and is achieved when the extent or values gained at the offset site (measured by type, amount and condition) are equivalent to or exceed those being lost at the impact site.	Loss/gain calculation does not achieve no net loss. Compensation required	Loss/ gain calculation demonstrates no net loss for freshwater values. Compensation required for loss of freshwater extent.

[13] Text in the description of principles incorporates statements and examples from both the NPS-FM and NPS-IB versions. The term “biodiversity offsetting” here encompasses aquatic ecological values and functions.

[14] NPS-IB specifies a requirement for net gain; NPS-FM specifies no net loss and preferably a net gain.

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).	Satisfied	Satisfied
Leakage	Offset design and implementation avoids displacing harm to other indigenous biodiversity in any location.	Satisfied	Satisfied
Long-term outcomes	An offset is managed to secure outcomes lasting at least as long as impacts, preferably in perpetuity, considering funding, location, management, and monitoring.	Satisfied	Satisfied
Landscape context	Offsetting occurs where it provides the best ecological outcome, preferably/ ideally close to the impact site or within the same ecological district, considering ecosystem interactions, spatial (and hydrological[15]) connections, and ecosystem function.	Satisfied (best ecological outcome achieved considering available sites)	Satisfied (best ecological outcome achieved considering available sites)
Time lags	Delay between loss and gain is minimised so gains are achieved within the consent period or within 35 years.	Satisfied	Satisfied
Science and mātauranga Māori	Design and implementation is informed by science and mātauranga Māori.	Satisfied	Satisfied
Tangata whenua and stakeholder participation	Effective early participation of tangata whenua and stakeholders is demonstrated in planning, evaluation, selection, design, implementation, and monitoring.	Satisfied	Satisfied
Transparency	Design, implementation, and communication of results is transparent and timely.	Satisfied	Satisfied
Overall Assessment		Principles satisfied; No Net Loss not fully achieved through offset; compensation required.	Principles met. No Net Loss fully achieved for freshwater values. Compensation required for extent of freshwater streams.

[15] Hydrological connections are specific to the NPS-FM

Table 24: Principles for biodiversity compensation (derived from NPS-IB Appendix 4 and NPS-FM Appendix 7) [1]

Principle	Description	Outcome
Adherence to effects management hierarchy	Biodiversity compensation is a commitment to redress more than minor residual adverse effects, contemplated only after avoidance, minimisation, remediation, and offsetting are sequentially exhausted.	Satisfied
When biodiversity compensation is not appropriate	Not appropriate where biodiversity is irreplaceable or vulnerable; effects are uncertain, unknown, or little understood but potentially significantly adverse or irreversible; or no technically feasible options exist to secure proposed net gain within acceptable timeframes.	Satisfied
Scale of biodiversity compensation	Lost values are addressed by positive effects that outweigh adverse effects, including when species depend on introduced species for their persistence.	Satisfied
Additionality	Compensation achieves gains beyond what would occur in its absence, including gains beyond minimisation, remediation, or offsetting, such as gains that are additional to any minimisation and remediation or offsetting undertaken in relation to the adverse effects of the activity.	Satisfied
Leakage	Compensation avoids displacing harm to other indigenous biodiversity in any location (including harm to existing biodiversity at the compensation site).	Satisfied
Long-term outcomes	Compensation is managed to secure outcomes lasting at least as long as the impacts, preferably in perpetuity, considering funding, location, management, and monitoring.	Satisfied
Landscape context	Compensation is placed where it results in the best ecological outcome, ideally near the impact site or within the same ecological district, considering ecological interactions, spatial and hydrological connections, and ecosystem function.	Satisfied in conjunction with offset
Time lags	Delay between loss and gain is minimised to ensure gains occur within the consent period or within 35 years.	Satisfied
Trading up	If included, gains must be greater than losses and must not involve losses to Threatened or At Risk (declining), vulnerable, or irreplaceable species.	Satisfied with no reliance on trading up
Financial contributions	Only considered where no effective on-the-ground option exists and funds directly support intended biodiversity gains consistent with all principles.	Satisfied - Financial contributions not proposed
Science and mātauranga Māori	Design and implementation is informed by science and mātauranga Māori.	Satisfied
Tangata whenua and stakeholder participation	Effective early participation is demonstrated in planning, evaluation, selection, design, implementation, and monitoring.	Satisfied
Transparency	Design, implementation, and communication of results is transparent and timely.	Satisfied
Overall Assessment		Principles met; Lost values are addressed by positive effects that outweigh adverse effects

9.7 Biodiversity Offset Accounting Model (BOAM)

A like-for-like quantitative loss/gain calculation involves measuring biodiversity at matched impact and offset sites and then balancing predicted losses with anticipated gains at an offset site. No net loss is demonstrated when the losses and gains match, and a net gain is demonstrated when biodiversity gains exceed those lost.

The Department of Conservation Biodiversity Offset Accounting Model (BOAM) is a spreadsheet calculator that enables comparison of measured or estimated values of biodiversity attributes and incorporates a contingency for time until anticipated gains are achieved, and the level of confidence that offset actions will deliver anticipated outcomes. The BOAM calculator combines attribute scores (used as an indicator of ecological value) and extent (ha) into a currency of "ecological condition x area", enabling loss of higher value features to be addressed through an increase in extent of the offset area.

The BOAM calculator has been used to estimate the required offset area to address the residual effects of terrestrial vegetation and wetland removal, but we have not relied solely on the calculations.

9.8 Terrestrial Offset and Compensation

9.8.1 Overview

The following sections detail the components of the biodiversity offset/ compensation package proposed to address the loss of 44.46 ha of significant indigenous forest and scrub and associated terrestrial fauna habitat over the life of the proposed quarry expansion.

The terrestrial ecology offset and compensation proposal includes:

- a total of 85.62 ha of revegetation within the Hunua Quarry landholding and adjacent properties, at Meremere Quarry and within the Hunua Regional Park;
- comprehensive pest management across 83.9 ha of forest and scrub within the Hunua Quarry Site and adjacent Focus Areas staged during the consent implementation (excluding Hunua Pit re-afforestation), in accordance with the Pest Management Plan provided with the application (Boffa Miskell 2026b). The pest management plan for the Site will be updated and enhanced as part of the revised pest management strategy);
- comprehensive pest management across 29.4 ha of forest and scrub within the Meremere Quarry Site and adjacent revegetation areas for the duration of the consent, in accordance with the Pest Management Plan provided with the application (Boffa Miskell 2026b).
- Extensive weed control to make way for revegetation plantings, particularly within Hunua Road and Hunua Regional Park.

9.8.2 Revegetation offset areas

Indigenous forest revegetation of will be undertaken in two tranches.

Stages 1 – 4 of the quarry development involves clearance of 17.07 ha of indigenous forest. Planting of **Tranche 1** will commence with the granting of consent, and includes all revegetation within Focus Area 1 other than the Hunua Quarry Pit, and all of Focus Areas 2 and 3, comprising a total area of 59.82 ha.

Stages 5 – 8 of quarry development will involve removal of 27.39 ha of mature and early successional indigenous vegetation[16]. **Tranche 2** (25.8 ha) of revegetation planting at the infilled Hunua Quarry Pit will commence at approximately Yr 30.

9.8.3 Offset Calculations

Five ecosystem attributes were selected to inform the BOAM for loss of forest extent, with baselines derived from measured values compiled during vegetation surveys (refer Section 5.1.2):

- Stem density (stem/ha)
- Basal area (biomass) (m^2/ha)
- Canopy cover (%)
- Canopy height (m)
- Humus/ litter depth (cm)

Attributes relating to improved ecosystem connectivity (edge effect, patch size, fragmentation) have not been accounted for in the model. However, these contextual attributes were considered in the process of site selection. All revegetation sites adjoin existing stands of mature forest, so that the planting will buffer and expand existing indigenous forest areas and improve landscape connectivity. Forest areas will provide a seed source to planted areas, facilitating natural forest succession.

The calculated area of impact and offset area required is provided in **Appendix 13**. Based on nominated attributes, the minimum offset area required for the loss of 23.57 ha of mature secondary indigenous forest and 20.89 ha of early successional forest and scrub is in the order of 96.7 ha of offset planting, representing a ratio of approximately 1:2.2.

The BOAM requires selection of "benchmark" values as a standard by which the impacted site and the anticipated performance of the proposed offset can be assessed. The benchmarks selected include species composition, forest canopy structure and habitat characteristics that broadly reflect the successional stage of the forest. Benchmarks for each forest ecosystem attribute were calculated as the 95th percentile of the data collected from the RECCE plots across two categorise (early and late successional vegetation communities).[17]

As described in Section 5.1.2, vegetation mapping and analysis grouped vegetation communities into distinct successional stages, which have been grouped into two broad categories for the purpose of offset calculation:

- Early successional forest and scrub.

[16] Note: there is no vegetation clearance during stages 5 and 6.

[17] The benchmarks for the biodiversity attributes are a target used to quantify whether the planting area can provide comparable ecosystem services to the vegetated habitats being lost (i.e., vegetation does not need to be of old/large specimens to provide suitable resources for fauna such as food and shelter).

- Mature secondary forest (including tawa-taraire forest and kauri, podocarp, broadleaf remnants).

The timeframes to reach the biodiversity outcome at the enhancement planting areas for the selected biodiversity attributes vary depending on vegetation category, with benchmarks ranging between 5 and 30 years (noting that not all mature forest ecosystem functions are expected to occur within this timeframe).

A standard "discount rate" of 3% was applied to the model to account for time delays before anticipated biodiversity outcomes are realised in the planting area. We note that this applies a conservative approach to the model, as the staged development of the Hunua Quarry (Stages 1 to 8) enables planting to be undertaken concurrently with, or in advance of, vegetation clearance.

Confidence in achieving species diversity and canopy cover in the planting area is assessed as 75 - 90%, which is relatively conservative given that successful revegetation planting is routinely undertaken. The Ecological Management Plan includes maintenance specifications, and the Pest Management Plan addresses how weeds and browsing pests will be controlled. The proximity of SEAs and/ or forest remnants close to proposed revegetation sites will promote spontaneous regeneration in planted areas and add to species richness.

Based on specified model parameters outlined above, BOAM calculates a minimum total of 96.7 ha of revegetation/restoration is required to fully offset the Project.

The full model workings are provided in **Appendix 13**. The enhancement planting area required equates to a ratio of approximately 1 : 2.2 relative to the overall impact area.

Areas identified for revegetation amount to a total of 85.62 ha, leaving a shortfall of 11.08 ha. Accordingly:

- Stages 1 – 4 of quarry development will involve removal of 17.03 ha of indigenous vegetation (mainly mature secondary broadleaf forest), requiring an offset of 40.2 ha. Tranche 1 plantings (59.82 ha) will commence with the granting of consent and fully offset Stages 1 – 4 and provides a buffer in advance for Tranche 2.
- Stages 5 – 8 of quarry development will involve removal of 27.39 ha of mature and early successional indigenous vegetation, requiring a modelled offset of 56.5 ha. Tranche 2 (25.8 ha) plantings will commence at approximately Yr 30 and partly offset Stages 5 – 8. Combined with the additional buffer planting from Tranche 1 (19.62 ha) this provides a total of 45.42 ha.
- As to the shortfall of 11.08 ha (96.7 ha minus 85.62 ha), an additional area of 16.33 ha of existing indigenous bush has been identified for protection and strategic and comprehensive pest and weed control over the Hunua Quarry property and adjoining revegetation areas is proposed by way of compensation to address the shortfall in planting area and ensure biodiversity benefits meet or exceed losses. This compensation is addressed in the next section.

9.8.4 Terrestrial Biodiversity Compensation

9.8.4.1 Retirement, enhancement and protection of existing bush

Areas of existing bush within Focus Areas owned by Winstones have been identified as having values of merit for long term protection. These areas equate to 16.33 ha of indigenous vegetation that are proposed to be retired from grazing, managed to remove weed infestations, infill planted where removal of invasive woody weeds have created canopy gaps, and protected for the future and to provide additional compensation to offset the shortfall in offset areas.

9.8.4.2 Pest Management

Pest management will update and build upon the existing programme (Hunua Quarry site), incorporate new enhancement areas (Hunua and Meremere sites) and align with the long-term staging of the Symonds pit expansion. The approach aims to gain efficiencies, improve pest management outcomes, establish defendable pest-suppressed areas and improve ecological connectivity for indigenous flora and fauna between the two large SEAs to the north and south of the Hunua Quarry landholding over the long term.

Comprehensive, long term, landscape-scale pest management will also be deployed across the Hunua Quarry and Meremere Focus Areas[18]. The landscape-scale pest management is a substantial addition to the existing pest management undertaken across the Site to meet requirements of the current operation.

The goal of the pest management approach is to achieve sustained pest suppression across all pest management areas, and pest plant removal for offset planting areas, eventually establishing one larger, connected area defended from pest incursions in and around the Site. The desired outcome of this pest management approach is to protect indigenous species recovery and enhance ecological value across the sites.

Pest management is to continue with and build upon the existing offset pest management programme (Hunua Quarry site), utilise new enhancement offset pest management areas (Hunua Quarry and Meremere Quarry sites) and align with the long-term staging of the Symonds Hill pit expansion.

The pest management programme will therefore continue to use existing protocols, guidelines and devices, supplemented and intensified with new pest management technologies/systems overtime. This approach aims to gain efficiencies, improve pest management control, protect existing and enhance new areas, establishing defendable restoration areas with actual and potential future ecological connectivity.

The Hunua Quarry site has the potential to become a large, ecologically valuable area of local and regional significance over the long term. If successful, this restored site would form a key connection / corridor between the significant ecological areas surrounding the quarry.

The Meremere Quarry site offers the opportunity to enhance a new, defendable, moderately sized site through restoration, protection and sustainability of restored indigenous ecological values.

The pest management programme for the Hunua and Meremere Quarry sites will:

- be divided into adequately sized, defendable and connected areas based on stage of management (existing management, new enhancement management and/or potential future enhancement areas);
- continue to maintain the existing pest control and monitoring activities (where applicable in Hunua Quarry site);

[18] Auckland Parks already undertake extensive pest management in the Hunua Ranges.

- update the existing pest management network (where applicable);
    - fill in any gaps in existing networks on the same distribution layout,
    - supplement and enhance with a grid of new autonomous and Ai species recognition pest management technologies/tools,
    - intensify management network on external perimeters of management areas where these connect with suitable (external) pest habitats; and
- implement new offset enhancement pest management areas including pest animal and pest plant control and monitoring.

Pest management areas shall, by the time each area enters the final ongoing management phase, be generally of the same approach and methodology and have implemented all existing, supplementary and enhancement activities (with some small variations by area). This is to ensure the programme is consistent across areas and across both sites, maximising efficiencies and outcomes.

The proposed pest management programme will be a long-term project with multiple stages and phases spread out over many years. Therefore, pest management will need employ a flexible and nimble adaptive management approach with regular revisions, embracing advancements in pest management and remaining up to date with best practice, guidelines and protocols.

Pest management areas are shown in **Figure 40** and **Figure 41**, and further detail is provided in the Pest Management Plan submitted as part of this substantive application.

Pest management actions will be implemented across Winstone Aggregates existing management areas (Hunua Quarry) and proposed new enhancement areas (Hunua and Meremere Quarries). Actions include:

- Sustained suppression of key target predator/pest animals (rats, possums, hedgehogs, mustelids, feral cats).
- Sustained suppression of key target pest animal browsers (ungulates, possums, Leporidae).
- Removal of wandering stock from enhancement planting areas.
- Removal of pest plants in planting enhancement areas.
- Sustained suppression of key target invasive pest plants in all pest management areas outside of enhancement planting areas (elimination for some species if feasible).

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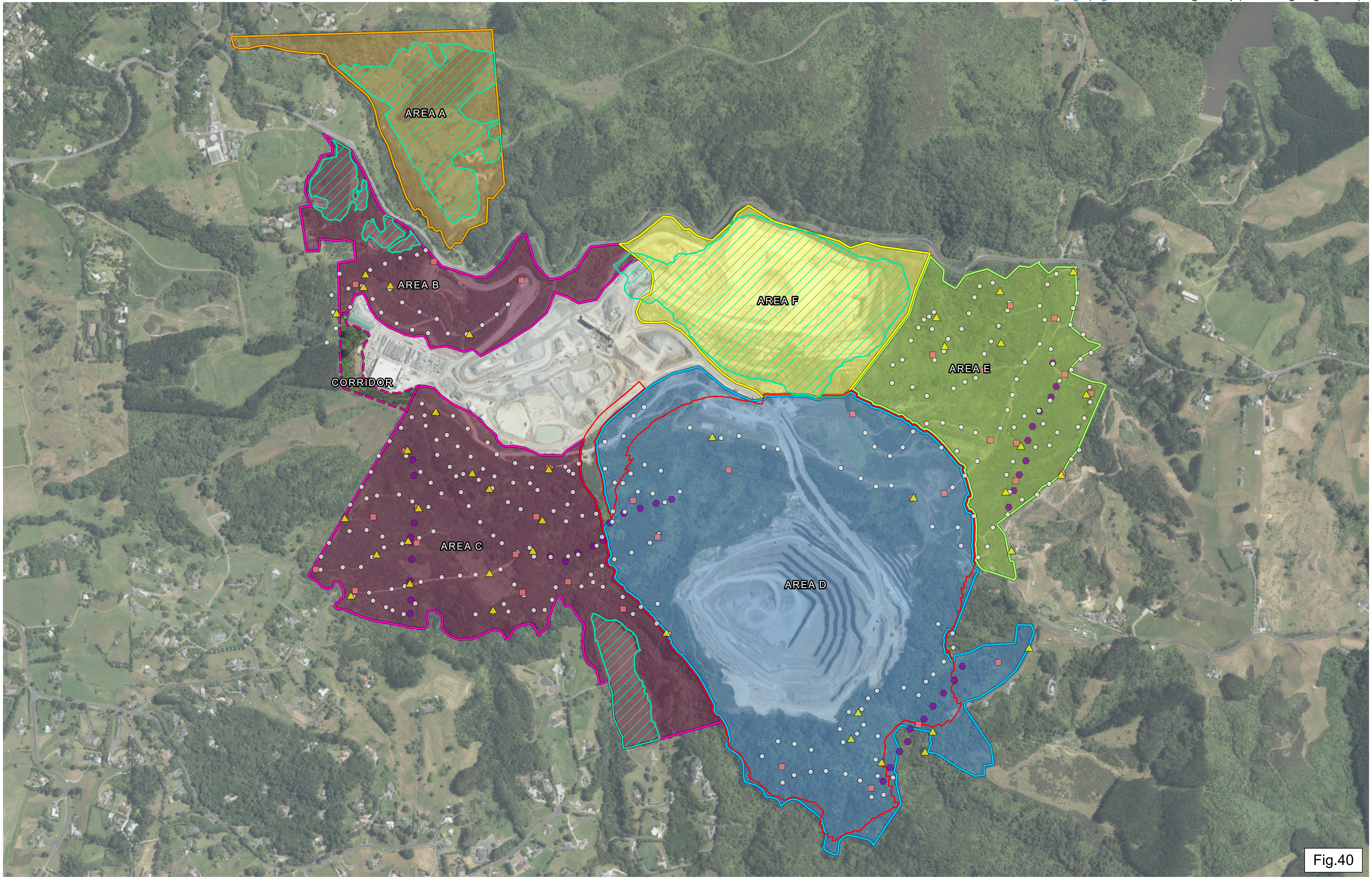

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Data Sources: Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors, Boffa Miskell Limited

Projection: NZGD 2000 New Zealand Transverse Mercator

LEGEND

- Quarry Development Area

Proposed pest management areas

- New pest management/enhancement planting area
- Existing pest management area
- Existing pest management. New enhancement planting area
- Existing pest management. Potential future enhancement area
- Potential future pest management area
- Pest management corridor
- Proposed Mitigation Planting

Existing pest management devices

- DOC 200
- Timms
- Bait stations
- Monitoring stations

HUNUA QUARRY DEVELOPMENT

Hunua Pest Management Areas

Date: 27 March 2026 | Revision: 0

Plan prepared for Winstone Aggregates by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: HCo | Checked: AWi

Fig. 41

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Data Sources: Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors, Boffa Miskell Limited

Projection: NZGD 2000 New Zealand Transverse Mercator

LEGEND

- New pest management/enhancement planting area
- Land boundary

HUNUA QUARRY DEVELOPMENT

Meremere Pest Management Areas

Date: 27 March 2026 | Revision: 0

Plan prepared for Winstone Aggregates by Boffa Miskell Limited

Project Manager: Ian.Boothroyd@boffamiskell.co.nz | Drawn: HCo | Checked: AWi

9.8.5 Summary of offset and compensation outcomes

Effects management for the residual effects to terrestrial ecological values and extent include:

Offset: enhancements to ecological values of over 85 ha of new planting and protection of over 15 ha of existing mature vegetation (including after clearance of clusters of pine trees and privet at Hunua Road properties, and pine trees at Judge Richardson Drive).

Compensation: integrated and comprehensive landscape-scale pest management for both replanted and existing bush areas will provide pest management to over 100ha of land, in addition to the areas of land where pest management is currently provided.

Based on anticipated ecological benefits of the proposed revegetation, BOAM calculations (Appendix 13) indicate that the proposed revegetation will not wholly offset the loss of ecological values due to the quarry development. However, further compensatory measures including protection and enhancement of existing indigenous forest and scrub, and 65.62 ha of long term weed and pest control (integrating and updating existing pest control operations within the Site) will achieve overall positive ecological benefit as a result of the project.

9.9 Wetland Offsets

9.9.1 Overview

The proposed Quarry expansion will result in the loss of a total area of 0.44 ha of natural inland wetland, of which 0.21 ha comprises several small patches of ecologically significant forest seepage, and 0.23 ha is degraded exotic grass-dominated swamp (refer **Figure 27**).

Five ecosystem attributes were selected to inform the BOAM for loss of wetland ecological values and extent:

- Indigenous wetland plant dominance (%)
- Hydrological connection (Rank score 0-5)
- Connectivity / buffering (%)
- Hydraulic function (Rank score 0-5)
- Habitat value (Rank score 0-5)

9.9.2 Offset calculations

The anticipated timeframe to reach the ecological enhancement outcomes for the selected wetland attributes is five years, reflecting the resilience of wetland ecosystem habitats and functions.

A standard discount rate of 3% was applied to the model to account for time delays before these biodiversity outcomes are realised in the planting area. As noted above, the discount rate applies a conservative approach to the model.

We have adopted a high degree of confidence (90%) that the wetland enhancement outcomes will be achieved, as wetland restoration is routinely and successfully undertaken.

We estimate that a minimum total of 2.4 ha of wetland revegetation/restoration is required to offset and compensate for the removal of 0.44 ha of wetlands. The BOAM outcomes are provided in **Appendix 14**. The wetland enhancement planting area required equates to a ratio of approximately 5x the impact area of the overall vegetation.

9.9.3 Wetland offset and compensation areas and approach

A total of at least 2.51 ha of wetland extent will be reinstated and planted, comprising: numerous small features in Focus Areas 1 and 2, and 2 ha of alluvial terrace wetlands in Focus Area 3 (Hunua Regional Park):

- 0.21 ha at the Hunua Road sites and 0.15 ha at the Judge Richardson Drive site, where 7 farm ponds will be decommissioned to reinstate native wetlands;
- 0.15 ha of degraded swamp at Meremere Quarry will be retired from grazing and revegetated to restore native wetland; and
- 2 ha of blackberry infested, flood-prone alluvial terraces in Hunua Regional Parkland will be cleared of weeds and revegetated to restore native wetland.

Wetland features identified for restoration are within a matrix of newly revegetated and existing forest and scrub, and thus over time the feature will develop “wet forest” characteristics akin to the features to be removed.

The tasks and actions required to establish the proposed planting areas are set out in the Ecological Management Plan. These actions include planting, fencing, removal of stock, and pest plant and pest animal management. Note, pest animal control also considers deer and goats which are known to be present within the Site and surrounding land.

Revegetation will include supplementary planting of canopy species as required (after removal of woody weeds and initial planting of pioneer species) to infill canopy gaps and facilitate the development of a secondary forest structure.

Based on anticipated ecological benefits of the proposed reinstated and restored wetland areas, BOAM calculations (**Appendix 14**) indicate that the proposed wetland enhancement will achieve no net loss of wetland extent or values as a result of the project.

9.10 Freshwater Ecology Offset and Compensation

9.10.1 Overview

We have taken an overall integrated approach whereby several improvements to waterways at specific locations provide for the overall offset of loss and change to waterways because of the Project. These include re-connecting waterways, provision for improved fish passage and planting the riparian margins of waterways.

We have used the ECR based on SEV calculations as a means of informing the overall offset but have not relied on it as the only and total component of the proposed effects management for residual aquatic effects.

In the case of the Project, the constrained location of the aggregate means that alternative options for quarry expansion are unavailable and thus the loss of freshwater ecological values resulting from the pit development (including associated extraction, culverts, stream realignment and access roads) on the loss of freshwater ecological values are unavoidable.

Our proposed freshwater offset comprises a mix of:

- Planting riparian vegetation along stream margins.
- Re-establishing connectivity and linkages to and between reaches of existing watercourses.
- Removal of willow, blackberry and other woody weeds from reaches of streams and rehabilitation with native riparian vegetation.

We have used the area calculations within the site of biodiversity loss (i.e., stream area loss as the residual effects of the proposed pit development) to inform the proposed offset/compensation but have not relied on the quantifications alone as the method as benefits for aquatic ecosystems can be derived from the management of other attributes that are not incorporated into the ECR/SEV methodology (e.g., improvements to fish passage, benefits for threatened species, enhancements to spawning sites).

Note the offset and compensation approach relevant to the realignment of Mangapū Tributary is not addressed in this section but is contained in section 11 below.

9.10.2 Freshwater offset and compensation locations

9.10.2.1 Locations

The freshwater offset locations occur in the same Focus Areas as set out above:

- Waipokapū Stream tributary (**Figure 37**).
- Meremere Quarry Stream (**Figure 38**).
- Mangatawhiri River (**Figure 39**).

9.10.2.2 Waipokapū Stream Tributary

The upper reaches of Waipokapū Stream have high ecological values with good aquatic habitat due to its naturally meandering channel, coarse boulder/cobble/gravel streambed, and diverse run-riffle-pool habitat sequences. Riparian vegetation along the upper catchment comprised mixed native/exotic vegetation and rank grass and weedy groundcover that provided moderate shade.

The proposed offset location occurs on a tributary of Waipokapū Stream and forms part of a complex of waterways (including Mangapū Stream) that form Slippery Creek that drains westwards and which enter the Manukau Harbour at Drury.

The location of the proposed freshwater offset is at 482 and 484 Hunua Road. The location has some 600 m of stream length available for improvement to aquatic ecological values, and the removal of fish barriers to improve the connectivity of headwater tributaries with the mainstem.

The proposed offset location comprises two tributary streams that have been modified with online farm ponds and farm track crossings.

An SEV assessment was undertaken on the larger tributary of the proposed mitigation site, directly upstream of a farm pond). The stream was shallow, narrow and soft-bottomed (**Table**

25). Riparian vegetation was predominately low intensity grazed pasture with long dense grass in most areas noted during the site visit, providing good groundcover. A stand of mature pine trees on the hill north of the SEV site, combined with the incised channel, provide high shade. Water quality was moderate, with high water temperature and good dissolved oxygen levels and low water clarity at the time of our site visit (**Table 25**).

Table 25: Habitat and water quality parameters, Waipokapū Stream tributary

Instream Habitat	
Average wetted width (m)	0.315
Average Depth (m)	0.05
Max depth (m)	0.16
Average Velocity (m/s)	<0.01
Substrate	silt/sand 100%
Fish habitat	shallow pools
Riparian	
Proportion shade at water surface*	High (71-90%)
Riparian vegetation type	Low intensity grazed pasture
Proportion of tree cover in riparian zone	20% (some mature pines and weedy shrubs)
Water Quality**	
Temperature (°C)	19.2
Dissolved Oxygen (%)	92.5
Dissolved Oxygen (µg/l)	8.54
Specific conductivity (µs/cm)	229
pH	7.29
Clarity (m)	0.3

* Value taken from Vshade in SEV calculation spreadsheet
** Measured on a YSI Pro DSS water quality meter

Macroinvertebrate communities at the Waipokapū Stream tributary had metric values ranging from excellent to poor (**Table 26**). Over 60% of the sample comprised mud snails and seed shrimps, both of which are commonly found in low flowing systems and tolerable of poor water quality.

Compared to regional reference site data, Richness and MCI values were slightly below the average for soft-bottomed exotic or native forest sites (mean Richness 28 to 33, MCI 126 to 127) and similar to the rural site values (mean Richness 26, mean MCI 100).

The most probable cause based on our observations are periodic high flows and associated channel erosion and sediment deposition.

Table 26: Macroinvertebrate metrics, Waipokapū Stream tributary.

Metric	**Value**	**Interpretation**
Taxonomic Richness	25	Excellent
EPT Richness	4	Moderate
%EPT abundance	1.8%	Poor
MCI	103	Good
QMCI	3.3	Poor

The stream channel has been historically highly modified through channelisation and realignment to improve drainage of the surrounding catchment, this modification has resulted in poor connectivity to the floodplain leading to a low Hydraulic function score of 0.48 (**Table 27**). The Biogeochemical function scores was reduced due to minimal riparian vegetation and predominant silt/ sand substrate (score of 0.41). Habitat provision score was 0.31, with unsuitable galaxiid spawning due to the deepened and incised channel. Biodiversity function scores were poor for fish, with no fish being observed within our stream reach, however, shortfin eels were noted in the pond below. The invertebrate communities were classified as good bring the overall biodiversity score to 0.33.

The overall SEV score was 0.40, toward the upper end of the "Poor" range. The mean SEV value for native forest reference sites reported by Storey et al (2011) was 0.92 for native forest sites, 0.80 for exotic forest sites and 0.61 for rural sites. These results indicate functions are sub-optimal for a rural stream.

Table 27: SEV Function Scores for Waipokapū Stream tributary.

Function Category	Mean Score
Hydrological	0.48
Biogeochemical	0.41
Habitat Provision	0.31
Biodiversity	0.33
Overall SEV score	**0.40**

9.10.2.3 Meremere Quarry Stream

No formal aquatic assessments or measurements have been undertaken of the Meremere Quarry Stream. Samples for eDNA detections were undertaken from sites located on the upper and lower reaches of the watercourse within the quarry site. The two eDNA sample locations were selected to be above and below a significant existing perched culvert that completely prevents fish passage upstream.

Shortfin eels were the only fish detected from the eDNA samples, with very strong DNA signatures below the perched culvert and only a very weak detection upstream of the culvert. A single macroinvertebrate of conservation interest was detected from upstream eDNA samples from the Meremere Quarry Stream: *Zephlebia pirongia* (Naturally uncommon).

The downstream environment of the Meremere Quarry Stream is the Whangamarino Wetland, a RAMSAR[19] wetland site in the Lower Waikato River catchment. The Whangamarino Wetland is a 7,000 ha mosaic of swamps, fens and peat bogs and is habitat for several fish species.

Removal of the significant fish barrier at the Meremere Quarry stream creates access for fish to and from a headwater catchment of this RAMSAR listed wetland and will improve the overall ecological resilience and populations of aquatic fauna and enhancing opportunity for dispersal. Improvements to fish passage at this location provides access to over 1,900 m of length of watercourse.

[19] RAMSAR = A Ramsar wetland is a site of international importance designated under the 1971 Ramsar Convention, an environmental treaty dedicated to the conservation and "wise use" of wetlands. These sites are recognized for their ecological, hydrological, and biodiversity value, protecting crucial habitats for birds, fish, and other wildlife.

9.10.3 ECR calculations

We have applied the Ecological Compensation Ratio (ECR) method based on SEV calculation but have not relied upon it to fully inform the aquatic offset or compensation required for managing residual effects. The ECR utilises the SEV score to calculate a ratio of mitigation required to stream lost. SEV surveys have been carried out at the Mangapū Stream Tributary, and the streams to be crossed for the haul road, and at the proposed aquatic offset site at 484 Hunua Road.

The loss of watercourse and associated ECR calculations are outlined below in Table 28. Further information and data for ECR calculations is available in **Appendix 15**.

The stream reaches available for offset are set out below. Enhancements to aquatic values will be in the form of accepted practice native riparian planting with a 10 m buffer on either side (20 m in total), for small ("stride-able") streams, and 20 m buffers for wider streams, as well as the removal of stock access to the enhanced watercourses.

Table 28: Stream Ecological Compensation Ratios (ECRs) calculations for impacted watercourses at Hunua Quarry Development

Impact Site	Mangapu Stream tributary	Tribs 3 and 4
ECR	4.13	3.6
Length Impacted Stream (after remedy)	630 m	527 m
Width Impacted Stream (mean)	1.1 m	0.59 m
Area of compensation required	2,860 m^2	1,120 m^2
Length offset stream available	1,610 m	
Area of stream available	1,610 m^2	
Width of stream available (mean)	1.0 m	
Comments	The restoration of Hunua and Meremere focus area streams will account for 40% of the estimated offset for impacts on Mangapū Stream.	

9.10.4 Freshwater Offset and Compensation Actions

The proposed offset approach for the unavoidable loss of stream extent resulting from the Project is an integrated suite of measures at several locations (Focus areas as listed above), including within the Slippery Creek catchment, that will lead to restoration of stream length, riparian planting resulting in enhanced stream habitat and aquatic ecological values, reduction in bank erosion, improved fish passage and connectivity, and the cessation of stock grazing and their access to waterways.

As components of the freshwater offset and compensation package are planned for the same location as components of the vegetation offset, the overall result is, the complete re-vegetation and restoration of a headwater tributary catchments. Increased native planting in headwater catchments will improve the quality of water from the start as it as it descends its catchment.

9.10.5 Restoration of aquatic ecological values

9.10.5.1 Waipokapū Stream

Three farm ponds at 482 and 484 Hunua Road will be removed following fish salvage, and the stream channel re-connected and re-formed at the Waipokapū Stream headwaters. The reformation of the stream may result in changes to putative wetlands that have formed in association with the farm ponds (and therefore excluded as natural inland wetlands under the NPS-FM). This amounts to some 150 m of stream length but combined with improvements to fish passage connections with the Waipokapū Stream mainstem, it opens over 600 m of stream extent to fish that is currently denied.

Several fish barriers occur at 482/484 Hunua Road which includes perched / incorrectly placed culverts and farm ponds. Removal of these potential fish barriers should increase the access to, and the available habitat of fish species currently recorded from Waipokapū Stream. Fish records for Waipokapū Stream are detailed above and include longfin and shortfin eels, common and redfin bullies, and banded kokopu.

The watercourse channels are also highly modified (deepened and straightened) to aid in drainage. This has resulted in minimal connection to flood plains and reduced hydrological heterogeneity. Through stock exclusion and riparian planting, it is expected that the channel will return to a more natural flow regime.

9.10.5.2 Meremere Quarry Stream

It is proposed to enhance the riparian margins of the watercourse at the Meremere Quarry site. This amounts to some 400 m of watercourse length, although the watercourse is wider here with some wetland character at the margins.

A significant perched culvert exists at the upper face of the quarry that prevents all fish from migrating to the upper catchment. The eDNA sampled revealed an extremely low signature of eels above the perched culvert compared to the very strong detection signature below the culvert; testimony to the significant barrier the culvert presents. Improving the ability for fish to migrate upstream opens up over 1.9 km of extent of watercourse availability for the benefit of dispersal, food and refuge for the resilience of the eel populations.

9.10.5.3 Mangatawhiri River

Winstone Aggregates already have agreed a stream improvement project with Auckland Parks that identifies some 2,580 m of watercourse enhancement. The stream improvement is to remove weed infestations (crack willow, blackberry and woody weeds) from the Mangatawhiri River. These works will include the spraying of herbicide, progressive and / or partial removal of willow trees, blackberry and other woody weeds, and revegetation of riparian margins with native vegetation.

The location of the proposed riparian weed removal and enhancement is shown as Area 3 in **Figure 39.** The proposed riparian restoration work over some 2,580 m of Mangatawhiri River is expected to occur over a 5 year period.

9.10.5.4 Additional beneficial outcomes

Although not accounted for in the freshwater offset set out above it is worth noting that, as included in the forest vegetation offset detailed above, it is proposed to undertake a complete re-vegetation of the property at 484 Hunua Road and at the Meremere Quarry Stream catchment.

Although the terrestrial planting is not included as part of the freshwater offset, the benefits of the retirement of the entirety of these tributary catchments to improved water quality of Waipokapū Stream and Whangamarino Wetland will result in:

- Reduced nutrient loads to downstream watercourses and wetlands.
- Reduced sedimentation of downstream watercourses and wetlands.
- Reduced instream temperatures of headwater streams to downstream watercourses and wetlands.

There is significant bank erosion and pugging throughout the Waipokapū Stream and Meremere Quarry stream tributary channels as there are currently no stock exclusion measures in place. It is proposed to provide fencing to exclude stock from these replanted catchments and this will reduce nutrient inputs, prevent bank erosion and sediment loss, and reduce loss of riparian vegetation.

9.10.5.5 Weed and Pest Control

All areas of planting will be subject to the Pest Management Plan up to establishment of foliage cover targets that will be set out in the Ecological Management Plan. This pest management approach will increase the success and quality of ecological outcomes and is a beneficial effect of the integrated package of actions.

9.10.6 Summary of Freshwater offset and compensation outcomes

Effects management for the residual effects to freshwater ecological values and extent include:

Offset: enhancements to ecological values of over 4,000 m of watercourse (including after clearance of willow, blackberry and other woody weeds on the Mangatawhiri River).

Compensation: enabling access of migratory native fish to over 2,500 m of stream length currently denied (extent of watercourse), retirement and re-vegetation of two headwater catchments (of the Waipokapū Stream and Waikato River respectively) thus improving water quality, re-connecting watercourses for upper and lower catchments (connectivity) through improvements to fish passage.

We consider that collectively these outcomes provide for a no net loss of aquatic ecological values and an overall net gain for aquatic values and access to an increased extent of watercourse.

10.0 Mangapū Tributary Realignment

10.1 Overview

Realignment of Mangapū Tributary is required to allow for the pit development and access to the aggregate. The realignment is proposed for Stage 2, occurring early in the quarry development. The realignment does not constitute a reclamation (as defined above) but is a re-location of the watercourse; essentially the watercourse is moved with the aim of it remaining as much as is practicable with the same ecological values and functionality.

The existing catchment areas (prior to realignment) are:

- Mangapū Tributary upstream of the confluence: 1.67 km^2.
- Mangapū Stream at proposed tie in location: 1.84 km^2.
- Confluence of Mangapū Stream and Mangapū Tributary: 4 km^2.

The modified catchment statistics following the Stage 2 works are:

- Mangapū Tributary at the realignment point: 1.55 km^2 (7.2% reduction).
- Confluence of Mangapū Stream and Mangapū Tributary after the realignment: 3.88 km2 (3% reduction).

The existing Mangapū Tributary channel is 1,200 m in length and the realigned channel length will be 571 m (including meanders). A modelled extent of the realignment channel is shown in **Figure 37**.

The proposed realignment of the Tributary will result in an approximate 0.12 km^2 reduction in catchment area in the lower portion of the Mangapū Tributary catchment. This will cause a small reduction in flows to the realigned watercourse and Mangapū Stream itself. The proposed realignment will also modify the confluence location of where Mangapū Tributary flows into the mainstem of Mangapū Stream.

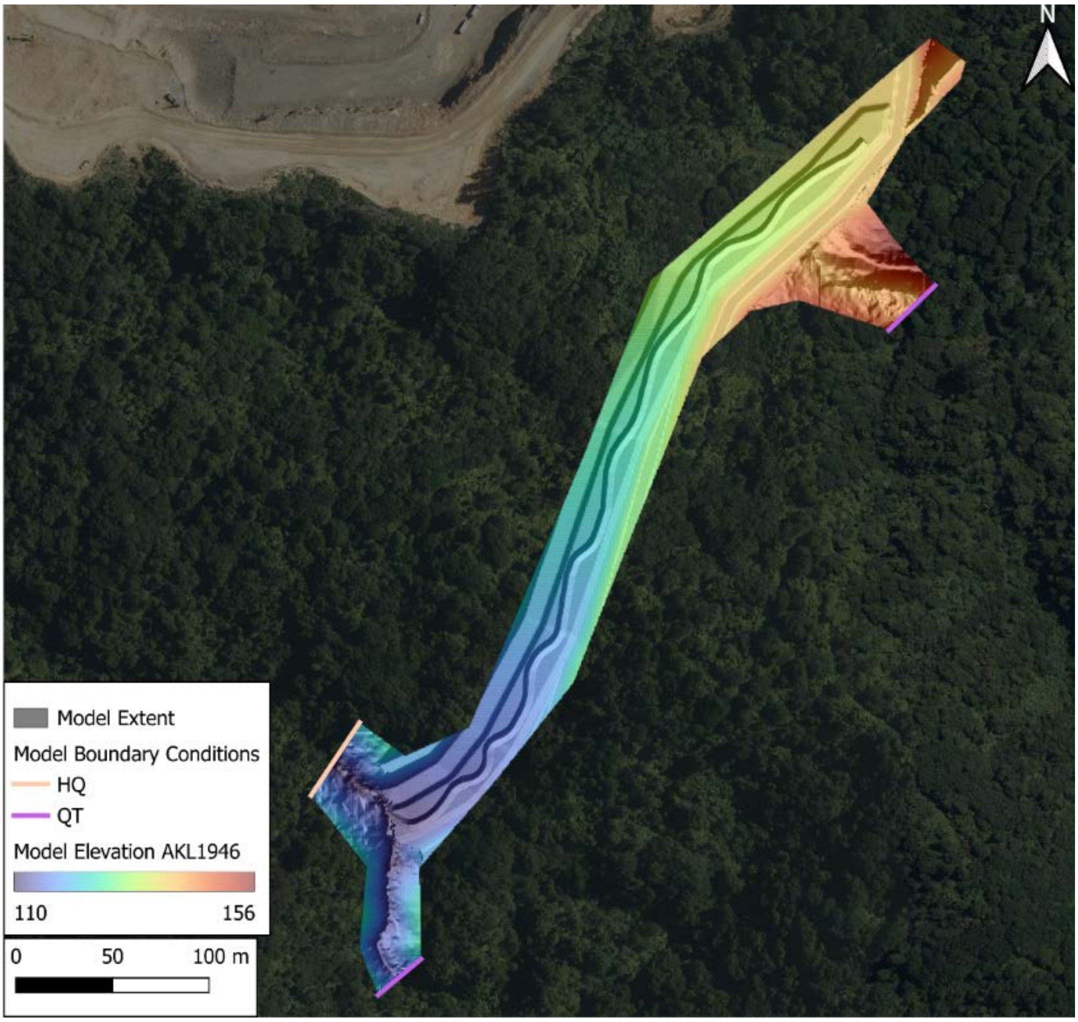


Figure 42: Model (Tuflow) of the extent of the realigned channel design, Hunua Quarry Development (from PDP 2026a).

10.2 Staging of Stream Realignment

Initially, it is proposed to install a bridge across the existing Mangapū Tributary stream bed to provide access to the works area to enable the construction of the channel. The bridge will be a temporary feature until the realignment is fully formed and the channel is fully livened.

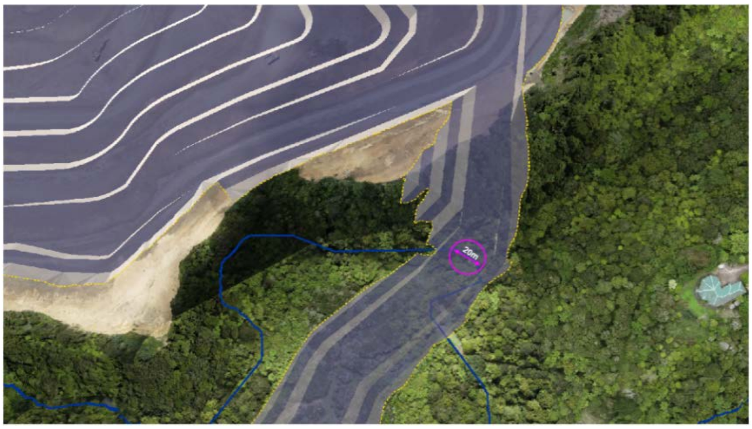
This will involve undertaking fauna salvage from an area of approximately 5.5 ha of vegetation (including low kanuka shrubland, tall kanuka forest, and mature podocarp-broadleaved forest) which will be removed during the first season of works to enable machinery to access the tributary and works area. The bridge will be constructed during April or May when water flows are low and once vegetation clearance and gecko salvage have concluded.

The proposed bridge spans 6.5 m, with the stream bead approximately 4 m wide and the bridge abutments will be 10 m apart and positioned 3 m horizontally away from the stream bed (**Figure 38**). The bridge will be designed to be 2 m vertically above the stream bed.

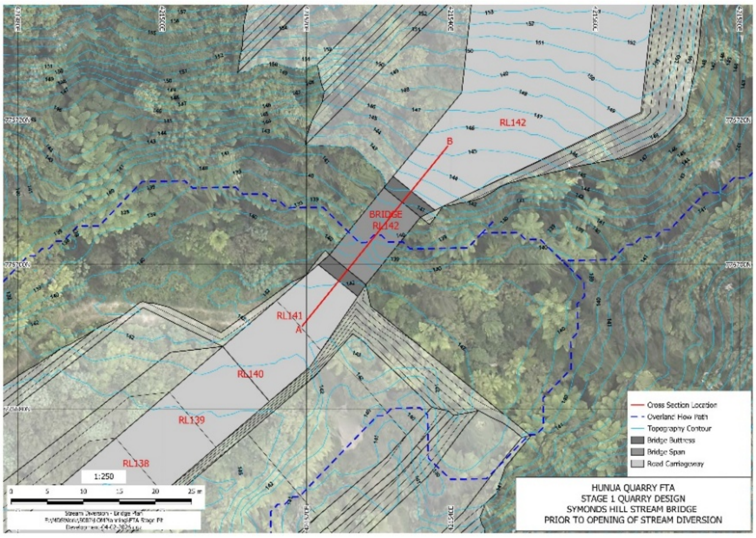
The access allows for a 20 m buffer to allow for the exact location of bridge abutments pending ground investigations and detailed design. It also allows for preparatory earthworks and installation of temporary ESCs during construction.

The bridge construction will not involve any instream works, and the abutments will be at least 3 m away from the stream. As noted above, ESC will be applied and no effects on the freshwater ecological values are expected from the construction (or removal) of the bridge.

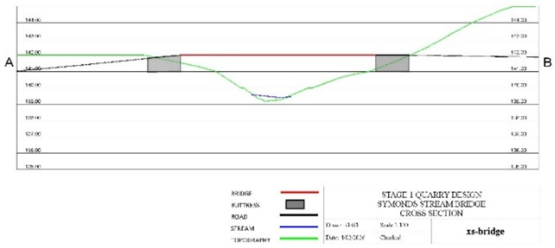
Once vegetation clearance has commenced, baseline and detailed topographical surveys can be undertaken to inform the design of the required earthworks. The 10 m wide access road on the western side of the future realigned tributary will be constructed, and sediment control infrastructure will be installed during the earthworks season (October-April). Runoff containing sediment will initially discharge to existing 150RL ponds. Once, the clearance of vegetation has been completed, a new sediment pond will be constructed at the same location as the 150RL ponds and have the same discharge location.



a) Approximate location of proposed bridge, Mangapū Tributary.



b) Approximate location and dimensions of proposed bridge, Mangapū Tributary.



c) Cross-section of proposed bridge, Mangapū Tributary.

Figure 43: Approximate location of proposed bridge crossing at the Mangapū Tributary, prior to the proposed stream realignment.

At no time will an instream structure be built or operated within the Mangapū Tributary or the realigned channel.

10.3 Construction of stream realignment

The new stream channel will be constructed by breaking up the rock to create a channel that is deeper than the proposed finished level and built back up with an impermeable liner and rocks to prevent the water flows seeping into the rock.

The channel will have two main components: a large cut of bank flood channel incorporating a smaller, meandering low flow channel. Whilst the realigned stream channel will be formed in rock, there will be soft materials used to create the channel, such as the channel liner and the bedding material for the stream banks and cut face planting, and manage erosion caused by the flowing water.

10.4 Realigned channel design

The design of the Mangapū Tributary realignment has taken a high level conceptual approach to achieve the following outcomes:

- Develop the design to accommodate Stage 8 of the Quarry expansion (i.e., including loss of minor headwater channels of the tributary).
- Realignment design to reflect the final (i.e., including Stage 8 flow/quantity of the Mangapū Stream (and not replicate the Mangapū Tributary flow/quantity).
- Avoid long-term augmentation or other alternative provision of water to sustain flow in the realigned tributary.
- Design focus is to create equivalent stream habitat characteristics to provide for equivalent aquatic and riparian ecological values.
- Design variation in habitat types from upper to lower portions of realignment reflecting transitions as they occur moving downstream along the existing Mangapū Tributary.

- Design a waterfall at the lowest end of the realignment to provide for climbing fish but prevent non-climbing fish entering the realigned channel (reflects existing Mangapū Tributary).
- Provide compensation, as required, for any calculated loss of ecological values.

We have incorporated these concepts into a series of principles of design as set out below.

10.4.1 Principles of design

The design objective of the stream realignment is to ensure that stream ecological functions are maintained or improved upon, including providing appropriate aquatic habitat for macroinvertebrates and plants, while conveying water.

The following high-level principles of design will be applied to the realignment of the Mangapū Tributary:

- As much as practicable, the realignment should be designed with an average width of no less than 0.6 m, with a maximum width of up to 6 m.
- As much as possible, the stream realignment channel must be a similar extent and stream area as the existing Mangapū Tributary. This aims to ensure that loss of extent and values of the watercourse is minimised.
- The channel design does not have to replicate the form of the channel of the Mangapū Tributary but would benefit from a low-flow (or baseflow) channel, a bank full channel and where small streamside gravel bars.
- As much as possible, water flow should allow for the hydrology of the existing Mangapū Tributary (i.e., flows intermittently or permanently like the existing channel).
- The channel should accommodate, as much as practicable, natural meanders (or otherwise) like the stream to be reclaimed.
- The instream habitat should reflect a level of complexity and hydrologic heterogeneity through the creation of natural features such as cascades, runs, riffles, gravel bars, and small and large pools.
- The final substrate should reflect that naturally occurring in the Mangapū Tributary, including any changes that occur longitudinally upstream to downstream.
- The stream profile should allow the planting of riparian vegetation close to and extending over and into the water surface at the margins to create ample stream edge habitat. This can be low stature planting that provides vegetation overhang over and into the watercourse and to enhance habitat for the aquatic ecosystem.
- To the extent practicable, riparian vegetation is to be planted along the length of the stream realignment. Appropriate riparian species selection will enhance stream ecology through providing shade to the stream, reducing water temperature, producing habitat and providing a food source. As much as possible, riparian vegetation should extend along either side of the realignment channel.

10.4.2 Stream Realignment Design Framework

The following sections provide a framework for the design and construction of the steam realignment. Schematics of the anticipated outcome of the stream alignment are shown in **Figures 39 and 40**. The details of the approach will be defined through the Stream Realignment Management Plan.

Channel length and meander

The stream cut is expected to convey the 1% AEP flow with climate change to 3.8 degrees of warming and include a minimum of 500 mm of freeboard below the proposed haulage road on the true right bank (PDP 2026a).

The proposed realignment channel length will be at least 570 m, including a meandering channel designed to convey regular rainfall events up to the mean annual flood.

Boulders, submerged logs, etc. will be used to aid meander development and increase flow heterogeneity **(Figures 39 and 40).**

Meanders are important for ecological function because they extend the stream length, provide a diversity of habitats including gravel bars and undercut banks at bends, provide a range of instream water velocities which enables diverse habitats for a range of different species.

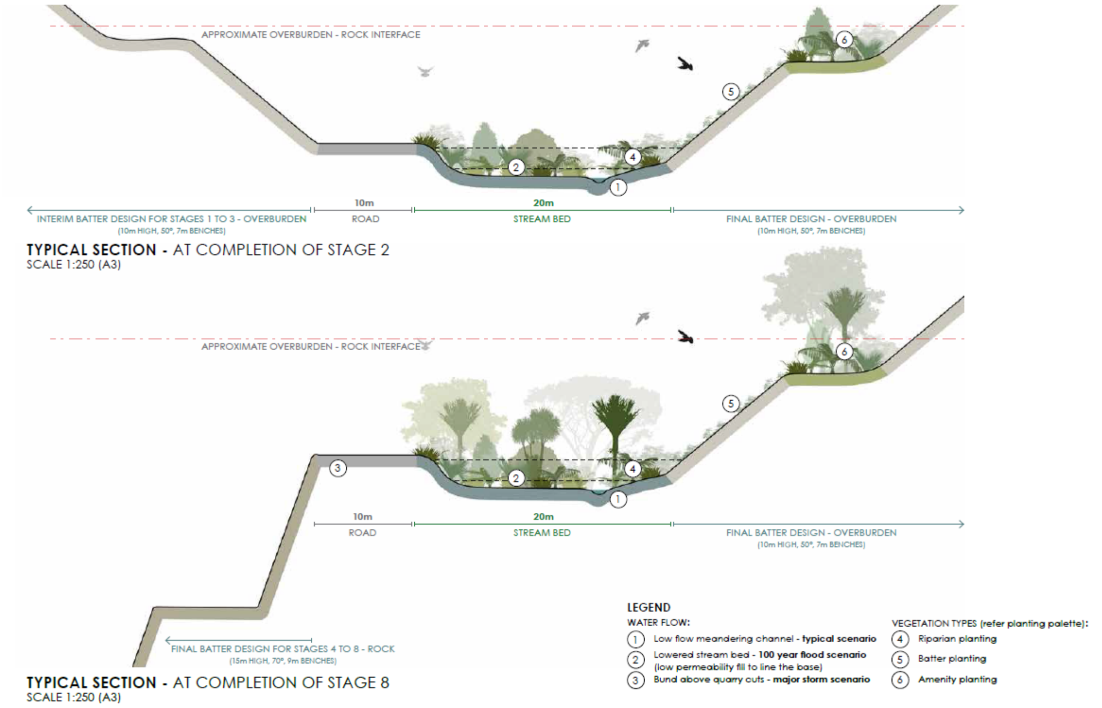
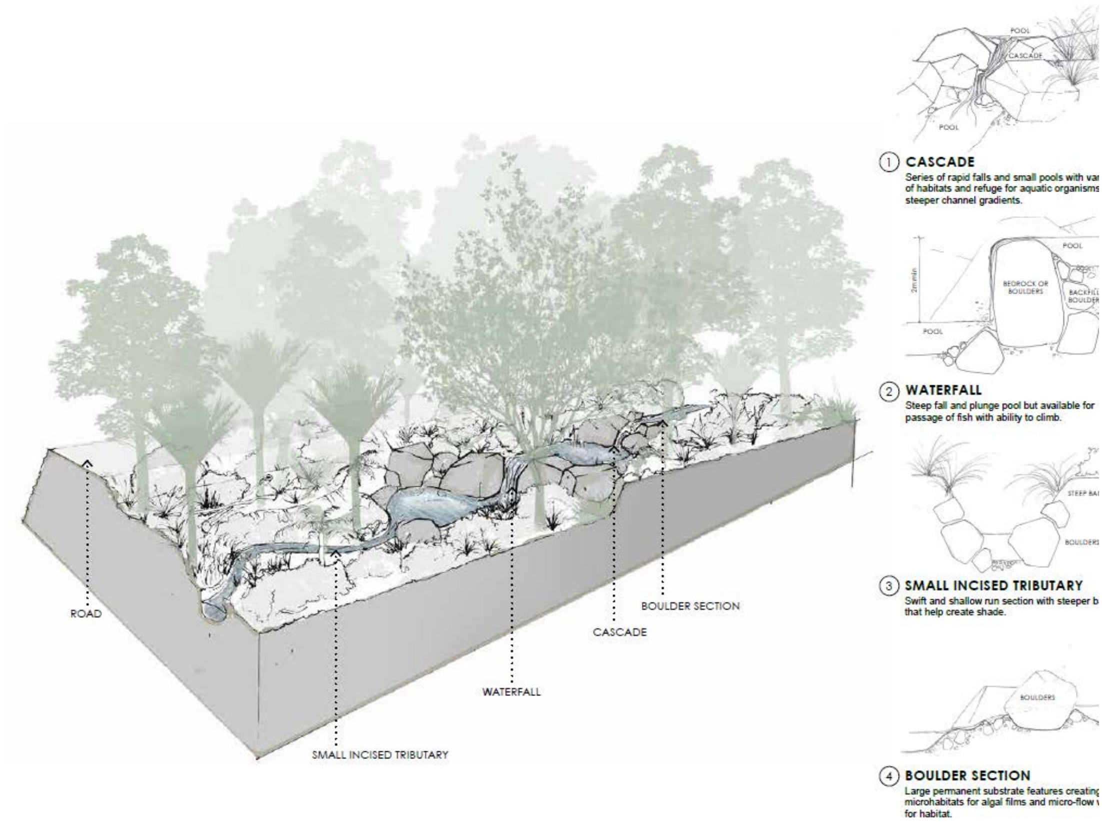
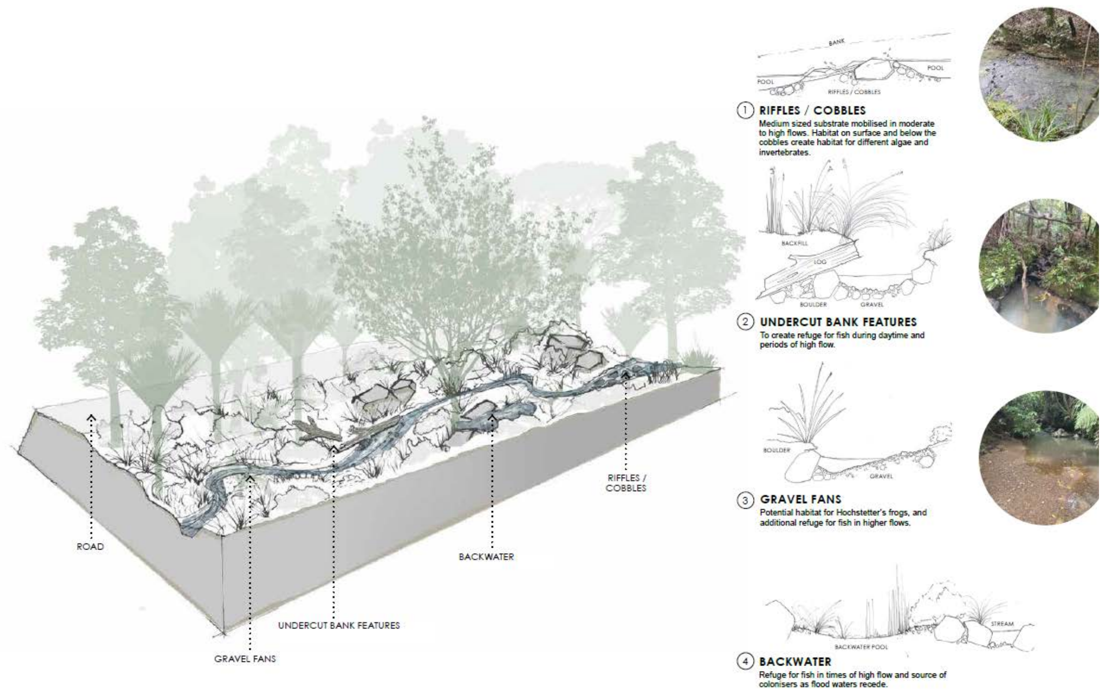


Figure 44: Indicative cross-section of the realigned channel at Stage 2 and Stage 8.



a) Lower reaches



b) Upper reaches

Figure 45: Indicative design features of the realigned Mangapū Tributary, Hunua Quarry Development.

Habitat diversity and channel complexity

Stream heterogeneity, stability and instream habitat complexity will be enhanced through the creation of natural features such as cascades, runs, riffles, gravel bars, and small and large pools. These features will be created utilising natural substrates such as rocks, logs, gravels, cobbles and large boulders.

The outcome is anticipated to reflect the equivalent characteristics that are consistent with the habitat present in the Mangapū Tributary. The channel complexity and availability will ‘naturalise’ over time as the new realignment channel becomes established.

A shallow low flow channel will also be included in the channel design. The purpose of a low flow channel is to provide flow when climate conditions typically result in low rainfall conditions. The low flow channel extends the period of habitat availability should dry conditions persist.

Habitat diversity and channel complexity are important for ecological function because they create environments for a range of biotic species supporting a range of aquatic ecosystem functions.

Stream depth, wetted width and velocity

Stream depth and wetted width affect the total area of habitat that can be utilised by aquatic biota, and the volume of water conveyed during normal flows. Stream width, depth will reflect the equivalent characteristics and be consistent with the habitat present in the Mangapū Tributary. With the design seeking to create a stream that meets an average depth and width, some localised variation will be included for the creation of large and small pools and meanders. These depths and widths shall be established at the detailed design stage.

The channel design will create a low flow or baseflow channel, a bank full channel and floodplain areas (not necessarily continuously along the length of the realignment), to the extent possible. The low flow must connect to the relevant seasonal groundwater or equivalent flow to ensure water flow reflects the water classification of the Mangapū Tributary (i.e., permanent flow).

Indicative channel characteristics and habitats are provided in **Appendix 16**.

Stream depth, wetted width and velocity are important for ecological function because they create the habitat available for aquatic biota and support a range of aquatic ecosystem function.

Fish passage structures

The NPS-FM and NES-F require fish passage to be maintained. As set out above, only three species of native fish were recorded from the Mangapū Tributary: long and short-fin eels and banded kokopu. All three species are capable climbing fish, evidenced by existing natural barriers (waterfalls and cascades) downstream that limit access for non-climbing fish. Accordingly, the preliminary design has been developed to accommodate these fish species (PDP 2026a).

Fish passage will be provided to allow for migration of these fish species, including areas where fish can rest and feed (e.g., lower gradient and refuges), and appropriately sized and staged waterfalls and cascade sequences. The latter provide for gradient and flow energy control.

At the connection of the Mangapū Tributary and a lesser tributary, a waterfall/cascade sequence up to 8 m as a vertical stream invert differential is included in the design. This feature will enable the native (climbing) fish species currently present in the tributary to continue to move upstream into the realigned tributary and into the headwater catchments. This waterfall feature will provide a barrier for non-climbing exotic fish species from entering the realigned channel if any enter the system in the future. The prevention of exotic fish into the realigned channel is an important component of the design, as currently no exotic fish have been detected in the Mangapū Tributary.

Water quantity and stream flows

Water flows in New Zealand rivers are highly variable and can change rapidly between high flow and low flow states very quickly. Freshwater ecosystems and the species that live in them rely on this variability to thrive. Environmental flows and levels are an inclusive term that encompasses ecological flows, cultural flows and the flows required for social (including human health and well-being), recreation and economic activities. Ecological flows are the flows that water bodies themselves need for their natural processes, including ecosystem health to support species to thrive in habitats ki uta ki tai (from the mountains to the sea).

The different flow types that are important for the variability in rivers natural systems, include[20]:

- flushing flows that can clear out periphyton and sediment;
- median annual low flow (MALF) that indicate the lowest flow level you could expect naturally in a system;
- flood flows that help to form new channels, move boulders, and maintain the natural form and character of a river; and
- a variety of flow types that support fish life cycles such as cues for migration, opening river mouths so fish can move between fresh and sea water, and flows that over top the banks. Many indigenous species spawn on the banks of rivers and require variability.

Water quantity (the extent and variability in the level or flow of water) is one of the five biophysical components for the ecosystem health value in the NPS-FM.

As outlined above, several measures or metrics can be used for determining a suitable flow to support aquatic ecological values. As much as is practicable, the existing median annual low flow (MALF) is a suitable hydrological metric to aim for the realigned channel.

Native (climbing) fish have been detected in the Mangapū Tributary. Accordingly, it is essential that provision for the migration and passage of these native fish is formed in the realigned channel in terms of the stream flows.

Fish swimming capabilities and instream water velocity, as well as climbing ability are essential understanding of the ability for fish species to migrate. Guidance on fish passage is provided in the Fish Passage Guidelines (NIWA 2024). These guidelines are generally aimed at constructed features (e.g., culverts, weirs) and less attention is given to realignment of stream channels, especially those with well-formed natural substrates. Nevertheless, the commentary and advice in the fish passage guidelines is helpful in providing advice on fish swimming speeds required within the proposed realignment channel.

Fish have three basic categories of swimming speed – sustained, prolonged, and burst. Sustained swimming occurs aerobically and can be maintained indefinitely without muscle

[20] https://www.waigoodpolicy.org.nz/practice-notes/environmental-flows-and-levels

fatigue. Experimentally, it is typically defined by a swimming speed that a fish can maintain for greater than 200 minutes[21].

NIWA (2024) explain that fish use sustained swimming for activities like migration and foraging. Burst swimming is an anaerobically-fuelled process that leads to muscle fatigue over a period of less than 20–30 seconds. Fish typically use burst (20-30 seconds) swimming for prey capture and predator avoidance.

Critical swimming speeds for relevant native species in the Mangapū Stream are provided in Table 29. For design purposes, sustained swimming should be the focus. We note that a commonly accepted standard rule-of-thumb for culverts (greater than 10 m in length) is 0.3 m/s.

Noting that the indicative swimming speeds detailed from the guidelines are mean values, the banded kokopu is in the moderate range of swimming speed for galaxiids (mean 0.36, min 0.07, max 0.81, all m/s), and for elvers the mean critical swimming speed is slightly higher. At 70% of these measured swimming speeds, the mean velocities would be in the order of 0.25 m/s up to 0.41 m/s. This range of velocity would be indicative as averaged for run/riffle habitat arrangements within the stream realignment, acknowledging that cascades would have faster velocities over much shorter distances.

Table 29: Mean critical swimming speeds for a range of native fishes during their primary upstream migratory life stage.

	Mean maximum sustained swimming speed (m/s)	Mean critical swimming speed (m/s)	Mean size (cm)
Banded Kokopu	0.25	0.36	4.2
Longfin elver	0.22	0.41	4.1

Riparian Vegetation

Riparian vegetation will be planted along the length of the stream realignment. Riparian vegetation plays an important role in the ecological success of a stream realignment. Using appropriate riparian species selection will enhance stream ecology through providing shade to the stream, reducing water temperature, providing habitat and a food source. Riparian vegetation will be chosen to mimic the local vegetation and be appropriate for the local bioclimatic conditions.

The stream profile will enable the planting of riparian vegetation close to and extending over the water surface to create ample stream edge habitat. This will provide shading to the water surface, detritus in the form of fallen leaves and potential habitat for macroinvertebrate species.

Further detail on the proposed riparian planting is provided in the Stream Realignment Management Plan and indicated in the schematic at **Figure 37**.

Livening the realigned stream

A key stage in the realignment is the staging of the switching of the water flow from the existing to the newly realigned channel, or the livening[22] of the realignment. It is intended that

[21] The maximum sustained swimming speed is typically approximated using a critical swimming speed test. More recent research suggests that the maximum sustained swimming speed is only 60–80% of the critical swimming speed. For design purposes, the maximum sustained swimming speed should be assumed to be around 70% of a measured critical swimming speed (NIWA 2024).

[22] Livened = When a connection is 'livened' (e.g., water can flow from the distribution network to the connection).

the realignment channel will progressively become live, with a phased diversion of the stream flows over time. To achieve this involves blocking the Mangapū Tributary once the realignment channel has been sufficiently established and diverting the stream flow into the new channel. It is intended that the existing tributary channel remains viable to convey flows, particularly more extreme flows, to prevent flood flows entering the realignment channel before vegetation and sediment accumulation have established enough to withstand larger flows.

Because the construction and development of the realigned channel is expected to occur in advance of the stages of expansion, there is an opportunity for the livening of the channel to be expanded over a period of time, rather than a sudden 'switch over'. What this means is the opportunity for a transition of ecological values from one channel to another, rather than the more typical abrupt stop/start in one single moment in time.

It is proposed that livening occurs through a staged transition of flows from the Mangapū Tributary to the realigned tributary over some 18-24 months as set out in Table 30.

Table 30: Phases of livening of Mangapū Tributary, Hunua Quarry Development.

Phase of livening	Mangapū Tributary	Realigned channel	Ecological Actions
Pre-livening	100% flow	Channel construction	Construction of instream channel habitat features Vegetation clearance and fauna salvage and relocation (as required).
Phase 1 Extended period of time (many months)	66% flow	34% flow	Monitoring aquatic colonisation and values
Phase 2 Moderate period of time (2-3 months)	34% flow	66% flow	Monitoring aquatic colonisation and values Aquatic fauna salvage and relocation
Phase 3 Short period of time (2-3 weeks)	Flow ceases	100% flow	Outcome monitoring commences

We emphasise that livening will only occur once the instream habitat features have been designed and built in to the realigned channel. The phased livening provides opportunity for monitoring the colonisation and advancement of aquatic ecological values, allowing for modifications prior to full livening at Phase 3. The transitioning of the ecological values from the Mangapū Tributary to the realigned channel is an important factor in the management of effects of the Project.

The phased livening means that for a period of time there is additional (temporary) stream extent, with differing aquatic ecological values (one mature channel and one developing channel). The mature aquatic ecological values will persist in the Mangapū Tributary channel but will likely diminish as flows are reduced as the phases progress. However, we expect the aquatic ecological values of the realigned channel to improve as flows increase and the habitat settles, biofilms and algal food sources mature, and invertebrates and fish colonise the channel. Thus, the aquatic ecological values transition over the period of livening.

As applicable, when salvage and relocation of aquatic fauna (fish and koura) from the Mangapū Tributary is implemented, the realigned channel becomes a realistic option for relocation. Details of the livening and colonisation monitoring is detailed in the Stream Realignment Management Plan.

Natural colonisation of the realigned channel

Colonisation occurs as aquatic species not initially present at a location occupy new or available habitat. Freshwater organisms colonise aquatic habitats though many avenues including:

- Drift from upstream populations.
- Migration from downstream sources.
- Egg laying from adult (insects) direct into the stream.

Invertebrate and algal drift from upstream is a well know phenomenon in aquatic ecology and is the most likely source of colonists in the initial phases of the realigned stream. Although the headwater streams had a lower diversity of macroinvertebrates, the eDNA detections confirm a diverse fauna and flora upstream of the realignment suggesting a substantive source of colonists for the realigned channel.

The benefit of the phased livening of the realigned channel means that:

- Organic layers of bacteria and algae will form in the habitat prior to the removal of the current stream.
- The organic layers provide a food source for invertebrates that colonise the formed channel.
- Variation in natural (but not full volume capacity) flows enables the formed habitat to adjust to flowing water.

Further colonisation will be aided by the relocation of fish and koura (and associated invertebrates) from planned salvage from the current Mangapū Tributary (see section 11.8 below).

The phased livening of the realigned channel means that a staged reduction in flow within the Mangapū Tributary will make the salvage of aquatic fauna less challenging but also means that salvage will need to be efficient and timely as flows recede. Details of aquatic fauna salvage and relocation is outlined below and in more detail in the Aquatic Fauna Salvage and Relocation Plan.

Monitoring of the colonisation and the progression of aquatic values is proposed thus providing for adaptive responses as required and as detailed in the Stream Realignment Management Plan.

Erosion and sediment control

Erosion is a natural stream process, and it is expected that erosion protection will be required along the stream in high energy locations such as at the waterfall sites and prominent bends in the stream. The erosion protection incorporated into the design include:

- Plunge pools/scour basins at the downstream end of waterfalls and cascade features. These areas allow for the energy of the flowing water to dissipate.
- Linear rock placement with suitably sized rock to arrest lateral and erosion and downwards scour.
- Protection of the new confluence of the realigned tributary with the mainstem Mangapū streams with the considered placement of rock.

PDP (2026c) sets out the methodology for erosion and sediment control for diversions.

10.5 Characteristics of the realigned Mangapū Tributary

10.5.1 Reach between the confluences

PDP (2026a) confirm that the proposed new channel will have a steeper gradient than the existing Mangapū Tributary at approximately 7.5% gradient compared to 5% for the existing channel. The steeper gradient will result in a higher-than-average velocity in the stream, resulting in the potential for increased sediment transportation through the new channel into the Mangapū Stream. Thus, there is a potential for increased sediment deposition into the Mangapū Stream especially around the new confluence of the Mangapū Stream mainstem and the realignment channel.

There will be a notable increase in flood depths and velocities (up to 100 mm and 0.2 m/s respectively), where there is potential for channel erosion and bed rock exposure, along with the potential for additional sediment to be transported downstream.

Increased velocities will transport the finer sediments of the stream substrate potentially held longer in suspension, and which may result in a change in substrate composition (PDP 2026a).

Notwithstanding changes in flow and substrate, all watercourses find their own natural equilibrium or a steady state where the ecological characteristics and features stabilise. Depending on existing channel morphology, changes in channel shape such as widening generally results in stream velocities decreasing and depth becomes shallower, thus reducing erosion and restricting more widening, as the stream finds a natural equilibrium without the need for intervention. The extent of any channel morphological changes is dependent on the current channel shape and structure.

10.5.2 Downstream of the existing Mangapū tributary confluence

PDP (2026a) conclude that potential changes of the confluence of the Mangapū Tributary to the Mangapū Stream mainstem to a further upstream location will have a localised impact on the sediment load in the stream around the existing confluence. This occurs as sediment will no longer be entering at the current location. Any deposition which is currently occurring will slowly cease, which may also result in modifications to the stream channel. PDP (2026a) consider that any changes would occur gradually and any effects would be minor.

10.6 Monitoring

10.6.1 Instream monitoring

Immediately following the livening of the realigned channel and inspection should be undertaken by a suitably qualified Freshwater Ecologist to ensure that the realigned channel is functioning as intended.

To measure the overall success of the realigned channel ongoing monitoring is required. The success is to be measured using habitat and macroinvertebrate community composition metrics. These are detailed below.

10.6.2 Monitoring parameters

The following monitoring parameters and methods will be undertaken as set out in Table 31.

Table 31: Proposed monitoring parameters and methods for the realigned Mangapū Tributary channel, Hunua Quarry Development..

Monitoring attribute	Method	Metrics	Protocol (where appropriate)
Habitat	Rapid Habitat Assessment (RHA)	HQS	Clapcott et al. (2020)
Settled sediment	In-stream visual estimate of % sediment cover	Fine sediment cover (%)	Sediment Assessment Method 2 (Clapcott et al. 2011)
Algal cover	Periphyton cover (%)	• No algae • (bare substrate) • Films • Mats, • Filaments.	National Environmental Monitoring Standards for Periphyton (NEMS 2022a)
Macroinvertebrates	Benthic macroinvertebrates	• Taxa number • MCI, • EPT, • %EPT	National Environmental Monitoring Standards for Macroinvertebrates (NEMS 2022b)
Riparian planting	Cover% Planted success%	Cover% Planted success%	

10.6.3 Frequency of monitoring

Ecological Monitoring of the stream channel should be undertaken annually for five years post-livening, and again at Year 10 to ensure the realigned channel is meeting ecological objectives and function. If the objectives and functions are being met, then no further monitoring is required.

10.6.4 Monitoring and maintenance of riparian vegetation

Riparian planting maintenance is essential for achieving long-term objectives in water quality, erosion control, habitat enhancement, and channel stability. Neglecting maintenance can lead to ecological failure, increased sediment loads, and costly remedial works.

The riparian vegetation planting should be inspected at least every three months by a suitably qualified person in the year following the planting. The plants should be inspected to assess plant health. Where any plants appear to be in poor health or dying, the plants shall be removed and replanted, or care measures implemented as soon as is practicable.

Pest plants shall be assessed within the riparian planting. Where pest plants are considered to be dominating the vegetation and/or smothering desired plants then control activities shall be undertaken as soon as is practicable.

Riparian management maintenance activities include:

- Regular inspections to monitor plant survival, removal of invasive species and to maintain stream bank integrity.
- Replacement of dead plants to maintain continuity in vegetation/riparian buffer (particularly important in early growth stages).
- Removal of sediment/ debris following a flood event that may hinder growth.

10.6.5 Indicative Performance Targets

The indicative targets for the performance of the realigned channel are set out in Table 32. These performance targets have been drawn from the existing ecological values as assessed above, NOF from the NPS-FM, and related metrics (i.e., RHA).

Table 32: Indicative thresholds for the realigned Mangapū Tributary, Hunua Quarry Development.

Realigned Mangapū Tributary **Metric**	**Threshold**
Habitat Quality Score band	Good
Deposited fine sediments NOF Table 16	= or > Band B
MCI Band NOF Table 14	= or > Band C

10.6.6 Reporting

A report summarising the ecological monitoring will be prepared and submitted to Council in June in the year of sampling.

10.7 Effects management of the stream realignment

10.7.1 Avoidance: Unavoidable loss

There is a demonstrated functional need for the unavoidable removal of the Mangapū Tributary in order to access the resource. An extent of 1,200 m of length (estimated as 1,770 m^2 of stream area) of the Mangapū Tributary will be removed.

10.7.2 Remedy: Realignment and staged livening

In the application of the Effects Management Hierarchy (Section 9), the stream realignment represents a remedy for the removal of the Mangapū Tributary. Essentially the remedy is to 'move' the stream, so the watercourse is not lost or reclaimed. Rather it is placed elsewhere.

We have described the phased livening of the realigned stream, and the transition of the aquatic ecological values from the existing Mangapū Steam tributary to the realigned channel above. The opportunity for the livening of the realigned Mangapū Tributary channel can occur over several months or even up to two years. This arises because of the staging of the quarry development as detailed in Section 1 of our assessment. The phased livening means that for a period of time there is additional (temporary) stream extent, albeit with differing aquatic ecological values (one mature channel and one developing channel).

Accordingly, the transition of aquatic ecological values and to some degree the extent of the watercourse reduces the lag time typically associated with the removal of a watercourse, and the benefit accrued to a second watercourse (i.e., offset or compensation in terms of the effects management hierarchy).

10.7.3 Residual effects of the stream realignment

Following realignment of Mangapū Tributary there remains a residual 630 m of stream extent that has been removed and cannot be replaced. Notwithstanding the realignment of the Mangapū Tributary in part, the creation of additional new stream length and channels is not a feasible option. However, improving connectivity of streams in a watercourse network where it forms a viable and credible improvement in the extent of availability of the catchment length and stream area to aquatic fauna is an acceptable compensation. Below we describe stream connectivity improvements across two catchments that compensate for removal of stream extent.

Following realignment of 571 m of the Mangapū Tributary, the residual effect is a loss of 370 m of mainstem stream length plus some 260 m of small tributaries length (total of 630 m). This equates to a loss of 693 m^2 of stream ecological values, based on an average width of 1.1 m across all stream classifications.

We report on the ECR calculations below, but the outcome is a calculated requirement for enhancements to the ecological values of a stream area of 2,860 m^2, equating to 2,600 m of stream length.

We have applied this quantum to a mix of aquatic offset and aquatic compensation as set out below.

10.7.4 Ecological Compensation Ratio (ECR)

As outlined above, SEV information was collected to inform the offset proposed. The details of the SEV and the calculations of the ECR are set out in **Appendix 15**.

The ECR for the loss of the residual extent and values of Mangapū Tributary is 4.13, resulting in an offset stream area of some 2,860 m^2, equating to 2,600 m of stream length (at an average of 1.1 m stream width).

The overall aquatic offset and compensation for the residual effects of the loss of extent and values of all watercourses including Mangapū Tributary is set out in section 9.10. The combined offset and compensation for the loss of extent and values of all watercourses, integrated into locations where effects management for all aspect of the project are also located provides for a substantive overall positive gain for aquatic biodiversity and extent of access to watercourses. Accordingly, the effects management hierarchy is satisfied.

11.0 Approvals relating to complex freshwater fisheries activities

The proposed stream realignment and placement of culverts require a complex freshwater fisheries activity approval under schedule 9 of the FTAA. The response to the approval requirements is set out in **Table 33**.

Table 33: Summary of information required for complex freshwater fisheries activity, Hunua Quarry Development.

Regulation	Information requirement	Mangapū Tributary realignment Outcome	Tributaries 3 and 4 Haul Road culverts Outcome
Schedule 9 Approvals relating to complex freshwater fisheries activities			
Clause 2 Information required in referral application including standard and complex freshwater fisheries activity			
2(a)	whether an in-stream structure is proposed (including formal notification of any dam or diversion structure) and the extent to which this may impede fish passage; and	No instream structure is planned or envisaged for the diversion or the realigned channel (noting the stream diversion / reclamation may be considered a structure).	Installation of culvert with steep gradient and velocity forms will block fish passage. Residual effect is offset and compensated ahead of loss with improvements to fish passage and instream values.
2(b)	whether any other complex freshwater fisheries activities are proposed.	Salvage and relocation is proposed for the fish and koura inhabiting the Mangapū Tributary to be realigned.	Salvage and relocation is proposed for the fish and koura inhabiting tribs 3 and 4.
Clause 3 Information required in application for complex freshwater fisheries activity approval			
3(a)	(i) a description of the type of structure or fish facility: (ii) the dimensions of the structure or fish facility: the design of the structure or fish facility: the placement of the structure or fish facility: the water flows: (vi) the operating regime:	No instream structure is planned or envisaged for the diversion or the realigned channel.	The description of the type of structure is provided in PDP (2026d)
3(b)	the freshwater species and values present (with particular focus on threatened, data-deficient, and at-risk species as defined in the New Zealand Threat Classification System):	The fish species detected from eDNA sampling in the Mangapū Tributary are: • Long fin eel (At Risk declining) • Short fin eel (Not threatened) • Banded kokopu (Not threatened)	The fish species recorded in the Mangapū Stream with access to trib 3 and lower reaches of trib 4: • Long fin eel (At Risk declining) • Short fin eel (Not threatened) • Banded kokopu (Not threatened)
3(c)	the water quality and quantity in the surrounding habitat (at the proposed structure location, upstream and downstream):	Water quality remains the same as current upstream. Potential for erosion and sediment intrusion at location and downstream as realignment settles and is expected	Water quality and quantity remain the same as current location, upstream and downstream. Velocities may vary within culvert depending on gradient.

Regulation	Information requirement	Mangapū Tributary realignment Outcome	Tributaries 3 and 4 Haul Road culverts Outcome
		to meet an equilibrium similar to current. Water quantity varies with length and gradient of realignment.	
3(d)	how the passage of fish will be provided for or impeded.	No instream structure is planned or envisaged for the diversion or the realigned channel.	Passage of fish will be blocked through culvert gradient and elevated velocities. Residual effect is offset and compensated ahead of loss with improvements to fish passage and instream values.
Clause 5 Criteria for assessment of applications for complex freshwater fisheries activity approval			
5(b)	the alignment of the proposed activity with best practice and the New Zealand Fish Passage Guidelines; and	The realigned channel has been designed, as much as is practicable, to meet the climbing and swimming speeds to provide for fish migration and fish habitat.	Passage of fish will be blocked through culvert gradient and elevated velocities. Residual effect is offset and compensated ahead of loss with improvements to fish passage and instream values
5(c)	how the proposed activity will manage risks to freshwater values or habitat, including prevention of access to or spread of invasive species; and	Risks to freshwater ecological values and habitat will be managed through the creation and maintenance of equivalent character of habitat features within the realignment and offset/compensation. eDNA sampling did not detect any invasive fish or any known species of risk. Risks from invasive aquatic species will be managed through the formation of equivalent ecological and habitat features within the realigned channel, most notably waterfalls that prevent invasive fish from moving upstream. Essentially the status quo remains.	Risks to freshwater ecological values and habitat will be offset/compensated for as part of Stages 1-4, i.e., the offset/compensation for the loss of tribs 3 and 4 will occur some decades ahead of the actual loss. This includes the loss of fish passage resulting from the construction of the culverts. Construction will be undertaken in accordance with best practice avoiding fish migration season.
5(d)	the availability and quality of the habitat upstream and downstream of the proposed activity; and	Natural habitat remains available upstream and downstream; and formed within the realigned channel.	Natural habitat remains available upstream and downstream. Upstream of trib 4 is ephemeral and is unsuitable habitat for fish.
5(e)	the presence of threatened, data-deficient, or at-risk species under the New Zealand Threat Classification System in the vicinity of the proposed activity; and	The Long fin eel, present in the Mangapū Tributary is classified as At-Risk declining.	The Long fin eel, present in the Mangapū Stream is classified as At-Risk declining.

Regulation	Information requirement	Mangapū Tributary realignment Outcome	Tributaries 3 and 4 Haul Road culverts Outcome
5(f)	the advantages and disadvantages of providing fish passage upstream or downstream of the proposed activity.	Natural waterfall characteristics are included in the realignment design to provide passage for the existing fish species inhabiting the Mangapū Tributary (all species with ability to pass the natural features) whilst excluding those fish that are unable to climb and do not currently exist in the tributary.	Although natural watercourses exist upstream and downstream in tribs 3 and 4, the ephemeral nature of upstream trib 4 is largely unsuitable as fish habitat, and fish habitat is limited upstream in trib 3. Residual effect of loss of tribs 3 and 4 is offset and compensated ahead of loss with improvements to fish passage and instream values..

12.0 Monitoring

Monitoring of the progress and success of the proposed offset and compensation measures is an important component of ensuring that the expected outcomes of the effects management hierarchy are achieved.

Recommended monitoring of the performance of the proposed offset and compensation actions is provided in the following respective management plans:

- Mangapū Stream Tributary Realignment Plan (Prepared by Boffa Miskell, dated 24 March 2026).
- Ecological Management Plan (Prepared by Boffa Miskell, dated 24 March 2026).
- Lizard Management Plan (Prepared by Boffa Miskell, dated 24 March 2026).
- Aquatic Fauna Salvage and Relocation Plan (Prepared by Boffa Miskell dated 24 March 2026).
- Pest Management Plan (Prepared by Boffa Miskell, dated 24 March 2026).

In each plan the objectives and purpose of the plan actions are outlined, along with the methods to be used, thresholds to be achieved (where appropriate) and any adaptive actions in response to any deviations from expected outcomes (where appropriate).

13.0 Summary of the Application of the Effects Management Hierarchy

13.1 Terrestrial Ecology

A summary of the effects management for the effects of the Project on terrestrial ecology is set out in Table 34 and the status of indigenous biodiversity following effects management in Table 35.

Table 34: Summary of application of effects management for terrestrial ecological effects of the Hunua Quarry Development.

	Terrestrial Ecology			
	Vegetation	**Fauna: Lizards**	**Fauna: Avifauna**	**Fauna: Bats**
Ecological Values				
Avoid	Avoid loss of vegetation where possible	Avoid fatality through salvage of geckos and any other native lizards (if detected).	Avoid tree felling during bird breeding season (August – February).	Avoid fatality of bats through implementation of standard tree felling protocols.
Minimise	Minimise vegetation loss as much as is practicable.	Minimise fatality through salvage of geckos and any other native lizards (if detected), via management plan protocols	Check for nests if felling occurs during bird breeding season.	Check for nests if felling occurs during roosting season - resource consent condition
Remedy	-	Relocation of geckos to release site with appropriate pest management for protective benefit of the population.	No remedy required.	No remedy required.
Residual Effect	Yes	No	No	No
Biodiversity Offset	Planting 85.62 ha of new offset areas as offset for residual effects.	N/A	N/A	N/A

	Terrestrial Ecology			
	Vegetation	**Fauna: Lizards**	**Fauna: Avifauna**	**Fauna: Bats**
Ecological Values				
	Increased forest margin edge.			
Biodiversity Compensation	Comprehensive and improved staged pest management strategy across over 100 ha of mature and planted vegetation.	Integrated and comprehensive landscape-scale pest management strategy	Integrated and comprehensive landscape-scale pest management strategy	N/A
Outcome	No net loss; net ecological gain			

Table 35: Status of terrestrial indigenous biodiversity (IB) following effects management

Indigenous biodiversity maintenance	**Vegetation**	**Herpetology**	**Avifauna**	**Bats**
Ecological values	Taraire/Tawa Forest: High Mature kanuka: High Other vegetation: Low to moderate	Fauna: High Habitat: Low-Moderate	Fauna: Moderate Habitat: Low - Moderate	Fauna: Negligible Habitat: Low - moderate
Population size	Increase in IB after planting and restoration measures implemented.	Salvage and relocation methods implemented for protective benefit to population.	No reduction after seasonal avoidance and/or bird nest check protocols applied (effects management). No fatalities to breeding population.	No bat population at site. No reduction after effects management. No mortality to breeding population.
Occupancy	Occupancy of native plants will not be impacted.	Occupancy of native lizards will not be impacted in their natural range.	Occupancy of native avifauna will not be impacted in their natural range.	Occupancy of bats is not occurring at present. Opportunity for occupancy to increase through terrestrial and aquatic offset

Indigenous biodiversity maintenance	Vegetation	Herpetology	Avifauna	Bats
Ecological values	Taraire/Tawa Forest: High Mature kanuka: High Other vegetation: Low to moderate	Fauna: High Habitat: Low-Moderate	Fauna: Moderate Habitat: Low - Moderate	Fauna: Negligible Habitat: Low - moderate
				planting and improved connectivity. Similar length and type of forest margin remains at quarry edge.
Ecosystem function	Improved ecosystem functioning after planting and restoration measures implemented as well as pest and weed management.	No reduction in function of herpetology habitats. Overtime, after planting and restoration measures, and implementation of pest management measures, the function of habitats for native lizards is expected to improve.	No reduction in function of avifauna habitats. Overtime, after planting and restoration measures, and implementation of pest management measures, function of habitats for native avifauna is expected to improve.	Majority of mature indigenous vegetation within SEA_T_5323 including potential roost trees and forest edge remains. Overtime, after planting and restoration measures, and implementation of pest management measures, function of habitats for bats is expected to improve an opportunity for bat occupancy.
Range and extent	Increase in range and extent of native terrestrial vegetation.	No reduction. Range and extent of native lizard movement maintained and enhanced through planting and restoration measures, improved connectivity and pest management.	No reduction. Range and extent of native avifauna movement maintained and enhanced through offset planting and restoration measures, improved connectivity and pest management.	Negligible reduction as no current occupancy. Majority of mature indigenous vegetation within SEA_T_5323 including potential roost trees and forest edge remains. Opportunity for range and extent

Indigenous biodiversity maintenance	Vegetation	Herpetology	Avifauna	Bats
Ecological values	Taraire/Tawa Forest: High Mature kanuka: High Other vegetation: Low to moderate	Fauna: High Habitat: Low-Moderate	Fauna: Moderate Habitat: Low - Moderate	Fauna: Negligible Habitat: Low - moderate
				of bat activity and movement with habitat is maintained and enhanced over time with enhancement planting and improved connectivity and opportunity.
Connectivity	Increase in vegetation connectivity once planting area established.	Increase in extent and habitat connectivity once planting areas established.	Increase in extent and habitat connectivity once planting area established.	No reduction. Range and extent of habitat connectivity opportunity for bats is maintained. With enhancement planting and restoration measures, connectivity of habitats for native bats is expected to improve.
Resilience and adaptability	Increase in resilience and adaptability after planting and restoration measures implemented. Resilience improved through implementation of pest and weed management.	Increase in resilience and adaptability after planting and restoration measures implemented. Resilience improved through implementation of pest management.	Increase in resilience and adaptability after planting and restoration measures implemented. Resilience improved through implementation of pest management.	Retention of majority of mature indigenous vegetation of SEA_T_5323 which includes potential roost trees. Increase in resilience and adaptability after planting and restoration measures, and the

Indigenous biodiversity maintenance	Vegetation	Herpetology	Avifauna	Bats
Ecological values	Taraire/Tawa Forest: High Mature kanuka: High Other vegetation: Low to moderate	Fauna: High Habitat: Low-Moderate	Fauna: Moderate Habitat: Low - Moderate	Fauna: Negligible Habitat: Low - moderate
				implementation of pest management. Similar length and type of forest margin remains at quarry edge.
Summary	Indigenous biodiversity is maintained and enhanced; net ecological gain	Indigenous biodiversity is maintained and enhanced; net ecological gain	Indigenous biodiversity is maintained and enhanced; net ecological gain	Indigenous biodiversity is maintained and enhanced; net ecological gain

13.2 Freshwater ecology (watercourses and wetlands)

In Table 36, we set out all of the stream infrastructure, realignment and stream loss resulting from the Hunua Quarry Development, and the effects management in response in Table 37. The outcome following effects management is provided in Table 38.

Table 36: Summary of effects of the Hunua Quarry Development of freshwater ecology.

Watercourse	Stage Quarry development	Purpose of stream modification / removal	Estimated Length of stream modification / removal
Mangapū Tributary	Stage 2	Bridge	No loss
Mangapū Tributary	Stage 2	Stream realignment	1,200 m (570 m realigned; 630 m removed)
Mangapū Stream trib 3	Stage 7 (total removal of trib 3 incorporated in to Stages 1-4 offset/compensation and including Haul Road culverts)[23]	Haul Road; Quarry expansion	475 m

[23] Offset and compensation provided up front in relation to this impact.

Mangapū Stream trib 4	Stage 7 (total removal of trib 4 incorporated in to Stages 1-4 offset/compensation and including Haul Road culverts)	Haul Road; Quarry expansion	40 m

Table 37: Summary of effects management for freshwater ecology and wetlands, Hunua Quarry Development.

Freshwater Ecology				
	Watercourse: Mangapū Tributary	**Watercourse: Mangapū Stream tributaries 3 and 4**	**Fauna: Fish and koura**	**Wetlands**
Ecological Values	Very high	High	Moderate	Low-moderate
Avoid	Unavoidable realignment of 1,800 m^2 (approximately 1,200 m length) of intermittent and permanent stream.	Unavoidable loss of 527 m length of intermittent and permanent watercourses	Avoid fatality through salvage of fish and koura from watercourse prior to removal of watercourse.	Unavoidable loss of 0.44 ha of wetland area.
Minimise	Minimise stream loss as much as is practicable. Maintain passage opportunity for climbing fish	Minimise stream loss as much as is practicable.		
Remedy	Stream realignment of approximately 570 m length. Flow augmentation to sustain MALF flows as needed.	N/A	Relocate of salvaged fish and koura to stream realignment and/or Mangapū Stream for the protective benefit of the fish populations: living, migration and reproduction.	
Residual Effect	Unavoidable loss of 630 m length of watercourse extent and aquatic ecological values.	Unavoidable loss of 527 m length of watercourse and aquatic ecological values.	No residual effects.	Unavoidable loss of 0.44 wetland extent and aquatic ecological values.
Freshwater Offset	Values: [Enhance 2,860 m^2 (approx. 2,600 m length)]	Values: [Enhance 1,120 m^2 (approx. 1,900 m length)]	N/A	Values: 2.51 ha 0.30 ha wetland reinstatement & enhancement in

Freshwater Ecology				
	Watercourse: Mangapū Tributary	**Watercourse: Mangapū Stream tributaries 3 and 4**	**Fauna: Fish and koura**	**Wetlands**
Ecological Values	Very high	High	Moderate	Low-moderate
	600 m of ecological value enhancements at headwater tributary of Waipokapū Stream	400 m of ecological value enhancements at Meremere Quarry Stream 2,580 m of stream length of ecological value enhancements at Mangatawhiri River		farm ponds at Hunua Rd 2 ha wetland restoration on alluvial terraces at Hunua Regional Park
Freshwater Compensation	Extent of watercourse available following improvements to fish passage: 600 m of stream accessible inland for migratory climbing fish at Waipokapū Stream headwater. At least 1,915 m of stream accessible inland for migratory climbing fish at Meremere Quarry Stream Aquatic Values: Removal of fish barriers to enable extent of penetration to headwater habitat by native fish Native vegetation (as per terrestrial offset) to create headwater catchment benefit and improved water quality as it enters downstream at Waipokapū Stream. Native vegetation (as per terrestrial offset) to create headwater catchment benefit and improved water quality as it enters downstream at Meremere Quarry Stream and ultimately to the RAMSAR-listed Whangamarino Swamp. Enhanced connection of Meremere Quarry Stream with the RAMSAR-listed Whangamarino Wetland.		N/A	Enhancement of 0.03 ha of wetland around farm ponds at Hunua Rd Enhancement of 0.15 ha of wetland at Meremere Quarry

Freshwater Ecology				
	Watercourse: Mangapū Tributary	**Watercourse: Mangapū Stream tributaries 3 and 4**	**Fauna: Fish and koura**	**Wetlands**
Ecological Values	Very high	High	Moderate	Low-moderate
Outcome	Effects management hierarchy is satisfied, with overall net gain of freshwater ecological values and opportunity to access a greater extent of freshwater features.			

Table 38: Summary of status of freshwater ecology following the application of effects management.

Freshwater management	**Wetlands**	**Watercourses**
Ecological feature	Forest seepages	Permanent and intermittent watercourses
Ecological values	High	High
Loss of extent and values of freshwater feature	Loss of 0.44 ha of wetland, offset by 2.4 ha of wetland restoration, enhancement and development (fully offset)	Realignment of 570 m of watercourse. Loss of 1,157 m length of watercourse, offset by provision of 3,938 m^2 of enhanced aquatic ecological values. 4,000 m of extent of watercourse connected for migratory climbing fish access that is currently denied including to and from downstream RAMSAR-listed Whangamarino Wetland.
Fish passage	N/A	Improvement to fish barriers and connectivity at headwater tributary of Waipokapū Stream. Improvement to fish barrier at Meremere Quarry Stream and establishment of connection to and from Whangamarino wetland.
Water quality	Planting pasture in forest species: reductions in nutrients, sediments and temperature to and within wetlands.	Planting pasture in forest species: reductions in nutrients, sediments and temperature to downstream environments.
Summary	Wetland ecology values are maintained and enhanced through full offset at a factor of 5x the area lost to Hunua Quarry development.	Freshwater ecology values are maintained and enhanced through offsetting the majority of stream aquatic values removed, and compensation for loss of stream extent as well as provision of enhanced connectivity and water quality that more than provides for the shortfall in offset area, leading to an

	overall net gain for the extent of freshwater and ecological values.

14.0 Concluding Comments

This report provides an assessment of the ecological values of the location and the potential and actual effects of the proposed Hunua Quarry Development expansion on these values. The location of the aggregate will mean the loss of indigenous vegetation and the removal of wetlands and watercourses. Key fauna will be salvaged and relocated, and part extent and values of the watercourse will be realigned.

The remaining residual effects of loss of indigenous vegetation, wetlands and watercourses will be managed through application of the effects management hierarchy with a package of offset and compensation measures.

Effects management is focused on an integrated offset and compensation outcome over three Focus Areas with similar attributes. These Focus Areas have the potential to become biodiversity hubs in their own right within their respective landscapes.

Overall, subject to the implementation of the recommended effects management actions, the ecological effects associated with the Hunua Quarry Development will result in no net loss of terrestrial, wetland and aquatic habitat extent or values, and positive effects that outweigh adverse effects, equating to a net positive gain, in accordance with aquatic and indigenous biodiversity offsetting and compensation principles.

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Appendix 1: Expert Summary Statement

Dr Ian Boothroyd: Statement of Qualifications & Experience

I am a Senior Principal Ecologist at Boffa Miskell Limited. Boffa Miskell is a multi-disciplinary environmental consultancy specialising in planning, urban design, landscape design, ecology, biosecurity and engagement. I have been employed at Boffa Miskell since June 2014.

I hold the qualifications of BSc (Hons) Manchester University 1977), MSc Applied Hydrobiology (University of Wales, 1980) and DPhil (Waikato University, 1988). I am an appointed Fellow of both the Royal Society of Biology (FRSB) and the Environment Institute of Australia and New Zealand (FEIANZ), a life member of the New Zealand Freshwater Sciences Society, and a member of the Resource Management Law Association. I am a Certified Environmental Practitioner (CEnvP, Ecology).

I have 40 years of professional experience in the field of resource management, including roles as Manager Environmental Monitoring and Compliance (Hawke's Bay Regional Council), Research Director (NIWA), Senior Lecturer (University of Auckland, and as a consultant environmental practitioner for 25 years. I am also an experienced independent environmental commissioner and appointed as a Freshwater Commissioner by the New Zealand government.

My experience includes environmental assessment and management and decision-making in the New Zealand environment, and I am familiar with environmental protocols, criteria and performance standards. I have led multidisciplinary teams for large and often complex projects. My experience extends to large land management and subdivision projects, designations, renewable energy, roading, mining, quarrying, water treatment, biodiversity management and offsets, multi-criteria assessments through to investigations and assessments, consent conditions, fast track applications and presentation of expert evidence at hearings, Environment Court and Boards of Inquiry.

I am also an experienced independent environmental commissioner and appointed as a Freshwater Commissioner by the New Zealand government. My experience includes environmental assessment and management and decision-making in the New Zealand environment, and I am familiar with environmental protocols, criteria and performance standards. I have led multidisciplinary teams for large and often complex projects.

I confirm that, in my capacity as co-author and reviewer of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

Ian Boothroyd, March 2026

Dr Sarah Flynn: Statement of Qualifications & Experience

I am a Senior Principal Ecologist with Boffa Miskell Limited. I have worked as a terrestrial ecologist for over 30 years, joining Boffa Miskell in 2014.

I hold the qualifications of Bachelor of Science (Botany), Master of Science with Honours (Botany) and Doctor of Philosophy (Environmental Science) from the University of Auckland.

I have been involved in ecological assessments in relation to the Application since 2025. My involvement has included site assessment, data analysis, technical advice and review, and report preparation for assessments relating to terrestrial vegetation, wetlands and terrestrial fauna.

While my areas of technical specialisation are botany and plant ecology, I am an experienced consultant ecologist with a strong background in ecological effects assessment and environmental risk management, specialising in evaluating the impacts of infrastructure and development projects on terrestrial and wetland ecosystems. I am skilled in interpreting ecological data, applying evidence-based mitigation strategies, and designing and implementing monitoring frameworks to support evidence-based decision-making, regulatory compliance and biodiversity conservation across a range of ecological disciplines.

In the course of my work, I have prepared numerous ecological assessments including for major infrastructure projects, undertaken district-wide surveys to identify Significant Natural Areas, undertaken a variety of projects pertaining to ecosystem restoration and management, and provided ecology-related strategic and policy advice for a wide range of clients around New Zealand, including local authorities, land developers, infrastructure and power sectors, including wind farm projects. My experience includes close collaboration with subject matter experts to develop risk assessment frameworks to assess and manage project-specific effects related to specialised fields (e.g., biosecurity, threatened fauna).

I confirm that, in my capacity as co-author and reviewer of this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

Sarah Flynn, March 2026

Katherine Muchna: Statement of Qualifications & Experience

I am currently employed as a Senior Ecologist / Senior Principal with Boffa Miskell Limited (Boffa Miskell), a national multi-disciplinary environmental planning and design consultancy. I hold the qualifications of Bachelor of Science (Ecology and Chemistry) from the University of Otago, and a Master of Science (Environmental Science) from the University of Auckland. I am a Certified Environmental Practitioner with the Environment Institute of Australia and New Zealand (EIANZ), and a member of the Society for Research of Amphibians and Reptiles (SRARNZ). I have practiced as a full-time consultant ecologist for 20 years. I joined Boffa Miskell's Auckland office in 2014. In this role I provide ecological consultancy services to a wide range of clients in the specialist area of herpetofauna (lizards and frogs). I have published ecological research relating to native frogs in national peer-reviewed journals in my role as an academic supervisor. I confirm that, in my capacity as contributor to this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

Katherine Muchna, March 2026

Katrina McDermott: Statement of Qualifications & Experience

I am Principal Ecologist at Boffa Miskell Limited. Boffa Miskell is a multi-disciplinary environmental consultancy specialising in planning, urban design, landscape design, ecology, biosecurity and engagement. I have been employed at Boffa Miskell since November 2016. I hold the qualifications of BSc (Hons) (University of Auckland 2009) and a MSc (Hons) (University of Auckland 2010). I am a certified Environmental Practitioner (CEnvP), and a member of the New Zealand Freshwater Sciences Society and the Coastal Science Society. I have 15 years of professional experience as a consultant environmental practitioner. My experience includes environmental impact assessments across subdivision, mining, roading, quarrying and forestry, through to catchment-wide monitoring and feature mapping. I have completed the Auckland Council Stream Ecological Valuation (SEV) training course and have extensive experience undertaking SEV surveys and the implementation of the Environmental Compensation Ratio used for mitigating stream loss. I can confirm that, in my capacity as author of this report, I have abided by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

Katrina McDermott, March 2026.

<u>Dr Ashley Flood: Statement of Qualifications and Experience</u>

I am an Associate Principal Ecologist at Boffa Miskell Limited. Boffa Miskell is a multi-disciplinary environmental consultancy specialising in planning, urban design, landscape design, ecology, biosecurity and engagement. I have been employed at Boffa Miskell since September 2021. I hold the qualifications of BSc Double Major in Biological Sciences and Marine Science (University of Auckland, 2014), PGDipSci in Marine Sciences (Distinction, University of Auckland, 2015), MSc in Marine Science (Hons 1*st*, University of Auckland, 2017) and a PhD in Marine Sciences (University of Auckland, 2021). I am a Certified Environmental Practitioner (CEnvP). My consultancy experience includes assessing ecological values and providing advice on a range of projects in the marine, freshwater, and terrestrial ecology disciplines. I can confirm that, in my capacity as contributor to this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

Ashley Flood, March 2026

<u>Victoria Smith: Statement of Qualifications and Experience</u>

I am a Professional Ecologist at Boffa Miskell Limited. Boffa Miskell is a multi- disciplinary environmental consultancy specialising in planning, urban design, ecology and biosecurity and engagement. I have been employed at Boffa Miskell since April 2023. I hold the qualifications of BSc Double Major in Biological Science and Environmental Science (University of Auckland, 2020), PGDipSci in Biosecurity and Conservation (University of Auckland, 2021) and a MSc in Biosecurity and Conservation (First Class Hons, University of Auckland, 2022). My consultancy experience includes the production and implementation of native bird and bat management plans, as well as assessing native bird and bat values and effects. I confirm that, in my capacity as a contributor to this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

Victoria Smith, March 2026.

Hannah Cole: Statement of Qualifications and Experience.

I am a Senior Geospatial Specialist at Boffa Miskell Limited. Boffa Miskell is a multi-disciplinary environmental consultancy specialising in planning, urban design, landscape design, ecology and biosecurity and engagement. I have been employed at Boffa Miskell since July 2021. I hold the qualifications of BSc Double Major in Geography and Earth Science (University of Auckland, 2018). I have five years of experience in consultancy, nine years of professional experience in the geospatial industry. My experience has primarily been within ecology and biosecurity spheres, leading the delivery of technical GIS elements, developing tools for field collection, analysis and ecosystem mapping.

I confirm that, in my capacity as a contributor to this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023. Victoria Smith, March 2026.

Hannah Cole, March 2026

Lauren Mackenzie: Statement of Qualifications and Experience

I am a Professional Ecologist and Biosecurity Consultant at Boffa Miskell Limited. Boffa Miskell is a multi-disciplinary environmental consultancy specialising in planning, urban design, landscape design, ecology, biosecurity and engagement. I have been employed at Boffa Miskell since January 2024. I hold the qualifications of BSc in Ecology (The University of Auckland, 2020), PGDipSci Biosecurity and Conservation (Distinction, The University of Auckland, 2021), and MSc Biosecurity and Conservation (1^{st} Class Hons, The University of Auckland, 2022). My experience includes ecological assessments and contributions to management and decision-making in the New Zealand environment, with a particular focus on botany, wetlands, biosecurity and fauna. I confirm that, in my capacity as a contributor to this report, I have read and abide by the Environment Court of New Zealand's Code of Conduct for Expert Witnesses Practice Note 2023.

Lauren Mackenzie, March 2026.

Alice Dee: Statement of Qualifications and Experience

I am a Graduate Ecologist at Boffa Miskell Limited; my employment began in April 2025. Boffa Miskell is a multi-disciplinary consultancy working in ecology, engagement, biosecurity, landscape design, planning and urban design. I have a BSc Double Major in Oceanography and Geology from University of Otago, 2021. My Professional memberships include The Society for Research of Amphibians and Reptiles, New Zealand Ecological Society, and Environment Institute of Australia and New Zealand Inc.

I have over two years' experience in ecological consulting, including a role as on-site freshwater lead for a large roading project. Between 2022- 2024 I worked for environmental and engineering consultancy Tonkin and Taylor. I have gained lizard and bat ecological experience throughout my career. My frog experience comes from volunteer research in Australia for the Australian Museum and consultancy through Boffa Miskell. My scope has ranged from a complex large-scale roading project, containing many teams and dynamic environmental landscapes, to quarries, mines, water treatment, subdivisions, and large renewable energy projects. I have carried out assessment and management of ecosystems based on environmental protocols, consent conditions, and criteria.

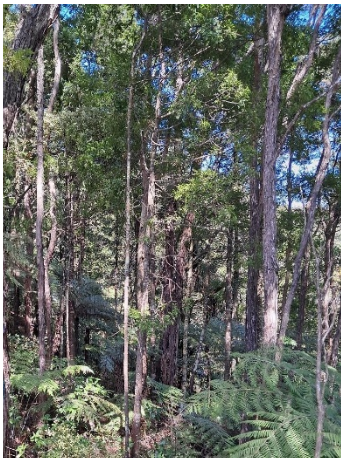
I confirm that in my capacity as contributor to this report, I have read and abide by the Environmental Court of New Zealand's Code of Conduct and Expert Witnesses Practice Note 2023.

Alice Dee, March 2026.

Appendix 2: Herpetology - Lizard transects



Transect 1: Mature Kanuka with silverfern understory. Some hangehange, gahnia and sapling scrub growing in canopy gaps between mature canopy trees.



Transect 2: Mixed kanuka and podocarp. Understory dominated by silver fern, kanono, hangehange, and toropapa. Some keikei along gulley sides.

Transect 3: Broadleaf forest (tawa, taraire, kohekohe). Nikau, silverfern, mahoe, supplejack and hangehange dominated understory.

Transect 4: Mature gulley species (Rimu, Puriri, Kahikatae) and kanuka. Silver fern, hangehange, nikau dominated understory.

Tree fern-dominated regenerating forest

Mature kanuka with fern-dominated understory

Taraire, tawa, podocarp forest

Bracken, rank grass



Native early succession broadleaf / weedy scrub mix

Appendix 3: Deployment of Bat Acoustic Recorders

Recorder ID	Location	Bats Y/N	Comments
10890	Manuka scrub - north	N	Outside the confirmed expansion area
1265	Dominant taraire, tawa	N	Within expansion area
1700	Scrub/ native bush	N	Just within expansion area
1267	Edge of paddock / gorse / manuka	N	Outside the confirmed expansion area
1847	Pit edge	N	Within expansion area
4723	Scrub / open ground	N	Outside the confirmed expansion area
10874	Native forest / stream edge	N	Outside the confirmed expansion area
12421	Manuka scrub / track edge	N	Outside the confirmed expansion area
10879	Native bush - south - near stream	N	Within expansion area
12440	Gorse and scrub	N	Within expansion area
1853	Native bush - south	N	Within expansion area
1979	Native bush - most southerly point	N	Within expansion area
1833	Manuka scrub,/ track edge	N	Outside the confirmed expansion area
355	Along track / regenerating veg	N	Outside expansion area
12416	Gorse, pampas, track edge	N	Within expansion area
1800	Pit edge – northern (Hunua) pit	N	Outside the confirmed expansion area
1342	Native regeneration	N	Outside the confirmed expansion area
1318	Native bush - south	N	Within expansion area
12373	Manaku, ferns, mahoe	N	Outside the confirmed expansion area
12442	Mamaku	N	Within expansion area
10881	Manuka / gorse	N	Within expansion area
10987	Native forest / stream edge	N	Within expansion area

Appendix 4: Stream Assessment Methods

Stream Ecological Valuation

The SEV is recommended by Auckland Council for providing an ecological valuation of streams. The SEV uses a set of fourteen qualitative and quantitative variables to assess the integrity of stream ecological functions (Table 4-1). Field work consists of a comprehensive assessment of the in-stream and riparian environment. This typically includes a fish survey, aquatic macroinvertebrate sampling and cross-sections of the stream to measure width, depth and substrate, as well as using qualitative parameters for reach-scale attributes. We relied on eDNA for presence of fish, and in conjunction with field samples, for macroinvertebrates.

Table 4-1: Summary of the 14 ecological functions used to calculate the SEV score.

Hydraulic functions:	Biogeochemical functions:
Processes associated with water storage, movement and transport. • Natural flow regime • Floodplain effectiveness • Connectivity for species migrations • Natural connectivity to groundwater	Relates to the processing of minerals, particulates and water chemistry. • Water temperature control • Dissolved oxygen levels maintained • Organic matter input • In-stream particle retention • Decontamination of pollutants
Habitat provision:	**Biotic functions:**
The types, amount and quality of habitats that the stream reach provides for flora and fauna. • Fish spawning habitat • Habitat for aquatic fauna	The occurrences of diverse populations of native plants and animals that would normally be associated with the stream reach. • Fish fauna intact • Invertebrate fauna intact • Riparian vegetation intact

This data is analysed using a series of formulae in order to produce an SEV score of between 0-1, where a 0 is a stream with no ecological value and 1 is a pristine stream with maximum ecological value. Interpretation of SEV scores is given in the Table 4-2 below.

Table 4-2. Interpretation of SEV scores.

Score	Category
0 - 0.40	Poor
0.41 – 0.60	Moderate
0.61 – 0.80	Good
0.81+	Excellent

Ecological Compensation Ratio

To calculate the amount of enhancement required to mitigate the impacts of streamworks an environmental compensation ratio (ECR) was calculated.

The environmental compensation ratio utilises the SEV score to calculate a ratio for the minimum area to be restored as mitigation for unavoidable stream loss. The ECR has the underlying principle of 'not net loss' and is based upon 'no net loss of area-weight stream function'. A minimum ratio of compensation of 1:1 is required.

The formula for calculating the ECR is as below:

- *ECR = [(SEVi-P – SEVi-I)/(SEVm-P – SEVm-C)] x 1.5*
- *SEVi-C & SEVi-P are the current and potential SEV values respectively for the site to be impacted.*
- *SEVm-C & SEVm-P are the current and potential SEV values respectively for the site where environmental compensation is to be applied.*
- *SEVi-I is the predicted SEV value of the stream to be impacted, after impact.*
- *1.5 is a multiplier.*

The ECR calculation requires the prediction of a 'potential' and 'impact' SEV scores. The potential scores for impact sites assume that best practise enhancement works have been undertaken. The prediction of the impact scores assume that the proposed streamworks have been undertaken. The generally accepted SEV score for culverts is 0.2. The predicted potential and impact scores do not include biotic functions (invertebrate fauna intact and fish fauna intact) as they are too difficult to predict.

The ECR considers that environmental compensation ratios greater than 1 are valid because of:

- The ecological risk factors associated with the cumulative loss of streams and the steady change in areal distribution of high-quality stream reaches;
- The long time-lag before full benefits of environment compensation (i.e. from riparian planting) accrue to the mitigated sites; and
- The overall difference between the expected and actual success of stream restoration methods.

Biological Indices

Macroinvertebrate Community Index

The Macroinvertebrate Community Index (MCI) score is a biotic index that can be used as an indicator of stream water quality. It relies on the fact that biological communities are a product of their environment – with different organisms having different habitat preferences and pollution tolerances (Stark & Maxed 2007). The MCI involves assigning tolerance values to all taxa based on their tolerance to pollution. Taxa that are characteristic of pristine conditions score higher than taxa that are predominantly found in polluted conditions, where 0.1 is the lowest and 10 is the highest. The final MCI scores are calculated using presence-absence data, with the scores range from 0 to 200, with streams with no taxa present scoring 0 and streams in exceptionally pristine conditions scoring 200 (Stark 1993).

***Table 3-3**. Interpretation of MCI scores. From Stark and Maxted 2007.*

Quality Class	Descriptions	MCI or MCI-sb Score
Excellent	Clean Water	> 119
Good	Doubtful quality or possible mild pollution	100 – 119
Fair	Probably moderate pollution	80-99
Poor	Probably severe pollution	<80

Other Indices

EPT taxa refers to the number of taxa present from within three generally pollution-sensitive orders of insects; Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies). The caddisfly species *Oxyethira* and *Paroxyethira* were excluded from EPT calculations as they are considered to be generally pollution tolerant.

Appendix 5: Plant species recorded in vegetation surveys

Species name (*)	Common name	National Threat Status[18]	Auckland Threat Status [19]
Acaena novae-zelandiae	Red Bidibid	Not Threatened	Not Threatened
Acianthus sinclairii	Heart-leaved Orchid	Not Threatened	Not Threatened
Agathis australis	Kauri	At Risk - Declining	At Risk - Declining
*Allium triquetrum**	Onion Weed		
Alseuosmia macrophylla	Toropapa	Not Threatened	Not Threatened
Aristotelia serrata	Wineberry	Not Threatened	Not Threatened
Asplenium bulbiferum	Hen And Chicken Fern	Not Threatened	Not Threatened
Asplenium flaccidum	Drooping Spleenwort	Not Threatened	Not Threatened
Asplenium oblongifolium	Shining Spleenwort	Not Threatened	Not Threatened
Asplenium polyodon	Sickle Spleenwort	Not Threatened	Not Threatened
Astelia hastata	Tank Lily	Not Threatened	Not Threatened
Astelia solandri	Perching Lily	Not Threatened	Not Threatened
Beilschmiedia tarairi	Taraire	Not Threatened	Not Threatened
Beilschmiedia tawa	Tawa	Not Threatened	Not Threatened
Blechnum chambersii	Lance Fern	Not Threatened	Not Threatened

Blechnum filiforme	Thread Fern	Not Threatened	Not Threatened
Diploblechnum fraseri		Not Threatened	Not Threatened
Blechnum novae-zelandiae	Kiokio	Not Threatened	Not Threatened
Brachyglottis repanda	Rangiora	Not Threatened	Not Threatened
Caladenia species			
Carex banksiana	Fine-leaved Bastard Grass	Not Threatened	Not Threatened
Carex flagellifera	Glen Murray Tussock	Not Threatened	Not Threatened
Carex forsteri	Forster's sedge	Not Threatened	Threatened - Regionally Endangered
Carpodetus serratus	Putaputawētā / Marble Leaf	Not Threatened	Not Threatened
Carex sinclairii	Sinclair's Sedge	Not Threatened	Data Deficient - Data Deficient
Carex uncinata	Bastard grass	Not Threatened	Not Threatened
*Cenchrus clandestinus**	Kikuyu Grass		
Centella uniflora	Centella	Not Threatened	Not Threatened
Chiloglottis cornuta	Bird orchid	Not Threatened	At Risk - Naturally Uncommon
Clematis paniculata	White Clematis	Not Threatened	Not Threatened
Coprosma arborea	Mamangi	Not Threatened	Not Threatened
Coprosma grandifolia	Kanono	Not Threatened	Not Threatened
Coprosma lucida	Shining Karamu	Not Threatened	Not Threatened
Coprosma rhamnoides	Mikimiki	Not Threatened	Not Threatened

Coprosma spathulata subsp. spathulata		Not Threatened	Not Threatened
Cordyline australis	Ti Kōuka / Cabbage Tree	Not Threatened	Not Threatened
Cordyline banksii	Ti Ngahere	Not Threatened	Not Threatened
Corybas "Kaimai"	Spider Orchid	Not Threatened	Not Assigned - NA
Corynocarpus laevigatus	Karaka	Not Threatened	Not Threatened
Corybas macranthus	Silver-back Spider Orchid	Not Threatened	Not Threatened
*Cortaderia selloana**	Pampas Grass		
Cyathea dealbata	Silver Fern	Not Threatened	Not Threatened
Cyathea medullaris	Mamuku	Not Threatened	Not Threatened
Dacrydium cupressinum	Rimu	Not Threatened	Not Threatened
Dacrycarpus dacrydioides	Kahikatea	Not Threatened	Not Threatened
*Dactylis glomerata**	Cocksfoot		
Deparia petersenii subsp. congrua		Not Threatened	Not Threatened
Dianella nigra	Turutu	Not Threatened	Not Threatened
Dicksonia squarrosa	Rough Tree Fern	Not Threatened	Not Threatened
Didymocheton spectabilis	Kohekohe	Not Threatened	Not Threatened
*Digitalis purpurea**	Foxglove		
Drymoanthus adversus	Drymoanthus	Not Threatened	Not Threatened
Earina mucronata	Bamboo Orchid	Not Threatened	Not Threatened
Elatostema rugosum	Parataniwha	Not Threatened	Not Threatened

Freycinetia banksii	Kiekie	Not Threatened	Not Threatened
Fuscospora truncata	Hard beech	Not Threatened	At Risk - Declining
Gahnia lacera	Cutty Grass	Not Threatened	Not Threatened
Gahnia xanthocarpa	Gahnia	Not Threatened	Not Threatened
Geniostoma ligustrifolium var. ligustrifolium	Hangehange	Not Threatened	Not Threatened
Gonocarpus species			
Griselinia lucida	Puka	Not Threatened	Not Threatened
Haloragis erecta subsp. erecta	Toatoa	Not Threatened	Not Threatened
Hedycarya arborea	Pigeonwood	Not Threatened	Not Threatened
Histiopteris incisa	Water Fern	Not Threatened	Not Threatened
Hiya distans		Not Threatened	At Risk - Declining
Hymenophyllum demissum	Drooping Filmy Fern	Not Threatened	Not Threatened
Hymenophyllum flabellatum	Fan-Like Filmy Fern	Not Threatened	Not Threatened
Juncus polyanthemus		Non-resident Native - Coloniser	
Knightia excelsa	Rewarewa	Not Threatened	Not Threatened
Kunzea ericoides	Kānuka	Not Threatened	Not Threatened
Lastreopsis hispida	Hairy Fern	Not Threatened	Not Threatened
Laurelia novae-zelandiae	Pukatea	Not Threatened	Not Threatened
Lecanopteris pustulata	Hound's Tongue	Not Threatened	Not Threatened

Leptopteris hymenophylloides	Crepe Fern	Not Threatened	Not Threatened
Leptospermum scoparium	Mānuka	Not Threatened	Not Threatened
Leucopogon fasciculatus	Tall Mingimingi	Not Threatened	Not Threatened
*Ligustrum lucidum**	Tree Privet		
*Ligustrum sinense**	Chinese Privet		
Lindsaea trichomanoides		Not Threatened	Not Threatened
Litsea calicaris	Mangeao	Not Threatened	At Risk - Declining
*Lonicera japonica**	Japanese Honeysuckle		
*Lotus pedunculatus**	Lotus		
Loxogramme dictyopteris	Lance Fern	Not Threatened	Not Threatened
Lygodium articulatum	Mangemange	Not Threatened	Not Threatened
Melicytus ramiflorus subsp. ramiflorus	Māhoe	Not Threatened	Not Threatened
Melicope simplex	Poataniwha	Not Threatened	Threatened - Regionally Endangered
Metrosideros colensoi	Rata	Not Threatened	Data Deficient - Data Deficient
Metrosideros fulgens	Rata	Not Threatened	Not Threatened
Metrosideros perforata	Akatea	Not Threatened	At Risk - Declining
Microlaena avenacea	Bush Rice Grass	Not Threatened	Not Threatened
Lecanopteris scandens	Fragrant Fern	Not Threatened	Not Threatened
Myrsine australis	Red Māpou	Not Threatened	Not Threatened
Nertera dichondrifolia		Not Threatened	Not Threatened

Nestegis cunninghamii	Black Maire	Not Threatened	Threatened - Regionally Endangered
Olearia rani var. rani	Heketara	Not Threatened	Not Threatened
Oplismenus hirtellus subsp. imbecillis		Not Threatened	Not Threatened
Paesia scaberula	Lace Fern	Not Threatened	Not Threatened
Pakau pennigera	Gully Fern	Not Threatened	Not Threatened
Parapolystichum glabellum	Smooth Shield Fern	Not Threatened	Not Threatened
Passiflora tetrandra	Kōhia / Native Passion Vine	Not Threatened	Not Threatened
*Phytolacca octandra**	Inkweed		
Phyllocladus trichomanoides	Tanekaha	Not Threatened	Not Threatened
*Pinus radiata**	Radiata Pine		
Piper excelsum subsp. excelsum	Kawakawa	Not Threatened	Not Threatened
Pittosporum tenuifolium	Kōhūhū	Not Threatened	Not Threatened
Podocarpus totara var. totara	Tōtara	Not Threatened	Not Threatened
Polyphlebium venosum	Veined Bristle Fern	Not Threatened	Not Threatened
Pectinopitys ferruginea	Miro	Not Threatened	Not Threatened
*Prunella vulgaris**	Selfheal		
Pseudopanax crassifolius	Lancewood	Not Threatened	Not Threatened
Pterostylis banksii	Tutukiwi	Not Threatened	Not Threatened
Pteridium esculentum	Bracken	Not Threatened	Not Threatened
Pteris tremula	Shaking Or Tender Brake	Not Threatened	Not Threatened

Ptisana salicina	King Fern	At Risk - Declining	At Risk - Declining
Pyrrosia eleagnifolia	Leather-leaf Fern	Not Threatened	Not Threatened
Rhopalostylis sapida	Nikau	Not Threatened	Not Threatened
Ripogonum scandens	Supplejack	Not Threatened	Not Threatened
Rumohra adiantiformis	Leathery Shield Fern	Not Threatened	Not Threatened
Schoenus apogon		Not Threatened	Not Threatened
Schefflera digitata	Patē / Seven Finger	Not Threatened	Not Threatened
Schoenus maschalinus	Dwarf Bog Rush	Not Threatened	Not Threatened
Schoenus tendo	Kauri Sedge	Not Threatened	Not Threatened
*Selaginella kraussiana**	Selaginella		
Syzygium maire	Swamp Maire	Threatened - Nationally Vulnerable	Threatened - Regionally Critical **Note: Found outside expansion area.**
Tmesipteris elongata	Fork Fern	Not Threatened	Not Threatened
*Ulex europaeus**	Gorse		
Vitex lucens	Puriri	Not Threatened	Not Threatened
Libocedrus plumosa	Kawaka	Not Threatened	At Risk - Declining

Appendix 6: Elegant gecko salvage records

During ecological surveys associated with the Assessment of Environmental Effects conducted by Bioresearches Ltd (2007), a population of Auckland green gecko (*Naultinus elegans elegans*), now known as the elegant gecko, was discovered in the then proposed stage 5 quarry footprint. The elegant gecko is classified as At Risk-Declining (Hitchmough et al 2026) and all lizards and geckos are absolutely protected by the Wildlife Act 1953. Elegant gecko occurs within kānuka shrublands and forest throughout the Symonds Hill area, within vegetation types very similar to those within the proposed quarry expansion and access road route. Accordingly, these geckos are almost certain to be in areas of kānuka vegetation within the proposed works footprint.

Resource consents 34132 and LU 8730 issued for the development of the Symonds Hill Extraction Area required that a Lizard Relocation Plan be developed and implemented. The methods for salvage, capture and relocation are described in a Lizard Relocation Plan (LRP) and which is used as a guide for lizard salvage from the pit development footprint.

The results of salvage and relocation of elegant geckos at Symonds Hill are provided in **Table 5**.

For the 2018 salvage operations, RMA Ecology (2018) report that all geckos were caught from tall kānuka trees with geckos at heights between 7 m and 10 m. This is despite the abundance of mature and sapling mānuka, and abundant other native species within patches or nearby. No other geckos or skinks were observed or captured within the proposed clearance areas. In their conclusion to the 2025 salvage operations report, RMA Ecology (2025) stated that the two elegant geckos were both found within mature kānuka forest, confirming this habitat type as the highest quality within the current vegetation clearance footprint.

Table 5: Summary statistics of elegant geckos salvaged from Symonds Hill, 2011 to 2025 (from RMA Ecology 2018 and 2025).

Year	Gender[1]		Reproductive status			Person search hours	Search efficiency[2]
	Male	Female	Juvenile	Sub-adult / Adult	Gravid		
2011	15	19	11	16	11	142	3.9
2014	24	25	17	24	8	484	9.3
Feb 2016	6	6	0	7	5	137.5	11.5
Oct 2016	0	5	0	4	1	55.5	11.1
Nov 2016	1	6	3	0	7	37	3.4
Dec 2016	3	1	0	0	0	47	11.8
Feb 2018	0	2	0	0	1	35.8	17.9
Feb 2019	3	2	0	4	1	24	4.8
Feb 2020	1	0	0	1	0	44.5	44.5
Feb 2022	0	0	0	0	0	15.25	N/A

Year	Gender[1]		Reproductive status			Person search hours	Search efficiency[2]
	Male	Female	Juvenile	Sub-adult / Adult	Gravid		
Feb 2024	0	0	0	0	0	12	N/A
Apr 2025	2	0	0	2	0	24	12

[1] Gender was not able to be determined for three geckos during salvaging in 2014 and four geckos in 2011. [2] Person hours search for each gecko.

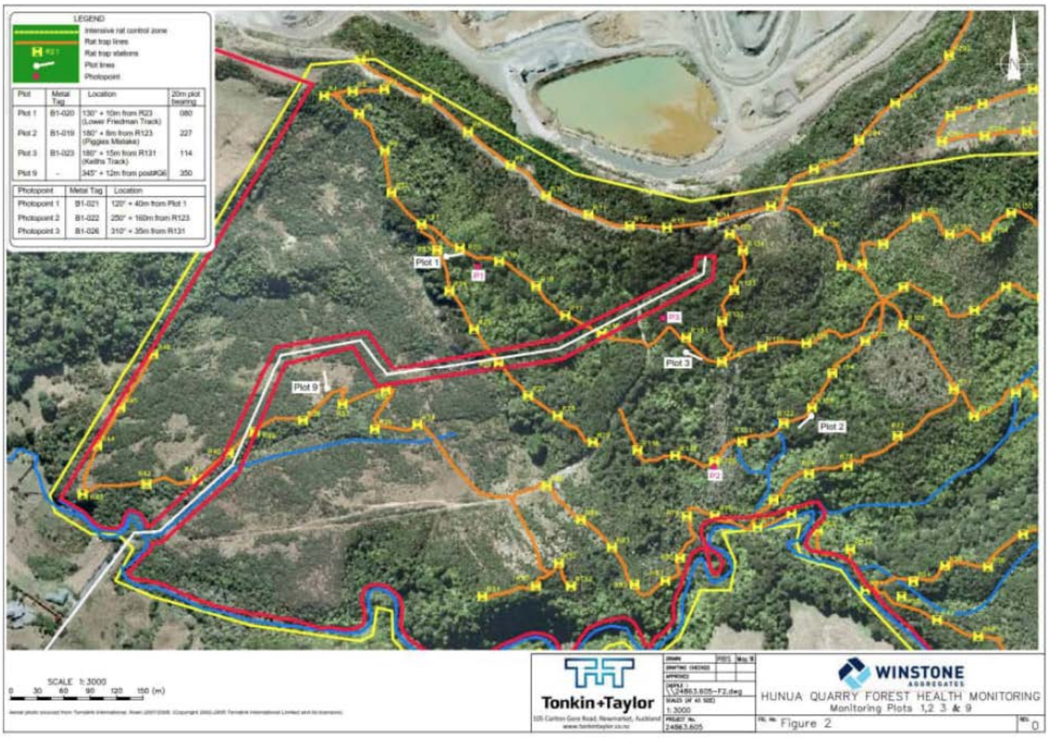
Appendix 7: Avifauna Desktop Assessment

Species list	Scientific Name	Conservation status (Robertson et al. 2021)	Native forest	Exotic Forest	Scrub / shrubland	Farmland / open country	Freshwater / wetlands	Coastal / Estuary	Oceanic	Urban/Residential	OSNZ Bird Atlas AE 69 - 70	eBird with 10 km of site	BioResearches AEE 2007	BML 2025 surveys
New Zealand dabchick	Poliocephalus rufopectus	Threatened - Nationally Increasing									✓	✓		✓
Grey duck	Anas superciliosa	Threatened - Nationally Vulnerable									✓	✓		
Wrybill	Anarhynchus frontalis	Threatened - Nationally Increasing									✓			
Caspian tern	Hydroprogne caspia	Threatened - Nationally Vulnerable									✓	✓		
White heron	Ardea alba	Threatened - Nationally Critical									✓	✓		
Long-tailed cuckoo	Eudynamys taitensis	Threatened - Nationally Vulnerable									✓	✓		
Australasian bittern	Botaurus poiciloptilus	Threatened - Nationally Critical										✓		
New Zealand falcon	Falco novaeseelandiae	Threatened - Nationally Increasing										✓		
North Island kōkako	Callaeas wilsoni	Threatened - Nationally Increasing										✓		
Pacific reef heron	Egretta sacra	Threatened - Nationally Endangered										✓		
Banded dotterel	Anarhynchus bicinctus	At Risk - Declining										✓		
New Zealand dotterel	Anarhynchus obscurus	At Risk - Recovering									✓	✓		
New Zealand pipit	Anthus novaeseelandiae	At Risk - Naturally Uncommon									✓	✓		✓
New Zealand Kaka	Nestor meridionalis septentrionalis	At Risk - Recovering									✓	✓		
Pied Cormorant	Phalacrocorax varius	At Risk - Recovering									✓	✓		
Great Cormorant	Phalacrocorax carbo	At Risk - Relict									✓	✓		✓
Little Pied Cormorant	Phalacrocorax melanoleucos	At Risk - Relict									✓	✓		✓
Little black Cormorant	Phalacrocorax sulcirostris	At Risk - Naturally Uncommon										✓		
Banded rail	Gallirallus philippensis	At Risk - Declining									✓	✓		
Spotless crake	Zapornia tabuensis	At Risk - Declining									✓	✓		
South Island oystercatcher	Haematopus finschi	At Risk - Declining									✓	✓		
Variable oystercatcher	Haematopus unicolor	At Risk - Recovering									✓	✓		
Bar-tailed godwit	Limosa lapponica	At Risk - Declining									✓	✓		
Red knot	Calidris canutus	At Risk - Declining									✓	✓		
Silver gull	Chroicocephalus novaehollandiae	At Risk - Declining									✓	✓		
Black-billed gull	Chroicocephalus bulleri	At Risk - Declining									✓	✓		
Royal spoonbill	Platalea regia	At Risk - Naturally Uncommon									✓	✓		
White-fronted tern	Sterna striata	At Risk - Declining										✓		
Eastern Cattle-Egret	Ardea coromanda	Migrant									✓	✓		
Black swan	Cygnus atratus	Not Threatened										✓		
Silvereye	Zosterops lateralis	Not Threatened									✓	✓	✓	✓
Welcome swallow	Hirundo neoxena	Not Threatened									✓	✓	✓	✓
Tomtit	Petroica macrocephala toitoi	Not Threatened									✓	✓		✓
New Zealand fantail	Rhipidura fuliginosa placabilis	Not Threatened									✓	✓	✓	✓
Grey warbler	Gerygone igata	Not Threatened									✓	✓	✓	✓
New Zealand bellbird	Anthornis m. melanura	Not Threatened									✓	✓		
Tui	Prosthemadera n. novaeseelandiae	Not Threatened									✓	✓	✓	✓
Sacred kingfisher	Todiramphus sanctus vagans	Not Threatened									✓	✓	✓	✓
Morepork	Ninox n. novaeseelandiae	Not Threatened									✓	✓		✓
Swamp Harrier	Circus approximans	Not Threatened									✓	✓	✓	✓
White-faced Heron	Egretta novaehollandiae	Not Threatened									✓	✓		✓
Spur-winged plover	Vanellus miles	Not Threatened									✓	✓	✓	✓
Pukeko	Porphyrio melanotus	Not Threatened									✓	✓	✓	✓
Shining cuckoo	Chrysococcyx lucidus	Not Threatened									✓	✓		✓
Kereru	Hemiphaga novaeseelandiae	Not Threatened									✓	✓	✓	✓
Gray teal	Anas gracilis	Not Threatened									✓	✓		
Paradise shelduck	Tadorna variegata	Not Threatened									✓	✓	✓	
Australasian shoveler	Spatula rhynchotis	Not Threatened									✓	✓		
Pied stilt	Himantopus leucocephalus	Not Threatened									✓	✓		✓
Southern black-backed gull	Larus dominicanus	Not Threatened									✓	✓		
Weka	Gallirallus australis	Not Threatened										✓		
Black-tailed godwit	Limosa limosa	Vagrant										✓		
Little Egret	Egretta garzetta	Vagrant									✓	✓		
Eastern curlew	Numenius madagascariensis	Vagrant										✓		
Yellowhammer	Emberiza citrinella	Introduced									✓	✓	✓	✓
European goldfinch	Carduelis carduelis	Introduced									✓	✓		✓
Redpoll	Acanthis flammea	Introduced									✓	✓	✓	
European greenfinch	Chloris chloris	Introduced									✓	✓	✓	✓
Common chaffinch	Fringilla coelebs	Introduced									✓	✓	✓	✓
House Sparrow	Passer domesticus	Introduced									✓		✓	✓
Dunnock	Prunella modularis	Introduced									✓	✓	✓	
Eurasian blackbird	Turdus merula	Introduced									✓	✓	✓	✓
Song Thrush	Turdus philomelos	Introduced									✓	✓	✓	✓
Common myna	Acridotheres tristis	Introduced									✓	✓	✓	✓
European starling	Sturnus vulgaris	Introduced									✓	✓	✓	✓
Eurasian skylark	Alauda arvensis	Introduced									✓	✓	✓	✓
Australian magpie	Gymnorhina tibicen	Introduced									✓	✓	✓	
Eastern rosella	Platycercus eximius	Introduced									✓	✓	✓	✓
Sulphur-crested cockatoo	Cacatua galerita	Introduced									✓	✓		
Spotted dove	Streptopelia chinensis	Introduced									✓	✓		✓
African collared-dove	Streptopelia risoria	Introduced									✓	✓		
Red junglefowl	Gallus gallus	Introduced									✓	✓		
Indian peafowl	Pavo cristatus	Introduced									✓	✓		
Ring-necked pheasant	Phasianus colchicus	Introduced									✓	✓	✓	✓
Wild turkey	Meleagris gallopavo	Introduced									✓	✓		
California quail	Callipepla californica	Introduced									✓	✓	✓	✓
Mallard	Anas platyrhynchos	Introduced									✓	✓		✓
Muscovy duck	Cairina moschata	Introduced									✓			
Canada goose	Branta canadensis	Introduced									✓	✓		
Graylag goose	Anser anser	Introduced									✓	✓		
Rock pigeon	Columba livia	Introduced										✓		

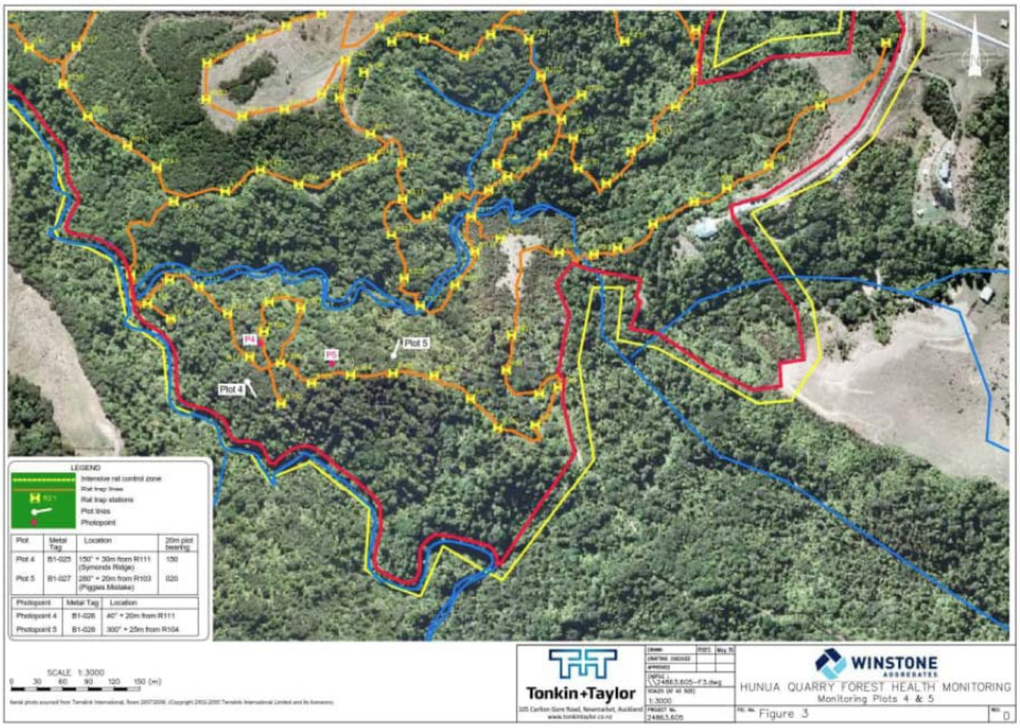
Common name and māori name of bird species

Common name	māori name
New Zealand dabchick	weweia
Grey duck	pārera
Wrybill	ngutu pare
Caspian tern	taranui
White heron	kōtuku
Long-tailed cuckoo	koekoeā
Australasian bittern	matuku-hūrepo
New Zealand falcon	kārearea
North Island kōkako	kōkako
Pacific reef heron	matuku moana
Banded dotterel	pohowera
New Zealand dotterel	tūturiwhatu
New Zealand pipit	pihoihoi
New Zealand Kaka	kākā
Pied Cormorant	kāruhiruhi
Great Cormorant	māpunga
Little Pied Cormorant	kawaupaka
Little black Cormorant	kawau tūī
Banded rail	moho pererū
Spotless crake	pūweto
South Island oystercatcher	tōrea
Variable oystercatcher	tōrea pango
Bar-tailed godwit	kuaka
Red knot	huahou
Red-billed gull	tārapunga
Black-billed gull	tarāpuka
Royal spoonbill	koōtuku ngutupapa
White-fronted tern	tara
Eastern Cattle-Egret	-
Black swan	kakīānau
Silvereye	tauhou
Welcome swallow	warou
Tomtit	miromiro
New Zealand fantail	piwakawaka
Grey warbler	riroriro
New Zealand bellbird	korimako
Tui	tūī
Sacred kingfisher	kōtare
Morepork	ruru
Swamp Harrier	kāhu
White-faced Heron	matuku moana
Spur-winged plover	-
Pukeko	pūkeko
Shining cuckoo	pipiwharauria
Kereru	kererū
Gray teal	tētē-moroiti
Paradise shelduck	pūtangitangi
Australasian shoveler	kuruwhengi
Pied stilt	poaka
Southern black-backed gull	karoro
Weka	weka
Black-tailed godwit	-
Little Egret	-
Eastern curlew	-
Yellowhammer	hurukōwhai
European goldfinch	kōurarini
Redpoll	-
European greenfinch	-
Common chaffinch	pahirini
House Sparrow	tiu
Dunnock	-
Eurasian blackbird	manu pango
Song Thrush	manu-kai-hua-rakau
Common myna	maina
European starling	tāringi
Eurasian skylark	kairaka
Australian magpie	makipai
Eastern rosella	kākā uhi whero
Sulphur-crested cockatoo	-
Spotted dove	-
African collared-dove	-
Red junglefowl	-
Indian peafowl	pikao
Ring-necked pheasant	-
Wild turkey	korukoru
California quail	tikaokao
Mallard	rakiraki
Muscovy duck	-
Canada goose	kuihi
Graylag goose	kuihi
Rock pigeon	kererū aropari

Appendix 8: Forest Health Bird Monitoring Plots



2 Location of plots in Block 1 (kanuka forest).



A3 Location of plots in Block 2 (mature broadleaved forest).

Appendix 9: Bird species recorded in the vicinity of Symonds Hill Pit

Introduced species

Eight of the fifteen introduced species that were detected within the Site have a primary habitat of farmland / open country. Two species are common in urban / residential areas, one inhabits freshwater / wetlands (mallard) and four species utilise scrub/scrubland (Eurasian blackbird, Eastern rosella, ring-necked pheasant and California quail).

None of these species are considered to contribute to the indigenous ecology within and surrounding the Site. Introduced species are not considered further in this assessment.

Not Threatened species

Not Threatened native avifauna are usually sufficiently common, abundant and widespread, that their local, regional and national populations will not be affected by a project. Although the national threat classifications for avifauna (Robertson et al., 2021) largely consider rarity at the national scale, they do not always reflect regional or local rarity. In some cases, species listed as Not Threatened may still play an important role in local ecological processes or contribute significantly to a site's biodiversity. In such instances, these Not Threatened species will be treated as key species for assessment.

Not threatened native species for which there are records within 10 km of the Site but were not detected within the Site during avifauna surveys, are unlikely to be affected by this project and have not been considered further.

When combining the results from all avifauna survey methods, fifteen Not Threatened species were detected within the Site. They can be separated into four broad groups:

Native forest / scrubland species

These are native birds whose primary habitat is indigenous forest and scrubland. The species detected within the Site include tomtit, fantail, tui, kotare, ruru, shining cuckoo, kereru, silvereye, and grey warbler. Of these species the tui, silvereye and grey warbler were the most abundant and conspicuous birds across the Site. These results align with the previous bird surveys in Section 5.2.3.1.

Silvereye, grey warbler, kotare and **fantail** are not considered to be a species of concern as they were observed throughout the Site and outside the footprint of the proposed pit expansion. Native forest and scrubland in the southern end of the Site and outside the proposed pit expansion footprint will provide habitat for dispersal, roosting, foraging and nesting.

Kererū, tūi and **shining-cuckoo** are not considered to be species of concern as they are able to disperse across the site and into the wider landscape. Additionally, the abundance and conspicuousness of grey warbler (the species that the shining cuckoo nest parasitise) provides nesting opportunities for the shining cuckoo to lay their eggs. Kererū were identified in the 2002 report by Bioresearchers as being a key species of note. They were predominantly observed in the south and eastern ends of Symonds Hill Pit.

Tomtit are found in both the North and South Islands and inhabit mature native forest types, including exotic plantation forests. They are present in the Hunua Regional Park and in the mature forest in the southern area of the Site. They are not considered to be species of concern as they were detected on the border of the proposed pit expansion and habitat to the south is available for their dispersal.

Freshwater / wetland species

These are native birds that rely on freshwater habitats for breeding or feeding or are often found near open water or wetland habitat. The species detected within the Site are **kōtare, pūkeko** and **pied stilt.**

Both the kōtare and pūkeko are common, abundant and widespread nationally and across the Auckland region. Their populations are unlikely to be affected by this project.

Pied stilts were observed twice during the survey period, always incidentally. The small number of observations and their absence from the Site reflects the lack of suitable habitat for them to utilise. This species is considered to be unlikely to be affected by this project, at a local or national scale.

Farmland / open country

These are native birds that have adapted to pastoral landscapes (e.g. **harrier hawk, welcome swallow**, and the **spur-winged plover**). These are a widespread and abundant species that have adapted to rural environments, land use and human activity. All three species are considered to be common and widespread at a regional and national scale and as such unlikely to be affected by this project.

Coastal / estuary species

White-faced heron are the only coastal / estuary species recorded within the quarry during the survey period. Only one observation was recorded, and this was outside the proposed pit expansion, in the silt ponds. The small number of observations and their absence from the proposed pit expansion reflects the lack of suitable habitat for them to utilise. This species is considered to be unlikely to be affected by this project.

At Risk species

Of the eighteen At Risk species were identified in the desktop review only three were recorded on site. **The NZ pipit**, the **black shag** and the **little pied shag**.

Twelve species have been identified as being highly unlikely to use the site due to their coastal and/or wetland habitat requirements, these are the **NZ dotterel, the banded dotterel, banded rail, spotless crake, South Island pied oystercatcher, variable oystercatcher, bar-tailed godwit, red knot, red-billed gull, black billed gull, royal spoonbill** and the **white fronted tern**. These species are unlikely to be affected by this project and have not been considered further.

Forest species

Kākā (At Risk – Recovering) were not detected within the Site during the survey period. Kākā have been recorded within 10 km of the site and GPS transmitter data (Section 4.2.3.3) shows flight paths that cross over the Site. The mature forest in the southern end of the Site is able to provide opportunities for roosting, nesting and foraging. Although it is documented that kākā have a low nesting success rate in areas of high mammalian predator density. Targeted ARD surveys did not detect any vocalisations over the survey period. However, it is still likely that kākā use the site occasionally.

NZ pipit (At Risk – Naturally Uncommon) were recorded three times across the survey period, all incidental observations and all were observed along roading tracks in and out of Symonds Hill Pit. They are also present within 10 km of the Site. NZ pipit appear to have adapt to a level of disturabance within the current footprint of Symonds Hill Pit. As such, this species is unlikely to be affected by this project and is not considered to be a species of concern.

Waterbirds

Pied shag (At Risk - Recovering) have been recorded within 10 km of the Site. However, no observations have been recorded during the survey period, and no suitable habitat is available for nesting or foraging. The silt ponds on site may provide roosting opportunities as they traverse the wider landscape. This species is not considered to be a species of concern for this site.

Little pied shag (At Risk - Relict) has been recorded within 10 km of the site and observed once incidentally at the silt pond at the entrance of the Site (Table 10). However, the small number of observations reflect the lack of suitable habitat. The silt ponds on site may provide roosting opportunities as they traverse the wider landscape. This species is not considered to be a species of concern for this site.

Black shag (At Risk - Relict) has been recorded within 10 km of the Site and once during the 5MBC (Table 7) at the silt pond at the entrance of the Site. However, the small number of observations reflect the lack of suitable habitat. The silt ponds on site may provide roosting opportunities as they traverse the wider landscape. This species is not considered to be a species of concern for this site.

Little black shag (At Risk – Naturally Uncommon) have been recorded within 10 km of the Site. However, no observations have been recorded during the survey period, and no suitable habitat is available for nesting or foraging. The silt ponds on site may provide roosting opportunities as they traverse the wider landscape. This species is not considered to be a species of concern for this site.

Threatened species

Of the ten species recorded within 10 km of the Site only one species has been recorded on Site. This is the NZ dabchick.

Eight species have been identified as being highly unlikely to use the site due to their habitat requirements, and limited dispersal ability (kokako) these are the **grey duck, wrybill, Caspian tern, white heron, Australasian bittern, NZ falcon, North Island kokako** and the **reef heron**. These species are unlikely to be affected by this project and have not been considered further.

Forest species

Long-tailed cuckoo (Threatened – Nationally Vulnerable) were not detected across the Site. Mature forest is present for roosting and foraging but the no records or observations of the species, whitehead, that the long-tailed cuckoo requires to nest parasitise (long-tailed cuckoo lay their eggs in the nests of whitehead, in the North Island, and the whitehead incubate and raise its chicks). Long-tailed cuckoo is not considered to be a species of concern.

Waterbirds

NZ dabchick (Threatened – Nationally Increasing) were observed once, incidentally, in a silt pond outside the proposed pit expansion footprint. This species is also recorded within 10 km of the Site. Aside from the silt ponds there is no suitable habitat for the dabchick to use, and it is likely that they use these ponds to move across the wider landscape. The NZ dabchick is not considered to be a species of concern.

Appendix 10: Acoustic Bat Monitor ID number, survey date and habitat type

Recorder deployment ID			
Oct-25	Nov-25	Feb-26	Habitat description
1847	12427	12441	Tawa-taraire forest with mature kanuka (WF9)
12421	1092	10761	Native planting/weedy scrub mix AND Exotic species (pine, rank grasses, pampas scrub)
12440	12384	11303	Native planting/weedy scrub mix
1265	10984	11059	Tawa-taraire forest with mature kanuka (WF9)
12373	1977	12465	Tree fernland with nikau, emergent puriri and broadleaf scrub (VS5)
1700	1858	12416	Tree fernland with nikau, emergent puriri and broadleaf scrub (VS5)
1979	500	3797	Tawa-taraire forest with mature kanuka (WF9)
1853	12434	3523	tawa-taraire forest with mature kanuka AND Tree fernland with nikau, emergent puriri and broadleaf scrub
10879	1972	355	Tawa-taraire forest with mature kanuka (WF9)
1267	11415	11415	Open pasture
1136	10890	10877	Open pasture
10987	3649	10875	Kanuka forest with emergent broadleaves and podocarps (VS2) AND Kauri, podocarp, broadleaf forest (WF11)
10874	1861	12486	Kanuka forest with emergent broadleaves and podocarps (VS2) AND Kauri, podocarp, broadleaf forest (WF11)
1833	2044	10933	Kanuka forest with emergent broadleaves and podocarps (VS2)
12442	3797	11113	Tree fernland with nikau, emergent puriri and broadleaf scrub (VS5) AND Native planting/weedy scrub mix
12486	10877	12427	Tree fernland with nikau, emergent puriri and broadleaf scrub (VS5) AND Kanuka forest with emergent broadleaves and podocarps (VS2)
10881	11052	10807	Native planting/weedy scrub mix
12416	11004	11795	Native planting/weedy scrub mix
4723	11002	10767	Native planting/weedy scrub mix AND Exotic species (pine, rank grasses, pampas scrub)
10890	10761	12440	Tree fernland with nikau, emergent puriri and broadleaf scrub
1800	1267	-	Hunua pit edge
1342	10807	11163	Kanuka forest with emergent broadleaves and podocarps (VS2)
355	4717	10890	Native planting/weedy scub mix
1318	1222	11054	Tawa-taraire forest with mature kanuka
1833	2044	10933	Kanuka forest with emergent broadleaves and podocarps (VS2)
-	1972	355	Tawa-taraire forest with mature kanuka
-	1136	12419	Tawa-taraire forest with mature kanuka
-	-	12147	Tawa-taraire forest with mature kanuka

Appendix 11: Significance criteria (AUP)

Schedule 3 Significant Ecological Areas – Terrestrial Schedule

Factors for assessing ecological value [rps]

An area shall be considered to have significant ecological value if it meets one or more the sub-factors 1 to 5 below. These factors are also referred to in B7.2.2(1).

These factors have been used to determine the areas included in Schedule 3 Significant Ecological Areas – Terrestrial Schedule, and will be used to assess proposed future additions to the schedule.

Factors:

(1) REPRESENTATIVENESS

Sub-factor:

(a) It is an example of an indigenous ecosystem (including both mature and successional stages), that contributes to the inclusion of at least 10% of the natural extent[1] of each of Auckland's original ecosystem types[2] in each ecological district of Auckland (starting with the largest, most natural and intact, most geographically spread) and reflecting the environmental gradients of the region, and is characteristic or typical of the natural ecosystem diversity of the ecological district and/or Auckland.

(2) THREAT STATUS AND RARITY

Sub-factors:

(b) It is an indigenous habitat, community or ecosystem that occurs naturally in Auckland and has been assessed (using the IUCN threat classification system) to be threatened, based on evidence and expert advice (including Holdaway et al. Status assessment of NZ naturally uncommon ecosystems[3]).

(c) It is a habitat that supports occurrences of a plant, animal or fungi that has been assessed by the Department of Conservation and determined to have a national conservation status of threatened or at risk; or

(i) it is assessed as having a regional threatened conservation status including Regionally Critical, Endangered and Vulnerable and Serious and Gradual Decline.

(d) It is indigenous vegetation that occurs in Land Environments New Zealand Category IV where less than 20% remains.

(e) It is any indigenous vegetation or habitat of indigenous fauna that occurs within an indigenous wetland or dune ecosystem.

(f) It is a habitat that supports an occurrence of a plant, animal or fungi that is locally rare; or

  (i) it has been assessed by the Department of Conservation and determined to have a national conservation status of Naturally Uncommon, Range Restricted or Relict.

(3) DIVERSITY

Sub-factors:

(g) It is any indigenous vegetation that extends across at least one environmental gradient resulting in a sequence that supports more than one indigenous habitat, community or ecosystem type e.g., an indigenous estuary to an indigenous freshwater wetland.

(h) It supports the expected indigenous ecosystem diversity for the habitat(s).

(i) It is an indigenous habitat type that supports a typical species richness or species assemblage for its type.

(4) STEPPING-STONES, MIGRATION PATHWAYS AND BUFFERS

Sub-factors:

(j) It is an example of an indigenous ecosystem, or habitat of indigenous fauna that is used by any native species permanently or intermittently for an essential part of their life cycle (e.g. known to facilitate the movement of indigenous species across the landscape, haul-out site for marine mammals) and therefore makes an important contribution to the resilience and ecological integrity of surrounding areas.

(k) It is an example of an ecosystem, indigenous vegetation or habitat of indigenous fauna, that is immediately adjacent to, and provides protection for, indigenous biodiversity in an existing protected natural area (established for the purposes of biodiversity protection); or

  (i) it is an area identified as significant under the ‘threat status and rarity’ or ‘uniqueness’ criteria. This includes areas of vegetation (that may be native or exotic) that buffer a known significant site. It does not include buffers to the buffers.

(l) It is part of a network of sites that cumulatively provide important habitat for indigenous fauna or when aggregated make an important contribution to the provision of a particular ecosystem in the landscape.

(m) It is a site which makes an important contribution to the resilience and ecological integrity of surrounding areas.

(5) UNIQUENESS OR DISTINCTIVENESS

Sub-factors:

(n) It is habitat for a plant, animal or fungi that is endemic to the Auckland region (i.e. not found anywhere else).

(o) It is an indigenous ecosystem that is endemic to the Auckland region or supports ecological assemblages, structural forms or unusual combinations of species that are endemic to the Auckland region.

(p) It is an indigenous ecosystem or a habitat that supports occurrences of a plant, animal or fungi that are near-endemic (i.e., where the only other occurrence(s) is within 100km of the council boundary).

(q) It is a habitat that supports occurrences of a plant, animal or fungi that is the type locality for that taxon.

(r) It is important as an intact sequence or outstanding condition in the region.

(s) It is a habitat that supports occurrences of a plant, animal or fungi that is the largest specimen or largest population of the indigenous species in Auckland or New Zealand.

(t) It is a habitat that supports occurrences of a plant, animal or fungi that are at (or near) their national distributional limit.

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[1] "Natural extent" is intended to mean a combination of our understanding of the historic pre-human diversity, distribution and extent of ecosystems in Auckland and what we would expect this to be given past and current environmental drivers.

[2] The Department of Conservation's ecosystem classification system described over 135 ecosystems in New Zealand (Singers and Rogers in press). Of these 35 ecosystems are known to have occurred in Auckland and these are what is meant by original ecosystems. They include the more recent indigenous dominated shrub and scrublands that have evolved as a result of human modification of the landscape.

[3] Status Assessment of New Zealand's Naturally Uncommon Ecosystems, ROBERT J. HOLDAWAY, SUSAN K. WISER and PETER A. WILLIAMS. Conservation Biology. Volume 26, Issue 4, pages 619–629, August 2012

Appendix 12: Stream classification criteria (AUP)

The Unitary Plan Chapter J1 (Definitions) specifies the criteria for the classification of watercourses as either permanent, intermittent or ephemeral. These definitions are listed below. The definition of the watercourse has implications under the relevant objectives and policies in the Unitary Plan and affects the activity status of any proposed works within watercourses under the regional rules of the Unitary Plan. These criteria have been applied in our assessment of watercourses described below.

River or Stream

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

Permanent river or stream

The continually flowing reaches of any river or stream.

Intermittent stream

Stream reaches that cease to flow for periods of the year because the bed is periodically above the water table. This category is defined by those stream reaches that do not meet the definition of permanent river or stream and meet at least three of the following criteria:

- it has natural pools;
- it has a well-defined channel, such that the bed and banks can be distinguished;
- it contains surface water more than 48 hours after a rain event which results in stream flow;
- rooted terrestrial vegetation is not established across the entire cross-sectional width of the channel;
- organic debris resulting from flood can be seen on the floodplain; or
- there is evidence of substrate sorting process, including scour and deposition

Ephemeral stream

Stream reaches with a bed above the water table at all times, with water only flowing during and shortly after rain events. This category is defined as those stream reaches that do not meet the definition of permanent river or stream or intermittent stream.

Overland Flow Path

Low point in terrain, excluding a permanent watercourse or intermittent river or stream, where surface runoff will flow, with an upstream contributing catchment exceeding 4,000 m^2[24].

[24] Definition is proposed to be amended by PC120 to the AUP(OP) to " a low point in terrain (excluding permanent streams) where surface runoff will flow during rainfall events".

Appendix 13: Terrestrial Ecology BOAM

	This section captures which elements of biodiversity, and over what area, will be impacted by the proposal					This section is where the change in measure of each Biodiversity Attribute due to the proposed Impact is quantified, and Attribute Biodiversity Value calculated. Inputs are derived from direct measures, existing data or models where available, or expert estimated predictions			
	Biodiversity Component	Biodiversity Attribute		Measurement Unit	Area of Impact (ha)	Benchmark	Measure prior to Impact	Measure after Impact	Biodiversity Value
0.1	WF9/11	0.1a	Stem density	trees/ha	23.57	1250	1250	0	-23.57
		0.1b	Basal area (biomass)	m2/ha	23.57	50	35	0	-16.50
		0.1c	Canopy cover	%	23.57	80	80	0	-23.57
		0.1d	Canopy height	m	23.57	15	12	0	-18.86
		0.1e	Litter depth	cm	23.57	20	7	0	-8.25

	Biodiversity Component	Biodiversity Attribute		Measurement Unit	Area of Impact (ha)	Benchmark	Measure prior to Impact	Measure after Impact	Biodiversity Value
0.2	VS	0.2a	Stem density	trees/ha	20.89	1500	1250	0	-17.41
		0.2b	Basal area (biomass)	m2/ha	20.89	30	15	0	-10.45
		0.2c	Canopy cover	%	20.89	85	80	0	-19.66
		0.2d	Canopy height	m	20.89	12	7.5	0	-13.06
		0.2e	Litter depth	cm	20.89	5	2.5	0	-10.45

	This section captures which elements of biodiversity are to be accounted for, and the benchmark value for the Attribute. The information matches that in the Impact Model					These cells provide information about the proposed Offset Actions			Calculations can be made for a finite end point, or at five yearly time-steps over 35 years. Indicate preference in Column K and Follow the instructions in Column L		This section is where the marginal change in the measure of Biodiversity Attribute due to the Offset Action is quantified. Inputs are derived from direct measure, existing data or models where available, or expert estimated predictions. Attribute Biodiversity Value at the Offset Site is compared to the Attribute Biodiversity Value at the Impact Site to calculate the Net Present Biodiversity Value for each Attribute						This is the average Net Present Biodiversity Value for the Biodiversity Component
	Biodiversity Component	Biodiversity Attribute		Measurement Unit	Benchmark	Proposed Offset Actions	Offset area (ha)	Confidence in Offset Actions			Measure prior to Offset	Measure after Offset	Time till endpoint (years)	Biodiversity Value at Offset Site	Biodiversity Value at Impact Site	Attribute Net Present Biodiversity Value	Component Net Present Biodiversity Value
0.1	WF9/11	0.1a	Stem density	trees/ha	1250	Revegetation	65	Very confident >90%	Finite end point	Continue to Column M	0	7500	5	53.55	-23.57	29.98	13.81
		0.1b	Basal area (biomass)	m2/ha	50	Revegetation	65	Very confident >90%	Finite end point	Continue to Column M	0	30	28	16.28	-16.50	-0.22	
		0.1c	Canopy cover	%	80	Revegetation	65	Very confident >90%	Finite end point	Continue to Column M	0	80	5	53.55	-23.57	29.98	
		0.1d	Canopy height	m	15	Revegetation	65	Very confident >90%	Finite end point	Continue to Column M	0	12	20	27.50	-18.86	8.64	
		0.1e	Litter depth	cm	20	Revegetation	65	Very confident >90%	Finite end point	Continue to Column M	0	7	30	8.95	-8.25	0.70	

	This section captures which elements of biodiversity are to be accounted for, and the benchmark value for the Attribute. The information matches that in the Impact Model					These cells provide information about the proposed Offset Actions			Calculations can be made for a finite end point, or at five yearly time-steps over 35 years. Indicate preference in Column K and Follow the instructions in Column L		This section is where the marginal change in the measure of Biodiversity Attribute due to the Offset Action is quantified. Inputs are derived from direct measure, existing data or models where available, or expert estimated predictions. Attribute Biodiversity Value at the Offset Site is compared to the Attribute Biodiversity Value at the Impact Site to calculate the Net Present Biodiversity Value for each Attribute						This is the average Net Present Biodiversity Value for the Biodiversity Component
	Biodiversity Component	Biodiversity Attribute		Measurement Unit	Benchmark	Proposed Offset Actions	Offset area (ha)	Confidence in Offset Actions			Measure prior to Offset	Measure after Offset	Time till endpoint (years)	Biodiversity Value at Offset Site	Biodiversity Value at Impact Site	Attribute Net Present Biodiversity Value	Component Net Present Biodiversity Value
0.2	VS	0.2a	Stem density	trees/ha	1500	Revegetation	30	Very confident >90%	Finite end point	Continue to Column M	0	7500	5	24.71	-17.41	7.31	2.65
		0.2b	Basal area (biomass)	m2/ha	30	Revegetation	30	Very confident >90%	Finite end point	Continue to Column M	0	30	30	11.80	-10.45	1.36	
		0.2c	Canopy cover	%	85	Revegetation	30	Very confident >90%	Finite end point	Continue to Column M	0	80	5	23.26	-19.66	3.60	
		0.2d	Canopy height	m	12	Revegetation	30	Very confident >90%	Finite end point	Continue to Column M	0	8	12	13.40	-13.06	0.34	
		0.2e	Litter depth	cm	5	Revegetation	30	Very confident >90%	Finite end point	Continue to Column M	0	3.5	20	11.10	-10.45	0.66	

Appendix 14: Wetlands BOAM

	This section captures which elements of biodiversity, and over what area, will be impacted by the proposal					This section is where the change in measure of each Biodiversity Attribute due to the proposed Impact is quantified, and Attribute Biodiversity Value calculated. Inputs are derived from direct measures, existing data or models where available, or expert estimated predictions			
	Biodiversity Component	Biodiversity Attribute		Measurement Unit	Area of Impact (ha)	Benchmark	Measure prior to Impact	Measure after Impact	Biodiversity Value
0.3	forest seepage	0.3a	Indigenous wetland plant dominance	%	0.21	100	85	0	-0.18
		0.3b	Hydrological connection	Rank score	0.21	5	4	0	-0.17
		0.3c	Connectivity / buffering	%	0.21	100	10		-0.21
		0.3d	Hydraulic function	Rank score	0.21	5	4		-0.17
		0.3e	Habitat value	Rank score	0.21	5	4		-0.17

Measure prior to Impact
Enter the Attribute measure at the Impact site prior to the impact occurring expressed in the stated Unit of Measurement (Column F).

	Biodiversity Component	Biodiversity Attribute		Measurement Unit	Area of Impact (ha)	Benchmark	Measure prior to Impact	Measure after Impact	Biodiversity Value
0.4	exotic swamp	0.4a	Indigenous wetland plant dominance	%	0.23	100	0.5	0	0.00
		0.4b	Hydrological connection	Rank score	0.23	5	0.5	0	-0.02
		0.4c	connectivity / buffering	Rank score	0.23	100	10	0	-0.02
		0.4d	Hydraulic function	Rank score	0.23	5	2	0	-0.09
		0.4e	Habitat value	Rank score	0.23	5	1	0	-0.05

	This section captures which elements of biodiversity are to be accounted for, and the benchmark value for the Attribute. The information matches that in the Impact Model					These cells provide information about the proposed Offset Actions			Calculations can be made for a finite end point, or at five yearly time-steps over 35 years. Indicate preference in Column K and Follow the instructions in Column L		This section is where the marginal change in the measure of Biodiversity Attribute due to the Offset Action is quantified. Inputs are derived from direct measure, existing data or models where available, or expert estimated predictions. Attribute Biodiversity Value at the Offset Site is compared to the Attribute Biodiversity Value at the Impact Site to calculate the Net Present Biodiversity Value for each Attribute						This is the average Net Present Biodiversity Value for the Biodiversity Component
	Biodiversity Component	Biodiversity Attribute		Measurement Unit	Benchmark	Proposed Offset Actions	Offset area (ha)	Confidence in Offset Actions			Measure prior to Offset	Measure after Offset	Time till endpoint (years)	Biodiversity Value at Offset Site	Biodiversity Value at Impact Site	Attribute Net Present Biodiversity Value	Component Net Present Biodiversity Value
0.3	forest seepage	0.3a	Indigenous wetland plant dominance	%	100	Revegetation	1.8	Very confident >90%	Finite end point	Continue to Column M	5	100	5	1.41	-0.18	1.23	0.70
		0.3b	Hydrological connection	Rank score	5	Revegetation	1.8	Very confident >90%	Finite end point	Continue to Column M	4.5	5	0	0.17	-0.17	0.00	
		0.3c	Connectivity / buffering	%	100	Revegetation	1.8	Very confident >90%	Finite end point	Continue to Column M	10	100	5	1.33	-0.21	1.12	
		0.3d	Hydraulic function	Rank score	5	Revegetation	1.8	Very confident >90%	Finite end point	Continue to Column M	3.5	4.5	5	0.30	-0.17	0.13	
		0.3e	Habitat value	Rank score	5	Revegetation	1.8	Very confident >90%	Finite end point	Continue to Column M	1	5	5	1.19	-0.17	1.02	

	This section captures which elements of biodiversity are to be accounted for, and the benchmark value for the Attribute. The information matches that in the Impact Model					These cells provide information about the proposed Offset Actions			Calculations can be made for a finite end point, or at five yearly time-steps over 35 years. Indicate preference in Column K and Follow the instructions in Column L		This section is where the marginal change in the measure of Biodiversity Attribute due to the Offset Action is quantified. Inputs are derived from direct measure, existing data or models where available, or expert estimated predictions. Attribute Biodiversity Value at the Offset Site is compared to the Attribute Biodiversity Value at the Impact Site to calculate the Net Present Biodiversity Value for each Attribute						This is the average Net Present Biodiversity Value for the Biodiversity Component
	Biodiversity Component	Biodiversity Attribute		Measurement Unit	Benchmark	Proposed Offset Actions	Offset area (ha)	Confidence in Offset Actions			Measure prior to Offset	Measure after Offset	Time till endpoint (years)	Biodiversity Value at Offset Site	Biodiversity Value at Impact Site	Attribute Net Present Biodiversity Value	Component Net Present Biodiversity Value
0.4	exotic swamp	0.4a	Indigenous wetland plant dominance	%	100	Revegetation	0.6	Very confident >90%	Finite end point	Continue to Column M	5	100	5	0.47	0.00	0.47	0.26
		0.4b	Hydrological connection	Rank score	5	Revegetation	0.6	Very confident >90%	Finite end point	Continue to Column M	4.5	5	0	0.06	-0.02	0.03	
		0.4c	connectivity / buffering	Rank score	100	Revegetation	0.6	Very confident >90%	Finite end point	Continue to Column M	10	100	5	0.44	-0.02	0.42	
		0.4d	Hydraulic function	Rank score	5	Revegetation	0.6	Very confident >90%	Finite end point	Continue to Column M	3.5	4.5	5	0.10	-0.09	0.01	
		0.4e	Habitat value	Rank score	5	Revegetation	0.6	Very confident >90%	Finite end point	Continue to Column M	1	5	5	0.40	-0.05	0.35	

Appendix 15: Freshwater Offset Accounting (SEV)

Introduction

The loss of watercourses in the pit expansion is unavoidable. The SEV assessment results are used in the ECR (Environmental Compensation Ratio) calculation, which determines the amount of stream restoration required for the amount of stream lost or degraded. The ECR is frequently used within the Auckland region to guide mitigation for streams that are being culverted or infilled. The ECR calculation uses actual and predicted SEV scores of the impact and mitigation sites and includes a time lag factor (that accounts for the time difference between the loss of the watercourse and reaching the completion target through improvement at the mitigation site). The AUP(OP) makes reference to using the SEV (amongst other references) in establishing restoration and enhancement options (Policy E3.3(4) a).

Only the most downstream extent of the watercourses within the proposed pit extension area contained enough water to undertake a full SEV survey. The resulting SEV score will be applied to all permanent and intermittent streams within the area for the purposes of the ECR calculation. This is considered to be a conservative approach.

ECR Calculation

The identified stream offset site at 484 Hunua Road includes two intermittent tributaries that drain into Waip Stream. An SEV was undertaken on the larger of the two tributaries and had a current SEV value (minus fauna) of 0.41 (SEVm-C).

An SEV score of 0.66 has been used for the potential value after restoration (SEVm-P). This score is based off the potential value of the SEV assessments shown in the body of the report. This assumes best practise restoration planting of a rural stream with no existing riparian vegetation, to a width of 10 m either side.

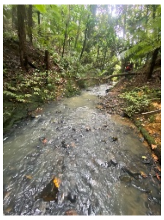
The calculation returns a ECR Ratio of 4.8, or a total mitigation stream area of 384 m^2 for the loss of stream length from the quarry expansion. This equates to some 1,088 m of stream length (where the offset stream average width is 0.35 m).

Typical stream enhancement is planting and fencing the riparian margins of streams. An estimate of planting requirements to offset the loss of stream length would be approximately 2.2 ha (assuming planting 10 m either side of the stream channel).

Offset site 1 has approximately 610 m of intermittent stream length available for restoration.

Site	Mangapū (SEV2 and SEV3)	Minus Diversion Length (~570m)	Tribs 3 and 4
Width (m)	1.1	1.1	0.59
Length (m)	1200	630	527
Streambed area impact (m2)	1320	693	310.93
SEV Current (Full SEV)	0.88	0.88	0.759
SEV Current (minus Fauna)	0.906	0.906	0.79
SEVi-P	0.906	0.906	0.79
SEVi-I	0	0	0
SEVm-C	0.39	0.39	0.39
SEVm-P	0.719	0.719	0.719
ECR Ratio	4.13	4.13	3.60
Mitigation Area Required (m2)	5452.52	2862.57	1119.92
Length (m)	**4956.00**	**2602.34**	**1898.16**

Appendix 16: Stream realignment characteristics

	Upper portion				Lower portion			
Attributes	**Dimensions**	**Gradient**	**Proportion of length (%)**	**Example photo**	**Dimensions**	**Gradient**	**Proportion of length (%)**	**Example photos**
Cascades	0.5-1.5 m height 0.5-1.5 m width	Moderate	5 - 15		0.5 - 1.5 m height 0.5 - 1.5 m width	Moderate	5 - 10	
Riffles	0.5 – 3 m in length	Low	15 - 20		2 – 10 m in length	Low	15 - 20	
Runs	3 – 40+ m	Low-Moderate	40 - 50		20 – 80 m in length	Low-Moderate	50 - 70	
Pools	1.5 - 3 m radius 0.3 – 1 m depth	Low	5 - 10		1.5 - 5 m radius 0.3 – 1 m depth	Low	10 - 15	
Waterfalls	1 – 3 m high	High	5 - 10		2 – 3 m high	High	5 - 10	
Backwaters	1 – 3 m	Low	2 - 5		1 – 3 m	Low	2 - 5	
Undercut banks	0.5 – 1.5 m	Low - Moderate	2 - 5		0.5 – 1.5 m	Low - Moderate	2 - 5	
Characteristics								
Stream Width	0.5 – 4 m				0.5 – 2.5 m			
Substrate/features		• Good mix of cobbles, gravel, bedrock and silt /sand • Fewer large boulders • More consistent slow runs and riffles • Shallow pools				• Dominance of large boulders with mix of cobbles, gravel, bedrock and silt /sand • High hydraulic diversity of habitats • 1 - 2 deep pools • Flow noticeably slower than upper portion (channel wider?) • Gravel beaches		
Meanders		Meanders with 3 – 4 gravel beaches				Fewer meanders with 5 - 6 gravel beaches		
Banks		• Undercut banks						

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