Boffa Miskell

Gleeson Quarries Huntly Limited – District and Regional Resource consents for new fill sites within quarry landholdings

Ecological Impact Assessment
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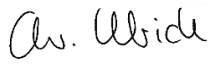
	Dr Tine Ulrich Ecologist Boffa Miskell Limited	
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Appendices

1.0 Executive Summary

Gleeson Quarries Huntly Limited seek resource consent for the use of four new fill areas within the Gleeson Quarries Huntly Ltd landholdings. Use of new fill areas is to be staged and will encompass disposal of quarry overburden material and important managed fill.

The purpose of this report is to outline the findings of an ecological assessment of the present terrestrial and freshwater ecological values within the four new proposed fill areas and the ecological context, to provide an assessment of the potential ecological effects of the proposed change in land-use and to present recommendations how to avoid, minimise, mitigate and/or compensate any potential adverse ecological effects. One major constraint of this report is it was done out of season for bat and avifauna surveys and as such recommends further work t finalise an assessment of ecological effects.

The Gleeson Huntly Quarry Site is located within the southern extend of Meremere Ecological District to the south of Huntly on the western bank of the Waikato River. Modified broadleaf-podocarp forest remnants are featured within and adjacent to the Site, one of which, outside the western boundary of the property, is identified as a Significant Natural Area. Several wetlands are present within the Site, which meet Waikato Regional Council RPS Section 11a criteria for ecological significance.

Within the footprint of the proposed new land-use, areas of gorse-dominated or native broadleaved early successional scrub, exotic forest/treeland, wetland vegetation and pasture grassland were identified. All these vegetation types were assessed as having low or low to negligible ecological value.

The proposed new fill areas provide a range of different habitats that may be utilised by a variety of native fauna species. This includes but is not limited to; herpetofauna species such as copper skink; Threatened or At Risk bird species utilising wetland or ungrazed grassland habitat features on the Site; the Threatened – Nationally Critical long-tailed bat likely utilising vegetation on the Site for commuting, foraging and/or roosting; and shortfin eels that have been observed in the three identified wetland areas.

The proposed change in land-use will result in the staged removal of:

- Large areas of gorse-dominated early successional scrub;
- Large areas of pasture grassland;
- A notable proportion of native broad-leaved early successional scrub including the occasional large native tree;
- Two small areas of exotic forest/treeland;
- 1,530 m^2 wetland habitat present on site;
- 525 m ephemeral waterway; and
- 90 m intermittent waterway.

The habitat loss outlined above will result in the loss of associated habitat for herpetofauna, bird, bat and freshwater fauna habitat.

Furthermore, the proposed activities have the potential to result in:

- Changes to hydrology of freshwater habitats downstream of the proposed new fill areas; and
- Sediment related discharges and stormwater discharge into downstream freshwater environments, and
- Direct impact on individual fauna, if present, due to earthwork/construction activity that could result in incidental disturbance, injury or killing.

The assessed potential level of ecological effects are summarised below:

Ecological feature	Assessed potential level of effect
Vegetation	Removal: Very low to low
Herpetofauna	Habitat loss: Low Injury/Mortality (without mitigation): Very High
Avifauna	Wetland habitat loss: Very High Remaining habitat loss: Low to very low Injury/Mortality (without mitigation): Very High
Bats	Habitat loss: - Moderate or very high, depending on presence of communal roost sites; - Very low if bats are confirmed **not to use** the Site Injury/Mortality (without mitigation): Very High
Freshwater	Habitat loss: Very low to low Erosion and sedimentation: Very low Stormwater discharge: Very low

The following summarises our recommendations to manage any potential adverse effects from the proposed change in land-use:

- Undertake avifauna and long-tailed bat surveys enabling a completed comprehensive assessment of effects that will facilitate determination of appropriate management;
- Preparation and implementation of a Fauna Management Plan which outlines strategies to avoid, minimise, remedy or mitigate any potential adverse effects on native fauna;
- Creating wetland habitat at a ratio of 1:1 to mitigate for the loss of 1530 m^2 total wetland area; and
- Implementation of an appropriate fill management as well as erosion and sediment control plan to avoid any discharge effects on downstream freshwater receiving environments.

2.0 Introduction

2.1 Background

Gleeson Quarries Huntly Limited (Gleeson Quarries, owned by Gleeson and Cox Ltd) seek resource consent for the disposal of quarry overburden material as well as imported, managed fill to four new fill areas within Gleeson Quarries Huntly Ltd landholdings. Managed fill will comprise construction and development material including material and soil containing asbestos, peat and less than 5% organic material.

2.2 Site Location

The Huntly Quarry Site is located of Riverview Road, approximately 3 Km South of Huntly. The Quarry has been operating since 1980. The existing overburden fill site is located to the south-west of the aggregate extraction area and has reached capacity. Gleeson Quarries are therefore seeking consents for the development of four additional overburden fill areas which will also be used for managed fill. The proposed fill areas are referred to as Fill Areas 2, 3, 4 and 5 (Appendix 1)[1].

The proposed fill areas are all located on landholdings to the north, north-east and north-west of the aggregate extraction area which is hereafter referred to as "the Site" (Appendix 1). The Site is located to the west of the Waikato River, on the other side of Riverview Road. The western boundary of the Site adjoins forested areas featuring stream tributaries to Lake Puketirini and Lake Waahi. The Site encompasses rolling hill pastureland interspersed with areas of pine forestry, some of which have recently been harvested. Patches of remnant native forest occur primarily around the boundaries of the Site.

Proposed fill areas 2, 4 and 5 occur in minor gullies while the proposed fill area 3 is located within a shallow basin which has previously been used for fill disposal[2].

2.3 Scope of this report

The purpose of this ecological report is to:

- Describe and assess the existing terrestrial and freshwater ecological values present within four areas identified as new fill areas (fill areas 2 – 5);
- Discuss the likely and potential effects on the ecological values for these proposed sites from the change in land-use; and
- Provide recommendations for appropriate measures to avoid/minimise/remediate/ mitigate and/or compensate any adverse effects from the proposed new land-use on the ecological values present within the proposed fill areas 2-5.

[1] The proposal initially included an additional potential fill site, referred to as Site 1, which has now been omitted from the proposal.

[2] Previous fill disposal related to tailings from the adjacent mine operation.

3.0 Methods

3.1 Desktop analysis

Existing information including available literature and aerial imagery for the area encompassing the proposed new fill areas were reviewed to inform the methods and approach to assessing the ecological values. Key sources that were reviewed included:

- Additional Fill Sites Scope of Works document (Paua Planning, 2019);
- Ecological values & Issues of the area associated with the Stevensons Huntly Quarry proposed expansions (Boffa Miskell Limited, 2001);
- Application for a Change of Resource Consent Conditions on Consent Number LUC0035/11 under Section 127 of the Resource Management Act, 1991 (Paua Planning, 2019);
- Aerial imagery outlining the proposed boundaries, design and contours for four new fill sites (fill areas 2-5; Paua Planning, 2019);
- Waikato District Council's operative and proposed district plans;
- Waikato Regional Council's (WRC) water classification maps;
- NZ Topo Map[3];
- Significant natural areas of the Waikato District: terrestrial and wetland ecosystems (van der Zwan & Kessels, 2017); and
- NIWA New Zealand Freshwater Fish Database (NZFFD).

3.2 Site ecological assessments

Field investigations including terrestrial and freshwater ecological surveys as well as ground-truthing for each proposed fill area were conducted from 25 to 29 June 2019.

Due to unavoidable project timeframes and a requirement for the report to be completed outside the season for appropriate fauna surveys, we were unable to undertake surveys for the presence of lizards, bats or breeding wetland birds and waterfowl. Instead we undertook qualitative habitat assessments with the presumption the fauna is present in the area. This has resulted in conservative ecological assessments and intensive management and mitigation measures to manage potential effects.

We recommend survey work for the aforementioned fauna groups is undertaken so the effects can be more accurately defined, and management applied.

3.2.1 Terrestrial vegetation

During the week of 26 – 29 June 2019 the watercourse flowing through each potential fill area was walked (where safe) and the vegetation assemblages described. A species list for the entire site was also compiled and is shown in Appendix 2.

[3] https://www.topomap.co.nz/

3.2.2 Herpetofauna

During the site walk over, the fill sites were assessed for lizard habitat value and any incidental lizard observations were noted. The survey included the assessment of habitat structure and availability as well as connectivity to potential habitat outside of the works footprint.

3.2.3 Bat Roost Assessments

The vegetation within the potential fill sites was also assessed for potential to provide roost habitat for long-tailed bats. Trees offering potential bat roost habitat are defined as being >15 cm diameter at breast height (DBH), and have one of more of the following features:

- Crack, crevices, cavities and/or fractured limbs large enough to support roosting bat(s);
- Sections of loose flaking bark large enough to support roosting bat(s);
- A hollow trunk, stem or branches;
- Deadwood in canopy or stem of sufficient size to support roost cavities or hollows; or
- Bat droppings, grease marks and/or urine staining around cavities.

3.2.4 Avifauna

During the site walk over a list of bird species seen and/or heard across the site was compiled and the value of the vegetation within the proposed fill sites was assessed for its potential to provide habitat for native birds. Value assessments included:

- The extent and diversity of the wetland and terrestrial vegetation communities present;
- The maturity of the vegetation assemblages; and
- Connectivity of the habitats to high quality habitats outside of the works extent.

3.2.5 Freshwater

Each proposed fill area was investigated at multiple locations or along the whole length of potential watercourses, depending on accessibility and safety. The presence or absence of flowing or pooled water was recorded along with information relating to channel dimensions, substrate, shade, vegetation, and fencing status. Wetland areas featuring permanent freshwater habitat with suitable water depth were assessed for water and sediment quality as well as macroinvertebrate and fish communities.

Stream habitat assessment

No perennial stream reaches were observed; however, areas featuring intermittent stream reaches were present. These were assessed at a more in-depth level for the presence and ecological value of freshwater habitat[4]. In addition, rapid stream habitat and condition assessments were completed. This assessment method is based on the Waikato Regional

[4] Assessment criteria included wetted width, water depth, water flow type, substrate composition, bank stability and material (where appropriate) as well as riparian zone characteristics.

Council Ecological Monitoring of Streams methods (REMS), adjusted to the specific survey conditions[5] (Appendix 3).

Wetland habitat assessment

Wetland areas were assessed for wetland condition following monitoring frameworks modified from the Coordinated Monitoring of New Zealand Wetlands guidelines (Clarkson et al., 2004, Appendix 4). Specifically, the following wetland parameters were evaluated:

- Hydrological integrity;
- Physicochemical parameters;
- Ecosystem intactness;
- Browsing and predation regimes; and
- Dominance of native plants.

Water and sediment quality

Water quality spot measurements encompassing dissolved oxygen, temperature, pH and specific conductivity were collected from areas featuring permanent freshwater habitat using an YSI ProPlus handheld multiparameter meter. In addition, water and sediment grab samples were collected, chilled and delivered to Hill Laboratories for analysis. Water samples were analysed for heavy metals (arsenic, cadmium, chromium, copper, nickel, lead and zinc), aluminium, iron, turbidity, total suspended solids and nutrients (nitrogen, nitrite, nitrate, and phosphorus). Sediment samples were analysed for heavy metals, iron and nutrients.

Macroinvertebrate communities

Macroinvertebrate samples were collected using kick-net (0.5 mm mesh) sampling following Protocol C2 as outlined within current best practise guidelines (Stark, Boothroyd, Harding, Maxted, & Scarsbrook, 2001). Samples were preserved in ethanol and analysed by a taxonomist according to Protocol P1 for coded abundance. Species richness and EPT taxa richness[6] were calculated for all samples.

Fish communities

Fish surveys were undertaken using un-baited fyke nets and Gee's minnow traps following guidelines from (Joy, David, & Lake, 2013), as well as utilising hand-netting were feasible. Nets and traps were deployed within suitable habitat for three consecutive nights from 26 June 2019. They were checked every morning and any fish caught were identified, measured and released where captured.

Stream classification

The Waikato Regional Plan offers a limited definition of ephemeral waterways and does not include intermittent waterways. Therefore, for the purpose of this freshwater ecological

[5] REMS includes the assessment of macrophytes and periphyton (if applicable), physical stream characteristics as well as qualitative habitat assessments utilising a habitat condition scoring system. Nine habitat parameters are scored from 0 (poor) to 20 (optimal), which is subsequently utilised to characterise the overall ecological condition of the area as either 'poor', 'marginal', 'suboptimal' or 'optimal'.

[6] EPT taxa are three macroinvertebrate taxa with an elevated sensitivity towards nutrient enriched, polluted waterways and include ephemeroptera (mayflies), plecoptera (stoneflies) and trichoptera (caddisflies).

assessment, ephemeral, intermittent and perennial streams were defined utilising the definitions provided within the Auckland Unitary Plan (Auckland Council, 2018) as outlined below:

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

Intermittent stream: Stream reaches that cease to flow for periods of the year because the bed is periodically above the water table. This category is defined by those stream reaches that do not meet the definition of permanent river or stream and meet at least three of the following criteria:
(a) it has natural pools;
(b) it has a well-defined channel, such that the bed and banks can be distinguished;
(c) it contains surface water more than 48 hours after a rain event which results in stream flow;
(d) rooted terrestrial vegetation is not established across the entire cross-sectional width of the channel;
(e) organic debris resulting from flood can be seen on the floodplain; or
(f) there is evidence of substrate sorting process, including scour and deposition.

Permanent river or stream: The continually flowing reaches of any river or stream.

Wetland definition

For the purpose of this freshwater ecological assessment, freshwater systems were defined as wetlands following the definition provided within the Waikato Regional Plan and the New Zealand Resource Management Act (1991) as follows:

Wetland: Includes permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions.

Furthermore, under the Waikato Regional Plan Rule 3.7.4.7, drainage of wetlands representing "significant habitat of indigenous fauna is considered a "discretionary activity" which requires resource consent.

3.3 Assessment of ecological values and level of ecological effects

The assessment of the level of effect on ecological values associated with the proposed new fill sites follows the Environmental Institute of Australia and New Zealand (EIANZ) Impact Assessment Guidelines (Roper-Lindsay, Fuller, Hooson, Sanders, & Ussher, 2018). This method involves the evaluation of the ecosystem/habitat values (Table 1) and species ecological values (Table 2) in combination with an assessment of the magnitude of effects (Table 3), which allows the assignment of an overall level of effect using the decision matrix presented in Table 4.

3.3.1 Assigning ecological value to vegetation, habitats and species

For vegetation and terrestrial as well as freshwater habitats, we have assigned ecological value based on the matters outlined in Table 1 and Table 2 (from Roper-Lindsay et al. (2018)).

Table 1. Guidelines for assessing ecological value to ecosystems/habitats (adapted from Roper-Lindsay et al. (2018)).

Matter	Assessment considerations
Representativeness	Extent to which area is typical or characteristic Size
Rarity/distinctiveness	Amount of habitat or vegetation remaining Supporting nationally or locally threatened, at risk or uncommon species Regional or national distribution limits Endemism Distinctive ecological features Natural rarity
Diversity and pattern	Level of natural diversity Biodiversity reflecting underlying diversity
Ecological context	Contribution to network, buffer, linkage, pathways Role in ecosystem functioning Important fauna habitat Contribution to ecosystem services

Table 2. Guidelines for assigning ecological value to species (adapted from Roper-Lindsay et al. (2018)).

Threat category	Assigned Value
Threatened – Nationally Critical, Endangered or Vulnerable	Very High
Nationally At Risk – Declining	High
Nationally At Risk – Recovering, Relict or Naturally Uncommon	Moderate
Locally (ED) uncommon or distinctive species	Moderate
Nationally and locally common indigenous species	Low
Exotic species, including pests, species having recreational value	Negligible

3.3.2 Assessing magnitude of effect

Once ecological values have been determined, the magnitude of the effect on ecological values was assessed. The magnitude of the effect is a measure of the extent, or scale, of the effect, its duration, and the degree of change that it will cause. A typical scale of magnitude ranges from very high to negligible, as shown in Table 3.

Table 3: Criteria for describing magnitude of effect (adapted from Roper-Lindsay et al. (2018)).

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

3.3.3 Assessing level of ecological effect

The overall level of the effect was determined by applying the following matrix (Table 4), which combined the ecological value of the site or species (Table 1 and Table 2) and the magnitude of effect (Table 3).

Table 4: Criteria for describing overall level of effect (adapted from Roper-Lindsay et al. (2018)).

		ECOLOGICAL VALUE				
		Very High	**High**	**Moderate**	**Low**	**Negligible**
MAGNITUDE	**Very High**	Very High	Very High	High	Moderate	Low
	High	Very High	Very High	Moderate	Low	Very Low
	Moderate	High	High	Moderate	Low	Very Low
	Low	Moderate	Low	Low	Very Low	Very Low
	Negligible	Low	Very Low	Very Low	Very Low	Very Low
	Positive	Net gain	Net gain	Net gain	Net gain	Net gain

4.0 Results

4.1 Terrestrial Ecology

4.1.1 Site context

The property is located within Meremere Ecological District (ED), close to the southwestern boundary of the district which borders the Raglan ED to the west and the Hamilton ED to the south.

The Meremere ED encompasses a large basin surrounding the Waikato River, containing alluvial flats and a series of lakes and wetlands, notably the Whangamarino Swamp to the north. The ED has been extensively modified by agricultural land uses as well as open cast coal mining and aggregate extraction. The property encompasses a complex of small valleys in rolling to broken hill country.

Historically, rimu-tawa forest dominated the hill country, remnants of which extend south across the Hakarimata Scenic Reserve (van der Zwan & Kessels, 2017).

Modified broadleaf-podocarp forest remnants occur within and adjacent to the property (Appendix 1). One such remnant occurs along the western boundary of the Site and is classified as a Significant Natural Area (SNA) in the proposed Waikato District Plan, of local significance based on criteria in Table 11-1 of the Waikato Regional Policy Statement. Elsewhere, the property contains patches of exotic forest, gorse/broom scrub, regenerating indigenous forest and scrub patches, and exotic grassland (as broadly mapped in Landcare's LCDB v3.3 database).

4.1.2 Vegetation

Overview

Proposed fill areas are described in the following section. Note that one of the sites assessed as part of site investigations ('Fill Area 1') has been excluded from consideration and is not described, however numbering of proposed fill areas has been retained for the sake of consistency with other assessments.

Fill Area 2

Fill Area 2 is 3.8 ha and is situated in a relatively shallow gully basin. A single watercourse flows along the base of the gully. This fill area was previously planted in pines which were clear-felled in mid-2015. With the exception of a thin riparian strip at the base of the gully, exotic scrub (gorse, pampas, woolly nightshade and inkweed) cover the site. The riparian margin comprises 3 – 5 m tall broadleaved scrub including māhoe, pigeonwood, wineberry, kawakawa, hangehange, red matipo, koromiko, and pate, with a few larger nikau, māhoe, tawa and pukatea. Two very large, old pines occur on the upper slopes of the fill area footprint, and a stand of tanekaha occurs outside of the fill area footprint.

A small patch of wetland and open water is situated approximately two thirds up the gully (Figure 1). Forestry tracks abut the wetland immediately upstream and downstream and have probably modified its size and depth. Vegetation is a mosaic of native and exotic sedges and

herbs, including *Carex virgata*, common water milfoil, water pepper, *Gahnia xanthocarpa*, soft rush, buttercup, spearwort, kikuyu and various other herbaceous weeds and grasses.

Figure 1: View of wetland located in Fill Area 2 from the true left bank.

Figure 2: View across the Fill Area 2 gully bottom from the mid slope of the true right bank. Note the native broadleaf scrub in the gully bottom and the gorse-covered upper slopes.

Figure 3: View upstream from under the native scrub canopy in the gully bottom of Fill Area 2. Scrub dominated by māhoe and ponga.

Figure 4: View downstream from the true right bank. One of the more mature pukatea trees is visible in the centre of the photo. The native forest edge in the background delimits the boundary of the site.

Fill Area 3

Fill Area 3 covers 4.2 ha within a grazed paddock, a large part of which appears to be relatively regularly inundated. A wetland surrounding an area of shallow open water is located near the middle of the fill area.

Edgar's rush (a native rush species) dominates much the flat paddock, interspersed with patches of rank grass (evidently not recently grazed, but extensively pugged). Wetland vegetation comprises *Isolepis prolifera* and Edgar's rush swards surrounding the area of open water. This vegetation is likely to have invaded the pasture following attempts to convert the area to grazing land, and does not appear to be a remnant of an original wetland feature. Rank kikuyu grass interspersed with gorse cover the surrounding slopes.

Figure 5: View of the wetland located near the centre of Fill Area 3 surrounded by rank grass and Edgar's rush. Note rank grass and gorse on the dry slopes.

Figure 6: Area of wet paddock to the west of the Fill Area 3 wetland. Flora assemblage includes Edgar's rush, rank grass and a number of other herbaceous exotics including spearwort.

Figure 7: View of the Fill Area 3 wetland.

Fill Area 4

Fill Area 4 covers 5.1 ha and comprises a shallow basin with two watercourse branches in the upper reaches that converge to form a single main stem. As with Fill Area 2, most of Fill Area 4 was previously planted in pines that were harvested in 2016. The riparian margin of the middle reach of approximately 20 m in width along each bank has been planted in redwoods which have not been harvested.

A small wetland is located in the downstream section of the middle reach, and appears to have been artificially induced through the bunding of the watercourse to create a forestry track. Mature *Carex secta* grades into a thin strip of native scrub vegetation including mamaku, ponga, wheki ponga, kawakawa, and mahoe which is bounded by the planted redwoods. A few mature native trees are interspersed through the redwoods, including pukatea, tawa and rimu (with epiphytes including kiekie and *Astelia*).

Downstream of the wetland, low native and exotic scrub has regenerated following pine harvest. Gorse, Chinese privet, woolly nightshade and pampas dominate the middle and upper slopes, with patches of rank kikuyu grass. The watercourse margin contains native wetland species including giant umbrella sedge, *Carex secta*, *Carex virgata*, and *Carex maorica*. Other wet tolerant species include kiekie and kiokio in addition to a mix of native broadleaved shrubs.

The downstream reach flows into a small area of mature native forest with remnant pines occurring on the upper slope.

Recent native and exotic scrub typical of a recently clear-felled area dominates slopes in the upper reaches of Fill Area 4, above the redwoods. Small stands of mature secondary native forest including rimu, pigeonwood, māhoe, and kanuka are also present on the upper slopes.

Figure 8: View downstream of the lower reach of Fill Area 4 from the forestry track. Recent regenerating scrub typical of post clear-fell harvest.

Figure 9: View facing upstream in Fill Area 4 towards the forestry track.

Figure 10: View upstream of the middle reach of Fill Area 4 including the wetland bordered by exotic redwood trees.

Figure 11: View downstream in the middle reach of Fill Area 4. Regeneration under the redwoods is limited but native regeneration is apparent along the stream corridor.

Figure 12: View upstream of the true left branch of the upper reach of Fill Area 4. Recent native regeneration on lower slope with gorse upslope. Note the stand of mature native trees including rimu on the true left bank.

Figure 13: View downstream of the true right branch of the upper reach of Fill Area 4. Single semi-mature rimu in the centre of the image, surrounded by gorse which dominates the reach.

Fill Area 5

Fill Area 5 covers 2.5 ha, in a more incised gully than the other three fill areas. Much of the fill area either comprises a recently cutover pine harvest site, or retired pasture.

The upper extent of this fill area does not contain a watercourse, but has an overland flow path through rank grassland which becomes more channelised below the quarry/forestry track. The head of the gully has been fenced and contains dense native scrub (3-6 m tall). The dominant species include māhoe, hangehange, kawakawa, pate, ponga, mamaku, and occasional karaka. Exotic species including gorse, pampas, Himalayan honeysuckle, beggar's ticks, inkweed and banana passionfruit are also present.

Mature pine trees with a subcanopy of native scrub covers the land below the toe of the fill site, where the sediment retention pond will be located.

Figure 14: View downstream of Fill Site 5 from the true right bank. The pine trees approximately delimit the toe of the fill area.

Figure 15: View upstream of Fill Area 5 from the true right bank. Dense native regeneration is apparent in the fenced area with gorse covering the upper slopes.

Figure 16: View upstream from the gully floor. Dense native regeneration with the occasional weed species such as gorse and banana passionfruit.

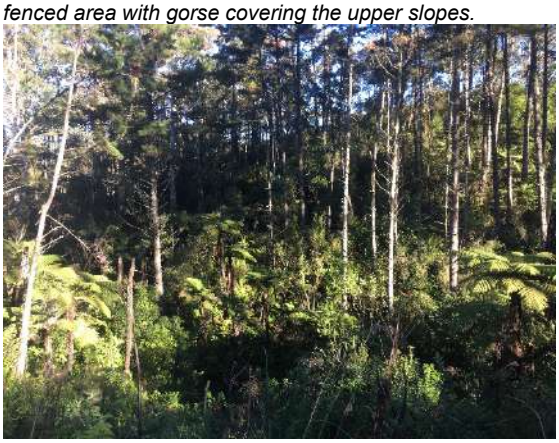


Figure 17: View from the true left bank across the gully bottom in the lower reach of Fill Area 5, into mature pines where the proposed sediment retention pond will be located.

Vegetation classifications

Vegetation types within the footprint of each proposed fill area are summarised below.

Table 5: Vegetation types present in each proposed fill area.

Fill Area	Vegetation types present
Fill Area 2	• Gorse-dominated scrub • Native broadleaved scrub • Wetland vegetation • Secondary podocarp-broadleaf forest (outside of footprint)
Fill Area 3	• Pasture/grassland • Gorse-dominated scrub • Wetland vegetation
Fill Area 4	• Gorse-dominated scrub • Exotic forest/treeland (a stand of redwood trees) • Pasture/grassland • Native broadleaved scrub • Wetland vegetation • Secondary podocarp-broadleaf forest (outside of footprint)
Fill Area 5	• Pasture/grassland • Gorse-dominated scrub • Native broadleaved scrub • Exotic forest/treeland

4.1.3 Herpetofauna (lizards)

Herpetofauna species

The initial survey and desktop assessment identified that there is potential for native lizards and frogs to be found within the intended works footprint. Native lizard species include both ground-based and arboreal lizards. Table 6 shows the native herpetofauna species likely to be found within the wider Huntly area, and includes habitat type and likelihood of being found within the project footprint.

The introduced plague skink *Lampropholis delicata* was observed in various locations throughout the Site. The plague skink is an unwanted organism under the Biosecurity Act 1993.

Table 6. Native herpetofauna species potentially found within the wider Huntly area.

Species	Common name	Threat classification	Habitat type	Likelihood of presence within footprint[7]
Oligosoma ornatum	Ornate skink	At Risk - Declining	Forests, shrublands and grasslands where there is plenty of ground refugia	Possible
O. aeneum	Copper skink	Not Threatened	Grassland, dense scrubland, forests	Likely
O. striatum	Striped skink	At Risk - Declining	Lowland podocarp forest and rank pasture with pampas	Possible
O. infrapunctatum "crenulate"	Crenulate skink	At Risk - Relict	Dense open grassland, scrub shrublands and bracken fields as well as forest edges	Possible
Dactylocnemis pacificus	Pacific gecko	At Risk - Relict	Coastal and lowland forest	Possible
Mokopirirakau granulatus	Forest gecko	At Risk - Declining	Broadleaved podocarp forest, seral scrublands	Possible
Naultinus elegans	Elegant gecko	At Risk - Declining	Seral scrubland – kanuka stands, podocarp forest	Possible
Leiopelma hochstetteri	Hochstetter's Frog	At Risk - Declining	Forested rocky stream / tributary margins	Unlikely – habitat in poor condition and no records within 20km of site.

[7] Note no survey has been carried out and this assessment is based on habitat available, quality of this habitat, and presence of species in the surrounding area.

Herpetofauna habitat

Fill Area 2

Remnant broadleaved forest on the riparian margins of this site offers potential habitat for striped, forest and elegant gecko.

Fill Area 3

It is unlikely that any native lizards will be present in Fill Area 3, due to the damp nature of the grazed paddock. There is also very little scrub, and the frequency of grazing suggests there is inconsistency in retreat site availability for ground dwelling lizards.

Fill Area 4

This Fill Area has potential habitat for copper, ornate and crenulate skink. The available habitat here includes suitable retreat sites (such as *Carex spp.*) for ground based native lizards. Although the regenerating scrub provides some connectivity to the native forest remnant outside the footprint, there is a low likelihood of native lizards being found at this site due to the site's history of clearance and modification.

This area has a small rocky tributary that could have been suitable habitat for Hochstetter's frog, however it is fragmented from other tributaries in the area and has been degraded through forestry activities. This reach was opportunistically searched using a flash light and no frogs were observed.

Fill Area 5

This site offers a low-quality habitat for any native lizards. Although there is some retreat site availability, the connectivity between other habitats is low. It is unlikely there would be any species of lizard present here.

This area has a small rocky tributary that could have been suitable habitat for Hochstetter's frog, however it is fragmented from other tributaries in the area and has been disturbed through forestry activities. This reach was opportunistically searched using a flash light and no frogs were observed.

4.1.4 Avifauna (birds)

Avifauna species

During the site assessments 24 bird species were seen and/or heard across the site (Appendix 5). Both native and introduced species were common with 13 native and 11 introduced species being observed respectively.

The assemblage is typical of agricultural habitats areas with introduced species such as finches and magpies dominating observations. The majority of native species observed are common and widespread such as silvereyes and fantails.

Two native species classified as “At Risk” were also observed. A New Zealand pipit was seen in the retired pasture at Fill Area 3 while a Pied Shag was observed flying overhead near Fill Area 2.

NZ pipit occupy open habitats including agricultural areas, and nest in long grass. Hence, large parts of the property outside the proposed fill sites could provide nesting habitat for NZ pipits.

Pied shag generally nest along coastal cliffs but there is a breeding colony on the nearby Hakanoa Lake (approximately 4 km to the northeast). The limited freshwater habitats within the site indicate that pied shags are unlikely to be resident but disperse across the site when moving between the complex of freshwater lakes to the north.

In addition to the species of birds identified during the fieldwork, other ‘Threatened’ or ‘At Risk’ species that have been previously recorded in the Meremere Ecological District, and which may use habitats available on the site, include various wetland-associated birds such as fernbird, spotless crake, marsh crake and pāteke, and New Zealand dabchick. However, wetland features present are generally small and lack good quality cover for nesting or refuge.

Karearea (native falcon – ‘At Risk’) has also been recorded in the Hakarimata Scenic Reserve, located 2 km to the south.

Avifauna habitat

The vegetation types on site provide habitats of varying type and quality for common native birds as well as ‘Threatened’ and ‘At Risk’ species including New Zealand pipit, New Zealand falcon, and various wetland birds and waterfowl.

All proposed fill sites contain areas of gorse-dominated scrub. Gorse provides dense cover for birds that spend time close to the ground, but it does not provide diversity in terms of food resources or complex habitat over multiple structural tiers.

Silvereye, fantail, and kingfisher were commonly observed amongst the gorse, and fernbird (‘At Risk – Declining’) may use this habitat (though it is not particularly favoured). No fernbird were observed during the field surveys but they are less conspicuous during winter.

Fill Sites 2, 4 and 5 contain areas of native broadleaved scrub, which contains a variety of food resources, good cover and some habitat complexity. However, the habitat patches present within the fill sites are small, often not measuring more than 10 m in width, and are common elsewhere in the surrounding landscape. The landscape-wide mosaic of scrub patches provide habitat for common native birds, but individual patches within the fill sites are unlikely to be of particular value. Nor are these features likely to provide important habitat for any ‘Threatened’ or ‘At Risk’ species known to occur within the site or Ecological District.

Fill sites 4 and 5 contain stands of Secondary broadleaf-podocarp forest

The secondary native forest patches have diverse species assemblages and habitat structure and are larger in extent (compared to the early successional patches associated with the watercourses). The mature native vegetation within these patches are limited across the Ecological District and provide preferred habitat for the 'At Risk – Recovering' New Zealand Falcon as well as more common native species like kereru. New Zealand Falcon were not observed during the site visit but are known to be present in the wider landscape.

With the exception of the stand of redwoods in Fill Area 4, the exotic forest/ treeland patches in and adjacent to proposed fill sites have a regenerating native understorey and thus a complex habitat structure including a mature canopy, which is favoured by native forest birds. If New Zealand falcon are present in the wider landscape, they likely use the vantage points the mature pines provide amongst the matrix of scrubland (where passerines are prolific) for foraging.

Wetlands and open water bodies are present within proposed Fill Sites 2, 3 and 4. These features are small and have all been impacted by human modification or disturbance. Nevertheless, these wetlands may be occasionally used by 'Threatened' or 'At Risk' wetland species that traverse around the mosaic of wetland habitat in the wider landscape, including fernbird, spotless crake, marsh crake, pāteke, and New Zealand dabchick. In particular, features with open water bodies are attractive to dabchick, pateke, grey duck and bittern.

All proposed fill sites contain areas of rank pasture. Exotic grassland has limited habitat value for most native birds. However, 'At Risk' New Zealand pipit nest in ungrazed grassland. A New Zealand pipit was observed and therefore may be nesting in the pasture/grassland on site.

4.1.5 Bats

A review of the national bat database administered by the Department of Conservation shows long-tailed bats have been recorded 10 km to the south of the site along the margin of the Hakarimata Scenic Reserve (detected 2009) and the Komakorau Stream (detected 1999) approximately 10 km to the southeast.

Long-tailed bats are opportunistic and inhabit a broad range of habitats including exotic forest and secondary forest, both of which contain mature trees that provide preferred habitat. Site proximity to the Waikato River, secondary forest patches and areas of mature pine indicate potential for bats to be present.

Potential roost trees were identified in Fill Area 2 (in the old growth pines), Fill Areas 4 and 5 - in the exotic plantings, and individual mature native trees in native scrub in Fill Area 4.

Long-tailed bats preferentially use linear features such as vegetation edges and waterways for foraging and dispersal such as the mature pines along the eastern boundary of the site and the secondary native remnants along the western and northern boundaries. Large exotic and native trees within these areas may provide bat roosting habitat, but suitable habitat features are generally limited except for the old growth pines in Fill Area 2.

Bats may also use the site's wetland areas for foraging, but they are unlikely to be important habitats given the proximity of the site to the Waikato River and the large freshwater lakes such as Lake Waahi to the north.

4.2 Freshwater Ecology

At the time of the site surveys, weather conditions were dry and clear with little wind. Moderate rainfall of approximately 14 mm had occurred in the 24 hours preceding the first day of the site surveys (Figure 18).

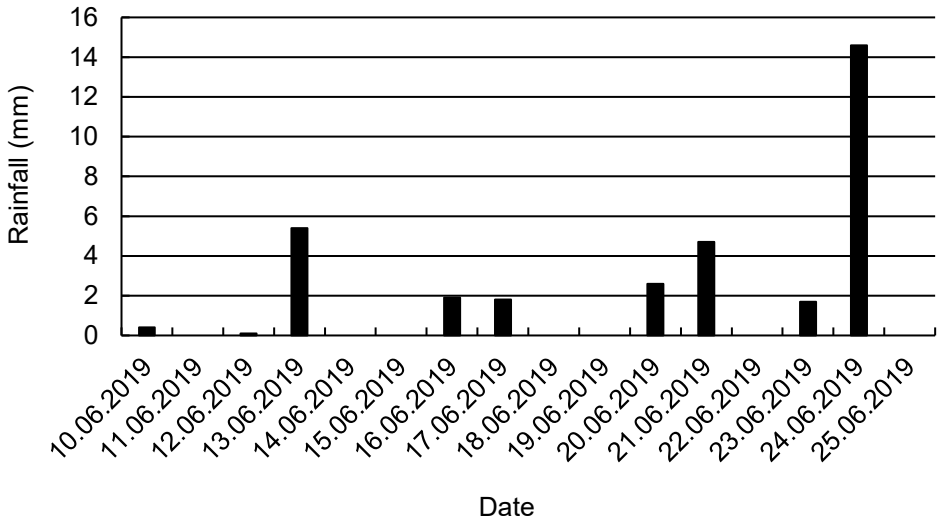


Figure 18. Daily Rainfall in mm during the two weeks prior to the site surveys. Rainfall data obtained from the nearest NIWA cliflo weather station in Ruakura, Hamilton and downloaded from https://cliflo.niwa.co.nz/.

The proposed new fill areas are part of two catchments. Fill area 2 are part of the Lake Waahi and Lake Puketirini catchment, while fill areas 3, 4 and 5 are part of the Waikato River Catchment. Both catchments are located within the Lower Waikato Catchment Zone[8]. Appendix 1 provides an overview of the watercourses observed throughout all five sites including ephemeral and intermittent watercourses, and permanent wetland habitat.

Geological features across the quarry were dominated by clay soils at moderate gradients. Consequently, wetland habitat is located at the base of gullies.

No permanent streams were observed across any of the five sites. Aside from fencing along the quarry landholdings' boundary, none of the watercourses or wetlands observed across fill areas 2 - 4 have been fenced, and no animal pest control measures are in place across the Site. Reaches of intermittent watercourses within the quarry boundaries were limited, with little water depth and flow. Wetland areas were observed within fill area 2, 3 and 4.

4.2.1 Fill Area 2

Fill area 2 has a sub-catchment area of approximately 7 ha and represents a single gully system. The upper slopes of the gully did not feature any watercourse channels or flowing water at the time of the site visit; however, overland flow paths are likely during rain events. Approximately one third downstream into the gully is a permanent palustrine wetland with an area of approximately 450 m^2 (Appendix 1, Figure 19).

[8] https://www.waikatoregion.govt.nz/Services/Regional-services/River-and-catchment-management/catchment-management-zone-map/

Figure 19. Wetland within fill area 2.

Aquatic habitat features within the wetland are predominantly from macrophytes such as *Carex virgat*a, common water milfoil, water pepper, *Gahnia xanthocarpa* and exotic species including soft rush, buttercup, spearwort, kikuyu and various other herbaceous weeds and grasses, as well as woody debris from previous forestry harvest within the catchment.

The main current anthropogenic impacts on this wetland habitat include:

- Impacted hydrological integrity due to bunding;
- Reduced ecosystem intactness due to wetland loss and limited connectivity to downstream habitat; and
- Reduced presence of native plants (Appendix 6).

Immediately below the forestry track at the downstream extent of the wetland is a reach of moderate gradient lacking any instream habitat. Further downstream, an overgrown ephemeral watercourse of approximately 160 m in length was observed without any defined channel and

minimal surface water (of about 2 cm depth) found only in a few areas (Appendix 1, Figure 20). These features are likely a barrier to upstream migration for most native fish species.

Figure 20. Overgrown ephemeral watercourse downstream of the wetland area within fill area 2.

A small channelised intermittent watercourse 13 m in length, was detected immediately upstream of the boundary. The watercourse had approximately 4 cm water depth and a channel width of 30 cm (Appendix 1).

4.2.2 Fill Area 3

Fill area 3 has a sub-catchment area of approximately 5.9 ha. The area has previously been used as a fill site. Subsequently, the site is utilised for grazing with a small amount of pine forestry that has been harvested. The area has been used for cattle grazing as evident in extensive old soil pugging damage; however, the length of grass indicates that the area has not been grazed recently.

Low hill slopes encompass a shallow, open basin that features an unshaded, permanent palustrine wetland area of approximately 700 m^2 in size within the centre of the basin (Appendix 1, Figure 21). Aquatic habitat features are predominantly macrophytes along the edges and within a small island at the centre of the wetland, including *Isolepis prolifera*, Edgars rush, soft rush and water pepper, while additional riparian vegetation other than pasture grasses was absent. The slopes surrounding the paddock are covered rank kikuyu grass interspersed with a small amount of gorse.

Figure 21. Wetland area within fill area 3.

The main modifications observed within this wetland habitat include:

- Reduced ecosystem intactness due to limited connectivity to downstream habitat;
- Evidence of previous stock damage; and
- Reduced presence of native plants (Appendix 6).

An unshaded, ephemeral watercourse of approximately 145 m long, was identified downstream of the wetland extent toward the northern property boundary. The ephemeral watercourse was diffuse and had very limited waterflow over muddy/clay substrate. Pasture grass was present throughout the watercourse. This is a barrier to any upstream migration for most native fish species. A more defined, unshaded ephemeral channel lacking any riparian vegetation besides pasture grasses was observed beyond the boundary connecting to ponded areas within the northern landholding (Figure 22).

Figure 22. Ephemeral watercourse beyond the quarry boundary.

4.2.3 Fill Area 4

Fill area 4 has a sub-catchment area of approximately 11 ha. It features a branched gully system at the southern, upstream end of the fill area. Both gully branches featured overgrown tree slash from previous forestry harvesting.

No evidence of a waterway was observed within the eastern branch; however, the branch will likely contain overland flow paths during rain events. The western branch featured an overgrown ephemeral watercourse of approximately 50 m in length with no defined stream channel. The watercourse contained wet and muddy substrate and isolated areas of standing water between 2 and 15 cm deep (Figure 23, Appendix 1).The substrate appeared anoxic in some areas. Riparian vegetation included *Carex secta*, inkweed, *Galium palustre*, kikuyu grass, soft rush (*Juncus effusus*), gorse, blackberry, woolly nightshade, Chinese privet, black nightshade, kawakawa, juvenile silver fern, rimu, mahoe, akeake, and kanuka.

Figure 23. Ephemeral watercourse within western gully branch at the upstream reach of fill area 4.

At the convergence of the two gully branches is a forestry track and stacked tree slash. A small forest stream, approximately 40 m long, was observed downstream of the slash (Figure 24).

Figure 24. Stacked tree slash upstream of the intermittent forest stream.

The forest stream was classified as intermittent, as it features a well-defined channel with small, natural pools and surface water more than 48 hours after a previous rain event resulting in stream flow, while no rooted terrestrial vegetation was established across the channel (Section 2.2.5). However, the limited water depth observed during the site surveys 24 to 72 hours after previous rainfall indicate that this stream flow will cease during dry periods .

The stream has a vegetated riparian area of approximately 20 m width on both stream banks providing a high level of stream shading (Figure 25). Riparian vegetation was predominantly comprised of native species such as mamaku, ponga, kawakawa and mahoe gradually leading into planted redwood stands at either side.

Stream banks were mostly stable along the assessed stream reach with no signs of erosion. Organic instream features such as woody debris and leaf litter were present. Iron floc was prevalent at the upstream extent of the stream, and an associated sheen was observed on water surface throughout the whole watercourse within fill area 4.

Stream substrate was dominated by silt and mud, with localised bedrock also found in some sections, often with an organic overlay of leaf litter and/or woody debris. No aquatic macrophytes were observed. Some periphyton was present with up to 50% substrate covered by green algae film of less than 3 mm thickness within the downstream section of the stream. Similarly, up to 30% substrate coverage by light brown algae film of less than 3 mm thickness was observed within the upstream section of the intermittent stream reach.

The stream had an average wetted width of 1.2 m and featured mostly pooled slow-flowing sections connected by small runs and riffles (Figure 26). Average water depth ranged from 7 cm to 25 cm, with a maximum water depth of 45 cm within a pool.

Figure 25. Highly shaded intermittent forest stream reach within fill area 4.

Figure 26. Intermittent stream habitat with localised bedrock, and small pools connected by riffles and runs.

The overall qualitative habitat score for the assessed stream reach was 110 out of a possible 180 using the REMS qualitative habitat assessment protocol (Table 7). The reach was assessed as optimal in the context of bank stability and channel alteration, and suboptimal in terms of riparian vegetation zone width, vegetative bank protection, channel sinuosity and abundance as well as diversity of aquatic habitat. Marginal parameters included the presence of sediment deposition and visible periphyton while poor pool variability was observed.

Table 7. Rapid qualitative assessment results for the intermittent stream reach within area 4.

Habitat parameter	Stream reach condition	Justification
Riparian vegetation zone width	Suboptimal	Riparian vegetation zone not very dense.
Vegetative protection	Suboptimal	No continuous bank surface coverage.
Bank stability	Optimal	No evidence of erosion.
Channel sinuosity	Suboptimal	Predominantly straight upstream section.
Channel alteration	Optimal	No evidence of channel modification.
Sediment deposition	**Marginal**	Deposition of fine sediment observed throughout reach.
Pool variability	**Poor**	Restricted to small, shallow pools.
Abundance and diversity of habitat	Suboptimal	Instream habitat limited to woody debris and leaf litter.
Periphyton	**Marginal**	Some periphyton visible throughout reach.
Total score /180	**110**	

At the downstream end, the stream opens up into a permanent palustrine wetland which is bunded at its downstream extent by another forestry track. The wetland is approximately 380 m^2 in size. It is partly shaded along its edges and features aquatic habitat including woody debris and *Azolla rubra*. Mature *Carex secta* is prevalent along the wetland edge (Figure 27). Riparian

vegetation features a small stand of mature natives such as pukatea, tawa and rimu with associated epiphytes kiekie and tank lily, interspersed with redwood trees.

Figure 27. Bunded wetland within fill area 4.

The main current anthropogenic impacts on this wetland habitat include:

- Impacted hydrological integrity due to bunding;
- Reduced ecosystem intactness due to limited connectivity to downstream habitat; and
- Reduced presence of native plants (Appendix 6).

Downstream of the forestry track, a piped outlet drains into an open corrugated iron pipe over a steep gradient. An ephemeral watercourse of approximately 80 m in length continues from this point downstream towards the property boundary. It is characterised by clay/mud substrate with highly shaded but isolated areas of small pools or small channelised areas. Water surface featured a sheen resulting from iron flow throughout the watercourse. Pools had a maximum water depth of 25 cm and maximum width of 1 m. Flow channels had very little water flow with an approximate water depth of 2 cm and channel width of up to 40 cm. Vegetation throughout the watercourse was dominated by soft rushes, sedges, buttercup, Chinese privet and giant umbrella sedge.

Downstream of the ephemeral watercourse a more channelised short, intermittent stream reach was observed featuring a 4 m bedrock drop approximately 5 m upstream of the property boundary. This drop as well as the diffuse ephemeral watercourse and the corrugated iron pipe present barriers to upstream migration for most native fish species.

4.2.4 Fill Area 5

Fill area 5 has a sub-catchment area of approximately 5.6 ha. It features a single, steep and incised gully that has been fenced. A large area of the gully has been affected by previous forestry harvesting as evident by overgrown tree slash present throughout the lower two-thirds of the gully. The upper extent of the gully will likely contain overland flow paths during rain events.

Below a forestry track, an ephemeral watercourse of approximately 110 m contained narrow channels of approximately 20 cm in width that were dry at the time of the survey (Appendix 1, Figure 28).

Downstream, where the watercourse enters mature pine and regenerating native subcanopy, it changes to an intermittent stream with a well-defined channel, small pools and surface water present more than 48 hours after rain. However, the limited water depth indicates that this stream reach will cease to flow during dry periods.

The intermittent stream reach is approximately 50 m to the boundary and has a vegetated riparian area of over 20 m width on both stream banks, providing a high level of stream shading (Appendix 1, Figure 29). Riparian vegetation was predominantly comprised of pine with native subcanopy species such as māhoe, hangehange, kawakawa, pate, ponga and mamaku.

Stream banks were stable along the observed reach without any signs of erosion. Abundant organic instream features such as woody debris and leaf litter was present. Inorganic stream substrate within the assessed reach featured cobbles and boulders with some areas of sand and silt.

No aquatic macrophytes or periphyton was observed. The stream had an average wetted width of 1 m along the assessed reach, while average water depth ranged from 1.6 to 9.6 cm and featured predominantly small pools connected by runs and riffles with limited water flow. One koura (*Paranephrops planifrons,* classified as ‘Not Threatened’ (Grainger et al., 2018)) was encountered during the stream assessment (Figure 30).

Figure 28. Dry ephemeral channel within fill area 5.

Figure 29. Highly shaded intermittent stream reach within fill area 5.

Figure 30. Koura observed within the intermittent stream reach in fill area 5.

The overall qualitative habitat score for the assessed stream reach was 134 out of a possible 180 using the REMS qualitative habitat assessment protocol (Table 8). The reach was assessed as optimal in the context of riparian vegetation zone width, vegetative bank protection, channel sinuosity and alteration, and the absence of periphyton. The reach was classified as suboptimal in terms of bank stability and abundance as well as diversity of aquatic habitat. Marginal parameters included the presence of sediment deposition throughout the assessed reach while the lack of diversity in velocity/depth regimes was assessed as poor.

Table 8. Rapid qualitative assessment results for the intermittent stream reach within area 5.

Habitat parameter	Stream reach condition	Justification
Riparian vegetation zone width	Optimal	Continuous and dense bankside vegetation with over 10 m buffer width.
Vegetative protection	Optimal	Bank surfaces and immediate riparian zones densely covered by native vegetation.
Bank stability	Suboptimal	Infrequent signs of bank erosion.
Channel sinuosity	Optimal	Natural stream pattern.
Channel alteration	Optimal	No evidence of channel modification.
Sediment deposition	Marginal	Sediment deposition observed throughout assessed reach, especially at obstructions and bends.
Velocity/depth regimes	Poor	Dominated by slow, shallow velocity/depth regime.
Abundance and diversity of habitat	Suboptimal	Limited to woody debris and leaf litter with few small areas of undercut bank.
Periphyton	Optimal	No periphyton observed.
Total score /180	**134**	

4.2.5 Water and sediment quality

A summary of the water quality data including water quality spot measurements, nutrient and metal screen with comparative guideline values is provided in Table 9. Sediment quality data and guideline values are provided in Table 10. Appendix 1 indicates the sampling locations for water quality spot measurements, water and sediment grab sampling. The complete laboratory report is provided in Appendix 7.

Table 9. Water quality results.

Analytes	Unit	Wetland			Applicable guideline values
		Fill Area 2	Fill Area 3	Fill Area 4	
Water quality					
Temperature	°C	7.6	9.8	10.1	< 10°C: Excellent; 10-12°C: Satisfactory[9]
Dissolved oxygen	mg/L	3.7	12.1	6.5	
	%	**32.0**	108.4	**59.2**	> 90: Excellent; < 80: Unsatisfactory[9]
Specific conductivity	µS/cm	**247.1**	**785.0**	**154.1**	115[10]
pH	pH units	**6.2**	**6.0**	6.6	6.5-7.0: Satisfactory; < 6.5: Unsatisfactory[9]
Turbidity	NTU	4.0	**16.9**	**11.8**	2-5: Satisfactory; > 5: Unsatisfactory[9]
Total suspended solids	g/m^3	5.0	**20.0**	**21.0**	8.8[10]
Nutrients					
Total nitrogen	g/m^3	**0.61**	**1.14**	**0.53**	>0.5: Unsatisfactory[9]

[9] Waikato Regional Council Water Quality Guidelines (https://www.waikatoregion.govt.nz/environment/natural-resources/water/rivers/healthyrivers/how-we-measure-quality/)

[10] Australian and New Zealand Environment and Conservation Council (ANZECC) 2018. Australian and New Zealand Guidelines for Fresh and Marine Waters Quality. Default guideline values for physical and chemical stressor, 80th percentile.

Total ammoniacal nitrogen	g/m^3	**0.042**	0.011	< 0.010	0.01[10]
Nitrite-N	g/m^3	< 0.002	0.004	< 0.002	
Nitrate-N	g/m^3	0.003	0.008	< 0.002	0.065[10]
Nitrite-N + Nitrate-N	g/m^3	0.005	0.011	0.003	0.04 - 0.1[11]
Total kjeldahl nitrogen	g/m^3	**0.60**	**1.13**	**0.53**	0.04 - 0.1[11]
Dissolved reactive phosphorus	g/m^3	< 0.004	< 0.004	< 0.004	0.014[10]
Total phosphorus	g/m^3	0.034	**0.055**	**0.073**	0.01-0.04: Satisfactory; >0.04: Unsatisfactory[9]
Metals					
Dissolved aluminium	g/m^3	0.018	**0.169**	0.009	0.08[10]
total aluminium	g/m^3	0.035	**0.440**	0.042	0.08[10]
Dissolved iron	g/m^3	0.90	0.110	0.980	
Total iron	g/m^3	2.10	1.750	3.000	
Dissolved arsenic	g/m^3	< 0.0010	< 0.0010	< 0.0010	0.094[10]
Total arsenic	g/m^3	< 0.0011	< 0.0011	< 0.0011	0.094[10]
Dissolved cadmium	g/m^3	< 0.00005	0.00035	< 0.00005	0.0004[10]
Total cadmium	g/m^3	< 0.000053	< 0.00037	< 0.000053	0.0004[10]
Dissolved chromium	g/m^3	< 0.0005	< 0.0005	< 0.0005	0.0006[10]
Total chromium	g/m^3	< 0.00053	< 0.00053	< 0.00053	0.0006[10]
Dissolved copper	g/m^3	< 0.0005	< 0.0005	< 0.0005	0.0018[10]
Total copper	g/m^3	< 0.00053	0.0009	< 0.00053	0.0018[10]
Dissolved lead	g/m^3	< 0.00010	< 0.00010	< 0.00010	0.0056[10]
Total lead	g/m^3	< 0.00011	0.00034	< 0.00011	0.0056[10]
Dissolved nickel	g/m^3	0.0009	**0.022**	< 0.0005	0.0013[10]
Total nickel	g/m^3	0.00095	**0.022**	< 0.00053	0.0013[10]
Dissolved zinc	g/m^3	0.0101	**0.061**	< 0.0010	0.015[10]
Total zinc	g/m^3	0.0113	**0.063**	0.0016	0.015[10]

Water quality screening indicated unsatisfactory results for dissolved oxygen (fill area 2 and 4), pH (fill area 2 and 3), turbidity (fill area 3 and 4), total nitrogen (all wetlands) and total phosphorus (fill area 3 and 4) when compared to the WRC water quality guidelines, with dissolved oxygen and pH below guidelines while turbidity, total nitrogen and total phosphorus exceeded guideline values[7]. Similarly, total suspended solids (fill area 3 and 4), total ammoniacal nitrogen (fill area 2) and some metals (fill area 3) were elevated when compared to current ANZECC guidelines for freshwater and marine quality[8]. Concurrently, total kjeldahl nitrogen was elevated at all three wetlands when compared to the MfE water quality guidelines[9].

While these parameters do not meet the standards outlined in the aforementioned guidelines, wetlands naturally exhibit low pH and dissolved oxygen as well as elevated turbidity and total suspended solids, metal concentrations, nitrogen and phosphorus levels. In this context, the water quality parameters observed for all three wetlands may represent normal wetland conditions.

[11] Ministry for the Environment, 1992. Water Quality Guidelines No. 1: Guidelines for the Control of Undesirable Biological Growths in Water.

Sediment quality data shows that all metal concentrations were below appropriate guideline values[10] indicating minimal potential for biological harm to wetland biota (Table 10).

Table 10. Sediment quality results.

Analytes	Unit	Wetland			Applicable guideline values
		Fill area 2	Fill area 3	Fill area 4	
Nutrients					
Total nitrogen	g/100g dry weight	0.27	0.30	0.44	
Nitrite-N	mg/kg dry weight	< 1.5	< 1.8	< 1.7	
Nitrate-N	mg/kg dry weight	< 2.2	< 2.5	< 2.4	
Nitrite-N + Nitrate-N	mg/kg dry weight	< 1.5	< 1.8	< 1.7	
Total recoverable phosphorus	mg/kg dry weight	510	470	1,110	
Metals					
Total recoverable iron	mg/kg dry weight	13,000	29,000	36,000	
Total recoverable arsenic	mg/kg dry weight	2.1	7.7	6.4	20[12]
Total recoverable cadmium	mg/kg dry weight	0.168	0.24	0.196	1.5[12]
Total recoverable chromium	mg/kg dry weight	5.3	7.7	5.4	80[12]
Total recoverable copper	mg/kg dry weight	8.4	14.6	11.4	65[12]
Total recoverable lead	mg/kg dry weight	11.9	17.9	12.0	50[12]
Total recoverable nickel	mg/kg dry weight	2.9	12.9	4.2	21[12]
Total recoverable zinc	mg/kg dry weight	32	69	61	200[12]

All three wetlands exhibit water and sediment quality parameters that are likely representative of natural wetland habitat processes. In this context, wetlands provide an important ecosystem function for downstream habitats relating to attenuation and treatment of water which removals contaminants and thereby improves the water quality of downstream waterways.
Macroinvertebrate communities

Macroinvertebrate diversity was limited with 34 taxa identified from the three sampled wetland areas. The wetlands at fill areas 2 and 3 both featured 22 taxa while the wetland at fill area 4 featured 18 different taxa. A previous survey of taxonomic richness in wetlands throughout all New Zealand regions indicated an average taxonomic richness of 49 taxa for wetlands in the Waikato region, while average taxonomic richness on a national level varied from 47 to 96 (Suren & Sorrell, 2010). In this context, the wetlands evaluated in this assessment present a relatively low number of taxa; however, the aforementioned survey included only two wetlands from the Waikato region.

Macroinvertebrate taxa were dominated by oligochaete worms, copepods and damsel fly, while a high abundance of midges was observed at site 2 and 3. These taxa have previously been shown to dominate the macroinvertebrate community of wetlands across New Zealand (Suren & Sorrell, 2010). However, in the 2010 nationwide survey, high abundance was also observed for proboscis worms, ostracods, caddis fly and mites, which are less abundant or absent in the site's wetlands. Furthermore, the macroinvertebrate community in these wetlands featured an elevated abundance of flat worms within fill area 4, as well as leeches and water fleas within fill areas 2 and 4.

[12] Australian and New Zealand Environment and Conservation Council (ANZECC). 2018. Australian and New Zealand Guidelines for Fresh and Marine Waters Quality. Sediment quality default guideline values.

These differences to the observations made by Suren & Sorrell (2010) indicate that the macroinvertebrate community within the site's wetlands may not be representative of high-quality wetland habitat as is to be expected of modified and artificially induced wetland systems. The full list of Macroinvertebrate taxa observed at each fill area is provided in Appendix 8.

4.2.6 Fish communities

The only fish species observed was shortfin eel (*Anguilla australis;* Figure 31) with one eel caught in fill sites 2 and 4, and seven eels caught within fill site 3 (350 to 620 mm). Shortfin eels are common throughout New Zealand with a widespread distribution and are classified as 'Not Threatened' (Dunn et al., 2018). They are known to tolerate degraded habitat and water quality parameters. They can migrate into freshwater habitats with limited connectivity due to their remarkable climbing abilities over steep wet surfaces or through wet soil and vegetation.

The limited species assemblage for all three survey sites scored 'poor' in the fish Index of Biotic Integrity (IBI) which indicates that all three wetland sites are characterised by limited connectivity and restricted access for native migratory fish species and/or limited ecological value as freshwater habitat for native aquatic biota.

Previous records from the New Zealand freshwater fish database for Lake Puketirini tributaries, within the sub-catchment to the east of fill sites 2 and 3, include (other than shortfin eel) banded kokopu (*Galaxias fasciatus*), giant kokopu (*G. argenteus*) and longfin eel (*Anguilla dieffenbachii*). Giant kokopu and longfin eel are classified as 'At Risk – Declining' (Dunn et al., 2018). These species were not found at the surveyed sites indicating poor habitat connectivity, fish passage barriers and/or lack of suitable habitat values.

Black mudfish (*Neochanna diversus*) are classified as 'At Risk – Declining' (Dunn et al., 2018) and have previously been observed in the wider area[13]. No mudfish were found during the onsite fish surveys; however, mudfish exhibit poor climbing abilities hence are unlikely to be present within the observed wetland areas due to the outlined obstacles to fish passage including gradients and lack of connectivity.

Despite sub-optimal fish survey timing, the low species diversity reflects observed habitat values.

[13] https://www.doc.govt.nz/nature/native-animals/freshwater-fish/mudfish/black-mudfish/

Figure 31. Shortfin eel caught within the bunded wetland at fill site 2.

5.0 Ecological Values

5.1 Assessment of terrestrial ecological value

5.1.1 Assessment of vegetation value

The ecological values of the above vegetation types have been assessed as per 2018 EIANZ guidelines (Tables 1 and 2 in Section 2.3.1).

We note that due to the perceived threat to the family Myrtaceae from Myrtle rust (de Lange et al., 2018) the Department of Conservation has changed the threat status of Myrtle species e.g. rata now has a conservation status of *Threatened – nationally vulnerable*, similar to other native plants within *Metrosideros* genus. Kanuka also has a conservation status of *Threatened – nationally vulnerable*. However, in this case it would be inappropriate, (and following guidance in the proposed draft NPS for biodiversity (the Collective Group publication)) to attribute an elevated ecological value based solely on these common species being present.

Table 11. Vegetation ecological values.

Vegetation type	Ecological value	Explanation
Gorse-dominated early successional scrub	low to negligible	Primary value is as a buffer to other habitats, namely the native broadleaf early successional shrubland.

Native broadleaved early successional scrub	low	Not representative vegetation that originally occupied the area; unlikely to develop into secondary native forest without restoration due to limited regeneration of later-successional components. Poor structural diversity and small spatial extent of the patches means the patches are extensively impacted by edge effects, with limited contribution to ecosystem functions.
Secondary podocarp-broadleaf forest	High	Rated high for representativeness and rarity/distinctiveness due to the lack of mature native forest throughout the Meremere ED and the wider Waikato Ecological Region, despite impacts of grazing on the understory vegetation and the limited spatial extent of the remnants.
Exotic forest/treeland	Low	Rated low for Representativeness, Rarity/distinctiveness and Diversity and Pattern. Limited value with respect to ecological context as exotic forest patches provides canopy structure and provides forest interior habitat that is otherwise limited in the landscape.
Wetland vegetation	Low	Degraded examples which contain no substantive remnants of the ecosystems present prior to reclamation and drainage; habitat quality is poor. Some value with respect to restoration potential as wetland habitat is very underrepresented nationally, though more than 20% of original wetland habitat remains within the Meremere ED (van der Zwan & Kessels 2017).
Pasture grassland	Low-negligible	Rated very low or low for all assessment matters in Table 1. Rank grassland provides habitat for 'At Risk' NZ pipit which were observed on the site, but such habitat is common in the surrounding landscape and therefore this finding was not given much weight.

5.1.2 Assessment of herpetofauna value

As the field surveys were undertaken in winter, lizard surveys were not undertaken due the low activity levels of herpetofauna during colder seasons. Instead, habitat available on site was used as a proxy for the value of different features of the site for herpetofauna. The likelihood of lizards occurring in these habitats considers the factors listed below:

1. Habitat quality compared to habitat available in the wider landscape;
2. Connectivity to potential source habitats (given the low mobility of herpetofauna); and
3. Level of previous disturbance (namely clear-fell forestry or grazing).

The overall likelihood of 'Threatened' or 'At Risk' native lizards being present is low. Non-threatened ground dwelling lizards may be present at Fill Areas 2 and 4. These species are all protected under the Wildlife Act 1953. Arboreal lizards are unlikely to be present.

Table 12 summarises the likelihood of herpetofauna for species in each threat classification occurring within different habitats available onsite and the corresponding ecological value of these habitats.

Table 12: Assessment of potential for the habitats identified on site to be occupied by herpetofauna. The value assessment considers the likelihood of each habitat to be occupied by herpetofauna species of varying threat classifications (Burns et al., 2018; Hitchmough et al., 2016).

	Habitat type					
Likelihood of species occurring	**Gorse-dominated early successional shrubland**	**Native broadleaf early successional shrubland**	**Secondary podocarp-broadleaf forest**	**Exotic forest/ treeland**	**Wetland vegetation**	**Pasture/ grassland**
Nationally Threatened	-	-	-	-	-	-
At Risk – Declining[1]	Possible	Possible	Potential	Possible	Unlikely	Unlikely
At Risk (other)[2]	Possible	Possible	Potential	Possible	Unlikely	Possible
Not Threatened[3]	Potential	Potential	Likely	Potential	Unlikely	Potential
Pest species[4]	Confirmed	Likely	Likely	Likely	Unlikely	Likely
Assessment of value for herpetofauna	**Low**	**Low**	**High**	**Low**	**Negligible**	**Low**

[1] Ornate skink, striped skink, forest gecko, elegant gecko, Hochstetter's frog (refer to Table 6 for habitat preferences)
[2] Crenulate skink, Pacific gecko
[3] Copper skink
[4] Plague skink

5.1.3 Assessment of avifauna habitat values

Overall, the most valuable habitats for birds in the proposed fill areas are the wetlands, which may provide both connectivity within the wider wetland mosaic and core breeding habitat for Threatened or At Risk birds. Consequently, the wetlands have been assigned a **High** ecological value for native birds.

Gorse and grassland can also be used by 'At Risk' species such as fernbird or New Zealand pipit but areas within the proposed fill sites are not especially well connected or high quality and are abundant in the wider landscape. Consequently, these habitats have been assigned an ecological value of **Low** for native birds.

5.1.4 Assessment of bat value

Long-tailed bats are classified as 'Threatened – Nationally Critical'.

Long-tailed bats have been recorded in the nearby Hakarimata Scenic Reserve. They are a highly mobile species and are likely to use the site's vegetation. The mature pine stands and the larger native trees could provide roost habitat.

Long-tailed bats preferentially forage along linear features such as forest edges and open waterways[14]. Vegetation types within the site have differing value, with the secondary podocarp-broadleaf forest, exotic forest/treeland, and wetlands assessed as **Very High** value, while the remainder of the site has **Low** value for long-tailed bats.

5.2 Assessment of freshwater ecological values

The freshwater habitat types observed encompass ephemeral and intermittent watercourses as well as permanent wetland areas. Significance and ecological value of these habitats are outlined below.

5.2.1 Watercourses

No watercourses observed across any of the five surveyed sites have been identified under the WRC's water classification maps or the Waikato District plan. Similarly, none of the watercourses have been identified as significant natural area (SNA) within the Waikato District plan. However, watercourses observed within fill sites 4 and 5 have been classified as Waikato River Catchment within the Tangata Whenua layer of the Waikato District plan.

None of the ephemeral or intermittent watercourses are considered significant under the Waikato RPS indigenous biodiversity criteria.

Table 13 displays the ecological value for the watercourses observed in fill areas 2, 3 and 4. This assessment is based on the representativeness, rarity/distinctiveness, diversity/pattern and ecological context of the evaluated watercourses (Table 1) and the ecological value of species present within these habitats (Table 2).

Table 13. Representativeness, rarity/distinctiveness, diversity/pattern and ecological context of the observed watercourses.

Matter	Ephemeral watercourses	Intermittent stream reaches at downstream extents of Fill area 2&4	Intermittent stream reaches in Fill area 4 and Fill area 5[15]
Representativeness	Negligible: • Small diffuse watercourses. • Low quality habitat. • Impacted by anthropogenic modifications. • No distinct hydrological conditions.	Negligible: • Very short reaches. • Impacted by anthropogenic modifications. • Small channel dimensions. • No distinct hydrological conditions.	Moderate: • Small reaches. • Sub-optimal stream habitat. • No permanent water. • Limited aquatic habitat and biodiversity.

[14] The waterways on site are all too small to provide an open water channel that a long-tailed bat would use to forage over and drink from.

[15] These refer to the stream reaches that have been assessed in more depth for ecological value including a REMS assessment.

	• Highly limited water. • No instream fish habitat. • No fencing. • Exotic vegetation.	• No permanent water. • Limited aquatic habitat and biodiversity. • No fencing. • Exotic vegetation.	
Rarity/distinctiveness	Negligible: Habitat type is not uncommon within Ecological District or on national level. Habitat does not support any threatened, at risk or uncommon freshwater fauna species. No distinctive ecological features were observed.		
Diversity and pattern	Negligible: No instream habitat available for fish species. Habitat for macroinvertebrates very limited (spatial and temporal). Habitat quality affected by catchment land use and anthropogenic modifications.	Low: Aquatic biodiversity affected by periodic lack of water during dry season. Habitat quality affected by catchment land use.	
Ecological context	Low: Some contribution to ecosystem function in the context of water treatment and flow attenuation, thereby buffering of downstream habitats. Provide habitat to wetland and terrestrial species. Limited connectivity/presence of fish migration barriers.	Low: Providing freshwater ecosystem services, temporary freshwater fauna habitat availability. Limited connectivity/presence of fish migration barriers (Especially stream reach Fill area 4).	
Overall ecological value	**Negligible**	**Negligible**	**Low**

The overall ecological value for all ephemeral watercourses observed on the Site is **negligible**. Similarly, intermittent watercourse sections observed at the downstream extent of fill area 2 and 4 present an overall **negligible** ecological value. The overall ecological value for intermittent stream reaches observed in the mid-section of fill area 4 and within fill area 5 is **low**.

5.2.2 Wetland areas

The site's wetland areas are considered significant as outlined within criteria 4 and 6 under the WRC Regional Policy's Statement criteria[16]:

"It is indigenous vegetation, habitat or ecosystem type that is under-represented (20% or less of its known or likely original extent remaining) in an Ecological District, or Ecological Region, or nationally."

and

[16] https://www.waikatoregion.govt.nz/council/policy-and-plans/regional-policy-statement/rps2016/part-b/11/a/

"It is wetland habitat for indigenous plant communities and/or indigenous fauna communities (excluding exotic rush/pasture communities) that has not been created and subsequently maintained for or in connection with: […]".

Table 14 shows the ecological assessment for the site's wetlands.

Table 14. Ecological value of wetlands observed in fill area 2, 3 and 4.

Matter	**Wetland habitats ecological value**
Representativeness	Low: Relatively small wetland areas impacted by anthropogenic modifications in wetland area and surrounding catchment including impact on hydrological integrity and ecosystem intactness. Furthermore, no pest control or fencing and presence of exotic vegetation.
Rarity/distinctiveness	Moderate: Habitat type assumed to be relatively well represented within Meremere Ecological District[17], however, nationally underrepresented. Habitat does not support any threatened, at risk or uncommon freshwater fauna species. No distinctive ecological features were observed.
Diversity and pattern	Low: Aquatic biodiversity limited to some of the macroinvertebrates commonly found in wetlands throughout New Zealand and common fish species. Habitat quality affected by catchment land use and anthropogenic modifications.
Ecological context	Low: Providing permanent aquatic fauna habitat. Contribution to ecosystem function in the context of water treatment. Limited connectivity to downstream/upstream habitats.
Overall ecological value	**Low**

The assessed overall ecological value for all wetlands observed on the Site is **low**. This reflects the observed ecological key points including small sized and modified wetlands with low habitat quality and limited connectivity. However, the ecological value does not detract from the ecological significance conferred on the wetlands by the criteria in the Regional Policy Statement.

5.3 Ecological Significance

The proposed fill areas encompass vegetation communities which are modified, recently established, and in several cases, predominantly exotic. The ecological values and significance of these sites is primarily associated with their habitat values for native fauna.

The Operative Waikato District Plan assigns significance to vegetation assemblages that provide habitat for at risk and threatened native fauna (refer to Criterion Oc3, Part 3 Appendix Oc - Significant Indigenous Vegetation Criteria). This criterion is not limited to indigenous vegetation and is adapted from Table 11-1 of the Waikato Regional Policy Statement.

Given the seasonal limitations to undertaking fauna surveys, our evaluation of ecological significance is based on 'reasonable likelihood' that threatened native fauna may inhabit or use the identified features.

In particular, mature native forest remnants (all outside the proposed fill sites), and stands of exotic forest and treeland, are ecologically significant due to the high likelihood that they provide

[17] Van der Zwan, W. and Kessels, G. (Kessels Ecology; 2017). Significant natural areas of the Waikato District: terrestrial and wetland ecosystems. WRC Technical Report 2017/36.

habitat for ‘Threatened’ or ‘At Risk’ native fauna, including long-tailed bats. Native lizards and New Zealand falcon may also use and/ or inhabit these areas.

Wetlands within the site, while small in extent and extensively modified, may be used by wetland bird species as ‘stepping stone’ habitat as they move between the larger lakes and wetlands that occur in the surrounding landscape. While somewhat less likely, native waterfowl could potentially use these features for breeding. Hence, the wetland features meet ecological significance criteria.

Native and exotic scrub is not assessed as ecologically significant as these habitats are unlikely to be important for bats or threatened bird species, though these areas may be used incidentally for foraging. Native herpetofauna could be present in areas of native scrub with connectivity to high-value source habitat, such as Fill Areas 2 and 4, but persistence of lizard populations in these features is improbable due to the frequency and extent of disturbance to these features. Gorse can provide cover and protection for ground-dwelling skinks from potential predators, particularly within the pampas that was interspersed throughout this vegetation type. However, the habitat structure is not diverse or complex indicating that this vegetation is not high-quality habitat.

Pasture areas within fill sites are not assessed as ecologically significant because this habitat is extensive in the surrounding landscape and has limited habitat value for the majority of native fauna. However, ungrazed grassland provides cover for ground dwelling lizards and ‘At Risk’ New Zealand pipit nest in such habitats, hence there are risks to significant native fauna associated with developing these sites that need to be appropriately mitigated.

5.4 Summary of ecological values and significance

Vegetation values are variable across the site and between fill sites. They range from high for secondary podocarp-broadleaf forest to low-negligible for gorse dominated early successional scrub and pasture.

Native and exotic forest stands and wetland features within the site have been assessed as of high or very high potential value for herpetofauna, avifauna and bats under EIANZ guidelines (2018), and meet significance criteria outlined in the Waikato Operative District Plan significance criteria.

Other habitats of lesser value also have potential to support significant indigenous fauna populations. These assessments are precautionary and based on habitat availability without the benefit of survey data. We recommend fauna surveys to provide a more accurate assessment of the vegetation habitat value and significance.

Under EIANZ guidelines (2018), the ephemeral and intermittent watercourses present on the site have been assessed to be of negligible to low ecological value. Concurrently, none of these watercourses have been identified under the WRC water classification maps, the Waikato RPS indigenous biodiversity criteria or the Waikato Operative District Plan as significant ecological features.

In the context of freshwater ecology, wetland areas identified on the Site have been assessed to be of low ecological value, while these are identified as meeting significance criterion Oc3 of the Operative Waikato District Plan.

6.0 Assessment of Potential Ecological Effects

6.1 Assessment of potential effects on terrestrial ecological values

The magnitude and level of effect on terrestrial ecological values was assessed as per EIANZ guidelines (refer Tables 3 and 4 in Section 2.3.1).

6.1.1 Vegetation

The potential effects on vegetation are presented in Table 15.

Table 15. Summary of potential effects on vegetation.

Gorse-dominated early successional scrub	Magnitude of effect: **Negligible** – Large areas of gorse scrub will be removed from the site however it is abundant in the wider landscape, the ecological district, region and nationally. The removal of gorse will not negatively impact the post-development character of the site and the management of pest plant species is included as Policy 3.1.2(a)(ii) of the WDP (proposed) to maintain or enhance indigenous biodiversity. As per Section 5.1.1, the vegetation value of gorse-dominated scrub on site was assessed as **Negligible.** Level of effect of the removal of gorse-dominated early successional shrubland is assessed as **Very Low.**
Native broadleaved early successional scrub	Magnitude of effect: **Moderate** – The removal of the native scrub will result in the removal of a notable proportion of this vegetation type on the Site. Yet, early successional shrubland is still well represented in the wider landscape, the ecological district, ecological region and nationally. As per Section 5.1.1, the vegetation value of native scrub on site was assessed as **Low.** Level of effect of the removal of native broadleaf early successional shrubland is assessed as **Low.**
Secondary podocarp-broadleaf forest	Magnitude of effect: **Low –** The stands of secondary forest are all being avoided. The magnitude of effect has been assigned as low as opposed to Negligible because there is the occasional larger native tree included within the early successional broadleaf scrub that will require removal**.** As per Section 5.1.1, the vegetation value of the secondary forest on site was assessed as **High.** Level of effect of the removal of secondary broadleaf-podocarp forest is assessed as **Low.**
Exotic forest/treeland	Magnitude of effect: **Low** – Two small area of exotic forest/treeland will require removal, the stand of redwoods in Fill Area 4 and a small proportion of planted pine to facilitate the creation of the sediment control infrastructure in Fill Area 5. As per Section 5.1.1,

	the vegetation value of exotic forest/treeland on site was assessed as **Low.** Level of effect of the removal of exotic forest/treeland is assessed as **Very Low.**
Wetland vegetation	Magnitude of effect: **High** - The removal of wetland habitat in Fill Areas 2 – 4 will result in the loss of a large proportion of the wetland habitat available on site. Although wetland habitat is still relatively well represented within the Meremere ED, it is threatened nationally. As per Section 5.1.1, the vegetation value of wetland vegetation on site was assessed as **Low.** Level of effect of the removal of wetland vegetation is assessed as **Low.**
Pasture grassland	Magnitude of effect: **Negligible** – Large areas of gorse scrub will be removed from the site however it is abundant in the wider landscape, the ecological district, region and nationally. Its removal will not negatively impact the post-development character of the site. As per Section 5.1.1, the vegetation value of the pasture/grassland on site was assessed as **Negligible.** Level of effect of the removal of pasture/grassland is assessed as **Very Low.**

6.1.2 Fauna

The potential effects on native fauna are presented in Table 16.

Table 16. Summary of potential effects on native fauna.

Herpetofauna	Habitat loss The magnitude of effect will be no more than **Moderate** based on the level of disturbance in the fill areas and the limited mobility of herpetofauna to recolonise these areas. Therefore, the level of effect for herpetofauna is likely to be **Low**. Injury or mortality The magnitude of effect from vegetation removal without appropriate measures to minimise the potential for injury or mortality to herpetofauna would be **Very High**. This would result in a **Very High** level of effects depending on the number and threat status of the individuals affected.
Avifauna	Habitat loss The magnitude of effect from the removal of early successional scrub and pasture/grassland has been assessed as **Negligible**, based on the species observed on site and habitat assessments. This result in a **Low** to **Very Low** level of effect**.** However, the magnitude of effect from the removal of the wetlands in Fill Areas 2 – 4 has been assessed as **High.** This would result in a **Very High**

	level of effects if Threatened or At Risk species are confirmed using these habitats. Injury or mortality The magnitude of effect from removal of vegetation during the nesting season that could result in the injury or mortality of native birds and their eggs and fledglings is assessed as **Very High**. This would result in a **Very High** level of effect depending on the number and threat status of the birds affected.
Bats	Habitat loss The magnitude of effect from habitat removal may be **Low** or **Very High**, depending on whether communal roost habitat is identified on site that cannot be avoided. Consequently, the level of effect from habitat loss may be **Moderate** if no communal roost sites will be removed**, or Very High** in the case of communal roost habitat loss. Injury or mortality The magnitude of effect from removal of occupied roosts resulting in the injury or mortality of long-tailed bats is assessed as **Very High.** This would result in a **Very High** level of effect. Level of effects will be reassessed to **Very Low** if follow-up surveys determine bats are not using the site.

6.2 Assessment of potential effects on freshwater ecological values

6.2.1 Potential adverse effects

The proposed use of new overburden/ fill sites will result in the loss of most of the site's watercourses and the three observed wetland areas. Furthermore, the change in land use will involve development of access roading and tip-heads as well as installation of sediment retention ponds (Appendix 9 and 10). The activities and effects associated with the proposed new land-use include:

- Watercourse removal and possible changes to the hydrology of downstream freshwater habitats; and
- Sediment related discharges into water and stormwater discharge.

6.2.2 Watercourse removal

The proposed new land-use will result in the removal of ephemeral and intermittent watercourses, as well as permanent wetland areas (Appendix 1). The lengths of watercourse loss for each flow type, and the area of wetland loss is provided for each fill area in Table 17.

Table 17. Overview of aquatic habitats types and extent of removal.

Fill Area	Habitat type	Length/area removed

2	Ephemeral watercourse	160 m
	Wetland	450 m^2
3	Ephemeral watercourse	145 m
	Wetland	700 m^2
4	Ephemeral watercourse upstream	50 m
	Intermittent watercourse upstream	40 m
	Ephemeral watercourse downstream	60 m
	Wetland	380 m^2
5	Ephemeral watercourse	110 m
	Intermittent watercourse	50 m

Overall, the proposed new land-use will result in the loss of approximately:

- 525 m of ephemeral waterway classified as negligible ecological value;
- 90 m of intermittent waterway classified as low ecological value; and
- 1,530 m^2 of wetland area classified as low ecological value.

The magnitude of effect will be **High** due to complete loss of waterways and wetland habitat although downstream aquatic environments will be retained.

Section 7.2 outlines our recommendations for the management of the associated effects of the loss of aquatic habitat with low ecological values.

The loss of watercourses and wetland habitats outlined within this assessment will potentially affect the hydrology of downstream freshwater habitats. The ecological effect of the proposed change in land use will be minimised if changes to water volume and velocity are minimised.

6.2.3 Sediment and ongoing stormwater discharges

Proposed earthworks and subsequently stormwater entering waterways from the proposed fill sites may affect the water quality of aquatic habitat downstream of the site through erosion and sediment runoff.

The managed fill operations are expected to have **Negligible** magnitude of effect on downstream water quality provided that the fill acceptance, leachability limits and placement depth limits and criteria are adhered to consistent with Section 6 (Managed Fill Acceptance) of the Gleeson Managed Fill – Huntly Fill Manage Plan Draft as at 05/11/2019. As well as implementing the quarterly monitoring of water discharges for the contaminants and review procedures if elevated levels of contaminates are detected (Section 9.5).

6.2.4 Level of effects from proposed change in land-use

The proposed change in land use includes removal of the wetlands observed within fill areas 2, 3 and 4. This may have an unfavourable impact on downstream habitats as the associated wetland function in terms of water treatment and contaminant removal would be removed as well. Table 18 shows the level of effect from the proposed change in land use.

Table 18. Overview of the level of effect from the proposed new land use.

Feature	Ecological value	Effect	Magnitude of effect	Level of effect
Ephemeral and intermittent watercourses	Negligible	Habitat loss	High	Very low
Intermittent watercourses and permanent wetland areas	Low	Habitat loss	High	Low
Retained ephemeral and intermittent watercourses	Negligible	Erosion and sedimentation	Negligible	Very low
Retained ephemeral and intermittent watercourses	Negligible	Stormwater discharge	Negligible	Very low

All level of effects are assessed as being **Low** to **Very Low**.

7.0 Recommended effects management

7.1 Terrestrial Ecology

7.1.1 Vegetation

Due to the low levels of effects of vegetation we do not consider mitigation solely for the purposes of mitigating effects on vegetative ecological values necessary. However as outlined below the value of this vegetation is likely (dependant on surveys) to be in the habitat values it provides to indigenous fauna.

7.1.2 Fauna survey and management

We recommend undertaking surveys for avifauna and long-tailed bats to enable completion of a comprehensive and accurate assessment of effects, and so that appropriate management methods can be more fully determined.

Surveys for wetland birds and waterfowl should be undertaken during the breeding season (August to March inclusive) to provide an assessment of the value of the site's wetland habitats for avifauna.

Acoustic surveys for bats should be undertaken to determine whether bats are regularly using and roosting in vegetation on the property. On that basis, mitigation measures can be determined to manage effects on birds and bats if appropriate. If surveys identify that threatened fauna do frequent these sites, such measures may include habitat protection and enhancement elsewhere on the property, or some form of offset package.

Native lizards are relatively sedentary and slow to disperse and given the extensive recent disturbance of the fill areas, we have assessed that there is a low likelihood of large lizard populations occurring within the impacted habitats.

Consequently, we do not consider that follow-up lizard survey is necessary to more accurately define effects and management. However, lizard site-specific survey and salvage will be required prior to and during habitat removal, to minimise mortality to any resident population.

If bird and bat surveys determine that the site has significant fauna values, we recommend the preparation and implementation of a Fauna Management Plan (FMP) as a principal mitigation measure to guide site management. The FMP should include the following:

1. An outline of the ways that the project will avoid, remedy, or mitigation any potential effects on indigenous fauna including but not limited to:
    a. Redesign, reconfiguring the proposal to avoid or minimise potential effects of native fauna.
    b. Optimal timing and staging of vegetation clearance to minimise harm to native fauna:
        i. Giving highest priority to 'Threatened' or 'At Risk' species;
        ii. Where practicable, avoid the bird breeding season (1 August to 31 March);
        iii. Where practicable, undertake clearance works within the active period for lizards (1 September to 30 April, weather dependent); and
        iv. If birds are confirmed breeding in the wetlands, these areas will need to be avoided during the breeding season (1 August to 31 March) as nest checks in such habitat can result in damage or abandonment of nests. Wetlands can be cleared outside of the active period for lizards as this habitat has very low value for native herpetofauna.
    c. Tree felling protocols to avoid the removal of an occupied bat roost.
    d. Operational impact reduction strategies such as lighting regimes, avoidance areas, work timeframes, etc.
    e. Description of survey, trapping and relocation methodology for lizards, including description of a relocation site with provision for additional refugia, long term protection and pest management (as required).
    f. Success monitoring for released lizards (if required).

7.2 Freshwater Ecology

The primary effects of the proposed change in land use on freshwater habitats include the loss of ephemeral and intermittent watercourses as well as permanent wetlands.

Under Clause 6 of Section 88 and Schedule 4 of the Resource Management Act an Ecological Impact Assessment must include:

"[…] a description of the mitigation measures […] to be undertaken to help prevent or reduce the actual or potential effect […].

7.2.1 Wetlands

The wetland areas within proposed fill areas 2, 3 and 4 are of low ecological value; however, they meet Operative Waikato District Plan and WRC RPS Section 11a criteria for ecological significance (Section 5.3). The total loss of wetland habitat due to the proposed change in land

use requires mitigation as outlined under Policy 3.7.3 of the WRC Regional Plan[18], to minimise adverse ecological effects and facilitate a 'no net loss' or 'net gain' outcome:

"…land drainage activities within wetlands that are areas of significant indigenous vegetation and/or significant habitats of indigenous fauna […], are undertaken in a manner that avoids changes in water level that lead to:

g. shrinking or loss of the wetland, or

h. accelerated dewatering […], or

i. significant adverse effects on tangata whenua values of the wetland, or

[…]

f. adverse effects on the natural character of wetlands, […]

and remedy or mitigate otherwise."

7.2.2 Waterways

The proposed change in land use will result in the total loss of 90 m intermittent stream length and 525 m ephemeral stream length. These waterways are not classified as significant habitat and the associated ecological values range from low to negligible. Furthermore, the level of effect from the proposed land change has been classified as low to very low, with no significant adverse effects. Consequently, there is no policy driver for the requirement of mitigation for this stream loss. However, we consider that there are opportunities to enhance waterways in the mitigation of effects of wetland loss and fauna habitat.

7.2.3 Recommended mitigation strategies

We recommend the following strategies to mitigate for and thereby avoid/minimise adverse effects from the proposed change in land use on aquatic ecosystems:

1. Carry out recommend fauna surveys to complete ecological effects assessment and develop appropriate avoid, remedy, or mitigation strategies where required.
2. Creating wetland habitat at a ratio of 1:1 (wetland loss: wetland creation). This is proposed to mitigate for the loss of 1530 m^2 in total from fill areas 2, 3 and 4. We recommend realising all wetland mitigation in one or two areas that are not affected by the proposed change in land use or by any potential future spatial expansion of the quarry's activities. Should wetland creation not be feasible within the property's extent, it may be undertaken on other available land. We recommend the preparation and implementation of a wetland restoration plan that includes the parameters relating to the following:
    - Wetland establishment locations;
    - Wetland plant species;
    - Fencing;
    - Pest plant control;

[18] https://www.waikatoregion.govt.nz/Council/Policy-and-plans/Rules-and-regulation/Regional-Plan/Waikato-Regional-Plan/3-Water-Module/37-Wetlands/373-Policies/

- Pest animal control; and
- Connectivity.

3. We recommend native fish relocation practices are implemented for the wetlands in areas 2, 3 and 4 in dependence on the proposed filling activities:
    - If the wetland areas are to be pumped preceding filling activities, we recommend that native fish are captured during the pumping activities and translocated into suitable habitat.
    - Should no pumping of the wetland areas occur, native fish are to be captured and translocated directly before filling activities to avoid that fish are returning into the wetland areas during infill activities.
4. Develop an erosion and sediment control plan to minimise sediment discharge effects on downstream freshwater receiving environments.

All the above recommended mitigation strategies should be outlined in an Ecological Management Plan for the site.

8.0 Conclusion

The applicant proposed to fill 4 sites on the Gleeson's Quarry property with overburden from ongoing quarrying operations and external managed fill material. The filling proposal will result in the removal of native scrub, gorse, pasture and pine forest, along with short reaches of ephemeral and intermittent watercourses, and small areas of wetlands. The removal of native and exotic scrub, pasture, ephemeral and intermittent stream reaches will result in a low or very low level of effect, if appropriately managed with seasonal constraints to minimise effects on native fauna, but tall forest stands (both native and exotic) and wetland areas are of potential significance, as threatened native fauna known to be present in the wider landscape may use and/or inhabit these features. Further surveys are required to more accurately assess habitat value and significance.

Additional potential effects include possible changes to the hydrology of downstream freshwater habitats and sediment related discharges into waterways. Appropriate mitigation for the outlined adverse effects include creation of new wetland area(s) outside of the effect envelope of the quarry's activities as well as implementing erosion and sediment control practices.

Effects of wetland loss can be mitigated through the creation of 1530 m^2 of new wetland area. Effects on fauna can be avoided by undertaking fish translocation prior to wetland filling/during pumping activities and by undertaking lizard site-specific survey and salvage prior to and during habitat removal. Effects on water quality of downstream watercourses from elevated sediment discharges can be minimised with an erosion and sediment control plan.

Provided that these measures are implemented appropriately, we conclude that the development of the proposed fill sites will manage effects on the environment to the extent that effects are, on balance, low to negligible.

9.0 References

Auckland Council. (2018). *Auckland unitary plan operative in part - updated 13 July 2018*. Auckland Council.

Burns, R. J., Bell, B. D., Haigh, A., Bishop, P., Easton, L., Wren, S., … Makan, T. (2018). *Conservation status of New Zealand amphibians, 2017* (New Zealand Threat Classification Series No. 25). Wellington: Department of Conservation.

Clarkson, B. R., Sorrell, B. K., Reeves, P. N., Champion, P. D., Partridge, T. R., & Clarkson, B. D. (2004). *Handbook for monitoring wetland condition: Coordinated monitoring of New Zealand wetlands* (Revised). Wellington: Ministry for the Environment.

de Lange, P. J., Rolfe, J. R., Barkla, J. W., Courtney, S. P., Champion, P. D., Perrie, L. R., … Ladley, K. (2018). *Conservation status of New Zealand indigenous vascular plants, 2017* (New Zealand Threat Classification Series No. 22). Wellington: Department of Conservation.

Dunn, N. R., Allibone, R. M., Closs, G. P., Crow, S. K., David, B. O., Goodman, J. M., … Rolfe, J. R. (2018). *Conservation status of New Zealand freshwater fishes, 2017* (New Zealand Threat Classification Series No. 24). Wellington: Department of Conservation.

Grainger, N., Harding, J., Drinan, T., Collier, K., Smith, B., Death, R., … Rolfe, J. (2018). *Conservation status of New Zealand freshwater invertebrates, 2018* (New Zealand Threat Classification Series No. 28). Wellington: Department of Conservation.

Hitchmough, R. A., Barr, B., Lettink, M., Monks, J., Reardon, J., Tocher, M., … Rolfe, J. (2016). *Conservation status of New Zealand reptiles, 2015* (New Zealand Threat Classification Series No. 17). Wellington: Department of Conservation.

Joy, M., David, B., & Lake, M. (2013). *New Zealand freshwater fish sampling protocols. Part 1: Wadeable rivers and streams* [New Zealand Freshwater Fish Sampling Protocols]. Palmerston North: Massey University.

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

Stark, J. D., Boothroyd, I. K. G., Harding, J. S., Maxted, J. R., & Scarsbrook, M. R. (2001). *Protocols for sampling macroinvertebrates in wadeable streams* (p. 65). Wellington: Prepared for the Ministry for the Environment.

Suren, A. J., & Sorrell, B. (2010). *Aquatic invertebrate communities of lowland wetlands in New Zealand: Characterising spatial, temporal and geographic distribution patterns* (Science for Conservation No. 305).

van der Zwan, W., & Kessels, G. (2017). *Significant natural areas of the Waikato District: Terrestrial and wetland ecosystems* (Waikato Regional Council Technical Report No. TR2017/36). Waikato Regional Council.

Appendix 1: Site context and ecological features of the proposed new fill areas

Boffa Miskell

www.boffamiskell.co.nz

0 200 m

1:7,000 @ A3

Data Sources: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community, Waikato District Council.
Projection: NZGD 2000 Mount Eden Circuit

- Site Boundary
- Watercourse
  - Ephemeral
  - Intermittent
- Site Vegetation
  - Exotic forest
  - Secondary podocarp-broadleaf forest
  - Wetland
- Fill Area
- Site 1
- Significant Natural Area (WDC legal effect)
- Sampling site (water, sediment, macroinvertebrates sampling and fish survey)
- Bedrock drop
- Confluence
- Old growth pine

DRAFT

GLEESON QUARRIES HUNTLY LIMITED

Site Ecology

Date: 30 July 2019 | Revision: F

Plan prepared by Boffa Miskell Limited

Project Manager: Georgia.Cummings@boffamiskell.co.nz | Drawn: JWa | Checked: TUI

Appendix 2: Vegetation species list

Species name	Common name	Notes
Aristotelia serrata	Wineberry	
Asplenium flaccidum	Hanging spleenwort	
Astelia hastata	Tank lily	(on mature natives)
Beilschmiedia tawa	Tawa	
Bidens frondosa	beggars' ticks (e)	
Brachyglottis repanda	Rangiora	
Carex maorica	Maori sedge	
Carex secta	Purei	
Carex uncinata	hook sedge	
Carex virgata	Pukio	
Cenchrus clandestinus	Kikuyu grass (e)	
Cirsium spp.	Thistle (e)	
Coprosma grandifolia	large-leaved coprosma	Fill 4 – D/S of redwoods and pond
Coprosma lucida	Shining karamu	
Coprosma robusta	Karamu	
Cortaderia selloana	Pampas (e)	
Corynocarpus laevigatus	Karaka	Fill 4 – Boundary confluence
Cyathea cunninghamii (?)	Gully tree fern	Fill 4 – U/S of bund
Cyathea dealbata	Pōnga	
Cyathea medullaris	Mamaku	
Cyperus eragrostis	Umbrella sedge (e)	
Cyperus ustulatus	Giant umbrella sedge	
Dacrydium cupressinum	Rimu	
Dicksonia squarrosa	Wheki	
Diplazium australe	-	
Dodonaea viscosa	Akeake	
Doodia australis	Rasp fern	
Elaeocarpus hookerianus (I think, ID through binos)	Pokaka	
Elatostema rugosum	Parataniwha	Fill 5 – D/S (under pines)
Freycinetia banksii	Kiekie	
Gahnia xanthocarpa	Gahnia	Fill 1 confluence (wetland)
Galium palustre subsp. palustre	Marsh bed straw (e)	Fill 4 - Main wetland + stream under redwoods
Geniostoma ligustrifolium var. ligustrifolium	Hangehange	
Hedycarya arborea	Pigeonwood	
Hedychium gardnerianum	Kahili ginger (e)	
Isolepis prolifera	Isolepis prolifera	
Juncus edgariae	Edgar’s rush	Fill 3
Juncus effusus	Soft rush (e)	
Knightia excelsa	Rewarewa	
Kunzea robusta	Kānuka	

Laurelia novae-zelandiae	Pukatea	
Leucopogon fasciculatus	Tall mingimingi	
Leycesteria formosa	Himalayan honeysuckle (e)	Fill 5 – U/S of pines
Ligustrum sinense	Chinese privet (e)	
Lonicera japonica	Japanese honeysuckle (e)	
Melicytus ramiflorus	Mahoe	
Metrosideros perforata	Akatea	
Metrosideros robusta	Northern rata	Fill 1 - native
Microsorum pustulatum subsp. pustulatum	Hounds tongue	
Microsorum scandens	Fragrant fern	
Myriophyllum propinquum	Common water milfoil	
Myrsine australis	Red matipo	
Oplismenus Hirtellus Subsp. Imbecillis	-	
Parablechnum novae-zelandiae	Kiokio	
Passiflora tripartita	Banana passionfruit (e)	
Persicaria hydropiper	Water pepper	
Phyllocladus trichomanoides	Tanekaha	Fill 2 – Native boundary
Phytolacca octandra	Inkweed (e)	
Pinus radiata	Pine (e)	
Piper excelsum subsp. excelsum	Kawakawa	
Pneumatopteris pennigera	Gully fern	
Prumnopitys ferruginea	Miro	
Pseudopanax crassifolius	Lancewood	
Ranunculus flammula	Spearwort (e)	
Ranunculus repens	Buttercup (e)	
Rhopalostylis sapida	Nikau	Fill 2 riparian
Rubus fruticosus	Blackberry (e)	
Schefflera digitata	Pate	
Sequoia sempervirens	Redwood (e)	
Solanum mauritianum	Woolly nightshade (e)	
Solanum nigrum	Black nightshade (e)	
Symphytum officinale or Verbascum thapsus	Comfrey or woolly mullein (e)	See photo IMG_8777
Tradescantia fluminensis	Tradescantia (e)	
Typha orientalis	Raupo	
Ulex europaeus	Gorse (e)	
Veroncia stricta var. stricta	Koromiko	
Veronica americana	American brooklime (e)	

Appendix 3: Waikato Regional Council Ecological Monitoring of Streams (REMS) Field sheet

FIELD ASSESSMENT COVER FORM: (100m reach)

WADEABLE HARD-BOTTOMED AND SOFT-BOTTOMED STREAMS

STREAM NAME:		**ASSESSOR:**	
SITE NUMBER:	**SAMPLE NUMBER:**	**DATE:**	**TIME (NZST):**

GPS COORDINATES: **Downstream end of reach - Easting –** **Northing –**
Upstream end of reach - Easting – **Northing –**

Canopy Cover: Open Partly shaded Significantly shaded

Channel shading (%):

Riparian Fencing:
None/ ineffective
One side/ partial both sides
Complete both sides

Dominant rip.landuse (≤20m)

Commercial	Industrial
Agriculture	Residential
Urban	Retired Grass
Parkland	Forestry
Crops/hort	Native shrub
Field/Pasture	Native forest

Weather Conditions Current Past 24 hrs
Storm (heavy rain)
rain (steady rain)
Showers (intermittent)
% cloud cover
clear / sunny

Has there been heavy rain in the past 2 days?
Yes No

Water Level: Dry Isolated pools Perennial

Litter: Abundant Common Rare Absent

Temperature: _____ ^{o}C Conductivity: _____µS/cm Ambient

Dissolved Oxygen: _____ % _____ mg/L pH:

Turbidity: Clear Slightly turbid Turbid Highly turbid/Opaque Stained Other_____

INORGANIC SUBSTRATE

Compaction
assorted sizes tightly packed &/or overlapping
moderately packed with some overlap
mostly a loose assortment with little overlap
no packing / loose assortment easily moved.

Embeddedness
<5% gravel-boulder particles covered by fine sediment
5-24% covered by fine sediment
25-49% covered by fine sediment
50-75% covered by fine sediment
>75% covered by fine sediment

% surficial substrate size composition
(should sum to 100%)

Substrate type	Diameter	Percentage
Bedrock	-	
Boulder	> 256mm	
Cobble	>64-256mm	
Gravel	>2-64mm	
Sand	>0.06-2mm	
Silt	0.004-0.06mm	
Clay	<0.004mm	

ORGANIC SUBSTRATE
(% cover in reach - need not sum to 100%)

Large wood (>10 cm diameter): _____%
Detritus (small wood, sticks, leaves etc > 1 mm): _____%
Muck/mud (fine organic matter < 1 mm): _____%

HABITAT TYPES SAMPLED (% of effort; each column should sum to 100%)
Stones: _____% Riffles: _____%
Woody debris:_____%
Macrophytes: _____%
Edges: _____% Runs: _____%

Water odours
Normal/None
Petroleum
Fishy
Sewage
Chemical
Other:

Sediment/ Substrate deposits
None
Sludge
Fiber
Sand
Shells
Other:

Water surface oils
None
Slick
Sheen
Globs
Flecks
Other:

Litter
Abundant
Common
Rare
Absent

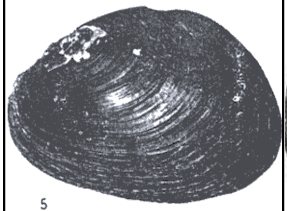
Sediment/ Substrate odour
Normal/ None
Petroleum
Anaerobic
Sewage
Chemical
Other:

Water level
Dry
Isolated pools
Perennial

NO. INVERTEBRATES RETURNED TO STREAM
Koura: _____ Shrimps: _____
Crabs: _____ Mussels: _____
Others (specify) _____

Species of mussel (tick)

Hyridella



Shell smooth; up to 100mm long; variable shell shape

Cucumerunio

Nodules and ridges on upper part of shell; up to 90mm long

Proportion of Study reach (%)
Pool
Riffle
Run
Chute
Waterfall

Comments

Site location map

Periphyton Assessment

	Transect	1	2	3	4	5
Thin (<0.5mm) Mat/Film	**Green %age cover**					
	Light Brown %age cover					
	Black/ Dark brown %age cover					
Medium (<3mm) mat/film	**Green %age cover**					
	Light Brown %age cover					
	Black/ dark brown %age cover					
Thick (>3mm) mat/film	**Green %age cover**					
	Light Brown %age cover					
	Black/ dark brown %age cover					
Filaments short (<2cm)	**Green %age cover**					
	Brown/ Reddish %age cover					
Filaments long (>2cm)	**Green %age cover**					
	Brown/ Reddish %age cover					
Bryophyte						

Iron floc

WADEABLE HARD-BOTTOMED STREAMS – 100 m reach

Qualitative Habitat Assessment Field Data Sheet

STREAM NAME:	**SITE NUMBER:**
SAMPLE NUMBER: **ASSESSOR:**	**DATE:**

Habitat Parameter	Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Riparian Vegetative Zone Width (score each bank riparian zone)	• Bankside vegetation buffer is >10m • Continuous and dense	• Bankside vegetation buffer is <10m • Mostly continuous	• Pathways present and/or stock access to stream • Mostly healed over	• Breaks frequent • Human activity obvious
SCORE ___(LB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
SCORE ___(RB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Mean LB&RB_____				
2. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	• Bank surfaces and immediate riparian zones covered by native vegetation • Trees, understorey shrubs, or non-woody plants present • Vegetative disruption minimal	• Bank surfaces covered mainly by native vegetation • Disruption evident • Banks may be covered by exotic forestry	• Bank surfaces covered by a mixture of grasses/shrubs, blackberry, willow and introduced trees • Vegetation disruption obvious • Bare soil/closely cropped vegetation common	• Bank surfaces covered by grasses and shrubs • Disruption of streambank vegetation very high • Grass heavily grazed • Significant stock damage to the bank
SCORE ___(LB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
SCORE ___(RB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Mean LB&RB_____				
3. Bank Stability (score each bank) Note: determine left of right side by facing downstream	• Banks stable • Erosion/bank failure absent or minimal • <5% of bank affected	• Moderately stable • Infrequent, small areas of erosion mostly healed over • 5-30% of bank eroded	• Moderately unstable • 30-60% of bank in reach has areas of erosion • High erosion potential during floods	• Unstable • Many eroded areas • 60-100% of bank has erosional scars
SCORE ___(LB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
SCORE ___(RB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Mean LB&RB_____				
4. **Frequency of Riffles**	• Riffles relatively frequent • Distance between riffles divided by width of stream = 5-7 • Variety of habitat is key	• Occurrence of riffles infrequent • Distance between riffles divided by width of stream = 7-15	• Occassional riffle or run • Bottom contours provide some habitat • Distance between riffles divided by width of stream = 15-25	• Generally flat water, shallow riffles • Poor habitat • Distance between riffles divided by width of stream = >25
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

SUBTOTAL : _____

Habitat Parameter	*Category*			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
5. Channel Alteration	• Changes to channel/dredging absent or minimal • Stream with normal pattern	• Some changes to channel/dredging • Evidence of past channel/dredging • Recent channel/dredging not present	• Channel changes/dredging extensive • Embankments or shoring structures present on both banks • 40 to 80% of reach channelised and disrupted	• Banks shored with gabion or cement • >80% of the stream reach channelised and disrupted. • Instream habitat altered or absent
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
6. Sediment Deposition (out of channel and in channel)	• Little/no islands or point bars present • <20% of the bottom affected by sediment deposition	• New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of the bottom affected; • Slight deposition in pools	• Some deposition of new gravel, sand or fine sediment on old and new bars • 50-80% of the bottom affected • Sediment deposits at obstructions, constrictions, and bends	• Heavy deposits of fine material • Increased bar development • >80% of the bottom changing frequently • pools almost absent due to sediment deposition
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
7. Veloctity/Depth Regimes	• 4 velocity/depth regimes present • slow/deep, slow/shallow, fast/shallow, fast/deep	• 3 of 4 velocity/depth regimes present • If fast/shallow is missing then score lower	• 2 of 4 velocity/depth regimes present • If fast/shallow or slow/shallow are missing score low	• Dominated by 1 velocity/depth regime • Usually slow/deep
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
8. Abundance and Diversity of Habitat	• >50% substrate favourable for invertebrate colonisation and wide variety of woody debris, riffles, root mats, snags/submerged logs/undercut banks/cobbles. • Substrate provides abundant fish cover • Must be not new and not transient	• 30-50% substrate favourable for invertebrate colonisation • Snags/submerged logs/undercut banks/cobbles • Fish cover common • Moderate variety of habitat types. Can consist of some new material	• 10-30% substrate favourable for invertebrate colonisation • Fish cover patchy • 60-90% substrate easily moved by foot • Woody debris rare or may be smothered by sediment	• <10% substrate favourable for invertebrate colonisation • Fish cover rare or absent • Substrate unstable or lacking • Stable habitats lacking or limited to macrophytes
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
9. Periphyton	• Periphyton not visible on hand held stones • Stable substrate • Surfaces rough to touch	• Periphyton not visible on stones • Stable substrate • Periphyton obvious to touch	• Periphyton visible • <20% cover of available substrate	• Periphyton obvious and prolific • >20% cover of available substrate
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Total Score ____	NB: Use only means of LB and RB values			

WADEABLE SOFT-BOTTOMED STREAMS – 100 m reach

Qualitative Habitat Assessment Field Data Sheet

STREAM NAME:	**SITE NUMBER:**
SAMPLE NUMBER: **ASSESSOR:**	**DATE:**

Habitat Parameter	Category			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
1. Riparian Vegetative Zone Width (score each bank riparian zone)	• Bankside vegetation buffer is >10m • Continuous and dense	• Bankside vegetation buffer is <10m • Mostly continuous	• Pathways present and/or stock access to stream • Mostly healed over	• Breaks frequent • Human activity obvious
SCORE ___(LB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
SCORE ___(RB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Mean LB&RB_____				
2. Vegetative Protection (score each bank) Note: determine left or right side by facing downstream.	• Bank surfaces and immediate riparian zones covered by native vegetation • Trees, understorey shrubs, or non-woody plants present • Vegetative disruption minimal	• Bank surfaces covered mainly by native vegetation • Disruption evident • Banks may be covered by exotic forestry	• Bank surfaces covered by a mixture of grasses/shrubs, blackberry, willow and introduced trees • Vegetation disruption obvious • Bare soil/closely cropped vegetation common	• Bank surfaces covered by grasses and shrubs • Disruption of streambank vegetation very high • Grass heavily grazed • Significant stock damage to the bank
SCORE ___(LB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
SCORE ___(RB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Mean LB&RB_____				
3. Bank Stability (score each bank) Note: determine left of right side by facing downstream	• Banks stable • Erosion/bank failure absent or minimal • <5% of bank affected	• Moderately stable • Infrequent, small areas of erosion mostly healed over • 5-30% of bank eroded	• Moderately unstable • 30-60% of bank in reach has areas of erosion • High erosion potential during floods	• Unstable • Many eroded areas • 60-100% of bank has erosional scars
SCORE ___(LB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
SCORE ___(RB)	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Mean LB&RB_____				
4. **Channel sinuousity**	• Bends increase stream length 3-4 times longer than if it was in a straight line	• Bends increase the stream length 2-3 times longer than if it was in a straight line	• Bends increase the stream length 1-2 times longer than if it was in a straight line	• Channel straight
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1

SUBTOTAL : _____

Soft bottomed continued

Habitat Parameter	*Category*			
	Optimal	**Suboptimal**	**Marginal**	**Poor**
5. Channel Alteration	• Changes to channel/dredging absent or minimal • Stream with normal pattern	• Some changes to channel/dredging • Evidence of past channel/dredging • Recent channel/dredging not present	• Channel changes/dredging extensive • Embankments or shoring structures present on both banks • 40 to 80% of reach channelised and disrupted	• Banks shored with gabion or cement • >80% of the stream reach channelised and disrupted. • Instream habitat altered or absent
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
6. Sediment Deposition	• Little/no islands or point bars present • <20% of the bottom affected by sediment deposition	• New increase in bar formation, mostly from gravel, sand or fine sediment • 20-50% of the bottom affected; • Slight deposition in pools	• Some deposition of new gravel, sand or fine sediment on old and new bars • 50-80% of the bottom affected • Sediment deposits at obstructions, constrictions, and bends	• Heavy deposits of fine material • Increased bar development • >80% of the bottom changing frequently • pools almost absent due to sediment deposition
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
7. Pool Variability	• Pools evenly mixed • Large/shallow, Large/deep, Small/shallow, Small/deep	• Majority of pools large/deep • Very few shallow pools	• Prevalence shallow pools	• Majority of pools small/shallow
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
8. Abundance and Diversity of Habitat	• >50% substrate favourable for invertebrate colonisation and wide variety of woody debris, riffles, root mats, snags/submerged logs/undercut banks/cobbles. • Substrate provides abundant fish cover • Must be not new and not transient	• 30-50% substrate favourable for invertebrate colonisation • Snags/submerged logs/undercut banks/cobbles • Fish cover common • Moderate variety of habitat types. Can consist of some new material	• 10-30% substrate favourable for invertebrate colonisation • Fish cover patchy • 60-90% substrate easily moved by foot • Woody debris rare or may be smothered by sediment	• <10% substrate favourable for invertebrate colonisation • Fish cover rare or absent • Substrate unstable or lacking • Stable habitats lacking or limited t macrophytes
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
9. Periphyton	• Periphyton not visible on hand held stones • Stable substrate • Surfaces rough to touch	• Periphyton not visible on stones • Stable substrate • Periphyton obvious to touch	• Periphyton visible • <20% cover of available substrate	• Periphyton obvious and prolific • >20% cover of available substrate
SCORE ___	20 19 18 17 16	15 14 13 12 11	10 9 8 7 6	5 4 3 2 1
Total Score ____	NB: Use only means of LB and RB values			

Stream:_____ **Located number**_____ **Sample Number** _____ **Date**:_____

Transect	Average wetted width (m)	Average depth (m) (Thalweg + 4 points)	Total cover	Vegetation cover (% wetted area)							
				Rooted submerged plants						Rooted emergent plants	
				Total submerged	Surface-reaching		Below surface		Epiphyton	Total emergent	Species
					Sub-total	Species	Sub-total	Species			
1											
2											
3											
4											
5											

Species codes:

Native spp.
Introduced spp.

SUBMERGED SPECIES/Surface reaching

Cd - *Ceratophyllum demersum* HORNWORT
Ec - *Elodea Canadensis* CANADIAN PONDWEED
Ed - *Egeria densa* EGERIA
Lm - *Lagarosiphon major* LAGROSIPHON
Pk - *Potamogeton crispus* CURLED PONDWEED
Po - *Potamogeton ochreatus* BLUNT PONDWEED
Nh - *Nitella hookeri/cristata* NITELLA
ST *Callichtriche stagnalis* STARWORT

EMERGENT SPECIES

An - *Apium nodiflorum* WATER CELERY
Gm - *Glyceria maxima* REED SWEET GRASS
Gr - other grass spp.
Lp - *Ludwigia palustris* WATER PURSLANE
Mg - *Mimulus guttatus* MONKEY MUSK
Ma - *Myriophyllum aquaticum* PARROTS FEATHER
Na - *Nasturtium officinale/microphyllum* WATERCRESS
Ph - *Persicaria hydropiper* WATER PEPPER
Ps - *Persicaria decipiens* SWAMP WILLOW WEED
Ve - *Veronica anagallis-aquatica/Americana* WATER SPEEDWELL

Rooted emergent: None Rare Sparse Common Abundant
Rooted submerged: None Rare Sparse Common Abundant

Appendix 4: Coordinated Monitoring of New Zealand's Wetlands Framework Field sheet

Table 2: Wetland Record Sheet

Wetland name: **Date:**
Region: **GPS/Grid Ref.:**
Altitude: **No. of plots sampled:**

Classification: I System	IA Subsystem	II Wetland Class	IIA Wetland Form

Field team:

Indicator	Indicator components	Specify and Comment	Score 0– 5[1]	Mean score
Change in hydrological integrity	Impact of manmade structures			
	Water table depth			
	Dryland plant invasion			
Change in physico-chemical parameters	Fire damage			
	Degree of sedimentation/erosion			
	Nutrient levels			
	von Post index			
Change in ecosystem intactness	Loss in area of original wetland			
	Connectivity barriers			
Change in browsing, predation and harvesting regimes	Damage by domestic or feral animals			
	Introduced predator impacts on wildlife			
	Harvesting levels			
Change in dominance of native plants	Introduced plant canopy cover			
	Introduced plant understorey cover			
Total wetland condition index /25				

[1]Assign degree of modification thus: 5=v. low/ none, 4=low, 3=medium, 2=high, 1=v. high, 0=extreme

Main vegetation types:

Native fauna:

Other comments:

Pressure	Rating[2]	Specify and Comment
Modifications to catchment hydrology		
Water quality within the catchment		
Animal access		
Key undesirable species		
% catchment in introduced vegetation		
Other pressures		
Total wetland pressure index /30		

[2]Assign pressure scores as follows: 5=very high, 4=high, 3=medium, 2=low, 1=very low, 0=none

Table 3: Wetland Plot Sheet

Wetland name: **Date:** **Plot no:**
Plot size (2m x 2m default)**:** **Altitude:** **GPS/GR:**
Field leader: **Structure:** **Composition:**

Canopy (bird's eye view)			**Subcanopy**			**Groundcover**		
Species[1] (or Substrate)	**%**	**H**	**Species**	**%**	**H**	**Species**	**%**	**H**

[1] % = % cover: total canopy % cover = 100%; H = maximum height in m; indicate introduced species by *

Additional species in vicinity in same vegetation type:

Comments:

Indicator (use plot data only)	**%**	**Score 0–5**[2]	**Specify & Comment**
Canopy: % cover introduced species			
Understorey: % cover introduced spp[3]			
Total species: % number introduced spp			
Total species: overall stress/dieback	NA		
Total plot condition index /20	NA		

[2]5=0%: none, 4=1–24%: very low, 3=25–49%; low, 2=50–75%: medium, 1=76–99%: high, 0=100%; very high
[3]Add subcanopy and groundcover % cover for introduced species

Field measurements:

Water table cm		Water conductivity uS (if present)	
Water pH (if present)		von Post peat decomposition index	

Soil core laboratory analysis (2 soil core subsamples)**:**

Water content % dry weight		Total C %	
Bulk Density T/m^3		Total N %	
pH		Total P mg/kg	
Conductivity uS			

Foliage laboratory analysis (leaf/culm sample of dominant canopy species):

Species		%N		%P	

Appendix 5: Bird species list

Species		Conservation Status (as per Robertson et al., 2017)
Common name	**Scientific name**	
Australian Magpie	*Gymnorhina tibicen*	Introduced and Naturalised
Chaffinch	*Fringilla coelebs*	Introduced and Naturalised
Common myna	*Acridotheres tristis*	Introduced and Naturalised
Common pheasant	*Phasianus colchicus*	Introduced and Naturalised
Dunnock	*Prunella modularis*	Introduced and Naturalised
Eastern rosella	*Platycercus eximius*	Introduced and Naturalised
Eurasian blackbird	*Turdus merula*	Introduced and Naturalised
Eurasian skylark	*Alauda arvensis*	Introduced and Naturalised
European goldfinch	*Carduelis carduelis*	Introduced and Naturalised
Grey warbler	*Gerygone igata*	Not Threatened
Kereru	*Hemiphaga novaeseelandiae*	Not Threatened
Mallard	*Anas platyrhynchos*	Introduced and Naturalised
New Zealand pipit	*Anthus novaeseelandiae*	At Risk - Declining
North Island fantail	*Rhipidura fuliginosa placabilis*	Not Threatened
Pied shag	*Phalacrocorax varius*	At Risk - Recovering
Pukeko	*Porphyrio melanotus*	Not Threatened
Ruru (morepork)	*Ninox novaeseelandiae*	Not Threatened
Sacred kingfisher	*Todiramphus sanctus*	Not Threatened
Silvereye	*Zosterops lateralis*	Not Threatened
Song thrush	*Turdus philomelos*	Introduced and Naturalised
Swamp harrier	*Circus approximans*	Not Threatened
Tūī	*Prosthemadera novaeseelandiae*	Not Threatened
Welcome swallow	*Hirundo neoxena*	Not Threatened
White-faced heron	*Egretta novaehollandiae*	Not Threatened

Appendix 6: Wetland condition features

Site	Parameters						
	Wetland Size	Hydrological Integrity	Physico-chemical parameters	Ecosystem intactness	Fencing	Animal pest control measures	Dominance of native plants
Site 1	200 m^2	No impact observed	N/A	Impacted by limited connectivity to upstream and downstream habitat due to undefined ephemeral watercourses filled with overgrown tree slash	None	None	Limited: Majority of canopy species replaced by harvested pine; Exotic plants surrounding wetland included gorse, pampas grass, inkweed, woolly nightshade
Fill area 2	450 m^2	Impacted from bunding at upstream and downstream extent through two forestry tracks; likely increased water table depth	Increased nutrient levels: Elevated total nitrogen, ammoniacal nitrogen, total kjeldahl nitrogen concentrations. However, likely reflective of natural wetland condition.	Impacted by loss of small wetland area at upstream extent due to forestry track. Further impacted by limited connectivity to downstream habitat due to drop from bunded downstream extent and due to abundance of overgrown tree slash in downstream reach. Downstream reach did not feature defined water channels	None	None	Limited: Majority of canopy species replaced by harvested pine; Exotic plants surrounding wetland included gorse, pampas grass, inkweed, soft rush, buttercup, spearwort, kikuyu and woolly nightshade
Fill area 3	700 m^2	No impact observed	Impacted from previous stock access; Increased nutrient levels: Elevated total nitrogen, total kjeldahl nitrogen, total phosphorus concentrations; Increased metal levels: Elevated aluminium, nickel and zinc; However, increased parameters likely reflective of natural wetland condition.	Impacted by undefined watercourses to downstream habitat reducing connectivity	None: Stock trampling damage observed	None	Canopy species replaced by harvested pine; Exotic plants surrounding wetland included gorse, pasture grass species and kikuyu grass
Fill area 4	380 m^2	Impacted from bunding at downstream extent through forestry track; likely increased water table depth	Impacted from increased nutrient levels: Elevated total nitrogen, total kjeldahl nitrogen and total phosphorus concentrations. However, likely reflective of natural wetland condition.	Impacted by limited connectivity to downstream habitat due to corrugated pipe over pronounced gradient and undefined downstream watercourse	None	None	Reduced: Large proportion of surrounding canopy trees replaced by redwoods; Majority of catchment canopy species replaced by harvested pine: other exotic plants surrounding wetland predominantly pasture grasses and gorse.

Appendix 7: Water and sediment quality laboratory report

Hill Laboratories
TRIED, TESTED AND TRUSTED

R J Hill Laboratories Limited
28 Duke Street Frankton 3204
Private Bag 3205
Hamilton 3240 New Zealand

T 0508 HILL LAB (44 555 22)
T +64 7 858 2000
E mail@hill-labs.co.nz
W www.hill-laboratories.com

Certificate of Analysis

Client:	Boffa Miskell Limited	**Lab No:**	2199449	SPv1
Contact:	Tine Ulrich	**Date Received:**	27-Jun-2019	
	C/- Boffa Miskell Limited	**Date Reported:**	05-Jul-2019	
	PO Box 1094	**Quote No:**	99748	
	Waikato Mail Centre	**Order No:**	BM19472	
	Hamilton 3240	**Client Reference:**	BM19472	
		Submitted By:	Tine Ulrich	

Sample Type: Sediment

Sample Name:		Fill 4 DS WL [Sediment] 26-Jun-2019 12:30 pm	Fill 2 DS WL [Sediment] 26-Jun-2019 9:25 am	Fill 3 DS WL [Sediment] 26-Jun-2019 11:00 am		
Lab Number:		2199449.4	2199449.5	2199449.6		
Individual Tests						
Dry Matter	g/100g as rcvd	28	31	27	-	-
Total Recoverable Iron	mg/kg dry wt	36,000	13,000	29,000	-	-
Total Recoverable Phosphorus	mg/kg dry wt	1,110	510	470	-	-
Total Nitrogen*	g/100g dry wt	0.44	0.27	0.30	-	-
Nitrite-N*	mg/kg dry wt	< 1.7	< 1.5	< 1.8	-	-
Nitrate-N*	mg/kg dry wt	< 2.4	< 2.2	< 2.5	-	-
Nitrate-N + Nitrite-N*	mg/kg dry wt	< 1.7	< 1.5	< 1.8	-	-
Heavy metal, trace level As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Recoverable Arsenic	mg/kg dry wt	6.4	2.1	7.7	-	-
Total Recoverable Cadmium	mg/kg dry wt	0.196	0.168	0.24	-	-
Total Recoverable Chromium	mg/kg dry wt	5.4	5.3	7.7	-	-
Total Recoverable Copper	mg/kg dry wt	11.4	8.4	14.6	-	-
Total Recoverable Lead	mg/kg dry wt	12.0	11.9	17.9	-	-
Total Recoverable Nickel	mg/kg dry wt	4.2	2.9	12.9	-	-
Total Recoverable Zinc	mg/kg dry wt	61	32	69	-	-

Sample Type: Aqueous

Sample Name:		Fill 4 DS WL [Surface Water] 26-Jun-2019 12:30 pm	Fill 2 DS WL [Surface Water] 26-Jun-2019 9:25 am	Fill 3 DS WL [Surface Water] 26-Jun-2019 11:00 am		
Lab Number:		2199449.1	2199449.2	2199449.3		
Individual Tests						
Turbidity	NTU	11.8	4.0	16.9	-	-
Total Suspended Solids	g/m³	21	5	20	-	-
Dissolved Aluminium	g/m³	0.009	0.018	0.169	-	-
Total Aluminium	g/m³	0.042	0.035	0.44	-	-
Dissolved Iron	g/m³	0.98	0.90	0.11	-	-
Total Iron	g/m³	3.0	2.1	1.75	-	-
Total Nitrogen	g/m³	0.53	0.61	1.14	-	-
Total Ammoniacal-N	g/m³	< 0.010	0.042	0.011	-	-
Nitrite-N	g/m³	< 0.002	< 0.002	0.004	-	-
Nitrate-N	g/m³	< 0.002	0.003	0.008	-	-
Nitrate-N + Nitrite-N	g/m³	0.003	0.005	0.011	-	-
Total Kjeldahl Nitrogen (TKN)	g/m³	0.53	0.60	1.13	-	-
Dissolved Reactive Phosphorus	g/m³	< 0.004	< 0.004	< 0.004	-	-
Total Phosphorus	g/m³	0.073	0.034	0.055	-	-

Sample Type: Aqueous						
Sample Name:		Fill 4 DS WL [Surface Water] 26-Jun-2019 12:30 pm	Fill 2 DS WL [Surface Water] 26-Jun-2019 9:25 am	Fill 3 DS WL [Surface Water] 26-Jun-2019 11:00 am		
Lab Number:		2199449.1	2199449.2	2199449.3		
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Dissolved Arsenic	g/m³	< 0.0010	< 0.0010	< 0.0010	-	-
Dissolved Cadmium	g/m³	< 0.00005	< 0.00005	0.00035	-	-
Dissolved Chromium	g/m³	< 0.0005	< 0.0005	< 0.0005	-	-
Dissolved Copper	g/m³	< 0.0005	< 0.0005	< 0.0005	-	-
Dissolved Lead	g/m³	< 0.00010	< 0.00010	< 0.00010	-	-
Dissolved Nickel	g/m³	< 0.0005	0.0009	0.022	-	-
Dissolved Zinc	g/m³	< 0.0010	0.0101	0.061	-	-
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Arsenic	g/m³	< 0.0011	< 0.0011	< 0.0011	-	-
Total Cadmium	g/m³	< 0.000053	< 0.000053	0.00037	-	-
Total Chromium	g/m³	< 0.00053	< 0.00053	< 0.00053	-	-
Total Copper	g/m³	< 0.00053	< 0.00053	0.00090	-	-
Total Lead	g/m³	< 0.00011	< 0.00011	0.00034	-	-
Total Nickel	g/m³	< 0.00053	0.00095	0.022	-	-
Total Zinc	g/m³	0.0016	0.0113	0.063	-	-

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.
Unless otherwise indicated, analyses were performed at Hill Laboratories, 28 Duke Street, Frankton, Hamilton 3204.

Sample Type: Sediment			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Environmental Solids Sample Drying*	Air dried at 35°C Used for sample preparation. May contain a residual moisture content of 2-5%.	-	4-6
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	4-6
Heavy metal, trace level As,Cd,Cr,Cu,Ni,Pb,Zn	Dried sample, <2mm fraction. Nitric/Hydrochloric acid digestion, ICP-MS, trace level.	0.010 - 0.4 mg/kg dry wt	4-6
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed). US EPA 3550.	0.10 g/100g as rcvd	4-6
2M KCl Extraction*	2M potassium chloride extraction of as received fraction for analysis of NH4N, NO2N and NO3N. Analyst, 109, 549, (1984).	-	4-6
Total Recoverable digestion	Nitric / hydrochloric acid digestion. US EPA 200.2.	-	4-6
Total Recoverable Iron	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	4-6
Total Recoverable Phosphorus	Dried sample, sieved as specified (if required). Nitric/Hydrochloric acid digestion, ICP-MS, screen level. US EPA 200.2.	40 mg/kg dry wt	4-6
Total Nitrogen*	Catalytic Combustion (900°C, O2), separation, Thermal Conductivity Detector [Elementar Analyser].	0.05 g/100g dry wt	4-6
Nitrite-N*	FIA determination of 2M potassium chloride extraction on as received fraction. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	1.0 mg/kg dry wt	4-6
Nitrate-N*	Calculation: (Nitrate-N + Nitrite-N) - Nitrite-N.	1.5 mg/kg dry wt	4-6
Nitrate-N + Nitrite-N*	Automated cadmium reduction, FIA determination of 2M potassium chloride extraction on as received fraction. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	1.0 mg/kg dry wt	4-6

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Heavy metals, dissolved, trace As,Cd,Cr,Cu,Ni,Pb,Zn	0.45µm filtration, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012.	0.00005 - 0.0010 g/m³	1-3
Heavy metals, totals, trace As,Cd,Cr,Cu,Ni,Pb,Zn	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 22nd ed. 2012 / US EPA 200.8	0.000053 - 0.0011 g/m³	1-3
Filtration, Unpreserved	Sample filtration through 0.45µm membrane filter.	-	1-3
Total Digestion	Nitric acid digestion. APHA 3030 E (modified) 23rd ed. 2017.	-	1-3

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Turbidity	Analysis using a Hach 2100N, Turbidity meter. APHA 2130 B 23rd ed. 2017.	0.05 NTU	1-3
Total Suspended Solids	Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5µm), gravimetric determination. APHA 2540 D (modified) 23rd ed. 2017.	3 g/m^3	1-3
Filtration for dissolved metals analysis	Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B 23rd ed. 2017.	-	1-3
Dissolved Aluminium	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.003 g/m^3	1-3
Total Aluminium	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017 / US EPA 200.8.	0.0032 g/m^3	1-3
Dissolved Iron	Filtered sample, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.02 g/m^3	1-3
Total Iron	Nitric acid digestion, ICP-MS, trace level. APHA 3125 B 23rd ed. 2017.	0.021 g/m^3	1-3
Total Nitrogen	Calculation: TKN + Nitrate-N + Nitrite-N. Please note: The Default Detection Limit of 0.05 g/m^3 is only attainable when the TKN has been determined using a trace method utilising duplicate analyses. In cases where the Detection Limit for TKN is 0.10 g/m^3, the Default Detection Limit for Total Nitrogen will be 0.11 g/m^3.	0.05 g/m^3	1-3
Total Ammoniacal-N	Phenol/hypochlorite colourimetry. Flow injection analyser. (NH_4-N = NH_4^+-N + NH_3-N). APHA 4500-NH_3 H (modified) 23rd ed. 2017.	0.010 g/m^3	1-3
Nitrite-N	Automated Azo dye colorimetry, Flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1-3
Nitrate-N	Calculation: (Nitrate-N + Nitrite-N) - NO2N. In-House.	0.0010 g/m^3	1-3
Nitrate-N + Nitrite-N	Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO_3^- I (modified) 23rd ed. 2017.	0.002 g/m^3	1-3
Total Kjeldahl Nitrogen (TKN)	Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N_{org} D (modified) 4500 NH_3 F (modified) 23rd ed. 2017.	0.10 g/m^3	1-3
Dissolved Reactive Phosphorus	Filtered sample. Molybdenum blue colourimetry. Flow injection analyser. APHA 4500-P G (modified) 23rd ed. 2017.	0.004 g/m^3	1-3
Total Phosphorus	Total phosphorus digestion, ascorbic acid colorimetry. Discrete Analyser. APHA 4500-P B & E (modified from manual analysis and also modified to include a reductant to reduce interference from any arsenic present in the sample) 23rd ed. 2017. NWASCO, Water & soil Miscellaneous Publication No. 38, 1982.	0.004 g/m^3	1-3

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

Helena Bertram BSc
Client Services Manager - Environmental

Appendix 8: Aquatic macroinvertebrate species list

			Sampling Site		
General Group	Taxa	Common Name	Fill area 2	Fill area 3	Fill area 4
Hydrozoa	Hydra	Freshwater Hydra			20 (A)
Platyhelminthes	Platyhelminthes	Flat Worm	5 (C)	5 (C)	500 (VVA)
Nemertea	Nemertea	Proboscis worms	1 (R)		20 (A)
Gastropoda	Physa sp.	Freshwater snail		1 (R)	
Gastropoda	Pseudosuccinea columella	FW snail (introduced)	20 (A)	5 (C)	1 (R)
Oligochaeta	Oligochaeta	Oligochaete worms	20 (A)	100 (VA)	500 (VVA)
Hirudinea	Hirudinea	Leeches	100 (VA)	5 (C)	100 (VA)
Collembola	Collembola	Springtails	20 (A)		5 (C)
Crustacea	Cladocera	water flea	500 (VVA)	20 (A)	500 (VVA)
Ostracoda	Ostracoda	Ostracods		20 (A)	
Copepoda	Copepoda	Copepods	500 (VVA)	500 (VVA)	500 (VVA)
Odonata	Aeshna brevistyla	lancer dragonfly		1 (R)	
Odonata	Austrolestes colensonis	blue damselfly	5 (C)	1 (R)	20 (A)
Odonata	Hemicordulia australiae	sentry dragonfly	1 (R)		
Odonata	Procordulia sp.	Dragonfly	1 (R)		1 (R)
Odonata	Xanthocnemis	Damsel fly	500 (VVA)	500 (VVA)	20 (A)
Hemiptera	Anisops wakefieldi	Back swimmer	5 (C)	20 (A)	1 (R)
Hemiptera	Microvelia macgregori	Waterskaters	20 (A)	20 (A)	
Hemiptera	Sigara sp.	water boatmen		20 (A)	1 (R)
Coleoptera	Staphylinidae	Rove beetle		1 (R)	
Coleoptera	Antiporus sp.	diving beetle	1 (R)		
Coleoptera	Enochrus tritus	Water beetle	20 (A)	20 (A)	1 (R)
Diptera	Ceratopogonidae	Fly larvae	5 (C)		
Diptera	Orthocladiinae	midges	20 (A)	20 (A)	1 (R)
Diptera	Tanytarsini	non-biting midges	500 (VVA)		
Diptera	Chironomus spp.	non-biting midges	1 (R)		
Diptera	Chironomus zealandicus	non-biting midges		100 (VA)	
Diptera	Corynoneura	non-biting midges	20 (A)		
Diptera	Paralimnophila sp.	crane fly			1 (R)
Diptera	Tanytarsini sp.	Midge fly larvae		100 (VA)	20 (A)
Trichoptera	Oxyethira albiceps	Axe-head caddis	1 (R)		
Trichoptera	Triplectides sp.	Case caddis larvae		1 (R)	
Arachnida	Acarina	Mites		1 (R)	
Arachnida	Pseudoscorpionida	False scorpions		1 (R)	

Appendix 9: Scope of works documentation

1.1 Client and Project Information		
Name of Client/Organisation Gleeson and Cox Ltd	Name of Project Gleeson Quarries Huntly Limited– New District and Regional Resource consents for excavation and disposal of quarry overburden material onsite and importation of managed fill (clean fill) to an identified fill site within the quarry landholdings.	
Legal Description: PT LOT 9 – 10 DP1278, CT SA922/109 DP 25272, CT SA656/223 Lot 9 DP 1278 and Part Lot 10, DP 1278, CT SA149/243 Pt Lot 11 DP 1278, CT SA 200/118 Lot 1 DPS 75436 CT SA 57C/382 Pt Lot 11 DP 1278, CT SA 200/119 Pt Lot 12 DP 1278, CTSA 144/120 Lot 1 DPS 4285 CTSA29C/651		
Project Manager(s) & Consent Planners Kate Madsen - Paua Planning Ltd		
Name of Contact Person Biance Schoeman Paua Planning Ltd	Project Location Riverview Road, Huntly	Project No. PAU310 Overburden Regional Consent PAU311 Overburden District Consent PAU312 Managed Fill Regional Consent PAU313 Managed Fill Regional Consent
Contact's Mailing Address 180 Bawden Road Albany	City Auckland	Postal Code 0792
Email address of Contact Person biance@pauaplanning.co.nz		
Telephone Number (DDI)		Mobile number: 021 087 75913

1.2 Project Background:

- The quarry site located off Riverside Road, Huntly has been operated by Stevenson Resources Ltd (SRL) since 1980. The quarry was purchased by Gleeson & Cox in December 2018. Mining reports indicate there is still 30-50 years of accessible deposits left to extract.
- Land-use resource consent under the RMA was granted in July 2000 to deposit overburden and remove native vegetation[1].
- A further land-use consent was granted in 2010[2] by Waikato District Council (WDC) to extend the boundaries of the quarry and establish an Overburden Disposal Area.
- Variations to the 2010 consent were subsequently granted in September 2014, March 2018 and September 2018[3].
- Overall, the rate of extraction has increased from 900,000 tonnes per annum (average of 650,000 tonnes over a five year period) to 1,400,000 tonnes per annum (average of 1,000,000 tonnes over a five year period). A s127 variation to the district consent LUC0035/11 to increase the maximum tonnage from the present level of 1,400,000 tonnes to a new maximum of **1,800,000 tonnes** per annum is currently underway.
- Regional Consents were obtained in 2000 for a water take from the Waikato River, diversion and discharge

[1] WDC No. 69 000 14 5
[2] LUC0035/11 granted 17 November 2010
[3] LUC0035/11.01; LUC0035/11.02; LUC0035/11.03

of stormwater runoff, land disturbance in a high risk area, discharge of stormwater, discharge of overburden and groundwater take. These are due to expire in June 2020

- There are two remaining regional consents (for earthworks and vegetation clearance within a high risk erosion area and to divert an ephemeral watercourse) that do not expire until 2045.

Image 1: Huntly Quarry Site location

1.3 Project Description:

The existing consented overburden fill site (located to the west of the main quarry) has reached its capacity and therefore a new overburden fill site is required. Resource consents (regional and district) under the Resource Management Act ('RMA') are required to provide for the placement of overburden on the site.

Gleeson Quarries Huntly Limited is also investigating the feasibility to establish and operate a managed / clean fill site at the Huntly Quarry. It is anticipated that the same fill areas will be used for both overburden and managed fill. The proposed fill sites are located on farm land around the north and western sides of Huntly Quarry on Riverview Road, Huntly.

At this stage there are five proposed fill sites – three of these are potential managed fill sites, one is a combination managed fill & overburden, and one is overburden only. These are shown on the attached indicative site plan (this is about to be updated with more accurate volumes, extent etc. The attached is therefore a very preliminary drawing). The fill numbering is no more than the conceptual order of filling. There is potentially 4 managed fill sites and one internal overburden site. Fill site 2,3,4 and 5 is however preferred, but still needs to be confirmed.

Refer Map 1

Basic initial parameters of assessments required to cover the following information:

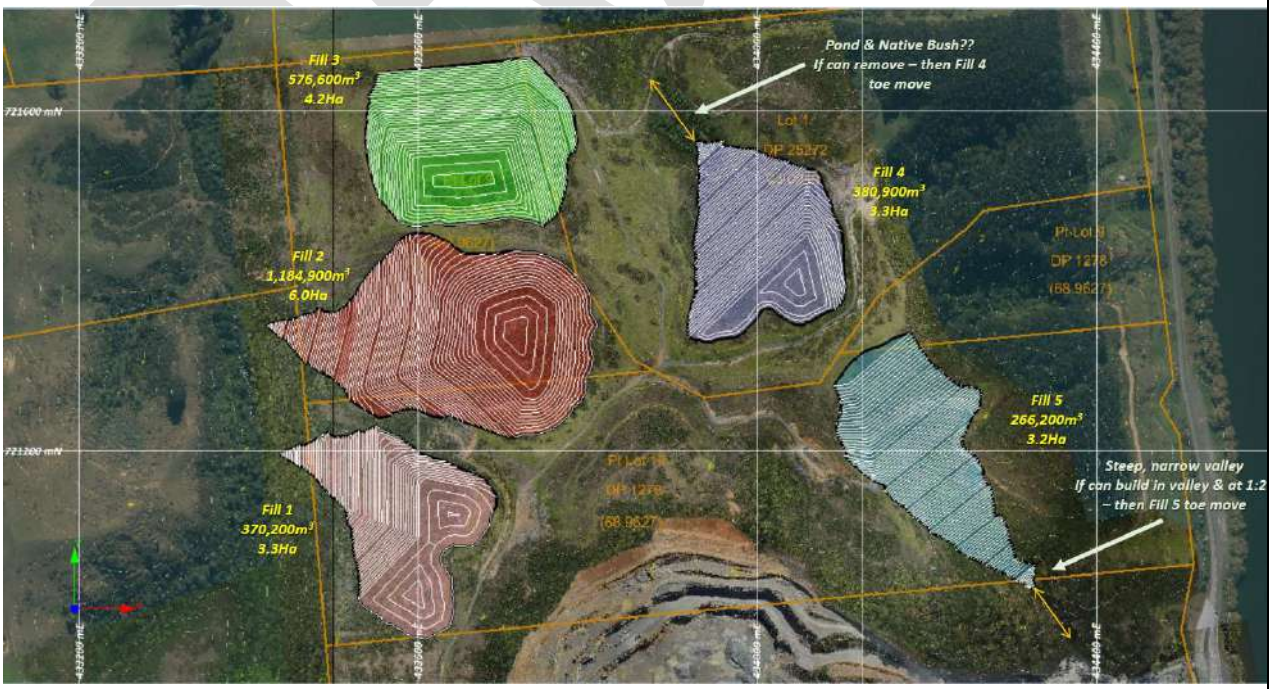
- Volume, area, length and batter height of the proposed activity.
- The proposed start and completion times of the activity.
- Description of the topography, soil type and vegetation.
- What effects the activity will have on the environment including:
- the potential effects on soil erosion, slope stability (including the potential to exacerbate preexisting deep seated land instability), adjacent water bodies and water quality,
- the extent to which the activity will adversely affect areas of significant indigenous vegetation and significant habitats of indigenous fauna2,
- the extent to which the activity will affect sites of significance to tangata whenua as Kaitiaki,
- the extent to which the activity will affect neighbouring properties,

- the extent to which the activity will affect any lawfully established structure.
- the extent to which the activity will affect any cave system, wetland or geothermal feature,
- the extent to which the discharge will comply with the requirements of Policy 1 in Chapter 6.1 of this Plan with regard to objectionable effects from particulate matter,
- the effects on the uses and values of adjacent water bodies,
- the effects on uses and values of adjacent water bodies as identified in the Regional Coastal Plan.
- The design and construction methods to be used.
- Methods to control water and sediment run-off from the site.
- The characteristics and sources of the material to be received at the site, and the measures to ensure that the material meets the definition of cleanfill or overburden in this Plan.
- An assessment of the acid drainage potential of the material.
- Methods to control airborne particulate matter.
- Any measure necessary to rehabilitate the land following the completion of activity.

Experts required:

- Land and Fill Assessment
- Geotechnical Engineering
- Erosion and Sediment Control
- Hydrological
- Stormwater Discharge
- Discharge Contaminants
- Fill management plan
- Traffic
- Noise
- Ecology
- Archaeology
- Cultural Impact Assessment/Iwi
- Visual and Landscape

The Ecological Assessment needs to investigate and carefully assess the ecological effects associated with the potential fill sites for the purposes of a resource consent application.



Map 1: Huntly Quarry potential fill area(s) for assessment

Description of applications that require ecological input:

- District and regional applications for excavation and disposal of overburden within identified fill site(s) (pending confirmation from the Quarry Land Use & Fill assessment and Geotechnical investigation; preferred fill option to be advised once this is completed). Capacities to be confirmed.
- District and regional applications to establish and operate a managed clean fill site within identified fill site(s) north, north-west and north-east of the existing quarry as shown in Map 1.
- Bundled application for regional consents which are expiring in June 2020: Discharge to land permit, Land use consent for land disturbance (probably replaced with above mentioned regional consent applications.

Notes:

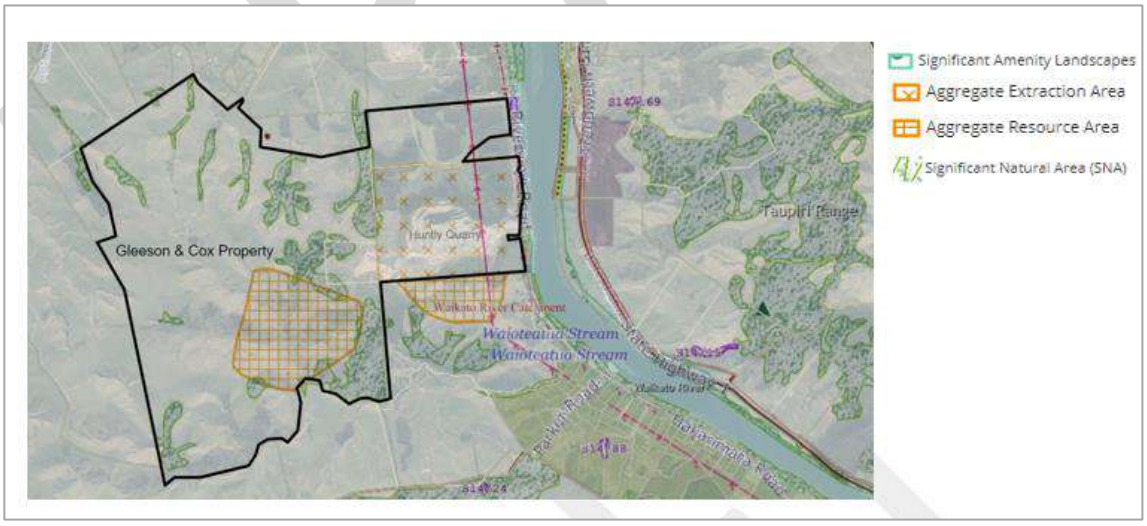
- The original ecological report completed by Boffa Miskell Limited in 2001 assessed the ecological values and potential issues relating to several bush areas and associated natural habitats (i.e streams or wetlands) within the area of quarry activities at that time.
- The quarry property has since increased due to the purchase of the 'Payne Block' (north of the active quarry area).
- The statutory plans and tools used to assess the significance of the natural areas have been updated and changed since the original report.

1.4 Project Site:

The original assessment indicated that the remaining 20% of the natural area of the quarry property is covered in manuka, pine and gum slopes. Based on the Waikato District **Operative** plan there is limited natural environment of significance to take note of except the eastern boundaries of the property which forms part of the Landscape Policy area.

The Waikato District **Proposed** Plan however lists several of the bush areas on the quarry property as Significant Natural Areas and the section known as the Landscape Policy area would then form part of the Significant Amenity Landscape.

It is key that any potential adverse effect on these areas is addressed in the Ecological assessment, and the location of the fill site(s) in relation to any waterways, significant indigenous vegetation and habitat is assessed, as well as potential loss of ecological corridors, biodiversity and cumulative effects.



Map 2: Waikato Proposed District Plan and Huntly Quarry Property

In the existing resource consent, there is specific conditions that relates to screen planting and vegetation. The resource consent conditions PC 10 - 12 requires that the areas of pine and eucalypt is retained in perpetuity and enhanced through native vegetation as illustrated in Map 3. It is required that the ecological study assesses the effect of the clearance of sections of these areas due to the location of the fill sites and assist with other/additional management measures.

Map 3: Area of pine and eucalypt to be retained

Further there are three properties as listed in the table below with a Notices Pursuant to Section 195(2) Climate Change Response Act 2002. The land has been classified as "pre-1990 forest land" which means that it must be replanted after harvest. This is to do with the Kyoto Protocol and the trading of carbon credits and NZ complying with its obligations regarding the aims of the Kyoto Protocol. It is required that the Ecological assessment will also assess these areas and advise on management measures to ensure that this notice is complied with.

Property Details	**"Restrictions"**
PT LOT 9 – 10 DP1278, CT SA922/109	9111245.1 Notice Pursuant to Section 195(2) Climate Change Response Act 2002
PT LOT 9 – 10 DP 25272, CT SA656/223	9255221.1 Notice Pursuant to Section 195(2) Climate Change Response Act 2002
Lot 9 DP 1278 and Part Lot 10, DP 1278, CT SA149/243	9109950.1 Notice Pursuant to Section 195(2) Climate Change Response Act 2002

1.5 Deliverables:

Including but not limited to:

1. Ecological walkover to determine the quantity/quality of native vegetation and habitats within identified potential fill sites; identification of any overland flow paths/streams (intermittent, ephemeral or perennial) or wetland areas.

2. If any sensitive ecological feature is identified, advice as to measures to avoid/remedy/mitigate potential adverse effects related to the overburden/fill operations.

3. Assessment and recommendations completed in line with the Waikato Operative & Proposed District Plan and Waikato Regional Policy statement and plan, specifically:

    - The Waikato Operative District Plan identifies areas of significant indigenous vegetation and significant habitats of indigenous fauna by assessment against the criteria listed in Part 3 Appendix OC- Significant Indigenous Vegetation Criteria of the Plan. The criteria are to be used to identify areas of significant indigenous vegetation and significant habitats of indigenous fauna as they exist at the time the criteria are being applied.
    - Please refer to Section D Appendix 2 of the Proposed Waikato District Plan for the Criteria for

Determining Significance of Indigenous Biodiversity (if relevant).

- Waikato Regional Policy Statement, Part B, 11 Indigenous biodiversity: 11 A Criteria for determining significance of indigenous ecological value.
- The Waikato Regional Plan contains rules relating to the clearance of vegetation in "high risk erosion areas", and adjacent to water courses, and rules relating to tracking and earthworks and works within water courses.
- Reference Waikato Regional Proposed Plan Change 1 Waikato and Waipa River Catchments (needs to be net gain to catchment)
- Department of Conservation guidelines for assessing significant ecological value.
- Any other recent guidelines and criteria.

3. The extent to which the activity will adversely affect areas of significance indigenous vegetation and significant habitats of indigenous fauna.

4. Any measure necessary to rehabilitate the land following the completion of the activity.

5. Recommendations for mitigations in order to reduce effects (existing and proposed).

6. Any suggested conditions for consent.

1.5 Previous Reporting/Plans relevant to this Scope of Works:

Document Name	Date	Author
Ecological Values & Issues of the area associated with the Stevensons Huntly Quarry Proposed Expansions	July 2001	Boffa Miskell Limited, July 2001
Quarry Development Project – Huntly Quarry	September 2009	Terra Mining Consultants
103164 Regional consent Discharge permit: Discharge to land	August 2000	Waikato Regional Council
103162 Regional consent Land use consent: Land Disturbance	August 2000	Waikato Regional Council

Additional historical reports are available on request.

1.6 Timeline of Project:

Stage 1: Agreement to and acceptance of scope (parameters may need further clarification or detail or may reduce subject to instruction from Gleeson & Cox re preferred dump site(s)).

Stage 2: Conduct survey/site visit etc. in order to complete Ecological Assessment

Stage 3: Draft plans/ecological assessment report provided for review: 26 July 2019

Stage 4: Final report for lodgement: 5 August 2019

The proposed lodgement date for resource consent application is **12 August 2019.**

1.7 Approval Requirements:

Please include the hourly rate & number of hours estimated to complete the Ecological Assessment in the fee proposal.

1.8 Additional Requirements and/or Conditions:

Please provide confirmation of professional liability insurances (certificates).

Any exceedance of an agreed scope of works in excess of 10% will require a new scope of works to be agreed upon.

This scope of works contains privileged and commercially sensitive information which is to be kept confidential until such time as consent applications are lodged, and all information becomes public.

Please notify Paua Planning in advance of any additional requirements e.g. meeting with site manager, information required from Gleeson & Cox, Council engineers etc.

Appendix 10: Proposed fill sites and sediment treatment ponds locations

N

Pond 2. Catchment ~ 5.25 ha.
Capacity 1,575 m3. Pond
bottom ~ 48 x 14m.

Pond 3. Catchment ~ 6.95 ha.
Capacity 2,085 m3. Pond
bottom ~ 53 x 16m.

Fill 3
~ 575,000m3
4.2 Ha

Fill 4
~ 800,000m3
5.1 Ha

Fill 2
~ 630,000m3
3.8 Ha

Fill 5
~ 180,000m3
2.5 Ha

Super silt fence
during pond
construction.

Pond 1. Catchment ~ 5.71 ha.
Capacity 1,715 m3. Pond
bottom ~ 49 x 15m.

Fill 1 option
- discarded

Pond 4. Catchment ~ 3.56 ha.
Capacity 1,070 m3. Pond
bottom ~ 38 x 11.5m.

QUARRY

Legend

- Property boundary
- Consented quarry limits (approx)
- Super silt fence
- Ridge line
- Ecological area
- Proposed fill site
- Sediment retention pond
- Electricity transmission lines
- Indicative access road and tiphead
- Watercourse
- 1.0m high topsoil clean water diversion bund
- 1.0m high dirty water diversion bund
- Sediment pond catchment

Gleeson Quarries

GLEESON QUARRIES LTD - HUNTLY QUARRY
PROPOSED FILL SITES - EROSION & SEDIMENT CONTROL

NOTES
1. 20M CONTOURS
2. THE EXTENT, AREA & VOLUME OF EACH FILL IS INDICATIVE
3. FILL NUMBERING FOR CONVENIENCE ONLY & DOES NOT REFLECT ANY GIVEN ORDER OF FILLING

Date: 14 July 2019
Scale: 1: 3,300 approx
Dwg No: HQ-19-10-1
Rev: A

Erosion Management Ltd
35 Hastings Parade, PO Box 32-364,
Devonport, Auckland. 0744. N.Z.
Ph. 0274 751 340
Email: brian@erosion.co.nz


N
Lake Waahi
Riverview Road
Waikato River
Property Boundary
Fill 3
Fill 4
Fill 2
Fill 5
QUARRY
Draft

About Boffa Miskell

Boffa Miskell is a leading New Zealand professional services consultancy with offices in Auckland, Hamilton, Tauranga, Wellington, Christchurch, Dunedin and Queenstown. We work with a wide range of local and international private and public sector clients in the areas of planning, urban design, landscape architecture, landscape planning, ecology, biosecurity, cultural heritage, graphics and mapping. Over the past four decades we have built a reputation for professionalism, innovation and excellence. During this time we have been associated with a significant number of projects that have shaped New Zealand's environment.

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