



# **New Zealand Aluminium Smelters Limited NZAS Closure Preliminary Study**

## **Environmental Study Report – Ecology**

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# 1. Introduction

## 1.1 Project Overview

Rio Tinto (RT) engaged GHD to undertake a Preliminary Study (PS) for the closure of New Zealand Aluminium Smelter (NZAS). The PS is being completed in accordance with RT Closure Study Definition Guidance Note (CSDGN) RTPR-PMT-GND-0015. Section 11.2 of the CSDGN requires the completion of environmental studies to fill knowledge gaps, reduce risks, evaluate closure options, develop a strategy to manage environmental aspects and relevant stakeholder expectations, and improve the accuracy of closure cost estimates.

Based on a desktop study of existing information, GHD compiled an Environmental Knowledge Base Gap Analysis Report 12533899-2100-EV-RPT-00001 that outlined the key gaps identified and risks associated with ecology, hydrology/ hydrogeology, air quality, climate change and coastal erosion, noise and vibration, hazardous materials and wastes, and rehabilitation and revegetation.

In terms of ecology, GHD identified key gaps in ecological knowledge including habitat mapping of at-risk flora and fauna species at NZAS. To fill this gap, Boffa Miskell, a subconsultant to GHD, undertook an ecology survey at NZAS during 15-17 December 2020 (herpetologist and ornithologist) and 5-7 January 2021 (botanist and entomologist) to:

- Refine site knowledge of at-risk flora and fauna to inform environmental constraints assessment, impact assessment, rehabilitation and revegetation tasks and Post Closure Monitoring and Maintenance (PCMM) activities.
- Examine and record the current vegetation communities across Tiwai Point to allow for enhancement of vegetation maps, show presence of at-risk species and representative assemblages already present and note the implications for closure.
- Identify local fauna at Tiwai Point and note the presence of at-risk/ threatened species and their habitat locations.
- Inform what flora species are part of the “priority ecosystem”. The Department of Conservation (DoC) lease area is classified as a “priority ecosystem” in the Southland Murihiku Conservation Management Strategy 2016 (the CMS).
- Identify vegetation communities for more concentrated flora and fauna surveys in later stages of the closure study.

## 1.2 Purpose of Document

The purpose of this document is to fill gaps in the baseline understanding of site ecology identified in the Environmental Knowledge Base Gap Analysis Report 12533899-2100-EV-RPT-00001.

Potential ecological impacts associated with closure of NZAS, management measures and specific closure criteria are presented in:

- Environmental Design Specifications - 12533899-2300-EV-MEM-00001
- Flora and Fauna Considerations for Revegetation Report - 12533899-4400-EV-RPT-00001
- Updated Site Closure Environmental Management Plan (SEMP) - 12533899-2300-EV-PLN-00001
- Environmental Impact Assessment for Closure Memorandum - 12533899-2400-EV-MEM-00001

- Environmental Post Closure Monitoring and Management Plan - 12533899-7100-EV-PLN-00001

### **1.3 Scope**

The following activities were undertaken in the preparation of this document:

- Completion of an Ecology Site Investigation at NZAS as per the Site Investigation Plan for Ecological Survey (12533899-4400-EV-PLN-00001).
- Consolidation of data collected during the Ecology Site Investigation and identification of the relevant assessment criteria and legislation/ policies.
- Reporting of site investigation findings and ecological values and their significance.
- Identification of implications that these ecological values may have on closure activities.

### **1.4 Disclaimer**

This report has been prepared by GHD for New Zealand Aluminium Smelter Ltd (NZAS Ltd) and may only be used and relied on by NZAS Ltd for the purpose agreed between GHD and NZAS Ltd as set out in this report.

GHD otherwise disclaims responsibility to any person other than NZAS Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

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## 2. Environmental Knowledge Base

### 2.1 Recommended Preliminary Study Activities

A number of gaps in the existing RT environmental knowledge base have been identified and are detailed in the Environmental Knowledge Base Gap Analysis Report (12533899-2100-EV-RPT-00001). The following activities were recommended to be completed during the PS to address gaps in the environmental knowledge base:

1. Conduct vegetation and habitat surveys to:
  - Determine the distribution of At-Risk and Threatened plant species, primarily within the areas likely to be disturbed or otherwise impacted by closure works.
  - Identify likely habitat and presence of At-Risk and Threatened fauna (birds, lizards, insects).
  - Provide a baseline for weed distribution and determine any exotic species that may spread when the site is disturbed, or any species that are presently putting native flora and fauna at risk.
2. Conduct high level avifauna surveys to garner up-to-date information on nesting and foraging bird species on and surrounding the peninsula.
3. Discuss potential interaction of ecology and groundwater contamination issues, toxicity and dispersal with PS hydrology and HAZMAT leads.

This report has been completed in response to WBS 2300 and items 1 and 2 above . Item 3 is ongoing and will continue to be addressed during the PS, and the results of these discussions will be incorporated into an effects assessment once closure activities are better defined.

## 3. Methodology

### 3.1 Desktop Review

The desktop investigation included a review of scientific literature (published and unpublished), and relevant websites. Ecological databases were also accessed including:

- LENZ Threatened Environments Classification (Landcare Research Ltd, 2012).
- Two 10 x 10 km grid squares of the Ornithological Society of New Zealand's (OSNZ) Atlas of Bird Distribution in New Zealand that encompasses the proposed project site (C. J. R. Robertson et al., 2007).
- The DOC-administered herpetofauna distribution (BioWeb) database.

### 3.2 Field Method

During field visits, each community and habitat type within the study area was visited. This included walking the coastal margin, the perimeter of the smelter, each of the roads/tracks, as well as undertaking walking transects throughout the large expanses of scrub across the site. Figure 1-1 below shows the primary areas that were visited, though it does not include the smaller transects into the scrublands as these varied between ecologists.



**Figure 3-1: Primary locations visited during site visits in December 2020 and January 2021 (shown in orange).**

#### 3.2.1 Vegetation

To establish the native (and exotic) plant assemblages, communities and botanical values present, the project botanist undertook walking transects in January 2021 to observe and record species within the study area. The descriptions of the various assemblages were

compiled to create a vegetation map that describes the plant communities within the proposed development area.

### 3.2.2 Avifauna

The site was walked by the project ornithologist and the diversity and abundances of At-Risk and Threatened species observed within different habitat types were recorded. A banded dotterel survey was conducted within the smelter grounds and other areas of potential habitat for this species in the wider area. Playback surveys were conducted for South Island fernbird in habitat where they had previously been detected as well as other areas of potential habitat within the site. These surveys involved playing taped calls of fernbird and listening for responses.

### 3.2.3 Herpetofauna

As a number of lizard surveys<sup>1</sup> have been undertaken previously at this site, it was considered unnecessary to do so again at this stage. Instead, the site was walked by the project herpetologist in December 2020, and potential lizard habitats were mapped.

### 3.2.4 Terrestrial Invertebrates

The site was walked by the project entomologist, and potential host plants were inspected for notable invertebrates. Light trapping was also undertaken for one night.

## 3.3 Assessment Criteria

The methodology for assessing the ecological values within the site follows the EIANZ Ecological Impact Assessment Guidelines (Roper-Lindsay et al. 2018), which is considered to represent the best practice approach in New Zealand. Four ‘matters’ were considered to assess the ecological value of terrestrial vegetation communities in a site/ area. Table 3-1 describes the attributes to consider against each ‘matter’. Table 3-2 presents the criteria for determining the combined ecological value of terrestrial vegetation communities in a site/ area.

**Table 3-1 Attributes to consider when assigning ecological value to terrestrial vegetation communities (Roper-Lindsay et al. 2018)**

Assessment Matter	Attributes to be Considered
Representativeness	<p>Criteria for representative vegetation and habitats:</p> <ul style="list-style-type: none"> <li>• Typical structure and composition</li> <li>• Indigenous species dominate</li> <li>• Expected species and tiers are present</li> <li>• Thresholds may need to be lowered where all examples of a type are strongly modified</li> </ul> <p>Criteria for representative species and species assemblages:</p> <ul style="list-style-type: none"> <li>• Species assemblages that are typical of the habitat</li> <li>• Indigenous species that occur in most of the guilds expected for the habitat type</li> </ul>

<sup>1</sup> Lettink, 2008,

Rarity/ Distinctiveness	<p>Criteria for rare/ distinctive vegetation and habitats:</p> <ul style="list-style-type: none"> <li>• Naturally uncommon, or induced scarcity</li> <li>• Amount of habitat or vegetation remaining</li> <li>• Distinctive ecological features</li> <li>• National priority for protection</li> </ul> <p>Criteria for rare/ distinctive species or species assemblages:</p> <ul style="list-style-type: none"> <li>• Habitat supporting nationally Threatened or At-Risk species, or locally uncommon species</li> <li>• Regional or national distribution limits of species or communities</li> <li>• Unusual species or assemblages</li> <li>• Endemism</li> </ul>
Diversity and Pattern	<ul style="list-style-type: none"> <li>• Level of natural diversity, abundance and distribution</li> <li>• Biodiversity reflecting underlying diversity</li> <li>• Biogeographical considerations – pattern, complexity</li> <li>• Temporal considerations, considerations of lifecycles, daily or seasonal cycles of habitat availability and utilisation</li> </ul>
Ecological Context	<ul style="list-style-type: none"> <li>• Site history, and local environmental conditions which have influenced the development of habitats and communities</li> <li>• The essential characteristics that determine an ecosystem's integrity, form, functioning, and resilience (from “intrinsic value” as defined in RMA)</li> <li>• Size, shape and buffering</li> <li>• Condition and sensitivity to change</li> <li>• Contribution of the site to ecological networks, linkages, pathways and the protection and exchange of genetic material</li> <li>• Species role in ecosystem functioning – high level, key species identification, habitat as proxy</li> </ul>

**Table 3-2 Scoring for sites or areas combining values for four matters (Roper-Lindsay et al. 2018)**

Ecological Value	Description
Very High	<ul style="list-style-type: none"> <li>• Area rates High for three or all of the four assessment matters listed in Table 3-1</li> <li>• Likely to be nationally important and recognised as such.</li> </ul>
High	<ul style="list-style-type: none"> <li>• Area rates High for two of the assessment matters listed in table 3.1, Moderate and Low for the remainder.</li> <li>• Area rates High for 1 of the assessment matters listed in table 3.1, Moderate for the remainder.</li> <li>• Likely to be regionally important and recognised as such.</li> </ul>
Moderate	<ul style="list-style-type: none"> <li>• Area rates High for one matter, Moderate and Low for the remainder, or</li> </ul>

	<ul style="list-style-type: none"> <li>• Area rates Moderate for two or more assessment matters Low or Very Low for the remainder.</li> <li>• Likely to be important at the level of the Ecological District.</li> </ul>
Low	<ul style="list-style-type: none"> <li>• Area rates Low or Very Low for majority of assessment matters and Moderate for one.</li> <li>• Limited ecological value other than as local habitat for tolerant native species.</li> </ul>
Negligible	<ul style="list-style-type: none"> <li>• Area rates Very Low for three matters and Moderate, Low or Very Low for remainder.</li> </ul>

For fauna (avifauna, herpetofauna and terrestrial invertebrates), and their habitats, the ‘threat status’ as classified by the Department of Conservation has been used to determine Ecological Value (Table 3-3).

**Table 3-3 Factors to consider when assigning value to fauna (Roper-Lindsay et al. 2018)**

Ecological Value	Determining Factors
Very High	<ul style="list-style-type: none"> <li>• Nationally Threatened species found in the ZOI (zone of influence) either permanently or seasonally.</li> </ul>
High	<ul style="list-style-type: none"> <li>• Species listed as At-Risk – Declining, found in the ZOI, either permanently or seasonally.</li> </ul>
Moderate	<ul style="list-style-type: none"> <li>• Locally (Ecological District) uncommon or distinctive species; or</li> <li>• Species listed as any other category of At-Risk, found in the ZOI either permanently or seasonally.</li> </ul>
Low	<ul style="list-style-type: none"> <li>• Nationally and locally common indigenous species.</li> </ul>
Negligible	<ul style="list-style-type: none"> <li>• Exotic species, including pests, species having recreational value.</li> </ul>

### 3.4 Relevant Legislation/ Policy

A range of regulations and governance is in effect in terms of vegetation clearance and habitat disturbance, which have been developed under the overarching Resource Management Act (RMA, 1991). These include the New Zealand Coastal Policy Statement (NZCPS), the Southland Regional Policy Statement (RPS) and the Invercargill City District Plan (ICDP). We note that the NZCPS on Indigenous biodiversity is not yet active. We also note that while DOC have a conservation management strategy which includes the peninsula, it is not legislation that governs activities and effects management.

#### 3.4.1 New Zealand Coastal Policy Statement 2010

The NCPS addresses activities in the Coastal Environment. The entire Tiwai Peninsula is within the coastal environment; Zone B: Coastal terrestrial area (BML 2019), therefore all of the policies in the NZCPS apply. In particular, Policy 11 which states:

*To protect indigenous biological diversity in the coastal environment:*

- a. *avoid adverse effects of activities on:*
  - i. *indigenous taxa that are listed as threatened or at risk in the New Zealand Threat Classification System lists;*
  - ii. *taxa that are listed by the International Union for Conservation of Nature and Natural Resources as threatened;*
  - iii. *indigenous ecosystems and vegetation types that are threatened in the coastal environment, or are naturally rare;*
  - iv. *habitats of indigenous species where the species are at the limit of their natural range, or are naturally rare;*
  - v. *areas containing nationally significant examples of indigenous community types; and*
  - vi. *areas set aside for full or partial protection of indigenous biological diversity under other legislation; and*
- b. *avoid significant adverse effects and avoid, remedy or mitigate other adverse effects of activities on:*
  - i. *areas of predominantly indigenous vegetation in the coastal environment;*
  - ii. *habitats in the coastal environment that are important during the vulnerable life stages of indigenous species;*
  - iii. *indigenous ecosystems and habitats that are only found in the coastal environment and are particularly vulnerable to modification, including estuaries, lagoons, coastal wetlands, dunelands, intertidal zones, rocky reef systems, eelgrass and saltmarsh;*
  - iv. *habitats of indigenous species in the coastal environment that are important for recreational, commercial, traditional or cultural purposes;*
  - v. *habitats, including areas and routes, important to migratory species; and*
  - vi. *ecological corridors, and areas important for linking or maintaining biological values identified under this policy.*

### **3.4.2 Southland Regional Policy Statement 2017**

In addition, Chapter 7 of the Southland RPS contains policies and rules that regulate the loss of and effects to indigenous biological diversity on the coast. In particular, Section 7.3 which states:

#### ***Policy COAST.1 – Direction on locations for activities***

*...Thresholds (for example, zones, standards or targets) or specified acceptable limits of change should be set for coastal processes, resources or values under threat or at significant risk from adverse cumulative effects, such as protection from coastal hazards, water quality degradation, sedimentation, provision of public access, indigenous biodiversity loss, natural character preservation, natural features and landscapes protection, and management of harmful aquatic organisms.*

#### ***Policy COAST.2 – Management of activities in the coastal environment***

*Ensure adequate measures or methods are utilised within the coastal environment when making provision for subdivision, use and development to:*

- (a) protect indigenous biodiversity, historic heritage, natural character, and natural features and landscape values...*

And other policies that look to enable development but protect valued indigenous biological diversity.

### **3.4.3 Invercargill City District Plan 2019**

The ICDP recognises several biodiversity related issues and has policies directed at these issues:

#### **Issues**

*The significant resource management issues for biodiversity:*

**ECO-I1** *Invercargill's indigenous ecosystems have been reduced in diversity and extent over time and while further subdivision, land use change, and development has the potential to pose risks in some areas, it also provides opportunity for enhancement.*

**ECO-I2** *Amenity values can be adversely affected by clearing and altering areas of indigenous biodiversity.*

#### **Objectives**

**ECO-O1** *Indigenous biodiversity and habitats with indigenous biodiversity values are maintained to a healthy functioning state and, where appropriate, restored and enhanced.*

**ECO-O2** *The natural character and biodiversity of wetlands, and rivers and their margins, are protected from inappropriate subdivision, use and development.*

#### **Policies**

**ECO-P1 Identification:** *To identify known areas of significant indigenous biodiversity by delineating these on the District Planning Maps and use the criteria to identify additional areas of significance...*

**ECO-P2 Promotion:** *To promote and encourage the establishment, protection, maintenance, restoration and enhancement of indigenous ecosystems and habitats with indigenous biodiversity values.*

#### **ECO-P3 Protecting Significant Indigenous Biodiversity:**

1. *To protect significant indigenous biodiversity by avoiding, remedying or mitigating the adverse effects of subdivision, land use and development within areas containing ecosystems and habitats with significant indigenous biodiversity values.*
2. *To have regard to the following potential adverse effects in considering subdivision, land use and development that may adversely affect indigenous ecosystems and habitats with indigenous biodiversity values:*
  - a. *Fragmentation of, or reduction in the extent of, significant indigenous vegetation or significant habitats of indigenous fauna;*
  - b. *Fragmentation or disruption of connections and linkages between significant ecosystems or significant habitats of indigenous fauna;*
  - c. *Loss of, or damage to, buffering of significant ecosystems or significant habitats of indigenous fauna; and*
  - d. *Loss or reduction of rare or threatened indigenous species populations or habitats.*

#### **ECO-P4 Maintaining Indigenous Biodiversity:**

3. *To maintain indigenous biodiversity by avoiding, remedying or mitigating the adverse effects of subdivision, land use and development on indigenous biodiversity.*
4. *To have regard to the following potential adverse effects in considering subdivision, land use and development that may adversely affect indigenous ecosystems and habitats with indigenous biodiversity values:*

- a. Fragmentation of, or reduction in the extent of, indigenous vegetation or habitats of indigenous fauna;*
- b. Fragmentation or disruption of connections and linkages between ecosystems or habitats of indigenous fauna;*
- c. Loss of, or damage to, buffering of ecosystems or habitats of indigenous fauna; and*
- d. Loss or reduction of rare or threatened indigenous species' populations or habitats.*

Appendix 2 (APP2) of the ICDP also contains criteria which was used to assess the significance of indigenous biodiversity in 1999.

### **3.5 Effects Hierarchy**

The legislation/ policies provided in Section 3.4 is a hierarchical list with the NZCPS being the most stringent. Following the NZCPS, the rules and policies in the Southland RPS and ICDP still need to be accounted for but where the NZCPS is satisfied, these regulations are also likely to be met.

For areas in the Coastal Environment (i.e. the entire Tiwai Peninsula) Policy 11 of the NZCPS is the highest order document. The policy states that adverse effects will need to be avoided for Very High Value systems (not affected and mitigated or offset, but avoided).

The moderate, low, and seasonally high value areas allow a level of effect to these areas with appropriate management, as outlined in Section 11 b. *“avoid significant adverse effects and avoid, remedy or mitigate other adverse effects of activities”*.

Moderate (and to a certain extent, high) value areas are such on site that as long as substantive restoration/ rehabilitation occurred effects could be suitably managed/ mitigated.

Low value areas have little issue and can absorb a high level of adverse effect without concern.

Seasonally high value areas can also be modified extensively without significant adverse effect but only where there are management and processes to ensure the seasonally present high value species are appropriable managed so as to be absent at the time of effects or the effects are managed around those values such that there is no important adverse effect to those species.

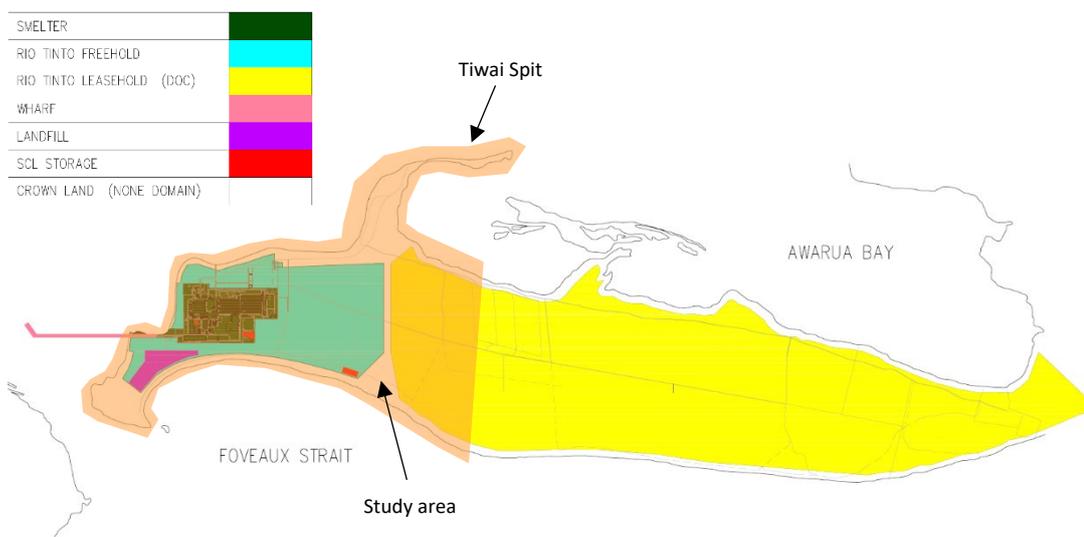
## 4. Results

### 4.1 Study findings

This section combines the results of the desktop and field investigations to describe the existing environment within the study site.

### 4.2 Site Context

The study site is located at the western end of the Tiwai Peninsula, 15 km south of Invercargill. The study area incorporates all domains within the RT Freehold Land, the adjacent margins of the DoC administered leasehold land, and the surrounding coastal areas (Crown Land) including Tiwai Spit (Figure 4-1).



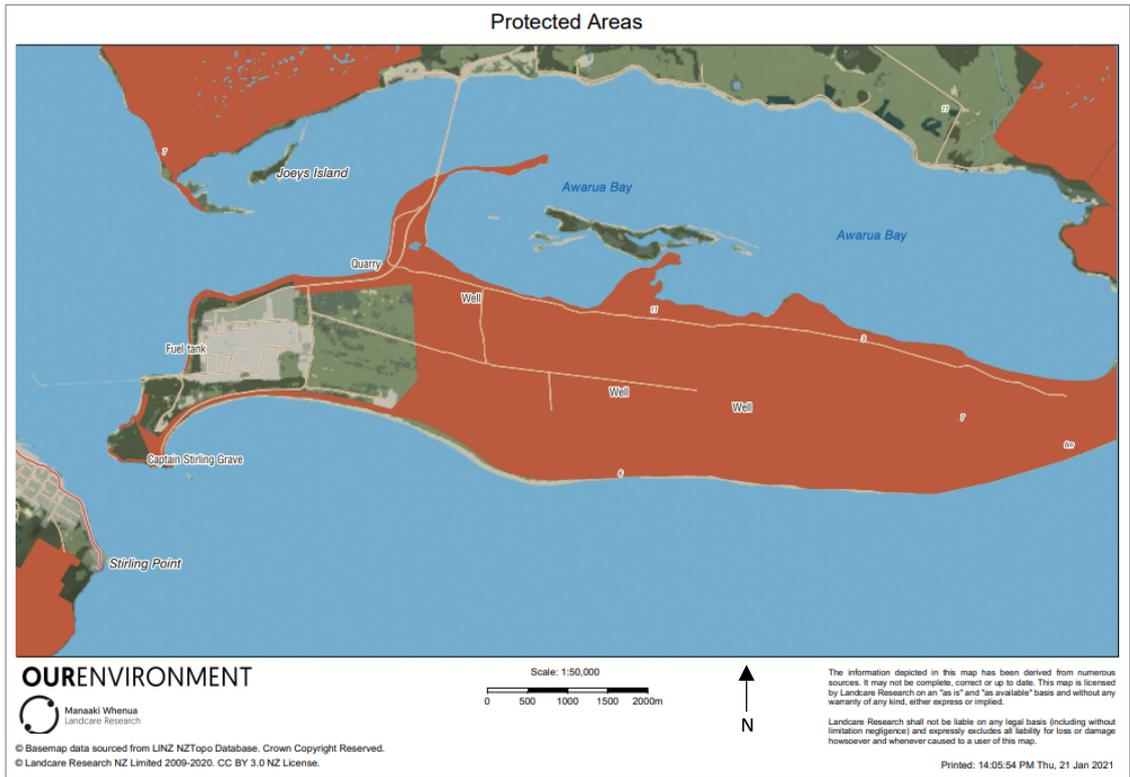
**Figure 4-1 Study Domains**

The Tiwai Peninsula falls within the Waituna Ecological District (ED 78.02). This District is characterised by extensive wetlands and salt marshes, shrublands comprised of mānuka, tussocks or flax, and small podocarp-hardwood forest remnants. The soils are primarily peat or sand soils with poor drainage, and notable fauna of the district include a number of rare marshland bird species, coastal migrants, and At-Risk Lizard species.

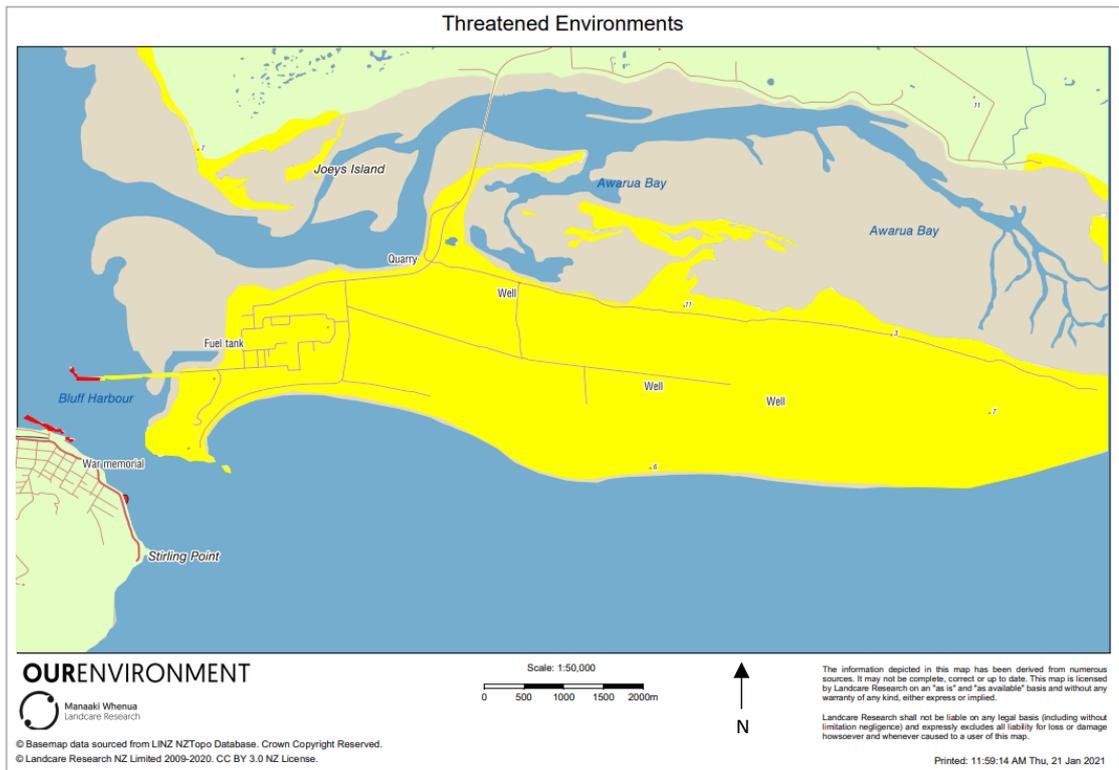
The majority of the peninsula is legally protected by the Department of Conservation (DoC); this includes the RT leasehold land and the coastal areas surrounding the smelter (Protected Areas Network 2007). The RT freehold land is not afforded protection (Figure 4.2).

According to the LENZ Threatened Environments Classification, the Tiwai Peninsula falls within a Category 3 Area: environments with between 20% and 30% indigenous cover remaining, considered to be much reduced and seriously fragmented (Threatened Environments Classification 2012; Figure 4.3).

Many features within the peninsula (e.g. sand dunes, dune deflation hollows, shell barrier beaches, shingle beaches, coastal turfs, stable sand dunes and coastal cliffs) are recognised as historically rare ecosystems (Williams et al. 2007). The wider estuary is also of high quality, high value, and naturally rare ecosystem.



**Figure 4-2 Threatened Environments classification of the Tiwai Peninsula**



**Figure 4-3 Threatened Environments classification of the Tiwai**

### 4.3 Terrestrial vegetation

Geology and soil types on the Tiwai Peninsula are quite unique, in the New Zealand context and the site has a range of distinctive and uncommon plant communities, which contain many nationally Threatened and At-Risk plant species (as per de Lange et al. 2018), including a number of species that are only found in Southland and Stewart Island, or are usually found in alpine areas. Threatened, At-Risk, and locally uncommon plant species occur throughout the survey area.

Vegetation across much of the site is dominated by indigenous plant species, although there are some localised areas that are more modified as a result of human activities (e.g. landfill, cathode dump, effluent disposal area, tracks, infrastructure, former livestock grazing) and fires (natural and/ or human induced).

The vegetation and habitats along the coastal edge (south of the smelter) are of very high ecological value, and if lost these would be unlikely to recover nor could they be restored. These include excellent examples of rare coastal vegetation sequences that contain a number of Threatened and At-Risk plant species, which in turn support several rare and nationally threatened moth species (see Section 4.6).

The core part of the Tiwai Peninsula contains a mosaic of indigenous shrubland, flaxland, and fernland (bracken), with areas of copper tussock (*Chionochloa rubra* subsp. *cuprea*) and other wetland species, particularly in the northern half of the site.

There are also some open areas (on freer draining/ stony substrates) with examples of rare herbaceous species in amongst dwarf shrubs (prickly mikimiki, *Leptecophylla juniperina* subsp. *juniperina* and porcupine shrub, *Meliclytus alpinus*), mosses and lichens.

Table 4.1 outlines the main vegetation community types present across the study area, and the characteristic and Threatened/At-Risk species present within those communities.

**Table 4-1 The main vegetation communities**

Vegetation/ habitat type	Main native plant species	Threatened/ At-Risk species
Mosaic of harakeke-mingimingi-bracken-copper tussock, and secondary growth scrub	<ul style="list-style-type: none"> <li>• <i>Chionochloa rubra</i> subsp. <i>Cuprea</i></li> <li>• <i>Coprosma propinqua</i></li> <li>• <i>Griselinia littoralis</i></li> <li>• <i>Leptecophylla juniperina</i> subsp. <i>juniperina</i></li> <li>• <i>Phormium tenax</i></li> <li>• <i>Pittosporum tenuifolium</i></li> <li>• <i>Podocarpus laetus</i></li> <li>• <i>Pseudopanax colensoi</i> var. <i>fiordense</i></li> <li>• <i>Pteridium esculentum</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Aciphylla subflabellata</i></li> <li>• <i>Coprosma acerosa</i></li> <li>• <i>Leptospermum scoparium</i></li> <li>• <i>Libertia peregrinnans</i></li> </ul>
Olearia nummulariifolia shrubland	<ul style="list-style-type: none"> <li>• <i>Coprosma propinqua</i></li> <li>• <i>Leptecophylla juniperina</i> subsp. <i>juniperina</i></li> <li>• <i>Olearia nummulariifolia</i></li> <li>• <i>Phormium tenax</i></li> <li>• <i>Pteridium esculentum</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Pimelea prostrata</i> subsp. <i>ventosa</i></li> </ul>
Mānuka scrub	<ul style="list-style-type: none"> <li>• <i>Coprosma propinqua</i></li> <li>• <i>Cordyline australis</i></li> <li>• <i>Leptospermum scoparium</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Leptospermum scoparium</i></li> </ul>

Vegetation/ habitat type	Main native plant species	Threatened/ At-Risk species
	<ul style="list-style-type: none"> <li>• <i>Pittosporum tenuifolium</i></li> <li>• <i>Pteridium esculentum</i></li> </ul>	
Porcupine shrub shrubland-grassland	<ul style="list-style-type: none"> <li>• <i>Acaena microphylla</i> var. <i>pauciglochidiata</i></li> <li>• <i>Melicytus alpinus</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Acaena microphylla</i> var. <i>pauciglochidiata</i></li> <li>• <i>Coprosma acerosa</i></li> <li>• <i>Leptinella serrulata</i></li> </ul>
Prickly mingimingi shrubland	<ul style="list-style-type: none"> <li>• <i>Coprosma acerosa</i>, <i>Coprosma propinqua</i></li> <li>• <i>Leptecophylla juniperina</i> subsp. <i>juniperina</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Coprosma acerosa</i></li> </ul>
Coastal freshwater wetland	<ul style="list-style-type: none"> <li>• <i>Acaena novae-zelandiae</i></li> <li>• <i>Blechnum minus</i></li> <li>• <i>Carex geminate</i></li> <li>• <i>Carex virgata</i></li> <li>• <i>Ficinia nodosa</i></li> <li>• <i>Juncus pallidus</i></li> <li>• <i>Phormium tenax</i></li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>
Coastal herbfield-mossfield-pebblefield	<ul style="list-style-type: none"> <li>• <i>Acaena microphylla</i> var. <i>pauciglochidiata</i></li> <li>• <i>Coprosma acerosa</i></li> <li>• <i>Ficinia nodosa</i></li> <li>• <i>Gaultheria macrostigma</i></li> <li>• <i>Gentianella saxosa</i></li> <li>• <i>Hydrocotyle novae-zeelandiae</i> var. <i>montana</i></li> <li>• <i>Leptinella pusilla</i></li> <li>• <i>Muehlenbeckia axillaris</i></li> <li>• <i>Poa cita</i></li> <li>• <i>Pimelea prostrata</i> subsp. <i>ventosa</i></li> <li>• <i>Raoulia</i> aff. <i>hookeri</i> 'coast'</li> <li>• <i>Selliera radicans</i></li> <li>• <i>Various mosses and lichens</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Acaena microphylla</i> var. <i>pauciglochidiata</i></li> <li>• <i>Coprosma acerosa</i></li> <li>• <i>Epilobium elegans</i></li> <li>• <i>Gentianella saxosa</i></li> <li>• <i>Geranium sessiliflorum</i> var. <i>arenarium</i></li> <li>• <i>Libertia peregrinnans</i></li> <li>• <i>Leptinella pusilla</i></li> <li>• <i>Leptinella serrulate</i></li> <li>• <i>Mentha cunninghamii</i></li> <li>• <i>Pimelea prostrata</i> subsp. <i>ventosa</i></li> <li>• <i>Raoulia</i> aff. <i>hookeri</i> 'coast'</li> </ul>
Estuarine saltmarsh	<ul style="list-style-type: none"> <li>• <i>Plagianthus divaricatus</i></li> <li>• <i>Apodasmia similis</i></li> <li>• <i>Sarcocornia quinqueflora</i> subsp. <i>quinqueflora</i></li> <li>• <i>Samolus repens</i></li> </ul>	<ul style="list-style-type: none"> <li>• <i>Atriplex buchananii</i></li> <li>• <i>Oxybasis ambigua</i></li> <li>• <i>Zostera muelleri</i> subsp. <i>novazelandica</i></li> </ul>
Exotic grassland with scattered harakeke, mingimingi and bracken	<ul style="list-style-type: none"> <li>• <i>Coprosma propinqua</i></li> <li>• <i>Phormium tenax</i></li> <li>• <i>Pteridium esculentum</i></li> </ul>	<ul style="list-style-type: none"> <li>• None</li> </ul>

A complete list of plant species recorded during the site survey is provided in Appendix C.

The location of encountered Threatened and At-Risk plant species recorded at Tiwai Point on 5-7 January 2021 is illustrated in the map below using species codes. Table 4.2 defines the species codes, and Figure 4.5 – Figure 4.10 show some of the encountered threatened species.



**Figure 4-4 Threatened and At-Risk plant species**

**Table 4-2 Threatened vegetation species and code on map**

Species code	Scientific name	Common name	Conservation Status (de Lange et al. 2018a)
ATRbuc	<i>Atriplex buchananii</i>	-	Threatened-Nationally Vulnerable
LIBper	<i>Libertia peregrinans</i>	Native iris, Mīkoikoi	Threatened-Nationally Vulnerable
ACAmvp	<i>Acaena microphylla</i> var. <i>pauciglochidiata</i>	Bidibid, Piripiri	At-Risk-Declining
ACIsu	<i>Aciphylla subflabellata</i>	Speargrass, Spaniard, Kurikuri	At-Risk-Declining
COPace	<i>Coprosma acerosa</i>	Sand coprosma	At-Risk-Declining
GERsva	<i>Geranium sessiliflorum</i> var. <i>arenarium</i>	-	At-Risk-Declining
LEPpus	<i>Leptinella pusilla</i>	Button daisy	At-Risk-Declining
LEPser	<i>Leptinella serrulata</i>	Dryland button daisy	At-Risk-Declining
LEPsco	<i>Leptospermum scoparium</i>	Mānuka, Tea tree	At-Risk-Declining
MENcun	<i>Mentha cunninghamii</i>	NZ mint	At-Risk-Declining
OXYamb	<i>Oxybasis ambigua</i>	-	At-Risk-Declining
PIMpro	<i>Pimelea prostrata</i> subsp. <i>ventosa</i>	Pinātoro, NZ daphne	At-Risk-Declining
RAO aff hoo 'coast'	<i>Raoulia</i> aff. <i>hookeri</i> 'coast'	-	At-Risk-Declining
ZOSmue	<i>Zostera muelleri</i> subsp. <i>novazelandica</i>	Eelgrass	At-Risk-Declining
GENsax	<i>Gentianella saxosa</i>	-	At-Risk-Naturally Uncommon
TETetr	<i>Tetragonia tetragonoides</i>	Kōkihi, NZ spinach, tūtae-ikamoana	At-Risk-Naturally Uncommon

Species code	Scientific name	Common name	Conservation Status (de Lange et al. 2018a)
EPIele	<i>Epilobium elegans</i>	Willow herb	Data Deficient



**Figure 4-5 Buchanan's orache (*Atriplex buchananii*)**



**Figure 4-8 NZ mint (*Mentha cunninghamii*)**



**Figure 4-6 Native iris (*Libertia peregrinans*)**



**Figure 4-9 NZ daphne (*Pimelea prostrata* subsp. *Ventosa*)**



**Figure 4-7 Sand Coprosma (*Coprosma acerosa*)**



**Figure 4-10 *Oxybasis ambigua***

Several other plant species recorded at the site are considered to be significant/ notable because they are uncommon in the Ecological District or are at regional or national distributional limits. These are presented in Table 4.3.

**Table 4-3 Other notable vegetation species**

Species code	Scientific name	Common name	Conservation Status (de Lange et al. 2018a)
OLEnum	<i>Olearia nummulariifolia</i>		Not Threatened
CHlrsc	<i>Chionochloa rubra</i> subsp. <i>cuprea</i>	Red tussock	Not Threatened
PODlae	<i>Podocarpus laetus</i>	Thin-bark tōtara, Hall's tōtara	Not Threatened
PSEcvf	<i>Pseudopanax colensoi</i> var. <i>fiordensis</i>	Mountain five-finger	Not Threatened

#### 4.4 Avifauna

The habitats available for avifauna at the project site include coastline (beach, rocky shoreline and coastal vegetation), mown grass/ turf with areas of white gravels, indigenous shrubland, flaxland and tussock and exotic grassland.

The desktop review provided a base list of 80 bird species that use, or may use, habitat at the project site and immediate surrounds (Appendix A). This list was narrowed down to 64 species when species were excluded as their primary habitats were not within the project area, and/ or are likely to be very rare visitors to the site. The list of 64 species is provided in Table 4.4 and includes seven Threatened species, 12 At-Risk species, five non-resident natives, 24 Not Threatened native or endemic species, and 16 introduced species. 29 of the native and endemic species listed primarily use coastal/ estuarine habitats, that is, habitat around the periphery of the site and in the wider Awarua Bay, Bluff harbour and oceanic areas surrounding the Tiwai Peninsula (denoted by a pale yellow background in Table 4.4). Of these 29 species, 14 are Threatened or At-Risk, and five are migratory species.

During the field walkover, 35 of the 64 species were observed. Of the 35 species observed, 26 were native (including non-resident natives) or endemic and nine were introduced.

Two Threatened species were detected on site: black-billed gull and banded dotterel. One black-billed gull was observed roosting on a coastal headland along Awarua Bay. 22 banded dotterel (including two large chicks) were observed on mown grass/ turf and flat gravel areas within the fenced grounds of the Smelter Domain. Previous surveys by Wildlands detected seven nesting pairs using these habitats within the smelter grounds (Pierce, 2004). During the site walkover, seven banded dotterel were observed foraging on the coastal edge and low tide sand/ pebble bars along coastline north of the wharf (within Bluff harbour). One banded dotterel was observed on coastline along Awarua Bay and five dotterels were observed foraging in an area of mown grass outside of the fenced smelter grounds near the reception area. A previous survey by Wildlands also detected two pairs of breeding banded dotterel on the mound of buried contaminants in the Landfill Domain (Pierce, 2004).



**Figure 4-11 Example of banded dotterel habitat within the Smelter Domain**



**Figure 4-12 Coastal foraging habitat north of the wharf**

Ten At-Risk species were detected during the site walkover (see Table 4-4). Red-billed gull, eastern bar-tailed godwit, pied shag, Stewart Island shag, black shag and royal spoonbill were observed foraging and roosting in coastal areas. South Island pied oystercatcher were observed in coastal areas and a few individuals were observed foraging in mown grass along Tiwai Road (Access Road) near the smelter (including a pair with two large chicks). Variable oystercatchers were observed foraging in coastal areas and a pair was observed nesting (one egg was observed in the nest) on the edge of Tiwai Road near the smelter. Three South Island fernbird calls were heard in response to playback calls within flax-bracken-prickly mingimingi-coprosma-red tussock habitat. New Zealand pipit were observed along road/ track edges.



**Figure 4-13 A variable oystercatcher nest with an egg by the roadside**



**Figure 4-14 Flaxland habitat where fernbird calls were heard**

Table 4-4 shows avifauna species that use, or potentially use, habitat within the project site. Species observed during the field walkover are indicated by a tick in the far-right column. Species highlighted pale yellow use coastal/ estuarine habitat (including migratory species). Primary habitats are shown in dark green and secondary habitats are shown in light green.

**Table 4-4 Avifauna species that use, or potentially use, habitat within the project site**

SPECIES		CONSERVATION STATUS (Robertson et al. 2017)		Native forest	Exotic Forest	Scrub / shrubland	Farmland/ open country	Freshwater/ wetlands	Coastal/ estuary	Oceanic	Detected during field walkover
Black-billed gull	<i>Larus bulleri</i>	Threatened	Nationally Critical								✓
Reef heron	<i>Egretta sacra</i>	Threatened	Nationally Endangered								
Black-fronted tern	<i>Chlidonias albostratus</i>	Threatened	Nationally Endangered								
Banded dotterel	<i>Charadrius bicinctus</i>	Threatened	Nationally Vulnerable								✓
Wrybill	<i>Anarhynchus frontalis</i>	Threatened	Nationally Vulnerable								
Caspian tern	<i>Hydroprogne caspia</i>	Threatened	Nationally Vulnerable								
Lesser knot	<i>Calidris canutus rogersi</i>	Threatened	Nationally Vulnerable								
South Island pied oystercatcher	<i>Haematopus finschi</i>	At-Risk	Declining								✓
Red-billed gull	<i>Larus novaehollandiae scopulinus</i>	At-Risk	Declining								✓
NZ pipit	<i>Anthus n. novaeseelandiae</i>	At-Risk	Declining								✓
White-fronted tern <sup>2</sup>	<i>Sterna s. striata</i>	At-Risk	Declining								

<sup>2</sup> Observed at sea only, not on land within the project site.

SPECIES		CONSERVATION STATUS (Robertson et al. 2017)		Native forest	Exotic Forest	Scrub / shrubland	Farmland/ open country	Freshwater/ wetlands	Coastal/ estuary	Oceanic	Detected during field walkover
Fernbird	<i>Bowdleria punctata</i>	At-Risk	Declining								✓
Eastern bar-tailed godwit	<i>Limosa lapponica baueri</i>	At-Risk	Declining								✓
Pied shag	<i>Phalacrocorax varius</i>	At-Risk	Recovering								✓
Stewart Island Shag	<i>Leucocarbo chalconotus</i>	At-Risk	Recovering								✓
NZ dotterel	<i>Charadrius obscurus</i>	At-Risk	Recovering								
Variable oystercatcher	<i>Haematopus unicolor</i>	At-Risk	Recovering								✓
Black shag	<i>Phalacrocorax carbo novaehollandiae</i>	At-Risk	Naturally Uncommon								✓
Royal spoonbill	<i>Platalea regia</i>	At-Risk	Naturally Uncommon								✓
Pacific golden plover	<i>Pluvialis fulva</i>	Non-Resident Native	Migrant								
Ruddy turnstone	<i>Arenaria interpres</i>	Non-Resident Native	Migrant								✓
Sharp-tailed sandpiper	<i>Calidris acuminata</i>	Non-Resident Native	Migrant								
Red-necked stint	<i>Calidris ruficollis</i>	Non-Resident Native	Migrant								
Eastern little tern	<i>Sternula albifrons sinensis</i>	Non-Resident Native	Migrant								

SPECIES		CONSERVATION STATUS (Robertson et al. 2017)		Native forest	Exotic Forest	Scrub / shrubland	Farmland/ open country	Freshwater/ wetlands	Coastal/ estuary	Oceanic	Detected during field walkover
Spotted shag	<i>Stictocarbo p. punctatus</i>	Not Threatened	Not Threatened								
Paradise shelduck	<i>Tadorna variegata</i>	Not Threatened	Not Threatened								✓
NZ shoveler	<i>Anas rhynchos variegata</i>	Not Threatened	Not Threatened								✓
Pied stilt	<i>Himantopus h. leucocephalus</i>	Not Threatened	Not Threatened								✓
Morepork	<i>Ninox n. novaeseelandiae</i>	Not Threatened	Not Threatened								
Kingfisher	<i>Todiramphus sanctus vagans</i>	Not Threatened	Not Threatened								
Brown creeper	<i>Mohoua novaeseelandiae</i>	Not Threatened	Not Threatened								
Grey warbler	<i>Gerygone igata</i>	Not Threatened	Not Threatened								✓
Bellbird	<i>Anthornis m. melanura</i>	Not Threatened	Not Threatened								
Kereru	<i>Hemiphaga novaeseelandiae</i>	Not Threatened	Not Threatened								
Australasian gannet	<i>Morus serrator</i>	Not Threatened	Not Threatened								
South Island fantail	<i>Rhipidura fuliginosa</i>	Not Threatened	Not Threatened								
Little shag	<i>Phalacrocorax melanoleucos brevirostris</i>	Not Threatened	Not Threatened								✓
NZ scaup	<i>Aythya novaeseelandiae</i>	Not Threatened	Not Threatened								
Grey teal	<i>Anas gracilis</i>	Not Threatened	Not Threatened								

SPECIES		CONSERVATION STATUS (Robertson et al. 2017)		Native forest	Exotic Forest	Scrub / shrubland	Farmland/ open country	Freshwater/ wetlands	Coastal/ estuary	Oceanic	Detected during field walkover
Pukeko	<i>Porphyrio m. melanotus</i>	Not Threatened	Not Threatened								
Welcome swallow	<i>Hirundo n. neoxena</i>	Not Threatened	Not Threatened								✓
Tui	<i>Prosthemadera n. novaeseelandiae</i>	Not Threatened	Not Threatened								✓
White-faced heron	<i>Egretta novaehollandiae</i>	Not Threatened	Not Threatened								✓
Black swan	<i>Cygnus atratus</i>	Not Threatened	Not Threatened								✓
Swamp harrier	<i>Circus approximans</i>	Not Threatened	Not Threatened								✓
Spur-winged plover	<i>Vanellus miles novaehollandiae</i>	Not Threatened	Not Threatened								✓
Black-backed gull	<i>Larus d. dominicanus</i>	Not Threatened	Not Threatened								✓
Silvereye	<i>Zosterops lateralis</i>	Not Threatened	Not Threatened								✓
Rock pigeon	<i>Columba livia</i>	Introduced	Introduced								✓
Skylark	<i>Alauda arvensis</i>	Introduced	Introduced								
Dunnock	<i>Prunella modularis</i>	Introduced	Introduced								
Blackbird	<i>Turdus merula</i>	Introduced	Introduced								✓
Song thrush	<i>Turdus philomelos</i>	Introduced	Introduced								✓
Yellowhammer	<i>Emberiza citrinella</i>	Introduced	Introduced								
Chaffinch	<i>Fringilla coelebs</i>	Introduced	Introduced								✓

SPECIES		CONSERVATION STATUS (Robertson et al. 2017)		Native forest	Exotic Forest	Scrub / shrubland	Farmland/ open country	Freshwater/ wetlands	Coastal/ estuary	Oceanic	Detected during field walkover
Greenfinch	<i>Carduelis chloris</i>	Introduced	Introduced								
Goldfinch	<i>Carduelis</i>	Introduced	Introduced								✓
Redpoll	<i>Carduelis flammea</i>	Introduced	Introduced								✓
House sparrow	<i>Passer domesticus</i>	Introduced	Introduced								✓
Starling	<i>Sturnus vulgaris</i>	Introduced	Introduced								✓
Magpie	<i>Gymnorhina tibicen</i>	Introduced	Introduced								✓
Canada goose	<i>Branta canadensis</i>	Introduced	Introduced								
Feral goose	<i>Anser anser</i>	Introduced	Introduced								
Mallard	<i>Anas platyrhynchos</i>	Introduced	Introduced								

## 4.5 Herpetofauna

### 4.5.1 Desktop assessment

The DoC herpetofauna database (BioWeb) has recent records (<30 years)<sup>3</sup> for four species of lizard within 15 km of the study area. These are listed in Table 4-5. Conservation status and nomenclature follows Hitchmough et al. (2016).

**Table 4-5 Native lizard species recorded within 15 km of the study site**

Common Name	Scientific Name	Conservation Status	Habitat Preferences	Functional group
Recent records (<30 years)				
Southern grass skink	Oligosoma aff. polychroma Clade 5	At-Risk – Declining	Dry open areas with low vegetation or debris such as logs or stones for cover.	Terrestrial skink
Green skink	Oligosoma chloronoton	At-Risk – Declining	Scrublands, tussock grasslands, flaxlands, rockpiles.	Terrestrial skink
Cryptic skink	Oligosoma inconspicuum	At-Risk – Declining	Scrublands, grasslands, coastal areas and boulderfields	Terrestrial skink
Korero gecko	Woodworthia “Otago/Southland large”	At-Risk – Declining	Loose rocks, holes and crevices in trees or rocky outcrops.	Terrestrial/ arboreal gecko

Two lizard surveys have been undertaken at the peninsula; one in 2008 (Lettink, 2008) and another in 2012. During these surveys, there were observations of southern grass skink, green skink and cryptic skink. No geckoes were observed during either survey.

### 4.5.2 Habitat Assessment

During the site walkover, significant areas of lizard habitat were observed. The flax/ tussock lands present over much of the peninsula could provide suitable habitat for all of the species identified in Table 4.5. Figure 4.15 and Figure 4.16 show examples of this habitat. The grassy coastal areas also provide good quality skink habitat (Figure 4.17), and the rocky shorelines could provide habitat to both skinks and geckoes (Figure 4.18). The only areas that may not provide lizard habitat within the study area are the hard, impermeable surfaces (roads, concreted areas etc), the southern sandy beach (except areas of debris), and the regularly mown grass and fine, embedded gravel areas around the smelter, which do not provide sufficient cover or refugia.

<sup>3</sup> Additionally there was a single record of an “unidentified green gecko” (likely jewelled gecko), but this record was from 1980 and is now considered out-of-date.



**Figure 4-15 Flaxland-tussockland. Potential habitat for a number of native lizard species**



**Figure 4-17 Grassy dunelands to the south/southeast of the smelter**



**Figure 4-16 Low tussockland habitat**



**Figure 4-18 Rocky shoreline with woody debris. Potential refugia for native lizards.**

Based on previous surveys and the habitat assessment, it is considered highly likely that the southern grass skink, cryptic skink and green skink are all present within the study area. It is also possible that the korero gecko is present within the site, given its known presence in the

wider landscape. While green geckoes have not been commonly seen in and around the area, this could be due to their low detectability and a low survey effort rather than their absence from the peninsula. Therefore, it is possible that these may be present in the area as well.

In summary, all of the species described in Table 4.5 could potentially be present within the study area.

#### 4.6 Terrestrial invertebrates

Previous surveys of the peninsula have recorded a small population of a highly threatened moth, *Asaphodes frivola* (*A. frivola*), on Tiwai Spit, northeast of the smelter (Patrick, 2014). This is one of only two known populations of the moth, the other being at the Three Sisters Sand Dune to the west. This moth has a conservation status of Threatened – Nationally Critical.

During the site surveys in January 2021, Tiwai Spit was resurveyed for *Asaphodes frivola*, to determine if the moth and its habitat have persisted. *A. frivola* larvae were observed on the remuremu at the estuary surrounding Tiwai Spit .

Surveys throughout the study area also resulted in observations of a number of other notable invertebrate species. Tiwai Spit supported a community of *Dasyuris partheniata* (At-Risk – Declining) within the speargrass to the east of Tiwai Road. The foredunes to the south and southeast of the smelter support populations of the moths *Notoreas casanova* (Threatened – Nationally Vulnerable) and *Sporophyla oenospora* (Threatened – Nationally Critical), as well as two undescribed moth species (*Meterana nsp.*, *Lycaena nsp.*), which are considered likely to be rare/ threatened. *N. casanova* and the undescribed *Meterana* are also present on the open quartz gravel areas where mat daphne is growing.

The shrubland/ grassland areas which cover much of the peninsula supports a diverse array of indigenous moths and butterflies, including the At-Risk *Dasyuris partheniata*. A species list is provided in Appendix B.



**Figure 4-19 Notoreas Casanova**



**Figure 4-20 Meterana meyricki (commonly on Pimelea)**

**TIWAI BOULDER COPPER BUTTERFLY – *Lycaena* new species**



Male (left) female (right) with wingspans of 20-22 mm  
Flight period is late November to late February  
Flying by day in open turf and stony areas

**Figure 4-21 Tiwai boulder copper butterfly**

## 5. Ecological Values

### 5.1 Terrestrial vegetation

The coastal vegetation communities contain many Threatened and At-Risk plant species, which support a variety of rare and threatened fauna. These communities are therefore considered to be of **Very High Value**.

The shrublands/ flaxlands/ tussock grasslands at the core of the site also have examples of At-Risk or Threatened species throughout, and is highly diverse, relatively intact, and representative. They also provide habitat to a number of At-Risk fauna (e.g. fernbird, native skink species, invertebrates), therefore the shrublands/ flaxlands/ tussock grasslands at the core of the site are considered to be of **High Value**.

The mown grass and open gravel areas around the smelter and scattered across the site generally have low value in terms of vegetation and habitat condition; however, they have high contextual value as a nesting habitat for a threatened species (banded dotterel). They are therefore considered to be of **low** value overall, and seasonally **Very High Value** as banded dotterel nesting habitat.

There are large areas on the southern side of the site that were recently burned off (2018) and are now beginning to regenerate as bracken fernland-grassland with occasional flaxes. These areas currently have low, sparse vegetation, and limited diversity. It is expected that they will revegetate rapidly, especially where weeds do not dominate. They also provide some habitat for At-Risk species, primarily the native skinks present across the site, however the habitat here is of lower quality than that of the adjacent flaxlands/ tussock grasslands. This area is currently considered to be of **Moderate Value**.

### 5.2 Avifauna

Many Threatened and At-Risk avifauna species use, or potentially use, habitat within and surrounding the study site. The habitats used by these species include coastline (beach, rocky shoreline and coastal vegetation), mown grass/ turf with areas of white gravels, indigenous shrubland, flaxland and tussock and exotic grassland. Many of these species primarily use coastal/ estuarine habitats. Following the EIANZ guidelines for determining fauna values, these species are considered to have **Moderate, High or Very High Value** (see Table 5.1).

### 5.3 Herpetofauna

All of the species known to be present or potentially present within the study area have a conservation status of At-Risk – Declining (Hitchmough et al. 2016). Lizards are expected to be present across most of the site, wherever there is suitable cover and food sources – this includes the flax/ tussock grasslands, the coastal foredunes, the rocky coastal margins along the western and northern coasts, and the regenerating grasslands where recent fires have occurred. Following the EIANZ guidelines for determining fauna values, any lizards present and their habitats are considered to be **High Value**.

### 5.4 Terrestrial invertebrates

A number of Threatened and At-Risk invertebrate species are present (Hoare et al. 2017). These species are present in a variety of habitats across the site, including the salt marshes at Tiwai Spit, the foredunes to the south and southeast of the smelter, and the flax/ tussock grasslands covering much of the remaining study area. Following the EIANZ guidelines, these species and their habitats are considered to be **High or Very High Value** (see Table 5.1).

## 5.5 Summary

Ecological values are summarised below in **Error! Reference source not found.**Table 5.1.

**Table 5-1 Ecological values of habitats and indigenous species within the project site**

Classification	Ecological component	Criteria	Ecological Value
Vegetation/ Habitat	Coastal cushionfield, grassland and saltmarsh communities	Representativeness – High Rarity/ Distinctiveness – High Diversity and Pattern – High Context – High	<b>Very High</b>
	Coastline	Representativeness – High Rarity/ Distinctiveness – High Diversity and Pattern – High Context – High	<b>Very High</b>
	Shrublands/ flaxlands/ tussock grasslands	Representativeness – Moderate Rarity/ Distinctiveness – Moderate Diversity and Pattern – High Context – High	<b>High</b>
	Mown grass/ turf and gravel areas (including buried contaminant mound)	Representativeness – Low Rarity/ Distinctiveness – Low Diversity and Pattern – Low Context – High (habitat)	<b>Low</b> (but note areas can have high value for particular species even when low vegetation value)
	Recently burned areas	Representativeness – Low Rarity/ Distinctiveness – Low Diversity and Pattern – Low Context – Moderate	<b>Moderate</b>
Avifauna	Black-billed gull	Threatened – Nationally Critical	<b>Very High</b>
	Reef heron	Threatened – Nationally Endangered	<b>Very High</b>
	Black-fronted tern	Threatened – Nationally Endangered	<b>Very High</b>
	Banded dotterel	Threatened – Nationally Vulnerable	<b>Very High</b>
	Wrybill	Threatened – Nationally Vulnerable	<b>Very High</b>
	Caspian tern	Threatened – Nationally Vulnerable	<b>Very High</b>
	Lesser knot	Threatened – Nationally Vulnerable	<b>Very High</b>
	South Island pied oystercatcher	At-Risk – Declining	<b>High</b>
	Red-billed gull	At-Risk – Declining	<b>High</b>

Classification	Ecological component	Criteria	Ecological Value
	New Zealand pipit	At-Risk – Declining	<b>High</b>
	White-fronted tern	At-Risk – Declining	<b>High</b>
	South Island fernbird	At-Risk – Declining	<b>High</b>
	Eastern bar-tailed godwit	At-Risk – Declining	<b>High</b>
	Pied shag	At-Risk – Recovering	<b>Moderate</b>
	Stewart Island shag	At-Risk – Recovering	<b>Moderate</b>
	New Zealand dotterel	At-Risk – Recovering	<b>Moderate</b>
	Variable oystercatcher	At-Risk – Recovering	<b>Moderate</b>
	Black shag	At-Risk – Naturally Uncommon	<b>Moderate</b>
	Royal spoonbill	At-Risk – Naturally Uncommon	<b>Moderate</b>
Herpetofauna	Southern grass skink	At-Risk – Declining	<b>High</b>
	Green skink	At-Risk – Declining	<b>High</b>
	Cryptic skink	At-Risk – Declining	<b>High</b>
	Korero gecko (potential)	At-Risk – Declining	<b>High</b>
Terrestrial invertebrates	Asaphodes frivola	Threatened – Nationally Critical	<b>Very High</b>
	Notoreas casanova	Threatened – Nationally Vulnerable	<b>Very High</b>
	Sporophyla oenospora	Threatened – Nationally Critical	<b>Very High</b>
	Dasyuris partheniata	At-Risk – Declining	<b>High</b>

## 5.6 Significance (Section 6c RMA)

The ICDP outlines the following significance criteria (Part two, page 43, ECO-P1):

- Representativeness
- Rarity/ distinctiveness
- Diversity and pattern
- Ecological context

Those communities which have been assigned ecological values of **High** and **Very High** (Figure 5.1) meet all of the criteria and should be considered “significant”. The **Moderate** value area (that which was burnt) is not yet representative, does not have rare and distinctive attributes (we assume lizard colonisation has not occurred), and does not have the patterns and diversity expected. It is unlikely significant, however, there may be an argument around its ecological contextual importance. The **Low** value areas are not significant.

The areas with seasonal (or periodic) values are sometimes significant, depending on the presence of particular (avian in the main) species.

## 5.7 Implications for closure

Implications for closure will be addressed in more detail in a subsequent Environmental Impact Assessment, which will be outlined in the Environmental Impact Assessment for Closure Memorandum (12533899-2400-EV-MEM-00001, CAL.11-2400-H-MMO-00001) to be completed as part of the PS.

Adverse effects to and in the areas of habitat of **Very High Value** with a number of very special habitat/ community types and/ or species (see Table 5.1) must be avoided. By “avoid” we mean that there can be no loss of individuals that are classified as Threatened, and no loss of extent of threatened habitat types. High value habitats (shown in blue in Figure 3) may tolerate some level of impact (with appropriate mitigative actions), but care will need to be taken that any disturbance has no follow-on effects for adjacent Very High Value areas.

Additionally, there are areas within the site which have Seasonal Very High Value. These are areas where the Threatened banded dotterel was observed to be nesting, and so will need to be avoided during the nesting season (August to January). Outside of the nesting season these areas would be considered to be Low Value, and with appropriate management can be affected.

Areas of **Low** value include the areas of exotic plantation, mown grass (outside of the nesting season), and regularly disturbed gravel areas. A range of adverse effects can be entertained in these areas, as long as management regimes are in place to manage weed species and counter effects on specific species and/ or seasonal use effects. Pine plantation and shelterbelts may be removed from the site, as long as measures are put in place to avoid any adjacent Very High or High value areas when doing so (e.g. felling away from these areas).

The recently burnt area (denoted in red in Figure 5.1) has a currently **Moderate** value. It is expected that this will improve to **High** (and significant) over the next 20 years provided that weed invasion does not become dominant. Currently, effects within this area could be entertained if rehabilitation actions are sufficient to mitigate for any loss of ecological value and an effective weed management programme is put in place.

The closure risks related to ecology are outlined and reviewed in the broader Environmental Impact Assessment for Closure Memorandum (12533899-2400-EV-MEM-00001 / CAL.11-2400-H-MMO-00001) which includes Environmental Risk Assessment for the Closure Central Case.

With proper care, the site offers high potential to rehabilitate habitat which is currently of moderate and low value, increase the range of At-Risk and Threatened species, and secure the existing High and Very High Value habitats with appropriate land management practices, including weed and pest control. The site as a whole however, has many areas of constraint where no adverse effect to the existing habitat is allowed by legislation.



## 5.8 Recommendation for follow-up actions

At this stage, without the finalisation of specific closure activities, detailed recommendations cannot be provided. However, general recommendations in regard to management of the valued fauna (often in low and moderate value habitats) broadly include the following:

### Short-term actions:

- **Lizard management and salvage: If any areas in which native lizards may reside will be affected<sup>4</sup>,** Under the part 1 of the Wildlife Act (1953), a Lizard Management Plan should be prepared prior to any closure activities, and a Wildlife Authority (permit to handle and relocate lizards) applied for<sup>5</sup>. Permits typically take a minimum of 3 months, and in some cases up to 8 months to process, so this will need to be considered well in advance of closure. The Lizard Management Plan should include methods to salvage and relocate any lizards present within any disturbance area, and mitigation requirements (e.g. pest control, habitat enhancement) for the relocation site.
- **Avifauna management:** An avifauna management plan should also be prepared as required by the Wildlife Act, given the variety of Threatened and At-Risk species known to be present within the site. This plan should include methods to discourage nesting within areas of concern, methods to avoid and protect any vulnerable avifauna within the site, and mitigation measures to ensure no net loss of habitat to Threatened and At-Risk species.
- **Invertebrates:** Areas that support critically threatened invertebrate species (Tiwai Spit and the southern foredunes) should be avoided, as any disturbance of these habitats could have considerable adverse effects that would be difficult to mitigate or offset.

### Long-term actions:

- **Vegetation:** Given the presence of a number of threatened plants across the site resource consents will be required to enable vegetation removal. These consents will set out the process required to obtain regulator approval for mitigation practices, location and extent. Vegetation clearance should be managed and minimised in order to avoid disturbance to these species. An ecological management plan should incorporate clearance methods which limit disturbance in High Value areas, avoid disturbance in Very High Value areas, and implement mitigation/ offset requirements to ensure no net loss of values. Any vegetation clearance within this site will likely require a high ecological compensation ratio, therefore potential replanting sites will need to be considered early if any High Value vegetation areas are to be cleared.

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<sup>4</sup> Potential lizard habitats cover most of the site – the areas which are not considered lizard habitat include hard, impermeable surfaces (roads, concreted areas etc), the southern sandy beach (except areas of debris), and the regularly mown grass and fine, embedded gravel areas around the smelter.

<sup>5</sup> As a requirement of the Wildlife Act 1953

## 6. Conclusion

The site is generally considered to be of **High** to **Very High** value with a number of very special habitat/ community types. Many of the communities present support Threatened or At-Risk plant, bird, lizard or invertebrate species, and any disturbance to these sites may have significant adverse effects at a population level. The site is within the Coastal Environment defined in the NZCPS, which directs that adverse effects to these values shall be avoided.

Areas of **Low** value include the areas of exotic plantation, mown grass, and regularly disturbed gravel areas. However, some of these areas have **Seasonally High** value due to particular faunal use. The recently burnt area has a **Moderate** value and is expected to improve to **High** value over the next 20 years where weed invasion does not become dominant.

Disturbance to areas identified as **High** and **Very High** value should be avoided. Areas of **Low** and **Moderate** value can be disturbed with particular management regimes in place to counter effects on specific species and/ or seasonal use by valued species.

The closure risks related to ecology are outlined and reviewed in the broader Environmental Impact Assessment for Closure Memorandum (12533899-2400-EV-MEM-00001 / CAL.11-2400-H-MMO-00001) which includes Environmental Risk Assessment for the Closure Central Case.

With proper care, the site offers high potential to rehabilitate very valuable habitat, increase the range of special species living there, and secure the existing high and very high value habitats through avoiding or minimising loss of ecological values and effective and ongoing weed and pest control.

## 7. References

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## 8. Acronyms

The acronyms that apply to this document are outlined in **Error! Reference source not found..**

**Table 8-1 Acronyms**

Acronym	Definition
CMS	Conservation Management Strategy
DoC	Department of Conservation
EIANZ	Environment Institute of Australia and New Zealand
HAZMAT	Hazardous Material
ICDP	Invercargill City District Plan
LENZ	Land Environments of New Zealand
MVCC	Minimum Viable Closure Cost
NZAS	New Zealand Aluminium Smelters
NZCPS	New Zealand Coastal Policy Statement
OSNZ	Ornithological Society of New Zealand
PCMM	Post Closure Monitoring and Management
PS	Preliminary Study
RMA	Resource Management Act (1991)
RPS	Regional Policy Statement
SCEMP	Site Closure Environmental Management Plan
RT	Rio Tinto
ZOI	Zone of Influence

# Appendices







## Appendix B – Invertebrate species list

FAMILY/ Genus/ species	Ecology/ hostplant	Threat Status*	Local habitat use
<b>Nepticulidae</b>		*Hoare <i>et al.</i> 2017	
<i>Stigmella hakekeae</i>	leaf mining larvae on <i>Olearia</i> species, here <i>Olearia nummularifolia</i>		Shrubland by bridge
<b>Hepialidae</b>			
<i>Wiseana copularis</i>	larvae subterranean on roots		Grassland - shrubland areas
<i>W. umbraculata</i>	larvae subterranean on roots		Wetland areas
<b>Choreutidae</b>			
<i>Asterivora colpota</i>	larvae in webbing on underside of <i>Senecio</i> species		Road edges and open areas and shrubland
<b>Glyphipterigidae</b>			
<i>Glyphipterix achlyoessa</i>	larvae bore in grass stems		Grassland areas
<i>G. barbata</i>	larvae bore stems of copper tussock		Tall grassland-shrubland areas
<i>G. iochaera</i>	larvae bore in <i>Juncus</i> species		Turf and estuarine areas
<i>G. oxymachaera</i>	larvae bore in grass stems		Coastal turf areas
<i>G. triselena</i>	larvae bore in grass stems		Coastal turf areas
<b>Plutellidae</b>			
<i>Chrysorthenches porphyritis</i>	larvae on totara foliage		Shrubland
<b>Tortricidae</b>			
<i>Apoctena persecta</i>	larvae web leaves of small-leaved <i>Coprosma</i> species and feed on foliage		Shrubland
<i>Capua semiferana</i>	larvae feed on leaf litter under shrubs		Shrubland
<i>Epichorista siriana</i>	larvae on grasses		Grassland - shrubland areas
<i>Harmologa petrias</i>	larvae on <i>Ozothamnus</i> foliage		Shrubland
<i>Harmologa</i> new species	larvae on <i>Ozothamnus</i> foliage		Shrubland
<i>Merophyas paraloxa</i>	larvae in saltmarsh sward		Coastal estuarine areas
<i>Protithona potamias</i>	larvae in saltmarsh sward		Coastal estuarine areas
<i>Strepsicrates ejectana</i>	larvae on manuka		Grassland - shrubland areas
<i>S. zopherana</i>	larvae on manuka		Grassland - shrubland areas
<b>Depressariidae</b>			
<i>Eutorna inornata</i>	larvae in saltmarsh sward		Coastal estuarine areas
<b>Gelechiidae</b>			
<i>Kiwaia cheradias</i>	larvae in short turf sward		Coastal turf areas
<i>K. lithodes</i>	larvae feed on <i>Raoulia hookeri</i> cushions		Coastal turf areas
<i>Megcraspedus calamagonus</i>	larvae in copper tussock seedheads		Tall grassland areas
<b>Elachistidae</b>			
<i>Cosmiotes ombrodoca</i>	larvae mine grasses		Open turf areas

<i>Elachista thallophora</i>	larvae on copper tussock		Tall grassland areas
<b>Oecophoridae</b>			
<i>Gymnobathra parca</i>	larvae on leaf litter		Tall grassland-shrubland areas
<i>Gymnobathra sarcoxantha</i>	larvae in case and feed on leaf litter		Tall grassland-shrubland areas
<i>Gymnobathra</i> new species	larvae on leaf litter		Tall grassland-shrubland areas
<i>Leptocroca scholaea</i>	larvae feed on leaf litter		Tall grassland-shrubland areas
<i>Stathmopoda horticola</i>	larvae polyphagous on fruits		Tall grassland-shrubland areas
<i>Tingena melinella</i>	larvae feed on leaf litter		Tall grassland-shrubland areas
<i>T. choradelpha</i>	larvae feed on leaf litter		Tall grassland-shrubland areas
<i>T. compsogramma</i>	larvae feed on leaf litter		Tall grassland-shrubland areas
<i>T. innotatella</i>	larvae feed on leaf litter		Tall grassland-shrubland areas
<i>T. maranta</i>	larvae feed on leaf litter		Tall grassland-shrubland areas
<i>T. ombrodella</i>	larvae feed on leaf litter		Tall grassland-shrubland areas
<i>T. perichlora</i>	larvae feed on leaf litter		Tall grassland-shrubland areas
<i>T. pronephela</i>	larvae feed on leaf litter		Tall grassland-shrubland areas
<i>Trachypepla anastrella</i>	larvae feed on leaf litter		Tall grassland-shrubland areas
<b>Pterophoridae</b>			
<i>Pterophorus innotatalis</i>	larvae mine <i>Dichondra</i> leaves		Coastal turf areas
<i>Platyptilia aelodes</i>	larvae on flowers of <i>Gentiana saxosa</i>		Coastal turf areas
<i>Stenoptilia zophodactyla</i>	larvae on <i>Centuaria</i> and <i>G. saxosa</i>		Coastal turf areas
<b>Pyralidae</b>			
<i>Delogenes limodoxa</i>		Currently proposed as "Threatened - Nationally Critical"	Coastal turf areas
<i>Sporophylla oenospora</i>		Threatened - Nationally Critical	Coastal turf areas
<b>Crambidae</b>			
<i>Deana hybreasalis</i>	larvae on <i>Clematis</i> species		Tall grassland-shrubland
<i>Diasemia grammalis</i>	larvae on mat pohuehue - <i>Muehlenbeckia axillaris</i>		Coastal turf areas
<i>Eudonia feredayi</i>	larvae on mosses		Coastal turf areas
<i>E. asterisca</i>	larvae on mosses		Tall grassland-shrubland
<i>E. cyptastis</i>	larvae on mosses		Estuarine turf areas
<i>E. leptalea</i>	larvae a sod-webworm on plant roots		Coastal turf areas
<i>E. minusculalis</i>	larvae on mosses		Tall grassland-shrubland
<i>E. oculata</i>	larvae on mosses		Tall grassland-shrubland

<i>E. philerga</i>	larvae on mosses		Tall grassland-shrubland
<i>E. steropaea</i>	larvae on mosses		Coastal turf areas
<i>E. submarginalis</i>	larvae on mosses		Coastal turf areas
<i>Orocrambus angustipennis</i>	larvae in grasses and sedges		Tall grassland-shrubland
<i>O. flexuosellus</i>	larvae in grass stems		Short grasslands
<i>O. lewisi</i>	larvae on tussock grasses		Open grasslands
<i>O. ramosellus</i>	larvae in grass stems		Tall grassland-shrubland
<i>O. xanthogrammus</i>	larvae feed on cushions of <i>Raoulia hookeri</i> cushions		Coastal turf areas and sand dunes
<i>Scoparia chalicodes</i>	larvae on mosses		Open areas
<i>S. augastis</i>	larvae on mosses		Estuarine turf areas
<i>S. autumnna</i>	larvae on mosses		Tall grassland-shrubland
<i>S. ergatis</i>	larvae on mosses		Open areas
<i>S. exilis</i>	larvae on mosses		Open areas
<i>S. tetracycla</i>	larvae on <i>Coprosma acerosa</i>		Coastal dunes
<i>Udea flavidalis</i>	larvae on pohuehue species		Tall grassland-shrubland
<b>Lycaenidae</b>			
<i>Lycaena</i> new species 1: common copper group	larvae on scrambling and large-leaved pohuehue - <i>Muehlenbeckia complexa</i> and <i>M. australis</i>		Grassland and shrubland areas
<i>Lycaena</i> new species 2: boulder copper group	larvae on mat pohuehue - <i>Muehlenbeckia axillaris</i>		Coastal turf and open quartz gravel areas
<b>Nymphalidae</b>			
<i>Argyrophenga antipodum</i>	larvae on copper tussock		Copper tussock areas
<b>Geometridae</b>			
<i>Arctesthes catapyrrha</i>	larvae on <i>Nertera</i> , <i>Colobanthus</i> , <i>Plantago</i> and other diminutive herbs		Foredune turf areas
<i>Asaphodes abrogata</i>	larvae on <i>Plantago</i> species		Edges of open areas and roads
<i>A. aegrota</i>	larvae on herbs		Turf and open areas
<i>A. frivola</i>	larvae on <i>Selliera radicans</i>	Threatened - Nationally Critical	Estuarine areas
<i>Austrocidaria cedrinodes</i>	larvae on small-leaved <i>Coprosma</i> species		Grassland and shrubland
<i>A. gobiata</i>	larvae on small-leaved <i>Coprosma</i> species		Grassland and shrubland
<i>A. similata</i>	larvae on small-leaved <i>Coprosma</i> species		Grassland and shrubland
<i>Chloroclystis nereis</i>	larvae in <i>Pseudognaphalium</i> flowers		Open areas and road edges
<i>C. filata</i>	larvae on flowers of shrubs		Grassland and shrubland
<i>C. inductata</i>	larvae on flowers of shrubs		Grassland and shrubland
<i>Dasyuris partheniata</i>	larvae on <i>Aciphylla glaucescens</i>	At-Risk - Declining	Grassland and shrubland
<i>Declana junctilinea</i>	larvae on various shrubs and lianes		Grassland and shrubland
<i>Epicyme rubropunctaria</i>	larvae on <i>Haloragis erecta</i>		Edges of open areas and roads
<i>Epyaxa rosearia</i>	larvae on herbs		Grassland and shrubland

<i>E. venipunctata</i>	larvae on herbs		Grassland and shrubland
<i>Helastia corcularia</i>	larvae on herbs		Open areas and shrubland edges
<i>Homodotis falcata</i>	larvae on leaf litter		Open areas and shrubland edges
<i>Hydriomena deltoidata</i>	larvae on herbs including <i>Plantago</i>		
<i>Microdes epicryptis</i>	larvae on <i>Juncus</i> in damp areas		Turf and estuarine areas
<i>Notoreas casanova</i>	larvae on <i>Pimelea ventosa</i>	Threatened - Nationally Vulnerable	Coastal turf and open quartz gravel areas
<i>Orthoclydon praefectata</i>	larvae on flax		Grassland and shrubland
<i>Pasiphila sandycias</i>	larvae on small-leaved <i>Coprosma</i>		Grassland and shrubland
<i>P. bilineolata</i>	larvae on <i>Hebe elliptica</i> flowers		Grassland and shrubland
<i>P. charybdis</i>	larvae on <i>Hebe elliptica</i> flowers		Grassland and shrubland
<i>P. fumipalpata</i>	larvae on <i>Hebe elliptica</i> flowers		Grassland and shrubland
<i>Pseudocoremia lupinata</i>	larvae on manuka		Grassland and shrubland
<i>Xanthorhoe occulta</i>	larvae on low-growing herbs		Grassland and shrubland
<b>Noctuidae</b>			
<i>Agrotis ipsilon</i>	larvae polyphagous on herbs		Grassland and shrubland
<i>Agrotis</i> new species aff. <i>innominata</i>	larvae on <i>Calystegia</i>		Sand dunes
<i>Bityla defigurata</i>	larvae on pohuehue - <i>Muehlenbeckia australis</i>		Grassland and shrubland
<i>Diarsia intermixta</i>	larvae on nettles		Grassland and shrubland
<i>Ichneutica moderata</i>	larvae on low-growing herbs		Grassland and shrubland
<i>I. mutans</i>	larvae on low-growing herbs		Grassland and shrubland
<i>I. atristriga</i>	larvae on grasses		Grassland and shrubland
<i>I. steropastis</i>	larvae on flax		Grassland and shrubland
<i>I. acontistis</i>	larvae on grasses		Grassland and shrubland
<i>I. ceraunias</i>	larvae on copper tussock		Grassland and shrubland
<i>I. chryserythra</i>	larvae on low-growing herbs		Grassland and shrubland
<i>I. infensa</i>	larvae on <i>Carex</i> species		Coastal turf and wetland edges
<i>I. lignana</i>	larvae on grasses		Grassland and shrubland
<i>I. longstaffi</i>	larvae on <i>Dracophyllum</i>		Grassland and shrubland
<i>I. phaula</i>	larvae on grasses		Grassland and shrubland
<i>I. plena</i>	larvae on low-growing herbs		Grassland and shrubland
<i>I. micrastra</i>	larvae on herbs		Grassland and shrubland
<i>I. morosa</i>	larvae on grasses		Grassland and shrubland
<i>I. paracausta</i>	larvae on grasses		Grassland and shrubland
<i>I. propria</i>	larvae on grasses		Grassland and shrubland
<i>I. rubescens</i>	larvae on herbs including <i>Luzula</i> here		Grassland and shrubland
<i>I. sulcana</i>	larvae on sedges		Grassland and shrubland
<i>I. temperata</i>	larvae on herbs		Coastal turfland
<i>I. ustistriga</i>	larvae on various shrubs and lianes		Grassland and shrubland

<i>Meterana ochthistis</i>	larvae polyphagous on shrub foliage		Grassland and shrubland
<i>M. stipata</i>	larvae on scrambling and large-leaved pohuehue - <i>Muehlenbeckia complexa</i> and <i>M. australis</i>		Grassland and shrubland
<i>Meterana</i> new species aff. <i>meyricci</i>	larvae on <i>Pimelea ventosa</i>	Threatened - Nationally Endangered	Coastal turf and open areas
<i>Physetica phricias</i>	larvae on matagouri		Grassland and shrubland
<i>P. caerulea</i>	larvae on herbs		Coastal turf and sand dunes
<i>P. homoscia</i>	larvae on <i>Ozothamnus</i> foliage		Grassland and shrubland
<i>Rhaphsa scotoscialis</i>	larvae on leaf litter		Grassland and shrubland
<i>Schrankia costaestrigalis</i>	larvae on <i>Juncus</i> species		Estuarine turf areas
<b>Arctiidae</b>			
<i>Metacrias strategica</i>	hairy larvae are distinctive and feed on grasses and herbs		Short-tussock grassland and turfland
<i>Nyctemera annulata</i>	larvae distinctive black and orange and hairy: feed on herbaceous <i>Senecio</i> spp.		Edges of open areas and roads

## Appendix C – Plant Species List

Scientific name	Common name	Life form	Conservation Status (de Lange et al. 2018a)
<b>NATIVE VASCULAR PLANT SPECIES</b>			
<i>Acaena microphylla</i> var. <i>pauciglochidiata</i>	bidibidi, piripiri	dicot herb	At-Risk-Declining
<i>Acaena novae-zelandiae</i>	red bidibidi	dicot herb	Not Threatened
<i>Aciphylla subflabellata</i>	speargrass, spaniard, kurikuri	dicot herb	At-Risk-Declining
<i>Androstoma empetrifolium</i>		shrub	Not Threatened
<i>Apium prostratum</i>	NZ celery	dicot herb	Not Threatened
<i>Apodasmia similis</i>	oioi	rush	Not Threatened
<i>Asplenium appendiculatum</i>	ground spleenwort	fern	Not Threatened
<i>Asplenium obtusatum</i>	shore spleenwort	fern	Not Threatened
<i>Atriplex buchananii</i>		dicot herb	Threatened-Nationally Vulnerable
<i>Austroderia richardii</i>	toetoe	grass	Not Threatened
<i>Blechnum discolor</i>	crown fern, piupiu	fern	Not Threatened
<i>Blechnum minus</i>	swamp kiokio	fern	Not Threatened
<i>Blechnum novae-zelandiae</i>	kiokio	fern	Not Threatened
<i>Blechnum penna-marina</i>	little hard fern	fern	Not Threatened
<i>Calystegia soldanella</i>	shore bindweed	vine	Not Threatened
<i>Carex breviculmis</i>	grassland sedge	sedge	Not Threatened
<i>Carex geminata</i>	cutty grass, rautahi	sedge	Not Threatened
<i>Carex solandri</i>		sedge	Not Threatened
<i>Carex trifida</i>		sedge	Not Threatened
<i>Carex virgata</i>	swamp sedge	sedge	Not Threatened
<i>Celmisia gracilentia</i>	slender mountain daisy, pekapeka	dicot herb	Not Threatened
<i>Centella uniflora</i>	centella	dicot herb	Not Threatened
<i>Chionochloa rubra</i> subsp. <i>cuprea</i>	red tussock	grass	Not Threatened
<i>Colobanthus muelleri</i>		dicot herb	Not Threatened
<i>Coprosma acerosa</i>	sand coprosma	shrub	At-Risk-Declining

<i>Coprosma dumosa</i>	mikimiki	shrub	Not Threatened
<i>Coprosma grandifolia</i>	kanono	tree	Not Threatened
<i>Coprosma petriei</i>	turfy coprosma	shrub	Not Threatened
<i>Coprosma propinqua</i>	mingimingi, mikimiki	shrub	Not Threatened
<i>Coprosma repens</i>	taupata	shrub	Not Threatened
<i>Coprosma rigida</i>	stiff coprosma	shrub	Not Threatened
<i>Cordyline australis</i>	cabbage tree, tī kōuka	tree	Not Threatened
<i>Coriaria angustissima</i>	small-leaved tutu	shrub	Not Threatened
<i>Crassula moschata</i>	stonecrop	dicot herb	Not Threatened
<i>Dichelachne crinita</i>	plume grass	grass	Not Threatened
<i>Dichondra brevifolia</i>	dichondra	dicot herb	Not Threatened
<i>Eleocharis acuta</i>	sharp spike sedge	sedge	Not Threatened
<i>Epilobium komarovianum</i>	creeping willow herb	dicot herb	Not Threatened
<i>Epilobium elegans</i>	willow herb	dicot herb	Data Deficient
<i>Festuca novae-zelandiae</i>	fescue tussock, hard tussock	grass	Not Threatened
<i>Ficinia nodosa</i>	club rush, wiwi	sedge	Not Threatened
<i>Fuchsia excorticata</i>	tree fuchsia, kōtukutuku	tree	Not Threatened
<i>Fuchsia perscandens</i>	climbing fuchsia	vine	Not Threatened
<i>Gaultheria macrostigma</i>	prostrate snowberry	shrub	Not Threatened
<i>Gentianella saxosa</i>		dicot herb	At-Risk-Naturally Uncommon
<i>Geranium brevicaule</i>	short-flowered cranesbill	dicot herb	Not Threatened
<i>Geranium sessiliflorum</i> var. <i>arenarium</i>		dicot herb	At-Risk-Declining
<i>Gonocarpus micranthus</i>		dicot herb	Not Threatened
<i>Griselinia littoralis</i>	broadleaf, kāpuka	tree	Not Threatened
<i>Gunnera monoica</i>	native gunnera	dicot herb	Not Threatened
<i>Hebe elliptica</i>	Kokomuka, shore hebe, shore koromiko	shrub	Not Threatened
<i>Helichrysum filicaule</i>	slender everlasting daisy	dicot herb	Not Threatened
<i>Histiopteris incisa</i>	water fern, mātātā	fern	Not Threatened
<i>Hydrocotyle novae-zeelandiae</i> var. <i>montana</i>	pennywort	dicot herb	Not Threatened
<i>Hypericum pusillum</i>	swamp hypericum	dicot herb	Not Threatened
<i>Ileostylus micranthus</i>	green mistletoe	mistletoe	Not Threatened
<i>Isolepis cernua</i>	slender club rush	sedge	Not Threatened

<i>Juncus edgariae</i>	leafless rush, wī	rush	Not Threatened
<i>Juncus pallidus</i>	giant rush, leafless rush, wī	rush	Not Threatened
<i>Juncus planifolius</i>	flat-leaved rush	rush	Not Threatened
<i>Lagenophora pumila</i>	papatāniwhaniwha	dicot herb	Not Threatened
<i>Lepidosperma australe</i>	square sedge, square-stemmed sedge	sedge	Not Threatened
<i>Leptecophylla juniperina</i> subsp. <i>juniperina</i>	prickly mingimingi, mikimiki	shrub	Not Threatened
<i>Leptinella pusilla</i>	button daisy	dicot herb	At-Risk-Declining
<i>Leptinella serrulata</i>	dryland button daisy	dicot herb	At-Risk-Declining
<i>Leptospermum scoparium</i>	mānuka, tea tree	tree	At-Risk-Declining
<i>Leucopogon fraseri</i>	dwarf heath, pātōtara	shrub	Not Threatened
<i>Libertia peregrinans</i>	native iris, mikoikoi	monocot herb	Threatened-Nationally Vulnerable
<i>Lobelia angulata</i>	pratia	dicot herb	Not Threatened
<i>Luzula banksiana</i> var. <i>acra</i>	woodrush	rush	Not Threatened
<i>Luzula rufa</i>	woodrush	rush	Not Threatened
<i>Lycopodium fastigiatum</i>	alpine clubmoss, mountain clubmoss	fern	Not Threatened
<i>Lycopodium scariosum</i>	creeping clubmoss	fern	Not Threatened
<i>Meliccytus alpinus</i>	porcupine shrub	shrub	Not Threatened
<i>Mentha cunninghamii</i>	NZ mint	dicot herb	At-Risk-Declining
<i>Microsorium pustulatum</i>	hounds tongue, kōwaowao	fern	Not Threatened
<i>Microtis unifolia</i>	onion orchid, maikaika	orchid	Not Threatened
<i>Muehlenbeckia axillaris</i>	creeping pōhuehue	vine	Not Threatened
<i>Muehlenbeckia complexa</i>	scrub pōhuehue, wire vine	vine	Not Threatened
<i>Myriophyllum pedunculatum</i> subsp. <i>novae-zelandiae</i>	water milfoil	dicot herb	Not Threatened
<i>Myrsine australis</i>	red māpou, red matipo	tree	Not Threatened
<i>Leptostigma setulosum</i>		dicot herb	Not Threatened
<i>Olearia nummulariifolia</i>		shrub	Not Threatened
<i>Oxybasis ambigua</i>		dicot herb	At-Risk-Declining
<i>Ozothamnus vauvilliersii</i>	mountain tauhinu	shrub	Not Threatened
<i>Paesia scaberula</i>	ring fern, pig root fern	fern	Not Threatened

Phormium tenax	lowland flax, harakeke	monocot herb	Not Threatened
Pimelea prostrata subsp. ventosa	pinatoro, NZ daphne	shrub	At-Risk-Declining
Pittosporum tenuifolium	kōhūhū, black matipo	tree	Not Threatened
Plagianthus divaricatus	saltmarsh ribbonwood, mākaka	shrub	Not Threatened
Plantago triandra	glossy plantain	dicot herb	Not Threatened
Poa cita	silver tussock, wī	grass	Not Threatened
Poa species		grass	
Podocarpus laetus	thin-bark tōtara, Hall's tōtara	tree	Not Threatened
Polystichum vestitum	prickly shield fern, pūniu	fern	Not Threatened
Pseudognaphalium luteoalbum	jersey cudweed	dicot herb	Not Threatened
Pseudopanax colensoi var. fiordensis	mountain five-finger	tree	Not Threatened
Pteridium esculentum	bracken, rārahu, rauaruhe	fern	Not Threatened
Ranunculus acaulis		dicot herb	Not Threatened
Raoulia aff. hookeri 'coast'		dicot herb	At-Risk-Declining
Raoulia glabra	mat daisy	dicot herb	Not Threatened
Rytidosperma gracile	danthonia	grass	Not Threatened
Sarcocornia quinqueflora subsp. quinqueflora	glasswort	dicot herb	Not Threatened
Scleranthus brockiei		dicot herb	Not Threatened
Selliera radicans	remuremu	dicot herb	Not Threatened
Senecio glomeratus	native groundsel, fireweed	dicot herb	Not Threatened
Senecio minimus	native fireweed	dicot herb	Not Threatened
Solanum laciniatum	poroporo	shrub	Not Threatened
Suaeda novae-zelandiae	sea blite	dicot herb	Not Threatened
Tetragonia tetragonoides	kokihi, New Zealand spinach, tutae-ikamoana	dicot herb	At-Risk-Naturally Uncommon
Thelymitra species	sun orchid	orchid	
Viola cunninghamii	white violet	dicot herb	Not Threatened
Zostera muelleri subsp. novazelandica	eelgrass	grass	At-Risk-Declining
<b>NATIVE NON-VASCULAR PLANT AND LICHEN SPECIES</b>			<b>Conservation Status (de Lange et al. 2018b)</b>
Cladonia confusa		lichen	

Cladonia species		lichen	
Cladia species		lichen	
Hypogymnia species		lichen	
Menegazzia species		lichen	
Parmotrema perlatum	black stone flower	lichen	Not Threatened
Peltigera species		lichen	
Physcia adscendens	hooded rosette lichen	lichen	Not Threatened
Placopsis species		lichen	
Podostictina pickeringii		lichen	Not Threatened
Pseudocyphellaria neglecta/crocata agg.		lichen	Not Threatened
Pulchrocladia retipora		lichen	Not Threatened
Ramalina celastri	cartilage lichen	lichen	Not Threatened
Stereocaulon ramulosum		lichen	Not Threatened
Teloschistes chrysophthalmus	gold-eye lichen	lichen	Not Threatened
Teloschistes velifer		lichen	Not Threatened
Usnea species	old man's beard lichen	lichen	
Usnea rubicunda		lichen	Not Threatened
Xanthoria parietina	maritime sunburst lichen	lichen	Not Threatened
Hypnum cupressiforme	cypress-leaved plait moss	moss	
Racomitrium species	woolly moss	moss	
Thuidium species		moss	
<b>EXOTIC VASCULAR PLANT SPECIES</b>			
Acetosa acetosella	sheeps sorrel	dicot herb	
Achillea millefolium	yarrow	dicot herb	
Agrostis capillaris	brown top	grass	
Aira praecox	early hair grass	grass	
Anagallis arvensis	scarlet pimpernel	dicot herb	
Angelica pachycarpa	angelica	dicot herb	
Anthoxanthum odoratum	sweet vernal	grass	
Atriplex hastata		dicot herb	
Bellis perennis	daisy	dicot herb	
Callitriche stagnalis	starwort	dicot herb	

<i>Centaurea erythraea</i>	centaury	dicot herb	
<i>Cerastium fontanum</i>	mouse-ear chickweed	dicot herb	
<i>Cirsium arvense</i>	Californian thistle	dicot herb	
<i>Cirsium vulgare</i>	Scotch thistle	dicot herb	
<i>Cupressus macrocarpa</i>	macrocarpa, Monterey cypress	tree	
<i>Cytisus scoparius</i>	scotch broom	shrub	
<i>Dactylis glomerata</i>	cocksfoot	grass	
<i>Digitalis purpurea</i>	foxglove	dicot herb	
<i>Erica lusitanica</i>	spanish heath	shrub	
<i>Euphrasia nemorosa</i>	eyebright	dicot herb	
<i>Festuca rubra</i>	red fescue	grass	
<i>Hedera helix</i>	ivy	vine	
<i>Holcus lanatus</i>	Yorkshire fog	grass	
<i>Hypericum perforatum</i>	St Johns wort	dicot herb	
<i>Hypochaeris radicata</i>	catsear	dicot herb	
<i>Jacobaea vulgaris</i>	ragwort	dicot herb	
<i>Juncus articulatus</i>	jointed rush	rush	
<i>Juncus bufonius</i>	toad rush	rush	
<i>Juncus procerus</i>		rush	
<i>Leucanthemum vulgare</i>	oxeye daisy	dicot herb	
<i>Linum catharticum</i>	purging flax	dicot herb	
<i>Lolium arundinaceum</i> subsp. <i>arundinaceum</i>	tall fescue	grass	
<i>Lotus pedunculatus</i>	lotus	dicot herb	
<i>Lupinus arboreus</i>	tree lupin	shrub	
<i>Lupinus polyphyllus</i>	Russell lupin	dicot herb	
<i>Luzula congesta</i>		rush	
<i>Malus domestica</i>	apple	tree	
<i>Malva arborea</i>	tree mallow	dicot herb	
<i>Parentucellia viscosa</i>	tarweed	dicot herb	
<i>Pilosella officinarum</i>	mouse-ear hawkweed	dicot herb	
<i>Pinus radiata</i>	radiata pine	tree	
<i>Plantago australis</i>		dicot herb	

<i>Plantago coronopus</i>	bucks horn plantain	dicot herb	
<i>Plantago lanceolata</i>	narrow-leaved plantain	dicot herb	
<i>Prunella vulgaris</i>	selfheal	dicot herb	
<i>Rubus fruticosus</i>	blackberry	shrub	
<i>Rumex obtusifolius</i>	broad-leaved dock	dicot herb	
<i>Sagina procumbens</i>	procumbent pearlwort	dicot herb	
<i>Salix xfragilis</i>	crack willow	tree	
<i>Sedum acre</i>	stonecrop	dicot herb	
<i>Sonchus oleraceus</i>	pūhā, smooth sow thistle	dicot herb	
<i>Spergularia marina</i>	sea spurrey	dicot herb	
<i>Trifolium dubium</i>	suckling clover	dicot herb	
<i>Trifolium pratense</i>	red clover	dicot herb	
<i>Trifolium repens</i>	white clover	dicot herb	
<i>Ulex europaeus</i>	gorse	shrub	
<i>Verbascum virgatum</i>	moth mullein	dicot herb	
<i>Vicia sativa</i>	vetch	dicot herb	

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