DECEMBER 2023

# Ecology Report

## NEWCOMBE ROAD SAND QUARRY

Prepared for R S Sand Ltd

alliancecology.co.nz

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# Executive Summary

RS Sand Ltd (RS Sand) is applying to the Waikato Regional Council and Waipā District Council to establish and operate a sand quarry on a rural property at 77 Newcombe Road, Cambridge (the Site).

The quarry is proposed to extract and process up to 400,000 tonnes of sand from the pit area per year (depending on demand) for approximately 25 years.

This report provides an assessment of the ecological values of the site, the potential effects of the proposal on these values, and measures required to address adverse effects.

The report is based on desktop and field investigations of the ecological values onsite. The assessment of effects has been undertaken in accordance with the Ecological Impact Assessment Guidelines (EcIAG) (EIANZ 2018). Guidance on the residual effects management measures needed for ecological benefits to outweigh adverse effects has been provided through the application of Biodiversity Compensation Models (Tonkin & Taylor 2021).

In broad terms the site includes alluvial terrace, gully and floodplain habitats. Intensively grazed pastureland is the predominant vegetation type on alluvial terraces though mature stands of exotic trees are also present. Several gully systems incise the upper main terrace of the property. These gullies include exotic-dominated forest, exotic pine plantation forestry, exotic-dominated scrub and rank pasture grassland. Most gullies include gully seepage wetlands, and gully streams on site range from ephemeral to permanent in nature. The floodplain at the base of the gullies is dominated by exotic and rank pasture grasses but also includes riparian floodplain wetlands and a large gully basin wetland. The lower reaches of the Karapiro stream are located along the northern property boundary.

All terrestrial vegetation types and wetland habitats onsite support or may support nationally 'Threatened', nationally 'At Risk' or 'Regionally uncommon' species, most notably the nationally 'Threatened' long-tailed bat. The Karapiro stream also supports a diverse range of fish species, five of which are 'At-Risk declining'.

None of the terrestrial vegetation or wetland habitats on the site are classified as Significant Natural Areas (SNAs). However, the Waipā District Significant Natural Area (SNA) assessment[1] has ranked two significant natural areas (SNAs) in close proximity. The terrestrial vegetation types and wetland and freshwater habitat types with the highest ecological values are located outside the proposed project footprint. Nevertheless, the project is expected to have effects on ecological values, most importantly on long-tailed bats, copper skink, and gully seepage wetlands.

[1] Waipa District Plan 1 November 2016

Effects on these and other ecological values will be further avoided, remedied and mitigated through a range of proposed measures. These measures centre on rehabilitating pasture habitat (remediation); the provision of bunding or native mitigation plantings; undertaking vegetation clearance and earthworks outside of bird breeding season; adopting a bat roost tree felling protocol; and lizard salvaging and relocation operations. Sediment and erosion controls will also be implemented to prevent sediment from entering the Karapiro stream.

Residual adverse effects that cannot be avoided, remedied or mitigated include the permanent loss of 7.89 ha of habitat for terrestrial and wetland biodiversity values. Additionally there will be a temporary loss of 19.63 ha of pasture habitat. The type and quantum of habitat loss corresponds to a potentially 'High' level of residual effects for pekapeka/long-tailed bats, and a 'Moderate' level of residual effects for gully seepage wetland habitat and copper skink (if present). Effects on all other ecological values were assessed as either 'Low' or 'Very Low'.

Measures proposed to address residual effects on pekapeka/long-tailed bats, copper skink, and wetlands include approximately 14.38 ha of habitat restoration and enhancement within terrestrial floodplain and gully habitat outside but near to the project footprint. The proposed native revegetation will:

- Create additional habitat and ecological connectivity for bats and other native forest fauna along approximately 2 km of riparian margin, linking up two Significant Natural Areas; and
- Provide buffering and ecological connectivity for approximately 3.69 ha of floodplain and gully seepage wetlands through the native revegetation of wetlands and associated wetland margins.

Proposed revegetation will begin in the first winter planting season following consent approval and well in advance of most impacts, which will occur from 1 – 25 years following consent approval depending on staging.

To improve the likelihood that native plantings will persist in the long-term, the plantings should be protected from livestock browsing through stock exclusion fencing and a 20-year weed control programme. Felled log deployment into revegetation sites is also recommended.

In conclusion, we consider all potential adverse effects to be adequately addressed. A net positive outcome for key biodiversity values is expected to be achieved.

# 1. Introduction

## 1.1. Background

RS Sand Ltd (RS Sand) is applying to the Waikato Regional Council and Waipā District Council to establish and operate a sand quarry on a rural property at 77 Newcombe Road, Cambridge (the Site).

The Site is located on three records of title which have a total area of 134.67 hectares, although the quarry is only proposed on approximately 27.09 hectares in the western portion of the properties (Appendix A, Figure 1). The quarry is made up of a 23 hectare pit area towards the western boundary and a 4 hectare plant area (for processing and stockpiling) to the east of the pit. A potential 'restoration and habitat enhancement area' of 14 hectares is located on the southern margin of Karapiro stream (Appendix A, Figure 2 and 3).

## 1.2. Project description

The pit area is estimated to contain 7,409,700 tonnes (4,116,500m$^3$) of sand resource, comprising a mixture of pit sand and concrete sand. The quarry is proposed to extract and process up to 400,000 tonnes of sand from the pit area per year (depending on demand) for approximately 25 years.

The following section of the report describes the project operations. These project activities are expected to have effects on terrestrial, freshwater and wetland ecological values.

### 1.2.1. Staging and layout

Extraction will be based on the following stages:

- Stage 1. Years 1 to 1.7 2.7ha 495,000 tonnes (275,000m$^3$).
- Stage 2. Years 1.7 to 6.1 3.4ha 1,327,500 tonnes (737,500m$^3$).
- Stage 3. Years 6.1 to 13.9 6.6ha 2,346,300 tonnes (1,303,500m$^3$).
- Stage 4. Years 13.9 to 20.7 5.2ha 2,049,300 tonnes (1,138,500m$^3$).
- Stage 5. Years 20.7 to 25 5.1ha 1,191,600 tonnes (662,000m$^3$).

Excavations of the pit area will begin 10-15m from the Karapiro Stream and move towards Newcombe Road. The stages are approximately 120m wide and will excavate approximately 35m below the existing ground level of the existing terrace. The bottom floor of the pit area will be approximately 10m above the level of the Karapiro Stream bank. An internal haul road will link the pit and plant areas.

The proposed plant area includes a centrally located processing plant and a water recycling pond towards the north. The plant building will use and discharge water to and from the recycling pond to grade the sand. Graded sand will be stockpiled around the plant area. The southwestern portion of the plant area will contain an office and breakroom building, maintenance workshop, car parking, weighbridge, and wheel wash.

Access will be provided via a new vehicle crossing on Newcombe Road, to the west of the Site's existing access. An internal road of 20m width will provide access to the weighbridge and stockpiling area, before being realigned to the south to enable excavation of Stage 5.

### 1.2.2. Establishment

To establish the quarry, the top 2m of ground of the plant area will be stripped to form a level and stable platform, while the top 7.5m of Stage 1 will be stripped to access the sand beneath. The stripped material is assumed to comprise of 50% overburden and 50% pit sand.

Overburden from the plant area will be used to form bunding along the western and southern boundaries of the pit area, the eastern boundary of the plant area and the internal access road from Newcombe Road to screen the activities. The bunds will be approximately 2.5 – 5m high in relation to existing ground level, 8m wide and will be planted with vegetation capable of growing up to 2-3m high. Topsoil and some overburden from Stage 1 will be placed along the northern boundary of Stage 2 and re-grassed.

Pit sand excavated to form the land area and Stage 1 will (where necessary) be processed and stockpiled at the processing area and sold.

As excavations progress through the stages, the floor and faces of the pit will be reinstated with overburden and topsoil and re-grassed.

### 1.2.3. Operation

The quarry is proposed to operate for up to 50 weeks of the year on the following basis:

- Monday to Friday – 7:00am to 5:00pm.
- Saturday – 7:00am to 12:00pm.
- Sundays and public holidays – Closed.

A 30-50 tonne excavator will be used to extract sand from the pit area, while 30-40 tonne articulated dump trucks will transport the sand to the plant area via the internal pit road. An average of 71 trucks per weekday and up to a maximum of 200 trucks could visit the site on the busiest day (depending on the demand for sand).

Extraction of groundwater is required to operate the plant and suppress dust associated with the proposed quarry. The required daily take is likely to be a maximum of 1,100m$^3$, which results in an annual groundwater take of 290,000m$^3$, as described in the AEE (Kinetic Environmental, 2023).

The operational effects of the quarry will be addressed via management plans including Quarry Management, Dust Management, Erosion and Sediment Control, and Traffic Management plans.

## 1.3. Report Purpose and Scope

Alliance Ecology Ltd has been engaged by RS Sand[2] to prepare an ecological assessment of effects associated with the proposed sand quarry to inform the Assessment of Environmental Effects (AEE) and accompany the resource consent applications. To this end, the report:

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

The overarching objective and intended outcome for this project is to generate ecological benefits that outweigh residual adverse effects. This approach broadly aligns with Waikato Regional Council's objectives and policies for indigenous biodiversity as set out in the Waikato Regional Policy Statement[3] and with Biodiversity Compensation Principles set out in Schedule 4 of the National Policy Statement for Indigenous Biodiversity (NPS-IB).

# 2. Methods

## 2.1. Desktop investigations

A desktop review was undertaken to inform the methodology and approach to the ecological assessment and to determine the wider ecological context of the site. The review included published and unpublished reports and papers, and records from the following databases:

- Waikato Regional Council biodiversity layer (2012) and aerial imagery of the site to assess habitat suitability for terrestrial fauna;
- Waipa District Council intramaps;
- NZ Herpetofauna Atlas Webmap;
- Historical records of bat presence from the New Zealand bat distribution database (DOC);
- New Zealand Plant Conservation Network Database (NZPCND); and eBird database; (https://ebird.org);
- New Zealand freshwater fish database (NZFFD, NIWA, 2018); and
- Ministry for the Environment (MFE), 2020. Wetland delineation protocols (WDP) and subsequent revision (2022).

[2] This report has been prepared in accordance with the terms and conditions set out in the proposed Offer of Service dated 11 January 2021.
[3] The Waikato Regional Policy Statement. Waikato Regional Council May 2016 (updated December 2018).

## 2.2. Field investigations

### 2.2.1. Initial field investigations (2019-2021)

General field investigations were undertaken on 13 and 14 January 2021 to characterise and map terrestrial, wetland and freshwater values within the project footprint and surrounds. These investigations included:

- Characterisation of plant species dominance and composition within terrestrial and wetland vegetation types including the application of Wetland Delineation Protocols (MFE 2020) (see Section 2.2.3 below).
- Biodiversity condition assessments associated with potential impacts such as browsing pressure and weed infestation.
- Habitat assessments for forest and wetland birds, lizards, and invertebrates with a focus on the presence or potential presence of nationally 'Threatened' or 'At Risk' species. Specific long-tailed bat surveys using Automatic Bat Monitors (ABMs), were undertaken by Bluewattle Ecology Ltd from December 2019/January 2020 and from May to June 2020 prior to the field investigations described above. The associated Long-Tailed Bat Report, including a description of survey methods, is provided in Appendix B.
- Classification of streams based on the Waikato Regional Plan definitions for farm canals, ephemeral streams, perennial streams and permanent streams.
- Assessment of options and recommendations for effects avoidance and mitigation.
- Assessment of options and recommendations for addressing any residual effects that cannot be avoided or mitigated, through habitat restoration and enhancement.

### 2.2.2. Further field investigations (September 2023)

Further field investigations were undertaken in September 2023 to address council S92 requests. These investigations included:

- Further bat survey work to identify high value roost trees (refer to updated bat report in Appendix B).
- Re-delineation of wetlands within the project footprint and proposed compensation areas located within the Karapiro stream floodplain and associated gully slopes along the northern boundary of the site ('restoration and habitat enhancement areas' in Appendix A, Figures 2 and 3).
- Mapping of proposed planting zones to inform proposed habitat restoration and enhancement in the Ecological Management Plan.
- Freshwater ecology assessment including:
    - deployment of 12 Gee's minnow traps in potential mudfish habitat within the Gully A basin wetland
    - eDNA surveys for mudfish and freshwater fish within Karapiro Stream.

### 2.2.3. Wetland assessments

All areas of potential wetland within or potentially affected by the proposed project footprint and within the proposed compensation area were initially assessed in accordance with the Wetland Delineation Protocols (MfE, 2020) and then re-assessed in general accordance with the revised WDP (MfE 2022).

The WDP sets out the methods for classifying and delineating freshwater wetlands based on vegetation, soil and hydrological characteristics. This document refers to Clarkson (2014), Fraser et al. (2018) and MfE (2021) for vegetation, wetland (hydric) soil assessment and hydrology assessment methods respectively. In accordance with the WDP the presence and relative abundance of all species was estimated, within all potential wetlands.

All areas were assessed as wetlands where plant species that are associated with wetland soils were common. The wetland plant categories in Clarkson (2014) used within this assessment were:

- Obligate (OBL): species that occur almost always in wetlands (estimated probability > 99 % in wetlands);
- Facultative Wetland (FACW): species that occur usually in wetlands (67 – 99 %);
- Facultative (FAC): species that are equally likely to occur in wetlands or non-wetlands (34 – 66%);
- Facultative Upland (FACU): species that occur occasionally in wetlands (1 – 33 %); and
- Upland (UPL): species that rarely occur in wetlands (< 1%).

Where the vegetation present within the defined wetland area across all strata was dominated by species classified as OBL or FACW species, the area was confirmed to be a wetland.

However, the re-delineation of wetlands deviated from the WDP in that:

- Assessments were based on the wetland as a whole, rather than on representative plots.
- If the wetland was not exclusively dominated by OBL or FACW species and there was uncertainty necessitating a dominance test or prevalence test under the WDP, the area of interest was instead simply and conservatively assumed to be a wetland based on vegetation.

Following confirmation of 'wetland' status, further assessment was undertaken to identify 'natural inland wetlands' defined in accordance with the NPS-FM (December 2022 amendment). Natural inland wetlands included all wetlands that did not meet the definition of a constructed wetland (MfE, 2023), irrespective of the degree of modification or inducement through anthropogenic land use activities.

In addition to the wetlands that were potentially affected by the proposed project, wetlands within the proposed compensation area were also assessed using the approach described above.

#### 2.2.4. Stream and freshwater fauna assessments

A visual assessment was undertaken in representative sections of the ephemeral streams within the project footprint and of intermittent and permanent streams near the project footprint, including the Karapiro Stream. Additionally, fish surveys were undertaken in the gully basin wetland and the Karapiro Stream.

Within the gully basin wetland, a targeted mudfish survey was undertaken using standard mudfish sampling methodology[4], with 12 Gee's minnow traps set throughout the wetland. The traps were partially submerged with an air gap and were set in the afternoon and collected the following morning. Any fish captured in the traps were identified and measured before being released back into the habitat from which they were captured. Trapping was used instead of collecting composite eDNA samples because the water depth was considered suitable (at c.20-30cm deep) and because unlike eDNA, trapping provides information on relative abundance if mudfish are captured.

Within the Karapiro Stream eDNA was collected to determine the fish species composition. Sample collection followed the recommended methods, with six replicate samples collected from the Karapiro Stream adjacent to the gully basin wetland. The water samples were filtered, preserved, and sent to Wilderlab for metabarcoding analysis. For each replicate sample, between 510 and 1,000 ml of water was filtered through the syringe.

### 2.3. Assessment of Ecological Effects

An assessment of ecological effects was undertaken in accordance with the Ecological Impact Assessment Guidelines (EcIAG)(EIANZ, 2018).[5] These guidelines provide a systematic, consistent and transparent framework for undertaking assessment of effects, while also providing for professional judgement and flexibility where appropriate.

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

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

#### 2.3.1. Step one: Assigning ecological value

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

#### 2.3.2. Step two: Assessing the magnitude of effects

[4] Ling, N.; O'Brien, L.K.; Miller, R.; Lake, M. 2013: A revised methodology to survey and monitor New Zealand mudfish. Department of Conservation, Wellington (unpublished).
[5] Environment Institute of Australia and New Zealand Inc. (2018). Ecological Impact Assessment (EcIAG). EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd Edition.

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

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

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

#### 2.3.3. Step three: Assessing the level of effects

An overall 'Level of Effect' (after efforts to avoid, remedy or mitigate for effects) was identified for each habitat/fauna type using a matrix approach. This approach combines the ecological values with the magnitude of effects resulting from the activity (Appendix C, Table 6). We note that unlike Table 6 of the EcIAG we consider a 'High' value x 'Low' Magnitude of effect to constitute a 'Moderate' rather than 'Low' Level of Effect.

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

These offsetting or compensation measures are considered necessary where the level of effect is assessed as 'Moderate' or higher. However, a level of effects deemed to be 'Very High' may not comply with the 'Limits to offsetting' principle (Section 5.6 below).

# 3. Ecological Characteristics and Values

## 3.1. Ecological context

The site is situated just east of Cambridge, which lies within the eastern periphery of the Hamilton Ecological District (approx. 160,000 ha) (Appendix A, Figure 1).

The geological characteristics and soils in the Hamilton ED are largely influenced by the presence of the Waikato River and associated tributaries. Evidence from soil core samples and pollen analysis suggests that historically, most of this area was once covered in conifer-broadleaf forest (Newnham et al., 1989) with the ranges to the west dominated by broadleaf forest and podocarp forest to the east of the Hamilton basin. In the steeper and hillier regions, rimu/tawa forest with emergent hardwood, broadleaf species formed the second tier and a ground cover of ferns would have been typical. Kahikatea semi-swamp forest would have been dominant in the wetter, low-lying areas with extensive wetland and peat bog systems (Clarkson et al., 2007). Mixed conifer-broadleaf forest would have grown on the slightly elevated mounds and ridges. The well drained terraces adjacent to the Waikato River and associated tributaries would once have been totara-matai-kowhai forest.

Large areas of forests have been cleared and wetlands drained both pre- and post-European settlement (Newnham et al., 1989). Much of the area has been converted to farmed pasture and residential property with only a handful of original forest and wetland habitats remaining. Most of these remaining areas of indigenous vegetation are small and fragmented. Leathwick et al. (1995) calculated the decline in indigenous vegetation since 1840 and current percentage cover. Since 1840, indigenous vegetation reduced by 97.77 % in the Hamilton ED. Percentage cover of indigenous vegetation in 1995 was about 1 % forest and less than 1 % scrub and wetland for the entire Hamilton ED.

Multiple threatened species are found within the Hamilton ED. The nationally threatened long-tailed bat (*Chalinolobus tuberculatus*) has been recorded throughout the area. Threatened lizard species include the Pacific sticky-toed gecko (*Hoplodactylus pacificus*), Auckland green gecko (*Naultinus elegans*) and speckled skink (*Oligosoma infrapunctatum*), which have been recorded near the western margins. Mobile bird species such as the 'At risk' North Island kākā have been recorded near the south-eastern margins, near Cambridge and the southern suburbs of Hamilton city. Multiple threatened bird species, as classified in Robertson et al. (2021), are found in lake, wetland and peat bog habitats within the district. The Hamilton ED is also home to numerous threatened fish species as identified in Dunn et al. (2018).

The NIWA FFDB indicates the presence of shortjaw kokopu (*Glaxias postvectis*) and lamprey (*Geotria australis*), both classified as 'Threatened-nationally vulnerable', and longfin eel, inanga, giant kokopu (Galaxias argenteus), torrentfish and black mudfish (*Neochanna diversus*), all classified as 'At risk-declining' within 20 km of the site.

The Hamilton ED has multiple protected areas that are managed by private landowners, local district councils and the Department of Conservation (DOC). Significant habitats for indigenous fauna also exist outside of areas of indigenous vegetation (e.g. long-tailed bats in exotic tree stands; black mudfish populations in highly modified drains and willow wetlands).

## 3.2. General site description

The 134.67 ha Site at 77 Newcombe Road, Cambridge is approximately 3 km due east of the Cambridge town (Appendix A, Figure 1).

The site is situated on alluvial terrace and flood plains of the Karapiro Stream, which is likely a former tributary of the Waikato River. None of the habitats on the site are classified as Significant Natural Areas (SNAs). However, the Waipa District Significant Natural Area (SNA) assessment[6] has ranked two significant natural areas (SNAs) in close proximity (Appendix B, Figure 5).

- SNA WP366: Karāpiro Stream, Thornton Road riparian willow wetland (unprotected) (20m from the northwestern site boundary)

[6] Waipa District Plan 1 November 2016

- SNA WP379: Karāpiro - Cambridge, Waikato River riparian shrubland remnants (unprotected) (120m from the northeastern site boundary).

These two SNAs are characterised by the riparian protection values they provide for a number of nationally at risk and threatened fauna species, including native fish species and long-tailed bat (Deichmann & Kessels 2013).[7] Long-tailed bats are a nationally threatened species with the highest threat category assignment of 'nationally critical' (Townsend et al. 2008).

Intensively grazed pastureland is the predominant vegetation type on the alluvial terrace of the site with three stands of mature exotic trees found along the entrance driveways and around buildings near Newcombe Road.

Several gully systems incise the upper main terrace of the property, leading to the lower flood plain through which the Karapiro Stream flows along the northern boundary of the site (Appendix A, Figure 1). These gullies include exotic-dominated forest, exotic-dominated scrub and rank pasture grassland but also include small pockets of native terrestrial vegetation to varying degrees. All gullies include gully seepage wetlands (Appendix A, Figure 1) and Gullies A, B and E include ephemeral streams. Gullies to the east and west of the footprint include permanent streams.

Broad habitat descriptions of these gullies (see Appendix A, Figure 1 and Appendix F for representative site photographs) are as follows:

**Gullies within or immediately adjacent to the project footprint (west to east)**

- Gully A is dominated by exotic plantation forest, exotic-dominated forest and exotic scrub. The exotic-dominated forest also includes small patches of native tree fern. Gully A is also likely to include wetland seeps and includes an ephemeral stream. At the toe of this forested area, situated between the forest and the Karapiro Stream, is a relatively large basin, dominated by a mosaic of willow and rough pastureland, also including wetland habitat with patches of native sedges.[8]
- Gully B includes pasture, exotic-dominated forest, and gully wetland seeps with a small stretch of ephemeral stream between these seeps. An overland flow path is present at the bottom of the gully.
- Gullies C and D are both in pasture but include a gully wetland seep. Both gullies included evidence of an overland flow path/ephemeral stream.
- Gully E includes pasture and exotic-dominated forest and small gully wetland seeps and an ephemeral stream. Most of the gully wetland seeps and the ephemeral stream area are outside the footprint.
- Gully F is vegetated and dominated by mixed native/exotic forest with a smaller proportion of exotic-dominated forest. The gully is heavily impacted by invasive weeds. It includes a permanent stream and is also likely to include wetland seepages. Gully F is outside but immediately adjacent to the project footprint.

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[7] Deichmann, B & Kessels, G. 2013. Significant Natural Areas of the Waipa District: Terrestrial and Wetland Ecosystems. Kessels & Associates Ltd for Waikato Regional Council: Technical report 2013/16
[8] Part of Gully A could not be accessed due to dominance of dense blackberry

A steep bank which drops from the main upper farm terrace some 40-50m down to the Karapiro Stream is in pasture, aside from vegetation contained within the gullies.

The floodplain area at the bottom of the gully is dominated by rank and improved pasture grassland but also includes a large willow-dominated gully basin wetland and several exotic dominated floodplain wetlands. Whilst dominated by exotics, both the gully basin wetland and floodplain wetlands include smaller native-dominated patches. The Karapiro stream sits within the floodplain and is approximately 3-5 metres in width.

All terrestrial and wetland habitat types are subject to the effects of livestock, invasive weeds and introduced mammalian predators and browsers.

## 3.3. Vegetation/habitat characteristics

Specific vegetation/habitat types and recorded plant species within each of these habitat types are provided in Table 3.1 below. Representative landscape and habitat photos are provided in Appendix F.

**Table 3.1. Habitat types within or near to the project footprint**

| Habitat/vegetation type | Areal extent/ location | Description of habitat/vegetation types and identified plant species (no threatened plants were identified)[9] |
|---|---|---|
| Mixed native/exotic forest | Gully F only | Even mix of native and exotic dominated forest habitat.<br><br>Patches of native forest dominated by mahoe, treefern (mamaku and silverfern) but also includes cabbage tree and karamu (*Coprosma robusta*) and patches of exotic-dominated forest. Mixed exotic forest dominated by crack willow, poplar or grey willow. Also includes English privet, Eastern buckthorn, and hawthorn. |
| Exotic pine plantation forest | Gully A only | Exotic pine is approximately 20 – 25 years old with sparse understory. Ground cover dominated by bare earth and pine needles and several exotic species, most notably tradescantia. |
| Exotic dominated forest | Gully, A, B, E, and F | Exotic forest dominated by crack willow, poplar or grey willow. Also includes English privet, Eastern buckthorn, and hawthorn.<br><br>In Gully A, exotic dominated forest also includes small patches of native treefern (mamaku and silverfern) that comprise approximately 7% of the exotic dominated forest in this gully. Other native species recorded in exotic-dominated forest type include cabbage tree, |

[9] A number of plant species in the Myrtaceae family are potentially present onsite but outside the project footprint (most likely in Gully B). This includes common species such as kanuka, manuka and several species of climbing rata. These species have been assigned a threat status in accordance with the New Zealand Threat Classification System based on the potential impact of myrtle rust, a serious fungal disease that affects plants in the myrtle (Myrtaceae) family.

| Habitat/vegetation type | Areal extent/ location | Description of habitat/vegetation types and identified plant species (no threatened plants were identified)[9] |
|---|---|---|
| | | *Muehlenbeckia australis*, karamu, waterfern, shaking brake fern and rasp fern. |
| Exotic dominated scrub | Gully A only | Mixed exotic scrub is dominated by blackberry, Chinese privet, exotic bindweed, gorse, pampas, Himalayan honeysuckle, Japanese honeysuckle raspberry, inkweed, exotic broom. Native species present include *Coprosma robusta*, *Muehlenbeckia australis*, rasp fern and bracken fern. |
| Pasture | Terrace, floodplain and gullies | Improved and rank exotic pasture grassland |
| Gully seepage wetlands | All gullies | Dominated almost exclusively by native *Carex geminata* but may also include crack willow, grey willow or pampas and *Juncus effusus*. See Appendix D for WDP assessments. |
| Gully basin wetlands | Gully A (outside but adjacent to the project footprint) | The gully basin wetland is best described as a willow swamp forest with pukio (*Carex secta*) and water pepper dominating the understorey. The willows provide ample shade to the wetland beneath, and habitat features such as pukio root structures as well as large wood were present. The wetland water depth was 20-30 cm and although water quality parameters were not measured, the water was relatively cool and highly turbid with anoxic sediments present. The wetland and Karapiro Stream were disconnected at the time of the site visit but appear to be frequently connected during high flow events (see Appendix D for WDP assessments). |
| Floodplain wetlands | Along Karapiro Stream (outside but adjacent to the project footprint) | Floodplain wetlands are dominated by native *Carex geminata* and exotic *Juncus effusus*, mercer grass, Yorkshire fog and water pepper. See Appendix D for WDP assessments. |
| Karapiro stream | Adjacent to the project footprint | The lower reaches of the Karapiro Stream are located along the northern property boundary. The Karapiro Stream is a tributary stream that joins the Waikato River at Cambridge. At this location, the stream is soft-bottomed with substrate dominated by sand (80%) with gravel in riffle sections and some fine sediment deposition within the pools. The stream is c.5.5m wide and 0.2-0.6 m deep. Macrophytes comprised <5% of the stream channel and included Canadian pondweed (*Elodea canadensis*) and water pepper (*Persicaria* |

| Habitat/vegetation type | Areal extent/ location | Description of habitat/vegetation types and identified plant species (no threatened plants were identified)[9] |
|---|---|---|
| | | *hydropiper*). Large woody debris were present, as was organic matter in the pools.<br><br>A Rapid Habitat Assessment (RHA) for the site scored the stream at 44 out of 100. Bank and riparian scores for the stream were particularly low with a high amount of bankside erosion noted (30-40% of the stream bank). Riparian vegetation was protected by a narrow single wire fenced margin of 2-5 m and was limited to rank grass with some small crack willow (*Salix cinerea*) and patches of rautahi (*Carex geminata*). Hydraulic heterogeneity score was relatively high with several hydraulic components recorded including run and pool habitat, with the occasional riffle and backwater. |
| Permanent streams | Gully B (outside but adjacent to the project footprint) | Permanent tributary streams of the Karapiro Stream were present in several of the large gullies and were all located outside of the project footprint, within the compensation area. These small streams (<0.5m wide and <0.05m deep) were soft-bottomed, with bed substrates dominated by sand, although gravel was present in fast flowing riffles. In areas where stock had access, the streams were heavily pugged, and the stream channel was less defined. Most of these streams were unfenced and the riparian vegetation was limited to rank grass with the occasional willow. Macrophytes were present and included water pepper, watercress (*Nasturtium officinale*), starwort (*Callitriche stagnalis*), water celery (*Apium nodiflorum*) and *Glyceria declinata*. |
| Ephemeral streams | Gully A, B and E include ephemeral streams as does Gully F (but outside the project footprint). | Ephemeral streams were present in gullies A, B and E within the project footprint. During the site visit in September 2023, the lowest section of the streambed in Gully A was dry. The stream in Gully B was flowing for a section but flow ceased at the wetland, with no connection to the Karapiro Stream. The stream in Gully E had a defined channel, much of which was dry, with damp sediments in places; there was no connection to the Karapiro Stream. These have conservatively been assessed as ephemeral streams, being streams 'that flow continuously for at least three months between March and September but do not flow all year'. |

## 3.4. Fauna

The presence, likely presence or potential presence of native birds, lizards, invertebrates and fish that are classified as nationally 'Threatened' or 'At Risk' or that are otherwise legally protected under the Wildlife Act (1953) was assessed based on a combination of field observations and assessments of habitat suitability for a range of species. Habitat suitability assessments for taxa were a function of landscape context, habitat structure (complexity and diversity), vegetation composition and condition. Habitat quality was assessed based on professional opinion, noting:[10]

- Presence: species confirmed as present through field observation or records, or conservatively assumed to be present based on known presence in the vicinity.
- Possible occasional use: a species is likely to use the habitat only occasionally, given the importance of the habitat and area for the species life-cycle — particularly for highly mobile or migratory species — and habitat condition.
- Possible presence: habitat was considered potentially suitable but species not observed and not recorded as present.

Importantly, the site is known to support long-tailed bats (Appendix B), which are classified as 'Threatened- Nationally Critical'. The site may also support up to five nationally 'Threatened' or 'At Risk' birds, one species of 'At Risk' lizard, and five species of nationally 'At Risk' fish (Table 3.2).

Based on desktop investigations of relevant databases, landscape context and onsite habitat suitability, it is unlikely that any other nationally 'Threatened' or 'At Risk' species are present, but this cannot be ruled out.

Black mudfish were not detected in the gully basin wetland and the connectivity and poor water quality mean that the wetland is unlikely to provide suitable habitat for this species. In terms of other habitats, the seepage wetlands and ephemeral streams are dry for most of the year and the floodplain wetlands have little to no standing water and high connectivity to the Karapiro Stream. These habitats are also considered unsuitable to support black mudfish.

[10] The assessment of habitat suitability for fauna contributes to the ecological value assigned to the various terrestrial vegetation and wetland habitat types (refer s4.3.1 and Table 4.2 below). Refer also to Table 3.2 below for habitat suitability and likely population characteristics of the site for nationally 'Threatened' or 'At Risk' species.

## Table 3.2. Nationally 'Threatened' or 'At Risk' species that are known to be present or are potentially present on site

| Species | Threat status (NZTCS)[11] | Habitat suitability and likely population characteristics of the site |
|---|---|---|
| Long-tailed bat | Threatened (nationally critical) | See Long-tailed Bat Report, Appendix B. In summary, based on habitat assessments and survey results:<br><br>The site includes a variety of structural and ecosystem traits that provide habitat for bats, including mature linear stands of trees and deeply incised gullies. It lies close to the Karapiro Stream and the Waikato River, where insects tend to aggregate at dusk and dawn, and where mature trees with cavity-bearing qualities for roost are situated in relative shelter from wind.<br><br>The most important of these habitat features are likely to be the vegetated gullies leading to the Karapiro Stream and the mature exotic trees left in clusters or rows. Pasture, while being utilised, is likely to be less important because bats are an edge-adapted species so open grassland is not preferred habitat.<br><br>The mature stands of exotic trees and vegetated gullies on the property may also be used by bats as roosting habitat. Within this vegetation, long-tailed bats may roost in cavities, splits and loose bark in both native and exotic trees (including standing dead trees), as well as in large hollow tree stumps and hollow tree ferns.<br><br>The data indicates that bats use, or are likely to use, the site and its surrounding locality as follows:<br><br>• Commuting: The mature shelterbelt trees at the site access, all of Gully F and the margin of the Karapiro Stream are likely to be used as regular commuting corridors across and along this site. Bats are likely to fly over the entire site on a regular basis, but likely favour the gullies and shelterbelts.<br>• Foraging: The stream in Gully F, the margins of the Karapiro Stream and the wetland areas at the bottom of Gully A alongside the Karapiro Stream. The open pastures are also likely to be used occasionally for foraging. |

[11] New Zealand Threat Classification System (Townsend et al, 2008).

| Species | Threat status (NZTCS)[11] | Habitat suitability and likely population characteristics of the site |
|---|---|---|
| | | • Roosting: The mature trees within gullies are possibly used for roosting by solitary bats or as an occasional communal roost by bats. The mature trees found in the shelterbelts, as well as the isolated trees within the pastureland, are less likely to be used as communal roost trees, but roosting may still occur in these trees. |
| New Zealand pipit | At Risk (Declining) | Possibly present in exotic scrub and floodplain wetland habitats and pasture |
| New Zealand falcon | Threatened (Nationally vulnerable) | Possible occasional use of forested habitats |
| Kākā | At Risk (Recovering) | Possible occasional use of forested habitats |
| Black shag | At Risk (Relict) | Uses riverine habitats and roosts in large trees in proximity to river margins |
| Australasian bittern | Threatened (Nationally Critical) | Possibly present on occasion in the floodplain wetland habitats. These wetlands provide only low-quality habitat due to their relatively small size, low habitat diversity and ongoing browsing pressure |
| Spotless crake | At Risk (Declining) | Likely present within basin wetland in Gully A (outside the project footprint), particularly in areas dominated by carex species. Unlikely to be present in gully wetland seepages due to poor habitat suitability or in floodplain wetlands due to browsing pressure from livestock. |
| Copper skink | At Risk (Declining) | Likely present in all terrestrial habitat types except improved pasture |
| Īnanga | At Risk (Declining) | Present in the gully basin wetland outside the project footprint and in the Karapiro Stream (eDNA confirmation). |
| Longfin eel | At Risk (Declining) | Present in Karapiro stream outside the project footprint (eDNA confirmation) |
| Torrentfish | At Risk (Declining) | Present in Karapiro stream outside the project footprint (eDNA confirmation) |
| Giant kōkopu | At Risk (Declining) | Present in Karapiro stream outside the project footprint (eDNA confirmation) |
| Kākahi | At Risk (Declining) | Present in Karapiro stream outside the project footprint (eDNA confirmation) |

# 4. Assessment of ecological effects

Key terrestrial and wetland ecological values onsite include the long-tailed bat and associated terrestrial and wetland vegetation/habitat types that provide important habitat for this species.

In close proximity to the project footprint, the site also includes the Karapiro stream, two permanent streams, a large gully comprising mixed native/exotic forest (Gully F), and a moderately-sized gully basin wetland at the bottom of Gully A that includes small patches of native wetland vegetation. These features support or may support several 'Threatened' or 'At Risk' terrestrial, wetland and freshwater species.

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

## 4.1. Potential for adverse effects

Construction and operational activities associated with the Newcombe Road Sand Quarry have the potential to result in a range of adverse effects on terrestrial and wetland values.

Potential adverse effects on ecological values relating to construction include:

- Approximately 27.09 ha of terrestrial and wetland vegetation/habitat loss through staged vegetation clearance and earthworks, which will be undertaken over a period of 25 years. Specifically:
    - 23.29 ha of pasture grassland (of which 4.09 ha will be permanently lost[12])
    - 2.22 ha of exotic dominated scrubland
    - 1.04 ha of exotic pine plantation forest
    - 0.37 ha of mature exotic-dominated forest
    - 0.174 ha of native dominated gully seepage wetland (this is based on the 0.074 ha of gully seepage wetlands delineated within the footprint in Gullies B-E and assumes that there is approximately 0.1 ha of native gully wetland seepage habitat within Gully A which could not be accessed due to dominance of dense blackberry). This estimate is conservative as no wetland habitat was detected via drone aerial imagery analysis within Gully A.
- The creation of habitat edge effects, altering the composition and health of adjacent vegetation (i.e. habitat degradation), which may affect habitat suitability for flora and fauna.
- Direct mortality or injury to species, for example all plants and most of the smaller, less mobile species (e.g. native lizards and invertebrates) may be harmed during vegetation clearance or earthworks activities. Likewise, roosting bats could potentially be harmed during vegetation clearance activities. Outside of bird breeding season, bird mortality would be low; however, during breeding season,

[12] The remainder (the pit footprint) will be rehabilitated back into pasture

vegetation removal has the potential to result in the destruction of nests, eggs and fledglings.

- Habitat fragmentation and isolation due to the loss and reduction of available habitat types, and severance of habitat which reduces the ability for plants and animals to disperse across the landscape for food, shelter, and breeding purposes.
- Noise, vibration or dust effects related to construction and operations.
- For wetlands, sediment runoff to wetlands and watercourses that may affect the quality of aquatic habitats, and potential changes in hydrology.

Potential long-term adverse effects after construction may include:

- Ongoing habitat degradation associated with edge effects and fragmentation, which permanently affect movement of some species.
- Ongoing disturbance effects, particularly on habitat margins/edges, through noise, dust and lighting.
- Ongoing degradation of aquatic habitat quality through:
    - contaminated stormwater discharge into aquatic receiving environments
    - increased risk of spills of potential toxins (for example, oil or chemicals) from cartage vehicles.

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

## 4.2. Overview of proposed measures to avoid, remedy or mitigate effects

Potential adverse effects on terrestrial and wetland values associated with the construction and operation of the project will be avoided, remedied or mitigated through:

- Seasonal constraints on vegetation clearance. The vegetation clearance programme will be affected by specific timing restrictions to avoid or minimise effects on fauna that are legally protected under the Wildlife Act (1953). This includes avoidance of vegetation clearance:
    - outside of earthworks season (i.e., should not be undertaken from 1 May – 1 October) due to the need for erosion and sediment controls to be in place in accordance with the relevant management plan;
    - during colder months when bats are less active and when roosting bats are less likely to be detected through standard bat tree felling protocol methods;
    - during peak bird breeding season to reduce harm to eggs or chicks (August to December inclusive); and
    - in accordance with seasonal constraints for salvaging and relocating lizards and invertebrates.
- Vegetation clearance protocols which will include:

  - physical delineation of vegetation to be cleared in Gully A and Gully E to avoid inadvertent clearance and to minimise potential damage to branches and roots; and
  - directional felling in Gully A and Gully E to prevent damage to vegetation immediately adjacent to the footprint.
- Sediment control measures will be undertaken to avoid or minimise effects on wetlands and the aquatic receiving environment.
- Vegetation/habitat clearance salvage and relocation operations for nationally 'Threatened', 'At Risk', or legally protected species present or potentially present onsite. This will include:
  - best practice bat tree felling protocol to reduce the risk of harming roosting bats;
  - copper skink salvage and relocation to mitigate for effects on this species if present; and
  - redeployment of dead standing wood into existing vegetation outside the project footprint to mitigate for potential effects on peripatus and provide additional habitat for relocated lizards.
- The use of bunding and mitigation plantings to primarily reduce potential effects on surrounding habitats associated with general disturbance. This will include:
  - 2.5m high western bunds planted with low-stature native vegetation;
  - 5m high southern and eastern bunds planted with low-stature native vegetation;
  - Native mitigation plantings of approximately 0.837 ha (10m width x 837m) between the western edge of Gully A basin wetland and the head of Gully E (See Appendix A, Figure 2).

These measures to avoid, remedy or mitigate potential adverse effects will be detailed in the respective ecological management plans.

## 4.3. Level of effects assessment

Table 4.1 below sets out the potential 'Level of Effects' for terrestrial and wetland values after efforts to avoid, remedy or mitigate for effects. This 'Level of Effects' assessment is based on the more detailed Ecological Values assessment in Section 4.3.1 (Tables 4.2 and 4.3) and the Magnitude of Effects Assessment in Section 4.3.2 (Table 4.4). Of key importance:

- The level of residual effects on long-tailed bat is expected to be 'High' due to the permanent loss of higher value long-tailed bat habitat and the temporary loss of lower value pasture habitat that will be rehabilitated back into pasture habitat;
- The level of residual effects on copper skink if present is expected to be 'Moderate' due to the permanent loss of habitat; and
- The level of residual effects on gully seepage wetlands is assessed as being 'Moderate' due to the permanent loss of gully seepage wetland habitat.

Residual effects on habitat values, individual species or species assemblages that are assessed as being 'Moderate' or higher warrant habitat restoration or enhancement measures to offset or compensate for these effects as set out in Section 5.

**Table 4.1: Level of effects on habitats and threatened or at risk species after measures to avoid, remedy or mitigate for effects (Appendix C, Table 6)**

| Ecological value | Ecological value category | Magnitude of effects category | Level of effects category |
|---|---|---|---|
| Habitat/ vegetation type | | | |
| Mixed exotic native (outside the project footprint) | High | Negligible | Very Low |
| Exotic pine plantation (Gully A) | Moderate | Low | Low |
| Exotic dominated forest | Moderate | Low | Low |
| Exotic dominated scrub | Moderate | Low | Low |
| Pasture | Low | Low | Very Low |
| Gully seepage wetlands | Moderate | Moderate | Moderate |
| Gully basin wetland (outside the project footprint) | High | Negligible | Very Low |
| Native fauna species | | | |
| Long-tailed bat | Very High | Moderate | High |
| Australasian bittern (Matuku hūrepo) | Very High | Negligible | Low |
| Spotless crake (Pūweto) | High | Negligible | Very Low |
| Pipit | High | Low | Low |
| Kārearea (New Zealand falcon) | Very high | Negligible | Low |
| Kākā | Moderate | Negligible | Very Low |
| Black shag | Moderate | Negligible | Very Low |
| Copper skink | High | Low (if present) | Moderate (if present)[13] |
| Īnanga | High | Low | Low |
| Longfin eel | High | Low | Low |
| Torrentfish | High | Low | Low |
| Giant kōkopu | High | Low | Low |
| Kākahi | High | Low | Low |

[13] A high value x low magnitude of effect equates to a low level of effect overall. However, I have conservatively assigned a moderate level of effect on the basis that the number of copper skink within the project footprint is unknown but could be high.

### 4.3.1. Ecological values assessment

The ecological values associated with each habitat type and for nationally 'Threatened' or 'At Risk species that help inform the overall Level of Effects assessment are assessed below in Tables 4.2 and 4.3.

**Table 4.2: Ecological values assessment for terrestrial vegetation and wetland habitat types based on tables in Appendix C**

| Ecosystem types | Value of terrestrial vegetation and wetland habitat types within or immediately adjacent to the project footprint (based on Ecological Impact Assessment guidelines (EcIAG 2018) | 'Ecological Value' (EcIAG) |
|---|---|---|
| **Terrestrial ecosystem types** | | |
| Mixed exotic-native secondary forest **(Gully F)** | Representativeness: **Moderate**<br>• Indigenous species common but exotic species also common with an abundance of invasive weeds, also grazed by stock in the more accessible areas and indigenous biodiversity is compromised by the full suite of introduced mammalian browsers.<br>Rarity/distinctiveness: **High**<br>• Not a threatened ecosystem type but forest with a high proportion of native plant species is locally uncommon in the landscape.<br>• Nationally threatened species present (long-tailed bat) and likely to be used occasionally by kaka and kārearea, and copper skink potentially present.<br>Diversity and Pattern: **Moderate**<br>• A number of indigenous plant species are present but diversity is compromised by livestock browsing, predation and browsing from introduced mammalian pests, and by the abundance of invasive weeds.<br>Ecological context: **Moderate**<br>• Relatively large tract of forest that provides ecological connectivity in the landscape. | '**High**': 'High' for one matter and 'Moderate' for remaining matters. |
| Exotic pine plantation forest) (**Gully A**) | Representativeness: **Very Low**<br>• Not representative of an indigenous ecosystem type<br>Rarity/distinctiveness: **High**<br>• Nationally threatened species present (long tailed bat) and likely to be used occasionally by kākā and kārearea, and copper skink potentially present.<br>Diversity and Pattern: **Very Low** | '**Moderate**': Habitat type rates 'High' for one matter, 'Moderate' for one matter and 'Low' or 'Very Low' for all other matters. |

| | | |
|---|---|---|
| | • Very low native diversity and pattern<br>Ecological context: **Moderate**<br>• Relatively large tract of forest that provides ecological connectivity in the landscape | |
| Exotic-dominated forest (**Gully, A, B, E and F**) | Representativeness: **Very Low**<br>• Not representative of an indigenous ecosystem type<br>Rarity/distinctiveness: **High**<br>• Not an indigenous or threatened ecosystem type but nationally threatened species present (long tailed bat) and likely to be used occasionally by kaka and kārearea and copper skink potentially present.<br>Diversity and Pattern: **Low**<br>• Low native diversity and pattern<br>Ecological context: **Moderate**<br>• Relatively large tract of forested habitat that provides ecological connectivity in the landscape | '**Moderate**': Habitat type rates 'High' for one matter, 'Moderate' for one matter, and 'Low' or 'Very Low for all other matters. |
| Exotic-dominated scrub (**Gully A**) | Representativeness: **Very Low**<br>• Not representative of an indigenous ecosystem type<br>Rarity/distinctiveness: **High**<br>• Nationally threatened species present (long tailed bat) and the 'At Risk copper skink potentially present.<br>Diversity and Pattern: **Very Low**<br>• Very Low native diversity and pattern<br>Ecological context: **Low**<br>• Provides some ecological connectivity in the landscape, particularly for long-tailed bats | '**Moderate**': Habitat type rates 'High' for one matter, and 'Low' or 'Very Low for all other matters |
| Pasture | Representativeness: **Very Low**<br>• Not representative of an indigenous ecosystem type<br>Rarity/distinctiveness: **Moderate**<br>• Nationally threatened species likely present (long tailed bat) but habitat type of less value than other habitat types.<br>Diversity and Pattern: **Very Low**<br>• Very Low native diversity and pattern<br>Ecological context: **Low**<br>• Provides limited connectivity for long-tailed bat | '**Low**': Habitat type rates 'Moderate' for one matter and 'Very Low' or 'Low' for 3 matters |
| **Wetland ecosystem types** | | |
| Gully seepage wetlands | Representativeness: **Moderate**<br>• Representative species composition but indigenous biodiversity compromised by livestock browsing and trampling as well as | '**Moderate**': 'High' for one matter, 'Moderate' for one |

| | | |
|---|---|---|
| | browsing and predation pressure from introduced mammalian pests<br>Rarity/distinctiveness: **High**<br>• Wetlands are a nationally threatened ecosystem type and likely to provide foraging habitat for the nationally threatened long-tailed bat<br>Diversity and Pattern: **Low**<br>• Indigenous plant species are present but low species richness and diversity due to small size coupled with the impacts of livestock browsing and predation and browsing from introduced mammalian pests and competition by invasive weeds.<br>Ecological context: **Low**<br>• Small size so limited value for ecological buffering or ecological connectivity | matter and 'Low' for the remainder |
| Gully basin wetland (bottom of Gully A outside the footprint) | Representativeness: **Moderate**<br>• Representative species composition but indigenous biodiversity compromised by livestock browsing and trampling as well as browsing and predation pressure from introduced mammalian pests<br>Rarity/distinctiveness: **High**<br>• Wetlands are a nationally threatened ecosystem type<br>• Possible that one of more nationally "Threatened' or 'At Risk' wetland bird species are present and likely important for the nationally threatened long-tailed bat<br>Diversity and Pattern: **Moderate**<br>• A number of indigenous wetland plant species are present but diversity is compromised by livestock browsing and predation and browsing from introduced mammalian pests and from the abundance of invasive weeds<br>Ecological context: **Moderate**<br>• Moderate size so some value for ecological buffering or ecological connectivity | '**High**': 'High' for one matter and 'Moderate' for other matters |

### Table 4.3: Ecological values assessment for species based on tables in Appendix C

| Fauna | Conservation status (based on the most recent NTCTS report issued for each fauna group) | Observed within, or close to the Project footprint | 'Ecological Value' of species (as per EIANZ guidelines) |
|---|---|---|---|
| **Bats that are present or potentially present within the Project footprint** | | | |
| Long-tailed bat | Threatened - Nationally Critical | Yes | 'Very High' |
| **Native forest birds that are present or potentially present within the Project footprint** | | | |
| Pipit | At Risk – Declining | No but expected to be present | 'High' |
| Kārearea (New Zealand falcon) | Threatened – Nationally vulnerable | No but possibly present | 'Very High' |
| Kākā | At Risk - Recovering | No but possibly present on occasion | 'Moderate' |
| Black shag | At Risk - Relict | No but expected to be present | 'Moderate' |
| Bellbird | Not Threatened (but is a "Keystone species", (i.e., is critical to seed dispersal of native species and the ecological integrity of native forests) | No but assumed present in low numbers | 'Moderate' |
| Kereru | | No but assumed present in low numbers | 'Moderate' |
| Tūī | | Yes | 'Moderate' |
| Shining cuckoo | Not Threatened | Yes | 'Low' |
| Fantail | Not Threatened | Yes | 'Low' |
| Grey Warbler | Not Threatened | Yes | 'Low' |
| Pukeko | Not Threatened | Yes | 'Low' |
| Sacred Kingfisher | Not Threatened | Yes | 'Low' |
| Australasian Harrier | Not Threatened | Yes | 'Low' |
| Silvereye | Not Threatened | Yes | 'Low' |
| **Native wetland birds that are present or potentially present within the Project footprint** | | | |
| Australasian bittern (Matuku hūrepo) | Threatened - Nationally Critical | No but assumed present on occasion in floodplain wetlands | 'Very High' |

| Fauna | Conservation status (based on the most recent NTCTS report issued for each fauna group) | Observed within, or close to the Project footprint | 'Ecological Value' of species (as per EIANZ guidelines) |
|---|---|---|---|
| Spotless crake (Pūweto) | At Risk - Declining | No but possibly present in Gully basin wetland | 'High' |
| **Native lizards that are present or potentially present within the Project footprint** | | | |
| Copper skink (moko) | At Risk - Declining | No but assumed present based on known presence in the vicinity | 'High' |
| **Notable native terrestrial invertebrates that are present or potentially present within the Project footprint** | | | |
| Auckland tree weta | Not threatened, regionally uncommon[14] | No but assumed present | 'Moderate' |
| Peripatus | Not threatened | No but assumed present | 'Moderate' |
| **Notable freshwater fauna that are present in streams and wetlands close to the Project footprint** | | | |
| Īnanga | At Risk (declining) | Present in gully basin wetland (outside footprint) | 'High' |
| Longfin eel | At Risk (declining) | eDNA confirmation in Karapiro stream (outside footprint) | 'High' |
| Torrentfish | At Risk (declining) | eDNA confirmation in Karapiro stream (outside footprint) | 'High' |
| Giant kōkopu | At Risk (declining) | eDNA confirmation in Karapiro stream (outside footprint) | 'High' |
| Kākahi | At Risk (declining) | eDNA confirmation in Karapiro stream (outside footprint) | 'High' |
| Other fish species (Appendix G) | Non-threatened | eDNA confirmation in Karapiro stream (outside footprint) | 'Low' |

[14] Overdyck (2020)

### 4.3.2. Magnitude of effects assessment

The magnitude of effects on ecological values is assessed based on the extent, intensity, duration and timing of effects associated with the project. This 'Magnitude of Effects' assessment (Table 4.4) is independent of the ''At Value' assigned to each habitat/vegetation type and species.

**Table 4.4: 'Magnitude of Effects' assessment (Appendix C, Tables 4 – 5)**

| Biodiversity value | Project effects | Efforts to avoid, remedy or mitigate effects) | Magnitude of Effect (EcIAG 2018) |
|---|---|---|---|
| **Vegetation/habitat type (associated species values are addressed below)** | | | |
| Mixed native/exotic regenerating forest (Gully F) | Outside the project footprint but potential for low level indirect effects due to proximity | Native mitigation plantings to buffer potential indirect effects | Negligible |
| Exotic plantation forest (Gully A) | Permanent loss of 1.04 ha, which constitutes a moderate loss per se and a negligible proportion of what is available within the surrounding landscape (<1%) and in the Ecological District. | Vegetation clearance protocols<br>Native mitigation plantings to buffer potential indirect effects | Low |
| Exotic dominated forest (gullies A, B, E, F) | Permanent loss of 0.37 ha, which equates to a low quantum of loss per se and a Low proportion of what is available within the surrounding landscape and in the Ecological District. | Vegetation clearance protocols<br>Native mitigation plantings to buffer potential indirect effects | Low |
| Exotic dominated scrub | Permanent loss of 2.22 ha, which equates to a moderate quantum of loss per se and a negligible proportion of what is available within the surrounding landscape and in the Ecological District. | Vegetation clearance protocols<br>Native mitigation plantings to buffer potential indirect effects | Low |
| Pasture | Permanent loss of 4.09 ha, which equates to a moderate quantum of loss per se and a negligible proportion of what is available in the surrounding landscape and in the Ecological District. | None | Low |
| Gully seepage wetlands | Permanent loss of an expected 0.17 ha, which equates to a moderate quantum of wetland loss per se, and a moderate proportion of what is | None | Moderate |

| Biodiversity value | Project effects | Efforts to avoid, remedy or mitigate effects) | Magnitude of Effect (EcIAG 2018) |
|---|---|---|---|
| | available within the immediately surrounding landscape, and a negligible proportion of what is available in the Ecological District. | | |
| Gully basin wetlands | Negligible potential for indirect negative effects relating to hydrological changes associated with sand quarrying extraction because the bottom floor of the pit area will be approximately 10m above the level of the Karapiro Stream bank and because the wetland condition is strongly influenced by overtopping of the Karapiro stream (as indicated by the presence of inanga). The potential for water quality degradation is also considered low. | Vegetation clearance protocols<br>Native mitigation plantings to buffer potential indirect effects | Negligible |
| **Native Species** | | | |
| **Bats that are present or potentially present within the Project footprint** | | | |
| Long-tailed bat | Permanent loss of an estimated 7.89 ha of habitat that includes pasture, exotic dominated forest, exotic plantation forest, exotic dominated scrub and gully seepage wetlands, which collectively equates to:<br>• a moderate areal extent of loss per se and<br>• a low proportion of what remains available in the surrounding landscape and<br>• a negligible proportion of what remains in the Ecological District.<br>In addition to direct effects, loss of these habitat types may also have localised indirect negative effects associated with general disturbance and potential effects on ecological connectivity. | Avoidance of clearance during bat breeding season when detection of roost sites is less likely.<br>Implementation of bat tree felling protocols to reduce the potential for harm to roosting bats | Moderate |
| **Native forest or grassland birds that are present or potentially present within the Project footprint** | | | |

| Biodiversity value | Project effects | Efforts to avoid, remedy or mitigate effects) | Magnitude of Effect (EcIAG 2018) |
|---|---|---|---|
| NZ Pipit | Permanent loss of up to 6.31 ha of habitat that includes pasture and exotic dominated scrub, which collectively equates to a moderate areal extent per se but a negligible proportion of what remains available in the surrounding landscape and a negligible proportion of what remains in the Ecological District. | None | Low |
| Kārearea (New Zealand Falcon), Kākā, bellbird, kereru, tui, and other terrestrial birds | Permanent loss of up to 3.63 ha of variable quality habitat, which includes exotic dominated forest, exotic plantation forest and exotic dominated scrub. Loss of these habitats may also have localised indirect negative effects associated with general disturbance. | Vegetation clearance protocols<br>Seasonal constraints on vegetation clearance during peak bird breeding season | Negligible |
| Australasian bittern (Matuku hūrepo) | Potential habitat outside project footprint | None required | Negligible |
| Spotless crake (Pūweto) | Potential habitat outside project footprint | Vegetation clearance protocols and mitigation planting in proximity to potential habitat in the Gully Basin wetland (Gully A) | Negligible |
| **Lizards that are present or potentially present within the Project footprint** | | | |
| Copper skink | Permanent loss of at least 3.06 ha of habitat, which constitutes a low proportion of what is available in the surrounding landscape and a negligible proportion of what is available in the Ecological District. | Vegetation clearance protocols and salvage and relocation protocols | Low (if present) |
| **Notable invertebrates that are present or potentially present within the Project footprint** | | | |
| Auckland tree weta | Permanent loss of at least 3.06 ha of habitat, which constitutes a low proportion of what is available in the surrounding landscape and a | Vegetation clearance protocols and salvage and relocation protocols | Low |

| Biodiversity value | Project effects | Efforts to avoid, remedy or mitigate effects) | Magnitude of Effect (EcIAG 2018) |
|---|---|---|---|
| | negligible proportion of what is available in the Ecological District. | | |
| Peripatus | Permanent loss of at least 3.06 ha of low quality habitat, which constitutes a low proportion of what is available in the surrounding landscape and a negligible proportion of what is available in the Ecological District. | Vegetation clearance protocols and habitat salvage and relocation protocols (coarse wood salvage and relocation) | Low |
| **Notable freshwater fauna that are present in streams and wetlands close to the Project footprint** | | | |
| Īnanga, | If left unmitigated, sediment discharge could potentially enter the gully basin wetland outside the Project footprint. | Sediment and erosion control measures in accordance with WRC Guidelines to ensure there is no direct discharge of sediment-laden water to the aquatic receiving environment. | Low |
| Longfin eel, torrentfish, giant kōkopu Kākahi | If left unmitigated, sediment discharge could potentially enter the Karapiro stream outside the Project footprint. | Sediment and erosion control measures in accordance with WRC Guidelines to ensure there is no direct discharge of sediment-laden water to the aquatic receiving environment. | Low |
| Other fish species | If left unmitigated, sediment discharge could potentially enter the Karapiro stream outside the Project footprint. | Sediment and erosion control measures in accordance with WRC Guidelines to ensure there is no direct discharge of sediment-laden water to the aquatic receiving environment. | Low |

# 5. Residual effects management

## 5.1. Residual effects to be addressed

As assessed in Section 4, the project is expected to have residual adverse effects of 'Moderate' or higher (after efforts to avoid, remedy or mitigate effects) on several habitats and species. Specifically:

- The 'Level of Effects' on long-tailed bats after measures to avoid, remedy or mitigate effects was assessed as 'High.'
- The 'Level of Effects' on copper skink after measures to avoid, remedy or mitigate effects was assessed as potentially 'Moderate' if present.
- The 'Level of Effects' on native-dominated gully seepage wetlands was assessed as 'Moderate' after measures to avoid, remedy or mitigate effects.

## 5.2. Objectives and intended ecological outcomes

The overarching objective of the residual effects management package is to achieve Net positive[15] outcomes for residual effects on wetlands and copper skinks within 10 years of impacts and for bats within 15 years of impacts at a given location. To this end, we have focused on the following ecological outcomes:

- A substantive net increase in the areal extent of native wetland and terrestrial habitat types that were historically present within floodplains and gully slopes in the landscape and wider Hamilton Ecological District (above and beyond what is currently present).
- Improved ecological connectivity for native flora and fauna, and buffering of native habitats through:
    - Providing riparian connectivity between existing SNAs adjoining the site;
    - Greater connectivity between wetland and terrestrial ecosystem habitat types including between gully basin wetland, wetland floodplain habitats, and mixed podocarp-broadleaved habitats on gully slopes;
    - The linking of smaller habitat fragments to create larger contiguous habitat; and
    - Improved ecological health of the Karapiro stream and associated tributaries via over 2km of wetland and terrestrial riparian planting.

The approach taken also addresses residual effects that were assessed as 'Low' or 'Very Low', and will provide biodiversity benefits for some values that are unlikely to be affected, e.g. floodplain wetland habitats.

## 5.3. Biodiversity offsetting versus compensation

For this project, all proposed habitat restoration and enhancement measures have been defined as 'compensation'. Whilst biodiversity offsetting was considered in the first

[15] Net positive outcomes equate to positive effects to indigenous biodiversity that outweigh adverse effects, as per principle 3, Appendix 4 of the NPS-IB.

instance, the proposed habitat restoration and enhancement measures do not meet the definition of offsetting. This is because neither impacts within the footprint, nor benefits associated with the proposed restoration and enhancement, can be quantifiably measured with an adequate degree of precision or certainty. Specifically:

- Long-tailed bats are difficult to monitor with adequate precision and have extensive home ranges, which obscures site-specific cause and effect;
- 'Like for like' offsetting is not desired (e.g. offsetting effects on exotic dominated vegetation is better achieved through native habitat restoration, which constitutes a 'trade-up'); and
- 'Like for like' offsetting is not possible, (e.g. addressment of the loss of gully seepage wetlands with the re-creation of gully wetland seepage habitats elsewhere).

## 5.4. Determining compensation requirements: Biodiversity Compensation Models

Biodiversity Compensation Models (Baber et al., 2021a; Baber et al 2021c; Tonkin & Taylor, 2021) were used as decision support tools to provide guidance on the type and amount of compensation required to achieve net positive biodiversity benefits for long-tailed bats, copper skink and wetlands. These models:

- Provide additional transparency, process and rigour to the process of addressing residual adverse effects through compensation measures at proposed habitat restoration/ enhancement site(s); and
- Operate at the 'as close to offset as possible' end of the compensation continuum.

In broad terms, the BCMs are based on:

- Available information and expert assessment of the amount and quality of habitat that will be adversely affected at the impact sites;
- Available information and expert assessment of the quality of habitat that will be subject to habitat restoration and enhancement at the compensation sites; and
- Assessment of the potential biodiversity benefits associated with proposed habitat restoration and enhancement measures.

## 5.5. Proposed compensation package

As guided by BCM outputs, we expect that to achieve biodiversity benefits that outweigh impacts for key biodiversity values will require approximately 14.38 ha of habitat restoration and enhancement within the existing Karapiro stream floodplain and associated gully slopes along the northern boundary of the property (Appendix A, Figures 2 and 3). This is in addition to the approximately 0.84 ha of native mitigation planting along the northern boundary of the project footprint which is aimed to reduce the potential for adverse effects on adjacent wetlands.

This 14.38 ha of habitat restoration and enhancement will:

- Create additional habitat and ecological connectivity for bats and other native forest fauna along approximately 2 km of riparian margin, linking up two Significant Natural Areas; and
- Provide buffering and ecological connectivity for approximately 3.69 ha of floodplain and gully seepage wetlands through the native revegetation of associated wetland margins.

Native revegetation will be staged over a five-year period commencing in the first winter planting season following consent approval. To improve the likelihood that native plantings will persist in the long-term, the plantings will be protected from livestock browsing through stock exclusion fencing[16] and will also include a 20-year weed control programme. This weed control programme is expected to be relatively resource intensive until canopy-cover is achieved given the diversity and abundance of invasive weeds in the landscape. Infill planting and control of mammalian browsers (e.g. rabbits and hares) and pukeko will be undertaken as required.

All native plants will be eco-sourced and plant composition will include species that:

- Were historically present onsite;
- Have a high chance of survival and establishment within planted areas due to the appropriateness of site conditions for associated species;
- Provide a diversity and early supply of resources for fauna (e.g., year-round availability of fruits and flowers for native birds);
- Provide good roosting habitat for bats and other indigenous terrestrial fauna in the longer term; and
- Are supported by iwi partners through iwi consultation and inputs.

Felled trees and fallen logs in various states of decomposition are ecologically important to forest regeneration processes and as habitat for a wide range of flora and fauna. Felled native (preferably) or exotic log deployment into revegetation sites should be undertaken. A minimum of 20 m / ha of cut up stockpiled logs should be deployed into restoration sites. These log materials should be placed in locations where they cannot move or enter streams. Long-term protection of all sites where restoration and habitat enhancement is undertaken will be required through protective covenants.

## 5.6. Assessment against the NPS-IB

The NPS-IB applies to indigenous biodiversity in the terrestrial environment, including to natural inland wetlands, and specified highly mobile fauna.[17]

We have assessed the proposed habitat restoration and enhancement measures against the 13 principles for biodiversity compensation set out in Appendix 4 of the NPS-IB. This assessment is provided in Table 5.1 below.

[16] Any stock exclusion fencing required under the Resource Management (Stock Exclusion) Regulations 2020 is not counted as part of the compensation package since it does not meet the additionality principle (refer Section 5.6 below).
[17] NPS-IB at 1.3.

### Table 5.1. Assessment against Biodiversity Compensation Principles set out in Appendix 4 of the NPS-IB

| Principle | NPS-IB Explanation | Assessment |
|---|---|---|
| Adherence to the effects management hierarchy | *Biodiversity compensation is a commitment to redress more than minor residual adverse effects, and should be contemplated only after steps to avoid, minimise, remedy, and offset adverse effects are demonstrated to have been sequentially exhausted.* | Principle met.<br>Effort has been made to avoid, remedy or mitigate effects in the first instance. For the residual adverse effects remaining, offsetting was considered but ruled out as being neither practical nor possible, due to difficulties in collecting and interpreting quantitative data and challenges in quantitively predicting future gains. |
| When biodiversity compensation is not appropriate | *Biodiversity compensation is not appropriate where indigenous biodiversity values are not able to be compensated for.*<br>*Examples of biodiversity compensation not being appropriate include where:*<br>*(a) the indigenous biodiversity affected is irreplaceable or vulnerable;*<br>*(b) effects on indigenous biodiversity are uncertain, unknown, or little understood, but potential effects are significantly adverse or irreversible;*<br>*(c) there are no technically feasible options by which to secure a proposed net gain within acceptable timeframes.* | Principle met.<br>In no instance is the 'limits to offsetting' principle considered to be breached, including for 'specified highly mobile fauna' in Appendix 2 NPS-IB. |
| Scale of biodiversity compensation | *The indigenous biodiversity values lost through the activity to which the biodiversity compensation applies are addressed by positive effects to indigenous biodiversity (including when indigenous species depend on introduced species for their persistence), that outweigh the adverse effects* | Principle met.<br>BCMs have been applied to 'sense check' the scale of compensation for terrestrial and wetland biodiversity values. BCMs indicate that positive effects to indigenous biodiversity values will outweigh the adverse effects. |

| Principle | NPS-IB Explanation | Assessment |
|---|---|---|
| Additionality | *Biodiversity compensation achieves gains in indigenous biodiversity above and beyond gains that would have occurred in the absence of the compensation, such as gains that are additional to any minimisation and remediation or offsetting undertaken in relation to the adverse effects of the activity* | Principle met.<br>The proposed restoration and enhancement activities would not otherwise occur in the absence of the project. Stock exclusion required by the Resource Management (Stock Exclusion) Regulations 2020 is not counted as part of the proposed compensation, since this is non-additional. |
| Leakage | *Biodiversity compensation design and implementation avoids displacing harm to other indigenous biodiversity in the same or any other location.* | Principle mostly met except for pipit which are known to forage in managed grassland habitat that will be subject to native re-vegetation. However, the scale of effect is considered low due to the high availability of managed grassland in the surrounding landscape coupled with the relatively large territory sizes of pipit. |
| Long-term outcomes | *Biodiversity compensation is managed to secure outcomes of the activity that last as least as long as the impacts, and preferably in perpetuity. Consideration must be given to long-term issues around funding, location, management, and monitoring.* | Principle met.<br>The benefits associated with habitat restoration and enhancement activities are proposed in perpetuity where possible. All areas of revegetation, wetland buffer planting and terrestrial planting are to be protected via covenant or other legal mechanism. |
| Landscape context | *Biodiversity compensation is undertaken where this will result in the best ecological outcome, preferably close to the impact site or within the same ecological district. The action considers the landscape context of both the impact site and the compensation site, taking into account interactions between species, habitats and* | Principle met.<br>The proposed compensation package is near the impact site and will result in a considerable increase in native ecosystem types and ecological connectivity in the landscape that will also |

| Principle | NPS-IB Explanation | Assessment |
|---|---|---|
| | *ecosystems, spatial connections, and ecosystem function.* | benefit species identified as 'specified highly mobile fauna' in Appendix 2 NPS-IB). |
| Time lags | *The delay between loss of, or effects on, indigenous biodiversity values at the impact site and the gain or maturity of indigenous biodiversity at the compensation site is minimised so that the calculated gains are achieved within the consent period or, as appropriate, a longer period (but not more than 35 years).* | Principle met.<br><br>BCMs indicate that net positive outcomes are expected within 10 or 15 years of commencement and time lag has been factored into the scale of compensation required to generate net positive outcomes. |
| Trading up | *When trading up forms part of biodiversity compensation, the proposal demonstrates that the indigenous biodiversity gains are demonstrably greater or higher than those lost. The proposal also shows the values lost are not to Threatened or At Risk (declining) species or to species considered vulnerable or irreplaceable.* | Principle met.<br><br>The compensation approach involves 'trading up' the loss of low value habitat for restoration and enhancement of higher value indigenous habitat types. |
| Financial contributions | *A financial contribution is only considered if: (a) there is no effective option available for delivering biodiversity gains on the ground; and (b) it directly funds an intended biodiversity gain or benefit that complies with the rest of these principles.* | Not applicable |
| Science and mātauranga Māori | *The design and implementation of biodiversity compensation is a documented process informed by science, and mātauranga Māori.* | Principle met with discussions ongoing<br><br>Engagement with mana whenua is described in the Assessment of Environmental Effects (AEE). |
| Tangata whenua and stakeholder participation | *Opportunity for the effective and early participation of tangata whenua and stakeholders is demonstrated when planning for biodiversity compensation, including its evaluation, selection, design, implementation, and monitoring.* | Principle met with discussions ongoing.<br><br>Engagement with mana whenua is described in the Assessment of Environmental Effects (AEE). |
| Transparency | *The design and implementation of biodiversity compensation, and communication of its results to the public,* | Principle met. |

| Principle | NPS-IB Explanation | Assessment |
|---|---|---|
| | *is undertaken in a transparent and timely manner.* | This principle is met via the BCM (Appendix E) which provides transparency around the design of the compensation package and the draft Ecological Management Plan which, among other things, sets out how the compensation package will be implemented. |

## 5.7. Assessment against the NPS-FM

The NPS-FM includes policies to avoid the reduction of natural inland wetlands, protect their values and promote their restoration; and to avoid the loss of river extent and values to the extent practicable. A full assessment of the proposal against the provisions of the NPS-FM is provided in Section 11.1 of the Assessment of Environmental Effects.

In accordance with the NPS-FM, potential ecological effects on freshwater and wetlands have been managed such that:

- All 'natural inland wetlands' in the Study Area (impact footprint and immediate surrounds including the compensation area) have been identified.
- The proposal meets the relevant 'gateway' tests in s3.22 of the NPS-FM regarding the loss of natural inland wetlands. As described in the AEE (Section 11.2.1), the quarrying activity is of significant regional benefit and has a functional need to be in this location. The effects management hierarchy has been applied to manage effects on natural inland wetlands, as described at section 5.6 above.
- Those adverse effects on natural inland wetlands which cannot be avoided, remedied, mitigated or offset, will be compensated for. We have assessed the proposed habitat restoration and enhancement measures against the 13 Principles for Aquatic Compensation set out in Appendix 7 of the NPS-FM. This assessment is provided in Table 5.2 below.

Policy 6 of the NPS-FM requires 'no further loss of extent of natural inland wetlands, their values are protected, and their restoration is promoted'.

Although there will be a permanent loss in the extent of approximately 1.7 ha of natural inland wetlands, being gully seepage wetlands, recreation of these wetlands is not proposed as:

- It is challenging to recreate seepage wetlands and their associated hydrology, particularly in sandy, highly permeable soils. Correspondingly, there is a high degree of uncertainty that no net loss outcomes could be achieved even if proposed.

- Considerably better ecological outcomes can be achieved by improving the indigenous dominance and ecological integrity of potentially high value wetlands in the broader landscape as is proposed.

Importantly, the proposed restoration of these potentially high value wetlands will achieve better outcomes overall for the health and well-being of water bodies and freshwater ecosystems. The proposed approach is therefore consistent with the hierarchy of obligations in Te Mana o te Wai.

**Table 5.2. Assessment against Aquatic Compensation Principles set out in Appendix 7 of the NPS-FM**

| Principle | NPS-FM Explanation | Assessment |
|---|---|---|
| Adherence to the effects management hierarchy | *Aquatic compensation is a commitment to redress more than minor residual adverse effects, and should be contemplated only after steps to avoid, minimise, remedy, and offset adverse effects are demonstrated to have been sequentially exhausted.* | Principle met.<br><br>The effects management hierarchy has been applied sequentially, focussing first on avoiding potential adverse effects on the extent and values of natural inland wetlands and streams as described at Section 4.2 above.<br><br>Offsetting was considered but ruled out as being neither practical nor possible, due to difficulties in collecting and interpreting quantitative data and challenges in quantitively predicting future gains. |
| When aquatic compensation is not appropriate | *Aquatic compensation is not appropriate where, in terms of conservation outcomes, the extent or values are not able to be compensated for.* | In no instance is the 'limits to offsetting' principle considered to be breached. |
| Scale of aquatic compensation | *The extent or values to be lost through the activity to which the aquatic compensation applies are addressed by positive effects that outweigh the adverse effects.* | Principle met.<br><br>The extent of aquatic compensation proposed is such that the wetland values to be lost are addressed by positive effects on natural inland wetlands that outweigh the adverse effects, as described at Section 5 above.<br><br>BCMs have been applied to 'sense check' the scale of compensation for |

| Principle | NPS-FM Explanation | Assessment |
|---|---|---|
| | | wetland biodiversity values. BCMs indicate that positive effects to indigenous biodiversity values will outweigh the adverse effects. |
| Additionality | *Aquatic compensation achieves gains in extent or values above and beyond gains that would have occurred in the absence of the compensation, such as gains that are additional to any minimisation and remediation or offsetting undertaken in relation to the adverse effects of the activity.* | Principle met.<br>The proposed restoration and enhancement activities would not otherwise occur in the absence of the project. |
| Leakage | *Aquatic compensation design and implementation avoids displacing harm to other locations (including harm to existing biodiversity at the compensation site).* | Principle met. |
| Long-term outcomes | *Aquatic compensation is managed to secure outcomes of the activity that last as least as long as the impacts, and preferably in perpetuity. Consideration must be given to long-term issues around funding, location, management, and monitoring.* | Principle met.<br>The benefits associated with habitat restoration and enhancement activities are proposed in perpetuity where possible. All areas of wetland buffer planting are to be protected via covenant or other legal mechanism |
| Landscape context | *An aquatic compensation action is undertaken where this will result in the best ecological outcome, preferably close to the impact site or within the same ecological district. The action considers the landscape context of both the impact site and the compensation site, taking into account interactions between species, habitats and ecosystems, spatial and hydrological connections, and ecosystem function.* | Principle met.<br>The proposed compensation package is near the impact site and will result in an increase in native ecosystem extent and ecological connectivity in the landscape. |

| Principle | NPS-FM Explanation | Assessment |
|---|---|---|
| Time lags | *The delay between loss of extent or values at the impact site and the gain or maturity of extent or values at the compensation site is minimised so that the calculated gains are achieved within the consent period or, as appropriate, a longer period (but not more than 35 years).* | Principle met.<br>BCMs indicate that net positive outcomes are expected within 10 years or 15 years of commencement and time lag has been factored into the scale of compensation required to generate net positive outcomes. |
| Trading up | *When trading up forms part of aquatic compensation, the proposal demonstrates that the aquatic extent or values gained are demonstrably of greater or higher value than those lost. The proposal also shows the values lost are not to Threatened or At Risk/Declining species or to species considered vulnerable or irreplaceable.* | Principle met.<br>The compensation approach involves 'trading up' the loss of low value wetland habitat for restoration and enhancement of higher value indigenous wetland habitat. |
| Financial contributions | *A financial contribution is only considered if it directly funds an intended aquatic gain or benefit that complies with the rest of these principles.* | Not applicable |
| Science and mātauranga Māori | *The design and implementation of aquatic compensation is a documented process informed by science where available, and mātauranga Māori at place.* | Principle met with discussions ongoing.<br>Engagement with mana whenua is described in the Assessment of Environmental Effects (AEE). |
| Tangata whenua and stakeholder participation | *Opportunity for the effective and early participation of tangata whenua or stakeholders is demonstrated when planning aquatic compensation, including its evaluation, selection, design, implementation, and monitoring.* | Principle met with discussions ongoing.<br>Engagement with mana whenua is described in the Assessment of Environmental Effects (AEE). |
| Transparency | *The design and implementation of aquatic compensation, and communication of its results to the public, is undertaken in a transparent and timely manner.* | Principle met.<br>This principle is met via the BCM (Appendix E) which provides transparency around the design of the compensation package and the draft |

| Principle | NPS-FM Explanation | Assessment |
|---|---|---|
| | | Ecological Management Plan which, among other things, sets out how the compensation package will be implemented. |

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# 7. Applicability

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

Report prepared by:

..........................................................

Matt Baber

Principal Ecologist/ Director

Alliance Ecology Ltd

# Appendix A: Figures

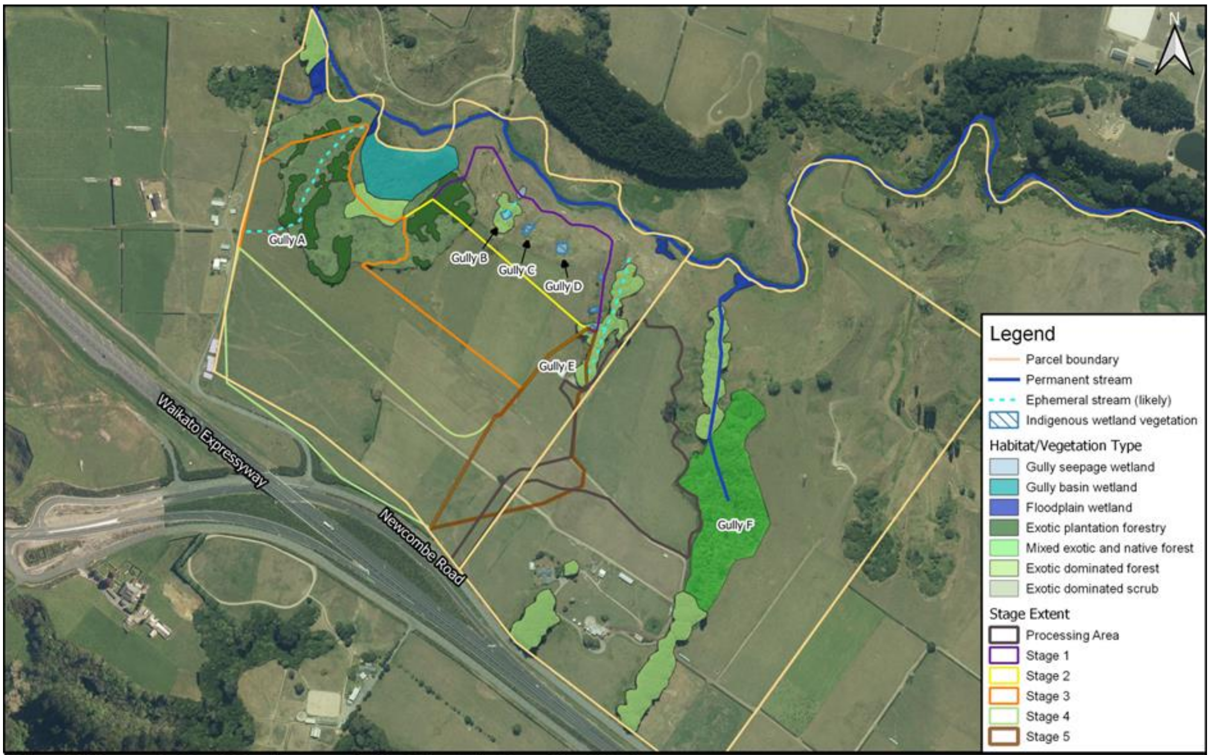


**Figure 1. Newcombe Road Sand Quarry - Habitat/Vegetation Type Classifications**

Date: 02/10/23
Created by: Brenda Bartels
Client: Alliance Ecology Ltd
Project: RS Sands Quarry
Data sourced from LINZ under Creative Commons Attribution 4.0 International

0 100 200 300 400 500 600 m

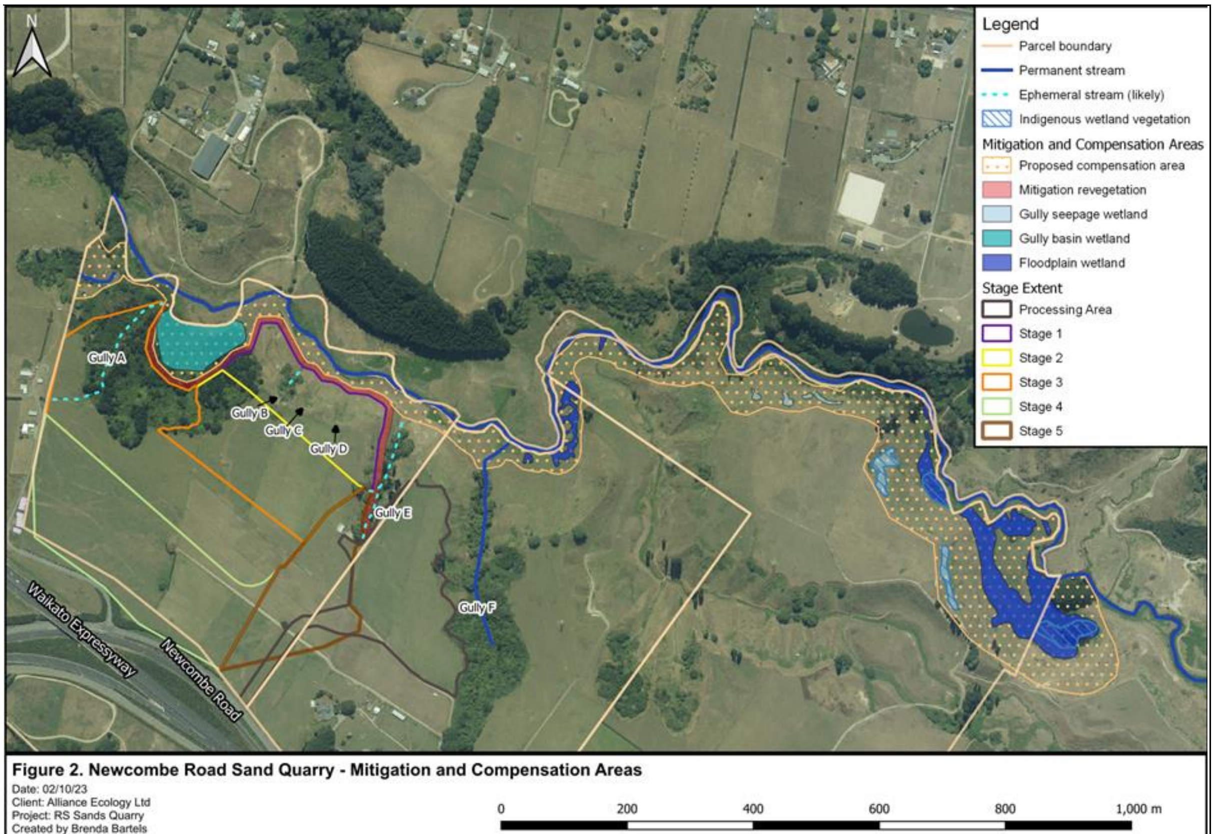


**Figure 2. Newcombe Road Sand Quarry - Mitigation and Compensation Areas**

Date: 02/10/23
Client: Alliance Ecology Ltd
Project: RS Sands Quarry
Created by Brenda Bartels
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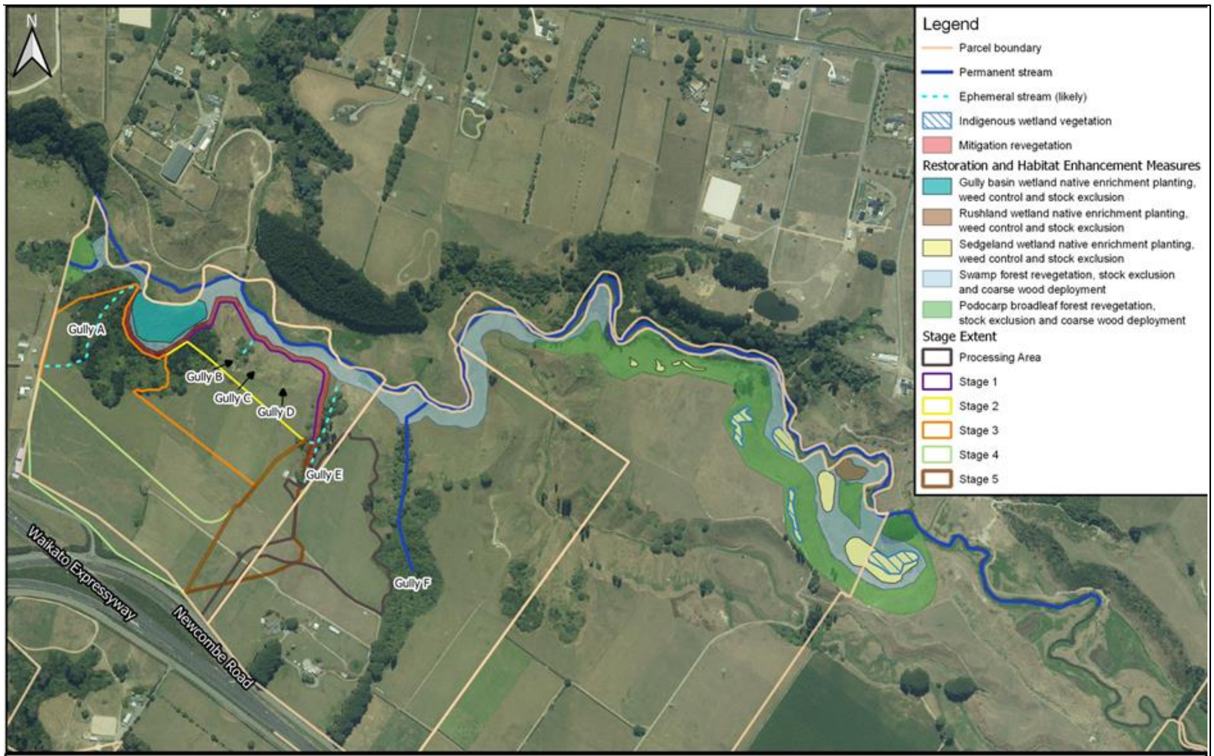


**Figure 3. Newcombe Road Sand Quarry - Restoration and Habitat Enhancement within the Compensation Area**

Date: 02/10/23
Client: Alliance Ecology Ltd
Project: RS Sands Quarry
Created by Brenda Bartels
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0 200 400 600 800 1,000 m

# Appendix B: Long-tailed bat report

# *RS Sands Ltd*

## Baseline long-tailed bat survey & preliminary effects assessment on bats of the prosed sand mine at Newcombe Road, Cambridge 2020, including potential tree roost assessment 2023

Bluewattle Ecology

# Table of Contents




Prepared by: Eva Kessels[1] & Gerry Kessels[2]

Reviewed by: Dr Matt Baber[3]



Version: Final 041223 Amended 04 December 2023

PWF Ref: FUL.00601




[1] Class A & B Bat Competency Certification – Department of Conservation
[2] Class A, B, C & D Bat Competency Certification – Department of Conservation
[3] Alliance Ecology

## Executive Summary

RS Sand Limited have engaged Bluewattle Ecology (via Fulton Hogan Ltd/Kinetic Environmental Ltd) to undertake investigative, baseline bat surveys at a farm at 77 Newcombe Road, south of Cambridge, to support resource consents for a proposed sand quarry at this location. Automatic bat monitors were placed in within likely key habitats on the property. Two baseline acoustic long-tailed bat surveys were conducted between the period of December 2019 and June 2020, at 77 Newcombe Road, Cambridge, New Zealand.

In the December - January survey 159 bat passes were recorded over a total of 21 monitoring nights. Total bat passes averaged 0.95 passes per detector per night, equating to a low level of bat activity. In the May - June survey, a total of 4,709 bat passes were recorded over 41 nights of surveying, averaging 14.4 bat passes per functional ABM per night. Levels of bat activity were considered low-moderate, although one site detected a high-level average of 177 bat passes per night, indicative of a potential bat roost site at this survey location.

The property at 77 Newcombe Road exhibits a variety of structural and ecosystem traits which provide functional habitat for bats, including mature linear stands of trees, deeply incised gullies and close proximity to a stream and river system – the Karapiro Stream and the Waikato River, where insects tend to aggregate at dusk and dawn, and mature trees with cavity bearing qualities for roost are situated in relative shelter from wind.

The most important habitat features are likely to be the gullies leading in the Karapiro Stream and the mature exotic trees left in clusters or rows. Pasture, while being utilised, is likely to be less important in this locality for bats as they are an edge adapted species, and open grassland is not preferred habitat.

Before suitable avoidance, remediation and mitigation measures are adopted, the preliminary level of adverse effects assessment on on long-tailed bats is summarised as follows :

- Loss of open pastureland for foraging and commuting habitat - Moderate level of effect on bats;
- Loss of of gully and shelterbelt and pastureland habitat within 25 m of shelterbelts and gully habitats - High level of effect on bats;
- Loss of occupied solitary roost trees and unoccupied potential roost tree habitat – High level of effects on bats; and
- Loss of occupied roost tree – Very High level of effect on bats.

In order to address these [potential adverse effects of the proposed Newcombe sand mine on long-tailed bats, the following measures are recommended:

a) A survey and risk profile inventory of all potential bat roost trees is undertaken in accordance with best practice before sand extraction begins;

b) A Bat Management Plan (BMP) should be prepared by a recognised bat expert and implemented across the site which will outline detailed protocols around potential bat roost tree removal and ongoing monitoring; and

c) The loss of habitat of bats within the site is suitably mitigated, including appropriate offset offset measures such as buffer planting, animal pest control, erection of artificial bat roosts, habitat restoration, and long-term protection of high quality bat habitat areas. The type and quantum of any mitigation measures is best determined by biodiversity offset compensation or quantitative modelling.

Subject to review of the detailed sand extraction process and review of the full suite of avoidance, remediation, mitigation, offset and monitoring measures as broadly outlined above, the overall level of adverse effects on long-tailed bats as a consequence of this proposal is likely to be low.

# 1 Introduction

## 1.1 Scope

RS Sand Limited have engaged Bluewattle Ecology (via Fulton Hogan Ltd/Kinetic Environmental Ltd) to undertake investigative, baseline bat surveys at a farm at 77 Newcombe Road, south of Cambridge, to support resource consents for a proposed sand quarry at this location (Figure 1).

To gain an understanding of the habitat features that are of value to long-tailed bats it is necessary to monitor the site's key potential bat habitat features. Automatic bat monitors (ABMs) were placed within likely key habitats on the property that would would provide suitable habitat for bat roosting, foraging and commuting.

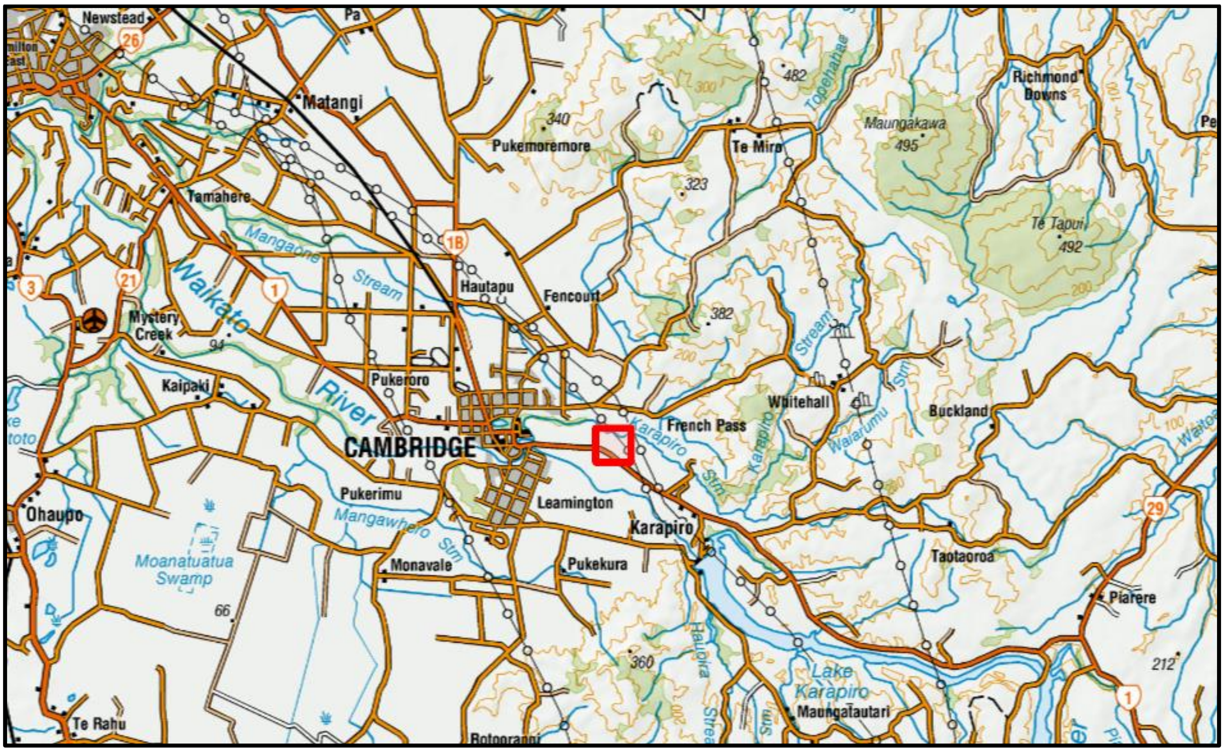



Figure 1: Location map of Newcombe Road sand quarry site

## 1.2 Background

Long-tailed bats (*Chalinolobus tuberculatus*, Threatened – Nationally Critical=- O'Donnell 2018[4]) are distributed widely throughout modified agricultural landscapes within the Waikato region, including in the vicinity of Cambridge. Review of the Department of Conservation (DOC) Bat Distribution Database (supplied in November 2020[5]), as well as several studies in this area, confirm that this species is found within rural habitats alongside the Waikato River and Karapiro Stream gully system in this locality (Kessels & Blair 2013[6]; Connolly 2013[7]).

Despite being classified as Nationally Critically Endangered by DOC, the presence of long-tailed bats within this highly modified landscape demonstrates they are able to adapt to major landscape change

[4] O'Donnell, C.F.J.; Borkin, K.M.; Christie, J.E.; Lloyd, B.; Parsons, S.; Hitchmough, R.A. 2018: Conservation status of New Zealand bats, 2017. New Zealand Threat Classification Series 21. Department of Conservation, Wellington. 4 p.

[5] Data supplied by from Moira Pryde, Technical Advisor, Research and Development, Department of Conservation -Te Papa Atawhai

[6] Kessels, G & Blair, J. 2013. Te Awa Lifecare Village Ltd. Assessment of Ecological Effects of the Te Awa Lifecare Village. Kessels Ecology.

[7] Connolly, T. 2013. Waikato Expressway: Cambridge Section. Long-tailed Bat Surveys Summer 2012-13 Lloyd Property, Mellow Manor, Karapiro Gully. Opus International Consultants.

from indigenous vegetation to landscape dominated by almost 100% exotic vegetation over time. This is despite likely ongoing pressures from introduced animal competition and predation.

Nonetheless, it appears that several structural and functional habitat factors must be present or addressed, including the presence of mature and well-vegetated corridor pathways and habitats for commuting, foraging and roosting habitats key for maintaining the life cycle requirements of this species (Dekrout et al 2014)[8]. These structural features, be they exotic or indigenous vegetation, access to stream, river, wetland or lake ecosystems, and varied topographical characteristics are likely critical to maintain the presence of bats in a rural landsacpe (Davidson-Watts 2019)[9].

The property at 77 Newcombe Road exhibits all of these structural and ecosystem traits likely to provide functional habitat for bats, including mature linear stands of trees, deeply incised gullies and proximity to a stream and river system – the Karapiro Stream and the Waikato River, where insects tend to aggregate at dusk and dawn, and mature trees with cavity bearing qualities for roost are situated in relative shelter from wind.

It is expected that the subject site is utilised throughout the year by long-tailed bats for commuting and foraging, as well as possibly roosting habitat. The most important habitat features are likely to be the gullies leading in the Karapiro Stream and the mature exotic trees left in clusters or rows. Pasture, while being utilised, is likely to be less important in this locality for bats as they are an edge adapted species, and open grassland is not preferred habitat (Parsons et el 1997).

# 2 Methodology

## 2.1 Acoustic Surveys

Two surveys were undertaken at the site – one from December 2019 to January 2020 and another from May until June 2020.

Omni-directional frequency compression monitors - “AR3” and “AR4” (also called automated bat monitors or ABMs), manufactured by DOC, were deployed to investigate the activity of long-tailed bats within the site according to best practice methodological protocols (Sedgeley 2012)[10]. The location of these detectors is shown in Figure 2 and coordinates and site descriptors detailed in Appendix A.

In the December - January survey, 12 ABMs were deployed with data collected from 8. The detectors were deployed on 19 December 2019 and retrieved 9 January 2020 (Table 1).

In the May survey, eight ABMs were placed near previously surveyed sites as in January 2020. The ABMs were deployed on 15 May 2020 and retrieved on 22 June 2020 (Table 1).

ABMs record any sound that may be a bat call or echolocation. When it is triggered by a potential bat pass it records one file for each pass. The recordings are prepared in a form of a compressed image of a spectrogram, and are saved onto an SD card in the form of bitmap format images. The images were viewed using BatSearch 3.12, software that was developed by DOC to help quickly view the files and create data from them. The frequency spectrum covered ranges from 0 Hz to 88 kHz and images represent 1-6 seconds of recording.

All detectors were calibrated to have the same time and date settings (NZST) and were pre-set to start monitoring one hour before sunset until one hour after sunrise. The distance between detectors of distinct monitoring locations was at least 50 m apart to increase the chance of independent bat

[8] Dekrout, BD Clarkson & S Parsons (2014) Temporal and spatial distribution and habitat associations of an urban population of New Zealand long-tailed bats (Chalinolobus tuberculatus), New Zealand Journal of Zoology, 41:4, 285-295, DOI: 10.1080/03014223.2014.953551

[9] Davidson-Watts Ecology Ltd. (2019). Long-tailed Bat Trapping and Radio Tracking Baseline Report 2018 and 2019 Southern Links, Hamilton. Prepared for AECOM.

[10] Sedgeley J. 2012. Bats: roost occupancy and indices of bat activity—automatic bat detectors. Inventory and monitoring toolbox: bats DOCDM-590899. Department of Conservation, wellington.

monitoring. The recorders were suspended at least 2 m above the ground to reduce superfluous detections caused by terrestrial insects (usually cicada species).


**Figure 2: Location of detectors deployed at Newcombe Road proposed sand mine, 19/12/19 – 9/01/20; 15/05/20 – 22/06/20.**

### 2.2 Ecological Effects Assessment

A preliminary effects assessment and management recommendations of the proposed sand extraction operation on long-tailed bats was undertaken in accordance with the Ecological Impact Assessment guidelines (EcIA) developed by the Ecological Institute of Australia and New Zealand (EIANZ)[11].

### 2.3 Potential Roost Tree Assessment

On 23 September 2023 a update memo regarding the potential removal of potentially affected areas were evaluated from a broad perspective to determine their suitability as bat habitats for foraging, commuting, or roosting. Specifically, trees that could serve as potential bat roosts were assessed to further inform the Bat Management Plan, as requested by the Waipa District Council peer review ecologist. This is memo is contained in Appendix D.

[11] Environment Institute of Australia and New Zealand Inc. (2018). Ecological Impact Assessment (EcIA). EIANZ guidelines for use in New Zealand: terrestrial and freshwater ecosystems. 2nd Edition.

# 3 Results

## 3.1 January Survey

A total of 159 bat passes were recorded over a total of 21 monitoring nights, averaging 0.95 passes per functional ABM per night. Bats were detected on 61% (13/21) of consecutive monitoring nights. Passes were recorded on 61% (8/13) of the detectors. Of these passes, 99% were classified as stereotypical search phase passes used for orientation and foraging; 1 (out of 159) of these search phase passes were coupled with 'social' calls recorded inadvertently on the 28 kHz channel.

Overall nightly activity trends showed that bat activity peaked at the second hour after sunset (8:45pm) with 115 of the total passes recorded. Average passes per night across all detectors = 159/ 21 = 7.57 passes. Bat calls were obtained for every ABM. Note that BW04 recorded for 8 nights and ProSoc2 recorded for 4 nights

A summary of the results is shown in Table 2 and Figure 3a below, with detailed results for each ABM presented in Appendix B. '

**Table 1: Corresponding detector number to site location of detectors deployed at Newcombe Road, 19/12/19 – 9/01/20; 15/05/20 – 22/06/20.**

| Site | Detector number | Deployment date |
|---|---|---|
| **1** | PRS1 | 19/12/19 – 9/01/20 |
| **2** | PRS2 | 19/12/19 – 9/01/20 |
| **3** | KB48 | 19/12/19 – 9/01/20 |
| **4** | ProSoc2 | 19/12/19 – 9/01/20 |
| **5** | PRS3 | 19/12/19 – 9/01/20 |
| **6** | WEC2 | 19/12/19 – 9/01/20 |
| **7** | WEC7 | 19/12/19 – 9/01/20 |
| **8** | BW08 | 19/12/19 – 9/01/20 |
| **9** | BW01 | 15/05/20 – 22/06/20 |
| **10** | PRS4 | 15/05/20 – 22/06/20 |
| **11** | BW04 | 15/05/20 – 22/06/20 |
| **12** | PRS1 | 15/05/20 – 22/06/20 |
| **13** | BW06 | 15/05/20 – 22/06/20 |
| **14** | PRS2 | 15/05/20 – 22/06/20 |
| **15** | BW05 | 15/05/20 – 22/06/20 |
| **16** | KB48 | 15/05/20 – 22/06/20 |

**Table 2: Distribution of total activity levels recorded at Newcombe Rd during the Dec 2019 -Jan 2020** (survey throughout the night at all locations including bat passes per night within 1-hour after sunset and bat passes per night within one hour before sunrise)

| Site | Bat passes per night | Bat passes per night within 1-hour after sunset | Bat passes per night within one hour before sunrise |
|---|---|---|---|
| **Site 1 – PRS1** | 2 | 0.09 | 0 |
| **Site 2 – PRS2** | 3.38 | 0.19 | 0 |
| **Site 3 – KB48** | 0.61 | 0 | 0 |
| **Site 4 – ProSoc2** | 0.24 | 0 | 0 |
| **Site 5 – PRS3** | 0.48 | 0 | 0 |
| **Site 6 – WEC2** | 0.24 | 0 | 0 |
| **Site 7 – WEC7** | 0.10 | 0 | 0 |
| **Site 8 – BW04** | 0.52 | 0.05 | 0 |

### 3.2 May-June Survey

Monitoring in May-June 2020 resulted in the detection of bat activity at all 8 different locations (Table 2). The average percentage of nights with bat passes across all detectors was 44%. A high level of bat activity was detected within the landscape during the survey. A total of 4,709 bat passes were recorded over 41 nights of surveying, averaging 14.4 bat passes per functional ABM per night. An overview of the bat activity results is shown in Figures 3-5. The graphs show activity levels expressed as average number of bat passes per night for all ABM deployed.

At total of 1,848 bat passes were detected in the first hour after sunset, across seven of the eight ABMs. No bat passes were detected in the first hour before sunrise by any of the eight of the ABMs (Table 2).

Detector BW06 (Site 13) detected a consistently high number of bat calls per night (average = 103.8), suggesting this site was likely an important foraging and/or commuting area during the survey period. BW06 reported 4,256 detections, or 90.4% of all calls which may be indicative of a roost site nearby. However, because no bat passes were detected 11-12 hours after sunset, suggest there may not be a roost present, or the bats may be returning via a different route if there was a local roost present.

Limited detection occurred in detector BW04 (7% of all nights) and in detector PRS1 (12%), most likely due to battery failure.

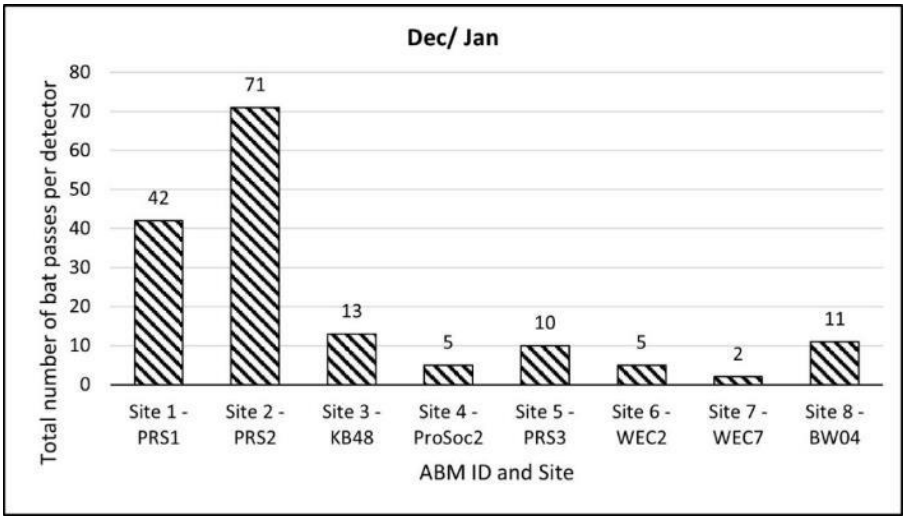
Over 70 feeding buzzes were captured by BW06 (Site 13) across the monitored nights. BW01, BW03 and BW04 each recorded one feeding buzz and PRS1 recorded three feeding buzzes.

Compared to the January survey, there was much greater bat activity detected in the May-June survey, predominantly due to the large number of positive passes detected at Site 13.

**Table 3: Distribution of total activity levels at Newcombe Rd during the May-June survey 2020** (recorded throughout the night at all locations including bat passes per night within 1-hour after sunset and bat passes per night within one hour before sunrise)

| Site | Bat passes per night | Bat passes per night within 1-hour after sunset | Bat passes per night within one hour before sunrise |
|---|---|---|---|
| **Site 9 - BW01** | 3.86 | 1.14 | 0 |
| **Site 10 - PRS4** | 0.68 | 0.22 | 0 |
| **Site 11 - BW04** | 5.22 | 12.67 | 0 |
| **Site 12 - PRS1** | 38.40 | 29 | 0 |
| **Site 13 - BW06** | 177.33 | 66.91 | 0 |
| **Site 14 - PRS2** | 0.36 | 0.18 | 0 |
| **Site 15 - BW05** | 4.25 | 1 | 0 |
| **Site 16 - KB48** | 0.08 | 0 | 0 |

- Based on all functional detector nights



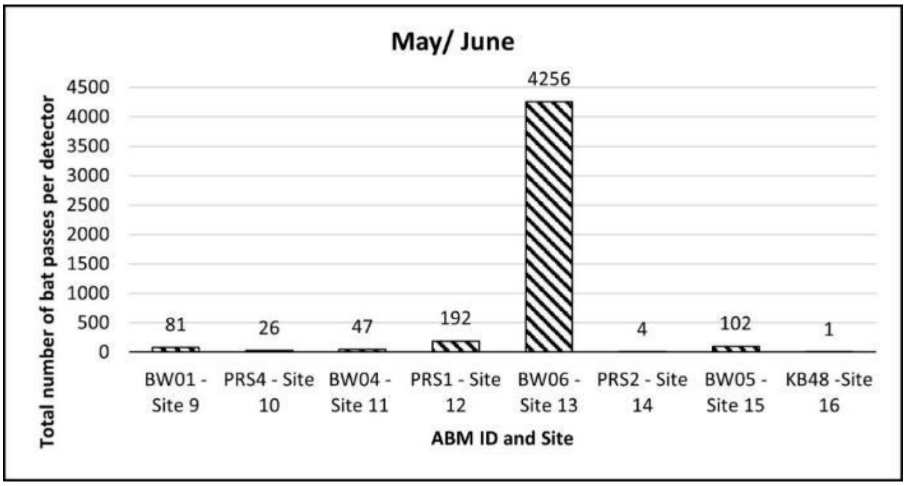
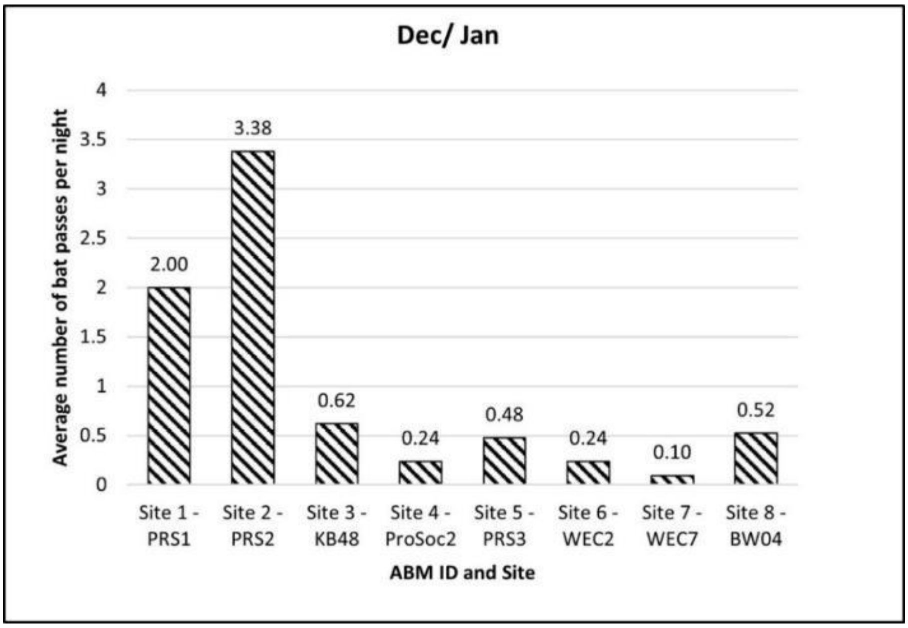




**Figure 3a &b: Total bat passes for each ABM for both surveys at Newcombe Rd.**



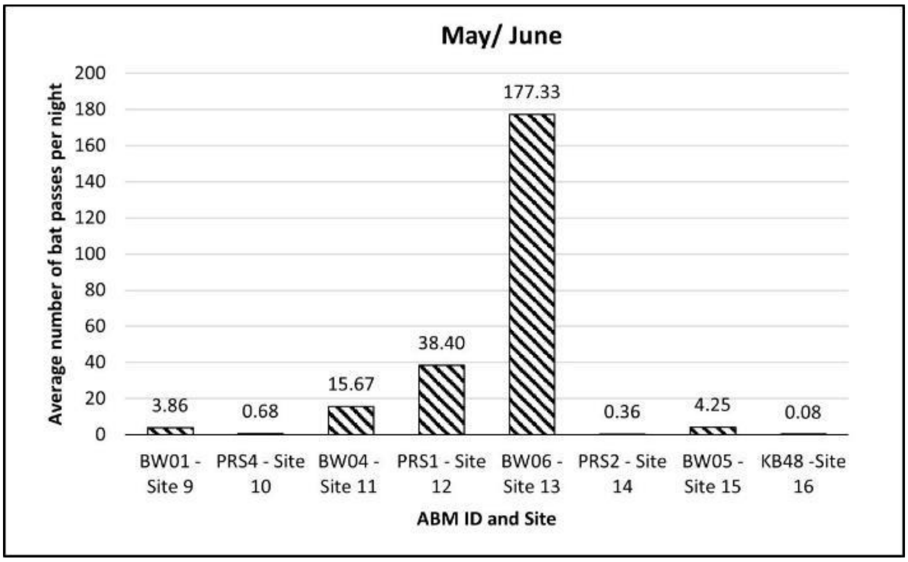




**Figure 4a &b: Average bat passes per recorded night for each ABM for each survey at Newcombe Rd**

Weather conditions during the entire Dec-Jan survey period were optimal for bat emergence (refer to Appendix B - Table B-1). Minimum temperatures at dusk for bat emergence are >8°C, ideally >10°C (O'Donnell, 2000)[12]. Dusk temperatures remained above 10°C during the entire survey period. Mean rainfall was low at 0.37 mm, with an average minimum temperature of 11 °C. The lowest dusk temperature recorded during the survey was 14.6°C and the coldest temperature recorded during the survey was 5.9°C. Rainfall was present six times during the survey period. Wind conditions were mild and suitable across the survey period, with maximum wind gusts below 20 km/hr.

Weather conditions during the entire May-June survey period were reasonable for bat emergence (refer to Appendix B - Table B-2). Minimum temperatures at dusk for bat emergence are >8°C, ideally >10°C. Dusk temperatures remained above 10°C during the entire survey period, with the exception of the lowest dusk temperature recorded during the survey which was 7.4°C on one night only. The coldest temperature recorded during the survey was -1.9°C. Rainfall was present once during the survey period. Wind conditions were mild and suitable across the survey period, with maximum wind gusts below 13 km/hr. Mean rainfall was 2.1 mm, with an average minimum temperature of 5.62 °C.

[12] O'Donnell, C. 2000. Influence of season, habitat, temperature, and invertebrate availability on nocturnal activity of the New Zealand long- tailed bat (Chalinolobus tuberculatus). New Zealand Journal of Zoology 27: 207-221.

# 4 Preliminary effects assessment on bats & recommendations

## 4.1 Habitat Value

Long-tailed bats are utilising the area of the Newcombe Road proposed sand mine and surrounding landscape features as commuting and foraging habitat.

Figure 5 shows the location of these habitats and known significant natural areas (Deichmann & Kessels 2013)[13].

Due to the large number of feeding buzzes, social calls and general activity at Site 13 within Gully B, it is possible that the mature willow and poplar trees were being utilised as a roost site during the May-June survey. There was not evidence of roosting at any of the sites during the previous December – January survey, although ABM surveys are not generally able to definitely detect roosting habitats where social or bi-modal activity is not obvious. Further surveys employing dusk watches, or radiotracking would be required to establish roosts with a greater degree of certainty.

There are number of mature exotic trees on site which are suitable *potential* roosting habitat for bats. These are generally trees greater that 15 cm diameter at breast height (dbh), and which have cavities and crevasses which bats can crawl into (e.g. Figure 6). Generally, isolated tree in paddocks aren't used as roost trees because bats prefer groups of mature trees or double-lined shelter belts for roosting. Sometimes a solitary bat can use a tree for a temporary roost for a night or two though, and these can be difficult to locate without intensive radio tracking. Maternity or communal roosts, where female bats regularly occupy over the spring and summer month to raise their pups, are generally in sheltered areas with many mature trees. There is no evidence of a maternity site at Newcome Road at this point in time. While ABM surveys alone usually cannot determine roosts sites, high level activities over the spring-summer months, with bi-modal patterns of emergence/return activity patterns, can suggest a communal roost in the locality of the acoustic survey. These types of data were not found during the December-January surveys.

The location is being used for foraging and commuting though. As the data analysis show, commuting and feeding buzzes were found at many of the sites surveyed and detection rates ranged from low to high. Generally, bats are edge adapted animals, using the edges of forest as a guide to commuting within a landscape. They are opportunistic feeders of insects, but generally will return to areas, often over water or along side streams, rivers and lakes to feed on emerging flying insects. Bats can and do fly and forage over pasture but generally favour edge habitats.

The data therefore indicates that the Newcombe Road proposed sand mine site site and its surrounding locality main habitats for long-tailed bats:

- Commuting habitat: The mature shelterbelt trees at the site access, all of Gully B and the margin of the Karapiro Stream are likely to be used as regular commuting corridors across and along this site. Bats are likely to fly over all of the site on a regular basis, but likely less often that the gullies and shelterbelts.
- Foraging habitat: The main foregoing habitats are likely to be with the stream of Gully B, the margins of the Karapiro Stream and the wetland areas at the tope of Gully D alongside the Karapiro Stream. The open pastures are likely to be occasionally used for foraging but less often than these other habitats.
- Roosting habitat: The mature trees within Gully B are possibly used for roosting by solitary bats or as an occasional communal roost by bats. The mature trees within Gully C and Gully D are possibly used as roosting habitat. The mature trees found in the shelterbelts, as well as the isolated trees within the pastureland, are less likely to be used as communal roost trees, but roosting may still occur in these trees.

[13] Deichmann, B & Kessels, G. 2013. Significant Natural Areas of the Waipa District: Terrestrial and Wetland Ecosystems. Kessels & Associates Ltd for Waikato Regional Council: Technical report 2013/16

Therefore, in accordance with the EcIA guidelines for assessing ecological value the Newcombe Road site for bats is considered to be 'Very High'.[14]

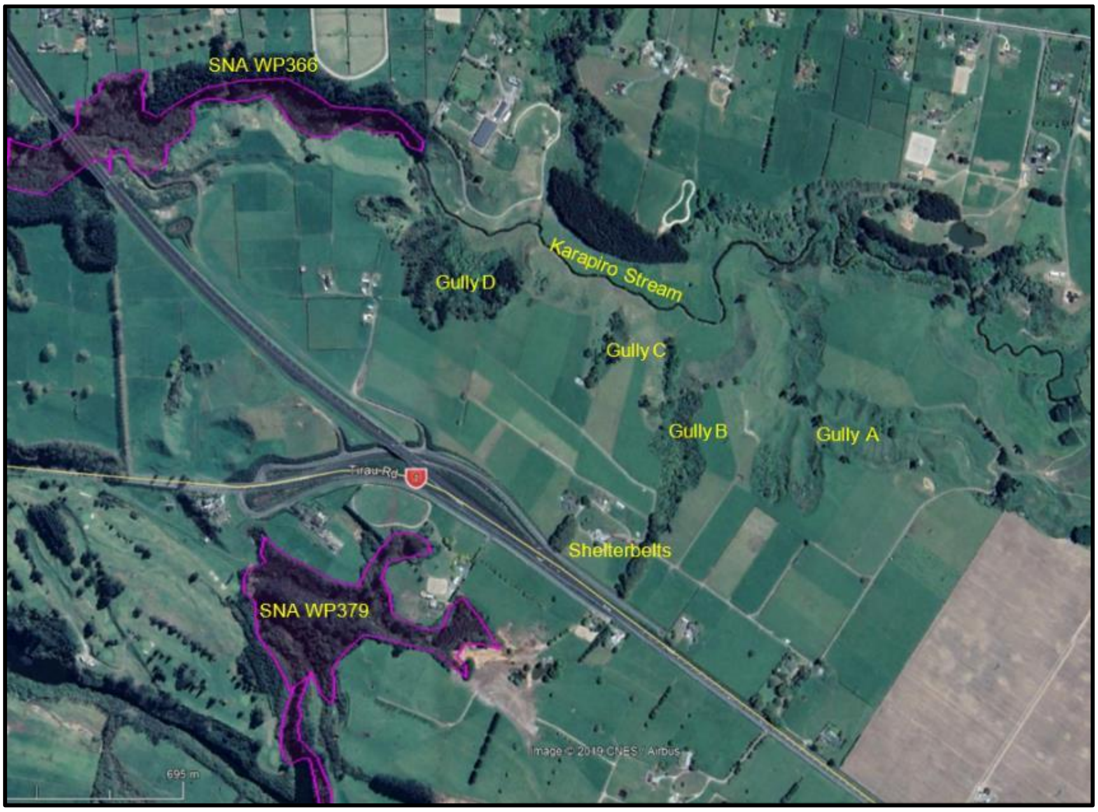



**Figure 5: Location of key habitats for bats and WRC listed SNAs at Newcombe Road**

**Figure 6: Crevices within these poplars are examples of potential bat roost trees at Newcombe Road**

[14] Refer to Table 5 (p67 EciA guidelines): "Nationally Threatened species, found in the ZOI either permanently or seasonally"

### 4.2 Preliminary ecological effects evaluation on bats

The removal of pasture and portions of some of the gully areas associated with the sand mine operation will result in the temporary loss of foraging and commuting habitat for bats. This effect is likely to cause a short-term disruption to movement of bats across this property. However, in the context of habitat availability in the wider landscape, long-term adverse significant adverse effects are unlikely to be discernible. Jones et al (2019)[15] suggest that long-tailed bats may be more resilient to development than the only other extant NZ bat species (short-tailed bat), because they appear less dependent on unmodified indigenous forest (due to their wide distribution throughout New Zealand), and because they are thought to be more flexible with their roost choice, as well as being edge-adapted (Borkin & Parsons, 2009; O'Donnell et al., 2006)[16]. There will, however, still be residual short to medium terms loss of habitat which will require mitigation. Opportunities for mitigation of lost foraging and commuting habitat require further consideration in the detailed ecological effects assessment for the project as a whole.

At this point in time there is no evidence that occupied bat roosts would be impacted by the proposed sand extraction operation. However, bats utilise a large number of trees as roosts throughout their home range and this can vary from year to year so that predicting roost tree usage within a bat population's home range without undertaking radio tracking is not possible. There are a number of trees on the site which could be utilised as bat roost trees which would be removed, or indirectly impacted, by the sand mine operation – these are termed potential bat roost trees. Trees that fit this category are not currently known to be occupied by bats but because they exhibit cavity bearing properties may be used by bats for roosting, although currently there is no evidence that they are occupied.

While any loss of an occupied roost tree can be considered to be a significant impact on a local population of bats, especially an occupied communal roost tree, the loss of potential roost trees is considered to be a lesser effect. However, given the uncertainty surrounding roost tree usage in rural Waikato landscapes, all potential roost trees should be checked immediately before felling to ensure they are not occupied, and if they are, a contingency strategy to avoid or offset these adverse effects should be put in place to address all scenarios, no matter how low the risk of one of those scenarios eventuating.

There may be a number of indirect and cumulative adverse effects of the sand mine extraction process on bats in this locality. For example, if night-time lighting is used on site this has potential to impact bat behaviour. Further effect assessment is required of each of these indirect and cumulative effects (such as lighting), in the detailed impact assessment reporting.

In accordance with the EcIA guidelines the 'Magnitude of Effect' of loss of foraging and commuting habitats for long-tailed bats is considered to be 'Moderate' in the short to medium term (0 to 25 years) and 'Low' in the long-term).[17] This is because the loss of the habitat in this locality is a small proportion of pastureland and exotic habitat for bats. Long-tailed bats are known to have a home range of

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[15] Jones C., Borkin K., Smith D. (2019). Roads and wildlife: the need for evidence-based decisions; New Zealand bats as a case study. New Zealand Journal of Ecology 43(2): 3376

[16] Borkin K.M. and Parsons S. 2009: Long-tailed bats' use of a Pinus radiata stand in Kinleith Forest: recommendations for monitoring. New Zealand Journal of Forestry 53(4): 38 43; O'Donnell C.F.J., Christie J.E., and Simpson W. 2006: Habitat use and nocturnal activity of lesser short-tailed bats (Mystacina tuberculata) in comparison with long-tailed bats

[17] Refer to Table 8 (p83) EcIA guidelines: Low: Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances or patterns; and/or Having a minor effect on the known population or range of the element/feature. Moderate: Loss or alteration to one or more key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; and/or Loss of a moderate proportion of the known population or range of the element/feature; High: Major loss or major alteration to key elements/features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; and/or Loss of a high proportion of the known population or range of the element/feature; Very High: Total loss of, or very major alteration to, key elements/features/ of the existing baseline conditions, such that the post-development character, composition and/or attributes will be fundamentally changed and may be lost from the site altogether; and/or Loss of a very high proportion of the known population or range of the element/feature.

hundreds of hectares (Dekrout et al 2014)[18]. In the long-term, as the site is rehabilitated and pasture and trees are established, bats will be able to re-enter and utilise this habitat for foraging and commuting.

In accordance with the EcIA guidelines the 'Magnitude of Effect of the loss of any occupied roost tree could range from 'Very High' if a communal bat tree is removed to 'High' if a solitary bat roost tree is removed. Suitable measures are required for robust prefelling checks of potential bat roost trees to ensure these are not occupied before being felled. If potential roost trees are proposed to be removed, suitable consent conditions will be required to monitor all potential roost trees before felling, and to avoid removal of any occupied roost trees. If a known roost tree is to be removed, implementation of robust biodiversity offset or compensation measures will be required to address this significant potential impact. At this point in time there is a small risk of finding an occupied communal roost tree within the sand mine footprint, particularly if intrusion into the gullies and mature shelterbelt trees are limited to as minimal an extent as possible.

Combining the ecological value of habitat for bats with the Magnitude of Effects of the proposed sand mine on bats leads to the following EcIA 'Level of Effects' thresholds for each habitat type associated with proposed sand mine at Newcombe Road before suitable avoidance, remediation and mitigation measures[19]:

- Loss of open pastureland for foraging and commuting habitat - Moderate level of effect on bats;
- Loss of of gully and shelterbelt and pastureland habitat within 25 m of shelterbelts and gully habitats - High level of effect on bats;
- Loss of occupied solitary roost trees and unoccupied potential roost tree habitat – High level of effects on bats; and
- Loss of occupied roost tree – Very High level of effect on bats.

# 5 Conclusion & Recommendations

The subject property provides foraging and commuting habitat for long-tailed bats. Some of the mature exotic trees in the gully systems may also provide roosting habitat for bats. The airspace above the open pastureland is likely being occupied by bats as they fly to and from key feeding and roosting habitats and for occasional foraging. However, the most significant habitats are likely to be the gully system, mature tree shelter belts and the riparian margins of the Karapiro River.

In order to address the effects of the proposed Newcombe sand mine on long-tailed bats, the following measures are recommended:

d) A survey and inventory of all potential bat roost trees is undertaken in accordance with best practice before sand extraction begins;

e) A Bat Management Plan (BMP) should be prepared by a recognised bat expert and implemented across the site which will outline detailed protocols around tree removal and ongoing monitoring; and

f) The loss of habitat of bats within the site is suitably mitigated, including appropriate offset offset measures such as buffer planting, animal pest control, erection of artificial bat roosts, habitat restoration, and long-term protection of high quality bat habitat areas. The type and quantum of any mitigation measures is best determined by biodiversity offset compensation or quantitative modelling.

[18] Dekrout, A.S., Clarkson, B.D. & Parsons, S. (2014). Temporal and spatial distribution and habitat associations of an urban population of New Zealand long-tailed bats (Chalinolobus tuberculatus), New Zealand Journal of Zoology, 41:4, 285-295, DOI: 10.1080/03014223.2014.953551

[19] Refer to Table 10 (p84) EcIA guidelines.

Subject to review of the detailed sand extraction process and review of the full suite of avoidance, remediation, mitigation, offset and monitoring measures as broadly outlined above, the overall level of adverse effects on long-tailed bats because of this proposal is likely to be low.

# Appendix A: ABM coordinates for the 2020 Newcombe Road Quarry long-tailed bat survey

Table A-1: Locations of ABMs for Dec 2019 – Jan 2020 survey

| *Site* | January Survey | Latitude | Longitude |
|---|---|---|---|
| ***1*** | PRS1 (In Cabbage tree in large gully) | 37°53’27.04”S | 175°30’21.44”E |
| ***2*** | PRS2 (On cabbage tree near gate and stream) | 37°53’27.51”S | 175°30’23.37”E |
| ***3*** | KB48 (In large willow in gully) | 37°53’37.56”S | 175°30’43.05”E |
| ***4*** | ProSoC2(Poplar at bottom of gully) | 37°53’34.61”S | 175°30’36.11”E |
| ***5*** | PRS3 (On oak tree next to track) | 37°53’48.92”S | 175°30’40.56”E |
| ***6*** | WEC2 (On fence post) | 37°53’40.05”S | 175°30’41.45”E |
| ***7*** | WEC7 (On driveway near road) | 37°53’47.30”S | 175°30’32.84”E |
| ***8*** | BW04 (On tree fork, side of gully) | 37°53’33.84”S | 175°30’37.01”E |

Table A-2: Locations of ABMs for May-June 2020 survey

| *Site* | May Survey | Latitude | Longitude |
|---|---|---|---|
| ***9*** | BW01 (South of small gully) | 37°53’30.36”S | 175°30’18.18”E |
| ***10*** | PRS4 (On pine tree branch) | 37°53’31.25”S | 175°30’22.07”E |
| ***11*** | BW04 (Cabbage tree 50m west of stream, below pylon) | 37°53’25.58”S | 175°30’23.15”E |
| ***12*** | PRS1 (On Poplar tree, top SE corner of gully) | 37°53’34.11”S | 175°30’37.60”E |
| ***13*** | BW06 (Bottom of gully, poplar tree branch) | 37°53’38.07”S | 175°30’42.61”E |
| ***14*** | PRS2 (Far NE end of paddock) | 37°53’43.91”S | 175°30’46.47”E |
| ***15*** | BW05 (At first poplar) | 37°53’47.35”S | 175°30’42.95”E |
| ***16*** | KB48 (On driveway) | 37°53’48.38”S | 175°30’33.29”E |

# Appendix B: Weather data during the two survey periods

Table B-1: Summary of January survey weather conditions during the survey period. Temperatures in °C, precipitation in mm and wind speed in m/s. Data obtained from NIWA CliFlo database, at 26117

| Date | Maximum Temperature(C) | Minimum Temperature (C) | Precipitation (mm) | Maximum Wind speed (m/s) |
|---|---|---|---|---|
| **19/12/19** | 19.3 | 9.5 | 0.8 | 10.8 |
| **20/12/19** | 20.3 | 11.9 | 0 | 16.5 |
| **21/12/19** | 21.4 | 8.3 | 4.6 | 9.8 |
| **22/12/19** | 21.3 | 7.8 | 0 | 9.3 |
| **23/12/19** | 24.2 | 11.6 | 0 | 9.3 |
| **24/12/19** | 25.3 | 16 | 0 | 8.2 |
| **25/12/19** | 25.9 | 13.4 | 0 | 7.2 |
| **26/12/19** | 22.3 | 10.6 | 0 | 6.7 |
| **27/12/19** | 25 | 11.2 | 0 | 10.8 |
| **28/12/19** | 22.3 | 10.5 | 0.4 | 14.9 |
| **29/12/19** | 20.5 | 5.9 | 0 | 12.9 |
| **30/12/19** | 20.4 | 14.1 | 0 | 12.4 |
| **31/12/19** | 23.4 | 10.6 | 0.2 | 8.8 |
| **1/01/20** | 26.5 | 10.3 | 0 | 9.8 |
| **2/01/20** | 22.7 | 7.5 | 0 | 10.8 |
| **3/01/20** | 24 | 14.4 | 0 | 13.9 |
| **4/01/20** | 22.5 | 14.5 | 0.6 | 17 |
| **5/01/20** | 19.5 | 12.4 | 0 | 12.4 |
| **6/01/20** | 19.8 | 14.3 | 1.2 | 18.5 |
| **7/01/20** | 19.9 | 12.5 | 0 | 13.9 |
| **8/01/20** | 19.8 | 6.7 | 0 | 9.8 |
| **9/01/20** | 21.1 | 7.5 | 0 | 12.4 |

Table B-2: Summary of May survey weather conditions during the survey period. Temperatures in °C, precipitation in mm and wind speed in m/s. Data obtained from NIWA CliFlo database, at 26117

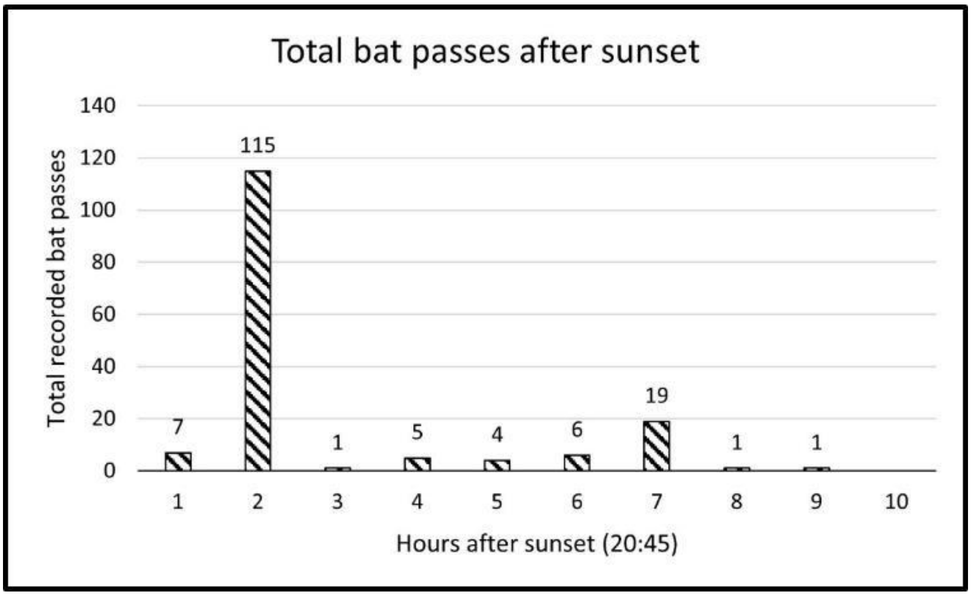
| *Date* | *Maximum Temperature(C)* | *Minimum Temperature (C)* | *Precipitation (mm)* | *Wind max gusts (m/s)* |
|---|---|---|---|---|
| **15/05/2020** | 19.3 | 2.5 | 0 | 4.1 |
| **16/05/2020** | 19.3 | 8.8 | 0 | 5.7 |
| **17/05/2020** | 20.4 | 6.3 | 0 | 6.2 |
| **18/05/2020** | 20.4 | 3.8 | 0 | 5.7 |
| **19/05/2020** | 19 | 3.2 | 0 | 6.7 |
| **20/05/2020** | 18 | 1.1 | 0 | 4.6 |
| **21/05/2020** | 17.3 | 0 | 0 | 4.1 |
| **22/05/2020** | 16.7 | 1.6 | 0 | 4.1 |
| **23/05/2020** | 17.6 | -1.9 | 0 | 4.6 |
| **24/05/2020** | 13.1 | 2.3 | 0 | 6.7 |
| **25/05/2020** | 19.7 | 11.3 | 9.6 | 9.8 |

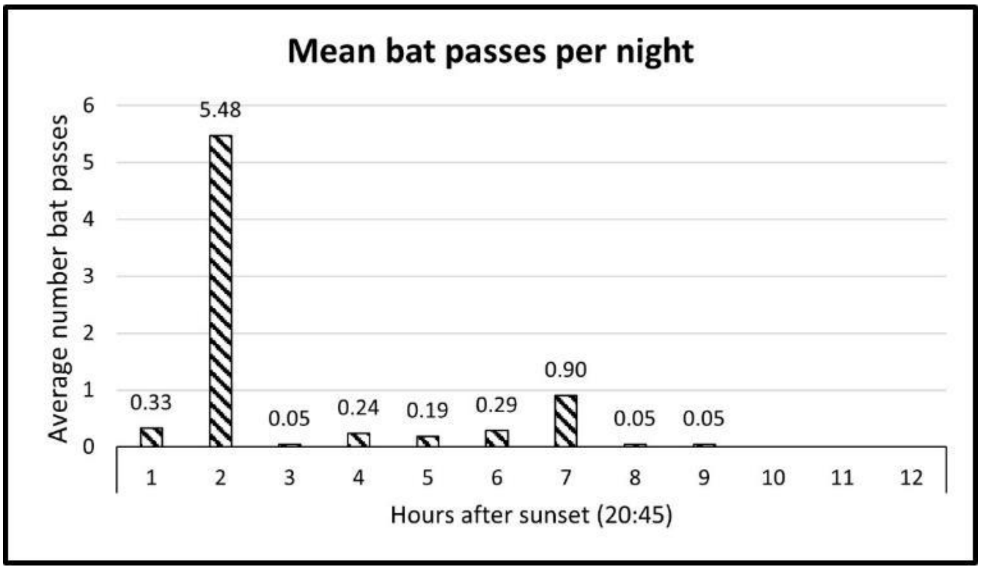
| | | | | |
|---|---|---|---|---|
| **26/05/2020** | 19.7 | 11.1 | 4.8 | 5.1 |
| **27/05/2020** | 20 | 10.4 | 0 | 4.6 |
| **28/05/2020** | 14.7 | 2.3 | 0 | 2.6 |
| **29/05/2020** | 18 | 6.4 | 0 | 2.6 |
| **30/05/2020** | 15 | 8.7 | 3.4 | 5.7 |
| **31/05/2020** | 18.5 | 9.2 | 0.2 | 7.2 |
| **1/06/2020** | 16.7 | 10.8 | 4.2 | 8.8 |
| **2/06/2020** | 17.4 | 12.4 | 21 | 12.4 |
| **3/06/2020** | 18.6 | 4.8 | 0 | 8.8 |
| **4/06/2020** | 17.4 | 7.4 | 2.6 | 12.4 |
| **5/06/2020** | 18.6 | 7.1 | 1.6 | 7.2 |
| **6/06/2020** | 16.8 | 3.4 | 0.6 | 10.3 |
| **7/06/2020** | 16.5 | 6.2 | 1.2 | 10.8 |
| **8/06/2020** | 15.3 | 0.5 | 0 | 8.8 |
| **9/06/2020** | 16 | 1.1 | 0 | 11.3 |
| **10/06/2020** | 16.9 | -0.1 | 0 | 3.6 |
| **11/06/2020** | 12.5 | 2.7 | 0.2 | 8.8 |
| **12/06/2020** | 17.1 | 5.9 | 0.2 | 8.2 |
| **13/06/2020** | 18.2 | 5.5 | 1.2 | 3.6 |
| **14/06/2020** | 16 | 6.8 | 0 | 3.6 |
| **15/06/2020** | 15.4 | 7.8 | 0 | 6.7 |
| **16/06/2020** | 16.2 | 5.3 | 0 | 3.1 |
| **17/06/2020** | 16 | 8 | 0 | 6.2 |
| **18/06/2020** | 18.4 | 8.1 | 0 | 11.8 |
| **19/06/2020** | 17 | 4.7 | 25.8 | 5.1 |
| **20/06/2020** | 17.6 | 4.6 | 0 | 5.1 |
| **21/06/2020** | 17.3 | 9.2 | 3.4 | 7.7 |
| **22/06/2020** | 18.8 | 9.9 | 0.6 | 8.8 |

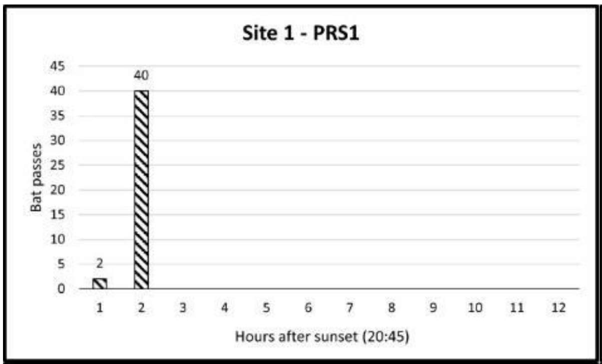
# Appendix C: HAS for each individual detector and across all detectors

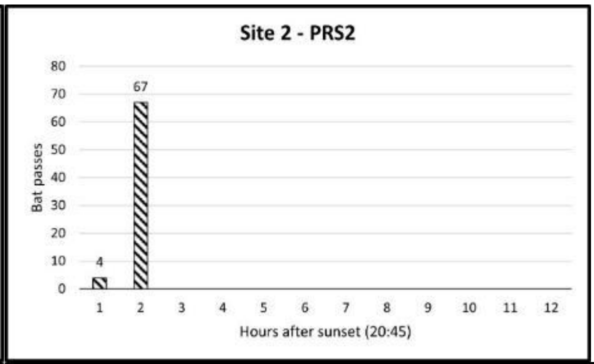
******Note a change of scale on the y axis*

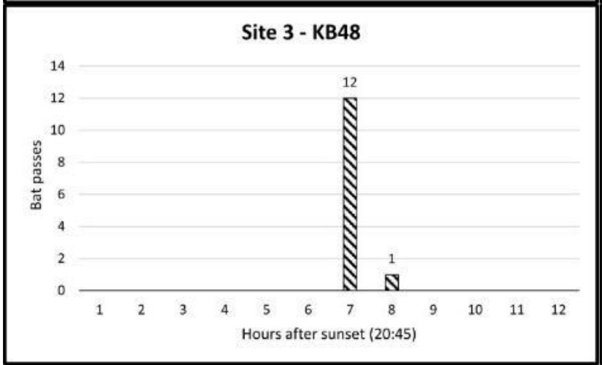
**December/January Survey data**

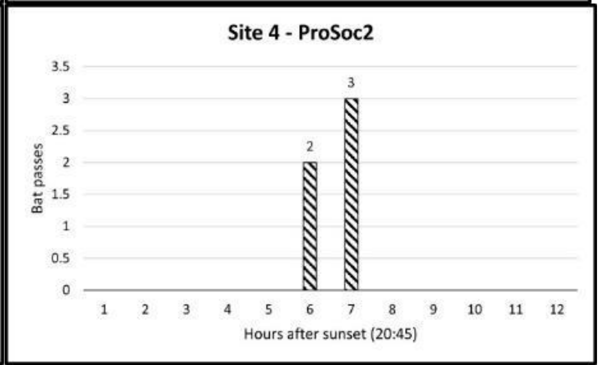


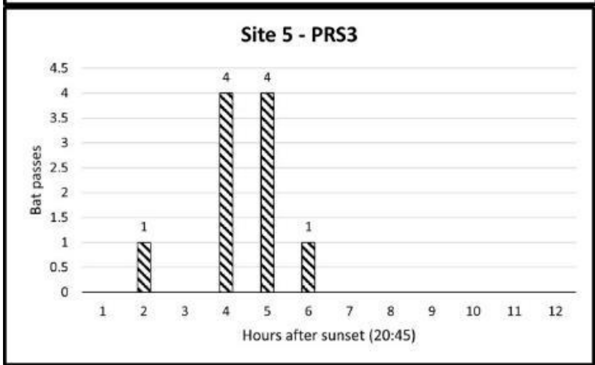



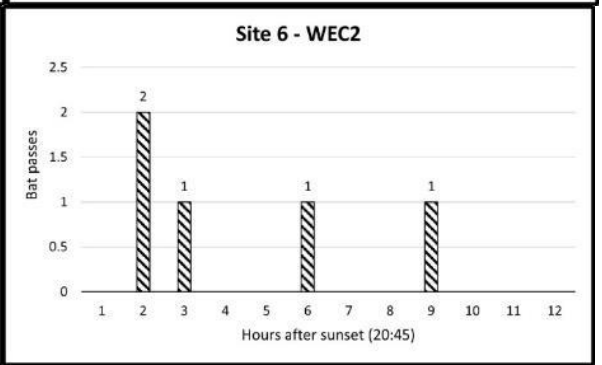

Site 1 - PRS1
Bat passes
45 40 35 30 25 20 15 10 5 0
2
40
1 2 3 4 5 6 7 8 9 10 11 12
Hours after sunset (20:45)

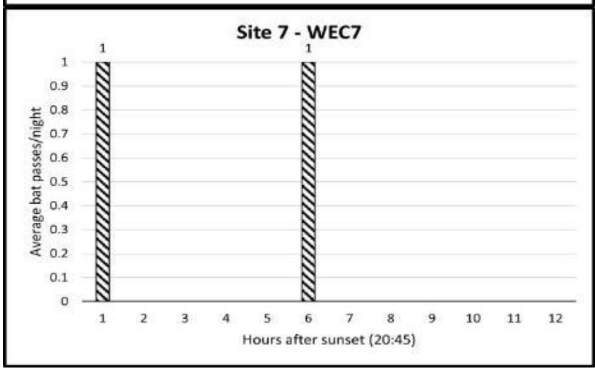

Site 2 - PRS2
Bat passes
80 70 60 50 40 30 20 10 0
4
67
1 2 3 4 5 6 7 8 9 10 11 12
Hours after sunset (20:45)

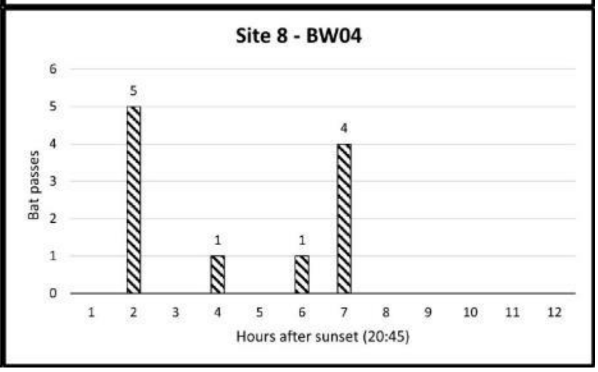

Site 3 - KB48
Bat passes
14 12 10 8 6 4 2 0
12
1
1 2 3 4 5 6 7 8 9 10 11 12
Hours after sunset (20:45)


Site 4 - ProSoc2
Bat passes
3.5 3 2.5 2 1.5 1 0.5 0
2
3
1 2 3 4 5 6 7 8 9 10 11 12
Hours after sunset (20:45)

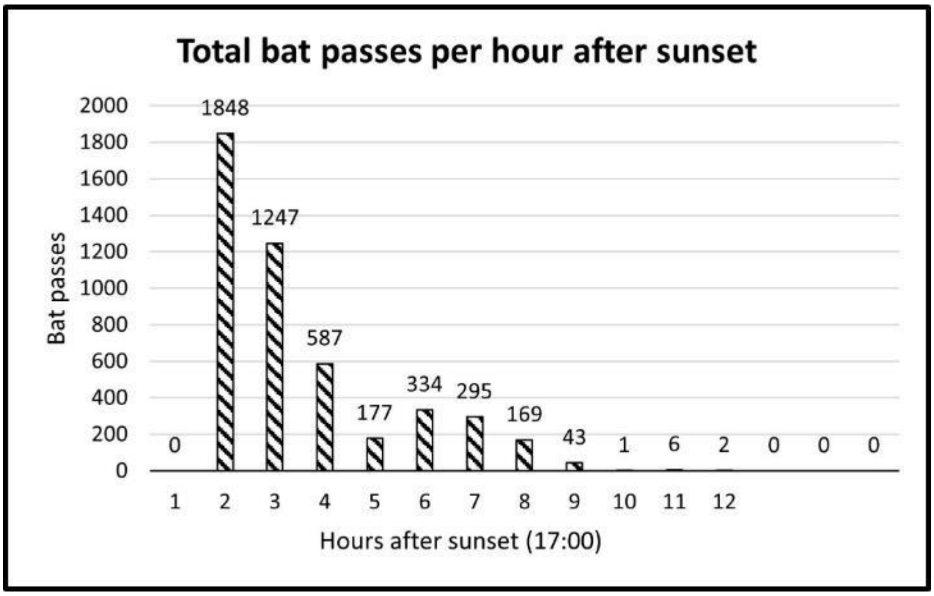

Site 5 - PRS3
Bat passes
4.5 4 3.5 3 2.5 2 1.5 1 0.5 0
1
4
4
1
1 2 3 4 5 6 7 8 9 10 11 12
Hours after sunset (20:45)

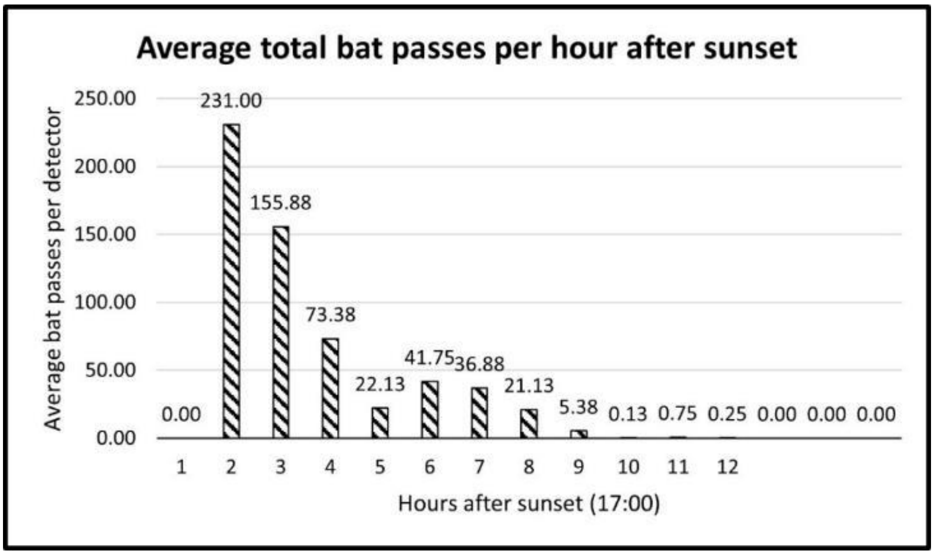

Site 6 - WEC2
Bat passes
2.5 2 1.5 1 0.5 0
2
1
1
1
1 2 3 4 5 6 7 8 9 10 11 12
Hours after sunset (20:45)


Site 7 - WEC7
Average bat passes/night
1 0.9 0.8 0.7 0.6 0.5 0.4 0.3 0.2 0.1 0
1
1
1 2 3 4 5 6 7 8 9 10 11 12
Hours after sunset (20:45)

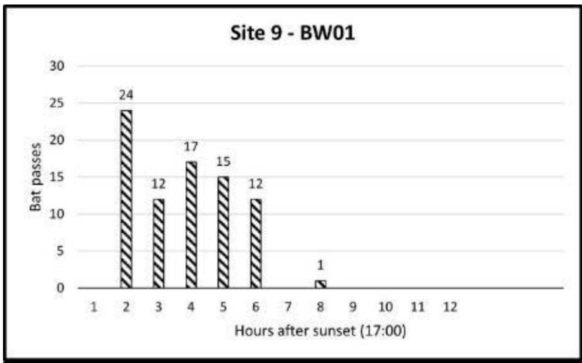

Site 8 - BW04
Bat passes
6 5 4 3 2 1 0
5
1
1
4
1 2 3 4 5 6 7 8 9 10 11 12
Hours after sunset (20:45)

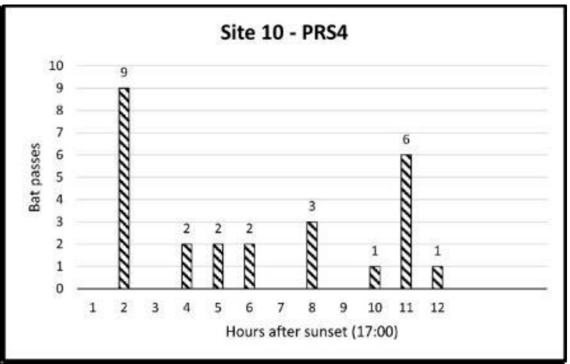
**May/ June Data**

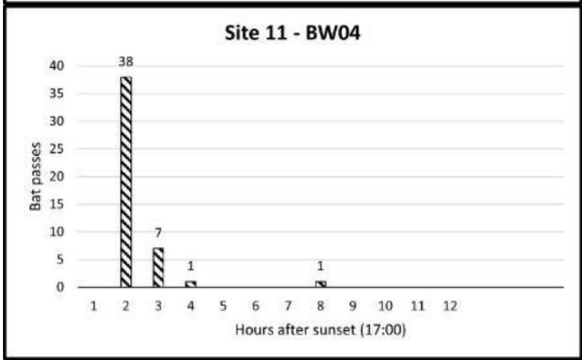


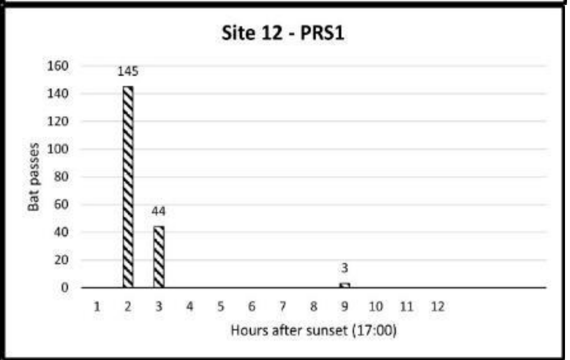



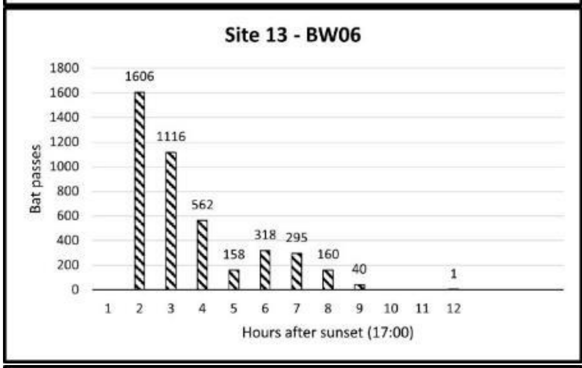
## Bat passes per hour after sunset: May to June 2020

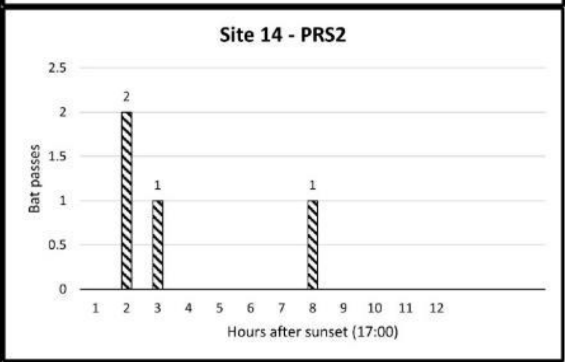


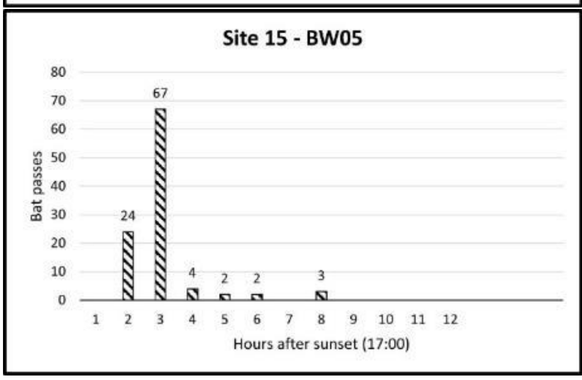



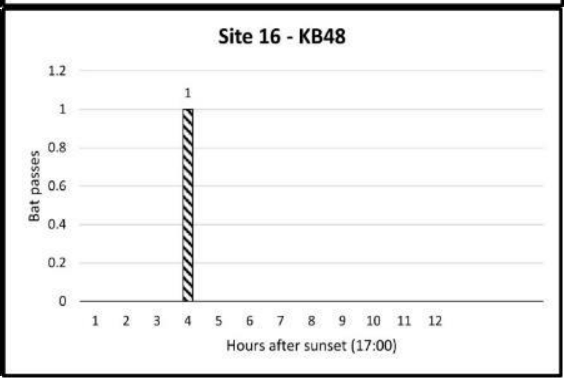



# Appendix D: Interim report RS Sands Bat Roost tree assessment

Bluewattle Ecology

KESSELS & ASSOCIATES LTD T/A BLUEWATTLE ECOLOGY

575 GROVE ROAD, RD5, HAMILTON 3285, NEW ZEALAND

To: Christian McDean

From: Titia Schamhart

CC: Arthur Fulton; Kurt Hine; Jo Young

Date: 24 September 2023

Re: Interim report RS Sands Bat Roost tree assessment

This memo serves as a preliminary update regarding my discoveries and suggestions concerning the potential removal of exotic and native trees, bush and affected wetlands at the Newcombe Road Sand Quarry in Cambridge. I conducted an examination of the trees slated for felling within the areas outlined on the provided maps on August 21, 2023.

## 6 Roost Tree Inspection

Potentially affected areas were evaluated from a broad perspective to determine their suitability as bat habitats for foraging, commuting, or roosting. Specifically, I assessed trees that could serve as potential bat roosts. The identification of roost features followed criteria derived from Smith et al. (2017) and involved a habitat assessment. Trees with a diameter greater than 15 cm at breast height (DBH) and displaying one or more of the following characteristics were considered as potential bat roosts:

- Cracks, crevices, cavities, fractured limbs, or deformities large enough to accommodate roosting bats.
- Portions of loose flaking bark of sufficient size to support roosting bats.
- Hollow trunks, stems, or branches.
- Deadwood within the canopy or stem, of appropriate dimensions to sustain roost cavities or hollows.

The map provided in Attachment 2 illustrates that the majority of the designated felling area consists of pines (Zone A) and gullies (Zone B, E, G), characterized by medium to large-sized structures and evident cavity-bearing attributes, which might serve as roosting habitat for long-tailed bats (Attachment 1, Photo 2 and 8). The pine forest (Zone A) shows a stand of trees and wetland species predominantly made up of exotics with regenerating natives. Along the bush edge there are natives regenerating with larger numbers of Toetoe and other self-seeded nursery crop species. In the lower wetland area (Zone C) it appears that the stand of willows has been effectively sprayed and self-seeded regenerating natives starting to emerge.

Roosting potential is primarily observed in the form of cracks and hollows within mature trees, as shown in the example photo 7. The East border on the map encompasses a collection of smaller trees situated in a gully (Zone G), presenting a potentially low to medium roosting potential, while its wetland nature renders it valuable as foraging habitat. This area is high quality bat foraging habitat linking in with the high value (zone H) tree line so while it is has low to medium roost tree habitat, it has high value for commuting and foraging.

Due to the substantial bat activity across the property and the diverse quality levels of bat habitat, it's important to note that every tree within this property with a diameter exceeding 15 cm at breast height (DBH) must undergo inspection according to the tree felling protocol detailed in Attachment 3 before any felling activities.

# 7 Recommendations

1. **Preservation Priority**: Preservation of the old pines and minimizing any activities that may disturb these trees is preferable due to their high roost potential, but if found to be occupied as a maternity roost (unlikely but not zero probability), measures to preserve and buffer occupied maternity roost trees within the quarry footprint would be required.
2. **Supervised Tree Felling**: For other large trees with medium to high roost potential, work closely with a certified bat ecologist to supervise any tree felling activities. Ensure they follow approved tree felling protocols.
3. **Mitigation Measures**: Implement mitigation measures such as installing bat boxes (short term), providing alternative roosting sites by strategically planting and protecting cavity bearing exotic and native trees and restoring wetlands and riparian margin vegetation (long term) to compensate for any loss of roosting, commuting or foraging habitat.

Compliance and Reporting:

Titia Schamhart

**Senior Ecologist**

Bluewattle Ecology

## *ATTACHMENT 1: PHOTOS OF BAT HABITAT ASSESSMENT*

**Photo 1: (Zone D) Eucalyptus with High Roost Potential, located directly East of the pine forest.**

**Photo 2: (Zone C) Wetland (Low Roost Potential but High Value Foraging Habitat) surrounding sprayed willows, at the edge of (Zone A) pine forest (Medium to High Roost Potential).**

**Photo 3: (Zone E) Exotic stand with Medium to High Roost Potential at the top of centrally located gully.**

**Photo 4: (Zone G) Gully to the East of the property, with overall Low Roost Potential, but with several standalone pines with Medium Roost Potential and overall High Value Foraging Habitat.**

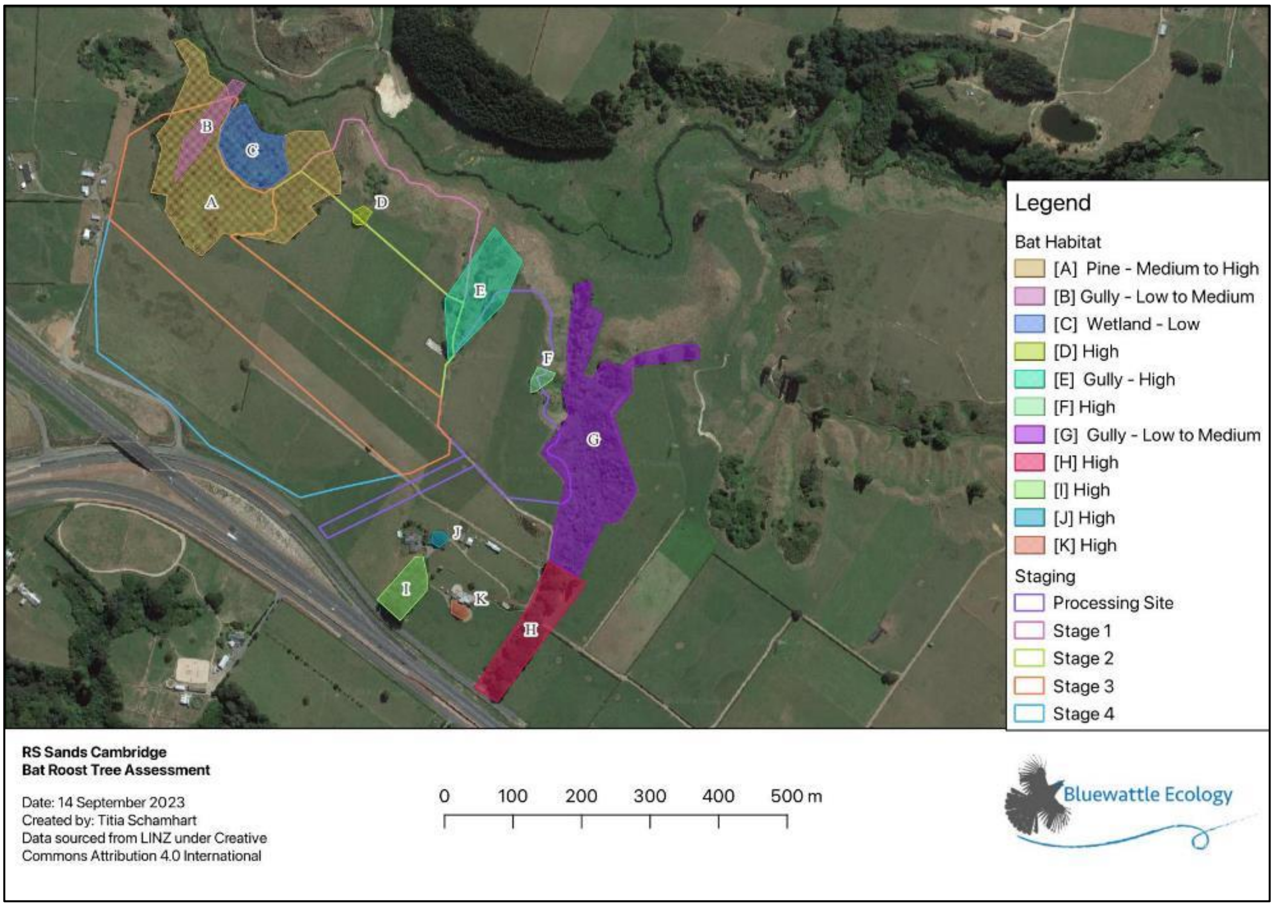
**Photo 5: Stream running past the North boundary of the property, proving high foraging and commuting habitat.**

**Photo 6: (Zone E) Gully in the centre of the property, with several mature poplars with High Roost Potential.**

**Photo 7: (Zone H) Clear hollow in plane tree with High Roost Potential (outside the staging zone)**

**Photo 8: (Zone F) Poplars on the edge of the Eastern gully with High Roost Potential (inside the borders of the Processing Site).**

## ATTACHMENT 2: POTENTIAL BAT ROOST TREE ASSESSMENT



## *ATTACHMENT 3: TREE FELLING PROTOCOL*

# Protocols for minimising the risk of felling bat roosts

## (Bat Roost Protocols (BRP))

Version 2: October 2021 approved by the New Zealand Department of Conservation's Bat Recovery Group

**The use of these protocols should be a final step in the avoid/remedy/mitigate hierarchy. Avoidance of felling bat roost trees should be the first step in any project.**

## Purposes of this document:

1. To outline why protection of roosts is important for the persistence of New Zealand bats and why removal of known and potential roosts should be avoided.
2. Where roost removal cannot be avoided, to set out the minimum requirements and protocols for removing trees in areas where bats are present, to minimise the risk of killing bats.

This protocol does not eliminate the risk to bats of death or injury because bats or active bat roosts can be missed. The best way to eliminate risk of felling an active roost is to avoid felling any known or potential roosts.

## Context

### The status of New Zealand bats

New Zealand's two extant bat species (pekapeka) are classified as threatened.

Long-tailed bats are classified as 'Nationally Critical' because the species is likely to have a 70% decline in numbers within three generations.

Lesser short-tailed bats comprise three subspecies. The northern subspecies is classified as 'Nationally Vulnerable' because there are 1000-5000 mature individuals and the predicted decline in numbers is 10-50% within three generations. The central subspecies is 'Declining' because there are 20 000-100 000 mature individuals, and the predicted decline is 10-50% within three generations. The southern subspecies is 'Recovering' because there are 1000-5000 individuals, and the predicted increase is >10% within three generations.

### Threats to bats

This document deals specifically with roost protection; however, roost protection is only part of the wider issue of habitat loss. Habitat loss through land clearance, habitat degradation, fragmentation and disturbance and loss of roosts reduces roosting, foraging and socialising areas. Individual bats and colonies are also threatened by the local felling of individual trees.

Bats have large home ranges which can include unprotected peri-urban habitat. Protecting habitat and maintaining connectivity of vegetation are crucial for bats being able to persist and flourish in the environment.

Predation and competition by introduced predators: mustelids, rats, cats, and possums have all been implicated in the decline of bats[1].

### Roosts are critical to the survival of bats

Roosts are where bats gather to shelter during the day and at night. They are used to socialise, mate, give birth, and raise young. Bats have very specific requirements when they are choosing roosts and are not just choosing any

[1] O'Donnell CFJ; Christie JE; Hitchmough RA; Lloyd B; Parsons S 2010. The conservation status of New Zealand bats, 2009. New Zealand Journal of Zoology 37: 297– 311.

tree[2]. The specialised features of roosts make them rare and almost irreplaceable in any landscape or habitat type except over very long-time frames. People sometimes falsely suggest that "bats can just move to another tree". This is not the case, particularly where trees suitable as roosts are limited[3].

Bats demonstrate high site fidelity to existing roosts and their specific roosting areas, and they move on a rotation among these. Because roost trees are likely to be rare, and are occupied to fulfil specialised requirements, felling breeding roost trees even when bats are absent will have a significant negative effect. If the number of suitable roosts and their surrounding habitat is reduced in the landscape, bats are forced to use roosts that are less thermally efficient. This means they will use more energy to survive, resulting in reductions in survival and lower reproductive success. In this way, roost removal is likely to result in higher risk of local extinction.

Bats can roost in native or exotic vegetation – therefore it should not be presumed that exotic species such as pine trees will not support bats. Roosts, including maternity roosts, have been found in many exotic species including, but <u>not limited to</u>, pine, poplar, oak, and acacia species, black locust, willow, eucalyptus and Tasmanian blackwoods.

Bats are at risk of being injured or killed when trees are felled

If a tree is felled with a bat in it, it is highly likely that the bat will be injured or killed, although this may not be apparent at the time because injuries, such as bruises and fractures, which would hinder bats' ability to fly well, may take time to be obvious.

The highest risk of injuring or killing bats or trapping them within their roosts is when they are heavily pregnant, when young are still dependent on the roost (late November – February) and when bats are more likely to be in torpor (May – September). Heavily pregnant bats are slower and less agile, and young bats cannot fly, so their chances to escape are reduced when roost trees are felled. Also, it is possible that if the larger female-dominated maternity roosts are cut down when females are raising their young to independence (October-March), a whole colony of bats could be destroyed at one time.

During winter bats use torpor (a type of hibernation) more often than during other times of year, so if trees are cut down in winter, bats may be unable to rouse from torpor and to fly away in time to escape. Additionally, it is significantly harder, sometimes impossible, to detect bats roosting in trees during torpor. For these reasons, trees with potential bat roost features must not be cut down in winter. Bats also use torpor for short periods during summer, for example, if the weather gets cold, so the risk of killing or injuring bats that cannot escape falling trees exists at any time of the year.

Bat roost protocols and the RMA

The occurrence of bats and bat habitat is a matter of 'significance' under Section 6(c) of the Resource Management Act (RMA). Bat roost protocols have become a standard part of bat management plans that may be required under RMA consents. Where developments require consents, and bats (a threatened species) are present, the developments should 'Avoid' impacting bats and bat habitat. Bat roost protocols only attempt to minimise the number of bats killed by tree felling, therefore implementing bat roost protocols where bats are present should be considered a last resort after following the RMA hierarchy of "avoid, remedy, mitigate, offset, compensate".

[2] Whilst we use the word tree frequently in this document, we acknowledge that bats also use non-tree vegetation as roosts and the terms tree and vegetation should be considered as interchangeable in the context of this document. We acknowledge that there are also non-vegetation roosts that are used and require protection. These include rocky bluffs, caves and occasionally buildings.

[3] Many references available, for example, Borkin KM; Parsons S. 2011. Sex-specific roost selection by bats in clearfell harvested plantation forest: improved knowledge advises management. Acta Chiropterologica 13(2): 373-383; Borkin KM; O'Donnell CFJ; Parsons S. 2011. Bat colony size reduction coincides with clear-fell harvest operations and high rates of roost loss in plantation forest. Biodiversity and Conservation 30; Sedgeley JA; O'Donnell CFJ 1999b. Roost selection by the long-tailed bat, *Chalinolobus tuberculatus*, in temperate New Zealand rainforest and its implications for the conservation of bats in managed forests. Biological Conservation 88:261–276; Sedgeley JA; O'Donnell CFJ 2004. Roost use by long-tailed bats in South Canterbury: Testing predictions of roost site selection in a highly fragmented landscape. New Zealand Journal of Ecology 28:1-18.

This protocol has therefore been framed following the RMA hierarchy by first focusing on the avoidance of effects, helping to identify and avoid the removal of roost trees, and to minimise the risk to bats of death or injury if avoidance is not possible. This approach is usually informed by gathering data on bats in the local areas and seeking advice from a competent bat ecologist.

**Identifying and protecting *both active and inactive (i.e., trees used by bats at other times of year) roosts* by avoiding their removal is an important step in supporting the survival and persistence of bats.**

Bat roost protocols and the Wildlife Act 1953

NZ bats are absolutely protected species under the Wildlife Act 1953. It is an offence to catch alive or kill, hunt, possess, molest, or disturb bats under the Act. Any projects where tree or vegetation removal overlaps with the occurrence of bats, there is a risk of killing or injuring any bats that may be present. Following the bat roost protocols minimises the chance of killing or injuring bats.

## Bat roost protocol

**When and how to use the protocol**

Whenever vegetation removal is proposed in areas where bats are potentially present and where their habitat may be impacted, follow the decision tree (Figure 1) below as a guide to what sort of action should be undertaken. The decision tree is designed firstly to avoid felling bat roost trees, secondarily aimed at moving roost trees, and only if unavoidable, felling roost trees (but only once vacated).

None of the methods of inspecting roosts described below eliminates the risk of failing to identify bats when they are present. Therefore, techniques such as filling in cavities with expandable foam are not supported as a tool. This is because there is a risk of trapping bats that have not been detected within cavities. In addition, this method removes roosts from the landscape that bats are dependent on.

**Definitions**

**Competencies:** a set of competencies developed by the NZ Bat Recovery Group[4] to ensure that anyone working with bats is competent to do so. Contact bathandler@doc.govt.nz for a list of competencies and requirements to become an authorised competent bat worker.

*Competencies referred to in this document:*

2.1 Bagging storage, handling, measuring, weighing, sexing, aging, temporary marking and releasing appropriately:
For long-tailed bats: 50 individuals
For short-tailed bats: 50 individuals

3. High risk activities – Roost felling (all of these competencies include the understanding of what to do when bats are found during tree felling as per Appendix 6 of 'Initial veterinary care for New Zealand Bats' https://cdn.ymaws.com/www.nzva.org.nz/resource/resmgr/docs/other_resources/Initial_Vet_Care_NZ_Bats.pdf)

3.1 Assessing roost tree use using Automatic Bat Monitors - Demonstrate correct timing, placement, and interpretation of data for 10+ times according to DOC's Tree Felling Protocols.

3.2 Undertake roost watches/emergence counts at 10+ occupied roosts where the entrance is visible.

3.3 In at least two different forest/habitat types, including the forest/habitat type where trees are going to be assessed: evaluate 10+ potential roost features in trees (e.g., cavities, peeling bark, epiphytes).

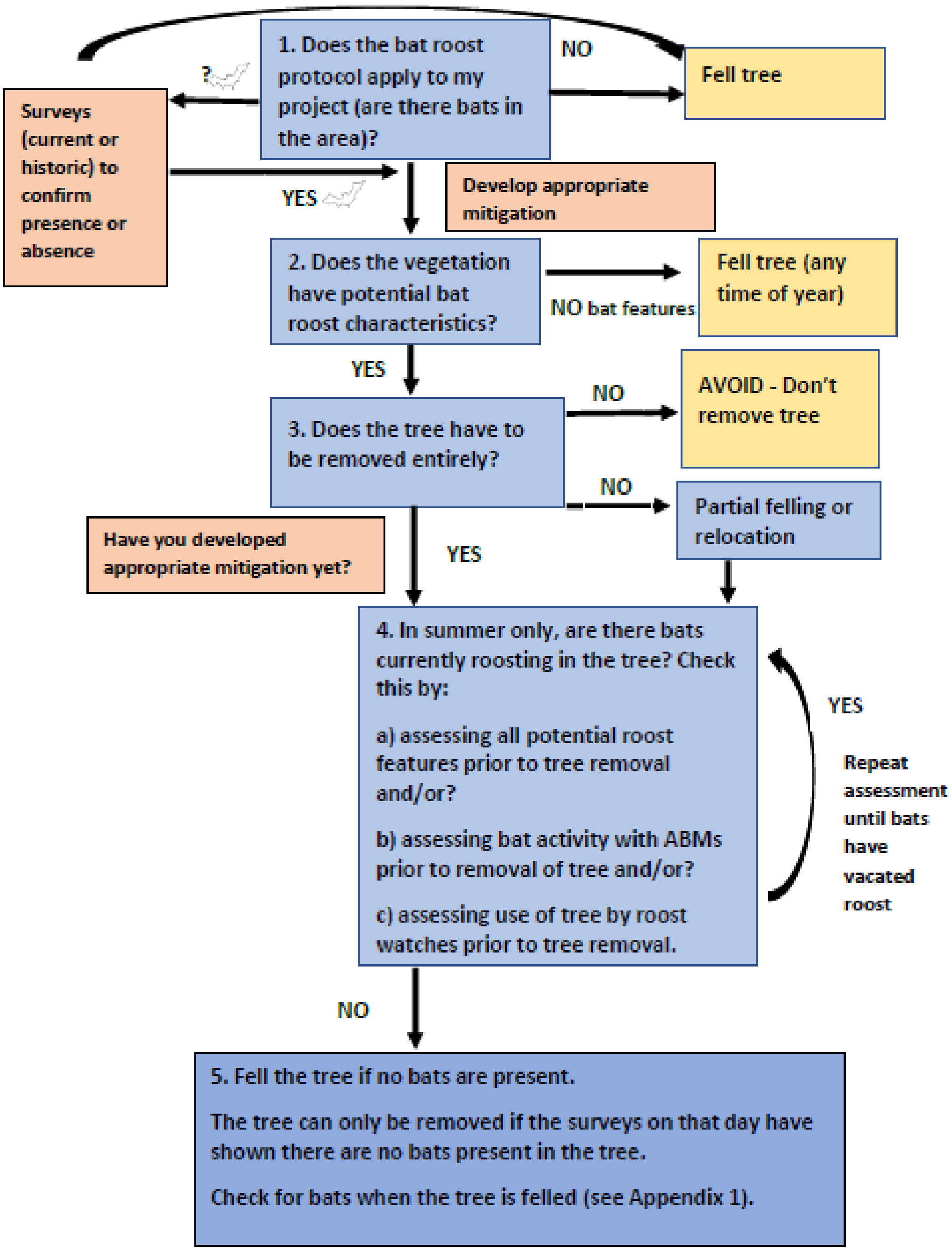
**Authorised competent bat worker:** A bat worker who has met the required ethical standards to be registered as a competent, authorised bat worker by the New Zealand Bat Recovery Group for the work which they are undertaking.

**ABM:** automated bat monitoring unit/detector

[4] A group of bat specialists that advise on bat issues and assess bat competencies

**Figure 1. Tree removal in bat areas flow chart**

Each numbered step relates to a step in the Decision Tool for Tree Removal. Follow each step fully in the text to work through the process.




**Mitigation/compensation**

If trees are felled and habitat lost, then compensation measures should be considered to address the adverse effects. What these measures should be is beyond the scope of this document. Provision of artificial roosts in the short-term and planting for the long-term are some of the methods commonly used in development projects, but their effectiveness is untested and a future research need.

| Step 3. Does the tree have to be removed entirely? | Response | Who can make this assessment? | When? |
|---|---|---|---|
| a) Is the only option to remove the tree entirely? | If yes, continue to step 4<br><br>If no, consider leaving the tree in place, cutting off specific limbs only or relocating the tree. If any felling, partial felling (where the part to be felled has potential bat roost features) or tree relocation takes place you **MUST** proceed to step 4.<br><br>If a roost (active/inactive) is confirmed, then advice should be obtained at a project level in writing from DOC before proceeding. | Project leader | Any time |

**Notes for Step 3**

Trees must only be relocated when bats are absent and when standard automated bat monitoring unit (ABM) weather conditions are met (see notes section 4b for appropriate weather conditions), and in consultation with an authorised bat ecologist with all competencies of level 3: 'High risk activities – Roost felling'.

| Step 4. Are there bats currently roosting in the tree? (Follow a or b or c or a combination) | Response | Who can make this assessment? | When |
|---|---|---|---|
| a) Are potential features being used by roosting bats? A tree climber may be required to check all features (see notes for 4a below).<br><br>If roost is occupied repeat 4a another day until roost is vacated. | If yes, **THE TREE MUST NOT BE FELLED UNTIL BATS HAVE VACATED IT.**<br><br>If no, the tree can be removed on the day of the tree inspection following step 5.<br><br>If bats continue to use the roost, then the tree must not be cut down until the bats leave the roost. At this point re-consider again | An approved person at Competency Level 3.3 or an experienced tree-climber (e.g., an arborist) working with an approved person at Competency Level 3.3.<br><br>If the latter, the tree climber must provide information along with photographs or video footage, to the approved person at Competency Level 3.3 who assesses and decides whether the tree can be removed. | October 1st to April 30th when the temperature is 7°C or greater at official sunset in the South Island or 10 °C or greater in the North Island. |

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| | | | |
|---|---|---|---|
| | whether this tree must be felled. Advice must be obtained at a project level in writing from DOC prior to felling the tree. | If roosts are known or confirmed through this process, then this information must be communicated to the nominated DOC bat ecologist for this project. | |
| b) Is bat activity recorded at any time during two consecutive, valid survey nights preceding tree felling[13]? At least two nights are required as it is possible for bats to enter or leave a roost without echolocating, or to not leave the roost for a night. | If yes (bats are detected), survey must continue on subsequent nights[14] until no bat activity is recorded for two consecutive nights (to indicate bats have left the area) prior to felling. **OR** roost features of each tree must be visually assessed via climbing as in 3.<br><br>If bat activity is consistent in the area and 2 nights with zero bat passes cannot be obtained, Go to 4c or 4a.<br><br>If no bats are detected for two consecutive nights, the vegetation can be removed on the day immediately following the survey nights using the method in 5. | An approved person at Competency Level 3.1 | October 1st to April 30th and when conditions meet the requirements for standard ABM weather conditions (see 4b notes). |
| c) Are bats observed entering the vegetation?<br><br>This involves watching vegetation to identify bats returning to or exiting roosts. It should only be used in combination with previous ABM monitoring (4b) (see notes 4c for method). At | If yes (bats are seen at either watch), it is a confirmed roost. Removal of a roost should be avoided to minimise effects | An approved person at Competency Level 3.2[15]. | Between October 1st and April 30th only **AND** when weather parameters meet |

[13] Le Roux et al (2013) found that in and around Hamilton "The longest consecutive monitoring period without bat detections at each site was three nights during winter." Le Roux et al 2013. New Zealand Journal of Zoology (2013): Spatial and temporal variation in long-tailed bat echolocation activity in a New Zealand city, New Zealand Journal of Zoology, DOI: 10.1080/03014223.2013.827125.
[14] Subsequent nights may be those immediately following bat detection or later dates.
[15] If more than one person is required for a roost watch at a tree, a minimum of one approved person at Competency Level 3.2 must be present on site for the duration of the roost watch to supervise.

| | | | |
|---|---|---|---|
| least two nights are required as it is possible for bats to enter or leave a roost without being detected, or to not leave the roost for a night. | of vegetation removal on bats.<br><br>Techniques used previously to ensure previously active roosts are no longer active have included the following: Watches must continue on subsequent nights until no bats are observed entering or exiting the roost for two consecutive nights (to indicate the roost is no longer active) prior to felling.<br><br>If no bats are observed entering or exiting for two consecutive nights, the vegetation can be removed on the day immediately following the survey nights using the method in 5. | | the roost watch requirements. |

**Notes for Step 4.**

*4a) Tree climbing and inspection*

Care must be taken while climbing trees to avoid disturbing, removing or destroying tree features with bat roost potential such as sections of loose bark or cavities in dead wood. Using mobile elevated platforms can be a good option. Bats are less likely to be active over colder periods, so climbing to check whether bats are present in potential roost features must take place between October 1st to April 30th when the temperature is 7 °C [16] (South Is) or 10 °C (North Is) or greater at official sunset on the night previous to inspection.

A tree climber may be required to check all potential bat roost features:

- Can bats be seen? An endoscopic camera should be available for this step and every possible corner of each potential roosting feature inspected, i.e., cavity/crack etc. Cracks, holes, and splits may lead to cavities or may be superficial. A cavity may be wet indicating no/low potential as a bat roost.

[16] O'Donnell CFJ 2000. Influence of season, habitat, temperature and invertebrate availability on nocturnal activity of the New Zealand long-tailed bat (*Chalinolobus tuberculatus*). New Zealand Journal of Ecology 207-221.



- Can bats be heard? Search of tree features should be accompanied by use of a hand-held bat detector. If bats are present and not in torpor, then detection of presence listening at 25 kHz (for social calls) and 40 kHz (for echolocation calls) may help to determine if long-tailed bats are present. Short-tailed bat social calls are often audible or detected at 25-27 kHz.
- Is guano present or urine staining?

*4b) ABM survey work*

Bat activity is to be recorded using ABMs. Location of ABMs must provide sufficient coverage to be able to determine if bat roosts are present in one or more of the trees[17]. 'Valid' survey nights must have the following features:

- Begin one hour before official sunset and end one hour after official sunrise.
- Temperature 10°C or greater for the first four hours after official sunset time for the North Island and 7°C for the South Island[18].
- Precipitation < 2.5 mm in the first 2 hours after official sunset, and < 5 mm in the first 4 hours after official sunset.

Prior to the commencement of surveys, ABMs must be checked for correct operation at a site where bat activity is known to be regular, or by using the DOC – Bat Recorder Tester (Tussock Innovation Ltd) phone app made for this and available from Google Play Store. Faulty or suspect ABMs must not be deployed, and ABMs must be redeployed if faults occur.

*4c) Roost watches*

The following weather conditions define a valid night for roost watches:

- Temperature greater than 10°C all night between official sunset and sunrise for the North Island and 7 °C for the South Island.
- Precipitation < 2.5 mm for each two-hour period between official sunset and sunrise

Roost watches should include the deployment of ABMs and analysis of data for the night of the roost watch.

*Emergence watches*

- Each tree must be watched initially from sunset until it becomes too dark to see by sufficient people to observe all potential exit points. This must be supported by the use of handheld detectors. The aim of emergence watches is to identify potential roost locations within the vegetation. Infra-red and thermal imaging cameras may be useful in this process.

[17] Department of Conservation-manufactured AR4 bat detectors are considered likely to detect long-tailed bats only over short distances i.e., up to 30-60 m distant from the detector (S. Cockburn, Department of Conservation, pers. Comm.). This is similar to detection distances of other detector types.
[18] South Island temperatures are based upon O'Donnell (2000) as above. North Island temperatures are based on data collected in Kinleith plantation forest, centred around Tokoroa, Central North Island; Smith D, Borkin K. 2017. Appendix B: Influence of climate variables on long-tailed bat activity in an exotic conifer plantation forest in the central North Island. P 136-145. In: Smith, D, K Borkin, C Jones, S Lindberg, F Davies and G Eccles (2017). Effects of land transport activities on New Zealand's endemic bat populations: reviews of ecological and regulatory literature. NZ Transport Agency research report 623. 249pp.

*Roost re-entry watches*

The time when bats return to roosts can vary based on temperature and time of year.[19,20]

- Observers must then return the next morning and watch the tree to determine whether bats return to the vegetation.
- Roost re-entry watch timing should be based on patterns of activity recorded onsite with ABMs, i.e., as a guide watches should begin two hours prior to when the last passes were recorded on the ABMs on previous nights and finish one hour after official sunrise time. Where this information is not available and at minimum, watches shall begin two hours prior to official sunrise until one hour after sunrise. Infra-red and/or thermal imaging cameras may be useful as a supplementary tool in this process.

The methods above (Climbing and inspecting; ABM use and roost watches) can be implemented as in steps 4.

If bats are sighted, or sign detected, or a roost (active/inactive) is confirmed, the approved bat ecologist, as soon as possible, shall:

- Call the tree felling supervisor to inform them which affected tree(s) cannot be felled due to detection of bat sign.
- Send an email to the site manager, and a bat ecologist representing the council and DOC detailing the results of the survey and outlining the measures for protection or relocating the roost tree.
- A record (including photos) of any vegetation containing bat roosts shall be kept detailing the date; size, location and species of tree or other vegetation; roost type, e.g., cavity, peeling bark, broken branch; detail outlining how presence of bats was confirmed; the number of bats present; and species present, if known.

| **Step 5. Fell the tree if no bats present** | **Response** | **Who can make this assessment?** | **When** |
|---|---|---|---|
| NB: Vegetation removal must take place on the day of tree inspection or the day immediately following night surveys that confirm that there are no bats present. | | | |
| a) If you have undertaken a visual inspection of the vegetation (following step 4a, then the vegetation can be removed **ONLY ON THE DAY OF INSPECTION** and meets the valid weather conditions (defined in notes 4c) at official sunset the day prior to inspection.<br><br>If you have undertaken ABM surveys or roost watches 4b or 4c the vegetation can be removed **ONLY ON THE DAY IMMEDIATELY FOLLOWING SURVEY COMPLETION** (i.e., if the survey ends in morning the tree can be felled the same day only). | | People who are familiar with the document shown in footnote[21], and physically able to check/inspect tree for signs of bats once felled. | When the inspection method chosen allows. |
| Trees must be inspected for signs of bats once felled and before removing from the site, if safe to do so.<br><br>Follow Appendix 1 if bats are detected during vegetation removal. | | | |

[19] Dekrout AS 2009. Unpublished PhD thesis. University of Auckland, New Zealand Pp 168.
[20] Griffiths R. 2007. Activity patterns of long-tailed bats (Chalinolobus tuberculatus) in a rural landscape, South Canterbury, New Zealand. New Zealand Journal of Zoology, 34:3, 247-258, DOI: 10.1080/03014220709510083.
[21] https://cdn.ymaws.com/www.nzva.org.nz/resource/resmgr/docs/other_resources/Bat_Care_Advice.pdf

## Appendix 1. If bats are detected during tree relocation or removal

NB: Vegetation removal must take place on the day of tree inspection or the day roost watches or two consecutive nights of ABM data have confirmed that there are no bats present. If practical, trees are to be inspected for signs of bats once felled and before removing from site. People inspecting trees should be familiar with the Bat Care Advice document shown in footnote[22] and able to check/inspect tree for signs of bats once felled.

If during the felling of a tree bats are detected, felling of that tree must stop immediately if safe to do so, and DOC and an approved bat ecologist at Competency Level 2.1 must be consulted.

If bats do not fly away or are potentially injured/found on the ground, felling can only re-start once permission has been obtained from DOC after consultation with an approved bat ecologist at Competency Level 2.1.

If bats are detected once the tree has been felled, all further work must stop, and DOC and an approved bat ecologist at Competency Level 2.1 must be contacted. The felled tree must be thoroughly inspected by the approved bat ecologist for further bats.

If any bats are found on the ground or in the tree once felled, place the bat in a cloth bag in a dark, quiet place at ambient (or slightly warmer) temperature and take to a veterinarian for assessment as soon as possible. A maximum of two bats should be kept in one bag. After delivering the bat to the vet, contact an approved bat ecologist at Competency Level 2.1 in consultation with the vet and DOC (0800 DOC HOT, 0800 362 468).

Bats must be kept for three days under observation and must be kept out of torpor for this time. Additional detail is found at the links provided in this footnote[23]. Vets must euthanise bats whose injuries are causing suffering and are not likely to heal sufficiently to allow rehabilitation and return to the wild. The approved bat ecologist at Competency Level 2.1 and vet must consult with DOC to consider appropriate rehabilitation options where suffering is minimal and chances of return to the wild are high.

Euthanised bats or any dead bats (or bat parts) found must be handed to DOC.

[22] https://cdn.ymaws.com/www.nzva.org.nz/resource/resmgr/docs/other_resources/Bat_Care_Advice.pdf
[23] https://cdn.ymaws.com/www.nzva.org.nz/resource/resmgr/docs/other_resources/Initial_Vet_Care_NZ_Bats.pdf

# Appendix C: Ecological Impact Assessment Guideline Tables

### Table 1: Ecological values assigned to habitats (adapted from EIANZ, 2018)

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

### Table 2: Ecological values assigned to species (adapted from EIANZ, 2018)

| Value | Species values |
|---|---|
| Very high | Nationally Threatened - Endangered, Critical or Vulnerable |
| High | Nationally At Risk – Declining. |
| Moderate | Nationally At Risk - Recovering, Relict or locally uncommon or rare |
| Low | Not Threatened Nationally, common locally |
| Negligible | Exotic species, including pests |

### Table 3: Scoring for sites or areas combining values for four matters in Table 1

| Value | Description |
|---|---|
| Very High | Area rates High for 3 or all of the four assessment matters listed in Table 1.<br>Likely to be nationally important and recognised as such. |
| High | Area rates High for 2 of the assessment matters, Moderate and Low for the remainder, or<br>Area rates High for 1 of the assessment maters, Moderate for the remainder.<br>Likely to be regionally important and recognised as such. |
| Moderate | Area rates High for one matter, Moderate and Low for the remainder, or<br>Area rates Moderate for 2 or more assessment matters Low or Very Low for the remainder<br>Likely to be important at the level of the Ecological District. |
| Low | Area rates Low or Very Low for majority of assessment matters and Moderate for one.<br>Limited ecological value other than as local habitat for tolerant native species. |
| Negligible | Area rates Very Low for 3 matters and Low or Very Low for remainder. |

## Table 4: Criteria for describing magnitude of effect (EIANZ, 2018)

| Magnitude | Description |
|---|---|
| Very high | Total loss of, or very major alteration to, key elements/features/ of the existing baseline[1] conditions, such that the post-development character, composition and/or attributes will be fundamentally changed and may be lost from the site altogether; AND/OR<br><br>Loss of a very high proportion of the known population or range of the element/feature |
| High | Major loss or major alteration to key elements/features of the existing baseline conditions such that the post-development character, composition and/or attributes will be fundamentally changed; AND/OR<br><br>Loss of a high proportion of the known population or range of the element/feature |
| Moderate | Loss or alteration to one or more key elements/features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; AND/OR<br><br>Loss of a moderate proportion of the known population or range of the element/feature |
| Low | Minor shift away from existing baseline conditions. Change arising from the loss/alteration will be discernible, but underlying character, composition and/or attributes of the existing baseline condition will be similar to pre-development circumstances or patterns; AND/OR<br><br>Having a minor effect on the known population or range of the element/feature |
| Negligible | Very slight change from the existing baseline condition. Change barely distinguishable, approximating the 'no change' situation; AND/OR<br><br>Having negligible effect on the known population or range of the element/feature |

[1]Baseline conditions are defined as 'the conditions that would pertain in the absence of a proposed action' (EIANZ, 2018).

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

| Timescale | Description |
|---|---|
| Permanent | Effects continuing for an undefined time beyond the span of one human generation (taken as approximately 25 years) |
| Long-term | Where there is likely to be substantial improvement after a 25 year period (e.g. the replacement of mature trees by young trees that need > 25 years to reach maturity, or restoration of ground after removal of a development) the effect can be termed 'long term' |
| Temporary[1] | Long term (15-25 years or longer – see above)<br>Medium term (5-15 years)<br>Short term (up to 5 years)<br>Construction phase (days or months) |

[1]Note that in the context of some planning documents, 'temporary' can have a defined timeframe

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

| Level of effect[1] / Magnitude[2] | Very high | High | Moderate | Low | Negligible |
|---|---|---|---|---|---|
| Very high | Very high | Very high | High | Moderate | Low |
| High | Very high | Very high | Moderate | Low | Very low |
| Moderate | High | High | Moderate | Low | Very low |
| Low | Moderate | Low | Low | Very low | Very low |
| Negligible | Low | Very low | Very low | Very low | Very low |

[1] Ecological value from Tables 1-3.

[2] Magnitude of effect from Table 4, considering the timescales in Table 5.

# Appendix D: Wetland Delineation Protocol Results

### Table D1: Wetlands characteristic summary

| Gully | Size (ha) | Dominant species |
|---|---|---|
| Gully seepage wetlands within the Project footprint (estimated total 0.17 ha) | | |
| Gully A | 0.1 ha* | Likely > 80% native *Carex geminata* but unknown due to access issues that prevent being able to delineate and characterise wetlands |
| Gully B | 0.016<br>0.0042 | > 80% native *Carex geminata*<br>Dominated by exotic species |
| Gully C | 0.0051 | > 80% native *Carex geminata* |
| Gully D | 0.0087 | > 80% native *Carex geminata* |
| Gully E | 0.038 | > 80% native *Carex geminata* |
| Gully basin wetland adjacent to the project footprint | | |
| Gully A | 0.886 ha | 30% grey willow, 30% crack willow, 20% *Carex geminata*, 15% *Carex virgata* |

### Table D2: WDP Hydric vegetation composition and relative abundance. Gully A was inaccessible so it was assumed wetlands were present but hydric vegetation or composition could not be determined

| Hydric vegetation test | Clarkson 2014 hydric vegetation category | Wetlands within the project footprint | | | | |
|---|---|---|---|---|---|---|
| | | Gully A* | Gully B | Gully C | Gully D | Gully E |
| Hydric test | | N/A | Rapid | Rapid | Rapid | |
| Common name (Latin abbreviation) | | | | | | |
| *Carex geminata* (CARgem) | FACW | ? | 29% | 65% | 81% | 62% |
| Crack willow (SALfra) | FACW | ? | 21% | 0% | 0 | 10% |
| Soft Rush (JUNeff) | FACW | ? | 7% | 2% | 3% | 2% |
| Creeping buttercup (RANrep) | FAC | ? | 4% | 8% | 4% | 8% |
| Bindweed (CALsep) | FAC | ? | 1% | 2% | 3% | 0 |
| Blackberry (Rubfru) | FAC | ? | 10% | 4% | 6% | 2% |

| Hydric vegetation test | Clarkson 2014 hydric vegetation category | Wetlands within the project footprint | | | | |
|---|---|---|---|---|---|---|
| | | Gully A* | Gully B | Gully C | Gully D | Gully E |
| *Isolepis prolifera* (ISOpro) | OBL | ? | 2% | 1% | 0 | 0 |
| Yorkshire fog (HOLlan) | FAC | ? | 4% | 1% | <1 | 4% |
| Water pepper(PERhyd) | FACW | ? | 15% | 0 | 0 | 0 |
| Swamp kiokio (BLE min) | FACW | ? | 1% | 1% | 2% | 6% |
| Pampas (CORsel) | FAC | ? | 4% | 16% | 0 | 0 |
| Water pepper (PERhyd) | FACW | ? | 2% | 0 | 0 | 1% |
| Creeping bent (AGRsto) | FACU | ? | 1% | <1% | 1% | 0 |
| Birds-foot trefoil (LOTcor) | FACU | ? | 1% | <1% | <1% | 0 |
| Cabbage tree (CORaus) | FACW | ? | 2% | 0 | 0 | 0 |
| Totals (%) | | ? | 100% | 100% | 100% | 95% |

# Appendix E: Biodiversity Compensation Modelling Report

DECEMBER 2023

Alliance Ecology™

# Biodiversity Compensation Modelling Report

## NEWCOMBE ROAD SAND QUARRY

Prepared for R S Sand Ltd

allianceecology.co.nz

# Table of Contents

# 1 Introduction

## 1.1 Background

RS Sand Limited is seeking to obtain district and regional resource consents for a proposed sand quarry at 77 Newcombe Road Cambridge.

As set out in the Newcombe Road Sand Quarry Ecology Report (Alliance Ecology, November 2023) (herein 'Project Ecology Report')), project activities are expected to have residual adverse effects on several terrestrial and wetland values that cannot be avoided, remedied or mitigated.

Residual effects assessed as being 'Moderate' or higher (Table 1.1 below) warrant offset or compensation in the form of habitat restoration or enhancement measures.

**Table 1.1: Summary of residual effects on key biodiversity values that require offsetting or compensation**

| Ecological value | Ecological value category | Magnitude of effects category | Level of effects category |
|---|---|---|---|
| Long-tailed bats | Very High | Moderate | High |
| Copper skink | High | Low (if present) | Moderate (if present) |
| Gully seepage wetlands | Moderate | Moderate | Moderate |

## 1.2 Report Purpose and Scope

Alliance Ecology Ltd has been engaged by RS Sand to prepare a Biodiversity Compensation Modelling (BCM) Report associated with the proposed sand quarry to support the Project Ecology Report.

This report describes the application of the BCM approach to determine the appropriate type and quantum of proposed habitat restoration and enhancement measures needed to address residual adverse effects.

# 2 Application of Models

## 2.1 Background

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

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

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

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

## 2.2 Limitations and constraints

In applying any biodiversity offset or compensation model, it is important to acknowledge the limitations, constraints and uncertainties associated with such models. Most notably and particularly with respect to the BCMs, these limitations, constraints and uncertainties have the potential to generate false positives, i.e. instances where the models generate net positive outcomes when the converse is true. This occurs when:

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

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

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

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

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

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

The BCMs and other models are therefore appropriately used as a decision support tool to help identify compensation measures that are expected to result in tangible net positive outcomes for affected biodiversity values. As is the case for this Project, BCMs rely upon expert knowledge and experience to determine the data inputs and also the appropriateness and validity of the proposed compensation measures.

# 3 Biodiversity Compensation Models (BCMs)

## 3.1 Overview

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

BCMs were run for long-tailed bats, copper skink and gully seepage wetlands because the level of residual effects is expected to be 'Moderate' or higher. These BCMs assess the likelihood of achieving net positive outcomes on these biodiversity values based on:

- Available information on the areal extent of impact and the areal extent of the proposed habitat restoration and enhancement site(s).
- Expert assessment supported by a review of relevant literature or data (where quantitative data is unavailable) on:
  - The reduction in habitat value or population/assemblage at the impact site(s) as a result of the project activities; and
  - The increase in habitat value or population/assemblage that can be directly attributed to compensation actions at the habitat restoration and enhancement compensation site(s) within a fixed time period.
- The expected benefit attributed to the proposed habitat restoration and enhancement measures at year 10 (i.e. 10 years after impact) for copper skink and wetlands and year 15 for bats. At this point revegetation is expected to average 20 years old for copper skink and wetlands and 25 years old for bats , noting that vegetation/habitat loss is expected to occur in stages from Year 1 to Year 27 post-consent).
- An assigned percentage confidence (i.e. 50 to < 75 %, 75 to < 90 %, and ≥ 90 %) that those offset actions would achieve the expected benefit.
- Assigned time discount rate of 3 % to account for the time lag between when an impact is likely to occur and when the offset benefit is likely to be achieved.

The BCMs suggest that net positive outcomes are likely to be achieved for all modelled biodiversity values as a result of the proposed type and quantum of habitat restoration activities. While models were not run for all biodiversity values expected to be impacted by the project, net positive outcomes are also expected for these values, particularly for native vegetation. Moreover, while the loss of some less significant biodiversity values cannot be ruled out, the magnitude of net positive outcomes for most biodiversity values would be expected to adequately compensate for any such loss that may occur.

Sections 3.2 – 3.4 below provide a summary of data inputs and outputs and a detailed description of the data inputs for long-tailed bats, copper skink and wetland biodiversity respectively. These data inputs are informed through the detailed desktop and field investigations described in the Ecology Report, which underpins the EMP and related documentation submitted as part of the resource consent application.

# 4 Long-tailed bat/Pekapeka BCM

## 4.1 Overview

The inputs for this model have been determined by Gerry Kessels (Bluewattle Ecology), who is an experienced, and DOC approved, long-tailed bat expert.

The long-tailed bat BCM relates to the permanent loss of 7.89 ha of variable quality habitat for long-tailed bat and temporary loss of low value pasture. Specifically, this includes the permanent loss of approximately 4.09 ha of pasture, 3.64 ha of exotic terrestrial vegetation and 0.174 ha of wetland habitat, and a temporary loss of 19.2 ha pasture (which will be returned into pasture in stages, approximately ten years after its removal).

The level of residual effects was assessed as 'High' for long-tailed bat/ pekapeka.

Proposed compensation for loss of native and exotic habitat for long-tailed bat includes 14.38 ha of weed control, stock exclusion and native revegetation of pasture and grazed wetland habitat along the Karapiro Stream. Habitat enhancement also includes installation of artificial roost boxes for bats to account for the time lag associated with temporary loss of low value pasture while it is opened for sand extraction. As sand extraction is completed, the exposed quarry faces will be returned back to pasture over an approximately ten-year period.

## 4.2 BCM

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

In conclusion, the BCM predicts that 20% net positive outcomes for effects on long-tailed bat habitat will be exceeded through the proposed compensation actions, i.e., the compensation score is 38.8% higher than the impact score.

**Table 4.1 Long-tailed bat BCM data inputs (see Appendix A for a detailed explanation of model inputs)**

| General model descriptor inputs | |
|---|---|
| **Model inputs** | **Explanation** |
| **Biodiversity type** | Long-tailed bat/ Pekapeka terrestrial and wetland habitat |
| **Technical expert input(s)** | Gerry Kessels |
| **Benchmark** | A benchmark of 5 equates to high value mature native forest supporting a large population of long-tailed bats, subject to long-term pest control and that is at carrying capacity. |

| | |
|---|---|
| **How many habitat types OR sites are impacted** | 5 |
| **Number of proposed compensation measures** | 1 |
| **Net positive target** | 20 % (i.e. the compensation score needs to be at least 20 % higher than the impact score) |
| **Impact model inputs and descriptions** | |
| **Habitat/site impacted** | Pasture |
| **Impact contingency (risk)** | Very high risk/Very high value (calculated impact score is multiplied by 1.2 (+20%))<br><br>Long-tailed bats are classified as Nationally Threatened (Nationally Critical) which equates to a 'Very high' ecological value under EcIAG (Roper Lindsay et al. 2018). |
| **Impact contingency (uncertainty)** | Moderate uncertainty (calculated biodiversity impact score is multiplied by 1.1 (+10%))<br>Impacts on bats associated with habitat loss and disturbance are generally understood but uncertainties remain. |
| **Areal extent of impact (ha)** | Approximately 4.09 ha. This is the extent of permanent loss, i.e. the project footprint is approximately 27.09 ha and the pit, which will be rehabilitated back into pasture, is approximately 23 ha. |
| **Value score prior to impact** | Data input score: 0.5<br><br>Explanation: Pasture within the project footprint has been assigned a score of 0.5 relative to the benchmark of 5, e.g., it is considered to equate to 10 % the value of benchmark habitats. This assessment is based on desktop and field investigations and using professional judgement. Most of the low value pasture only has a value of 0.25; however, approximately 2.7 ha of this pasture habitat is 25 m from the edge of the higher quality shrubland and exotic forest remnants. This 25 m zone of pasture provides edge habitat for bats for foraging and commuting, thus is of higher value than pasture in 'open fields', hence the overall aggregated value of pasture has been assigned 0.5. |
| **Value score after impact** | 0.001<br><br>There will be a permanent and complete loss of habitat within the footprint (noting that the formula cannot work with 0). |
| **Habitat/site impacted** | Exotic plantation forestry (approximately 17 years old) |

| | |
|---|---|
| **Impact contingency (risk)** | Very high risk/Very high value (calculated impact score is multiplied by 1.2 (+20%)) |
| **Impact contingency (uncertainty)** | Moderate uncertainty (calculated biodiversity impact score is multiplied by 1.1 (+10%))<br><br>Impacts on bats associated with habitat loss and disturbance are generally understood but uncertainties remain. |
| **Areal extent of impact (ha)** | 1.04 ha |
| **Value score <u>prior to</u> impact** | Data input score: 2.5<br><br>Explanation: Assessed as having moderate value (low-range) for bats relative to the benchmark of 5, i.e., considered to equate to 40 % of the value of benchmark habitats. This habitat has a number of potential roosts sites in it, although the trees are on average less than 15 years old, which means their cavity bearing properties have not fully developed. |
| **Value score <u>after</u> impact** | 0.001<br>There will be a permanent and complete loss of habitat within the footprint (noting that the formula cannot work with 0). |
| **Habitat/site impacted** | Exotic-dominated scrub (approximately 12 years old but varies) |
| **Impact contingency (risk)** | Very high risk/Very high value (calculated impact score is multiplied by 1.2 (+20%))<br>See explanation above. |
| **Impact contingency (uncertainty)** | Moderate uncertainty (calculated biodiversity impact score is multiplied by 1.1 (+10%))<br><br>Impacts on bats associated with habitat loss and disturbance are generally understood but uncertainties remain. |
| **Areal extent of impact (ha)** | 2.22 ha |
| **Value score <u>prior to</u> impact** | Data input score: 1<br>Explanation: Exotic scrub habitat within the project footprint was assessed as having ‘Low’ value for bats and has been assigned a score of 1 relative to the benchmark of 5, e.g., these habitats are considered to equate to 20% the value of benchmark habitats. |
| **Value score <u>after</u> impact** | 0.001<br>There will be a permanent and complete loss of habitat within the footprint (noting that the formula cannot work with 0). |

| **Habitat/site impacted** | Mature exotic-dominated forest (age varies) |
|---|---|
| **Impact contingency (risk)** | Very high risk/Very high value (calculated impact score is multiplied by 1.2 (+20%))<br>See explanation above. |
| **Impact contingency (uncertainty)** | Moderate uncertainty (calculated biodiversity impact score is multiplied by 1.1 (+10%))<br><br>Impacts on bats associated with habitat loss and disturbance are generally understood but uncertainties remain. |
| **Areal extent of impact (ha)** | 0.37 ha |
| **Value score <u>prior to</u> impact** | Data input score: 3<br>Explanation: Mature exotic forest was assessed as having High value for bats because of the numerous cavity bearing properties each of the trees contains.  The value of these scattered large exotic trees is diminished slightly because they are fairly isolated and more exposed to weather, thus likely to be less favourable for roosting habitat. This forest type is thus assigned a score of 3 relative to the benchmark of 5, i.e., these habitats are considered to equate to 60 % the value of benchmark habitats for bats. |
| **Value score <u>after</u> impact** | 0.001<br>There will be a permanent and complete loss of habitat within the footprint (noting that the formula cannot work with 0). |
| **Habitat/site impacted** | Gully seepage wetlands |
| **Impact contingency (risk)** | Very high risk/Very high value (calculated impact score is multiplied by 1.2 (+20%))<br>See explanation above. |
| **Impact contingency (uncertainty)** | Moderate uncertainty (calculated biodiversity impact score is multiplied by 1.1 (+10%))<br><br>Impacts on bats associated with habitat loss and disturbance are generally understood but uncertainties remain. |
| **Areal extent of impact (ha)** | 0.17 ha |
| **Value score <u>prior to</u> impact** | Data inputs: 2<br>Explanation: Gully seepage wetlands were assessed as having Moderate value for bats and have been assigned a score of 2 relative to the benchmark of 5, e.g., these habitats are considered to equate to 40 % the value of benchmark habitats for bats. These grazed wetlands will likely |

| | |
|---|---|
| | produce additional habitat (as compared to pasture) for insects which bats will feed on, but they are small in size and compromised by stock grazing. |
| **Value score <u>after</u> impact** | 0.001<br><br>There will be a permanent and complete loss of habitat within the footprint (noting that the formula cannot work with 0). |
| **Compensation model inputs** | |
| **Compensation type 1** | Native revegetation of pasture habitat and roost boxes |
| **Discount rate** | +3 % (the default discount score as per Maseyk et al. (2015); Baber et al. (2021a). The discount rate addresses the temporal time lag between the impact occurring and the biodiversity gains being generated by the conservation action(s). |
| **Finite end-point** | 15 years after impact (noting that revegetation at this time will average 25 years in age) |
| **Compensation contingency (confidence)** | High confidence (75 – 90%) |
| **Areal extent (ha) of compensation type** | 14.38 ha |
| **Value score <u>prior to</u> compensation measure (relative to benchmark)** | Data value input: 1<br><br>Explanation: Pasture in the proposed compensation area is expected to be of greater importance for commuting and foraging given that it is located on the margin of the Karapiro stream and riverine/stream gullies are expected to be of high value for bats |
| **Value score <u>after</u> compensation measure (relative to benchmark)** | **3** (i.e. relative to the benchmark, a 40% gain in value).<br><br>The increase in score is not considered to be higher because, while the revegetation will be 25 years old, the trees are generally still too young to have formed suitable roosting cavities.<br><br>The increase in score is not considered to be lower because 25 year old terrestrial indigenous vegetation along river/stream margins is expected to constitute important foraging and commuting habitat for bats and artificial roosts are expected to provide roosting habitat until cavities form. |

## Table 4.2: Long-tailed bat BCM input/output summary table and weighted table scores.

This table indicates a Net Gain outcome of 38.8% within 15 years following the implementation of proposed residual effects management measures, based on the compensation score being 38.8% higher than the impact score.[1]

| Model Inputs | | | | | |
|---|---|---|---|---|---|
| Input descriptors | Input data | | | | |
| Project/reference name | Newcombe Rd Sand Quarry | | | | |
| Biodiversity type | Long-tailed bats | | | | |
| Technical expert(s) input | Gerry Kessels | | | | |
| Benchmark | 5 | | | | |
| How many habitat types OR sites are impacted | 5 | | | | |
| Number of proposed compensation actions | 1 | | | | |
| Net gain target | 20% | | | | |
| Habitat/Site Impact(s) | Pasture | Wetland | Exotic dominated scrub | Exotic dominated forest | Pine forest |
| Impact risk contingency: | 4 | 4 | 4 | 4 | 4 |
| Impact uncertainty contingency: | 2 | 2 | 2 | 2 | 2 |
| Areal extent of impact (ha): | 4.09 | 0.174 | 2.22 | 0.37 | 1.04 |
| Value score prior to impact: | 0.5 | 2 | 1 | 3 | 2.5 |
| Value score after impact: | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| Compensation Action(s) | Native reveg + roost box | | | | |
| Discount rate: | 3.0% | | | | |
| Finite end point (years): | 15 | | | | |
| Compensation confidence contingency: | 2 | | | | |
| Areal extent (ha) of compensation type: | 14.38 | | | | |
| Value score prior to compensation: | 1 | | | | |
| Value score after compensation: | 3 | | | | |

| Model outputs | | | | | | |
|---|---|---|---|---|---|---|
| | Total impact score | Pasture | Wetland | Exotic dominated scrub | Exotic dominated forest | Pine forest |
| Impact score | -2.19519 | -0.53880 | -0.09183 | -0.58549 | -0.29294 | -0.68613 |
| | Total compensation score | Native reveg + roost box | | | | |
| Compensation score | 3.04589 | 3.04589 | | | | |
| Net gain outcome | 38.8% | | | | | |

[1] The absolute (+) impact score.

# 5 Copper skink habitat BCM

The type and quantum of proposed habitat restoration and enhancement measures to address residual effects on copper skink habitat is expected to result in net positive outcomes at year 10 (when the average revegetation is 20 years old), i.e., the compensation score is 88.9% higher than the impact score following 10 years of implementation.

Table 5.1 below describes the data inputs into the copper skink BCM. Table 5.2 below provides a data input and output summary.

In conclusion, the BCM predicts that 20% net positive outcomes for effects on copper skink habitat will be greatly exceeded through the proposed compensation actions, i.e. the compensation score is 88.9% higher than the impact score.

### Table 5.1 Copper skink habitat BCM data inputs (see Appendix A for a detailed explanation of model inputs)

| General model descriptor inputs | |
|---|---|
| **Model inputs** | **Explanation** |
| **Biodiversity type** | Copper skink habitat |
| **Technical expert input(s)** | Matt Baber |
| **Benchmark** | A benchmark of 5 equates to high value mature native forest margin with rank grassland wetland or riparian margins. Habitat would include high ground-habitat complexity, including refugia, and ground vegetative cover or leaf litter. Habitat would be sunny or only partially shaded, have been subject to long-term pest management, and would be at carrying capacity. |
| **How many habitat types OR sites are impacted** | 1 |
| **Number of proposed compensation measures** | 1 |
| **Net Gain target** | 20 % (i.e. the compensation score needs to be at least 20 % higher than the impact score) |
| **Impact model inputs and descriptions** | |
| **Habitat/site impacted** | Exotic terrestrial vegetation |

| | |
|---|---|
| **Impact contingency (risk)** | High risk/high value (calculated impact score is multiplied by 1.1 (+10%))<br><br>Copper skink are classified as nationally At Risk (Declining) which equates to a 'high' ecological value under EcIAG (Roper Lindsay et al. 2018). |
| **Impact contingency (uncertainty)** | Moderate uncertainty (calculated biodiversity impact score is multiplied by 1.10 (+10%)) |
| **Areal extent of impact (ha)** | 3.64 ha – all terrestrial vegetation types excluding managed/grazed pasture. |
| **Value score <u>prior to</u> impact** | 2 (Moderate). The habitat is considered to be of moderate value for copper skink (at the lower range of moderate). It is not assigned a higher value because no copper skink were detected during manual searches (turning over all cover objects that were present and accessible). The number of plague skinks present was high (plague skinks are expected to have a negative impact on copper skink populations) and there was a general lack of cover objects, which provide suitable habitat. The habitat was not considered to be of lower value because copper skink are readily found in these habitat types. |
| **Value score <u>after</u> impact** | 0.001<br><br>There will be a permanent and complete loss of habitat within the footprint (noting that the formula cannot work with 0). |
| **Compensation model inputs** | |
| **Compensation type 1** | Native revegetation within pasture habitat |
| **Discount rate** | +3 % (the default discount score as per Maseyk et al. (2015); Baber et al. (2021a). The discount rate addresses the temporal time lag between the impact occurring and the biodiversity gains being generated by the conservation action(s). |
| **Finite end-point** | 10 years from impact (which equates to 20 years revegetation) |
| **Compensation contingency (confidence)** | High confidence (75-90%) |
| **Areal extent (ha) of compensation type** | 12.04 ha (non-wetland habitat within the compensation site) |
| **Value score <u>prior to</u> compensation measure (relative to benchmark)** | 0.25 (Marginal overall)<br><br>Existing pasture habitat is not suitable because of the low stature of the vegetation, due to livestock browse. However, there are small pockets of |

| | |
|---|---|
| | low-moderate vegetation in select areas which elevates the score across the compensation area. |
| **Value score <u>after</u> compensation measure (relative to benchmark)** | 2.5 (i.e. relative to the benchmark, a 40% gain in value relative to the benchmark).<br><br>The increase in score is not considered to be lower because the revegetated areas will include a high proportion of forest/rank grass margin habitat (over 4km of edge habitat), and will include the deployment of logs to provide additional refugia.<br><br>The increase in score is not considered to be higher because some of this habitat will have developed into shaded/interior forest that is less suitable for copper skink. Additionally, pest control is limited to browsers only (e.g. rabbits, pukeko and possums). |

### Table 5.2 Copper skink habitat BCM input/output summary table and weighted score tables

This table indicates a net positive outcome of 88.9% at 10 years following the implementation of residual effects management measures, based on the compensation score being 88.9% higher than the impact score.[2]

| Model Inputs | |
|---|---|
| **Input descriptors** | **Input data** |
| Project/reference name | Newcombe Rd Sand Quarry |
| Biodiversity type | Copper skink habitat |
| Technical expert(s) input | Matt Baber |
| Benchmark | 5 |
| How many habitat types OR sites are impacted | 1 |
| Number of proposed compensation actions | 1 |
| Net gain target | 20% |
| **Habitat/Site Impact(s)** | **Exotic terrestrial veg** |
| Impact risk contingency: | 3 |
| Impact uncertainty contingency: | 2 |
| Areal extent of impact (ha): | 3.64 |
| Value score prior to impact: | 2 |
| Value score after impact: | 0.001 |
| **Compensation Action(s)** | **Native reveg/hab enhance** |
| Discount rate: | 3.0% |
| Finite end point (years): | 10 |
| Compensation confidence contingency: | 2 |
| Areal extent (ha) of compensation type: | 12.04 |
| Value score prior to compensation: | 0.25 |
| Value score after compensation: | 2.5 |

| Model outputs | | |
|---|---|---|
| | **Total impact score** | **Exotic terrestrial veg** |
| **Impact score** | **-1.76088** | -1.76088 |
| | **Total compensation score** | **Native reveg/hab enhance** |
| **Compensation score** | **3.32599** | 3.32599 |
| **Net gain outcome** | **88.9%** | |

[2] The absolute (+) impact score.

# 6 Wetland BCM

After effects avoidance measures, the proposed project is expected to result in the permanent loss of 0.17 ha of gully seepage wetlands. The type and quantum of proposed habitat restoration and enhancement measures to address residual effects on wetlands is expected to result in net positive outcomes for wetlands at year 10 (when the average restoration and habitat enhancement will be at 20 years old, as described at Section 3.1 above).

Table 6.1 below describes the data inputs into the Wetland BCM. Table 6.2 below provides a data input and output summary, and includes weighted habitat scores for different habitat types, which apply before and after wetland restoration.

In conclusion, the BCM predicts that 20 % net positive outcomes for effects on wetlands will be greatly exceeded through the proposed compensation actions (i.e., the compensation score is 265.4% higher than the impact score following 10 years of implementation).

### Table 6.1 Wetland Biodiversity BCM inputs (see Appendix A for a detailed explanation of model inputs)

| General model descriptor inputs | |
|---|---|
| **Model inputs** | **Explanation** |
| **Biodiversity type** | Wetland habitat |
| **Technical expert input(s)** | Matt Baber |
| **Benchmark** | 5<br><br>A benchmark of 5 equates to a large, natural, indigenous-dominated freshwater wetland that provides the full suite of wetland biodiversity values, has been subject to intensive pest control for an extended period, is bordered by intact native forest and in which all species present are at carrying capacity. |
| **How many habitat types OR sites are impacted** | 1 |
| **Number of proposed compensation measures** | 3 |
| **Net positive target** | 20 % (i.e. the compensation score needs to be at least 20% higher than the impact score) |

| Impact model inputs and descriptions | |
|---|---|
| **Habitat/site impacted** | Gully seepage wetlands |
| **Impact contingency (risk)** | Moderate risk/value (calculated biodiversity impact score is multiplied by 1.05 (+5%)). |
| **Impact contingency (uncertainty)** | Moderate uncertainty (calculated biodiversity impact score is multiplied by 1.1 (+10%)) |
| **Areal extent of impact (ha)** | 0.17 ha (including indirect effects) |
| **Value score prior to impact** | 2 (relative to the benchmark of 5)<br>"Moderate" ecological value as per the characterisation and assessment of values for gully seepage wetlands in the Ecology Report. |
| **Value score after impact** | A value of 0.001 (noting that the formula cannot work with zero). |
| **Compensation model inputs** | |
| **Compensation type 1** | Gully basin restoration (weed control, native enrichment planting and stock exclusion. Stock exclusion required by the Resource Management (Stock Exclusion) Regulations 2020 is not counted as it does not satisfy the additionality principle.[3] |
| **Discount rate** | +3 % (the default discount score as per Maseyk et al. (2015); Baber et al. (2021a). The discount rate addresses the temporal time lag between the impact occurring and the biodiversity gains being generated by the conservation action(s). |
| **Finite end-point** | 10 years |
| **Compensation contingency (confidence)** | High confidence (75%-90 %) |
| **Areal extent (ha) of compensation type** | 0.886 ha |
| **Value score prior to compensation measure (relative to benchmark)** | 3.5 "High" (at the moderate range high) as describe in Table 4.3.1 of the Ecology report |

[3] Refer to Sections 5.6 and 5.7 of the Ecology Report (Alliance Ecology 2023) for an assessment of the compensation package against the relevant compensation principles in the National Policy Statement for Indigenous Biodiversity 2023 and the National Policy Statement for Freshwater Management 2020 (Amended February 2023).

| | |
|---|---|
| **Value score <u>after</u> compensation measure (relative to benchmark)** | 3.75 (i.e. relative to the benchmark a 5 % gain in ecological value).<br><br>The removal of invasive wetland plants and stock exclusion is expected to increase the indigenous dominance and habitat quality and generate a 15% gain relative to the benchmark. However, we expect a gain of only 5% because gains associated with stock exclusion are not additional, . |
| **Compensation type 2** | Gully seepage wetland restoration (weed control, terrestrial revegetation of wetland margins and stock exclusion. Stock exclusion required by the Resource Management (Stock Exclusion) Regulations 2020 is not counted as it does not satisfy the additionality principle.[4] |
| **Discount rate** | +3% (default) |
| **Finite end-point** | 10 years |
| **Compensation contingency (confidence)** | High (75 %-90 %)<br>A high confidence has been applied that the proposed wetland restoration will achieve predicted gains |
| **Areal extent (ha) of compensation type** | 0.307 ha |
| **Value score <u>prior to</u> compensation measure (relative to benchmark)** | 2 which equates to a Moderate (low range of moderate) value, noting that the gully seepage wetlands in the compensation area are similar in composition, condition and size to those present in the project footprint. |
| **Value score <u>after</u> compensation measure (relative to benchmark)** | 2.75 (15% improvement relative to the benchmark).<br><br>The removal of invasive wetland plants, stock exclusion and terrestrial revegetation of the wetland margin is expected to increase the indigenous dominance and habitat quality of gully seepage wetlands and generate a 15% gain relative to the benchmark. We note that we expect a 30% improvement overall due to the exclusion of stock; however, stock exclusion cannot be counted. |
| **Compensation type 3** | Floodplain wetland restoration (restoration and habitat enhancement of swamp forest, rushland and sedgeland habitats) via native revegetation or enrichment, weed control and stock exclusion. Stock exclusion required by the Resource Management (Stock Exclusion) Regulations 2020 is not counted as it does not satisfy the additionality principle.[5] |
| **Discount rate** | +3% (default) |
| **Finite end-point** | 10 years |

[4] Ibid.
[5] Ibid.

| | |
|---|---|
| **Compensation contingency (confidence)** | High (75 %-90 %)<br>A high confidence has been applied that the proposed habitat enhancement will achieve predicted gains. |
| **Areal extent (ha) of compensation type** | 2.513 ha |
| **Value score <u>prior to</u> compensation measure (relative to benchmark)** | 3<br><br>Floodplain wetlands are deemed of 'High' value (at the lower range of High) on the basis that native vegetation is present in some locations and most floodplain wetland areas are moderately sized. However, floodplain wetlands are not considered to be higher in value as they are heavily impacted by stock and exotic weeds, and some of the wetlands are very small and surrounded by managed pasture. |
| **Value score <u>after</u> compensation measure (relative to benchmark)** | 3.75<br><br>A 15% improvement (relative to the benchmark) is expected from the proposed compensation measures. We note that we expect a 30% improvement overall due to the exclusion of stock; however, stock exclusion cannot be counted.<br><br>We expect the 15% gain due to an increase in indigenous dominance in floodplain wetlands that will be associated with the proposed wetland revegetation and enrichment coupled with weed control. Furthermore, terrestrial revegetation around wetland margins will provide significant buffer benefits to wetlands as well as connectivity to terrestrial habitats, which is important for a number of aquatic invertebrates with bi-phasic life cycles, i.e. an aquatic larval phase and a terrestrial adult phase. |

## Table 6.2 Wetland biodiversity BCM input/output summary table and weighted score table

This table indicates a Net Gain outcome of 265.4% within 10 years based on the compensation score being 265.4% higher than the impact score[6].

| Model Inputs | | | |
|---|---|---|---|
| **Input descriptors** | **Input data** | | |
| Project/reference name | Newcombe sand quarry | | |
| Biodiversity type | Wetland habitat | | |
| Technical expert(s) input | Matt Baber | | |
| Benchmark | 5 | | |
| How many habitat types OR sites are impacted | 1 | | |
| Number of proposed compensation actions | 3 | | |
| Net gain target | 20% | | |
| **Habitat/Site Impact(s)** | **Habitat/Site Impact 1** | | |
| Impact risk contingency: | 2 | | |
| Impact uncertainty contingency: | 2 | | |
| Areal extent of impact (ha): | 0.17 | | |
| Value score prior to impact: | 2 | | |
| Value score after impact: | 0.001 | | |
| **Compensation Action(s)** | **Gully basin wetland** | **Gully seepage wetland** | **Floodplain** |
| Discount rate: | 3.0% | 3.0% | 3.0% |
| Finite end point (years): | 10 | 10 | 10 |
| Compensation confidence contingency: | 2 | 2 | 2 |
| Areal extent (ha) of compensation type: | 0.886 | 0.307 | 2.513 |
| Value score prior to compensation: | 3.5 | 2 | 3 |
| Value score after compensation: | 3.75 | 2.75 | 3.75 |

| Model outputs | | | | |
|---|---|---|---|---|
| | **Total impact score** | **Habitat/Site Impact 1** | | |
| **Impact score** | **-0.07850** | -0.07850 | | |
| | **Total compensation score** | **Gully basin wetland** | **Gully seepage wetland** | **Floodplain** |
| **Compensation score** | **0.28686** | 0.02719 | 0.02827 | 0.23140 |
| **Net gain outcome** | **265.4%** | | | |

[6] The absolute (+) impact score.

# 7 References

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

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

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

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

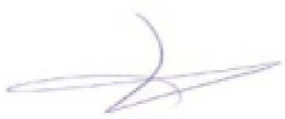
New Zealand Government (2023) National Policy Statement for Indigenous Biodiversity (Wellington, 2023).

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

# 8 Applicability

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

Report prepared by:



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Matt Baber

Principal Ecologist/ Director

Alliance Ecology Ltd

# Appendix A: BCM input descriptions

## (Table 3.1 Baber et al. 2021a)

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

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

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| | could be assessed as one, provided the impacts are appropriately captured in the assessment.<br><br>If there are more than 5 habitat types or sites/locations impacted, a new BCM can be created, and the overall impact scores added. |
| **Number of proposed compensation actions** | **Instruction**<br><br>Select from the drop-down menu the number of different compensation actions proposed. Up to 5 different compensation actions can be selected.<br><br>**Explanation**<br><br>Where compensation actions differ AND are undertaken in different locations or sites, or the spatial extent of the compensation action is different, then each action must be assessed independently. In some instances, different compensation actions in the same location can be lumped into a single compensation action (e.g. native revegetation and weed control), provided appropriate justification is given. Similarly, it may be appropriate to combine the same compensation action at different locations into a single compensation action, with appropriate explanation. |
| **Net positive target** | **Instruction**<br><br>Manually type in the desired net positive target as a percentage, e.g., if the number 20 is typed, this will be converted to 20%.<br><br>**Explanation**<br><br>In general terms, the greater the assigned net positive outcome target, the greater the likelihood that net positive outcomes will be achieved. For compensation a net positive outcome target of 20% is considered by the authors to be generally appropriate. This equates to a 20% exceedance of No Net Loss, i.e. the Compensation Score is 20% higher than the Impact Score. However, the selected net positive outcome target will need to be justified and should be assigned on a case-by-case basis. |
| **Habitat/site impacts** | **Instruction**<br><br>Manually type the name of the habitat(s) or site(s) impacted. The number of named habitat(s) or site(s) will need to match the number of proposed compensation actions specified above. |
| **Impact risk contingency** | **Instruction**<br><br>Select from the drop-down menu:<br><br>1 = Negligible or low risk/ Negligible or low value (calculated impact score is multiplied by 1.0 (+0%))<br><br>2 = Moderate risk/Moderate value (calculated impact score is multiplied by 1.05 (+5%)) |

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| | 3 = High risk/High value (calculated impact score is multiplied by 1.1 (+10%))<br><br>4 = Very high risk/Very high value (calculated impact score is multiplied by 1.2 (+20%))<br><br>**Explanation**<br><br>The impact risk contingency addresses the increased likelihood that adverse effects will result in the permanent and irreplaceable loss of significant biodiversity values when impacting on habitats or species that are of higher ecological value. The assigned ecological value is based on the EcIAG ecological value assessment.<br><br>The risk contingency percentage multiplier is commensurate with the EcIAG assigned ecological value with the multiplier assigned to each ecological value category based on testing under a range of scenarios[7].<br><br>For avoidance of doubt, the impact risk contingency relates to the biodiversity type. For example:<br><br>If the model biodiversity type is 'long-tailed bat' then the impact risk contingency relates to the assigned ecological value for long-tailed bat and would therefore be the same across the different long-tailed bat habitat types that are impacted and included in the model (e.g. pasture versus shelterbelts, versus mature forest).<br><br>If the model biodiversity type is a broad habitat type, e.g. 'native forest', and the impacts relate to more specific habitat types that differ in their ecological value, then the impact risk contingency for each habitat type will be different (e.g. kauri forest versus young regenerating kānuka forest). |
| **Impact uncertainty contingency** | **Instruction**<br><br>Select from the drop-down menu:<br><br>1 = Low uncertainty (calculated impact score is multiplied by 1.05 (+5%))<br><br>2 = Moderate uncertainty (calculated impact score is multiplied by 1.1 (+10%))<br><br>3 = High uncertainty (calculated impact score is multiplied by 1.2 (+20%))<br><br>4 = Very high uncertainty (the model will not work if this option is selected)<br><br>**Explanation**<br><br>By providing for a greater margin of error, the impact uncertainty contingency addresses the increased risk of permanent or irreplaceable biodiversity loss when impacting on more complex habitats, or on species for which there is less |

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

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| | information regarding species-specific impacts associated with an effect. The rationale for category selection will need to be justified on ecological grounds.<br><br>Where very high uncertainty exists in relation to adverse effects, this constitutes a limit to the use of the BCM model; project redesign or avoidance of effects should instead be considered.<br><br>The percentage multipliers used for the impact uncertainty contingency levels have been assigned based on testing different multipliers under a range of scenarios.[8] |
| **Areal extent of impact (ha)** | **Instruction**<br>Manually type in the areal extent of impact in hectares with respect to the value being considered (incorporating both direct and indirect effects).<br><br>**Explanation**<br>If there is more than one habitat type or more than one site of the same habitat type, then impact (ha) will relate to that specific habitat or site. However, the total habitat loss (ha) will be automatically summed and factored into the impact score calculations. |
| **Value prior to impact** | **Instruction**<br>Manually type in a numerical score between 0 and 5 that relates to the value score prior to impact relative to the benchmark value score of 5.<br><br>**Explanation**<br>The assigned value score in all instances must relate explicitly to the biodiversity type that the model relates to.<br>Adequate detail must be provided to justify the assigned ecological value score based on desktop and field investigations. This enables an understanding of the adequacy and certainty surrounding the assessment and should include an explanation of why the value score was neither higher nor lower.<br><br>**Habitat value scores:** For habitats, the ecological value prior to impact relates to the representativeness, rarity and distinctiveness, diversity and pattern, and ecological context associated with the habitats/vegetation types within a project footprint as assessed against the benchmark. Refer to Section 5.2 and Table 4 of the Ecological Impact Assessment Guidelines (EcIAG, Roper-Lindsay *et al.* 2018), |

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

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| | the detail of which would be provided in the Assessment of Ecological Effects report for the Project.<br><br>In broad terms:<br>< 1 = Negligible<br>1 - <2 = Low<br>2 - <3 = Moderate<br>3 - <4 = High<br>4 - <5 = Very High<br>5 = Benchmark<br>NB:<br>In some instances, consideration of loss of 'potential value' may be required for impact values (e.g. for natural inland wetlands under the National Policy Statement for Freshwater Management 2020 (NPS FM)). This should be considered in the context of the value affected and the potential value if it were restored (using best practice, reasonable efforts). Ensure that the reporting outputs are clear as to whether the 'existing' or 'potential' values were used to quantify the compensation measures.<br>The EcIAG (Roper-Lindsay *et al.* 2018) assessment of ecological value does not assess the contribution that a particular habitat type may make to ecological functioning or the provision of ecosystem services. We recommend that these factors are also considered when assessing the value of impacted habitats.<br><br>**Species or species assemblage value scores:** The EcIAG (Roper-Lindsay *et al.* 2018) does not include criteria for determining habitat suitability for a given species. Since habitat suitability is a key component of a magnitude of effects assessment, this will ideally be addressed in subsequent versions of the EcIAG. In the interim we set out proposed criteria below:<br>0 = Habitat not suitable.<br>< 1 = Marginal habitat that may be used but is not important for any part of the species or species assemblage life-cycle(s).<br>1 - <2 = Relatively low value habitat that provides some but not all of a species or species assemblages life-history requirements and/or the habitat is of low quality and the relative abundance within the habitat is low compared to other habitat types.<br>2 - <3 = Relatively moderate value habitat that provides for most, if not all, of a species or species assemblage's life-history requirements and/or the habitat quality is of moderate quality and the relative abundance within the habitat is moderate compared to other habitat types. |

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| | 3 - <4 = Relatively high value habitat that would typically provide for all species or species assemblage life-history requirements and/or provides a critical resource or resource(s) for life-history requirements. The habitat quality is high and the relative abundance within the habitat is, or is likely to be, high compared to other habitat types.<br><br>4 - <5 = Relatively very high value habitat that provides for all species or species assemblage life-history requirements and/or provides a critical resource or resource(s) needed for life-history requirements. The habitat quality is very high and the relative abundance within the habitat is or is likely to be very high compared to other habitat types. Likely to be a local hotspot for that species.<br><br>5 = Highest quality habitat and/or relative abundance for a given species or species assemblage, likely to be a regional hotspot or benchmark with the species or species assemblage at carrying capacity.<br><br>As with habitat scores, adequate detail must be included from desktop and field investigations to provide transparent justification for each value score. The reader needs to understand the adequacy and certainty surrounding the assessment and requires an explanation of why the score was neither higher nor lower. The model assumes a static rather than temporally dynamic biodiversity baseline at the impact site. The predicted NNL/NG outcome is therefore relative to pre-impact values.<br><br>In instances where population densities or relative abundance appear higher in seemingly less suitable habitats than in more suitable habitats, this will need to be addressed and reflected in the relative value scores. |
| **Value after impact** | **Instruction**<br><br>Manually type in a numerical score between 0 and 5 that relates to the value score after the impact relative to the benchmark value score of 5.<br><br>**Explanation**<br><br>The explanation for determining the habitat or species scores after impact is the same as the method for determining these scores prior to impact except that the assessment value score relates to the impact site after the impact has occurred.<br><br>NB:<br><br>The drop in ecological value relates to the magnitude of impact based on the EcIAG, which is a function of the extent, intensity, frequency and permanence of the impact. It is important to factor in all types of impacts associated with the project which may range from earthworks, vegetation and sedimentation to increased exposure to artificial lighting or noise, or domestic mammalian predators.<br><br>The model does not accept a value score of 0 as the formula will not work, but it does allow for a score of 0.001 (virtually zero). |

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| **Compensation action(s)** | **Instruction**<br>Manually enter the compensation action proposed. The number of different compensation measures (habitat(s) or site(s)) will need to match the number of proposed compensation actions specified above.<br><br>**Explanation**<br>The compensation action relates to each type of habitat creation, restoration, or enhancement activity that is proposed, e.g., native revegetation into existing pasture and/or weed and mammalian pest control in existing forest.<br><br>As long as it is explained, it is appropriate to lump different compensation types where they are applied as a total package within a particular habitat or site (e.g. bush retirement coupled with weed control and mammalian pest control). |
| **Discount rate** | **Instruction**<br>Manually enter a discount rate.<br><br>**Explanation**<br>The discount rate addresses the temporal time lag between the impact occurring and the biodiversity gains being generated by the conservation action(s).<br>A discount rate of 3% is recommended. This is the same as the discount rate recommended in the BOAM user guide (Maseyk *et al.* 2015), which is informed by research in Gibbons *et al.* 2015. That said, we note that a discount rate of 3% rewards benefits that deliver faster than those that take longer but provide greater ecological outcomes in the longer term, i.e. it punishes the tortoise and rewards the hare). For example, revegetation may deliver greater biodiversity gains in the long term for habitats than mammalian pest control, but all else being equal, a discount rate of 3% will favour mammalian pest control over revegetation because gains would be predicted to occur almost immediately after commencement of pest control operations. |
| **Finite end-point** | **Instruction**<br>Manually enter the number of years between impact and assessment of biodiversity gain at the compensation site(s) resulting from compensation actions.<br><br>**Explanation**<br>The finite end-point is the time period (years) over which to calculate NPBV. This equates to the time between the commencement of proposed compensation action(s) and an assessment of the associated benefits for the affected biodiversity value (e.g. native revegetation at 20 years). |

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| | For pest control this time period would be short because biodiversity gains occur almost immediately after commencement of pest control operations. However, these biodiversity gains will diminish once the pest control is terminated, and this needs to be addressed when applying the model.<br><br>The finite end-point should generally be tied to the duration of the biodiversity management and monitoring programmes that are used to verify that the benefits at compensation sites have been achieved. For instance, if the finite end point is set at 10 years from commencement of compensation, then the biodiversity management and monitoring programme should be undertaken for 10 years (but possibly longer if predicted biodiversity gains are not achieved and adaptive management or contingency measures are required). |
| **Compensation confidence contingency** | **Instruction**<br>Select from the drop-down menu:<br>1 = Very high confidence (>90%)<br>2 = High confidence (75%-90%)<br>3 = Moderate confidence (50-75%)<br>4 = Low confidence (< 50%) (The model will not work if this option is selected).<br><br>**Explanation**<br>The approach used to assign compensation confidence contingency is aligned with the approached used in Maseyk *et al.* (2015) except that the term 'offset' has been changed to 'compensation'.<br><br>The compensation confidence contingency relates to the level of confidence in the likely success of the proposed compensation measures and methodology (see above). This reflects that even well-established management methods sometimes fail to achieve targets for a multitude of reasons. The model does not consider confidence in the implementer of the proposed compensation. Nor does it consider likelihood of abandonment of the project post-impact but prior to the implementation of compensation actions.<br><br>Very high confidence: The proposed compensation measure uses methods that are well tested and repeatedly proven to achieve intended biodiversity gains; evidence-based expert opinion is that success is very likely. Likelihood of success is > 90%. Calculated biodiversity gain is multiplied by 0.925.<br>High confidence: The proposed compensation measure uses methods that are well known, often implemented, and which have been proven to succeed greater than 75% of the time. However, complicating factors and/or expert opinion |

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| | precludes greater confidence in this compensation measure. Likelihood of success is greater than 75% but less than 90%. Calculated biodiversity gain is multiplied by 0.825.<br><br>Moderate confidence: The proposed compensation measure uses methods that have either been successfully implemented in New Zealand or in the situation and context relevant to the compensation site but infrequently, or the outcomes of the proposed compensation measures are not well proven or documented, or success rates elsewhere have been shown to be variable. Likelihood of success is > 50% but < 75%. Calculated biodiversity gain is multiplied by 0.625.<br><br>Low confidence: Should not use the compensation measure and the model will not work if this option is selected on the basis that uncertainty is too high. |
| **Areal extent (ha) of compensation action** | **Instruction**<br><br>Manually enter the areal extent (ha) of the proposed compensation action. |
| **Value score prior to compensation action** | **Instruction**<br><br>Manually type in a numerical value score between 0 and 5 that relates to the value score at the compensation site(s) prior to implementation of compensation action(s).<br><br>**Explanation**<br><br>Adequate detail must be provided to justify the assigned ecological value score based on desktop and field investigations and assessed using EcIAG (Roper-Lindsay *et al.* 2018 or an updated version). This enables an understanding of the adequacy and certainty surrounding the assessment and should include an explanation of why the value score prior to the implementation of the compensation action(s) was neither higher nor lower.<br><br>The EcIAG (Roper-Lindsay *et al.* 2018) assessment of ecological value does not include an assessment of value in relation to ecological functioning or the provision of ecosystem services. We recommend that these factors are also considered when assessing the habitat value associated with a compensation action(s).<br><br>Note that the model does not accept a value score of 0 as the formula will not work, but it does allow for a score of 0.001 (virtually 0). |
| | **Instruction**<br><br>Manually type in a numerical value score between 0 and 5 that relates to the value score at the compensation site(s) after implementation of compensation action(s) as assessed at the finite end point (years).<br><br>**Explanation** |

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| | Adequate detail must be provided to justify the assigned ecological value score after implementation of compensation actions based on desktop and field investigations and assessed using EcIAG (Roper-Lindsay *et al.* 2018 or an updated version).<br><br>This enables an understanding of the adequacy and certainty surrounding the assessment and should include an explanation of why the compensation value score after implementation of the compensation action(s) was neither higher nor lower.<br><br>The EcIAG (Roper-Lindsay *et al.* 2018) assessment of ecological value does not include an assessment of value in relation to ecological functioning or the provision of ecosystem services. We recommend that these factors are also considered when assessing the habitat value associated with a compensation action(s). |

# Appendix F: 2 Awa Ecology Freshwater Assessment

19 October 2023

RS Sands Limited
c/o Alliance Ecology

By email to Matt Baber mbaber@allianceecology.co.nz

Dear Matt,

# S92 request for WRC APP145695 in relation to Freshwater Ecology aspects being the Karapiro Stream and Mudfish - Newcombe Road Sand Quarry

## 1 Introduction

This letter has been prepared in response to a s92 request for further information regarding a resource consent application (APP145695) from RS Sand Ltd to operate a sand quarry on a rural property at 77 Newcombe Road, Cambridge.

This letter provides a response to the s92 request from Stuart Penfold dated 26 June 2023 which specifically requested information regarding the Karapiro Stream and Mudfish as per points 11 and 12 below.

'***Karapiro Stream*** *- Quarrying operations and excavation of the pit area will begin 10-15m from the Karapiro Stream and ongoing operations have the potential to discharge sediment laden water to the stream via SRP discharge or overland flows. Iwi have also noted the significance of the stream with respect to the location of the proposed works.*

*The ecological report has stated that the Karapiro Stream is outside of the project footprint and does not assess the potential impact on the Stream from the proposed works. Furthermore, there is also no comment on the potential for the movement of species from the stream to the wetlands'*

*'11. Please provide an assessment of the ecological values and potential effects of the proposal on the Karapiro Stream.*

***Mudfish*** *- There is little reference to Black mudfish (Neochanna diversus) being present and/or affected by the proposed works.*

*12. Please confirm or otherwise the presence of Black mudfish on or near the site and provide an assessment of effects of the proposal on this species.'*

## 2 Methods

A site visit was undertaken on the 20th and 21st of September 2023 to assess the streams and wetlands[1] onsite. A visual assessment was undertaken in representative sections of the streams and fish surveys were undertaken in the gully basin wetland and the Karapiro Stream (as per the footnote in the s92 request).

Within the gully basin wetland, a targeted mudfish survey was undertaken, using standard mudfish sampling methodology[2], with 12 Gee's minnow traps set throughout the wetland. The traps were

[1] Wetlands are assessed in more detail elsewhere and are only mentioned briefly in this letter.
[2] Ling, N.; O'Brien, L.K.; Miller, R.; Lake, M. 2013: A revised methodology to survey and monitor New Zealand mudfish. Department of Conservation, Wellington (unpublished).

partially submerged with an air gap and were set in the afternoon and collected the following morning. Any fish captured in the traps were identified and measured before being released back into the habitat from which they were captured. Trapping was used instead of collecting composite eDNA samples because the water depth was considered suitable (at c.20-30cm deep) and to provide an indication of the population dynamics if captured.

Within the Karapiro Stream Environmental DNA (eDNA) was collected to determine the fish species composition. EDNA sample collection followed the recommended protocols with six replicate samples collected from the Karapiro Stream adjacent to the gully basin wetland (see the location map in the main report). The water samples were filtered, preserved, and sent to Wilderlab for metabarcoding analysis. For each replicate sample between 510 and 1,000 ml of water was filtered through the syringe.

# 3 Results

## 3.1 Habitat descriptions

### 3.1.1 Karapiro Stream

The lower reaches of the Karapiro Stream are located along the northern property boundary for the site. The Karapiro Stream is a tributary stream that joins the Waikato River at Cambridge. At this location, the Karapiro Stream is soft-bottomed with substrate dominated by sand (80%) with gravel in riffle sections and some fine sediment deposition within the pools (Photo 1). The stream is c.5.5m wide and 0.2-0.6 m deep. Macrophytes comprised <5% of the stream channel and included Canadian pondweed (*Elodea canadensis*) and water pepper (*Persicaria hydropiper*). Large woody debris were present as was organic matter in the pools.

A Rapid Habitat Assessment (RHA) for the site scored the stream at 44 out of 100. Bank and riparian scores for the stream were particularly low with a high among of bankside erosion noted (30-40% of the stream bank). Riparian vegetation was protected by a narrow single wire fenced margin of 2-5 m and was limited to rank grass with some small crack willow (*Salix cinerea*) and patches of rautahi (*Carex geminata*). Hydraulic heterogeneity score was relatively high with several hydraulic components recorded including run and pool habitat, with the occasional riffle and backwater.

### 3.1.2 Gully Basin Wetland

The gully basin wetland is best described as a willow swamp forest with pukio (*Carex secta*) and water pepper dominating the understorey (Photo 2). The willows provides ample shade to the wetland beneath, and habitat features such as pukio root structures as well as large wood were present. The wetland water depth was 20-30 cm and although water quality parameters were not measured the water was relatively cool and was highly turbid with anoxic sediments present. The wetland and the Karapiro Stream were disconnected at the time of the site visit but appear to be frequently connected during high flow events.

### 3.1.3 Permanent Streams

Permanent tributary streams of the Karapiro Stream were present in several of the large gullies and were all located outside of the project footprint, within the compensation area. These small streams (<0.5m wide and <0.05m deep) were soft-bottomed, with bed substrates dominated by sand, although gravel was present in fast flowing riffles. In areas where stock had access, the streams were heavily pugged, and the stream channel was less defined (Photo 3). Most of these streams were unfenced and the riparian vegetation was limited to rank grass with the occasional willow. Macrophytes were present and included water pepper, watercress (*Nasturtium officinale*), starwort (*Callitriche stagnalis*), water celery (*Apium nodiflorum*) and *Glyceria declinata*.

### 3.1.4 Ephemeral streams

Ephemeral streams were present in gully A, B and E, within the project footprint. During the site visit in September 2023, the lowest section of the streambed in Gully A was dry. The stream in Gully B was flowing for a section but flow ceased at the wetland, with no connection to the Karapiro Stream. The stream in Gully E had a defined channel and much of the channel was dry, with damp sediments in places, there was no connection to the Karapiro Stream. These have conservatively been assessed as ephemeral streams, that is a stream '*that flow continuously for at least three months between March and September but do not flow all year*'.

*Photo 1: Karapiro Stream.*

*Photo 2: Gully basin wetland.*

*Photo 3: Ephemeral Stream in Gully E.*

*Photo 4: Permanent Stream in Gully F.*

## 3.2 Fish survey results

### 3.2.1 Karapiro Stream

The NIWA Freshwater Fish Database (FFDB)[3] holds several records for fish within the Karapiro Stream, one record from 2011 is within close proximity to the site and recorded a range of species including common smelt, shortfin eel, torrent fish (At Risk declining), gambusia and koi carp. Other species that have been recorded in the stream include longfin eel (At Risk declining), inanga (At Risk declining), rainbow trout, Cran's bully and kakahi (At Risk declining).

The eDNA sample collected as part of this assessment recorded the presence of eighteen species, five species with an At-Risk declining threat status, and seven introduced species. Cran's bully and koi carp have the highest detection rates with several koi carp observed during the assessment. Longfin and shortfin eels also had a high detection rate. The Karapiro supports a diverse assemblage of species that both reside in the stream and use the stream as a migration corridor.

### 3.2.2 Gully basin wetland

Three species of fish were captured in the gully basin wetland, inanga, introduced gambusia and two juvenile perch. Eels were also present, with eel slime present at the entrance to one of the set traps.

Although the Karapiro Stream and the gully basin wetland were disconnected during the site visit, the fish assemblage present and the poor water quality of the wetland indicate frequent connectivity.

### 3.2.3 Black mudfish

Black mudfish were not detected in the gully basin wetland and the connectivity and poor water quality mean that the wetland is unlikely to provide suitable habitat for this species. In terms of other habitats, the seepage wetlands and ephemeral streams are dry for most of the year and the floodplain wetlands have little to no standing water and high connectivity to the Karapiro Stream, these habitats are also considered unsuitable to support black mudfish.

*Table 1: Fish, kōura and kakahi recorded in the Karapiro Stream. Species highlighted light green have a threat status of 'At Risk-Declining' (Dunn et al. 2018) and species highlighted yellow are introduced.*

| | **Karapiro Stream** | | **Gully basin wetland** |
|---|---|---|---|
| **Species** | **Recorded from the FFDB** | **eDNA (average detections from 6 replicates)** | **Number (size range) of fish captured** |
| Longfin eel (*Anguilla 4dieffenbachi*) | y | 8,077 | |
| Īnanga (*Galaxias maculatus*) | y | 27 | 3 (82-101) |
| Torrentfish (*Cheimarrichthys fosteri*) | Y | 12 | |
| Giant kōkopu (*Galaxias argenteus*) | | 10 | |
| Kakahi (*Echyridella menziesii*) | y | 361 | |
| Shortfin eel (*Anguilla australis*) | Y | 1,272 | |
| Common bully (*Gobiomorphus cotidianus*) | Y | 581 | |
| Redfin bully (*Gobiomorphus huttoni*) | | 6 | |
| Cran's bully (*Gobiomorphus basalis*) | Y | 19,954 | |
| Common smelt (*Retropinna retropinna*) | Y | 88 | |
| Kōura (*Paranephrops planifrons*) | Y | 104 | |
| Gambusia (*Gambusia affinis*) | y | 22 | c.200 |

[3] https://nzffdms.niwa.co.nz/

| | | | |
|---|---|---|---|
| Koi carp (*Cyprinus rubrofuscus*) | y | 19,955 | |
| European perch (*Perca fluviatilis*) | | 235 | 2 |
| Rudd (*Scardinius erythrophthalmus*) | | 10 | |
| Goldfish (*Carassius auratus*) | | 79 | |
| Brown trout (*Salmo trutta*) | | 80 | |
| Rainbow trout (*Oncorhynchus mykiss*) | y | 28 | |

# 4 Potential effects on freshwater ecology

The Karapiro Stream supports a diverse range of fish species including several species with a threat status, has a **high** ecological value, and is culturally significant. The gully basin wetland supports inanga and has a **high** ecological value[4].

Although the Karapiro Stream and gully basin wetland are located outside of the project footprint, they are located within 10-15 m of the project footprint, and areas within the project footprint naturally drain toward these features. Activities associated with the ongoing operation of the proposed sand quarry have the potential to generate sediment, which, if unmitigated, could potentially enter the receiving environment. Elevated suspended and deposited sediments can smoother habitats and reduce the photosynthesis of benthic plants. Suspended sediments can also impact on aquatic biota by clogging the food filtering or trapping apparatus of stream insects as well as the gills of fish, reducing the feeding efficiency (particularly for visual predators).

To ensure there is no direct discharge of sediment-laden water from the quarry to the receiving environment, erosion, and sediment control practices in accordance with the Waikato Regional Council Guidelines will need to be implemented. Fulton Hogan has prepared an 'Erosion & Sediment Control Plan Processing Area and Site Establishment' which shows the location of key erosion and sediment control devices in this area, including a sediment retention pond, clean water diversions, perimeter and screening bunds and silt fences. In addition to this, a 10 m wide indigenous vegetation buffer between the project footprint and the Karapiro Stream gully is proposed as part of the mitigation revegetation package (Appendix A).

In terms of connectivity of the Karapiro Stream to ephemeral streams and wetlands, there is no connectivity with seepage wetlands or the ephemeral streams that are proposed to be impacted by the proposal. The ephemeral streams appear to be dry for much of the year and generally flow underground before reaching any discharge point with the Karapiro Stream. The gully basin wetland and the floodplain wetlands are connected to the stream during high-flow events and these areas will not be affected by this proposal, but rather enhanced as part of the compensation package.

## 4.1 Overall level of effect

Provided sediment and erosion controls are implemented successfully and considering the separation and the 10m wide indigenous vegetation buffer of the Karapiro Stream and gully basin wetland from the site, the magnitude of the effect is expected to be **low**. Resulting in a **low** overall level of effect.

Additionally, the proposed compensation package includes the retirement and restoration of >14 ha of land stretching over a 2 km length of the Karapiro Stream's true left bank. This substantial amount of restoration will result in a net gain in ecological value and functioning to the Karapiro Stream and associated floodplain and seepage wetlands.

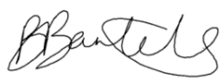
[4] Alliance Ecology. 2022. Newcombe Road Sand Quarry: Ecology Report. Prepared for RS Sands Ltd.

## 5 Summary

This letter has been prepared in response to a s92 request for further information regarding a resource consent application from RS Sand Ltd to operate a sand quarry on a rural property at 77 Newcombe Road, Cambridge. The applicant's reviewer requested information regarding the ecological values and potential effects on the Karapiro Stream and the presence of black mudfish. A summary of the results of that assessment is provided below:

- Visual assessments of the Karapiro Stream, gully basin wetland, and ephemeral and permanent streams on site were undertaken to describe the habitats. The Karapiro Stream and gully basin wetland had many structural elements and were considered to provide good habitat conditions, albeit degraded. The permanent streams were all outside of the project footprint and were not assessed further. The ephemeral streams were mostly dry at the time of the assessment and have conservatively been assessed as ephemeral.
- In terms of connectivity, ephemeral streams and seepage wetlands impacted by the proposal had no connectivity to the Karapiro Stream. The gully basin wetland and floodplain wetlands appear to be connected to the Karapiro Stream during high flow events (again these are not impacted as part of the proposal).
- The Karapiro Stream supports a diverse range of fish species including eighteen species, five of which have a threat status of At-Risk declining. The Karapiro Stream has a **high** ecological value and is culturally significant.
- The gully basin wetland supports inanga and has already been previously assessed as having **high** ecological value.
- Black mudfish were not detected in the gully basin wetland and the connectivity and poor water quality mean that the wetland is unlikely to provide suitable habitat for this species.
- Provided sediment and erosion controls are implemented successfully and considering the separation and the 10m wide indigenous vegetation buffer of the Karapiro Stream and gully basin wetland from the site, the magnitude of the effect is expected to be **low**. Resulting in a **low** overall level of effect.
- The compensation package includes the retirement and restoration of >14 ha of land stretching over a 2 km length of the Karapiro Stream's true left bank. This substantial amount of restoration will result in a net gain in ecological value and functioning to the Karapiro Stream, gully basin wetland and associated floodplain and seepage wetlands.

Yours sincerely



Brenda Bartels
Senior Ecologist
2 Awa Ecology

# Appendix G: Representative site photos

Photograph 1. Example of open pasture landscape (Alluvial terrace) with exotic-dominated forest in the background

Photograph 2: Example of open pasture landscape (Alluvial terrace) with exotic-dominated forest in the background (Alluvial terrace)

Photograph 3. Example of mixed native-exotic forest (Gully B) which is outside the footprint

Photograph 4. Example of exotic dominated forest Gully C (outside the project footprint)

Photograph 5. Example of exotic dominated forest Gully G (inside the project footprint)

Photograph 6. Largest native tree fern and cabbage tree patch within exotic dominated forest in Gully G (inside the project footprint)

Photograph 7. Example of exotic dominated forest Gully C (inside the project footprint) also showing ephemeral stream/overland flowpath/cattle track exiting the gully.

Photograph 8. Example of exotic dominated forest Gully F (inside the project footprint) also showing ephemeral stream/overland flowpath exiting the gully.

Photograph 9. Example of exotic plantation forest Gully G (inside the project footprint)

Photograph 10. Example of exotic plantation forest Gully G (lower trees are outside the project footprint) along with gully basin wetland which is outside the project footprint

Photograph 11. Example of Gully Basin Wetland under willow canopy

Photograph 12. Example of Gully Basin Wetland with native dominated understory (Carex Secta)

Photograph 13. Example of Gully Basin Wetland with native dominated understory (Carex Geminata)

Photograph 14. Example of exotic dominated scrub inside the fooptrint (Gully G)

Photograph 15. Example of exotic dominated scrub inside project footprint (Gully G)

Photograph 16. Example of exotic dominated scrub outside of project footprint and standing on ephemeral stream/overland flowpath at base of Gully (Gully G)

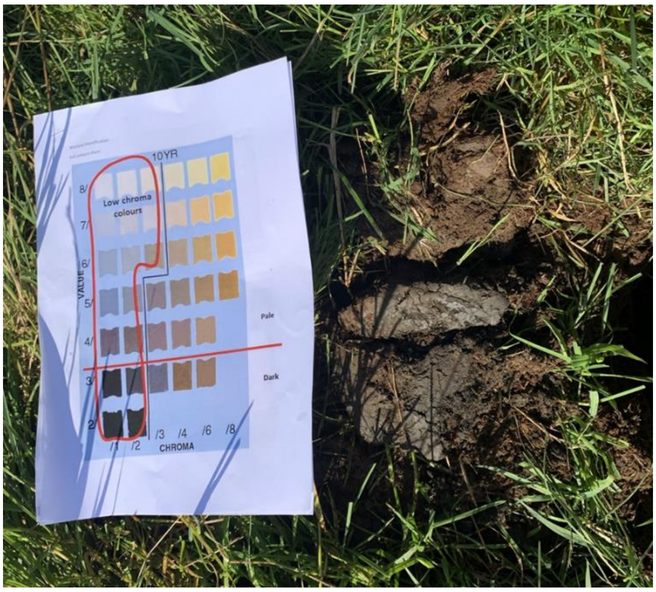
Photograph 17. Example of Gully Seepage Wetland (native Carex Geminata) within the Project footprint (Gully E)

Photograph 18. Example of floodplain wetland (native Carex Geminata) outside the Project footprint

Photograph 19. Example of non-wetland floodplain habitat outside of the footprint as determined through hydric soil testing (see below) and wetland plant classifications.


Photograph 20. Hydric soil testing (non-wetland soils).

Photograph 21. Example of wetland floodplain outside of the footprint as determined through hydric soil testing (see below) and wetland plant classifications.




Photograph 22. Hydric soil test indicating wetland soils based on colouration

Photograph 23. Hydric soil test indicating wetlands based on mottling