

**ECOLOGICAL ASSESSMENT OF  
PROPOSED LAND USE CHANGES FOR THE  
UNIVERSITY OF CANTERBURY FIELD STATION AT  
BIRDLINGS FLAT, KAITORETE SPIT, CANTERBURY**

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R4328



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# 1. INTRODUCTION

The Department of Physics and Astronomy at the University of Canterbury (UC) has undertaken upper atmospheric research at Kaitorete Spit Scientific Reserve since the 1970s, based at the Birdlings Flat Field Station (see Figure 1). The University has a concession from the Department of Conservation (DOC) to utilise *c.*56 hectares of the Scientific Reserve from 2006 to 2016 (Concession CA16785). This concession has now expired and the University is applying to renew their concession.

The Department of Physics and Astronomy no longer requires the research facilities at the Field Station, and is in the process of removing all obsolete equipment from the site, including the aerial arrays. The Spatial Engineering Research Centre of the College of Engineering would now like to use the Field Station to support their research on remotely-piloted aircraft systems, also called Unmanned Autonomous Vehicles (UAVs) or drones. The aim of the research is to develop and improve the capabilities of UAVs for a variety of remote sensing work, including biodiversity and pest control sensing, marine ecology, rural fire monitoring, personal air transport, and structure inspections (Ladley 2017). The work will involve using existing and proposed new infrastructure at the Field Station for the assembly of UAV frames and their associated remote sensing instruments. The Field Station is located within an existing UAV test range – Segregated Airspace Zone - set up by UC in 2015 in consultation with the Civil Aviation Authority (CAA) (see Figure 2).

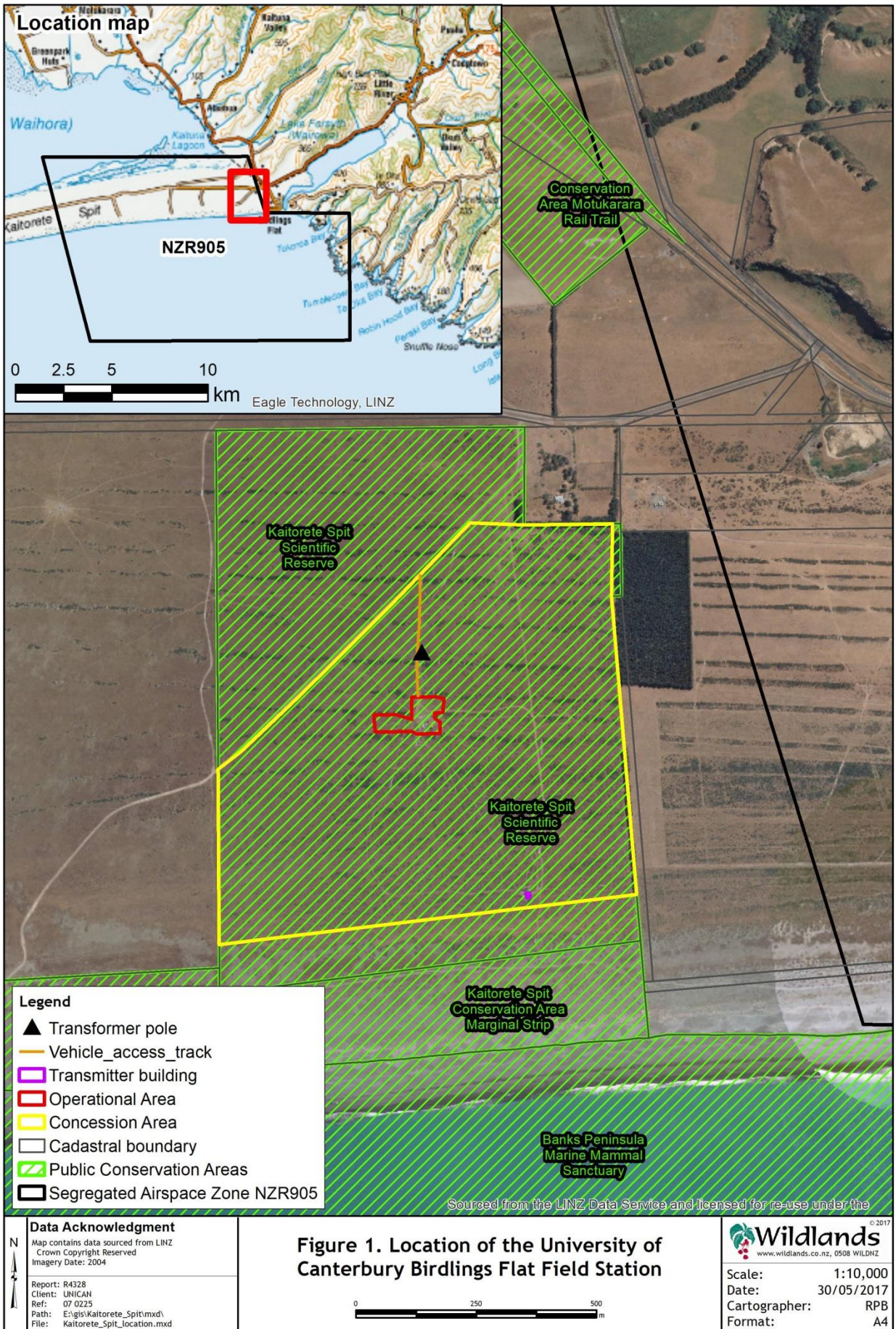
The University is in the process of removing some of the existing infrastructure installed by the Department of Physics and Astronomy that is no longer needed: aerial arrays, a storage container, a building, and fencing. The University now wishes to construct a new building and other infrastructure to support the Spatial Engineering Research Centre research programme. This will require a resource consent and a building consent from Christchurch City Council (CCC).

The University commissioned Wildland Consultants to provide an ecological assessment of the proposed infrastructure and activities of the Field Station. This report provides a description of the ecological features and values (vegetation, birds, lizards and terrestrial invertebrates) at the site, an assessment of potential effects on ecological values from the proposed infrastructure and activities, and measures to avoid, remedy and/or mitigate potential adverse effects on ecological values.

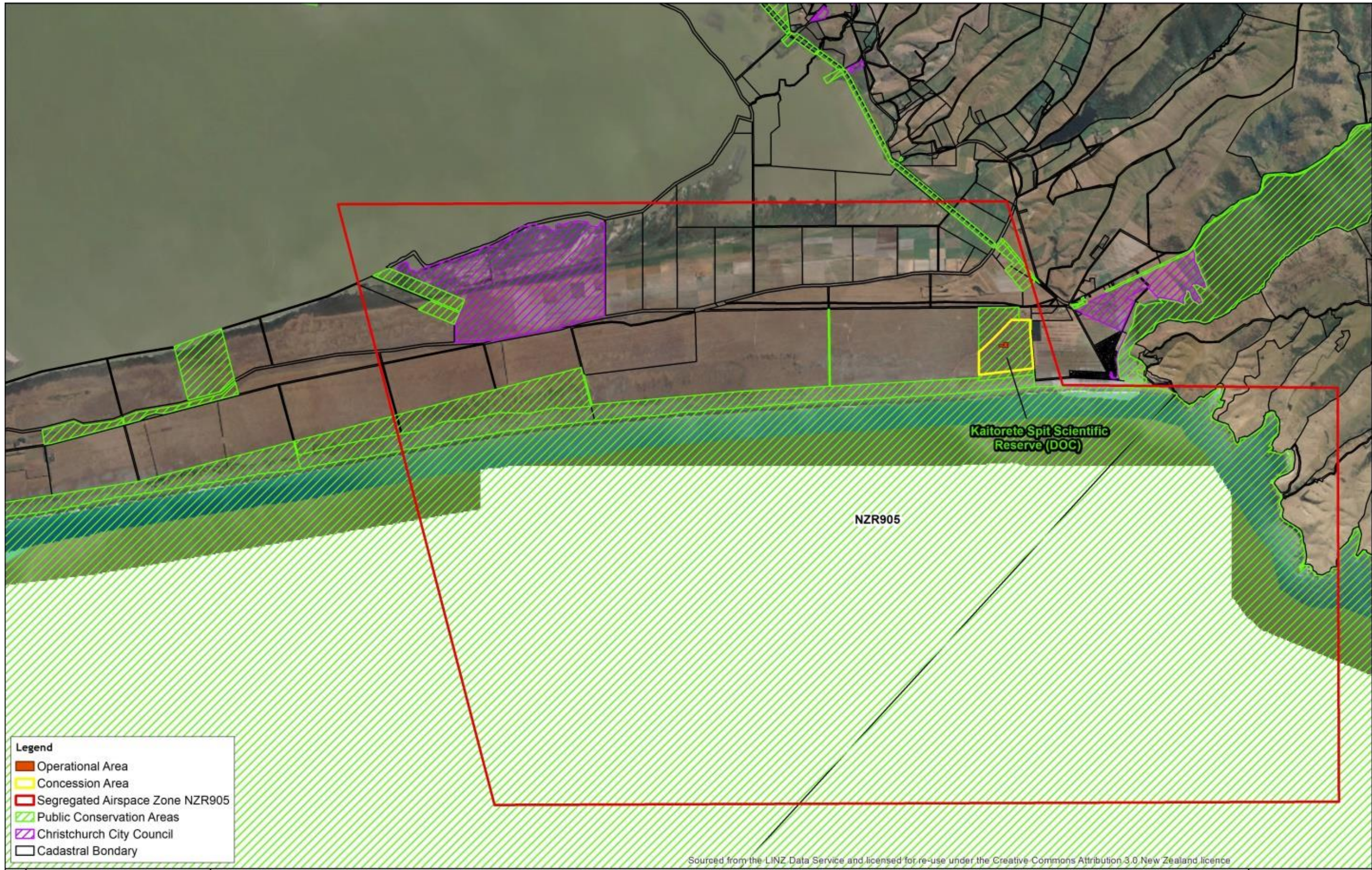
For the purposes of this report “the site” comprises three defined areas:

- Concession Area: *c.*56 hectares (Figure 1).
- Segregated Airspace Zone: 3,254 hectares on Kaitorete Spit (Figure 2).
- Operational Area: buildings and other infrastructure, less than one hectare (Figure 3).







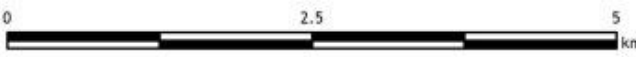


**Legend**

- Operational Area
- Concession Area
- Segregated Airspace Zone NZR905
- Public Conservation Areas
- Christchurch City Council
- Cadastral Boundary

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**Figure 2. Segregated Airspace Zone on Kaitorete Spit**



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 Date: 30/05/2017  
 Cartographer: RPB  
 Format: A3R



## 2. SITE LOCATION AND DESCRIPTION

Birdlings Flat Field Station is located at the eastern end of Kaitorete Spit about one kilometre west of Birdlings Flat village. The Concession Area covers *c.*56 hectares of Kaitorete Spit Scientific Reserve (91 ha in total) and is in close proximity to other public conservation land managed by the Department of Conservation, e.g. Kaitorete Spit Conservation Area Marginal Strip and Waihora Scientific Reserve (Figures 1-2). The Banks Peninsula Marine Mammal Sanctuary adjoins Kaitorete Spit to the south of the Concession Area. Note that effects on the marine environment are outside the scope of this report.

The Concession Area contains three existing buildings and other infrastructure that was installed by the Department of Physics and Astronomy prior to 2006. Existing infrastructure is described in detail in the draft Department of Conservation Concession Application prepared by the University (Ladley (2017)). A brief summary is provided below.

The Concession Area currently contains the following infrastructure:

- Main ‘receiver’ building (112.5 m<sup>2</sup>) (Plate 1).
- White shed (31 m<sup>2</sup>) (*to be removed*) (Plates 1-2).
- Fencing between the main building and white shed (*to be removed*) (Plate 2).
- Shipping container (*to be removed*).
- Transmitter building (43 m<sup>2</sup>) and communications antenna (currently used by Orion and the NZ Police) (Plates 3 and 6).
- Vehicle access tracks (Plates 4-5).
- Transformer pole (Plate 5).
- Underground power cable (between the transformer pole and main building).
- Aerial arrays (*in the process of being removed*).

Most of these features are located within the Operational Area (Figure 3), which covers an area of 0.70 hectares. The entire perimeter of the Concession Area is fenced, including the southern coastal margin. The Concession Area has been grazed by sheep in previous years, but the site is not grazed at present (Jenny Ladley, University of Canterbury, pers. comm.). Control of introduced animal pests and weeds such as sweet briar (*Rosa rubiginosa*) and karo (*Pittosporum crassifolium*) has been carried out by contractors on behalf of the University (Jenny Ladley, University of Canterbury, pers. comm.).



Plate 1: Main 'receiver' building (112.5 m<sup>2</sup>), white shed (to be removed), and the fenced compound in between.



Plate 2: The white shed and fencing are to be removed, as well as stacks of timber and other materials next to the main 'receiver' building.



Plate 3: Transmitter building (43 m<sup>2</sup>) and communications antenna (used by Orion and NZ Police) near the southern boundary of the Concession Area.



Plate 4: Vehicle access track from the entrance gate to the main 'receiver' building and white shed (looking south).

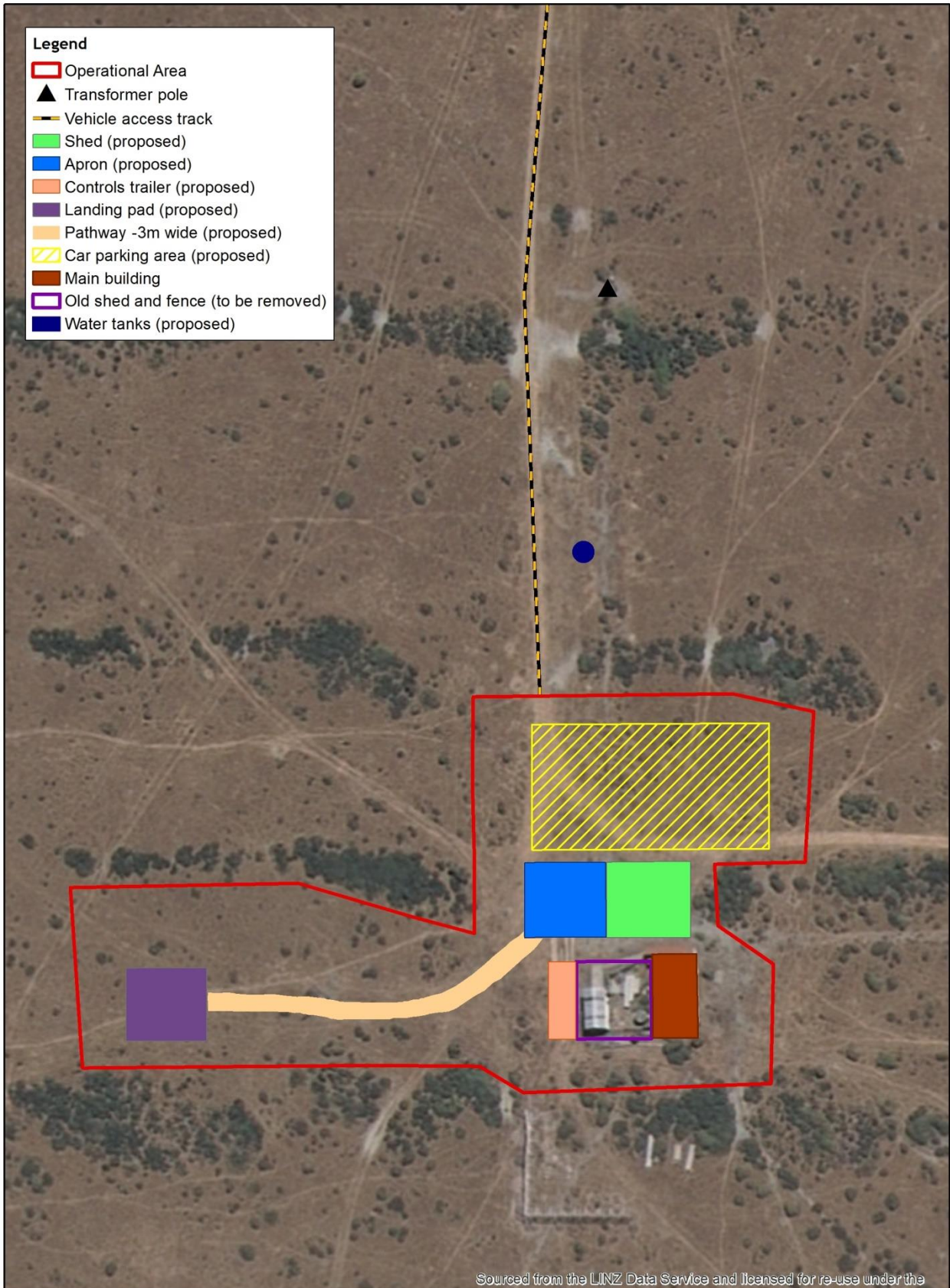


Plate 5: Transformer pole and other power poles next to main vehicle access track.



Plate 6: Southern boundary of the Concession Area, with the Transmitter Building and communications antenna in the background.





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<p><b>Data Acknowledgment</b></p> <p>Map contains data sourced from LINZ Crown Copyright Reserved Imagery Date: 2004</p>	<p>Report: R4328</p> <p>Client: UNICAN</p> <p>Ref: 07 0225</p> <p>Path: E:\gis\Kaitorete_Spit\mxd\</p> <p>File: Operational_area.mxd</p>
	<p>N</p>

**Figure 3. Operational Area at UC Birdlings Flat Field Station**

0 25 50 m

<p><b>Wildlands</b> © 2017</p> <p>www.wildlands.co.nz, 0508 WILDNZ</p>	
Scale:	1:1,000
Date:	30/05/2017
Cartographer:	RPB
Format:	A4

### 3. ECOLOGICAL CONTEXT

#### 3.1 General character

Kaitorete Spit is a c.25 km-long barrier ridge of Holocene gravels partially covered in sand dunes that rise to only about five metres above sea level. The spit varies in width from 100 metres to 3.5 kilometres. The coastal margin is characterised by a shingle beach, an extensive sand dune ecosystem, and sand flats (Christchurch City Council 2016a). The active dune system comprises active foredunes and more stable inner dunes, with an older system of deflating dunes about 100 metres inland of the active dunes (Davis 2002).

#### 3.2 Ellesmere Ecological District

The project area is located within Ellesmere Ecological District, in the Canterbury Plains Ecological Region (McEwen 1987). Ellesmere Ecological District encompasses brackish Lake Ellesmere (20,000 hectares) and Kaitorete Spit, which separates Lake Ellesmere from the sea.

The climate is harsh and dry, with cool winters and onshore southerlies with numerous fogs, and dry summers with persistent cold easterlies and occasional hot foehn winds from the northwest. Kaitorete Spit is the driest part of central Canterbury, with annual rainfall of only 400-550 mm (McEwen 1987). Salt spray is common and widespread because of the frequent and sustained winds. Further inland, around Lake Ellesmere, annual rainfall increases to up to 650 mm.

Kaitorete Spit is recognised as having nationally significant ecological values and is considered to be a national priority for conservation (Davis 2002). Nowhere else in New Zealand is there a sequence from coastal sand dunes dominated by pikao/pingao, through semi-natural indigenous grassland and shrubland, to a wetland of international importance (Christchurch City Council 2016a, Christchurch City Council 2016c).

#### 3.3 Land Environments of New Zealand (LENZ)

Most of Kaitorete Spit, including the Concession Area, is classified as LENZ Level IV category J2.1b (Leathwick *et al.* 2003). This land environment is classified as ‘Acutely Threatened’ (the highest threat category), as only 2.6% indigenous vegetation cover remains on this land environment nationally (Cieraad *et al.* 2015).

#### 3.4 Naturally uncommon ecosystems

Kaitorete Spit contains five naturally uncommon ecosystem types (Williams *et al.* 2007):

- Active sand dunes.
- Stable sand dunes.
- Dune deflation hollows.
- Shingle beach.
- Stony beach ridge.

All of these ecosystem types have been classified as “Endangered” at a national scale (Holdaway *et al.* 2012).



### 3.5 Vegetation

Kaitorete Spit contains the largest extent of naturally-vegetated dunelands in New Zealand, and the largest population of pikao/pingao (*Ficinia spiralis*) in the country (pikao is classified as At Risk-Declining, de Lange *et al.* 2013). Beyond the dunes there are substantial areas of extensively grazed semi-natural dryland grassland dominated by danthonia (indigenous and introduced *Rytidosperma* spp.) with bracken fernland, tussockland, mossfield, cushionfield, stonefield, and shrubland, as well as some developed pasture and cultivated fields that extend to Lake Ellesmere/Te Waihora (Christchurch City Council 2016a).

Kaitorete Spit probably comprises the largest remaining area of indigenous dryland vegetation in lowland Canterbury. It contains many threatened and/or uncommon dryland plants, with at least 13 indigenous vascular plant species classified as nationally Threatened or At Risk<sup>1</sup> (Table 1).

Table 1: Nationally Threatened and At Risk vascular plant species present on Kaitorete Spit (conservation status from de Lange *et al.* 2013).

Scientific Name	Common Name	Conservation Status (de Lange <i>et al.</i> 2013)	Habitat
<i>Muehlenbeckia astonii</i>	Shrubby tororaro, wiggwig	Threatened-Nationally Endangered	Grassland/shrubland
<i>Craspedia</i> 'kaitorete' undescribed species (c) CHR 529115	Kaitorete Spit woollyhead	Threatened-Nationally Endangered	Sand dune deflation hollows
<i>Daucus glochidiatus</i>	Native carrot	Threatened-Nationally Vulnerable	Grassland
<i>Geranium retrorsum</i>	Turnip-rooted geranium	Threatened-Nationally Vulnerable	Grassland
<i>Carmichaelia corrugata</i>	Dwarf broom	At Risk-Declining	Grassland
<i>Ficinia spiralis</i>	Pikao, pingao	At Risk-Declining	Sand dunes
<i>Poa billardierei</i>	Sand tussock	At Risk-Declining	Sand dunes
<i>Muehlenbeckia ephedroides</i>	Leafless pōhuehue	At Risk-Declining	Grassland
<i>Raoulia monroi</i>	Fan-leaved mat daisy	At Risk-Declining	Grassland
<i>Acaena buchananii</i>		At Risk-Naturally Uncommon	Grassland
<i>Carmichaelia appressa</i>	Prostrate broom	At Risk-Naturally Uncommon	Grassland, back dunes
<i>Colobanthus brevisepalus</i>		At Risk-Naturally Uncommon	Grassland
<i>Leptinella serrulata</i>		At Risk-Naturally Uncommon	Grassland

Kaitorete Spit contains two undescribed plant species that are endemic to the Spit:

- *Craspedia* 'Kaitorete' unnamed species (c) CHR 529115: occurs in stable dune deflation hollows.
- *Pimelea* aff. *prostrata* 'Kaitorete' (Not threatened): occurs in dry grassland and dune deflation hollows.

*Carmichaelia appressa* (prostrate broom) is almost endemic to Kaitorete Spit, although it also occurs along the Rakaia River (Davis 2002, NZPCN 2015).

<sup>1</sup> See Appendix 1 and Townsend *et al.* 2008 for explanations of the different categories in the New Zealand Threat Classification System.

In addition, Kaitorete Spit is the national distribution limit for two plant species:

- *Muehlenbeckia astonii*: southern national limit.
- *Akeake (Dodonaea viscosa)*: southern national limit.

Kaitorete Spit is the national stronghold for *Muehlenbeckia astonii* (shrubby tororaro/wiggwig), classified as Threatened-Nationally Endangered, with more than 95% of the estimated national population occurring on the Spit (de Lange and Jones 2000). Over 3,400 individual plants were recorded on Kaitorete Spit in 2007 (Dutton 2007, see distribution map in Appendix 1). Only a small number of these plants occur on public conservation land and thus have legal protection.

### 3.6 Avifauna

Kaitorete Spit is a long finger of land (25 km in length) that forms a barrier between Lake Ellesmere/Te Waihora and the Pacific Ocean. Birdlife on Kaitorete Spit is heavily influenced by the abundance and composition of birds on Lake Ellesmere/Te Waihora. Te Waihora is the largest wetland of its type in New Zealand and is considered a wildlife habitat of international importance because it supports more indigenous bird species than any other single habitat in New Zealand (Hearnshaw and Hughey 2010). A total of 204 (133 indigenous) bird species have been recorded to use the lake and its periphery, with 80 species being regular users (O'Donnell 1985; A. Crossland, unpublished data). A census of birds on the lake is now undertaken annually by the Waihora Ellesmere Trust. In the 2017 census 42,800 individual birds were counted on the lake in a single day during February.

On the seaward or south side of the Spit, there is stony sea shore habitat that supports an abundance of sea birds that either use the spit to navigate up and down the coast, or move across it from Lake Ellesmere/Te Waihora to roost or feed (Plate 7). Some of these seabirds are nationally Threatened (Robertson *et al.* 2017). For example, the black-billed gull (*Larus bulleri*) is classified as Threatened-Nationally Critical, Caspian tern (*Hydroprogne caspia*) is Threatened-Nationally Vulnerable, and white-fronted tern (*Sterna striata*) is At Risk-Declining (see Table 2).

Table 2: Nationally Threatened and At Risk bird species known to occur on Kaitorete Spit (conservation status from Robertson *et al.* 2017).

Common Name	Scientific Name	Conservation Status (Robertson <i>et al.</i> 2017)	NZ Status
Black Stilt	<i>Himantopus novaezelandiae</i>	Threatened-Nationally Critical	Endemic
Black-fronted tern	<i>Chlidonias albobristatus</i>	Threatened-Nationally Endangered	Endemic
Caspian tern	<i>Hydroprogne caspia</i>	Threatened-Nationally Vulnerable	Native
Wrybill	<i>Anarhynchus frontalis</i>	Threatened-Nationally Vulnerable	Endemic
Red knot	<i>Calidris canutus</i>	Threatened-Nationally Vulnerable	Native
Banded dotterel	<i>Charadrius bicinctus</i>	Threatened-Nationally Vulnerable	Endemic
Bar-tailed godwit	<i>Limosa lapponica</i>	At Risk-Declining	Native
Black-billed gull	<i>Larus bulleri</i>	At Risk-Declining	Endemic
New Zealand pipit	<i>Anthus novaeseelandiae</i>	At Risk-Declining	Endemic
SI pied oystercatcher	<i>Haematopus finschi</i>	At Risk-Declining	Endemic
White-fronted tern	<i>Sterna striata</i>	At Risk-Declining	Native



Plate 7: Seabirds foraging close to the shore and roosting on the beach at Kaitorete Spit can be seen in the middle distance (27 June 2015, supplied by Niall Muga).

Kaitorete Spit is also visited by long-distance annual migrants such as wrybill (*Anarhynchus frontalis*), which is classified as Threatened-Nationally Vulnerable (Crossland *et.al.* 2012, Roberson *et al.* 2017). Some migrants, such as the bar-tailed godwit (*Limosa lapponica*, At Risk-Declining) come from as far as Alaska. Flocks of red knot (*Calidris canutus* Threatened-Nationally Vulnerable) migrate from Siberia. The Spit supports a sizeable population of the migratory banded dotterel (*Charadrius bicinctus*), which is classified as Threatened-Nationally Vulnerable. Banded dotterel use the extensive dune systems and grassland - often with low stature vegetation and open stony ground - as breeding habitat, and particularly prefer very short or sparse grassland (Plate 8). There is concern that this population is declining rapidly, with estimates suggesting that there may have been as many as 101 pairs per 100 hectares in the 1970s, compared with one pair per 100 hectares today (Crossland 2017a).



Plate 8: Banded dotterel nest in typical nesting habitat on Kaitorete Spit (from Crossland 2017).

Other species of conservation importance that have been noted to use Kaitorete Spit include: black stilt (*Himantopus novaezelandiae*, Threatened-Nationally Critical), with one observed to nest on the Spit with a hybridised stilt in 2017 (Crossland 2017b); South Island pied oystercatcher (*Haematopus finschi*, At Risk-Declining); black-fronted tern (*Chlidonias albostratus*, Threatened-Nationally Endangered); and New Zealand pipit (*Anthus novaeseelandiae*, At Risk-Declining).

In addition, other Threatened and At Risk bird species that are known to use Lake Ellesmere/Te Waihora, including grey duck (*Anas superciliosa*, Threatened-Nationally Critical), white heron (*Ardea modesta*, Threatened-Nationally Critical), Australasian bittern (*Botaurus poiciloptilus*, Threatened-Nationally Critical), and Australasian crested grebe (*Podiceps cristatus*, Threatened-Nationally Vulnerable).

### 3.7 Lizards

Five lizard species occur on Banks Peninsula (Lettink and Whitaker 2004). Four of these species collectively occupy duneland, shrubland, and farmland habitats on Kaitorete Spit (Table 3; Department of Conservation Herpetofauna Database). Lizard habitat values of Kaitorete Spit are well known due to a substantial body of information amassed over the last 40 years, e.g. Morris 1971, 1974; Freeman 1993, 1994, 1997a, b; Lettink 2004, 2007; Lettink and Cree 2007; Lettink and Seddon 2007; Lettink *et al.* 2008; Lettink *et al.* 2010.

Table 3: Lizard species found on Kaitorete Spit and their conservation status (nomenclature and conservation status from Hitchmough *et al.* 2016).

Common Name	Scientific Name	Conservation Status
Canterbury spotted skink <sup>1</sup>	<i>Oligosoma</i> aff. <i>lineocellatum</i> "central Canterbury"	Threatened-Nationally Vulnerable
Southern grass skink	<i>Oligosoma</i> aff. <i>polychroma</i> Clade 5	At Risk-Declining
Waitaha/Canterbury gecko	<i>Woodworthia</i> cf. <i>brunnea</i>	At Risk-Declining
McCann's skink	<i>Oligosoma maccanni</i>	Not Threatened

Of the four species present, the Canterbury spotted skink is the largest and most threatened. It is known from a handful of sites in the greater Christchurch area, including Banks Peninsula, and most populations are small and/or declining (Lettink 2015). Kaitorete Spit was a former stronghold for the species (Freeman 1997b), but monitoring undertaken over the last decade has revealed substantial declines, including a steep decline and the near loss of a sub-population living in duneland to the south ( $\leq 150$  metres) of the Concession Area in Kaitorete Scientific Reserve that has been monitored since 2003 (Lettink *et al.* 2008; Department of Conservation unpublished data). At that site, a small grid of pitfall traps used for lizard monitoring in most years since 2003 (2003-2007, 2009 and 2012-2017; Lettink *et al.* 2008; Department of Conservation unpublished data) has not yielded any captures of spotted skinks since 2009, although one individual was observed there as recently as 2016 (Anita Spencer, Department of Conservation Mahaanui Office, pers. comm.). In contrast, McCann's skink is the most abundant species, with densities of 1850 skinks/hectare reported from duneland (Freeman 1997a).

<sup>1</sup> The spotted skink is a cryptic species complex. Animals from Birdlings Flat/Kaitorete Spit have been genetically tested and belong to the Canterbury spotted skink taxon (Greaves *et al.* 1997; Hitchmough *et al.* 2016).

In general, shrublands support the greatest lizard species richness (all four species and vital refuge habitat for Canterbury spotted skink) and farmland contains the fewest species (Southern grass skink and McCann's skink; Lettink 2004; Lettink and Seddon 2007; Lettink *et al.* 2008). Waitaha/Canterbury gecko may occur in farmland where abundant cover is present, including human-made objects and materials, e.g. buildings, firewood, stacks of roofing iron or timber (Lettink and Whitaker 2004).

### 3.8 Invertebrates

Kaitorete Spit has an outstanding and distinctive suite of invertebrates across many groups, with Lepidoptera (butterflies and moths) probably the best studied (Patrick 1994, 2012, 2013). From these studies it is clear that the invertebrate fauna of Kaitorete Spit reflects both the dryness and windiness of the Spit environment. These characteristics include flightlessness in the females of many species, although one species has both sexes short-winged and flightless, e.g. *Kiwaia* new species "plains jumper".

The distinctiveness of the invertebrate fauna is illustrated by the presence of four moth species that are endemic to the Spit:

- *Kupea electilis* (Threatened-Nationally Vulnerable, Stringer *et al.* 2012).
- *Scythris niphozela* (At Risk-Naturally Uncommon).
- *Kiwaia jeanae* (At Risk-Naturally Uncommon).
- *Notoreas* new species.

Other moths that are uncommon in Ellesmere Ecological District but have relatively large populations on Kaitorete Spit are:

- *Heliothela atra*: day-flying moth of *Melicytus* shrublands.
- *Gadira leucophthalma*: beaked moss moth.
- *Ericodesma aerodana*: leaf-roller of *Pimelea* mats.

Kaitorete Spit is an important place for indigenous moths and butterflies, with at least 165 species occurring there, including 11 nationally Threatened or At Risk species (Table 4). Key habitats for indigenous moths are the sand dunes, dry grassland/shrubland, and saltmarsh. All of these habitats cover extensive areas on Kaitorete Spit, and contain certain plant species that sustain the various specialised moth species. Key plant species for moths are the three species of indigenous broom (*Carmichaelia* spp.) in the dry shrubland and sand dunes, all five species of *Muehlenbeckia*, the subshrub *Pimelea* aff. *prostrata* and the extensive pikao (*Ficinia spiralis*) sedgeland and *Raoulia australis* cushions in the dunes.



Table 4: Nationally Threatened and At Risk moth species present on Kaitorete Spit (conservation status from Stringer *et al.* 2012).

Scientific Name	Endemic to Kaitorete Spit	Conservation Status (Stringer <i>et al.</i> 2012)	Habitat
<i>Scythris</i> "stripe"	No	Threatened-Nationally Critical	Shrubland
<i>Kiwaia</i> "plains jumper"	No	Threatened-Nationally Endangered	Duneland
<i>Stathmopoda albimaculata</i>	No	Threatened-Nationally Endangered	Shrubland
<i>Gadira leucophthalma</i>	No	Threatened-Nationally Vulnerable	Duneland
<i>Kupea electilis</i>	Yes	Threatened-Nationally Vulnerable	Duneland
<i>Ericodesma aerodana</i>	No	At Risk-Declining	Duneland
<i>Samana acutata</i>	No	At Risk-Relict	Shrubland
<i>Bityla sericea</i>	No	At Risk-Naturally Uncommon	Shrubland
<i>Eurythecta robusta</i>	No	At Risk-Naturally Uncommon	Grassland
<i>Kiwaia jeanae</i>	Yes	At Risk-Naturally Uncommon	Duneland
<i>Scythris niphozela</i>	Yes	At Risk-Naturally Uncommon	Shrubland

Other invertebrate species of note here are the New Zealand ant lion (*Weeleus acutus*), the normally montane grasshopper *Sigauss campestris*, and the increasingly rare red katipō spider *Latrodectus katipo* (At Risk-Declining, Sirvid *et al.* 2012). Kaitorete Spit holds the largest national population of red katipō (Patrick 2002).

## 4. METHODS

### 4.1 Literature review

In order to be able to evaluate the ecological values of the site within a wider context, a literature search was undertaken for existing ecological information on Kaitorete Spit and Lake Ellesmere/Te Waihora. The literature search included databases such as the Department of Conservation Herpetofauna Database.

### 4.2 Field visit

A brief visit of about 3.5 hours was undertaken to the Concession Area in fine, calm weather on 5 May 2017. Relevant project team members have undertaken a considerable amount of previous work on the Spit.

### 4.3 Vegetation

A survey of the vegetation in the Concession Area was carried out on 5 May 2017. All indigenous vascular plant species seen in the Concession Area were recorded, and the abundance of each species was estimated using the 'DAFOR' method: a qualitative method with five abundance categories: Dominant, Abundant, Frequent, Occasional, and Rare. Non-vascular plant species and fungi were also recorded and photos were taken of any species not able to be identified in the field. Locations of all Threatened, At Risk and locally uncommon<sup>1</sup> plant species found in the Concession Area were recorded using a GPS unit.

<sup>1</sup> Species that are considered to be uncommon in Ellesmere Ecological District.

#### 4.4 Avifauna

The Concession Area, and the beach immediately to the south, were visited on 5 May 2017, and all birds seen and heard were recorded. This visit was insufficient to reliably survey bird populations in the area, mainly because it was the wrong time of year for many bird species to be present. However, reliable records of birds that inhabit Kaitorete Spit and the habitats they use are available, e.g. Crossland (2017a, 2017b). The site visit did provide the opportunity to evaluate habitats within and adjacent to the project area that may be relevant to bird species in the area.

#### 4.5 Lizards

A site visit was undertaken for 3.5 hours on 5 May 2017. Weather conditions were fine, sunny and calm. Areas and structures affected by the proposed activities were inspected for lizards and their sign (sloughed skins and faeces). This included the surplus shipping container, old wooden shed and various materials (stacked timber, posts) stored in a fenced yard. In addition, visual searching was undertaken using binoculars to locate active (emerged) skinks, targeting likely basking sites encountered while walking through the reserve, e.g. stone deposits fringed by indigenous shrubs and vines. The presence of favoured plant species that provide important resources for lizards - invertebrate prey, fruit, shelter and refuge from predation by pest mammals (Whitaker 1987) - was noted.

#### 4.6 Invertebrates

Prior to the site visits a comprehensive literature search was carried out and the resulting references were collated and assessed for relevance. A site visit was made on 5 May 2017 and a total of 3.5 hours was spent assessing the ecological values of the Concession Area. The day was calm and warm, allowing a full appraisal of the fenced site and vegetation within it that is habitat for shrubland and grassland invertebrates. The fully fenced site was traversed on foot with all invertebrate species and habitats noted, backed up by photographs. Particular attention was paid to the indigenous shrubland, open stony patches and silver tussock areas.

#### 4.7 Ecological significance assessment

The site is located in Canterbury Region and is therefore subject to provisions in the Canterbury Regional Policy Statement (RPS). Appendix 3 of the Canterbury RPS sets out 10 criteria to be used to determine ecological significance under Section 6(c) of the RMA (1991). A site is considered to be ecologically significant if it meets one (or more) of the criteria. Guidance on interpretation of the criteria is provided in Wildland Consultants (2013).

As the infrastructure and activities proposed by UC will affect ecological values in the Operational Area, the Concession Area, and in the wider area (in particular the Segregated Airspace Zone), it is appropriate to assess the ecological significance of each of these areas.

The ecological significance of the wider area (i.e. Kaitorete Spit and Lake Ellesmere/Te Waihora) has recently been assessed by Christchurch City Council using the Canterbury RPS criteria, as part of the Christchurch District Plan review. A list of sites

that have been assessed as ecologically significant is provided in Chapter 9 of the Operative Christchurch District Plan (Appendix 9.1.6.1 Schedule of Sites of Ecological Significance). The Concession Area is located within one of the Significant Ecological Sites: 'Kaitorete Spit SES/E/2' (Christchurch City Council 2016a) and adjoins another Significant Ecological Site: 'Birdlings Flat Shrublands SES/H/14' (Christchurch City Council 2016b)<sup>1</sup>. The Segregated Airspace Zone includes part of another Significant Ecological Site: 'Lake Ellesmere/Te Waihora and margins SES/E/1' (Christchurch City Council 2016c).

## 5. VEGETATION AND FLORA

The Concession Area comprises a series of parallel stony beach ridges, which adjoin the coastal sand dunes of Kaitorete Spit Conservation Area Marginal Strip (Figure 1). Stony beach ridges are a naturally uncommon ecosystem type (Williams *et al.* 2007), and Kaitorete Spit is one of only two examples in the South Island with indigenous vegetation (Christchurch City Council 2015b). The Concession Area is part of a more extensive sequence of indigenous shrubland that runs eastwards across to Lake Forsyth/Wairewa (Partridge 2008, Christchurch City Council 2015b - Birdlings Flat Shrublands). The shrubland tends to occur in parallel lines that correspond to slight depressions. These lines are clearly visible on aerial photographs (see Figure 1).

Although vegetation cover within the Concession Area has been modified by human activities, such as vegetation clearance and livestock grazing, and by introduced browsing mammals (hares and rabbits), the underlying landform has not been altered and the vegetation appears to retain a high degree of naturalness and resilience.

Vegetation in the Concession Area consists mostly of indigenous shrubland interspersed with short grassland dominated by introduced danthonia species (often *Rytidosperma racemosum* - indigenous *Rytidosperma* species may also be present as a minor component) (Plates 9-14). The most abundant shrub species is mikimiki (*Coprosma propinqua*), followed by *C. crassifolia*. Other shrub species include matagouri (*Discaria toumatou*), porcupine shrub (*Melicytus alpinus*), common broom (*Carmichaelia australis*), and niniao (*Helichrysum lanceolatum*, Plate 10). A single young māhoe (*Melicytus ramiflorus*) was seen poking its growing tip up through mikimiki (Plate 11).

Scrub pōhuehue (*Muehlenbeckia complexa*) is abundant throughout the shrubland; with plants climbing through other vegetation as well as being self-supported. Leafless bush lawyer (*Rubus squarrosus*) is also relatively common (Plate 12). Occasional silver tussock (*Poa cita*) is present in the grassland, as is the indigenous rock fern, *Cheilanthes sieberi*.

Indigenous mosses are common in the shrubland-grassland, with *Triquetrella papillata* being the most abundant species. A number of indigenous herbs, including *Convolvulus waitaha*, *Dichondra brevifolia*, and *Oxalis exilis*, are also present.

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<sup>1</sup> Site Significant Statements were downloaded from Appendix 9.1.6.1 Schedule of Sites of Ecological Significance <https://districtplan.ccc.govt.nz/pages/plan/book.aspx?exhibit=DistrictPlan>





Plate 9: Vegetation in the Concession Area consists of a mosaic of indigenous shrubland (*Coprosma propinqua* and *C. crassifolia*) and short grassland dominated by introduced danthonia species (most likely *Rytidosperma racemosum*).



Plate 10: Occasional niniao (*Helichrysum lanceolatum*) plants were seen in amongst the mikimiki (*Coprosma propinqua* and *C. crassifolia*) in the Concession Area.



Plate 11: A single māhoe plant was seen poking its tip up through mikimiki (*Coprosma propinqua*).



Plate 12: Leafless bush lawyer (*Rubus squarrosus*) was often seen climbing on mikimiki (*Coprosma propinqua*) in the Concession Area.



Plate 13: Occasional bare, stony patches occur throughout the Concession Area; these provide important habitats for some indigenous plant and fauna species.



Plate 14: Vehicle tracks occur throughout the Concession Area - these disturbed areas tend to be dominated by introduced grasses and herbs, as well as indigenous mosses.

Occasional bare, stony patches occur throughout the Concession Area (Plate 13). These appear to be natural features of the stony beach ridge system, and are likely to provide important habitats for some indigenous plant species that prefer open, stony ground.

A number of vehicle tracks crisscross the Concession Area - these disturbed areas tend to be dominated by introduced grasses and herbs, with a high cover of indigenous mosses such as *Triquetrella papillata* (Plate 14).

## 5.1 Operational area

Vegetation in the Operational Area is much more highly modified compared to the rest of the Concession Area (Plates 15-20). Most of the land around the buildings has been disturbed by previous human activity at the Field Station, and the current vegetation in this area consists of introduced grasses and herbaceous species (it was not possible to identify all of the species present due to the lack of flowering material at the time of the survey). Recent disturbance by vehicles (bare stones and vehicle tracks) was evident on the northern side of the buildings (Plate 18). A few indigenous shrubs (*Coprosma propinqua*) and vines (*Muehlenbeckia complexa*) are present in the fenced area between the two main buildings (Plate 2).

The western arm of the Operational Area, in the vicinity of the proposed landing pad, is not as modified as the rest of the Operational Area, however the vegetation is still dominated by introduced plant species and several vehicle tracks pass through this area. The vegetation consists of short grassland dominated by introduced danthonia (probably *Rytidosperma racemosum*), with scattered indigenous shrubs (mostly *Coprosma propinqua*, with occasional matagouri and porcupine shrub), scrub pōhuehue, dicot herbs, and mosses (Plates 19-20).



Plate 15: Operational Area: west side of the white shed. The vegetation immediately to the north and west of the buildings is highly modified and dominated by introduced species.



Plate 16: Operational Area: looking west from the white shed towards the proposed landing pad location. The highly modified vegetation extends some distance west of the buildings.





Plate 17: Operational Area: looking north from the main buildings along the main vehicle access track. This area is highly modified and dominated by introduced plant species.



Plate 18: Operational Area: a large disturbed area with introduced vegetation, bare stones, and recent vehicle tracks is present to the north of the buildings.



Plate 19: The vegetation in the proposed landing pad location consists of short grassland dominated by introduced danthonia (*Rytidosperma* spp.), with scattered indigenous shrubs (mostly *Coprosma propinqua*).

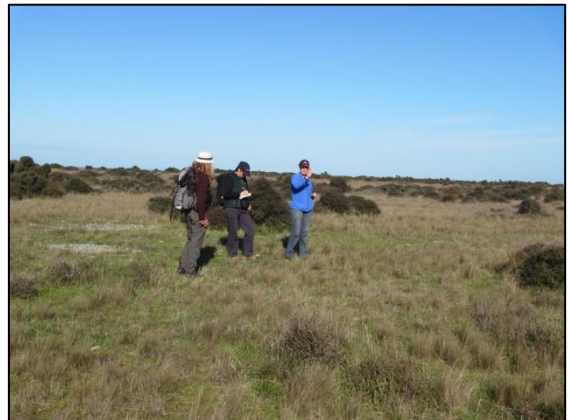


Plate 20: Short grassland dominated by introduced danthonia in the vicinity of the proposed landing pad.

## 6. FLORA

### 6.1 Indigenous

In total, 41 vascular plant species were recorded in the Concession Area during the site visit: these comprised 18 indigenous species, 22 introduced species, and one species that is indigenous to New Zealand but does not occur naturally in Ellesmere Ecological District or elsewhere in the South Island (Appendix 3). In addition, 11 non-vascular plant species (mosses and lichens) were recorded in the Concession Area - these are all indigenous species (Appendix 3). Only seven indigenous vascular plant species and three non-vascular species were found within the Operational Area.

No nationally Threatened plant species were seen in the Concession Area during the site visit, however one At Risk species was recorded: prostrate broom (*Carmichaelia appressa*, Plate 21), which is classified as At Risk-Naturally Uncommon (de Lange *et al.* 2013). Several *C. appressa* plants were seen towards the southern boundary of the

Concession Area on sandier substrates (GPS waypoint = 1574949.97E, 5147538.04N). This species is common on the sand dunes immediately south of the Concession Area.

Another species of note recorded in the Concession Area was short-flowered cranesbill (*Geranium brevicaule*, Plate 22). This species is considered to be uncommon in Ellesmere Ecological District (Christchurch City Council 2016a), and appears to occupy relatively restricted habitats as it was only found in a few bare stony and mossy patches in the Concession Area (GPS waypoint = 1574780.57E, 5147711.51N).

It is possible that other Threatened, At Risk, or locally uncommon plant species may occur within the Concession Area, but they were not found due to the brevity and timing of the site visit. For instance, some herbaceous species that occur in dry grassland on Kaitorete Spit are not visible above-ground during autumn-winter, e.g. *Geranium retrorsum*, *Daucus glochidiatus*.

The Segregated Airspace Zone (Figure 2) encompasses the eastern-most part of the *Muehlenbeckia astonii* (Threatened-Nationally Endangered) population on the Spit (Appendix 2). The number of individuals that occur within this area is unknown, however based on recent observations (Wildland Consultants 2015) it is likely that fewer plants remain now compared to the 2007 *M. astonii* survey.



Plate 21: Several prostrate broom (*Carmichaelia appressa*) plants were seen in the southern part of the Concession Area. This species is common on sand dunes to the south of the Concession Area.

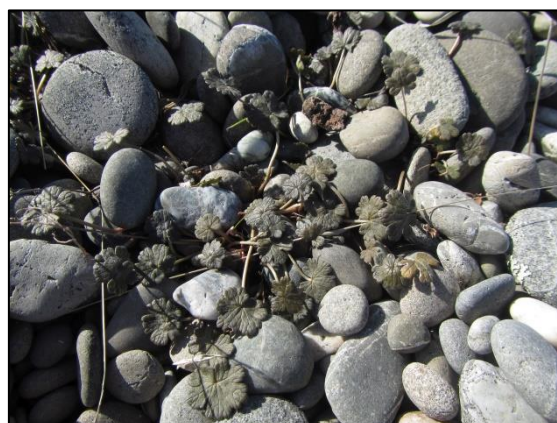


Plate 22: A few plants of short-flowered cranesbill (*Geranium brevicaule*) were found in bare stony patches and moss in the Concession Area. This species is considered to be uncommon in Ellesmere Ecological District.

## 6.2 Pest plants (weeds)

Three introduced pest plant species were seen in the Concession Area during the site visit:

- Scotch broom (*Cytisus scoparius*)
- Sweet briar (*Rosa rubiginosa*)
- Karo (*Pittosporum crassifolium*) - this species is indigenous to New Zealand but does not occur naturally in the South Island.

Scotch broom is listed as a 'Containment Control Pest' in the Canterbury Regional Pest Management Strategy (Maw 2011), while sweet briar is listed as a 'Restricted Pest'. A few plants of Scotch broom were seen in the fenced area between the main' receiver

building and the white shed, but most of these were dead (and appeared to have been sprayed). Occasional sweet briar and karo plants were seen in amongst the shrubland in the Concession Area, however these species are being controlled by a contractor.

## 7. FAUNA

### 7.1 Avifauna

Various bird species (indigenous and introduced) were seen or heard during the visit to the Concession Area (see Table 5). However, this was not the ideal time of year to detect some of the Threatened and uncommon bird species listed in Section 3.6. The shrubland-grassland habitat that dominates the Concession Area is not likely to hold sizeable populations of threatened birds. However, it is possible that banded dotterel may occasionally nest on or use the short grass on the vehicle tracks and around the buildings in the Concession Area. New Zealand pipit may also use this area, although none were noted during the survey. Beyond the Concession Area, the Segregated Airspace Zone (Figure 2) contains many important bird habitats including the coastal dune land area to the south where a New Zealand pipit was seen and banded dotterel are known to nest (M. Lettink, pers. obs.); the beach area to the south where a flock of c.30 black-billed gulls were seen. Caspian terns, white-fronted terns, and black-fronted terns have been seen along this beach during a previous survey (Wildland Consultants 2015). The Segregated Airspace Zone also includes part of Lake Ellesmere/Te Waihora and ephemeral lagoons and saltmarsh associated with it, including the Birdling's Lagoon Reserve (Christchurch City Council). A large number of bird species typical of the Lake Ellesmere/Te Waihora avifauna will utilise in these habitats, and as many as 27 pairs of banded dotterel have been observed nesting in the Christchurch City Council Reserve (Crossland 2017a). Banded dotterel will also be sparsely distributed in cultivated land around the Concession Area and will nest there occasionally.

Table 5: Bird species observed during the visit to the Concession Area on 5 May 2017.

Common Name	Scientific Name	Conservation Status (Robertson <i>et al.</i> 2017)	NZ Status
Black-billed gull*	<i>Larus bulleri</i>	At Risk-Declining	Endemic
NZ pipit*	<i>Anthus novaeseelandiae</i>	At Risk-Declining	Endemic
Pied shag*	<i>Phalacrocorax varius</i>	At Risk-Recovering	Native
Black-backed gull*	<i>Larus dominicanus</i>	Not Threatened	Native
Paradise shelduck	<i>Tadorna variegata</i>	Not Threatened	Endemic
Silvereye	<i>Zosterops lateralis</i>	Not Threatened	Native
Swamp harrier	<i>Circus approximans</i>	Not Threatened	Native
Welcome swallow	<i>Hirundo neoxena</i>	Not Threatened	Native
Australian magpie	<i>Gymnorhina tibicen</i>	Introduced and Naturalised	Introduced
Blackbird	<i>Turdus merula</i>	Introduced and Naturalised	Introduced
Common pheasant	<i>Phasianus colchicus</i>	Introduced and Naturalised	Introduced
Eurasian skylark	<i>Alauda arvensis</i>	Introduced and Naturalised	Introduced
European greenfinch	<i>Carduelis chloris</i>	Introduced and Naturalised	Introduced
Feral pigeon	<i>Columba livia</i>	Introduced and Naturalised	Introduced
House sparrow	<i>Passer domesticus</i>	Introduced and Naturalised	Introduced
Yellowhammer	<i>Emberiza citrinella</i>	Introduced and Naturalised	Introduced

\*These species were seen outside the Concession Area in the dunelands and beach to the south.



## 7.2 Lizards

A total of 34 lizards were observed in the Concession Area during the site visit, consisting of 25 Canterbury geckos (Plate 23), five McCann's skinks, and four southern grass skinks. Most of these lizards - 19 geckos and one southern grass skink - were found during a brief (10 minute) inspection of stacked timber in the fenced yard between the main buildings. Geckos were revealed by torchlight inspection of the gaps between lengths of wood and the skink was seen basking at the base of the timber stack (Plate 24). The inside of the shipping container was not accessed.



Plate 23: Waitaha/Canterbury gecko. This primarily nocturnal species will readily colonise stacked materials and buildings.



Plate 24: Many Waitaha/Canterbury geckos and one southern grass skink were found in this stack of timber.

## 7.3 Invertebrates

Dry shrublands, grasslands, and sand dunes of Kaitorete Spit support 165 species of moth and butterfly of which four species are confined (endemic) to Kaitorete Spit (Patrick 1994). Eleven of these moths and butterfly species are of conservation interest (Wildland Consultants 2012) (Table 4). Overall, Kaitorete Spit is a nationally significant coastal ecosystem for indigenous insects because of its size, naturalness, intactness, degree of endemism, and the presence of rare and nationally threatened species, and the Concession Area is an integral part of the natural areas on the Spit.

The Concession Area contains an excellent example of the typical shrubland-grassland component of Kaitorete Spit. This is a distinctive ecosystem that features rows of *Coprosma*-dominated shrubland festooned in scrub pōhuehue, and in places, leafless bush lawyer. Other woody plants include matagouri growing in a low spreading form adjacent and below the *Coprosma* shrubs. An occasional upright broom (*Carmichaelia australis*) extends out of the *Coprosma* shrubs. From the field visit it is clear that the Concession Area is an important habitat for indigenous invertebrates typical of shrubland-grassland habitats on Kaitorete Spit. It will support the suite of indigenous invertebrates typical of this ecosystem on Kaitorete Spit, including threatened and uncommon species, given its connection to the main shrublands on the Spit.

All of these woody plants support specialised moths and butterflies with scrub pōhuehue being one of the richest host plants for New Zealand's Lepidoptera fauna. On the Spit it supports over 17 moth and butterfly species including the noctuid moth *Bityla sericea* (classified as At Risk-Naturally Uncommon by Stringer *et al.* 2012), undescribed

Canterbury common copper butterfly (*Lycaena* new species “Canterbury Plains”), rare Canterbury endemic Rauparaha’s copper butterfly (*Lycaena rauparaha*), an uncommon leaf mining moth *Zapyrastra calliphana* and stem moth *Morova subfasciata* (Patrick 1994, Wildland Consultants 2012). The larvae of the rare geometrid moth *Samana acutata* (At Risk-Relict) feed on both of the indigenous brooms of Kaitorete Spit, of which only a small population of *Carmichaelia australis* is present within the Concession Area.

The uncommon and Nationally Threatened oecophorid moth *Stathmopoda albimaculata* (Threatened-Nationally Endangered) is associated with the leafless lawyer (*Rubus squarrosus*) on Kaitorete Spit. The relationship with this plant has not been thoroughly investigated but the larvae of this species may feed on this plant. Leafless lawyer is conspicuous as a liane in the shrublands of the Concession Area.

The undescribed striped *Scythris* species is a very distinctive species with a chocolate-coloured stripe across its pale forewings. It was discovered at Kaitorete Spit in shrubland close to the Concession Area in 1987 by John Dugdale. It was subsequently found at Stony Beach on Banks Peninsula in 2002. These are the only two sites known for the moth, which is classified as Threatened-Nationally Critical.

Copper butterflies are a conspicuous element in the butterfly fauna of Kaitorete Spit. Of the three species present, two are characteristic of the shrubland zone, with the undescribed Canterbury common copper particularly common (Plate 25), while Rauparaha’s copper (*Lycaena rauparaha*) is uncommon, as it is elsewhere in Canterbury (Plate 26). Rauparaha’s copper butterfly conservation status has only recently been recognised and is expected to be formally classified as Threatened in the next assessment of New Zealand’s Lepidoptera fauna. The rare noctuid moth *Agrotis cerapachoides*, which has a small population here (Patrick 2013), is also to have its threat status assessed in the next round.



Plate 25: Canterbury common copper butterfly (*Lycaena* new species “Canterbury Plains”) on scrub pōhuehue (*Muehlenbeckia complexa*) and mikimiki (*Coprosma propinqua*) at Birdlings Flat Field Station (5 May 2017).



Plate 26: Rauparaha’s copper butterfly (*Lycaena rauparaha*) showing the distinctive brown underside of the hindwing, which distinguishes it from other New Zealand copper butterflies.

Inter-shrubland grassland and rear dunes support the Kaitorete Spit endemic crambid moth Kupe’s grass moth (*Kupea electilis*) (Wildland Consultants 2012). This species is only locally common on Kaitorete Spit because it has a flightless female, which severely limits dispersal. The six known populations are scattered across Kaitorete Spit and are not



continuous. From habitat profiling and experience with a population close to the Scientific Reserve, it is possible that the Concession Area supports a population of this species, although it will be more widespread on the seaward side of the fence in the rear dunes. It is classified as Threatened-Nationally Vulnerable.

Inter-tussock and inter-shrub habitats present here also appear suitable for a range of widespread indigenous insects typical of the dry grasslands of the eastern and central South Island. The insect fauna of Kaitorete Spit is characterised by a suite of day-active (diurnal) species such as the small grasshopper *Phaulacridium marginale*, black ant *Monomorium antarcticum*, and the crambid moths *Scoparia exilis*, *S. chalicodes*, *Orocrambus corruptus*, and *Eudonia sabulosella* – many of these species have larvae that feed on the mosses that are abundant and locally dominant within the Concession Area.

#### 7.4 Pest animals

A brown hare (*Lepus europaeus*) was seen in the Concession Area during the site visit and droppings were widespread. A feral cat (*Felis catus*) was observed just outside the Concession Area during the site visit, and a cat skeleton was seen in the fenced compound between the main buildings. Rabbits (*Oryctolagus cuniculus*), mice (*Mus musculus*), hedgehogs (*Erinaceus europaeus*), rats (*Rattus* spp.), possums (*Trichosurus vulpecula*), and mustelids (*Mustela* spp.) are also likely to be present in the Concession Area.

## 8. ECOLOGICAL SIGNIFICANCE ASSESSMENT

The Concession Area is located within an area that has been identified as a Significant Ecological Site in the operative Christchurch District Plan: SES/E/2 ‘Kaitorete Spit’ (Christchurch City Council 2015a) (see significance assessment summary in Table 6). For the purposes of this report, it is appropriate to assess the significance of the Concession Area in its own right, as well as the Operational Area, so that potential effects on those areas resulting from the activities proposed can be evaluated. We have therefore assessed the ecological significance of the Operational Area and the Concession Area separately, using the Canterbury RPS criteria (see Tables 6-8).

As the Segregated Airspace Zone (Figure 2) also covers part of the Lake Ellesmere/Te Waihora Significant Ecological Site (SES/E/1 ‘Lake Ellesmere/Te Waihora and margins’, Christchurch City Council 2015c) a summary of the significance assessment for this area is also provided in Table 6.

The **Operational Area** is considered to be significant when assessed against the Canterbury RPS criteria, as it meets three of the criteria: 4, 5 and 10 (see Table 7 for a full explanation). The **Concession Area** is also considered to be ecologically significant when assessed against these criteria, as it meets eight of the criteria: 1, 2, 3, 4, 5, 6, 8, and 10 (see Table 8 for a full breakdown and explanation).

Table 6: Ecological significance assessment summary for the **Operational Area**, the **Concession Area** (see Figure 1), and the wider area - **Kaitorete Spit** and **Lake Ellesmere/Te Waihora** - using the significance criteria in Appendix 3 of the Canterbury Regional Policy Statement (see Tables 7 and 8 for a full explanation of the assessment).

Criterion	Operational Area	Concession Area	Kaitorete Spit <sup>1</sup>	Ellesmere/Te Waihora <sup>2</sup>
<b><u>Representativeness</u></b>				
1. Indigenous vegetation or habitat of indigenous fauna that is representative, typical or characteristic of the natural diversity of the relevant ecological district. This can include degraded examples where they are some of the best remaining examples of their type, or represent all that remains of indigenous biodiversity in some areas.	No	Yes	Yes	Yes
2. Indigenous vegetation or habitat of indigenous fauna that is a relatively large example of its type within the relevant ecological district.	No	Yes	Yes	Yes
<b><u>Rarity/Distinctiveness</u></b>				
3. Indigenous vegetation or habitat of indigenous fauna that has been reduced to less than 20% of its former extent in the Region, or relevant land environment, ecological district, or freshwater environment.	No	Yes	Yes	Yes
4. Indigenous vegetation or habitat of indigenous fauna that supports an indigenous species that is threatened, at risk, or uncommon, nationally or within the relevant ecological district.	Yes	Yes	Yes	Yes
5. The site contains indigenous vegetation or an indigenous species at its distribution limit within Canterbury Region or nationally.	Yes	Yes	Yes	Yes
6. Indigenous vegetation or an association of indigenous species that is distinctive, of restricted occurrence, occurs within an originally rare ecosystem, or has developed as a result of an unusual environmental factor or combinations of factors.	No	Yes	Yes	Yes
<b><u>Diversity and Pattern</u></b>				
7. Indigenous vegetation or habitat of indigenous fauna that contains a high diversity of indigenous ecosystem or habitat types, indigenous taxa, or has changes in species composition reflecting the existence of diverse natural features or ecological gradients.	No	No	Yes	Yes
<b><u>Ecological Context</u></b>				
8. Vegetation or habitat of indigenous fauna that provides or contributes to an important ecological linkage or network, or provides an important buffering function.	No	Yes	Yes	Yes
9. A wetland which plays an important hydrological, biological or ecological role in the natural functioning of a river or coastal system.	No	No	Yes	Yes
10. Indigenous vegetation or habitat of indigenous fauna that provides important habitat (including refuges from predation, or key habitat for feeding, breeding, or resting) for indigenous species, either seasonally or permanently.	Yes	Yes	Yes	Yes

<sup>1</sup> From Christchurch City Council 2016a: Significance Statement for SES/E/2 Kaitorete Spit.

<sup>2</sup> From Christchurch City Council 2016c: Significance Statement for SES/E/1 Lake Ellesmere/Te Waihora & margins.

Table 7: Ecological significance assessment for the **Operational Area (<1 ha, see Figure 3)** using the significance criteria in Appendix 3 of the Canterbury Regional Policy Statement.  
Key: Veg = Vegetation, Bird = Avifauna, Liz = Lizards, Inv = Invertebrates.

Criterion	Met	Explanation - Operational Area (<1 ha)
<b>Representativeness</b>		
1. Indigenous vegetation or habitat of indigenous fauna that is representative, typical or characteristic of the natural diversity of the relevant ecological district. This can include degraded examples where they are some of the best remaining examples of their type, or represent all that remains of indigenous biodiversity in some areas.	No	<ul style="list-style-type: none"> <li>The vegetation in the Operational Area has been heavily modified and is dominated by introduced grasses and herbs, and is not representative of indigenous vegetation in Ellesmere Ecological District (ED).</li> <li>The 4 ha launch site is a small degraded area not typical of that used by birds in the area.</li> <li>Lizard habitat in the Operational Area consists mainly of man-made structures (buildings and stacked materials) with a few indigenous shrubs and vines.</li> <li>The exotic grassland at the site is not representative of the natural diversity of indigenous invertebrate habitat in the Ellesmere ED.</li> </ul>
2. Indigenous vegetation or habitat of indigenous fauna that is a relatively large example of its type within the relevant ecological district.	No	<ul style="list-style-type: none"> <li>The Operational Area does not contain any indigenous vegetation that is a relatively large example of its type in Ellesmere ED.</li> <li>The habitat available to indigenous birds is well-represented elsewhere on Kaitorete Spit.</li> <li>Only a small portion of the Operational Area contains suitable (man-made or natural) cover for lizards and the area that they occupy is not a large example of a lizard habitat.</li> <li>The site is a modified example of habitat for indigenous invertebrates typical of Kaitorete Spit's grassland-shrubland ecosystem.</li> </ul>
<b>Rarity/Distinctiveness</b>		
3. Indigenous vegetation or habitat of indigenous fauna that has been reduced to less than 20% of its former extent in the Region, or relevant land environment, ecological district, or freshwater environment.	No	<ul style="list-style-type: none"> <li>Although the Operational Area is located on an Acutely Threatened land environment (LENZ Level IV category J2.1b) (Cieraad <i>et al.</i> 2015), it does not contain indigenous vegetation that meets this criterion.</li> <li>The habitat type provided for birds at this site has not been significantly reduced in size within the ED, but has been reduced in its quality due to the influx of weeds and human disturbance.</li> <li>The site does not provide lizard habitat that meets this threshold.</li> <li>The site does not meet this threshold for invertebrates.</li> </ul>
4. Indigenous vegetation or habitat of indigenous fauna that supports an indigenous species that is threatened, at risk, or uncommon, nationally or within the relevant ecological district.	Yes Liz	<ul style="list-style-type: none"> <li>The Operational Area does not contain any indigenous plant species that are nationally Threatened or At Risk, or uncommon in Ellesmere ED.</li> <li>The habitat at this site is unlikely to support any indigenous bird species that are nationally Threatened or At Risk or uncommon in the ED.</li> <li>Waitaha/Canterbury gecko and southern grass skink are present. Both species are classified as At Risk-Declining (Hitchmough <i>et al.</i> 2016).</li> <li>The Operational Area is unlikely to support invertebrate species that fit this criterion because the habitat that is present is modified (i.e. indigenous shrubs are sparse and exotic grassland dominates).</li> </ul>
5. The site contains indigenous vegetation or an indigenous species at its distribution limit within Canterbury Region or nationally.	Yes Liz	<ul style="list-style-type: none"> <li>The Operational Area does not contain vegetation or indigenous plant species at their regional or national distributional limits.</li> <li>None of the bird species likely to use the habitat at the site are at their distribution limits.</li> <li>Waitaha/Canterbury gecko is at its southern regional limit on Kaitorete Spit.</li> <li>The site does not contain any invertebrate species at their regional or national distribution limits.</li> </ul>

<b>Criterion</b>	<b>Met</b>	<b>Explanation - Operational Area (&lt;1 ha)</b>
6. Indigenous vegetation or an association of indigenous species that is distinctive, of restricted occurrence, occurs within an originally rare ecosystem, or has developed as a result of an unusual environmental factor or combinations of factors.	No	<ul style="list-style-type: none"> <li>• The Operational Area does not contain any indigenous vegetation that meets this criterion.</li> <li>• None of the bird species likely to use the habitat at the site are endemic to Kaitorete Spit or the wider ED.</li> <li>• The presence of one species of skink and one species of gecko is not distinctive or of restricted occurrence.</li> <li>• The site does not contain invertebrates that meet this criterion.</li> </ul>
<b><u>Diversity and Pattern</u></b>		
7. Indigenous vegetation or habitat of indigenous fauna that contains a high diversity of indigenous ecosystem or habitat types, indigenous taxa, or has changes in species composition reflecting the existence of diverse natural features or ecological gradients.	No	<ul style="list-style-type: none"> <li>• The Operational Area contains a low diversity of indigenous plant species and vegetation/habitat types.</li> <li>• The birds likely to inhabit the site are not likely to be diverse due to the vegetation and ecosystem type.</li> <li>• Lizard diversity is moderate (two species).</li> <li>• The site is ecologically uniform compared to the surrounding grassland/shrubland so does not meet this criterion.</li> </ul>
<b><u>Ecological Context</u></b>		
8. Vegetation or habitat of indigenous fauna that provides or contributes to an important ecological linkage or network, or provides an important buffering function.	No	<ul style="list-style-type: none"> <li>• The Operational Area does not contain vegetation or habitat that provides important linkages for bird species.</li> <li>• The habitat occupied by lizards at the site is small and not essential to the persistence of lizard populations in the wider area (Concession Area or Segregated Airspace Zone).</li> <li>• The site does not provide an important link in the ecological linkage for indigenous invertebrates.</li> </ul>
9. A wetland which plays an important hydrological, biological or ecological role in the natural functioning of a river or coastal system.	No	<ul style="list-style-type: none"> <li>• The Operational Area does not contain any wetlands.</li> </ul>
10. Indigenous vegetation or habitat of indigenous fauna that provides important habitat (including refuges from predation, or key habitat for feeding, breeding, or resting) for indigenous species, either seasonally or permanently.	<b>Yes</b> Liz	<ul style="list-style-type: none"> <li>• The Operational Area does not provide important habitat for indigenous birds.</li> <li>• The buildings and stacked materials provide lizards with secure over-wintering sites and refuge from predators (e.g. introduced mammals and some bird species).</li> <li>• The site does not provide important habitat for indigenous invertebrate species.</li> </ul>

Table 8: Ecological significance assessment for the **Concession Area (56 ha)** using the significance criteria in Appendix 3 of the Canterbury Regional Policy Statement.  
Key: Veg = Vegetation, Bird = Avifauna, Liz = Lizards, Inv = Invertebrates.

Criterion	Met	Explanation - Concession Area (56 ha)
<b>Representativeness</b>		
1. Indigenous vegetation or habitat of indigenous fauna that is representative, typical or characteristic of the natural diversity of the relevant ecological district. This can include degraded examples where they are some of the best remaining examples of their type, or represent all that remains of indigenous biodiversity in some areas.	Yes Veg Bird Liz Inv	<ul style="list-style-type: none"> <li>Although the original vegetation cover in the Concession Area has been modified, the site contains indigenous shrubland-grassland that is representative of indigenous vegetation in the Ellesmere Ecological District (ED).</li> <li>The indigenous bird fauna likely to visit the Concession Area over the course of a year is representative of that on Kaitorete Spit and the wider ED.</li> <li>The site contains remnant coastal shrubland that provides representative habitat for indigenous lizards.</li> <li>The shrubland-grassland-mossfield habitat of the Concession Area is representative of such habitats in Ellesmere ED, and is overall a very good example of such habitat for indigenous invertebrates.</li> </ul>
2. Indigenous vegetation or habitat of indigenous fauna that is a relatively large example of its type within the relevant ecological district.	Yes Veg Liz Inv	<ul style="list-style-type: none"> <li>The Concession Area contains indigenous shrubland that is a relatively large example of its type in the Ellesmere ED.</li> <li>The site is a large example of coastal shrubland habitat for indigenous lizards.</li> <li>The site is a relatively large example of grassland-shrubland habitat on Kaitorete Spit for invertebrates.</li> </ul>
<b>Rarity/Distinctiveness</b>		
3. Indigenous vegetation or habitat of indigenous fauna that has been reduced to less than 20% of its former extent in the Region, or relevant land environment, ecological district, or freshwater environment.	Yes Veg Liz Inv	<ul style="list-style-type: none"> <li>The Concession Area is located on an Acutely Threatened land environment (LENZ Level IV category J2.1b) (Cieraad <i>et al.</i> 2015), and contains 'indigenous vegetation' that meets this criterion.</li> <li>Coastal shrubland habitat for lizards has been significantly reduced in size within the ED. A relatively-recent local example is the clearance of shrublands for housing (the 'Seaforth Subdivision') at Birdlings Flat c. 10 years ago.</li> <li>The Concession Area provides indigenous shrubland and grassland habitats for indigenous invertebrates that meet this criterion.</li> </ul>
4. Indigenous vegetation or habitat of indigenous fauna that supports an indigenous species that is threatened, at risk, or uncommon, nationally or within the relevant ecological district.	Yes Veg Bird Liz Inv	<ul style="list-style-type: none"> <li>The site contains one nationally At Risk plant species: <i>Carmichaelia appressa</i> (At Risk-Naturally Uncommon) and one species that is uncommon in Ellesmere ED: <i>Geranium brevicaula</i>.</li> <li>The Concession Area may provide habitat for two bird species (banded dotterel and NZ pipit) classified as Threatened-Nationally Vulnerable and At Risk-Declining respectively.</li> <li>Waitaha/Canterbury gecko and southern grass skink are present. Both species are At Risk-Declining. Canterbury spotted skink (Threatened-Nationally Vulnerable) occur &lt;200 m from the Concession Area and could also be present.</li> <li>The Concession Area provides habitat for three nationally Threatened and two At Risk moth species: <ul style="list-style-type: none"> <li><i>Scythris "stripe"</i> (Threatened-Nationally Critical)</li> <li><i>Stathmopoda albimaculata</i> (Threatened-Nationally Endangered)</li> <li><i>Kupea electilis</i> (Threatened-Nationally Vulnerable)</li> <li><i>Samana acutata</i> (At Risk-Relict)</li> <li><i>Bityla sericea</i> (At Risk-Naturally Uncommon).</li> </ul> </li> <li>It also provides habitat for two indigenous moth species that are uncommon nationally and in Ellesmere ED: <ul style="list-style-type: none"> <li><i>Agrotis ceropachoides</i> (no threat status as not ranked yet)</li> <li><i>Lycaena rauparaha</i> (no threat status as not ranked yet)</li> </ul> </li> </ul>



Criterion	Met	Explanation - Concession Area (56 ha)
5. The site contains indigenous vegetation or an indigenous species at its distribution limit within Canterbury Region or nationally.	Yes Liz Inv	<ul style="list-style-type: none"> <li>The Concession Area does not contain any indigenous plant species at their regional or national distributional limits (<i>Carmichaelia appressa</i> occurs further west and south of the site).</li> <li>None of the bird species likely to use the habitat provided by the paddock are at their distribution limit.</li> <li>Waitaha/Canterbury gecko is at its southern regional limit.</li> <li>The site supports one indigenous invertebrate species that reaches its national distribution limit on Kaitorete Spit: the moth <i>Kupea electilis</i> is endemic to Kaitorete Spit.</li> </ul>
6. Indigenous vegetation or an association of indigenous species that is distinctive, of restricted occurrence, occurs within an originally rare ecosystem, or has developed as a result of an unusual environmental factor or combinations of factors.	Yes Veg Inv	<ul style="list-style-type: none"> <li>The Concession Area contains indigenous shrubland-grassland that occupies a naturally uncommon ecosystem type: stony beach ridge (Williams <i>et al.</i> 2007).</li> <li>The birds likely to inhabit the Concession Area are not likely to be distinctive due to the vegetation and ecosystem types available.</li> <li>The association of lizard species (Waitaha/Canterbury gecko, southern grass skink and McCann's skink) is not distinctive or of restricted occurrence (note: significance under this criterion would be met if Canterbury spotted skink is present).</li> <li>The suite of indigenous invertebrates that occurs in indigenous shrubland-grassland habitats on the Spit is highly distinctive.</li> </ul>
<b><u>Diversity and Pattern</u></b>		
7. Indigenous vegetation or habitat of indigenous fauna that contains a high diversity of indigenous ecosystem or habitat types, indigenous taxa, or has changes in species composition reflecting the existence of diverse natural features or ecological gradients.	No	<ul style="list-style-type: none"> <li>The Concession Area contains a relatively low diversity of vegetation/habitat types and indigenous plant species.</li> <li>The birds likely to inhabit the Concession Area are not likely to be diverse due to the vegetation or ecological gradients present.</li> <li>Known lizard diversity is moderate (three species).</li> <li>Although the relatively intact indigenous plant community in the Concession Area is important for invertebrates, the site is not particularly diverse in terms of invertebrate species or habitat.</li> </ul>
<b><u>Ecological Context</u></b>		
8. Vegetation or habitat of indigenous fauna that provides or contributes to an important ecological linkage or network, or provides an important buffering function.	Yes Bird Liz Inv	<ul style="list-style-type: none"> <li>The Concession Area is typical of vegetation communities that were once widespread on Kaitorete Spit. Kaitorete Spit provides connectivity between Lake Ellesmere/Te Waihora and the ocean for species such as Caspian tern and white-fronted tern. It is also an important stop-over point for many migratory waders e.g. bar-tailed godwit, wrybill, banded dotterel.</li> <li>The lizard habitat is continuous, providing important linkages to shrublands and dunelands to the west, east and south.</li> <li>The site supports important indigenous shrubland and grassland that will contribute to invertebrate connectivity across Kaitorete Spit.</li> </ul>
9. A wetland which plays an important hydrological, biological or ecological role in the natural functioning of a river or coastal system.	No	<ul style="list-style-type: none"> <li>The site does not contain any wetlands.</li> </ul>
10. Indigenous vegetation or habitat of indigenous fauna that provides important habitat (including refuges from predation, or key habitat for feeding, breeding, or resting) for indigenous species, either seasonally or permanently.	Yes Bird Liz Inv	<ul style="list-style-type: none"> <li>The Concession Area may provide habitat for two bird species (banded dotterel and NZ pipit), classified as Threatened-Nationally Vulnerable and At Risk-Declining respectively. The habitat is suitable for nesting banded dotterel and winter feeding for NZ pipit.</li> <li>The Concession Area contains important habitat for lizards, including feeding and breeding sites, and refuge from predators (e.g. introduced mammals and some bird species).</li> <li>The Concession Area provides important permanent habitat for indigenous invertebrates because of its size, excellent condition and connectivity across Kaitorete Spit.</li> </ul>

## 9. PROPOSED INFRASTRUCTURE AND ACTIVITIES

### 9.1 Infrastructure proposed within the Concession Area

Existing infrastructure in the Concession Area and the proposed new infrastructure and activities are described in detail in the draft concession application prepared by the University of Canterbury (Ladley 2017). A brief summary is provided below.

The University proposes to install the following new infrastructure within the Concession Area:

- Shed - 15 × 16 m (240 m<sup>2</sup>) (Plate 27).
- Apron - up to 15 × 15 m (up to 225 m<sup>2</sup>) (Plate 28).
- Landing pad - 15 × 15 m (225 m<sup>2</sup>) (Plate 29).
- New transformer and concrete pad - 2 x 2.5 m.
- Pathway - between new shed and landing pad (approx. 60 m long and three metres wide).
- New underground power cable - c.150 m long (Figure 4).
- Moveable trailer (for a flight operations centre).
- Shipping container (for storage).
- Water storage tanks (for fire-fighting purposes).

Existing and proposed structures in the Operational Area are shown in Figure 3.



Plate 27: Corner pegs showing the proposed location of the new shed in front of the main 'receiver' building. Photograph by Jenny Ladley, subsequent to our site visit on 5 May 2017.



Plate 28: Corner pegs showing the proposed location of the apron in front of the white shed. Photograph by Jenny Ladley, subsequent to our site visit on 5 May 2017.



Plate 29: The surface of the proposed landing pad (225 m<sup>2</sup>) will be covered in temporary materials such as outdoor flooring mats (photo from Ladley 2017). The pad will be no higher than 150 mm off above the ground.



Figure 4: Aerial photograph showing the existing transformer pole and proposed route of the new underground power cable (copied from Ladley 2017).

## 9.2 Removal of existing infrastructure

As part of this proposal, the University intends to remove some existing (obsolete) infrastructure and equipment from the Concession Area, i.e. the aerial arrays, shipping container, white shed, fences, and other materials. The University has already begun the process of removing the aerial arrays and removing old equipment from buildings, and has applied to the Department of Conservation for a Wildlife Act Permit which covers the removal these structures (Wildlife Permit 55396-FAU DOC3024189).

## 9.3 Operational Activities

The Spatial Engineering Research Centre plans to use the Operational Area to launch UAVs for research purposes. The UAVs will fly in a Segregated Airspace Zone (NZR905), which includes:

- 3,254 hectares of land on Kaitorete Spit.
- 331 hectares over Lake Ellesmere/Te Waihora.
- Approximately 9,100 hectares of ocean.



The Segregated Airspace Zone encompasses public conservation land administered by the Department of Conservation, Christchurch City Council, and privately-owned land. Overflight of private land will be in compliance with CAA regulations and in consultation with landowners when required by CAA rules.

UAV flights will occur at altitudes higher than 60 metres, but are likely to be lower than 1,000 metres. UAVs will mostly be small multi-rotor units approximately 1-1.5 metres in diameter, or small fixed-wing units with a two-metre wing span. Occasionally, larger developmental prototypes will be flown; these will be the size of a small aircraft, weighing up to 1,400 kg, and up to six metres in length and a 10 metre wingspan. Maximum downwash speeds are expected to be 120 kph at 1.5 metres above ground and 40 kph at 2.5 metres above ground. All UAVs are electrically-powered, and will not carry any liquid petrochemical fuels.

UAVs are to be flown during normal working hours between Monday and Friday, and not at weekends or at night. The expected frequency of UAV flights will be up to 10 flights per day, totalling 400 per year. Larger prototype UAVs will be flown up to three times per day for as many as four days per week.

Flight paths will be in a south to northwest direction from the Operational Area, therefore UAVs are not expected to fly over Birdlings Flat or Banks Peninsula (Jenny Ladley, University of Canterbury pers. comm.). For the purposes of this ecological assessment, we have assumed that UAVs will not fly east of the Concession Area.

The noise level of the smaller UAVs has been estimated to be 65dba at five metres (slightly louder than an alarm clock) and this is predicted to drop to imperceptible levels after 500 metres. Noise levels for the larger UAVs are expected to be higher, and will depend on their design and the technology being used. A research team of up to 10 people will be present at the site during UAV flight operations.

The UAVs will be assembled and stored on-site in the new shed. Larger UAVs will be moved to and from the landing pad along the pathway using a small vehicle (golf cart).

While the majority of the UAVs to be operated will be small multi-rotor units that do not require a runway for take-off and landing, UC also proposes to run occasional test flights of small fixed-wing UAVs. These fixed-wing UAVs are not expected to have a wing span of more than three metres and will require approximately 100 metres of straight track to use as a take-off and landing runway. The University proposes to use one of the existing vehicle tracks in the Concession Area for this purpose - the main vehicle access track from the gate to the Operational Area has been suggested (Jenny Ladley, University of Canterbury, pers. comm.). The exact track will be identified after consultation with Department of Conservation staff, specifically looking at possible bird nesting sites and indigenous vegetation surrounding the track (Ladley 2017). The University does not expect that any new surface or modification to the existing track/s will be required, unless at a later date, and in consultation with the Department of Conservation, it becomes evident that the use of a mat product is necessary.

## 9.4 Weed and pest control

The University will be responsible for the day-to-day operation of the Field Station, including maintenance of the buildings and site, maintaining a weed control programme, and assisting with mammalian predator control in the area (Ladley 2017). As part of its operations, UC proposes the following:

- A contractor will undertake control of sweet briar and karo within the Concession Area. The control (using the cut and paint/weed kill method) will start in 2017 and there will be an ongoing programme.
- A contractor will carry out mammalian pest management to augment the existing Department of Conservation trapping lines in Kaitorete Spit Scientific Reserve (Figure 5). They propose to set up 40 'DOC200' traps around the edge of the Reserve. The University will also collate and supply trapping data to DOC as required.



Figure 5: Existing predator trap lines maintained by the Department of Conservation are shown in black, new trap lines that the University proposes to establish are shown in red (map supplied by UC).

## 10. POTENTIAL ECOLOGICAL EFFECTS

### 10.1 Vegetation and flora

#### Construction Effects

Construction of the proposed shed, apron, and concrete pad for the transformer unit will result in disturbance to soils and the permanent loss of vegetation cover (at least 270 m<sup>2</sup>) within the Concession Area, as the ground will be levelled and the surface will be covered in concrete or hard surfaces. In order to avoid/minimise adverse effects on indigenous vegetation and fauna, UC proposes to locate these structures in the most modified part of the Concession Area, i.e. the Operational Area on Figure 3. The proposed footprint of

these structures is within an area that has already been highly disturbed and is dominated by introduced plant species (i.e. does not contain indigenous vegetation), and construction of the shed, apron, and concrete pad will therefore have **less than minor adverse effects** on indigenous vegetation.

The proposed landing pad must be located at least 60 metres away from buildings and other structures (Ladley 2017), therefore it is not possible for it to be located within the highly disturbed area around the existing buildings, or to reduce the length of the pathway between the apron and landing pad. The proposed landing pad and pathway are located to the west of the main buildings in an area that contains scattered indigenous shrubs and other indigenous plants. Installation of the landing pad and pathway is likely to require the removal of a small number of indigenous shrubs, although UC has stated that they intend to use existing tracks as far as practicable and that “impact to local vegetation and habitats will be avoided by establishing a pathway that travels around the native shrubland areas.” The destruction of a small number of indigenous shrubs (e.g. less than 10) is considered to be a **less than minor adverse effect**, as this would have a negligible effect on the overall intactness and long-term viability of the indigenous shrubland in the Concession Area.

Installation of the new underground power cable will require the excavation of a 500 mm wide trench (using an excavator) between the transformer pole and the main ‘receiver’ building. This will result in the destruction of soils and vegetation along the route of the cable (150 metres long). In order to minimise damage to indigenous vegetation (and fauna), UC proposes to bury the cable in a new trench alongside the main vehicle access road, as re-opening the old trench would damage some indigenous shrubs that have colonised that line. If the route of the new power cable runs immediately along the main vehicle access track and disturbance to adjacent indigenous shrubs is avoided (or minimised) during construction then installation of the new power cable will have a **less than minor adverse effect** on indigenous vegetation.

Construction and installation of the proposed infrastructure will result in an increase in vehicles entering the Concession Area, including access by heavy vehicles, e.g. trucks carrying concrete and other building materials. If vehicle movements are restricted to the main access track and the Operational Area, which do not contain significant indigenous vegetation, then adverse effects on indigenous vegetation will be **less than minor**.

In addition to the permanent loss of vegetation cover in the footprint of the proposed infrastructure, some disturbance to vegetation elsewhere within the Operational Area is likely during the construction phase, as a result of movement and storage of equipment and building materials around the building sites. This adverse effect will be **less than minor** if disturbance to indigenous plants is kept to a minimum and only a small number of indigenous shrubs (e.g. less than 10 individuals) are destroyed during construction, as this would have a negligible effect on the long-term viability of the indigenous shrubland in the Concession Area.

Removal of existing obsolete infrastructure is expected to have **less than minor adverse effects** on indigenous vegetation in the Concession Area, provided that vehicles and machinery are restricted to existing vehicle tracks and other disturbed areas, and damage to indigenous shrubs is avoided or kept to an absolute minimum.



Other effects of construction and removal of existing structures include vibration from vehicles and machinery, and dust from excavation of the building foundations and, however this likely to have **less than minor adverse effects on indigenous vegetation**.

There is a risk that vehicles, gravel/stones, and other building materials brought into the Concession Area during construction could contain weed propagules (or pathogens) that would pose a threat to ecological values in the Scientific Reserve. If a new invasive weed or pest was able to establish and spread widely in the Reserve as a result of the proposed works then this would constitute a **more than minor adverse effect** on indigenous vegetation.

### Operational Effects

The activities research proposed will result in a variety of operational effects in the Operational Area, Concession Area, and the Segregated Airspace Zone.

The proposed activities will result in a substantial increase in the number and frequency of vehicles entering the Concession Area, as UC proposes to launch up to 10 UAV flights per day, totalling 400 flights per year. If vehicles were allowed to drive anywhere in the Concession Area, particularly in the less modified parts of the Concession Area - away from buildings and existing tracks - then this could cause considerable disturbance and damage to indigenous vegetation, which would constitute a **more than minor adverse effect**. However, if vehicles entering the Concession Area are restricted to the Operational Area and main vehicle access track (shown on Figure 3), then adverse effects on indigenous vegetation from vehicle movements are expected to be **less than minor**.

The exact location of the unformed runway had not been specified at the time of writing this report, however if the main vehicle access track is used for the runway and the existing track is not modified (e.g. widened or covered in artificial surfaces), then potential adverse effects on indigenous vegetation from this activity are expected to be **less than minor**.

Other potential effects from operation of the UAVs include vibration, heat, 'downwash' and dust from take-offs and landings, however these are all likely to have **less than minor adverse effects** on indigenous vegetation.

The risk of fire as a result of the proposed UAV research activities poses the most serious threat to indigenous vegetation in the Concession Area and the wider Kaitorete Spit area. Kaitorete Spit is one of the driest parts of Canterbury, often experiencing extreme drought conditions during summer, thus making it extremely vulnerable to fire. The likelihood of a fire occurring and the location and size of the area that could be affected is difficult to predict, as it depends on the operation of the UAVs, including timing and potential for crashes, and the effectiveness of the fire management measures that are put in place.

As the UAVs may fly anywhere within the Segregated Airspace Zone, it is assumed that that they could crash and potentially start a fire anywhere within this zone. The Segregated Airspace Zone includes part of the largest and most important population of *Muehlenbeckia astonii* (Threatened-Nationally Endangered) in New Zealand (see map in Appendix 2). Long-term viability of the *M. astonii* population on Kaitorete Spit is already of concern because of the lack of recruitment (seedling survival and growth) and gradual

loss of existing plants as a result of browsing mammals (livestock and hares/rabbits) and habitat destruction/modification (de Lange and Jones 2000). Almost all of the known plants occur on private land and have no legal protection or active conservation management. Individual *M. astonii* plants have shown some capacity to regenerate after being burnt (Dutton 2007), which suggests that a fire may not cause the death of all burnt individuals, however the ability of the population to recover in the long-term is uncertain. The potential effect of a fire on *M. astonii* would range from a **minor to a major adverse effect**, depending on how many individuals were permanently lost and the long-term impact on the survival of the population.

The Segregated Airspace Zone passes over part of the western section of Kaitorete Spit Scientific Reserve (Figure 2). The Scientific Reserve contains nationally significant indigenous vegetation and plant species, including pikao (At Risk-Declining) and the Kaitorete Spit woollyhead (*Craspedia* 'Kaitorete'), an undescribed species that is endemic to the Spit and classified as Threatened-Nationally Endangered. A potential fire in the Scientific Reserve, depending on the extent and nature of the indigenous vegetation affected, could constitute a **major adverse effect**. This effect could be temporary (e.g. localised loss of pikao, which may regenerate) or permanent (loss of all *Craspedia* 'Kaitorete' from the reserve), depending on the long-term consequences of the fire. The Segregated Airspace Zone is also relatively close to Waihora Scientific Reserve (less than two kilometres to the west) and this reserve also contains highly significant indigenous vegetation and nationally Threatened and At Risk plant species, which could be adversely affected by a potential fire.

## 10.2 Avifauna

### Construction Effects

It is possible that two indigenous bird species - banded dotterel (Threatened-Nationally Vulnerable) and New Zealand pipit (At Risk-Declining) - may occasionally use the short grassland in and around the Operational Area. However, the area of short grassland around the site is small and does not contain patches of bare ground typically associated with banded dotterel nesting. Therefore the reduction in available habitat for banded dotterel and NZ pipit directly resulting from the proposed developments within the Operational Area are not considered significant, and is therefore likely to have **less than minor** adverse effects. However, consideration should be given to not undertaking construction during the banded dotterel breeding season, August to December. This period would also cover most of the NZ pipit breeding season. If construction was to occur during this period, an inspection of the site should be undertaken to determine whether nesting banded dotterel or NZ pipit are present.

### Operational Effects

Launching of UAVs in the Operational Area is expected to have **less than minor** effects on bird species present at Kaitorete Spit. However, UAV flight over the Concession Area and throughout the Segregated Airspace Zone could affect birds. These impacts could be either indirect, through disturbance, or direct, i.e. bird strike.

## Disturbance

There is potential that small slow-flying UAVs may cast shadows or give the appearance of a hawk, or other bird of prey, and this may generate alarm responses in birds nesting or roosting on the ground. If such alarm responses do occur and exceed natural levels then it may affect the nesting or foraging success of certain bird species, and consequently individual survival. However, whether or to what extent UAVs may cause these effects on New Zealand bird species is largely unknown. It should also be noted that UAVs have the potential to be used to study threatened bird species in a manner that may be less invasive than ground-based techniques, and this could be a potential benefit.

Most research to date on disturbance to birds by UAVs has been carried out overseas, and has largely been driven by interest in using UAVs to survey bird colonies. In general, the research has suggested that species responses can be quite varied and may be related to whether avian predators are a significant threat to that species (Borelle and Fletcher 2017). Also, Borelle and Fletcher (2017) warn that effects on birds may not always be obvious through behavioural responses, but could be physiological, resulting from stress. Vas *et al.* (2015) flew a quiet quadcopter drone more than 200 times at different angles and speeds near populations of semi-captive mallard ducks (*Anas platyrhynchos*), wild flamingos (*Phoenicopterus* spp.), and common greenshanks (*Tringa nebularia*) and noted that in 80% of cases birds ignored the drone, suggesting a 20% disturbance rate. They also noted larger flocks were more likely to respond than smaller flocks. They specifically suggested that UAV launches should be no closer than 100 metres from where birds are present. McEvoy *et al.* (2016) found disturbance of waterfowl occurred if UAVs flew below 60 metres above the ground, and on an angle that suggested they were flying towards birds, i.e. an attack angle. However, Lyons *et al.* (2017) noted that water birds (ducks, piscivores, and waders) were reluctant to take flight, staying grounded if a UAV was present overhead. They also noted aggressive interactions between magpies and UAVs, and concluded that there could be potential for raptors to have encounters with UAVs, even at higher altitudes. New Zealand falcon (*Falco novaeseelandiae*) has been observed attacking a UAV (W. Shaw, Wildland Consultants, pers. obs.).

If most UAV flying is undertaken at very high altitudes and the UAVs achieve these heights quickly following a steep take-off and landing then the effects of UAV activity are likely to be **less than minor**. However, it would still be necessary to monitor disturbance levels to ensure that they are low. If there is a lot of low-flying UAV activity within the Segregated Airspace Zone that results in cumulative or constant disturbance to some birds species then the adverse effects could be **more than minor**. However, it must be stressed that whether or not such effects will occur are unknown. The overseas research described above suggests that responses by individual species will be variable, and there is no data available for the species present on Kaitorete Spit.

## Bird Strike

The potential impact of mortality from collisions with UAVs on the long-term population viability of bird species is less well studied. Although, Greene (2015) noted that while most airplane bird strikes occur during take-off and landing (unless with long-distance migratory species), most UAVs operate at 200 metres or below, meaning they are in the flight path of many non-migratory bird species (Greene 2015). There is considerable bird life at Kaitorete Spit and Lake Ellesmere/Te Waihora with many migratory species



visiting the area (see Section 3.6). Four hundred UAV flights per year will be a substantial increase in air space activity over Kaitorete Spit. If bird strikes were to become a common occurrence then the adverse effects would be considered to be **more than minor**. However, if UAV flights are managed in a way that prevents bird strikes, then these effects would be **less than minor**.

### 10.3 Lizards

#### Construction Effects

Mortality is a direct and short-term effect limited to the deconstruction and installation phases. Lizards living in buildings, human-made materials, stone piles, and indigenous vegetation (particularly in the indigenous shrubs *Coprosma* spp., matagouri, and *Meliccytus alpinus*, and vine *Muehlenbeckia complexa*) ear-marked for deconstruction and removal - particularly the white shed, shipping container, and materials stacked in the fenced yard - or to be affected by the installation of new infrastructure are at risk of being injured or killed. The number of individuals that could be affected is unknown but could easily exceed 100 individuals. Most of these are expected to be Waitaha/Canterbury geckos due to this species' tendency to use human-made structures and stacked materials for communal retreat sites. This effect is considered to be **major** but can be mitigated (see Section 10.3).

Habitat loss is a direct and permanent loss of artificial structures and indigenous vegetation that provide lizards with shelter and refuge from predators. This adverse effect is considered to be **minor**, given the relatively small area that will be affected and the abundance of natural retreat sites in the vicinity. Avoidance and mitigation measures for this effect are described in Section 10.3.

Vehicle strike is a direct but short-term effect caused by vehicles colliding with (thereby injuring or killing) lizards that are basking or moving along tracks within the Concession Area. This adverse effect is considered **less than minor** due to low traffic volumes and the typically-sparse vegetation cover in disturbed areas flanking the tracks.

#### Operational Effects

Noise disturbance is a direct and temporary effect limited to UAV launching and landing events. The magnitude of this effect is unknown as reptiles are typically neglected in studies testing the effects of noise disturbance. UAVs flying directly over emerged (basking or foraging) skinks are likely to be perceived as aerial predators and induce a flight response, i.e. cause animals to seek cover. Nocturnal geckos are unlikely to be affected because they are rarely emerged during the day (they do move about within their diurnal retreats for thermoregulation purposes). UAVs flying at the predicted altitudes of 60 to 1,000 metres are not expected to have any effects on lizards. Overall, this adverse effect is anticipated to be **less than minor**.

Vehicle strike is a direct and temporary effect caused by vehicles colliding with (thereby injuring or killing) lizards that are basking or moving along tracks in the Concession Area. This adverse effect is expected to be **less than minor** due to relatively low traffic volumes and sparse vegetation cover in the disturbed areas flanking the tracks.

The University will contribute to an existing Department of Conservation pest mammal control programme targeting mustelids by providing additional (40 “DOC200”) traps. Effects of the predator control programme (in its current or extended form) on lizards are unknown and should not necessarily be presumed to be positive. This is because the predator control programme does not target the entire mammalian predator guild. For lizards, this includes mice, rats, mustelids, hedgehogs, and cats. Also, the control programme is undertaken over a relatively-small scale, and could be increasing rodent abundance and overall predation rates of lizards, a process known as ‘meso-predator release’, c.f. Norbury *et al.* (2013).

## 10.4 Invertebrates

### Concession Area

The potential effect of the proposal can be managed to have **less than minor** effects if the following principles are followed:

- Minimise damage to natural vegetation during any building removal, construction of new buildings or alteration of existing buildings and landing pad construction.
- Restrict, where possible, all construction to the already highly disturbed area beside the core buildings. This includes storage of materials and vehicle parking.
- No construction of additional formed roads or tracks through the lease.
- Ensure that any fire risk the new activities pose is fully addressed by a plan that minimises any additional fire risk.

Construction of the landing pad and access to it from the building complex will remove some natural vegetation and therefore habitat for the indigenous invertebrates of the shrubland-grassland habitat in the Concession Area. This can and must be minimised to fit the criterion of “less than minor effects”. Any bare gravel areas created in this clearance should be left bare and not planted. Ongoing control and monitoring of exotic weeds should be maintained.

## 11. MEASURES TO AVOID, REMEDY, AND/OR MITIGATE POTENTIAL ADVERSE EFFECTS

### 11.1 Vegetation and flora

#### Avoidance of Potential Adverse Effects During Construction

Construction and installation of the proposed infrastructure is expected to have **less than minor adverse effects** on significant indigenous vegetation in the Concession Area, provided that the measures below are followed:

- Disturbance to the ground surface and destruction of indigenous shrubs and other plant species must be kept to a minimum during construction of the proposed infrastructure, i.e. the shed, apron, concrete pad for the transformer unit, landing pad, pathway, underground power cable, water tanks, controls trailer, and shipping

container. The footprint of the landing pad and route of the pathway should avoid indigenous shrubs as much as possible.

- Minimise vehicle activity in the Concession Area by careful planning and coordination of construction works. Use the smallest/lightest vehicles possible.
- Vehicles entering the Concession Area during construction of the proposed infrastructure must not drive outside the Operational Area or main vehicle access track and should use the designated car parking area (see Figure 3). No new vehicle tracks must be made.
- Erection of fencing or other physical and visual barriers (e.g. waratahs and danger tape and/or road cones) is required prior to construction in order to clearly delineate the boundaries of the Operational Area and avoid damage to indigenous vegetation.
- Minimise the amount of gravel and artificial building materials (steel, timber, plastic, foam etc.) brought in for construction of the proposed infrastructure.
- Avoid bringing vehicles, gravel, or other building materials that may contain weed propagules (or pathogens) into the Concession Area.
- Install the underground power cable within a conduit tube so that changes to the power supply in future can be carried out without needing to dig up and re-lay the cable again.
- Contractors working on-site should be selected carefully and monitored closely (by appropriate UC staff) to ensure that they are not causing unnecessary disturbance to indigenous vegetation.
- No fires or smoking should be permitted anywhere in the Concession Area.

Operation of the Field Station is expected to have **less than minor adverse effects** on significant indigenous vegetation in the Concession Area provided that the measures below are followed:

- Minimise vehicle access to the Concession Area. Vehicle access to the site should be controlled through a booking system run by UC Field Services (Ladley 2017).
- Vehicles entering the Concession Area must not drive outside the Operational Area and must use the designated car parking area. Vehicles should not be used to move UAVs around the Concession Area or recover UAVs that have crash-landed. No new vehicle tracks must be made.
- Erection of physical or visual barriers (e.g. waratahs and danger tape and/or road cones) is required to clearly delineate boundaries of the Operational Area and avoid damage to indigenous vegetation during research activities.
- For fixed-wing UAVs, limit launching and landing to the Operational Area or to the main vehicle access track.
- Discourage UAV researchers from walking outside the Operational Area. If this is necessary for recovery of a UAV then researchers should use existing tracks as much as possible.
- Maintain the existing boundary fences to stock-proof standard.



- No fires or smoking should be permitted anywhere in the Concession Area.
- Avoid launches of fixed-wing UAVs during hot, windy days in summer when fire risk is extremely high.
- A detailed Fire Management Plan - including provision of adequate water supply for fire-fighting purposes - must be developed and implemented to minimise the risk of a fire occurring as a result of operation of the Field Station. Rapid response times will be essential. All researchers using the Field Station should read the Fire Management Plan and know what to do in the event of a fire in the Concession Area (or elsewhere in the Segregated Airspace Zone).
- Implement a mandatory induction process for all researchers who use the Field Station to ensure that they are aware of the ecological significance of the Scientific Reserve and agree to abide by the conditions of the concession and Christchurch City Council resource consent (in particular vehicle use). For example, access to the site must be approved by a supervisor and researchers must sign an agreement acknowledging that they understand and agree to the conditions.

#### Mitigation of Potential Adverse Effects

The University should maintain its existing weed control programme for sweet briar, karo, and Scotch broom in the Concession Area. Weed control and monitoring should be carried out annually by a suitably qualified and experienced contractor (approved by the Department of Conservation) using appropriate methods that minimise effects on indigenous vegetation. This should include surveillance for and control of any new weed species (the arrival of other weed species is quite likely given the close proximity of the Concession Area to Birdlings Flat settlement).

A fire resulting from the launch or landing (crash) of a UAV could have **major adverse effects** on significant indigenous vegetation and habitats within the Concession Area and elsewhere on Kaitorete Spit if it destroyed a substantial area of indigenous vegetation or a large number of threatened and uncommon plants (in particular *Muehlenbeckia astonii*). A major adverse effect would require substantial mitigation or compensation, such as protection and management of threatened plant species (e.g. *Muehlenbeckia astonii*) or weed and/or animal pest control on Kaitorete Spit. It is not appropriate to provide specific mitigation measures here, but in the event of a major fire appropriate mitigation measures should be identified and implemented in consultation with a suitably qualified and experienced ecologist, as well as the Department of Conservation, Christchurch City Council, and other relevant parties.

## 11.2 Avifauna

#### Avoidance of Potential Adverse Effects from Construction

It would be desirable if construction falls outside the August-December period as banded dotterel and New Zealand pipit will be unlikely to be nesting in the area outside of this period. If construction is to occur during this time, then a survey of the construction area would be necessary to check for the presence of banded dotterel and New Zealand pipit. Also, during construction activities, the amount of shingle introduced to the site should be limited, because if shingle is present it may encourage banded dotterel to nest there.

## Avoidance or Mitigation of Potential Adverse Effects from Operational Activities

Avoidance or mitigation of any adverse effects of UAV operational activities on birds on Kaitorete Spit and Lake Ellesmere/Te Waihora requires the establishment of a comprehensive avifauna management and monitoring plan which includes UAV operational guidelines. The plan should have enough flexibility to allow the guidelines and operations to be changed if monitoring indicates that adverse effects are occurring. The plan would be developed by a UAV expert in collaboration with a suitably qualified ecologist. It would describe how to monitor bird behavioural responses to UAVs, particularly for Threatened and At Risk species, with some habitats in the Segregated Airspace Zone identified for avoidance at the outset. The plan will also provide a system for reporting bird strikes or any near misses. Review of the plan and monitoring results should be an integral part of the consent requirements overseen by Christchurch City Council, Department of Conservation, Environment Canterbury, and Ngāi Tahu.

Current flexibility in drone configuration, sensor specification, and data telemetry affords researchers a range of options to reduce potential behavioural and physiological effects on birds, for example perceived predation risk may be reduced by minimising platform size, outline and flight profile, speed, proximity, and colour (Borrelle and Fletcher 2017). If any potential adverse effects are observed then mitigation options should be evaluated at that time by a suitably qualified and experienced ecologist.

### 11.3 Lizards

#### Avoidance of Potential Adverse Effects

Some habitat loss is inevitable, however, by installing new infrastructure in bare and previously disturbed areas, and by limiting vehicle use to the existing tracks, it should be possible to avoid potential adverse effects on lizards (the exact footprint of the new infrastructure had not been defined at the time of the site visit). Physical site marking (e.g. using blaze paint or danger tape) is required to avoid unnecessary and accidental clearance of indigenous shrub/vineland by contractors, who may not be aware of its values.

#### Mitigation of Potential Adverse Effects

Measures to reduce mortality and injury of lizards during the deconstruction phase are set out in Wildlife Act Authorisation 55396-FAU, issued to the University of Canterbury by the Department of Conservation on 3 May 2007. Briefly, this permit requires:

- Dismantling of any structures or habitat that is likely to contain lizards to be directed by a suitably qualified herpetologist (Special Condition 4).
- Use of appropriate capture, handling and holding methods (Special Conditions 5-7).
- Animals to be transferred to suitable and secure release sites (as assessed by a suitably qualified herpetologist) in the vicinity (<500 metres) of the development footprint under appropriate weather conditions (Special Conditions 7-9).

At the time of the site visit, deconstruction and removal of materials was scheduled for May 2017 (under the supervision of Chris McClure; a suitably-qualified herpetologist). However, UC has since decided to delay deconstruction until October 2017 to give displaced animals the best chance of survival. Being cold-blooded, lizards have very limited mobility in cold weather and may not be able find secure over-wintering sites, increasing their vulnerability to predation. In general, New Zealand lizards should not be moved outside of their active season (October to April for most species).

If all of the above measures are followed, the potential adverse effects of the proposed activities on lizards and their habitats are expected to be **less than minor**.

#### 11.4 Invertebrates

If the listed points under Section 10.1 (Vegetation) above are followed then the building reconfiguration, construction of the launch pad, and other associated activities will have **less than minor adverse effects** on significant invertebrate habitats and species in the Concession Area.

Potential adverse effects of building removal, construction, material storage, and vehicle movements can be avoided if the already highly disturbed area adjacent to the existing buildings is used for much of the material and vehicle movements and storage. Vegetation clearance associated with the proposed landing pad can and must be minimised, and if so will have **less than minor adverse effects** on the indigenous invertebrates and their habitat within this part of the Scientific Reserve.

The potential for an increased risk of fire within the Concession Area and the wider Kaitorete Spit area is not currently known and a detailed Fire Management Plan is required, as already noted above.

## 12. CONCLUSIONS

### Vegetation and Flora

Kaitorete Spit is an area of outstanding ecological value with special ecosystems and habitats (relatively natural and intact dryland communities flanked by saltmarsh on the margins of Lake Ellesmere), and a suite of locally endemic and threatened species.

The Concession Area (56 hectares) contains significant indigenous vegetation, however most of the new infrastructure and research activities proposed by UC will occur in the Operational Area, which mostly comprises highly modified vegetation dominated by introduced plant species. Construction of the proposed infrastructure and operation of the Field Station are likely to have **less than minor adverse** effects on indigenous vegetation within the Operational Area and Concession Area if the measures outlined in this report to avoid and minimise potential adverse effects are implemented.

The potential impact of a fire on indigenous vegetation in the Concession Area or elsewhere on Kaitorete Spit could range from a **minor to major adverse effect**, depending on the extent of damage. The likelihood of a fire occurring on the Spit and the extent of any impacts on indigenous vegetation is difficult to predict, as it depends on the



ability of the applicant to prevent fires during operation of the UAVs, and the effectiveness of the fire response and control measures that are put in place. A detailed Fire Management Plan should be developed in consultation with an ecologist/s in order to address these issues.

### Avifauna

Although Kaitorete Spit and adjacent Lake Ellesmere/Te Waihora are nationally important areas for water birds and migratory waders, the Operational Area is a small area of modified grassland and buildings within shrubland, and the activities proposed in the Operational Area are not likely to adversely affect Threatened or At Risk birds within this area. However, the Segregated Airspace Zone does cover an area that is used by a large number of birds, including many Threatened and At Risk species, therefore a plan needs to be developed that provides clear operational guidelines for UAV use and a monitoring strategy to ensure that UAV activities do not adversely affect bird species.

### Lizards

The Concession and Operational Areas contain significant habitat for indigenous lizards, including two species of moderate conservation concern: Canterbury/Waitaha gecko and southern grass skink; both classified as At Risk-Declining. Potential adverse effects of the proposed activities on lizards and their habitats **can be reduced to less than minor** overall if the avoidance and mitigation measures outlined in this report are implemented. Extending predator control should not be presumed to be of benefit to lizards unless careful consideration is given specifically to this aspect.

### Invertebrates

The Concession Area contains significant indigenous invertebrate habitat and supports species of national conservation importance, including a number of nationally Threatened, At Risk, and uncommon moth and butterfly species. If managed appropriately, the activities proposed in the Concession Area will have **less than minor effects** on this habitat and its suite of invertebrates. Confining the demolition and construction works to the already highly disturbed Operational Area is the most important action required. Fire risk is a serious issue and must be addressed in a detailed Fire Management Plan.

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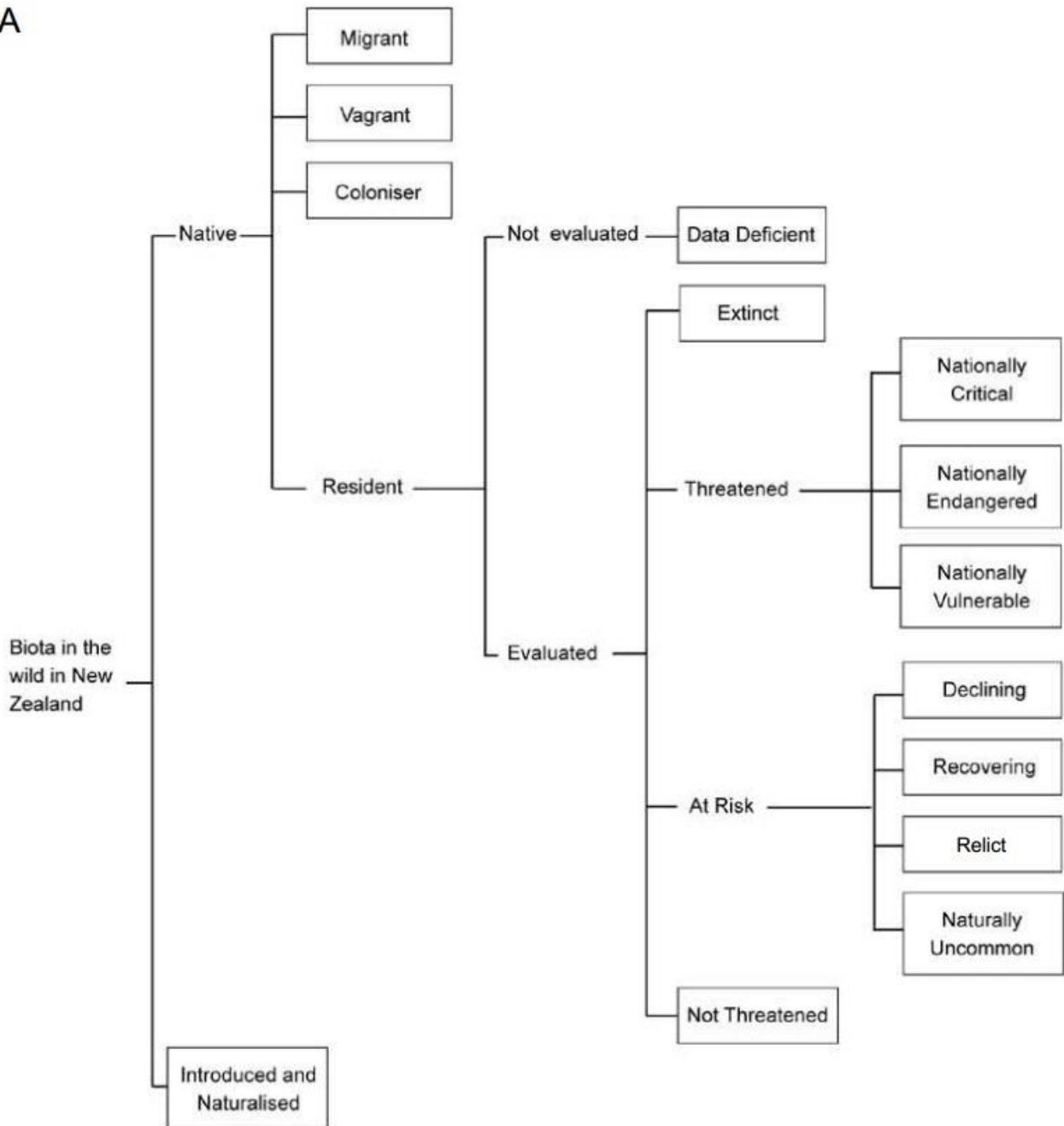


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## NEW ZEALAND THREAT CLASSIFICATION SYSTEM

The diagram below summaries the different categories in the Threat Classification System for New Zealand species (copied from Townsend *et al.* 2008).

A



A species is classified as Threatened-Nationally Critical, Threatened-Nationally Endangered, or Threatened-Nationally Vulnerable - if it meets one of the criteria in a row beneath each category (Townsend *et al.* 2008).

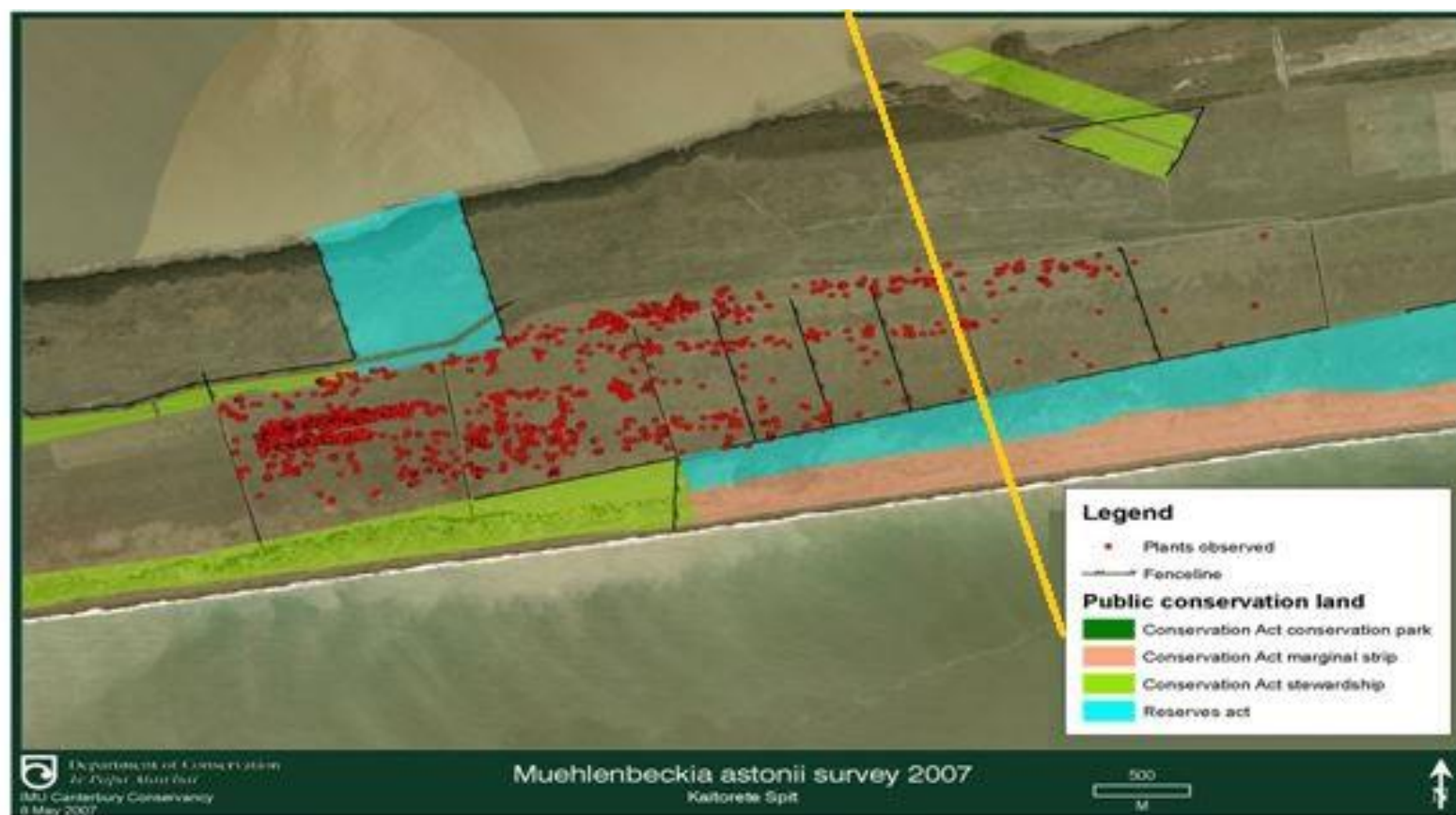
Criteria for a Species to be Classified as 'Threatened' in the NZ Threat Classification System		
Nationally Critical	Nationally Endangered	Nationally Vulnerable
<p><b>1. Very small population (natural or unnatural)</b> A taxon is 'Nationally Critical', regardless of population trend and regardless of whether the population size is natural or unnatural, when evidence indicates that:</p> <ol style="list-style-type: none"> <li>1. There are fewer than 250 mature individuals; or</li> <li>2. There are <math>\leq 2</math> sub-populations <i>and</i> <math>\leq 200</math> mature individuals in the largest sub-population; or</li> <li>3. The total area of occupancy is <math>\leq 1</math> ha (0.01 km<sup>2</sup>).</li> </ol>	<p><b>1. Small population (natural or unnatural) that has a low to high ongoing or predicted decline</b> A taxon is 'Nationally Endangered' when evidence indicates that it fits at least one Status criterion <i>and</i> the Trend criterion as follows:</p> <p><b>Status</b></p> <ol style="list-style-type: none"> <li>1. The total population size is 250-1,000 mature individuals; or</li> <li>2. There are <math>\leq 5</math> sub-populations <i>and</i> <math>\leq 300</math> mature individuals in the largest sub-population; or</li> <li>3. The total area of occupancy is <math>\leq 10</math> ha (0.1 km<sup>2</sup>).</li> </ol> <p><b>Trend</b> There is an ongoing or predicted decline of 10-50% in the total population due to existing threats, taken over the next 10 years or three generations, whichever is longer.</p>	<p><b>1. Small, increasing population (unnatural)</b> To trigger 'Nationally Vulnerable', taxa must have current population sizes that result from unnatural causes. Such taxa are defined as 'Nationally Vulnerable' when evidence indicates that they fit at least one Status criterion <i>and</i> the Trend criterion as follows:</p> <p><b>Status</b></p> <ol style="list-style-type: none"> <li>1. The total population size is 250-1,000 mature individuals; or</li> <li>2. There are <math>\leq 5</math> sub-populations <i>and</i> <math>\leq 300</math> mature individuals in the largest sub-population; or</li> <li>3. The total area of occupancy is <math>\leq 10</math> ha (0.1 km<sup>2</sup>).</li> </ol> <p><b>Trend</b> The population is increasing (&gt;10%) and is predicted to continue to increase over the next 10 years or three generations, whichever is longer.</p>
<p><b>2. Small population (natural or unnatural) with a high ongoing or predicted decline</b> A taxon is 'Nationally Critical' when evidence indicates that it fits at least one Status criterion <i>and</i> the Trend criterion as follows:</p> <p><b>Status</b></p> <ol style="list-style-type: none"> <li>1. The population comprises 250-1,000 mature individuals; or</li> <li>2. There are <math>\leq 5</math> sub-populations <i>and</i> <math>\leq 300</math> mature individuals in the largest sub population; or</li> <li>3. The total area of occupancy is <math>\leq 10</math> ha (0.1 km<sup>2</sup>).</li> </ol> <p><b>Trend</b> There is an ongoing or predicted decline of 50-70% in the total population due to existing threats, taken over the next 10 years or three generations, whichever is longer.</p>	<p><b>2. Small stable population (unnatural)</b> To trigger this pathway to 'Nationally Endangered', taxa must have current population sizes that result from unnatural causes. Such taxa are defined as 'Nationally Endangered' when evidence indicates that they fit at least one Status criterion <i>and</i> the Trend criterion as follows:</p> <p><b>Status</b></p> <ol style="list-style-type: none"> <li>1. The total population size is 250-1,000 mature individuals; or</li> <li>2. There are <math>\leq 5</math> sub-populations <i>and</i> <math>\leq 300</math> mature individuals in the largest sub-population; or</li> <li>3. The total area of occupancy is <math>\leq 10</math> ha (0.1 km<sup>2</sup>).</li> </ol> <p><b>Trend</b> The population is stable (<math>\pm 10\%</math>) and is predicted to remain stable over the next 10 years or three generations, whichever is longer.</p>	<p><b>2. Moderate, stable population (unnatural)</b> To trigger 'Nationally Vulnerable', taxa must have current population sizes that result from unnatural causes. Such taxa are defined as 'Nationally Vulnerable' when evidence indicates that they fit at least one Status criterion <i>and</i> the Trend criterion as follows:</p> <p><b>Status</b></p> <ol style="list-style-type: none"> <li>1. The total population size is 1,000-5,000 mature individuals; or</li> <li>2. There are <math>\leq 15</math> sub-populations <i>and</i> <math>\leq 500</math> mature individuals in the largest sub-population; or</li> <li>3. The total area of occupancy is <math>\leq 100</math> ha (1 km<sup>2</sup>).</li> </ol> <p><b>Trend</b> The population is stable (<math>\pm 10\%</math>) and is predicted to remain stable over the next 10 years or three generations, whichever is longer.</p>

Criteria for a Species to be Classified as 'Threatened' in the NZ Threat Classification System		
Nationally Critical	Nationally Endangered	Nationally Vulnerable
<p><b>3. Population (irrespective of size or number of sub-populations) with a very high ongoing or predicted decline (&gt;70%)</b> A taxon is 'Nationally Critical' when the population has an ongoing trend or predicted decline of &gt;70% in the total population due to existing threats taken over the next 10 years or three generations, whichever is longer.</p>	<p><b>3. Moderate population and high ongoing or predicted decline</b> A taxon is 'Nationally Endangered' when evidence indicates that it fits at least one Status criterion <i>and</i> the Trend criterion as follows:</p> <p><b>Status</b> 1. The total population size is 1,000-5,000 mature individuals; or 2. There are ≤15 sub-populations <i>and</i> ≤500 mature individuals in the largest sub-population; or 3. The total area of occupancy is ≤100 ha (1 km<sup>2</sup>).</p> <p><b>Trend</b> There is an ongoing or predicted decline of 50-70% in the total population due to existing threats, taken over the next 10 years or three generations, whichever is longer.</p>	<p><b>3. Moderate population, with population trend that is declining</b> A taxon is 'Nationally Vulnerable' when evidence indicates that it fits at least one Status criterion <i>and</i> the Trend criterion as follows:</p> <p><b>Status</b> 1. The total population size is 1,000-5,000 mature individuals; or 2. There are ≤15 sub-populations <i>and</i> ≤500 mature individuals in the largest sub-population; or 3. The total area of occupancy is ≤100 ha (1 km<sup>2</sup>).</p> <p><b>Trend</b> There is an ongoing or predicted decline of 10-50% in the total population due to existing threats, taken over the next 10 years or three generations, whichever is longer.</p>
		<p><b>4. Moderate to large population and moderate to high ongoing or predicted decline</b> A taxon is 'Nationally Vulnerable' when evidence indicates that it fits at least one Status criterion <i>and</i> the Trend criteria as follows:</p> <p><b>Status</b> 1. The total population size is 5,000-20,000 mature individuals; or 2. There are ≤15 sub-populations <i>and</i> ≤1,000 mature individuals in the largest sub-population; or 3. The total area of occupancy is ≤1,000 ha (10 km<sup>2</sup>).</p> <p><b>Trend</b> There is an ongoing or predicted decline of 30-70% in the total population due to existing threats, taken over the next 10 years or three generations, whichever is longer.</p>
		<p><b>5. Large population and high ongoing or predicted decline</b> A taxon is 'Nationally Vulnerable' when evidence indicates that it fits at least one Status criterion <i>and</i> the Trend criterion as follows:</p> <p><b>Status</b> 1. The total population size is 20,000-100,000 mature individuals; or 2. The total area of occupancy is ≤10,000 ha (100 km<sup>2</sup>).</p> <p><b>Trend</b> There is an ongoing or predicted decline of 50-70% in the total population or area of occupancy due to existing threats, taken over the next 10 years or three generations, whichever is longer.</p>



DISTRIBUTION OF *MUEHLENBECKIA ASTONII* ON KAITORETE SPIT

Map of *Muehlenbeckia astonii* (Threatened-Nationally Vulnerable) plants recorded during the 2007 survey of Kaitorete Spit (from Dutton 2007). The western boundary of the Segregated Airspace Zone (NZR905, Civil Aviation Authority) is shown in yellow. The University of Canterbury Birdlings Flat Field Station is located approximately 8 km to the east of this line.



## PLANT SPECIES RECORDED AT BIRDLINGS FLAT FIELD STATION

Plant species recorded at Birdlings Flat Field Station (Kaitorete Spit Scientific Reserve) during the site visit on 5 May 2017. The abundance of each species in the Operational Area and Concession Area was estimated using a qualitative scale (D = dominant, A = abundant, F = frequent, O = occasional, R = rare).

### Indigenous Plant Species

Scientific Name	Common Name	Life Form	Abundance	
			Operational Area	Concession Area
<i>Calystegia tuguriorum</i>	NZ bindweed, pōwhiwhi	vine	-	O
<i>Carmichaelia appressa</i> <sup>1</sup>	prostrate broom	shrub	-	R
<i>Carmichaelia australis</i>	common broom	shrub	-	R
<i>Cheilanthes sieberi</i>	rock fern	fern	R	O
<i>Convolvulus waitaha</i>	grass convolvulus	dicot herb	-	O
<i>Coprosma crassifolia</i>	thick-leaved coprosma, mikimiki	shrub	-	F
<i>Coprosma propinqua</i>	mikimiki, mingimingi (North Island)	shrub	O	A
<i>Dichondra brevifolia</i>	dichondra	dicot herb	-	O
<i>Discaria toumatou</i>	matagouri, wild irishman, tūmatakuru	shrub	R	O
<i>Geranium brevicaule</i> <sup>2</sup>	short-flowered cranesbill	dicot herb	-	R
<i>Helichrysum lanceolatum</i>	niniaio	shrub	-	O
<i>Leucopogon fraseri</i>	dwarf heath, pātōtara	shrub	-	O
<i>Melicytus alpinus</i>	porcupine shrub	shrub	O	O
<i>Melicytus ramiflorus</i>	māhoe, whiteywood	tree	-	R
<i>Muehlenbeckia complexa</i>	scrub pōhuehue, wire vine	vine	O	A
<i>Oxalis exilis</i>	yellow oxalis	dicot herb	O	O
<i>Poa cita</i>	silver tussock, wī	grass	-	O
<i>Rubus squarrosus</i>	leafless bush lawyer, tātarāmoa	vine	R	F
<b>Non-Vascular Plant Species</b>				
<i>Campylopus introflexus</i>	heath star-moss	moss	-	O
<i>Hypnum cupressiforme</i>	cypress-leaved plait moss	moss	-	O
<i>Polytrichum juniperinum</i>	juniper polytrichum moss	moss	-	O
<i>Pseudocyphellaria crocata</i>	yellow specklebelly	lichen	-	R
<i>Racomitrium</i> species	woolly moss	moss	-	F
<i>Ramalina glaucescens</i>		lichen	O	O
<i>Teloschistes chrysophthalmus</i>	gold-eye lichen	lichen	-	O
<i>Triquetrella papillata</i>		moss	O	A
<i>Usnea</i> species	old man's beard lichen	lichen	-	O
<i>Xanthoria parietina</i>	maritime sunburst lichen	lichen	-	O
<i>Xanthoparmelia</i> species	rockshield lichen	lichen	R	O

<sup>1</sup> *Carmichaelia appressa* is classified as 'At Risk-Naturally Uncommon' (de Lange *et al.* 2013).

<sup>2</sup> *Geranium brevicaule* is uncommon in Ellesmere Ecological District (Christchurch City Council 2015a).

## Introduced Plant Species

Scientific Name	Common Name	Life Form	Abundance	
			Operational Area	Concession Area
<i>Acaena agnipila</i>	Australian sheeps bur	dicot herb	-	O
<i>Acetosa acetosella</i>	sheeps sorrel	dicot herb	F	F
<i>Austrostipa nodosa</i>	needle grass	grass	F	F
<i>Cirsium arvense</i>	Californian thistle	dicot herb	O	O
<i>Cirsium vulgare</i>	Scotch thistle	dicot herb	O	O
<i>Cytisus scoparius</i>	scotch broom	shrub	R	R
<i>Dactylis glomerata</i>	cocksfoot	grass	R	R
<i>Echium vulgare</i>	vipers bugloss	dicot herb	R	O
<i>Erodium cicutarium</i>	storksbill	dicot herb	O	O
<i>Galium aparine</i>	cleavers	dicot herb	R	R
<i>Geranium molle</i>	dovesfoot cranesbill	dicot herb	O	O
<i>Hypochaeris radicata</i>	catsear	dicot herb	O	O
<i>Lagurus ovatus</i>	harestail	grass	O	O
<i>Marrubium vulgare</i>	horehound	dicot herb	O	R
<i>Pittosporum crassifolium</i> <sup>1</sup>	karo	tree	O	O
<i>Plantago lanceolata</i>	narrow-leaved plantain	dicot herb	-	O
<i>Rosa rubiginosa</i>	sweet briar, briar rose	shrub	A	A
<i>Rytidosperma species</i>	danthonia	grass	O	O
<i>Stellaria media</i>	chickweed	dicot herb	O	O
<i>Trifolium fragiferum</i>	strawberry clover	dicot herb	O	O
<i>Trifolium repens</i>	white clover	dicot herb	O	O
<i>Urtica urens</i>	nettle	dicot herb	O	O
<i>Vicia sativa</i>	vetch	dicot herb	-	O

<sup>1</sup> Although *Pittosporum crassifolium* is indigenous to New Zealand, it does not occur naturally in Canterbury and is considered to be a weed on Kaitorete Spit.

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