

# Assessment of Potential Ecological Effects of the Proposed Nova Energy Solar Farm near Twizel

---

Contract Report No. 6620a

Providing outstanding ecological services to sustain and improve our environments



# Assessment of Potential Ecological Effects of the Proposed Nova Energy Solar Farm near Twizel

**Contract Report No. 6620a**

March 2026

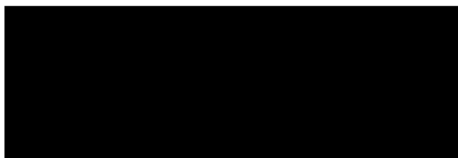
**Project Team:**

Kelvin Lloyd – Project oversight and management  
Vikki Smith – Project oversight and management, report author  
(terrestrial invertebrates)  
Rose Stuart – Report author (freshwater fauna)  
Lucian Funnell – Report author (freshwater fauna)  
Della Bennet – Report author (avifauna)  
Fraser Gurney – Report author (avifauna)  
Eleanor Gunby – Report author (avifauna)  
Samantha King – Report author (lizards)  
Cameron Thorp – Report author (lizards)  
Lydia Metcalfe – Report author (vegetation)  
Justyna Giejsztowt – Report author  
Andrew Wells – Technical review (vegetation)  
Des Smith – Peer review

**Prepared for:**

Nova Energy  
95 Customhouse Quay  
PO Box 3142  
Wellington 6141

Reviewed and approved for release by:



Nick Goldwater  
Senior Principal Ecologist  
Wildland Consultants Ltd  
16/03/2026



---

Cite this report as follows:

Wildland Consultants. (2026). *Assessment of potential ecological effects of the proposed Nova Energy Solar Farm near Twizel*. Wildland Consultants Contract Report No. 6620a. Prepared for Nova Energy. 98pp.

---

**Dunedin Office**

764 Cumberland Street, Dunedin, Ph 03-477-2096

**Head Office**

99 Sala Street, PO Box 7137, Te Ngae, Rotorua Ph 07-343-9017 Email: [rotorua@wildlands.co.nz](mailto:rotorua@wildlands.co.nz)

[www.wildlands.co.nz](http://www.wildlands.co.nz)



## Executive Summary

Ecological surveys of vegetation, habitats, and plants, lizards, birds, and terrestrial invertebrates were undertaken in the summers of 2022-2024 across the proposed solar farm site on outwash plains between the Ōhau River and Twizel River, south of Twizel in the Mackenzie Basin.

The site has largely been cultivated and mostly supports improved pasture or exotic vegetation, but small areas of uncultivated outwash plain support indigenous vegetation. These areas have been excluded from the proposed development area. Scarps run across the north and down each side of the site, and these are critical habitats for indigenous biodiversity values including populations of Threatened and At Risk plants, lizards, and invertebrates. These scarps have also been excluded from the proposed development area.

Important biodiversity values at the site include:

- Seven plant species classified as At Risk or Threatened.
- Eight Threatened and nine At Risk avifauna species may be present at the site.
- Three lizard species have been confirmed at the site, including two At Risk species and one Not Threatened species.
- Four notable terrestrial invertebrate species have been confirmed at the site.
- An ephemeral wetland is in the north of the site, and other wetlands, are located on an alluvial terrace on the eastern side of the site.

In general, these biodiversity values are concentrated on the margins of the site. Potential adverse effects associated with development on the margins of the site would include loss of habitat, modification of habitat, and habitat fragmentation, being detrimental to protected indigenous species, including Threatened, and At Risk species. The solar panel layout has been adjusted in response to these findings so that no development is proposed on these margins, and substantial setbacks from wetlands and rivers are proposed. As such, potential adverse effects on ecological values at the edges of the site are avoided.

Remaining potential adverse effects will be addressed by applying the following avoidance, minimisation, and mitigation measures:

- Avoiding high and moderate-quality habitat for flora and fauna within the site.
- Biosecurity protocols to prevent and manage weed incursions on site.
- Dust and sediment management.
- Scheduling construction work outside the bird breeding season where practicable.
- Incorporating anti-bird-strike measures into panel design, such as tracking arrays, anti-reflective panels, and panel spacings which break up the surface of the panels.
- Incidental Discovery Protocols for lizards, invertebrates, and avifauna.
- Grazing under the photovoltaic panels to suppress exotic vegetation.
- Salvage and translocation of Threatened and At Risk grasshoppers and wētā.
- Creation of lizard habitat enhancement corridors.
- Creation of buffer zones between important habitat and enhancement areas and impact areas.
- Habitat enhancement for avifauna, lizards and invertebrates.
- Creation of habitat nodes and corridors for lizards.
- Avoidance of herbicide sprays.



- Pest mammal monitoring and control.
- Pest plant monitoring and control.
- Population monitoring for indigenous flora and fauna, including carcass and nest monitoring for avifauna.
- Adaptive management protocols.
- Compensation for avifauna mortality and, if necessary, lizards and invertebrates.

Details of proposed management measures are set out in the separate draft management plans for invertebrates, avifauna, pest mammals, lizards, and biosecurity.



# Contents

<b>Executive Summary</b>	<b>3</b>
<b>1.0 Introduction</b>	<b>7</b>
<b>2.0 Methods</b>	<b>7</b>
2.1 Desktop assessment	7
2.2 Field assessment	9
2.3 Statutory context	12
2.4 Ecological assessment framework	16
<b>3.0 Ecological Context</b>	<b>16</b>
3.1 Site description	16
3.2 Pukaki Ecological District	16
3.3 Nearby protected areas	16
3.4 Sites of natural significance	17
3.5 Threatened environment classification	17
3.6 Land cover database	17
3.7 Inland outwash gravels	17
3.8 Braided rivers	17
3.9 Notable hydro scheme modifications	21
3.10 Hydropower inundation areas	21
3.11 Current and recent land use	21
<b>4.0 Vegetation and Habitats</b>	<b>21</b>
4.1 Overview	21
4.2 Vegetation and habitat types	22
<b>5.0 Flora</b>	<b>27</b>
5.1 Overview	27
5.2 Rare, Threatened and At Risk taxa	27
5.1 Pest plants and ecological weeds	29
<b>6.0 Avifauna</b>	<b>29</b>
6.1 Desktop assessment	29
6.2 Field survey findings	32
<b>7.0 Lizards</b>	<b>33</b>
7.1 Desktop assessment	33
7.2 Field survey results	39
7.3 Lizard habitats	42
<b>8.0 Terrestrial Invertebrates</b>	<b>43</b>
8.1 Desktop assessment	43
8.2 Field survey	44
<b>9.0 Freshwater Fauna</b>	<b>49</b>
9.1 Desktop assessment	49
<b>10.0 Terrestrial Introduced Fauna</b>	<b>50</b>



<b>11.0</b>	<b>Statutory Assessment</b>	<b>50</b>
11.1	Ecological significance	50
11.2	Mackenzie District Plan	52
<b>12.0</b>	<b>Assessment of Potential Adverse Effects</b>	<b>53</b>
12.1	Overview of potential effects	53
12.2	Vegetation and flora	56
12.3	Avifauna	57
12.4	Lizards	60
12.5	Invertebrates	62
12.6	Freshwater	63
<b>13.0</b>	<b>Effects Management</b>	<b>64</b>
13.1	Vegetation	64
13.2	Avifauna	66
13.3	Lizards	71
13.4	Invertebrates	72
13.5	Freshwater fauna	79
13.6	Refuelling of machinery	79
13.7	Wildlife management	79
13.8	Ecological enhancement	80
13.9	Overall assessment of ecological effects	81
<b>14.0</b>	<b>Conclusions</b>	<b>83</b>
	<b>References</b>	<b>83</b>
	<b>Appendix 1</b>	<b>88</b>
	Vascular plant species recorded at the site	88
	<b>Appendix 2</b>	<b>91</b>
	Evaluation of the ecological significance of vegetation and habitats using the Canterbury Regional Policy Statement	91
	<b>Appendix 3</b>	<b>94</b>
	Solar shade modelling	94



## 1.0 Introduction

Nova Energy is proposing to develop a solar energy farm east of Twizel township (Figure 1). The application is being considered under the Fast-track Approvals Act 2024 (FTAA).

Nova Energy commissioned Wildland Consultants (Wildlands) to assess the ecological features and values present at this site and identify potential ecological effects associated with the proposed solar farm, using a combination of both desktop and field-based methods<sup>1</sup>. The following ecological features are considered in this report:

- Habitat and vegetation.
- Flora.
- Avifauna.
- Lizards.
- Terrestrial invertebrates.
- Freshwater fauna.

Measures have been developed by which to avoid, remedy or mitigate potentially adverse effects, as well as methods for monitoring ecological outcomes and compensation where effects cannot be managed by other means.

This report has been prepared for Nova Energy Limited in respect of its application for all approvals under the Twizel Solar Project under the FTAA. The Panel appointed to consider the application for the Twizel Solar Project may rely on this report for the purpose of making its decision under the FTAA.

The authors of this report ( [REDACTED] [REDACTED] ) have read the Expert Witness Code of Conduct set out in the Environment Court Practice Note 2023. The authors have complied with the Code of Conduct in preparing this report. The content of the report is within the authors' area of expertise, and the authors have not omitted to consider material facts known to them that might alter or detract from the opinions expressed in the report.

## 2.0 Methods

### 2.1 Desktop assessment

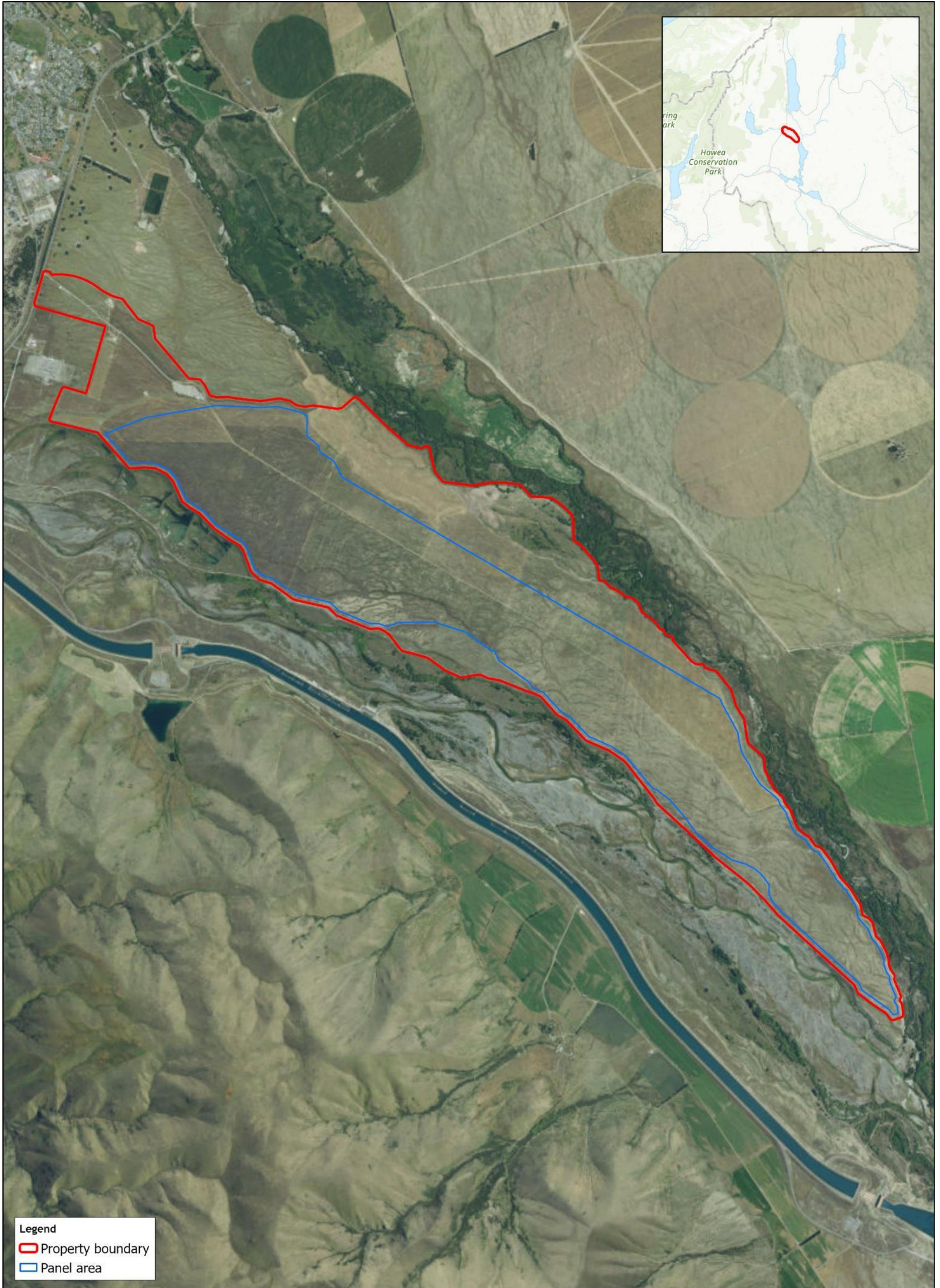
Desktop assessments were undertaken between 2021 and 2025 to inform field surveys (described in 2.2 below) and consider whether species in the area that were not found during field surveys could be on site. Since the desktop assessments were carried out, thorough field surveys have been completed, and the ecology team is familiar with the ecology of the site and local area.

#### 2.1.1 Avifauna

A desktop assessment for avifauna was carried out using the online bird database eBird (maintained by Cornell University). All species with records within five kilometres of the proposed solar farm were reviewed (January 2021 to May 2025).

---

<sup>1</sup> This report assesses ecological values only. Assessment of landscape values and effects management has been undertaken separately and is not considered in this report.



**Legend**

- Property boundary
- Panel area

**Data Acknowledgment**  
 Contains data sourced from the LINZ Data Service licensed for reuse under CC BY 4.0

Report: 7414  
 Ref: 11940  
 Client: Nova Energy  
 Name: Figure1\_Location\_AEE.aprx  
 Path: \\v64g1s1g1s2\gis\Twizel\_SolarFarm\_DN\mxd\2025\

**Figure 1. Location of the proposed solar farm site**

**Wildlands**  
 www.wildlands.co.nz, 0908 WILDNZ

Scale: 1:28,000  
 Date: 17/02/2026  
 Cartographer: LW  
 Format: A3



### 2.1.2 Herpetofauna

Department of Conservation BioWeb Herpetofauna Database records within 20 kilometres of the site were assessed in 2022 for herpetofauna values which may be on site.

### 2.1.3 Freshwater fauna

A desktop assessment of freshwater fauna in the area was undertaken using the New Zealand Freshwater Fish Database (Stoffels 2022), which is hosted by NIWA and accessed online. The New Zealand Freshwater Fish Database also holds records of some freshwater invertebrate species, although these are usually only mahinga kai and freshwater insects are not typically recorded. Records from the Twizel and Ōhau rivers adjacent to the proposed site were assessed, along with any records from connected waterways within the surrounding area. The presence of dams and hydro-generation structures was taken into consideration, as these pose significant barriers to fish movement throughout the waterways in this area.

### 2.1.4 Terrestrial invertebrates

A desktop assessment of terrestrial invertebrates was undertaken using the Global Biodiversity Information Facility GBIF<sup>1</sup> in April 2023. GBIF data was filtered using a polygon covering the site of the proposed development as well as an area encompassing a five-kilometre radius around the site. Insecta, Mollusca, Arachnida, and Chilopoda were included as species filters as they cover notable species of terrestrial invertebrate in South Canterbury. Freshwater species (primarily mayflies/Ephemeroptera) were deleted from the dataset.

## 2.2 Field assessment

Field surveys were undertaken in 2022-2024. The state of the environment is not expected to have changed materially since that time due to the lack of measurable environmental changes or extreme ecological events in the local area that may otherwise have affected ecological values. Ecological values at the site appear to be stable based on the two years of surveys and based on environmental stability in the local area. The conclusions drawn from the 2022-2024 surveys remain applicable.

### 2.2.1 Vegetation, habitats, and flora

#### *Survey 1*

An initial field survey was undertaken on 8 and 9 December 2022 by two people. Vegetation and habitat types were identified and mapped (using aerial photography) and described following the structural classes of Atkinson (1985). Hard copy field mapping was digitised using ArcGis10.8.

Locations of Threatened and At Risk species were recorded using a hand-held GPS unit (refer Table 1). All vascular plant species observed are listed in Appendix 1.

#### *Survey 2*

A second vascular plant survey was undertaken on 19 December 2023, and 23 and 24 January 2024, by one person. The focus of the second survey was to search the site for Threatened and At Risk plants. Key habitats of indigenous plants identified in the initial surveys were thoroughly searched, and the locations of individual plants or clusters were recorded using a handheld GPS. The wider panel area

---

<sup>1</sup> GBIF.org (20 April 2023) GBIF Occurrence Download <https://doi.org/10.15468/dl.4ggabt>



was also traversed on foot in a 'zigzag' pattern to search for Threatened and At Risk plants and indigenous vegetation.

### 2.2.2 Avifauna

A site visit was undertaken on 14 and 15 December 2022. Due to the large size of the site, four discrete continuous transects were evaluated to ensure that all habitat types were surveyed and to encompass as much of the area as possible. All bird species seen or heard while walking each transect were also recorded, and any additional species detected while travelling between the separate transects were recorded as incidental counts. The location of any Threatened or At Risk species within the site were recorded using a hand-held GPS unit. Bird species using the waterways adjacent to the site were also recorded (Table 3).

### 2.2.3 Lizards

Two lizard surveys of the site were undertaken.

#### *Survey 1*

An initial site visit that was undertaken on 16 December 2022, during which 74 artificial cover objects (ACOs) were placed along six transects in lizard habitat throughout the site. A habitat assessment was also undertaken during this first site visit. Incidental lizard encounters were recorded.

A survey of the ACOs was subsequently undertaken over four days (three nights) in warm conditions (c.23°C) between 27 February and 3 March 2023. ACOs were checked daily between 7:30 am and 1:00 pm, to avoid the hottest part of the day.

Additionally, limited manual and visual searching was undertaken. Manual searching consisted of lifting rocks or other debris (e.g. pieces of wood) to detect lizards within refuges. Visual searching consisted of slowly walking through talus slopes looking for basking skinks.

#### *Survey 2*

A site visit was undertaken between 3-4 October 2023 to set up 120 ACOs at the site. ACOs were set up along the east-west fence line through the centre of the site.

A lizard survey was subsequently undertaken between 18-23 December 2023 using the ACOs, as well as Gee's minnow (funnel) traps and visual and manual searching. Twenty-five funnel traps were set up on 18 December, and an additional 25 traps were set up on 19 December.

Traps were set up in an area of old river terrace and talus, at the base of an area of scarp herbfield and grassland in the central southern part of the site. During the previous lizard survey of the site, lizards were detected in this area in high abundance (i.e. within complex rock piles at the base of the scarp), and it was considered possible that Lakes skink may be present in this habitat. Therefore, funnel traps were set up partially buried within rock piles, to increase the likelihood of capturing Lakes skink. All funnel traps were baited with Berry Bliss lollies (The Natural Confectionery Co.<sup>TM</sup>; a known lizard attractant) and grass was added to protect any lizards caught from predation and desiccation.

Funnel traps and ACOs were checked daily over five days in hot conditions (c.25°C) between 19-23 December and removed on 23 December 2023. ACOs were checked between 8:00 am and 1:00 pm to avoid the hottest part of the day. Limited manual and visual searching were undertaken in areas of rock piles.



#### 2.2.4 Terrestrial invertebrates

Invertebrate survey methods are summarised in Figure 2.

##### *General invertebrate survey*

Initially, three field visits were undertaken for a general invertebrate field survey: 28 February and 1 and 3 March 2023. A total of approximately 16 hours was spent searching the site for any notable terrestrial invertebrates. The survey included searching for potential habitats for minute grasshopper (*Sigaus minutus*; Threatened-Nationally Vulnerable) and short-horned grasshopper (*Phaulacridium otagoense*; At Risk-Declining), which were both identified in the desktop survey as possibly being present. A sweep net was used to capture flying and jumping insects for identification.

##### *Targeted grasshopper and wētā survey*

Targeted grasshopper and Tekapo ground wētā surveys were conducted in summer 2023. The full methodology is described in the report (Wildland Consultants, 2024a). Methodology was based on the robust grasshopper population monitoring transect protocol developed by Schori *et al.* (2020), with guidance from T. Murray (pers. comm.), adapted for presence-only detection. Live-capture pitfall traps were used to detect presence of Tekapo ground wētā.

Fifteen transects were established on site on the 19 and 20 December 2023. Transects were approximately 100 m long, estimated using the GPS receiver. Transects were distributed throughout potential grasshopper habitat.

Each transect was walked five times in weather conditions suitable for robust grasshopper activity (temperature exceeding 14°C, winds below gale-force, no precipitation; Schori *et al.* 2020). Any habitat patches encountered between transects were briefly searched.

Three sets of five live-capture pitfall traps were deployed to detect Tekapo ground wētā. Traps consisted of the typical standard lidded cup design used for invertebrates, with a hole drilled in the bottom of each cup and baited with a small piece of canned pear. Each trap was left out for two nights and checked every day.

If minute grasshoppers were found in any transect, or if Tekapo ground wētā were found in any line of pitfall traps, that transect or line of pitfall traps would be discontinued as presence of Threatened species had been determined.

##### *Tekapo ground wētā tracking tunnel survey*

After confirming the presence of Tekapo ground wētā on site, a methodology was designed to use tracking tunnels to find out more about their distribution throughout the site. Methodology was based on previous studies where tracking tunnels have been used to detect and monitor wētā (primarily giant wētā; e.g. Watts *et al.* 2011). The full methodology is described in the report (Wildland Consultants, 2024b).

The tracking tunnel survey was carried out over two nights in April 2024 during fine, sunny weather with cold, clear nights. Six tracking tunnel transects were run across the whole property (Figure 2). Each transect consisted of ten tracking tunnels spaced 50 metres apart to give good coverage of the site while minimising the potential for double-counting the same individual Tekapo ground wētā. Black Trakka™ tracking tunnels with ready-inked cards were baited with tinned pear, which has been used in live-capture pitfall traps for Tekapo ground wētā (T. Murray, pers. comm.).

Prints on tracking cards were analysed to identify which animals had used the tunnels. Prints made by insects were sorted into wētā prints, potential wētā prints, and other insect prints. Since wētā species



cannot be reliably discerned from prints alone, and Tekapo ground wētā are the most likely ground wētā species of their size to be on the property, all large wētā prints were considered likely to be Tekapo ground wētā. Potential wētā prints were similar to wētā prints but smaller. They are likely to indicate insects with similar footprints, juvenile Tekapo ground wētā, or other, smaller wētā species.

Prints from mice and hedgehogs were also recorded for the interests of pest mammal monitoring and control (Section 10).

#### *Unmanned aerial vehicle (UAV) survey*

After minute and Otago short-horned grasshopper were both confirmed on site, a UAV survey was commissioned to better understand the distribution of their habitat on site. The survey took place in November 2024 and mapped as much of the habitat that had not been walked through as possible, where minute and Otago short-horned grasshopper habitat had been found or were suspected. Some areas could not be mapped due to legal constraints (proximity to aerodrome) and the logistics of mapping such a large area. The area surveyed is presented along with results in Section 8.2.

The UAV photographs were examined for potential habitat, characterised by yellow to red patches (denoting dry plants) mottled with white or pale brown (denoting bare ground, rocks, or sparse plant cover). These areas were then mapped to assess the distribution of potential habitat for minute and Otago short-horned grasshoppers on site.

The UAV survey is also described in the Terrestrial Invertebrate Management Plan (Wildland Consultants, 2025a).

## 2.3 Statutory context

### 2.3.1 The Fast-track Approvals Act

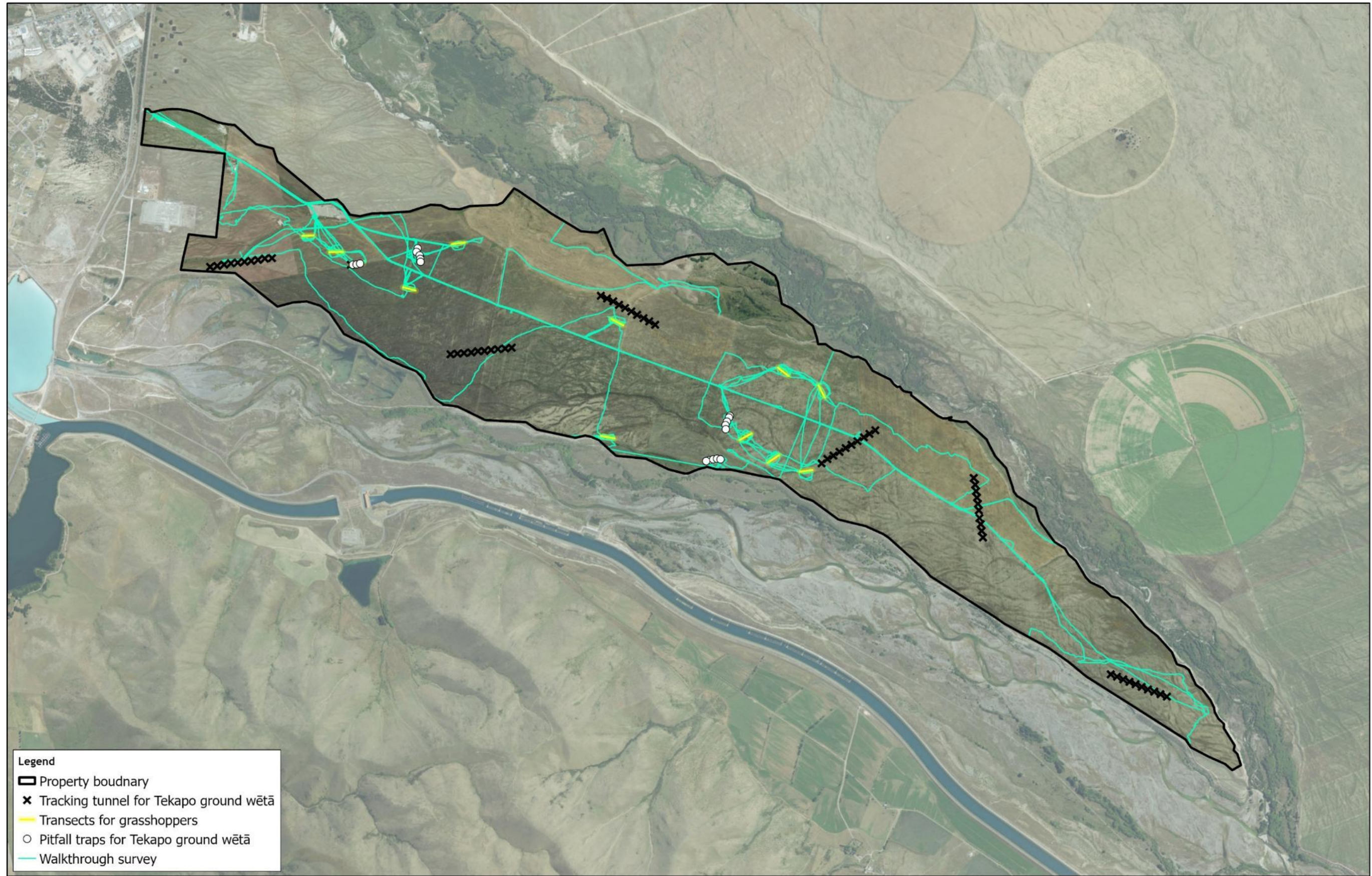
The FTAA streamlines the consenting process for nationally and regionally significant development and infrastructure projects. The purpose of the FTAA 2024 is to “facilitate the delivery of infrastructure and development projects with significant regional or national benefits”. As a nationally and regionally significant development, the Twizel solar farm has been referred to apply for approval under the FTAA.

Under section 85 of the FTAA, the Panel may decline an application if the Panel forms the view that those adverse impacts are sufficiently significant to be out of proportion to the project’s regional or national benefits, even after considering the following:

- Any conditions that the Panel may set in relation to those adverse impacts; and
- Any conditions or modifications that the applicant may agree to or propose to avoid, remedy or mitigate offset, or compensate for those adverse impacts.

### 2.3.2 Resource Management Act

The Resource Management Act 1991 (RMA) is the principal legislation governing the use, development, and protection of natural and physical resources in Aotearoa New Zealand. The purpose of the RMA is to promote the sustainable management of natural and physical resources in a way that enables people and communities to provide for their social, economic, and cultural wellbeing while safeguarding the life-supporting capacity of air, water, soil, and ecosystems.



**Legend**

- Property boundary
- x Tracking tunnel for Tekapo ground wētā
- Transects for grasshoppers
- Pitfall traps for Tekapo ground wētā
- Walkthrough survey

**Data Acknowledgment**  
 Contains data sourced from the LINZ Data Service licensed for reuse under CC BY 4.0

Report: 7414  
 Ref: 11940  
 Client: Nova Energy  
 Name: Figure2\_TerrestrialInvertebrates\_AEE.aprx  
 Path: E:\gis\Twizel\_SolarFarm\_DN\mxd\2025\

Figure 2. Terrestrial invertebrate surveys previously conducted at the proposed solar farm site in Twizel



**Wildlands**  
 www.wildlands.co.nz, 0508 WILDNZ

Scale: 1:25,000  
 Date: 18/02/2025  
 Cartographer: LW  
 Format: A3R



When considering a Fast-track resource consent application, including conditions, the Panel must take into account:

- the purpose of the FTAA; and
- the provisions of Parts 1, 3, 6 and 8 to 10 of the RMA that direct decision making on an application for resource consents (but excluding Section 104D of that Act); and
- the relevant provisions of any other legislation that directs decision making under the RMA.

However, the greatest weight needs to be given to the purpose of the FTAA.

Under the RMA, territorial and regional authorities are required to identify and protect significant indigenous vegetation and significant habitats of indigenous fauna (Section 6(c)), as matters of national importance. This is implemented through regional and district plans, which set rules and policies for the management of biodiversity and ecosystems. Section 31 of RMA requires territorial authorities to maintain indigenous biological diversity within their district. This provision mandates that territorial authorities must take an active role in protecting and preserving the diversity of indigenous species and ecosystems, ensuring that land use and development activities do not result in a net loss of biodiversity. It further compels authorities to consider biodiversity values when preparing and implementing district plans and consenting processes.

Appendix 1 sets out the criteria for identifying significant indigenous vegetation or significant habitats of indigenous fauna that qualify a specific area as a Significant Natural Area (SNA).

### 2.3.3 Wildlife Act 1953

All indigenous lizards, most indigenous birds, and some indigenous invertebrates, are protected under the Wildlife Act 1953. It is an offence to disturb or destroy protected wildlife without a Wildlife Act Authorisation (WAA; also known as a wildlife permit) from the Department of Conservation. A permit must be obtained from the Department before any protected wildlife (and/or their habitats) can be disturbed, handled, translocated or killed, including the lizards and avifauna considered in this report. Because of these requirements, provisions for the management of indigenous fauna provided in this report need to be considered within the context of the Wildlife Act 1953.

Wildlife permits can be sought as part of a substantive application under the FTAA. When considering a Fast-track wildlife permit application, the Panel must take into account:

- the purpose of the FTAA; and
- the purpose of the Wildlife Act 1953 and the effects of the project on the protected wildlife that is to be covered by the approval; and
- information and requirements relating to the protected wildlife that is to be covered by the approval (including, as the case may be, in the New Zealand Threat Classification System or any relevant international conservation agreement).

However, the greatest weight needs to be given to the purpose of the FTAA.

As part of this application, a Wildlife Approval (also known as a wildlife permit) is sought for the accidental disturbance and harm of lizards, handling them as part of the Incidental Discovery Protocol for lizards, and handling avifauna carcasses as part of carcass monitoring (Section 13).

### 2.3.4 Canterbury Regional Policy Statement

Ecological values at the site were assessed against the ecological significance criteria in the Canterbury Regional Policy Statement (CRPS; Appendix 2), and the Mackenzie District Plan.



Areas of ecological significance in Canterbury are areas of vegetation or habitats that meet one or more of the criteria listed in Appendix 3 of the Canterbury Regional Policy Statement (CRPS). The CRPS criteria set can be used to assess significance of indigenous vegetation and habitat of indigenous fauna against 10 criteria within four categories:

- Representativeness.
- Rarity or distinctive features.
- Diversity and pattern.
- Ecological context.

### 2.3.5 Canterbury Land and Water Regional Plan

The Canterbury Land and Water Regional Plan includes provisions relating to (among other things), water quality and the discharge of contaminants to land or water, management of wetlands and riparian margins, and the maintenance of biodiversity and critical habitats.

### 2.3.6 Mackenzie District Plan

Relevant rules and definitions outlined in the operative Mackenzie District Plan (MDP) include those relating to indigenous vegetation and vegetation clearance. Under REG-P6 of the MDP, renewable electricity generation activities are provided for where several criteria are met. These include using the effects management hierarchy to manage effects related to the development, as set out in this Assessment of Ecological Effects. The REG chapter of the MDP limits the applicability of many of the other chapters in the MDP when the activity is for the generation of renewable energy, as in the Twizel Solar Farm.

### 2.3.7 Natural wetlands

Natural wetlands are identified according to the Resource Management Act (RMA; 1991) and the National Policy Statement for Freshwater Management 2020 (NPS-FM). The RMA defines wetlands as “permanently or intermittently wet areas, shallow water, and land/water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions”.

A natural inland wetland is defined in the operative NPS-FM as a wetland (as defined in the Act) that is not:

- a. In the coastal marine area; or
- b. A deliberately constructed wetland, other than a wetland constructed to offset impacts on, or to restore, an existing or former natural inland wetland; or
- c. A wetland that has developed in or around a deliberately constructed water body, since the construction of the water body; or
- d. A geothermal wetland; or
- e. A wetland that:
  - i. Is within an area of pasture used for grazing; and
  - ii. Has vegetation cover comprising more than 50% exotic pasture species (as identified in the National List of Exotic Pasture Species using the Pasture Exclusion Assessment Methodology (see clause 1.8)); unless
  - iii. The wetland is a location of a habitat of a threatened species identified under clause 3.8 of this National Policy Statement, in which case the exclusion in 9e) does not apply.

Development within 100 metres of areas classified as wetlands is restricted in some circumstances under the NES-FM. The vegetation and habitats on the site and within 100 metres of its boundaries



were evaluated for wetland status. Wetland delineation using vegetation plots and soil and hydrology tests was not required during the site visit, as wetland status was easily determined using the rapid assessment method. Wetlands outside the site were determined by reviewing aerial imagery. Our assessment did not formally delineate these areas but noted where such areas may trigger this definition.

## 2.4 Ecological assessment framework

The ecological assessment was conducted by suitably-qualified ecological specialists with knowledge and experience of the Mackenzie Basin flora and fauna as well as the provision of AEEs. The Ecological Institute of Australia and New Zealand (EIANZ) guidelines for conducting ecological assessments through a matrix were not followed. Instead, a nuanced approach was used, based on ecological knowledge and experience. A variety of factors were considered leading to each level of effect, including those that are typically omitted from EIANZ assessments, such as the influence of site-specific characteristics.

## 3.0 Ecological Context

### 3.1 Site description

The site (Lot 3/DP422901/RT489342) is a long, narrow section of land to the east of Twizel (Figure 1). The Ōhau River is located along the southern boundary and the Twizel River to the north. The site is mostly flat with an access road through the centre and old river terraces near the boundary. It is currently used as pastoral land for farming. It is zoned Rural and is classified as an Outstanding Natural Landscape. The proposed area for development is located on outwash plain and river terraces between the Twizel and Ōhau Rivers, and includes areas of historic river channels and old oxbows.

### 3.2 Pukaki Ecological District

The proposed solar farm site is located within the Pukaki Ecological District (McEwen 1987), which is characterised by dry outwash plains between Lakes Tekapo and Benmore, mostly below 600 metres above sea level. The geology is fluvioglacial outwash deposits, with isolated greywacke and argillite hills. The climate is semi-arid to sub-humid with cold winters, warm summers and 600-1,600 mm of rainfall annually. Soils are moderately fertile but prone to drought in summer, they are easily erodible in steep areas with bare screes being common. Pasture now occupies much of this Ecological District, with some tussockland and areas of indigenous scrub (matagouri, coprosma, kōwhai, and corokia) remaining. Significant grazing impacts are due to sheep and rabbits. The braided riverbeds provide important habitat to several bird species, and there are also notable rare insect species in the area.

### 3.3 Nearby protected areas

The Lake Ruataniwha Conservation Area surrounds much of the proposed solar farm site. It is made up of several discrete areas of land, which includes the Ruataniwha wetland adjacent to the site. The Ruataniwha SNA encroaches slightly on the site, though the wetland is entirely outside the site. One area lies along most of the Twizel River side of the proposed solar farm property, with another area on the Ōhau River side nearest to Lake Ruataniwha. The Ben Ōhau Conservation Area is approximately five kilometres to the north and the Glenbrook Conservation Area is approximately 10 kilometres to



the south (Figure 3). The Lake Ruataniwha, Ben Ōhau, and Glenbrook Conservation Areas are all protected DOC Stewardship Areas<sup>1</sup>.

### 3.4 Sites of natural significance

An area along the Ōhau River is identified as a Site of Natural Significance in the MDP, primarily for its avifauna habitat values, as well as areas of wetland. It extends along the Ōhau river from Lake Benmore into, and including, parts of Lake Ruataniwha and its margins (Figures 3 and 4). As shown in Figure 3, there are two locations where this area overlaps with the boundary of the proposed solar farm property, both in the south-west corner of the site. The Ruataniwha wetland is considered a nationally significant wetland as it provides important habitat for a number of Threatened avifauna species (DOC 2025).

### 3.5 Threatened environment classification

The proposed solar farm development is classified by the Threatened Environment Classification database as within a 'poorly protected' threatened land environment (>30% indigenous cover left with <10% protected), reflecting limited formal protection but moderate remaining indigenous cover (Figure 5). This means that it falls into the threatened environment classification of being 'poorly protected' but also not strongly threatened by historic loss.

### 3.6 Land cover database

Various land cover types have been mapped in the New Zealand Land Cover Database<sup>2</sup> for the potential solar farm site. Most of the area is described as depleted grassland with smaller areas of high-producing and low-producing grassland also present. Patches of exotic hardwood trees are present along river margins.

### 3.7 Inland outwash gravels

Inland outwash gravels (or outwash plains) are a historically rare ecosystem type and a critically endangered ecosystem (Williams *et al.* 2007, Holdaway *et al.* 2012). Most of the site has been mapped as an outwash plain or terrace formed in the latest late Otiran glacial stage. Outwash plains are located in intermontane basins and are characterised by gravels which are well drained and result in low nutrients, supporting sparse vegetation (Manaaki Whenua 2023, Barrell *et al.* 2011).

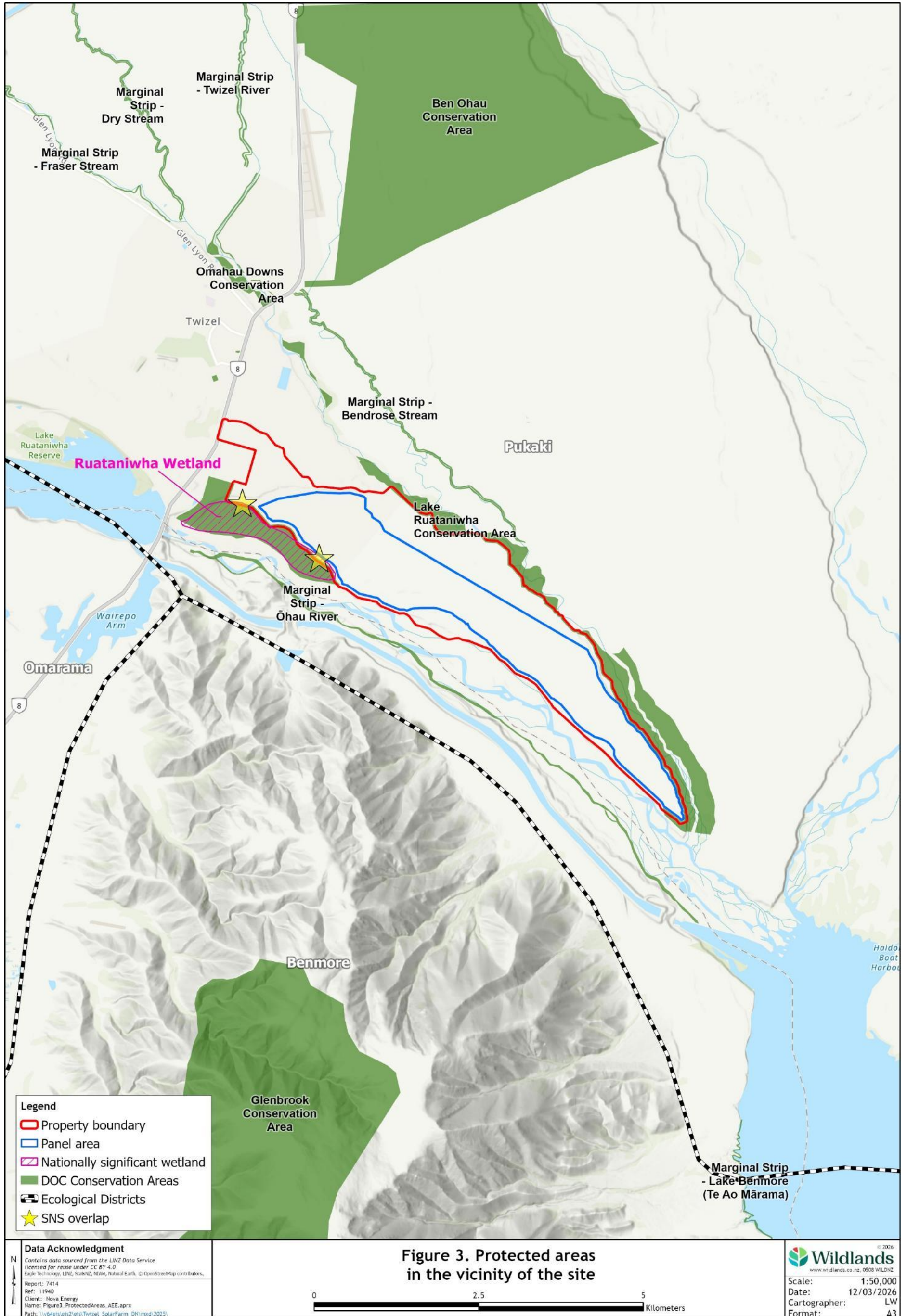
### 3.8 Braided rivers

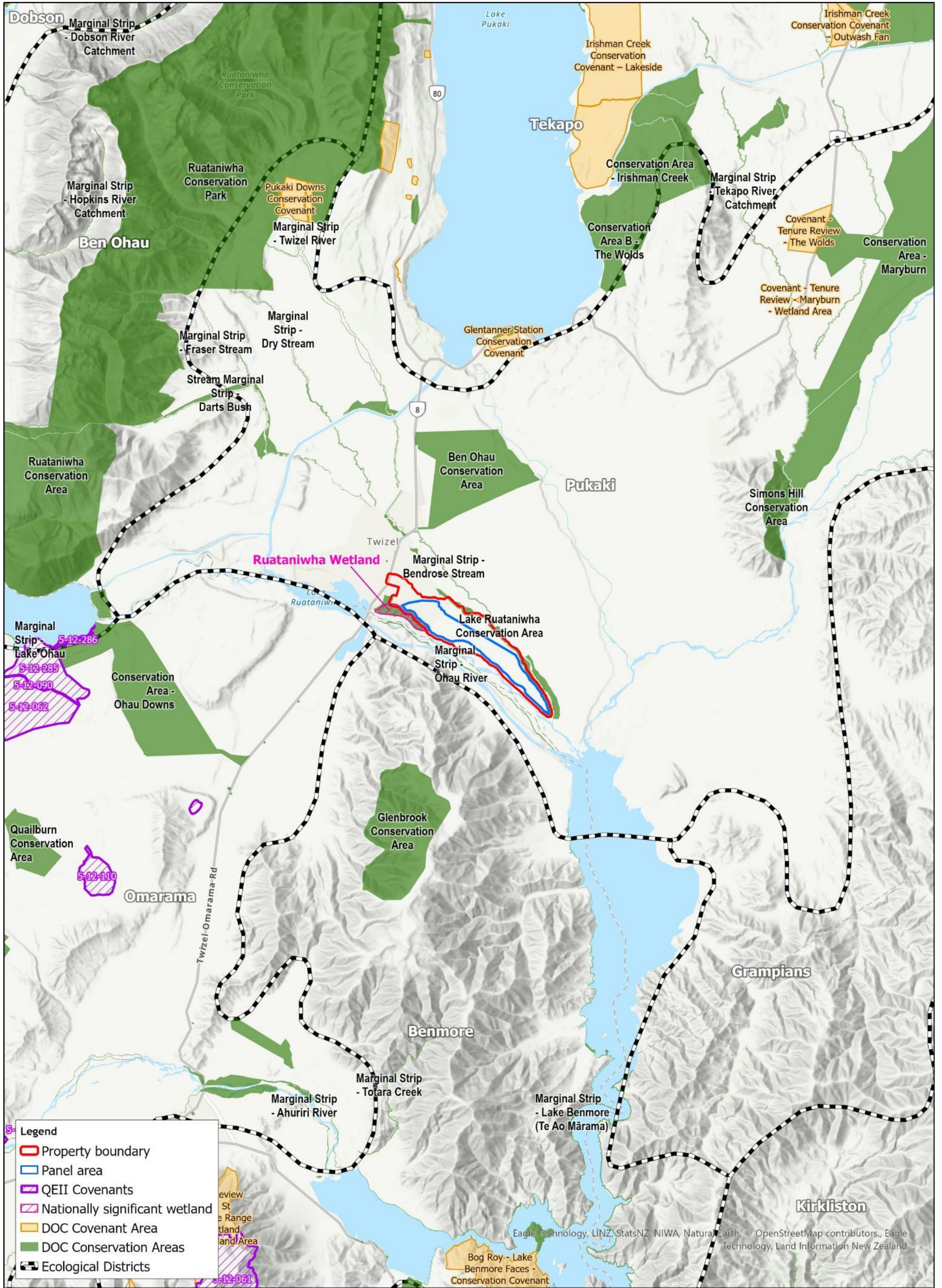
The site is flanked by two braided river systems, the Ōhau River and Twizel River. Braided rivers and their associated gravel beds have been identified as a historically rare ecosystem type and are naturally uncommon on a national basis (Williams *et al.* 2007). Braided river ecosystems are therefore classified as Threatened-Endangered (Holdaway *et al.* 2012). Sixty-four percent of Aotearoa New Zealand's braided rivers occur in Canterbury. The braided rivers of the Mackenzie Basin drain into the Waitaki river. The braided rivers and wetlands of the upper Waitaki Basin are subject to active restoration under "Project River Recovery" This programme is run by the Department of Conservation and funded by Meridian Energy and Genesis Energy under a compensatory agreement that recognises the impacts of hydroelectric power development on these rivers and wetlands (DOC 2020).

---

<sup>1</sup> Protected under the Conservation Act 1987.

<sup>2</sup> <https://iris.scinfo.org.nz/layer/104400-lcdb-v50-land-cover-database-version-50-mainland-new-zealand/>





**Legend**

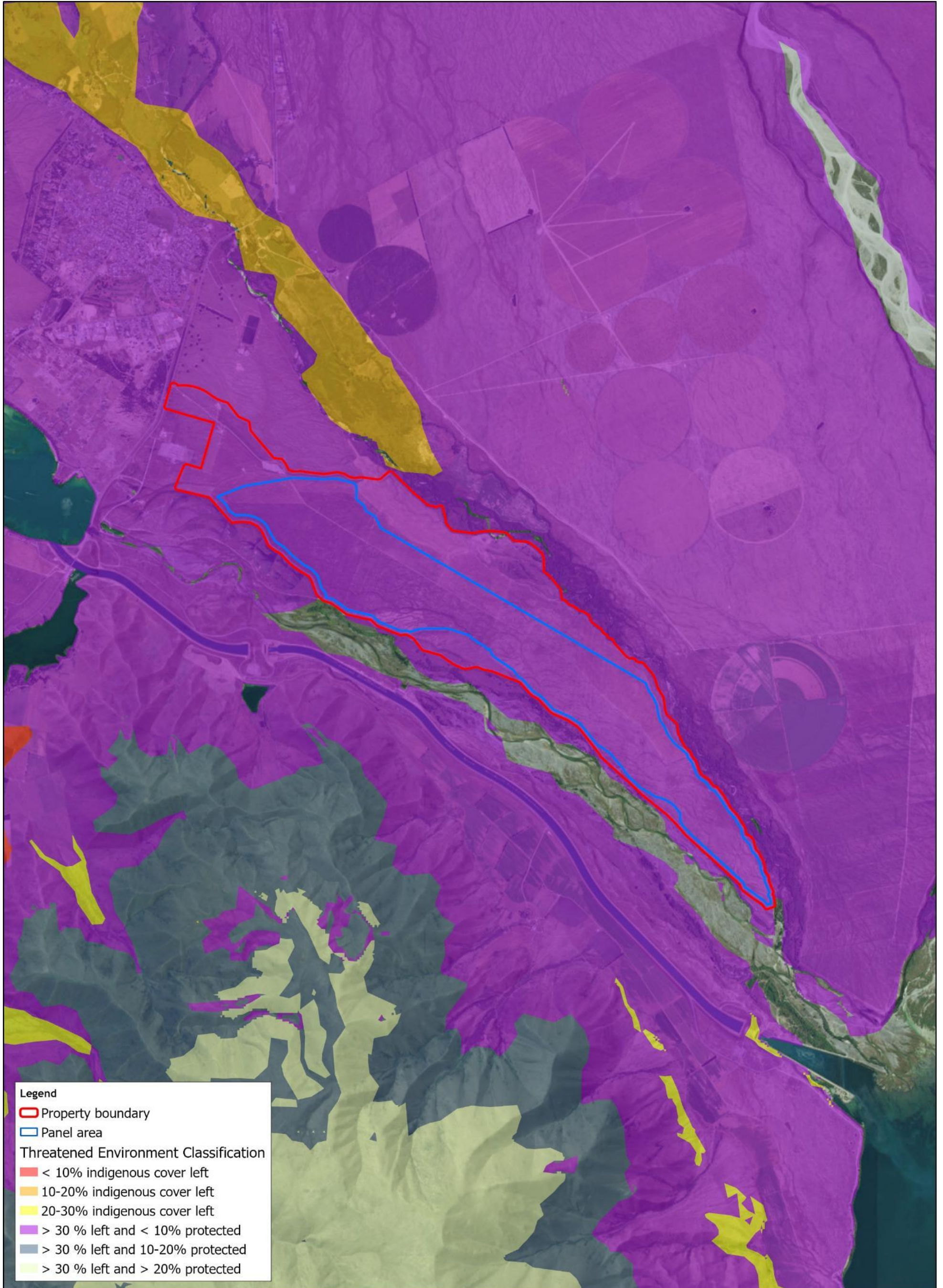
- Property boundary
- Panel area
- QEII Covenants
- Nationally significant wetland
- DOC Covenant Area
- DOC Conservation Areas
- Ecological Districts

**Data Acknowledgment**  
 Contains data sourced from the LINZ Data Service licensed for reuse under CC BY 4.0  
 Report: 7414  
 Ref: 11940  
 Client: Nova Energy  
 Name: Figure 4. Wider Protected Areas\_AEE.aprx  
 Path: \\v64gts2\gis\Twizel\_SolarFarm\_DN\mxd\2025\

**Figure 4. Protected areas within the wider area**



**Wildlands**  
 www.wildlands.co.nz, 0508 WILDNZ  
 Scale: 1:150,000  
 Date: 17/02/2026  
 Cartographer: LW  
 Format: A3



**Data Acknowledgment**  
 Contains data sourced from the LINZ Data Service licensed for reuse under CC BY 4.0  
 Eagle Technology, LINZ, Eagle Technology, Land Information New Zealand, GIBCO,  
 Report: 7414  
 Ref: 11940  
 Client: Nova Energy  
 Name: Figure5\_TEC\_AEE.aprx  
 Path: \\v64g1s1s2\gis\Twizel\_SolarFarm\_DN\mxd\2025\

**Figure 5. Threatened Environment Classification of the site**



**Wildlands** © 2026  
 www.wildlands.co.nz, 0508 WILDNZ  
 Scale: 1:40,000  
 Date: 24/02/2026  
 Cartographer: LW  
 Format: A3



### 3.9 Notable hydro scheme modifications

The proposed solar development site is near several hydropower stations which are part of the larger Waitaki hydro scheme. This scheme comprises five hydro-generation stations in the Upper Waitaki and three in the Lower Waitaki as well as a series of dams and canals to optimise generation potential. Development of this scheme has resulted in notable modifications to the surrounding environment due to the construction of dams, formation of lakes (e.g. Lake Benmore), and diversion of water through canals, drastically altering hydrological regimes of the rivers in the Mackenzie basin. Construction of dams has also hindered the movement of aquatic species through the river system.

The site lies alongside the Ōhau B and C canals, which connect Lake Ruataniwha and Lake Benmore, and are associated with two power stations (Ōhau B and Ōhau C).

### 3.10 Hydropower inundation areas

Parts of the proposed solar farm property fall within the hydroelectricity inundation hazard area identified in the MDP. This includes a larger area along the northern side of the property, and a smaller area on the southern side. These areas are recognised as those at risk of inundation due to the unlikely event of a dam or canal breach only and do not reflect any natural hazards, for example flooding from rivers.

### 3.11 Current and recent land use

The site is currently operating under a farm lease arrangement, predominantly used for cropping and sheep grazing. The area is subdivided into fenced paddocks, some of which have been used for hay/baleage production. Most of the site has been cultivated by direct-drilling, and this has led to a widespread distribution of improved pasture species across the site. A quarry is located in the northwestern part of the site.

## 4.0 Vegetation and Habitats

### 4.1 Overview

Fifteen vegetation and habitat types were identified at the site:

#### Terrestrial habitats

1. Flood channel shrubland (1.2 hectares)
2. Sweet brier shrubland (22.4 hectares)
3. Browntop-sweet vernal-clover grassland (488.3 hectares)
4. Alluvial grassland (35.7 hectares)
5. Scarp herbfield and grassland (10.2 hectares)
6. [Wilding conifer]/scarp herbfield and grassland (4.2 hectares)
7. Sweet vernal-mouse-ear hawkweed herbfield and grassland (2.9 hectares)
8. Haresfoot trefoil-sweet vernal- grassland (5.3 hectares)
9. Old river terrace (8.1 hectares)
10. Haresfoot trefoil herbfield (272.3 hectares)
11. Earthworks and quarrying (3.5 hectares)



### Wetland habitats

12. Ephemeral wetland (0.1 hectares)
13. Tall fescue-rautahi marsh (2.1 hectares)
14. Alder forest (1.9 hectares)
15. Crack willow forest (0.8 hectares)

These vegetation/habitat types are described below and mapped in Figure 6.

## 4.2 Vegetation and habitat types

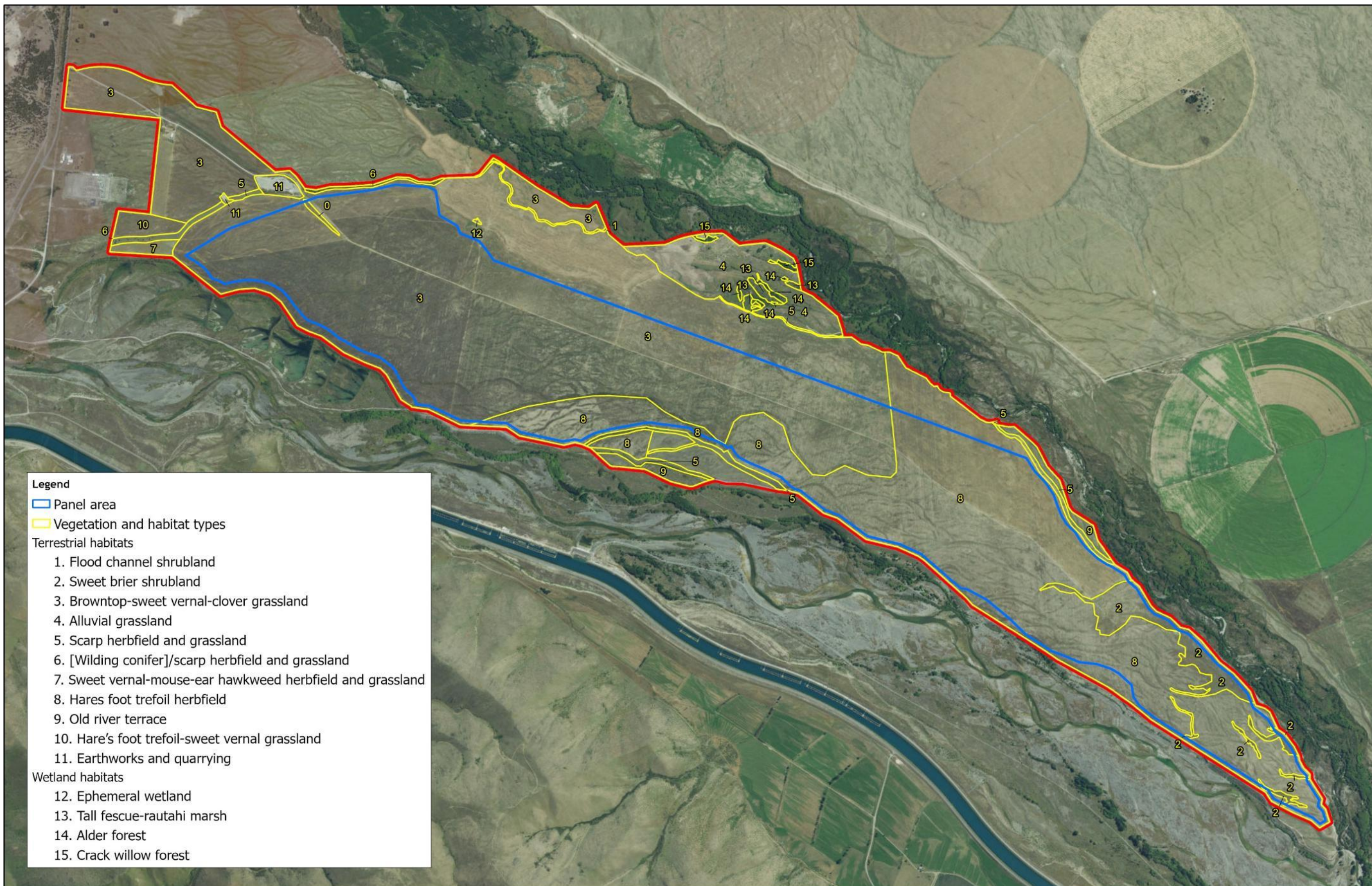
### Terrestrial

#### 1. Flood channel shrubland

Shrubland occurs along a seasonally wet flood channel in the northeastern part of the site. The indigenous shrub tūmatakuru/matagouri (*Discaria toumatou*) is common along edges with occasional exotic woody species including elder (*Sambucus nigra*), sweet brier (*Rosa rubiginosa*) and broom (*Cytisus scoparius*). A large crack willow is also present in this area. The ground cover is dominated by sweet vernal, browntop (*Agrostis capillaris*), and Yorkshire fog (*Holcus lanatus*), along with yarrow (*Achillea millefolium*), red fescue (*Festuca rubra*), white clover (*Trifolium repens*), creeping buttercup (*Ranunculus repens*), cleavers (*Galium aparine*), mouse ear chick weed (*Cerastium fontanum*), and bog stitchwort (*Stellaria alsine*). In areas that lack shrubs, small, localised wetlands are present, containing pasture species (sweet vernal, browntop, Yorkshire fog, rautahi (*Carex coriacea*), oval sedge (*Carex leporina*), *Juncus conglomeratus*, and track rush (*Juncus tenuis*).



**Plate 1** – Flood channel shrubland with tūmatakuru and sweet brier.



**Legend**

- ▭ Panel area
- ▭ Vegetation and habitat types

**Terrestrial habitats**

1. Flood channel shrubland
2. Sweet brier shrubland
3. Browntop-sweet vernal-clover grassland
4. Alluvial grassland
5. Scarp herbfield and grassland
6. [Wilding conifer]/scarp herbfield and grassland
7. Sweet vernal-mouse-ear hawkweed herbfield and grassland
8. Hares foot trefoil herbfield
9. Old river terrace
10. Hare's foot trefoil-sweet vernal grassland
11. Earthworks and quarrying

**Wetland habitats**

12. Ephemeral wetland
13. Tall fescue-rautahi marsh
14. Alder forest
15. Crack willow forest

**Data Acknowledgment**  
 Contains data sourced from the LINZ Data Service  
 licensed for reuse under CC BY 4.0  
 Esri® Technology, Land Information New Zealand, GCS, Community maps contributors  
 Report: 7414  
 Ref: 11940  
 Client: Nova Energy  
 Name: Figure6\_Veg\_AEE.aprx  
 Path: \\v64gts1g12\gis\Twizel\_SolarFarm\_DHI.mxd\2025\

**Figure 6. Vegetation and habitats at the site**



**Wildlands**  
 www.wildlands.co.nz, 0908 WILDNZ  
 Scale: 1:22,000  
 Date: 17/02/2026  
 Cartographer: LW  
 Format: A3R



## 2. Sweet brier shrubland

Sweet brier forms patches of shrubland in the southern part of the site, with a ground cover dominated by occasional spring speedwell (*Veronica verna*), haresfoot trefoil (*Trifolium arvense*), browntop, sweet vernal, viper's bugloss, yarrow, sheep's sorrel (*Rumex acetosella*), *Bromus tectorum*, and white clover.

## 3. Browntop-sweet vernal-clover grassland

Exotic-dominated improved pasture grassland in the northern part of the site comprises patches of browntop and sweet vernal, red fescue, and *Bromus* sp. This area also contains a high abundance of yarrow and red clover (*Trifolium pratense*) probably due to the presence of more productive soils. This grassy vegetation also contains patches of herbfield dominated by white clover, mouse-ear hawkweed and red clover with haresfoot trefoil, sheep's sorrel and occasional sweet vernal and woolly mullein (*Verbascum thapsus*).



**Plate 2** – Browntop-sweet vernal-clover grassland, towards the interior of the site.

## 4. Alluvial grassland

A small stream runs through alluvial grassland in the eastern part of the site. Vegetation is taller in stature and comprises exotic grasses and herbs with occasional indigenous species. Pasture species – including sweet vernal, browntop, Yorkshire fog and white clover – are abundant, as well as *Juncus conglomeratus*, jointed rush, red fescue, bog stitchwort, water forget-me-not (*Myosotis laxa*), and lotus (*Lotus pedunculatus*) in marshy areas. Indigenous sedges rautahi, pūkiō (*Carex secta*), and bog rush (*Schoenus pauciflorus*) are occasionally present along stream margins with the indigenous herb *Bulbinella angustifolia* also present in some areas. Woody species – including common alder (*Alnus glutinosa*), sweet brier and tumatakuru – are also present occasionally on stream banks.



## 5. Scarp herbfield and grassland

Stony scarps on the eastern and western margins of the site support low stature vegetation dominated by exotic herbs and grasses, haresfoot trefoil, mouse-ear hawkweed (*Pilosella officinarum*), red fescue, and occasional sweet brier. Creeping pohuehue (*Muehlenbeckia axillaris*), māikaika/onion orchid (*Microtis unifolia*), white clover, purging flax (*Linum catharticum*), vulpia hair grass (*Vulpia myuros*), sheep's sorrel, yarrow and *Bromus tectorum* are also common. The indigenous herb *Convolvulus verecundus* f. *verecundus* is also present on these scarps, as is occasional New Zealand harebell (*Wahlenbergia albomarginata*) and golden spaniard (*Aciphylla aurea*).

Similar dryland vegetation is likely present around the perimeter of the property.



**Plate 3** – Example of scarp herbfield and grassland in the western part of the site.

## 6. [Wilding conifer]/scarp herbfield and grassland

In the northwestern part of the site, the scarp dividing the outwash plain has scattered Corsican pine (*Pinus nigra*) and ponderosa pine (*P. ponderosa*) above grassland dominated by red fescue, sweet vernal, browntop, and hard tussock (*Festuca novae-zelandiae*). Numerous sub-shrubs, herbs, and smaller grasses are present including purging flax, mouse-ear hawkweed, red clover, New Zealand harebell, *Plantago novae-zelandiae*, *Celmisia gracilentia*, *Raoulia australis*, white sun orchid (*Thelymitra longifolia*), desert broom (*Carmichaelia petriei*), *Pimelea prostrata*, *Coprosma petriei*, *Luzula rufa*, hooked sedge (*Carex breviculmis*), blue tussock (*Poa colensoi*), and dwarf broom (*Carmichaelia vexillata*).

## 7. Sweet vernal-mouse-ear hawkweed herbfield and grassland

Scattered sweet brier and porcupine shrubs above abundant sweet vernal and mouse-ear hawkweed are present on the lower uncultivated outwash plain in the northwestern part of the site. Onion orchid, white sun orchid, *Prasophyllum colensoi*, *Thelymitra colensoi*, New Zealand



harebell, Australian sheep's burr (*Acaena agnipila*), sheep's sorrel, haresfoot trefoil, creeping pohuehue, *Geranium brevicaule*, red clover, red fescue, and viper's bugloss are also present.

#### 8. Haresfoot trefoil herbfield

This herbfield is dominated by haresfoot trefoil, mouse-ear hawkweed with occasional *Bromus* sp., white clover, sheep's sorrel, sweet vernal and viper's bugloss. Brier rose is present occasionally. Some areas are more exclusively dominated by mouse-ear hawkweed with occasional sweet vernal, sheep's sorrel and haresfoot trefoil. Brier, viper's bugloss, king devil (*Pilosella praealta*) and silvery hair grass (*Aira caryophyllea*) are more abundant in rocky areas.

#### 9. Old river terrace

Two examples of old river terrace are present in both the eastern and western margins of the site with vegetation mostly comprising of mouse-ear hawkweed, sweet vernal, māikaika/onion orchid and red fescue. Indigenous species including hooked sedge, creeping pohuehue, common mat daisy, *Convolvulus verecundus f. verecundus* and māikaika/white sun orchid (*Thelymitra longifolia*) are common as well as exotic herbs, catsear (*Hypochaeris radicata*), haresfoot trefoil, and spring speedwell. Woody species are occasionally present, including broom and *Melicactus alpinus* and wilding lodgepole pine (*Pinus contorta*).

#### 10. Haresfoot trefoil-sweet vernal-grassland

Uncultivated upper outwash plain in the northwestern part of the site supports a grassland dominated by sweet vernal and haresfoot trefoil, with occasional browntop, sheep's sorrel, white clover, red clover and St John's wort (*Hypericum perforatum*). Occasional taller sweet brier and viper's bugloss are scattered within this grassland.

#### 11. Earthworks and quarrying

These areas comprise a consented operational quarry site.

### Wetlands

#### 12. Ephemeral wetland

An ephemeral wetland is present in the northern part of the site. Vegetation within this habitat is comprised of abundant celery-leaved buttercup (*Ranunculus sceleratus*) and curled dock (*Rumex crispus*). Exotic rushes toad rush (*Juncus bufonius*) and jointed rush (*Juncus articulatus*) and the exotic herb Shepherd's purse *Capsella bursa-pastoris* are common. Other exotic species present include spring speedwell, storks-bill (*Erodium cicutarium*), water forget-me-not, oval sedge, prickly puha (*Sonchus asper*), tall willowherb (*Epilobium ciliatum*) and kneed foxtail (*Alopecurus geniculatus*). Two indigenous herbs which are often associated with ephemeral wetlands are present, mudwort (*Limosella lineata*) and *Glossostigma diandrum*.

#### 13. Tall fescue-rautahi marsh

Marsh wetland is present in the northeastern part of the site on the alluvial terrace. Vegetation in this area is dominated by tall fescue (*Lolium arundinaceum*) and rautahi with lotus, sweet vernal, *Bulbinella angustifolia*, oval sedge, Yorkshire fog, *Juncus conglomeratus*, and yarrow. An indigenous sedge, *Carex kaloides*, is also present in this area.



**Plate 4** – Ephemeral wetland habitat.

#### 14. Alder forest

Alder trees about six metres tall in an old river channel have formed a closed canopy, with no other woody species present in the canopy or sub-canopy. Groundcover is either densely vegetated with exotic grasses such as sweet vernal and tall fescue and herbs (bog stitchwort, Californian thistle, dock and hawkbit) or very sparse with celery leaved buttercup and water forget-me-not amongst extensive pugging by stock.

#### 15. Crack willow forest

Small patches of forest dominated by crack willow (*Salix xfragilis*) are present in wet old river channels in the east of the alluvial grassland at the eastern margin of the site. These were not inspected closely, as this vegetation type is well outside the panel area.

## 5.0 Flora

### 5.1 Overview

Twenty-seven indigenous and 68 exotic vascular plant species were recorded during the site visit (Appendix 1).

### 5.2 Rare, Threatened and At Risk taxa

Six of the indigenous species observed at the site are classified as At Risk – Declining and an additional species, *Pimelea sericeovillosa* subsp. *pulvinaris*, is classified as Threatened – Nationally Vulnerable (Table 1; Plate 5) (de Lange *et al.* 2024).



**Table 1 – Rare, Threatened, and At Risk vascular plant species observed at the site.**

Species	Common Name	Plant Type	Threat Ranking
<i>Carex kaloides</i>	-	Sedge	At Risk – Declining
<i>Carmichaelia petriei</i>	Desert broom	Shrub	At Risk – Declining
<i>Carmichaelia vexillata</i>	Dwarf broom	Shrub	At Risk – Declining
<i>Convolvulus verecundus f. verecundus</i>	-	Herb	At Risk – Declining
<i>Pimelea sericeovillosa</i> subsp. <i>pulvinaris</i>		Herb	Threatened – Nationally Vulnerable
<i>Raoulia australis</i>	Common mat daisy	Herb	At Risk – Declining
<i>Rytidosperma exiguum</i>		Grass	At Risk - Declining

*Convolvulus verecundus f. verecundus* is cryptic when not flowering and was recorded widely on the margins of the site during the 2022 field survey (Figure 7). In only one of these locations was *Convolvulus verecundus f. verecundus* flowering. An additional survey for *Convolvulus verecundus f. verecundus* was undertaken in summer 2023-2024 with more populations detected across the site.

Of the species classified as ‘At Risk – Declining’, desert broom, dwarf broom, and common mat daisy were only observed on scarp and terrace riser habitats. *Rytidosperma exiguum* (At Risk – Declining) and *Pimelea sericeovillosa* subsp. *pulvinaris* (Threatened – Nationally Vulnerable) were also detected on scarp and terrace riser habitats at low abundance (Figure 7).

In 2024, at the same time field surveys were being undertaken, the national threat classification for vascular plants was revised, this resulted in the status of *Convolvulus verecundus f. verecundus* changing from ‘Threatened – Nationally Vulnerable’ (de Lange *et al.* 2024) to ‘At Risk – Declining’ (de Lange *et al.* 2024). *Pimelea sericeovillosa* subsp. *pulvinaris* maintained its classification of ‘Threatened – Nationally Vulnerable’ (de Lange *et al.* 2024). *Rytidosperma exiguum*, *Carmichaelia petriei*, *Carex kaloides*, *Carmichaelia vexillata*, and *Raoulia australis* are still listed as ‘At Risk – Declining’ and matagouri/tūmatakuru is no longer At Risk (de Lange *et al.* 2024).

Although surveys focused on species within the site area, Threatened and At Risk plants are also present outside the site boundary and potentially adjacent to the fenceline. Species include *Convolvulus verecundus f. verecundus* and *Lepidium solandri* (Threatened - Nationally Critical)<sup>1</sup>.



**Plate 5:** *Convolvulus verecundus f. verecundus* in flower at the site.



**Plate 6:** *Raoulia australis* in flower at the site.

<sup>1</sup> *Lepidium solandri* observations noted by Susan Walker as part of the Department of Conservation review, May 2026.



## 5.1 Pest plants and ecological weeds

Six plant species recorded in the site are listed as either 'pest' or 'Organisms of Interest' (OOI) in Environment Canterbury's Regional Pest Management Plan (CRPMP; 2018-2038; Table 2). An additional six plants have been identified as ecological weeds.

**Table 2** – Pest plants and Organisms of Interest (PEST, OOL, respectively), listed in the CRPMP that were recorded at the site.

Scientific Name	Common Name(s)	Growth Form	Pest Status
<i>Cytisus scoparius</i>	Broom	Shrub	PEST
<i>Echium vulgare</i>	Viper's' bugloss	Herb	OOI
<i>Hypericum perforatum</i>	St John's wort	Herb	OOI
<i>Lolium arundinaceum</i>	Tall fescue	Grass	Ecological weed
<i>Lupinus polyphyllus</i>	Russell lupin	Herb	PEST
<i>Pilosella officinarum</i>	Mouse-ear hawkweed	Herb	OOI
<i>Pinus contorta</i> <i>Pseudotsuga menziesii</i>	Wilding conifers	Tree	PEST
<i>Rosa rubiginosa</i>	-	Shrub	Ecological weed
<i>Salix fragilis</i>	Crack willow	Tree	Ecological weed
<i>Sambucus nigra</i>	Elder	Shrub	Ecological weed
<i>Sedum acre</i>	Stonecrop	Herb	Ecological weed
<i>Solanum dulcamara</i>	Bittersweet	Herb	Ecological weed

## 6.0 Avifauna

### 6.1 Desktop assessment

The desktop assessment recorded 60 species and two hybrid taxa within five kilometres of the site (Table 3). Of these, 44 are indigenous and 18 are exotic.

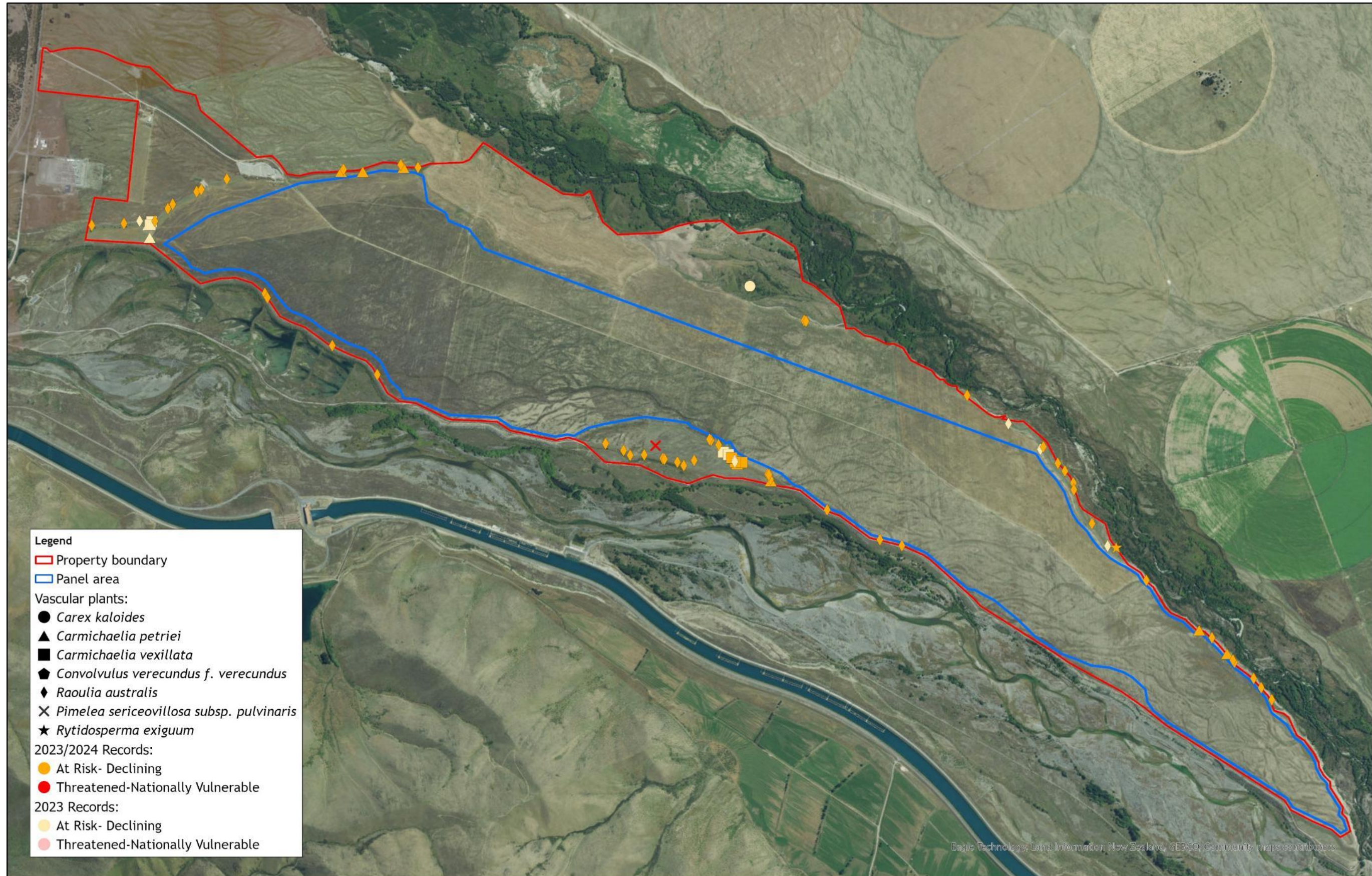
Nine Threatened species have been recorded in the vicinity of the site:

- Nationally Critical: kakī/black stilt (*Himantopus novaeseelandiae*) and kotuku/white heron (*Ardea alba modesta*).
- Nationally Endangered: tarapirohe/black-fronted tern (*Chlidonias albostrigatus*).
- Nationally Vulnerable: taranui/Caspian tern (*Hydroprogne caspia*), kārearea/eastern falcon (*Falco novaeseelandiae novaeseelandiae*), pūteketeke/Australasian crested grebe (*Podiceps cristatus australis*), pāpera/grey duck (*Anas superciliosa*), and kawau tikitiki/spotted shag (*Phalacrocorax punctatus*).
- Nationally Increasing: ngutu pare/wrybill (*Anarhynchus frontalis*).

Nine At Risk species have been recorded in the vicinity of the site:



- Declining: pohowera/banded dotterel (*Charadrius bicinctus bicinctus*), tarāpuka/black-billed gull (*Chroicocephalus bulleri*), kotoreke/marsh crake (*Zapornia pusilla affinis*), pīhoihoi/New Zealand pipit (*Anthus novaeseelandiae novaeseelandiae*), tōrea/South Island pied oystercatcher (*Haematopus finschi*), tarāpunga/red-billed gull (*Chroicocephalus novaehollandiae scopulinus*), and tara/white-fronted tern (*Sterna striata striata*).



**Legend**

- Property boundary
- Panel area

Vascular plants:

- *Carex kaloides*
- ▲ *Carmichaelia petriei*
- *Carmichaelia vexillata*
- ◆ *Convolvulus verecundus f. verecundus*
- ◆ *Raoulia australis*
- × *Pimelea sericeovillosa subsp. pulvinaris*
- ★ *Rytidosperma exiguum*

2023/2024 Records:

- At Risk- Declining
- Threatened-Nationally Vulnerable

2023 Records:

- At Risk- Declining
- Threatened-Nationally Vulnerable

**Data Acknowledgment**  
 Contains data sourced from the LINZ Data Service (licensed for reuse under CC BY 4.0)

Report: 7414  
 Ref: 11940  
 Client: Nova Energy  
 Name: Figure7\_ThreatenedPlants\_AEE.aprx  
 Path: \\v64gis\gis2\gis\Twizel\_SolarFarm\_DHI\mxd\2025\

**Figure 7. Locations of Threatened and At Risk plants at the site**



**Wildlands**  
 www.wildlands.co.nz, 0508 WILDNZ

Scale: 1:21,000  
 Date: 17/02/2026  
 Cartographer: LW  
 Format: A3R



- Relict: māpunga/black shag (*Phalacrocorax carbo novaehollandiae*) and kawaupaka/little shag (*Microcarbo melanoleucos brevirostris*).
- Naturally Uncommon: Australian coot (*Fulica atra australis*) and kawau tūi/little black shag (*Phalacrocorax sulcirostris*).

## 6.2 Field survey findings

Of the 38 taxa recorded during the site visit (Table 3), 21 were indigenous species, 16 were exotic, and one *Anas* sp. was not identified to species level. Two Threatened species were observed: tarapirohe/black-fronted tern and pāraera/grey duck. Five At Risk species were observed: pohowera/banded dotterel, tarāpuka/black-billed gull, tōrea/South Island pied oystercatcher, māpunga/black shag, and kawaupaka/little shag.

Introduced passerines were the most common species group across the site, with Eurasian skylark (*Alauda arvensis*, Introduced and Naturalised) being particularly abundant. All species detected during the site visit were also recorded in the desktop assessment.

Tōrea/South Island pied oystercatcher were observed feeding and roosting in the browntop-sweet vernal-cover grassland on the site (Figure 8). One bird was observed sitting on what looked like a nest, although this could not be confirmed. The short grassland provides suitable breeding habitat for tōrea/South Island pied oystercatcher to breed. Tarapirohe/black-fronted terns were observed flying over the site and foraging in the river along the site's southern border (Figure 8).

### Adjacent important sites

Several areas are important to avifauna on the southern margins of the site and these are shown collectively in Figure 8 as an "important avifauna area". Large numbers of waterfowl and waders, including the Threatened pāraera/grey duck and At Risk pohowera/banded dotterel and tōrea/South Island pied oystercatcher, were present in wetlands between the Ōhau River and the southern margin of the site (opposite the Ōhau B Power Station, as shown in Figure 8). The Department of Conservation kakī/black stilt captive breeding centre is adjacent to the proposed solar farm site. Kakī/black stilt have been previously recorded at a range of areas near the site, including around Lake Ruataniwha, the Lake Benmore/Ohau River delta, and lagoons located in the vicinity of the Ohau River and the DOC captive breeding facility. It is possible that kakī/black stilt may travel over the site while moving between these habitats.

While matuku-hūrepo/Australasian bittern (*Botaurus poiciloptilus*, Threatened – Nationally Critical) were not detected during the desktop or field surveys, the Department of Conservation data shows they have been previously recorded at nearby sites, including the Ōhau River, Pukaki River, Tekapo River, Twizel River, Lake Ōhau, Lake Poaka, and Lake Ruataniwha (C. O'Donnell, pers. comm.). This suggests that matuku-hūrepo/Australasian bittern are present within the area and are likely to fly over the site when moving between habitat patches. However, matuku-hūrepo/Australasian bittern movements within the Mackenzie District have not been specifically tracked before, and all Department of Conservation data in the area, apart from one data point, comes from pre-2005 (C. O'Donnell, pers. comm.). This makes it challenging to determine the abundance, flight height, and flight paths of matuku-hūrepo/Australasian bittern near the site. However, it is anticipated that regular activity of matuku-hūrepo/Australasian bittern will occur throughout the area as they are likely to move between the multiple nearby sites they use.

The Ōhau River and its delta on Lake Benmore provide important habitat for various Threatened and At Risk species, including māpunga/black shag and kawaupaka/little shag, which were observed feeding in the river during the site visit. Wetland patches in the Ōhau River are known habitat for the At Risk kotoreke/marsh crake. While pūweto/spotless crake (*Zapornia tabuensis*, At Risk – Declining) were not identified during the desktop assessment or field visit, it is likely they may also be present in



the area, particularly in locations similar to those where matuku-hūrepo/Australasian bittern and kotoreke/marsh crane are found.

Tracking data for tarapirohe/black-fronted terns at a colony on the upper Ōhau River show they transit over the site, particularly the southern area (C. O'Donnell, pers. comm.). Movement appears highest around dawn (4-7 am) and dusk (6-10 pm) (C. O'Donnell, pers. comm.). However, it is difficult to determine from the available data how long tarapirohe/black-fronted tern generally spend in the area, whether they are transiting or foraging, and the heights at which they are flying.

## 7.0 Lizards

### 7.1 Desktop assessment

Six species of indigenous lizard, including four species of skink and two species of gecko, have been recorded within 20 kilometres of the site (Table 4). These species are:

- McCann's skink (*Oligosoma maccanni*; Not Threatened).
- Southern grass skink (*O. chionochloescens*; At Risk – Declining).
- Lakes skink (*O. aff. chloronoton* “West Otago”; Threatened – Nationally Vulnerable).
- Scree skink (*O. laxa*; Threatened – Nationally Vulnerable).
- Southern Alps gecko (*Woodworthia* “Southern Alps”; At Risk – Declining).
- Jewelled gecko (*Naultinus gemmeus*; At Risk – Declining).

McCann's skink and southern grass skink are widespread throughout the Mackenzie District, and often persist in areas of grassland habitat comprising rank grass and scrub similar to that found at the proposed site. Southern Alps gecko are commonly found in rocky areas with shrubland, talus slopes, and braid plains.

Potential habitat (complex rock piles) for Lakes skink is present in an area of old river terrace along the central southern edge of the site. This species has become increasingly rare and is sparsely spread across the Mackenzie District, and is therefore considered unlikely to be present. While this area also provides appropriate habitat for scree skink, this species is particularly rare at lower elevations and is highly unlikely to be present within the site. Multiple intensive surveys have failed to detect either species on site.

It is unlikely that jewelled gecko are present at the site. All available shrubland is restricted to a narrow strip of talus slope and as a result of this habitat fragmentation, it is highly unlikely that any populations or remnant individuals remain within the project area.



**Table 3:** Bird species detected during the desktop assessment and site visit for the proposed Nova Energy solar farm near Twizel. Common names, scientific names, and threat classification are from Robertson *et al.* (2021), and protection status from the Wildlife Act 1953.

Common Name(s)	Scientific Name	Threat Classification 2021	Protection Status	Likelihood of Presence at Site
<b>Indigenous</b>				
Kakī/black stilt	<i>Himantopus novaeseelandiae</i>	Threatened – Nationally Critical	Protected	Highly likely
Kotuku/white heron	<i>Ardea alba modesta</i>	Threatened – Nationally Critical	Protected	Possible
Tarapirohe/black-fronted tern	<i>Chlidonias albostratus</i>	Threatened – Nationally Endangered	Protected	Seen during visit
Kārearea/eastern falcon	<i>Falco novaeseelandiae novaeseelandiae</i>	Threatened – Nationally Vulnerable	Protected	Possible
Kawau tikitiki/spotted shag	<i>Phalacrocorax punctatus</i>	Threatened – Nationally Vulnerable	Protected	Unlikely
Pārera/grey duck	<i>Anas superciliosa</i>	Threatened – Nationally Vulnerable	Protected but can be hunted	Seen during visit
Pūteketeke/Australasian crested grebe	<i>Podiceps cristatus australis</i>	Threatened – Nationally Vulnerable	Protected	Unlikely
Taranui/Caspian tern	<i>Hydroprogne caspia</i>	Threatened – Nationally Vulnerable	Protected	Highly likely
Ngutu pare/wrybill	<i>Anarhynchus frontalis</i>	Threatened – Nationally Increasing	Protected	Likely
Kotoreke/marsh crake	<i>Zapornia pusilla affinis</i>	At Risk – Declining	Protected	Highly likely
Pihoihoi/New Zealand pipit	<i>Anthus novaeseelandiae novaeseelandiae</i>	At Risk – Declining	Protected	Possible
Pohowera/banded dotterel	<i>Charadrius bicinctus bicinctus</i>	At Risk – Declining	Protected	Seen during visit
Tara/white-fronted tern	<i>Sterna striata striata</i>	At Risk – Declining	Protected	Unlikely
Tarāpuka/black-billed gull	<i>Chroicocephalus bulleri</i>	At Risk – Declining	Protected	Seen during visit
Tarāpunga/red-billed gull	<i>Chroicocephalus novaehollandiae scopulinus</i>	At Risk – Declining	Protected	Unlikely
Tōrea/South Island pied oystercatcher	<i>Haematopus finschi</i>	At Risk – Declining	Protected	Seen during visit
Kawaupaka/little shag	<i>Microcarbo melanoleucos brevirostris</i>	At Risk – Relict	Protected but can be hunted	Seen during visit



Common Name(s)	Scientific Name	Threat Classification 2021	Protection Status	Likelihood of Presence at Site
Māpunga/black shag	<i>Phalacrocorax carbo novaehollandiae</i>	At Risk – Relict	Protected but can be hunted	Seen during visit
Australian coot	<i>Fulica atra australis</i>	At Risk – Naturally Uncommon	Protected	Unlikely
Kawau tūi/little black shag	<i>Phalacrocorax sulcirostris</i>	At Risk – Naturally Uncommon	Protected	Highly unlikely
Grey duck – mallard hybrid	<i>Anas superciliosa</i> × <i>platyrhynchos</i>	Not Threatened	Protected but can be hunted	Seen during visit
Kāhu/swamp harrier	<i>Circus approximans</i>	Not Threatened	Protected but can be hunted	Seen during visit
Kakīānau/black swan	<i>Cygnus atratus</i>	Not Threatened	Protected but can be hunted	Seen during visit
Karoro/southern black-backed gull	<i>Larus dominicanus dominicanus</i>	Not Threatened	Not protected	Seen during visit
Kererū/New Zealand pigeon	<i>Hemiphaga novaeseelandiae</i>	Not Threatened	Protected	Possible
Korimako/bellbird	<i>Anthornis melanura melanura</i>	Not Threatened	Protected	Possible
Kotare/New Zealand kingfisher	<i>Todiramphus sanctus vagans</i>	Not Threatened	Protected	Possible
Kuruwhengi/Australasian shoveler	<i>Spatula rhynchotis</i>	Not Threatened	Protected but can be hunted	Seen during visit
Matuku moana/white-faced heron	<i>Egretta novaehollandiae</i>	Not Threatened	Protected	Seen during visit
Ngirungiru/South Island tomtit	<i>Petroica macrocephala macrocephala</i>	Not Threatened	Protected	Highly unlikely
Pāpango/New Zealand scaup	<i>Aythya novaeseelandiae</i>	Not Threatened	Protected	Seen during visit
Pied stilt - black stilt hybrid	<i>Himantopus himantopus</i> × <i>novaezealandiae</i>	Not Threatened	Protected	Highly likely
Pīpīwharau/roa/shining cuckoo	<i>Chrysococcyx lucidus lucidus</i>	Not Threatened	Protected	Possible
Pīwakawaka/South Island fantail	<i>Rhipidura fuliginosa fuliginosa</i>	Not Threatened	Protected	Likely
Poaka/pied stilt	<i>Himantopus himantopus leucocephalus</i>	Not Threatened	Protected	Seen during visit
Pūkeko/pukeko	<i>Porphyrio melanotus melanotus</i>	Not Threatened	Protected but can be hunted	Unlikely
Pūtangitangi/paradise shelduck	<i>Tadorna variegata</i>	Not Threatened	Protected but can be hunted	Seen during visit
Riroriro/grey warbler	<i>Gerygone igata</i>	Not Threatened	Protected	Seen during visit
Spur-winged plover	<i>Vanellus miles novaehollandiae</i>	Not Threatened	Protected	Seen during visit
Tauhou/silvereye	<i>Zosterops lateralis lateralis</i>	Not Threatened	Partially protected	Seen during visit
Tētē-moroiti/grey teal	<i>Anas gracilis</i>	Not Threatened	Protected but can be hunted	Seen during visit

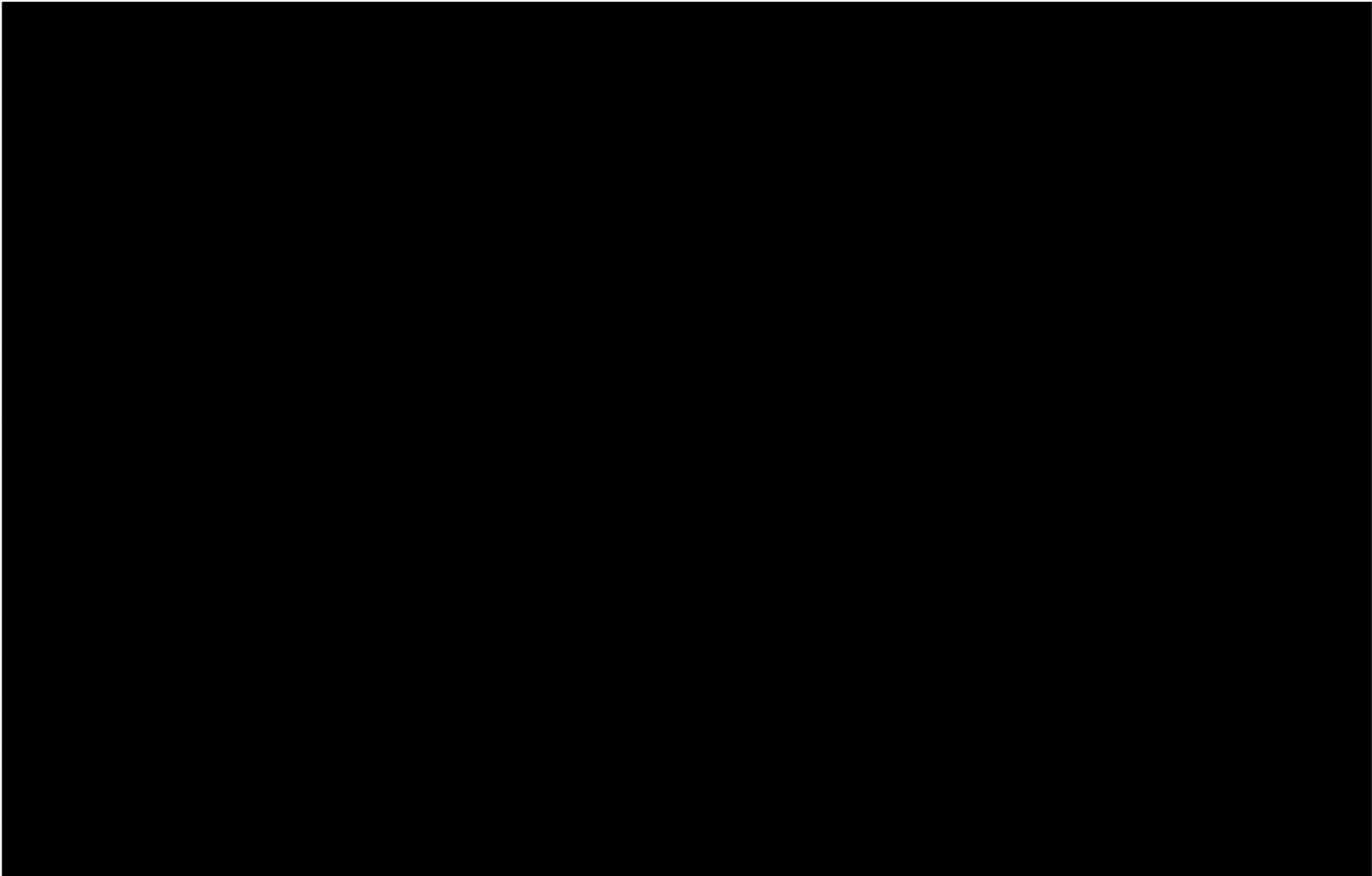


Common Name(s)	Scientific Name	Threat Classification 2021	Protection Status	Likelihood of Presence at Site
Tūi/Tui	<i>Prosthemadera novaeseelandiae novaeseelandiae</i>	Not Threatened	Protected	Highly unlikely
Warou/welcome swallow	<i>Hirundo neoxena neoxena</i>	Not Threatened	Protected	Seen during visit
White-winged black tern	<i>Chlidonias leucopterus</i>	Non-resident Native – Migrant	Protected	Highly unlikely
<b>Exotic Species</b>				
Anas sp.	<i>Anas sp.</i>	-		Seen during visit
Australian magpie	<i>Gymnorhina tibicen</i>	Introduced and Naturalised	Not protected	Seen during visit
California quail	<i>Callipepla californica</i>	Introduced and Naturalised	Not protected	Likely
Canada goose	<i>Branta canadensis</i>	Introduced and Naturalised	Not protected	Seen during visit
Chaffinch	<i>Fringilla coelebs</i>	Introduced and Naturalised	Not protected	Seen during visit
Common redpoll	<i>Acanthis flammea</i>	Introduced and Naturalised	Not protected	Seen during visit
Common starling	<i>Sturnus vulgaris</i>	Introduced and Naturalised	Not protected	Seen during visit
Dunnock	<i>Prunella modularis</i>	Introduced and Naturalised	Not protected	Seen during visit
Eurasian blackbird	<i>Turdus merula</i>	Introduced and Naturalised	Not protected	Seen during visit
Eurasian skylark	<i>Alauda arvensis</i>	Introduced and Naturalised	Not protected	Seen during visit
European greenfinch	<i>Chloris chloris</i>	Introduced and Naturalised	Not protected	Seen during visit
European goldfinch	<i>Carduelis carduelis britannica</i>	Introduced and Naturalised	Not protected	Seen during visit
House sparrow	<i>Passer domesticus</i>	Introduced and Naturalised	Not protected	Seen during visit
Little owl	<i>Athene noctua</i>	Introduced and Naturalised	Partially protected	Possible
Mallard	<i>Anas platyrhynchos</i>	Introduced and Naturalised	Protected but can be hunted	Seen during visit
Muscovy duck	<i>Cairina moschata</i>	Introduced, Not Established	Not protected	Unlikely
Passerine sp.	<i>Passeriformes sp.</i>	Introduced and Naturalised		Seen during visit
Rock pigeon	<i>Columba livia</i>	Introduced and Naturalised	Not protected	Seen during visit
Song thrush	<i>Turdus philomelos</i>	Introduced and Naturalised	Not protected	Seen during visit
Yellowhammer	<i>Emberiza citrinella</i>	Introduced and Naturalised	Not protected	Seen during visit



**Table 4:** Lizard records from a Department of Conservation BioWeb Herpetofauna Database search within a 20-kilometre radius of the site and an assessment of the likelihood of the presence of these species at the site. Conservation status is from Hitchmough *et al.* (2026). The likelihood of occurrence for each species is based on their known habitat preferences and distribution in the wider area.

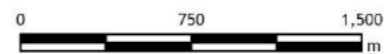
Species	Common Name	Conservation Status	Nearest Record (km)	Preferred Habitats	Likelihood of Occurrence
<i>Oligosoma maccanni</i>	McCann's skink	Not Threatened	< 0.1	Open habitats – dry rocky environments such as rock outcrops, and montane grassland.	<b>Presence confirmed</b> (through site survey).
<i>Oligosoma chionochloescens</i>	Southern grass skink	At Risk – Declining	< 0.1	Prefers damp or well vegetated habitats such as rank grasslands, wetlands, stream/river edges, and gullies.	<b>Presence confirmed</b> (through site survey).
<i>Oligosoma aff. chloronoton</i> "West Otago"	Lakes skink	Threatened – Nationally Vulnerable	10.1	Rocky scrubland, river terraces, scree, talus, boulderfield and braid plains.	<b>Unlikely</b> (increasingly rare therefore unlikely to be present at this site – some habitat present on site but not detected during multiple surveys).
<i>Oligosoma laxa</i>	Scree skink	Threatened – Nationally Vulnerable	4	Crevice rock outcrops, river terraces, scree, talus, boulderfield and braid plains.	<b>Highly unlikely</b> (increasingly rare therefore unlikely to be present at this site – some habitat present on site but not detected during multiple surveys).
<i>Woodworthia</i> "Southern Alps"	Southern Alps gecko	At Risk – Declining	0.5	Scrub, forest, crevice rock outcrops, rocky shrubland, boulder beaches, river terraces, scree, talus, boulderfield and braid plains.	<b>Presence confirmed</b> (through site survey).
<i>Naultinus gemmeus</i>	Jewelled gecko	At Risk – Declining	5	Scrub, forest, shrubland and tussockland.	<b>Unlikely</b> (some suitable dense scrub habitat present on site, but the habitat has been regenerating since 1980s with no natural contiguous forest associations).



**Data Acknowledgment**  
Contains data sourced from the LINZ Data Service  
licensed for reuse under CC BY 4.0  
Eagle Technology, Land Information New Zealand, GEDCO, Community maps contributors

Report: 7414  
Ref: 11940  
Client: Nova Energy  
Name: Figure8\_Avifauna\_AEE.aprx  
Path: \\v\gis\gis2\gis\Twizel\_SolarFarm\_DN\mod\2025\

Figure 8. Avifauna and important habitats for avifauna in the vicinity of the site



**Wildlands** © 2026  
www.wildlands.co.nz 0508 WILDNZ

Scale: 1:30,000  
Date: 12/03/2026  
Cartographer: LW  
Format: A3R



## 7.2 Field survey results

Figure 9 and Table 5 show the combined lizard survey results from Survey 1 and Survey 2.

**Table 5 – Summary of lizard survey effort and weather conditions at the site. ‘ph’ refers to ‘person hours’.**

Date	Weather	Activity and Effort	Species Detected
12 December 2022	Sunny, warm (no temperatures recorded)	Opportunistic observations	3 unidentified skinks
16 December 2022	Sunny, warm (no temperatures recorded)	74 ACOs installed	6 McCann’s skinks 4 Southern Alps geckos 4 unidentified skinks
28 February 2023	High cloud, calm 18.2°C, 68.5% RH-24°C, 44.7% RH	74 ACOs checked 4 ph visual and manual searches	15 McCann’s skinks 4 southern grass skinks 1 Southern Alps gecko 5 unidentified skinks
1 March 2023	Overcast/low cloud clearing 15.2°C, 76.9% RH – 24.9°C, 46% RH	74 ACOs checked 3 ph visual and manual searches	13 McCann’s skink (1 recapture) 2 Southern Alps geckos 1 unidentified skink
2 March 2023	Sunny, slight breeze 18.2°C, 70.7% RH – 28.8°C, 34.9% RH	74 ACOs checked 3 ph visual and manual searches	13 McCann’s skinks (3 recaptures)
3 March 2023	Sunny, turning cloud, slight breeze, SW front approaching 12.1°C, 65.9% RH – 21°C, 54% RH	74 ACOs checked and removed	8 McCann’s skinks (1 recapture)
3-4 October 2023	Sunny, warm (no temperatures recorded)	120 ACOs installed	None
18 December 2023	Sunny, hot, light breeze 24.8-24.5°C, 36.3-38% RH	25 Gee’s minnow traps installed 0.5 ph visual and manual searches	None
19 December 2023	Sunny, hot, calm 22.9-28.1°C, 48.1-24.3% RH	25 Gee’s minnow traps checked and an additional 25 Gee’s minnow traps installed 120 ACOs checked 0.5 ph visual and manual searches	30 McCann’s skinks 2 Southern Alps geckos
20 December 2023	Sunny, hot, calm 27.2-30.7°C, 30.5-34% RH	50 Gee’s minnow traps checked 120 ACOs checked 0.5 ph visual and manual searches	45 McCann’s skinks (1 recapture) 1 Southern Alps gecko



Date	Weather	Activity and Effort	Species Detected
21 December 2023	Sunny, hot, calm 26.3-26.8°C, 37.5-36.2% RH	50 Gee's minnow traps checked 120 ACOs checked, 0.5 ph visual and manual searches	36 McCann's skinks (4 recaptures) 10 Southern Alps geckos 1 mouse (dead)
22 December 2023	Overcast turning sunny in afternoon, warm-hot, light breeze 15.1-28.1°C, 64-33.1% RH	50 Gee's minnow traps checked 120 ACOs checked 0.5 ph visual and manual searches	33 McCann's skinks (6 recaptures) 3 Southern Alps geckos (1 recapture)
23 December 2023	Sunny with intermittent cloudy periods, warm-hot, light breeze 19-24°C, 53.8-48.2% RH	50 Gee's minnow traps checked and removed 120 ACOs checked and removed 0.5 ph visual and manual searches	35 McCann's skinks (6 recaptures) 3 Southern Alps geckos
<b>Total</b>	<b>Temperature range 12.1 – 30.7°C</b>	<b>225 Gee's minnow trap nights</b> <b>896 ACO checks</b> <b>13 ph manual searches</b>	<b>229 McCann's skinks</b> <b>4 southern grass skinks</b> <b>13 unidentified skinks</b> <b>26 Southern Alps geckos</b> <b>1 mouse (dead)</b>

### Survey 1

Total survey effort for Survey 1 included 296 ACO checks and ten person hours of visual and manual searches. Lizards detected during Survey 1 included:

- 7 Southern Alps geckos.
- 50 McCann's skinks (including 5 recaptures).
- 4 southern grass skinks.
- 13 unidentified skinks.

Unidentified skinks were seen either basking or under ACOs but were too quick to catch due to the hot conditions. It is highly likely these were McCann's skinks, based on their size and the abundance of this species on site.

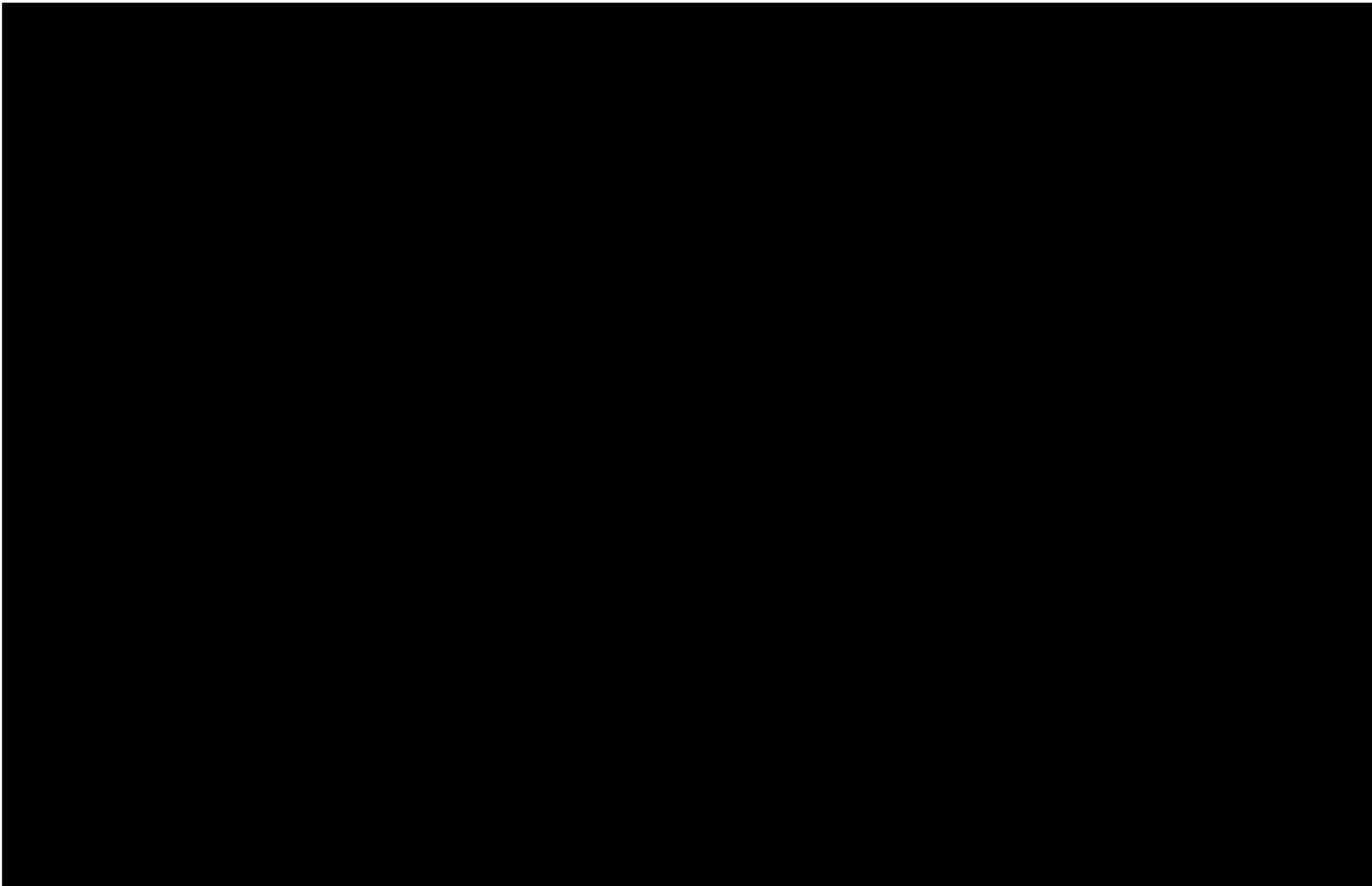
### Survey 2

Total survey effort for Survey 2 included 600 ACO checks, 225 funnel trap nights, and three person hours of visual and manual searches. Lizards detected during Survey 2 included:

- 19 Southern Alps geckos (including 1 recapture).
- 179 McCann's skinks (including 17 recaptures).

No other lizard species were detected on site during the surveys.

Indigenous lizard species present within the site are part of wider populations associated with remnant habitats throughout the Mackenzie basin. Indigenous lizard populations in the Mackenzie District are in decline due to intensive farming practices and pressure from habitat loss, climate change, and predation. Therefore, following the second survey, where high quality habitats were targeted for additional lizard species and substantial survey effort was undertaken, no additional lizard species are considered likely to be present on site.

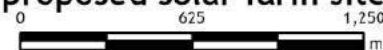


**Data Acknowledgment**  
Contains data sourced from the LINZ Data Service  
Licensed for reuse under CC BY 4.0

---

Report: 6996  
Ref: 11028-2013  
Client: Nova Energy  
Name: Figure\_Lizards\_Survey\_Dec2024\_V2.aprx  
Path: \\v64ps1.gis2.gis\Twizel\_SolarFarm\_EN\mxd\2025\

**Figure 9. Combined results from the February-March and December 2023 lizard surveys at the proposed solar farm site, Twizel**



**Wildlands**  
www.wildlands.co.nz 0508 WILD12

---

Scale: 1:25,000  
Date: 17/02/2026  
Cartographer: LW  
Format: A3R



Lizard survey methods sometimes have poor detection rates because of typically low population densities, cryptic colouration of some species, difficulty in surveying preferred habitats and behaviour/activity patterns of lizards.

### 7.3 Lizard habitats

Lizards were captured in various vegetation and habitat types and are likely to be found within the following vegetation and habitat types (Figure 6):

- Flood channel shrubland.
- Sweet brier shrubland.
- Browntop-sweet vernal-clover grassland.
- Alluvial grassland.
- Scarp herbfield and grassland.
- [Wilding conifer]/scarp herbfield and grassland.
- Sweet vernal-mouse-ear hawkweed herbfield and grassland.
- Haresfoot trefoil herbfield.
- Old river terrace.
- Earthworks and quarrying.

Lizard habitat of varying quality is present on site. Lizard habitat quality is considered to largely be based on the complexity of the habitat, with more complex habitat providing more abundant refuges and food resources, which can support higher lizard densities and species diversity. Lizard habitat quality areas on site are included in Table 6.

**Table 6** – Size of lizard habitat quality areas on site.

Lizard Habitat Quality	Size of Area (hectares)
High	2.27
Moderate	21.63
Low	33.98
Very low	766.11
Not assessed	44.57
<b>Total area of site</b>	<b>868.54</b>

Both McCann's skinks and sign (scat) were detected under ACOs in areas with minimal ground cover along the central fence line, such as around small amounts of dense vegetation or small groupings of loose rocks, indicating that McCann's skink are likely present across the site in low densities in low-quality habitat. McCann's skink is considered to be the only species present along the central fence line and in other areas of low-quality habitat, due to the dry, exposed habitat, and shallow retreat site availability in these areas.

Note that areas of flood channel shrubland and alluvial grassland habitat in the central northern part of the site were not assessed during the lizard surveys, as these areas are not included within or in close proximity to the proposed development area. Based on a desktop assessment of these areas, lizards are considered likely to be present in these habitats in at least moderate densities where dense ground cover vegetation (e.g. rank grass) is present.



### i. High-quality lizard habitats

Areas of high-quality habitat, where the highest lizard species diversity and high densities of lizards are present, include:

- The area of talus rock piles and dense ground cover vegetation at the base of the scarp herbfield and grassland where it intersects with the area of old river terrace in the central southern part of the site.

### ii. Moderate-quality lizard habitats

Areas of moderate-quality habitat, where lizards are present or considered likely to be present in moderate densities, include:

- All other areas of scarp herbfield and grassland around the edges of the site.
- The area of rock piles at the western end of the central fence line.

### iii. Low-quality lizard habitats

Areas of low-quality habitat, where lizards are present in low densities, include:

- Sweet brier shrubland and discrete areas of browntop-sweet vernal-clover grassland and haresfoot trefoil-sweet vernal grassland where there is relatively denser ground cover vegetation that has not been recently cultivated (e.g., the strip of grass along the northern side of the central fence line).

### iv. Very low quality lizard habitats

Areas of very low-quality habitat, where lizards may be present in very low densities, include:

- Most of the central area of the site, where panels are proposed (comprising browntop-sweet vernal-clover grassland and haresfoot trefoil-sweet vernal grassland), has been largely cultivated and ground cover vegetation is sparse. Lizards are likely to be present in very low densities in marginal areas where there is sufficient rocky/vegetative ground cover<sup>1</sup>.

## 8.0 Terrestrial Invertebrates

### 8.1 Desktop assessment

The GBIF desktop survey revealed three notable invertebrate species recorded within a five-kilometre radius of the site (Table 7).

Tekapo ground wētā (*Hemiandrus fabella*; Threatened-Nationally Endangered (Trewick *et al.* 2022)) and New Zealand blue butterfly (*Zizina oxleyi*, Not Threatened but declining<sup>2</sup>) are other notable species that were identified on the site during the field survey (see Section 8.2).

<sup>1</sup> Surveys in similar habitats throughout the Mackenzie Basin have found McCann's skink are still present in sites that are perceived to be barren or lack significant cover or vegetation. Although no McCann's skinks were detected in the panel areas, it is highly likely that they will be persisting in very low densities in this marginal habitat.

<sup>2</sup> Patrick B. and Patrick H. 2012: Butterflies of the South Pacific. Otago University Press and Otago Museum.



**Table 7 – Invertebrate species of interest found in the desktop survey within a five-kilometre radius of the site.**

Species	Common Name	Threat Status	Habitat	Reason for Designation as a Species of Interest	Likelihood of Occurrence on Site
<i>Brachaspis robustus</i>	Robust grasshopper	Threatened-Nationally Endangered (Trewick <i>et al.</i> 2022)	Open rocky areas on braided riverbeds.	Protected under the Wildlife Act (1953). Threatened by introduced predators and habitat loss.	Unlikely –habitat not present.
<i>Sigaus minutus</i>	Minute grasshopper	Threatened-Nationally Vulnerable (Trewick <i>et al.</i> 2022)	Open rocky areas.	Threatened by introduced predators and habitat loss.	Possible – potential habitat present on site (confirmed on site during field surveys).
<i>Phaulacridium otagoense</i>	Otago short-horned grasshopper <sup>1</sup>	At Risk-Declining (Trewick <i>et al.</i> 2022)	Open rocky areas and herbfields	Threatened by genetic incursion by <i>P. marginale</i> .	Possible – potential habitat present on site (confirmed on site during field surveys).

## 8.2 Field survey

Results from all invertebrate surveys are summarised in Figure 10.

### General invertebrate field survey

The general invertebrate field survey was carried out during a range of weather conditions, from rainy and cool to sunny and hot. Warm, sunny weather was most common, when most invertebrates are likely to be active.

Table 8 lists invertebrate species found during the field survey. In general, habitat was either lacking or low-quality for indigenous invertebrates, although higher quality minute and short-horned grasshopper habitat was present in the old river terrace at the central-southern edge of the property. The invertebrate fauna was generally found to be lacking in overall diversity, though high in relative diversity of indigenous invertebrates, as expected for a highly modified site with high sun exposure and low rainfall.

**Table 8 – Invertebrate species found in the field survey of the proposed solar farm site in February-March 2023.**

Species	Common Name	Threat Status	Habitat	Species of Interest?
<i>Sigaus minutus</i>	Minute grasshopper	Threatened-Nationally Vulnerable (Trewick <i>et al.</i> 2022)	Open habitat with bare or rocky ground, with lichen and moss for food plants.	Yes – threatened species.
<i>Orocrambus vitellus</i>	Grass moth	Not assessed (Hoare <i>et al.</i> 2015)	Indigenous and exotic grassland.	No.
<i>Orocrambus</i> sp.	Grass moth	Not assessed (Hoare <i>et al.</i> 2015)	Indigenous and exotic grassland.	No.

<sup>1</sup> Common names do not exist for many invertebrates, including *Phaulacridium otagoense*. A non-standard common name is provided here for consistency and ease of reference.

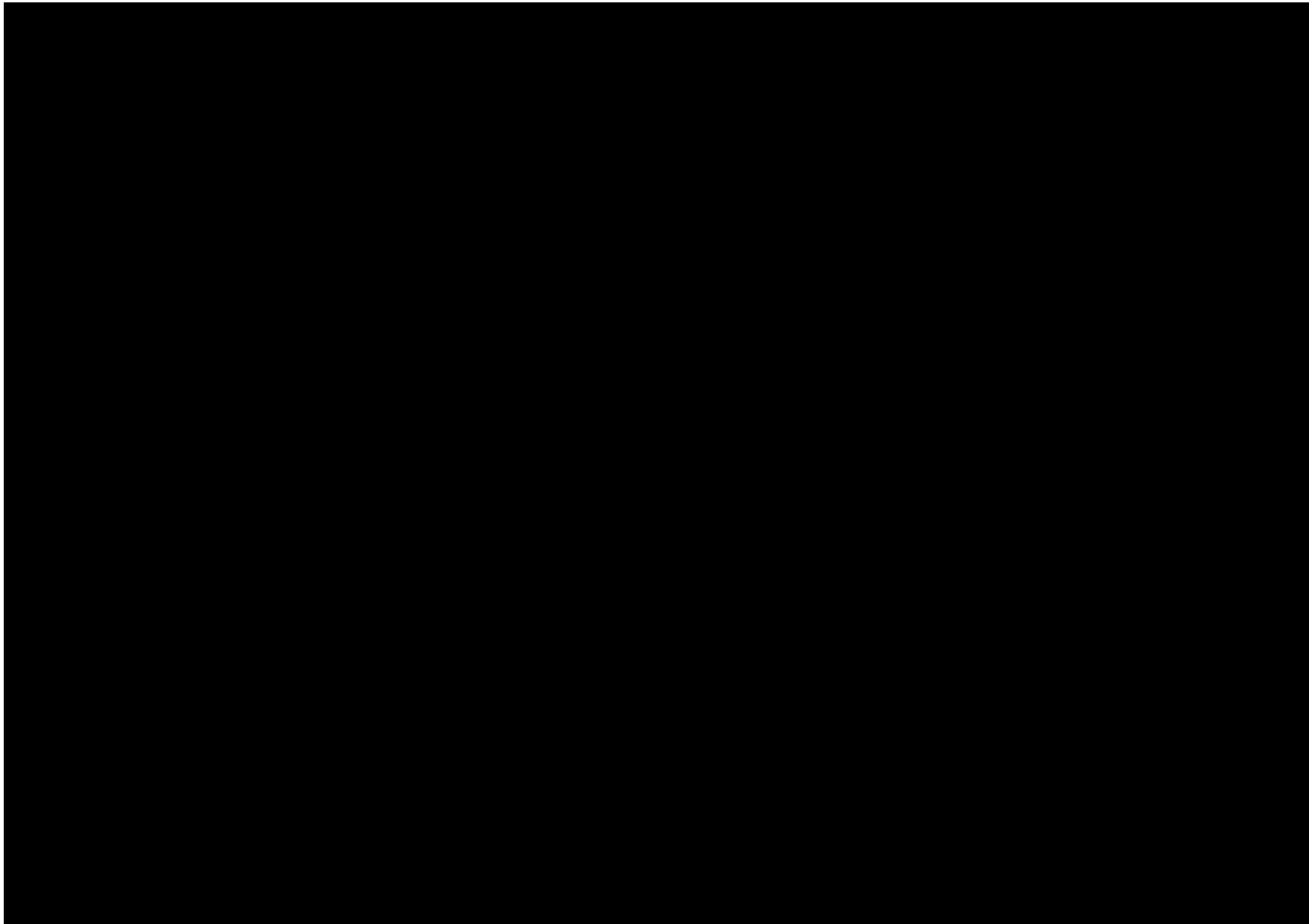


Species	Common Name	Threat Status	Habitat	Species of Interest?
<i>Bombus</i> spp.	Bumblebee	Introduced and naturalised (Ward <i>et al.</i> 2017)	Meadow with exotic flowers.	No.
<i>Pieris rapae</i>	Cabbage white butterfly	Introduced pest	Open fields with brassica plants for larval food.	No.
Formicidae	Ant	Not assessed (Ward <i>et al.</i> 2017)	Nests found in loose sandy soil.	No.
<i>Eudonia catexesta</i>	Stone moth	Not assessed (Hoare <i>et al.</i> 2015)	Larvae associated with mosses; adults have been seen feeding on the indigenous daisy <i>Helichrysum intermedium</i> .	No.
<i>Anoteropsis urquharti</i>	Wolf spider	Not threatened (Sirvid <i>et al.</i> 2021)	Mountain scree and stony ground.	No.
<i>Socca pustulosa</i>	Orb weaver spider	Not threatened (Sirvid <i>et al.</i> 2021)	Ubiquitous throughout New Zealand.	No.
<i>Phaulacridium marginale</i>	Short-horned grasshopper	Not threatened (Trewick <i>et al.</i> 2022)	Open lowland habitat.	No.
<i>Phaulacridium otagoense</i>	Otago shot-horned grasshopper	At Risk – Declining (Trewick <i>et al.</i> 2022)	Open, very dry habitat with sparse plant cover.	Yes – At Risk.
<i>Zizina oxleyi</i>	New Zealand blue butterfly	Not threatened (Hoare <i>et al.</i> 2015)	Open, sunny areas with nearby shelter, leguminous plants for larval food, and flowers for adult food.	Yes – thought by experts to be declining. Has disappeared throughout much of its historical range.
<i>Vespula</i> sp.	Wasp	Introduced pest	Any habitat associated with humans.	No.
Diptera (families Tachinidae, Acalyptatae, Calliphoridae, Syrphidae, Muscidae)	Flies	Not Assessed, Not Threatened, or introduced (Andrew <i>et al.</i> 2012)	Ubiquitous	No.
<i>Philaenus spumarius</i>	Meadow spittlebug	Introduced pest	Grasslands	No.
<i>Boldenaria boldenarum</i>	Boulder copper	Not assessed (Hoare <i>et al.</i> 2015)	Pohuehue and open, stony areas.	No.
<i>Hemiandrus fabella</i>	Tekapo ground wētā	Threatened – Nationally Endangered (Trewick <i>et al.</i> 2022)	Braided river terraces.	Yes – Threatened.

Despite the lateness of the season (March 2023), three minute-grasshopper individuals (one mating pair plus one female) were observed in one location on site (Plate 7; Figure 10). Habitat patches for minute grasshopper and short-horned grasshopper were observed throughout the site.

New Zealand blue butterfly was found on site, along with suitable habitat.

Robust grasshopper habitat was not found at the site.





**Plate 7** – Female minute grasshopper basking on a small patch of bare ground.

#### **Targeted grasshopper and wētā survey**

Weather conditions throughout the targeted surveys were generally close to optimal for grasshopper detection. Only five out of six grasshopper transect runs were completed due to weather constraints, which was considered adequate, as the purpose was to detect presence of grasshoppers throughout the site rather than to monitor numbers.

Tekapo ground wētā were detected in two out of the three sets of pitfall traps (within the concept panel area, near the western edge; Plate 10). Two individuals were caught. The hardness of the ground prevented more than 15 live-capture pitfall traps from being set. Running the traps for 2-3 nights increased the sample size, and succeeded in detecting Tekapo ground wētā presence on site, but does not provide much information concerning their distribution.

Minute grasshoppers were found on the old river terrace at the central-southern edge of the property (outside the concept panel area), in approximately the same location as they were found previously (Figure 10). They were not found elsewhere despite available habitat. The area of river terrace in the southern-central part of the site, where minute grasshoppers were found, is the best quality grasshopper habitat on site, with the highest abundance and diversity of grasshoppers present.

The western third of the property has patches of grasshopper habitat that are highly degraded with exotic grass, but Otago short-horned grasshopper was frequently detected there and on the same terrace on the southern edge as the minute grasshoppers (Figure 10). Within these areas, Otago short-horned grasshopper appears to be relatively abundant.

Some areas of the property have been ploughed and are therefore not suitable habitat. In the central portion of the property, particularly south of the road, there are patches of potential habitat for grasshoppers. Neither Otago short-horned nor minute grasshoppers were found in this part of the property despite numerous transects and searching between transects. This may be due to farming practises such as ploughing or spraying, or the presence of a predator or competitor such as tiger



beetles, which were seen on site. There may be other factors involved, as the habitat requirements of these species are not fully understood.

The western end of the site where Otago short-horned grasshoppers and Tekapo ground wētā were found appears to be of high value for grasshoppers and wētā. Minute and Otago short-horned grasshopper are unlikely to be present in the central or eastern terrace portions of the site, though their possible presence in undetectable numbers cannot be ruled out in suitable habitat.

At the very eastern tip of the site is a field planted with barley. Due to the shading effect from the barley, there is no habitat in the field that would support the grasshopper species of interest.

Tekapo ground wētā were detected in two out of the three sets of pitfall traps (within the concept panel area, near the western edge; Plate 8). Two individuals were caught. The hardness of the ground prevented more than 15 live-capture pitfall traps from being set. Running the traps for 2-3 nights increased the sample size, and succeeded in detecting Tekapo ground wētā presence on site, but did not provide much information concerning their distribution.

### **Tekapo ground wētā tracking tunnel survey**

Out of 60 tracking cards, 33 showed signs of animal activity. Four tracking cards showed large wētā tracks likely to be Tekapo ground wētā. These were located within the western third of the site, and at the eastern tip. Potential wētā tracks were also found in the western half and eastern tip, though it was difficult to tell whether they were Tekapo ground wētā.



**Plate 8** – Tekapo ground wētā caught in a live-capture pitfall trap on site.

### **Unmanned aerial vehicle survey**

This project represents the first-time aerial photography has been used to identify potential minute and Otago short-horned grasshopper habitat. Large, open patches that are likely to be suitable habitat for minute and Otago short-horned grasshopper were obvious in the photographs. However, results should be interpreted with the understanding that some habitat aspects that may affect minute and



Otago short-horned grasshopper distribution may not be apparent in the photographs. Aerial imagery is not expected to detect all aspects relative to ecology, especially for invertebrates.

Out of 107 hectares mapped by UAV, 48 hectares were identified as potential minute or Otago short-horned grasshopper habitat, characterised by short-stature vegetation mixed with bare ground and/or stones (Figure 11). Habitat was mostly found in large patches south and east of the central fence line, with small patches of low-quality habitat north of the fence line and to the west. A large part of the property north of the fence line appears to have been cultivated, and some areas are wetlands, both of which are unlikely to provide habitat for minute and Otago short-horned grasshopper.

The UAV and walkthrough surveys combined have given detailed mapping of potential minute and Otago short-horned grasshopper habitat distribution. The areas of habitat shown in Figure 11 include patches identified during the walkthrough and UAV surveys, but the extent to which habitat patches spread outside the UAV polygons is unknown.

The detailed and comprehensive distribution of each notable invertebrate species and habitat cannot be fully known due to the size of the site and incomplete knowledge of some of the habitat requirements for these species. Therefore, a conservative approach is taken for the purposes of this assessment which assumes the distribution of Tekapo ground wētā and Otago short-horned grasshopper is wider than observed, and that minute grasshopper may be found in other areas of habitat not surveyed throughout the site.

## 9.0 Freshwater Fauna

### 9.1 Desktop assessment

Within the waterways immediately adjacent to the proposed solar farm site, including the Twizel and Ōhau Rivers, there are 117 records of the presence of 11 fish species (Table 9).

**Table 9** – New Zealand Freshwater Fish Database records from waterways immediately adjacent to the proposed solar farm development. Threat status as listed in Dunn *et al.* 2025.

Scientific Name	Common Name	Number of NZFFD Records	Threat Status
<i>Anguilla dieffenbachii</i>	Longfin eel	5	At Risk - Declining
<i>Galaxias brevipinnis</i>	Koaro	20	At Risk - Declining
<i>Galaxias cobitinis</i>	Lowland longjaw galaxias	13	Threatened - Nationally Vulnerable
<i>Galaxias macronasus</i>	Bignose galaxias	17	Threatened - Nationally Vulnerable
<i>Galaxias paucispondylus</i>	Alpine galaxias	1	At Risk - Naturally Uncommon
<i>Galaxias vulgaris</i>	Canterbury galaxias	21	At Risk – Naturally Uncommon
<i>Gobiomorphus breviceps</i>	Upland bully	59	At Risk – Naturally Uncommon
<i>Gobiomorphus cotidianus</i>	Common bully	10	Not Threatened
<i>Oncorhynchus mykiss</i>	Rainbow trout	20	Introduced and naturalised
<i>Oncorhynchus nerka</i>	Sockeye salmon	2	Introduced and naturalised
<i>Salmo trutta</i>	Brown trout	63	Introduced and Naturalised



Of these species, six are classified as At Risk or Threatened. Within the wider area the NZ Freshwater Fish Database records two additional species not found in the waterways immediately adjacent to the site. The additional species include a single record of kākahi/freshwater mussels (*Echyridella menziesii*; At Risk - Declining) in an upper tributary of Wairepo Creek, and a single record of chinook salmon (*Oncorhynchus tshawytscha*; Introduced and Naturalised) at the Ōhau A tailrace.

The nature of the Waitaki hydro system poses major challenges to many indigenous fish species. A large proportion of Aotearoa New Zealand's fish assemblage is migratory, requiring access to the sea to complete their lifecycle. Of the species identified in this area, only longfin eels are obligate migrants, to maintain populations of longfins within this system, there is a trap and transfer programme operation to shift juvenile elvers upstream, and migrant adults downstream. Two other indigenous species, kōaro, and common bullies, are typically considered as migratory species, but have been known to form successful landlocked populations. All other indigenous fishes present are non-migratory.

One of the most significant threats facing the non-migratory species is competition and predation pressure from introduced salmonid species. In this area, the abundance of salmonids is particularly high due to the number of salmon farms within the Upper Waitaki, increasing the predatory pressure of these species.

## 10.0 Terrestrial Introduced Fauna

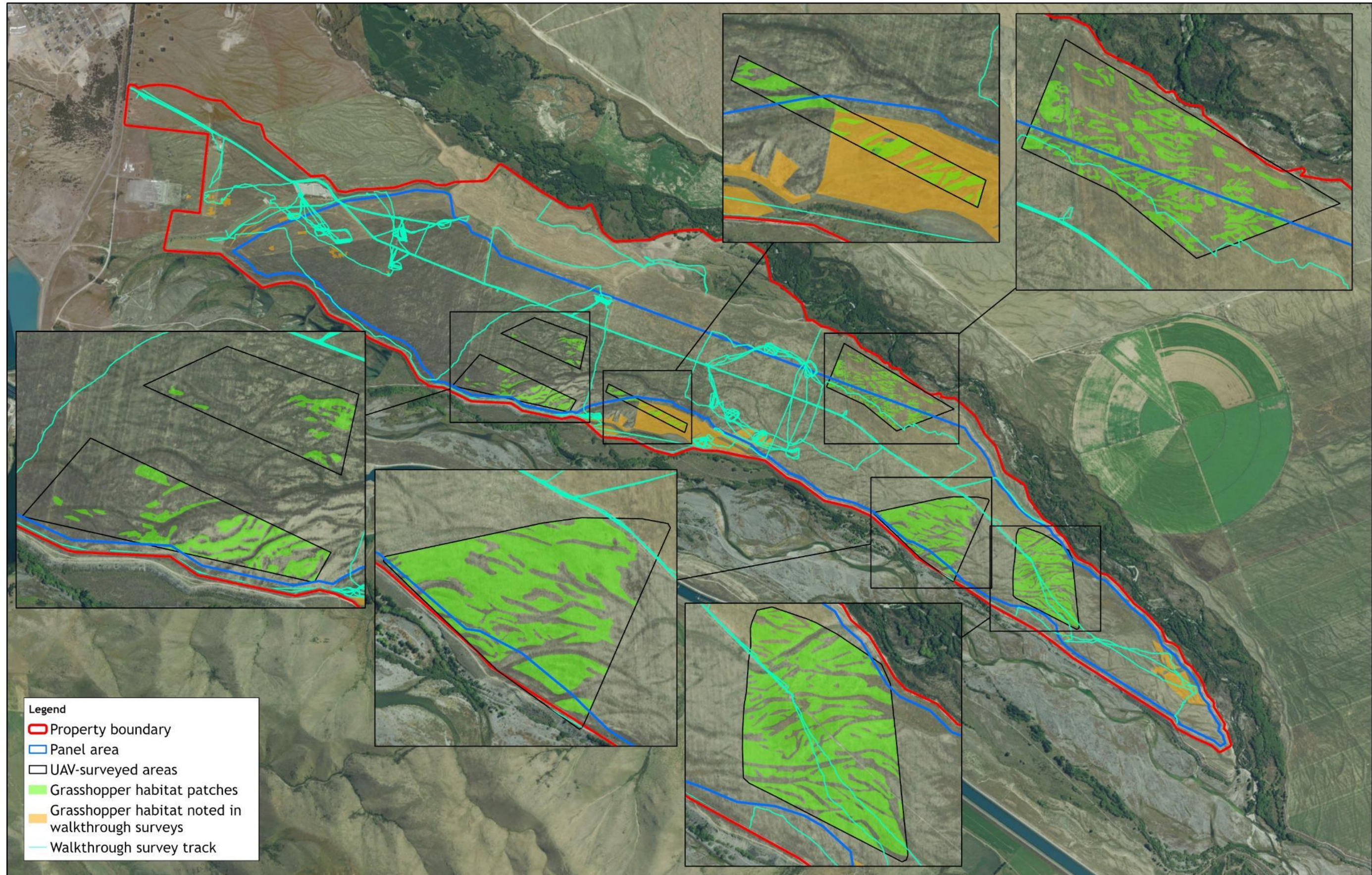
Targeted surveys for terrestrial introduced fauna were not undertaken as part of the site visit, however, lagomorph (European rabbit *Oryctolagus cuniculus cuniculus* and brown hare *Lepus europaeus occidentalis*) sign and browse was common throughout the site. Other introduced mammals are either confirmed or likely to be present permanently or periodically at the site, including feral cat (*Felis catus*), hedgehogs (*Erinaceus europaeus*), rodents (*Rattus rattus*) and mustelids (*Mustela* spp).

Mouse tracks were detected throughout the site in tracking tunnels set for Tekapo ground wētā (Section 8.2) and hedgehog tracks were found in the central third area of the site. A feral cat was spotted during tracking tunnel checks at the western end of the site.

## 11.0 Statutory Assessment

### 11.1 Ecological significance

Each vegetation and habitat type within the site was assessed against the ecological significance criteria in the Canterbury Regional Policy Statement (Appendix 2). All vegetation/habitat types except 'sweet brier shrubland' contained ecologically significant values, mostly because of habitat value for Threatened and At Risk indigenous fauna (Appendix 2). While exotic terrestrial vegetation types (such as browntop-sweet vernal-clover grassland) are modified with little to no indigenous plant species present and contain few indigenous values from a vegetation perspective, their structure nevertheless provides habitat values important for dryland fauna in lieu of suitable habitat comprising indigenous vegetation. This includes improved pasture vegetation types which provide habitat for minute grasshopper and McCann's skink, and Tōrea/South Island pied oystercatcher potentially breed in these habitats at the site. It is also possible that after rainfall events, kakī/black stilt could utilise pasture vegetation for foraging.



**Legend**

- ▬ Property boundary
- ▬ Panel area
- UAV-surveyed areas
- Grasshopper habitat patches
- Grasshopper habitat noted in walkthrough surveys
- ▬ Walkthrough survey track

**Data Acknowledgment**  
 Contains data sourced from the LINZ Data Service  
 licensed for reuse under CC BY 4.0

Report: 7414  
 Ref: 11940  
 Client: Nova Energy  
 Name: Figure 11\_Habitats\_AEE.aprx  
 Path: \\v64gis\gis2\gis\Twizel\_SolarFarm\_DN\mxd\2025\

Figure 11. Grasshopper habitat patches at the proposed solar farm site in Twizel



**Wildlands**  
 www.wildlands.co.nz, 0508 WILDNZ

Scale: 1:25,000  
 Date: 12/03/2026  
 Cartographer: LW  
 Format: A3R



Thirteen of the 15 vegetation/habitat types met the criteria for rarity and distinctiveness as Threatened or At Risk vascular plant or indigenous fauna species are present in these habitats. The ephemeral wetland habitat also meets the criteria for rarity. Ephemeral wetlands are rare ecosystem types, and all wetland habitats are ecologically significant due to widespread reduction and modification throughout Canterbury. Thus alder- and willow-dominant wetlands were also assessed as significant. Indigenous vegetation and habitats - including, flood channel shrubland, tall fescue marsh, scarp herbfield and grassland, [wildling conifer]/scarp herbfield and grassland, old river terrace and sweet vernal-mouse-ear hawkweed - met the significance criteria for ecological context, as they provide important habitat for indigenous fauna and/or connectivity across the site.

All indigenous vegetation types at the site have high ecological value, reflecting the limited extent of indigenous vegetation at the site and within the wider district, as well as the presence of areas with Threatened or At Risk plants among the vegetation. These vegetation types are therefore ecologically significant based on vegetation values alone.

## 11.2 Mackenzie District Plan

Most of the vegetation within the site (including the browntop-sweet vernal-clover grassland) meets the definition of improved pasture (Table 10, Figure 12) and does not meet the definition of indigenous vegetation (although the two are not mutually exclusive).

**Table 10 – Vegetation and habitat types evaluated against definitions for ‘improved pasture’ and natural wetland in the Mackenzie District Plan.**

Vegetation Habitat Type	Status	Improved Pasture	Natural Wetland
1. Flood channel shrubland	Indigenous	No	Yes
2. Sweet brier shrubland	Exotic	No	No
3. Browntop-sweet vernal-clover grassland	Exotic	Yes	No
4. Alluvial grassland	Exotic	Yes	No
5. Scarp herbfield and grassland	Indigenous	No	No
6. [Wildling conifer]/scarp herbfield and grassland	Indigenous	No	No
7. Sweet vernal-mouse-ear hawkweed herbfield and grassland	Indigenous	No	No
8. Haresfoot trefoil-sweet vernal grassland	Exotic	Yes	No
9. Old river terrace	Indigenous	No	No
10. Haresfoot trefoil herbfield	Exotic	No	No
12. Ephemeral wetland	Indigenous	No	Yes
13. Tall fescue-rautahi marsh	Indigenous	No	Yes
14. Alder forest	Exotic	No	Yes
15. Crack willow forest	Exotic	No	Yes

Seven vegetation habitat types present at the site met the definition of indigenous vegetation as defined in the Mackenzie District Plan (Table 10). These areas are mostly on the margins of the site, comprising uncultivated outwash plain, alluvial and scarp habitats (Figure 13).

Four natural wetlands are present on the site (Figure 13). All the identified wetland habitat types meet the ecological significance criteria.



The Mackenzie District Plan includes a chapter on renewable energy generation, which limits the relevance of other provisions specified in the Mackenzie District Plan when considering renewable energy generation activities.

The quarry area was not assessed against District Plan provisions, as this is a consented activity, operated by a third party.

## 12.0 Assessment of Potential Adverse Effects

### 12.1 Overview of potential effects

This section describes potential effects from the project **before** effects management has been applied. Effects management is outlined in Section 13.

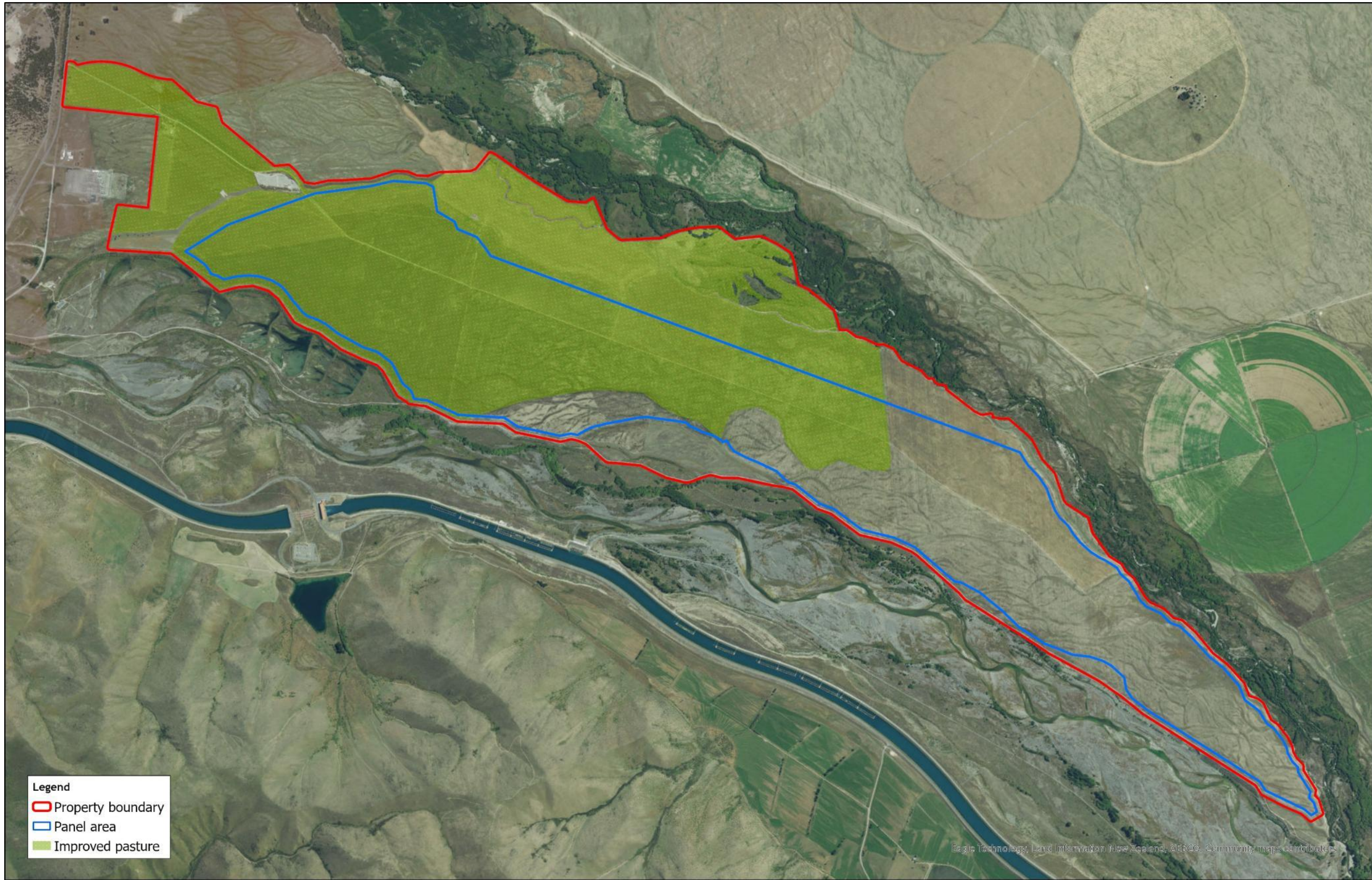
The project has been informed by ecological survey information provided by Wildlands and includes solar panels located in exotic grassland at the site. The design includes minimum setbacks from key ecological values. For example, a minimum setback of 35 metres will be applied to all indigenous vegetation and known locations of Threatened and At Risk plants that are subject to increased shading, while a 100-metre setback will be applied for wetland within and outside the site. A 20-metre setback will be applied to all property boundaries, so that the development will always be at least 20 metres away from the edge of the braided rivers, both of which are outside the property boundaries.

Aspects of the project which may impact ecological values include:

- Earthworks and construction.
- Shading from solar panels.
- Solar panels creating an obstacle and a reflective surface.
- Weed control.
- Introduction of new surfaces, such as gravel and concrete.
- Machinery, vehicle and human movement around the site.
- Auxiliary infrastructure such as buildings and roads.
- Pest mammal control.

The site is currently subject to grazing and localised quarrying. This land use will change with the construction of the solar farm. Ecological effects resulting from the change in land use and establishment of the solar farm are likely to include:

- Vegetation and flora:
  - Loss of indigenous vegetation
  - Loss of At Risk, Threatened, and rare plants
  - Microclimatic changes beneath solar panels, resulting in changes to vegetation.
  - Modifications to wetland habitat
  - Risk of introduction of pest plants
- Avifauna
  - Habitat modification or loss
  - Displacement of breeding fauna
  - Death or injury of avifauna during construction
  - Ongoing disturbance of avifauna
  - Risk of bird strike



**Legend**

- Property boundary
- Panel area
- Improved pasture

Esri, Technology, Land Information New Zealand, AEECO, Community maps contributors

**Data Acknowledgment**  
Contains data sourced from the LINZ Data Service licensed for reuse under CC BY 4.0

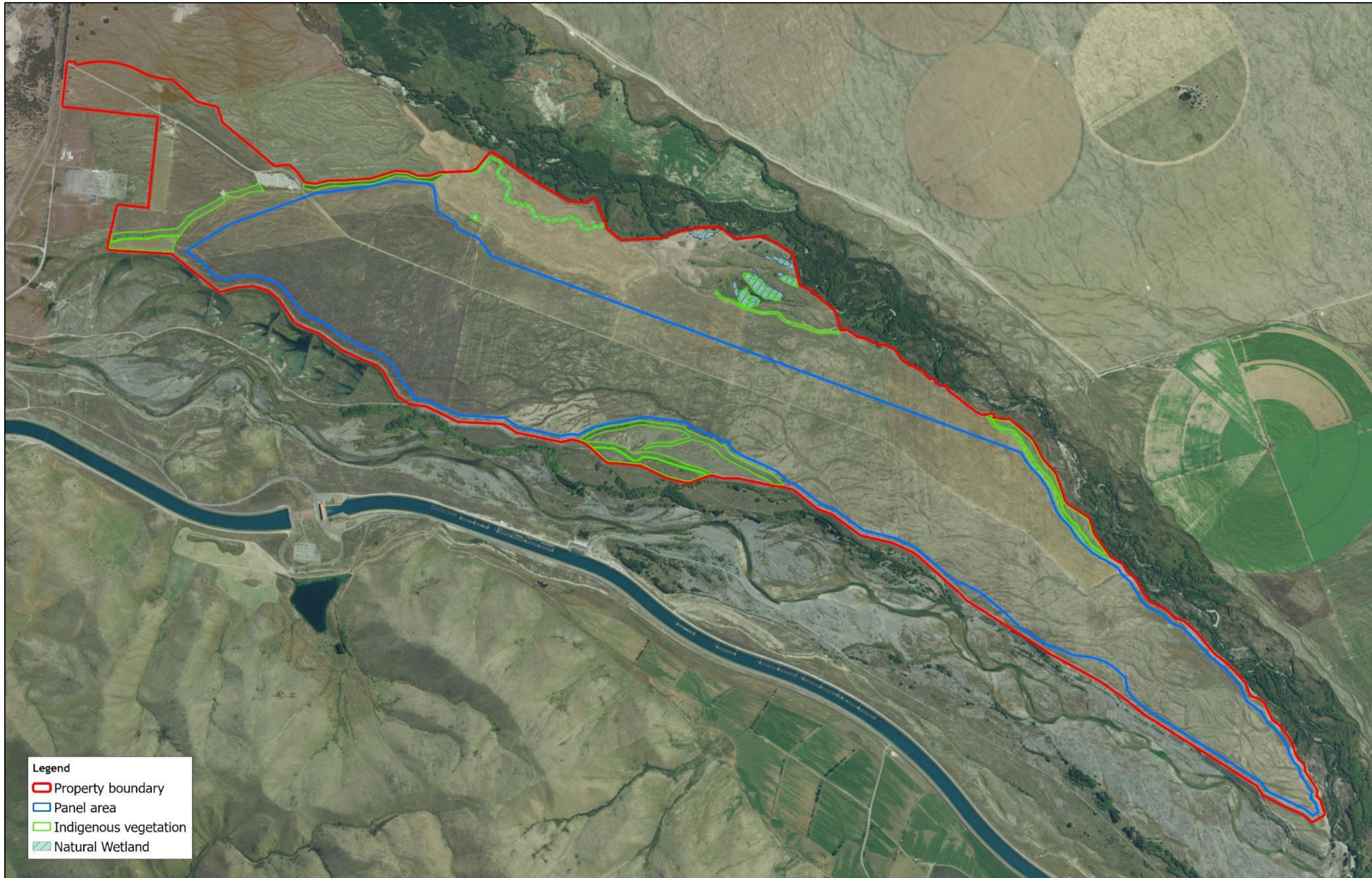
Report: 6620  
Ref: 10120  
Client:  
Name: Figure12\_Pasture\_AEE.aprx  
Path: \\w64gsgis2\gis\Twizel\_SolarFarm\_D\N\mxd\2025\

**Figure 12. The distribution of improved pasture at the site**



**Wildlands**  
www.wildlands.co.nz 0508 WILDNZ

Scale: 1:22,000  
Date: 17/02/2026  
Cartographer: LW  
Format: A3R



**Legend**

- Property boundary
- Panel area
- Indigenous vegetation
- Natural Wetland

**Data Acknowledgment**  
Contains data sourced from the LINZ Data Service licensed for reuse under CC BY 4.0  
Esri, DeLorme, Garmin, IGN, Intermap, iPC, NITD, NRCAN, Swisstopo, USGS, AeroGRID, IGN, Esri, Community maps contributors  
Report: 7414  
Ref: 11940  
Client: Nova Energy  
Name: Figure13\_Wetland\_AEE.aprx  
Path: \\v64gipg12\gis\Twizel\_SolarFarm\_DHM\mxd\2025\

**Figure 13. The distribution of indigenous vegetation and natural wetlands at the site**



**Wildlands** © 2026  
www.wildlands.co.nz 0508 WILDNZ  
Scale: 1:22,000  
Date: 17/02/2026  
Cartographer: LW  
Format: A3R



- Lizards
  - Injury/death/displacement of lizards
  - Loss of lizard habitat
  - Fragmentation of lizard habitat
  - Reduction of lizard habitat quality (shading from panels)
  - Operational disturbance to lizards
  - Disturbance to lizards during earthworks
  - Breeding failure/displacement of lizards
- Invertebrates
  - Reduction in invertebrate habitat
  - Mortality and disturbance to invertebrates
  - Reduction in invertebrate habitat quality due to shading
- Freshwater
  - Sedimentation of nearby rivers
  - Contamination of nearby rivers
- Ongoing weed management impacts on all biodiversity types

## 12.2 Vegetation and flora

### 12.2.1 Overview

The overall level of effect for the project on vegetation is considered to be **minor to more than minor** before effects management is applied.

### 12.2.2 Loss of indigenous vegetation

Most of the vegetation present within the site is exotic, with indigenous vegetation restricted to the margins of the site. Indigenous vegetation types present on the site have very high ecological values, due to the relatively small proportion of indigenous vegetation remaining in the wider area, and the presence of Threatened species. No indigenous vegetation or habitat is present within the panel area, however, indigenous vegetation could be lost through indirect effects including disturbance during construction, shading, or damaged by weed sprays. Depending on its scale and location, indigenous vegetation loss may have **more than minor** adverse effects on indigenous vegetation communities. This effect level is based on the presence of Threatened or At Risk plants combined with the magnitude of habitat loss, which would be a relatively small area in the context of the site, but a permanent effect.

### 12.2.3 Direct loss of At Risk, Threatened, and Rare plants

Seven Threatened or At Risk species were identified at the wider site during field surveys. These are largely located within indigenous vegetation/habitat types on the margins of the site and/or directly adjacent to the fence line. Threatened and At Risk species are also present outside the site. Without management (Section 13), this effect would be **minor**. Although no Threatened or At Risk species have been observed within the layout design, due to the size of the site it is possible that some species were not detected, although this is unlikely given that the panel area is located on modified and grazed vegetation.

### 12.2.4 Microclimate changes beneath solar panels, resulting in changes to vegetation

Changes in the microclimate beneath the tracking solar panels may affect the floristic composition of the site. The development area comprises exotic grassland, including species which typically



thrive in full sun. Species that thrive in shade, slightly lower temperatures, and increased soil moisture will likely colonise the spaces underneath the solar panels. These species are likely to be non-indigenous. Without management, this effect is likely to be **minor**.

#### 12.2.5 Modification of wetland habitat

No wetlands are within the panel area. Wetland habitats outside the panel area have the potential to be affected by potential earthworks (roading and construction) if not managed effectively, which could cause sediment to flow into these systems or impact the hydrology. All wetlands within the site are in the northwestern part of the site and outside of the proposed panel area, the Ruatahiwha wetland is located near the boundary of the site. Ephemeral wetlands are rain fed only and therefore the proposed activities are not expected to impact the hydrology of the wetland. Without management (Section 13), the impacts on wetlands are likely to be **less than minor**.

#### 12.2.6 Risk of introduction of pest plants

If proposed works require transport of roading aggregate, soil or fill for construction, there is the potential that these materials will be contaminated with seeds of pest plants and ecological weeds which are not already present at the site, particularly if roading materials are brought in from outside the area. Vehicles and machinery operating at the site also have the potential to transport seed of unwanted plants to the site. This, combined with clearance of existing vegetation, would accelerate the establishment of undesired species at the site, which could have **a more than minor adverse effect**, depending on the species introduced.

### 12.3 Avifauna

#### 12.3.1 Overview

The overall level of effect for the project on avifauna is considered to be **minor to more than minor** before effects management is applied.

#### 12.3.2 Habitat modification or loss

The development of the solar farm may affect various indigenous species including tōrea/South Island pied oystercatcher which may lose foraging (and potentially breeding) habitat within the open grassland areas. Tarapirohe/black-fronted tern will potentially lose foraging habitat for large insects, including grasshoppers and lizards, if the site becomes less suitable for these species. Similarly, although not observed during the site survey, pīhoihoi/New Zealand pipit (*Anthus novaeseelandiae novaeseelandiae*) and pohowera/banded dotterel (*Charadrius bicinctus bicinctus*) may also breed and forage within open grassland. Kakī/black stilt were also not observed during the site survey, but could potentially forage in grassland after rainfall, although higher-quality braided river and wetland habitat is available in the surrounding area. Without management (Section 13.2.1), this effect is likely to be **minor**. This effect level considers several factors including the threat status of kakī/black stilt, and the magnitude of habitat modification and loss, which would be a long-term or permanent effect over a relatively large portion of the site.

#### 12.3.3 Displacement of breeding avifauna during construction

Construction activities create disturbances such as noise, vibration, machinery operation, and increased human activity. This disturbance is likely to cause birds to change their behaviour by abandoning or temporarily avoiding the site (and surrounding area) during the breeding season. This leads to behavioural and physiological responses that are presumed to be costly, which can lead to changes in habitat use, parental care, and reproductive success and may have long-lasting effects on populations (Weston *et al.* 2012). Disturbance from construction activities may displace Threatened and At Risk species in the Ōhau river and impact the Department of Conservation



kakī/black stilt captive breeding centre and nearby wetlands. Without management (Sections 13.2.2 and 13.2.3), this effect is likely to be **more than minor**. This effect level considers several factors including the threat status of tōrea/South Island pied oystercatcher and pīhoihoi/New Zealand pipit, and the magnitude of disturbance, which would be a temporary effect over a relatively large portion of the site.

#### 12.3.4 Death or injury during construction

Construction activities are likely to disturb birds breeding within the construction site. Adults, chicks or eggs may be injured or killed by ground clearance and machinery. Threatened or At Risk bird species that may nest within the solar farm site are tōrea/South Island pied oystercatcher, pohowera/banded dotterel, and pīhoihoi/New Zealand pipit. Without management (Section 13.2.2), this effect is likely to be **more than minor**. This effect level considers several factors including the threat status of the species impacted. The duration of this effect is considered to differ depending on the species. The magnitude of injury or loss of an individual could be considered a long-term effect for species with small populations with low reproduction rates, that take longer to recover from losses. For species which reproduce more quickly, the death or injury of an individual could be considered short term.

#### 12.3.5 Ongoing disturbance

The main access road will be unsealed and will run through the centre of the solar farm with road networks. With most vehicle movements being central of the solar farm, this will reduce the risk of ongoing disturbance to birds in the Ōhau or Twizel riverbeds, as the majority of vehicle movements will be well away from the rivers. Vehicle movements and maintenance work have the potential to cause ongoing disturbance in areas where an activity is being undertaken close to a river or where birds use the site. However, this disturbance would be short term, as maintenance vehicles will travel directly to the works area and are unlikely to remain running in one area for very long. If birds are breeding on site, then human activity will lead to disturbance.

Vehicle movements through the solar farm can lead to disturbance, mortality, or bird strikes with vehicles, due to birds breeding within gravel areas and potentially using vehicle tracks as breeding sites. In California, vehicle strikes at a photovoltaic (PV) solar farm after construction had ended were recorded as causing 5.6% of bird fatalities (Kagan *et al.* 2014), but this study did not specifically focus on breeding birds. This effect is likely to be **more than minor** without management (Section 13.2.4). This effect level considers the threat status of species impacted and the magnitude of effect, which is over a moderately-sized portion of the site. As discussed above, the duration of effect differs among species because population-level responses to the injury or loss of an individual vary.

#### 12.3.6 Risk of bird strike

Solar panels pose a potential risk to avifauna from strikes that can cause mortality or injury, leading to delayed mortality from starvation or predation (Kagan *et al.* 2014). Avifauna interactions with solar panels have been the subject of worldwide research, but no studies have been conducted specifically in Aotearoa New Zealand. The results of international studies should not be directly extrapolated to an Aotearoa New Zealand context due to differences in factors such as habitat types and avifauna migratory behaviour, as well as the limited detail provided about the management measures implemented. However, international studies can provide some context on avifauna interactions with PV solar farms, including fatality rates and causes of mortality, that can be used to inform management strategies.

Although identifying the causes of bird mortality at solar farms is often difficult, trauma from striking solar panels was identified as the main cause of mortality in California (Kagan *et al.* 2014). Fatality rates from PV solar farms were 2.49 across 10 sites in California and Nevada, 4.5 at a site in South



Africa (Visser *et al.* 2019), and 10.7 birds per megawatt per year (birds/MW/year) at a site in California (Walston *et al.* 2016).

Bird strike at solar farms can affect many taxa. Passerines, pigeons, and doves are often found among fatalities, including through collisions with solar panels and other on-site infrastructure (Kagan *et al.* 2014; Kosciuch *et al.* 2020; Conkling *et al.* 2023). In California, several studies found waterbirds, including coot and grebe species, are frequently among the fatalities at PV solar farms, including in those involved in collisions with solar panels (Kagan *et al.* 2014; Conkling *et al.* 2023). Reflected light from closely arranged solar panels can potentially attract birds by resembling water. This is known as the lake-effect hypothesis (Kagan *et al.* 2014, Walston *et al.* 2016, Kosciuch *et al.* 2020). Additionally, the presence of ponds adjacent to solar farms may attract waterbirds (Kagan *et al.* 2014). These factors are important to consider when understanding bird behaviour at solar farms. However, several studies in South Africa and the United States have found no evidence that birds are attracted to PV solar farms due to light pollution, including the lake-effect (DeVault *et al.* 2014, Visser 2016).

Birds recorded as fatalities at solar farms internationally include species that are close relatives of some indigenous Threatened or At Risk New Zealand species that are known or likely to occur at the proposed solar farm site. Among 2,642 known bird fatalities at California solar farms were Anatidae (ducks/geese/swans; 86 fatalities), Rallidae (crakes/coots/gallinules; 85 fatalities), Falconidae (falcons/caracaras; 45 fatalities), and Motacillidae (small passerine species including pipits; 35) (Conkling *et al.* 2023). Birds belonging to these families are close relatives of pāpera/grey duck, kotoreke/marsh crake and pūweto/spotless crake, kārearea/eastern falcon, and pihoihoi/New Zealand pipit.

While this suggests that bird strike may be a notable cause of bird mortality at solar farms, including bird species similar to those found in Aotearoa New Zealand, solar farms in California and Nevada are largely located in arid desert and grassland (Conkling *et al.* 2023, Kosciuch *et al.* 2020), while South African studies come from savanna grassland (Visser *et al.* 2019). These are different habitats from the semi-arid grassland that dominates the proposed solar farm site. Many species in the USA, including the waterbirds reported as fatalities by Kagan *et al.* (2014), are migratory, and over half of the mortality found in one study of California solar farms occurred during the autumn migration period (Conkling *et al.* 2023). Some waterbird species may use stopover or overwintering habitat near California solar farms, as suggested by Kosciuch *et al.* (2020), who found an increase in water-obligate numbers during autumn.

Most international studies of PV solar farms do not specifically address the effects of management measures used to minimise bird strike and bird fatalities, including whether fixed-tilt or tracking panel systems were installed or whether anti-reflective coatings were used on panels (Kosciuch *et al.* 2025). This lack of information makes it challenging to determine how applicable these studies are to the proposed solar farm design. However, some studies note the need to improve panel design by adding visual cues or altering panel orientation and spacing (Kagan *et al.* 2014, Visser *et al.* 2019). This suggests that these measures were likely not in place at the time of the research. Using tracking arrays and anti-reflective panel coatings were typically not used in the United States until 2014/2015, further indicating that many studies were conducted at solar farms that did not use these measures. As such, the solar farms examined in these studies are expected to pose a greater risk of bird strike than would be the case if effects management measures were in place. Where data has been compared between fixed-tilt and tracking systems, a lower proportion of aquatic bird fatalities were observed at facilities with tracking arrays than fixed-tilt arrays (Kosciuch *et al.* 2025). This suggests that fatality rates reported in many studies are not directly applicable to



newer solar farms, because they likely had higher fatality rates than solar farms that are implementing these technological advances will have.

Solar panels are typically located near the ground, and it has been suggested that low-flying birds may be particularly affected by bird strike (Smallie 2022). Many of the Threatened and At Risk bird species that are found near the solar farm, including matuku-hūrepo/Australasian bittern and kakī/black stilt, are generally expected to fly sufficiently high when moving between habitat patches that they minimise the likelihood of striking a solar array. Birds are at greater risk of colliding with solar panels when attempting to land within the site, not when using the area as a flyway. Because grassland is not the primary habitat type of many Threatened and At Risk birds, including matuku-hūrepo/Australasian bittern, kakī/black stilt, and pūweto/spotless crane, these species are considered unlikely to land within the solar farm site and should be at low risk of collision with the solar panels. Tarapirohe/black-fronted tern and tōrea/South Island pied oystercatcher could feed within the grassland habitat, but there is a large amount of high-quality foraging habitat nearby, including within the Ōhau, Pukaki, and Twizel rivers.

For species using adjacent habitats to the proposed solar farm site, the difference in elevation between the site and the braided river areas means birds can gain elevation before they approach the solar farm. This makes it less likely they will fly low enough to risk hitting the solar panels when crossing the site. Tarapirohe/black-fronted tern is one species that may fly regularly across the site when moving between foraging habitats but is expected to fly high enough when undertaking these flights to remain at a low risk of collision with panels.

In addition to panels, birds may also strike other structures and objects within solar farms, including vehicles (Section 12.3.5), buildings, fences, and overhead transmission lines, resulting in collisions, entanglements, and electrocutions. However, these have been uncommon sources of bird mortality at PV solar farms overseas (Kagan *et al.* 2014; Kosciuch *et al.* 2020; Visser *et al.* 2019).

Bird strike risk to panels at solar farms can be reduced through effects management, as described in Section 13.2.5-13.2.7. Without this management, this effect is likely to be **more than minor**. This effect level considers several factors including the threat status of species potentially impacted, including matuku-hūrepo/Australasian bittern and kakī/black stilt, and the magnitude of effect which covers a large portion of the site. As discussed above, the duration of this effect differs among species because population level responses to the injury or loss of an individual vary.

## 12.4 Lizards

### 12.4.1 Overview

The overall level of effect for the project on lizards is considered to be **minor to more than minor** before effects management is applied.

### 12.4.2 Injury/death/displacement

The proposed solar farm may result in the permanent displacement, injury and death of individual lizards within the proposed solar farm development area. Without management (Section 13), this effect is likely to be **more than minor**. This effect level considers the protected status of species potentially on site combined with the magnitude of effect, which encompasses a large area of the site and a long-term to permanent duration of effect.



### 12.4.3 Habitat loss

Lizard habitat is present throughout the impact area and loss of habitats at this site may not be avoided. The size and extent of the proposed solar farm development area mean the impact to lizard habitats could be notable within the context of the local area. Without management (Section 13), this effect is likely to be **more than minor**. This effect level considers the threat status of species potentially on site combined with the magnitude of effect, which encompasses a large area of the site and a long-term to permanent effect.

### 12.4.4 Habitat fragmentation

Although the site is an active farm, lizard habitat is connected throughout the site and is comprised of areas of low to high quality habitats, all of which are connected across the site via fence lines, or unmaintained areas. The proposed solar farm will result in the fragmentation of habitats across a large site with varying levels of population density of at least one Not Threatened species (McCann's skink) confirmed present within the proposed development area. Without management (Section 13), this effect is likely to be **minor**. This effect level considers the threat status of species potentially on site combined with the magnitude of effect, in which the effect was considered to cover a large area and a long-term to permanent duration, though the affected species is likely only present at low densities in most of the impacted area.

### 12.4.5 Reduction of lizard habitats due to shading

Lizard habitats within the site could be shaded due to the installation of solar panels, resulting in the gradual shift in vegetation and species composition. This could reduce population abundance of lizards on site. Without management (Section 13), this effect is likely to be **minor**, due to the likely low densities of lizard populations over most of the site. This effect level considers the threat status of species potentially on site combined with the magnitude of effect in which the effect was assessed as covering a large area and a long-term to permanent duration, though the affected species is likely only present at low densities in most of the impacted area.

### 12.4.6 Operational disturbance

Vehicle strikes, noise and dust may affect lizard populations along newly formed roads and vehicle accessways in areas adjacent to lizard habitat (e.g. where rock piles or ground cover vegetation is present along fence lines). While there is limited published literature about the impacts of dust on lizards, it is likely that lizards would avoid habitat if there was heavy dust deposition. Dust build up may also contribute to the deposition and increased growth of weedy vegetation within areas of rock piles on site, reducing interstitial spaces for lizards and therefore reducing habitat quality. Without management (Section 13), this effect is likely to be **minor**. This effect level considers the threat status of species potentially on site combined with the magnitude of effect, which is a small area of the site and a long-term effect.

### 12.4.7 Disturbance during earthworks

Disturbance during construction to lizards includes dust, vibration, and noise. This disturbance is likely to disrupt normal behaviour, including social dynamics in lizard populations adjacent to the site footprint as a result of earthworks. Without management (Section 13), across the site, this effect is likely to be **minor**. This effect level considers the threat status of species potentially on site combined with the magnitude of effect, which is considered to cover a large area of the site and a temporary effect duration.



#### 12.4.8 Breeding failure/avoidance

The proposed solar farm and associated earthworks may affect the behaviour of lizards, potentially altering social interactions and increasing stress, leading to reduced population functionality, poor breeding and low population recruitment. Without management (Section 13), this effect is likely to be **less than minor**, due to the likely low densities of lizard populations over most of the site. This effect level considers the threat status of species potentially on site combined with the magnitude of effect, which is a large area of the site and an ongoing/temporary effect, though the affected species is likely only present at low densities in most of the impacted area.

### 12.5 Invertebrates

#### 12.5.1 Overview

The overall level of effect for the project on terrestrial invertebrates is considered to be **minor to more than minor** before effects management is applied.

#### 12.5.2 Reduction in invertebrate habitat

Habitat for notable invertebrates has been identified within the proposed development footprint, though it is heavily modified. More important habitat has been identified in the central southern terrace and near the western margin of the site. The proposed development will remove a small amount of highly modified habitat that may support notable invertebrates at this site. Without management (Section 13), the effect is likely to be **minor**. This effect level considers the threat status of species affected (including Tekapo ground wētā which has the highest threat status of species on site), the permanence of habitat removal, and the relatively small amount of habitat that will be removed.

#### 12.5.3 Mortality and disturbance to invertebrates

All earthworks, including for the placement of trenching wires and the cut-fill earthworks for establishing contours, will cause the removal and destruction of any notable invertebrates present on the surface of the ground during works. This is likely to affect the Tekapo ground wētā particularly, if any burrows are unearthed during works. Vehicle strikes will also cause the death of invertebrates. Dust and vibrations associated with earthworks are likely to disturb insects and affect their behaviour. Little has been published on the effects of dust on invertebrates, but dust settling on insect bodies may cause injury from abrasion and/or blocking of external breathing apparatus.

Vehicle strikes, vibration, and dust from ongoing maintenance works may affect invertebrate populations near newly formed roads and vehicle accessways, particularly if they approach the riverbed.

Without management (Section 13), this effect is likely to be **minor**. This effect level considers the threat status of species affected (including Tekapo ground wētā which has the highest threat status of species on site), the short-term nature of the effects of removing individuals from the population (including their ability to be replaced by recruitment through breeding or immigration), and the relatively large area over which disturbance and mortality will occur.



#### 12.5.4 Reduction of habitat quality due to shading

High quality habitats within the site could be shaded out due to the solar panels. Shading has the double-edged effect of both reducing habitat quality through a gradual shift in vegetation composition and structure and reducing sunlight availability for basking species such as robust and minute grasshoppers. The creation of shaded areas is likely to benefit the New Zealand blue butterfly, but without management (Section 13), this effect is likely to have adverse effects that are **more than minor**. This effect level considers the threat status of species affected (including Tekapo ground wētā which has the highest threat status of species on site), the permanence of habitat modification, and the relatively large amount of habitat that will be modified.

The tracking array technology reduces the amount of permanent shading but rotating solar panels have been found to alter soil, temperature, and moisture microclimates underneath them due to the effects of dynamic shading patterns. This may impact plant and invertebrate communities (e.g. Grodsky and Hernandez 2020). Some effects will therefore remain due to the solar panels blocking the sunlight's path to the ground. As a result, vegetation is likely to grow taller underneath the solar panels, due to the increased moisture and shading from the sun (Li et al. 2025).

### 12.6 Freshwater

While there are no waterways within the area of the proposed site, consideration of the surrounding waterways remains important, particularly as the site is flanked by two braided river systems. Works will result in the disturbance of sediment, the quantity of which will depend on the method of construction. Sediment has the potential to enter waterways through overland flows, which can have several negative effects on freshwater fauna species. Small galaxiids and bullies, as well as many macroinvertebrate species, utilise hard surfaces and interstitial spaces for foraging, spawning and shelter. An increase in fine sediment within the waterways they inhabit would result in loss of this habitat (Ryan 1991; Jowett and Boustead 2001).

Sedimentation of a waterway can result in a decrease in the survival rate of fish eggs as it can reduce both space and oxygen availability within the interstitial spaces of the substrate (Ryan 1991), impacting the recruitment rates of fish that spawn in the area. Sedimentation can also lead to an increase in invertebrate drift as habitat becomes less suitable, which can result in a change in the community composition, diversity and abundance (Mathers *et al.* 2022; Davis *et al.* 2022). Changes in macroinvertebrate community would cause follow on effects on the fish species that feed on them. Finally, sedimentation can also reduce the availability of refuges within the substrate for small indigenous fish species, which can increase the likelihood of negative interactions with introduced salmonids (Coughlan 2022; Sowersby *et al.* 2015).

Without management (Section 13), the impact of sediment in surrounding waterways will be **more than minor**.

Machinery and vehicles working near the gravel bed of the active river could contaminate the waterway, including petrochemicals, oils and heavy metals, if not appropriately cleaned up in a timely manner through use of a spill kit and removal of contaminated material. Petrochemicals and oils can enter via spills or leaks or are washed off machinery during rain or driving through water. Spills and leaks onto gravel within the waterway are nearly as serious as those going directly into the water, as it is only time before a flood reaches and disperses the contaminant. The level of this effect is considered **more than minor** (in the event of a large contamination event) in the absence of effects management.



## 13.0 Effects Management

In this section, we discuss the management measures recommended to avoid, remedy or mitigate the potential adverse effects identified in Section 12 above.

### 13.1 Vegetation

#### 13.1.1 Avoidance of notable plant species and habitats

The proposed solar panel layout mostly comprises improved pasture and exotic vegetation. The proposed design avoids areas with indigenous vegetation and ecologically significant vegetation, including wetlands and known locations of Threatened and At Risk plants. The boundaries of the panel area have been modified to ensure these plants and habitats are avoided.

A further final survey for Threatened and At Risk plants will be undertaken post-consenting within the panel area by a suitably qualified ecologist with dryland plant experience to ensure that there have not been any unexpected changes to vegetation communities within the site. Given the panel area is modified exotic grassland, changes in vegetation communities resulting in Threatened or At Risk plants establishing within the panel area following the previous surveys is unlikely. However, the purpose of the survey is to provide additional reassurance that the panel area solely comprises exotic vegetation. In the unlikely event indigenous species or Threatened and At Risk species are detected in the panel area, consideration will need to be given to avoid any adverse ecological effects.

Vehicles will keep to tracks where possible and not drive on the land outside the panel area where indigenous vegetation has been found (Figure 7), thus preventing disturbance from vehicles from impacting vegetation.

Shade modelling undertaken by Nova (Appendix 3) identified a 27-metre maximum shadow in the middle of winter created by the solar panels in some parts of the site. To ensure that this shadow does not cast shade on areas of ecologically significant vegetation south of the panel area, a 10 to 35-metre panel setback has been applied to ecologically significant vegetation and locations of Threatened and At Risk plants, with the setbacks informed by the shade modelling at the site. Although no targeted surveys were undertaken outside the site, it is inferred that Threatened and At Risk plants and ecologically significant dryland habitat are present. The minimum set back from the panels to the edge of the site is 20 meters, in areas where shade modelling has identified an increase in shading as a result of the solar panels, a 35 meter set back has been applied to avoid potentially shading any Threatened and At Risk plants or habitat outside the site.

The 35-metre setback in southern parts of the site is a conservative approach, as the maximum identified shadow length is eight metres shorter.

The Biosecurity and Vegetation Management Plan (BVMP) (Wildlands 2026d) (discussed in Section 13.1.4 below) will be followed, including avoiding the use of agrichemical sprays on site which could otherwise damage or kill indigenous plants.

If the solar farm activities during construction and ongoing activity avoid wetlands, indigenous vegetation and Threatened and At Risk plants, setbacks are applied, and regular monitoring of At Risk and Threatened plants is undertaken, adhering to the BVMP, then potential effects on indigenous vegetation and habitats, including At Risk, Threatened and Rare plants (Section 12.2 above) will be **less than minor**.



### 13.1.2 Avoidance of wetland habitats, setbacks and sedimentation management

Under the NPS-FM, earthworks should not be undertaken within the vicinity of any wetlands to avoid adverse effects on wetland hydrology and through sedimentation. Consistently, a minimum 100-metre setback for earthworks occurring near wetlands within or near the site will be applied. The setback will be applied regardless of whether the wetlands are inside or outside the site. There is an ephemeral wetland in the north of the site, outside the panel area which will have the 100-metre setback applied. The 100-metre setbacks will ensure the wetlands on site and off-site will not be impacted by sediment or hydrological changes. Development will be undertaken in accordance with the proposed erosion and sediment control plan which has been prepared consistent with Canterbury Regional Council standards to ensure the protection of freshwater habitats and wetlands within and outside the project area. Impacts of the layout design on wetlands are therefore likely to be **negligible**.

### 13.1.3 Minimisation of microclimatic changes beneath solar panels

No indigenous vegetation is present beneath the panel area, this will be further confirmed following the final survey of the panel area. Although microclimatic changes may occur, controlled grazing and regular pest plant management will ensure that there is minimal adverse effects associated with changes in microclimate resulting in the spread of pest plants at the site. The lack of indigenous vegetation below the panels means there is little concern associated with microclimatic changes beneath solar panels impacting indigenous vegetation. The effects of microclimatic changes to vegetation beneath the solar panels (Section 12.2.4) is therefore considered to be **less than minor**.

### 13.1.4 Adherence to the Biosecurity Management Plan

The BVMP sets out provisions and guidance to ensure that the ecological values present at the site are preserved and that pest plants do not become widespread at the site. The risk of introduction of pest plants can be mitigated by using the existing access road as much as possible and avoiding indigenous vegetation and habitats. Biosecurity management during the development phase includes biosecurity checks, using local materials, and eco-sourcing plants.

During the development phase vehicles and machinery will be checked and cleaned of mud and debris prior to work commencing on the site. Any gravel, soil or fill brought into the site will be sourced locally. Gravel, soil or fill will be sourced from within the Mackenzie Basin from sites where Russel lupin (*Lupinus polyphyllus*) is not present. Adherence to the biosecurity checks outlined in the plan will be followed to ensure the risk of introducing new pest plants to the site is low.

Biosecurity management during the operational phase will also follow the biosecurity checks and procedures required during the development phase (including biosecurity checks and cleaning of vehicles). The BVMP also outlines methods and timeframes for pest plant control, which focuses on controlling woody weeds at the site and will be undertaken every three years, commencing one year from the beginning of development at the site. Regular monitoring will occur, including the establishment of photopoints and vascular plant surveys. The vascular plant surveys will ensure that Threatened and At Risk plants are not being negatively impacted by potential spread of woody weeds at the site. If the vascular plant surveys identify any issues relating to the biosecurity controls present at the site, further effort in the form of additional days spent surveying and controlling pest plants.

Ongoing solar generation is likely to require exotic vegetation control within the development footprint to ensure that panels are not shaded. Specifically, woody weeds such as wilding conifers may become established due to changes to land use. If wilding conifers become established, they will require control. Nova intends to continue to graze the site with sheep to reduce grass growth and the need for weed control. The use of herbicide will be kept to a minimum, and agricultural



sprays will not be used (instead using spray-free methods such as cut and paste where herbicide is necessary), to ensure that there are no adverse effects on lizards and invertebrates within the site.

The BVMP includes a requirement for vascular plant monitoring to be undertaken every three years, which will focus on monitoring Threatened and At Risk plants present around the perimeter of the site to ensure there are no adverse effects associated with the development on these populations. This will include both qualitative (observational walk-through) and quantitative (permanent monitoring plot) surveys. If a decline in At Risk vascular plants is detected around the perimeter of the site, then a management response will be triggered.

The BVMP includes adaptive management, which is triggered if either a decline in Threatened or At Risk is or an increase in past plants is detected during surveys. The approach taken will be informed by the reasons for the decline. If the cause in decline is obvious, for example pressure from pest plants, then additional control will be undertaken. If the cause is less obvious, further investigation will be undertaken, which would likely include consultation with DOC and/or engaging a consultant who specialises in dryland plants and management to determine the best course of action. The results from ongoing monitoring will inform the management measures to address the decline, if determined to be caused either directly or indirectly by the project. Further investigations may also be required. Adaptive management could include increasing pest animal or pest plant control efforts or adapting the sheep grazing regime. Further monitoring will be undertaken to ensure the success of the measures taken to address the decline. If there is no evidence that management has been effective, additional management will be undertaken and if necessary, the cause will be further investigated. The results of monitoring will also inform an assessment of whether the vascular plant survey methodology and control measures set out in the BVMP need to be updated. An assessment will be undertaken at the end of each three-yearly monitoring period to determine whether any changes need to be made to the BVMP.

If the above actions are implemented and the steps outlined in the BVMP (Wildlands 2026d) are followed, then effects of introduction of pest plants at the site (Section 12.2.6) will be **less than minor**.

## 13.2 Avifauna

### 13.2.1 Habitat enhancement

Avifauna habitat loss caused by solar farm development will be partially mitigated as areas at the edges of the site, where solar panels are not present, will continue to provide suitable habitat for avifauna, particularly with the implementation of the PMMP (Wildlands 2026). Some species may forage and potentially breed within the habitat between panel rows. Low residual adverse effects will remain from habitat loss associated with the developed areas of the site.

If the actions outlined in Section 13.2.2 (avoid construction during the breeding season and develop and implement management methods outlined in the AMP) are followed, the effect of habitat loss on avifauna (Section 12.3.2) will be **less than minor**.

### 13.2.2 Avoidance of breeding season or breeding individuals

The proposed solar farm footprint is to be developed mostly in grassland of various types, and although this type of habitat is readily available in the surrounding areas, this has the potential to affect breeding and foraging birds if construction work occurs during the breeding season. Construction activities during the breeding season (July – March inclusive) are more likely to injure or kill breeding birds, eggs, and chicks than at other times. Ideally, as much construction work as possible should occur outside the bird breeding season. However, given the size of the project, it is



inevitable that some of the construction will occur during the breeding season. Therefore, the implementation of an Avifauna Management Plan (Wildlands 2026c) is recommended.

The Avifauna Management Plan (AMP) outlines measures to manage the potential effects of the solar farm development on avifauna, including breeding birds. The AMP outlines methods to avoid attracting nesting birds during construction and includes protocols for conducting pre-works bird surveys and implementing setback distances from any nests that are located to ensure that nesting birds, nests, eggs, and chicks are not disturbed, injured, or killed. The AMP also includes incidental discovery protocols that must be followed if nesting birds, nests, or injured birds are discovered on site during construction (and for the life of the solar farm).

If the above actions are implemented, in combination with those outlined in Section 13.2.3 (implement setbacks from rivers) and Section 13.2.8 (implement avifauna monitoring during and post-construction), the effect of construction on breeding avifauna at the site (Section 12.3.3) will be **less than minor**.

### 13.2.3 Avoidance of disturbance during construction

Proposed works must avoid disturbing birds in the rivers and wetland areas adjacent to the site. To avoid this disturbance, a buffer area of 50 metres from wetlands should be maintained between the near edge of rivers/wetlands and any area where machinery and power tools are being used.

A setback of 20 metres from the boundaries of the site has also been implemented in the design to prevent disturbance to the Twizel and Ōhau river deltas. In particular, the river delta near the southeastern corner of the site and the area of wetland and riverbed on the southwestern side of the site should be left undisturbed. It is noted however that a public gravel road is located adjacent to the property's southern boundary, along the Ōhau River. The area of wetland in the southwestern side of the site is part of the Department of Conservation kakī/black stilt captive breeding centre. Before any works proceed, the Department of Conservation should be informed that works are going to be undertaken. A report on the noise that will be produced by construction and operations at the site has predicted construction noise to be between 34 and 48 dB  $L_{Aeq}$  at the Department of Conservation kakī/black stilt captive breeding centre, which is a similar level to that produced in a library reading room (Marshall Day Acoustics, 2026). This is an acceptable level of noise at the sanctuary and is considered unlikely to disturb kakī/black stilt.

If the above actions are implemented, in combination with the actions outlined in Section 13.2.2 (avoid construction during the breeding season and develop an AMP), the effect of construction-related disturbance on avifauna (Section 12.3.4) will be **less than minor**.

### 13.2.4 Minimisation of ongoing disturbance

The site has been designed to reduce ongoing disturbance to avifauna by including a setback from adjacent braided rivers (Section 13.2.3). To further reduce disturbance, vehicles travelling on-site should remain on designated access roads, drive at a slow speed, and reduce noise where possible (e.g. turn off machinery when not in use). All staff accessing the site for ongoing maintenance should be vigilant for the presence of birds and follow setbacks in place for any nesting avifauna (Section 13.2.2).

If the above actions are implemented, the effect of ongoing disturbance to avifauna (Section 12.3.5) will be **minor**.



### 13.2.5 Panel and solar farm design to minimise bird strike risk

The proposed layout of the solar farm can reduce the risk of bird strike on solar panels. The lake effect, where birds are attracted to the glare off the solar panels, can be reduced by breaking up the panels' reflection (Kagan *et al.* 2014). Two ways that should be used are to create large gaps between panel rows and to use panels with anti-reflective coating (Ahmed, 2022). The lack of an observed lake effect at one California solar farm was attributed to the combination of anti-reflective coatings on panels and having six-metre-wide gaps between panels (Ahmed, 2022). In the proposed solar farm layout, tracking arrangements are separated by either a five-metre-wide unpaved service road or a six-metre-wide central arterial road. There is a minimum of five-metre spacing between panel edges and north and south development areas are separated by roading and transmission lines, helping to break up reflection from the panels.

Having gaps between panel rows, such as those provided by roads in the proposed layout, can break up the potential lake effect (Ahmed, 2022). Roads will also give birds space to land at or depart from the site, given the access roads and corridors between blocks of panels are well-spaced. However, glare off the solar panels may still look like water to overflying birds, attracting them to the site. Birds may either try to dive into or land on the panels. For this reason, the panels that will be used at the site have anti-reflective coated front glass, which is designed to absorb rather than reflect light, and should greatly reduce the attraction to overflying birds.

A further approach to reduce bird strike risk involves adjusting the angle of solar panels in response to site conditions, which should help minimise glare and reduce bird strike risk (Olson, 2021). While there is limited research on this, a study in the United States found lower frequencies of waterbird fatalities at PV facilities with tracking arrays compared to those with fixed panel designs (Kosciuch *et al.* 2025). In the proposed layout, ground-mounted solar panels are arranged in rows that allow them to track the sun's movement, varying the angle of panels throughout the day to alter the spatial view. Each tracking arrangement consists of approximately 29 connected panels. Panels will also have a 55-degree night rest position from sunset until sunrise to minimise reflectivity, and, if practicable, will be positioned away from sources of polarised moonlight. These design features should reduce attractiveness to birds flying over the site during the day and at night.

If the above actions are implemented in combination with the actions in Sections 13.2.6 (implement carcass monitoring and trigger levels) and 13.2.7 (implement avifauna monitoring during and post-construction), the effects of bird strike on avifauna (Section 12.3.6) are expected to be **less than minor**.

### 13.2.6 Carcass monitoring and trigger levels

Post-construction carcass monitoring will provide data on bird strike rates and other causes of mortality. The AMP outlines post-construction carcass monitoring protocols, including systematic carcass searches to determine fatality rates at the site. A proposed consent condition specifies threshold mortality rates, whereby an independent review will be required following the injury or mortality of:

- A Nationally Critical or Nationally Endangered species.
- Two Nationally Vulnerable or Nationally Increasing birds within one survey, or of three within a 12-month period.
- Three At Risk birds within one survey, or of five within a 12-month period.
- Five Not Threatened indigenous birds within a survey, or of 15 within a 12-month period.

If these threshold mortality rates are reached or exceeded, they will trigger adaptive management of effects, as outlined in the AMP. The adaptive management process will involve:



- An investigation and review of the event by a SQAE in consultation with DOC. The report should be provided to Nova, DOC, and the Mackenzie District Council for review.
- Conducting Collision Risk Modelling (CRM) and Population Viability Analyses (PVAs) will be undertaken by a SQAE and suitably qualified biostatistician to inform management measures (Section 13.2.7).
- Adaptation of the site as recommended by the SQAE to prevent further fatalities, using methods such as:
  - UV paint on solar arrays or other structures. UV film or UV-reflective bands can reduce bird strike on windows by breaking up the reflection (Kagan *et al.* 2014, Swaddle *et al.* 2020) and should reduce bird strike on solar panels.
  - Flags, streamers, or similar visual deterrents on solar arrays. Flags and streamers can break up the reflection from the panels, reducing bird strike risk. These deterrents can also be applied to buildings and structures if bird strikes are attributed to them.
  - Bird-balls or other flight diverters on transmission lines to reduce bird strike with transmission lines by increasing the visibility of the wires. These typically reduce collision rates, although the effectiveness of different devices varies between species (Jenkins *et al.* 2010). If there are high levels of collision with wiring in specific areas, some could be moved underground if possible.
  - Modify the design of fences and buildings to reduce any observed entanglement or collision risk, e.g. reduce small gaps where birds could become stuck and adapt the fence design to reduce the risk of large birds becoming grounded and trapped between a fence and closely located objects, such as additional fencing or buildings (Visser *et al.* 2018).
  - The implementation of any panel technologies or designs that are developed during the lifespan of the solar farm that could reduce bird strike risk.
  - Targeted removal of panels or other structures. This may be required if bird strike remains high in a specific area of the site following the implementation of other management measures.
- In the event that management approaches were not fully effective, compensation payments towards off-site conservation initiatives for the affected species would be required (Section 13.2.7). Compensation would also be necessary in addition to onsite management if strike of a high-value Threatened species, including kakī/black stilt, occurred.

If the above actions are implemented in combination with the actions in Sections 13.2.5 (gaps between arrays, use anti-reflective panels and use tracking arrays), 13.2.7 (conduct CRM and PVAs to inform management and compensation, if required), and 13.2.8 (implement avifauna monitoring during and post-construction), the effect of bird strike on avifauna is expected to be **less than minor**.

### 13.2.7 Evidence-based compensation

If the mortality trigger levels (Section 13.2.6) are met or exceeded, and subject to data availability, the quantum and form of biodiversity compensation will be explicitly linked to quantified ecological risk, as determined through:

1. Collision Risk Modelling (CRM) using the Band collision risk model (or equivalent), and
2. Population Viability Analyses (PVAs) using Vortex.

This approach ensures that compensation is:

- Proportionate to predicted effects
- Species-specific, reflecting differential vulnerability
- Adaptive, allowing refinement as empirical data improves



### *Collision Risk Modelling*

Collision risk modelling will be conducted using the Band Model<sup>1</sup> or a similar approach to provide the collision risk for Threatened and At Risk avifauna species that use the site, dependent on the availability of necessary species-specific data. Information required to conduct CRM includes:

- Body length.
- Wingspan.
- Bird flight speed and flight height.
- Flight frequency.
- Approximate distance travelled per day.
- Habitat use, including at the site and within a five-kilometre radius.
- Flight and behavioural characteristics (e.g. polarised light sensitivity, nocturnal activity).
- Site characteristics (e.g. panel and infrastructure locations, size of panel area).

### *Population Viability Analyses*

PVAs can be used to model changes to a species or population over time. PVAs will be conducted using Vortex Analysis software to determine population-level consequences if bird strike of Threatened and At Risk avifauna species were to occur. Information required to conduct PVAs includes:

- Individual life spans and ages.
- Fecundity.
- Population sex ratio.
- Population size.

Information from CRM and PVAs will be used to inform the adaptive management approach (Section 13.2.6), including approaches that can be undertaken to reduce collision risk for specific species. The AMP will be reviewed and updated as required, based on the information obtained from these models. This could involve changes to the recommended management approaches for reducing collision risk or increased monitoring requirements.

CRM and PVAs will also inform the quantity and form of compensation, if it is required. As detailed in the AMP, compensation funding should be allocated to projects that aim to increase reproductive success, enhance adult survival or improve knowledge of a species. These include Project River Recovery, community-run conservation initiatives, GPS tracking projects, and MSc or PhD projects on the affected species.

## **13.2.8 Avifauna monitoring during and post-construction**

In our experience, there is often limited monitoring of live birds at solar farm sites during and after construction. However, construction can lead to ongoing changes in the habitat at a site, generating

---

<sup>1</sup> Band et al. (2007).



associated changes in bird behaviours and distributions that may be challenging to predict. For example, passerines used PV panels for shade and as perches during summer at USA solar farms (DeVault *et al.* 2014), while raptor abundances at a solar farm site in California decreased post-construction compared to pre-construction (Smith and Dwyer 2016). In South Africa, many bird species found as fatalities were more common within the site than in the surrounding area, indicating they may have been attracted to the solar farm (Visser *et al.* 2019). In Aotearoa New Zealand, species such as tōrea/South Island pied oystercatchers and pohowera/banded dotterel may be temporarily attracted to bare ground created during construction for foraging and nesting. Passerine species may perch on construction equipment and materials and forage on bare ground or grassland around the site.

Monitoring of bird abundances within the solar farm site during and post-construction will provide important information about the effects of construction and the presence of the solar farm on avifauna, including whether there are changes in the abundance and behaviour of birds, particularly Threatened and At Risk species. This information will help to inform proactive management approaches to reduce bird strike risk if birds appear attracted to a specific area of the site.

Apart from general equipment checks, any works undertaken post-construction will require a pre-works avifauna survey to be undertaken following the protocols outlined in the AMP. The AMP also outlines an incidental discovery protocol that must be followed by staff if nesting birds, nests, or injured birds are discovered on site, and the necessity for staff to move carefully on site to prevent collisions with or disturbance of nesting birds.

If the above actions are implemented in addition to those outlined in 13.2.2 (avoid construction during the breeding season and develop an AMP) and Section 12.2.3 (implement setbacks from rivers), the effect of construction on breeding avifauna will be **less than minor**. If the above actions are implemented in addition to those outlined in Sections 13.2.5 (have gaps between arrays, use anti-reflective panels and use tracking arrays) and 13.2.6 (implement carcass monitoring and trigger levels), the effect of bird strike on avifauna is expected to be **less than minor**.

Methods for undertaking avifauna monitoring during and post-construction are set out in the AMP. On site avifauna monitoring is proposed to occur monthly for six months prior to construction, weekly for at least the first year during construction, and either weekly or fortnightly depending on bird activity until construction is completed, and fortnightly for a minimum of three years post-construction. Carcass monitoring is proposed to occur monthly for six months prior to construction and for three years post-construction. Monitoring results should be reported annually, with a review at the end of three years to determine whether monitoring should continue.

## 13.3 Lizards

### 13.3.1 Avoid high and moderate-quality lizard habitats

Where high and moderate-quality lizard habitats are present, effects from solar farm development will avoid these habitats, including a 35-metre buffer zone to prevent shading of lizard habitat from solar panels. This includes areas of scarp herbfield and grassland and old river terrace. Avoidance of high and moderate-quality habitats is the most important measure adopted for the management of effects on lizards at the site.

Avoiding high and moderate quality habitats will contribute to **less than minor** adverse effects to lizards.



### 13.3.2 Project design that includes corridors and habitat remediation

Habitat corridors are recommended and will be created as part of the proposal whereby additional areas of land are avoided within the site to provide connectivity for species across the wider site, and to link habitats of varying quality.

Some habitat enhancement within lizard corridors, and within areas of high and moderate-quality lizard habitat, is recommended and will also be undertaken. This should include:

- Eco-sourced, lizard-friendly plantings.
- Pest plant control.
- The creation of rock piles within lizard habitat corridors.
- Control of pest mammals.

Plantings and the creation of rock piles will be implemented within specific areas at regular intervals along lizard habitat corridors as biodiversity nodes. Biodiversity nodes will provide small islands of high-quality habitat along corridors, where other areas of lizard habitat corridor are left to regenerate naturally over time but facilitate movement between habitats on site. A minimum of 30 biodiversity nodes of c.100m<sup>2</sup> is recommended and will be created.

The area of rock piles in the north-west of the site along the central fence line, covering c.1,250m<sup>2</sup>, is recommended and will also be included as a biodiversity node. The total area of biodiversity nodes where planting will be undertaken is therefore approximately 4,250 m<sup>2</sup>. Rock piles will be placed at the ends of biodiversity nodes and be between a maximum of 0.5 metres in height, 1-2 metres wide and five metres long. A lizard habitat corridor will be created along the central east-west fenceline, with two separate branches leading to the central southern area of scarp and one branch leading to the area of scarp in the far east of the site (see Figure 14 for a map of areas for lizard habitat corridors and biodiversity nodes).

Maintenance of native plantings is recommended to increase the success of plantings.

Project design including corridors and habitat remediation will contribute to **less than minor** adverse effects to lizards.

### 13.3.3 Lizard Management Plan (LMP)

A LMP has been prepared for the project (Wildlands 2026b) which sets out all proposed management measures to address potential adverse effects on lizards from the proposed solar farm development. Details of lizard management are included in detail in the LMP and include avoidance of high and moderate-quality lizard habitats and the creation of lizard habitat corridors, which include areas of habitat enhancement as described above. The LMP also includes an Incidental Discovery Protocol for solar farm contractors to follow in the case of encountering a lizard during works on site, and monitoring methodology for the survival of plantings and lizard uptake in enhanced habitats.

Site development with the implementation of the measures detailed in the LMP and outlined above in Sections 13.3.2 and 13.3.1 will result in a **less than minor** adverse effect on lizards.

## 13.4 Invertebrates

### 13.4.1 Habitat avoidance

The most important habitats for invertebrates are around the perimeter of the site which is being avoided. Destruction of indigenous legumes (such as indigenous broom) and indigenous flowering plants in other areas of the site should be avoided where possible to ensure continued access to



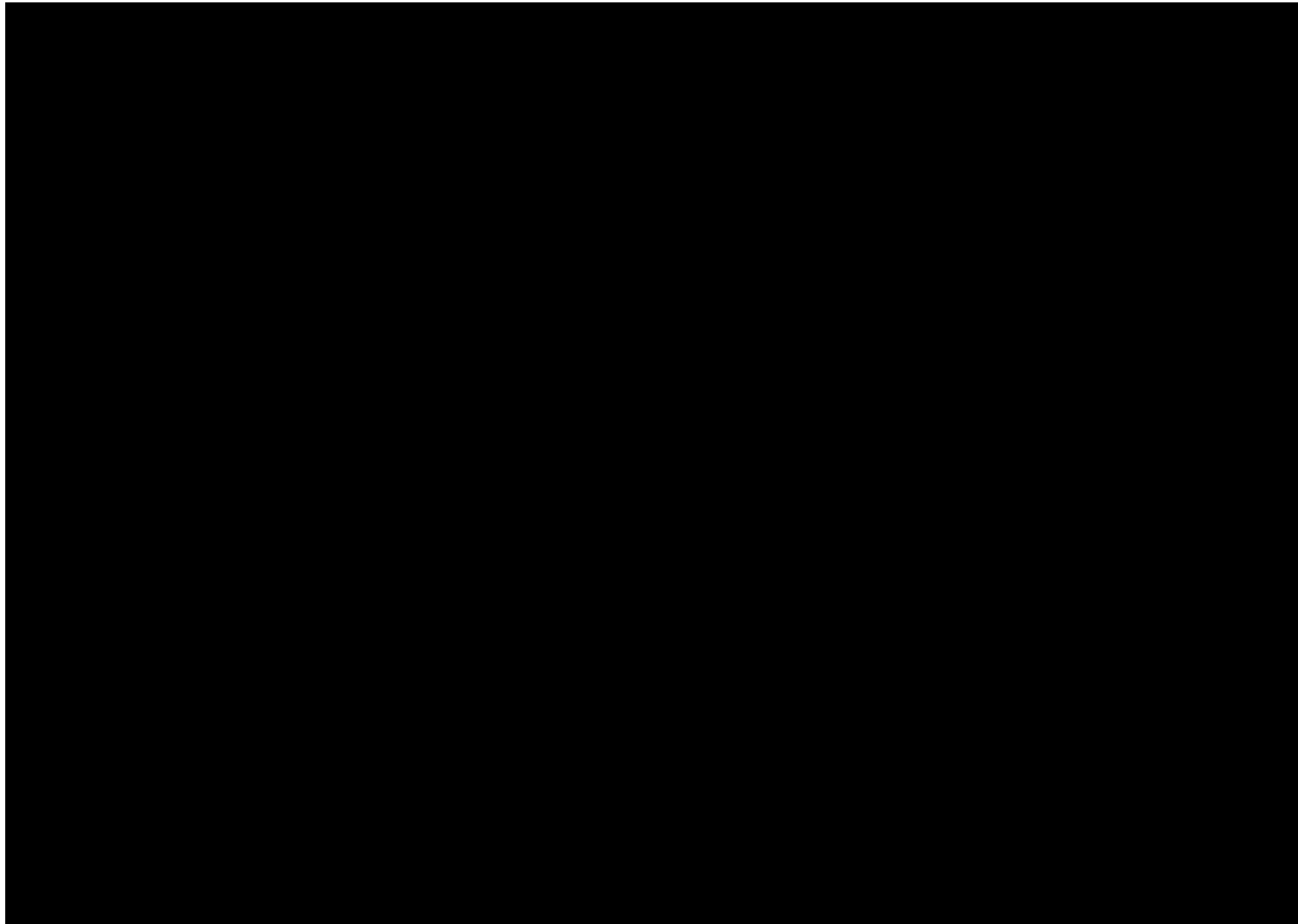
these for breeding and feeding for New Zealand blue butterfly. Loss of areas of bare ground and rock should be avoided where possible, to minimise loss of basking areas for New Zealand blue butterfly. These areas are excluded from the panel layout design (Figure 1).

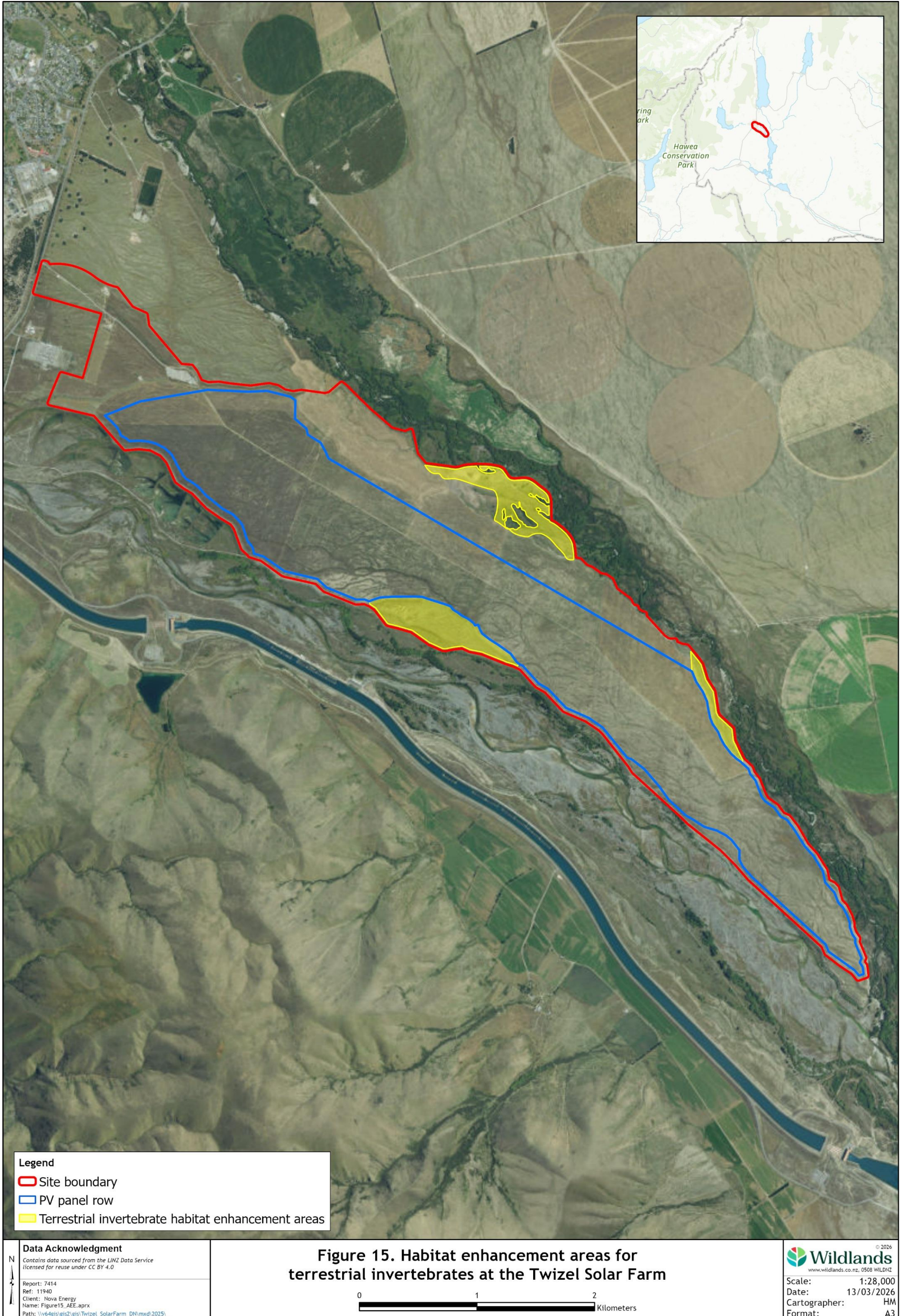
Short-stature herbs, even invasive species such as hawkweed, should not be controlled unless they are going to be replaced with indigenous herbfield vegetation (see Habitat Enhancement below). Short-stature herbs can provide important habitat for minute and Otago short-horned grasshoppers.

Seasonal, managed grazing will occur throughout the panel area to keep the exotic grasses short. This will minimise the habitat modification effects for Tekapo ground wētā and potentially also minute and Otago short-horned grasshoppers. It will also minimise exotic grasses smothering herbfield vegetation.

#### **13.4.2 Habitat enhancement**

An area of suitable habitat (Figure 15) will be enhanced and protected to balance the loss of Tekapo ground wētā and Otago short-horned grasshopper habitat present on site. The habitat identified for enhancement could potentially support indigenous invertebrates such as short-horned grasshopper and minute grasshopper, as well as increase connectivity between populations. This large area of enhanced habitat would replace the moderate and low-quality habitat being lost as a result of the development. Increasing connectivity between patches using the perimeter of the site as a corridor would help to manage the effects of habitat fragmentation. Some of the habitat proposed for enhancement in Figure 15 overlaps with proposed lizard enhancement areas, but since lizards and grasshoppers at the site have similar habitat requirements there should be no conflict arising from different habitat requirements.







The replacement of a heavily-modified, moderate-to-low value area of terrestrial invertebrate habitat (currently on site) with an enhanced area of high-value terrestrial invertebrate habitat (the proposed invertebrate enhancement area) is expected to bring ecological benefits that outweigh the detrimental impacts of the project from habitat loss and modification.

#### 13.4.3 Use grasshopper-friendly weed control techniques

Pesticide or herbicide sprays must not be used within or near short-stature herbs, areas of bare ground, or any areas identified so far as being potential or confirmed minute or short-horned grasshopper habitat. They must also be avoided anywhere Tekapo ground wētā have been found or are suspected (Figure 10). Weed control should instead be mechanical, hand-weeding, or use cut and paste herbicide.

#### 13.4.4 Dust management

Managing dust will avoid its impact on indigenous invertebrates. Management measures should include:

- Using water trucks to dampen dusty tracks before and during use.
- Implementing and enforcing speed limits. The speed limits should be decided based on dust levels caused by vehicles moving at different speeds.
- Avoiding work during particularly dry weather if work sites cannot manage dust using other methods.

#### 13.4.5 Pest mammal management

Pest mammal control will be undertaken throughout the site, through implementation of the pest mammal management plan (PMMP) prepared by Wildlands (2026e). The PMMP provides a full description of methods to be used including devices and timing for control and monitoring of pest mammal species. Changes to pest mammal control that deviate from the plan should be discussed with a suitably qualified ecologist prior to implementation.

#### 13.4.6 Grazing

Seasonal, managed grazing will occur throughout the panel area to keep the exotic grasses short. This will minimise the habitat modification effects for Tekapo ground wētā and potentially also minute and Otago short-horned grasshoppers. It will also minimise exotic grasses smothering herbfield vegetation.

If the above actions are implemented in combination with the actions in Sections 13.4.3 and 13.4.4, the effects of habitat loss on invertebrates (Section 12.5.1) are expected to be **less than minor** and the effects of habitat loss due to shading (Section 12.5) will be **minor**.

#### 13.4.7 Salvage and translocation

Populations of Tekapo ground wētā and minute and Otago short-horned grasshoppers that are within the area to be covered with solar panels, roads, or other infrastructure (Figure 1) are proposed to be salvaged and translocated using the protocols specified in the TIMP (Wildlands 2026a). The TIMP includes methods for salvaging Tekapo ground wētā and Otago short-horned grasshoppers at each site where they have been detected during previous surveys and are likely to be impacted by the panels. The salvage will be undertaken shortly before construction begins (approximately two weeks). Salvage methods will be walkthrough transects and live-capture pitfall traps.



In addition, the incidental discovery protocol outlined in the TIMP (2026a) is intended to be followed during construction, particularly in areas that have been identified as potential minute or Otago short-horned grasshopper habitat. This provides for identification and capture of Otago short-horned grasshoppers, Tekapo ground wētā, and minute grasshoppers. The Incidental Discovery Protocol outlines contacting relevant personnel, information needed, and when to restart work.

If the above actions are implemented in combination with the actions in Sections 13.4.1, 13.4.2 and 13.4.4, the effects of mortality and disturbance to invertebrates (Section 12.5.2) are expected to be **negligible**.

#### 13.4.8 Invertebrate Management Plan

A Terrestrial Invertebrate Management Plan (TIMP) has been developed (Wildlands 2026a). The TIMP outlines habitat protection and enhancement (including plants to be used for habitat enhancement), and salvage and translocation protocols for Tekapo ground wētā, Otago short-horned grasshopper and, if incidentally found within the panel area, minute grasshopper. Incidental discovery protocols are also included.

The objective of the TIMP is to meet specified performance standards relating to the maintenance of populations of Otago Short-horned grasshopper, minute grasshopper and Tekapo ground wētā.

The TIMP sets out protocols for achieving the performance standards, including adaptive management if unforeseen elements preclude the standards from being met.

Adaptive management will be triggered if there is no increase in Otago short-horned grasshopper and (if applicable) minute grasshopper on site, OR a decline in abundance or activity of Tekapo ground wētā both on site and in released populations. These trends must persist for at least two monitoring rounds to trigger adaptive management. Monitoring for enhancement plantings and pest mammal control is expected to identify major causes of invertebrate decline (e.g. predation, lack of available habitat), and adaptive management for enhancement plantings and pest mammals will respond quickly to any unforeseen issues with management.

The TIMP includes monitoring protocols to compare grasshopper and wētā abundance and activity after construction has commenced with the baseline data collected as part of the field surveys described in Section 2.2.4. Monitoring should be undertaken annually for the first three years following the onset of construction, and once every three years thereafter for twelve years. The monitoring protocols expand upon the methods of the baseline surveys. Adverse effects will be monitored by assessing trends in population abundance, activity and distribution as detected by standardised transects and pitfall trapping surveys.

#### 13.4.9 Research funding and collaboration (contingency)

If the above measures are implemented, it is likely that most effects of the development on invertebrates will be reduced to **less than minor**. However, as a contingency, compensation may be considered if monitoring shows that effects management is not successful despite adaptive management. The trigger for compensation would be any amount of decline in Tekapo ground wētā populations both within the panel area and in enhancement areas, detected for three monitoring rounds in a row (i.e. after adaptive management was implemented after the decline was detected over two monitoring rounds), and/or failure of Otago short-horned grasshopper populations (and any identified minute grasshopper populations within the panel area) to increase (detected under the same conditions).



**Table 11 – Flora and fauna management plans recommended for the Twizel Solar Farm, supplied alongside this Assessment of Ecological Effects.**

Management Plan	Outcome/Objective	Matters Covered	Performance Standards which Trigger Adaptive Management
Lizard (LMP)	Provide specific management measures to reduce the potential effects of the solar farm on lizards during construction and operation, particularly through the development and maintenance of biodiversity nodes and corridors.	<ul style="list-style-type: none"> <li>• Lizard habitat enhancement.</li> <li>• Lizard corridors.</li> <li>• Biodiversity nodes.</li> <li>• Incidental Discovery Protocol.</li> <li>• Monitoring and adaptive management.</li> </ul>	Decline in lizard numbers between any two monitoring rounds (i.e. between Years 1 and 5 or Years 3 and 7)).
Biosecurity (BVMP)	Provide specific management measures to reduce weeds on site and prevent new incursions, particularly through biosecurity checks and protocols, and monitoring protocols for pest plants.	<ul style="list-style-type: none"> <li>• Key pest plants detected on site and their control.</li> <li>• Biosecurity protocols for machinery and gravel.</li> <li>• Sourcing plants for habitat enhancement.</li> <li>• Monitoring and adaptive management.</li> </ul>	A statistically significant decline in At Risk or Threatened plants observed in vegetation monitoring plots or transects (quantitative surveys). Alternatively, an increase in pest plants or decrease in threatened and At Risk plants observed by the vegetation ecologist during qualitative surveys.
Terrestrial invertebrate (TIMP)	Provide specific management measures to reduce the potential effects of the solar farm on terrestrial invertebrates during construction and operation, particularly through salvage and translocation.	<ul style="list-style-type: none"> <li>• Enhancement planting.</li> <li>• Salvage and translocation.</li> <li>• Incidental Discovery Protocol.</li> <li>• Compensation.</li> <li>• Monitoring and adaptive management.</li> <li>• Timetable for implementation.</li> </ul>	No increase in Otago short-horned grasshopper and (if applicable) minute grasshopper on site, OR a decline in abundance or activity of Tekapo ground wētā both on site and in released populations.
Avifauna (AMP)	Provide specific management measures to reduce the potential effects of the solar farm on avifauna during construction and operation, particularly through incidental discovery and monitoring protocols.	<ul style="list-style-type: none"> <li>• Further detail on all avifauna management.</li> <li>• Incidental Discovery Protocol.</li> <li>• Monitoring protocols.</li> </ul>	Various metrics based on the presence of nesting birds and the results of monitoring live and dead birds post-construction.
Pest mammals (PMMP)	Provide management measures to control and monitor pest mammals, particularly devices used, their placement and intensity of control.	<ul style="list-style-type: none"> <li>• A fully prescribed and illustrated pest mammal management plan.</li> <li>• Device placement.</li> <li>• Schedule for checking devices.</li> <li>• Implementation plan.</li> </ul>	A general decline in pest mammal abundance between the same seasons in consecutive years. Instructions also given for auditing methods used.



Compensation would consist of a research grant of \$15,000 every year for three years towards a research project looking at the effects of solar farms in the Mackenzie Basin on invertebrate populations (including the shading effects of solar panels). Data from surveys and monitoring would be freely shared with the grant recipient to help in their research.

### 13.5 Freshwater fauna

All construction will be undertaken in accordance with an erosion and sediment control plan to ensure that there are no accidental discharges of disturbed sediment into the surrounding waterways. This includes consideration of the timing of works to avoid periods when high rainfall events are predicted.

The 100-metre setback from the surrounding wetlands and 20-metre setback from the edges of the site will reduce the risk of sediment or incidental chemical pollution.

If the development is set back at least 20 metres from the site boundary and a sedimentation plan is in place to prevent sediment from entering the waterways (as proposed), then, it is likely that the effects of the development on freshwater fauna will be reduced to **less than minor**.

### 13.6 Refuelling of machinery

Refuelling of machinery should be undertaken away from the active river gravel bed by staff trained in safe refuelling protocols. Machinery and vehicles should be regularly maintained and checked for oil and fuel leaks. A spill response plan should be created to quickly contain any spills of harmful chemicals. If these measures are in place, then water contamination is unlikely to be an issue and the level of effect is considered to be **negligible**.

### 13.7 Wildlife management

#### Overview

Management plans for avifauna (Wildlands 2026c), lizards (Wildlands 2026b), and invertebrates (Wildlands 2026a) have been drafted to detail specific management actions for each taxon group and provide extra guidance on effects management. The Lizard Management Plan and Avifauna Management Plan are also provided as part of the application for a Wildlife Approval.

#### Wildlife Approvals sought

A Wildlife Approval (WA) is required to carry out activities that could conceivably have adverse impacts on some indigenous fauna (Department of Conservation 2018). For the project, a WA is sought for handling, disturbing, or accidentally harming lizards as part of project activities, and handling bird carcasses as part of avifauna monitoring. A WA is not necessary for terrestrial invertebrates, as no protected species have been found on site.

#### Avifauna

The AMP is proposed to be implemented to avoid and reduce adverse effects on avifauna. The AMP outlines management actions, including a pre-construction survey of braided river bird nesting activity, establishing buffer areas around any active nest sites to protect them from disturbance, and reducing the long-term potential effects of the solar panels on avifauna. The solar farm is also designed to address the potential 'lake-effect' by breaking up the panel surface area, using an anti-reflective coating, and implementing additional measures outlined in the AMP. A WA will be required to retain any bird carcasses for identification purposes, carcass detection trials, and carcass persistence trials. While bird strike risk is considered to be low, it is important that a WA is



proactively obtained so that if any carcasses are located, they can be immediately collected and retained for identification.

### Lizards

Due to the presence of indigenous lizards, the proposed solar farm development requires a WA under Schedule 7 of the FTAA which includes approvals relating to the Wildlife Act (1953). An associated LMP has also been prepared for the project (Wildlands 2026b). A LMP is a required supporting document to accompany the WA, as is continuing to meet all other legal obligations when carrying out approved activities.

The Department of Conservation will need to be confident that, on balance, lizard populations will not be worse off than prior to development of the site. The LMP provides a comprehensive plan that clearly addresses the potential losses of lizard populations and their habitats. Management actions detailed in the LMP include avoidance of high and moderate-quality habitats, habitat enhancement and lizard population monitoring at specific sites.

### Invertebrates

Due to the presence on site of minute grasshopper, Tekapo ground wētā, and Otago short-horned grasshopper the TIMP (Wildlands 2026a) is proposed to be implemented to minimise impacts on these species.

## 13.8 Ecological enhancement

Ecological enhancement helps to manage the effects of habitat loss and fragmentation on lizards and invertebrates, as well as injury, death and displacement for lizards. Ecological enhancement has broad benefits for all taxa, although it is mainly focused on providing improved habitat for lizards and grasshoppers. All taxa are likely to benefit from pest mammal control across the site, but lizards and invertebrates will primarily benefit from enhancement plantings.

Habitat enhancement includes the removal of pest plants (see the BVMP for discussion and methods; Wildlands 2026d) and the planting of ecologically appropriate species (detailed in the TIMP and described in the LMP; Wildlands 2026a&b). Key indigenous species proposed for enhancement planting include:

- Porcupine shrub (*Melicactus alpinus*)
- Mat pōhuehue (*Muehlenbeckia axillaris*)
- Common mat daisy (*Raoulia australis*)
- Dwarf broom (*Carmichaelia vexillata*)
- *Coprosma petriei*

Plantings will focus on indigenous shrubs and dryland plants that provide food and shelter for lizards and invertebrates, and mat-forming and prostrate plants which provide food and basking places for grasshoppers. Ecological enhancement should also include pest mammal control in accordance with a Pest Mammal Management Plan (Wildlands 2026) to improve habitat for lizards, invertebrates, and breeding birds. Pest mammal control will target mustelids, rodents, feral cats, hedgehogs, and lagomorphs. The Pest Mammal Management Plan provides that pest mammal control will begin at least one month before any salvaged invertebrates are released into the areas enhanced for them (Figure 15), and before rock stacks are created for lizards that will also benefit invertebrates.

Any area that is enhanced or protected should be protected as a condition of consent to ensure that biodiversity loss does not occur over the lifetime of the project (at least 35 years).



## 13.9 Overall assessment of ecological effects

The ecological effects on indigenous biodiversity, if the effects management recommended in this report are implemented, are presented in Table 12. The assessment in Table 12 indicates levels of effect before and after the management measures described in this report.

**Table 12 – Ecological effects, their levels, proposed management and levels of effects following implementation of appropriate and effective management.**

Effect	Level of Adverse Effect Without Management	Effects Management and Management Plan Provisions	Expected Level of Adverse Effect With Management
Loss of indigenous vegetation	More than minor	<ul style="list-style-type: none"> <li>Panel array avoids significant and/or indigenous vegetation with a 35-metre setback.</li> </ul>	Less than minor
Microclimatic changes beneath solar panels, resulting in changes to vegetation.	Minor	<ul style="list-style-type: none"> <li>Indigenous vegetation is not present within the panel area.</li> <li>Controlled grazing under the panels.</li> </ul>	Less than minor
Modifications to wetland habitat	Less than minor	<ul style="list-style-type: none"> <li>100-metre buffer between development and wetlands at the site and outside the site.</li> </ul>	Negligible
Loss of At Risk, Threatened, and rare plants	Minor	<ul style="list-style-type: none"> <li>Panel array avoids At Risk, Threatened and rare plants.</li> <li>Minimum setback of 35 metres between solar panels and habitats which support Threatened and At Risk plants.</li> <li>Regular monitoring of indigenous plants.</li> <li>Adaptive management will be undertaken if a decline is observed during regular monitoring. The response will be determined by the cause of the effect and could include changes to pest plant and animal control or grazing regime. If the cause is not obvious, external parties may be consulted.</li> </ul>	Less than minor
Risk of introduction of pest plants	Minor to more than minor	<ul style="list-style-type: none"> <li>Regular control and monitoring of pest plants.</li> <li>Biosecurity protocols.</li> </ul>	Less than minor
Avifauna habitat modification or loss	Minor	<ul style="list-style-type: none"> <li>Boundary setback areas will provide some habitat.</li> <li>Offsite habitat enhancement could be funded.</li> <li>Pest mammal management.</li> </ul>	Less than minor
Displacement of breeding fauna	More than minor	<ul style="list-style-type: none"> <li>Avoidance of construction during the breeding season.</li> <li>Habitat enhancement.</li> </ul>	Less than minor
Death or injury of avifauna during construction	More than minor	<ul style="list-style-type: none"> <li>Avoidance of construction during the breeding season.</li> <li>Predator management and offsite habitat enhancement.</li> <li>Avifauna surveys prior to construction.</li> <li>Incidental Discovery Protocol.</li> </ul>	Less than minor
Ongoing disturbance of avifauna	More than minor	<ul style="list-style-type: none"> <li>Panel and site design has minimised the risk.</li> <li>Drive slowly, reduce noise, and remain on designated access roads.</li> </ul>	Minor



Effect	Level of Adverse Effect Without Management	Effects Management and Management Plan Provisions	Expected Level of Adverse Effect With Management
Risk of bird strike	More than minor	<ul style="list-style-type: none"> <li>Panel and site design has minimised the risk.</li> <li>Carcass monitoring and adaptive management as described in the AMP.</li> </ul>	Less than minor
Injury/death/displacement of lizards	More than minor	<ul style="list-style-type: none"> <li>Lizard corridors and nodes.</li> <li>Incidental Discovery Protocol.</li> <li>Habitat enhancement.</li> <li>Pest mammal management.</li> </ul>	Less than minor
Loss of lizard habitat	More than minor	<ul style="list-style-type: none"> <li>Lizard corridors and nodes.</li> <li>Habitat enhancement.</li> <li>Pest mammal management.</li> <li>Avoidance of high-quality lizard habitat.</li> </ul>	Less than minor
Fragmentation of lizard habitat	Minor	<ul style="list-style-type: none"> <li>Lizard corridors and nodes.</li> <li>Habitat enhancement.</li> <li>Pest mammal management.</li> <li>Avoidance of high-quality lizard habitat.</li> </ul>	Less than minor
Reduction of lizard habitat quality (shading from panels)	Minor	<ul style="list-style-type: none"> <li>Lizard corridors and nodes.</li> <li>Habitat enhancement.</li> <li>Setbacks from prime lizard habitat.</li> <li>Pest mammal management.</li> <li>Avoidance of high-quality lizard habitat.</li> </ul>	Less than minor
Operational disturbance to lizards	Minor	<ul style="list-style-type: none"> <li>Habitat enhancement.</li> <li>Avoidance of high-quality lizard habitat.</li> <li>Pest mammal management.</li> </ul>	Less than minor
Disturbance to lizards during earthworks	Minor	<ul style="list-style-type: none"> <li>Incidental Discovery Protocol.</li> <li>Habitat enhancement.</li> <li>Avoidance of high-quality lizard habitat.</li> </ul>	Less than minor
Breeding failure/displacement of lizards	Less than minor	<ul style="list-style-type: none"> <li>Habitat enhancement.</li> <li>Lizard corridors and nodes.</li> <li>Avoidance of high-quality lizard habitat.</li> </ul>	Less than minor
Reduction in invertebrate habitat	Minor	<ul style="list-style-type: none"> <li>Avoidance of quality habitat.</li> <li>Habitat enhancement.</li> <li>Pest mammal management.</li> <li>Monitoring and adaptive management.</li> </ul>	Less than minor
Mortality and disturbance to invertebrates	Minor	<ul style="list-style-type: none"> <li>Avoidance of quality habitat.</li> <li>Habitat enhancement.</li> <li>Use grasshopper-friendly weed control.</li> <li>Dust management.</li> <li>Pest mammal management.</li> <li>Salvage and translocation.</li> </ul>	Negligible
Reduction in invertebrate habitat quality due to shading	Significant	<ul style="list-style-type: none"> <li>Avoidance of quality habitat.</li> <li>Setbacks from high quality habitat.</li> <li>Habitat enhancement.</li> <li>Pest mammal management.</li> <li>Monitoring and adaptive management.</li> </ul>	Minor
Sedimentation of nearby rivers	More than minor	<ul style="list-style-type: none"> <li>Sediment management plan.</li> <li>Setbacks from river edge.</li> </ul>	Less than minor
Contamination of nearby rivers	More than minor	<ul style="list-style-type: none"> <li>Setbacks from river edge.</li> <li>Spill response plan.</li> </ul>	Negligible
Risk of introduction of pest plants	More than minor	<ul style="list-style-type: none"> <li>Weed and pest plant management to follow protocols in BVMP.</li> </ul>	Less than minor

With robust avoidance and management measures, which have been adopted as part of the project proposal, adverse effects will be substantially reduced as the project will be implemented in an ecologically sensitive manner that recognises and protects the site's significant ecological features and values.



In particular, project design that avoids areas of high ecological value will be critical to maintaining indigenous biodiversity at the site.

The proposed suite of management plans prepared by suitably qualified and experienced ecologists (Wildland Consultants 2025a–d) will ensure that remaining potential adverse effects are appropriately avoided or minimised, and compensated where necessary.

## 14.0 Conclusions

This report provides an assessment of potential ecological effects of a proposed solar energy development in the Mackenzie Basin. Various desktop and field surveys underpin the findings presented in this report. Despite being relatively degraded by cultivation, the site includes significant indigenous biodiversity values, mostly distributed around the margins of the site. Significant biodiversity values were not detected across most of the proposed panel area, but undetected values may be present.

Important indigenous biodiversity at the site includes:

- Wetland habitats.
- Seven plant species classified as At Risk or Threatened.
- Eight Threatened and nine At Risk avifauna species may be present at the site.
- Three lizard species have been confirmed at the site, including two At Risk and one Not Threatened species.
- Two Threatened and one At Risk - Declining terrestrial invertebrate species.

Nearby braided rivers comprise a naturally rare and threatened ecosystem type, and provide habitat for diverse significant biodiversity, including four At Risk and two Threatened fish species.

Various potentially adverse ecological effects have been identified in this report, primarily relating to habitat loss and modification, but also including mortality, disturbance, and short-term effects of construction activities. Many of the potential adverse effects can be managed effectively through avoidance, which has been incorporated into the project layout. However, additional effects management, such as habitat enhancement, salvage and translocation, pest mammal control, and the implementation of management plans, is required to manage other potential adverse ecological effects.

These effects management measures have been accepted by the applicant and form part of the proposal. Most effects will be less than minor after management, with some reduced to negligible and two effects (ongoing disturbance of avifauna and reduction of invertebrate habitat quality due to shading) conservatively reduced to minor.

## References

- Ahmed Q. (2022). Use of a utility-scale solar energy facility by avian populations in central California. *Master's Thesis*.
- Andrew, I. G., Macfarlane, R. P., Johns, P. M., Hitchmough, R. A., Stringer, I. A. N. (n.d.). The conservation status of New Zealand Diptera. *New Zealand Entomologist* 35(2): 99–102.
- Atkinson, I. A. E. (1985). Derivation of vegetation mapping units for an ecological survey of Tongariro National North Island, New Zealand. *New Zealand journal of botany*, 23(3), 361-378.



- Barrell D.J.A., Anderson B.G., Denton G.H., 2011: Glacial geomorphology of the central South Island, New Zealand. *GNS Science Monograph*. GNS Science.
- Conkling T.J., Fesnock A.L., and Katzner T.E. 2023: Numbers of wildlife fatalities at renewable energy facilities in a targeted development region. *PLoS ONE* 18(12).
- Coughlan A. 2022: Risk assessment and mitigations of the potential impacts of trout predation on New Zealand's indigenous fish species: a thesis presented in partial fulfilment of the requirements for the degree of Master of Science in Ecology at Massey University, Manawatū, New Zealand.
- Davis N.G., Hodson R., and Matthaei C.D. 2022: Long-term variability in deposited fine sediment and macroinvertebrate communities across different land-use intensities in a regional set of New Zealand rivers. *New Zealand Journal of Marine and Freshwater Research* 56(2): 191-212.
- DeVault T.L., Seamans T.W., Schmidt J.A., Belant J.L., Blackwell B.F., Mooers N., Tyson L.A., and Van Pelt L. 2014: Bird use of solar photovoltaic installations at US airports: Implications for aviation safety. *Landscape and Urban Planning* 122: 122-128.
- de Lange P.J., Rolfe J.R., Barkla J.W., Courtney S.P., Champion P.D., Perrie L.R., Beadel S.M., Ford K.A., Breitwieser I., Schonberger I., Hindmarsh-Walls R., Heenan P.B., and Ladley K. 2018: Conservation status of New Zealand indigenous vascular plants, 2017. *New Zealand Threat Classification Series* 22. Department of Conservation, Wellington.
- de Lange, P.J., Gosden, J., Courtney, S.P., Fergus, A.J., Barkla, J.W., Beadel, S.M., Champion, P.D., Hindmarsh-Walls, R., Makan, T., and Michel, P. 2024: Conservation status of vascular plants in Aotearoa New Zealand, 2023. *New Zealand Threat Classification Series* 43. Department of Conservation, Wellington. 105 p.
- Department of Conservation 2020: PRR Interim Strategic Plan 2020 – 2023. <https://www.doc.govt.nz/globalassets/documents/conservation/land-and-freshwater/freshwater/prr/draft-interim-strategic-plan-2020.pdf>
- Department of Conservation (2025). *NOVA Energy proposed solar farm - Twizel*. Letter of concerns number
- Dunn N.R., Closs G.P., Crow S.K., David B.O., Goodman J.M., Griffiths M., Hicks A.S., Hickford M.J.H., Jack D.C., Kitson J.C., Ling N., Waters J.M., Wylie M.J., Hitchmough R.A., Makan T. (2025) *Conservation status of New Zealand freshwater fishes, 2023*. *New Zealand Threat Classification Series* 46. Department of Conservation, Wellington. 66 p
- Environment Canterbury 2013: Canterbury Regional Policy Statement 2013. Environment Canterbury.
- Hitchmough R, Barr B, Knox C, Lettink M, Monks JM, Patterson GB, Reardon JT, van Winkel D, Makan T, Michel P. 2026. Conservation status of reptiles in Aotearoa New Zealand, 2025. Wellington: Department of Conservation. *New Zealand Threat Classification Series* 50.
- Hoare R.J.B., Dugdale J.S., Edwards E.D., Gibbs G.W., Patrick B.H., Hitchmough R.A., and Rolfe J.R. 2017: Conservation status of New Zealand butterflies and moths (Lepidoptera). *New Zealand Threat Classification Series* 20. Department of Conservation, Wellington. 13 pp.
- Holdaway R J. Wiser S K. and Williams P A. 2012: Status Assessment of New Zealand's Naturally Uncommon Ecosystems. *Conservation Biology*, 26(4), 619–629.
- Jenkins A.R., Smallie J.J., and Diamond M. 2010: Avian collisions with power lines: a global review of causes and mitigation with a South African perspective. *Bird Conservation International* 20, 263-278.



- Jowett I.G. and Boustead N.C. 2001: Effects of substrate and sedimentation on the abundance of upland bullies (*Gobiomorphus breviceps*). *New Zealand Journal of Marine and Freshwater Research* 35(3): 605-613.
- Kagan R.A., Viner T.C., Trail P.W., and Espinoza E.O. 2014: Avian mortality at solar energy facilities in southern California: A preliminary analysis.
- Kosciuch K., Riser-Espinoza D., Gerringer M., and Erickson W. 2020: A summary of bird mortality at photovoltaic utility scale solar facilities in the southwestern U.S. *PLoS ONE* 15(4).
- Manaaki Whenua 2023: *Inland Outwash gravels*.  
<https://www.landcareresearch.co.nz/publications/naturally-uncommon-ecosystems/inland-and-alpine/inland-outwash-gravels/>
- Marshall Day Acoustics (2026). *Twizel solar farm acoustic assessment* (Rp 001 20240874). Prepared for BTW Company.
- Mathers K.L., Doretto A., Fenoglio S., Hill M.J., and Wood P.J. 2022: Temporal effects of fine sediment deposition on benthic macroinvertebrate community structure, function and biodiversity likely reflects landscape setting. *Science of the Total Environment* 829: p.154612.
- McEwen M. 1987: *Ecological regions and districts of New Zealand*. Department of Conservation.
- Olson A. 2021: Reflecting on solar panel glare and how to mitigate it.  
<https://1898blog.burnsmcd.com/reflecting-on-solar-panel-glare-and-how-to-mitigate-it>
- Robertson H.A., Baird K.A., Elliott G.P., Hitchmough R.A., McArthur N.J., Maken T.D., Miskelly C.M., O'Donnell C.F.J., Sagar P.M., Scofield R.P., Taylor G.A., and Michel P. 2021: Conservation status of birds in Aotearoa New Zealand, 2021. *New Zealand Threat Classification Series 36*. Department of Conservation, Wellington. 43 pp.
- Ryan P.A. 1991: Environmental effects of sediment on New Zealand streams: A review. *New Zealand Journal of Marine and Freshwater Research* 25(2): 207-221.
- Schori, J. C., Steeves, T. E., & Murray, T. J. (2020). Designing monitoring protocols to measure population trends of threatened insects: A case study of the cryptic, flightless grasshopper *Brachaspis robustus*. *PLoS One*, 15(9), e0238636.
- Sirvid P.J., Vink C.J., Fitzgerald B.M., Wakelin M.D., Rolfe J., and Michel P. 2021: Conservation status of New Zealand Araneae (spiders). *New Zealand Threat Classification Series 34*. Department of Conservation, Wellington. 33 pp.
- Smallie J. 2022: *The proposed development of the four Mura solar PV projects: Avifaunal impact assessment*. Prepared for Red Cap Energy (Pty) Ltd.
- Smith J.A., and Dwyer J.F. 2016: Avian interactions with renewable energy infrastructure: An update. *The Condor* 118: 411-423.
- Sowersby W., Thompson R.M., and Wong B.B.M. 2015: Invasive predator influences habitat preferences in a freshwater fish. *Environmental Biology of Fishes* 99(2-3): 187-193.
- Stoffels R 2022: New Zealand Freshwater Fish Database (extended). The National Institute of Water and Atmospheric Research (NIWA). Sampling event data set <https://doi.org/10.15468/jbpw92>. Accessed June 2023.



- Swaddle J.P., Emerson L.C., Thady R.G., and Boycott T.J. 2020: Ultraviolet-reflective film applied to windows reduces the likelihood of collisions for two species of songbird. *PeerJ* 16: e9926.
- Trewick S., Hegg D., Morgan-Richards M., Murray T., Watts C., Johns P., and Michel P. 2022: Conservation status of Orthoptera (wētā, crickets and grasshoppers) in Aotearoa New Zealand, 2022. *New Zealand Threat Classification Series* 39. Department of Conservation, Wellington.
- Visser E., Perold V., Ralston-Paton S., Cardenal A.C., and Ryan P.G. 2019: Assessing the impacts of a utility-scale photovoltaic solar energy facility on birds in the Northern Cape, South Africa. *Renewable Energy* 133: 1285-1294.
- Walston L.J.Jr., Rollins K.E., LaGory, K.E., Smith K.P., and Meyers S.A. 2016: A preliminary assessment of avian mortality at utility-scale solar energy facilities in the United States. *Renewable Energy* 92: 405-414.
- Walston L.J.Jr., Rollins K.E., Smith K.P., LaGory K.E., Sinclair K., Turchi C., Wendelin T., and Souder H, 2015: *A review of avian monitoring and mitigation information at existing utility-scale solar facilities*. Prepared for U.S. Department of Energy, Sunshot Initiative and Office of Energy Efficiency & Renewable Energy, Report No. ANL/EVS-15/2.
- Ward D., Early J., Schnitzler F-R., Hitchmough R., Rolfe J., and Stringer I. 2017: Conservation status of New Zealand Hymenoptera. *New Zealand Threat Classification Series* 18. 14 pp.
- Watts, C., Stringer, I., Thornburrow, D., & MacKenzie, D. (2011). Are footprint tracking tunnels suitable for monitoring giant weta (Orthoptera: Anostomatidae)? Abundance, distribution and movement in relation to tracking rates. *Journal of Insect Conservation*, 15(3), 433-443.
- Weston M.A., McLeod E.M., Blumstein D.T., and Guay P-J. 2012: A review of flight-initiation distances and their application to managing disturbance to Australian birds. *Emu Austral Ornithology* 112(4): 269-286
- Wildland Consultants. (2024a). *Additional lizard, vegetation, and invertebrate surveys of a proposed Twizel solar farm*. (6986; p. 36). Nova Energy.
- Wildland Consultants. (2024b). *Tekapo ground wētā tracking tunnel survey for a proposed solar farm near Twizel* (6986b; p. 4). Nova Energy.
- Wildland Consultants (2026a). *Terrestrial Invertebrate Management Plan for Proposed Nova Energy Twizel Solar Farm*. Wildland Consultants Contract Report No. 7414a. Prepared for Nova Energy Ltd. 32pp.
- Wildland Consultants (2026b). *Lizard Management Plan for proposed Nova Energy Twizel solar farm*. Wildland Consultants Contract Report No. 7414b. Prepared for Nova Energy.
- Wildland Consultants (2026c). *Avifauna management plan for proposed Nova Energy Twizel solar farm*. Wildland Consultants Contract Report No. 7414c. Prepared for Nova Energy.
- Wildland Consultants (2026d). *Biosecurity and vegetation management plan for proposed Nova Energy Twizel solar farm*. Wildland Consultants Contract Report No. 7414d. Prepared for Nova Energy.
- Wildland Consultants (2025). *Response to Department of Conservation Letter of Concerns for the Nova Energy proposed solar farm, Twizel*. Wildland Consultants Contract Report No. 6620b. Prepared for Nova Energy.
- Wildland Consultants. (2026). *Pest mammal management plan for Nova Energy proposed solar farm, Twizel*. Wildland Consultants Contract Report No. 6620a. Prepared for Nova Energy. 27pp.
- Wildlife Act 1953. <https://legislation.govt.nz/act/public/1953/0031/latest/DLM276814.html>



Williams P.A., Wiser S., Clarkson B., and Stanley M. 2007: New Zealand's historically rare terrestrial ecosystems set in a physical and physiognomic framework. *New Zealand Journal of Ecology* 31(2): 199-128.



## Appendix 1

### Vascular plant species recorded at the site

Species	Common Name	Plant Type	Status
<i>Achillea millefolium</i>	Yarrow	Forb	Exotic
<i>Aciphylla aurea</i>	Golden spaniard	Forb	Indigenous Endemic
<i>Agrostis capillaris</i>	Browntop	Grass	Exotic
<i>Aira caryophyllea</i>	Silvery hair grass	Grass	Exotic
<i>Alnus glutinosa</i>	Common alder	Tree	Exotic
<i>Alopecurus geniculatus</i>	Kneed foxtail	Grass	Exotic
<i>Anthoxanthum odoratum</i>	Sweet vernal	Grass	Exotic
<i>Bromus</i> species		Grass	Indigenous Non-Endemic
<i>Bromus tectorum</i>	Cheatgrass	Grass	Exotic
<i>Bulbinella angustifolia</i>		Grass	Indigenous Endemic
<i>Capsella bursa-pastoris</i>	Shepherds purse	Forb	Exotic
<i>Carex breviculmis</i>	Hooked sedge	Grass	Indigenous Non-Endemic
<i>Carex coriacea</i>	Rautahi	Grass	Indigenous Endemic
<i>Carex kaloides</i>		Grass	Indigenous Endemic
<i>Carex leporina</i>	Oval sedge	Grass	Exotic
<i>Carex secta</i>	Pūkio	Grass	Indigenous Endemic
<i>Cerastium fontanum</i>	Mouse-ear chickweed	Forb	Exotic
<i>Cirsium arvense</i>	Californian thistle	Forb	Exotic
<i>Cirsium vulgare</i>	Scotch thistle	Forb	Exotic
<i>Convolvulus verecundus</i> f. <i>verecundus</i>		Forb	Indigenous Endemic
<i>Coprosma propinqua</i>	Mikimiki	Tree	Indigenous Endemic
<i>Cytisus scoparius</i>	Broom	Shrub	Exotic
<i>Dactylis glomerata</i>	Cocksfoot	Grass	Exotic
<i>Discaria toumatou</i>	Tūmatakuru, matagouri	Tree	Indigenous Endemic
<i>Echium vulgare</i>	Viper's bugloss	Forb	Exotic
<i>Eleocharis acuta</i>	Spike sedge	Grass	Indigenous Non-Endemic
<i>Epilobium ciliatum</i>	Tall willowherb	Forb	Exotic
<i>Erodium cicutarium</i>	Storksbill	Forb	Exotic
<i>Erythranthe guttata</i>	Monkey musk	Forb	Exotic
<i>Festuca novae-zelandiae</i>	Hard tussock	Grass	Indigenous Endemic
<i>Festuca rubra</i>	Red fescue	Grass	Exotic
<i>Galium aparine</i>	Cleavers	Forb	Exotic
<i>Galium palustre</i>	Marsh bedstraw	Forb	Indigenous Non-Endemic
<i>Glossostigma diandrum</i>		Forb	Indigenous Endemic
<i>Holcus lanatus</i>	Yorkshire fog	Grass	Exotic
<i>Hypericum perforatum</i>	St Johns wort	Subshrub	Exotic
<i>Hypochaeris radicata</i>	Catsear	Forb	Exotic
<i>Juncus articulatus</i>	Jointed rush	Grass	Exotic



Species	Common Name	Plant Type	Status
<i>Juncus bufonius</i>	Toad rush	Grass	Exotic
<i>Juncus conglomeratus</i>	Soft rush;	Grass	Exotic
<i>Juncus effusus</i>	Soft rush	Grass	Exotic
<i>Juncus tenuis</i>	Track rush	Grass	Exotic
<i>Leontodon taraxacoides</i>	Hawkbit	Herb	Exotic
<i>Limosella lineata</i>	Mudwort	Forb	Indigenous Non-Endemic
<i>Linum catharticum</i>	Purging flax	Forb	Exotic
<i>Lolium arundinaceum</i>	Tall fescue	Grass	Exotic
<i>Lolium</i> species		Grass	Exotic
<i>Lotus pedunculatus</i>	Lotus	Forb	Exotic
<i>Lupinus polyphyllus</i>	Russell lupin	Forb	Exotic
<i>Marrubium vulgare</i>	Horehound	Forb	Exotic
<i>Melicytus alpinus</i>	Porcupine shrub	Shrub	Indigenous Endemic
<i>Microtis unifolia</i>	Māikaika, onion orchid	Forb	Indigenous Non-Endemic
<i>Muehlenbeckia australis</i>	Puka	Vine	Indigenous Non-Endemic
<i>Muehlenbeckia axillaris</i>	Pōhuehue	Vine	Indigenous Non-Endemic
<i>Myosotis laxa</i>	Water forget-me-not	Forb	Exotic
<i>Navarretia squarrosa</i>	Californian stinkweed	Forb	Exotic
<i>Orobanche minor</i>	Broomrape	Forb	Exotic
<i>Phleum pratense</i>	Timothy	Grass	Exotic
<i>Pilosella officinarum</i>	Mouse-ear hawkweed	Forb	Exotic
<i>Pilosella praealta</i>	King devil	Forb	Exotic
<i>Pinus contorta</i>	Lodgepole pine	Tree	Exotic
<i>Pinus nigra</i>	Black pine	Tree	Exotic
<i>Plantago lanceolata</i>	Narrow-leaved plantain	Forb	Exotic
<i>Poa cita</i>	Silver tussock	Grass	Indigenous Endemic
<i>Poa pratensis</i>	Kentucky blue grass	Grass	Exotic
<i>Poa trivialis</i>	Rough stalked meadow grass	Grass	Exotic
<i>Potamogeton cheesemanii</i>	Mānahi	Forb	Indigenous Non-Endemic
<i>Potentilla anserinoides</i>	Kōwhai kura, silver weed.	Forb	Indigenous
<i>Prunella vulgaris</i>	Selfheal	Forb	Exotic
<i>Ranunculus glabrifolius</i>	Kawariki	Forb	Indigenous Non-Endemic
<i>Ranunculus repens</i>	Creeping buttercup	Forb	Exotic
<i>Ranunculus sceleratus</i>	Celery-leaved buttercup	Forb	Exotic
<i>Raoulia australis</i>	Common mat daisy	Subshrub	Indigenous Endemic
<i>Rosa rubiginosa</i>	Sweet brier	Shrub	Exotic
<i>Rumex acetosella</i>	Sheep's sorrel	Forb	Exotic
<i>Rumex crispus</i>	Curled dock	Forb	Exotic
<i>Salix fragilis</i>	Crack willow	Tree	Exotic
<i>Sambucus nigra</i>	Elder	Shrub	Exotic
<i>Schoenus pauciflorus</i>	Bog rush, sedge tussock	Grass	Indigenous Endemic
<i>Sedum acre</i>	Stonecrop	Forb	Exotic



Species	Common Name	Plant Type	Status
<i>Silene species</i>		Forb	Exotic
<i>Solanum dulcamara</i>	Bittersweet	Subshrub	Exotic
<i>Sonchus asper</i>	Prickly puha	Forb	Exotic
<i>Stellaria alsine</i>	Bog stitchwort	Forb	Exotic
<i>Stellaria media</i>	Chickweed	Forb	Exotic
<i>Thelymitra longifolia</i>	Māikaika, white sun orchid	Forb	Indigenous Non-Endemic
<i>Trifolium arvense</i>	Haresfoot trefoil	Forb	Exotic
<i>Trifolium dubium</i>	Suckling clover	Forb	Exotic
<i>Trifolium pratense</i>	Red clover	Forb	Exotic
<i>Trifolium repens</i>	White clover	Forb	Exotic
<i>Verbascum thapsus</i>	Woolly mullein	Forb	Exotic
<i>Verbascum virgatum</i>	Moth mullein	Forb	Exotic
<i>Veronica serpyllifolia</i>	Turf speedwell	Forb	Exotic
<i>Veronica verna</i>	Spring speedwell	Forb	Exotic
<i>Vulpia myuros</i>	Vulpia hair grass, rats tail fescue	Grass	Exotic
<i>Wahlenbergia albomarginata</i>	New Zealand harebell	Forb	Indigenous Endemic



## Appendix 2

### Evaluation of the ecological significance of vegetation and habitats using the Canterbury Regional Policy Statement

Ecological Significance Criteria	Indigenous Habitat							Exotic Habitats			
	Ephemeral wetland	Flood channel shrubland	Tall fescue-rautahi marsh	Scarp herbfield and grassland	[Wilding conifer]/scarp herbfield and grassland	Old river terrace	Sweet vernal-mouse-ear hawkweed herbfield and grassland	Improved pasture (Browntop-sweet vernal-clover grassland, Alluvial grassland, Haresfoot trefoil herbfield, Haresfoot trefoil-sweet vernal grassland)	Sweet brier shrubland	Crack willow forest	Alder forest
<b>Representativeness</b>											
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.	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met
Indigenous vegetation or habitat of indigenous fauna that is a relatively large example of its type within the relevant ecological district.	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met
<b>Rarity/Distinctiveness</b>											
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.	<b>Criterion met.</b> Land use intensification and pastoral development have resulted in an estimated loss of 90% of wetlands in Canterbury	This criterion is not met	<b>Criterion met.</b> Land use intensification and pastoral development have resulted in an estimated loss of 90% of wetlands in Canterbury	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	<b>Criterion met.</b> Land use intensification and pastoral development have resulted in an estimated loss of 90% of wetlands in Canterbury	<b>Criterion met.</b> Land use intensification and pastoral development have resulted in an estimated loss of 90% of wetlands in Canterbury
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.	<b>Criterion met.</b> Indigenous avifauna may use this site to forage, including kotoreke/marsh crake ( <i>Zapornia pusilla affinis</i> , At Risk – Declining), and Māpunga/black shag ( <i>Phalacrocorax carbo novaehollandiae</i> )	This criterion is not met	<b>Criterion met.</b> <i>Carex kaloides</i> (At Risk - Declining) is present. Indigenous avifauna may use this site to forage and breed, including kotoreke/marsh crake ( <i>Zapornia pusilla affinis</i> ,	<b>Criterion met.</b> <i>Convolvulus verecundus f. verecundus</i> , <i>Pimelea sericeovillosa</i> subsp. pulvinaris, and <i>Rytidosperma exiguum</i> are present. Indigenous avifauna may use this site to forage and breed. At Risk	<b>Criterion met.</b> Three species listed as At-Risk Declining, <i>Carmichaelia vexillata</i> , <i>Raoulia australis</i> , and <i>Carmichaelia petriei</i> (all At Risk-Declining), are present within this vegetation type. At Risk indigenous	<b>Criterion met.</b> <i>Convolvulus verecundus f. verecundus</i> (Threatened - Nationally Vulnerable) is present. Indigenous avifauna may use this site to forage and breed. At Risk indigenous lizard species	<b>Criterion met.</b> <i>Carmichaelia petriei</i> and <i>Convolvulus verecundus f. verecundus are</i> present. At Risk indigenous lizard species (southern grass skink and Southern Alps gecko) are found in this habitat.	<b>Criterion met.</b> Tōrea/South Island pied oystercatcher ( <i>Haematopus finschi</i> , At Risk – Declining) is present and possibly breeding, and other avifauna may use this site to forage and breed. Minute grasshopper, (Threatened - Nationally Vulnerable), is	This criterion is not met	This criterion is not met	This criterion is not met



Ecological Significance Criteria	Indigenous Habitat							Exotic Habitats			
	Ephemeral wetland	Flood channel shrubland	Tall fescue-rautahi marsh	Scarp herbfield and grassland	[Wilding conifer]/scarp herbfield and grassland	Old river terrace	Sweet vernal-mouse-ear hawkweed herbfield and grassland	Improved pasture (Browntop-sweet vernal-clover grassland, Alluvial grassland, Haresfoot trefoil herbfield, Haresfoot trefoil-sweet vernal grassland)	Sweet brier shrubland	Crack willow forest	Alder forest
	At Risk – Relict) and kawaupaka/little shag ( <i>Microcarbo melanoleucos brevirostris</i> , At Risk – Relict) and pāpera/grey duck ( <i>Anas superciliosa</i> , Threatened – Nationally Vulnerable) within the pond area.		At Risk – Declining).	indigenous lizard species (southern grass skink and Southern Alps gecko) are found in this habitat. New Zealand blue butterfly is found in this habitat. At Risk and Threatened invertebrates may be present in this habitat.	lizard species (southern grass skink) are found in this habitat. At Risk and Threatened invertebrates may be present in this habitat. Indigenous avifauna may use this site to forage and breed.	(southern grass skink) are found in this habitat.	Indigenous avifauna may use this site to forage and breed.	present on the central southern terrace, Otago short-horned grasshopper (At Risk – Declining) is present on the western side, and Tekapo Ground Wētā (Threatened – Nationally Endangered) is present in parts of the site.			
The site contains indigenous vegetation or an indigenous species at its distribution limit within Canterbury Region or nationally.	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met
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 combination of factors.	<b>Criterion met.</b> Ephemeral wetlands are listed as rare ecosystems	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met
<b>Diversity and Pattern</b>											
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.	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met	This criterion is not met
<b>Ecological Context</b>											
Vegetation or habitat of indigenous fauna that provides or contributes to an important ecological linkage or network, or provides an important buffering function.	Criterion not met	Criterion not met	Criterion not met	<b>Criterion met.</b> This habitat provides important connectivity within the site	<b>Criterion met.</b> This habitat provides important connectivity within the site	Criterion not met	Criterion not met	Criterion not met	Criterion not met	Criterion not met	Criterion not met
A wetland which plays an important hydrological, biological or ecological role in the natural functioning of a river or coastal system.	Criterion not met	Criterion not met	Criterion not met	Criterion not met	Criterion not met	Criterion not met	Criterion not met	Criterion not met	Criterion not met	Criterion not met	Criterion not met



Ecological Significance Criteria	Indigenous Habitat							Exotic Habitats			
	Ephemeral wetland	Flood channel shrubland	Tall fescue-rautahi marsh	Scarp herbfield and grassland	[Wilding conifer]/scarp herbfield and grassland	Old river terrace	Sweet vernal-mouse-ear hawkweed herbfield and grassland	Improved pasture (Browntop-sweet vernal-clover grassland, Alluvial grassland, Haresfoot trefoil herbfield, Haresfoot trefoil-sweet vernal grassland)	Sweet brier shrubland	Crack willow forest	Alder forest
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>Criterion met.</b> This habitat type provides important year-round habitat for indigenous avifauna.	<b>Criterion met.</b> This habitat type provides important year-round habitat for indigenous avifauna	<b>Criterion met.</b> This habitat type provides important year-round habitat for indigenous avifauna.	<b>Criterion met.</b> This habitat type provides important year-round habitat for indigenous lizard species (McCann's skink, southern grass skink and Southern Alps gecko). This habitat type provides important seasonal habitat for indigenous avifauna.	<b>Criterion met.</b> This habitat type provides important year-round habitat for indigenous lizard species (McCann's skink and southern grass skink). This habitat type provides important seasonal habitat for indigenous avifauna.	<b>Criterion met.</b> This habitat type provides important year-round habitat for indigenous lizard species (McCann's skink, southern grass skink and Southern Alps gecko). This habitat type provides important year-round habitat for indigenous avifauna.	<b>Criterion met.</b> This habitat type provides important year-round habitat for indigenous lizard species (McCann's skink, southern grass skink and Southern Alps gecko). This habitat type provides important seasonal habitat for indigenous avifauna.	<b>Criterion met.</b> This habitat type provides important habitat for indigenous lizard species (McCann's skink).	Criterion not met	Criterion not met	Criterion not met

## Appendix 3

### Solar shade modelling



#### MEMORANDUM

To: [REDACTED]  
 From: [REDACTED]  
 Date: 19 March 2026  
 Subject: Solar shade modelling

#### Summary

The layout of the Twizel solar project has been designed to avoid shading effects of panels on indigenous vegetation and Threatened and At Risk plants. Setbacks from areas of ecological value where such plant species are located were identified using shade modelling.

The sun position at the Twizel Solar Farm was modelled for a full year at 5 minute intervals to determine the position of the sun for modelling shadow length.

The Solar Concept layout, structure dimensions and operational panel angles were used as inputs to shade modelling.

The outcomes from the shade model show the longest possible shadows occur directionally in the morning WSW (~233°) and evening ESE (~125°) sectors at 27.6 m. This shadow length recurs from 31<sup>st</sup> May to 17<sup>th</sup> June.

To eliminate potential shading effects on indigenous vegetation and Threatened and At-Risk plants in areas where they exist near panel development, a directional shading setback of 35m (which includes a margin of safety on the longest potential shadow) is applied to any panel rows within the 35m setback, which have been relocated (deleted or moved north) to avoid any shadow effects.

#### 1 Purpose

The purpose of this memorandum is to document the shade model methodology that has been used to evaluate solar structure shade extents for the Twizel Solar Project. This memorandum describes how the model was applied to assess and adjust the concept design, to avoid potential shading of surrounding ecological values.

#### 2 Assumptions

Geographical and engineering considerations relevant to determining the sunrise and sunset angles that may create the maximum (worst case) shading effects include the following:

- a) Solar Array location and time base:
  - i New Zealand Standard Time;
  - ii Latitude -44.297036, Longitude 170.142452; and
  - iii The Twizel solar plant is located in the southern hemisphere, therefore the shading angles are casted southerly as the sun moves east to west from a northerly angle.
- b) Surrounding topography:
  - iv Identification of any sun blocking effects by the surrounding horizon and landscape that may alter the minimum solar height that creates shading; and
  - v Assessment of the topography and horizon profile for the Twizel site, creates a minimum solar height ( $\alpha_{min}$ ) of 3°.
- c) Design assumptions of concept solar panel layout:

- i Solar panel rows are aligned north to south:
- ii Solar panels are mounted on a single axis tracker, that moves east to west to follow the sun angle through the day:
- iii Solar panel trackers are configured for back-tracking to optimise energy output:
- iv Structure – axis height  $h = 1.5$  m and collector width  $w = 2.5$  m:
- v Tracker (panel) row spacing (Pitch) is 7.5 m, Ground Coverage ratio (GCR) is 0.33:
- vi Terrain: the modelling assumes flat ground, which is representative of the site conditions
- vii The following terms are defined in Table 1 as:

Table 1 : Assumption Symbols and meaning

Symbol	Meaning	Units / Notes
$\beta$	Tracker rotation about N–S axis	degrees; $\pm 60^\circ$ east (–), west (+)
$w$	Collector width	Meters (m) (here 2.5 m)
$h$	Axis height above ground	Meters (m) (here 1.5 m)
GCR	Ground Coverage Ratio	unitless (here 0.33)
$P$	Row pitch (axis-to-axis spacing)	Meters (m) $\approx 7.5$ m

### 3 Methodology

The following methodology was applied to determine the time and length of the maximum shadow created by the concept design:

- a) Compute the solar position at five minute intervals:

The solar position (elevation  $\alpha$ , azimuth  $\varphi$ ) was computed at 5 minute intervals across a full year using the National Oceanic and Atmospheric Administration (NOAA) analytical equations. (NOAA GML: <https://gml.noaa.gov/grad/solcalc/solareqns.PDF>)

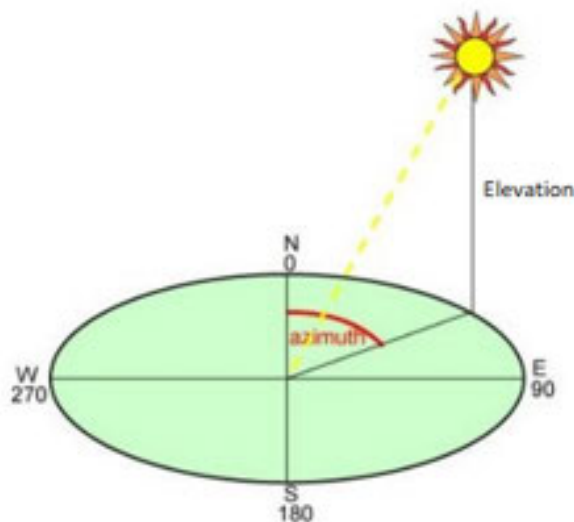
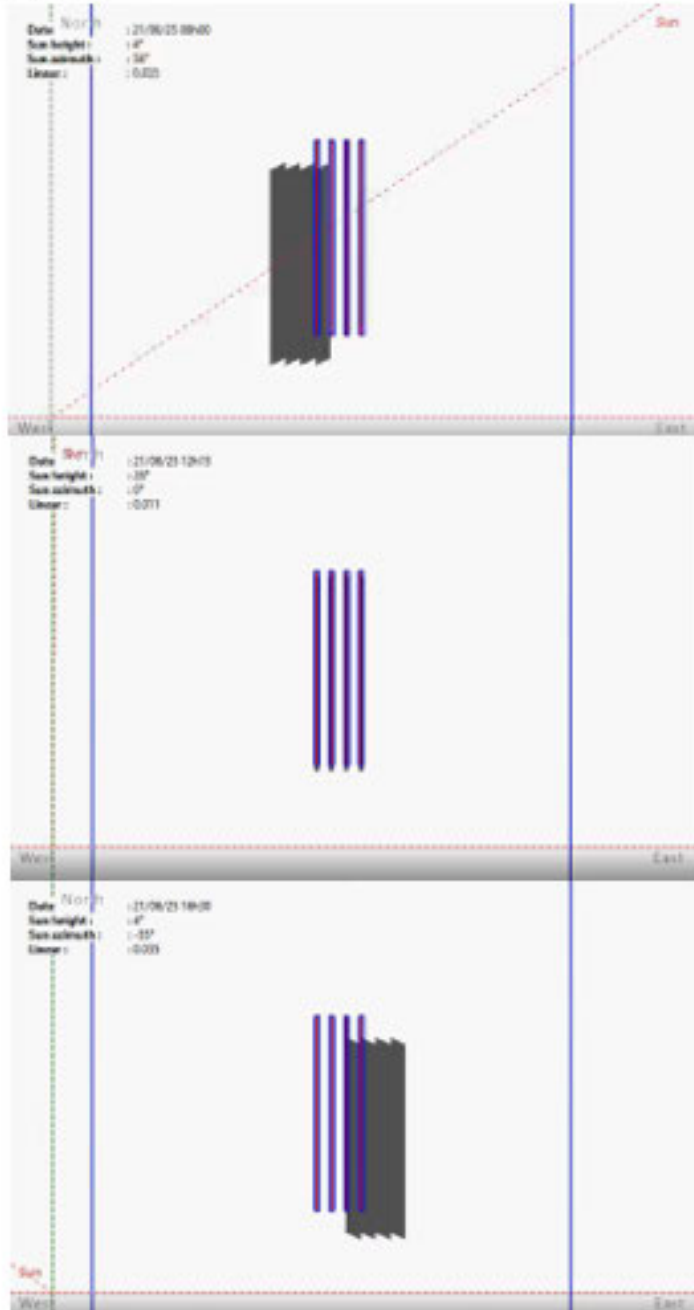


Figure 1: Solar Elevation and Azimuth

- b) A site specific azimuth–elevation horizon profile was applied ([refer section 2](#))

Any timestamps with elevation ( $\alpha$ ) of less than 3 degrees were excluded (as no direct beam sunrays). For each valid timestamp, singleaxis rotation ( $\beta$ ) and backtracking were calculated using the <sup>1</sup>[pvpmc](https://pvpmc.sandia.gov/modeling-guide/1-weather-design-inputs/array-orientation/single-axis-tracking/) conventions.

- c) Shadow length and associated vectors was obtained by projecting the highest casting point along the sun azimuth on level ground ([refer section 4](#)).
- d) Proof of concept: Industry standard Solar modelling software Pvsyst was used to model 3d scenes and check for assumptions, as shown in Figure 2: Shading in Morning, Mid-day and Evening resp.



<sup>1</sup> <https://pvpmc.sandia.gov/modeling-guide/1-weather-design-inputs/array-orientation/single-axis-tracking/>  
<sup>2</sup> [https://pvlib-python.readthedocs.io/en/stable/reference/generated/pvlib.tracking\\_singleaxis.html](https://pvlib-python.readthedocs.io/en/stable/reference/generated/pvlib.tracking_singleaxis.html)

Figure 2 : Shading in Morning, Mid-day and Evening resp.

#### 4 Calculations and results

The following calculations were performed:

a) Highest edge relative to axis at rotation  $\beta$ :

$$i \quad x_{top} = \sin(\beta) \frac{w}{2} \cos|\beta| \text{ (east +)}$$

$$ii \quad z_{top} = h + \frac{w}{2} \sin|\beta|$$

$$iii \quad L = x_{top} \cot \alpha - x_{top} \sin \phi \quad L \geq 0$$

iv Where the following terms in Table 2 are defined as:

Table 2 : Calculation symbols and meaning

Symbol	Meaning	Units / Notes
$\alpha$	Solar <b>elevation</b> above the horizon	degrees
$\phi$	Solar <b>azimuth</b> (clockwise from true north)	degrees
$\theta_z$	Solar <b>zenith angle</b>	$\theta_z = 90^\circ - \alpha$
$\alpha_{min}$	<b>Operational min. elevation</b> (cut-off)	degrees (here 3°)
$x_{top}$	<b>Horizontal offset</b> (east +) of the highest casting edge	
$z_{top}$	<b>Height</b> of highest casting edge above ground	

b) The results of the calculations are

i **Morning maximum (worst case) shadow length in west south west sector (~233°) is  $\approx 27.6$  m**

ii **Evening maximum (worst case) shadow length in east south east sector (~125°) is  $\approx 27.6$  m**

iii **Due south (180°) Check to determine longest midday shadow: the lowest elevation that clears the horizon is  $\alpha = 22.248^\circ \rightarrow L \approx 1.5 \cot(22.248^\circ) \approx 3.667$  m**

iv The **worst-case directional shadow length** recurs from 31<sup>st</sup> May to 17<sup>th</sup> June for the location of project, which.

#### 5 Implementation

The calculation results were applied to the panel row locations in the initial concept design, against the location of areas of significant ecological value to the south of the development area, to identify any panel rows that created shading effects on significant values.

The concept design was then revised to move any rows that were creating shading effects on significant values to ensure avoidance of shading effects.

a) With maximum (worst case) length of shadow calculated at 27.6m, an additional (27%) margin has been applied to create a (conservative) 35m shading setback for panel rows along the southern boundary which would otherwise shade areas of significant ecological value; and

b) The shading setback has been applied from the location of the area of significant ecological value, (as shown in Figure 3).

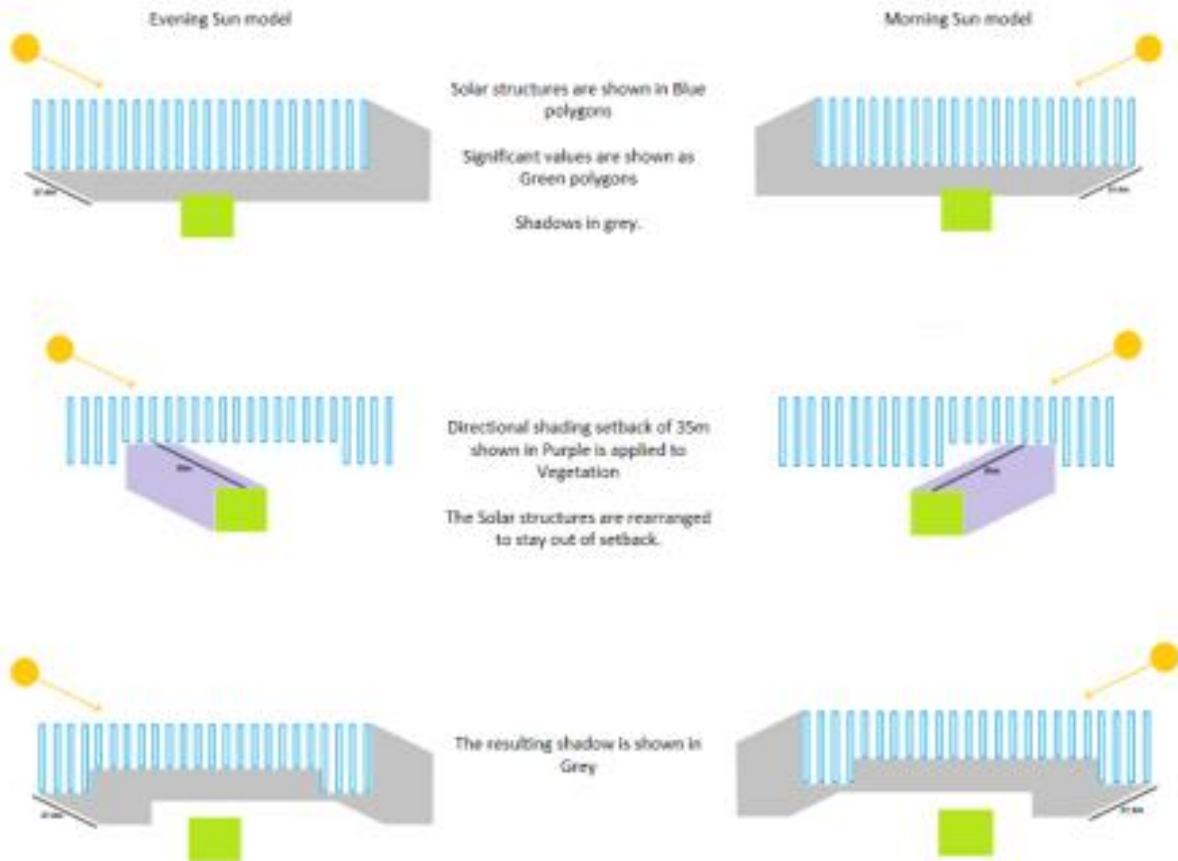


Figure 3 : Representation of shading setback panel adjustments



Call Free 0508 WILDNZ  
Ph +64 7 343 9017  
Fax +64 7 349018  
[ecology@wildlands.co.nz](mailto:ecology@wildlands.co.nz)

99 Sala Street  
PO Box 7137, Te Ngae