

# ecoLogical Solutions

Environmental Consultants



March 2026

## Barrytown South Mineral Sand Project Ecological Effects Assessment

Submitted to:  
Taiko Critical Minerals Limited



water



fauna



flora



land

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**Status:**

Final

**Issued:**

30 March 2026

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- Appendix B – Bird Species List
- Appendix C – Laboratory Water Quality Data
- Appendix D – Raw Macroinvertebrate Data
- Appendix E – Native Fish Capture and Relocation Plan



## Executive Summary

### Background

Tāiko Critical Minerals Ltd (TCM) proposes to extend mining for ilmenite, garnet and other minerals within Mining Permit MP 60785 at the Barrytown Flats to include the ‘Southern Block’ (SB), which is approximately 408 ha in extent and located between Canoe Creek and Fagan Creek. Mining activity would occur across 280 ha and additional earthworks may be undertaken within a further up to 72 ha to assist with recontouring and rehabilitation. Resource consents are being sought under Schedule 5 of the Fast Track Approvals Act 2024. Wildlife approvals are also being sought under Schedule 7 for management of lizards and avifauna. TCM’s application to seek resource consents to mine within the SB was accepted into the Fast Track process as a Schedule 2 Project on 6 October 2024.

Mining would include the following activities as set out in the Project Description:

- Initial works.
- Sequential mining of the area in three separate ‘sections’ (north of Granite Creek, south of Granite Creek and south of Cargill Road). Each section would be mined separately with no more than 16 ha disturbed at any one time (including up to 2 ha in “borrow” areas to aid in rehabilitation).
- Processing of ‘run of mine’ material.
- Management of processing water and stormwater.
- Staged rehabilitation and mine closure.
- Mining will be setback 20 m from the consent boundary, private property boundaries, Significant Natural Areas, Granite Creek, Fagan Creek and any property boundaries, and 50 m from Mean High Water Springs (MHWS).

### Purpose and Context

This report describes baseline terrestrial and freshwater surveys undertaken to contribute to mine planning and inform the application for Fast Track approvals and wildlife authorisations and also assesses the effects of the proposal on terrestrial and freshwater ecological values, including in light of the New Zealand Coastal Policy Statement (2010), the New Zealand National Policy Statement for Freshwater Management (2020) and the National Policy Statement for Indigenous Biodiversity (2023) where they apply.

The SB is located within the Punakaiki Ecological District (ED) and North Westland Ecological Region. The Barrytown Flats comprise a complex sequence of old dune ridges and alluvial deposits, which would have been vegetated with lowland (coastal) forest and wetland. Nearly all of the vegetation on the Barrytown Flats has been removed or modified by historical forest clearance and drainage for timber harvesting, flax milling and mining. Some wetlands remain, including high value wetlands such as Maher Swamp, and the majority of the steeper areas in the ED also remain in indigenous forest vegetation.

Land within the SB is currently used for dairy farming and mostly comprises highly modified ‘humped and hollowed’ ground vegetated with pasture. Canoe Creek Scenic Reserve adjoins the northern application boundary of the site (which is outside the mining area). Granite Creek and Little Granite Creek, along with several modified creeks and farm drains flow through the proposed mining area to the coast. Many of the watercourses, including Granite Creek, have been modified and/or diverted to varying degrees and are therefore characterised by straight lines and hard corners rather than natural meanders. A small coastal lagoon is within the SB, but outside of the proposed mining area.

SNA PUN-049 identified in the proposed Te Tai o Poutini District Plan is located

immediately east of the SB. There are no Schedule 1 or Schedule 2 wetlands identified in the West Coast Regional Land and Water Plan within or adjacent to the SB.

## Methods

Desktop survey combined with field surveys of vegetation, terrestrial fauna, wetlands, watercourses and aquatic fauna were undertaken in 2024 and 2025 and used to inform this assessment. Wetlands were identified, delineated and described in accordance with the Ministry for the Environment protocols (2022). Wetlands within 100 m of the site were identified, but not assessed directly, because access permission was not obtained.

The aquatic fauna and habitats at 10 sites within creeks and drains in the SB were surveyed, whilst surface water quality samples were collected from eight sites. Five benthic macroinvertebrate samples were collected from each of the ten aquatic ecology survey sites and 30 m<sup>2</sup> was surveyed for fish using electric fishing at each site. A single environmental DNA (eDNA) sample was collected at each site to complement electric fishing data. Physico-chemical data including temperature, dissolved oxygen, conductivity and pH were also recorded at both aquatic habitat and water quality sites. Flowing freshwater habitats were classified in accordance with the definitions outlined in the glossary of the Regional Land and Water Plan.

The ecological value of the terrestrial and aquatic features identified in the SB were assigned following the approach outlined in the Environment Institute of Australia and New Zealand's (EIANZ) Ecological Impact Assessment Guidelines (EclAG). The level of effects (both direct and indirect) on the values identified was assessed using the method outlined in the EclAG.

## Results

Six types of vegetation were recorded as follows:

- Approximately 98% of the vegetation within the SB and proposed mining area comprised grazed exotic pasture used for dairying and dairy support;
- South of Cargill Road, areas of less intensively grazed pasture were occasionally present around watercourses;
- Indigenous vegetation was present south of Cargill Road in the form of narrow strips of secondary coastal shrubland. In addition, a small strip of coastal shrubland was present along the eastern boundary of the proposed mining area near the proposed mining access route.
- Four snags (i.e., dead standing trees) of rātā (*Metrosideros* sp.) with epiphytes were present in the southeastern portion of the SB, outside the proposed mining area.
- Sparse shelterbelts and isolated over-mature *Pinus radiata* surrounded by grazed exotic pasture were centrally located within the proposed mining area.
- Riparian vegetation dominated by flax-with occasional māhoe, whekī, cabbage tree and *Carex geminata* was present along the raised margin of Wasabi Creek.

Thirty-three bird species have been recorded during the surveys to date at the SB. The species detected were generally exotic or common native species and the avifauna community generally reflects the highly modified state of the habitats within the SB. Fourteen bird species considered to be 'Threatened' or 'At Risk' were recorded within or near the SB, many of which were coastal birds. The majority of these coastal birds are unlikely to be using the SB or proposed mining area for feeding or nesting, instead occupying the small lagoon adjoining the SB and/or visiting nearby wetland and other habitats. Four 'Threatened' or 'At Risk' species have been recorded within the SB.

No lizards have been recorded within the SB, but there are database records of three species within c. 10 km of the site. The SB is within the known range of a fourth species which may also be present.

There are recent (2023) records of long-tailed bats from one location approximately 10 km south of the SB. Typical habitats used by long-tailed bats foraging, navigation or roosting were sparsely present within the SB.

A total of c. 42.12 ha of wetland was present within the SB and 35.76 ha within the proposed mining area. This includes c. 6.73 ha of 'natural inland wetland' which is subject to the National Environmental Standards for Freshwater (NES-F) and the NPS-FM. The longstanding presence of some of the constructed wetlands (e.g. associated with dredging), and their value, have been considered when assessing the effects and developing the rehabilitation plan for the site.

For assessment purposes, wetlands were grouped into five categories based on vegetation and landform types as follows: floodplain, palustrine, coastal lagoon, hump and hollow, and dredge pit.

There are seven highly modified natural creeks and several artificial drains within the SB. Modified natural creeks within the SB include, from north to south, an unnamed creek in the northern area of the SB (Northern Creek), unnamed creek in the north-central area (Central Creek), Clarke Creek, Little Granite Creek, Granite Creek, the unnamed creek referred to here as Wasabi Creek and an unnamed creek in the southern area (Southern Creek). There was approximately 5.46 km of continually or intermittently flowing aquatic habitat within the SB (3.98 and 1.48 km, respectively) and 4.28 km within the proposed mining area (2.88 and 1.40 km, respectively). There was approximately 1.05 km of ephemeral watercourse associated with Northern Creek within the SB and proposed mining area. In total there was approximately 13.62 km of artificial drain within the SB and 11.17 km within the mining area.

Stream sites exhibited near neutral pH, low to moderate electrical conductivity and total dissolved solids (TDS) concentrations, and generally low turbidity and total suspended solids concentrations. Water temperatures ranged between 11.7 and 19.1°C. All sites were moderately to well oxygenated. All surface waters were low to moderate alkalinity and soft (<50 g/m<sup>3</sup> hardness, as CaCO<sub>3</sub>), with low to moderate major cation and anion concentrations.

Nutrient concentrations were also either low or moderate. Ammoniacal nitrogen (Amm-N) concentrations placed sites in either the annual median A-attribute state or the annual median B-attribute state. Concentrations of dissolved metals and metalloids were low across all sites and almost totally met relevant guideline value concentrations. One exception was zinc at Site 2, which showed slight exceedance versus the hardness adjusted ANZECC (2000) 95%-ile trigger value on two occasions.

The pond sites, 11 and 4, had higher turbidity, TSS and major cation and anion concentrations, which in turn result in greater TDS concentrations and electrical conductivities. Most notable was the slight elevation of chloride, which is indicative of seawater influence. In addition, total nitrogen (TN) concentrations were elevated at these sites compared to the other surface water sites, due to organic nitrogen, and organic inputs are also apparent via an elevation in dissolved organic carbon (DOC).

Water physico-chemistry would not have been limiting aquatic biota at the time of the survey. Poor channel shade and slow flow in some drains mean water temperatures have the potential to be elevated during low flow conditions in summer and result in stressful conditions for certain aquatic biota.

The artificial drains within the SB are all man-made aquatic habitats and provide relatively homogenous aquatic habitat. Their entire catchments lie within the SB and they are

primarily groundwater fed. Aquatic flora was limited to common exotic emergent macrophytes and filamentous algae. Macroinvertebrate communities recorded from artificial drains were dominated by taxonomic groups that tolerate poor water quality which resulted in macroinvertebrate scores that indicate 'poor' community health. Artificial drains within the SB supported moderate native fish diversity reflecting the close proximity and connection with the marine environment allowing diadromous native fish species to migrate into them as juveniles. No introduced fish species were recorded, but five native fish species of conservation interest were present.

Northern Creek, Little Granite Creek, Granite Creek and Wasabi Creek were highly modified due to channel realignment, but have retained some natural sections. Clarke Creek, Central Creek and Southern Creek were highly modified due to realignment of their channels, and had higher proportions of sand/silt due to grazing and erosion and provided uniform run habitat that is not representative of natural streams in the area. The modified creeks within the SB generally supported macroinvertebrate communities with high proportions of taxonomic groups that can tolerate poor water quality and habitat conditions and had low macroinvertebrate community scores. The exception was Wasabi Creek which had slightly higher MCI and ASPM scores within the 'fair' to 'good' categories.

Modified creeks within the SB supported moderate native fish diversity and reflected the close proximity and connectivity with the marine environment allowing diadromous native fish species to migrate into them. No introduced fish species were recorded. The modified creeks within the SB supported at least six and perhaps up to nine native fish species of conservation interest. The fish communities recorded from natural rivers within the SB are typical of West Coast streams in the vicinity.

## Effects

Mining will result in vegetation clearance of up to 16 ha at any one time. The majority of vegetation within the proposed mining area comprises grazed exotic pasture (c. 278.7 ha) with 'negligible' ecological value, with smaller areas of rough exotic pasture (3.5 ha) with similarly low ecological value, but which might provide habitat for lizards. The remaining vegetation is of 'moderate' ecological value and comprises small isolated strips of indigenous coastal shrubland (0.9 ha) and flaxland (0.3 ha) along coastal and riparian margins. The removal of 'negligible' or 'low' ecological value vegetation across the site is expected to result in a 'very low' level of effect. No mitigation is considered necessary beyond what has been proposed with progressive rehabilitation.

Post-mining rehabilitation of the SB will establish more than 53 ha of riparian and wetland vegetation, including indigenous coastal shrubland with similar or higher ecological value than the existing vegetation. As a result, the overall level of effect is expected to be 'very low' or more likely a 'net gain' in ecological value of coastal shrubland (including riparian planting) post-mining.

The removal of flaxland with 'moderate' ecological value along coastal margins has potential to result in a 'moderate' level of effect without effects management. Post-mining rehabilitation of the SB in accordance with the RMP will establish a larger area of well-connected and buffered indigenous vegetation, including at least 16.8 ha of flaxland. The overall level of effect is expected to be 'very low' in the short – medium term and a 'net gain' in ecological value in the long term.

The bird species confirmed to be present within and surrounding the site are mainly species which would use the habitats within the site for foraging or only occasionally visit (e.g., oystercatchers, dotterels, gulls), although ground nesting species such as banded dotterel and perhaps oystercatchers might attempt to nest in areas of bare soil created. Only common native and exotic birds are likely to be nesting within the proposed mining area currently, although there is the potential for little blue penguin to be crossing the area to

reach burrows inland. In addition, tāiko, and perhaps other seabirds, could be affected by lighting at night if not properly managed.

Vegetation clearance could result in mortality of nesting birds if it occurs during the breeding season, although the effects would be restricted to a relatively small proportion of the site which will move over time as mining proceeds and therefore be relatively short term and local in nature. An Avian Management Plan (AMP) has been prepared which outlines how potential effects on birds will be managed, including regular survey to confirm bird presence, using visual and auditory cues to deter prospecting birds from settling and establishing nests in areas to be mined and fencing to exclude kororā. A wildlife act authority under the Wildlife Act (1953) will be required to manage birds and forms part of the application.

There is a very low risk that artificial light at night will adversely affect tāiko either leaving or returning to the colony to the north. Mining would only occur during daylight hours, but lighting may be necessary at night for health and safety reasons (e.g., to assess and remedy break downs). The AMP also outlines how adverse effects of artificial light at night will be managed, monitored and reported.

Post-mining rehabilitation will re-establish pasture similar to that present before mining across most of the site with an equivalent or larger area of shrubland, wetland and/or forest via the planted areas (including riparian plantings). These shrubland/forest and wetland habitats will provide additional habitat for species which nest in trees and most likely better habitat for species such as weka, pūkeko and harriers, which like dense cover and/or dense rush vegetation within which to construct their (ground based) nests.

There were a few small isolated areas within the mining area of habitat suitable for lizards. Vegetation clearance could result in direct injury or mortality of lizards. A Lizard Management Plan (LMP) has been prepared which includes actions to avoid/minimise lizard injury and mortality via salvage and relocation of any lizards detected. Post-mining rehabilitation of the SB will re-establish an equivalent or larger area of suitable lizard habitat with the overall level of effect assessed as a 'very low' to a 'net gain' post rehabilitation. No works are being undertaken within 50 m of the MHWS and no indirect effects (e.g., noise) are anticipated on herpetofauna species which may be using the coastal environment adjacent to the SB.

The vegetation proposed to be cleared is not suitable habitat for roosting bats. The relatively small, mobile footprint, combined with prompt rehabilitation as mining proceeds and the stream diversion method proposed and the increase in the overall extent and ecological value of wetlands as rehabilitation proceeds and is completed will ensure effects on bats will be 'low' in the short term and will result in a 'net gain' in the long term. The lighting management proposed for birds would also minimise effects on any bats using the area. Given that the vegetation clearance does not include potential roosts, a separate Bat Management Plan is not considered necessary.

Natural inland and other wetlands would generally be removed as mining proceeds, but the proposal includes construction of approximately 53.1 ha of wetland which substantially exceeds the extent of natural inland wetlands to be removed. The constructed wetland would be planted with indigenous vegetation and the ecological values are expected to exceed those of the current wetlands on the site substantially.

Earthworks associated with mining the site has the potential to result in fine sediment mobilisation and runoff into watercourses and wetlands. An Erosion and Sediment Control Plan (ESCP) has been developed by Ridley Dunphy Environmental Limited which sets out the appropriate timing, location, scale, design and maintenance of erosion and sediment control measures so as to avoid adverse effects of earthworks and sedimentation on aquatic habitats and fauna. In addition, setbacks will be established from key freshwater features that are retained (e.g., Granite Creek, Fagan Creek) and not directly affected in

order to minimise the potential for sediment reaching these freshwater environments.

The conservative water quality modelling undertaken using a mass-balance approach indicates that surface waters receiving modified groundwater could potentially fail to meet surface water quality guidelines for pH and various metals/metalloids. However, lime addition to tailings and slimes prior to deposition will result in porewater amelioration.

Approximately 4.2 km of temporary diversions and stream works will be required at Northern Creek, Central Creek, Clarke Creek, Wasabi Creek and Southern Creek. A further approximately 11.2 km of artificial drain within the proposed mining area will be diverted or reclaimed. These works will need to be carefully planned and implemented to maintain water conveyance, protect freshwater values, maintain fish passage and minimise adverse environmental effects. Little Granite Creek, Granite Creek, Canoe Creek and Fagan Creek would not be diverted. A Native Fish Capture and Relocation Plan has been prepared which will avoid and/or minimise effects on native fish, including 'Threatened' species.

The discharge locations of creeks to the Coastal Marine Area (CMA) will be retained at their existing locations and current 'catchment' boundaries will be maintained. All reconstructed creeks and artificial drains will be connected to the constructed wetland system or naturalised creek networks to support long-term site hydrology, ecological function and fish passage between the CMA and upstream habitats for diadromous native fish species.

To minimise potential effects on fish passage in temporary diversions or reconstructed creeks and artificial drains, channels will be constructed to 'key in' at the same or similar invert levels to avoid perching or creation of barriers that could affect fish passage. The low gradient of the topography within the SB means that this can be easily achieved.

The water take from Canoe Creek could affect flow and reduce habitat for aquatic fauna. A water take restricted to a maximum rate of 63 L/s, but more likely <9.5 L/s in the long-term, from lower Canoe Creek represents <10% of the annual Mean Annual Low Flow (MALF). A water take of this magnitude is expected to maintain instream conditions (i.e., habitat quality, native fish abundance). Ecological Solutions understands that shallow ground water would be extracted from lower Canoe Creek via a subsurface gallery or a direct surface water take with an appropriate fish screen which would avoid effects on native fish such as entrainment or accidental mortality.

### Application of the Effects Management Hierarchy

The proposal has appropriately applied the effects management hierarchy, including avoidance, minimisation/mitigation and remediation. The overall level of residual effects is such that offsetting and/or compensation are not required.

### Relevant Policy Considerations

Policies 3, 4, 6–8 and 13–15 of the NPS-IB are the most relevant. The proposal is consistent with these policies.

With respect to the NPS-FM the most relevant policies are Policies 3–9 and 11–14. The proposal is consistent with these policies.

In terms of the NZCPS, policy 11 is the most relevant. The proposal is consistent with Policy 11.

The Fast Track Approvals Act requires an overall assessment of the significance of effects. With respect to the effects on terrestrial and aquatic ecology and wetlands, having taken into account the ecological and land use context, the species and habitats present, the specific location, nature and duration of the proposed activities and the actions proposed to avoid, remedy and minimise/mitigate any effects, the short-term effects of the current project would be negligible, i.e., a barely distinguishable change which would have

negligible effect on the known population or range of the species and habitats present.

In the medium – long term, the effects of the current project would be positive, in that there will be a substantial increase in the extent and value of wetland, shrubland and forest habitats within the site, and the riparian vegetation will better connect the habitats than the pre-mining condition.

## 1.0 Introduction

### 1.1 Background

Tāiko Critical Minerals Ltd (TCM) holds resource consents from the Grey District and West Coast Regional Councils for mineral sand mining at the 'Central Block' (CB) within Mining Permit MP 60785 as shown in Figure 1. TCM proposes to extend mining to the 'Southern Block' (SB), which is approximately 408 ha in extent and located south of the already consented area, between Canoe Creek and Fagan Creek. Mining activity would occur on 280 ha within the SB, referred to as the 'mining disturbance area' as shown in Figure 2. In addition, earthworks may be undertaken within up to 72 ha of the SB outside the mining disturbance area to assist with recontouring and rehabilitation within the mining disturbance area. The affected land is owned by Moir Farms Maimai Limited, Barrytown Farms Ltd, Nikau Deer Farm and Cargill Road Barrytown Limited. Grey District Council also owns a small piece of road reserve which would be affected.

Resource consents are being sought under Schedule 5 of the Fast Track Approvals Act 2024 to undertake mineral sand mining using a floating dredge to obtain ilmenite, garnet and other minerals. Wildlife approvals are also being sought under Schedule 7 to enable management of lizards and avifauna. TCM's application to seek resource consents to mine within the SB was accepted into the Fast Track process as a Schedule 2 Project on 6 October 2024. A permit from the Ministry of Primary Industries and approval to transfer aquatic life under either section 26ZM(2) or 26ZM(3) of the Conservation Act 1987 from the Ministry of Primary Industries and Department of Conservation respectively is not required because Ecological Solutions Limited already holds the relevant permits and no species would be translocated to locations where that species is absent.

### 1.2 Scope

Ecological Solutions Limited was engaged to undertake baseline terrestrial and freshwater surveys necessary to prepare an ecological impact assessment (EclA). The EclA is to inform the application for Fast Track approvals and wildlife authorisations (resource consents, approvals and authorities) and contribute to mine planning so that adverse ecological effects attributable to mine establishment and operation can be managed appropriately. The SB and proposed mining disturbance area are located near the coast and adjoin streams and wetlands. Consequently, Ecological Solutions Limited was asked to consider the proposed activities in light of the New Zealand Coastal Policy Statement (2010), the New Zealand National Policy Statement for Freshwater Management (2020) and the National Policy Statement for Indigenous Biodiversity (2023) (where they apply).

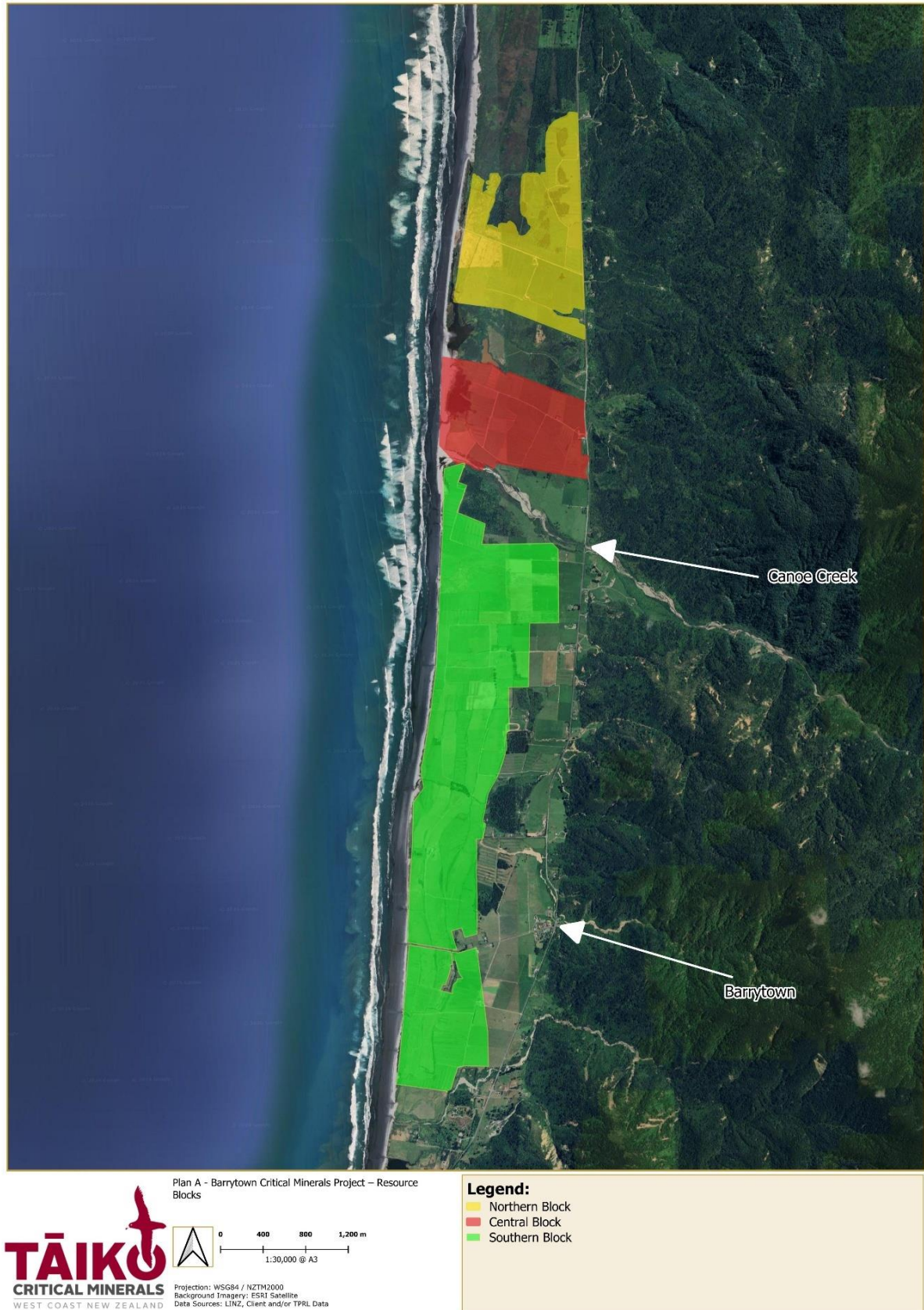


Figure 1: Location of Barrytown Critical Minerals Project Resource Blocks.

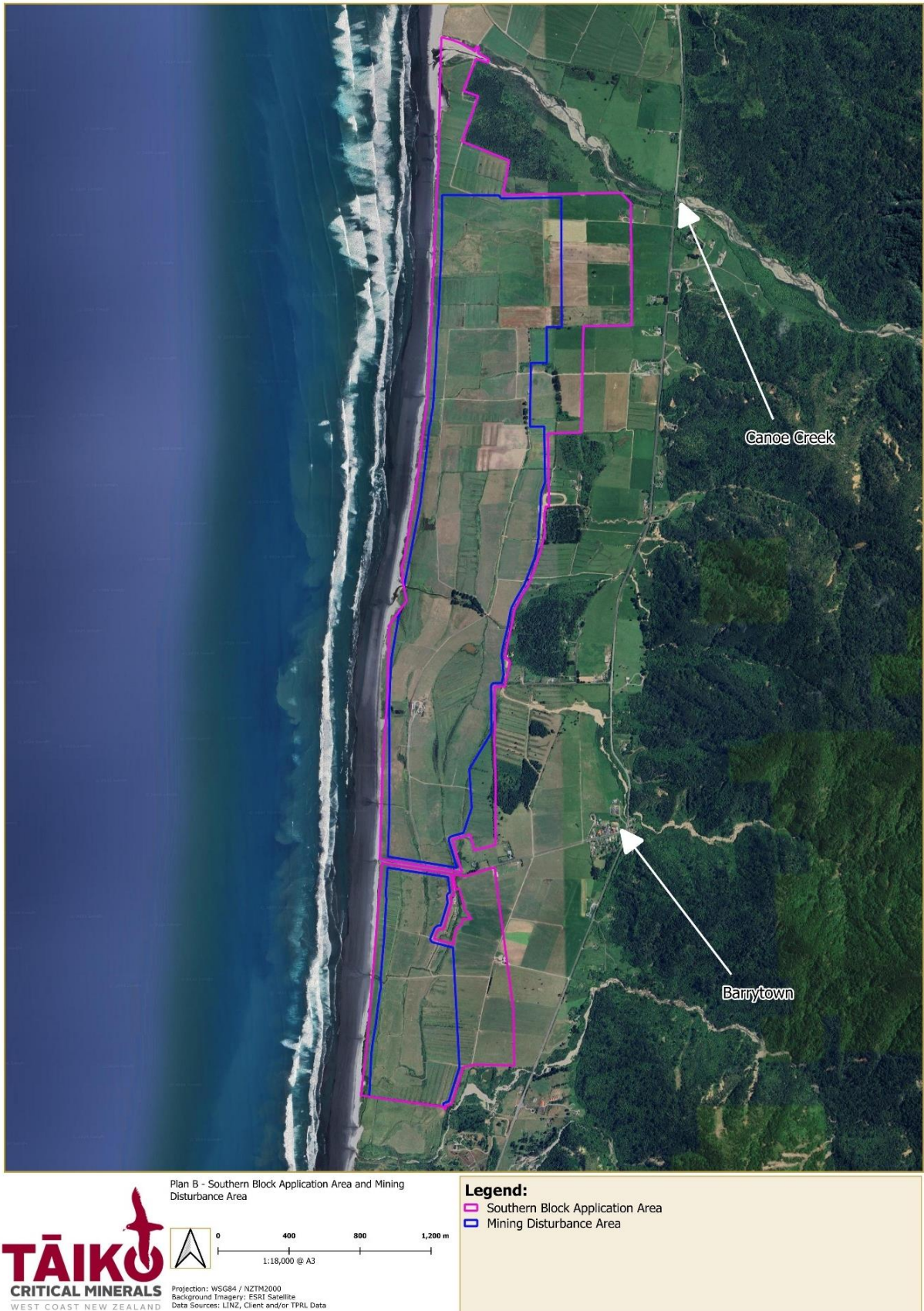


Figure 2: Location of the TCM Southern Block and Proposed Mining Area, Barrytown.

This report includes 12 sections as follows:

- This introduction (Section 1.0).
- Description of the ecological setting of the site (Section 2.0).
- Description of survey methods used to determine ecological values (Section 3.0).
- Description of terrestrial flora and fauna recorded during field surveys (Section 4.0).
- The findings with respect to wetlands at the site (Section 5.0).
- Description of results with respect to freshwater habitats at the site (Section 6.0).
- Summary of groundwater quality at the site (Section 7.0).
- An assessment of ecological values for each of the attributes present (Section 8.0).
- An assessment of ecological effects of the proposed activity (Section 9.0).
- Description of the application of the effects management hierarchy proposed to reduce these effects (Section 9.0).
- Assessment of proposed application against the National Policy Statement for Indigenous Biodiversity (Section 10.0).
- Assessment of proposed application against the National Policy Statement for Freshwater Management (Section 11.0)
- List of references used in preparing this report (Section 11.0).

### 1.3 Project Description

TCM is seeking approvals to undertake mineral sand mining within the SB. The Comprehensive Project Description (Tai Poutini Resources Limited 2026) describes the proposed mining activity within the SB in the following sections relevant to this EclA:

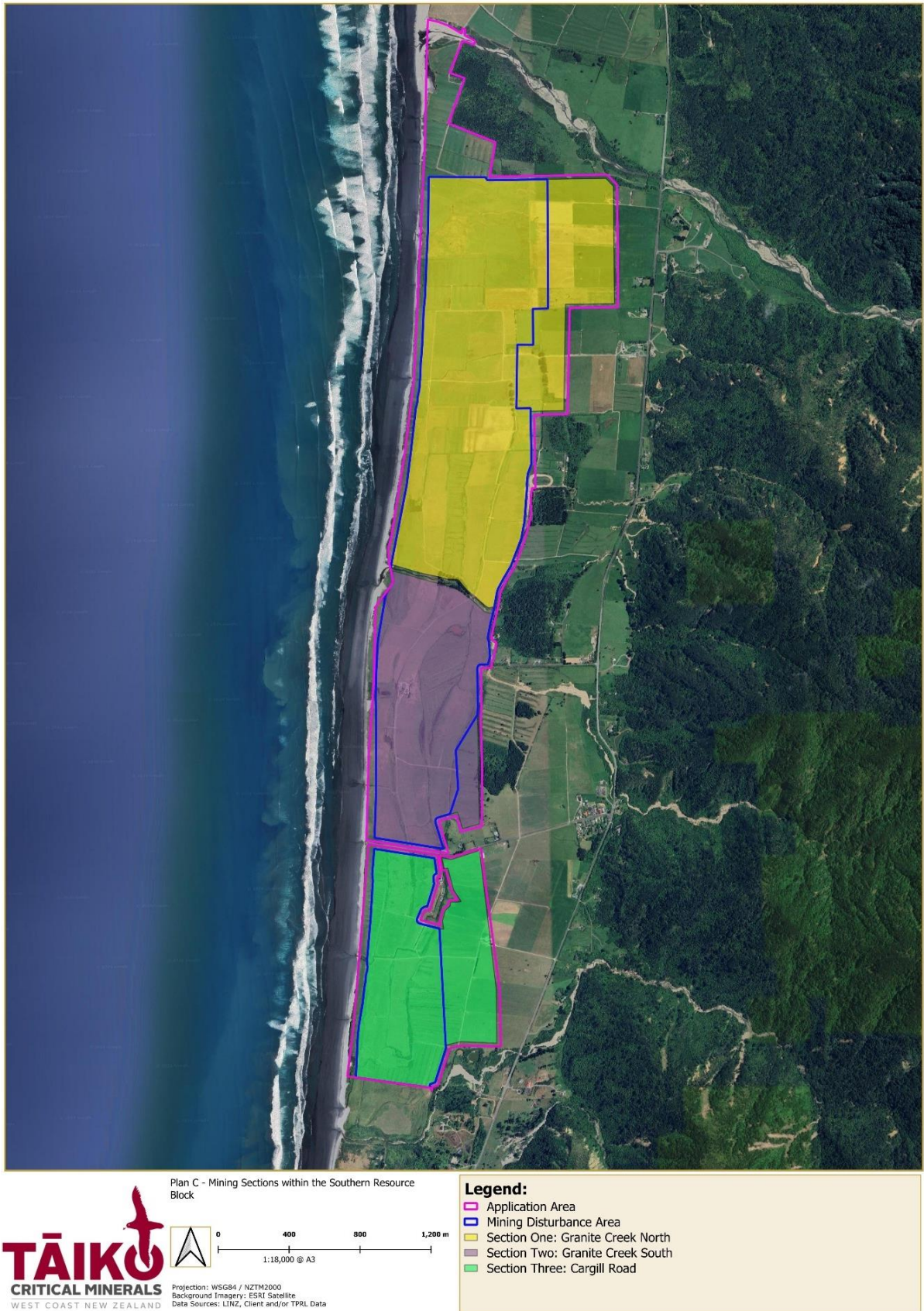
- Initial works.
- Indicative mining sequence and setbacks.
- Mining methodology.
- Processing of 'run of mine' material.
- Management of processing water and stormwater.
- Rehabilitation and mine closure.

Key aspects of the proposed activity are summarised below:

- The total area of the SB on the Barrytown Flats is approximately 408 ha. The proposed mining disturbance area is approximately 280 ha (c. 69% of the SB).
- Resource estimates indicate that mining 2,000,000 tonnes annually will produce 400,000 tonnes of heavy mineral concentrate (HMC) per year.
- Mine life is expected to be 14 years excluding preparation and rehabilitation. Proposed mining is anticipated to commence in approximately 2034–2035 once the mineral resource on the CB has been exhausted.
- Mining activities will be undertaken during daylight hours and not on Sundays.
- A Wet Concentrator Plant (WCP) and water supply from lower Canoe Creek were consented for mining the Central Block (CB). These consents will be retained, and extended to include the length of this project, but the WCP is proposed to be located within the SB. Consent has been granted by Grey District Council for a Mineral

Separation Plant (MSP) at Rapahoe where HMC will be processed further.

- Mining will be undertaken in three sections including: Section 1 (Granite Creek North), Section 2 (Granite Creek South) and Section 3 (Cargill Road) (refer to Figure 3). Only one of the three sections will be mined at a time.
- Mining setbacks will be established including: 20 m from the consent boundary, private property boundaries, Significant Natural Areas, Granite Creek, Fagan Creek and any property boundaries, 50 m from Mean High Water Springs (MHWS) and 200 m from dwellings other than where noise bunds are proposed.
- Mining will be undertaken using a floating dredge within a dredge pond (100 m wide x 100 m long). The dredge pond will be within a larger area referred to as a mining void. The mining void comprises the dredge pond, the area behind the dredge pond for deposit of tailings after processing (100 m wide x 50 m long), and the area in front of the dredge pond in preparation for mining (100 m wide x 100 m long).
- A mine starter pit will be constructed in each of the three sections (i.e., Granite Creek North, Granite Creek South, Cargill Road) to establish an initial dredge pond in which the floating dredge can operate. Separate starter pits are necessary because the three sections are divided by physical features that will not be disturbed (i.e., Granite Creek and Cargill Road). The first mine starter pit will be located in the southwestern corner of Section 1 (Granite Creek North).
- Mining will commence in the southwest corner of Section 1 (Granite Creek North) and progress east then north. Mining will generally progress in a north/south direction within a dredge pond (dimensions = 100 m wide x 100 m length). An exception will be when the floating dredge needs to turn along a strip as it reaches the northern or southern extents of the mining disturbance area and travel in an east/west direction to commence a new strip in a north/south direction.
- Each strip will be approximately 100 m wide and excavated up to a depth of 10 m below ground level noting that the depth of mining is dependent on the ore distribution. The total disturbed land area at any one time will be no more than 16 ha.
- Once the mine starter pit has been constructed, the following steps will be undertaken to enable the extraction of ore:
  - (a) Removal of pasture, and small areas of other vegetation.
  - (b) Stripping of topsoil and overburden.
  - (c) Diversion of creeks and drains (collectively for the purposes of this report called “watercourses”).
  - (d) Extraction of run of mine (ROM) material.
  - (e) Initial screening of ROM material and deposit of waste material.
  - (f) Pumping of run of mine material to WCP.
- Fauna management (i.e., lizards, birds) will be implemented prior to the removal of vegetation/habitat. Once completed, vegetation will be removed.
- Temporary watercourse diversions will be constructed to convey surface water in creeks and artificial drains during mining. Exceptions will be Granite Creek and Little Granite Creek, which will not be diverted. The diversion methodology will differ for each creek or artificial drain depending on the orientation of the channel (i.e., north/south or east/west), sequence of mining activities and future purpose of the land. Fish management will be implemented prior to and during the diversion of watercourses.



**Figure 3: Mining sections within the Southern Block, Barrytown.**

- Following the implementation of fauna management (if required), removal of vegetation, topsoil and overburden and diversion of watercourses, the floating dredge will extract ROM material from the newly stripped area in the dredge pond and pump it as a slurry to the WCP.
- ROM material will be pumped from the floating dredge as a slurry to a Field Screening Unit to screen coarse material before entering the desliming circuit to remove very fine silt and clay particles (i.e., slimes) to improve recovery of valuable heavy minerals and reduce load on the WCP. After screening and desliming, ROM will be pumped as a slurry to the WCP to extract HMC and then transported to the MSP at Rapahoe for further processing.
- Tailings produced by the initial screening of ROM material at the Field Screening Unit, tailings from the WCP after extracting HMC from ROM material, and tailings from the MSP at Rapahoe will be pumped back to the rear of the mining void. Tailings deposited back into the mining void will be levelled and contoured. Overburden and topsoil stripped during pre-mining preparation will be placed over the tailings to complete the mining sequence and allow rehabilitation to commence.
- After an area has been mined and the land contoured and rehabilitated, creeks will be reconstructed in accordance with the conditions of consent, and Rehabilitation Management Plan (RMP) (Tai Poutini Resources Limited 2026). Some artificial drains may be reinstated if contouring alone does not provide sufficient drainage.
- Progressive rehabilitation of the mining void will take place at the same time as mining occurs and is expected to be completed within 12 months after mining at a given location has been completed and after mining voids are filled with tailings, overburden and topsoil (that was stripped pre-mining) and contoured.
- As mining in each of the three sections (i.e., Granite Creek North, Granite Creek South, Cargill Road) is completed, each section will be rehabilitated to its final landform and will include the construction of a proposed wetland of approximately 53.1 ha that will be planted with indigenous species and fenced to exclude livestock.
- The five diverted creeks (i.e., Northern Creek, Central Creek, Clarke Creek, Wasabi Creek, Southern Creek) will be reconstructed with more natural meandering flow paths than currently. Watercourses will discharge to the coast at the same location as currently, since they are within the 50 m mining setback from MHWS and therefore will not be modified.

## 2.0 Ecological Setting

### 2.1 Site Description and History

The SB is located within the Punakaiki Ecological District (ED) and North Westland Ecological Region as shown in Figure 4 (McEwen 1987) within an area known as the Barrytown Flats. The Barrytown Flats are an elongated area approximately 17 km long (North–South) and 2 km wide (East–West), flanked to the east by the Paparoa Ranges and to the west by the Tasman Sea (Burllet and Lee 2019). The Barrytown Flats are composed of a complex sequence of old dune ridges and alluvial deposits, which would have been entirely covered in lowland (coastal) forest and wetland before clearance for mining and farming. Some wetlands, including high value wetlands such as Maher Swamp, remain within the Barrytown Flats as shown in Figure 4, with the majority of the steeper areas in the ED remaining in indigenous forest vegetation.



**Figure 4: West Coast Regional Plan Land and Water Plan Schedule 1 and 2 wetlands.**

Nearly all of the vegetation on the Barrytown Flats has been removed or modified by historical forest clearance and drainage for timber harvesting, flax milling and mining. Most of the Barrytown area has at some time been under licence for prospecting ilmenite and gold (Wilms 1985). During the 1930s and 1940s dredging of most of both the central and southern portions of the SB occurred. This has contributed to the current landform, including creating three large areas of lower relief that display signs of a higher water table than adjoining farmland. Additional drainage, including humping and hollowing, has occurred since the 1990s. Vegetation clearance over the past 50 years has removed large areas of gorse (*Ulex europaeus*) as part of farming the area. A small cluster of over mature pine (*Pinus radiata*) trees situated on the banks of Little Granite Creek, scattered isolated rātā (*Metrosideros* sp.) and a row of over-mature pine trees along a farm laneway are the only tall vegetation present within the SB.

Land within the SB is currently used for dairy farming and mostly comprises highly modified 'humped and hollowed' ground vegetated with pasture. Canoe Creek Scenic Reserve adjoins the northern application boundary of the site (and is outside the mining area) as shown in Figure 4. Granite Creek and Little Granite Creek, along with several smaller tributaries, flow through the proposed mining area to the coast. A number of small springs and farm drains are located throughout the site which currently provide water supply for livestock. Fagan Creek is situated on the southern boundary of the Cargill Road Barrytown Limited property. The mining permit boundary is situated approximately 20 m away from Fagan Creek at its closest point.

Granite Creek and Little Granite Creek have been fenced to prevent livestock access; however, the majority of the watercourses and wetlands within the site are unfenced. The banks of these unfenced areas are typically unstable and subject to erosion and/or pugging because of the limited riparian vegetation and unrestricted livestock access. Many of the watercourses, including Granite Creek, have been modified and/or diverted to varying degrees over time and are therefore characterised by straight lines and hard corners rather than natural meanders. A small coastal lagoon occurs in the northern part of the SB, but is located outside of the proposed mining area.

There is an area identified in the proposed Te Tai o Poutini Plan (TTPP) as a Significant Natural Area (SNA) immediately east of the SB. This area is identified as PUN-049 and the location is shown in Figure 5 (Section 2.2.2). PUN-049 is described in the TTPP as "*lowland kahikatea forest with some wetland character and scrub on the fringes. Provides a connecting stepping stone between the coast and the forested ranges*".

There are no Schedule 1 or Schedule 2 wetlands identified in the West Coast Regional Land and Water Plan (RLWP) within or adjacent to the SB. The closest Schedule 1 wetland is Maher Swamp, located north of the Central Block (CB) (see Figure 4).

## 2.2 Punakaiki Ecological District

### 2.2.1 Ecological setting

The Punakaiki ED was distinguished on the basis of geology, climate, land use, topography and vegetation (McEwen 1987). Punakaiki ED includes the western slopes and alpine crests of the Paparoa Ranges and associated synclines, as well as the coastal plains to the west ('the Barrytown Flats'). The Punakaiki ED also includes extensive areas of pākihi in previously logged areas like that of the Tiropahi Valley (McEwen 1987).

McEwen (1987) considered that there was a very high diversity of vegetation types throughout the Punakaiki ED according to the variety of drainage and fertility presented by an equally high diversity of landforms. She also considered the district unusual in the variety and quality of the indigenous forests that remain. Partly because of the diversity of habitat types, McEwen considered that there was a high diversity of invertebrates and birds

remaining within the ED. The ED is also home to the only known breeding colony of tāiko (Westland petrel, *Procellaria westlandica*) (McEwen 1987).

Maher Swamp, north of the SB at Barrytown, was originally set aside as a Flax Reserve and flax was harvested there (and at Razorback Swamp at the northern end of the Barrytown Flats) until the early 1950s and milled at Barrytown (Gardner 1992). Unlike most swamps in the region, Maher Swamp is comparatively nutrient rich (Gardner 1992). Gardner (1992) reported that characteristic pākihi species such as wire rush (*Empodisma minus*), tangle fern (*Gleichenia dicarpa*) and Centrolepis (*C. pallida*) were lacking at Maher Swamp and mānuka (*Leptospermum scoparium* agg.), bracken (*Pteridium esculentum*) and square sedge (*Lepidosperma australe*) were very infrequent. He also recorded only one species of *Sphagnum* (*S. cristatum*). At that time, Maher Swamp had large areas of raupō (*Typha orientalis*) and harakeke/flax (*Phormium tenax*) with smaller areas of Sinclair's sedge (*Carex sinclairii*) with *Coprosma tenuicaulis*, *Machaerina rubiginosa* and the exotic *Juncus canadensis* with sphagnum growing on the almost dry places. There was no willow. Gardner considered that *J. canadensis* had become the primary invader of disturbed peat there and that the floristic diversity was concentrated at the swamp's edges.

Plant species of interest at Maher Swamp included *Myriophyllum robustum* (At Risk – Naturally Uncommon; de Lange et al. 2024) in the large drain on the eastern side and swamp millet (*Isachne globosa*) and *Amphibromus fluitans*, which are both uncommon in the South Island.

Norton (1991<sup>1</sup>) also recorded sand coprosma (*Coprosma acerosa*) at Maher Swamp. Sand coprosma is regarded as 'At Risk – Declining' by de Lange et al. (2024).

Since approximately 2010, there has been a concerted effort to rehabilitate sand plain forest on the 80 ha former Rio Tinto property at the northern end of the Barrytown Flats (adjoining Nīkau Scenic Reserve and known as Te Ara Tāiko Nature Reserve) with the aim of restoring ecological connection between the coast and habitats inland.

Because of the topography and elevation of the Barrytown Flats, original freshwater habitats in the area would have been characterised by low order, moderate energy watercourses connected to large wetland swamps and perhaps fens. The steep upper catchments would have increased water velocity in streams, whilst nearer the coast, occasional flooding combined with poorly drained soils and high groundwater levels would have maintained large wetlands. These wetlands functioned to attenuate water flows and acted as slow-release water storage areas, minimising flooding and reducing sediment load at the coast. Wetlands would have harboured a variety of native terrestrial and aquatic flora and fauna, including a high diversity of native macroinvertebrates and fish species as well as birds.

Onley (1980) carried out 117 bird counts in five different low altitude forest types in the Punakaiki ED including Karst forest, Coastal forest, Old Tertiary forest, Limestone talus forest and cutover forest. The forests were all located below 170 m asl. Coastal forest was dominated by kāmahī (*Pterophylla racemosa*) with emergent rimu (*Dacrydium cupressinum*) and conspicuous northern rātā (*Metrosideros robusta*) and hīnau (*Elaeocarpus dentatus*). Coastal forest had the lowest number of bird species per count overall (9), with Old Tertiary forest having 10 native species and Karst forest having 13. These observations combined with information from the Land Environments of New Zealand and Threatened Environments Classification, indicate that the Punakaiki ED is relatively intact with respect to species, habitats and ecological functioning.

## 2.2.2 Significant Natural Areas within the Punakaiki Ecological District

Boffa Miskell identified potential significant natural areas within the Grey District on behalf of Grey District Council in 2006/2007. There are no Significant Natural Areas (SNAs) within

<sup>1</sup> <https://www.nzpcn.org.nz/publications/plant-lists/plant-lists-by-region/maher-swamp-barrytown-mahy/>

the application area, but there are a number of SNAs identified within Schedule 4 (Significant Natural Areas) of the TTPP on the wider Barrytown Flats, the features of which are summarised in Table 1. The locations of these SNAs are shown in Figure 5.

An area of indigenous vegetation to the east of the SB is identified in the TTPP as Site PUN-049. It is described in Section 2.1 above.

Canoe Creek Lagoon, adjoining the Central Block, is also identified as an SNA (PUN-W034), consisting of a lagoon and series of small lakes bordered by flax wetlands and coastal forest. Maher Swamp is located on public conservation land and identified as a significant wetland in the RLWP. An area adjacent to Maher Swamp is identified in Schedule 4 (Significant Natural Areas) of the TTPP as Site PUN-044 and contains kahikatea forest, coastal hill forest, and areas of flax and sedgeland. PUN-043 comprises dune forest and wetland with forest on dune ridges and harakeke (*Phormium tenax*)-dominated wetland in dune hollows.

**Table 1: Significant Natural Areas (SNAs) within and near the Barrytown Flats.**

| SNA identifier | Location  | Description  | Proximity to site  |
|----------------|---|--|--|
| PUN -W033      | Punakaiki/Barrytown Flats<br>Punakaiki Ecological District                | Flax dominated wetland and some coastal forest that extends from Nikau Scenic Reserve to the northern tip of Barrytown Flats. The wetland supports a brown mudfish population which are nationally threatened.   | 7 km north   |
| PUN-W034       | Punakaiki/Barrytown Flats<br>Punakaiki Ecological District                | Punakaiki Lagoon and Coastal Wetland sequence. A lagoon and series of small lakes bordered by flax wetlands and coastal forest. Significant vegetation and ecosystem sequence.   | 500 m north.<br>Adjacent to Central Block                      |
| PUN -123       | Punakaiki/Barrytown Flats<br>Punakaiki Ecological District                | Large area of broadleaved and rimu forest with occasional northern rata and hard beech. Serves as an ecological corridor between Paparoa National Park and Mayer Swamp.  | 4 km north   |
| PUN - 124      | Punakaiki/Barrytown Flats<br>Punakaiki Ecological District                | Coastal forest dominated by broadleaves and rimu with occasional nikau. This is an important breeding site for the Westland petrel.  | 7 km north   |
| PUN 043        | Punakaiki/Barrytown Flats<br>Maher Swamp<br>Punakaiki Ecological District | Raupō and harakeke/flax swamp.   | 2.5 km north   |
| PUN 044        | Punakaiki/Barrytown Flats<br>Punakaiki Ecological District                | Lowland forest and wetland adjoining Maher Swamp with adjacent coastal hill forest. Mix of kahikatea forest with northern rata and sparse rimu in places, but also extensive areas of flax and sedgeland. Provides an ecological corridor between the Maher Swamp and the forested land to the east of the road. | 2.5 km north   |
| PUN 049        | Barrytown<br>Punakaiki Ecological District                                | Lowland kahikatea forest with some wetland character and scrub on the fringes. Provides a connecting stepping stone between the coast and the forested ranges.   | Adjacent to application area.<br>140 m east of the Mining Area |



**Figure 5: Significant Natural Areas near the Barrytown Flats identified in the Proposed Te Tai o Poutini District Plan.**

The northern boundary of the SB is approximately 4.5 km south of the only known tāiko (Westland petrel) colony which is located between Punakaiki River and Waiwhero Creek (and identified as PUN-124 in the TTPP). Tāiko have a conservation threat status of 'At Risk (naturally uncommon)' with the qualifiers "one location" and "stable" (referring to the population, Robertson et al. 2021). The total population of tāiko is estimated to be 7,900–13,700 individuals or around 4,000 breeding pairs (Waugh and Bartle 2013, Birdlife International 2021). One of the known causes of tāiko mortality is grounding due to disorientation caused by artificial lighting at night. Of 296 tāiko discovered after a grounding between 2007 and 2023 where the location was known, 180 (61%) were collected in the Punakaiki area, 61 (21%) in and around Greymouth, 34 (11%) from the Westport area and 21 (7%) from the Hokitika or Charleston area (data supplied by S. van Smit, Department of Conservation, pers. comm. 27 March 2023). Thus, the Punakaiki area is important core habitat for tāiko. Waugh and Wilson (2017) considered the effects of lighting generally on the tāiko population were 'low'. Given the proposal to only mine during daylight hours, the potential for effects due to artificial lighting on tāiko has been avoided.

In the TTPP, the area identified as PUN-W033 is described as a flax dominated wetland with some coastal forest extending from Nīkau Scenic Reserve to the northern end of Barrytown Flats. The wetland is known to support a population of brown mudfish. The area identified in the TTPP as PUN-123 is described as broadleaved and rimu forest with occasional northern rata and hard beech and acts as an ecological corridor between the Paparoa Ranges and Maher Swamp.

## 3.0 Methods

### 3.1 Terrestrial Flora and Fauna

#### 3.1.1 Vegetation

A desktop assessment of aerial imagery (Google Earth, Retrolens), topographic maps, GIS datasets (including Land Cover Database version 5.0 (LCDB V5.0) and West Coast Regional Council data) and a review of available previous studies (summarised by Ecological Solutions Limited 2023) was used to inform an assessment of historic landcover and vegetation types as well as current landcover and vegetation types within the SB and the Punakaiki ED more generally. Vegetation at the site was surveyed during two walk-through surveys undertaken on 17–19 June 2024 and 21–23 January 2025. Vegetation was photographed and described in terms of composition, value, structure, and integrity. Any 'Threatened' or 'At Risk' plant species encountered were recorded. Vegetation within wetlands was surveyed as set out in Section 3.2 below.

#### 3.1.2 Avifauna

A list of birds recorded from within 10 km of the site prior to December 2024 was compiled from the eBird database. Two surveys were undertaken within the SB in July (winter) and October (spring) 2024. During the winter survey, 13 acoustic recorders (AR4s) were deployed within the SB, with another acoustic recorder (REY23 73), deployed during the spring survey (October 2024) bringing the number used in that survey to 14. In addition to the AR4s, 22 five-minute bird counts (5MBCs) were undertaken across the habitats present at the site. Each acoustic recorder was given a unique identifier and deployed for at least ten nights per survey. The recorders were set to record between 19:00 hrs and 07:30 hrs (i.e., overnight). The monitoring locations used in the surveys are described in Table 2 and shown in Figure 6.

**Table 2: Avifauna monitoring locations within the SB.**

| Station <sup>1</sup> | Monitoring method |      | Predominant Habitat Type | Easting    | Northing   |
|----------------------|-------------------|------|--------------------------|------------|------------|
|                      | AR                | 5MBC |                          |            |            |
| REY01                | -                 | ✓    | Grassland                | 1460915.00 | 5324825.00 |
| REY02                | -                 | ✓    | Grassland                | 1460933.37 | 5324617.81 |
| REY03 52             | ✓                 | ✓    | Grassland                | 1460887.00 | 5324226.00 |
| REY04 49             | ✓                 | ✓    | Grassland                | 1460886.00 | 5323989.99 |
| REY05 43             | ✓                 | ✓    | Pond/shrubland/grassland | 1460872.00 | 5323699.00 |
| REY06 34             | ✓                 | ✓    | Scrubland/grassland      | 1460856.00 | 5323515.99 |
| REY08 68             | ✓                 | ✓    | Scrubland/wetland        | 1461332.00 | 5324385.00 |
| REY09 36             | ✓                 | ✓    | Grass/treeland           | 1461531.00 | 5324377.00 |
| REY10 60             | ✓                 | ✓    | Grass/treeland           | 1461545.00 | 5324181.00 |
| REY11                | -                 | ✓    | Grassland                | 1461370.00 | 5324183.00 |
| REY12                | -                 | ✓    | Grassland                | 1461369.00 | 5323985.00 |
| REY13                | -                 | ✓    | Grassland                | 1461314.85 | 5323792.78 |
| REY14                | -                 | ✓    | Grassland                | 1461277.13 | 5323595.21 |
| REY15                | -                 | ✓    | Shrubland/grassland      | 1461230.10 | 5323401.55 |
| REY16 51             | ✓                 | ✓    | Scrubland/grassland      | 1461206.00 | 5323203.00 |
| REY17 57             | ✓                 | ✓    | Shrubland/grassland      | 1461401.00 | 5323162.00 |
| REY18 82             | ✓                 | ✓    | Treeland/grassland       | 1461158.00 | 5323018.00 |
| REY19 80             | ✓                 | ✓    | Shrubland/grassland      | 1460974.00 | 5323141.00 |
| REY20 61             | ✓                 | ✓    | Pond/shrubland/grassland | 1461095.00 | 5323611.99 |
| REY21 63             | ✓                 | ✓    | Grassland                | 1461036.00 | 5322848.00 |
| REY22                | -                 | ✓    | Pond/shrubland/grassland | 1460845.00 | 5322777.00 |
| REY23 73             | ✓                 | ✓    | Grassland                | 1460831.04 | 5322207.98 |

**Note:** <sup>1</sup> Codes include REY then location (first 2 #s) and unique AR identifier (second 2 #s) where both methods were used.



**Figure 6: Avifauna monitoring sites within the SB, Barrytown.**

### 3.1.3 Herpetofauna

A search of the Department of Conservation (DOC) Bioweb herpetofauna database records within 10 km of the site was undertaken with data retrieved in March 2024.

Potential herpetofauna habitat on or near the SB was identified and photographed and the location recorded during two walk-through surveys undertaken on 17–19 June 2024 and 21–23 January 2025.

### 3.1.4 Bats

Published and available unpublished reports and national bat database records (data retrieved on 4 February 2025) were reviewed to identify records of bats within 25 km of the SB. The information gathered was used to describe bat distribution and activity in relation to the SB.

Potential bat habitat (e.g., roosts, commuting routes and foraging sites) within the SB was identified and recorded during the two walk-through surveys undertaken on the 17–19 June 2024 and 21–23 January 2025. Any potential habitat was photographed and its location recorded.

## 3.2 Wetlands

An initial desktop assessment was carried out using aerial imagery (Google Earth, Retrolens), topographic maps and GIS datasets (i.e., LCDB V5.0, West Coast Regional Council). These were used to assist in assessing historic hydrological conditions and identifying possible wetland locations and extents within the SB for subsequent field survey.

Wetlands are defined in the Resource Management Act (RMA) as “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”.

The West Coast Regional Council defines wetlands in the glossary of the RLWP as:

*“Wetland includes permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of native plants and animals that are adapted to wet conditions and excludes areas of pasture where water ponds after rain”.*

The NPS-FM defines natural inland wetlands as a wetland (as defined in the Act) that is not:

- (a) *in the coastal marine area; or*
- (b) *a deliberately constructed wetland, other than a wetland constructed to offset impacts on, or to restore, an existing or former natural inland wetland; or*
- (c) *a wetland that has developed in or around a deliberately constructed water body, since the construction of the water body; or*
- (d) *a geothermal wetland; or*
- (e) *a wetland that:*
  - (i) *is within an area of pasture used for grazing; and*
  - (ii) *has vegetation cover comprising more than 50% exotic pasture species (as identified in the National List of Exotic Pasture Species using the Pasture Exclusion Assessment Methodology (see clause 1.8)); unless*
  - (iii) *the wetland is a location of a habitat of a threatened species identified under clause 3.8 of the NPS-FM, in which case the exclusion in (e) does not apply.*

Wetlands within the SB were identified, delineated and described during surveys on 17–19

June 2024 and 21–23 January 2025. Wetlands were identified in accordance with the National Policy Statement for Freshwater Management (2020) (NPS-FM) and wetland delineations carried out in accordance with MfE Wetland Delineation Protocols (2022). Wetlands were mapped during field surveys by annotating printed aerial photographs from recent aerial imagery. The location of vegetation plots to assist in wetland delineation was recorded. Wetland surveys were completed throughout the SB. Wetlands within 100 m of the site were not assessed directly because access permission was not obtained.

### 3.3 Watercourses

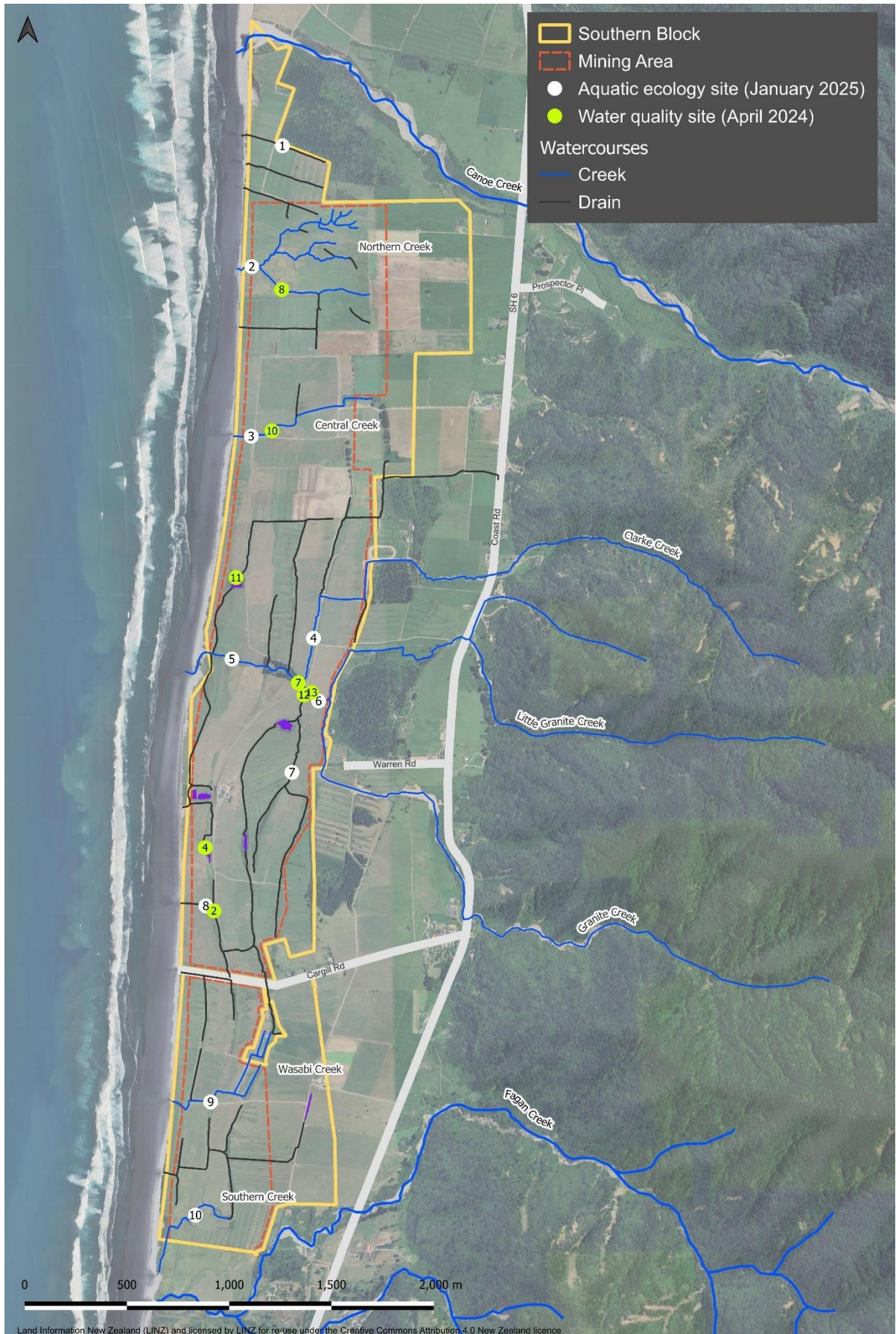
#### 3.3.1 Sampling sites

Granite Creek, Little Granite Creek and Clarke Creek originate in the hills east of SH6 and flow through the site before discharging to the sea. All other creeks and drains originate within the SB. The 10 sites surveyed within the SB during the survey of creeks and drains undertaken on 22 and 23 January 2025 are shown in Figure 7 and described in Table 3:

- Sites 1, 7 and 8 were located on artificial drains which were constructed either to drain land for farming or as part of historical mining at the site;
- Site 2 was located on the lower reaches of an unnamed creek (referred to here as Northern Creek).
- Site 3 was located in the lower reaches of a highly modified unnamed creek referred to here as Central Creek.
- Site 4 was located on Clarke Creek, which joins Granite Creek as a channelised (i.e., modified) creek within the SB.
- Sites 5 and 6 were located on Granite Creek;
- Site 9 was located on another highly modified unnamed creek referred to here as Wasabi Creek in the southern part of the site.
- Site 10 was located on a highly modified creek referred to here as Southern Creek.

**Table 3: Aquatic ecology sampling site details.**

| Site | Stream           | Description  | NZTM 2000  |            |
|------|------------------|--|------------|------------|
|      |                  |  | Northing   | Easting    |
| 1    | Artificial drain | Drain receiving water from natural wetland to the north of the site                        | 5325644.08 | 1461038.64 |
| 2    | Northern Creek   | Natural catchment in the northern portion of the site                                      | 5325053.19 | 1460889.15 |
| 3    | Central Creek    | Unnamed creek in the northern portion of site  | 5324223.38 | 1460886.48 |
| 4    | Clarke Creek     | Highly modified natural stream with catchment originating in hills east of SH6             | 5323133.50 | 1460791.85 |
| 5    | Granite Creek    | Lower tidally influenced reaches   | 5322928.20 | 1461215.78 |
| 6    | Granite Creek    | Above tidally influenced reach and below Little Granite Creek and Granite Creek confluence | 5323235.20 | 1461190.68 |
| 7    | Artificial drain | Drain with soft-bottomed bed   | 5322578.99 | 1461085.31 |
| 8    | Artificial drain | Lower reaches of drain network in southern portion of site                                 | 5321925.98 | 1460664.95 |
| 9    | Wasabi Creek     | Good flow and gravel/cobble bed  | 5320966.96 | 1460688.15 |
| 10   | Southern Creek   | Lower reaches of unnamed creek with artificial network in southern portion of site         | 5320413.25 | 1460613.54 |



**Figure 7: Location of water quality and aquatic ecology sampling sites, Barrytown.**

### 3.3.2 Water quality

In April 2024, surface water quality samples were collected for a suite of broad analyses from the eight sites shown in Figure 7. Samples were collected using standardised sampling techniques (USGS, 2014), which included shipping of samples iced and without delay. Laboratory analyses were conducted by Hill Laboratories, Hamilton.

Physico-chemical data including temperature, dissolved oxygen, conductivity and pH were also recorded at sites during the April 2024 survey using a calibrated hand held YSI meter. Physico-chemical data was also recorded at the ten aquatic ecology sites during the January 2025 survey using a calibrated hand held YSI meter. The time of day at which physico-chemical parameter data was collected was also recorded.

### 3.3.3 Watercourse classification

Flowing freshwater habitats within the site were classified in accordance with the definitions outlined in the glossary of the RLWP and were used to describe their status, which are:

**Drain** refers to an artificial channel or subsurface conduit (e.g. mole drain, tile drain or drainage tunnel, or roadside swale) constructed for the purpose of:

- Collecting and diverting surface runoff, but also includes water collected from sealed surfaces with no associated reticulated stormwater system such as roadside swales and concrete dish swales, or
- Intercepting groundwater in order to lower the water table or divert water (excluding a water race), and directing it to a receiving water body.

The channel must not incorporate the bed of an existing river or creek, or the water from the bed of an existing river or creek. The hollows of humped and hollowed land are considered drains.

**Ephemeral water body** a water body, which has the physical characteristics of the bed of a river, that dries up periodically, typically holding water for only a few days to months.

**Main stem** refers to the principal course of a river (i.e., does not include tributaries).

**Major farm drain** refers to the primary drain that:

- (a) Collects water from humped, hollowed, and flipped pasture;
- (b) Has a defined channel;
- (c) Carries water the majority of the time.

**River** means a continually or intermittently flowing body of fresh water; and includes a stream and modified watercourse; but does not include an artificial watercourse (including an irrigation canal, water supply race, canal for the supply of water for electricity power generation, and farm drainage canal) or ephemeral water bodies. A storm flowpath that carries flow only for a short period after heavy rain is not considered to be a river.

### 3.3.4 Habitat characteristics

Freshwater and riparian habitat data was collected at each of the ten aquatic ecology survey sites. Habitat can influence periphyton and benthic invertebrate communities so this data was collected to assist in the interpretation of results. The following habitat data was collected:

- Wetted channel width and water depth at transects on each stream.
- Water velocity.

- Habitat type (run, riffle, pool).
- Streambed substrate composition.
- Streambank erosion and bed scour (%).
- Organic matter content (leaf litter, woody debris).
- Riparian habitat characteristics.
- Channel shade (%).

### 3.3.5 Freshwater flora

Macrophyte (aquatic plants) and periphyton cover was assessed at each of the ten aquatic ecology survey sites. Macrophyte species were identified and the cover of each species was recorded. The type of periphyton and the cover of each type was also recorded.

### 3.3.6 Benthic macroinvertebrates

Five benthic macroinvertebrate samples were collected from the ten aquatic ecology survey sites using a kick net in accordance with the National Environmental Monitoring Standards for Macroinvertebrates (NEMS 2020). Samples were processed following Protocol P3 (full count with subsampling) outlined in Stark et al. (2001).

The following invertebrate metrics and indices were calculated from community data:

- *Community composition* – relative abundance of the main taxonomic groups making up the macroinvertebrate communities recorded from each watercourse. This metric can be used to provide a general indication of stream health based on the relative proportions of water quality and habitat sensitive and tolerant taxonomic groups.
- *Taxa number* – a measure of the overall health of the benthic macroinvertebrate community and habitat and water quality. In general, a high taxa number can be an indication of a healthy waterway. The number of taxa present at a site can be highly variable and can fluctuate depending on many factors including habitat, water quality and sampling effort.
- *Abundance* – a measure of the total number of individuals in a sample. Total abundance tends to increase in the presence of organic/nutrient enrichment, but declines in the presence of toxic pollution.
- *Macroinvertebrate Community Index (MCI)* – presence/absence-based index for measuring stream health in soft-bottomed streams. Individual taxa scores range from 1 (pollution tolerant) to 10 (highly pollution sensitive). The National Policy Statement for Freshwater Management 2020 (MfE 2020) (NPS-FM) presents MCI thresholds that categorise stream health into four attribute bands (A, B, C and D) as set out in Table 4 (MfE 2020).
- *Quantitative Macroinvertebrate Community Index (QMCI)* – the QMCI is a quantitative variant of the MCI and used to measure stream health for soft-bottomed streams. The NPS-FM (MfE 2020) also presents QMCI thresholds that categorise stream health into the four attribute bands (A, B, C and D) defined by MfE (2020) and set out in Table 4.
- *EPT taxa number* – a measure of the overall health of the community and of habitat and water quality. A community that has a higher number of water quality and habitat sensitive taxa from the groups Ephemeroptera (mayflies), Plecoptera (stoneflies) and Trichoptera (caddisflies) (EPT) indicates a healthier waterway.
- *Percent EPT (%EPT)* – another measure of suitability of the waterway for supporting

water quality and habitat sensitive taxa. A benthic macroinvertebrate community that has a higher percentage of water quality and habitat sensitive taxa from the EPT groups indicates a healthier waterway.

- **Average Score Per Metric (ASPM)** – average score of the normalised MCI-sb, EPT and %EPT. ASPM was introduced into the NPS-FM (MfE 2020). Scores range between 0 (low ecological integrity) and 1 (high ecological integrity) and interpreted based on the guidelines outlined in Table 4.

**Table 4: MCI, QMCI and ASPM attribute bands (MfE 2020).**

| Attribute                         | Description <sup>a,b</sup>  | MCI           | QMCI          | Description <sup>c</sup>   | ASPM          |
|-----------------------------------|---|---------------|---------------|--|---------------|
| <b>A</b>                          | Macroinvertebrate community indicative of pristine conditions with almost no organic pollution or nutrient enrichment.  | ≥130          | ≥6.50         | Macroinvertebrate communities have high ecological integrity, similar to that expected in reference condition. | ≥0.6          |
| <b>B</b>                          | Macroinvertebrate community indicative of mild organic pollution or nutrient enrichment. Largely composed of taxa sensitive to organic pollution / nutrient enrichment.                       | ≥110 and <130 | ≥5.5 and <6.5 | Macroinvertebrate communities have mild-to-moderate loss of ecological integrity.                              | <0.6 and ≥0.4 |
| <b>C</b>                          | Macroinvertebrate community indicative of moderate organic pollution or nutrient enrichment. There is a mixture of taxa sensitive and insensitive to organic pollution / nutrient enrichment. | ≥90 and <110  | ≥4.5 and <5.5 | Macroinvertebrate communities have moderate-to-severe loss of ecological integrity.                            | <0.4 and ≥0.3 |
| <b>National bottom line (NBL)</b> |   | <b>90</b>     | <b>4.5</b>    |  | <b>0.3</b>    |
| <b>D</b>                          | Macroinvertebrate community indicative of severe organic pollution or nutrient enrichment. Communities are largely composed of taxa insensitive to organic pollution / nutrient enrichment.   | <90           | <4.50         | Macroinvertebrate communities have severe loss of ecological integrity.  | <0.3          |

**Note:** <sup>a</sup> MCI; <sup>b</sup> QMCI; <sup>c</sup> ASPM.

### 3.3.7 Fish

A search of the New Zealand Freshwater Fish Database (NZFFD) was carried out for existing records of fish obtained since 1985 within the site and wider catchments. In addition, fish were surveyed at each sampling site using an electric fishing machine (EFM300). The fishing effort and area fished at each site was standardised (30 m<sup>2</sup>). All fish captured were identified, measured and returned to the watercourses. A single environmental DNA (eDNA) sample was collected at each site to provide an indication of fish species present and to complement electric fishing data. Samples were filtered, preserved and sent to Wilderlab laboratory for analysis using the multi-species test.

## 3.4 Surface Water and Groundwater Hydrology

The surface water and groundwater hydrology has been reviewed by Kōmanawa Solutions Limited (2026) who drew primarily on three investigations: Coffey Partners (1991), Vidanovich (2008) and Rekker (2020).

Coffey Partners (1991) reported surface water flows based on spot gauging, which was critically reviewed (Kōmanawa Solutions 2026), and is discussed in Section 6.2. Coffey Partners (1991), Vidanovich (2008) and Rekker (2020) defined aquifer properties and water level patterns to the immediate north and south of the proposed mining area. In addition, Kōmanawa Solutions Ltd conducted further groundwater investigations at five piezometers within the SB in 2022 with a focus on the proposed mining area and this included the determination of groundwater levels and flows and hydrological properties. The locations of the five piezometers (PZ-101, PZ-102, PZ-103, PZ-104, PZ-105) are shown in Figure 8.

The understanding of surface water and groundwater hydrology set out in this report has

been informed by the conclusions presented by Kōmanawa Solutions Ltd (2025, 2026). Surface water and groundwater quality data was obtained from sampling in April 2024 where groundwater bores were purged of approximately 50 L before collection of samples, which were shipped to Hill Laboratories, Christchurch, for analysis.

### 3.5 Assessment of Effects

The ecological value of features identified in the SB were assigned following the approach outlined in the Environment Institute of Australia and New Zealand’s (EIANZ) Ecological Impact Assessment Guidelines (EclAG) (Roper-Lindsay et al. 2018). The EclAG outlines a standardised approach for defining terrestrial and freshwater ecological values. The approach involves assessing four matters including: representativeness, rarity/distinctiveness, diversity/pattern and ecological context with consideration of the attributes outlined in Table 5 and/or Table 7 of the EclAG. The overall ecological value of the features identified within the SB were then assigned based on the four matters outlined above and using the scoring system outlined in Table 6 of the EclAG.

The level of effects (both direct and indirect) on the values identified were assessed using the method outlined in the EclAG. This involved determining the magnitude of effects based on criteria outlined in Table 8 of the EclAG, reproduced as Table 5 below, and assigning the overall level of effect using the matrix in Table 10 of the EclAG, provided as Table 6 below. The magnitude of the effects was considered at the ED scale unless otherwise indicated. The Fast Track Approvals Act requires an overall assessment of the significance of any adverse effects. This assessment is provided in Section 9.5.

**Table 5: Criteria for describing magnitude of effect.**

| Magnitude  | Description   |
|------------|---|
| Very high  | Total loss or very major alteration to key elements/ features of the baseline conditions such that the post development character/ composition/ 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 baseline (pre-development) conditions such that post development character/ composition/ 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 baseline conditions such that post development character/composition/attributes of baseline 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 baseline conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of baseline condition will be similar to pre-development circumstances/patterns; AND/OR having a minor effect on the known population or range of the element/feature.     |
| Negligible | Very slight change from baseline condition. Change barely distinguishable, approximating to the “no change” situation; AND/OR having negligible effect on the known population or range of the element/feature.   |

**Table 6: Criteria for describing level of effects.**

| Effect level<br>▼ | Ecological value ► |           |          |          |            |
|-------------------|--------------------|-----------|----------|----------|------------|
|                   | Very high          | High      | Moderate | Low      | Negligible |
| Very high         | Very high          | Very high | High     | Moderate | Low        |
| High              | Very high          | Very high | Moderate | Low      | Very low   |
| Moderate          | High               | High      | Moderate | Low      | Very low   |
| Low               | Moderate           | Low       | Low      | Very low | Very low   |
| Negligible        | Low                | Very low  | Very low | Very low | Very low   |
| Positive          | Net gain           | Net gain  | Net gain | Net gain | Net gain   |



**Figure 8: Location of piezometers within SB, Barrytown (Kōmanawa Solutions Ltd, 2026).**

## 4.0 Terrestrial Flora and Fauna

### 4.1 Vegetation

#### 4.1.1 Desktop assessment

Information from the Land Environments of New Zealand, Threatened Environments Classification, and previous studies (e.g., Onley 1980, McEwen 1987) indicate that outside the Barrytown Flats, the Punakaiki ED is relatively intact with respect to species, habitats and ecological functioning. A high diversity of vegetation types has been retained, including coastal forest, karst forest, old tertiary forest and limestone talus forest.

The predictive historic vegetation mapping by Leathwick et al. (2001) indicates that the vegetation within the SB would have comprised lowland coastal forest and wetland prior to forest clearance and land drainage to facilitate timber harvesting, flax milling, mining, dredging and livestock farming.

According to the LCDB V5.0, the majority of the SB currently comprises high producing exotic pasture, with small amounts of other land cover types including herbaceous freshwater vegetation (i.e., wetlands), broadleaved indigenous hardwoods, exotic forest and exposed sand/gravel. The Threatened Environment Classification for the level IV land environments within the SB is less reduced and better protected (Category 6: >30% remaining and >20% protected).

#### 4.1.2 Site surveys

##### 4.1.2.1 Summary

A description of the vegetation types present and their extent within the SB is summarised in Table 7. The location and distribution of each vegetation type is shown in Figure 9. More detailed descriptions of each vegetation type are provided in Sections 4.1.2.2– 4.1.2.7. A full list of vascular plants recorded within the SB is included as Appendix A.

**Table 7: Vegetation Cover within the SB and Proposed Mining Area.**

| Vegetation type              | Description   | SB (ha)       | Mining area   |                  |
|------------------------------|---|---------------|---------------|------------------|
|                              |   |               | Area (ha)     | % of Mining Area |
| Grazed exotic pasture        | Low stature exotic pasture species and crops.   | 395.46        | 273.46        | 97.93            |
| Rough exotic pasture         | Exotic pasture grasses and other exotic vegetation including gorse and blackberry. Higher stature than grazed exotic pasture above.   | 5.96          | 3.48          | 1.25             |
| Indigenous coastal shrubland | Nīkau and cabbage tree over low stature indigenous species including māhoe, kāmahī and tree ferns. Exotic vegetation present in gaps and edges. Species present with a conservation status included native broom ( <i>Carmichaelia australis</i> , 'At Risk – Declining') and <i>Solanum aviculare var. aviculare</i> (Threatened – Nationally Endangered). | 1.98          | 0.75          | 0.27             |
| Isolated rātā                | Snags of isolated rātā up to 15 m high with indigenous epiphytes. Potential bat roost habitat.  | 0.03          | 0.00          | 0.00             |
| Exotic pine                  | Over-mature pines, either isolated or present as sparse shelterbelts.   | 2.18          | 1.29          | 0.46             |
| Flaxland                     | Coastal fringe  | 0.35          | 0.25          | 0.09             |
| Non-vegetation               | Riverbed or coastal areas   | 1.51          | 0.00          | 0.00             |
| <b>Total</b>                 |   | <b>407.47</b> | <b>279.23</b> | <b>100</b>       |

**Note:** Total Area of SB = 408 ha (rounded up), Total Mining area within SB = 280 ha (rounded up).



**Figure 9: Vegetation types present within the mining area of the SB, Barrytown.**

#### 4.1.2.2 Grazed exotic pasture

Vegetation across the majority (~98%) of the SB and proposed mining area comprised grazed exotic pasture used for dairying and dairy support as shown in Figure 10. Pasture species present included perennial ryegrass (*Lolium perenne*), annual ryegrass (*Lolium rigidum*), browntop (*Agrostis capillaris*), white clover (*Trifolium repens*) and annual poa (*Poa annua*). Kale crops (*Brassica oleracea*) were also present in some paddocks. Occasional soft rush (*Juncus effusus*), wīwī (*Juncus edgariae*), ragwort (*Jacobea vulgaris*), lotus (*Lotus pedunculatus*), buttercup (*Ranunculus repens*) and dock (*Rumex* spp.), along with other common herbaceous pasture weeds, were scattered throughout the grazed pasture.



Figure 10: Grazed exotic pasture within the SB, Barrytown.

#### 4.1.2.3 Rough exotic pasture

South of Cargill Road, in the southern part of the proposed mining area, areas of pasture which have been less intensively grazed were occasionally present around watercourses. Species present included those mentioned above as well as other exotic pasture weeds such as *Carex ovalis*, gorse (*Ulex europaeus*) and blackberry (*Rubus fruticosus* agg.). The native sedge *Carex comans* was occasionally present in drier areas. At the time of survey, these areas of pasture were taller than the intensively grazed exotic pasture and therefore may provide more suitable habitat for lizards. An example of areas of rough exotic pasture is shown in Figure 11.



Figure 11: Rough exotic pasture at the southern extent of the SB, Barrytown.

#### 4.1.2.4 Indigenous coastal shrubland

Some indigenous vegetation was present south of Cargill Road in the form of narrow strips of secondary coastal shrubland growing along parts of the hump and hollow systems, drains and historic dredge pits. In addition, a small strip of coastal shrubland was present along the eastern boundary of the proposed mining area near the proposed mining access route as shown in Figure 9. An example of the indigenous coastal shrubland vegetation is shown in Figure 12.

The indigenous coastal shrubland was dominated by emergent nīkau (*Rhopalostylis sapida*) and cabbage tree (*Cordyline australis*) with māhoe (*Meliccytus ramiflorus*), kāmahi (*Pterophylla racemosa*), tree fern (*Dicksonia squarrosa*, *Cyathea medullaris*) and kiekie (*Freycinetia banksii*) making up the understorey. Pōhuehue (*Muehlenbeckia australis*) formed a dense covering growing epiphytically over much of this vegetation. Flax (*Phormium tenax*) was common in places at the edges. Native broom (*Carmichaelia australis* – ‘At Risk – Declining’), poroporo (*Solanum laciniatum*), *Coprosma propinqua*, kawakawa (*Piper excelsum*) and wineberry (*Aristotelia serrata*) were occasional, and swamp astelia (*Astelia grandis*) was patchily distributed. A single individual of *Solanum aviculare* var. *aviculare* (‘Threatened – Nationally Endangered’) was recorded in the area south of Cargill Road. Areas of indigenous coastal shrubland were affected by livestock grazing, fragmentation and weed incursion.



Figure 12: Indigenous coastal shrubland within the southern SB, Barrytown.

#### 4.1.2.5 Isolated rātā

Four snags (i.e., dead standing trees) of rātā (*Metrosideros* sp.) with surviving epiphytes of tank lily (*Astelia hastata*), akatea (*Metrosideros perforata*) and puka (*Griselinia lucida*) as shown in Figure 13, were present in the southeastern portion of the SB, outside the proposed mining area (see Figure 9). One rātā snag, approximately 15 m high, contained a cavity, and another approximately 4 m high had evidence of bird roosting.



**Figure 13: Isolated rātā snag with indigenous epiphytes within the southern SB, outside the proposed mining area, Barrytown.**

#### **4.1.2.6 Pine shelterbelts and isolated trees**

Sparse shelterbelts and isolated over-mature *Pinus radiata* were primarily centrally located within the proposed mining area (see Figure 9) surrounded by grazed exotic pasture as shown in Figure 14. The canopy of these trees was sparse, and there were no epiphytes or regenerating indigenous plants around the base of any trees.



**Figure 14: Isolated over-mature pines with a pine shelterbelt in the background within the SB, Barrytown.**

#### 4.1.2.7 Flaxland

Riparian vegetation dominated by flax-with occasional māhoe, whekī, cabbage tree and *Carex geminata* was present along the raised margin of Wasabi Creek, centrally located within the southern portion of the proposed mining area (see Figure 9). An example of this flaxland is shown in Figure 15.



Figure 15: Flaxland vegetation on the margins of Wasabi Creek.

## 4.2 Avifauna (Birds)

### 4.2.1 Desktop assessment

The eBird database included 8,723 records comprising 104 taxa (i.e., records identified to species or genus level) including seabirds, coastal birds and land birds. A list of bird species recorded is provided in Appendix B. Surveys undertaken in the Central Block (CB), immediately to the north of the SB, from 2021-2023 recorded forty-nine species of birds, including 14 considered to be 'Threatened' or 'At Risk', many of which were coastal birds. The majority of these coastal birds are unlikely to be using large areas of the SB or proposed mining area for feeding or nesting, instead occupying the small lagoon adjoining the SB and/or visiting nearby wetland and other habitats.

The 'Threatened' and 'At Risk' bird species likely to use the SB or proposed mining area, even as occasional visitors are listed in Table 8.

**Table 8: Threatened and At Risk birds recorded in eBird or during CB surveys and which may use the SB.**

| Common name                           | Scientific name                             | Conservation status (Robertson et al. 2021) |
|---------------------------------------|---|---|
| Tūturiwhatu/banded dotterel           | <i>Anarhynchus b. bicinctus</i>             | At Risk – Declining                         |
| Tarāpuka/black billed gull            | <i>Chroicocephalus bulleri</i>              | At Risk – Declining                         |
| Māpunga/black shag                    | <i>Phalacrocorax carbo novaehollandiae</i>  | At Risk – Relict                            |
| Kawaupaka/little shag                 | <i>Microcarbo melanoleucos brevirostris</i> | At Risk – Relict                            |
| Kororā/little blue penguin            | <i>Eudyptula minor</i>                      | At Risk – Declining                         |
| Koekoeā/long-tailed cuckoo            | <i>Eudynamys taitensis</i>                  | Threatened – Nationally Vulnerable          |
| Tarāpunga/red-billed gull             | <i>Chroicocephalus novaehollandiae</i>      | At Risk – Declining                         |
| Kōtuku ngutupapa/royal spoonbill      | <i>Platalea regia</i>                       | At Risk – Naturally Uncommon                |
| Mātātā/South Island fernbird          | <i>Poodytes p. punctatus</i>                | At Risk – Declining                         |
| Tōrea/South Island pied oystercatcher | <i>Haematopus finschi</i>                   | At Risk – Declining                         |
| Kārearea/New Zealand falcon ('bush')  | <i>Falco novaeseelandiae</i>                | At Risk – Declining                         |
| Tōrea tai/variable oystercatcher      | <i>Haematopus unicolor</i>                  | At Risk – Recovering                        |
| Pārerā/Pacific black duck             | <i>Anas superciliosa</i>                    | Threatened – Nationally Vulnerable          |
| Tara/white-fronted tern               | <i>Sterna s. striata</i>                    | At Risk – Declining                         |

#### 4.2.2 Site surveys

Thirty-three bird species have been recorded during the surveys to date at the SB. The species detected were generally exotic or common native species and the avifauna community generally reflects the highly modified state of the habitats within the SB. Most of the species recorded during surveys were typical of urban and rural environments, but four (shown in Table 9) are considered 'Threatened' or 'At Risk' by Robertson et al. (2021).

These include great spotted kiwi (*Apteryx maxima*, 'Threatened – Nationally Vulnerable'), red-billed gull (*Chroicocephalus novaehollandiae*, 'At Risk – Declining'), South Island pied oystercatcher (*Haematopus finschii*, 'At Risk – Declining') and variable oystercatcher (*Haematopus unicolor*, 'At Risk – Recovering'). None of these four species are likely to rely on the pasture habitat present in the proposed mining area, but all may visit such areas for feeding (especially in disturbed soil) or loafing. It is unlikely that great spotted kiwi will use the site given the lack of habitat and vegetated cover, and their presence in acoustic surveys is most likely to be the result of a distant call, recorded from the vegetated hills outside of the site.

The audio recordings of ducks (*Anas* spp.) were unable to be identified as either exotic mallard (*Anas platyrhynchos*) or the native grey duck (*Anas superciliosa*), which is 'Threatened – Nationally Vulnerable' and are indistinguishable audibly. They are also difficult to tell apart visually. It is possible that the birds heard were hybrids between the two, which are regarded as 'Not Threatened' (Robertson et al. 2021). Mallards were confirmed as present during 5MBCs.

Of the species listed in Table 8, kororā (little blue penguin, *Eudyptula minor*), are known to use the adjoining habitats and may cross the site to reach nests inland. No potential penguin burrows were detected during the field surveys and the vegetation across the majority of the site was unsuitable for penguin nesting, although they are known to nest under buildings at some locations.

**Table 9: Threatened and At Risk birds recorded during SB surveys.**

| Common name                           | Scientific name                        | Conservation status (Robertson et al. 2021) |
|---------------------------------------|--|---|
| Rōroa/great Spotted kiwi              | <i>Apteryx maxima</i>                  | Threatened – Nationally Vulnerable          |
| Tarāpunga/red-billed gull             | <i>Chroicocephalus novaehollandiae</i> | At Risk – Declining                         |
| Tōrea/South Island pied oystercatcher | <i>Haematopus finschi</i>              | At Risk – Declining                         |
| Tōrea tai/variable oystercatcher      | <i>Haematopus unicolor</i>             | At Risk – Recovering                        |

## 4.3 Lizards

### 4.3.1 Desktop assessment

There were three lizard species recorded on the Department of Conservation database within the Punakaiki ED. Two species of native gecko (forest gecko - *Mokopirirakau granulatus* and West Coast green gecko - *Naultinus tuberculatus*) and one species of native skink (Newman’s speckled skink - *Oligosoma* aff. *newmani* “Westland”). Distribution maps (from the New Zealand Herpetological Society website) also indicate that the SB is within the known distribution of Canterbury grass skink (*Oligosoma* aff. *polychroma* Clade 4) bringing the number of lizard species in the Punakaiki ED to four.

Records included one unidentified skink species (two records) located between 5.5–8.0 km from the site, one record of Newman’s speckled skink (At Risk – Declining) located 8.8 km from the site, one record of a West Coast *green gecko* (Threatened - Nationally Vulnerable) located 9.3 km from the site, and four records of forest gecko (At Risk – Declining) located 7–10 km from the site (Table 10).

**Table 10: Lizard records within 10 km of the SB.**

| Common name             | Scientific name                                 | Conservation status (Hitchmough et al. 2021) |
|-------------------------|---|--|
| West Coast green gecko  | <i>Naultinus tuberculatus</i>                   | Threatened – Nationally Vulnerable           |
| Forest gecko            | <i>Mokopirirakau granulatus</i>                 | At Risk – Declining                          |
| Newman's speckled skink | <i>Oligosoma</i> aff. <i>newmani</i> “Westland” | At Risk – Declining                          |

### 4.3.2 Site walkover

As described above, the vegetation across the majority of the SB, including most of the proposed mining area, comprised intensively grazed exotic pasture. This vegetation does not provide suitable habitat for lizards. Rough exotic pasture may provide intermittent, low-quality refuge for skinks when ungrazed. There were areas of higher quality potential lizard habitat outside, but adjoining, the proposed mining area, including rock piles, rank pasture and cobble along the western coastal boundary (as shown in Figure 16), woody debris (as shown in Figure 17), remnant forest vegetation along the true-left of Canoe Creek and tall forest on the eastern boundary. These grassland and rocky areas may support Newman’s speckled skinks and Canterbury grass skink whilst more vegetated areas may support Forest and/or West Coast green geckos and possibly skinks in the understorey. These higher quality areas are outside the proposed mining area and would not be directly affected by the proposed mining activity.



**Figure 16: Rough vegetation and cobble habitat outside the proposed mining area providing potential Newman’s speckled skink habitat.**

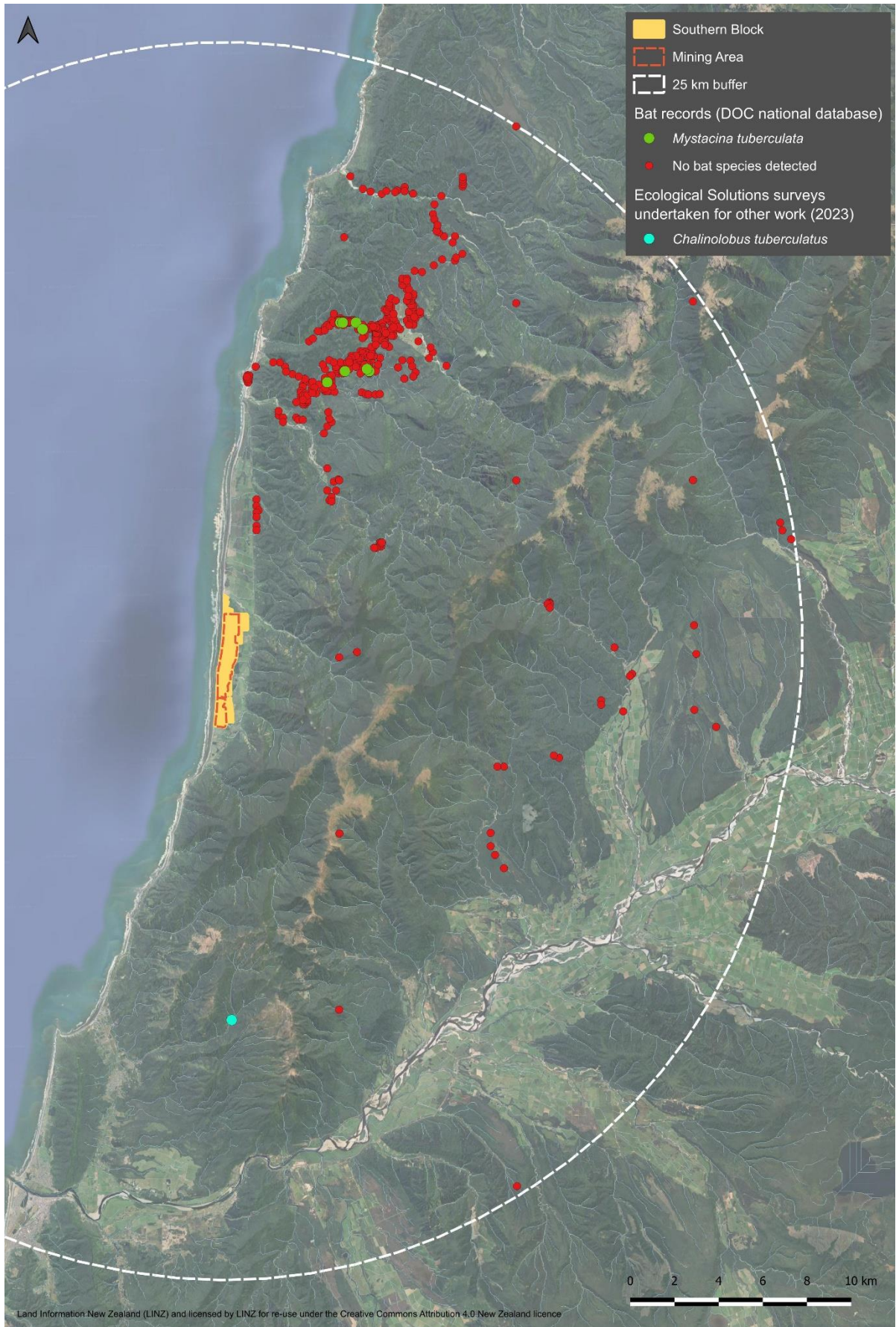


**Figure 17: Woody debris and cobble habitat outside the proposed mining area providing potential Newman’s speckled skink habitat.**

## 4.4 Bats

### 4.4.1 Desktop assessment

The national bat database indicates surveys at about 70 separate locations within 25 km of the SB (shown in Figure 18) have been carried out since 1992. These surveys have detected lesser short-tailed bat (*Mystacina tuberculata* – ‘Threatened – Nationally Increasing’) and long-tailed bats (*Chalinolobus tuberculatus* – ‘Threatened – Nationally Critical’). An additional survey undertaken by Ecological Solutions Limited in 2023, and not uploaded to the national database yet, include records from one location approximately 10 km south of the SB as shown in Figure 18. These records were of long-tailed bats.



**Figure 18: Bat records within 25 km of the SB, Barrytown.**

#### 4.4.2 Site walkover

The nearest contiguous indigenous forest cover to the SB is within the upper catchments of Canoe Creek, Clarke Creek, Little Granite Creek, Granite Creek and Fagan Creek east of State Highway 6 (SH6). This forest cover changes abruptly at the interface with SH6; whereby, to the west of SH6 the landscape is an expansive agricultural one dominated by open pasture with scattered forest remnants and watercourses with limited riparian vegetation. Several small ponds/dams and associated wetlands are also scattered across the SB and proposed mining area.

With respect to potential bat roost sites, two isolated stands/shelterbelts of over-mature exotic pine trees were present within the proposed mining area; however, these would be retained. Outside the mining area, but within the SB, the dead indigenous snags near the southern boundary could also be suitable for bat roosting. In addition, relatively small indigenous forest fragments adjoin the boundary outside the SB to the north, east and south. Examples of the types of habitats present that long-tailed bats (if present) may use for foraging, navigation or roosting are shown in Figure 19 and Figure 20.



**Figure 19:** The lower reaches of the streams across the SB may provide potential foraging habitat for bats.



**Figure 20: Indigenous forest remnants located outside the SB provides suitable bat roosting, foraging and commuting habitat.**

## 5.0 Wetlands

### 5.1 Introduction

Natural inland wetlands were present within both the SB and the proposed mining area at the locations shown in Figure 21. Many wetlands within the SB were associated with deliberately constructed drains (e.g., hump and hollows, historical dredge pits from previous mining) and therefore do not meet the RMA or RLWP definitions of a wetland or the definition of a 'natural inland wetland' outlined in the NPS-FM. Some of these wetlands (e.g., dredge pits) have been in existence a comparatively long time and some include indigenous vegetation. The longstanding presence of these wetlands, and their value, have been considered when assessing the effects and developing the rehabilitation plan for the site.

A total of c. 42.12 ha of wetland was present within the SB and 35.76 ha within the proposed mining area as set out in Table 11. This includes c. 6.73 ha which is considered 'natural inland wetland' (Table 11) and is therefore is subject to the National Environmental Standards for Freshwater (NES-F) and the NPS-FM, and a further c. 29 ha of wetland associated with deliberately constructed drains (e.g., poorly maintained hump and hollows, historical dredge pits) which are not subject to those regulations, but the removal of which could still have adverse ecological effects as detailed in Section 8.2.

Wetlands within the proposed mining area were similar to those in the wider SB. In terms of vegetation, the wetlands were characterised by common and widespread rush, sedge, grass and herb species typical of modified wetlands within the New Zealand agricultural landscape.

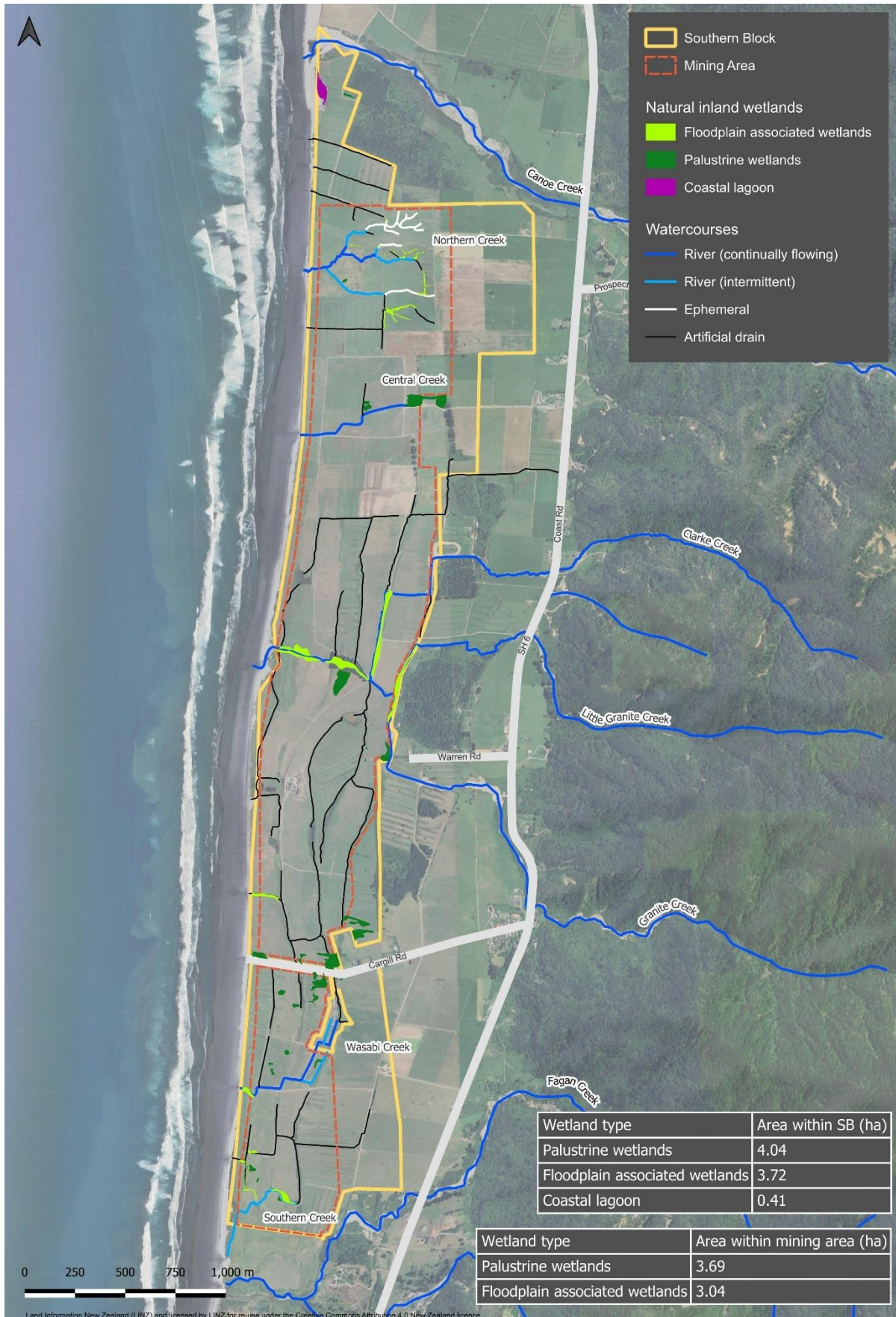
For assessment purposes, wetlands were grouped into five categories based on vegetation

and landform types as follows: floodplain, palustrine, coastal lagoon, hump and hollow, and dredge pit (see Table 11). Each of these wetland types are discussed in more detail in the following sections.

**Table 11: Wetlands within the SB and proposed mining area.**

| Wetland type  | Description  | SB<br>(ha)   | Mining area    |                            |
|---|--|--------------|----------------|----------------------------|
|   |  |              | Mining<br>(ha) | % of total<br>Mining area* |
| <b>Natural inland wetlands</b>                                  |  |              |                |                            |
| Floodplain  | Floodplains of small watercourses; vegetation typically dominated by <i>Carex</i> , <i>Isolepis prolifera</i> and watercress.  | 3.72         | 3.04           | 1.1                        |
| Palustrine  | Small isolated depressions throughout site. Vegetation dominated by <i>Juncus</i> and <i>Isolepis</i> .  | 4.04         | 3.69           | 1.3                        |
| Coastal Lagoon  | Small body of open water with <i>Isolepis prolifera</i> at the margins.  | 0.41         | 0.0            | 0.0                        |
| <i>Subtotal</i>   |  | <i>8.17</i>  | <i>6.73</i>    | <i>2.4</i>                 |
| <b>Wetlands associated with deliberately constructed drains</b> |  |              |                |                            |
| Hump and Hollow   | Vegetation dominated by <i>Isolepis</i> and <i>Juncus</i> rushland in poorly drained hollows of hump and hollowed paddocks. Watercress ( <i>Nasturtium officinale</i> ), water pepper ( <i>Persicaria hydropiper</i> ) and exotic grasses were frequent. | 22.87        | 18.39          | 6.6                        |
| Dredge Pit  | Long channels of wetland vegetation comprising mainly water pepper, <i>Isolepis prolifera</i> , watercress and <i>Carex</i> . Occasional open water.   | 11.08        | 10.64          | 3.8                        |
| <i>Subtotal</i>   |  | <i>33.95</i> | <i>29.03</i>   | <i>10.4</i>                |
| <b>Total (ha)</b>   |  | <b>42.12</b> | <b>35.76</b>   | <b>12.8</b>                |

**Note:** \* Total mine disturbance area = 280 ha.



**Figure 21: Location of natural inland wetlands within the SB, Barrytown.**



**Figure 22: Location of wetlands associated with deliberately constructed drains within the SB, Barrytown.**

## 5.2 Natural inland wetlands

### 5.2.1 Floodplain wetlands

Floodplain wetlands associated with some watercourses were variable in size and species composition. South of Cargill Road, vegetation within floodplain wetlands consisted of *Carex geminata*, *Carex virgata*, gorse and flax as shown in Figure 23. Floodplain wetlands were also present at the northern extent of the SB, where the vegetation consisted mainly of *Isolepis prolifera*, water pepper, water speedwell (*Veronica anagallis-aquatica*) and occasional jointed rush (*Juncus articulatus*) and soft rush as shown in Figure 24.



**Figure 23:** Example of vegetation within a floodplain wetland south of Cargill Road.



**Figure 24:** Example of vegetation within a floodplain wetland in the northern SB.

### 5.2.2 Palustrine wetlands

A number of wetlands not influenced by flowing water were present in isolated depressions throughout the SB and proposed mining area. These wetlands appeared to be naturally occurring rather than caused by historic gold dredging, farm drainage systems or other human modifications.

One of these wetlands was a small pond with soft rush and wīwī growing along the margins as shown in Figure 25. Pied stilt were recorded using this wetland. Vegetation at other palustrine wetlands was dominated by soft rush, wīwī and *Isolepis prolifera* and occasionally pure stands of water pepper. Palustrine wetlands were scattered throughout the SB in localised areas of poor drainage.

Exotic pasture species such as lotus, Yorkshire fog, white clover (*Trifolium repens*) and perennial ryegrass (*Lolium perenne*) were also present to a lesser extent within palustrine wetlands. Native obligate wetland species, including *Eleocharis acuta*, *Eleocharis gracilis* and *Isolepis cernua* were occasionally encountered.



**Figure 25:** Palustrine wetland within the southern portion of the SB.



**Figure 26:** Palustrine wetland dominated by soft rush and water pepper.

### 5.2.3 Coastal lagoon

A small coastal lagoon was present at the north-western extent of the SB, outside the proposed mining disturbance area, but within 100 m of its boundary, as shown in Figure 27. The lagoon is fed by various sources including Canoe Creek and two drains that form part of the hump and hollow drainage system directly east of the lagoon. Vegetation surrounding the coastal lagoon was similar to other wetland vegetation throughout the site, comprising mainly *Isolepis prolifera* with occasional *Juncus articulatus*, giant umbrella sedge (*Cyperus ustulatus*), *Carex geminata* and exotic pasture species. A stand of watercress was present at the outlet of a watercourse supplying the lagoon.



Figure 27: Coastal lagoon at the northern extent of the SB.

## 5.3 Wetlands Associated with Deliberately Constructed Drains

### 5.3.1 Hump and hollow wetlands

Vegetation within wetlands associated with hump and hollow and historical dredge pits was dominated by varying proportions of *Juncus* species (mainly *J. effusus* and *J. articulatus*), *Isolepis prolifera*, watercress (*Nasturtium officinale*, *N. microphyllum*), water pepper (*Persicaria hydropiper*) and pasture species. The area south of Cargill Road appeared to be less intensively grazed than the remainder of the site, with soft rush (*Juncus effusus*), wīwī (*Juncus edgariae*), *Carex* species and gorse more common than elsewhere at the site. North of Cargill Road *Isolepis prolifera* and water pepper dominated. Other species commonly encountered within these wetlands included jointed rush (*Juncus articulatus*), water speedwell, Yorkshire fog (*Holcus lanatus*), lotus (*Lotus pedunculatus*) and creeping buttercup. The presence of soil saturation, cracked mud and occasional surface water confirmed wetland hydrology at these constructed wetlands.

In areas subject to recent, or more intensive, livestock activity or maintenance, these hollows tended to be narrower and have a higher component of pasture species such as lotus and Yorkshire fog.

### 5.3.2 Dredge pits

The extensive dredging of the central and southern parts of the SB in the 1930s and 1940s, including within the proposed mining area, resulted in the creation of long channels of lower relief that have since developed wetland vegetation. The 'dredge pit wetlands' were clearly defined due to steep banks and a stark change from hydrophytic wetland vegetation within the former dredge pit to exotic pasture outside. Open water with red azolla (*Azolla rubra*) was present in some, generally larger and deeper, parts of the historic dredge channels.

Dominant species included water pepper, *Isolepis prolifera*, watercress and *Carex geminata*. Occasional flax, soft rush, *Carex virgata* and wīwī were also present. A stand of raupō (*Typha orientalis*) was present at a dredge pit wetland south of Cargill Road

## 6.0 Watercourses

### 6.1 Watercourse Classification

There are seven highly modified natural creeks and several artificial drains within the SB. Modified natural creeks within the SB include, from north to south, an unnamed creek in the northern area of the SB (referred to here as Northern Creek), unnamed creek in the north-central area (referred to here as Central Creek), Clarke Creek, Little Granite Creek, Granite Creek, the unnamed creek referred to here as Wasabi Creek and an unnamed creek in the southern area (referred to here as Southern Creek).

Watercourses within the SB and proposed mining area were classified in accordance with definitions in the RLWP with the locations shown in Figure 28 with the total lengths of each watercourse type summarised in Table 12. There was approximately 5.46 km of continually or intermittently flowing creek habitat within the SB (3.98 and 1.48 km, respectively) and 4.28 km within the proposed mining area (2.88 and 1.40 km, respectively) associated with Northern Creek, Central Creek, Clarke Creek, Little Granite Creek, Granite Creek, Wasabi Creek and Southern Creek (Table 12). There was approximately 1.05 km of ephemeral watercourse associated with Northern Creek within the SB and proposed mining area.

There was approximately 13.62 km of artificial drain (including major farm drains) within the SB and 11.17 km within the mining area (Table 12).

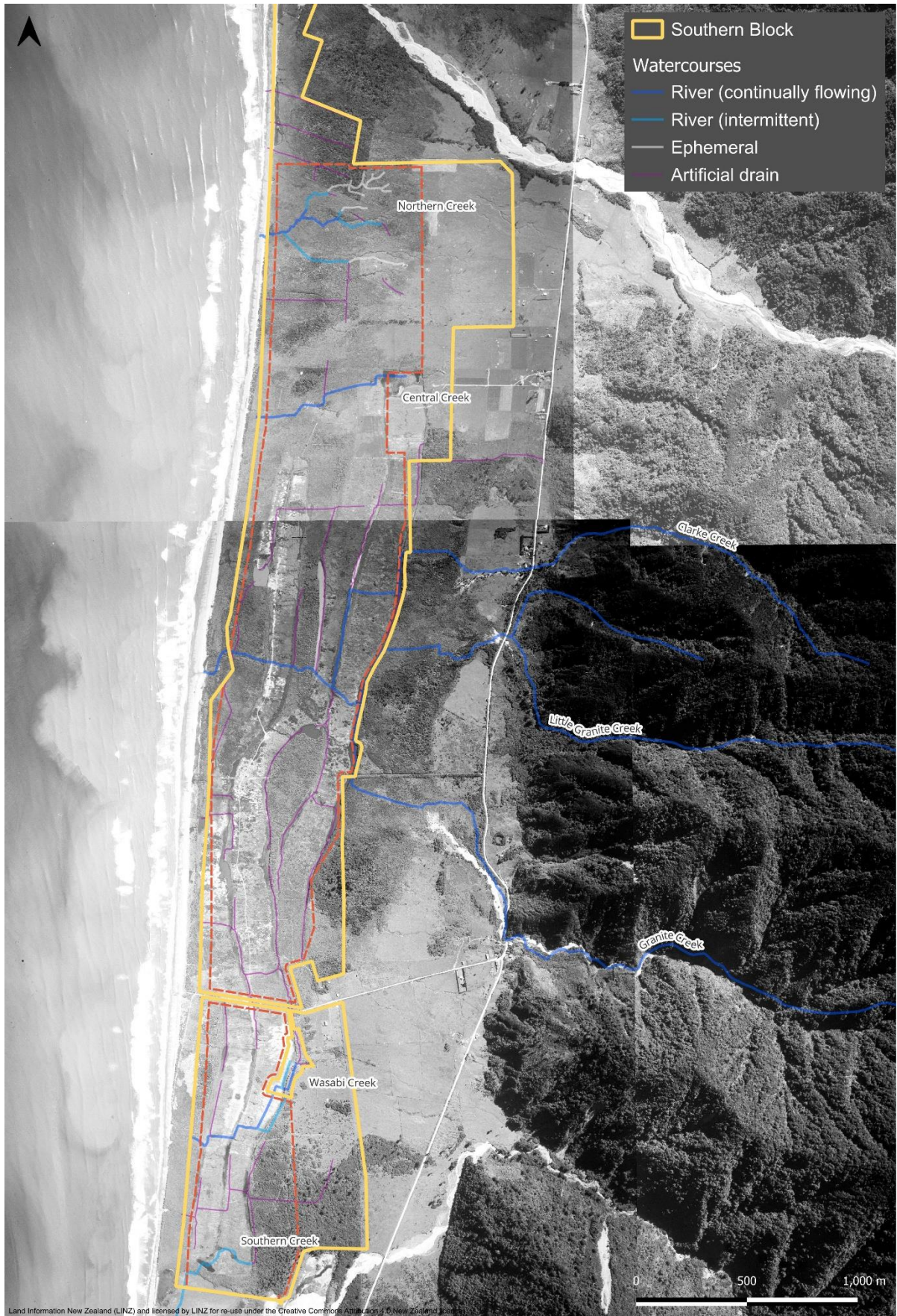
**Table 12: Watercourse lengths within the SB and proposed mining area.**

| Watercourse                             | SB (km)      | Mining area (km) |
|---|--------------|------------------|
| Creeks (continually flowing)            | 3.98         | 2.88             |
| Creeks (intermittent)                   | 1.48         | 1.40             |
| Ephemeral water body                    | 1.05         | 1.05             |
| Drain (artificial and major farm drain) | 13.62        | 11.17            |
| <b>Total</b>                            | <b>20.13</b> | <b>16.50</b>     |

There is a long history of modification to the landform within the SB due to gold dredging activity in the 1930s and 1940s and also through farming practices to further drain the land (e.g., humping and hollowing, drain construction). The network of artificial drains and dredge pits constructed during gold dredging is shown on an aerial image from 1951 along with the current alignment of watercourses for reference in Figure 29. Figure 29 indicates that the current alignment of the east-west flowing section of Granite Creek within the SB did not exist in 1951, with surface water appearing to flow laterally between artificial drains. Many of the artificial drains that currently exist are located within the alignment of remnant features associated with historical gold dredging activity.



**Figure 28: Status of watercourses based on RLWP definitions within the SB, Barrytown.**



**Figure 29: Historic (1951) aerial photograph showing extent of artificial drains constructed during gold dredge mining and current drain alignments.**

## 6.2 Surface Water Hydrology

Surface water flows and hydrology within the proposed mining footprint were reviewed by Kōmanawa Solutions (2026), taking into account previous gauging data (Coffey and Partners 1991) alongside NZ River Maps flow modelling (Whitehead and Booker 2020). While the previously estimated flow regime of Granite Creek downstream of the confluence with Little Granite Creek is considered broadly accurate, the modelled flows of surface waters outside the central zone are higher than previously estimated.

In addition, the review noted that while Granite Creek and Clarke Creek have moderate base flow retention, base flows were interpreted via an arbitrary, but logical, division of the mining footprint into three groundwater sub blocks: North (north of Granite Creek), Central (Granite Creek to Cargill Road) and South (Cargill Road to Fagan Creek).

While surface base flows in the North and South sub blocks of the proposed mining area may be negligible during dry periods, groundwater flows are not insignificant. Estimated groundwater flows at the front of the three sub blocks at a mean depth of 15 m are: North = 1,352 m<sup>3</sup>/d; Central = 1,422 m<sup>3</sup>/d; and, South = 2,411 m<sup>3</sup>/d (Kōmanawa Solutions 2025, 2026). This forms the basis for conservative modelling of surface water quality under low flow conditions when base flows may, nevertheless, still contribute to stream flows.

## 6.3 Surface Water Quality

Surface water sampling was conducted on 8–9 April 2024 at sites shown in Figure 7 (refer to Section 3.3.2). Site descriptions including visual observations are provided in Table 13. The full laboratory report is provided in Appendix C and the key parameters, notably those used in water quality modelling, are summarised in Table 14 and Table 15. For pH and conductivity, field measurements at the time of sampling are reported in preference to laboratory measurement due to the potential for changes in transit, which can be pronounced for samples that may have strong geochemical signatures due to groundwater influence. While the flows of streams or drains site sampled were not measured, sampling was only undertaken on such systems where flows were visibly greater than 1 L/s.

The results indicate that stream sites exhibited near neutral pH, low to moderate electrical conductivity and total dissolved solids (TDS) concentrations, and generally low turbidity and total suspended solids concentrations. Dissolved oxygen was expectedly 77.3–90.0% of saturation at sites with visible flows, the exception being 69.2% in a drain near aquatic ecology Site 2. All surface waters were low to moderate alkalinity and soft (<50 g/m<sup>3</sup> hardness, as CaCO<sub>3</sub>), with low to moderate major cation and anion concentrations.

**Table 13: Surface water site descriptions and qualitative visual characteristics.**

| Sites |         | Watercourses                 | RLWP status      | Time       | Clarity  | Colour       | Flow         |
|-------|---------|------------------------------|------------------|------------|----------|--------------|--------------|
| WQ    | Ecology |                              |                  |            |          |              |              |
| 8     | 2       | Northern Creek               | River            | 2:10 p.m.  | High     | Zero         | Low          |
| 10    | 3       | Central Creek                | River            | 2:40 p.m.  | High     | Zero         | Low          |
| 7     | 5       | Granite Creek D/S of ford    | River            | 12:45 p.m. | High     | Slight brown | Moderate     |
| 13    | 6       | Granite Creek U/S of ford    | River            | 8:55 a.m.  | High     | Zero         | Low-Moderate |
| 12    | 7       | Drain south of Granite Creek | Artificial drain | 8:45 a.m.  | High     | Zero         | Low-Moderate |
| 2     | 8       | Southern Drain at coast      | Artificial drain | 10:30 a.m. | High     | Zero         | Low          |
| 11    | -       | Pond                         | Pond             | 3:00 p.m.  | Moderate | Slight brown | NA           |
| 4     | -       | Lagoon                       | Lagoon           | 11:00 a.m. | Moderate | Slight brown | NA           |

**Table 14: Summary of key surface water quality parameters – physico-chemical and nutrients (April 2024).**

| Parameter / WQ site <sup>#</sup>                | 8 (2)<br>(Northern Cr.) | 10 (3)<br>(Central Cr.) | 7 (5)<br>(Granite Cr.) | 13 (6)<br>(Granite Cr.) | 12 (7)<br>(Drain) | 2 (8)<br>(Drain) | 11<br>(Pond) | 4<br>(Lagoon) | Guideline                      |
|---|-------------------------|-------------------------|------------------------|-------------------------|-------------------|------------------|--------------|---------------|--------------------------------|
| pH (pH units)*                                  | 7.1                     | 7.1                     | 6.8                    | 6.8                     | 6.9               | 6.6              | 6.8          | 6.8           | 6-9 <sup>A</sup>               |
| Temperature (°C)*                               | 14.9                    | 14.2                    | 13.6                   | 12.25                   | 12.65             | 11.5             | 16.4         | 15.2          | NA                             |
| Electrical conductivity (mS/m)*                 | 7.3                     | 7.9                     | 9.2                    | 7.8                     | 9.0               | 7.5              | 14.3         | 12.5          | NA                             |
| Turbidity (NTU)                                 | 0.89                    | 1.2                     | 3.7                    | 2.2                     | 5.9               | 1.4              | 18           | 3.5           | 5.6 <sup>B</sup>               |
| Total Suspended solids (TSS)                    | 3                       | <3                      | 5                      | <3                      | 3                 | <4               | 23           | 10            | NA                             |
| Total Dissolved solids (TDS)                    | 58                      | 65                      | 67                     | 66                      | 78                | 61               | 118          | 97            | NA                             |
| Dissolved oxygen (DO)*                          | 6.99                    | 9.22                    | 8.38                   | 9.26                    | 8.21              | 9.09             | 9.89         | 7.55          | ? <sup>A</sup>                 |
| DO (%)*   | 69.2                    | 90.0                    | 80.6                   | 86.5                    | 77.3              | 83.4             | 101          | 75.2          | ? <sup>A</sup>                 |
| Total Alkalinity (as CaCO <sub>3</sub> )        | 31                      | 29                      | 31                     | 25                      | 32                | 31               | 25           | 34            | NA                             |
| Bicarbonate (at 25°C)                           | 37                      | 36                      | 38                     | 30                      | 39                | 37               | 31           | 41            | NA                             |
| Total nitrogen (TN)                             | 0.17                    | 0.28                    | 0.46                   | 0.26                    | 0.50              | 0.36             | 0.97         | 0.51          | NA                             |
| Total ammoniacal nitrogen (Amm-N)               | <0.010                  | 0.016                   | 0.091                  | 0.018                   | 0.094             | 0.013            | <0.010       | <0.010        | <sup>C</sup> refer text        |
| Nitrate + nitrite nitrogen (NO <sub>x</sub> -N) | 0.032                   | 0.23                    | 0.29                   | 0.21                    | 0.31              | 0.31             | <0.002       | <0.002        | ≤1.0 <sup>C</sup> , refer text |
| Total Kjeldahl nitrogen (TKN)                   | 0.14                    | <0.10                   | 0.17                   | <0.10                   | 0.19              | <0.10            | 0.97         | 0.51          | NA                             |
| Total phosphorus (TP)                           | 0.026                   | 0.007                   | 0.007                  | 0.004                   | 0.012             | 0.006            | 0.13         | 0.047         | NA                             |
| Dissolved reactive phosphorus (DRP)             | <0.004                  | <0.004                  | <0.004                 | <0.004                  | <0.004            | <0.004           | 0.005        | <0.004        | ≤1.0 <sup>C</sup> , refer text |
| Dissolved organic carbon (DOC)                  | 0.9                     | 0.7                     | 1.0                    | 0.8                     | 2.3               | 0.7              | 10.3         | 6.3           | NA                             |

**Notes:** <sup>#</sup> Site in brackets represents ecological survey site; units g/m<sup>3</sup> unless stated; \*Field measurement; <sup>A</sup>WCRC (2014); <sup>B</sup>ANZECC (2000); <sup>C</sup>NPS-FWM (2020).

**Table 15: Summary of key surface water quality parameters – metals/metalloids and major ions (April 2024).**

| Parameter/Site <sup>#</sup> | 8 (2)<br>(Northern Cr.) | 10 (3)<br>(Central Cr.) | 7 (5)<br>(Granite Cr.) | 13 (6)<br>(Granite Cr.) | 12 (7)<br>(Drain) | 2 (8)<br>(Drain) | 11<br>(Pond) | 4<br>(Lagoon) | Guideline             |
|-----------------------------|-------------------------|-------------------------|------------------------|-------------------------|-------------------|------------------|--------------|---------------|-----------------------|
| Aluminium                   | 0.004                   | 0.005                   | 0.004                  | 0.015                   | 0.005             | <0.003           | 0.013        | <0.003        | 0.40 <sup>A,B</sup>   |
| Arsenic                     | <0.0010                 | <0.0010                 | 0.0014                 | 0.0014                  | 0.0017            | <0.0010          | <0.0010      | 0.0011        | 0.013 <sup>C</sup>    |
| Boron                       | 0.008                   | 0.010                   | 0.011                  | 0.011                   | 0.011             | 0.008            | 0.016        | 0.010         | 0.94 <sup>D</sup>     |
| Cadmium                     | <0.0005                 | <0.0005                 | <0.0005                | 0.0006                  | <0.0005           | <0.0005          | <0.0005      | <0.0005       | NA                    |
| Chromium                    | <0.0005                 | <0.0005                 | <0.0005                | 0.0006                  | <0.0005           | <0.0005          | 0.0013       | <0.0005       | 0.0033 <sup>E</sup>   |
| Cobalt                      | <0.0002                 | <0.0002                 | 0.0003                 | 0.0004                  | 0.0002            | <0.0002          | 0.0006       | <0.0002       | NA                    |
| Copper                      | <0.0005                 | <0.0005                 | <0.0005                | <0.0005                 | <0.0005           | <0.0005          | 0.0009       | <0.0005       | 0.0039 <sup>F,G</sup> |
| Iron (total)                | 0.28                    | 0.11                    | 1.3                    | 0.63                    | 1.2               | 0.46             | 3.5          | 1.82          | 1.0 <sup>H</sup>      |
| Iron                        | 0.05                    | 0.06                    | 0.51                   | 0.48                    | 0.62              | 0.19             | 1.2          | 0.86          | NA                    |
| Lead                        | <0.00010                | <0.00010                | <0.00010               | <0.00010                | <0.00010          | <0.00010         | 0.00039      | <0.00010      | 0.0034 <sup>I</sup>   |
| Mercury (total)             | <0.00008                | <0.00008                | <0.00008               | <0.00008                | <0.00008          | <0.00008         | <0.00008     | <0.00008      | NA                    |
| Mercury                     | <0.00008                | <0.00008                | <0.00008               | <0.00008                | <0.00008          | <0.00008         | <0.00008     | <0.00008      | NA                    |
| Manganese                   | 0.0034                  | 0.0056                  | 0.065                  | 0.044                   | 0.065             | 0.0087           | 0.083        | 0.026         | 1.9 <sup>J</sup>      |
| Molybdenum                  | <0.0002                 | <0.0002                 | <0.0002                | <0.0002                 | <0.0002           | <0.0002          | <0.0002      | <0.0002       | NA                    |
| Nickel                      | <0.0005                 | <0.0005                 | <0.0005                | <0.0005                 | <0.0005           | <0.0005          | 0.0012       | 0.0006        | 0.011 <sup>I</sup>    |
| Zinc                        | 0.018                   | 0.0040                  | <0.0010                | 0.0020                  | 0.0016            | 0.0013           | 0.0018       | 0.0013        | 0.011 <sup>I</sup>    |
| Silver                      | <0.00010                | <0.00010                | <0.00010               | <0.00010                | <0.00010          | <0.00010         | <0.00010     | <0.00010      | NA                    |
| Calcium                     | 7.6                     | 9.4                     | 9.2                    | 6.9                     | 9.1               | 8.2              | 9.2          | 12            | NA                    |
| Magnesium                   | 2.6                     | 2.3                     | 2.5                    | 2.0                     | 2.6               | 2.8              | 3.1          | 2.9           | NA                    |
| Potassium                   | 1.2                     | 1.2                     | 1.1                    | 0.86                    | 1.1               | 0.87             | 3.8          | 2.7           | NA                    |
| Sodium                      | 6.6                     | 6.8                     | 9.4                    | 9.3                     | 9.1               | 7.0              | 18.3         | 12.6          | NA                    |
| Chloride                    | 7.8                     | 9.5                     | 13                     | 13                      | 13                | 9.4              | 30           | 24            | NA                    |
| Sulfate                     | 2.3                     | 3.2                     | 3.1                    | 3.8                     | 3.0               | 2.9              | 7.5          | 1.6           | NA                    |

**Notes:** <sup>#</sup> Site in brackets represents ecological survey site; Dissolved fraction unless stated; <sup>A</sup>USEPA (2018); <sup>B</sup>hardness=40 g/m<sup>3</sup> CaCO<sub>3</sub>, pH=7.0, Dissolved Organic Carbon (DOC)=2 g/m<sup>3</sup>; <sup>C</sup>As(V), ANZECC (2000); <sup>D</sup>ANZECC (2018); <sup>E</sup>hardness=30 g/m<sup>3</sup> CaCO<sub>3</sub>;Cr(III), ANZECC (2000); <sup>F</sup>USEPA (2007); <sup>G</sup>hardness=25 g/m<sup>3</sup> CaCO<sub>3</sub>, pH=7.0, DOC=2.0 g/m<sup>3</sup>; <sup>H</sup>USEPA (1986); <sup>I</sup>hardness=30 g/m<sup>3</sup>, ANZECC (2000); <sup>J</sup>ANZECC (2000).

Nutrient concentrations were also either low or moderate. Ammoniacal nitrogen (Amm-N) concentrations placed Sites 2, 3, 6 and 8 in the annual median A-attribute state, whereas Site 5 (Granite Creek downstream of the ford) and Site 7 (the drain feeding from the south of Granite Creek) were in the annual median B-attribute state. Nitrate + nitrite (NO<sub>x</sub>-N) concentrations were below that defined as the annual median A-attribute state ( $\leq 1.0 \text{ g/m}^3$ ) and, similarly, dissolved reactive phosphorus (DRP) concentrations were below that defined as the five-year monthly median A-attribute state ( $\leq 0.006 \text{ g/m}^3$ ), at all sites.

Concentrations of dissolved metals and metalloids were low across all sites and almost totally met relevant guideline value concentrations. One exception was zinc at Site 2, which showed slight exceedance versus the hardness adjusted ANZECC (2000) 95%-ile trigger value on two occasions; viz.,  $0.018 \text{ g/m}^3$  versus  $0.008 \text{ g/m}^3$ .

The major points of difference at the pond sites, 11 and 4, were the tendencies to higher turbidity, TSS and major cation and anion concentrations, which in turn result in greater TDS concentrations and electrical conductivities. Most notable was the slight elevation of chloride, which is indicative of seawater influence. In addition, total nitrogen (TN) concentrations were elevated at these sites compared to the other surface water sites, due to organic nitrogen, and organic inputs are also apparent via an elevation in dissolved organic carbon (DOC).

#### 6.4 Physico-chemistry – January 2025

There was 0.8 mm of rainfall within 7-days prior to the survey and 23.8 mm of rain within the two-week period prior to the survey recorded at the Greymouth Aero EWS (NIWA). Spot measurements of water physico-chemistry were made during base flow conditions. A summary of spot measurements of water physico-chemistry at sites on artificial drains and modified creeks (i.e., Northern Creek, Central Creek, Clarke Creek, Granite Creek, Wasabi Creek and Southern Creek) during the survey are summarised in Table 16. Measurements were made between 8:50 a.m. and 3:00 p.m.

**Table 16: Water physico-chemistry during the ecological survey.**

| Ecology site | Watercourses                     | Time       | Temp. (°C) | Dissolved oxygen    |     | pH  | Conductivity (µS/m) |
|--------------|----------------------------------|------------|------------|---------------------|-----|-----|---------------------|
|              |                                  |            |            | (g/m <sup>3</sup> ) | (%) |     |                     |
| 1            | Artificial drain (northern area) | 3:00 p.m.  | 14.4       | 9.5                 | 93  | 7.3 | 78                  |
| 7            | Artificial drain (central area)  | 9:50 a.m.  | 13.1       | 8.4                 | 80  | 7.1 | 108                 |
| 8            | Artificial drain (southern area) | 11:00 a.m. | 12.2       | 8.7                 | 81  | 6.8 | 104                 |
| 2            | Northern Creek                   | 1:30 p.m.  | 14.0       | 9.1                 | 88  | 7.0 | 83                  |
| 3            | Central Creek                    | 1:40 p.m.  | 19.1       | 10.2                | 111 | 7.2 | 108                 |
| 4            | Clarke Creek                     | 8:50 a.m.  | 15.8       | 8.3                 | 83  | 7.0 | 140                 |
| 5            | Granite Creek (lower)            | 2:30 p.m.  | 18.9       | 8.7                 | 94  | 7.0 | 116                 |
| 6            | Granite Creek (upper)            | 3:20 p.m.  | 15.4       | 8.8                 | 88  | 6.8 | 97                  |
| 9            | Wasabi Creek                     | 9:45 a.m.  | 11.7       | 9.7                 | 89  | 6.9 | 87                  |
| 10           | Southern Creek                   | 11:40 a.m. | 14.5       | 9.5                 | 93  | 7.3 | 87                  |

Stream temperatures ranged between 11.7 and 19.1°C. All sites were moderately to well oxygenated with dissolved oxygen (DO) concentrations ranging between 8.3 to 10.2 g/m<sup>3</sup> and saturations between 80 and 111%. Stream pH was near-neutral and ranged between 6.8 and 7.3. Electrical conductivity was low at all sites and ranged between 78 and

140  $\mu$ S/m. Water physico-chemistry recorded at all sites would not have been limiting aquatic biota at the time of the survey. Poor channel shade and slow flow in some drains mean water temperatures have the potential to be elevated during low flow conditions in summer and result in stressful conditions for certain aquatic biota.

## 6.5 Habitat Characteristics

### 6.5.1 Overview

Watercourse habitat results are summarised in Table 17. Habitat characteristics are described separately for artificial drains (Sites 1, 7 and 8) and continually or intermittently flowing rivers (Sites 2, 3, 4, 5, 6, 9 and 10) within the SB.

**Table 17: Stream habitat characteristics at sites within the SB during the survey.**

| Site | Watercourse           | Mean depth (m) | Mean width (m) | Mean velocity (m/s) | Shade (%) | Habitat (%) <sup>1</sup> | Streambed (%) <sup>2</sup>         |
|------|-----------------------|----------------|----------------|---------------------|-----------|--------------------------|------------------------------------|
| 1    | Artificial drain      | 0.2            | 1.4            | 0.2                 | 40        | Po=20, Ri=10, Ru=70      | Br=30, Bo=3, Co=7, Gr=20, Sa/si=40 |
| 7    | Artificial drain      | 0.5            | 2.0            | 0.2                 | 20        | Ru=100                   | Gr=5, Sa/si=95                     |
| 8    | Artificial drain      | 0.5            | 1.9            | 0.4                 | 5         | Ri=5, Ru=95              | Co=5, Gr=55, Sa/si=40              |
| 2    | Northern Creek        | 0.3            | 2.2            | 0.5                 | 15        | Po=20, Ri=10, Ru=70      | Br=3, Bo=2, Co=15, Gr=70, Sa/si=10 |
| 3    | Central Creek         | 0.7            | 2.1            | 0.1                 | 10        | Po=40, Ru=60             | Gr=30, Sa/si=70                    |
| 4    | Clarke Creek          | 0.1            | 1.0            | 0.4                 | 10        | Po=3, Ru=95, Ch=2        | Gr=5, Sa/si=95                     |
| 5    | Granite Creek (lower) | 1.9            | 7.0            | 0.0                 | 0         | Ru=100                   | Co=30, Gr=30, Sa/si=40             |
| 6    | Granite Creek (upper) | 0.2            | 2.7            | 0.5                 | 30        | Po=30, Ri=50, Ru=20      | Bo=1, Co=25, Gr=34, Sa/si=40       |
| 9    | Wasabi Creek          | 0.2            | 3.5            | 0.7                 | 15        | Po=20, Ri=40, Ru=40      | Bo=5, Co=45, Gr=50                 |
| 10   | Southern Creek        | 0.2            | 1.5            | 0.4                 | 20        | Po=30, Ru=70             | Co=40, Gr=40, Sa/si=20             |

**Note:** <sup>1</sup>Habitat: Po = pool, Ri = riffle, Ru = run, Ch = chute; <sup>2</sup>Streambed: Br = weathered clay bedrock, Bo = boulder, Co = cobble, Gr = gravel, Sa/si = sand/silt.

### 6.5.2 Artificial drains

There are numerous artificial drains with an approximate total length of 13.62 km within the SB, including 11.17 km within the mining area. Artificial drains within the SB are remnant aquatic features of historical dredge mining activity or were constructed to drain low-lying farmland. Artificial drains within the SB do not incorporate the bed of an existing river or creek, or water from the bed of an existing river or creek, and meet the definition of an artificial drain in the RLWP. Artificial drains generally had straight channel alignments and provided aquatic habitat that was typically dominated by moderate-slow flowing runs and pools with shallower riffle habitat forming in some drains with flowing water and coarser hard-bottomed streambeds (e.g., Site 1). A selection of artificial drains was surveyed to provide an indication of ecological characteristics in this watercourse type within the site.

Site 1 was located on an artificial drain fed by the wetland to the immediate north of the SB and was a narrow (mean = 1.4 m), straight aligned drain that provided moderately diverse habitat (i.e., runs, riffles, small pools) due to variable water depths (0.08–0.43 m), diverse streambed and woody debris derived from the wetland as shown in Figure 30. The narrow channel meant it was moderate-well shaded by overhanging rank grass with a narrow strip of ungrazed rank grass between the channel and fenced wetland to the north.

Streambanks were generally stable and undercut in places (i.e., providing cover for fish). Habitat at Site 1 was of moderate quality for macroinvertebrates and fish.



**Figure 30: Aquatic habitat in artificial drain at Site 1.**

Site 7, shown in Figure 31, was located on an artificial drain in the central area of the SB and flowed into Granite Creek. The channel was U-shaped and stable, moderately wide (1.9–2.0 m), moderately deep (0.5 m), had sluggish flow (0.1 m/s) and dominated by uniformly deep run habitat (100%) with flow constrained by steep/incised streambanks. The streambed was sand/silt (95%) with some gravel (5%) and woody debris. The drain was fenced, but poorly shaded by overhanging low stature exotic vegetation. Habitat was poor for macroinvertebrates, but overhanging vegetation, undercut banks and deep run habitat provided moderate-good quality habitat for some native fish species (e.g., eel, *Inanga*).

Site 8 (Figure 32), was located in the lower reaches of an artificial drain network. The drain at Site 8 had a moderately wide (1.8–2.3 m), deep (mean = 0.5 m) and U-shaped channel with small floodplains and habitat dominated by uniform runs (95%) with moderate flow velocity (0.4 m/s). The streambed was mostly gravel (55%) and sand/silt (40%) with occasional cobble (5%). The channel and streambanks were stable, fenced and poorly shaded due to the riparian margin comprising rank exotic grasses and occasional shrubs. The drain provided moderate-poor quality habitat for macroinvertebrates and native fish.



**Figure 31: Habitat in artificial drain at Site 7.**



**Figure 32: Habitat in artificial drain at Site 8.**

### 6.5.3 Modified creeks

There are seven modified creeks that flow through the SB including Northern Creek, Clarke Creek, Little Granite Creek and Granite Creek which include 790 m of ephemeral flow paths (on Northern Creek) and total 3.13 km within the SB and 2.2 km within the mining area.

#### Northern Creek

Site 2 was located on the lower reaches of a natural, but modified, drainage system referred to as Northern Creek which originates within the SB. The upper reaches had ephemeral flow paths that transitioned into intermittently flowing river sections that seasonally hold water and then into continually flowing mid-lower river reaches that hold water year-round. The lower reach, at Site 2, was deeply incised, had variable widths (1.3–3.0 m), depths (0.15–0.5 m) and steep and eroding streambanks as seen in Figure 33. The streambed comprised a diverse mix of weathered clay (3%), boulder (2%), cobble (15%), gravel (70%) and sand/silt (10%). Habitat was diverse with run (80%), riffle (15%), pool (5%), woody debris and with variable flow velocities (0.2–0.8 m/s) reflecting the diverse habitats. The channel was fenced but poorly shaded (15%) by steep incised streambanks and overhanging rank grass. The lower reaches of the stream provided moderate quality habitat for invertebrates and native fish.



Figure 33: Habitat in Northern Creek at Site 2.

#### Central Creek

Site 3 was located in the lower reaches of Southern Creek which was moderately wide (1.6–2.5 m) and deep (mean = 0.7 m) with sluggish flow (0.1 m/s), a high proportion of sand/silt (70%) and habitat dominated by runs and pools (Figure 34). The creek was fenced but open, poorly shaded and choked with macrophytes which restricted flow. Habitat at Site 3 was poor for macroinvertebrates and moderate for some native fish species (e.g., eel).



**Figure 34: Habitat in lower reaches of Central Creek at Site 3.**

### Clarke Creek

Site 4 was located on Clarke Creek, which is a highly modified, but natural, creek which originates in the hills east of SH6 and flows onto Barrytown Flats and enters Granite Creek within the SB. The channel had a modified straight alignment, was incised, narrow (0.65–1.30 m), shallow (0.1–0.25 m) and dominated by run (95%) habitat with moderate flow velocity (0.4 m/s) as shown in Figure 35. The streambed comprised sand/silt (95%) and gravel (5%). The channel was fenced but poorly shaded (10%) by steep banks and rank grass. The highly modified section of Clarke Creek within the SB provided poor quality habitat for invertebrates and native fish.



**Figure 35: Habitat in Clarke Creek at Site 4.**

### Little Granite Creek

Little Granite Creek originates to the east of SH6 and flows onto the Barrytown Flats before entering the SB (Figure 36). The section of Little Granite Creek within the SB was classified as highly modified according to definitions in the RLWP and has been realigned prior to joining Granite Creek.



**Figure 36: Habitat in Little Granite Creek at Site 4.**

### Granite Creek

Granite Creek originates in the hills east of SH6 and flows onto the Barrytown Flats and into the SB before discharging at the coast. The section of Granite Creek within the SB is a highly modified, but natural, river according to definitions in the RLWP (West Coast Regional Council 2014). Granite Creek was sampled at Sites 5 and 6 below the Little Granite Creek confluence. The channel at the upstream Site 6 was moderately wide (2.1–3.2 m) with variable depths (0.07–0.5 m) and velocities (0.2–0.7 m/s; mean = 0.5 m/s) across run (20%), riffle (50%) and pool (30%) habitats. The streambed was diverse comprising boulder (1%), cobbles (25%), gravel (34%) and sand/silt (40%). The high proportion of sand/silt smothering instream surfaces was likely due to slips in the upper catchment being transported and deposited into the lower gradient lower reaches within the site (Figure 37). The channel was fenced with variable shade ranging from low-moderate. Habitat at Site 6 was moderate-poor for macroinvertebrates due to silt smothering instream surfaces and moderate for native fish.

The lower reaches of Granite Creek were surveyed at Site 5. Flow and habitat in the lower reaches of Granite Creek was influenced by a low weir constructed across the riverbed using bed material at the river mouth (Figure 38). The low weir held water up and resulted in the unnatural formation of very slow flowing (<0.1 m/s), wide (~7 m) and deep (>1.5 m) run/pool habitat. The streambed was coarse, comprising cobbles (30%), gravel (30%) and sand/silt (40%). The channel was fenced but poorly shaded and was lined with overhanging rank grass, flax and sedges that formed a wetland. The presence of a constructed low weir from bed material across the river mouth influenced flow and habitat

conditions resulting in the lower reaches providing uniform and poor-quality habitat for macroinvertebrates in its current state. The lower reaches of Granite Creek may provide potential inanga spawning habitat, but fish access could be affected by the weir.



**Figure 37: Habitat at upper Site 6 (top) and lower Site 5 (below) on Granite Creek.**



**Figure 38: Low weir at the river mouth of Granite Creek.**

### **Wasabi Creek**

Site 9 was located on Wasabi Creek south of Cargill Road and drained an area that was modified during historical dredge mining activity. Flow within Wasabi Creek was spring fed as the channel was well below the natural ground level resulting in good flow and moderate-high flow velocities (0.5–1.0 m/s) during base flow conditions. Habitat was diverse and characterised by run (40%), riffle (40%) and pool (20%) habitat with the streambed comprising cobble (45%), gravel (50%) and boulder (5%) (Figure 39). Wasabi Creek was fenced with riparian vegetation comprising rank grass, exotic shrubs (e.g., gorse) and occasional native ferns, which provided poor channel shade (15%). Wasabi Creek provided good quality habitat for invertebrates and native fish species.



**Figure 39: Habitat in Wasabi Creek at Site 9.**

## Southern Creek

Site 10 was located on Southern Creek, which is a small watercourse draining the southern portion of the SB. The channel was incised, narrow (1.2–1.8 m) and shallow (mean = 0.2 m) with moderate flow velocities (0.4 m/s). Habitat was dominated by shallow runs (70%) and pools (30%) with a diverse streambed comprising cobble (40%), gravel (40%) and sand/silt (20%). The creek was fenced but low stature rank grass, exotic shrub (e.g., gorse) and occasional native fern vegetation provided limited shade (20%) as shown in Figure 40. Habitat was of moderate-poor quality for macroinvertebrates and native fish species.



Figure 40: Habitat at Site 10.

## 6.6 Macrophytes and Periphyton

### 6.6.1.1 Macrophytes

Macrophyte cover was generally low in artificial drains and macrophytes were not recorded in Granite Creek (Sites 5 and 6) or the highly modified Clarke Creek (Site 7). Emergent macrophyte cover was low (<30%) at drain sites with watercress (*Nasturtium officinale*), monkey musk (*Erythranthe guttata*) and water pepper (*Persicaria hydropiper*) being the most common species recorded. An exception was high (80%) cover of watercress, monkey musk and water pepper choking the channel in Central Creek (Site 3), which reflected sluggish flow and sand/silt dominated streambed. The only submerged species recorded was low cover (10%) of the introduced curly pondweed (*Potamogeton crispus*) in an artificial drain (Site 7).

The macrophyte flora recorded in watercourses within the SB was typical of streams draining grazed pasture catchments with moderate-poor shade and dominated by common exotic species. The high proportion of gravel/cobble making up streambeds in most watercourses within the SB limited macrophyte cover despite poor channel shade.

### 6.6.1.2 Periphyton

Periphyton cover was low-moderate in watercourses draining the SB. Periphyton communities were made up by thin films in watercourses with gravel/cobble streambeds and riffles (i.e., Sites 1 and 7 on artificial drains, Northern Creek, Wasabi Creek), low cover (<1%) of medium-thick mat including *Phormidium* cyanobacteria (i.e., Site 1) and moderate-low cover (0–20%) of filamentous algae in artificial drains (i.e., Sites 1 and 8) and creeks (e.g., Northern Creek, Clarke Creek, Granite Creek, Wasabi Creek, Southern Creek). Filamentous algae cover was highest at Sites 2 and 8 (15–20% cover) and in watercourses with gravel/cobble streambeds, shallow riffles and poor channel shade.

Wasabi Creek (Site 9) had a clean gravel/cobble dominated streambed, shallow riffles and was poorly shaded, but supported thin film algae and very low (<5%) cover of thick mat and filamentous algae. The presence of thin films in this poorly shaded drain indicates a low nutrient environment and provided a good source of food for grazing macroinvertebrate taxa (e.g., mayflies, stoneflies, caddisflies).

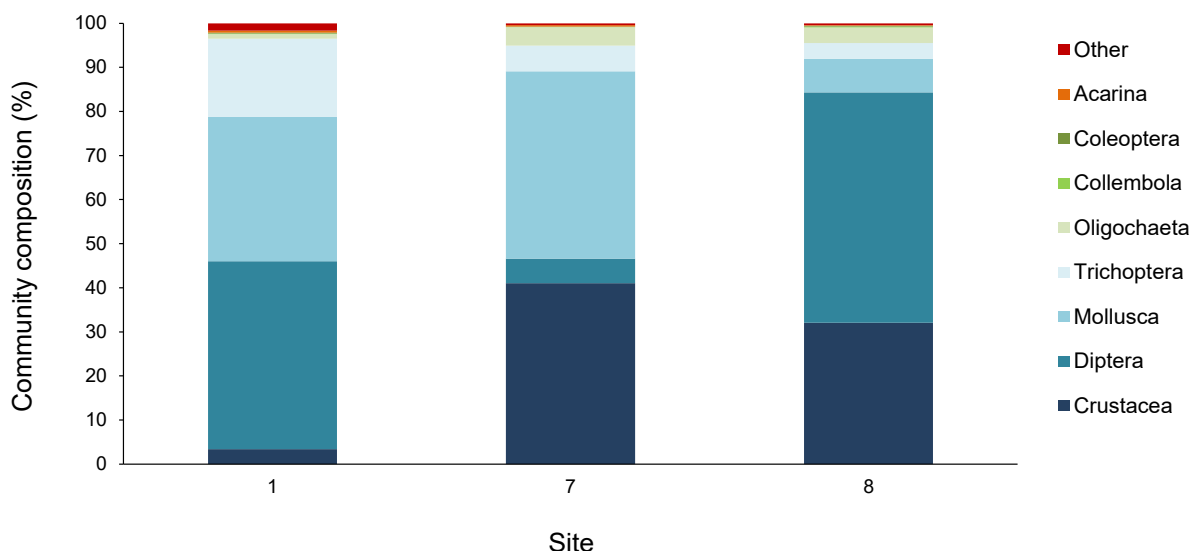
Overall, periphyton cover recorded in watercourses within the SB were not at nuisance levels, but the presence of low-moderate cover of thick mat and filamentous algae in some drains had potential to influence macroinvertebrate community composition and favour taxa that tolerate nutrient enrichment and algal growth (e.g., Sites 1, 2, 4, 6, 8, 9 and 10).

## 6.7 Macroinvertebrates

### 6.7.1 Artificial drains

#### 6.7.1.1 Community composition

Raw macroinvertebrate data is presented in Appendix D. Macroinvertebrate communities recorded at sites on artificial drains (Sites 1, 7 and 8) were dominated by Crustacea (amphipods, ostracods), Diptera (true-flies) or Mollusca (snails) (Figure 41). The communities recorded at Sites 7 and 8 that had deeper water in run/pool habitats, slow flow velocities, higher proportions of sand/silt and higher macrophyte cover had higher relative abundance of Crustacea (32–41%). Site 1 had a gravel/cobble dominated streambed and a higher proportion of shallow riffle habitat and was dominated by Diptera (43%). No kōura (freshwater crayfish) were recorded from artificial drains.



**Figure 41: Relative abundance (%) of the main taxonomic groups recorded at sites on artificial drains.**

### 6.7.1.2 Taxa richness and abundance

A moderate number of taxa (24–26 taxa, Figure 42) were recorded in artificial drains (Sites 1, 7 and 8). The most diverse taxonomic groups were dipterans and caddisflies. Artificial drains supported moderate-high invertebrate abundance (654–1,988 individuals).

### 6.7.1.3 EPT taxa richness and percent EPT abundance

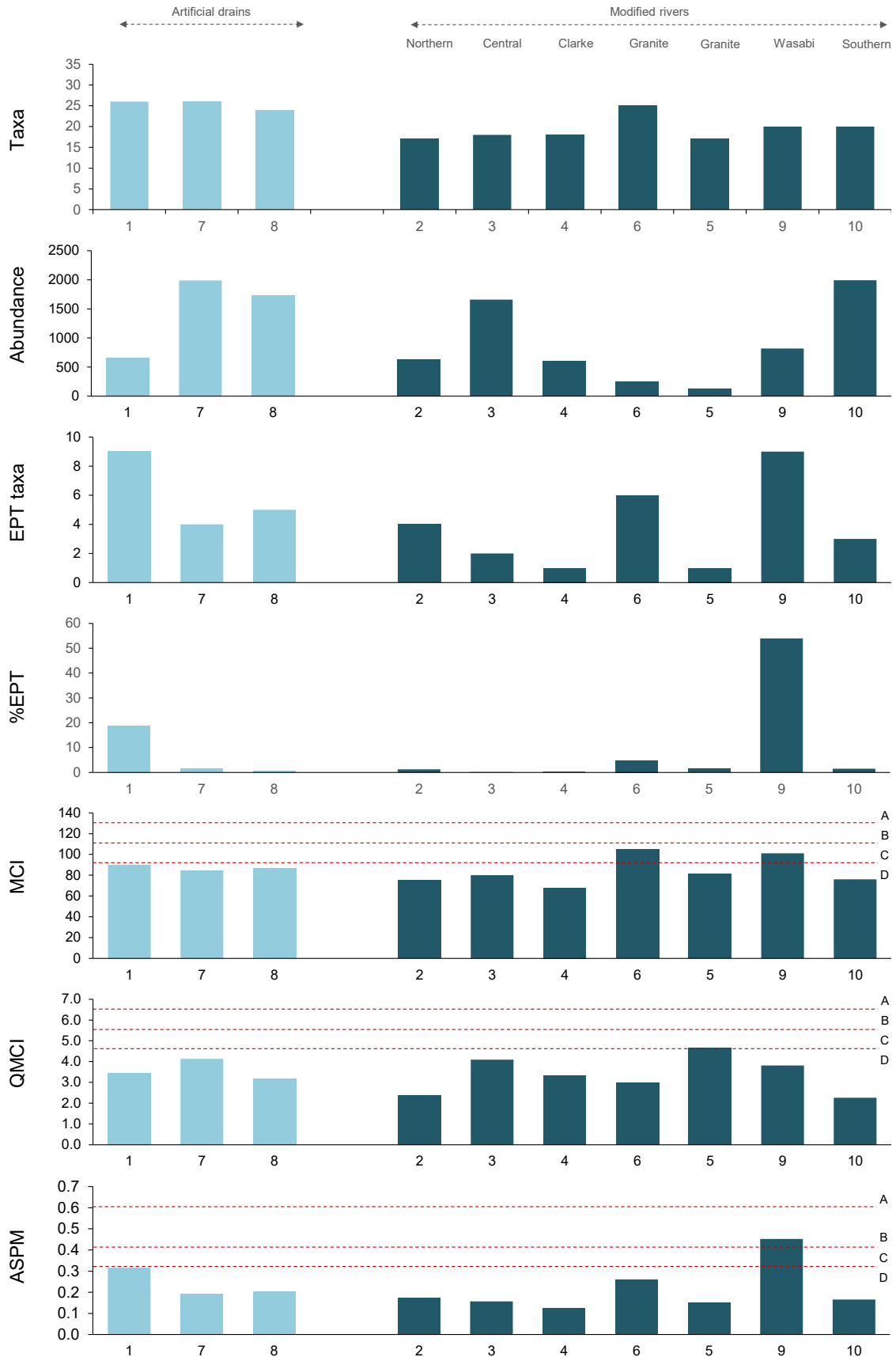
The number of water and habitat sensitive EPT taxa in artificial drains ranged between 4–9 (Figure 42). Highest EPT diversity was recorded at Site 1 due to the number of caddisfly taxa. The relative abundance of EPT taxa (%EPT) at Sites 7 and 8 was low (<2%) and moderate at Site 1 (19%) (Figure 42) due to relative abundance of *Triplectides* caddisflies.

### 6.7.1.4 MCI, QMCI and ASPM

MCI scores were similar in artificial drains and ranged between 85 and 90 (Figure 42) whilst QMCI scores ranged between 3.2 and 4.1 (Figure 42). MCI and QMCI scores were in Attribute Band D and below the NPS-FM National Bottom Line (NBL) (i.e., MCI <90, QMCI <4.5) and indicative of severe nutrient enrichment. ASPM scores ranged between 0.19 and 0.32 (Figure 42). The ASPM score for Site 1 was in Attribute Band C indicating moderate-to severe loss of ecological integrity whilst those for Sites 7 and 8 were in Attribute Band D (below NBL; <0.3) and indicative of severe loss of ecological integrity.

### 6.7.1.5 Summary

Artificial drains within the site were man-made aquatic environments and supported macroinvertebrate communities that reflected uniform habitat conditions and dominated by taxonomic groups that tolerate degraded water quality and habitat conditions. The drain where Site 1 was located supported moderate taxonomic diversity, moderate EPT diversity, moderate EPT abundance and supported a community that indicated 'fair' to 'good' health.



Note: NPS-FM: A = Excellent, B = Good, C = Fair, D = Poor (below national bottom line).

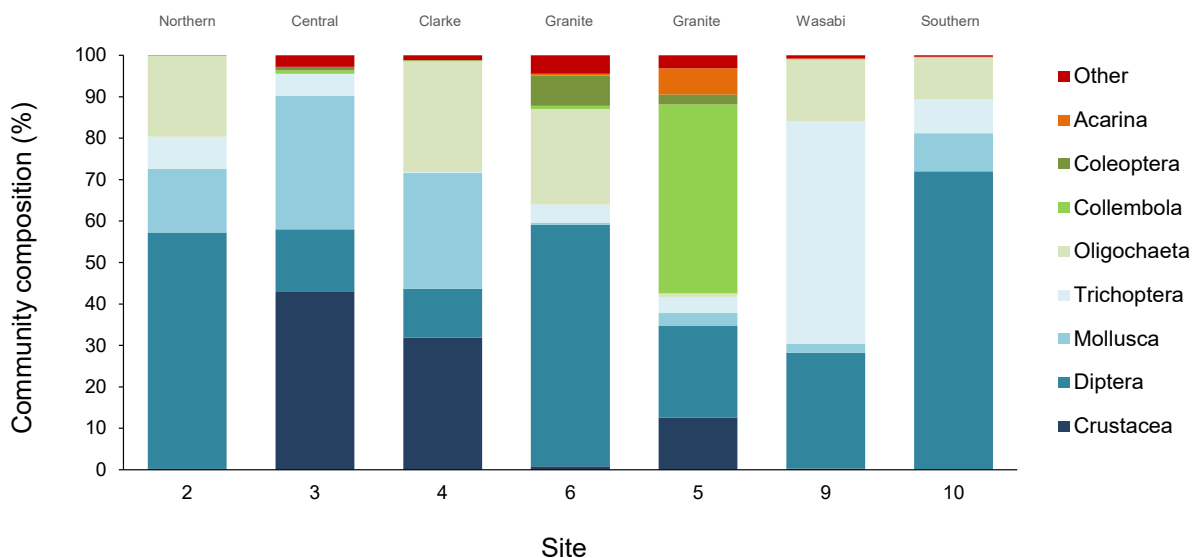
**Figure 42: Biological index scores for sites on artificial drains and modified creeks during the survey.**



## 6.7.2 Modified creeks

### 6.7.2.1 Community composition

Macroinvertebrate communities recorded from modified creeks were characterised by moderate-high proportions of Diptera (12–72%), Crustacea (0–43%), Mollusca (0–32%) and Oligochaeta (0–27%) (Figure 41). Wasabi Creek supported a higher proportion of Trichoptera (54%) than other creeks and reflected the clean gravel/cobble bed in riffles and low periphyton cover. Higher abundance of crustaceans in Central Creek, Clarke Creek and lower Granite Creek reflected slower flow velocities, run habitat and higher macrophyte cover. Other than Wasabi Creek, modified creeks within the site supported communities dominated by taxa that tolerate degraded conditions or nutrient enrichment. No kōura (freshwater crayfish) were recorded from modified creeks during the survey.



**Figure 43: Relative abundance (%) of the main taxonomic groups recorded at sites on modified creeks.**

### 6.7.2.2 Taxa richness and abundance

Modified rivers within the SB supported communities with moderate taxa richness (17–25 taxa) (Figure 42) and variable abundance ranging from 127–247 individuals at Granite Creek sites (5 and 6) to 1,991 individuals in Southern Creek (Figure 42).

### 6.7.2.3 EPT taxa richness and percent EPT abundance

EPT taxa richness was variable across sites on modified creeks (Figure 42). Lowest EPT taxa richness was recorded in Clarke Creek and lower Granite Creek (1 EPT taxa) whilst highest EPT taxa richness was recorded in upper Granite Creek (6 EPT taxa) and Wasabi Creek (9 EPT taxa).

Percent EPT taxa abundance was generally low in all creeks with the exception of Wasabi Creek where water quality and habitat sensitive EPT taxa made up 54% of community abundance (Figure 42). The most abundance EPT taxa recorded across sites were *Triplectides* caddisflies in Northern Creek and *Pycnocentroides*, *Pycnocentria* and *Hydrobiosis* caddisflies in Wasabi Creek. Mayflies and stoneflies were very rare and only recorded in very low abundance in upper Granite Creek and Wasabi Creek.

### 6.7.2.4 MCI, QMCI and ASPM

MCI scores were variable across modified creeks within the SB and ranged between 68 for

Clarke Creek and 105 for upper Granite Creek. MCI scores for all sites except upper Granite Creek (Site 6) and Wasabi Creek (Site 9) were in NPS-FM Attribute Band D, below the NBL and indicating 'poor' stream health (Figure 42). The MCI scores for upper Granite Creek (MCI = 105) and Wasabi Creek (MCI = 101) were in NPS-FM Attribute Band C and indicating 'fair' stream health.

QMCI scores ranged between 2.3 and 4.7 for Southern Creek (Site 10) and lower Granite Creek (Site 5). The higher QMCI score for lower Granite Creek reflected the abundance of moderate scoring Collembola (MCI = 6). QMCI scores for all modified creeks with the exception of lower Granite Creek were in Attribute Band D and indicating 'poor' stream health (Figure 42). The QMCI scores for lower Granite Creek (QMCI = 4.7) was in NPS-FM Attribute Band C and indicating 'fair' stream health.

ASPM scores were low for all modified creeks (ASPM = 0.13–0.26) within the SB with the exception of Wasabi Creek (ASPM = 0.45) (Figure 42). All modified creeks (except Wasabi Creek) had ASPM scores in Attribute Band D (below NBL) and indicated severe loss of ecological integrity. The ASPM score for Wasabi Creek was in Attribute Band B and indicated mild-moderate loss of ecological integrity.

### 6.7.2.5 Summary

Modified creeks within the SB generally supported macroinvertebrate communities dominated by taxonomic groups that tolerate modified or degraded water quality and habitat conditions. Exceptions were the communities in Wasabi Creek that supported moderate EPT taxa richness and abundance so had higher MC, QMCI and ASPM scores. Upper Granite Creek supported moderate EPT taxa richness so had a similar MCI score to Wasabi Creek, but had low QMCI and ASPM scores due to low EPT abundance. Kōura (freshwater crayfish) were not recorded from modified creeks during the survey.

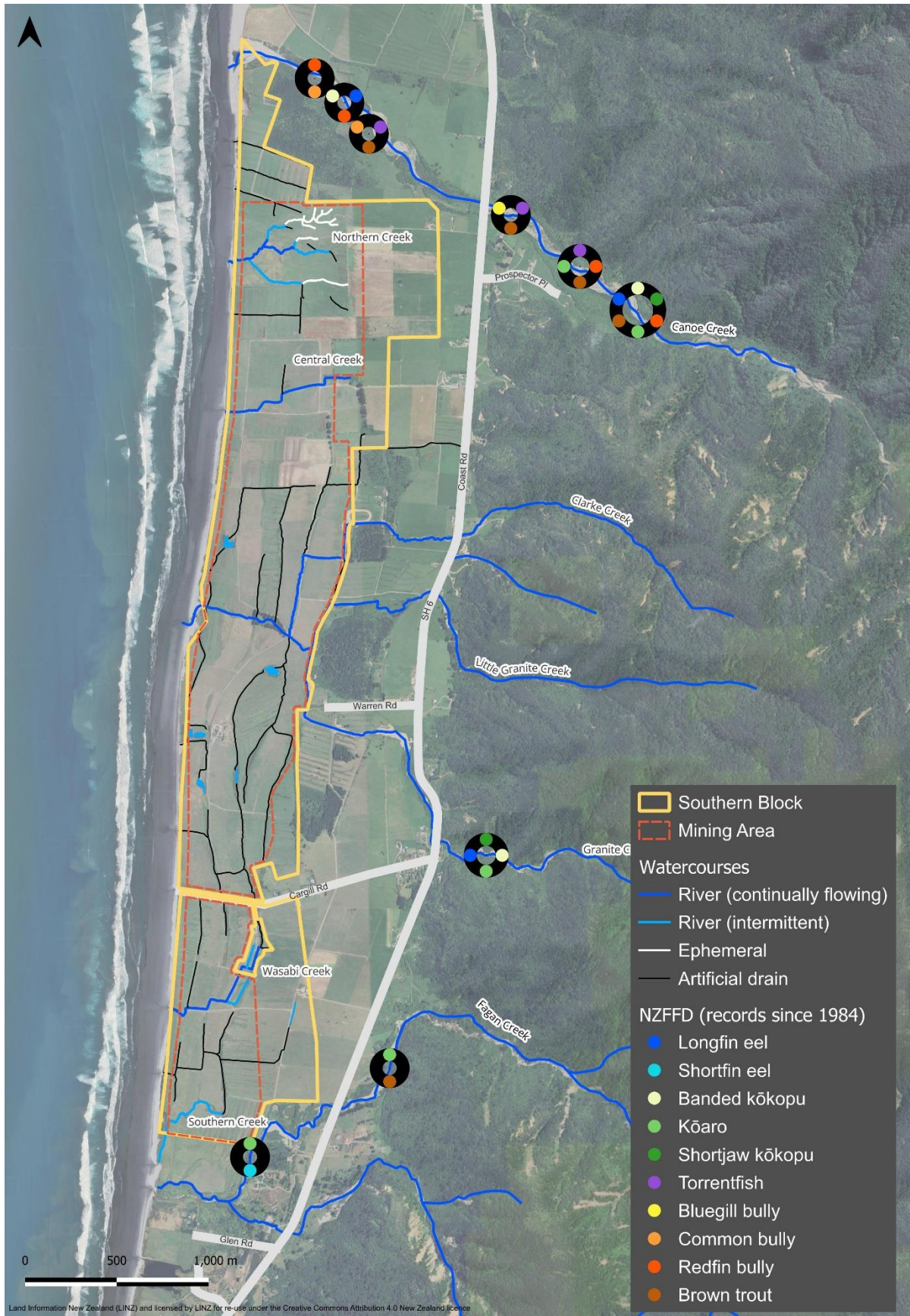
## 6.8 Fish Fauna

### 6.8.1 New Zealand Freshwater Fish Database

There are no records in the New Zealand Freshwater Fish Database (NZFFD) for watercourses within the site (Figure 44). There are NZFFD records of longfin eel (*Anguilla dieffenbachii*), banded kōkopu (*Galaxias fasciatus*), kōaro (*Galaxias brevipinnis*) and shortjaw kōkopu (*Galaxias postvectis*) in the mid-upper reaches of Granite Creek to the east of SH6 during surveys by the Department of Conservation in 1998 and 2022. These three native species are diadromous and migrate between the sea and freshwater to complete their life cycles so would have migrated up the highly modified lower reaches of Granite Creek to reach this habitat. These records also indicate there are no substantial barriers within the site for these species with 'good to excellent' climbing ability.

Additional fish species listed in the NZFFD from Canoe Creek to the immediate north of the SB and Fagan Creek to the immediate south of the SB include shortfin eel (*Anguilla australis*), torrentfish (*Cheimarrichthys fosteri*), common bully (*Gobiomorphus cotidianus*), bluegill bully (*Gobiomorphus hubbsi*), redbull (*Gobiomorphus huttoni*) and the introduced brown trout (*Salmo trutta*).

Canoe Creek and Fagan Creek are in a comparatively natural state and provide dissimilar habitat to watercourses within the SB. Fish records for Canoe Creek and Fagan Creek are therefore not directly comparable but provide an indication of fish species present in the vicinity of the SB.



**Figure 44: New Zealand Freshwater Fish Database records since 1984 for watercourses draining through the site and in adjacent catchments.**

Of the species listed in the NZFFD for the Granite Creek catchment, or in immediately adjacent catchments (i.e., Canoe Creek, Fagan Creek), shortjaw kōkopu are considered by Dunn et al. (2025) to be 'Threatened – Nationally Vulnerable'. Longfin eel and kōaro are considered to be 'At Risk – Declining', whilst torrentfish and bluegill bully are considered 'At Risk – Naturally Uncommon' (Dunn et al. 2025). Of these species, torrentfish and shortjaw kōkopu were not recorded within the SB during the EFM survey.

## 6.8.2 Electric fishing survey results

Eight fish species were recorded during an electric fishing machine (EFM) survey across ten sites within the SB on artificial drains and modified natural rivers. The number of each species caught, along with the range in fish length, is summarised in Table 18. The sites at which each species was recorded is also shown in Figure 45. Fish species recorded were longfin eel, shortfin eel, kōaro, banded kōkopu, īnanga (*Galaxias maculatus*), common bully, bluegill bully and redfin bully (Figure 46 and Figure 47).

The most abundant and widespread species recorded during the EFM survey were longfin eel (70 individuals across eight sites), redfin bully (57 individuals across eight sites) and īnanga (49 individuals across eight sites). The least abundant species recorded across sites were common bully (one individual at Site 1 on an artificial drain) and kōaro (three individuals at Site 9 on Wasabi Creek).

### 6.8.2.1 Artificial drains

Artificial drains within the SB supported 3–4 fish species based on the EFM survey. Four species including īnanga, banded kōkopu, redfin bully and bluegill bully were recorded at Site 1 on the artificial drain fed by a wetland to the immediate north of the SB. These species were recorded at Sites 7 and 8 on artificial drains and included shortfin eel, longfin eel and īnanga at Site 7 and longfin eel, banded kōkopu and redfin bully at Site 8. Fish diversity in drains was generally comparable with the number recorded from modified creeks within the site.

Fish species of conservation interest recorded from artificial drains included īnanga (Threatened – Nationally Vulnerable), longfin eel (At Risk – Declining), and banded kōkopu, redfin bully and bluegill bully (At Risk Naturally Uncommon) (Dunn et al. 2025). The artificial drains electric fished supported between 2–3 species of conservation interest. Although the artificial drains within the SB were man-made aquatic environments, they supported moderate-low native fish diversity including species of conservation interest.

### 6.8.2.2 Modified creeks

Based on the EFM survey, Site 2 (Northern Creek) and Site 4 (Clarke Creek) on modified natural rivers within the SB supported between 3–5 native fish species including shortfin eel, longfin eel, īnanga, banded kōkopu, kōaro, redfin bully, bluegill bully and common bully.

Southern Creek (Site 2) and upper Granite Creek (Site 6) had highest fish diversity (5 species) whilst lower Granite Creek (Site 5) had lowest diversity (1 species). The lower Granite Creek site was unable to be surveyed by EFM because it was un-wadeable due to the low rock weir constructed across the river mouth backing water up. A school of īnanga were observed in this lower reach above the weir indicating that, assuming that the weir has been present for more than one year, fish passage was still possible at some stage.

The most widespread species recorded across modified river sites were īnanga and redfin bully. The least widespread species across sites were banded kōkopu (upper Granite Creek), kōaro (Wasabi Creek) and common bully (Central Creek). The presence of kōaro in Wasabi Creek was of interest given it did not provide the type of habitat typically preferred by kōaro (i.e., turbulent boulder habitat with high cover).

**Table 18: Results of electric fishing machine survey at sites on artificial drains and modified natural creeks during the survey.**

| Common name                    | Scientific name                | Conservation status (Dunn et al. 2025) | Artificial drains |                  |                | Modified creeks |                 |                  |               |                 |                |                |
|--------------------------------|--------------------------------|--|-------------------|------------------|----------------|-----------------|-----------------|------------------|---------------|-----------------|----------------|----------------|
|                                |                                |  |                   |                  |                | Northern        | Central         | Clarke           | Wasabi        | Granite         |                | Southern       |
|                                |                                |  | 1                 | 7                | 8              | 2               | 3               | 4                | 9             | 5               | 6              | 10             |
| Longfin eel                    | <i>Anguilla dieffenbachii</i>  | At Risk – Declining                    | 2<br>(100–150)    | 3<br>(200–1,110) | 3<br>(120–190) | 33<br>(70–800)  | 1<br>(1,100)    | 24<br>(55–1,000) | -             | -               | 3<br>(110–130) | 1<br>(950)     |
| Shortfin eel                   | <i>Anguilla australis</i>      | Not Threatened                         | -                 | 1<br>(250)       | -              | -               | 4<br>(120–400)  | 2<br>(200–220)   | 7<br>(70–140) | -               | -              | 6<br>(110–450) |
| Kōaro                          | <i>Galaxias brevipinnis</i>    | At Risk – Declining                    | -                 | -                | -              | -               | -               | -                | 3<br>(50–115) | -               | -              | -              |
| Banded kōkopu                  | <i>Galaxias fasciatus</i>      | At Risk – Naturally Uncommon           | 8<br>(52–120)     | -                | 1<br>(85)      | -               | -               | -                | -             | -               | 2<br>(125–140) | -              |
| Īnanga                         | <i>Galaxias maculatus</i>      | Threatened – Nationally Vulnerable     | 1<br>(80)         | 1<br>(60)        | -              | 6<br>(60–80)    | 20 <sup>1</sup> | 4<br>(60–70)     | -             | 10 <sup>2</sup> | 4<br>(53–70)   | 3<br>(60–75)   |
| Common bully                   | <i>Gobiomorphus cotidianus</i> | Not Threatened                         | -                 | -                | -              | -               | 1<br>(130)      | -                | -             | -               | -              | -              |
| Bluegill bully                 | <i>Gobiomorphus hubbsi</i>     | At Risk – Naturally Uncommon           | 4<br>(60–66)      | -                | -              | -               | -               | -                | 9<br>(50–67)  | -               | 7<br>(45–60)   | -              |
| Redfin bully                   | <i>Gobiomorphus huttoni</i>    | At Risk – Naturally Uncommon           | 4<br>(36–80)      | -                | 2<br>(62–70)   | 5<br>(32–45)    | 2<br>(55–60)    | 6<br>(25–75)     | 7<br>(38–85)  | -               | 19<br>(30–75)  | 12<br>(25–65)  |
| <b>Total number of species</b> |                                |  | <b>5</b>          | <b>3</b>         | <b>3</b>       | <b>3</b>        | <b>5</b>        | <b>4</b>         | <b>4</b>      | <b>1</b>        | <b>5</b>       | <b>4</b>       |

**Note:** Size range in brackets. Lengths measured in mm. <sup>1</sup> 70 mm average. <sup>2</sup> No lengths recorded.





**Figure 45: Fish species recorded during the EFM survey within the SB, Barrytown.**



**Figure 46:** Kōaro at Site 9, redfin bully, common bully and banded kōkopu (from top to bottom) recorded at selected sites during the survey.



**Figure 47: Adult longfin eel at Site 3 and bluegill bully at Site 1 (from top to bottom) recorded during the survey.**

Fish species of conservation interest recorded from modified creeks within the SB included īnanga (Threatened – Nationally Vulnerable), longfin eel and kōaro (At Risk – Declining), and banded kōkopu, redfin bully and bluegill bully (At Risk Naturally Uncommon) (Dunn et al. 2025).

### 6.8.3 Environmental DNA results

Results of environmental DNA (eDNA) sampling at sites on artificial drains (Sites 1, 7, 8) and modified creeks (Sites 2, 3, 4, 5, 6, 9, 10) are presented in Table 19. Environmental DNA results provide an indication of the fish species present in each watercourse either at or near the point of sampling or upstream. For watercourses that originate within the SB (e.g., Sites 1, 2, 3, 7, 8, 9, 10), eDNA results are likely to accurately reflect what species occur within the SB. For sites on watercourses that originate outside the SB in hills to the east of SH6, it is possible eDNA in samples could have originated from outside the SB (i.e., upstream), meaning that the species recorded may not be present within the area to be mined, but do occur in the wider catchment. Results of eDNA sampling indicated the presence of more species within the SB than were captured during the EFM survey.

Of particular interest was the potential wide presence of the 'At Risk – Declining' giant kōkopu in watercourses across the SB including in artificial drains (Sites 7 and 8) and modified creeks including Northern Creek, Clarke Creek, Granite Creek, Wasabi Creek and Southern Creek. Giant kōkopu were not captured or observed during the EFM survey.

Results received from Wilderlab Ltd, where the samples were processed, do not differentiate shortjaw kōkopu from giant kōkopu. Based on habitat at Site 1, the record of 'shortjaw kōkopu or giant kōkopu' in this artificial drain is likely to be giant kōkopu based on habitat in the drain and connectivity with the wetland to the north of the SB.

Results show banded kōkopu and common bully are more widespread in watercourses within the SB than the EFM survey results indicated. There were weak counts for the 'Threatened – Nationally Vulnerable' lamprey (*Geotria australis*) in Granite Creek (Sites 5 and 6) and also in an artificial drain (Site 7), which indicates that they may be present, or at least pass through the SB.

**Table 19: Results of eDNA sampling at sites on artificial drains and modified creeks within the SB during the survey.**

| Common name  | Scientific name                      | Conservation status<br>(Dunn et al. 2025)                      | Sequence count    |             |              |                 |              |             |              |              |             |                |
|--|--------------------------------------|--|-------------------|-------------|--------------|-----------------|--------------|-------------|--------------|--------------|-------------|----------------|
|  |                                      |  | Artificial drains |             |              | Modified creeks |              |             |              |              |             |                |
|  |                                      |  | 1                 | 7           | 8            | Northern<br>2   | Central<br>3 | Clarke<br>4 | Granite<br>5 | Granite<br>6 | Wasabi<br>9 | Southern<br>10 |
| Longfin eel  | <i>Anguilla dieffenbachii</i>        | At Risk – Declining  | 4,738<br>Y        | 864<br>Y    | 1,245<br>Y   | 6,032<br>Y      | 1,940<br>Y   | 1,135<br>Y  | 1,093<br>N   | 2,560<br>Y   | 798<br>N    | 919<br>Y       |
| Shortfin eel   | <i>Anguilla australis</i>            | Not Threatened   | 276<br>N          | 272<br>Y    | 363<br>N     | 1,121<br>N      | 957<br>Y     | 301<br>Y    | 170<br>N     | 287<br>N     | 196<br>Y    | 135<br>Y       |
| Giant kōkopu   | <i>Galaxias argenteus</i>            | At Risk – Declining  | -                 | 71<br>N     | 202<br>N     | 103<br>N        | -            | 26<br>N     | 45<br>N      | 175<br>N     | 51<br>N     | 16<br>N        |
| Giant or shortjaw kōkopu                                 | <i>Galaxias argenteus/postvectis</i> | At Risk – Declining /<br>Threatened – Nationally<br>Vulnerable | 22<br>N           | -           | 88<br>N      | 165<br>N        | -            | -           | 41<br>N      | -            | -           | -              |
| Kōaro  | <i>Galaxias brevipinnis</i>          | At Risk – Declining  | 112<br>N          | -           | -            | 226<br>N        | -            | -           | -            | -            | 141<br>Y    | -              |
| Banded kōkopu  | <i>Galaxias fasciatus</i>            | Not Threatened   | 4,816<br>Y        | 563<br>N    | 692<br>Y     | 516<br>N        | 259<br>N     | 969<br>N    | 892<br>N     | 4,754<br>Y   | 375<br>N    | 871<br>N       |
| Īnanga   | <i>Galaxias maculatus</i>            | Threatened – Nationally<br>Vulnerable                          | 88<br>Y           | 11,747<br>Y | 162<br>N     | 1,744<br>Y      | 3,870<br>Y   | 11,999<br>Y | 15,347<br>Y  | 8,770<br>Y   | -           | 21,192<br>Y    |
| Lamprey  | <i>Geotria australis</i>             | Threatened – Nationally<br>Vulnerable                          | -                 | 55<br>N     | -            | -               | -            | -           | 8<br>N       | 5<br>N       | -           | -              |
| Common bully   | <i>Gobiomorphus cotidianus</i>       | Not Threatened   | -                 | 213<br>N    | -            | 268<br>N        | Y            | 1,160<br>N  | 4,852<br>N   | -            | -           | 320<br>N       |
| Bluegill bully   | <i>Gobiomorphus hubbsi</i>           | At Risk – Naturally<br>Uncommon                                | 2,122<br>Y        | -           | 48<br>N      | 108<br>N        | -            | -           | 105<br>N     | Y            | 2,453<br>Y  | -              |
| Redfin bully   | <i>Gobiomorphus huttoni</i>          | At Risk – Naturally<br>Uncommon                                | 14,840<br>Y       | 9,831<br>N  | 4,293<br>Y   | 7,909<br>Y      | 614<br>Y     | 6,323<br>Y  | 12,551<br>N  | 19,340<br>Y  | 4,745<br>Y  | 19,867<br>Y    |
| <b>Number of fish species detected in eDNA samples</b>   |                                      |  | <b>7 / 8</b>      | <b>8</b>    | <b>7 / 8</b> | <b>9 / 10</b>   | <b>5</b>     | <b>7</b>    | <b>10</b>    | <b>7</b>     | <b>7</b>    | <b>7</b>       |
| <b>Number of fish species captured during EFM survey</b> |                                      |  | <b>5</b>          | <b>3</b>    | <b>3</b>     | <b>3</b>        | <b>5</b>     | <b>4</b>    | <b>1</b>     | <b>5</b>     | <b>4</b>    | <b>4</b>       |

Note: Y = fish species recorded during EFM survey; N = fish species not recorded during EFM survey.



## 7.0 Groundwater Quality

Groundwater sampling sites are identified in Figure 8 (Section 3.4), and site descriptions and qualitative visual comments are provided in Table 20 below. Samples were collected using standardised sampling techniques (USGS, 2014). The full laboratory report is provided in Appendix C and the key parameters, notably those used in water quality modelling, are summarised in Table 21 and Table 22. For pH and conductivity field measurements at the time of sampling are reported in preference to laboratory measurement due to the potential for changes in transit, which can be highly pronounced for groundwater samples.

All samples had water quality characteristics consistent with being drawn from shallow bores and there were clear distinctions between bores at the eastern edge of the proposed mining zone (PZ-104 and PZ105) and those adjacent to the western coastal boundary (PZ-102 and PZ-103). Notably, the eastern bore groundwater had a greater carbonaceous signature, contained higher concentrations of nutrients and was more oxygenated than eastern bore groundwater. While all waters were mildly alkaline, of low alkalinity and, with the exception of iron, had low metal/metalloid concentrations, the latter were higher in the less oxidising/more reducing coastal groundwaters. Iron concentrations in all bores requires reflection since, ordinarily in groundwater, dissolved iron concentrations should be largely dominant. Yet, shallow bores with even low oxygen infiltration will result in oxidation to ferric forms, which finds expression in the total iron fraction, and is evidenced by the appearance of iron oxyhydroxides in surface waters.

Bore PZ101, which was coastal, but in the vicinity of the lagoon, exhibited more complex groundwater quality, having some features of a reduced environment, such as slightly elevated metal/metalloid concentrations, but being more alkaline and of greater alkalinity than PZ-102 and PZ-103. Notably, PZ-101 also had elevated nitrogen of more oxidised species (i.e., nitrate-N versus ammoniacal and organic nitrogen) and greater chloride status, which is likely indicative of potential influence from the lagoon rather than direct seawater intrusion. The lack of any significant observed easterly seawater influence is consistent with the Kōmanawa Solutions Limited consideration that the coastal lagoons and creek mouths function as freshwater barriers against saline wedges, that process assisted by the topographic gradient of Barrytown Flats to the Tasman Sea (Kōmanawa Solutions 2026).

**Table 20: Groundwater site descriptions and qualitative visual characteristics during sampling on 8–9 April 2024.**

| Site   | Description                              | Date/Time  | Clarity               | Appearance |
|--------|--|------------|-----------------------|------------|
| PZ-101 | Coastal, adjacent to small lagoon        | 11:35 a.m. | Low                   | Silty      |
| PZ-102 | Coastal, adjacent to lower Granite Creek | 12:20 p.m. | Low                   | Silty      |
| PZ-103 | Coastal, east of PZ-104                  | 9:45 a.m.  | Low                   | Silty      |
| PZ-104 | Boggy ground, north of Clarke Creek      | 10:30 a.m. | Moderate <sup>A</sup> | Silty      |
| PZ-105 | Boggy ground, adjacent to Granite Creek  | 9:15 a.m.  | Moderate <sup>A</sup> | Silty      |

**Notes:** Artesian flow or visible seepage of approximately 0.25 L/s.

**Table 21: Summary of groundwater physico-chemical and nutrients parameters.**

| Parameter/site                                  | PZ-101 | PZ-102 | PZ-103 | PZ-104 | PZ-105 |
|---|--------|--------|--------|--------|--------|
| pH (pH units)**                                 | 5.92   | 5.67   | 5.70   | 5.71   | 5.78   |
| Temperature (°C)**                              | 15.7   | 15.5   | 14.8   | 13.8   | 12.1   |
| Electrical conductivity (mS/m)**                | 16.4   | 9.5    | 10.3   | 10.7   | 7.9    |
| Turbidity (NTU)                                 | 132    | 1,110  | 290    | 1,080  | 1,500  |
| Total Suspended solids (TSS)                    | 77     | 3,000  | 820    | 1,270  | 3,400  |
| Total Dissolved solids (TDS)                    | 145    | 90     | 70     | 98     | 100    |
| Total Alkalinity (as CaCO <sub>3</sub> )        | 23     | 11.3   | 22     | 31     | 34     |
| Bicarbonate (at 25°C)                           | 28     | 13.8   | 26     | 37     | 41     |
| Total nitrogen (TN)                             | 5.5    | 1.4    | 1.1    | 3.6    | 6.2    |
| Total ammoniacal nitrogen (Amm-N)               | <0.010 | 0.035  | <0.010 | 0.36   | <0.010 |
| Nitrate + nitrite nitrogen (NO <sub>x</sub> -N) | 4.2    | <0.002 | 0.34   | <0.002 | 1.79   |
| Total Kjeldahl nitrogen (TKN)                   | 1.3    | 1.4    | 0.77   | 3.6    | 4.4    |
| Total phosphorus (TP)                           | 0.60   | 1.20   | 0.45   | 2.2    | 8.6    |
| Dissolved reactive phosphorus (DRP)             | 0.004  | <0.004 | 0.007  | <0.004 | 0.013  |
| Dissolved organic carbon *DOC)                  | 13.7   | 6.8    | 6.1    | 12.2   | 10.2   |

**Notes:** Units g/m<sup>3</sup> unless stated; \*Surface water quality guidelines for indicative purposes; \*\*Field measurement; <sup>A</sup>WCRC (2014); <sup>B</sup>ANZECC (2000); <sup>C</sup>NPS-FWM (2020).

**Table 22: Summary of key groundwater metals/metalloids and major ion parameters.**

| Parameter/site  | PZ-101   | PZ-102   | PZ-103   | PZ-104   | PZ-105   |
|-----------------|----------|----------|----------|----------|----------|
| Aluminium       | 0.13     | 0.24     | 0.17     | 0.029    | 0.024    |
| Arsenic         | 0.0026   | 0.020    | 0.0042   | < 0.0010 | < 0.0010 |
| Boron           | 0.011    | 0.009    | 0.010    | 0.016    | 0.012    |
| Cadmium         | <0.00005 | <0.00005 | <0.00005 | <0.00005 | <0.00005 |
| Chromium        | 0.0074   | 0.0118   | 0.0055   | < 0.0005 | < 0.0005 |
| Cobalt          | 0.0006   | 0.0005   | 0.0009   | < 0.0002 | < 0.0002 |
| Copper          | 0.0058   | 0.0026   | 0.0021   | 0.0010   | 0.0008   |
| Iron (total)    | 42       | 96       | 118      | 106      | 37       |
| Iron            | 0.44     | 3.3      | 7.7      | 0.05     | 0.06     |
| Lead            | 0.00058  | 0.0018   | 0.00055  | 0.00015  | 0.00014  |
| Manganese       | 0.035    | 0.11     | 0.26     | 0.0024   | 0.0065   |
| Mercury (total) | <0.00008 | <0.0021  | <0.0021  | <0.0021  | <0.00008 |
| Mercury         | <0.00008 | <0.00008 | <0.00008 | <0.00008 | <0.00008 |
| Molybdenum      | 0.0002   | 0.0008   | 0.0002   | <0.0002  | <0.0002  |
| Nickel          | 0.0029   | 0.0021   | 0.0024   | < 0.0005 | < 0.0005 |
| Silver          | <0.00010 | <0.00010 | <0.00010 | <0.00010 | <0.00010 |
| Zinc            | 0.0080   | 0.0038   | 0.0023   | 0.0025   | 0.0015   |
| Calcium         | 13       | 8.7      | 10       | 9.6      | 6.6      |
| Magnesium       | 5.2      | 1.6      | 2.1      | 3.8      | 1.8      |
| Potassium       | 5.5      | 2.0      | 2.7      | 1.7      | 0.91     |
| Sodium          | 15       | 8.0      | 12       | 10       | 11       |
| Chloride        | 27       | 13       | 20       | 12       | 16       |
| Sulfate         | 13       | 18       | 3.4      | 7.2      | 3.5      |

**Notes:** All units g/m<sup>3</sup>; Dissolved fraction unless stated

## 8.0 Ecological Values

### 8.1 Terrestrial Flora and Fauna

#### 8.1.1 Vegetation

The majority of vegetation (98%) within the SB was exotic, except for small isolated strips of secondary indigenous coastal shrubland, rātā snags and flaxland present along coastal and riparian margins. The rātā snags were located outside of the mine disturbance area.

The grazed exotic pasture at the site was considered to be of **'negligible'** ecological value as set out in Table 23. This vegetation occurred within highly modified habitats not representative of indigenous ecosystems, and lacked indigenous diversity and habitat complexity. It provided limited ecosystem services in the form of reducing sediment mobilisation to streams and the coast.

The rough exotic pasture at the site was less common than grazed exotic pasture, with only small isolated patches present (1.5% of the SB). This vegetation was dominated by exotic pasture and weed species, notably blackberry and gorse. It was taller with more structural diversity compared to areas of grazed exotic pasture. Because of the small extent, isolation, presence of weed species, high degree of modification and likelihood of intermittent disturbance by grazing livestock, its value as habitat for fauna (including lizards and nesting birds) was reduced and therefore the ecological value of this vegetation type was considered **'negligible'** as set out in Table 23.

Indigenous coastal shrubland was considered of **'moderate'** ecological value as set out in Table 23. This vegetation is representative of secondary coastal shrubland on the Barrytown Flats, and included nīkau and cabbage tree. One 'At Risk' species mākaka (*Carmichaelia australis*) and one 'Threatened' species poroporo (*Solanum aviculare* var. *aviculare*) (de Lange et al. 2024) were present. However, the vegetation was restricted in extent and was subject to edge effects and browsing impacts from livestock. The fragments of coastal shrubland were narrow, contained gaps dominated by exotic vegetation and were isolated from any other indigenous vegetation which reduced their overall value.

The isolated rātā snags within the SB were deemed of **'negligible'** botanical ecological value (see Table 23). They were not considered permanent features of the landscape, and will disappear over time with continued exposure to prevailing westerly weather. Indigenous epiphyte species were present in the snags, although these species are common and widespread.

Pine shelterbelts and isolated pine trees were considered to have **'negligible'** ecological value as set out in Table 23. This vegetation was exotic, sparse and does not provide connectivity or buffers to indigenous vegetation.

The flaxland present along riparian and coastal margins at the site was considered to have **'moderate'** ecological value (see Table 23). The vegetation was limited in extent and not diverse, being dominated by flax, and the native species present were common and widespread. Weeds were present. Flaxland is reduced in extent within the Punakaiki ED, and flaxland at the site was connected to both freshwater and coastal environments. The vegetation was dense and acted as a buffer to freshwater and coastal habitats from farming and other activities within the SB.

#### 8.1.2 Avifauna (Birds)

The desktop assessment revealed 104 bird taxa (i.e., records identified to species or genus level), and 49 threatened or at-risk bird species, within 10 km of the SB. The majority of these were coastal or seabirds that are unlikely to be more than occasional visitors to the site. Fourteen bird species of conservation interest may use the habitats within the SB.

Given the lack of forested habitat within the site, including limited foraging habitat and no potential daytime roosts, it is unlikely that rōroa/great spotted kiwi use the SB. The audio recordings collected during surveys likely originated from the foothills of the Paparoa Ranges <1 km east of the site.

Habitats within the SB were not well suited for cryptic species given their exposed and modified nature. Eleven of the species identified as possibly using the SB were not recorded in habitats within or adjoining the SB including fernbird/mātātā (*Poodytes punctatus*), Australasian bittern (*Botaurus poiciloptilus*) and Westland petrel/tāiko (*Procellaria westlandica*) and are unlikely to be present because of the very small amount of suitable habitat within the SB.

The overall ecological value of avifauna within the SB was considered ‘**high**’ (Table 23) due to the possible presence of species with either At Risk – Declining (eight species) or Threatened (one species typically found in forest) conservation status in the vicinity. The bird habitats are considered to be of ‘**negligible**’ value, comprising as they do farmland and exposed/open habitats with few indigenous species. The habitats are common across the Barrytown Flats.

### 8.1.3 Lizards

The desktop survey revealed records of Newman’s skink (At Risk - Declining), forest gecko (At Risk – Declining) and West Coast green gecko (Threatened - Nationally Vulnerable) within 10 km of the SB and proposed mining area. No lizards were observed during the walk-through and manual habitat searches undertaken within the SB. Habitats within the SB consisted primarily of grazed exotic pasture with low suitability for lizards. While a few small areas of marginally higher habitat suitability for ground dwelling skinks were present (e.g., rank pasture grass, organic debris), these were functionally isolated by frequently disturbed pasture areas, likely too small to support sustainable lizard populations and not in close proximity to a known source population from which dispersal could originate. Both forest gecko and West Coast green gecko use shrubland and forest habitat, with West Coast green gecko in particular occupying the canopy of mānuka (*Leptospermum scoparium* agg.) and kānuka (*Kunzea* spp.) shrubland. The suitable habitat for geckos at the site was limited to the small area of coastal shrubland. Due to the rarity and distinctiveness of the species found in proximity to the site, the lizards are of ‘**high**’ ecological value where they occur. The ecological value of lizard habitat within the proposed mining area is considered ‘**negligible**’ (Table 23).

### 8.1.4 Bats

The interrogation of the national bat database did not identify any recent (<10 yrs) records of bat activity within 25 km of the SB, although there was one record of a long-tailed bat within 10 km (Ecological Solutions Limited 2023). The vast majority of the acoustic bat surveys recorded in the database were undertaken in 2020 and were focussed around Bullock Creek approximately 15 km to the north (91% of surveys completed since 2014/15 were around Bullock Creek).

With regard to the Ecological Solutions Limited (2023) survey, there were fewer than 10 bat passes recorded at that location in both 1997 and 2023. No bat activity was recorded during a 2024 survey conducted by Ecological Solutions Limited at the same location. The low number and infrequent records indicate that any bat population in the area is unlikely to be large.

The SB contained some habitat features (e.g., creeks, ponds and wetlands) and adjoined others (creeks and forest) that could be used by long-tailed bats if moving throughout the landscape. These features may provide foraging, commuting and roosting opportunities for any resident extant long-tailed bat population. There are fewer of these features within the

mining area itself, however potential roost trees do occur within the SB including stands of exotic over-mature trees and dead snags. These trees would be retained under the current plans, and therefore the destruction of any potential roost trees is not anticipated.

In the absence of any site-specific bat activity data confirming presence within the proposed mining area, the size of long-tailed bat home ranges suggests that bats could use the wetlands and streams across the proposed mining area for foraging and commuting, although that use is likely to be infrequent. Potential roost features in the form of exotic mature trees were present inside and outside the mining area. Other landscape features that may be used by bats (watercourses, wetlands, vegetation) are present elsewhere on the Barrytown Flats. On that basis the ecological value of the bat habitat within the proposed mining area was considered '**low**' (Table 23).

**Table 23: Summary of terrestrial ecological values following the EciAG (Roper-Lindsay et al. 2018).**

| Feature                              | Representativeness | Rarity and Distinctiveness | Diversity and pattern | Ecological Context | Overall score | Comments   |
|--------------------------------------|--------------------|----------------------------|-----------------------|--------------------|---------------|--|
| Grazed exotic pasture                | Negligible         | Negligible                 | Negligible            | Negligible         | Negligible    | Exotic vegetation of low stature and diversity typical of agricultural land use.   |
| Rough exotic pasture                 | Low                | Low                        | Low                   | Low                | Negligible    | Higher stature, denser vegetation compared to highly grazed pasture. Dominated by exotic species.  |
| Indigenous coastal shrubland         | Moderate           | Very High                  | Low                   | Low                | Moderate      | Represents secondary indigenous coastal shrubland community typical of the Barrytown Flats. Few remaining examples of this vegetation type. Threatened and At Risk species present, but value limited by small size, isolated location and high proportion of edge.  |
| Isolated Southern rātā               | Low                | Low                        | Low                   | Low                | Negligible    | Isolated Southern rātā snags have retained native epiphytes that are common and widespread.  |
| Pine shelterbelts and isolated trees | Negligible         | Negligible                 | Negligible            | Negligible         | Negligible    | Exotic vegetation typical of agricultural land use. Shelterbelts are sparse and do not provide connectivity to indigenous habitats.  |
| Flaxland                             | Low                | Moderate                   | Low                   | Moderate           | Moderate      | Dense indigenous dominated vegetation along riparian and coastal margins that provides a buffer to these habitats. Flaxland is present in the ED including to the north of the site, but is largely reduced in extent.   |
| Bird habitat                         | Low                | Low                        | Low                   | Low                | Negligible    | Site comprises mostly grazed pasture with small and isolated areas of indigenous vegetation. Habitat for kiwi foraging present, but separated from forest habitats by SH6. Kororā may travel across the site.  |
| Bat habitat                          | Low                | Low                        | Moderate              | Low                | Low           | Suitable long-tailed bat foraging habitat (streams, wetlands) present within the SB. No suitable roost trees within the mining area.   |
| Lizard habitat                       | Low                | Low                        | Low                   | Low                | Negligible    | Small areas of potentially suitable, but low value, habitat for skinks exists within and around the proposed mining area.  |
| Threatened species                   |                    | Very high                  |                       |                    |               | No threatened species have been confirmed using the site. Threatened species present in the wider environment include long-tailed bats, West Coast green gecko and rōroa/great spotted kiwi. There are a small number of recent long-tailed bat records within 25 km, and records of rōroa calls from within the site, but the origin of |

| Feature         | Representativeness | Rarity and Distinctiveness | Diversity and pattern | Ecological Context | Overall score | Comments   |
|-----------------|--------------------|----------------------------|-----------------------|--------------------|---------------|--|
|                 |                    |                            |                       |                    |               | these calls is most likely forests east of SH6 (i.e., outside the SB).   |
| At Risk species |                    | High                       |                       |                    |               | At risk bird species have been confirmed using the site. Kororā may travel across the site to burrows. Newman's skink are also considered At Risk. |

## 8.2 Wetlands

Indigenous wetland extent in New Zealand has declined to less than 10% of the estimated pre-human coverage. While the West Coast region of New Zealand retains the largest extent of freshwater wetlands relative to other regions, it also has experienced some of the highest proportional loss (Stats NZ, 2018). Consequently, freshwater wetlands are considered rare both nationally and regionally. The national guidance on wetland management outlined in the NPS-FM further supports this conclusion.

While all freshwater wetlands with indigenous vegetation have at least a ‘high’ value for rarity, the wetlands within the SB and proposed mining area were generally dominated by exotic and common native species and not representative of indigenous wetland communities. Wetland areas were also small, with most having been induced by historic land modifications such as dredging and land drainage. Most of the wetlands identified offered good connectivity to other areas of surface water habitat within the SB (e.g., hump and hollow wetlands and floodplain wetlands). Each of the wetland types identified within the SB were assigned values separately and have values ranging between ‘negligible’ and ‘moderate’ (Table 24) based on the representativeness, rarity and distinctiveness, diversity and pattern and ecological context, including current and potential value in accordance with the NPS-FM.

**Table 24: Summary of wetland ecological values following the EciAG (Roper-Lindsay et al. 2018).**

| Feature                  | Represent. | Rarity and Distinctiveness | Diversity and pattern | Ecological Context | Overall value     | Comments   |
|--------------------------|------------|----------------------------|-----------------------|--------------------|-------------------|--|
| Hump and hollow wetlands | Low        | Low                        | Low                   | Low                | <b>Negligible</b> | Vegetation dominated by exotic and common widespread native species not representative of indigenous wetland communities. Wetlands are induced and degraded by livestock, resulting in little structural diversity. Some wetlands provide connectivity to the coastal lagoon, and are often connected to each other via drains or adjacent hollow wetlands. Hump and hollow wetlands are common on the West Coast. |
| Dredge pit wetlands      | Low        | Low                        | Low                   | Moderate           | <b>Low</b>        | Vegetation dominated by exotic and common widespread native species not representative of indigenous wetland communities. Induced wetlands. Provides some connectivity with other wetland types and freshwater environments, but mostly comprise isolated pits.  |
| Floodplain wetlands      | Low        | Moderate                   | Low                   | Moderate           | <b>Moderate</b>   | Dominated by exotic and common widespread native species not representative of indigenous wetland communities. Small, isolated wetlands associated with riparian zones. Provides buffer to aquatic habitats. Good potential for restoration.   |
| Palustrine wetlands      | Low        | Moderate                   | Low                   | Low                | <b>Low</b>        | Dominated by exotic and common widespread native species not representative of indigenous wetland communities. Small, isolated and not connected to other wetlands or indigenous vegetation. Limited potential for restoration.  |
| Coastal lagoon           | Moderate   | Moderate                   | Low                   | Moderate           | <b>Moderate</b>   | Smaller in extent than the coastal lagoon near the Central Block. Vegetation not biologically or structurally diverse; however, provides a stepping stone between other wetlands.  |

## 8.3 Watercourses

### 8.3.1 Artificial drains

All of the artificial drains within the SB are man-made aquatic habitats. Their entire catchments lie within the SB and they are primarily groundwater fed. The straight channel alignment and uniform cross section provide relatively homogenous aquatic habitat. Aquatic flora was limited to common exotic emergent macrophyte species (e.g., watercress) and filamentous algae in shallow/poorly shaded reaches.

Aquatic habitat provided by artificial drains was assessed as being of '**low**' ecological value as they were not representative of natural stream environments, not rare or distinctive aquatic environments, provided uniform rather than diverse habitat for aquatic biota and do not provide a migratory pathway for fish to or from upper catchments (Table 25).

The artificial drain where Site 1 was located provided slightly more diverse aquatic habitat (e.g., riffles, runs, pools), but its artificial nature, straight channel alignment and lack of native vegetated riparian margins meant habitat values were also '**low**' (Table 25).

Macroinvertebrate communities recorded from artificial drains were dominated by taxonomic groups that tolerate poor water quality (i.e., nutrient enrichment) and poor aquatic habitat (e.g., Crustacea, Diptera, Mollusca) and resulted in low EPT, %EPT, MCI, QMCI and ASPM scores that indicate 'poor' community health and '**low**' ecological value (Table 25).

Artificial drains within the SB supported moderate native fish diversity and reflected the close proximity and connection with the marine environment allowing diadromous native fish species to migrate into them as juveniles. No introduced fish species were recorded during the EFM survey or in eDNA samples. Artificial drains within the SB are groundwater fed and those that were surveyed held adequate surface water to support permanent fish communities. Artificial drains within the SB supported native fish species of conservation interest (i.e., two species at Sites 7 and 8, five species at Site 1) including longfin eel, Tnanga, banded kōkopu, redfin bully and bluegill bully. eDNA sampling indicated the potential presence of giant kōkopu (or shortjaw kōkopu, but less likely due to habitat). Overall fish fauna values for artificial drains at Sites 7 and 8 were assessed as 'moderate' whilst fish values for artificial drains at Site 1 was assessed as '**high**' (Table 25).

### 8.3.2 Modified creeks

Modified creeks within the SB included Northern Creek (Site 2), Central Creek (Site 3), Clarke Creek (Site 4), Little Granite Creek, Granite Creek (Sites 5 and 6), Wasabi Creek (Site 9) and Southern Creek (Site 10). All creeks within the SB are modified to some extent due to historical realignment of their channels.

Northern Creek, Little Granite Creek, Granite Creek and Wasabi Creek were highly modified due to channel realignment, but have retained some natural sections and were assessed as having habitat with '**moderate**' ecological value due to the gravel/cobble bed being representative of natural streams, and the moderately diverse habitat (e.g., runs, riffles, pools). Little Granite Creek and Granite Creek also provide a migratory pathway for diadromous native fish species into their upper catchments (Table 25).

Clarke Creek, Central Creek and Southern Creek were in a highly modified state due to realignment of their channels, had higher proportions of sand/silt due to grazing and erosion and provided uniform run habitat that is not representative of natural streams in the area. Clarke Creek extends east of SH6 so the section within the SB provides a migratory pathway for native diadromous fish into the upper catchment. Clarke Creek was assessed as having aquatic habitat of '**low**' ecological value (Table 25).

Modified natural rivers within the SB generally supported macroinvertebrate communities

with high proportions of taxonomic groups that can tolerate poor water quality and habitat conditions (e.g., Diptera, Crustacea, Oligochaeta), low EPT taxa richness and %EPT, and low MCI, QMCI and ASPM scores. An exception was higher EPT taxa richness and abundance in Wasabi Creek that resulted in slightly higher MCI and ASPM scores within the 'fair' to 'good' categories. Macroinvertebrate communities in all modified creeks within the SB, despite higher EPT taxa scores in Wasabi Creek, were assessed as having '**low**' ecological value and reflected the modified habitat conditions (Table 25).

Modified creeks within the SB supported moderate native fish diversity and reflected the close proximity and connectivity with the marine environment allowing diadromous native fish species to migrate into them. No introduced fish species were recorded during the EFM survey or in eDNA samples. Based on eDNA sampling, the modified creeks within the SB supported native fish species of conservation interest including longfin eel, īnanga, kōaro, banded kōkopu, redfin bully and bluegill bully and potentially giant kōkopu and lamprey (in Granite Creek). Shortjaw kōkopu (Nationally Vulnerable) have been recorded from mid-upper reaches of Granite Creek in hills to the east of SH6 and would migrate through the lower reaches within the SB. The fish communities recorded from natural rivers within the SB are typical of West Coast streams in the vicinity and were assessed as having '**high**' ecological value (Table 25).

**Table 25: Summary of aquatic ecological values within the SB following the approach EciAG (Roper-Lindsay et al. 2018).**

| Feature  | Representativeness | Rarity and Distinctiveness | Diversity and pattern | Ecological Context | Overall value   | Comments   |
|--|--------------------|----------------------------|-----------------------|--------------------|-----------------|--|
| <b>Artificial drains (Sites 7 and 8)</b>                           |                    |                            |                       |                    |                 |  |
| Habitat and aquatic flora  | Low                | Low                        | Low                   | Low                | <b>Low</b>      | Artificially created watercourses that originate within the SB. Provide uniform habitat and are common habitat in areas of lowland agricultural land use. Supports macroinvertebrate taxa typical of degraded or modified aquatic habitats. Supports at least 2–3 fish species of conservation interest based on EFM survey.   |
| Macroinvertebrates   | Low                | Low                        | Low                   | Low                | <b>Low</b>      |  |
| Fish   | Moderate           | High                       | Low                   | Low                | <b>Moderate</b> |  |
| <b>Artificial drains (Site 1)</b>                                  |                    |                            |                       |                    |                 |  |
| Habitat and aquatic flora  | Low                | Low                        | Moderate              | Low                | <b>Low</b>      | Artificially created watercourse that provide slightly more diverse habitat than other drains within the SB. Supports low EPT taxa richness, low %EPT abundance and low MCI, QMCI and ASPM scores. Supports five fish species of conservation interest based on EFM survey.  |
| Macroinvertebrates   | Low                | Low                        | Low                   | Low                | <b>Low</b>      |  |
| Fish   | Moderate           | High                       | Moderate              | Moderate           | <b>High</b>     |  |
| <b>Modified creeks (Clarke, Central, Southern)</b>                 |                    |                            |                       |                    |                 |  |
| Habitat and aquatic flora  | Low                | Low                        | Low                   | Moderate           | <b>Low</b>      | Highly modified natural rivers that provide aquatic habitat that is not representative of cobble/gravel streams common in the area due to realignment away from its natural flow path and higher proportion of sand/silt and affected by grazing. Supports macroinvertebrate communities dominated by tolerant taxa and have low EPT, %EPT, MCI, QMCI and ASPM scores indicative of 'poor' stream health. Supports three native fish species of conservation interest. Section of Clarke Creek within SB represents migratory pathway for diadromous native fish upstream. |
| Macroinvertebrates   | Low                | Low                        | Low                   | Low                | <b>Low</b>      |  |
| Fish   | Moderate           | High                       | Moderate              | Moderate           | <b>High</b>     |  |
| <b>Modified creeks (Northern, Little Granite, Granite, Wasabi)</b> |                    |                            |                       |                    |                 |  |
| Habitat and aquatic flora  | Moderate           | Low                        | Moderate              | Moderate           | <b>Moderate</b> | Modified natural rivers that have been realigned but provides more diverse habitat than other modified creeks within the site. Lower Granite Creek blocked at the mouth by a low gravel/cobble weir. Natural gravel/cobble dominated   |



| Feature            | Representativeness | Rarity and Distinctiveness | Diversity and pattern | Ecological Context | Overall value | Comments   |
|--------------------|--------------------|----------------------------|-----------------------|--------------------|---------------|--|
| Macroinvertebrates | Low                | Low                        | Low                   | Low                | <b>Low</b>    | streambed with evidence of sand/silt sedimentation due to slips in steep upper catchment. Provides diverse aquatic habitat of moderate quality, but is affected by sedimentation. Supports macroinvertebrate community dominated by tolerant taxa with low moderate-EPT, %EPT, MCI, QMCI, ASPM scores indicating 'fair' to 'poor' stream health. Supports more diverse native fish fauna including 3–5 native species of conservation interest. Sections of Little Granite Creek and Granite Creek within the SB represent important migratory pathway into upper catchment east of SH6. |
| Fish               | Moderate           | High                       | Moderate              | Moderate           | <b>High</b>   |  |

## 9.0 Assessment of Effects

### 9.1 Types of effects

This section assesses the actual and potential ecological effects in the terrestrial and aquatic environments associated with constructing and operating the mine as summarised in the Project Description (Section 1.3) and indicative mining path (Figure 48). The types of effects are as follows:

#### *Terrestrial Flora and Fauna*

- Terrestrial vegetation clearance.
- Effects on avifauna due to loss of potential habitat, potential for mortality of eggs, chicks and adults during vegetation clearance and other works, increased human disturbance and activity at the site affecting bird activity.
- Effects on lizards (if present) due to loss of potential habitat and potential injury or mortality during vegetation clearance.
- Effects on bats (if present) due to vegetation clearance resulting in the loss of potential roosting, foraging and commuting habitat and the potential for injury and mortality of roosting bats during vegetation clearance and wetland and stream drainage/diversion resulting in a loss of foraging habitat.
- Positive effects on botanical, avifauna and wetland values and perhaps lizard and bat habitats (if present) resulting from remediation, in particular, the proposed riparian planting.

#### *Ground and Surface Water Quality and Quantity*

Changes to the local hydrology, either within the site or beyond the site, have the potential to affect ecological values including flora and fauna in wetlands, modified creeks and artificial drains. Potential hydrological effects on ground and/or surface water quantity were assessed as negligible by Kōmanawa Solutions (2026) so only the potential changes in water quality and ecological effects are assessed in this report and include:

- Changes to physico-chemical parameters, such as pH and alkalinity.
- Mobilisation of metals/metalloids and nutrients to surface water bodies associated with the discharge of groundwater inflows that will take on the geochemical characteristics of deposited slimes and tailings.

#### *Wetlands*

Potential effects on wetlands and the small coastal lagoon adjoining the mining area include:

- Temporary loss of wetland extent.
- Positive effects as a result of the creation of c. 53.1 ha of wetland, which is substantially more than currently exists within the SB, as part of rehabilitation.

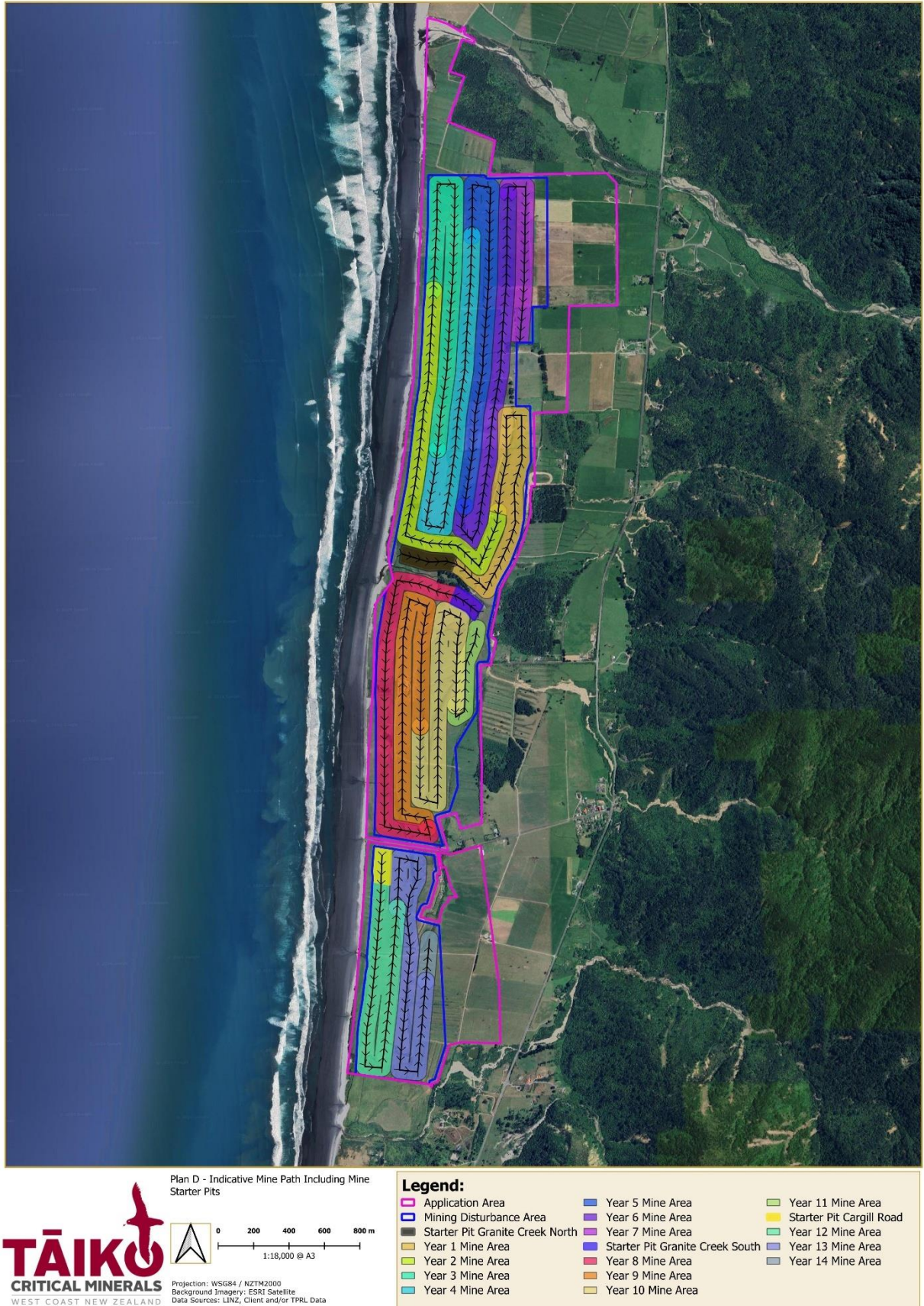
#### *Watercourses*

Potential effects on modified creeks and artificial drains within the SB include:

- Earthworks and sedimentation resulting in effects on water quality and biology within modified creeks and artificial drains.
- Temporary loss or disturbance of aquatic habitat in the creeks and artificial drains

within the SB prior to watercourses being re-established at their final location.

- Disturbance and/or mortality of native fish during site management as part of mining.
- Effects on native fish passage resulting from site management during mining.
- The potential for reduced flows in Canoe Creek as a result of the proposed water take.
- Positive effects as a result of the creation of watercourses with more natural meandering flow paths and with greater width and depth variability and habitat diversity and improved riparian shade within the SB as part of rehabilitation.



**Figure 48: Indicative mine path including mine starter pits within the Southern Block, Barrytown.**

## 9.2 Effects on Terrestrial Flora and Fauna

### 9.2.1 Terrestrial vegetation clearance

The terrestrial ecological effects have been assessed at the scales of the Barrytown Flats, the SB or nationally (in the case of tāiko) as appropriate. The mining and associated rehabilitation will be staged, meaning that the time lag between loss of habitats and replacement with planting and/or wetland construction is expected to be relatively short term (less than 10 years given that wetland construction occurs in Year 1 and 2 of mining).

Proposed mining activities will result in vegetation clearance of up to 16 ha at any one time. The majority of vegetation within the proposed mining area comprises grazed exotic pasture (c. 278.7 ha) with ‘negligible’ ecological value, with smaller areas of rough exotic pasture (3.5 ha) with similarly low ecological value. The remaining vegetation is of ‘moderate’ ecological value and comprises small isolated strips of indigenous coastal shrubland (0.9 ha) and flaxland (0.3 ha) along coastal and riparian margins.

Some mature pine and shelterbelt trees, also of ‘negligible’ ecological value will also be removed. The removal of ‘negligible’ or ‘low’ ecological value vegetation across the site is expected to result in a ‘very low’ level of effect. No mitigation is considered necessary beyond what has been proposed with progressive rehabilitation.

The removal of indigenous coastal shrubland with ‘moderate’ ecological value has potential to result in a ‘moderate’ level of effect without effects management. Post-mining rehabilitation of the SB in accordance with the Rehabilitation Management Plan prepared by Tai Poutini Resources Limited (2026) will re-establish more than 53 ha of riparian and wetland vegetation, including indigenous coastal shrubland with similar or higher ecological value than the existing indigenous coastal shrubland and including the one ‘Threatened’ and one ‘At Risk’ species present at the site as set out in the Landscape Mitigation Package (Glasson Huxtable 2026). As a result, the overall level of effect is expected to be ‘very low’ or more likely a ‘net gain’ in ecological value of coastal shrubland (including riparian planting) at the conclusion of mining.

The removal of flaxland with ‘moderate’ ecological value along coastal margins has potential to result in a ‘moderate’ level of effect without effects management. Post-mining rehabilitation of the SB in accordance with the RMP prepared by Tai Poutini Resources Limited (2026) and as illustrated in the Landscape Mitigation Package (Glasson Huxtable 2026) will establish a larger area of well-connected and buffered indigenous vegetation, including at least 13.4 ha of flaxland. This vegetation will be predominantly indigenous and managed to control weeds. On that basis it will have higher ecological value than the existing flaxland. Given the nature of this vegetation, and the proposal to use vegetation direct transfer (VDT), vegetation establishment is expected to be achievable relatively quickly and the effects of vegetation removal will be temporary in nature. As a result, the overall level of effect is expected to be a ‘very low’ in the short – medium term and a ‘net gain’ in ecological value at the conclusion of mining.

### 9.2.2 Effects on avifauna

The bird species confirmed to be present within and surrounding the site are mainly species which would use the habitats within the site for foraging or only occasionally visit (e.g., oystercatchers, dotterels, gulls). Only common native and exotic birds are likely to be nesting within the proposed mining area, although there is the potential for little blue penguin to be crossing the area to reach burrows inland. In addition, tāiko, and perhaps other seabirds, could be affected by lighting at night if not properly managed. Although pipit (*Anthus novaeseelandiae*) which are considered ‘At Risk – Declining’ have not been recorded during surveys at the site, they have been recorded within 10 km and are one of the few native birds likely to be nesting in pasture, although they are unlikely to use

intensively grazed pasture. Other ground nesting species include banded dotterel and perhaps oystercatchers. The existing small amount of shrubland/tree habitat at the site would currently limit its potential as nesting habitat for species that nest in trees.

Vegetation clearance could result in the permanent loss of suitable bird habitat without effects management. Post-mining rehabilitation of the SB in accordance with the RMP prepared by Tai Poutini Resources Limited (2026) will re-establish pasture similar to that present before mining across most of the site with an equivalent or larger area of shrubland, wetland and/or forest via the planted areas (including riparian plantings). These shrubland/forest and wetland habitats will provide additional habitat for species which nest in trees and most likely better habitat for species such as weka, pūkeko and harriers, which like dense cover and/or dense rush vegetation within which to construct their (ground based) nests. On that basis the post-mining vegetation will have similar or higher ecological value than the existing vegetation cover for birds. The effects will also be restricted to a relatively small proportion of the site which will move over time as mining proceeds and therefore be relatively short term and local in nature. As a result, the overall level of effect of terrestrial vegetation clearance on birds is expected to be 'low'.

Vegetation clearance has the potential to result in mortality of nesting birds if it occurs during the breeding season. The likely presence of kororā/little blue penguins (which are considered 'At Risk – declining' (Robertson et al. 2021)) throughout the year in surrounding habitats and the proximity to the only known tāiko colony mean that management of mining activities, and perhaps the birds themselves, will be required to protect birds living in the surrounding environment. An Avian Management Plan (AMP) has been prepared which outlines how potential effects on birds will be managed, including regular survey to confirm bird presence, using visual and auditory cues to deter prospecting birds from settling and establishing nests in areas to be mined and fencing to exclude kororā. A wildlife act authority under the Wildlife Act (1953) will be required to manage birds.

No work is being undertaken within 50 m of the MHWS and no indirect effects (e.g., noise) are anticipated for avifauna likely to be utilising the coastal environment adjacent to the SB.

There is a risk artificial light at night will adversely affect tāiko either leaving or returning to the colony to the north. Mining would only occur during daylight hours, but lighting may be necessary at night for health and safety reasons (e.g., to assess and remedy break downs). The AMP also outlines how adverse effects of artificial light at night will be managed, monitored and reported. Implementing appropriate mitigation measures, including those developed as part of consenting the mining activities at the CB and which comply with the Australian National Light Pollution Guidelines for Wildlife (2023), will result in a 'low' or 'very low' overall level of effect as set out in Table 31.

### 9.2.3 Effects on herpetofauna

Vegetation within the SB is comprised mostly of grazed exotic pasture, which does not provide suitable habitat for lizards. There were a few small isolated areas within the mining area of slightly more suitable lizard habitat (e.g., rank pasture grass suitable for Newman's speckled skink and shrubland areas suitable for gecko). There were also areas adjacent to the proposed mining area (e.g., woody debris, rock piles, rank pasture along coastal margin, shrubland and forest) which are suitable habitats for lizards, but which are outside the mining area and would not be affected either directly or indirectly.

Vegetation clearance resulting in direct injury or mortality of lizards has the potential to result in a 'high' level of effect without effects management. The Lizard Management Plan (LMP) includes actions to ensure work to clear vegetation avoids/minimises lizard injury and mortality via salvage and relocation of any lizards detected with the overall level of effect expected to be 'low' post effects management.

Post-mining rehabilitation of the SB in accordance with the RMP prepared by Tai Poutini

(2025) will re-establish an equivalent or larger area of suitable lizard habitat with the overall level of effect assessed as a 'very low' to a 'net gain' post rehabilitation as set out in Table 31.

No work is being undertaken within 50 m of the MHWS and no indirect effects (e.g., noise) are anticipated on herpetofauna species which may be using the coastal environment adjacent to the SB.

#### 9.2.4 Effects on bats

There are recent records of long-tailed bats within 25 km of the SB. There are large, old trees which could be potential roost trees, as well as other features important for commuting and foraging bats (if present), within or immediately adjacent to the SB, but outside of the proposed mining area. Exotic pine trees and shelterbelts within the SB will be retained. Given the low number and sporadic nature of the nearest records, the likelihood of a large population being present in the area is low. Nonetheless, such a population would be regionally, and perhaps nationally, important and therefore the pre-mitigation effect on bats is considered 'moderate'.

The vegetation proposed to be cleared is not suitable habitat for roosting bats. As a result, the potential for direct adverse effects on bats through either injuring or killing bats during vegetation clearance is 'negligible'.

Loss of potential foraging habitat via stream diversion and wetland removal within the SB could adversely affect bats if they are using the site. The relatively small, mobile footprint, combined with prompt rehabilitation as mining proceeds, the retention of the streams at the original location where they enter and leave the mining area, no loss of stream length and the increase in the overall extent and ecological value of wetlands as rehabilitation proceeds and is completed will ensure effects on bats will be 'low' in the short term and will result in a 'net gain' in the long term, as set out in Table 31.

If present, bats could also be affected by artificial lighting at night associated with the mobile mining plant, the Mine Water Facility and WCP. Lighting can delay roost emergence (where roosts are nearby), disrupt commuting routes, and illuminate foraging areas forcing bats to alter flight and foraging patterns. Given mining would only occur during daylight hours, and there is no suitable roosting habitat within the mining area, the level of effects pre-mitigation is 'low'. The need to manage externally visible lighting at night to protect wildlife has formed part of the project development and will ensure that effects on lighting are avoided where they can be and minimised where lighting is required. The lighting management proposed is consistent with the management plan for the CB and is expected to result in a 'very low' level of effects on bats as set out in Table 31. Given that the vegetation clearance does not include potential roosts, a separate Bat Management Plan is not considered necessary.

### 9.3 Effects on Wetlands

The wetlands within the proposed mining area will be removed and reconstructed as mining progresses, as guided by the RMP prepared by Tai Poutini Resources Limited (2026).

The location proposed for wetland construction is along the eastern margin of the mining area, as shown in Figure 49, whilst the wetlands to be removed occur throughout the site as shown in Figure 21. The mining sequence is shown in Figure 48.

Existing natural inland wetlands and other wetlands would generally be removed as mining proceeds, but rehabilitated wetlands would only be constructed following mining along the eastern boundary. Wetland construction will occur in Years 1 and 2 in the north of the SB and in Years 10 and 11 in the centre of the SB. Wetlands would therefore begin to be constructed and planted in the first year of mining, but wetland construction would not be completed until after final rehabilitation of the site at the end of mine life. The proposal

includes construction of approximately 53.1 ha of wetland as shown in Figure 49 to Figure 51, which substantially exceeds the extent of natural inland wetlands to be removed.

There are relatively few small, low-quality wetlands to be removed in the north (see Figure 21) and the overall wetland area created during Year 1 and 2 as part of rehabilitation will substantially exceed the area removed. The majority of the wetlands to be removed are within the central block, and wetland creation in the northern block early in the mine life, combined with the overall much larger extent of wetland being created relative to the amount of natural inland wetland being removed, would ensure that wetlands continue to be created and planted ahead of removal as set out in the Rehabilitation Management Plan prepared by Tai Poutini Resources Limited (2026).

These constructed and restored wetlands will take some time to establish and develop and their ecological values will improve with time, although any areas of VDT will retain most of their existing values when they are relocated. Whilst ecological value improves within the constructed wetland, some of the ecological functions that the existing wetlands provide will be provided by water management at the mine.

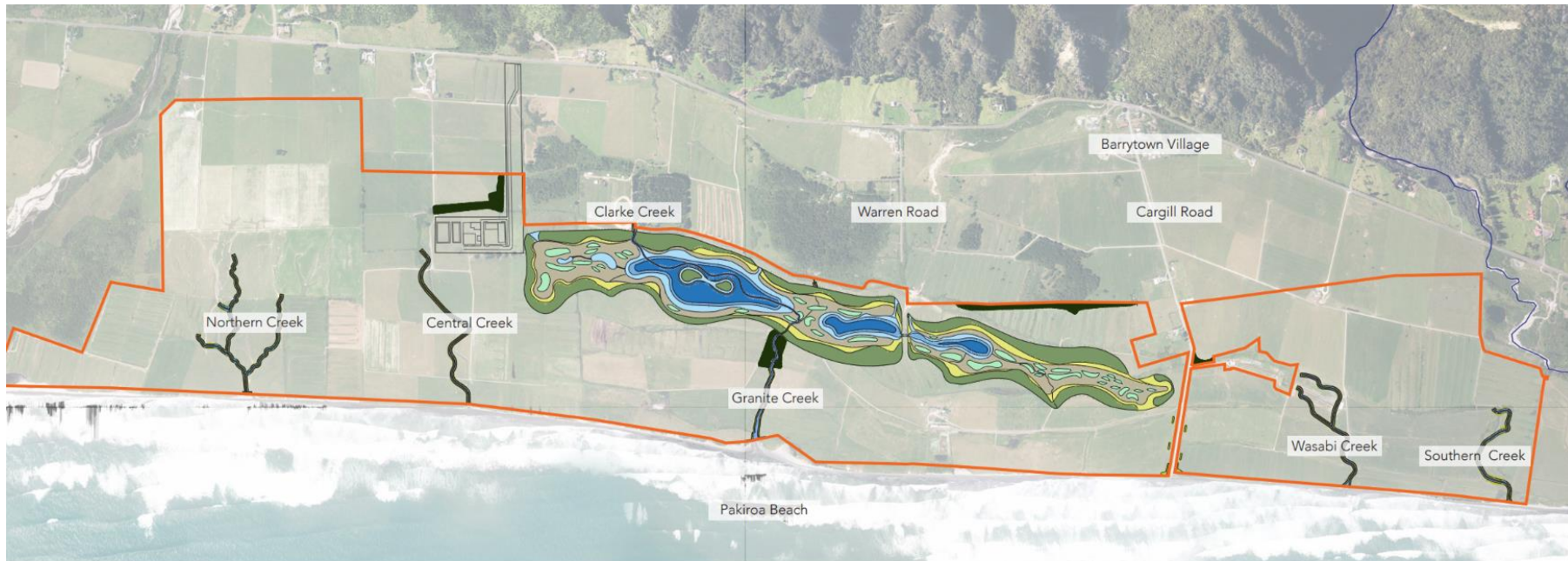
Given the site is currently a dairy farm and minimal soil disturbance and limited soil stockpiling is proposed, the soils are likely to be highly fertile and growth rates are likely to be good – very good. On that basis good vegetation cover should be achievable within five years in constructed wetlands.

Assuming that wetland cover and a basic level of ecological function will take approximately five years to develop post-construction, wetland values can be expected to return in years 5 and 12 in the northern area and years 15 and 16 in the central block. By year five, Figure 48 shows that mining is still within the northern block, and all the wetlands affected are within that block. By year 11 mining is nearing completion in the central block, allowing construction of wetlands to be completed there.

The natural inland wetlands to be removed in the southern block are mostly located in the west, and would be removed before construction of the new wetlands in the west (at the conclusion of mining). Nonetheless, substantial areas of wetland will have been created in the northern and central blocks, and the ecological values there will be improving as vegetation grows and creates complex habitats. The wetland removal and reconstruction process will be such that hydraulic separation between natural surface water and the dredge pit is maintained at all times.

The wetland types to be removed within the proposed mining area include induced hump and hollow (c. 18.39 ha) and dredge pit (c. 10.64 ha) wetlands which are not natural inland wetlands and to which the NPS-FM and NES-F do not apply, although they do have some ecological value. The palustrine wetlands (c. 3.69 ha), and floodplain wetlands (c. 3.04 ha) are natural inland wetlands and the NPS-FM requires that there be no loss of extent or values. The ecological value of these wetlands is 'moderate'. Removal of these wetland areas could result in a 'moderate' to 'very high' level of effect prior to effects management. The proposed mining schedule will ensure that wetlands are constructed in advance of their removal, and overall, there will be no loss of extent or values within the SB. The coastal lagoon will not be affected because it is located outside the mining disturbance area and well away from any areas where material for redistribution will be obtained.

The ecological value and function of wetlands will improve over time, particularly given the large and connected nature of the proposed constructed wetland relative to the multiple, small, disconnected and isolated wetlands currently present at the site, many of which have been brought about either by previous mining or drainage to support farming. On that basis the overall level of effect is expected to be 'very low' in the short term and a 'net gain' in the long-term allowing for effects management.



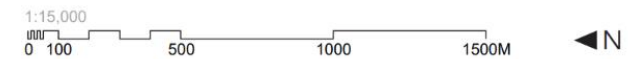
| KEY |   |
|-----|---|
|     | Shallow Marsh - Average Depth 0.4m<br>Total Area: 5.2ha   |
|     | Mid-depth Water - Average Depth 1m<br>Total Area: 2.8ha   |
|     | Deep Open Water - Average Depth 2m<br>Total Area: 4.8ha   |
|     | Flaxland and Dry Edge Vegetation<br>Total Area: 10.8ha    |
|     | Carex Rushlands<br>Total Area: 5.9ha                      |
|     | Raupo Wetland<br>Total Area: 14.3ha                       |
|     | Raised Islands<br>Total Area: 3.2ha                       |
|     | Riparian Planting<br>3-5m in width either side of channel |
|     | Existing Planting to be Retained                          |
|     | Application Area  |

TOTAL WETLAND AREA: 53.1ha Approximately

**Note:**  
At the completion of mining activity the application area will have:

- The existing planting areas that were retained
- Clusters of new planting along Cargill Road
- New riparian planting along creeks (five primary ones which have been realigned, plus Granite Creek)
- An extensive well functioning connected new wetland of approximately 53.1 hectares.

Refer to the **Rehabilitation Management Plan** for further details.



16.0

Landscape Mitigation

During Mining Final Outcome:  
Sections 1, 2 & 3 Combined

Project Number:  
2410

Revision:  
H

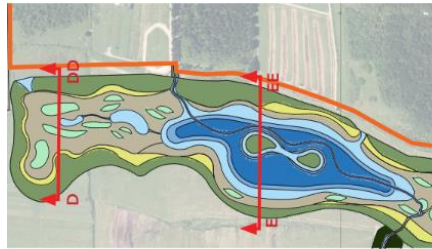
Scale:  
1:15,000@ A3

Design: GHLA  
Drawn: EM

Approved: NC

Date:  
19/5/2026

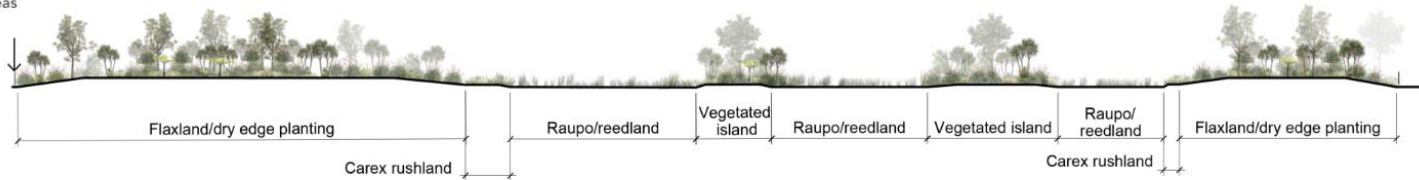
**Figure 49: Post mining rehabilitation outcome (Glasson Huxtable 2026).**



**Notes:**  
The design and layout of the well functioning large connected wetland has been informed by Landscape Architects, Ecologists and Hydrologists working together. Refer to the **Rehabilitation Management Plan** for further detail.

Key Plan - During Mining Section 1 From Page 14

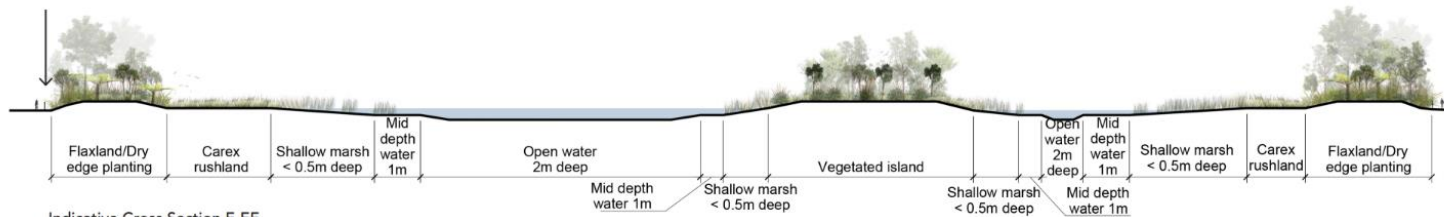
New stock proof fencing on the outside of all the planting areas



Indicative Cross Section D-DD

1:1,000  
0 10 20 30 40 50 60 70 80 90 100M

New stock proof fencing on the outside of all the planting areas



Indicative Cross Section E-EE

1:1,000  
0 10 20 30 40 50 60 70 80 90 100M

13.0

Landscape Mitigation

During Mining Section :  
North of Granite Creek

Project Number:  
2410

Revision:  
H

Scale:  
AS SHOWN

Design: GHLA  
Drawn: EM

Approved: NC

Date:  
19/5/2026

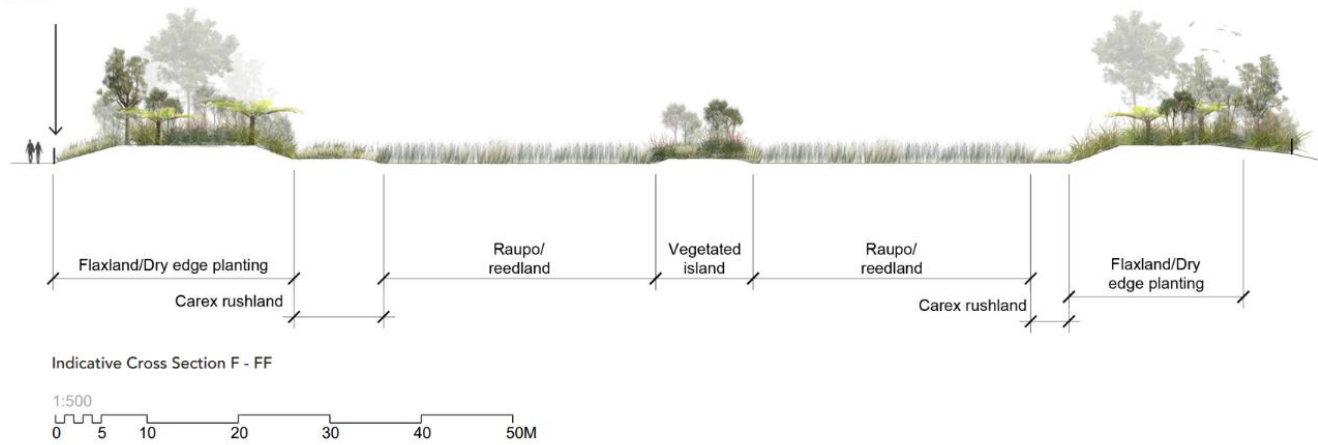
Figure 50: Post mining landscape mitigation plan north of Granite Creek (Glasson Huxtable 2026).





Key Plan - During Mining Section 2 From Page 15

New stock proof fencing on the outside of all the planting areas



Indicative Cross Section F - FF



14.0

Landscape Mitigation

During Mining Section:  
South Of Granite Creek

Project Number:  
2410

Revision:  
H

Scale:  
1:500 @ A3

Design: GHLA  
Drawn: EM

Approved: NC

Date:  
19/5/2026

**Figure 51: Post mining landscape mitigation plan south of Granite Creek (Glasson Huxtable 2026).**



## 9.4 Effects on Freshwater Ecology

### 9.4.1 Earthworks and sedimentation effects

Earthworks associated with mining the site has the potential to result in fine sediment mobilisation and runoff into watercourses and wetlands, including via discharges to groundwater.

Kōmanawa Solutions (2026) considered it unlikely that turbidity from discharges to ground would extend further than 40 m into the aquifer, with any particles beyond 20 m being fine clay. Increased turbidity could result in sediments coating fish and/or macroinvertebrate gills, smothering instream habitats or reducing the quality and palatability of periphyton, Kōmanawa Solutions considered that the potential for turbidity changes in the receiving environment is low, even without accounting for dilution in the creek and filtration in the creek bed substrate.

To minimise the risk of adverse effects on aquatic habitats and fauna from earthworks and sedimentation it is proposed that erosion and sediment control measures be implemented. An Erosion and Sediment Control Plan (ESCP) has been developed by Ridley Dunphy Environmental Limited which sets out the appropriate timing, location, scale, design and maintenance of erosion and sediment control measures so as to avoid adverse effects of earthworks and sedimentation on aquatic habitats and fauna. In addition, setbacks will be established from key freshwater features that will be retained (e.g., Granite Creek, Fagan Creek) and not directly affected in order to minimise the potential for sediment reaching these freshwater environments.

The ESCP has the objective of avoiding and/or minimising the potential adverse effects of earthworks and sedimentation. Based on this plan, the overall level of effect on freshwater ecology values assessed as 'low'.

### 9.4.2 Effects on water quality

#### 9.4.2.1 Modelling effects of water quality assumptions and inputs

Site-specific models have been constructed in order to estimate the post-mining water quality at the various ecological monitoring surface water sites identified in this assessment of effects. The two key hydrological assumptions of the surface water models are that the various affected water bodies will be approximately returned with similar hydrological profiles post excavation, and that groundwater flows will be essentially unchanged during the proposed mining operation, being maintained by the porewater of backfilled slimes and tailings.

There is no groundwater hydrology model to inform surface water modelling, however the conceptual approach used here involves the consideration of how surface water quality will emerge in the short to medium term immediately following backfilling with tailings and slimes, hence being affected by modified groundwater quality. It is also assumed that these effects will not persist in the long-term and that groundwater will return to pre-mining quality, which will ultimately see the return of surface waters to baseline quality.

Neither Site 1 nor Site 6 surface water quality was modelled because while the majority of surface water sites identified in this report will see short to medium term modifications in water quality due to direct inputs from the modified groundwater, it has been assumed that surface water quality at Site 1 and Site 6 will be unaffected by modified direct groundwater inputs since the former is at the northern boundary of the proposed mining area while, for the latter, a buffer zone will exist between the Granite Creek bed and peripheral groundwater flows. However, while surface water quality at Site 6 is expected to remain

unchanged, Site 5, downstream, will be indirectly affected by modified groundwater feeding in from contributing surface waters to the north and south.

Key elements that inform the inputs of the water quality modelling presented here relate to:

- Relative contributing surface water and groundwater flows;
- Surface water quality;
- Slimes and tailings porewater quality; and
- The relative slimes to tailings porewater volume.

The water quality modelling undertaken takes a conservative scenario in which surface water flows reflect 1 in 5-year low flow conditions, during which possible significant changes in short to medium term surface water quality due to inputs of groundwater with modified quality are more likely to be realised. Resultant surface water quality under median surface water flow conditions was also considered in order to understand changes in surface water quality that might occur more typically, but this was not modelled, since low flow conditions present the worst-case.

The surface water quality model assumptions under low conditions assumes the North sub block (north of Granite Creek) and South sub block (Cargill Road to Fagan Creek) based entirely on groundwater flows and that surface water quality in the North and South sub blocks reflects groundwater quality in totality.

For the Central sub block, 1 in 5-year flows are the sum of the maximum groundwater flow and the residual upgradient surface water flows gained by estimation versus the Granite Creek 1 in 5 year flow, i.e., 75 L/s (Kōmanawa Solutions 2026). The estimated surface water flows were based on surface water morphologies and velocities (Table 17).

Surface water and groundwater quality data is summarised in Table 26 and the Barrytown South block slimes and tailings geochemistry, as reported by Kōmanawa Solutions (2026), and is reproduced here in Table 27 for relevant dissolved parameters as well as total iron. It is noted that tailings and slimes contain elevated concentrations of iron in the total fraction, viz., 28 g/m<sup>3</sup> and 400 g/m<sup>3</sup>, respectively, which will remain largely in the form of iron oxyhydroxides on deposition since backfilling is to sub-surface zones that are toxic. The relative proportion of tailings to slimes to tailings is likely to be less than 9:1 (i.e., 90% v/v) based on data collected at Mananui where the maximum proportion of slimes was 10% (Kōmanawa Solutions 2023)).

The surface water quality model first uses a mass-balance approach, i.e., chemically unmixed concentrations of key parameters are derived from the addition of apportioned material loads from groundwater and surface water divided by volume.

Notably, where model loads are dependent on upgradient surface water quality consideration is given, where possible, the additive loads reflect the apportioned replacement of groundwater of baseline quality with the quality of tailings and slimes porewater, whereas the 1 in 5-year model for the North and South sub blocks is more straightforward since all surface water is derived from groundwater.

Based on tailings and slimes pore water quality, it is apparent that surface waters receiving modified groundwater could potentially fail to meet surface water quality guidelines for pH and various metals/metalloids, since porewater has lower pH, is less alkaline, has lower hardness, and has greater metal/metalloid concentrations than baseline groundwater. However, lime addition to tailings and slimes prior to deposition will result in porewater amelioration. It should be noted that a limitation of the surface water modelling conducted here is that only one sample of slimes and tailings was analysed for chemical composition.

Therefore, surface water quality modelling was undertaken via material balancing, followed by the determination of chemically mixed concentrations using the ion-association aqueous model, PHREEQC (USGS 2021), with tailings porewater adjusted to pH 8.5 and alkalinity and hardness to 100 g/m<sup>3</sup> (as CaCO<sub>3</sub>).

**Table 26: Summary of Barrytown South slimes and tailings porewater quality parameters – physico-chemical and nutrients.**

| Parameter/Site                                  | Slimes | Tailings |
|---|--------|----------|
| pH (pH units)**                                 | 5.60   | 5.60     |
| Electrical conductivity (mSm)                   | 10.4   | 2.9      |
| Total Dissolved solids (TDS)                    | 158    | 58       |
| Total Alkalinity (as CaCO <sub>3</sub> )        | 10     | 3.2      |
| Bicarbonate (at 25°C)                           | 12.2   | 3.9      |
| Total nitrogen (TN)                             | 5.12   | 1.57     |
| Total ammoniacal nitrogen (Amm-N)               | 0.39   | 0.11     |
| Nitrate + nitrite nitrogen (NO <sub>x</sub> -N) | 0.12   | 0.36     |
| Total Kjeldahl nitrogen (TKN)                   | 5.00   | 1.21     |
| Total phosphorus (TP)                           | 5.4    | 0.48     |
| Dissolved reactive phosphorus DRP)              | 0.006  | 0.005    |
| Dissolved organic carbon*(DOC)                  | 56     | <20      |

**Notes:** Units g/m<sup>3</sup> unless stated; \*as Total organic carbon (TOC).

**Table 27: Summary of slimes and tailings porewater quality parameters – metals/metalloids and major ions.**

| Parameter/Site | Slimes  | Tailings |
|----------------|---------|----------|
| Aluminium      | 1.13    | 0.68     |
| Arsenic        | 0.0029  | 0.0020   |
| Boron          | 0.029   | 0.014    |
| Cadmium        | 0.00007 | <0.00005 |
| Chromium       | 0.016   | 0.0084   |
| Copper         | 0.034   | 0.0094   |
| Iron (total)   | 400     | 28       |
| Iron           | 0.95    | 1.1      |
| Lead           | 0.0020  | 0.0032   |
| Manganese      | 0.38    | 0.048    |
| Mercury        | 0.0003  | 0.0022   |
| Nickel         | 0.33    | 0.0041   |
| Silver         | 0.00068 | 0.10     |
| Zinc           | 0.12    | 0.029    |
| Calcium        | 11      | 1.8      |
| Magnesium      | 1.9     | 0.50     |
| Potassium      | 2.0     | 0.88     |
| Sodium         | 3.8     | 1.9      |
| Chloride       | 4.8     | 1.6      |
| Sulfate        | 16      | 3.7      |

**Notes:** Dissolved fraction unless stated.

### 9.4.2.2 Predicted surface water quality

The surface water quality model outputs for the 1 in 5 year model are provided in Table 28 and Table 29 and demonstrate that with lime augmentation of tailings and slimes, relevant guidelines can be met under all modelled conditions. Due to the low contribution of modified groundwater to surface water flows under median flow conditions, changes to surface water quality would be ‘negligible’.

**Table 28: Modelled surface water quality for North and South sub block sites – 1 in 5-year flows.**

| Parameter                        | Sites 2, 3, 9, 10 | Guidelines                   |
|----------------------------------|-------------------|------------------------------|
| pH (pH units)                    | 8.3               | 6-9 <sup>A</sup>             |
| Hardness (as CaCO <sub>3</sub> ) | 96.8              | NA                           |
| Aluminium                        | 0.61              | 2.9 <sup>B,C</sup>           |
| Arsenic                          | 0.002             | 0.013 <sup>D,E</sup>         |
| Boron                            | 0.014             | 0.94 <sup>F</sup>            |
| Cadmium                          | < 0.00005         | 0.0006 <sup>C,D</sup>        |
| Chromium                         | < 0.0005          | 0.003 <sup>C,D,G</sup>       |
| Copper                           | < 0.0001          | 0.0079-0.0138 <sup>C,H</sup> |
| Iron                             | 0.83              | 1.0 <sup>I</sup>             |
| Lead                             | 0.0001            | 0.015 <sup>C,D</sup>         |
| Manganese                        | 0.050             | 1.9 <sup>C</sup>             |
| Mercury                          | < 0.00008         | 0.0006 <sup>D</sup>          |
| Nickel                           | < 0.0005          | 0.030 <sup>C,D</sup>         |
| Silver                           | 0.048             | 0.05 <sup>D</sup>            |
| Zinc                             | 0.011             | 0.022 <sup>C,D</sup>         |
| Ammoniacal-N                     | <0.005            | ≤ 0.02 <sup>J</sup>          |
| Nitrate-N                        | 0.067             | ≤ 1.0 <sup>K</sup>           |
| Phosphorus <sup>L</sup>          | 0.003             | ≤ 0.006 <sup>N</sup>         |

**Notes:** units g/m<sup>3</sup>; <sup>A</sup>WCRC (2014); <sup>B</sup>USEPA (2018); <sup>C</sup>hardness and pH as stated, Dissolved Organic Carbon (DOC)=2.5 g/m<sup>3</sup> for aluminium 2.0 g/m<sup>3</sup> for copper; <sup>D</sup>ANZECC (2000) default trigger; <sup>E</sup>As(V); <sup>F</sup>ANZECC (2018); <sup>G</sup>as Cr(VI); <sup>H</sup>USEPA (2007); <sup>I</sup>USEPA (1986); <sup>J</sup>NPS-FM attribute A annual median, pH adjusted; <sup>K</sup>NPS-FM attribute A annual median; <sup>L</sup>modelled as dissolved reactive phosphorus; <sup>M</sup>NPS-FM attribute B median; <sup>N</sup>NPS-FM attribute A 95%-ile.

### 9.4.2.3 Summary of surface water quality and effects

Worst-case, 1 in 5-year low flow, water quality models were constructed that assumed full base flow infiltration of modified groundwater to surface waters in the North and South sub blocks, and combined surface water and base flow contributions to the surface waters in the Central sub block.

As such, the surface water modelling indicates all relevant water quality guidelines will be met, which will in turn prove protective to aquatic biota. There will likely be some appearance of iron oxyhydroxides in surface waters but this should not result in smothering of surface water beds. A caveat to the modelling is that tailings and slimes will require augmentation with lime in order raise porewater pH and hardness and facilitate demobilisation of metals and metalloids.

Surface water quality following the proposed mining is expected to be altered on in the short to medium term as the plume of modified groundwater moves westward through the mined zone toward the coast, after which quality will revert to baseline as groundwater regains its pre-mining geochemical signatures with the overall level of effect assessed as ‘very low’.

**Table 29: Modelled surface water quality for Central sub block sites – 1 in 5 year flows.**

| Parameter                        | Sites 4, 7 | Guidelines                   | Site 8    | Guidelines                   | Site 5    | Guidelines                   |
|----------------------------------|------------|------------------------------|-----------|------------------------------|-----------|------------------------------|
| pH (pH units)                    | 7.1        | 6-9 <sup>A</sup>             | 7.2       | 6-9 <sup>A</sup>             | 6.9       | 6-9 <sup>A</sup>             |
| Hardness (as CaCO <sub>3</sub> ) | 42         | NA                           | 34        | NA                           | 34        | NA                           |
| Aluminium                        | 0.012      | 0.96-1.8 <sup>B,C</sup>      | 0.015     | 0.96-1.8 <sup>B,C</sup>      | 0.013     | 0.96-1.8 <sup>B,C</sup>      |
| Arsenic                          | 0.0016     | 0.013 <sup>D,E</sup>         | 0.0010    | 0.013 <sup>D,E</sup>         | 0.015     | 0.013 <sup>D,E</sup>         |
| Boron                            | 0.011      | 0.94 <sup>F</sup>            | 0.008     | 0.94 <sup>F</sup>            | 0.011     | 0.94 <sup>F</sup>            |
| Cadmium                          | <0.0005    | 0.0003 <sup>C,D</sup>        | <0.0005   | 0.0002 <sup>C,D</sup>        | <0.0005   | 0.0002 <sup>C,D</sup>        |
| Chromium                         | <0.0005    | 0.0013 <sup>C,D,G</sup>      | <0.0005   | 0.0011 <sup>C,D,G</sup>      | <0.0005   | 0.0011 <sup>C,D,G</sup>      |
| Copper                           | <0.0005    | 0.0039-0.0079 <sup>C,H</sup> | <0.0005   | 0.0039-0.0079 <sup>C,H</sup> | <0.0005   | 0.0079-0.0138 <sup>C,H</sup> |
| Iron                             | 0.59       | 1.0 <sup>I</sup>             | 0.10      | 1.0 <sup>I</sup>             | 0.51      | 1.0 <sup>I</sup>             |
| Lead                             | <0.0001    | 0.0052 <sup>C,D</sup>        | 0.0002    | 0.0040 <sup>C,D</sup>        | <0.0001   | 0.0040 <sup>C,D</sup>        |
| Manganese                        | 0.058      | 1.9 <sup>C</sup>             | 0.006     | 1.9 <sup>C</sup>             | 0.050     | 1.9 <sup>C</sup>             |
| Mercury                          | < 0.00008  | 0.0006 <sup>D</sup>          | < 0.00008 | 0.0006 <sup>D</sup>          | < 0.00008 | 0.0006 <sup>D</sup>          |
| Nickel                           | <0.0005    | 0.015 <sup>C,D</sup>         | <0.0005   | 0.012 <sup>C,D</sup>         | <0.0005   | 0.012 <sup>C,D</sup>         |
| Silver                           | <0.0001    | 0.05 <sup>D</sup>            | <0.0001   | 0.05 <sup>D</sup>            | <0.0001   | 0.05 <sup>D</sup>            |
| Zinc                             | 0.0059     | 0.011 <sup>C,D</sup>         | 0.018     | 0.0089 <sup>C,D</sup>        | 0.0040    | 0.0089 <sup>C,D</sup>        |
| Ammoniacal-N                     | 0.030      | ≤ 0.07 <sup>J</sup>          | <0.005    | ≤ 0.07 <sup>J</sup>          | 0.015     | ≤ 0.08 <sup>J</sup>          |
| Nitrate-N                        | 0.34       | ≤ 1.0 <sup>K</sup>           | 0.067     | ≤ 1.0 <sup>K</sup>           | 0.29      | ≤ 1.0 <sup>K</sup>           |
| Phosphorus <sup>L</sup>          | <0.004     | ≤ 0.006 <sup>M</sup>         | <0.004    | ≤ 0.006 <sup>M</sup>         | <0.004    | ≤ 0.006 <sup>M</sup>         |

**Notes:** units g/m<sup>3</sup>; <sup>A</sup>WCRC (2014); <sup>B</sup>USEPA (2018); <sup>C</sup>hardness and pH as stated, Dissolved Organic Carbon (DOC)=2.5 g/m<sup>3</sup> for aluminium 2.0 g/m<sup>3</sup> for copper; <sup>D</sup>ANZECC (2000) default trigger; <sup>E</sup>As(V); <sup>F</sup>ANZECC (2018); <sup>G</sup>Cr(III); <sup>H</sup>USEPA (2007); <sup>I</sup>USEPA (1986); <sup>J</sup>NPS-FM attribute A annual median, pH adjusted; <sup>K</sup>NPS-FM attribute A annual median; <sup>L</sup>modelled as dissolved reactive phosphorus; <sup>M</sup>NPS-FM attribute B median; <sup>N</sup>NPS-FM attribute A 95%-ile.

### 9.4.3 Loss or disturbance of aquatic habitat

#### 9.4.3.1 Introduction

Temporary diversions and stream works will be required to enable the staged extraction of mineralised material across the SB. Given the presence of Northern Creek, Central Creek, Clarke Creek, Wasabi Creek, Southern Creek and farm drains within the mining area, these works will need to be carefully planned and implemented to maintain water conveyance, protect freshwater values, maintain fish passage and minimise adverse environmental effects. Post-mining reconstruction will focus on achieving no net loss of stream extent and enhancing freshwater values through improved channel alignment, riparian fencing and planting.

#### 9.4.3.2 Design principles

The Rehabilitation Management Plan (RMP) prepared by Tai Poutini Resources Limited (2026) outlines the design principles for diversions and reconstructed watercourses and these are illustrated in the cross sections of reinstated streams shown in Figure 53. Diversions and reconstructed watercourses will be designed in accordance with best practice fluvial geomorphology and freshwater management principles, and will:

- (a) Maintain hydraulic capacity to convey design flows and prevent flooding.
- (b) Minimise erosion and sediment generation.
- (c) Promote stable channel forms and banks.
- (d) Support the establishment of riparian and aquatic habitat.
- (e) Integrate with final landforms and wetland systems.
- (f) Reflect, where practicable, natural channel patterns and gradients.

#### 9.4.3.3 Lengths of watercourses proposed to be diverted

Creeks to be diverted include Northern Creek, Central Creek, Clarke Creek, Wasabi Creek and Southern Creek (total approximate length = 4.2 km; Table 30). There is approximately 11.2 km of artificial drain within the proposed mining area that will be diverted or reclaimed. Little Granite Creek and Granite Creek would not be diverted. Canoe Creek and Fagan Creek to the north and south of the site, respectively, will also not be diverted.

**Table 30: Length and streambed area of continually flowing or intermittent modified creeks and artificial drains proposed to be diverted (Tai Poutini Resources Ltd 2026).**

| Watercourse    | Pre-mining length (m) | Mean width (m) | Streambed area (m <sup>2</sup> ) | Diversion methodology to be applied |
|----------------|-----------------------|----------------|----------------------------------|-------------------------------------|
| Northern Creek | 1,178                 | 2.2            | 2,592                            | East-west                           |
| Central Creek  | 764                   | 2.1            | 1,604                            | East-west                           |
| Clarke Creek   | 681                   | 1.0            | 681                              | North-south                         |
| Wasabi Creek   | 733                   | 3.5            | 2,566                            | North-south / East-west             |
| Southern Creek | 469                   | 1.5            | 704                              | East-west                           |
| <b>Total</b>   | <b>3,825</b>          |                | <b>8,146</b>                     |                                     |

#### 9.4.3.4 Lengths of watercourses proposed to be created post mining

Approximately 3.83 km of creek is proposed to be diverted and returned to newly constructed channels that will have an approximate total length of 4.35 km. These newly constructed channels will be sized to accommodate the post-mining flows and to ensure that there will be no loss of overall extent of aquatic habitats. Approximately 11.2 km of artificial drain will be diverted during mining. The overall length of artificial drain created may be shorter than the existing extent but will depend on hydrological conditions and need for drainage.

#### 9.4.3.5 Proposed methodology for diverting creeks and drains

To minimise the risk of adverse effects on aquatic habitats and fauna in both temporary diversions and constructed permanent channels, channel designs and construction methodologies, as well as dredge stream methodologies, have been developed and incorporated into the RMP prepared by Tai Poutini Resources Limited (2026).

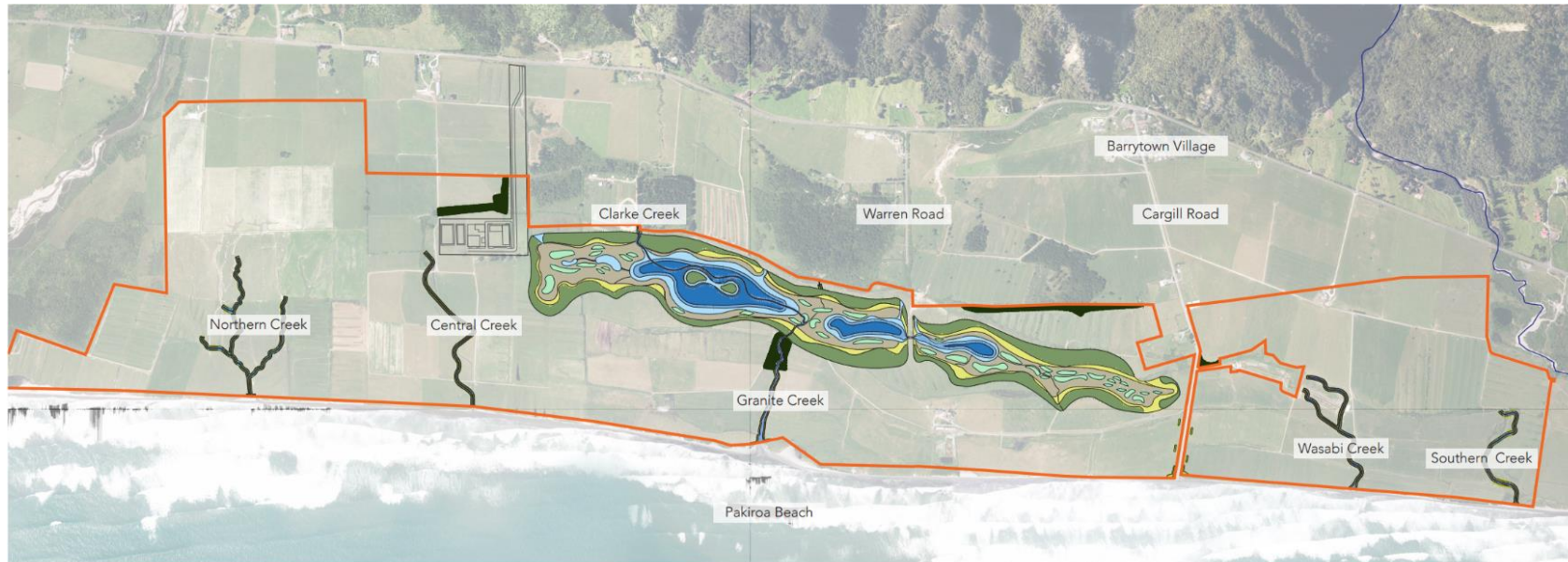
Two methods are proposed to manage the process of diverting creeks and drains and will depend on the orientation (i.e., north-south or east-west), hydrology, sequence of mining activities and future purpose of the surrounding land. North-south oriented creeks and drains will generally be diverted into previously mined and rehabilitated areas prior to mining reaching the existing channel alignment, except where mining occurs adjacent to the coastal setback boundary (Tai Poutini Resources Limited 2026). East-west oriented drains and creeks will be temporarily diverted behind the active mining void and into adjacent mined areas prior to mining progressing through the existing alignment. These temporary diversions will allow mining to proceed while maintaining downstream flows (Tai Poutini Resources Limited 2026). Following completion of mining through each alignment, permanent reconstructed channels will be constructed and flows reinstated in accordance with the site RMP prepared by Tai Poutini Resources Limited (2026).

Diverted creeks will discharge to the Coastal Marine Area (CMA) at the existing location (i.e., where they currently discharge prior to mining). Artificial drains may be retired or new artificial drains constructed in order to manage drainage within the site where required.

#### 9.4.3.6 Characteristics of reconstructed creeks

The final alignment of reconstructed creeks will maintain their predominant orientation and extent and will be enhanced via riparian planting and fenced so that there will be no overall 'loss of extent' and freshwater ecological values will be enhanced within the site (Figure 52). Creek sections that have been diverted are proposed to be reconstructed and rehabilitated along recontoured ground levels once mining through sections that have been completed and will no longer be affected by the mining path. The RMP prepared by Tai Poutini Resources Limited (2026) outlines channel and riparian features to be constructed and the implementation methods to avoid or minimise adverse effects on aquatic habitat and fauna.

The overall extent of creek habitat within the site will increase introducing meanders on reconstructed channels where they are currently straight aligned and have unnatural flow paths. The reconstructed creek channels will have variable channel widths, variable depths, a range of habitat types (e.g., run, riffle, pool), maintain natural streambed characteristics (i.e., predominantly hard-bottomed) and have floodplains sized to accommodate expected flows (Figure 53). Riparian areas will be planted to 5 m wide (for Granite Creek) or 3 m wide (for all other creeks) on each bank with eco-sourced indigenous species in accordance with the landscape plans prepared by Glasson Huxtable (2026) (shown in Figure 49 to Figure 51 in Section 9.3), with the overall aim of creating habitats with higher ecological value than prior to mining.

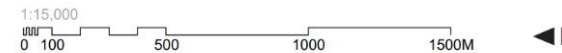


| KEY                                      |   |
|--|---|
|  | Shallow Marsh - Average Depth 0.4m<br>Total Area: 5.3ha   |
|  | Mid-depth Water - Average Depth 1m<br>Total Area: 2.8ha   |
|  | Deep Open Water - Average Depth 2m<br>Total Area: 4.8ha   |
|  | Flaxland and Dry Edge Vegetation<br>Total Area: 16.8ha    |
|  | Carex Rushlands<br>Total Area: 5.9ha                      |
|  | Raupo Wetland<br>Total Area: 14.2ha                       |
|  | Raised Islands<br>Total Area: 3.2ha                       |
|  | Riparian Planting<br>3-5m in width either side of channel |
|  | Existing Planting to be Retained                          |
|  | Application Area  |
| TOTAL WETLAND AREA: 53.1ha Approximately |   |

**Note:**  
At the completion of mining activity the application area will have:

- The existing planting areas that were retained
- Clusters of new planting along Cargill Road
- New riparian planting along creeks (five primary ones which have been realigned, plus Granite Creek)
- An extensive well functioning connected new wetland of approximately 53.1 hectares.

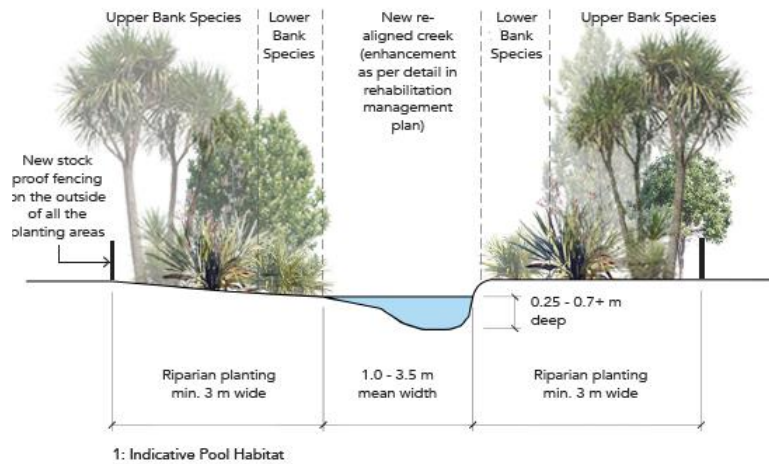
Refer to the **Rehabilitation Management Plan** for further details.



|      |                      |  |                         |                |                        |                           |              |                    |
|------|----------------------|--|-------------------------|----------------|------------------------|---------------------------|--------------|--------------------|
| 16.0 | Landscape Mitigation | During Mining Final Outcome:<br>Sections 1, 2 & 3 Combined | Project Number:<br>2410 | Revision:<br>H | Scale:<br>1:15,000@ A3 | Design: GHLA<br>Drawn: EM | Approved: NC | Date:<br>19/5/2026 |
|------|----------------------|--|-------------------------|----------------|------------------------|---------------------------|--------------|--------------------|

**Figure 52: Proposed post-mining location of rehabilitated creeks in relation to the proposed wetland (Tai Poutini Resources Limited 2026).**





**Realigned Creeks - Typical Cross Sections**

This page includes three typical cross sections to illustrate how the five realigned creeks (Northern, Central, Clarke, Wasabi and Southern) will work once mining has gone past. Each of these creeks will have riparian planting a minimum of 3.0 metres width on either side. There will be no loss of extent of the creeks once mining is complete. Design details will be further developed through the Rehabilitation Management Plan.

Of note, Granite Creek and Little Granite Creek will not be disturbed by mining activity. Granite Creek will be enhanced with riparian planting a minimum of 5.0 metres width on either side.

**Habitat sequences, widths and depths**

The aim is to have: run -> riffle -> pool habitat sequences. There will be meandering channels with variable widths and depths as this will encourage the formation of different habitats. Floodplains will also be incorporated. There will typically be deeper pools on bends, moderately deep runs on straighter sections, and shallow riffles that can flow into pools or between runs. Habitat depths will depend on the future hydrology and catchment size.

**Pool habitat**

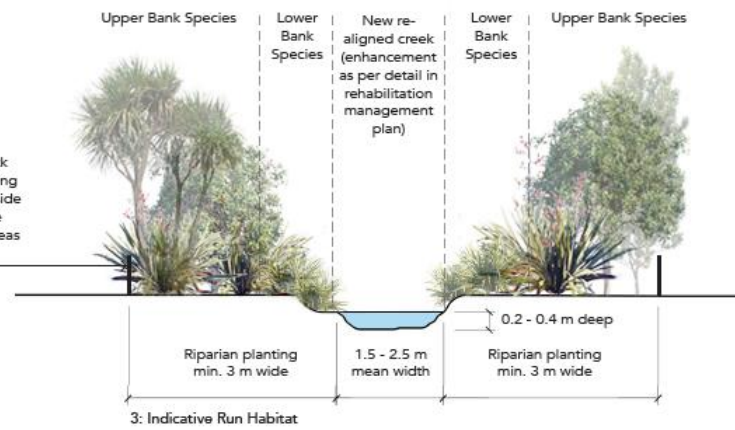
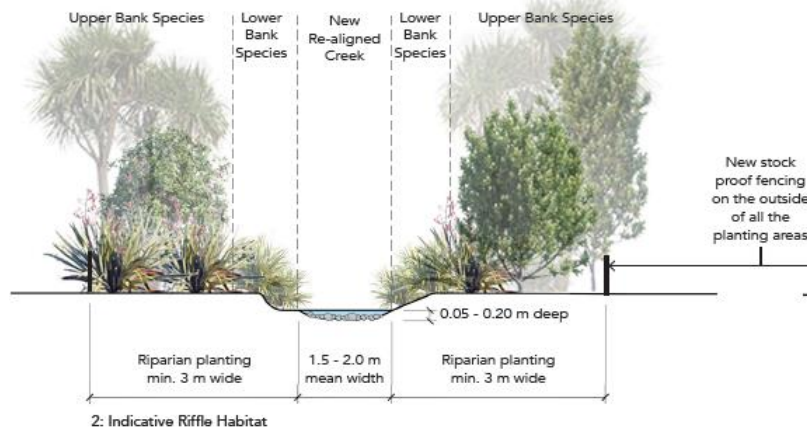
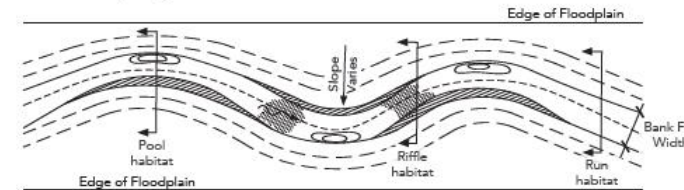
- Located on the meander bends of a channel
- Typically has fine sediment or small gravel
- Naturally grades from shallow on the inside of the bends to deeper on the outside
- Wider floodplains may occur on the inside of bends adjacent to pools

**Riffle habitat**

- Shallowest habitat
- Generally less common in lowland streams
- Bed has medium to large gravel plus small/large cobble plus the occasional boulder
- Typically narrower than pools and runs (but not always)

**Run habitat**

- Located on straighter sections of a channel
- Typically dominated by small to large gravel
- Can be more 'U' shaped but with variable depths if possible
- Typically narrower than pools



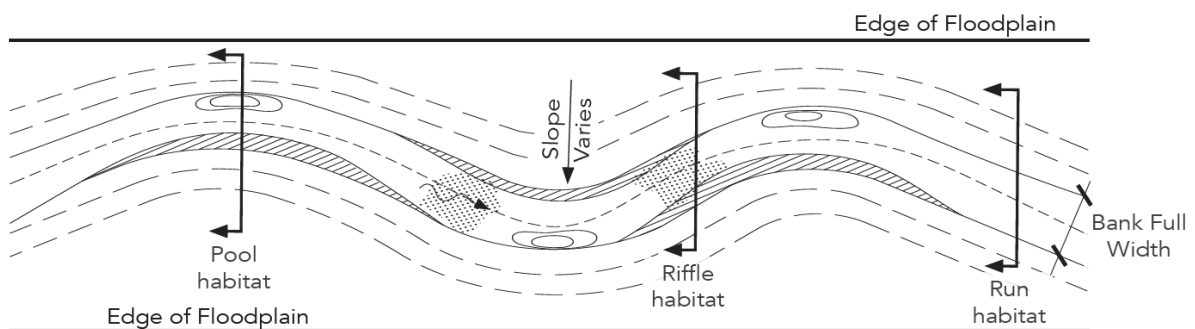
|      |                      |  |                         |                |                     |                           |              |                     |
|------|----------------------|--|-------------------------|----------------|---------------------|---------------------------|--------------|---------------------|
| 15.0 | Landscape Mitigation | During Mining Section:<br>Typical Realigned Creeks | Project Number:<br>2410 | Revision:<br>G | Scale:<br>1:50 @ A3 | Design: GHLA<br>Drawn: EM | Approved: NC | Date:<br>26/03/2026 |
|------|----------------------|--|-------------------------|----------------|---------------------|---------------------------|--------------|---------------------|

**Figure 53: Cross section profiles for reinstated streams at Barrytown (Glasson Huxtable Ltd 2026).**



Reconstructed creek channels will have a meandering pattern with variable widths and depths that will maintain the overall extent (i.e., length and bed area) and maximise instream habitat diversity and ecological values for aquatic fauna (e.g., pools on bends between shallower run and riffle habitats) (Figure 54). Constructing deeper pools on bends will provide suitable habitat for eel, īnanga and kōkopu species whilst shallow faster flowing riffle habitats will provide suitable habitat for elvers, bully, kōaro and water quality and habitat sensitive mayflies, stoneflies and caddisflies (EPT taxa). Proposed riparian planting along reconstructed creeks with indigenous vegetation will enhance habitat conditions for species with a preference for cover (e.g., banded kōkopu, giant kōkopu, kōaro), provide stream shade, limit algae growth, filter fine sediment and provide a source of woody debris and leaf litter as shelter and food for aquatic fauna. Woody debris will be incorporated into reconstructed channels where possible to stabilise the streambed and banks, trap sediment and organic matter, enhance habitat complexity and provide cover for native fish.

Effective implementation of the RMP prepared by Tai Poutini Resources Limited (2026) and the accompanying Native Fish Capture and Relocation Plan prepared by Ecological Solutions Limited (2026) will minimise the potential adverse effects of watercourse disturbance with the overall level of effect on native freshwater ecology values assessed as 'very low' in the short-term and 'net gain' in the long-term once reconstructed watercourses have reached an equilibrium state and fenced indigenous riparian vegetation has established.



**Figure 54: Example of stream alignment for reconstructed watercourses.**

#### 9.4.4 Effects on fish

Creeks proposed to be diverted include Northern Creek, Central Creek, Clarke Creek, Wasabi Creek, Southern Creek and artificial drains that support native fish communities with 'moderate' to 'high' ecological value due to the presence of native fish with 'Threatened' or 'At Risk' conservation status would also be diverted. The proposed mining and diversion of creeks and drains has potential to cause direct harm and/or mortality of native fish during diversion works.

The diversion of creeks and drains within the mining path will be implemented in accordance with the methodology outlined in Section 9.4.3.5 for north-south and east-west flowing watercourses. Potential harm or mortality of native fish during the diversion or reclamation of creeks, drains and dredge ponds, or any wetlands holding surface water, will be managed by relocating fish prior to and during disturbance in accordance with the Native Fish Capture and Relocation Plan (NFCRP) provided in Appendix E.

Implementing the NFCRP prior to and during the diversion of watercourses or reclamation of waterbodies holding surface water (e.g., ponds, wetlands) will minimise the potential harm or mortality of native fish with the overall level of effect on native freshwater fish values assessed as 'very low'.

### 9.4.5 Effects on fish passage

The following aspects of the proposed activity could adversely affect fish passage in watercourses if not designed and constructed appropriately:

- Temporary creek and drain diversions.
- Permanent reconstructed channels during rehabilitation.

The discharge locations of creeks to the Coastal Marine Area (CMA) will be retained at their existing locations and current 'catchment' boundaries will be maintained. All reconstructed creeks and artificial drains will be connected to the constructed wetland system or naturalised creek networks to support long-term site hydrology, ecological function and fish passage between the CMA and upstream habitats for diadromous native fish species.

To minimise potential effects on fish passage in temporary diversions or reconstructed creeks and artificial drains, channels will be constructed to 'key in' at the same or similar invert levels to avoid perching or creation of barriers that could affect fish passage. The low gradient of the topography within the SB means that this can be easily achieved.

Careful consideration that ensures the temporary diversions and reconstructed creeks and any artificial drains are constructed to maintain fish passage will avoid adverse effects on native diadromous native fish with the overall level of effect assessed as 'very low'.

### 9.4.6 Water supply and effects on Canoe Creek

Processing water will be required to fill ponds at the Mine Water Facility (MWF), storing water for when it is required to be used for processing run of mine material (ROM) at the Wet Concentrator Plant (WCP). The peak water take will occur when the WCP is restarted to process material from the SB or following maintenance or shutdowns (Tai Poutini Resources Limited 2026). Once processing is underway, water demand will significantly decrease. Water will be recycled and reused throughout the plant, reducing the need for a continuous fresh supply. Intermittent top-ups will be required to offset the water that remains in the Heavy Mineral Concentrate (HMC) and therefore lost from the site.

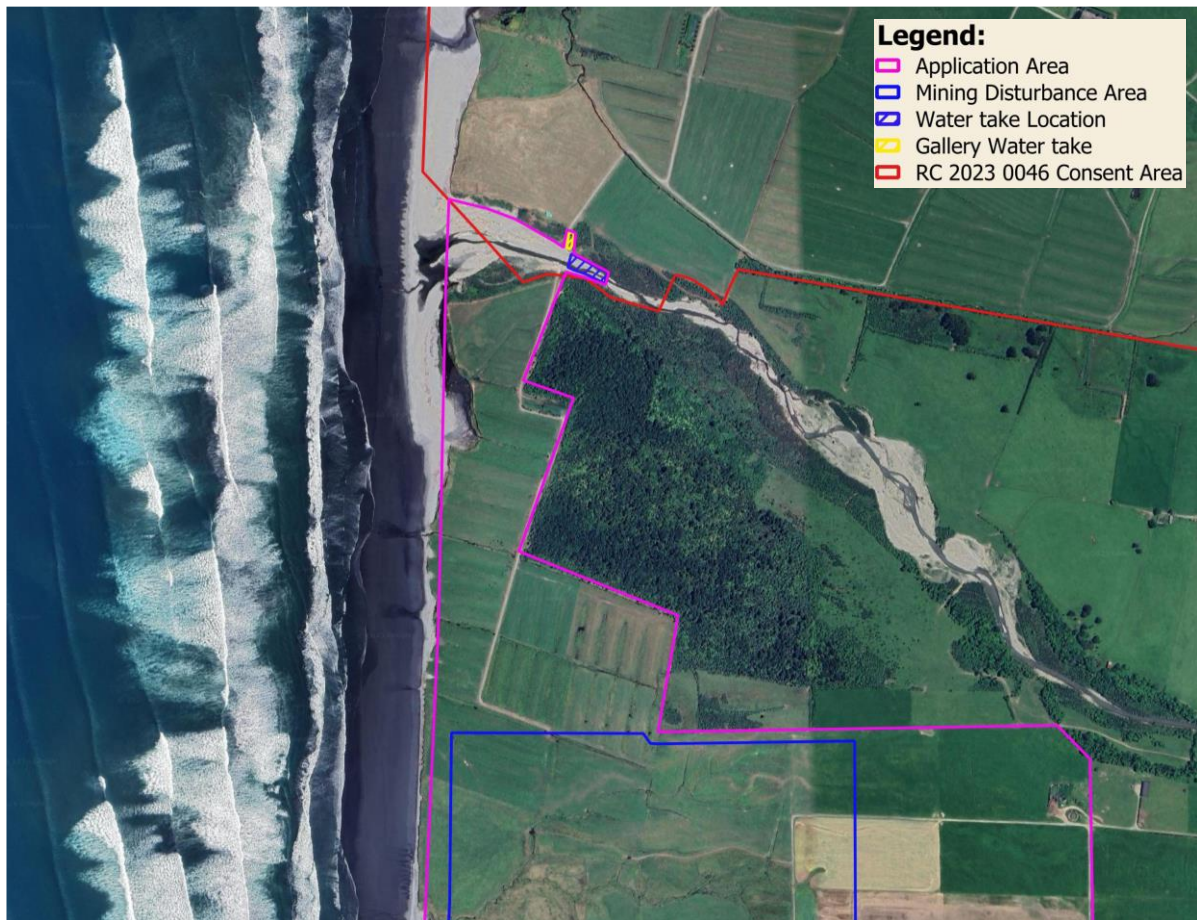
Processing water is proposed to be sourced from shallow ground water in lower Canoe Creek where TCM holds a current consent authorising the abstraction of water for processing CB-mined material at the WCP over a 12-year period (Tai Poutini Resources Limited 2026). The location of the proposed water take is shown on Figure 55. A longer-term consent is being sought via this process to ensure sufficient water is available to support mining of the SB once mining of the CB has been completed.

The proposed take is located adjacent to an existing farm access track near the coast with the pumping rate restricted to 63 L/s instantaneous rate, 5,400 m<sup>3</sup>/day or 62.5 L/s on a daily basis. The maximum rate of take is anticipated to be required for infrequent periods of up to seven days and it is anticipated that the long-term rate of abstraction will be <9.5 L/s. The proposed water take from lower Canoe Creek for mining the SB would only commence once mining of the CB has been completed.

The diversion of water away from watercourses has the potential to affect flow and reduce habitat for aquatic fauna. A water take restricted to a maximum rate of 63 L/s but more likely <9.5 L/s in the long-term from lower Canoe Creek near the coast represents <10% of the annual Mean Annual Low Flow (MALF). A water take of this magnitude is expected to maintain instream conditions (i.e., habitat quality, native fish abundance). The overall level of effect of the proposed water take on the amount and quality of habitat in lower Canoe Creek is assessed as 'very low' with no mitigation required.

Ecological Solutions understands that shallow ground water would be extracted from lower Canoe Creek via a subsurface gallery or a direct surface water take with an appropriate fish

screen. This method of take should avoid any risk of fish becoming entrained and 'relocated' from Canoe Creek so will avoid this potential adverse effect, which is assessed as 'very low'.



**Figure 55: Location of proposed water take and gallery on Canoe Creek (Tai Poutini Resources Limited 2026).**

## 9.5 Application of the Effects Management hierarchy

Where relevant, the Project has applied the effects management hierarchy as follows:

### Avoidance:

- Avoidance of mining through Granite Creek.
- Avoidance of removal of potential bat roosts (snags, over mature exotic trees).
- Mining to be undertaken during daylight hours, thereby avoiding potential for effects due to lighting on tāiko and perhaps kororā.
- Fencing to exclude kororā from the active mining area.
- 20 m setback from SNAs, Granite Creek and Fagan Creek.
- 50 m setback from MHWS.

### **Minimisation/Mitigation:**

- Implementation of the Avian Management Plan (AMP) required by condition 6 provides for regular monitoring of birds and implementation of management measures to avoid or minimise effects. The detailed matters to be included in the AMP are set out in condition 13. The AMP covers a range of matters related to birds, including monitoring to inform which species are using the site and detect any new species. It also includes managing of lighting at the site when required and deterrence of birds prospecting for nests in the actively mined area. The AMP also prescribes what would happen in the event of a seabird grounding within or near the site. A Wildlife Act Authority (WAA) is required, and is being applied for, to implement the AMP.
- Implementation of the Lizard Management Plan (LMP) required by condition 6 which provides for the implementation of management measures to avoid or minimise effects in the event that it is required (e.g., if lizards are detected at the site during pre-mining surveys). The matters to be covered in the LMP are set out in condition 14. The LMP provides for the relocation of any lizards salvaged prior to mining. As such there is a Wildlife Act Authority (WAA) is required, and is being applied for, to implement the LMP.
- Lime dosing of tailings and slimes to manage water quality prior to discharge.
- Management to protect fish as part of stream diversion and reinstatement as set out in the Native Fish Capture and Relocation Plan required by condition 6.
- Management of sediment via the Erosion Sediment and Control Plan for the site required by condition 6 in order to minimise effects of sediment on aquatic habitats and wetlands.

### **Remediation:**

- Implementation of the Rehabilitation Management Plan (RMP) required by condition 6. Condition 9 identifies the matters to be included in the RMP which sets out details of reconstruction and planting of the creeks, drains and wetlands at the Site.
- The RMP provides for the construction and planting of c. 53.1 ha of wetland, the restoration of approximately 4.35 km of creeks and construction of approximately 11.7 km of drains.
- The riparian margins of all reconstructed streams would be planted to a width of at least 3 m. Riparian vegetation adjoining Granite Creek would extend at least 5 m from each bank.
- In the addition, the reconstructed watercourses would be designed to include sinuosity and a variety of aquatic habitats (pools, riffles, runs and the like) and riparian planting would improve these aquatic habitats relative to the existing condition.
- These actions will serve to increase aquatic and terrestrial ecological values compared to pre-activity condition, including the provision of habitat for avifauna, herpetofauna, bat and fish species.

The overall level of effects taking into account the effects management proposed is set out in Table 31.

**Table 31: Magnitude and level of effects for the proposed development before and after mitigation.**

| Activity  | Effect   | Ecological value | Magnitude of effect | Level of effect (no mitigation) | Proposed mitigation measures  | Level of effect (with mitigation) |
|---|--|------------------|---------------------|---------------------------------|---|-----------------------------------|
| Terrestrial vegetation clearance – pasture (grazed)                     | Loss of botanical values   | Negligible       | Low                 | Very Low                        | Under the EclA guidelines Low and Very Low effects should not normally be of concern if design, construction and operational care is exercised to minimise adverse effects.   | Very low                          |
| Terrestrial vegetation clearance – pasture (ungrazed)                   | Loss of botanical values   | Negligible       | Low                 | Very Low                        | Under the EclA guidelines Low and Very Low effects should not normally be of concern if design, construction and operational care is exercised to minimise adverse effects.   | Very low                          |
| Terrestrial vegetation clearance – indigenous coastal shrubland         | Loss of botanical values   | Moderate         | Very high           | High                            | Planting of bund and other vegetation, including in association with riparian margins and implementation of proposed rehabilitation plan. Collection of seed and potentially salvage and relocation of threatened and at risk species present.  | Very low - Net gain               |
| Terrestrial vegetation clearance – Pine shelterbelts and isolated trees | Loss of botanical values   | Negligible       | N/A                 | N/A                             | Pine shelterbelts and isolated trees are to be avoided and retained.  | N/A                               |
| Terrestrial vegetation clearance - flaxland                             | Loss of botanical values   | Moderate         | Very high           | High                            | Planting adjoining the coastal lagoon and open coastline and implementation of proposed rehabilitation plan. VDT of flaxland where practicable.   | Very low - Net gain               |
| Terrestrial vegetation clearance – effects on avifauna                  | Direct mortality of eggs and chicks. Disturbance of little blue penguin crossing the site. | High             | Low                 | Moderate                        | Avian Management Plan includes actions to identify nests and provides for setback and other management as appropriate.<br><br>Seasonal bird monitoring to inform mining operations so that risks to conservation status birds can be identified and mitigated.<br><br>Mining during daylight hours. Compliance with Australian Light Pollution Guidelines for Wildlife (2023) to avoid and/or | Low – Net gain                    |



| Activity  | Effect   | Ecological value | Magnitude of effect | Level of effect (no mitigation) | Proposed mitigation measures  | Level of effect (with mitigation)                                     |
|---|--|------------------|---------------------|---------------------------------|---|---|
|   |  |                  |                     |                                 | <p>minimise effects on sea birds including tāiko.</p> <p>Rehabilitation Management Plan provides for increased forest/shrubland and wetland habitats.</p>   |   |
| Increased activity and human disturbance – effects on avifauna                              | Loss of foraging and/or reproductive success for birds using the site  | High             | Low                 | Moderate                        | Implementation of Avian Management Plan including commencing mining in the south west, avoiding habitats during the breeding season, fencing to exclude kororā from the mining arrea and monitoring birds for the life of mining to inform management decisions.                                      | Very low  |
| Increased light at night (fixed and mobile lighting) – effects on seabirds, including tāiko | Potential for grounding which can result in bird mortality.  | High             | Low                 | Low                             | Mining during daylight hours only. Implementation of Avian Management Plan, including management of lighting in accordance with Commonwealth of Australia guidelines  | Very low  |
| Terrestrial vegetation clearance – effects on herpetofauna                                  | Direct mortality of lizards due to vegetation clearance and loss of suitable lizard habitat                          | Moderate         | Moderate            | Moderate                        | <p>Preparation of a LMP by a suitably qualified ecologist, implementation of lizard management measures.</p> <p>Rehabilitation Management Plan to provide for herpetofauna habitat replacement / enhancement within the SB.</p>   | <p>Direct mortality: Low</p> <p>Habitat loss: Very low – Net gain</p> |
| Terrestrial vegetation clearance – Effects on bats  | Short term loss/disruption of a small amount of commuting habitat as diversions are implemented and wetlands removed | Moderate         | Moderate            | Moderate                        | <p>Exotic pine and shelterbelt trees to be avoided and retained. Low lying vegetation types to be cleared not suitable for bat roosts.</p> <p>Rehabilitation and enhancement of streams, wetlands and riparian vegetation would provide net positive benefit to bats in the medium to longer term</p> | Low – Net gain  |
| Artificial lighting – effects on bats   | Delay emergence from any nearby roots, disruption of commuting pathways, illumination of foraging habitat            | Moderate         | Moderate            | Moderate                        | Mining only during daylight hours. Compliance with Australian Lighting Pollution Guidelines for Wildlife to avoid and/or minimise effects on bats.  | Very low  |



| Activity   | Effect  | Ecological value | Magnitude of effect | Level of effect (no mitigation) | Proposed mitigation measures   | Level of effect (with mitigation) |
|--|---|------------------|---------------------|---------------------------------|--|-----------------------------------|
| Changes to ground and surface water hydrology – effects on fish                      | Reduction in water quantity reducing habitat quality and availability for fish fauna.   | High             | Negligible          | Very low                        | None   | Very low                          |
| Changes to ground and surface water hydrology – effects on watercourses and wetlands | Reduction in water quantity reducing habitat quality and extent.  | Moderate         | Negligible          | Very low                        | None   | Low – Very low                    |
| Earthworks and sedimentation   | Sedimentation and smothering of stream bed in onsite watercourses and the downstream catchment                                      | Moderate -High   | High                | Moderate – Very high            | Erosion and sediment controls (including associated with stream diversions and borrow pits) implemented in accordance with Erosion and Sediment Control Plan (Ridley Dunphy Limited 2023) and GD05 will reduce magnitude of effect to 'low'              | Low                               |
| Discharge of treated mine water via groundwater                                      | Effects on water quality in downstream receiving environment.   | High             | Low                 | Low                             | With lime augmentation of tailings and slimes, relevant guidelines can be met under all modelled conditions.   | Very low                          |
| Removal of watercourse habitat   | Complete removal of habitat beneath mining path. <i>Magnitude and level of effect based on highest instream value (fish fauna).</i> | High             | Very high           | Very high                       | Implementation of Native Fish Capture and Relocation Plan to guide de-fishing of affected habitat.<br><br>Reconstruction of habitat prior to removal or in association with rehabilitation immediately post mining (i.e., within rehabilitation period). | Very low – net gain               |
| Removal of wetlands  | Complete removal of habitat beneath mining path.  | Moderate         | Very High           | High                            | Construction of large amounts of wetland habitat prior to removal as mining moves across the site  | Very low – net gain               |
| Watercourse diversions and replacement– effects on fish passage                      | During the time watercourses are diverted around the active mine area fish passage could be restricted.                             | High             | Low                 | Low                             | Temporary stream diversions will be constructed such that fish passage is provided for. Fish management provisions in the Rehabilitation Management Plan will include detail as to how this can be achieved.   | Very low                          |



## 10.0 NPS-IB Assessment

### 10.1 Introduction

The Government introduced new policy direction around the protection and maintenance of biodiversity across Aotearoa New Zealand in the National Policy Statement for Indigenous Biodiversity (NPS-IB) in 2023. The NPS-IB directs local authorities to update their policies, plans and strategies to reflect the NPS-IB's direction. As part of this process, applications for resource consent made after August 2023 are required to have regard to the NPS-IB. With respect to the Fast Track application for the SB, the most relevant sections of the NPS-IB include Policies 3, 4, 6–8 and 13–15.

### 10.2 Assessment of proposed SB application against relevant NPS-IB direction

**Table 32: Assessment of proposed mining activities against relevant NPS-IB policies**

| NPS-IB Part 2 Objectives/Policies   | Measures to give regard to NPS-IB  |
|---|--|
| <b>Policy 3:</b> <i>A precautionary approach is adopted when considering adverse effects on indigenous biodiversity</i> | <p>The assessment of effects is conservative when considering adverse effects on indigenous biodiversity by:</p> <ul style="list-style-type: none"> <li>i) Avoidance of effects where that is practically achievable (e.g. not diverting Granite and Little Granite Creeks, not removing over mature pine trees that could be bat roosts).</li> <li>ii) If any doubt, species are assumed to be present (e.g. although no lizards have been detected to date, this assessment assumes lizards are present).</li> <li>iii) The worst-case scenario is assumed with respect to the effects (e.g., that tall trees are providing bat roosts).</li> <li>iv) Proactive recommendations have been made with respect to addressing effects, even if the risk of that effect materialising is low (e.g., management of kororā is provided for, even though if kororā are commuting across the site, the number of individuals would be very small and the level of effects at the population level similarly low).</li> <li>v) Focus on net positive for the project with respect to biodiversity (e.g., the construction of the wetland was not proposed to address any residual effects, rather it will restore more natural habitats representative of the pre-human habitats within the Barrytown Flats, which have generally been either substantially modified or removed).</li> </ul> |
| <b>Policy 4:</b> <i>Indigenous biodiversity is managed to promote resilience to the effects of climate change</i>       | <p>The proposal includes substantial native species revegetation within wetland areas and for buffering of waterways. An increase in the extent and integrity of indigenous wetland and riparian communities is expected to improve ecological resilience, including to climate change.</p>  |
| <b>Policy 6:</b> <i>Significant indigenous vegetation and</i>   | <p>The TTPP does not identify any significant indigenous vegetation or habitats of indigenous fauna within the proposed mining area.</p>   |

|   |  |
|---|--|
| <i>significant habitats of indigenous fauna are identified as SNAs using a consistent approach</i>  | The SB is a highly modified and actively managed agricultural landscape dominated by exotic pasture.   |
| <b>Policy 7:</b> <i>SNAs are protected by avoiding and managing adverse effects from new subdivision, use and development.</i>  | The nearest SNA identified in the proposed Te Tai o Poutini Plan (TTPP) is PUN-049. The proposed mining of the SB will not result in any direct or indirect adverse effects on SNA PUN-049. This example of lowland kahikatea forest with some wetland character and scrub on the fringes is located c. 145 m east of the proposed mining disturbance area.  |
| <b>Policy 8:</b> <i>The importance of maintaining indigenous biodiversity outside SNAs is recognised and provided for.</i>  | Vegetation within the site comprises predominantly exotic pasture and small fragmented areas of shelterbelt and exotic trees. A maximum of 16 ha will be disturbed at any one time with mined strips being progressively rehabilitated as mining proceeds. The Rehabilitation Management Plan includes indigenous planting and the creation of new wetland areas to provide habitat for indigenous flora and fauna. Consequently, indigenous biodiversity values will increase at the site following rehabilitation.   |
| <b>Policy 13:</b> <i>Restoration of indigenous biodiversity is promoted and provided for.</i>   | Restoration of indigenous biodiversity is proposed for the site by way of the Rehabilitation Management Plan, effective implementation of which will expand and protect ecological values and habitats. The Rehabilitation Management Plan details the restoration of indigenous vegetation within the proposed mining area during and at the completion of mining. The plan provides for the replacement and enhancement of existing botanical and ecological values, including extent. In addition, the plan provides for enhancements to floral and faunal ecological values where this is considered achievable (e.g., the use of appropriate vegetation to enhance avifauna, herpetofauna and bat habitats and the increased riparian vegetation contributing to improved aquatic habitats). Implementation of the Rehabilitation Management Plan is expected to result in the restoration and maintenance of indigenous biodiversity and a net gain in indigenous vegetation cover within the SB.  |
| <b>Policy 14:</b> <i>Increased indigenous vegetation cover is promoted in both urban and non-urban environments.</i>  |  |
| <b>Policy 15:</b> <i>Areas outside SNAs that support specified highly mobile fauna are identified and managed to maintain their populations across their natural range, and information and awareness of highly mobile fauna is improved.</i> | <p>Nine avian species which are likely to use the site (at least occasionally) are listed as ‘specified highly mobile fauna’ in Appendix 2 of the NPS-IB. This includes banded dotterel (At Risk – Declining), black shag (At Risk – Relict), New Zealand pipit (At Risk – Declining), black-billed gull (At Risk – Declining), Caspian tern (Threatened –Nationally vulnerable), red-billed gull (At Risk – Declining), South Island pied oystercatcher (At Risk – Declining), New Zealand ‘southern’ falcon (Threatened – Nationally Endangered), variable oystercatcher (At Risk – Recovering), and white fronted tern (At Risk – Declining).</p> <p>The ‘specified highly mobile fauna’ species likely to use the site are unlikely to rely on pasture habitats for breeding, but may use them infrequently for foraging. Their presence and the potential to be adversely affected by noise and other disturbance within the site, has informed the proposed effects management (e.g., the Avian Management Plan) in regard to mining activities within the SB.</p> |

## 11.0 NPS-FM Assessment

### 11.1 Introduction

The Government introduced new policy direction around the protection and maintenance of freshwater across Aotearoa New Zealand in the National Policy Statement for Freshwater Management (2000) in August 2020. The NPS-FM directs local authorities to update their policies, plans and strategies to reflect the NPS-FM's direction. As part of this process, applications for resource consent are required to have regard to the NPS-FM. With respect to the Fast Track application for the SB, the most relevant sections of the NPS-FM include Policies 3–9 and 11–14.

### 11.2 Assessment of proposed SB application against relevant NPS-FM direction

**Table 33: Assessment of proposed mining activities against relevant NPS-FM policies**

| NPS-FM Part 2 Objectives/Policies  | Measures to give regard to NPS-FM  |
|--|--|
| <b>Policy 3:</b> <i>Freshwater is managed in an integrated way that considers the effects of the use and development of land on a whole-of-catchment basis, including the effects on receiving environments.</i>   | Creeks and artificial drains within the site are highly modified or man-made features that will be disturbed but reconstructed and rehabilitated after an area has been mined and the land recontoured to ensure no loss of extent and values. Stormwater will be managed by bunds and re-used to ensure no direct discharges to watercourses. Fish passage will be provided in temporary diversions and post mining rehabilitated creeks for native species. Overall, the project ensures that the effects on the whole-of-catchment basis are responded to.  |
| <b>Policy 4:</b> <i>Freshwater is managed as part of New Zealand's integrated response to climate change.</i>  | The proposal includes substantial native species revegetation within wetland areas and for buffering of waterways. An increase in the extent and integrity of indigenous wetland and riparian communities is expected to improve ecological resilience, including to climate change.   |
| <b>Policy 5:</b> <i>Freshwater is managed (including through a National Objectives Framework) to ensure that the health and well-being of degraded water bodies and freshwater ecosystems is improved, and the health and well-being of all other water bodies and freshwater ecosystems is maintained and (if communities choose) improved.</i> | The majority of the highly modified creeks within the site have been channelised and have straight alignments, modified riparian margins (i.e., cleared, exotic weed dominated) and have low-moderate ecological value. The Rehabilitation Management Plan details the construction and enhancement of creeks to have more meandering flow paths, similar streambed compositions, greater instream habitat diversity (e.g., run, riffle, pool sequences) and native planted riparian margins. Collectively, these measures ensure the modified creek systems will be at least as long and with expected higher ecological values than what current exists and is consistent with the intent of Policy 5. |
| <b>Policy 6:</b> <i>There is no further loss of extent of natural inland wetlands, their values are protected, and their restoration</i>   | The project has proactively addressed the presence of any natural wetlands by mapping potential areas early in the design process. The Rehabilitation Management Plan outlines the creation of approximately 53.1 ha of wetland within the site to   |

|  |  |
|--|--|
| <i>is promoted.</i>  | offset the proposed removal of 6.73 ha of natural inland wetlands and 29.03 ha of non NPS-FM qualifying wetlands associated with deliberately constructed waterbodies. Created wetlands and riparian margins will be planted with indigenous species and will create more wetland habitat than what currently exists of higher ecological value, so is consistent with Policy 6.   |
| <b>Policy 7:</b> <i>The loss of river extent and values is avoided to the extent practicable.</i>  | The Rehabilitation Management Plan details the post-mining construction and enhancement of creeks that will be at least as long as those present pre-mining and are expected to have higher ecological value than currently through design (e.g., meandering, variable widths/depths and habitat). This approach is consistent with Policy 7.  |
| <b>Policy 8:</b> <i>The significant values of outstanding water bodies are protected.</i>  | There are no outstanding waterbodies within the site so Policy 8 is not applicable.  |
| <b>Policy 9:</b> <i>The habitats of indigenous freshwater species are protected.</i>   | The construction of creeks post-mining in accordance with the Rehabilitation Management Plan will ensure habitats for indigenous freshwater species are replaced and protected and is consistent with Policy 9.  |
| <b>Policy 11:</b> <i>Freshwater is allocated and used efficiently, all existing over-allocation is phased out, and future over-allocation is avoided.</i>  | The proposed water take from Canoe Creek gallery will be <10% of MALF and is expected to maintain instream conditions (i.e., habitat quality, native fish diversity and abundance). There are no other surface water takes proposed. The project is consistent with Policy 11.   |
| <b>Policy 12:</b> <i>The national target (as set out in Appendix 3) for water quality improvement is achieved.</i>   | Surface water modelling indicates all relevant water guidelines will be met and protective of aquatic biota so will be consistent with Policy 12   |
| <b>Policy 13:</b> <i>The condition of water bodies and freshwater ecosystems is systematically monitored over time, and action is taken where freshwater is degraded, and to reverse deteriorating trends.</i>         | Water quality monitoring will be undertaken in the active mine void and in creeks. Ecological monitoring will be undertaken in accordance with the Rehabilitation Management Plan on rehabilitated creeks to confirm they provide suitable habitat and have been recolonised by macroinvertebrates and fish to ensure no loss of ecological values and that ecosystem health has been retained. If ecosystem health has not been achieved, additional works will be undertaken in accordance with a specific creek diversion and development plan as described in the Rehabilitation Management Plan. The measures proposed are consistent with Policy 13. |
| <b>Policy 14:</b> <i>Information (including monitoring data) about the state of water bodies and freshwater ecosystems, and the challenges to their health and well-being, is regularly reported on and published.</i> | Results of monitoring will be reported and published and will be consistent with Policy 14.  |

## 12.0 References

- Beca. 2008. Draft guidelines for the selection of methods to determine ecological flows and water levels. Report prepared by Beca Infrastructure Limited for Ministry for the Environment. Published by the Ministry for the Environment, Wellington. March 2008. 120pp. + appendices.
- BirdLife International (2021) Species factsheet: *Procellaria westlandica*. Downloaded from <http://www.birdlife.org> on 13/07/2021.
- Biggs, B. J. F. 2000. New Zealand periphyton guideline. Detecting, Monitoring and Managing Enrichment of Streams. NIWA, Christchurch.
- Biggs, B. J. F., Kilroy, C. 2000. Stream periphyton monitoring manual. New Zealand Ministry for the Environment. National Institute of Water and Atmospheric Research: Christchurch, New Zealand, 246.
- Boffa Miskell Limited 2006. SNA report
- Burlet, L., Lee, G. 2019. Old Data, Changed Times, New Resource? A Case Study, Barrytown, New Zealand, Ilmenite Garnet Gold Zircon, ASEG Extended Abstracts, 2019:1, 1-5, DOI: 10.1080/22020586.2019.12072954
- Coffey and Partners. 1991. Water Management Study - Westland Ilmenite Project. Coffey and Partners International Project Z110 /1-AV, February 1991.
- Collier, K. J., Hamer, M. P., Champion, P. D. 2014. Regional guidelines for ecological assessments of freshwater environments: Aquatic plant cover in wadeable streams. Waikato Regional Council.
- Dawson DG, Bull PC 1975. Counting birds in New Zealand forests. *Notornis* 22: 101–109.
- Dunn, N.R.; Closs, G.P.; Crow, S.K.; David, B.O.; Goodman, J.M.; Griffiths, M.; Hicks, A.S.; Hickford, M.J.H.; Jack, D.C.; Kitson, J.C.; Ling, N.; Waters, J.M.; Wylie, M.J.; Hitchmough, R.A.; Makan, T. 2025: Conservation status of New Zealand freshwater fishes, 2023. New Zealand Threat Classification Series 46. Department of Conservation, Wellington. 66 p.
- Gardner, R.O. 1990. Whitebait to White Paint: Maher Swamp on the Barrytown lowland (North Westland) its history and prospect.
- Gibbs, H.S. 1964. Soils of Westland. *Proceedings of the NZ Grassland Association*, 26:11-21. <https://doi.org/10.33584/jnzg.1964.26.1191>
- Graham, A. A. 1990. Siltation of stone-surface periphyton in rivers by clay-sized particles from low concentrations in suspension. *Hydrobiologia* 199:107-115.
- Institution of Lighting Professionals. (2023). *Guidance Note 08/23: Bats and Artificial Lighting at Night*. Institution of Lighting Professionals.
- Jowett, I. G., Richardson, J. 2008. Habitat use by New Zealand fish and habitat suitability models. NIWA Science and Technology Series No. 55.
- Kōmanawa Solutions Limited. 2025a. Barrytown South Mineral Sand Project - Hydrological Effects Assessment. Unpublished report prepared for TiGa Minerals and Metals Pty Ltd. Report No: Z24011BTS-Rev0. November 2024.
- Kōmanawa Solutions Limited. 2025b. Water table and surrounding water levels, 1989-1990. Memo 1 April 2025.

- McEwen, W.M. 1987. Ecological Regions and Districts of New Zealand. Third revised edition in four 1:500 000 Maps. New Zealand Biological Resources Centre, Department of Conservation, Wellington.
- Ministry for the Environment 2020. National Policy Statement for Freshwater Management 2020.
- Ministry for the Environment. 2021. Defining 'natural wetlands' and 'natural inland wetlands'. Wellington: Ministry for the Environment.
- Onley, D.J. 1980. Bird counts in lowland forests in the Western Paparoas. *Notornis* 27:335-362.
- Rekker, J. 2020. Barrytown JV Ltd Mineral Sands Hydrological Assessment. Unpublished draft report. JH Rekker Consulting Ltd.
- Robertson, H.A., Baird, K.A., Elliott, G.P., Hitchmough, R.A., McArthur, N.J., Makan, T.D., Miskelly, C.M., O'Donnell, C.F.J., Sagar, P.M., Scofield, R.P., Taylor, G.A., Michel, P. 2021: Conservation status of birds in Aotearoa New Zealand, 2021. New Zealand Threat Classification Series 36. Department of Conservation, Wellington. 43 pp.
- StatsNZ. (2018, April 19). Wetland Extent. <https://www.stats.govt.nz/indicators/wetland-extent/>
- Stark, J., Maxted, J. R. 2007. A user guide for the Macroinvertebrate Community Index. Nelson, New Zealand.
- USEPA, 1986. Quality criteria for water. United States Environmental Protection Agency Office of Water EPA 440/5-86-001 May 1986.
- USEPA, 2007. Aquatic life ambient freshwater quality criteria - copper. 2007 revision. United States Environmental Protection Agency Office of Water EPA-822-R-07-001 February 2007.
- USEPA, 2018. Final aquatic life ambient water quality criteria for aluminium 2018. United States Environmental Protection Agency Office of Water EPA-822-R-18-001 December 2018.
- USGS, 2021. PHREEQC Version 3: <https://www.usgs.gov/software/phreeqc-version-3>.
- Vidanovich, P. 2008. Barrytown Airborne Geophysics Survey. Prepared for New Zealand Gold Ltd. Paul Vidanovich PVC Ltd, Auckland. (Mineral report MR4438).
- Waugh, S.M.; Bartle J.A. 2013. Westland petrel. In Miskelly, C.M. (ed.) New Zealand Birds Online. [www.nzbirdsonline.org.nz](http://www.nzbirdsonline.org.nz)
- Waugh, S.M., Barbraud, C., Adams, L., Freeman, A.N.D., Wilson, K.-J., Wood, G., Landers, T.J., Baker, G.B. 2015a. Modelling the demography and population dynamics of a subtropical seabird, and the influence of environmental factors. *The Condor* 117; 147-164.
- Waugh, S.M., and Wilson, K-J., (2017) Threats and threat status of the Westland petrel *Procellaria westlandica*. *Marine Ornithology* 45:195-203.
- West Coast Regional Council (WCRC) 2014. Regional land and water plan. West Coast Regional Council, May 2014.
- West Coast Regional Council (WCRC). 2021. Minutes of meeting of Te Tai o Poutini plan committee held on 29 October 2021.
- Wilms T. (1985) Soils of the Barrytown Flat, Westland. Unpublished report prepared for the Grampian Mining Company. New Plymouth, New Zealand.

Wilson, K.J. 2016. A review of the biology and ecology and an evaluation of threats to the Westland petrel *Procellaria westlandica*. Unpublished report prepared for the West Coast Penguin Trust. 46pp.

# APPENDIX A

## Vascular Plant Species List

| Scientific name                         | Common name                               | Wetland indicator rating | Biostatus origin       | Conservation status (de Lange et al. 2023) |
|---|---|--------------------------|------------------------|--|
| <b>TREES AND SHRUBS</b>                 |   |                          |                        |  |
| <i>Alnus glutinosa</i>                  | common alder                              | FACW                     | Exotic                 | Not Threatened                             |
| <i>Aristotelia serrata</i>              | wineberry; makomako                       | FACU                     | Indigenous Endemic     | Not Threatened                             |
| <i>Bidens frondosa</i>                  | beggars' ticks                            | FACW                     | Exotic                 | Not Threatened                             |
| <i>Buddleja davidii</i>                 | buddleia; butterfly bush                  | FACU                     | Exotic                 | Not Threatened                             |
| <i>Carmichaelia australis</i>           | native broom; mākaka                      | FACU                     | Indigenous Endemic     | At Risk - Declining                        |
| <i>Coprosma grandifolia</i>             | kanono; large-leaved coprosma             | FACU                     | Indigenous Endemic     | Not Threatened                             |
| <i>Coprosma propinqua</i>               | mingimingi                                | FAC                      | Indigenous Endemic     | Not Threatened                             |
| <i>Coprosma repens</i>                  | taupata                                   | #N/A                     | Indigenous Non-Endemic | Not Threatened                             |
| <i>Coprosma rhamnoides</i>              |   | UPL                      | Indigenous Endemic     | Not Threatened                             |
| <i>Cordyline australis</i>              | cabbage tree; Giant dracena; ti kōuka     | FACW                     | Indigenous Endemic     | Not Threatened                             |
| <i>Coriaria arborea</i>                 | tutu                                      | UPL                      | Indigenous Endemic     | Not Threatened                             |
| <i>Dacrycarpus dacrydioides</i>         | kahikatea                                 | FACW                     | Indigenous Endemic     | Not Threatened                             |
| <i>Eucalyptus species</i>               | gum; stringybark                          | #N/A                     | Exotic                 | Not Threatened                             |
| <i>Fuchsia excorticata</i>              | tree fuchsia; kōtukutuku                  | FACU                     | Indigenous Endemic     | Not Threatened                             |
| <i>Griselinia lucida</i>                | puka                                      | #N/A                     | Indigenous Endemic     | Not Threatened                             |
| <i>Haloragis erecta</i>                 | shrubby haloragis; toatoa                 | FACU                     | Indigenous Endemic     | Not Threatened                             |
| <i>Hedycarya arborea</i>                | pigeonwood; porokaiwhiri                  | UPL                      | Indigenous Endemic     | Not Threatened                             |
| <i>Hypolepis ambigua</i>                | pig fern                                  | UPL                      | Indigenous Endemic     | Not Threatened                             |
| <i>Meliclytus ramiflorus</i>            | māhoe; whiteywood                         | FACU                     | Indigenous Non-Endemic | Not Threatened                             |
| <i>Metrosideros excelsa</i>             | pōhutukawa                                | UPL                      | Indigenous Endemic     | Not Threatened                             |
| <i>Metrosideros robusta</i>             | Northern rātā                             | FACU                     | Indigenous Endemic     | At Risk - Declining                        |
| <i>Metrosideros umbellata</i>           | Southern rātā                             | UPL                      | Indigenous Endemic     | Not Threatened                             |
| <i>Pinus radiata</i>                    | Monterey pine; radiata pine               | FACU                     | Exotic                 | Not Threatened                             |
| <i>Piper excelsum</i>                   | kawakawa                                  | UPL                      | Indigenous Endemic     | Not Threatened                             |
| <i>Pittosporum eugenioides</i>          | lemonwood; tarata                         | -                        | Indigenous Endemic     | Not Threatened                             |
| <i>Pterophylla racemosa</i>             | kāmahi                                    | FACU                     | Indigenous Endemic     | Not Threatened                             |
| <i>Rhopalostylis sapida</i>             | nīkau                                     | FACU                     | Indigenous Endemic     | Not Threatened                             |
| <i>Salix fragilis</i>                   | crack willow                              | FACW                     | Exotic                 | Not Threatened                             |
| <i>Solanum aviculare var. aviculare</i> | poroporo                                  | -                        | Indigenous Non-Endemic | Threatened - Nationally Endangered         |
| <i>Solanum laciniatum</i>               | poroporo; bullibulli                      | -                        | Indigenous Non-Endemic | Not Threatened                             |
| <i>Sophora species</i>                  | kōwhai                                    |                          | Indigenous Endemic     | Not Threatened                             |
| <i>Ulex europaeus</i>                   | gorse                                     | FACU                     | Exotic                 | Not Threatened                             |
| <i>Veronica species</i>                 |   | -                        | -                      | -  |
| <i>Veronica stricta</i>                 | hebe; koromiko                            | FACU                     | Indigenous Endemic     | Not Threatened                             |
| <b>VINES AND LIANAS</b>                 |   |                          |                        |  |
| <i>Calystegia sepium</i>                | pink bindweed                             | FAC                      | Indigenous Non-Endemic | Not Threatened                             |
| <i>Freycinetia banksii</i>              | kiekie                                    | FACU                     | Indigenous Endemic     | Not Threatened                             |
| <i>Metrosideros perforata</i>           | akatea; small white rātā                  | FACU                     | Indigenous Endemic     | Not Threatened                             |
| <i>Muehlenbeckia australis</i>          | large-leaved muehlenbeckia                | FACU                     | Indigenous Non-Endemic | Not Threatened                             |
| <i>Muehlenbeckia complexa</i>           | small-leaved pohuehue; wire vine;         | FACU                     | Indigenous Non-Endemic | Not Threatened                             |
| <i>Ripogonum scandens</i>               | supplejack; kareao; pirita                | FACU                     | Indigenous Endemic     | Not Threatened                             |
| <i>Rubus fruticosus</i>                 | blackberry                                | FAC                      | Exotic                 | Not Threatened                             |
| <i>Tetragonia species</i>               | native spinach                            | -                        | Indigenous Non-Endemic | -  |
| <b>FERNS AND ALLIED PLANTS</b>          |   |                          |                        |  |
| <i>Asplenium flaccidum</i>              | drooping spleenwort; hanging spleenwort   | UPL                      | Indigenous Non-Endemic | Not Threatened                             |
| <i>Asplenium polyodon</i>               | sickle spleenwort                         | UPL                      | Indigenous Non-Endemic | Not Threatened                             |
| <i>Azolla rubra</i>                     | Pacific azolla; red azolla                | OBL                      | Indigenous Non-Endemic | Not Threatened                             |
| <i>Blechnum novae-zelandiae</i>         | kiokio                                    | FAC                      | Indigenous Endemic     | Not Threatened                             |
| <i>Blechnum penna-marina</i>            | little hard fern                          | FAC                      | Indigenous Non-Endemic | Not Threatened                             |
| <i>Cyathea dealbata</i>                 | silver fern; ponga                        | UPL                      | Indigenous Endemic     | Not Threatened                             |
| <i>Cyathea medullaris</i>               | black tree fern; mamaku                   | FACU                     | Indigenous Non-Endemic | Not Threatened                             |
| <i>Cyathea smithii</i>                  | kātote; Smith's tree fern; soft tree fern | FACU                     | Indigenous Endemic     | Not Threatened                             |

|  |   |      |                        |                |
|--|---|------|------------------------|----------------|
| <i>Dicksonia fibrosa</i>                                 | golden tree fern; whekī-ponga                           | UPL  | Indigenous Endemic     | Not Threatened |
| <i>Dicksonia squarrosa</i>                               | rough tree fern; whekī                                  | FACU | Indigenous Endemic     | Not Threatened |
| <i>Histiopteris incisa</i>                               | water fern; mātātā                                      | FAC  | Indigenous Non-Endemic | Not Threatened |
| <i>Microsorium pustulatum</i>                            | hound's tongue; kōwaowao                                | UPL  | Indigenous Non-Endemic | Not Threatened |
| <i>Microsorium scandens</i>                              | fragrant fern; mokimoki                                 | UPL  | Indigenous Non-Endemic | Not Threatened |
| <i>Nephrolepis cordifolia</i>                            | tuber ladder fern; tuber sword fern                     | FAC  | Exotic                 | Not Threatened |
| <i>Paesia scaberula</i>                                  | hard fern; ring fern; scented fern                      | FACU | Indigenous Endemic     | Not Threatened |
| <i>Pakau pennigera</i>                                   | gully fern; pākau                                       | FACU | Indigenous Non-Endemic | Not Threatened |
| <i>Pellaea rotundifolia</i>                              | button fern; New Zealand cliff brake; round-leaved fern | -    | Indigenous Non-Endemic | Not Threatened |
| <i>Pteridium esculentum</i>                              | bracken; rarauhe  | FACU | Indigenous Non-Endemic | Not Threatened |
| <i>Pyrrosia elaeagnifolia</i>                            | leather-leaf fern                                       | UPL  | Indigenous Endemic     | Not Threatened |
| <b>DICOTYLEDON HERBS</b>                                 |   |      |                        |                |
| <i>Anisotome species</i>                                 |   | -    | -                      | -              |
| <i>Apium species</i>                                     |   | -    | -                      | -              |
| <i>Callitriche stagnalis</i>                             | starwort  | OBL  | Exotic                 | Not Threatened |
| <i>Cerastium species</i>                                 |   | -    | Exotic                 | Not Threatened |
| <i>Digitalis purpurea</i>                                | foxglove  | UPL  | Exotic                 | Not Threatened |
| <i>Erythranthe guttata</i>                               | monkey musk   | OBL  | Exotic                 | Not Threatened |
| <i>Erythranthe moschata</i>                              | musk  | OBL  | Exotic                 | Not Threatened |
| <i>Geranium molle</i>                                    | dove's-foot cranesbill                                  | UPL  | Exotic                 | Not Threatened |
| <i>Goodenia radicans</i>                                 |   | FACW | Indigenous Non-Endemic | Not Threatened |
| <i>Gunnera tinctoria</i>                                 | Chilean rhubarb   | FAC  | Exotic                 | Not Threatened |
| <i>Hydrocotyle moschata</i>                              | hairy pennywort   | FAC  | Indigenous Endemic     | Not Threatened |
| <i>Lobelia angulata</i>                                  |   | FAC  | Indigenous Endemic     | Not Threatened |
| <i>Lotus pedunculatus</i>                                | lotus; birdsfoot treefoil                               | FAC  | Exotic                 | Not Threatened |
| <i>Lysimachia arvensis subsp. arvensis var. arvensis</i> | Scarlet pimpernel                                       | -    | Exotic                 | Not Threatened |
| <i>Myosotis species</i>                                  | forget-me-not   | -    | Exotic                 | Not Threatened |
| <i>Nasturtium microphyllum</i>                           | watercress; kōwhitiwhiti                                | OBL  | Exotic                 | Not Threatened |
| <i>Nasturtium officinale</i>                             | watercress; kōwhitiwhiti                                | OBL  | Exotic                 | Not Threatened |
| <i>Nertera depressa</i>                                  | bead plant; fruiting duckweed                           | FACU | Indigenous Non-Endemic | Not Threatened |
| <i>Persicaria hydropiper</i>                             | water pepper  | FACW | Exotic                 | Not Threatened |
| <i>Persicaria maculosa</i>                               | willow weed   | FACW | Exotic                 | Not Threatened |
| <i>Plantago lanceolata</i>                               | narrow-leaved plantain                                  | FACU | Exotic                 | Not Threatened |
| <i>Plantago major</i>                                    | broad-leaved plantain                                   | FACU | Exotic                 | Not Threatened |
| <i>Prunella vulgaris</i>                                 | self-heal   | FACU | Exotic                 | Not Threatened |
| <i>Rumex acetosella</i>                                  | sheep's sorrel  | FAC  | Exotic                 | Not Threatened |
| <i>Rumex obtusifolius</i>                                | broad-leaved dock                                       | FAC  | Exotic                 | Not Threatened |
| <i>Trifolium repens</i>                                  | white clover  | FACU | Exotic                 | Not Threatened |
| <i>Veronica anagallis-aquatica</i>                       | blue water speedwell                                    | OBL  | Exotic                 | Not Threatened |
| <b>DICOTYLEDON COMPOSITES</b>                            |   |      |                        |                |
| <i>Anthemis cotula</i>                                   | stinking mayweed  | -    | Exotic                 | Not Threatened |
| <i>Cirsium species</i>                                   | thistle   | -    | Exotic                 | Not Threatened |
| <i>Cirsium vulgare</i>                                   | Scotch thistle  | FACU | Exotic                 | Not Threatened |
| <i>Cotula coronopifolia</i>                              | bachelor's buttons                                      | FACW | Indigenous Non-Endemic | Not Threatened |
| <i>Erigeron sumatrensis</i>                              | broad-leaved fleabane                                   | FACU | Exotic                 | Not Threatened |
| <i>Hypochaeris radicata</i>                              | catsear   | FACU | Exotic                 | Not Threatened |
| <i>Jacobaea vulgaris</i>                                 | ragwort   | FACU | Exotic                 | Not Threatened |
| <i>Leontodon saxatilis</i>                               | hawkbit   | FAC  | Exotic                 | Not Threatened |
| <i>Rumex conglomeratus</i>                               | clustered dock  | FAC  | Exotic                 | Not Threatened |
| <b>GRASSES, SEDGES AND RUSHES</b>                        |   |      |                        |                |
| <i>Agrostis capillaris</i>                               | browntop bent   | FACU | Exotic                 | Not Threatened |
| <i>Agrostis stolonifera</i>                              | creeping bent   | FACW | Exotic                 | Not Threatened |
| <i>Alopecurus geniculatus</i>                            | kneed foptail   | FACW | Exotic                 | Not Threatened |
| <i>Carex comans</i>                                      | longwood tussock; maurea                                | FAC  | Indigenous Endemic     | Not Threatened |

|                                 |  |      |                        |                |
|---------------------------------|--|------|------------------------|----------------|
| <i>Carex dissita</i>            | forest sedge                                 | FAC  | Indigenous Endemic     | Not Threatened |
| <i>Carex gaudichaudiana</i>     | Gaudichaud's sedge                           | FACW | Indigenous Non-Endemic | Not Threatened |
| <i>Carex geminata</i>           | cutty grass; Rautahi; Toetoe rautahi;        | FACW | Indigenous Endemic     | Not Threatened |
| <i>Carex leporina</i>           | oval sedge                                   | FACW | Exotic                 | Not Threatened |
| <i>Carex maorica</i>            | Māori sedge                                  | OBL  | Indigenous Endemic     | Not Threatened |
| <i>Carex secta</i>              | pūkio; pūrei                                 | OBL  | Indigenous Endemic     | Not Threatened |
| <i>Carex virgata</i>            | swamp sedge                                  | OBL  | Indigenous Endemic     | Not Threatened |
| <i>Cyperus ustulatus</i>        | giant umbrella sedge                         | FACW | Indigenous Endemic     | Not Threatened |
| <i>Dactylis glomerata</i>       | cocksfoot                                    | FACU | Exotic                 | Not Threatened |
| <i>Eleocharis acuta</i>         | sharp spike sedge                            | OBL  | Indigenous Non-Endemic | Not Threatened |
| <i>Eleocharis gracilis</i>      | slender spike sedge                          | OBL  | Indigenous Non-Endemic | Not Threatened |
| <i>Holcus lanatus</i>           | Yorkshire fog                                | FAC  | Exotic                 | Not Threatened |
| <i>Isolepis aucklandica</i>     |  | OBL  | Indigenous Non-Endemic | Not Threatened |
| <i>Isolepis cernua</i>          | slender clubrush                             | OBL  | Indigenous Non-Endemic | Not Threatened |
| <i>Isolepis prolifera</i>       |  | OBL  | Indigenous Non-Endemic | Not Threatened |
| <i>Isolepis reticularis</i>     |  | FACW | Indigenous Endemic     | Not Threatened |
| <i>Juncus articulatus</i>       | jointed rush                                 | FACW | Exotic                 | Not Threatened |
| <i>Juncus australis</i>         | leafless rush                                | FACW | Indigenous Non-Endemic | Not Threatened |
| <i>Juncus bulbosus</i>          | bulbous rush                                 | OBL  | Exotic                 | Not Threatened |
| <i>Juncus canadensis</i>        | tailed-seed rush                             | OBL  | Exotic                 | Not Threatened |
| <i>Juncus edgariae</i>          | wiwi   | FACW | Indigenous Endemic     | Not Threatened |
| <i>Juncus effusus</i>           | soft rush                                    | FACW | Exotic                 | Not Threatened |
| <i>Juncus pallidus</i>          | giant rush                                   | FACW | Indigenous Non-Endemic | Not Threatened |
| <i>Juncus planifolius</i>       | flat-leaved rush; grass-leaved rush          | FACW | Indigenous Non-Endemic | Not Threatened |
| <i>Juncus sarophorus</i>        | broom rush                                   | FACW | Indigenous Non-Endemic | Not Threatened |
| <i>Juncus tenuis</i>            | track rush                                   | FACU | Exotic                 | Not Threatened |
| <i>Juncus usitatus</i>          |  | FACW | Indigenous Non-Endemic | Not Threatened |
| <i>Lolium perenne</i>           | perennial ryegrass                           | FACU | Exotic                 | Not Threatened |
| <i>Poa annua</i>                | annual poa; Winter grass                     | FACU | Exotic                 | Not Threatened |
| <i>Ranunculus repens</i>        | creeping buttercup                           | FAC  | Exotic                 | Not Threatened |
| <b>MONOCOTYLEDON HERBS</b>      |  |      |                        |                |
| <i>Astelia grandis</i>          | swamp astelia                                | OBL  | Indigenous Endemic     | Not Threatened |
| <i>Astelia hastata</i>          | tank lily                                    | UPL  | Indigenous Endemic     | Not Threatened |
| <i>Crocasmia xrocosmiiflora</i> | crocasmia; montbretia                        | UPL  | Exotic                 | Not Threatened |
| <i>Elodea canadensis</i>        | oxygen weed; Canadian pondweed               | OBL  | Exotic                 | Not Threatened |
| <i>Lemna disperma</i>           | common duckweed                              | OBL  | Indigenous Non-Endemic | Not Threatened |
| <i>Phormium tenax</i>           | flax; harakeke                               | FACW | Indigenous Endemic     | Not Threatened |
| <i>Potamogeton suboblongus</i>  | mānihi; mud pondweed; rērēwai                | OBL  | Indigenous Endemic     | Not Threatened |
| <i>Typha orientalis</i>         | raupō; bulrush                               | OBL  | Indigenous Non-Endemic | Not Threatened |
| <i>Zantedeschia aethiopica</i>  | arum lily; lily of the Nile; white arum lily | FAC  | Exotic                 | Not Threatened |

## APPENDIX B

### Bird Species List

| Common name                | Scientific name                        | Conservation status (Robertson et al. 2021) |
|----------------------------|--|---|
| Double-banded plover       | <i>Anarhynchus bicinctus</i>           | At Risk - Declining                         |
| Buller's shearwater        | <i>Ardenna bulleri</i>                 | At Risk - Declining                         |
| Sooty shearwater           | <i>Ardenna grisea</i>                  | At Risk - Declining                         |
| Red knot                   | <i>Calidris canutus</i>                | At Risk - Declining                         |
| Black-billed gull          | <i>Chroicocephalus bulleri</i>         | At Risk - Declining                         |
| Silver gull                | <i>Chroicocephalus novaehollandiae</i> | At Risk - Declining                         |
| Yellow-crowned parakeet    | <i>Cyanoramphus auriceps</i>           | At Risk - Declining                         |
| Little blue penguin        | <i>Eudyptula minor</i>                 | At Risk - Declining                         |
| South Island oystercatcher | <i>Haematopus finschi</i>              | At Risk - Declining                         |
| Bar-tailed godwit          | <i>Limosa lapponica</i>                | At Risk - Declining                         |
| South Island robin         | <i>Petroica australis</i>              | At Risk - Declining                         |
| New Zealand fernbird       | <i>Poodytes punctatus</i>              | At Risk - Declining                         |
| White-fronted tern         | <i>Sterna striata</i>                  | At Risk - Declining                         |
| Buller's albatross         | <i>Thalassarche bulleri</i>            | At Risk - Declining                         |
| White-capped albatross     | <i>Thalassarche cauta</i>              | At Risk - Declining                         |
| Baillon's crake            | <i>Zapornia pusilla</i>                | At Risk - Declining                         |
| New Zealand pipit          | <i>Anthus novaeseelandiae</i>          | At Risk - Naturally Uncommon                |
| Eurasian coot              | <i>Fulica atra</i>                     | At Risk - Naturally Uncommon                |
| Little Black cormorant     | <i>Phalacrocorax sulcirostris</i>      | At Risk - Naturally Uncommon                |
| Royal spoonbill            | <i>Platalea regia</i>                  | At Risk - Naturally Uncommon                |
| Westland petrel            | <i>Procellaria westlandica</i>         | At Risk - Naturally Uncommon                |
| New Zealand falcon         | <i>Falco novaeseelandiae</i>           | At Risk - Recovering                        |
| Variable oystercatcher     | <i>Haematopus unicolor</i>             | At Risk - Recovering                        |
| Northern giant-petrel      | <i>Macronectes halli</i>               | At Risk - Recovering                        |
| New Zealand kākā           | <i>Nestor meridionalis</i>             | At Risk - Recovering                        |
| Pied cormorant             | <i>Phalacrocorax varius</i>            | At Risk - Recovering                        |
| Little pied cormorant      | <i>Microcarbo melanoleucos</i>         | At Risk - Relict                            |
| Fairy prion                | <i>Pachyptila turtur</i>               | At Risk - Relict                            |
| Common diving-petrel       | <i>Pelecanoides urinatrix</i>          | At Risk - Relict                            |
| Great cormorant            | <i>Phalacrocorax carbo</i>             | At Risk - Relict                            |
| Fluttering shearwater      | <i>Puffinus gavia</i>                  | At Risk - Relict                            |
| Australasian grebe         | <i>Tachybaptus novaehollandiae</i>     | Coloniser                                   |
| Redpoll                    | <i>Acanthis flammea</i>                | Introduced and Naturalised                  |
| Eurasian skylark           | <i>Alauda arvensis</i>                 | Introduced and Naturalised                  |
| Mallard                    | <i>Anas platyrhynchos</i>              | Introduced and Naturalised                  |
| Graylag goose              | <i>Anser anser</i>                     | Introduced and Naturalised                  |
| Canada goose               | <i>Branta canadensis</i>               | Introduced and Naturalised                  |
| California quail           | <i>Callipepla californica</i>          | Introduced and Naturalised                  |
| European goldfinch         | <i>Carduelis carduelis</i>             | Introduced and Naturalised                  |
| European greenfinch        | <i>Chloris chloris</i>                 | Introduced and Naturalised                  |
| Rock pigeon                | <i>Columba livia</i>                   | Introduced and Naturalised                  |
| Yellowhammer               | <i>Emberiza citrinella</i>             | Introduced and Naturalised                  |
| Common chaffinch           | <i>Fringilla coelebs</i>               | Introduced and Naturalised                  |
| Australian magpie          | <i>Gymnorhina tibicen</i>              | Introduced and Naturalised                  |
| House sparrow              | <i>Passer domesticus</i>               | Introduced and Naturalised                  |

|                                       |   |                                    |
|---------------------------------------|---|------------------------------------|
| Dunnoek                               | <i>Prunella modularis</i>                             | Introduced and Naturalised         |
| European starling                     | <i>Sturnus vulgaris</i>                               | Introduced and Naturalised         |
| Eurasian blackbird                    | <i>Turdus merula</i>                                  | Introduced and Naturalised         |
| Song thrush                           | <i>Turdus philomelos</i>                              | Introduced and Naturalised         |
| Eastern cattle-egret                  | <i>Ardea coromanda/Bubulcus ibis coromandus</i>       | Migrant                            |
| Short-tailed shearwater               | <i>Ardenna tenuirostris</i>                           | Migrant                            |
| Ruddy turnstone                       | <i>Arenaria interpres</i>                             | Migrant                            |
| Arctic skua                           | <i>Stercorarius parasiticus</i>                       | Migrant                            |
| Pomarine skua                         | <i>Stercorarius pomarinus</i>                         | Migrant                            |
| Mallard x Pacific black duck (hybrid) | <i>Anas platyrhynchos x superciliosa</i>              | NA                                 |
| Pied x Black Stilt (hybrid)           | <i>Himantopus leucocephalus x novaezealandiae</i>     | NA                                 |
| Domestic hen                          | <i>Gallus gallus</i>                                  | NA                                 |
| Rifleman                              | <i>Acanthisitta chloris</i>                           | Not Threatened                     |
| Gray teal                             | <i>Anas gracilis</i>                                  | Not Threatened                     |
| New Zealand bellbird                  | <i>Anthornis melanura</i>                             | Not Threatened                     |
| New Zealand scaup                     | <i>Aythya novaeseelandiae</i>                         | Not Threatened                     |
| Shining-cuckoo                        | <i>Chrysococcyx lucidus</i>                           | Not Threatened                     |
| Australasian harrier                  | <i>Circus approximans</i>                             | Not Threatened                     |
| Black swan                            | <i>Cygnus atratus</i>                                 | Not Threatened                     |
| White-faced heron                     | <i>Egretta novaehollandiae</i>                        | Not Threatened                     |
| Weka                                  | <i>Gallirallus australis</i>                          | Not Threatened                     |
| Gray warbler                          | <i>Gerygone igata</i>                                 | Not Threatened                     |
| New Zealand pigeon                    | <i>Hemiphaga novaeseelandiae</i>                      | Not Threatened                     |
| Pied stilt                            | <i>Himantopus leucocephalus/Himantopus himantopus</i> | Not Threatened                     |
| Welcome swallow                       | <i>Hirundo neoxena</i>                                | Not Threatened                     |
| Kelp gull                             | <i>Larus dominicanus</i>                              | Not Threatened                     |
| Pipipi                                | <i>Mohoua novaeseelandiae</i>                         | Not Threatened                     |
| Australasian gannet                   | <i>Morus serrator</i>                                 | Not Threatened                     |
| Morepork                              | <i>Ninox novaeseelandiae</i>                          | Not Threatened                     |
| Tomtit                                | <i>Petroica macrocephala</i>                          | Not Threatened                     |
| Australasian swamphen                 | <i>Porphyrio melanotus</i>                            | Not Threatened                     |
| Tūī                                   | <i>Prothemadera novaeseelandiae</i>                   | Not Threatened                     |
| New Zealand fantail                   | <i>Rhipidura fuliginosa</i>                           | Not Threatened                     |
| Australasian shoveler                 | <i>Spatula rhynchotis</i>                             | Not Threatened                     |
| Paradise shelduck                     | <i>Tadorna variegata</i>                              | Not Threatened                     |
| Sacred kingfisher                     | <i>Todiramphus sanctus</i>                            | Not Threatened                     |
| Spur-winged plover                    | <i>Vanellus miles</i>                                 | Not Threatened                     |
| Silvereye                             | <i>Zosterops lateralis</i>                            | Not Threatened                     |
| Great egret                           | <i>Ardea alba</i>                                     | Threatened - Nationally Critical   |
| Australasian bittern                  | <i>Botaurus poiciloptilus</i>                         | Threatened - Nationally Critical   |
| Antipodean albatross                  | <i>Diomedea antipodensis</i>                          | Threatened - Nationally Critical   |
| Black-fronted tern                    | <i>Chlidonias albostratus</i>                         | Threatened - Nationally Endangered |
| Pacific reef-heron                    | <i>Egretta sacra</i>                                  | Threatened - Nationally Endangered |
| Kea                                   | <i>Nestor notabilis</i>                               | Threatened - Nationally Endangered |
| Wrybill                               | <i>Anarhynchus frontalis</i>                          | Threatened - Nationally Increasing |
| Pacific black duck                    | <i>Anas superciliosa</i>                              | Threatened - Nationally Vulnerable |

|                           |   |                                    |
|---------------------------|---|------------------------------------|
| Great spotted kiwi        | <i>Apteryx maxima</i>                           | Threatened - Nationally Vulnerable |
| Caspian tern              | <i>Hydroprogne caspia</i>                       | Threatened - Nationally Vulnerable |
| Blue duck                 | <i>Hymenolaimus malacorhynchos</i>              | Threatened - Nationally Vulnerable |
| Spotted shag              | <i>Phalacrocorax punctatus</i>                  | Threatened - Nationally Vulnerable |
| Hutton's shearwater       | <i>Puffinus huttoni</i>                         | Threatened - Nationally Vulnerable |
| Long-tailed koel          | <i>Urodynamis taitensis/Eudynamys taitensis</i> | Threatened - Nationally Vulnerable |
| King penguin              | <i>Aptenodytes patagonicus</i>                  | Vagrant                            |
| White-throated needletail | <i>Hirundapus caudacutus</i>                    | Vagrant                            |
| Tree martin               | <i>Petrochelidon nigricans</i>                  | Vagrant                            |
| Cyanoramphus sp.          | <i>Cyanoramphus sp.</i>                         | NA                                 |
| Small albatross sp.       | <i>Thalassarche sp.</i>                         | NA                                 |
| <i>Procellaria sp.</i>    | <i>Procellaria sp.</i>                          | NA                                 |
| Cormorant sp.             | <i>Phalacrocoracidae sp.</i>                    | NA                                 |

## APPENDIX C

### Laboratory Water Quality Data



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## Certificate of Analysis

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|                 |   |                          |                                 |      |
|-----------------|---|--------------------------|---------------------------------|------|
| <b>Client:</b>  | Komanawa Solutions Limited  | <b>Lab No:</b>           | 3538815                         | SPV1 |
| <b>Contact:</b> | Zeb Etheridge<br>C/- Komanawa Solutions Limited<br>4 Ash Street<br>Christchurch Central City<br>Christchurch 8011 | <b>Date Received:</b>    | 11-Apr-2024                     |      |
|                 |   | <b>Date Reported:</b>    | 29-Apr-2024                     |      |
|                 |   | <b>Quote No:</b>         | 130257                          |      |
|                 |   | <b>Order No:</b>         |                                 |      |
|                 |   | <b>Client Reference:</b> | Testing suite A (Surface water) |      |
|                 |   | <b>Submitted By:</b>     | Zeb Etheridge                   |      |

| Sample Type: Aqueous                    |                                       |                                   |                                   |                                   |                                   |           |
|---|---------------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------|
| Sample Name:                            | Site 1<br>08-Apr-2024<br>10:00 am     | Site 2<br>08-Apr-2024<br>10:30 am | Site 3<br>08-Apr-2024<br>10:15 am | Site 4<br>08-Apr-2024<br>11:00 am | Site 5<br>08-Apr-2024<br>11:35 am |           |
| Lab Number:                             | 3538815.1                             | 3538815.2                         | 3538815.3                         | 3538815.4                         | 3538815.5                         |           |
| Individual Tests                        |                                       |                                   |                                   |                                   |                                   |           |
| Sum of Anions                           | meq/L                                 | 1.47                              | 0.96                              | 0.95                              | 1.38                              | 1.78      |
| Sum of Cations                          | meq/L                                 | 1.54                              | 0.98                              | 0.96                              | 1.49                              | 1.88      |
| Turbidity                               | NTU                                   | 22                                | 1.35                              | 0.20                              | 3.5                               | 132       |
| pH                                      | pH Units                              | 7.4                               | 7.5                               | 7.5                               | 7.5                               | 6.6       |
| Total Alkalinity                        | g/m <sup>3</sup> as CaCO <sub>3</sub> | 43                                | 31                                | 30                                | 34                                | 23        |
| Bicarbonate                             | g/m <sup>3</sup> at 25°C              | 52                                | 37                                | 37                                | 41                                | 28        |
| Total Hardness                          | g/m <sup>3</sup> as CaCO <sub>3</sub> | 49                                | 32                                | 32                                | 42                                | 53        |
| Electrical Conductivity (EC)            | mS/m                                  | 15.3                              | 10.2                              | 10.1                              | 15.5                              | 21.1      |
| Total Suspended Solids                  | g/m <sup>3</sup>                      | 12                                | < 4                               | < 3                               | 10                                | 77        |
| Total Dissolved Solids (TDS)            | g/m <sup>3</sup>                      | 91                                | 61                                | 60                                | 97                                | 145       |
| Dissolved Calcium                       | g/m <sup>3</sup>                      | 13.7                              | 8.2                               | 7.9                               | 12.0                              | 12.5      |
| Total Iron                              | g/m <sup>3</sup>                      | 4.7                               | 0.46                              | 0.110                             | 1.82                              | 42        |
| Dissolved Magnesium                     | g/m <sup>3</sup>                      | 3.7                               | 2.8                               | 2.9                               | 2.9                               | 5.2       |
| Dissolved Mercury                       | g/m <sup>3</sup>                      | < 0.00008                         | < 0.00008                         | < 0.00008                         | < 0.00008                         | < 0.00008 |
| Total Mercury                           | g/m <sup>3</sup>                      | < 0.00008                         | < 0.00008                         | < 0.00008                         | < 0.00008                         | < 0.00008 |
| Dissolved Molybdenum                    | g/m <sup>3</sup>                      | < 0.0002                          | < 0.0002                          | < 0.0002                          | < 0.0002                          | 0.0002    |
| Dissolved Potassium                     | g/m <sup>3</sup>                      | 1.93                              | 0.87                              | 0.89                              | 2.7                               | 5.5       |
| Dissolved Silver                        | g/m <sup>3</sup>                      | < 0.00010                         | < 0.00010                         | < 0.00010                         | < 0.00010                         | < 0.00010 |
| Dissolved Sodium                        | g/m <sup>3</sup>                      | 9.4                               | 7.0                               | 7.0                               | 12.6                              | 15.1      |
| Chloride                                | g/m <sup>3</sup>                      | 20                                | 9.4                               | 9.3                               | 24                                | 27        |
| Total Ammoniacal-N                      | g/m <sup>3</sup>                      | 0.153                             | 0.013                             | < 0.010                           | < 0.010                           | < 0.010   |
| Nitrite-N                               | g/m <sup>3</sup>                      | < 0.002                           | < 0.002                           | < 0.002                           | < 0.002                           | 0.020     |
| Nitrate-N                               | g/m <sup>3</sup>                      | 0.007                             | 0.31                              | 0.31                              | < 0.002                           | 4.2       |
| Nitrate-N + Nitrite-N                   | g/m <sup>3</sup>                      | 0.007                             | 0.31                              | 0.31                              | < 0.002                           | 4.2       |
| Total Kjeldahl Nitrogen (TKN)           | g/m <sup>3</sup>                      | 0.37                              | < 0.10                            | < 0.10                            | 0.51                              | 1.27      |
| Dissolved Reactive Phosphorus           | g/m <sup>3</sup>                      | < 0.004                           | < 0.004                           | < 0.004                           | < 0.004                           | 0.004     |
| Total Phosphorus                        | g/m <sup>3</sup>                      | 0.063                             | 0.006                             | < 0.002                           | 0.047                             | 0.60      |
| Sulphate                                | g/m <sup>3</sup>                      | 1.7                               | 2.9                               | 2.9                               | 1.6                               | 13.1      |
| Total Organic Carbon (TOC)              | g/m <sup>3</sup>                      | 3.5                               | 0.7                               | < 0.5                             | 6.3                               | 13.7      |
| Leachate metals suite, dissolved, trace |                                       |                                   |                                   |                                   |                                   |           |
| Dissolved Aluminium                     | g/m <sup>3</sup>                      | 0.007                             | < 0.003                           | 0.003                             | < 0.003                           | 0.129     |
| Dissolved Arsenic                       | g/m <sup>3</sup>                      | < 0.0010                          | < 0.0010                          | < 0.0010                          | 0.0011                            | 0.0026    |
| Dissolved Boron                         | g/m <sup>3</sup>                      | 0.009                             | 0.008                             | 0.008                             | 0.010                             | 0.011     |
| Dissolved Cadmium                       | g/m <sup>3</sup>                      | < 0.00005                         | < 0.00005                         | < 0.00005                         | < 0.00005                         | < 0.00005 |
| Dissolved Chromium                      | g/m <sup>3</sup>                      | < 0.0005                          | < 0.0005                          | < 0.0005                          | < 0.0005                          | 0.0074    |
| Dissolved Cobalt                        | g/m <sup>3</sup>                      | 0.0009                            | < 0.0002                          | < 0.0002                          | < 0.0002                          | 0.0006    |
| Dissolved Copper                        | g/m <sup>3</sup>                      | < 0.0005                          | < 0.0005                          | < 0.0005                          | < 0.0005                          | 0.0058    |



This Laboratory is accredited by International Accreditation New Zealand (IANZ), which represents New Zealand in the International Laboratory Accreditation Cooperation (ILAC). Through the ILAC Mutual Recognition Arrangement (ILAC-MRA) this accreditation is internationally recognised. The tests reported herein have been performed in accordance with the terms of accreditation, with the exception of tests marked \* or any comments and interpretations, which are not accredited.



| Sample Type: Aqueous                    |                                       |                                   |                                   |                                   |                                   |           |
|---|---------------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-----------|
| Sample Name:                            | Site 1<br>08-Apr-2024<br>10:00 am     | Site 2<br>08-Apr-2024<br>10:30 am | Site 3<br>08-Apr-2024<br>10:15 am | Site 4<br>08-Apr-2024<br>11:00 am | Site 5<br>08-Apr-2024<br>11:35 am |           |
| Lab Number:                             | 3538815.1                             | 3538815.2                         | 3538815.3                         | 3538815.4                         | 3538815.5                         |           |
| Leachate metals suite, dissolved, trace |                                       |                                   |                                   |                                   |                                   |           |
| Dissolved Iron                          | g/m <sup>3</sup>                      | 2.1                               | 0.19                              | 0.03                              | 0.86                              | 0.44      |
| Dissolved Lead                          | g/m <sup>3</sup>                      | < 0.00010                         | < 0.00010                         | < 0.00010                         | < 0.00010                         | 0.00058   |
| Dissolved Manganese                     | g/m <sup>3</sup>                      | 0.167                             | 0.0087                            | 0.0032                            | 0.026                             | 0.035     |
| Dissolved Nickel                        | g/m <sup>3</sup>                      | 0.0007                            | < 0.0005                          | 0.0007                            | 0.0006                            | 0.0029    |
| Dissolved Zinc                          | g/m <sup>3</sup>                      | 0.0012                            | 0.0013                            | 0.0018                            | 0.0013                            | 0.0080    |
| Sample Name:                            | Site 6<br>08-Apr-2024<br>12:20 pm     | Site 7<br>08-Apr-2024<br>12:45 pm | Site 8<br>08-Apr-2024<br>2:10 pm  | Site 9<br>08-Apr-2024<br>2:25 pm  | Site 10<br>08-Apr-2024<br>2:40 pm |           |
| Lab Number:                             | 3538815.6                             | 3538815.7                         | 3538815.8                         | 3538815.9                         | 3538815.10                        |           |
| Individual Tests                        |                                       |                                   |                                   |                                   |                                   |           |
| Sum of Anions                           | meq/L                                 | 0.95                              | 1.08                              | 0.88                              | 0.91                              | 0.94      |
| Sum of Cations                          | meq/L                                 | 1.12                              | 1.13                              | 0.91                              | 0.92                              | 0.99      |
| Turbidity                               | NTU                                   | 1,110                             | 3.7                               | 0.89                              | 1.48                              | 1.19      |
| pH                                      | pH Units                              | 6.2                               | 6.8                               | 7.4                               | 7.4                               | 6.9       |
| Total Alkalinity                        | g/m <sup>3</sup> as CaCO <sub>3</sub> | 11.3                              | 31                                | 31                                | 30                                | 29        |
| Bicarbonate                             | g/m <sup>3</sup> at 25°C              | 13.8                              | 38                                | 37                                | 36                                | 36        |
| Total Hardness                          | g/m <sup>3</sup> as CaCO <sub>3</sub> | 28                                | 33                                | 29                                | 31                                | 33        |
| Electrical Conductivity (EC)            | mS/m                                  | 11.7                              | 12.0                              | 9.1                               | 9.3                               | 10.4      |
| Total Suspended Solids                  | g/m <sup>3</sup>                      | 3,000                             | 5                                 | 3                                 | 5                                 | < 3       |
| Total Dissolved Solids (TDS)            | g/m <sup>3</sup>                      | 90                                | 67                                | 58                                | 57                                | 65        |
| Dissolved Calcium                       | g/m <sup>3</sup>                      | 8.7                               | 9.2                               | 7.6                               | 8.3                               | 9.4       |
| Total Iron                              | g/m <sup>3</sup>                      | 96                                | 1.25                              | 0.28                              | 0.145                             | 0.107     |
| Dissolved Magnesium                     | g/m <sup>3</sup>                      | 1.56                              | 2.5                               | 2.6                               | 2.5                               | 2.3       |
| Dissolved Mercury                       | g/m <sup>3</sup>                      | < 0.00008                         | < 0.00008                         | < 0.00008                         | < 0.00008                         | < 0.00008 |
| Total Mercury                           | g/m <sup>3</sup>                      | < 0.0021                          | < 0.00008                         | < 0.00008                         | < 0.00008                         | < 0.00008 |
| Dissolved Molybdenum                    | g/m <sup>3</sup>                      | 0.0008                            | < 0.0002                          | < 0.0002                          | < 0.0002                          | < 0.0002  |
| Dissolved Potassium                     | g/m <sup>3</sup>                      | 2.0                               | 1.05                              | 1.22                              | 0.92                              | 1.18      |
| Dissolved Silver                        | g/m <sup>3</sup>                      | < 0.00010                         | < 0.00010                         | < 0.00010                         | < 0.00010                         | < 0.00010 |
| Dissolved Sodium                        | g/m <sup>3</sup>                      | 8.0                               | 9.4                               | 6.6                               | 6.3                               | 6.8       |
| Chloride                                | g/m <sup>3</sup>                      | 12.9                              | 12.9                              | 7.8                               | 8.5                               | 9.5       |
| Total Ammoniacal-N                      | g/m <sup>3</sup>                      | 0.035                             | 0.091                             | < 0.010                           | < 0.010                           | 0.016     |
| Nitrite-N                               | g/m <sup>3</sup>                      | < 0.002                           | 0.004                             | < 0.002                           | 0.002                             | < 0.002   |
| Nitrate-N                               | g/m <sup>3</sup>                      | < 0.002                           | 0.29                              | 0.031                             | 0.22                              | 0.23      |
| Nitrate-N + Nitrite-N                   | g/m <sup>3</sup>                      | < 0.002                           | 0.29                              | 0.032                             | 0.22                              | 0.23      |
| Total Kjeldahl Nitrogen (TKN)           | g/m <sup>3</sup>                      | 1.44                              | 0.17                              | 0.14                              | 0.10                              | < 0.10    |
| Dissolved Reactive Phosphorus           | g/m <sup>3</sup>                      | < 0.004                           | < 0.004                           | < 0.004                           | < 0.004                           | < 0.004   |
| Total Phosphorus                        | g/m <sup>3</sup>                      | 1.20                              | 0.007                             | 0.026                             | 0.008                             | 0.007     |
| Sulphate                                | g/m <sup>3</sup>                      | 17.6                              | 3.1                               | 2.3                               | 2.8                               | 3.2       |
| Total Organic Carbon (TOC)              | g/m <sup>3</sup>                      | 6.8                               | 1.0                               | 0.9                               | 0.5                               | 0.7       |
| Leachate metals suite, dissolved, trace |                                       |                                   |                                   |                                   |                                   |           |
| Dissolved Aluminium                     | g/m <sup>3</sup>                      | 0.24                              | 0.004                             | 0.004                             | 0.009                             | 0.005     |
| Dissolved Arsenic                       | g/m <sup>3</sup>                      | 0.0199                            | 0.0014                            | < 0.0010                          | < 0.0010                          | < 0.0010  |
| Dissolved Boron                         | g/m <sup>3</sup>                      | 0.009                             | 0.011                             | 0.008                             | 0.011                             | 0.010     |
| Dissolved Cadmium                       | g/m <sup>3</sup>                      | < 0.00005                         | < 0.00005                         | < 0.00005                         | < 0.00005                         | < 0.00005 |
| Dissolved Chromium                      | g/m <sup>3</sup>                      | 0.0118                            | < 0.0005                          | < 0.0005                          | < 0.0005                          | < 0.0005  |
| Dissolved Cobalt                        | g/m <sup>3</sup>                      | 0.0005                            | 0.0003                            | < 0.0002                          | 0.0002                            | < 0.0002  |
| Dissolved Copper                        | g/m <sup>3</sup>                      | 0.0026                            | < 0.0005                          | < 0.0005                          | < 0.0005                          | < 0.0005  |
| Dissolved Iron                          | g/m <sup>3</sup>                      | 3.3                               | 0.51                              | 0.05                              | 0.08                              | 0.06      |
| Dissolved Lead                          | g/m <sup>3</sup>                      | 0.00181                           | < 0.00010                         | < 0.00010                         | < 0.00010                         | < 0.00010 |
| Dissolved Manganese                     | g/m <sup>3</sup>                      | 0.110                             | 0.065                             | 0.0034                            | 0.0067                            | 0.0056    |
| Dissolved Nickel                        | g/m <sup>3</sup>                      | 0.0021                            | < 0.0005                          | < 0.0005                          | < 0.0005                          | < 0.0005  |
| Dissolved Zinc                          | g/m <sup>3</sup>                      | 0.0038                            | < 0.0010                          | 0.0176                            | 0.0021                            | 0.0040    |



| Sample Type: Aqueous                    |                                       |                                   |                                   |                                   |                                     |           |
|---|---------------------------------------|-----------------------------------|-----------------------------------|-----------------------------------|-------------------------------------|-----------|
| Sample Name:                            | Site 11<br>08-Apr-2024<br>3:00 pm     | Site 12<br>09-Apr-2024<br>8:45 am | Site 13<br>09-Apr-2024<br>8:55 am | Site 14<br>09-Apr-2024<br>9:15 am | Site 14 A<br>09-Apr-2024<br>9:45 am |           |
| Lab Number:                             | 3538815.11                            | 3538815.12                        | 3538815.13                        | 3538815.14                        | 3538815.15                          |           |
| Individual Tests                        |                                       |                                   |                                   |                                   |                                     |           |
| Sum of Anions                           | meq/L                                 | 1.52                              | 1.11                              | 0.96                              | 0.97                                | 1.23      |
| Sum of Cations                          | meq/L                                 | 1.66                              | 1.12                              | 0.96                              | 0.99                                | 1.61      |
| Turbidity                               | NTU                                   | 17.7                              | 5.9                               | 2.2                               | 290                                 | 1,080     |
| pH                                      | pH Units                              | 7.0                               | 6.7                               | 6.7                               | 6.4                                 | 6.1       |
| Total Alkalinity                        | g/m <sup>3</sup> as CaCO <sub>3</sub> | 25                                | 32                                | 25                                | 22                                  | 31        |
| Bicarbonate                             | g/m <sup>3</sup> at 25°C              | 31                                | 39                                | 30                                | 26                                  | 37        |
| Total Hardness                          | g/m <sup>3</sup> as CaCO <sub>3</sub> | 36                                | 34                                | 25                                | 24                                  | 34        |
| Electrical Conductivity (EC)            | mS/m                                  | 17.9                              | 11.9                              | 10.4                              | 10.8                                | 14.0      |
| Total Suspended Solids                  | g/m <sup>3</sup>                      | 23                                | 3                                 | < 3                               | 820                                 | 1,270     |
| Total Dissolved Solids (TDS)            | g/m <sup>3</sup>                      | 118                               | 78                                | 66                                | 70                                  | 98        |
| Dissolved Calcium                       | g/m <sup>3</sup>                      | 9.2                               | 9.1                               | 6.9                               | 6.6                                 | 10.2      |
| Total Iron                              | g/m <sup>3</sup>                      | 3.5                               | 1.24                              | 0.63                              | 37                                  | 118       |
| Dissolved Magnesium                     | g/m <sup>3</sup>                      | 3.1                               | 2.6                               | 1.95                              | 1.84                                | 2.1       |
| Dissolved Mercury                       | g/m <sup>3</sup>                      | < 0.00008                         | < 0.00008                         | < 0.00008                         | < 0.00008                           | < 0.00008 |
| Total Mercury                           | g/m <sup>3</sup>                      | < 0.00008                         | < 0.00008                         | < 0.00008                         | < 0.00008                           | < 0.0021  |
| Dissolved Molybdenum                    | g/m <sup>3</sup>                      | < 0.0002                          | < 0.0002                          | < 0.0002                          | < 0.0002                            | 0.0002    |
| Dissolved Potassium                     | g/m <sup>3</sup>                      | 3.8                               | 1.05                              | 0.86                              | 0.91                                | 2.7       |
| Dissolved Silver                        | g/m <sup>3</sup>                      | < 0.00010                         | < 0.00010                         | < 0.00010                         | < 0.00010                           | < 0.00010 |
| Dissolved Sodium                        | g/m <sup>3</sup>                      | 18.3                              | 9.1                               | 9.3                               | 11.0                                | 12.1      |
| Chloride                                | g/m <sup>3</sup>                      | 30                                | 13.3                              | 12.9                              | 15.6                                | 19.5      |
| Total Ammoniacal-N                      | g/m <sup>3</sup>                      | < 0.010                           | 0.094                             | 0.018                             | < 0.010                             | 0.36      |
| Nitrite-N                               | g/m <sup>3</sup>                      | 0.003 #1                          | 0.005                             | < 0.002                           | < 0.002                             | < 0.002   |
| Nitrate-N                               | g/m <sup>3</sup>                      | < 0.002                           | 0.30                              | 0.21                              | 0.34                                | < 0.002   |
| Nitrate-N + Nitrite-N                   | g/m <sup>3</sup>                      | < 0.002 #1                        | 0.31                              | 0.21                              | 0.34                                | < 0.002   |
| Total Kjeldahl Nitrogen (TKN)           | g/m <sup>3</sup>                      | 0.97                              | 0.19                              | < 0.10                            | 0.77                                | 3.6       |
| Dissolved Reactive Phosphorus           | g/m <sup>3</sup>                      | 0.005                             | < 0.004                           | < 0.004                           | 0.007                               | < 0.004   |
| Total Phosphorus                        | g/m <sup>3</sup>                      | 0.127                             | 0.012                             | 0.004                             | 0.45                                | 2.2       |
| Sulphate                                | g/m <sup>3</sup>                      | 7.5                               | 3.0                               | 3.8                               | 3.5                                 | 3.4       |
| Total Organic Carbon (TOC)              | g/m <sup>3</sup>                      | 10.3                              | 2.3                               | 0.8                               | 6.1                                 | 12.2      |
| Leachate metals suite, dissolved, trace |                                       |                                   |                                   |                                   |                                     |           |
| Dissolved Aluminium                     | g/m <sup>3</sup>                      | 0.013                             | 0.005                             | 0.015                             | 0.024                               | 0.169     |
| Dissolved Arsenic                       | g/m <sup>3</sup>                      | < 0.0010                          | 0.0017                            | 0.0014                            | < 0.0010                            | 0.0042    |
| Dissolved Boron                         | g/m <sup>3</sup>                      | 0.016                             | 0.011                             | 0.011                             | 0.012                               | 0.010     |
| Dissolved Cadmium                       | g/m <sup>3</sup>                      | < 0.00005                         | < 0.00005                         | < 0.00005                         | < 0.00005                           | < 0.00005 |
| Dissolved Chromium                      | g/m <sup>3</sup>                      | 0.0013                            | < 0.0005                          | 0.0006                            | < 0.0005                            | 0.0055    |
| Dissolved Cobalt                        | g/m <sup>3</sup>                      | 0.0006                            | 0.0002                            | 0.0004                            | < 0.0002                            | 0.0009    |
| Dissolved Copper                        | g/m <sup>3</sup>                      | 0.0009                            | < 0.0005                          | < 0.0005                          | 0.0008                              | 0.0021    |
| Dissolved Iron                          | g/m <sup>3</sup>                      | 1.16                              | 0.62                              | 0.48                              | 0.06                                | 7.7       |
| Dissolved Lead                          | g/m <sup>3</sup>                      | 0.00039                           | < 0.00010                         | < 0.00010                         | 0.00014                             | 0.00055   |
| Dissolved Manganese                     | g/m <sup>3</sup>                      | 0.083                             | 0.065                             | 0.044                             | 0.0065                              | 0.26      |
| Dissolved Nickel                        | g/m <sup>3</sup>                      | 0.0012                            | < 0.0005                          | < 0.0005                          | < 0.0005                            | 0.0024    |
| Dissolved Zinc                          | g/m <sup>3</sup>                      | 0.0018                            | 0.0016                            | 0.0020                            | 0.0015                              | 0.0023    |
| <b>Sample Name:</b>                     | Site 15 09-Apr-2024 10:30 am          |                                   |                                   |                                   |                                     |           |
| <b>Lab Number:</b>                      | 3538815.16                            |                                   |                                   |                                   |                                     |           |
| Individual Tests                        |                                       |                                   |                                   |                                   |                                     |           |
| Sum of Anions                           | meq/L                                 | 1.28                              |                                   |                                   |                                     |           |
| Sum of Cations                          | meq/L                                 | 1.29                              |                                   |                                   |                                     |           |
| Turbidity                               | NTU                                   | 1,500                             |                                   |                                   |                                     |           |
| pH                                      | pH Units                              | 6.2                               |                                   |                                   |                                     |           |
| Total Alkalinity                        | g/m <sup>3</sup> as CaCO <sub>3</sub> | 34                                |                                   |                                   |                                     |           |
| Bicarbonate                             | g/m <sup>3</sup> at 25°C              | 41                                |                                   |                                   |                                     |           |
| Total Hardness                          | g/m <sup>3</sup> as CaCO <sub>3</sub> | 40                                |                                   |                                   |                                     |           |
| Electrical Conductivity (EC)            | mS/m                                  | 13.9                              |                                   |                                   |                                     |           |
| Total Suspended Solids                  | g/m <sup>3</sup>                      | 3,400                             |                                   |                                   |                                     |           |

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| Sample Type: Aqueous                    |                              |           |
|---|------------------------------|-----------|
| Sample Name:                            | Site 15 09-Apr-2024 10:30 am |           |
| Lab Number:                             | 3538815.16                   |           |
| Individual Tests                        |                              |           |
| Total Dissolved Solids (TDS)            | g/m <sup>3</sup>             | 100       |
| Dissolved Calcium                       | g/m <sup>3</sup>             | 9.6       |
| Total Iron                              | g/m <sup>3</sup>             | 106       |
| Dissolved Magnesium                     | g/m <sup>3</sup>             | 3.8       |
| Dissolved Mercury                       | g/m <sup>3</sup>             | < 0.00008 |
| Total Mercury                           | g/m <sup>3</sup>             | < 0.0021  |
| Dissolved Molybdenum                    | g/m <sup>3</sup>             | < 0.0002  |
| Dissolved Potassium                     | g/m <sup>3</sup>             | 1.65      |
| Dissolved Silver                        | g/m <sup>3</sup>             | < 0.00010 |
| Dissolved Sodium                        | g/m <sup>3</sup>             | 10.4      |
| Chloride                                | g/m <sup>3</sup>             | 11.6      |
| Total Ammoniacal-N                      | g/m <sup>3</sup>             | < 0.010   |
| Nitrite-N                               | g/m <sup>3</sup>             | < 0.002   |
| Nitrate-N                               | g/m <sup>3</sup>             | 1.79      |
| Nitrate-N + Nitrite-N                   | g/m <sup>3</sup>             | 1.79      |
| Total Kjeldahl Nitrogen (TKN)           | g/m <sup>3</sup>             | 4.4       |
| Dissolved Reactive Phosphorus           | g/m <sup>3</sup>             | 0.013     |
| Total Phosphorus                        | g/m <sup>3</sup>             | 8.6       |
| Sulphate                                | g/m <sup>3</sup>             | 7.2       |
| Total Organic Carbon (TOC)              | g/m <sup>3</sup>             | 10.2      |
| Leachate metals suite, dissolved, trace |                              |           |
| Dissolved Aluminium                     | g/m <sup>3</sup>             | 0.029     |
| Dissolved Arsenic                       | g/m <sup>3</sup>             | < 0.0010  |
| Dissolved Boron                         | g/m <sup>3</sup>             | 0.016     |
| Dissolved Cadmium                       | g/m <sup>3</sup>             | < 0.00005 |
| Dissolved Chromium                      | g/m <sup>3</sup>             | < 0.0005  |
| Dissolved Cobalt                        | g/m <sup>3</sup>             | < 0.0002  |
| Dissolved Copper                        | g/m <sup>3</sup>             | 0.0010    |
| Dissolved Iron                          | g/m <sup>3</sup>             | 0.05      |
| Dissolved Lead                          | g/m <sup>3</sup>             | 0.00015   |
| Dissolved Manganese                     | g/m <sup>3</sup>             | 0.0024    |
| Dissolved Nickel                        | g/m <sup>3</sup>             | < 0.0005  |
| Dissolved Zinc                          | g/m <sup>3</sup>             | 0.0025    |

### Analyst's Comments

#1 It has been noted that the result for Nitrite-N was greater than that for Nitrate-N + Nitrite-N, but within the analytical variation of these methods.

#### Samples 2, 9-10 Comment:

Please note that the level of Uncertainty of Measurement (UOM) for the TOC result is significantly greater than that usually reported for this analyte (up to 200-300% at the 95% confidence level).

#### Samples 7-8, 13 Comment:

Please note that the level of Uncertainty of Measurement (UOM) for the TOC result is significantly greater than that usually reported for this analyte (up to 100-200% at the 95% confidence level).

### 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 simple 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. A detection limit range indicates the lowest and highest detection limits in the associated suite of analytes. A full listing of compounds and detection limits are available from the laboratory upon request. Unless otherwise indicated, analyses were performed at Hill Labs, 28 Duke Street, Frankton, Hamilton 3204.

| Sample Type: Aqueous                    |  |                                 |           |
|---|--|---------------------------------|-----------|
| Test                                    | Method Description   | Default Detection Limit         | Sample No |
| Leachate metals suite, dissolved, trace | 0.45µm Filtration, ICP-MS, trace level. APHA 3125 B : Online Edition.  | 0.00005 - 0.02 g/m <sup>3</sup> | 1-16      |
| Filtration, Unpreserved                 | Sample filtration through 0.45 µm membrane filter. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. | -                               | 1-16      |
| Total Digestion                         | Nitric acid digestion. APHA 3030 E (modified) : Online Edition.  | -                               | 1-16      |

| Sample Type: Aqueous                            |  |   |           |
|---|--|---|-----------|
| Test  | Method Description   | Default Detection Limit                   | Sample No |
| Total Digestion with HCl                        | Nitric/hydrochloric acid digestion. APHA 3030 E (modified) : Online Edition.   | -   | 6, 15-16  |
| Total acid digest for Silver analysis           | Boiling nitric / hydrochloric acid digestion (5:1 ratio). APHA 3030 F (modified) : Online Edition.   | -   | 1-16      |
| Total anions for anion/cation balance check     | Calculation: sum of anions as mEq/L calculated from Alkalinity (bicarbonate), Chloride and Sulphate. Nitrate-N, Nitrite-N. Fluoride, Dissolved Reactive Phosphorus and Cyanide also included in calculation if available. APHA 1030 E : Online Edition.  | 0.07 meq/L                                | 1-16      |
| Total cations for anion/cation balance check    | Sum of cations as mEq/L calculated from Sodium, Potassium, Calcium and Magnesium. Iron, Manganese, Aluminium, Zinc, Copper, Lithium, Total Ammoniacal-N and pH (H <sup>+</sup> ) also included in calculation if available. APHA 1030 E : Online Edition.  | 0.05 meq/L                                | 1-16      |
| Turbidity                                       | Analysis by Turbidity meter. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2130 B (modified) : Online Edition.  | 0.05 NTU                                  | 1-16      |
| pH  | pH meter. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 4500-H <sup>+</sup> B (modified) : Online Edition. Note: It is not possible to achieve the APHA Maximum Storage Recommendation for this test (15 min) when samples are analysed upon receipt at the laboratory, and not in the field. Samples and Standards are analysed at an equivalent laboratory temperature (typically 18 to 22 °C). Temperature compensation is used. | 0.1 pH Units                              | 1-16      |
| Total Alkalinity                                | Titration to pH 4.5 (M-alkalinity), autotitrator. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2320 B (modified for Alkalinity <20) : Online Edition.  | 1.0 g/m <sup>3</sup> as CaCO <sub>3</sub> | 1-16      |
| Bicarbonate                                     | Calculation: from alkalinity and pH, valid where TDS is not >500 mg/L and alkalinity is almost entirely due to hydroxides, carbonates or bicarbonates. APHA 4500-CO <sub>2</sub> D : Online Edition.   | 1.0 g/m <sup>3</sup> at 25°C              | 1-16      |
| Total Hardness                                  | Calculation from Calcium and Magnesium. APHA 2340 B : Online Edition.  | 1.0 g/m <sup>3</sup> as CaCO <sub>3</sub> | 1-16      |
| Electrical Conductivity (EC)                    | Conductivity meter, 25°C. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2510 B : Online Edition.  | 0.1 mS/m                                  | 1-16      |
| Total Suspended Solids                          | Filtration using Whatman 934 AH, Advantec GC-50 or equivalent filters (nominal pore size 1.2 - 1.5 µm), gravimetric determination. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2540 D (modified) : Online Edition.  | 3 g/m <sup>3</sup>                        | 1-16      |
| Total Dissolved Solids (TDS)                    | Filtration through GF/C (1.2 µm), gravimetric. Analysed at Hill Laboratories - Chemistry; Unit 1, 17 Print Place, Middleton, Christchurch. APHA 2540 C (modified: drying temperature of 103 - 105°C used rather than 180 ± 2°C) : Online Edition.  | 10 g/m <sup>3</sup>                       | 1-16      |
| Filtration for dissolved metals analysis        | Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B : Online Edition.  | -   | 6-7       |
| Filtration for dissolved metals analysis - Misc | Sample filtration through 0.45µm membrane filter and preservation with nitric acid. APHA 3030 B : Online Edition.  | -   | 6-7       |
| Dissolved Calcium                               | Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.  | 0.05 g/m <sup>3</sup>                     | 1-16      |
| Total Iron                                      | Nitric acid digestion, ICP-MS, trace level. APHA 3125 B : Online Edition.  | 0.021 g/m <sup>3</sup>                    | 1-16      |
| Dissolved Magnesium                             | Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.  | 0.02 g/m <sup>3</sup>                     | 1-16      |
| Dissolved Mercury                               | 0.45µm filtration, bromine oxidation followed by atomic fluorescence. US EPA Method 245.7, Feb 2005.   | 0.00008 g/m <sup>3</sup>                  | 1-16      |
| Total Mercury                                   | Acid digestion, ICP-MS, screen level. APHA 3125 B : Online Edition.  | 0.0021 g/m <sup>3</sup>                   | 6, 15-16  |
| Total Mercury                                   | Bromine Oxidation followed by Atomic Fluorescence. US EPA Method 245.7, Feb 2005.  | 0.00008 g/m <sup>3</sup>                  | 1-5, 7-14 |
| Dissolved Molybdenum                            | Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.  | 0.0002 g/m <sup>3</sup>                   | 1-16      |
| Dissolved Potassium                             | Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.  | 0.05 g/m <sup>3</sup>                     | 1-16      |
| Dissolved Silver                                | Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.  | 0.00010 g/m <sup>3</sup>                  | 1-16      |
| Dissolved Sodium                                | Filtered sample, ICP-MS, trace level. APHA 3125 B : Online Edition.  | 0.02 g/m <sup>3</sup>                     | 1-16      |

| Sample Type: Aqueous          |  |                         |           |
|-------------------------------|--|-------------------------|-----------|
| Test                          | Method Description   | Default Detection Limit | Sample No |
| Chloride                      | Filtered sample from Christchurch. Ion Chromatography. APHA 4110 B (modified) : Online Edition.  | 0.5 g/m <sup>3</sup>    | 1-16      |
| Total Ammoniacal-N            | Filtered Sample from Christchurch. Phenol/hypochlorite colourimetry. Flow injection analyser. (NH <sub>4</sub> -N = NH <sub>4</sub> <sup>+</sup> -N + NH <sub>3</sub> -N). APHA 4500-NH <sub>3</sub> H (modified) : Online Edition.  | 0.010 g/m <sup>3</sup>  | 1-16      |
| Nitrite-N                     | Filtered sample from Christchurch. Automated Azo dye colorimetry. Flow injection analyser. APHA 4500-NO <sub>2</sub> <sup>-</sup> I (modified) : Online Edition.   | 0.002 g/m <sup>3</sup>  | 1-16      |
| Nitrate-N                     | Calculation: (Nitrate-N + Nitrite-N) - Nitrite-N. In-House.  | 0.0010 g/m <sup>3</sup> | 1-16      |
| Nitrate-N + Nitrite-N         | Filtered sample from Christchurch. Total oxidised nitrogen. Automated cadmium reduction, flow injection analyser. APHA 4500-NO <sub>3</sub> <sup>-</sup> I (modified) : Online Edition.  | 0.002 g/m <sup>3</sup>  | 1-16      |
| Total Kjeldahl Nitrogen (TKN) | Total Kjeldahl digestion, phenol/hypochlorite colorimetry. Discrete Analyser. APHA 4500-N <sub>org</sub> D (modified) 4500 NH <sub>3</sub> F (modified) : Online Edition.  | 0.10 g/m <sup>3</sup>   | 1-16      |
| Dissolved Reactive Phosphorus | Filtered sample from Christchurch. Molybdenum blue colourimetry. Flow injection analyser. APHA 4500-P G (modified) : Online Edition.   | 0.004 g/m <sup>3</sup>  | 1-16      |
| Total Phosphorus              | Total phosphorus digestion, automated ascorbic acid colorimetry. Flow Injection Analyser. APHA 4500-P H (modified) : Online Edition.   | 0.002 g/m <sup>3</sup>  | 1-16      |
| Sulphate                      | Filtered sample from Christchurch. Ion Chromatography. APHA 4110 B (modified) : Online Edition.  | 0.5 g/m <sup>3</sup>    | 1-16      |
| Total Organic Carbon (TOC)    | Supercritical persulphate oxidation, IR detection, for Total C. Acidification, purging for Total Inorganic C. TOC = TC -TIC. The uncertainty of the calculated result is a combination of the uncertainties of the two analytical determinands in the subtraction calculation. Where both determinands are similar in magnitude, the calculated result has a significantly higher uncertainty than would normally be achieved if one of the results was significantly less than the other. In such cases, the elevated uncertainty should be kept in mind when interpreting the data. APHA 5310 C (modified) : Online Edition. | 0.5 g/m <sup>3</sup>    | 1-16      |

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

Testing was completed between 12-Apr-2024 and 29-Apr-2024. For completion dates of individual analyses please contact the laboratory.

Samples are held at the laboratory after reporting for a length of time based on the stability of the samples and analytes being tested (considering any preservation used), and the storage space available. Once the storage period is completed, the samples are discarded unless otherwise agreed with the customer. Extended storage times may incur additional charges.

This certificate of analysis must not be reproduced, except in full, without the written consent of the signatory.



Ara Heron BSc (Tech)  
Client Services Manager - Environmental

## APPENDIX D

### Raw Macroinvertebrate Data



|                         | MCI | Artificial drains |     |     |     |     |      | Rivers        |            |              |              |
|-------------------------|-----|-------------------|-----|-----|-----|-----|------|---------------|------------|--------------|--------------|
|                         |     | 1                 | 3   | 7   | 8   | 9   | 10   | Northern<br>2 | Clark<br>4 | Granite<br>6 | Granite<br>5 |
| <b>Ephemeroptera</b>    |     |                   |     |     |     |     |      |               |            |              |              |
| <i>Deleatidium</i>      | 8   | -                 | -   | -   | -   | 1   | -    | -             | -          | 1            | -            |
| <i>Nesameletus</i>      | 9   | -                 | -   | -   | -   | 1   | -    | -             | -          | -            | -            |
| <b>Plecoptera</b>       |     |                   |     |     |     |     |      |               |            |              |              |
| <i>Austroperla</i>      | 9   | -                 | -   | -   | -   | -   | -    | -             | -          | 1            | -            |
| <i>Stenoperla</i>       | 10  | -                 | -   | -   | -   | -   | -    | -             | -          | 1            | -            |
| <i>Zelandobius</i>      | 5   | 11                | -   | -   | -   | -   | -    | -             | -          | 1            | -            |
| <b>Trichoptera</b>      |     |                   |     |     |     |     |      |               |            |              |              |
| <i>Costachorema</i>     | 7   | -                 | -   | -   | -   | 3   | -    | -             | -          | -            | -            |
| <i>Helicopsyche</i>     | 10  | 1                 | -   | -   | -   | -   | -    | -             | -          | -            | -            |
| <i>Hudsonema</i>        | 6   | 17                | -   | -   | 6   | 2   | -    | -             | -          | -            | -            |
| <i>Hydrobiosis</i>      | 5   | 3                 | 1   | 2   | 2   | 26  | 22   | 5             | 2          | 7            | -            |
| <i>Oeconesidae</i>      | 9   | 2                 | -   | -   | 1   | -   | -    | -             | -          | -            | -            |
| <i>Oxyethira</i>        | 2   | 3                 | 86  | 87  | 50  | -   | 132  | 41            | -          | 3            | 3            |
| <i>Polypsectopus</i>    | 8   | -                 | -   | 4   | -   | -   | -    | -             | -          | -            | -            |
| <i>Psilochorema</i>     | 8   | 3                 | -   | 2   | 1   | 1   | 3    | 1             | -          | -            | -            |
| <i>Pycnocentria</i>     | 7   | 21                | -   | -   | -   | 81  | -    | 1             | -          | -            | -            |
| <i>Pycnocentroides</i>  | 5   | 4                 | -   | -   | 3   | 326 | -    | 1             | -          | -            | -            |
| <i>Triplectides</i>     | 5   | 62                | 1   | 21  | -   | 1   | 5    | -             | -          | 1            | 2            |
| <b>Odonata</b>          |     |                   |     |     |     |     |      |               |            |              |              |
| <i>Xanthocnemis</i>     | 5   | -                 | -   | 2   | -   | -   | -    | -             | 1          | -            | -            |
| <b>Hemiptera</b>        |     |                   |     |     |     |     |      |               |            |              |              |
| <i>Microvelia</i>       | 5   | -                 | 44  | -   | 1   | -   | -    | -             | 1          | -            | 3            |
| <i>Sigara</i>           | 5   | -                 | -   | -   | -   | -   | -    | -             | -          | -            | 1            |
| <b>Megaloptera</b>      |     |                   |     |     |     |     |      |               |            |              |              |
| <i>Archichauliodes</i>  | 7   | -                 | -   | -   | -   | -   | -    | -             | -          | 6            | -            |
| <b>Coleoptera</b>       |     |                   |     |     |     |     |      |               |            |              |              |
| Elmidae                 | 6   | -                 | -   | -   | -   | -   | -    | -             | -          | 6            | -            |
| <i>Enochrus</i>         | 5   | 1                 | 13  | -   | 3   | -   | -    | 1             | -          | -            | 1            |
| Hydrophilidae           | 5   | -                 | 1   | -   | -   | -   | -    | -             | -          | -            | -            |
| Scirtidae               | 8   | -                 | -   | 1   | -   | -   | 1    | -             | -          | 12           | 1            |
| Staphylinidae           | 5   | -                 | -   | -   | -   | -   | -    | -             | -          | -            | 1            |
| <b>Diptera</b>          |     |                   |     |     |     |     |      |               |            |              |              |
| <i>Austrosimulium</i>   | 3   | 1                 | 11  | 7   | 38  | 18  | 141  | 4             | 47         | 19           | 1            |
| <i>Chironomus</i>       | 1   | -                 | -   | -   | -   | -   | -    | 1             | 8          | -            | -            |
| <i>Corynoneura</i>      | 2   | 2                 | 161 | -   | 7   | -   | -    | 5             | -          | -            | 2            |
| Empididae               | 3   | -                 | 2   | 2   | -   | -   | 6    | 3             | 1          | 14           | -            |
| <i>Eriopterini</i>      | 9   | -                 | -   | -   | -   | 1   | -    | -             | -          | 3            | -            |
| <i>Maoridamesa</i>      | 3   | 2                 | -   | -   | 48  | 21  | 28   | 122           | -          | -            | -            |
| <i>Molophilus</i>       | 5   | -                 | -   | -   | -   | -   | -    | 1             | -          | -            | -            |
| Muscidae                | 3   | 1                 | -   | -   | -   | 1   | 12   | -             | 1          | -            | -            |
| Orthocladinae           | 2   | 267               | 69  | 83  | 800 | 185 | 1208 | 226           | 14         | 96           | 23           |
| <i>Paradixa</i>         | 4   | 1                 | 7   | 4   | 6   | -   | -    | -             | -          | -            | -            |
| <i>Paralimnophila</i>   | 6   | -                 | -   | -   | 1   | -   | 1    | -             | -          | -            | -            |
| <i>Polypedilum</i>      | 3   | 2                 | -   | 5   | -   | 3   | 36   | 1             | 1          | 3            | -            |
| Psychodidae             | 1   | -                 | -   | -   | -   | -   | -    | -             | -          | -            | 2            |
| <i>Stictocladus</i>     | 9   | -                 | -   | -   | -   | -   | -    | -             | -          | 6            | -            |
| Tanytopodinae           | 5   | -                 | -   | 4   | -   | -   | -    | -             | -          | 1            | -            |
| Tanytarsini             | 3   | 3                 | -   | 6   | -   | -   | -    | -             | -          | 2            | -            |
| <i>Zelandotipula</i>    | 6   | -                 | 1   | -   | 2   | -   | -    | -             | -          | -            | -            |
| <b>Lepidoptera</b>      |     |                   |     |     |     |     |      |               |            |              |              |
| <i>Hygraula</i>         | 4   | -                 | 1   | -   | -   | -   | -    | -             | -          | -            | -            |
| <b>Collembola</b>       |     |                   |     |     |     |     |      |               |            |              |              |
| Collembola              | 6   | 1                 | 14  | 1   | 3   | -   | -    | -             | 2          | 2            | 58           |
| <b>Crustacea</b>        |     |                   |     |     |     |     |      |               |            |              |              |
| Copepoda                | 5   | -                 | -   | 1   | -   | -   | -    | -             | -          | -            | -            |
| Ostracoda               | 3   | 5                 | -   | 2   | 10  | -   | 2    | -             | 11         | -            | -            |
| <i>Paracalliope</i>     | 5   | 17                | 712 | 808 | 544 | -   | -    | 1             | 184        | 1            | 11           |
| <i>Paraleptamphopus</i> | 5   | -                 | -   | 5   | -   | 2   | -    | -             | -          | -            | -            |
| <i>Paratya</i>          | 5   | -                 | -   | -   | -   | -   | -    | -             | -          | -            | 5            |
| Talitridae              | 5   | -                 | -   | -   | -   | -   | -    | -             | -          | 1            | -            |
| Tanaidacea              | 4   | -                 | -   | -   | -   | -   | -    | -             | -          | -            | -            |
| <b>Acarina</b>          |     |                   |     |     |     |     |      |               |            |              |              |
| Acarina                 | 5   | 3                 | -   | 6   | 3   | 2   | 2    | -             | -          | 1            | 8            |
| <b>Mollusca</b>         |     |                   |     |     |     |     |      |               |            |              |              |
| <i>Gyraulus</i>         | 3   | -                 | -   | -   | -   | -   | 1    | -             | -          | -            | -            |
| <i>Physella (Physa)</i> | 3   | -                 | 3   | -   | -   | -   | -    | -             | 1          | -            | -            |
| <i>Potamopyrgus</i>     | 4   | 213               | 532 | 844 | 131 | 18  | 182  | 98            | 169        | 1            | 4            |
| Sphaeriidae             | 3   | 1                 | -   | -   | -   | -   | -    | -             | 1          | -            | -            |
| <b>Other</b>            |     |                   |     |     |     |     |      |               |            |              |              |
| Oligochaeta             | 1   | 7                 | -   | 84  | 61  | 122 | 203  | 124           | 163        | 57           | 1            |
| Hirudinea               | 3   | -                 | -   | 1   | -   | -   | -    | -             | -          | -            | -            |
| Platyhelminthes         | 3   | -                 | -   | -   | 3   | -   | -    | -             | 4          | -            | -            |
| Rhabdocoela             | 3   | -                 | 1   | -   | -   | -   | -    | -             | -          | -            | -            |
| Nematoda                | 3   | -                 | -   | 2   | 1   | 4   | 3    | -             | 1          | -            | -            |
| Nemertea                | 3   | -                 | -   | 3   | -   | -   | 1    | -             | -          | -            | -            |
| Nematomorpha            | 3   | -                 | -   | -   | -   | -   | -    | -             | -          | 1            | -            |
| <b>Coelenterata</b>     |     |                   |     |     |     |     |      |               |            |              |              |
| <i>Hydra</i>            | 3   | -                 | -   | 1   | 2   | -   | 2    | -             | -          | -            | -            |



## APPENDIX E

### Native Fish Capture and Relocation Plan