

Application for a resource consent - Form 9

APP240351084

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Date and Time Created

27/03/2024 10:04

To cross reference Datacom with MAGIQ please click [Here](#). to add the Resource Consent number.

Property Details

Property Address

48 Ranfurly-Naseby Road, Naseby

Valuation Number

Refer Appendix 1 of AEE

Record of Title Number

Refer Appendix 1 of AEE

Legal Description(s) of the specific parcels that the resource consent application is for

Section 3 Block XIX Maniototo Survey District; Section 33 Block II Maniototo Survey District; Section 10 BLK XIX Maniototo Survey District; Section 23 BLK VI Naseby SD; Section 2 BLK II Maniototo; Section 5 BLK XIX Maniototo

What is your role in this application?

Agent acting on behalf of the applicant

Agent details

An agent acts on behalf of the applicant in the submission and processing of the application.

Organisation

The Property Group

First name

MISHKA

Last name

BANHIDI

Phone number

+64275663155

Email address

mbanhidi@gmail.com

Note that the applicant will also receive a copy of all correspondence.

Postal address:

L3 Craig Investment 36 Grant Road, Frankton, Queenstown
9300

Confirm that you have approval to act on behalf of the applicant

Yes

The applicant is the person(s) or organisation making the application.

Applicant details

Is this applicant an individual or an organisation?

Business / organisation

Organisation

Helios OTA Op LP

Contact Person

First name

Sarah

Last name

Brooks

Phone number

0272022087

Email address

sbrooks@heliosenergy.co.nz

Postal address:

Level 12 Generator Britomart 11 Britomart Place, Auckland
Central, Auckland 1010

Authority to apply on behalf

Confirm that the applicant is authorised to apply on behalf of the organisation Yes

Invoicing

Who is paying the invoice? Applicant

DETAILS

Activity or works proposed

Application type

Land use consent

Short description of your proposal

To construct, operate and maintain a Solar Farm (Mānīatoto Plain Solar Farm), being a Renewable Electricity Generation Activity

Provide a detailed description in the Assessment of Environmental Effects (AEE) or other document.

Assessment of Environmental Effects (AEE)

An application cannot be accepted for processing by the Council under Section 88 of the Resource Management Act 1991, without an Assessment of Environmental Effects (AEE).

Refer to the [guidelines for Assessment of Environmental Effects](#).

[Helios Energy Mānīatoto Plain Solar Project Resource Consent Application.pdf](#) (65 mb)

Assessment of the activity

You may need to provide an assessment of the activity against the following provisions:

- The matters set out in [Schedule 4 of the Resource Management Act 1991](#).
- Any relevant objectives, policies, or rules in a document.
- Any relevant requirements, conditions, or permissions in any rules in a document.
- Any other relevant requirements in a document (e.g. in a national environmental standard or other regulation).

Please do not load the same document that you loaded for AEE above

Other activities

Other applications

Are you required to apply for any other resource consents for this project? Yes

Provide a brief summary of the other consents required

Regional resource consent required from the Otago Regional Council for not meeting required setbacks to natural inland wetland under the National Environmental Standards for Freshwater Regulations 2020.

Is this project related to a building consent?

No

Pre-application information

Have you discussed this proposal with Council staff prior to this application?

Yes, a pre-application meeting

Name(s) of Council staff involved

Adam Vincent

Date of discussion

08/11/2023

Site visit requirements

Who is the site contact?

Applicant

Affected party approvals

All affected property owners, including trustees where properties are held in a trust, must sign written approval forms AND a copy of your plans.

- If an affected party does not give approval to your proposal this may impact on the way that the application is processed.
- Council’s duty planner can provide you with advice on which parties may be affected by your proposal.

[Download an affected party approval template form.](#)

Do you need affected party approval?
Reason

Unsure
Refer to AEE

National Environmental Standard – Contaminated Soil -
option selected

A review has been undertaken of District and Regional Council records and no records have been found suggesting an activity on the HAIL has taken place on the piece of land which is subject to this application. NOTE: depending on the scale and nature of your proposal you may be required to provide details of the records reviewed and the details found.

LIST OF FILES

[Helios Energy Mānīatototo Plain Solar Project Resource Consent Application.pdf](#) (65 mb)

[Helios Energy Mānīatototo Plain Solar Project Resource Consent Application.pdf](#) (65 mb)

[Helios Energy Mānīatototo Plain Solar Project Resource Consent Application.pdf](#) (65 mb)

25 March 2024
Our job no. 719093

Central Otago District Council
1 Dunorling Street
Alexandra 9320

Attention: Resource Consents Team Leader

To whom it may concern,

Application for Resource Consent – Ranfurly-Naseby Road, Mānīatoto Plain Solar Farm

Please find enclosed a resource consent application on behalf of Helios OTA Op LP to install and operate a solar farm at 48 Ranfurly-Naseby Road (the Site).

This application includes a Form 9, a detailed description of the proposal, along with an assessment of environmental effects and supporting appendices.

A lodgement deposit of \$2000.00 will be paid by electronic transfer upon receipt of an invoice.

The Property Group Limited (TPG) is the agent for this application and should be the contact for any correspondence or telephone discussions.

I would appreciate being able to review draft conditions prior to consent being issued.

Please contact me should you have any questions regarding the application.

Yours sincerely



Mishka Banhidi

Senior Planner
0275663155
mbanhidi@propertygroup.co.nz

Form 9

Application for Resource Consent - Section 88, Resource Management Act 1991

To:	Central Otago District Council
Applicant:	Helios OTA Op LP
Agent:	Mishka Banhidi Senior Planner The Property Group Limited (TPG) 0275663155 mbanhidi@propertygroup.co.nz
Address service:	for The Property Group Limited Queenstown Office PO Box 2130 Queenstown 9371 Attention: Mishka Banhidi
Invoice details:	Sarah Brooks Helios Energy Ltd Level 11, Generator Britomart 11 Britomart Place Auckland Central Auckland 1010
Site address:	48 Ranfurly-Naseby Road, Naseby
Legal description:	There are six titles that form the "Site": • Section 3 Block XIX Maniototo Survey District • Section 33 Block II Maniototo Survey District • Section 10 BLK XIX Maniototo Survey District • Section 23 BLK VI Naseby SD • Section 2 BLK II Maniototo • Section 5 BLK XIX Maniototo

Owners of site:	Geoffrey Andrew Shaw, Lauren Patricia Shaw and Polson Higgs Nominees (2011) Limited Glenspec Holdings Limited
Consent for:	To construct, operate and maintain a Solar Farm (Mānīatoto Plain Solar Farm), being a Power Generation Activity, which is a Discretionary Activity
Description:	Land use consent application
Enclosed:	Application and Assessment of Environmental Effects (AEE) Appendix 1 – Record of Title Appendix 2 – Site Layout Plan Appendix 3 – Proposed Consent Conditions Appendix 4 – Mānīatoto Solar Farm Landscape Effects Assessment and Graphic Supplement Appendix 5 – Mānīatoto Solar Farm - Ecological Impact Assessment Appendix 6 – Mānīatoto Solar Farm Construction Methodology Appendix 7 – Naseby Solar Farm Development Integrated Transport Assessment Appendix 8 – Helios Solar Farm Mānīatoto Assessment of Noise Effects Appendix 9 – Mānīatoto Solar Farm - Engagement Summary Appendix 10 – Naseby Solar Farm Hazardous Substance Assessment
Signed:	 Mishka Banhidi Senior Planner 0275663155 mbanhidi@propertygroup.co.nz
Date:	25 March 2024

Application for Resource Consent

48 Ranfurly-Naseby Road, Naseby

Mānīatoto Plain Solar Farm

Helios OTA Op LP

March 2024

Quality control

Title:	Application for Resource Consent – Mānīatoto Plain Solar Farm
Client:	Helios OTA Op LP
Job number:	719093
Version	For client review – 12 March 2024
Version	Final – 22 March 2024
Prepared by:	Mishka Banhidi
Signature:	
Reviewed by:	Katrina Ellis
Signature:	

1. Introduction

Helios OTA Op LP (Helios) hereby applies for resource consent from Central Otago District Council (Council) to construct, operate, and maintain a solar farm at 48 Ranfurly-Naseby Road, Naseby (the Site). The proposed solar farm is also known as the Mānīatoto Plain Solar Farm.

Helios is a Kiwi company established in early 2020 when the founders recognised the potential for grid-scale solar developments to make a positive contribution to the existing New Zealand energy mix. Helios believe large-scale solar generation will make a meaningful and rapid contribution to New Zealand's goal of reaching 100 percent renewable electricity generation by 2030 and will democratise Aotearoa's energy market to help deliver a more secure and affordable energy supply for the country.

The Site is zoned Rural Resource Area in the Central Otago District Plan (District Plan). The solar farm activity requires multiple resource consents for the reasons outlined in section 4 of this report. The application includes plans of the proposal which are included as Appendix 2.

2. Site description

2.1 Location and description

The subject site 48 Ranfurly-Naseby Road, Naseby is located between Ranfurly and Naseby towards the north-east of the Central Otago District. The site is shown in Figure 1 below. Note the solar site is shown below in yellow outline, but the legal extent of this property is larger. Although surrounded by mountain ranges on the east and west, the site is located within a basin of fairly flat topography with some undulating pastoral land. The site is north-east of State Highway 86 (Ranfurly Wedderburn Road).

Access to the site is from Ranfurly – Naseby Road along the western boundary and Ranfurly Back Road along the eastern boundary.



Figure 1: Aerial photograph of the Site (yellow outline)

Surrounding land uses are typically agricultural with some forestry, tourism, recreation, conservation, energy, infrastructure, and residential uses. A more detailed assessment of the surrounding land uses can be found within Section 3.1 of the Landscape Effects Assessment¹, appended as Appendix 4.

¹ Mānīatoto Solar Farm: Landscape Effects Assessment February 2024

The subject site is largely characterised by grassland used for livestock grazing and benefits from existing boundary vegetation across the site. The site is predominantly dryland exotic pasture, and contains shelterbelts, indigenous shrubland, constructed farm ponds, and wetlands. The site also contains multiple waterways with poor drainage that are located within the natural depressions of the topography.

The site has been utilised for farming, primarily sheep and beef grazing and contains some small-scale rural structures such as fencing and stockyards.

No residential properties are located within the proposed solar farm area, noting the dwelling at 48 Ranfurly-Naseby Road is located outside of the solar farm area.

The Ecological Impact Assessment (EIA)² appended as Appendix 5 identifies that the site has limited ecological value due to the historical removal of indigenous vegetation and its agricultural use. Shrubs at the site, though in decline, holds high ecological significance in accordance with the Otago Regional Policy Statement, and the National Policy Statement for Indigenous Biodiversity 2023 (NPS-IB).

There are two moderately large wetlands on the site (located centrally and in the southwest, hereafter referred to as the central wetland and southwest wetland) which support indigenous wetland vegetation, including species considered at risk. A number of smaller wetlands are not vegetated or support at risk species. As outlined within the EIA, all wetlands regardless of their tangible ecological values, are deemed ecologically significant due to regional and national reductions in wetland cover.

2.2 Zoning and Notations

The Site is zoned Rural Resource Area in the District Plan, with an overlay of “Other Rural Landscapes (ORL)”. There are no other district plan overlays or notations over the Site.

Neither Council or Otago Regional Council (ORC) map the Site as subject to any natural hazard, with the exception of some high-level seismic information that has been applied district wide. Liquefaction risk has been identified as “Domain A” – A liquefaction potential of “low to none”.

In relation to highly productive land, there is no regional mapping of Highly Productive Land under the National Policy Statement for Highly Productive Land (NPS-HPL). As such the Land Use Capability (LUC) maps are relevant. The land is subject to LUC Class 4 and LUC Class 3

² Mānīatoto Solar Farm - Ecological Impact Assessment, dated 18 December 2023

soil classifications. The very small areas of LUC Class 3 land are as follows and are shown in Figure 2 below:

- Northern corner LUC Class 3 - approximately 4.422 ha and is entirely excluded from development.
- Southern corner LUC Class 3 - approximately 18.594 ha. Approximately 12.35 ha of this 18.594 ha area will be within the solar farm area.

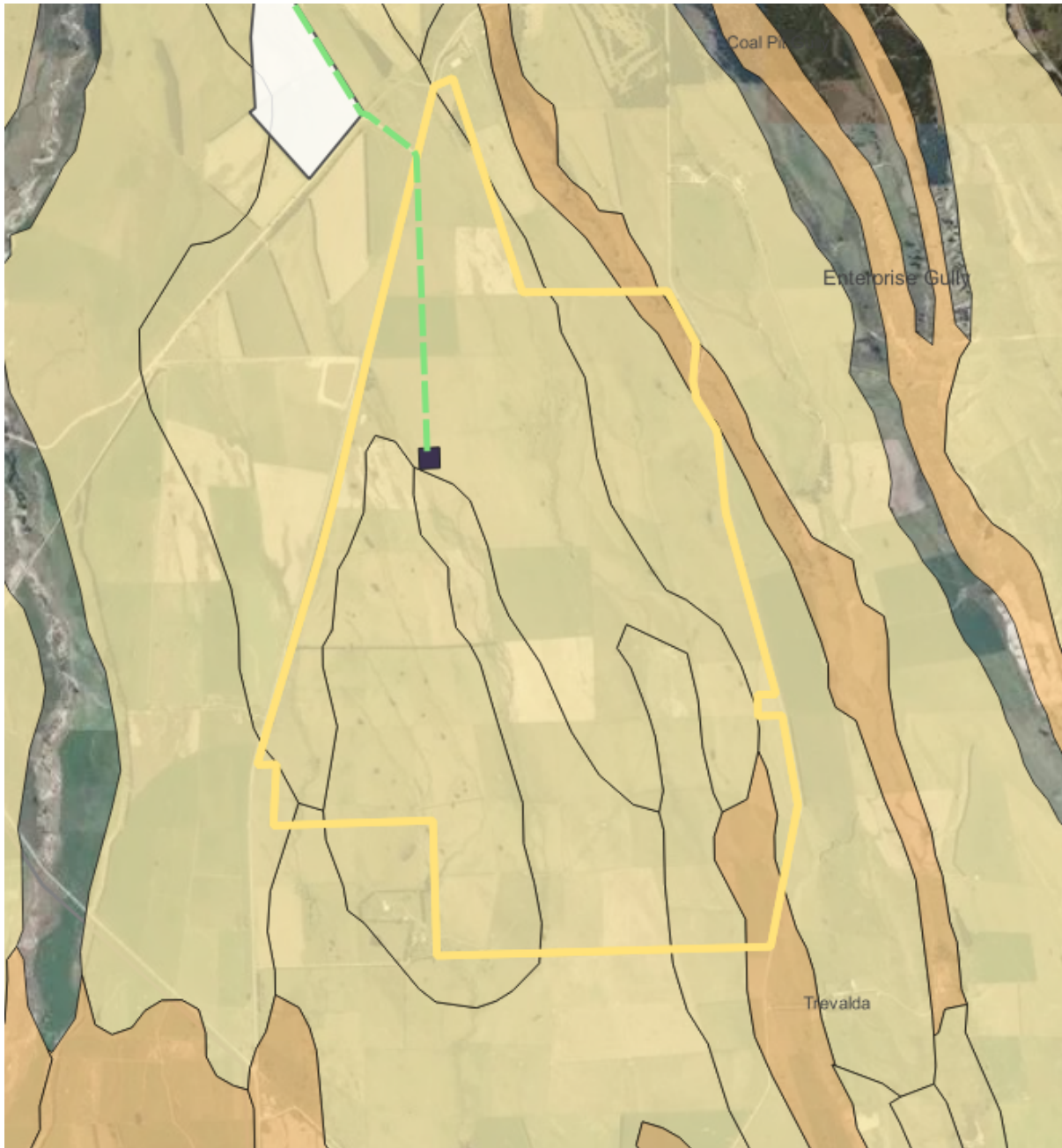


Figure 2: Extent of LUC Class 3 land within the Site

2.3 Legal Description

The subject site is comprised of six land parcels with a combined area of 797.1 ha of farmland in the Central Otago District, with the solar farm located within 665 ha of leased land. The Records of Title are appended as Appendix 1. Legal descriptions and property details of the land parcels are shown in Table 1 below.

Table 1: Records of Title

Record of Title details							
Identifier	Legal description	Area	Owner		Interests		
OT13D/517	Section 3 and Section 10 Block XIX Maniototo SD	132.05ha	Geoffrey Shaw, Patricia Polson Nominees Limited	Andrew Lauren Shaw and Higgs (2011)	Subject interests – none that would constrain the proposal	to various	
OT13D/516	Section 33 Block II Maniototo SD	227.5ha	Geoffrey Shaw, Patricia Polson Nominees Limited	Andrew Lauren Shaw and Higgs (2011)	Subject interests – none that would constrain the proposal	to various	
OT9C/187	Section 5 Block XIX Maniototo SD	106.5ha	Glenspec Holdings Limited		Subject interests – none that would constrain the proposal	to various	

3. Proposal

The application seeks resource consent to construct, operate and maintain an approximately 300MWac photovoltaic solar farm, and associated infrastructure including battery energy storage, substation and transmission line infrastructure for renewable electricity generation at 48 Ranfurly-Naseby Road, on the Mānīatoto Plain between Naseby and Ranfurly.

The proposed solar farm is to be built on land leased from two local farming families and will be connected into the National Grid via the Naseby Substation on Fennessy Road.

The general site layout of the solar farm is shown in Figure 3 below and appended as Appendix 2.

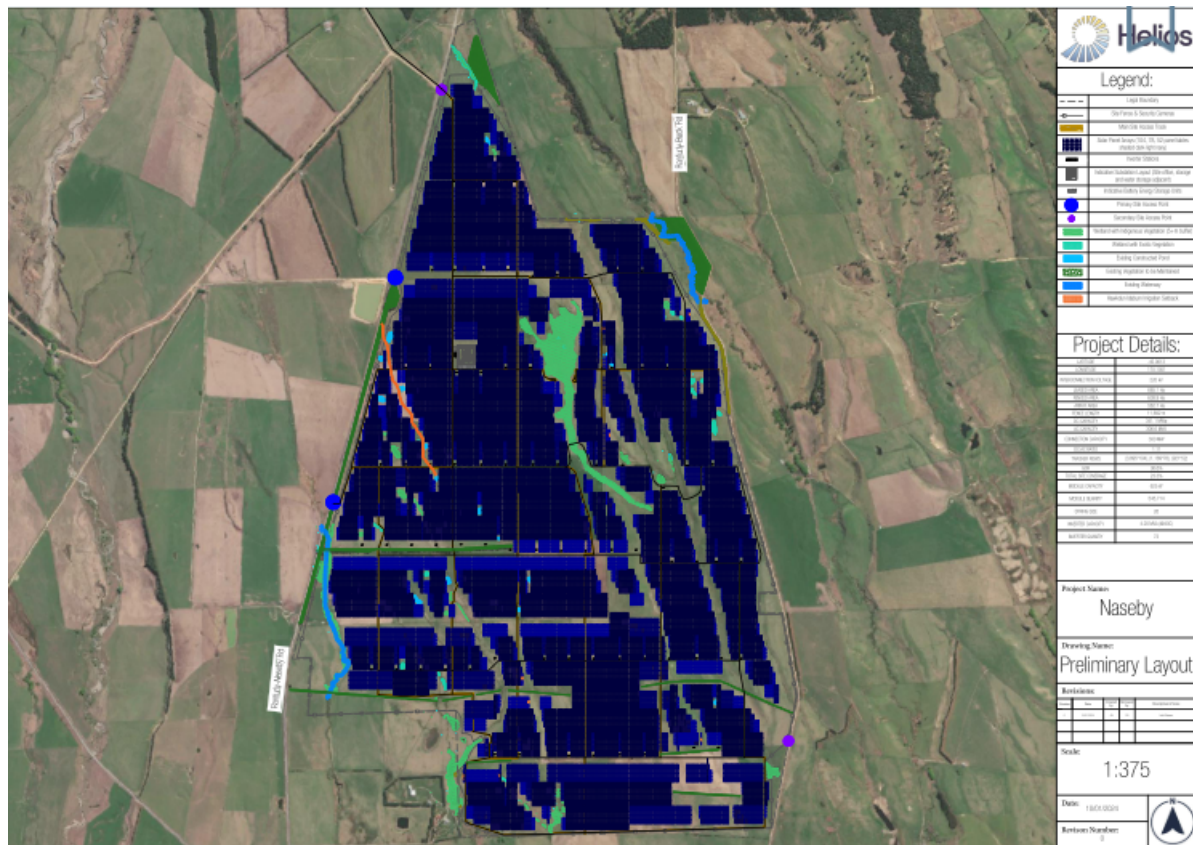


Figure 3: Site Layout Plan

3.1 Operational Solar Farm Components

Solar Panels

The solar farm will consist of approximately 550,810 solar panels, mounted on a tracking system. The panels will be aligned in north and south rows, and the panels will follow the movement of the sun throughout the day.

The solar panel dimensions will be:

- A maximum height above ground of approximately 2.8 m (when tilted to the maximum angle at the start and end of the day);
- A panel width of 2.4 m;
- A minimum height above ground of approximately 0.5 m (when tilted to the maximum angle); and
- A central axis (post / pole holding the panels above the ground) will be approximately 1.5 m above ground (Figure 4).

The central axis of the panel will be approximately 1.8 m high and each panel when rotated to the maximum angle will reach approximately 2.8 m above the ground at the highest point (refer to Figure 4). The panels will be arranged in rows approximately 6 m - 8 m apart (when measured

from pole to pole), which would leave at least a 3.6 m horizontal gap between the panels when positioned horizontally.

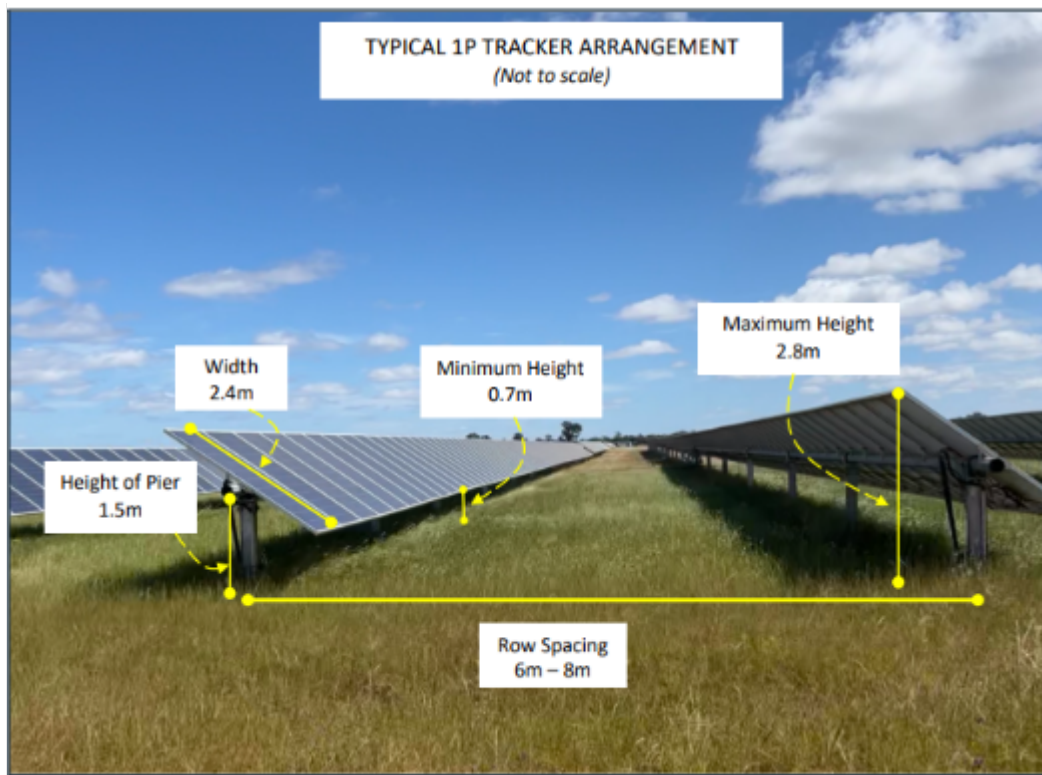


Figure 4: Typical dimension and layout of solar panels

When the sun is overhead and the solar panels are tilted parallel to the ground (i.e. at their maximum site coverage), they will along with all other above ground infrastructure buildings combined cover approximately 23.3% of the Site (155 ha in total).

The solar farm has been designed to allow enough space underneath and around the panels for compatibility with sheep grazing and pasture growth with a grass mix suitable for sheep grazing.

The solar panels are transported to the site in shipping containers and assembled on-site. The panels are installed on galvanised steel piles which are pile driven into the ground. No earthworks or concrete is required for the installation of the piles and panels.

Inverters

Seventy-three (73) inverters will be installed across the site. The inverters convert power generated by the solar panels from DC to AC current used in the electricity grid. These inverters will be distributed throughout the solar farm and used in the generation of power from the solar arrays.

The inverters will be located centrally within the site, away from shared boundaries. The dimensions of each inverter cabinet will be approximately 2.9 m high, 6.0 m long and 2.5 m wide; similar in size and bulk to 20ft shipping container units (refer to Figure 5 below). The specific make and model of inverter will be confirmed at the detailed design stage. These prefabricated structures will sit on piles approximately 600 mm above ground level. The

underlying ground will comprise compacted soil and stone. As an operational requirement to avoid overheating, this structure will be in a light grey colour palette.

Underground cabling will be installed across the site to connect the solar panel arrays with the inverters and the substation.



Figure 5: A typical Inverter

Battery Energy Storage System (BESS)

A BESS will be situated in the central west area of the Site, within a fenced off area next to the substation. The BESS will cover an approximate area of 2,000 m² (0.2 ha), with each battery unit approximately 3 m high. This is likely to comprise a series of 3 MW packaged battery units with the most likely options to be:

- 32 x Tesla Megapack; or
- 14 Power Electronics FS4390K 4.39 MW inverters with 10 banks of GridSolv Quantum Units.

If another BESS is determined as the most appropriate during detailed design, it would have a similar bulk and characteristics to the models outlined above.

The purpose of the BESS is to help manage the flows of energy generated by the solar panels and enable energy to be released into the National Grid overnight when solar energy is not being generated.

The BESS system will have a similar appearance to a 20-foot shipping container (Figure 6 below).



Figure 6: A typical BESS

The BESS will be housed on individual concrete plinths within a metallised compound. The prefabricated modules will be lifted onto the foundations. These structures are required to be white from an operational perspective to manage heat.

Substation

A new 33 / 220 kV substation will be constructed within the Site to collect power from the inverters throughout the site via 33kV cables and transform this to 220kV, suitable for transmission to the Transpower substation on Fennessy Road (Figure 7 below). The substation's exact layout and design is subject to future detailed design.

The solar farm substation will consist of a switchyard with an overall footprint of approximately 100 m x 110 m, being approximately 11,100m² (1.1 ha) in area, and will be accessed via internal site access tracks by vehicles who enter from Ranfurly-Naseby Road.

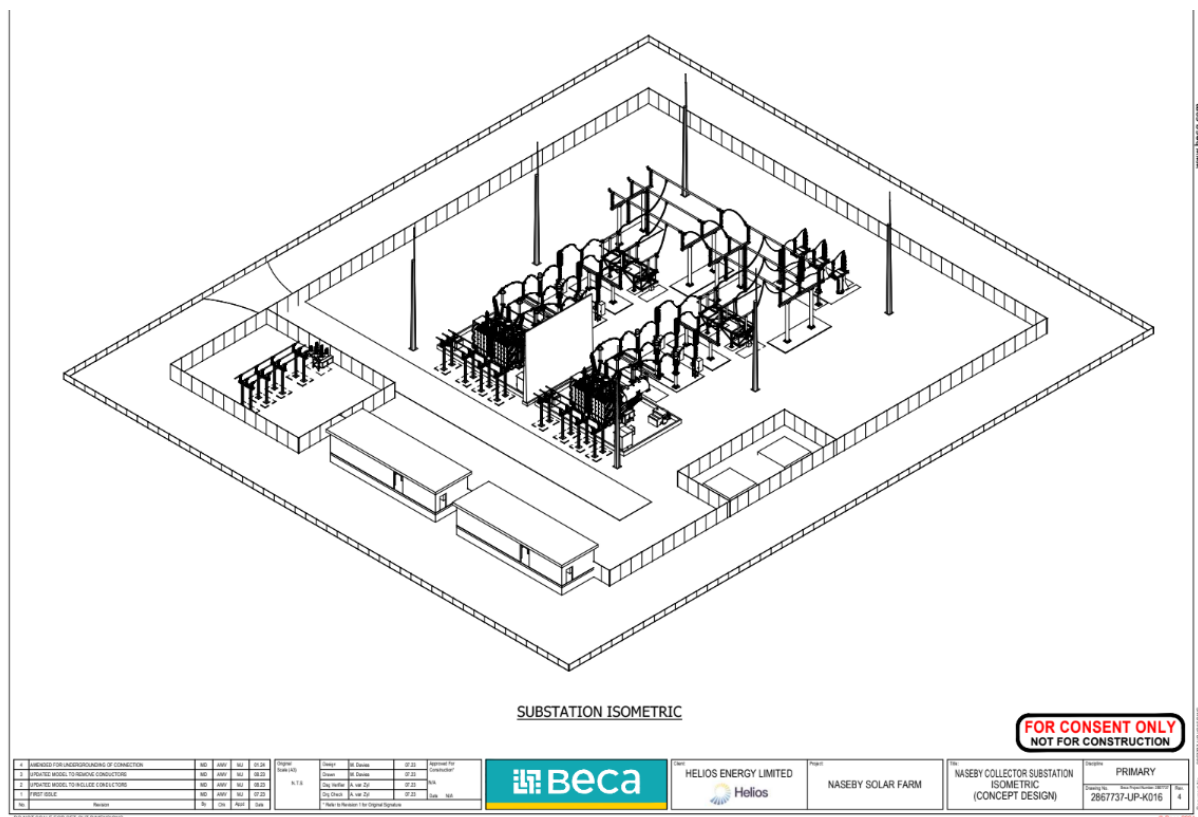


Figure 7: Indicative Substation Design

The substation will generally consist of a 150 mm layer of crushed rock aggregate, with approximately 500 mm of basecourse and sub-base material below this. Switchyard equipment will be mounted on concrete foundations. The perimeter of the facility will be enclosed with a lockable security fence and a stock fence. Within the substation there will also be up to two 33kV switch rooms (each approximately 6 m x 2 m).

Two 33/220kV 150 megavolt-amperes transformers will be installed on banded foundations. An oil treatment facility will be installed within a separate enclosure onsite to treat stormwater before discharging to land. An enclosure may be required over the capacitor banks if deemed necessary for harmonic mitigation. The capacitor banks will not contain any oil.

The 220kV transmission line to connect the site to the Transpower Naseby substation will terminate onto one 20 m high A frame within the switchyard. Lightning spikes will be mounted on top which will extend to 24 m high.

Lighting

External lighting will be provided onsite for intermittent emergency work and inspection purposes only. The substation, site office, and BESS areas will not be lit permanently at night. Lighting will be installed to comply with the District Plan lighting standards, with lighting directed downwards and onto the buildings.

Site Office

A new single-storey prefabricated office is proposed on the central portion of the site, near the substation building. This office building will be a standard model, generally 10.6 m long, 6.6 m wide, with an approximate area of 70 m². The maximum height of this building will be 3.6 m. The design of this building has yet to be finalised. However, building consent will be required and any servicing requirements addressed. It is noted that there is more than sufficient capacity on the site for onsite stormwater and wastewater treatment.

Water Tanks

Twelve (12) 25,000L above ground water tanks for firefighting purposes are proposed within the substation area.

Fencing

Two-metre-high deer fencing will be constructed around the perimeter of the site. The fences will be constructed with timber posts and mesh wire. Fences will be setback from external property boundaries to allow sufficient space for planting.

The substation and battery energy storage area will be surrounded by a wire mesh security fence, approximately 2.5 m in height.

Security Cameras

Security cameras will be installed on the security fencing around the perimeter of the site. Each of the cameras will point inwards and will be directed along the fence line. The cameras will not face toward neighbouring properties.

Planting

Screening Planting

A Landscape Effects Assessment (LEA) and Landscape Mitigation Plan (Figure 5A of the Graphic Supplement) has been prepared by Boffa Miskell and are attached as Appendix 4. The LEA identifies proposed mitigation planting along the boundaries of the solar farm to provide visual screening in front of the fence line. These recommendations, outlined within Section 6 of the LEA, form part of the proposal, are included as proposed consent conditions in Appendix 3 and are summarised below:

- Existing site boundary shelterbelts and vegetation are to be retained for screening purposes.
- Mitigation planting is to start in the first planting season after construction begins and finish by the end of the construction period.
- Prioritise planting along the boundaries closest to dwellings 2 and 4, as shown within the Graphic Supplement (Figures 7, 7A and 7B), and along the Ranfurly-Naseby Road.
- Use locally appropriate indigenous species for proposed native planting, focusing on tolerance to dry and extreme conditions and low fire-prevalence.

- Implement irrigation, monitoring, and maintenance for proposed and existing planting, including fenced wetland areas, to ensure plant health and growth.
- Prepare a Landscape Management Plan alongside the Landscape Mitigation Plan for both the establishment phase and ongoing routine monitoring and maintenance.
- Detail the mitigation and enhancement planting areas, specifying layout, species, grades, numbers, spacing, eco-sourcing, and implementation/maintenance programme.
- Require occasional pruning for view maintenance and 'spot' planting to fill in any gaps that may be evident between trees.
- Undertake replacement planting with evergreen species where necessary.
- Aim for 'drifts' of tree and shrub planting with a mix of species and plant sizes, avoiding an 'avenue' effect.
- Where practical, require on-site buildings and structures to have Light Reflectivity Value (LRV) of less than 30% to blend with existing infrastructure or natural landscape tones.
- Rehabilitate disturbed soil areas progressively or immediately post-construction.
- Limit night lighting to manually operated safety lighting at main component locations.

A Landscape Mitigation Plan has been developed, refer to Figure 5A in the Graphic Supplement (Appendix 4). The Landscape Mitigation Plan identifies the type, size and location of proposed mitigation planting. A Plant Species List has also been developed which identifies the botanical and common name, grade at time of planting, height after five years of planting, mature height, width and proposed spacings, refer to Figure 5B in the Graphic Supplement (Appendix 4). A final Landscape Mitigation Plan and Landscape Management Plan will be submitted to Council prior to construction for certification confirming the final layout, species, grades, numbers, spacing, eco-sourcing, a planting programme and specifications for implementation and ongoing maintenance.

Mitigation planting, wetland enhancement and supplementary planting

Vegetation removal is required over the project area to accommodate the solar farm. To remediate the loss of up to 250 matagouri, up to 100 desert broom, up to 100 porcupine shrubs, and up to 25 scrub pohuehue shrubs within the site, plantings of greater numbers of these species will be incorporated into ecological enhancement and landscape (boundary and screening) planting at the site, with these specific details found in the Landscape Mitigation Plan in the Graphic Supplement and the EIA (Appendix 5). In summary, the proposed mitigation planting measures are as follows:

- To account for time lags in the growth of new plantings and interim loss of existing shrubs that provide occasional feeding opportunities for (e.g.) indigenous birds such as grey warbler, at least double the number of plants will be established, specifically around 500 matagouri, 200 desert broom, 200 porcupine shrub, and 50 scrub pohuehue.
- Binding measures to undertake ongoing weed release, survival monitoring, and replacement of plants that do not establish / survive are also required, such as via a Vegetation Management Plan arising out of recommendations in the Project's LEA and associated Landscape Mitigation Plan.

- Because time lags and survival monitoring have been accounted for above, small grade (e.g. RX90) nursery plants could be used if larger plants cannot be obtained and provided so that survival monitoring and replacement occurs.

Helios also propose to undertake the following mitigation planting and other mitigation measures as additional measures recommended within the EIA:

- Remove crack willow and common alder from within the southwest wetland. Because of a risk of ongoing spread of these species from existing boundary plantings into wetlands, it is also proposed that these species are gradually replaced with natives or non-spreading exotic species along the existing boundary along Naseby-Ranfurly Road. For visual effects reasons, this will need to wait until new replacement screen plantings have been established and grown, to ensure screening is maintained.
- Undertake fencing along the southwest and central wetlands and supplementary planting within these wetlands and setbacks areas (total area c.31.3 ha). This planting work includes:
 - Planting appropriate wetland species to achieve ecological benefits include red tussock, purei, pūkio, *Carex kaloides*, grassland Spaniard, and bog rush.
 - Planting indigenous shrubs within the fenced 10 m wetland setback areas that also provide ecological benefits. Recommended species include matagouri, desert broom, scrub pohuehue, porcupine shrub, mikimiki (*Coprosma propinqua* var. *propinqua* and *C. intertexta*), and indigenous tree daisies (*Olearia odorata* and *O. bullata*).
 - Undertake wetland planting in scattered nodes of 5-10 plants (rather than mass planted across the entire wetland and setback area) of no less than 1% coverage (assuming 1m spacings). This will allow and accelerate natural spread based on habitat suitability. Based on a combined central and southwest wetland and setback area totalling c. 31.3 ha, 1% coverage at 1 m spacings equates to c.3100 plants.
 - As maturation of shrubs and wetland species will take many years in the interim, ongoing weed management, plant survival monitoring, and replacement of plants that do not establish / survive will be undertaken.
- Undertake ongoing removal of woody weeds within the southwest and central wetlands and wetland setback areas as necessary during the operation of the solar farm.
- Undertake predator control within the southwest and central wetlands (targeting mustelids and cats).
- The above measures will be detailed in a simple 'Wetland Enhancement Plan' to be prepared by a suitably qualified and experienced ecologist and implemented by Helios during construction and operation of the solar farm. The proposed planting will be completed in stages within the construction period and during planting seasons.

3.2 Site Preparation and Construction

Following early on-site investigations (including geotechnical investigations, piling tests and site surveys) and detailed design, the construction period is expected to take approximately 24 months. Due to the size of the site, construction is expected to be staged across the site. This will be followed by a period of commissioning activities. Below is a summary of the main stages. A more detailed Construction Methodology is provided in Appendix 6.

Site Preparation

This includes the removal of existing farm infrastructure. As the property is relatively flat, major earthworks are not required to prepare the site for the installation of the solar panels.

Piling and Trenching

The solar panel piles will be installed using driven ground pile methodology. No concrete foundations are required. The piles will be driven into the ground at regular intervals, with an expected depth of between 2.5 m to 3.0 m. The piles will be galvanized steel with a matte finish.

The DC cable trenches will be approximately 0.6 m wide and 0.8 m deep. The AC cable trenches may be wider at approximately 0.8 m wide and 1.2 m deep. The trenches will be completed in sections and backfilled with thermal sand to minimise the area of earthworks exposed at any one time.

Foundations

As the site is flat, minimal earthworks will be required to establish foundations for the inverters, substation and battery energy storage area. The battery energy storage area will be finished in gravel and each battery will sit on concrete plinths. Prefabricated inverter and battery units will be installed onto the foundations by crane.

Vegetation Removal

The vast majority of the site is pastoral grassed land, therefore, there will be no significant indigenous vegetation removal required. There will be the removal of some shelterbelt exotic trees located within the site, as well as the loss of natives detailed further above.

Earthworks

Given the large component of installation methodology required for the solar farm, only a small portion of the construction activities will involve earthworks.

Earthworks will be required for the installation of cables (AC and DC cables), internal access tracks, establishing a flat surface for the substation and inverter foundations, battery storage area, and small areas of cut and fill to enable efficient installation of solar panels in some areas.

Earthworks will be completed in stages to minimise the amount of soil exposed at any one time. All primary access tracks will be finished in an all-weather metalised surface, with secondary access tracks to remain grassed.

Directional boring / Horizontal Directional Drilling (HDD) will enable cabling beneath the central wetland without requiring surface disturbance or works within the wetland. Two boreholes with cables in triplex (6 cables) of approximately 100 mm thickness will be drilled to approximate 2 m depth with entry and exit holes >10 m from the wetland boundary (Figure 8 below).

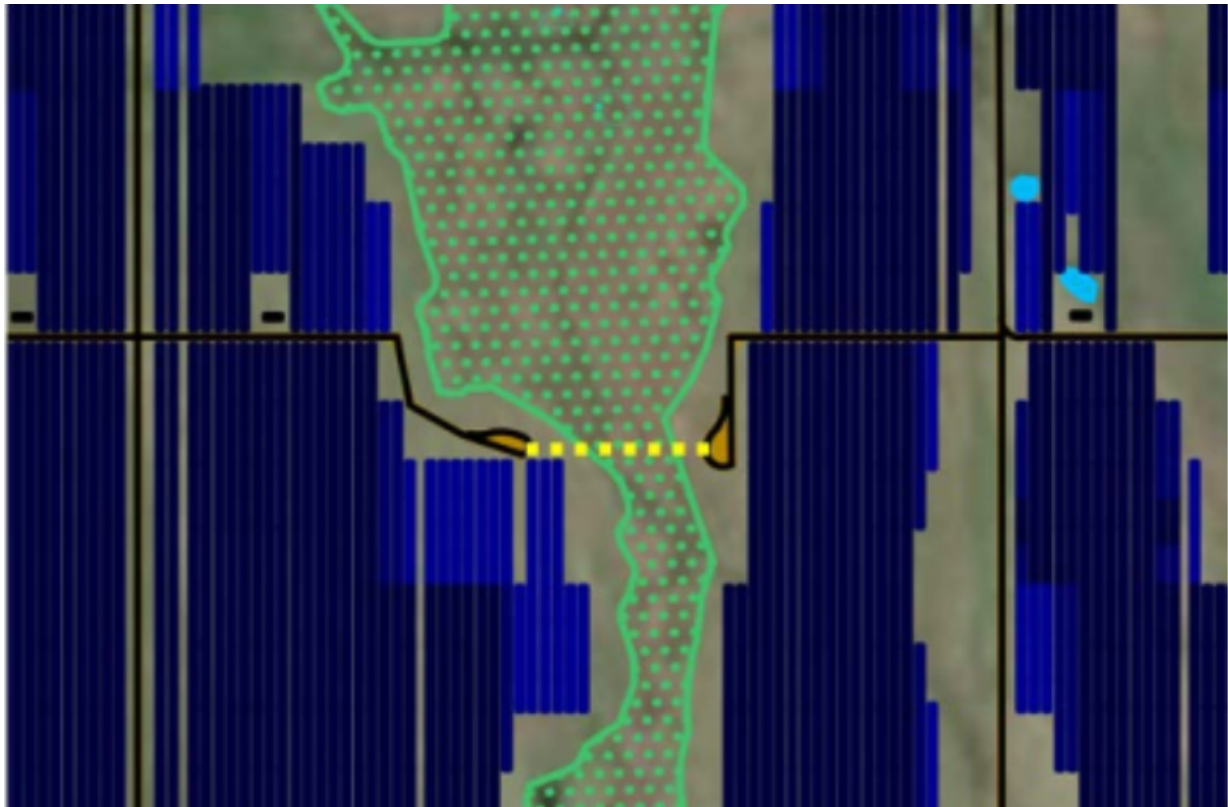


Figure 8: Horizontal Directional Drilling Indicative Location with Entry and Exit Points >10m from wetland habitat

A total approximate volume of 48,230m³ of earthworks will be undertaken across an approximate 15 ha area. This will be a mix of cut and fill works and all material will be reused onsite.

DC trenches will have a width of 0.6 m and depth of 0.8 m. AC trenches will have a width of 0.8 m and depth of 1.2 m. Trenches will be remediated in exotic grass.

Approximately 9,274m³ of thermal sand will be imported to the site for trenching purposes, as well as approximately 25,044m³ of Gap 20 gravel to create flat and stable areas for the inverters, substation, BESS and roading.

The estimated total area and volume of earthworks per project component is broken down as follows in Table 2:

Table 2: Estimated Earthworks Quantities

Component	Area of Earthworks	Volume of Earthworks
<i>Units</i>	<i>m2</i>	<i>m3</i>
DC Cable trenching	21,000	12,600
AC Cable Trenching	10,743	8,595
HV Cable Trench	1,660	1,992
Inverters	1,270	381
Roading	109,116	21,823
Substation	6,300	2,520
BESS Area	1,600	320
Total:	151,689	48,230

All earthworks will be undertaken in accordance with appropriate sediment and erosion control measures.

In the event that, during earthworks, an archaeological find is made or koiwi uncovered, work shall stop immediately and Aukaha shall be advised, and an appropriate course of action shall be determined in accordance with the Heritage New Zealand Pouhere Taonga Act 2014 and the appropriate iwi protocols.

Erosion and Sediment Control Measures

The following measures are proposed to manage sediment and erosion control during the construction period:

- Any exposed earth will be backfilled as soon as practicable.
- The trenching will be completed in stages to minimise the area of exposed earth at any one time.
- All excavated soils will be kept on site to be re-used or backfilled. If any excess soil is unable to be reused on-site it will be transported to an appropriate facility for disposal.
- The relatively flat topography of the site and free draining nature of the soils mean construction phase stormwater can be managed appropriately onsite by the contractor.

Dust Control

Earthworks will be completed in stages to minimise the amount of soil exposed at any one time. All vehicle crossings will be finished in an all-weather metalised surface.

The contractor will ensure appropriate measures to manage any dust within the boundaries of the site. Appropriate measures may include deploying water carts (or alternative dust suppression mechanism).

Site Access

Access 3 and 4 are to be secondary access points, primarily used to gain more direct access to other parts of the site to reduce the amount of travel through the site. Access 3 and 4 will not be used by heavy vehicles.

Figure 9 below shows the locations of these accesses. All accesses will be retained once construction is completed to allow for easier access to all parts of the site when required (although Access 1 and 2 will remain the primary accesses and Access 3 and 4 will receive minimal use).

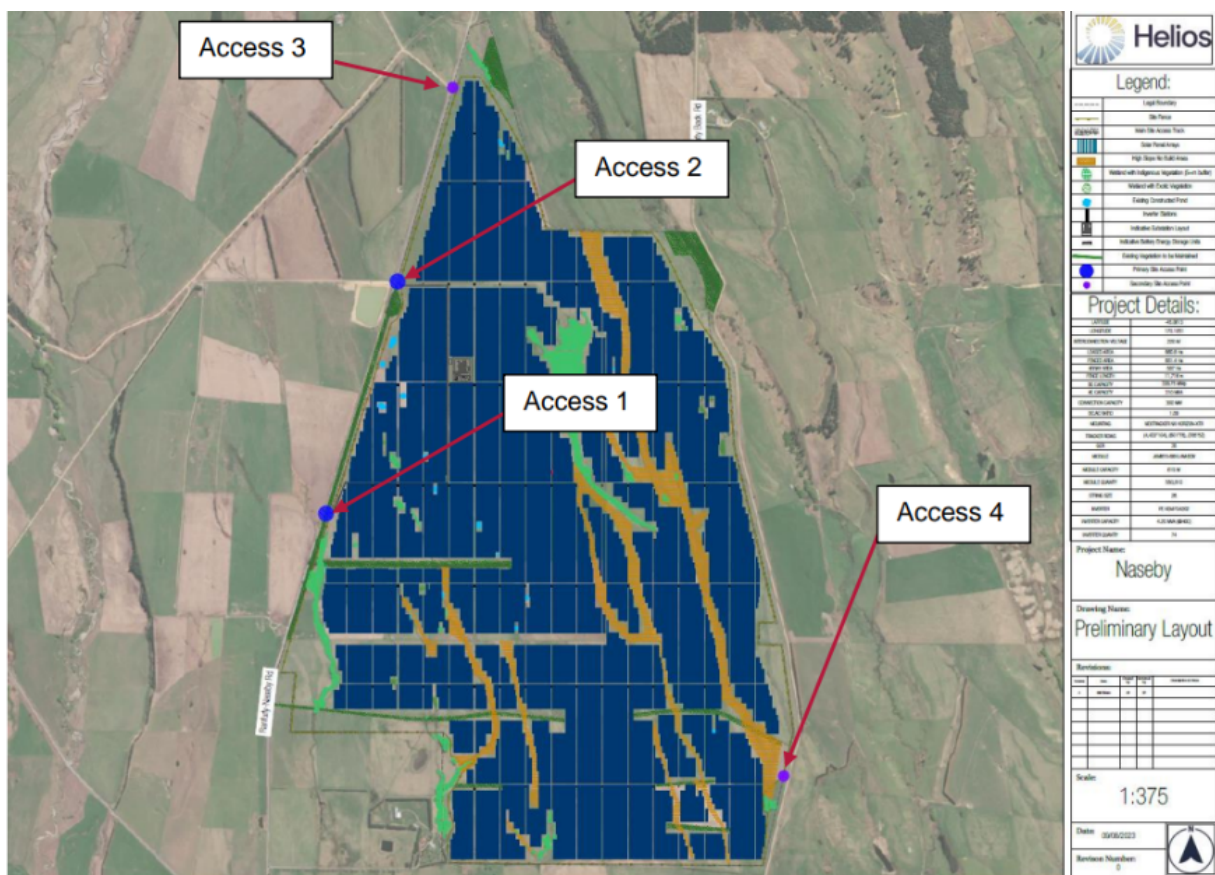


Figure 9: Proposed Access Locations. Source: Helios Energy

New sections of primary internal access tracks will be required (see route in Figure 9 above) which will be formed by the placement of sub-base aggregate, approximately 3.5-4.0 m wide, with necessary stormwater control. The primary access tracks will provide vehicle access to the

inverters located centrally across the site. Secondary access tracks will remain grassed to provide access between the panels and around the perimeter of the site.

Together with upgrades to existing access tracks, the total length of internal access tracks (new and existing) will be approximately 27 km.

Existing waterway crossings used to access across the site will be utilised for construction and operational vehicle access (predominantly construction). At time of detailed design, these will be further inspected to confirm whether any upgrade or new waterway crossings will be required, and additional resource consents sought if required. Therefore, at time of consent lodgement, it should be noted that works will be set back from waterways.

In addition to the above, the following measures (which are also recommended to be imposed as consent conditions) are proposed to ensure the safe and efficient operation of the roading network during the construction period (refer to the ITA in Appendix 7 and the Proposed Consent Conditions in Appendix 3):

- The contractor must follow appropriate processes to ensure disruption to the transport network is minimised during construction, and that any road reinstatement is completed to the satisfaction of Central Otago District Council. This will include preparation and approval of a Construction Traffic Management Plan (CTMP) by a suitably qualified and experienced professional and obtaining an approved Corridor Access Request from the road controlling authority (Central Otago District Council). At a minimum, the CTMP must address the following:
 - a) Ensure that truck drivers are advised to adhere to the speed limit and drive to the conditions during periods of adverse weather.
 - b) Ensure that truck drivers are advised of the circulation arrangements onsite, including the requirement to access the site via Access 1 and exit the site via Access 2.
 - c) Ensure that truck drivers are advised to stay on State Highway 85 (and travel through Ranfurly), so that they do not use Goff Road.
- Access 1, 2, 3 and 4 must be constructed in accordance with Figure 12.5 of the District Plan, with the geometry for Access 1 and 2 being in general accordance with that shown in the vehicle tracking.
- Access 1, 2 and 3 must be sealed from the edge of Ranfurly-Naseby Road to a distance not less than 5.0 m inside the property boundary.
- Only Access 1 and 2 are to be used by heavy vehicles.
- The layby area is set back sufficiently away from the gate to avoid vehicles queuing over the sealed access area.
- The use of Access 4 (and Ranfurly Back Road) must not include heavy vehicles and light vehicle movements may only consist of infrequent access to the rear parts of the solar farm.

Laydown Area

All parking and loading areas will also be constructed to an all-weather, metallised surface with necessary stormwater control.

A main construction laydown area will be constructed in the north-western side of the site near the two primary vehicle crossings. Dust will be controlled via water carts as required.

Construction Traffic

The ITA (attached as Appendix 7) details the traffic movements associated with the construction and operation of the solar farm.

Construction vehicles will enter Access 1 via Ranfurly-Naseby Road, drop off goods/materials at the laydown area, and exit via Access 2.

The average daily trips during peak months for the construction of the solar farm as calculated by Abley is likely to be 24 trips per day, comprising:

- 15 heavy vehicles, travelling either to or from the site, and
- 9 light vehicles, travelling either to or from the site.

Construction activities are likely to occur from 7am to 5pm Monday to Saturday. As such construction workers are likely to arrive on site between 7am to 9am, and leave between 4pm to 6pm, which equates to up to five vehicles per 2-hour period. In terms of delivery vehicles, up to three truck movements are anticipated within any given working hour.

Since Primary Construction Access 1 and 2 will operate as one-way accesses (with Access 1 being for entry only and Access 2 being egress only), it is not necessary to design the access to accommodate two-way movement of vehicles.

Construction equipment will include JCB earth movers (trenching), rollers (compacting access track and compounds), piling machines (for solar panel installation), and a crane (for positioning of inverters etc).

Construction Noise and Vibration

Construction of the solar farm will involve noise from the following sources:

- Delivery of panels, inverters and other components, requiring trucks and small cranes;
- Earthworks using trucks, loaders and excavators; and
- Installation of solar panels on pile driven support piles.

The total duration of construction is expected to be approximately 24 months, Monday to Saturday between 7.30am to 5pm.

The Assessment of Noise Effects by Marshall Day Acoustics (provided as Appendix 8) has concluded that construction noise will comply with the NZS 6803:1999 75dB construction noise limits.

Regarding vibration effects, the Assessment of Noise Effects concludes that there will be no perceptible vibration.

The preparation of a Construction Noise and Vibration Management Plan has not been considered necessary or recommended by Marshall Day Acoustics due to the proposal's

compliance with the District Plan noise limits, and that there will be no perceivable vibration effects.

Works in proximity to Waterways/ Wetlands

To assist with screening views of the solar panels and integrating the proposed development with the surrounding landscape, a combination of setbacks and screen planting are proposed. Regarding setback distances in relation to wetlands, constructed farm ponds and waterways, Table 3 below identifies the proposed setbacks which relate to construction and earthworks, i.e., of solar panels, cable trenches, accessways, inverters, and the like. These setbacks do not apply to proposed plantings for the purpose of ecological enhancement, or to perimeter fencing of wetlands.

Table 3. Setback distances in relation to wetlands, constructed farm ponds, and waterways.

Feature	Locations within Site	Construction and earthworks setback (min.)	Notes
Natural inland wetlands	Central wetland	10 m	Would also be fenced and enhanced
	Wetland and waterway in southwest of Site	10 m	Setback applies from the outermost of either the wetland or waterway boundary. Would also be fenced and enhanced
Natural inland wetlands	Small wetlands with indigenous vegetation (various locations)	5 m	Generally small features (c.<1000 m ²) - unfenced
	Small wetlands without indigenous vegetation (various locations)	5 m	Generally small features (c.<1000 m ²) - unfenced
Constructed farm ponds	Various locations	2 m	Not 'natural inland wetlands'. Unfenced
Waterways	Wetland and waterway in southwest of Site	10 m	Setback applies to the bank of the waterway
	Waterway in northeast of Site	10 m	Waterway located on lower terrace. Actual setback distance is c.>50 m

Connection to the Naseby Substation

The solar farm will be connected to the Naseby substation via a new underground 220kV transmission line. The construction of new underground transmission line is a Permitted Activity under Rule 13.7.9 of the District Plan.

Helios will work with the District Council and other relevant authorities to obtain any other required non-RMA approvals to install the 220kV transmission line.

3.3 Commissioning Activities

The commissioning process is the final stage in establishing a solar farm. This stage involves a series of tests to ensure all components including solar panels, inverters, transformers, switchgear and associated systems are installed and functioning correctly.

It also involves grid connection testing to ensure the power generated by the solar farm can be safely and effectively integrated into the electricity grid. While there are a number of electrical contractors required on site during this time, there are no prolonged or heavy construction related activities during the commissioning stage.

3.4 Operation of Solar Farm

Staff and maintenance

Once the solar farm is operational, activity will be very limited. No staff will live or permanently work onsite as the componentry is operated / monitored remotely. However, should componentry need to be replaced, it will need to be accessed. This is likely to be infrequent. Vehicle movement within the site will typically be by quad bike or small farm utility vehicle.

Once operational, it is anticipated that traffic movements to and from the solar farm will be of a low volume and intermittent. Up to two staff members are expected to visit the site five to six times per week, which will equate to approximately 12 trips per week. It is noted that this estimate is conservative, and traffic movement levels could be lower.

The inverters have a 20-year warranty and will likely require replacing once within the operational life of the solar farm. The replacements will be like for like on the same foundations. The substation will be maintained through regular maintenance visits.

No operational or maintenance works will be undertaken on the site outside of daylight hours except for emergency inspections or maintenance.

Solar panels have a silicon based non-stick surface and are cleaned adequately via rain.

Sheep grazing

As noted above, the land under and around the solar panels will remain as pastoral land.

The grazing of sheep is complementary to the operation of a solar farm, due to the size of sheep being able to freely move under and shelter amongst the panels without damaging them.

Appropriate fencing will be installed within the site to prohibit sheep from accessing waterways and substation/BESS infrastructure, as well as manage their grazing areas within the solar farm site. While it is acknowledged that some farm infrastructure will be removed in order to allow the

commissioning and operation of the solar farm, sufficient farm infrastructure, such as fencing will remain, allowing for the concurrent use of grazing and energy production.

Operational Noise

An Assessment of Noise Effects has been prepared by Marshall Day Acoustics (refer to Appendix 8). Noise will be generated during daylight hours from power generation, and primarily between the hours of 7am to 10pm, with generation potentially starting before 7am in summer periods (however this will be low, as solar levels are not high then).

The solar panels will make up the majority of the site and are installed on tracker frames which tilt slowly to align the panels to the sun throughout the day. The trackers are rotated around a central horizontal axis by a DC motor (which is small and low powered, approximately 300 watts). The tracker motors make very low levels of noise and operate intermittently during daylight hours and only for a short period as they make small incremental adjustments to the trackers.

There is a low level of noise generated by the cooling fans within the inverters. However, inverters will be positioned centrally throughout the site to ensure they are located away from residential properties.

The Assessment of Noise Effects concludes that the solar farm will be designed to comply with the noise limits in the District Plan, for all periods of the day, and for all assessed scenarios of operation.

BESS, transformer and inverter hazardous substances

Transformer and inverters contain oil, electrolyte and coolant for both electrical insulation and cooling. It is not anticipated these substances will be drained during the lifespan of the components. As such, this oil is a passive substance. The dominant volume of oil is contained in two transformers at the proposed substation, with the remainder of oil stored in the 74 inverters across the site. Electrolyte and coolant can also be found in the BESS units.

The proposed quantities of dimethyl carbonate contained in the batteries exceed the quantities permitted in the Rural Resource Area zone. While the entire activity is managed through Section 13 of the plan, resource consent would otherwise have been required for this storage. The substances will be managed through appropriate design and maintenance of the BESS. There will be fire extinguishers in appropriate locations, and appropriate personal protective equipment (PPE) for workers (as required by health and safety, and by hazardous substances regulations).

Fire Safety Measures

Helios has undertaken engagement with Fire and Emergency New Zealand (FENZ) (refer to the Engagement Summary document in Appendix 9) and have taken into account their feedback as part of the site design and on-site fire safety measures.

The proposal includes low fire risk plant species as part of the landscape design, appropriate access around the site to allow for fire trucks, and the provision of firefighting water supply via the 12 above ground water supply tanks. These measures will be incorporated into the detailed design. Further, an Emergency Management Plan will be developed between Helios, the yet to be appointed contractor, and FENZ to detail emergency service access and emergency response procedures during construction and operational phases, confirmation of on-site firefighting water supply and any other fire risk management measures and procedures.

3.5 Decommissioning of Solar Farm

At the end of the operational lifespan of the solar panels, the solar farm, including the substation building and all ancillary equipment, will be dismantled and removed from the site.

Materials will be reused or taken to an appropriate location for recycling or disposal. The site will be reinstated to its original pre-construction condition.

4. Statutory Framework

The following provides an assessment of the proposal against the relevant statutory framework to determine what resource consent(s) are required.

4.1 Central Otago District Plan

The site is zoned Rural Resource Area in the District Plan. The site is subject to the Other Rural Landscapes (ORL) overlay. See Figure 10 below:

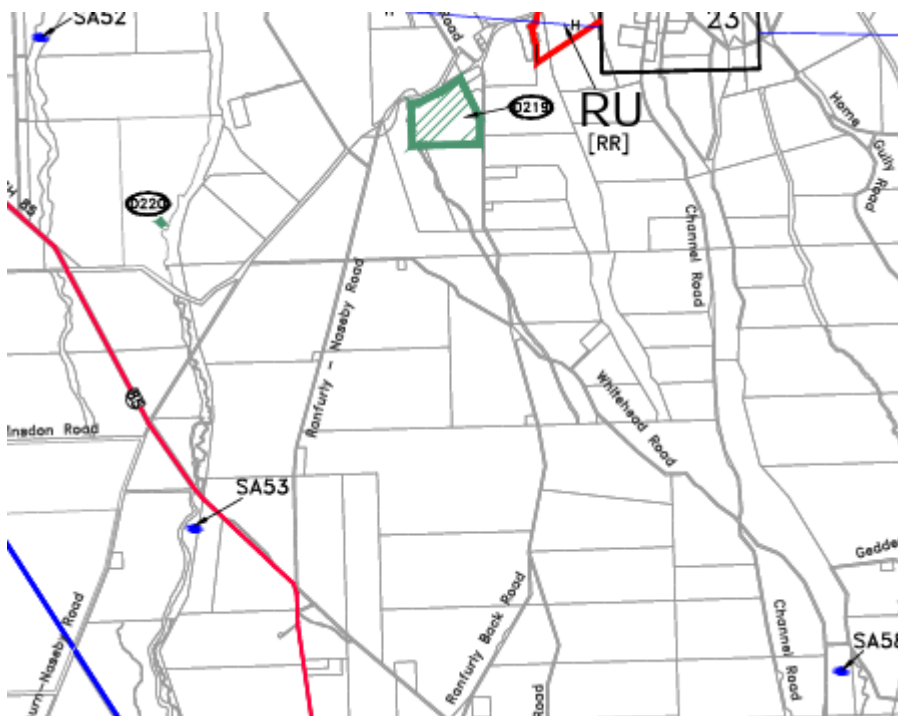


Figure 10: Zoning of site (Source: Central Otago District Plan)

The proposal falls within the definition of ‘Power Generation Facility’ which is defined as follows: “means a facility, operation or activity whose principal purpose is to generate energy, and includes hydroelectric, thermal and geothermal power stations, wind turbines and other power generation technology but excluding devices such as solar panels for the sole use of a domestic activity.”

This encompasses all works and activities directly involved with the building and operation of a new power generation facility. As stated within Section 13.7.4.(iii) this includes site preparation, earthworks, quarrying, concrete batching, plant construction, road construction and widening,

traffic generation, reservoir formation, clearance, or inundation of vegetation. Power Generation Facilities are a Discretionary Activity pursuant to Rule 13.7.4(iii) of the District Plan. As such, consent is required under section 9 of the RMA due to triggering Rule 13.7.4(iii) of the District Plan.

As outlined within Section 13.7.1 of the District Plan, the rules within section 13 provide a complete code for those activities to which Section 13 applies. With the exception of Financial Contributions, Subdivision and Definitions, no other rule in any part of the District Plan shall apply.

For clarity, Table 4 below includes some relevant breaches under the Rural Resource Area. While these individual rules are not formally triggered through this application as they are captured under Rule 13.7.4(iii), the table provides useful context on the District Plan framework as it relates to the nature of this application.

Table 4: Rural Resource Area Rules - Central Otago District Plan

Rule	Description	Comments	Compliance
4.7.4(ii)(a)	Noxious Effects	The storage of 107,600l of oil within the two proposed transformers will require resource consent as a Discretionary Activity	Discretionary Activity
4.7.6(c)	Waterbodies	Solar panels are located within the 20m setback	Discretionary Activity

The relevant objectives and policies of the District Plan are addressed within Section 6.1 of this report.

4.2 Activity status conclusion

The overall proposal requires resource consent from the District Council pursuant to:

- **Rule 13.7.4 (iii) Discretionary Activity** under the District Plan for the construction and operation of a power generation facility including all associated structures and activities.

Overall resource consent is required as a **Discretionary Activity**.

4.3 Scope of application

This application seeks resource consent under the District Plan to establish all aspects of the proposed development, including site works, construction, operation and maintenance.

If Council is of the view that resource consent is required for alternative or additional matters to those identified in Section 4.6 of this report, it has the discretion to grant consent to those matters as well as, or in lieu of those identified in this AEE.

Additionally, if Council is of the view that the activity status of any of the matters requiring consent is different to that described in Section 4.6 of this report, Council has the ability under Section 104(5) of the Act to process the application, regardless of the type of activity that the application was expressed to be for.

4.4 Regional Water Plan for Otago - Otago Regional Council

The site is located within the Central Otago Sub-Region and within the Taieri Freshwater Management Unit (FMU). There are a number of rivers, streams and wetlands identified across the site. At this stage, no resource consent against the Otago Regional Water Plan is required.

ORC is currently in the process of developing a Land and Water Regional Plan. Early community engagement is currently underway; the Minister for the Environment has directed the Council to prepare the new plan by the end of 2023. An assessment of the Land and Water Regional Plan will be undertaken once this has been developed.

4.5 National Environmental Standard for Assessing and Managing Contaminants in Soil to Project Human Health Regulations 2011 (NESCSCS)

The NESCSCS 2011 applies to land that currently has, or historically had, an activity or industry undertaken on it that is included in the Hazardous Activities and Industries List (HAIL). It includes resource consent requirements in relation to earthworks, subdivision and change of use of land, where there has been a HAIL.

The proposal includes both earthworks and a change of use of the site.

Based on a review of Council records, there is no known HAIL activity that has occurred on site. The subject site is not listed on ORCs Listed Land Use Register (LLUR) for sites within the Otago Region that have been subject to (HAIL) activities.

Further, Helios Ltd has discussed the HAIL list with the landowners, and they have confirmed there has been no known HAIL activity on site.

4.6 National Environmental Standards for Freshwater Regulations 2020 (NES-FW 2020)

The NES-FW 2020 sets standards for certain activities that pose a threat to freshwater and freshwater ecosystems. ORC is responsible for issuing resource consents for activities that are not able to meet the standards as defined in the NES-FW. A separate resource consent application is being prepared for not meeting permitted wetland setbacks, and will be lodged with and processed by ORC in due course.

4.7 Specified Infrastructure and National Significance

Under the Statutory Framework, including higher order documents, the proposed solar farm is considered specified infrastructure and of significance as follows:

The proposed solar farm will meet the definition of “*Specified Infrastructure*” under the National Environmental Standards for Freshwater³, specifically:

“Specified infrastructure has the meaning given by the National Policy Statement for Freshwater Management”.

The National Policy Statement for Freshwater Management⁴, provides a definition as follows:

“Specified infrastructure means any of the following:

(b) regionally significant infrastructure identified as such in a regional policy statement or regional plan.”

Regionally Significant Infrastructure is addressed by Otago Partially Operative Regional Policy Statement (PORPS)⁵ within Policy 4.3.2, as infrastructure including:

“Renewable electricity generation activities, where they supply the National Grid or local distribution network.”

In addition, the Proposed Otago Regional Policy Statement⁶ provides the definition of Regionally Significant Infrastructure as:

“renewable electricity generation facilities that connect with the local distribution network but not including renewable electricity generation facilities designed and operated principally for supplying a single premise or facility”.

Additionally, the National Policy Statement for Renewable Electricity Generation 2011 (NES-REG) recognises renewable electricity generation activities as a matter of national significance.

3

Resource Management (National Environmental Standards for Freshwater) Regulations 2020

⁴ National policy statement for freshwater management 2020 Section 3.21

⁵ Partially Operative Otago Regional Policy Statement 2019 Policy 4.3.2

⁶ Proposed Otago Regional Policy Statement 2021 - Part 1/ Interpretations/ definitions

Based on the above confirmations between both National and Regional policy instruments it is considered that the proposed solar farm will comfortably meet the definition of “Specified Infrastructure” referenced within the National Environmental Standards for Freshwater Regulations.

It is also considered Specified Infrastructure under the NPS-HPL (see section 8 assessment further below).

The proposed solar farm is also considered to be of regional and national significance.

As such, through the assessment below, the project is referred to as both specified infrastructure and a matter of regional or national significance. The relevant NES and NPSs are assessed in detail in section 6 below.

5. Assessment of Environmental Effects

In accordance with section 88(2)(b) and Clause 1(d) of Schedule 4 of the Resource Management Act 1991 (the Act), this assessment of environmental effects of the proposed activity has been prepared in such detail as corresponds with the scale and significance of the effects that it may have on the environment.

5.1 Permitted baseline and Existing Environment

In forming the opinion for the purposes of sections 95 and 104(1)(a) of the Act, adverse effects on the environment can be disregarded if a Plan permits an activity with that effect. Power generation activities are not permitted under the District Plan, while solar panels for domestic use can be permitted. Due to the difference in scale between these activities this is of limited relevance as a permitted baseline.

While it is considered that no relevant permitted baseline is applicable to this proposal the existing environment does have relevance. The 'environment' upon which effects should be assessed is therefore the existing and reasonably foreseeable future environment. As such it is relevant to consider some the associated activities as an expected occurrence within the wider context of the rural environment. Specifically, it is not fanciful for the existing landowner as part of a farming activity, to undertake works and construct buildings up to 20 m from waterways or undertake boundary treatments such as fencing and shelterbelt plantings, all of which would be permitted. In addition, the storage of hazardous materials within volumes permitted by the District Plan, could reasonably be expected on a working farm. These activities are considered to form part of the existing environment and are relevant when considering the resultant changes proposed, particularly in terms of landscape values such as openness and pastoral character.

5.2 Positive effects

The solar farm will result in significant positive effects including the following outcomes:

- The proposal supports Aotearoa New Zealand’s national commitment of doubling renewable energy generation to accelerate transition to a low-emissions, high-growth economy, and

net zero carbon emissions by 2050⁷. Under higher order documents, solar farms such as these are a matter of national significance.

- The proposal would create enough clean, renewable electricity to power the equivalent of 70,000 typical New Zealand homes annually. This increased resilience in power supply is significant, especially given New Zealand is forecast to need 70% more power by 2050 given the rapid electrification in private vehicles, transport, and industry sectors.
- Increasing New Zealand's solar energy resource will support the national economy during periods when power from other renewable energy sources is not sufficient to meet demand, such as during periods of low rainfall in the headwaters of the country's hydroelectric schemes or periods of low wind speeds impacting wind farms.
- The proposal will optimise activities on the site through energy generation and the ability to continue sheep grazing the land around and under the solar panels, allowing for an agricultural co-use of the land.
- The construction phase will create regional employment opportunities. The project is estimated to generate 200-250 jobs for the 24 month construction period and additional commissioning period. There will also be wider ancillary support requirements such as accommodation and catering for staff.
- Additional wetland enhancement measures (fencing and planting), noting these are additional mitigation measures proposed are above and beyond the required mitigation. This is considered to result in positive ecological effects, particularly in terms of indigenous biodiversity and the health and vitality of the wetlands and waterways.
- Section 13 of the District Plan emphasises the importance of the transmission network for meeting community needs, while also recognising the need to address negative impacts like visual effects.
- The Rural Resource Area chapter of the District Plan acknowledges that Power Generation Facilities can enhance rural environment values.
- Section 2.3.1 of the District Plan acknowledges the role of "human endeavours" like mining, viticulture, and energy generation activities such as the Clyde Dam in shaping the landscape values of the district.
- This recognition of energy production as part of the rural environment is relevant when evaluating the suitability of the proposed solar farm and its associated environmental effects.

⁷ Electrify NZ, National Party, dated March 2023

- Renewable energy generation is considered to be of national significance, and the proposed solar farm will contribute to New Zealand's target of 90% of electricity from renewable sources by 2025. The development of new renewable energy regeneration is outlined in the National Policy Statement for Renewable Energy Generation 2011 (NPS-REG) is a matter of National Significance.
- The proposed solar farm will positively contribute to the development of renewable generation and improve energy resilience at the national level.
- The solar farm project ensures a rural production activity is maintained on the land, allowing compatible activities like sheep grazing alongside solar generation. Despite having 23.3% site coverage, surrounding land will remain pasture, preserving a significant portion of highly productive land. Economic benefits to landowners support continued productive land use, and after decommissioning, the land will fully return to productive use. This integrated approach sustains rural productivity and renewable energy generation.

Overall, it is considered that renewable generation activities within the rural environment of the district are well established and anticipated by the District Plan.

5.3 Landscape and visual effects

The landscape assessment outlines the potential impacts during both the construction and operation phases of the proposed solar farm.

During construction, disturbances such as ground disruption, vehicle movement, and equipment installation are expected, with earthworks required for various project components such as solar panels, access tracks, and the substation. Construction activities will occur sequentially over a two-year period, with efforts to mitigate impacts through careful planning and planting initiatives starting in the first planting season from commencement of construction.

Once the solar farm is operational, the landscape will undergo a significant change, transitioning from open farmland to an energy landscape marked by solar panel arrays. While the solar panels will introduce new structures, efforts will be made to integrate them into the existing rural landscape, including maintaining pasture and utilising sheep grazing to manage vegetation. Additionally, mitigation measures such as development setbacks, no-build areas, and native planting buffers will be implemented to reduce the visual impact of the solar farm. These measures have been outlined within the LEA and the proposed conditions (Appendix 3).

Overall, with the proposed mitigation planting, the solar farm is expected to have minor adverse effects on local landscape character initially, with effects anticipated to diminish over time as planting becomes more established. Adverse effects on the local landscape are anticipated to reduce to less than minor, with adverse landscape effects on the wider basin reducing to less than minor. These effects are assessed in greater detail as follows.

Boffa Miskell have undertaken a Landscape Effects Assessment (LEA), appended as Appendix 4. This assessment is adopted⁸ for the purpose of this report. Noting where the assessment has been provided using Te tangi a te Manu 7-point methodology, this has been converted to the RMA conversion tool outlined within the LEA method statement, and is also illustrated in Figure 11 below. For example, a low-moderate landscape effect under Te tangi a te Manu corresponds to a minor adverse effect.



Figure 11: LEA Methodology Conversion Diagram

Visual Effects

The proposal has the potential to generate visual effects in terms of visual amenity and glint and glare.

Visual Amenity

Views of the landscape will largely be contained to neighbouring properties and snapshot views from roads, with more distant views available from elevated viewpoints. During construction, adverse visual effects will vary but decrease over time due to mitigation efforts. The mitigation planting, wetland fencing, and visual screening proposed will increase the indigenous vegetation and biophysical landscape values, with landscape effects reducing to minor effects over time within the immediate context and less than minor effects experienced within the wider basin and post construction landscape and visual effects on the wider environment are considered to be no more than minor, noting these effects are anticipated to reduce further over time as planting becomes more established. These mitigation works are outlined within the LEA and the proposed conditions.

⁸ Mānīatoto Solar Farm Landscape Effects Assessment, Boffa Miskell, 28 February 2024

Section 5.3.2 of the LEA addresses the visual effects on neighbouring dwellings as private vantage points. This assessment provides an assessment of anticipated visual effects on each dwelling utilising a 7-point assessment tool. The LEA has included visual effects during the construction phase and then provided a visual effects assessment from year one, and then again year five. Based on this assessment and utilising the assessment conversion tool outlined within Te tangi a te Manu, the following can be concluded in terms of visual effects on persons.

At Year 1 there will be less than minor visual effects on 788 Ranfurly Back Road (Dwelling 3), 5 Bypass Road (Dwelling 5), 793 Channel Road and 788 Ranfurly Back Ground (Dwelling 6), 8365 Ranfurly-Wedderburn Road, Ranfurly (Dwelling 7), 8358 Ranfurly-Wedderburn Road, Ranfurly (Dwelling 8), 8268 Ranfurly-Wedderburn Road, Ranfurly (Dwelling 9), 8249 Ranfurly-Wedderburn Road, Ranfurly (Dwelling 10), 8236 Ranfurly-Wedderburn Road, Ranfurly (Dwelling 11) 205 Gimmerburn-Naseby Road, Ranfurly (Dwelling 12), 256 Gimmerburn- Naseby Road, Ranfurly (Dwelling 13), 73 Brinsdon Road, Ranfurly (Dwelling 14), 146 Brinsdon Road, Ranfurly (Dwelling 15), 885 Ranfurly Back Road, Naseby (Dwelling 16) and 581 Ranfurly-Naseby Road (Dwelling 17).

There will be minor visual effects on 512 Ranfurly – Naseby Road (Dwelling 2) and 366 Ranfurly Back Road (Dwelling 4). By Year five, these effects would have been mitigated from established planting such that they are less than minor.

A more specific property by property assessment on these two properties is as follows:

512 Ranfurly- Naseby Road – Dwelling 2

The property is located to the north of the proposed solar farm. Longer distance views (approximately 1200 m) of the proposed solar farm will be available from southeast orientated windows, decking and garden areas. Views will appear as a thick dark band broken up visually through no build areas and mitigation planting. Post construction, visual and landscape effects are considered to be minor, with effects reducing overtime as the planting becomes more established.

366 Ranfurly Back Road - Dwelling 4

The property is located to the southeast of the proposed solar farm. Long distance views (900m) of the proposed solar farm will be available to the north/ northwest orientated windows, carpark and entrance garden areas. Views will appear as a thick dark band, broken up by the existing shelterbelt, rolling topography and no-build areas. Portions of the substation will likely be visible, albeit backdropped by topography and existing shelterbelts. Mitigation planting is proposed to soften and reduce the level of visibility, however due to the existing topography planting will need to reach 8 m - 12 m before screening from the carpark and garden area can be achieved.

Effects on Dwellings 2 and 4 are considered to be minor post construction (Year 1), with effects reducing overtime due to the growth of mitigation planting to less than minor (Year 5).

Glint and Glare

ITP Renewables have undertaken a Glint and Glare Study, which forms part of the LEA as Appendix B to the LEA.

For clarity the assessment of effects has been converted utilising the conversion outlined within Figure 11 of the LEA, where effects have been identified as “low” a conservative approach has include these as “minor” effects.

The Glint and Glare Study concludes that no significant impacts are predicted upon road safety or residential amenity and that glint effects are unlikely to occur due to the slow movement of the PV modules.

The glare effect on Ranfurly-Naseby Road and Ranfurly Back Road had a low to moderate impact (minor effects) on local traffic, concluding that mitigation is not required, however can be undertaken to reduce impact. In this instance boundary planting is proposed along Ranfurly-Naseby Road and Ranfurly Back Road as part of the wider mitigation strategy which will mitigate impacts of glint and glare.

Regarding glint, this assessment confirms that glint effects are unlikely to be experienced due to the slow movement of the panels however have addressed glare as being a likely effect.

Regarding glare, there will be less than minor or no glare effects on 512 Ranfurly–Naseby Road (Dwelling 2), 788 Ranfurly Back Road (Dwelling 3), 5 Bypass Road (Dwelling 5), 793 Channel Road and 788 Ranfurly Back Ground (Dwelling 6), 8365 Ranfurly-Wedderburn Road, Ranfurly, (Dwelling 7), 8358 Ranfurly-Wedderburn Road, Ranfurly (Dwelling 8), 8268 Ranfurly-Wedderburn Road, Ranfurly Dwelling 9), 8249 Ranfurly- Wedderburn Road, Ranfurly (Dwelling 10), 8236 Ranfurly- Wedderburn Road, Ranfurly (Dwelling 11), 205 Gimmerburn-Naseby Road, Ranfurly (Dwelling 12), 256 Gimmerburn-Naseby Road, Ranfurly (Dwelling 13), 73 Brinsdon Road, Ranfurly (Dwelling 14), 146 Brinsdon Road, Ranfurly (Dwelling 15), 885 Ranfurly Back Road, Naseby (Dwelling 16) and 581 Ranfurly-Naseby Road (Dwelling 17).

There will be minor glare effects on 366 Ranfurly Back Road (Dwelling 4).

A more specific property by property assessment is as follows:

Dwelling 4:

The Glint and Glare assessment model indicates an annual total of approximately 10 hours of glare, being a maximum of 15 minutes a day from 6 May to 7 July. This level of effect is identified within the LEA as “low-moderate” reducing to “low” over time with the growth of planting. Based on this, glare effects on Dwelling 4 are considered to initially be minor until vegetation is established.

Potential glare effects have been identified for Dwelling 4 through the Glint and Glare Study. However, when taking into account the location of the dwelling and existing planting onsite, these effects will be less than minor.

In conclusion, the Glint and Glare Study indicates that the proposed solar farm is not anticipated to have adverse impacts on road safety or residential amenity. Glint effects are deemed unlikely due to the slow movement of the PV modules. While glare effects are identified, they are expected to be less minor or non-existent for nearby dwellings, including those on Ranfurly-Naseby Road, Ranfurly Back Road, Channel Road, Ranfurly-Wedderburn Road, Gimmerburn-Naseby Road, Brinsdon Road, and Bypass Road. Mitigation measures, such as boundary planting along certain roads, are proposed to further minimise glare impacts, noting this is not required mitigation. Overall, the study suggests that any glare effects would be minor on the roading network, and less than minor or negligible on any person.

Visual effects conclusion

Overall, the findings within the Glint and Glare Study and LEA conclude that effects on the wider environment, subject to mitigation works, will be no more than minor. Visual and glint and glare effects on the above listed six dwellings will be minor initially, with effects reducing overtime (within five years) due to mitigation planting being established, noting this planting will be assured through the proposed conditions. Effects on all other persons will be less than minor or negligible.

5.4 Character and amenity effects

The site has both rural character and natural character values.

Natural character

The LEA outlines that the solar farm project area includes modified wetlands, which contribute to its natural character. Adverse effects on natural character are anticipated to diminish overtime due to the removal of stock from wetlands and the restoration planting. Relying on the conclusions of the LEA and the proposed conditions, effects on natural character will be less than minor, with beneficial effects on natural systems.

Rural amenity and character

Section 5.5 and 5.2.1 of the LEA addresses the effects on rural amenity of the proposal. The assessment acknowledges the shift in rural character because of the proposed solar farm. Specifically, a shift from undulating open pastoral farmland to a large solar farm with associated energy infrastructure. The sense of open space will be reduced to the areas between solar panels and the experiential aspect of open space will be further reduced by the proposed mitigation planting. However, the presence of sheep grazing will continue as will the rural productivity use of the site. As outlined within the LEA, the proposal will result in a change in rural amenity values, however the topography, existing and proposed planting will limit these impacts to within a 1 km radius of the site, with wider views limited to elevated viewpoints upwards of 6 km away. The compatibility with other wider ranging land uses is a factor such as the existing transmission line, substation radar and Naseby Forest.

Construction impacts will be temporary and staged. Overall, it is anticipated that there will be no more than minor temporary adverse effects on the landscape character of the area during construction.

The proposed solar farm will transform the rural landscape from open farmland to one with energy infrastructure. Despite its significant scale, mitigation efforts will integrate the proposal with the surrounding mixed use rural environment. The project's impact on the immediate landscape will be moderated by existing features and proposed planting, while the solar panels' low profile and strategic placement help ground the proposal into the landscape. Although the project will change the landscape character, its adverse effects will be mitigated with the establishment of mitigation planting.

The LEA has assessed the compatibility of the proposal with the existing natural character, with the existing wetlands cited as a primary contributor to the natural character values of the site. Effects on natural character during the construction period has been assessed as no more than minor, with longer term reduction in experiential aspect of natural character anticipated, due to the change from open pastoral landscapes to the proposed solar farm. Overall, natural character will be improved overall due to the fencing of wetlands, and proposed enhancement planting outlined within the LEA, the EIA and the proposed conditions.

Overall, once mitigation planting has been established, effects on wider rural character while changed, will be no more than minor, with effects on persons being less than minor. Effects on natural character are expected to improved overtime as a result of the proposal due the proposed native planting and wetland protection, which is more akin to the natural state of the land than pastoral farming.

5.5 Cumulative Effects

When considering the cumulative effects of the proposal, it is noted that resource consent (RC 220259) was granted in February 2023 for a 54.5 ha solar farm by Energy Bay Limited at 512 Ranfurly-Nasby Road, approximately 330 m north-east of the site. This is referred to as the Solar Bay solar farm. Refer to Figure 12 below for an aerial view of the respective locations of the Helios Mānīatoto Plain and Solar Bay solar farms.

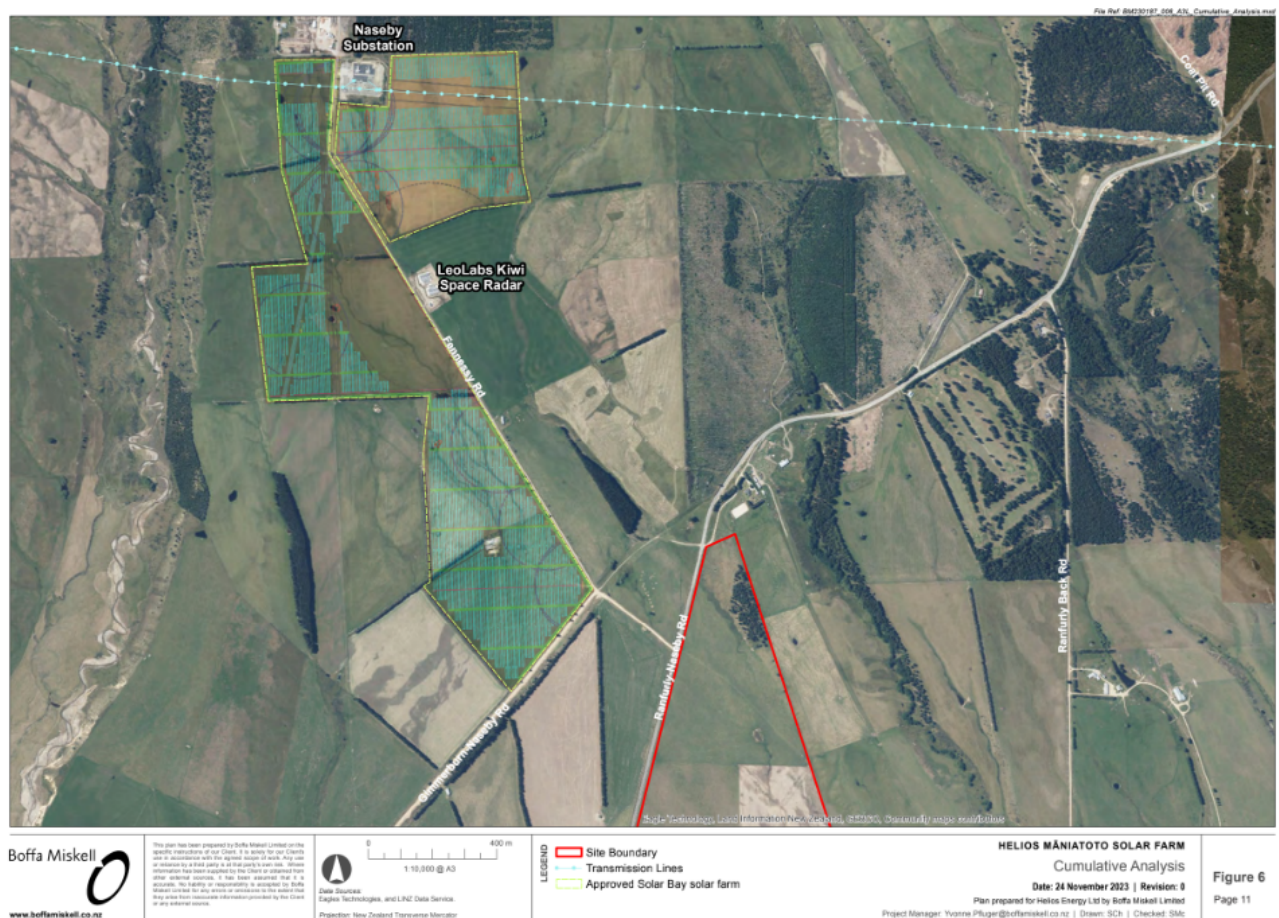


Figure 12: Cumulative Analysis - Consented Solar Bay solar farm in relation to proposed solar farm. Source: Boffa Miskell - Helios Mānīatoto Solar Farm Graphic Supplement.

The construction of the Mānīatoto Plain solar farm (proposed) and the Solar Bay solar farm (consented) would introduce solar farms to the rural environment, however, would not materially alter the landscape characteristics. The LEA⁹ notes that the Mānīatoto Plain solar farm would reinforce the pattern established by the consented environment. Both projects aim to minimise their impact on the landscape through screen planting and compatible land use activities such as sheep grazing.

⁹ Mānīatoto Solar Farm - Landscape Effects Assessment Boffa Miskell

The cumulative effect on the landscape character is expected to be no more than minor. Visibility of the solar farms will be primarily along local access roads like Ranfurly-Naseby Road and Gimmerburn-Naseby Road, however mitigation planting will gradually screen them from view. Overall, the solar farms will blend into the existing landscape, especially where they adjoin existing infrastructure such as substations and transmission lines. Cumulative visual effects are projected to be less than minor, particularly once planting is established. This planting is outlined within the LEA and the proposed conditions.

For the reasons above, it is considered that the existing landscape has the capacity to accommodate an additional solar farm with the rural values of the area being maintained. Overall cumulative landscape effects are no more than minor, cumulative visual effects are less than minor.

5.6 Building bulk and dominance effects

The proposed structures and buildings are detailed within section 3.1 of this report, and proposed setbacks and boundary treatment and screening are detailed within section 2.3 of the LEA. Structures are located centrally within the site away from boundaries and minimise bulk as far as practicable in order to avoid cumulative visual effects on the wider landscape. While it is acknowledged that the proposed solar farm will result in a noticeable change to the landscape due to the minimal bulk of the predominant panel structures and smaller infrastructure buildings, it is anticipated that adverse bulk and dominance effects will be minimised.

While the panels will extend across the width of the site, the bulk of the panels are mitigated from external viewpoints including the public roads due to the flat nature of the topography, spacing between rows of panels and proposed mitigation screening planting. Therefore, the cumulative effects of the solar farm infrastructure in terms of bulk and scale is considered to be less than minor.

The proposal will not result in overshadowing or loss of visual privacy for the immediate community. Due to the flat nature of the site and proposed low height of structures and buildings (a maximum height of 3.6 m) there will be no risk of overshadowing. The nature of the activity will ensure that there is no loss of visual privacy for receptors in the wider locality.

Overall, bulk and location effects are considered to be less than minor on both the receiving environment and people.

5.7 Noise effects

An Assessment of Noise Effects undertaken by Marshall Day Acoustics has been prepared and is appended in Appendix 8. This assessment is adopted for the purpose of this report, however for clarity the findings have been summarised as follows:

The proposed solar farm anticipates noise levels ranging from 15 to 30 dBA during standard operation, with peaks reaching up to 32 dBA during maximum activity. These levels fall within the low noise spectrum overall. Compliance with the District Plan's noise limits is therefore

confirmed, with daytime noise well below the 55 dB LA10 limit and nighttime noise comfortably below the 40 dB LA10 limit.

Noise projections also indicate that the solar farm's operations will generally be quieter than the existing ambient noise levels in the area, particularly during windy conditions where it could be between 10 to 20 dB quieter.

Construction activities will comply with permitted noise rules and New Zealand construction noise guidelines, with a temporary increase in road noise anticipated during construction. This will however, remain at low levels. A number of conditions are proposed to give Council comfort that noise limits will be adhered to (refer to Appendix 3).

In general, solar farm construction and operational noise is acceptable when considering noise effects. The separation distance between noise sources and nearby recipients, coupled with existing natural screening, ensures that both construction and operational noise levels from the solar farm will be less than minor and will comply with the relevant District Plan requirements.

Overall, noise effects are considered to be less than minor on both the wider receiving environment and people.

5.8 Transportation effects

An Integrated Transport Assessment (ITA) has been prepared by Abley¹⁰ and is appended as Appendix 7. This assessment is adopted for the purpose of this report, however for clarity, the findings have been summarised as follows.

The site has a frontage to Ranfurly-Naseby Road along its western boundary and Ranfurly Back Road along its eastern boundary. Ranfurly-Naseby Road is a two lane / two-way road that connects Ranfurly with Naseby via State Highway 85 at the Ranfurly end. This becomes Ramor Street and then Derwent Street as the road transitions into Naseby.

Ranfurly Back Road intersects with Goff Road near the Goff Road / State Highway 85 intersection. It has a posted speed limit of 100km/hr and is classified as a Rural Road in the New Zealand Transport Agency Waka Kotahi (NZTA) One Network Framework (ONF).

¹⁰ Naseby Solar Farm Development Transport Assessment - Abley August 2023

Ranfurly-Naseby Road has a posted speed limit of 100km/h and is classified as a Rural Connector in the NZTA ONF.

A total of four site accesses are proposed. Three will be from Ranfurly-Naseby Road and the fourth will be from Ranfurly Back Road. Access 1 and 2 will be the primary access points to be used by heavy vehicles during construction. There are existing gates in the locations of Access 1, 2 and 3. There is nothing present at Access 4 and a new vehicle crossing will therefore be required.

A number of conditions are proposed to assist with transport effects including the requirement of a Construction Traffic Management Plan (CTMP) within the CMP to give Council comfort that transport requirements and mitigation efforts will be adhered to (refer to Appendix 3).

Construction traffic effects

During the construction period there will be an increase in traffic activity on the surrounding road network for the approximate 24 month construction period which will include the movement of 40ft container trucks to and from the site and light vehicles transporting staff.

As outlined in the proposal, two primary access points to the site are proposed from Ranfurly-Naseby Road to be used by heavy vehicles during construction. It is proposed that an entry and exit configuration is established so that construction vehicles enter through one access point and exit via another.

Overall adverse effects from the construction period are considered to be temporary and result in adverse effects that are no more than minor on the wider environment and less than minor effects on people.

Operational traffic effects

Traffic levels during operation of the solar farm (once constructed) will be very low. There may be up to 12 trips to site per week. While there may be instances where a slightly higher level of activity occurs, this will not be significant, and there will be no capacity or safety issues arising from any fluctuations during operation.

The ITA confirms that the level of trip generation associated with the construction and operation can be absorbed by the existing capacity of the transport network. All vehicle accesses will be constructed to the standards required by the District Plan, including sealing and sight distances. While it is noted that Access 3 will be located closer to the Fennessy Road / Ranfurly-Naseby Road intersection than is permitted, this is unlikely to result in road safety effects.

A CTMP will be prepared and provided to Council, and road corridor access approval from CODC will be attained prior to construction. Overall, traffic effects on the wider environment will be no more than minor, and effects on people will be less than minor.

5.9 Health and safety effects (not related to hazardous substances)

No adverse risk to human health and safety has been identified with the construction and operation of the solar farm. A security fence will be erected around the site prior to construction and works will be undertaken in accordance with the Construction Methodology. The site will not be accessible to the general public. Signage will be erected on the fence in accordance with Health and Safety Regulations. As a result, health and safety effects are considered to be less than minor.

5.10 Earthworks effects

Earthworks have been reduced as far as practicable using a pile design for the tracking systems as proposed. The modification of the existing topography will be minimised to the maximum extent possible. Sediment laden runoff will be avoided by implementing erosion and sediment control measures in line with an Erosion and Sediment Control Plan (ESCP) recommended as a condition of consent, and through the proposed wetland planting and fencing. Subject to appropriate controls, it is considered that earthworks effects can be mitigated, and effects are considered to be no more than minor on the wider environment and less than minor on people.

The construction activity could result in temporary dust effects. In particular, the construction of the access tracks, installation of cabling and piling for solar panels will result in soil disturbance. The formed internal accessways will provide vehicle access to the inverters. Grassed tracks will be used to access the solar panel rows. The installation of the pile foundations for the tracking system and individual concrete plinths for the BESS are anticipated to result in less soil disturbance. A condition of consent is recommended within Appendix 3 to mitigate any dust effects.

The site will be progressively developed to ensure that the overall area of exposed soil is limited to specific areas of the site at any given time. The duration of bare exposed soil will be minimised with the immediate re-grassing of exposed surfaces once the works have been completed.

Earthworks will be completed in stages to minimise the amount of soil exposed at any one time. The contractor will deploy appropriate measures to manage any dust within the boundaries of the site. The proposed vegetated buffer around sections of the periphery of the site will provide a filter for dust when vehicles access the site for maintenance purposes.

An Erosion Sediment and Control Plan is recommended as a condition of consent and will ensure any required dust and erosion control to ensure that dust effects are less than minor on both the wider environment and people.

5.11 Effects on highly productive land

The proposal includes some land that is identified as highly productive under the National Policy Statement for Highly Productive Land. Specifically, the north-eastern portion and south-eastern portion of the site contains LUC Class 3 soils. This land is currently utilised for sheep farming. The remainder of the soils are classified as LUC Class 4 (not highly productive).

The vast majority of the Site is LUC Class 4 land. While there are areas of LUC Class 3 soils included within the proposed development site, approximately 10.66 ha will be excluded from solar development with 12.35 ha intended to be utilised for solar development.

The hardstand areas for the inverters, substation, BESS foundations and hardstand access tracks are the only areas where some form of ongoing land based primary production will be precluded during solar farm operation. These hardstand areas and access tracks make up less than 1.85% of the total solar farm site area, much of which is outside LUC Class 3 land. The access tracks have a dual use in providing farm vehicle access for sheep grazing.

The solar farm has been designed to enable sheep grazing as a concurrent use during operation, enabling the highly productive soils to remain available for rural production.

The proposal does not include the subdivision of land, and as such the land will continue to be three large land holdings that are able to support rural productive activities through ongoing sheep grazing co-located with the generation of renewable energy.

At the end of the solar farm's life cycle, Helios will remediate the land through removal of all solar farm buildings and structures, and reinstate the land in pasture. Planting will remain where suitable.

Overall, for the reasons discussed above, the proposal will have less than minor effects on highly productive land.

5.12 Reverse Sensitivity

As part of the site selection process, in-depth consideration is given to understanding the legally established activities within the environment, as well as understanding what is permitted to establish as of right.

The solar farm activity is not considered to be a sensitive activity, nor are any of its active components. As such, the proposal will be compatible with the existing rural and rural residential environment, and it is anticipated that the solar farm will not result in the potential for reverse sensitivity effects on the surrounding environment or existing established activities. Overall, reverse sensitivity effects are considered to be negligible.

5.13 Natural Hazards

The site is not subject to any known natural hazards. The site is not in close proximity to any known areas of natural hazards, with the exception of some high-level seismic information that has been applied district wide. Liquefaction risk has been identified within the Otago Regional

Council Natural Hazards Portal as “Domain A”¹¹ – A liquefaction potential of “low to none” and is unlikely to adversely affect the proposed development.

In relation to stormwater and flooding, while the proposal would result in a higher site coverage than present use as pastoral land, the total coverage of all solar farm components is 23.3% of the area of land leased for the project. Due to the elevation of the panels above ground level, there is high retention of permeable surfaces. The nature of the panels with gaps in between will ensure that levels of onsite stormwater soakage can be managed, and the proposal will not result in inundation beyond the site.

Overall adverse effects from natural hazards both on and off the site, will be less than minor.

5.14 Effects on cultural values

Te Rūnanga o Moeraki, Kāti Huirapa Rūnaka ki Puketeraki, Te Rūnanga o Ōtākou and Hokonui Rūnanga are mana whenua within the Otago region.

Aukaha is a mana whenua-owned consultancy that Helios have engaged with, as Aukaha works across Otago providing a range of services including resource management and planning on behalf of Kāi Tahu as a Treaty Partner.

Helios were in contact with Aukaha in July 2023 to outline the proposal and establish contact points for ongoing engagement. Helios is committed to discussion and incorporating feedback from Aukaha as the project progresses,

From a review of the Kāi Tahu Ki Otago Natural Resource Management Plan 2005 (KTKO NRMP) the following objectives and principles are highlighted to be of particular relevance to the project:

Section 5.2 (ii) Kā Whāika Matua - Ki Uta Ki Tai management of natural resources is adopted within the Otago region.

Section 5.3.4 Wai Māori General Policies, including:

4. To protect and restore the mauri of all water

¹¹ Otago Regional Council Natural Hazards GIS Maps

54. To promote land use that suits the type of land and climatic conditions.

55. To encourage the exclusion of stock from waterways.

56. To oppose the draining of wetlands. All wetlands are to be protected.

A solar farm requires passive technology within a light footprint to generate clean renewable electricity. There are no emissions, and solar farms have no impact on the soil or groundwater which is complementary to the principles of Ki Uta Ki Tai and sustainable land use.

With regard to land use that suits the type of land and climatic conditions, the solar farm does not require any water takes for operation or cleaning of the solar panels, which is an important consideration in the dry environment of the Mānīatoto Plain. Sheep grazing can continue to take place under the panels, and the solar farm will be decommissioned at the end of its operational life and the land returned to its original condition. It is also noted the site is not within any of the specific catchment management areas set out within the KTKO NRMP.

With regard to water, the wetland areas identified within the site by an ecologist will be fenced for protection from sheep, and will be enhanced through new wetland planting of native species. Across the wider site it is noted that there will be an overall net increase in planting, and many of these plants will be indigenous, apart from areas where exotic species are used for their faster growing capabilities to provide screening.

It is noted the KTKO NRMP provides detail of the importance placed on protecting important vistas and high points within the landscape. The site has been carefully selected within flat topography on the plain, and many views from local roads will be screened by existing planting, with addition planting proposed where required to screen views of the solar farm to the wider environment. Views in the area to the surrounding ranges will be retained.

Further, from a review of the District Plan maps and discussions to date with Aukaha, Helios is not aware of any wāhi tapu, wāhi taonga and sites of significance to Māori. The site is not a subject to a statutory acknowledgement.

Overall, for the reasons above, it is considered that the cultural effects of the proposal will be less than minor.

5.15 Use and storage of hazardous substances

An assessment by Beca¹² has been prepared in relation to the use and storage of hazardous substances, specifically the storage of oil associated with the two power transformers and the storage of dimethyl carbonate associated with the BESS. This assessment is adopted for the purpose of this report and appended in Appendix 10, and the findings have been summarised as follows.

The hazardous substances that will be used and stored on site are set out within Table 5:

Table 5: Proposed Hazardous Substances

Substance	Max Quantities	HSNO Classification	GHS 7 Classification	Physical Form	Storage Location
Dimethyl Carbonate ³ (wt%: 10)	113,751 L	3.1B	Flammable liquids Category 2	Liquid	Electrolyte in 32 BESS
Ethylene Glycol (400 litres (L) per container)	12,800 L	6.1D	Acute toxicity, oral (Category 4)	Liquid	Coolant in 32 BESS
		6.9B	Specific target organ toxicity – repeated exposure, oral (category 2), kidney		
Transformer Oil ⁴	325,400 L	6.1E	Aspiration hazard Category 1	Liquid	107,600 L in two power transformers and 217,800 L in 90 inverter transformers ⁵
		9.1C	Hazardous to the aquatic environment chronic Category 3		

Storage of the proposed quantities of dimethyl carbonate exceeds the limit specified in Schedule 19.14. of the District Plan. It is noted that the solar farm and BESS are not an office trade limited in the Third Schedule of the Health Act 1956 and that the hazardous substances will not be stored or used within 50 m of a surface water body or above a groundwater projection zone.

¹² Hazardous Substance Assessment: Naseby Solar Farm, Beca Limited, 20 December 2023

A qualitative risk assessment of the proposed hazardous substance materials is outlined in Table 6 below:

Table 6: Qualitative Risk Assessment

Hazardous properties	Hazardous substance	Hazards Classification	Potential Receptors	Risks	Controls Proposed to minimise risks
Fire and explosion	Dimethyl Carbonate	- Flammable liquids (3.1B) - Flammable liquids Category 2	- People - Property	- Exposure to workers during fire/ explosion associated with thermal runaway or electrical fire. - Exposure to workers due to loss of containment of liquid or volatile hazardous substances.	- The substances are contained within the manufactured battery so there will be no day-to-day handling exposure under routine operation. - Training will be provided for site staff, operators and workers. - Appropriate Personal protective equipment (PPE) is mandatory when handling or in close proximity to the substances. - Emergency response plan will be in place in accordance with the HS Regulations. - BESS unit is to be disconnected from the rest of the system in the event of hazardous event (i.e., fire, short-circuit etc). Design to consider separation distance between BESS units. - Fire extinguishers will be placed in appropriate locations as required by the HS Regulations. - Separation distance between the BESS and public spaces is at least 350m. This is well above the minimum separation distance required by Schedule 12 of the HS Regulations. - Substances such as coolants to the batteries will be topped up if found leaking. It is unlikely that the coolant will require replacing as it is contained in a closed-circuit system. - BESS will comply with Underwriters Laboratory (UL) Standard 9540: Energy Storage Systems and Equipment.

The potential risks associated with the BESS include:

- Worker exposure to fire or explosion due to thermal runaway or electrical fire.
- Worker exposure due to the loss of containment of hazardous substances.

To mitigate these risks to people and property, the BESS must be designed and maintained appropriately. This involves ensuring minimum separation distances from protected and public areas, strategically placing fire extinguishers, and providing workers with the necessary personal protective equipment (PPE) as per Health and Safety Regulations.

Prior to the commissioning of the facility, the Beca report makes the following recommendations:

- Review the final BESS area design and battery specifications against Health and Safety Regulations
- Update hazardous substances inventories, location plans, Safety Data Sheets (SDSs), and maintenance schedules to reflect the final site layout.

- Prepare an Emergency Response Plan (ERP) based on the actual BESS facility layout and submit it to the Central Otago District Council and FENZ for review.

Implementing these recommendations before the facility's operations commence will ensure that hazardous substance storage risks are effectively managed in compliance with both Hazardous Substances and New Organisms, and Health and Safety Regulations. A number of conditions are proposed including the requirement of an ERP (refer to Appendix 3).

Based on this assessment and subjection to appropriate conditions it is considered that the adverse effects associated with the storage of hazardous materials can be successfully mitigated and that associated adverse effects will be less than minor on both the wider environment and people.

5.16 Ecological effects

Boffa Miskell have undertaken an EIA,¹³ appended as Appendix 5. This assessment is adopted for the purpose of this report and summarised as follows.

Figure 13 below details the mapped vegetation, waterways, constructed ponds, and wetlands.

¹³ Mānīatoto Solar Farm - Ecological Impact Assessment December 2023

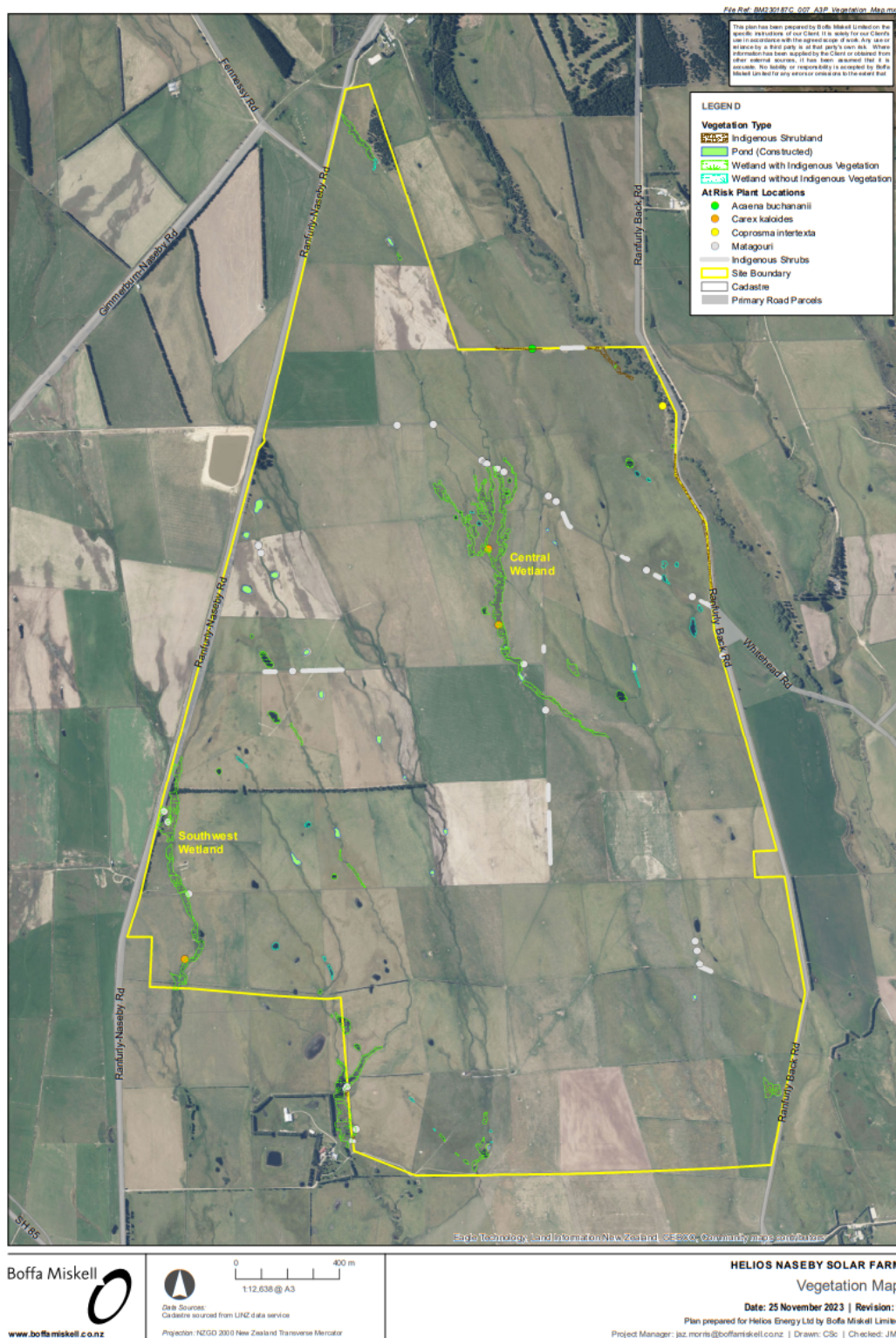


Figure 13: Vegetation, waterways, wetlands, and constructed ponds map of the Site. (Source Boffa Miskell)

Vegetation clearance for solar panel installation, cable trenches, access roads, and other construction activities will impact exotic pastures of minimal ecological value. No adverse

ecological effects are anticipated from this clearance due to the negligible ecological value of pastoral vegetation.

Removal of relict indigenous shrubs along fence lines constitutes a high-level adverse effect at the site scale but a very low-level effect at the larger scale. Remedial plantings are proposed to mitigate this impact, ensuring no net loss of significant shrub values in the long term.

All wetlands at the site will be avoided during construction and operation, with setbacks and directional drilling used to minimise potential effects. It is noted that these setbacks are smaller than permitted by both the District Plan and the NES-FW. However careful construction works management, proposed fencing and enhancement of wetlands through planting represent a net gain in significant wetland values, and as such any adverse effects will be mitigated. As outlined within the EIA the proposed enhancement of the central and southwest wetlands represents a net gain of significant wetland values.

Construction activities may lead to habitat loss or modification for indigenous avifauna species, albeit with very low to low adverse effects anticipated. Temporary disturbance of indigenous birds during construction is expected to be minimal, subject to measures aimed at avoiding disturbance, displacement, injury, or mortality of nesting indigenous birds during the breeding season. Moreover, the potential collision risk posed by solar panels to indigenous water and wetland birds necessitates a thorough literature review before commissioning, allowing for the application of further research findings and potential post-construction monitoring or mitigation measures. The EIA recommends a 'reappraisal' of bird strike literature review to be undertaken prior to solar farm commissioning, which would allow for the findings of further research to be applied, and any post construction monitoring or similar measures could be recommended at the time. Noting the ecology assessment has not raised adverse effects in terms of bird strike as a likely issue and has instead raised this in an abundance of caution as well as the to improve best practice information on the matter. Nevertheless a recommended condition of consent to ensure this further bird strike literature review is undertaken has been included within Appendix 3

The EIA recommends additional measures beyond the required mitigating planting, aiming for an even greater net gain in ecological enhancement. These measures, which will be detailed within a proposed "Wetland Enhancement Plan", are designed to elevate the ecological values of the site, particularly the freshwater ecology of identified wetlands. A number of conditions are proposed to implement these recommendations outlined within the EIA (refer to Appendix 3).

Overall, potential adverse ecological effects from the solar farm can be avoided or mitigated, with no identified residual adverse effects greater than low-level. On balance the project is expected to result in a net gain for wetland habitats and indigenous shrubs, ensuring no net loss of significant site features. Adverse ecological effects from the proposed solar farm can be avoided or mitigated, and on balance the ecological outcomes from the proposal are considered to be positive.

5.17 Conclusion

The proposal results in positive effects by contributing to New Zealand's national commitment to doubling renewable energy generation to accelerate transition to a low-emissions, high-growth economy, and net zero carbon emissions by 2050. Locating the solar farm within the Rural Resource Area is deemed operationally necessary, noting this aligns with the acknowledgement that energy generation activities are an anticipated activity within the District's Rural Environment as outlined in the District Plan.

The long-term use of highly productive land for primary production activities will be sustained through the maintenance of ground cover and periodic sheep grazing, minimising the environmental impact on soil and water resources compared to intensive farming practices. Construction effects are temporary and can be managed and mitigated through consent conditions.

Road users may experience minor construction/temporary effects. Solar panels and structures will be set back from road boundaries, low in height, and complemented by no-build areas, and proposed planting to reduce visual impact.

Transient viewers, such as motorists, will encounter fleeting views, further diminished as screen planting matures. Amenity effects on the environment, including noise, glare, landscape, and visual impacts, will be minimal reducing over time as planting is established. Operational effects are comparable to or less than permitted activities in the Rural (Plains) Zone.

Post-construction screen planting will mitigate visual and landscape character effects, while native species will enhance water quality and biodiversity. No reverse sensitivity effects are anticipated from the solar farm development. The activity is reversible, with all infrastructure removed upon lease term expiration, with Helios required to restore the site to its original state.

Overall adverse effects on the wider environment will be no more than minor with some minor adverse effects experienced by some owner and occupiers of nearby dwellings, noting these effects will reduce over five years with mitigation.

6. Objectives and policies

6.1 Central Otago District Plan

The following objectives and policies of the District Plan are relevant to this proposal.

Rural Resource Area

Objective 4.3.1	Needs of the District's People and Communities - To recognise that communities need to provide for their social, economic and cultural wellbeing, and for their health and safety at the same time as ensuring environmental quality is maintained and enhanced.
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Comment:	The proposed solar farm aims to balance the needs of the Central Otago District Community whilst ensuring environmental quality is maintained and enhanced. The solar farm will provide energy for approximately 70,000 homes annually, offering social and economic advantages through job creation and clean energy access. The solar farm will contribute to New Zealand's goal of doubling renewable energy generation to accelerate transition to a low-emissions, high-growth economy, and net zero carbon emissions by 2050. Clean, sustainable energy alternatives such as solar are essential to promote improved health outcomes for communities by reducing pollution. In this regard the proposal is providing for the social and economic wellbeing, and for the health and safety of communities on a local, regional and national level. The Construction Methodology further demonstrates best practice measures for ensuring the health and safety of workers through the construction, operation and decommission of the solar farm. Helios is in the process of engaging with local iwi via Aukaha, and are cognisant of the cultural wellbeing of the community. Helios has worked closely with ecological and landscape experts to avoid or minimise effects, specifically in relation to wetlands and waterbodies. All wetlands at the Site will be fully avoided by site works and operational activities, with setbacks applied. Fencing and enhancement of the central and southwest wetlands represents a net gain in terms of significant wetland values at the site. Overall, the proposed mitigation planting and fencing will enhance the natural character and biodiversity values of the Site¹⁴¹⁵. In essence, the proposal is cognisant of, and demonstrates the importance of, integrating community well-being with environmental responsibility in the solar farm's development and operation. The proposal is consistent with this Objective.
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¹⁴ Mānīatoto Solar Farm - Ecological Impact Assessment December 2023

¹⁵ Mānīatoto Solar Farm - Landscape Effects Assessment Boffa Miskell

Objective 4.3.3	Landscape and Amenity Values - To maintain and where practicable enhance rural amenity values created by the open space, landscape, natural character and built environment values of the District's rural environment, and to maintain the open natural character of the hills and ranges.
Policy 4.4.2	Landscape and Amenity Values – To manage the effects of land use activities and subdivision to ensure that adverse effects on the open space, landscape, natural character and amenity values of the rural environment are avoided, remedied, or mitigated.
Comment:	The site comprises an area of improved, grazed farmland and has avoided any significant hills or ranges. There are no Outstanding or Significant landscapes or features which relate to the site. The proposal will alter the Site's rural landscape into one containing energy infrastructure. Whilst this will reduce open space, rural elements such as sheep grazing will be maintained. The proposal will further enhance the wetlands on site by removing stock and undertaking restorative planting. This will contribute to the natural character, amenity and qualities of the site over time. The rural amenity and outlook will change as a result. However, visibility is limited to the immediate vicinity, with effects reduced from wider elevated views. The project aligns with existing varied land uses within the district such as an energy generation, forestry, infrastructure and viticulture and the mitigation planting will soften the visual impact over time. The large areas of planting including wetland fencing and improvements proposed, will greatly increase the indigenous vegetation and biophysical landscape values in the immediate area. This will enhance natural character and landscape values, mitigating adverse effects once fully established. The effects on the landscape, natural character and amenity values of the rural environment can be managed such that they are mitigated, and on the open space, landscape, natural character and amenity values of the rural environment
Objective 4.3.5	Water Resources – to maintain and enhance the quality of the District's water resources by avoiding, remedying or mitigating the adverse effects of land use activities adjacent to waterbodies.
Policy 4.4.4	Riparian Margins - To manage the effects of the use, development or protection of land within riparian margins of water bodies (including wetlands) to ensure that the natural character and amenity of water bodies and their margins are preserved, by, as far as practicable: (a) Maintaining bank stability,

	(b) Protecting, and where appropriate, enhancing riparian and instream habitat quality, (c) Maintaining and enhancing riparian vegetation, (d) Maintaining water quality, (e) Maintaining and enhancing public access to and along the lakes and rivers, (f) Reducing the incidence and severity of flooding where this is achievable, and (g) Maintaining and enhancing the safety and efficiency of navigation on the adjacent water body where this is relevant while recognising that some activities need to locate within riparian margins to operate efficiently.
Policy 4.4.5	Effects on Water Quality - To assist the Otago Regional Council in its role of maintaining and enhancing water quality, by ensuring allotments are adequate for effluent disposal requirements and encouraging the use of land management techniques that maintain and/or enhance the life supporting capacity of water.
Comment:	The proposal will maintain and enhance the quality of the District's water resources by maintaining stability, enhancing habitat quality, and riparian margins. Fencing off waterways and undertaking riparian planting will improve water quality and the onsite riparian environment. The proposed wetland enhancement plan aims to result in an overall net gain in freshwater ecology values to enhance the life supporting capacity of water. The project balances operational needs with environmental preservation, recognising the necessity of activities within riparian margins while minimizing adverse effects and improving water quality. Overall the proposal is constant with Objective 4.3.5 and policies 4.4.4, and 4.4.5.
Objective 4.3.6	Margins of Water bodies – to preserve the natural character of the District's water bodies and their margins
Policy 4.4.7	Significant Indigenous Vegetation, Wetlands, and Wildlife - To protect areas of: (a) Significant indigenous vegetation, (b) Significant habitats of indigenous fauna, (c) Significant wetlands, (d) Indigenous vegetation or habitats that support a significant indigenous freshwater fishery, and (e) Habitats of statutorily managed sports fish and game.

	from the adverse effects of land use activities and subdivision and to promote and encourage, where practicable, the retention, enhancement and reinstatement of indigenous ecosystems within the District.
Comment:	The proposed mitigation planting, no build areas and fencing have been designed to ensure the wetlands, waterways, and indigenous biodiversity is retained and enhanced. The large areas of planting will greatly increase the indigenous vegetation and biophysical landscape values in the immediate area. As outlined within the LEA, natural character values are anticipated to improve over time with the mitigation measures enhancing the existing natural character values. As outlined within the EIA the identified wetlands are considered significant and as such setbacks, no build areas, fencing and riparian planting have been designed to protect and enhance these areas with the ecological value anticipated to improve over time. The proposed wetland enhancement plan aims to improve the indigenous biodiversity values and health of the wetlands, above and beyond the required mitigation. On balance the ecological outcomes from the proposal are considered to be positive. Overall the proposal is constant with Objective 4.3.6 and Policy 4.4.7.

Overall, the proposed is consistent with the above objective and policies of the District Plan.

6.2 Otago Regional Policy Statement (2019)

Objective 4.2	Otago's communities are prepared for and able to adapt to the effects of climate change
Objective 4.3	Infrastructure is managed and developed in a sustainable way
Policy 4.3.2	Nationally and regionally significant infrastructure Recognise the national and regional significance of all of the following infrastructure: a) Renewable electricity generation activities, where they supply the National Grid or local distribution network; b) National Grid; c) Electricity sub-transmission infrastructure; PART B: Chapter 3 Otago has high quality natural resources and ecosystems Otago Regional Council Partially Operative Otago Regional Policy Statement, 15 March 2021 d) Telecommunication and radiocommunication facilities; e) Roads classified as being of national or regional importance; f) Ports and airports and associated navigation infrastructure;

	g) Defence facilities; h) Rail infrastructure; i) Municipal infrastructure.
Comment:	The solar farm will contribute to New Zealand's national commitments of doubling renewable energy generation to accelerate transition to a low-emissions, high-growth economy, and net zero carbon emissions by 2050¹⁶. Clean, sustainable energy alternatives such as solar are essential to reduce greenhouse gas emissions and reliance on fossil fuels. In this regard as the proposal is a renewable electricity generation activity, this is recognised as having national and regional significance. The proposed solar farm aligns with Objective 4.2 by contributing to mitigating climate change through the generation of renewable electricity. By supplying electricity to the National Grid, the solar farm supports Policy 4.3.2, contributing to national and regional renewable electricity generation activities.
Objective 4.4	Energy resources and supplies are secure, reliable and sustainable
Policy 4.4.1	Renewable electricity generation. Provide for renewable electricity generation activities, by all of the following: a) Recognising the benefits associated with those activities; b) Recognising the functional needs of those activities; c) Recognising the importance of the resource needs of those activities; d) Promoting the efficient use of existing structures or facilities; and e) Providing for activities associated with the investigation, identification, and development of potential renewable electricity generation sites and sources.

¹⁶ Electrify NZ, National Party, dated March 2023

Comment:	The solar farm directly addresses Objective 4.4 by promoting the development of sustainable and reliable energy sources. Policy 4.4.2 emphasises the importance of renewable electricity generation, which the solar farm fulfils by harnessing solar energy to produce electricity. This aligns with the broader goal of transitioning towards cleaner and more sustainable energy sources, contributing to the long-term sustainability and resilience of the energy infrastructure.
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6.3 Proposed Otago Regional Policy Statement 2021

Energy, Infrastructure and transport (EIT)	
EIT-EN-O1 – Energy and social and economic well-being	Otago's communities and economy are supported by renewable energy generation within the region that is safe, secure, and resilient.
EIT-EN-O2 – Renewable electricity generation	The generation capacity of renewable electricity generation activities in Otago: 1. Is maintained and, if practicable maximised, within environmental limits, and 2. Contributes to meeting New Zealand's national target for renewable electricity generation.
EIT-EN-O3 – Energy use	Development is located and designed to facilitate the efficient use of energy and to reduce demand if possible, minimising the contribution that Otago makes to total greenhouse gas emissions.
EIT-EN-P1 – Operation and maintenance	The operation and maintenance of existing renewable electricity generation activities is provided for while minimising its adverse effects.
EIT-EN-P2 – Recognising renewable electricity generation	Decisions on the allocation and use of natural and physical resources, including the use of fresh water and development of land:

activities in decision making	1. Recognise the national, regional and local benefits of existing renewable electricity generation activities, 2. Take into account the need to at least maintain current renewable electricity generation capacity, and recognise that the attainment of increases in renewable electricity generation capacity will require significant development of renewable electricity generation activities
EIT–EN–P3 Development and upgrade of renewable electricity generation activities	– The security of renewable electricity supply is maintained or improved in Otago through appropriate provision for the development or upgrading of renewable electricity generation activities and diversification of the type or location of electricity generation activities.
EIT–EN–P4 Identifying new sites or resources	– Provide for activities associated with the investigation, identification and assessment of potential sites and energy sources for renewable electricity generation and, when selecting a site for new renewable electricity generation, prioritise those where adverse effects on highly valued natural and physical resources and mana whenua values can be avoided or, at the very least, minimised.
EIT–EN–P6 Managing effects	– Manage the adverse effects of renewable electricity generation activities by: 1. Applying EIT–INF–P13, 2. Having regard to: a. The functional need to locate renewable electricity generation activities where resources are available, b. The operational need to locate where it is possible to connect to the National Grid or electricity sub-transmission infrastructure, c. And the extent and magnitude of adverse effects on the environment and the degree to which unavoidable adverse effects can be remedied or mitigated, or residual adverse effects are offset or compensated for; and 3. Requiring consideration of alternative sites, methods and designs, and offsetting or compensation measures (in accordance with any specific requirements for their use in this RPS), where adverse effects are potentially significant or irreversible.

EIT-EN-P7 Reverse sensitivity	– Activities that may result in reverse sensitivity effects or compromise the operation or maintenance of renewable electricity generation activities are, as the first priority, prevented from establishing and only if that is not reasonably practicable managed so that reverse sensitivity effects are minimised.
EIT-EN-P9 Energy conservation and efficiency	– Development is designed, including through roading, lot size, dimensions, layout, and orientation so that energy use is efficient, energy waste is minimised, and solar gain is optimised.
Comment: The proposed solar farm represents a significant opportunity to contribute positively to New Zealand's renewable energy targets and the social and economic well-being of Otago's communities. By generating renewable electricity, the project supports energy security and resilience within the region, aligning with the objectives of EIT-EN-O1. Furthermore, its location within the rural environment is deemed operationally necessary and aligned with the acknowledgement that energy generation activities are anticipated within the rural environment within the District Plan. The solar farm aims to increase the region's renewable energy capacity, supporting national targets as stipulated in EIT-EN-O2. Additionally, the project facilitates efficient energy use and minimizes greenhouse gas emissions, aligning with the goal of reducing Otago's contribution to total emissions. As outlined within Policy EIT-EN-P2 the increases in renewable electricity generation capacity will require sufficient development of renewable generation activities. This gives a clear direction that the proposed RPS recognises the national, regional and local benefits of REG and that the proposed solar farm is a clearly anticipated and desired activity within the region. The proposal will balance operational needs with minimising adverse environmental effects with a focus on improving the onsite natural character values¹⁷ and the onsite freshwater resources, particularly the identified wetlands¹⁸.	

¹⁷ Mānīatoto Solar Farm - Landscape Effects Assessment, Boffa Miskell, 24 February 2024

¹⁸ Mānīatoto Solar Farm - Ecological Impact Assessment, Boffa Miskell, December 2023

Moreover, the solar farm's development aims to increase Otago's renewable energy generation and will therefore improve the electricity security of the Region. The selection of the site prioritises locations where adverse effects on natural resources and cultural values are minimised. Noting the proposed activity is unlikely to result in reverse sensitivity concerns and can be operational concurrently with a primary land production activity on the Site with sheep grazing.

The Site has been carefully chosen to meet the functional and operational requirements of a solar farm whilst avoiding adverse effects. Where adverse effects have the potential to be experienced off mitigating measure have been employed to reduce adverse effects and, in some instances, to provide a net benefit, specifically ecological enhancement.

In summary, the proposed solar farm contributes to renewable energy generation and also demonstrates a commitment to sustainability, environmental stewardship, and community well-being, aligning with the overarching objectives and policies outlined through the Proposed Otago Regional Policy Statement.

6.4 National Policy Statement for Renewable Energy Generation 2011 (NPS-REG 2011)

The NPS-REG 2011 applies to renewable electricity generation activities at all scales, and covers the construction, operation, maintenance and upgrading of new and existing structures associated with renewable electricity generation.

The NPS-REG 2011 states that:

- *Renewable electricity generation, regardless of scale, makes a crucial contribution to the well-being of New Zealand, its people and the environment, and any reductions in existing REG will compromise achievement of the Government's renewable electricity target of 90% of electricity from renewable sources by 2025; and*
- *The development, operation, maintenance and upgrading of new and existing renewable electricity activities throughout New Zealand, and the associated benefits of REG, are matters of National Significance.*

The NPS-REG 2011 contains one objective as follows;

To recognise the national significance of renewable electricity generation activities by providing for the development, operation, maintenance and upgrading of new and existing renewable electricity generation activities, such that the proportion of New Zealand's electricity generated from renewable energy sources increases to a level that meets or exceeds the New Zealand Government's national target for renewable electricity generation.

Policies A, B, and C are most relevant to this proposal.

Policy A - Recognising the benefits of renewable electricity generation activities

The proposal meets the objective and Policy A as it provides a new renewable electricity generation activity which will assist in meeting the Governments national targets as follows:

- The proposal supports New Zealand's national commitments of doubling renewable energy generation to accelerate transition to a low-emissions, high-growth economy, and net zero carbon emissions by 2050¹⁹.
- The proposal would generate clean, renewable electricity to power the equivalent of 70,000 typical New Zealand homes annually. This increased resilience in power supply is significant, especially given New Zealand is forecast to need 70% more power by 2050 given the rapid electrification in private vehicles, transport and industry sectors.
- Increasing New Zealand's solar energy resource will support the national economy during periods when power from other renewable energy sources is not sufficient to meet demand. For example, during periods of low rainfall in the headwaters of the country's hydroelectric schemes or periods of low wind speeds impacting wind farms.

Policy B - Acknowledging the practical implications of achieving New Zealand's target for electricity generation from renewable resources

Policy B is reflected in the Proposed Otago Regional Policy Statement 2021. Specifically, policy EIT-EN-P2 which requires decision makers recognise that the attainment of increases in renewable electricity generation capacity will require significant development of renewable electricity generation activities. As discussed in section 7.3 above, the proposal will balance operational needs with minimising adverse environmental effects.

Policy C - Acknowledging the practical constraints associated with the development, operation, maintenance and upgrading of new and existing renewable electricity generation activities

There is a need to locate the renewable electricity generation activity where the renewable energy resource is available. The subject site has been selected due to its solar exposure and proximity to the National Grid, specifically the Transpower Naseby substation.

The selection of the site prioritises locations where adverse effects on natural resources and cultural values are minimised. Noting the proposed activity is unlikely to result in reverse sensitivity effects, and can be operational concurrently with a primary land production activity of sheep grazing on the Site.

In summary, the proposed solar farm contributes to renewable energy generation and also demonstrates a commitment to sustainability, environmental stewardship, and community well-being, aligning with the overarching objectives and policies of the NPS-REG 2011.

¹⁹ Electrify NZ, National Party, dated March 2023

6.5 National Policy Statement for Highly Productive Land 2022 (NPS-HPL 2022)

The purpose of the NPS-HPL is to ensure that highly productive land is protected for land-based primary production use and is not used for other purposes which would compromise the highly productive soils.

The NPS-HPL applies to all Highly Productive Land which, until regional mapping is undertaken and included in the Regional Policy Statement, is defined as Land Use Capability (LUC) Class 1, 2 and 3 land. The majority of the site is mapped as LUC Class 4 with a smaller portion located towards the south-east of the site identified as LUC Class 3. Approximately 12.35 ha of the identified LUC 3 land is proposed for solar panel use with 10.66 ha of LUC Class 3 excluded from solar development due to topographical constraints as well as a desire to minimise the use of LUC Class 3 land.

Part 2 of the NPS-HPL 2022 sets out the objectives and policies which are identified and discussed below.

There is one objective under the NPS-HPL 2022, which is as follows:

Highly productive land is protected for use in land-based primary production, both now and for future generations.

There are nine policies, of which, policies 1, 2, 4, 8 and 9 are considered relevant to the proposal. These are listed below. Policies 2, 4 and 8 are considered most relevant to the proposal.

Policy 1: Highly productive land is recognised as a resource with finite characteristics and long term values for land-based primary production.

Policy 2: The identification and management of highly productive land is undertaken in an integrated way that considers the interactions with freshwater management and urban development.

Policy 4: The use of highly productive land for land-based primary production is prioritised and supported.

Policy 8: Highly productive land is protected from inappropriate use and development.

Policy 9: Reverse sensitivity effects are managed so as not to constrain land-based primary production activities on highly productive land.

Comment:

Although the solar farm is not a primary production activity, it should be noted that once in operation the land will still be available for the grazing of sheep and will provide a financial benefit to the landowners to facilitate the productive use of the property.

In line with Policy 1, the finite characteristics and long-term values for land-based primary production of the site is recognised through the commitment to decommission the site and fully return it to its previous condition.

The solar farm project aligns with Policy 2 by contributing to the integrated management of highly productive land. It recognises the need for sustainable land use practices that consider interactions with freshwater management and renewable energy generation. The planting of native screen buffers around parts of the site, riparian planting and fenced wetlands will assist in improving the water quality and freshwater management.

Policy 4 acknowledges the need to prioritise and support land-based primary production. The solar farm, combined with sheep grazing, represents an innovative approach to land use that maintains productivity while diversifying economic activities. The project enhances the value of the land by harnessing renewable energy resources without compromising its primary production capabilities.

The solar farm project is consistent with Policy 8 by ensuring that highly productive land is protected from inappropriate use and development. The proposed solar farm development is not considered to be an inappropriate use given the status as specified infrastructure (see below) with the loss of highly productive land mitigated and minimised. The installation of solar panels and infrastructure does not degrade the land's productive capacity but rather enhances its value by contributing to renewable energy production. Concurrent sheep grazing serves to maintain the land's economic productivity and mitigation planting and fencing improves the ecological integrity, ensuring that the use of the land remains appropriate and sustainable.

No actual or potential reverse sensitivity effects are anticipated on land based primary production activities from the proposed solar farm consistent with Policy 9.

In summary, the proposed solar farm project, in conjunction with sheep grazing, aligns with these policies by promoting integrated land management, supporting primary production activities, and protecting highly productive land from inappropriate development. The proposal is consistent with the National Policy Statement and therefore national direction.

Part 3 of the NPS HPL sets out a non-exhaustive list of things that local authorities must do to give effect to the objective and policies.

Section 3.9 of the NPS states territorial authorities must avoid the inappropriate use or development of highly productive land that is not land-based primary production, however clause 2 provides a list of activities the NPS enables on productive land. Clause 3.9(2)(j)(i) states:

(2) A use or development of highly productive land is inappropriate except where at least one of the following applies to the use or development, and the measures in subclause (3) are applied:

(j) it is associated with one of the following, and there is a functional or operational need for the use or development to be on the highly productive land:

(i) the maintenance, operation, upgrade, or expansion of specified infrastructure:

The proposed activity falls within the definition of "Specified Infrastructure".

Specified infrastructure means any of the following:

- (a) infrastructure that delivers a service operated by a lifeline utility:
- (b) infrastructure that is recognised as regionally or nationally significant in a National Policy Statement, New Zealand Coastal Policy Statement, regional policy statement or regional plan:
- (c) any public flood control, flood protection, or drainage works carried out:
 - (i). by or on behalf of a local authority, including works carried out for the purposes set out in section 133 of the Soil Conservation and Rivers Control Act 1941; or
 - (ii). for the purpose of drainage, by drainage districts under the Land Drainage Act 1908

As outlined within Section 4.8 of this assessment the proposed activity is recognised as regionally significant within the Otago Regional Policy Statement.

The project comprises the maintenance, operation, upgrade, or expansion of specified infrastructure and there is a functional and operational need for the proposed activity to be located on HPL.

Whilst “new” specified infrastructure is not explicitly stated within this clause, it is broadly accepted that the NPS-HPL is not intended to preclude new activities that are associated with specified infrastructure. This is evidenced by the Ministry for the Environment’s Consultation Document²⁰ and consultation process (September and October 2023) confirming this is the policy intent of the NPS-HPL.

Considering, the policy intent of clause 3.9(2)(j)(i), it can be concluded that the Project is within the intended scope of the specified infrastructure exception.

It can be demonstrated that there is a ‘functional and operational need’ to be on HPL. That is:

- The solar farm needs to be close to a substation or transmission network.
- The small amount of HPL utilised (approximately 12.35 ha of panels) enables the viability of the overall development to make a meaningful impact to the generation of renewable

²⁰ Ministry for the Environment. 2023. Managing the use and development of highly productive land: Potential amendments to the NPS-HPL – Discussion document. Wellington: Ministry for the Environment.

energy. The site lines up with the agreed lease agreement area which mirrors field boundaries to enable continued farm management and sheep grazing as complimentary activities on the solar farm site.

- Adequate flat land is required (less than a 5-degree slope).
- The HPL is free of ecological, heritage or cultural constraints, which if present would make the project untenable by a responsible developer.
- The site represents a strong solar resource with medium to high sunshine hours and limited shading from natural features such as mountains.
- The site has suitable geology to ensure stability of the steel piles upon which the solar panels are installed.

As outlined within Section 3.9(2) the measures in subclause 3.9(3) must be applied to the activity:

- (3) *Territorial authorities must take measures to ensure that any use or development on highly productive land:*
- a) minimises or mitigates any actual loss or potential cumulative loss of the availability and productive capacity of highly productive land in their district; and*
 - b) avoids if possible, or otherwise mitigates, any actual or potential reverse sensitivity effects on land-based primary production activities from the use or development.*

In the long term there will be no actual or cumulative loss of the availability and productive capacity of HPL in the Otago Region. This is because post decommissioning, the Site will be able to be fully reinstated and utilised for land-based primary production.

During the operation of the solar farm, the highly productive soils will be available for rural production as sheep grazing is possible under the solar panels. The solar farm layout has been purposefully designed to enable potential alternative rural land use activities (e.g. sheep grazing) which can integrate with solar generation activities. This retains an element of traditional productive rural land use.

Agri-solar practices, exemplified by the American Solar Grazing Association (ASGA) in the USA, promote the integration of grazing and solar production. This approach is supported by research from institutions like Cornell University, Oregon State University, and Ohio State University, as well as in the United Kingdom and Australia. Despite a proposed site coverage of 23.3%, the design allows for retention of pasture around the solar arrays, preserving highly productive land. Future land use possibilities include agricultural or horticultural crops benefiting from the partial shade provided by the solar panels, creating microclimates that enhance plant growth and reduce water evaporation.

As outlined within this assessment no actual or potential reverse sensitivity effects on land-based primary production activities is anticipated. The solar farm can operate concurrently with land based primary production.

The proposed solar farm is not considered to be an inappropriate use or development of the highly productive land within the site. The activity falls comfortably within the definition of specified infrastructure; there is a functional and operational need for the use and development to be on the LUC Class 3 land (Clause 3.9(2)(j)(i)); and, the project comprises the intention of clause 3.9(2)(j)(i) being the maintenance, operation, upgrade or expansion of specified infrastructure.

Overall, the proposal is considered to pass the necessary tests within Part 3 of the NPS-HPL and is not considered an inappropriate use or development on LUC Class 3 land.

6.6 National Policy Statement on Electricity Transmission (NPS-ET)

The NPS-ET relates to the transmission of electricity around New Zealand via the National Grid of transmission lines and cables. It does not directly apply to electricity generation activities, rather it applies to the conveyance of electricity from these facilities around New Zealand. As such the NES-ET is of limited relevance to the solar farm proposal but will provide policy support for any required upgrades to associated transmission infrastructure beyond the site.

6.7 National Policy Statement for Freshwater Management 2020 (NPS-FM 2020)

The NES-FW contains regulations relating to wetlands, rivers and streams, including provision for the natural inland wetland restoration, wetland maintenance; regulating culverts and the provision of fish passage.

The site contains a number of rivers (as broadly defined) and wetlands that meet the definition of a natural inland wetland under the NES-FW. These features are identified on the ecology mapping contained in Appendix 5.

The NPS-FM 2020 directs local authorities on how to manage freshwater under the RMA through their planning documents. It also contains an objective and several policies that are relevant to considering applications for resource consents.

Policy 3 is most relevant to this proposal and states that *'freshwater is managed in an integrated way that considers the effects of the use and development of land on a whole-of-catchment basis, including the effects on receiving environments.'*

Clause 3.5 of the NPS-FM 2020 sets out the expected approach in order to give effect to Policy 3, and states:

(1) Adopting an integrated approach, ki uta ki tai, as required by Te Mana o te Wai, requires that local authorities must:

(a) recognise the interconnectedness of the whole environment, from the mountains and lakes, down the rivers to hāpua (lagoons), wahapū (estuaries) and to the sea; and

(b) recognise interactions between freshwater, land, water bodies, ecosystems, and receiving environments; and

(c) manage freshwater, and land use and development, in catchments in an integrated and sustainable way to avoid, remedy, or mitigate adverse effects, including cumulative effects

The proposed wetland fencing and planting is considered to result in positive effects for the catchment. The water quality of the waterways and wetlands will benefit from planted riparian buffers which will provide filters for any runoff from the land. The proposed land use is expected to result in better environmental outcomes due to the lower intensity stock grazing activity with the reduction of adverse impacts from, soil compaction, nutrient and bacterial contamination, nitrates and sedimentation. The EIA identifies additional measures beyond required mitigation planting to enhance ecological values which are proposed to be identified in a "Wetland Enhancement Plan," aimed at elevating the site's ecological values, particularly freshwater ecology. Construction activities including earthworks will avoid all wetlands, using setbacks and directional drilling to minimise adverse effects. Despite setbacks to some wetlands will be smaller than permitted under the District Plan and NES-FM, meticulous management, fencing, and wetland enhancement efforts will enable a net gain in significant wetland values, as emphasised in the EIA's proposal for central and southwest wetlands.

Overall, potential adverse ecological effects of the solar farm can be avoided or mitigated. In conclusion, adverse ecological effects can be mitigated or avoided, with positive freshwater management outcomes expected.

6.8 National Policy Statement for Indigenous Biodiversity

Section 1.3 (3) of the National Policy Statement for Indigenous Biodiversity states the following:

"Nothing in this National Policy Statement applies to the development, operation, maintenance or upgrade of renewable electricity generation assets and activities and electricity transmission network assets and activities. For the avoidance of doubt, renewable electricity generation assets and activities, and electricity transmission network assets and activities, are not "specified infrastructure" for the purposes of this National Policy Statement."

This confirms not only that the NPS-IB does not apply to the development of renewable energy but gives strong national direction in terms of the development of renewable electricity generation is prioritised within the policy context.

7. Consultation

Helios have undertaken an extensive pre-application engagement initiative aimed at actively involving the local community, key stakeholders and Aukaha from the outset. The key objectives of this engagement has been to inform and engage with the local community, iwi and stakeholders early in order to facilitate meaningful engagement. Steps included the following:

- Aukaha was directly contacted in July 2023 to outline the proposal and establish contact points for ongoing engagement. This engagement is ongoing and will involve the pre-circulation of the draft of this assessment prior to Aukaha's further consideration and feedback.
- Adjoining landowners were personally informed of the proposal through phone calls, brochure distribution, face-to-face meetings, and their attendance at the community drop-in session.
- Key stakeholders, including the local MP, Mayor, Councillors, FENZ, Department of Conservation, and Forest and Bird, were notified via email and invited to engage with Helios and invited to attend a community drop-in session. In particular, Forest and Bird were provided with an Executive Summary of the EIA in March 2024 in response to their request for more ecological information.
- A community drop-in session was held on 5 October 2023, at the Mānīototo Golf Club. Approximately 35-40 people attended the session, providing feedback through forms and verbally.
- Ongoing discussions have also occurred with adjoining landowners along Naseby-Ranfurly Road and Ranfurly Back Road. This engagement has been outlined within the Mānīatoto Solar Farm Engagement Summary, appended in Appendix 9.

8. Notification assessment

8.1 Public notification – section 95A

The matters to be considered by the consent authority when deciding whether or not to publicly notify an application are set out in Section 95A of the RMA. In October 2017, Section 95A was amended to have a four-step process to determine whether to publicly notify an application.

Step 1 – Mandatory Public Notification in certain circumstances (sections 95A (2) and (3):

Mandatory public notification is not required as the applicant does not request public notification [s95A(3)(a)], and the application has not been made jointly with an application to exchange recreation reserve land under section 15AA of the Reserves Act [s95A(3)(c)].

Step 2 – Preclusion to Public Notification:

Public notification is not precluded because the activity is not subject to any rule in the District Plan that precludes public notification [s95A(5)(a)] and the activity is not for a controlled activity [s95A(5)(b)(i)], a residential activity or subdivision of land [s95A(5)(b)(ii)], a boundary activity [s95A(5)(b)(iii)], or a prescribed activity [s95A(5)(b)(iv)].

Step 3 - Public Notification – Rule/Adverse Effects:

Public notification is not required as the application does not include an activity that is subject to any rule in the District Plan or NES that requires public notification, and in accordance with section 95D adverse effects on the environment will not be more than minor [s95A(8)(a) and (b)].

Step 4 – Special circumstances:

There are no special circumstances that warrant public notification under section 95A(9) because none of the circumstances of the application are exceptional or unusual.

Accordingly, it is considered that this application should be processed without public notification.

8.2 Limited notification – section 95B

Section 95B relates to limited notification of consent applications and (in summary) directs that, where notification of an application for resource consent is not required under Section 95A, the consent authority must give limited notification of the application to any affected person. Section 95B is also a four-step process to determine whether to limited notify an application.

Step 1 – Customary Rights and Marine Title Groups, and Statutory Acknowledgements:

There are no protected customary rights groups or customary marine title groups that will be affected by the proposal, and the proposal is not on, adjacent to, or likely to affect land subject to a statutory acknowledgement [s95B(2)(a) and (b) and s95B(3)].

Step 2 - Preclusions to Limited Notification:

There is no preclusion to limited notification as there is no rule in the District Plan that precludes limited notification of the application [s95B(6)(a)] and the application is for neither a district land use consent with controlled activity status or an activity prescribed by regulations made under section 360H(1)(a)(ii), which precludes limited notification [s95B(6)(b)].

Step 3 – Limited Notification – Affected Persons:

No persons have provided their written approval to this application. The directly adjoining neighbours have been considered within this assessment, Boffa Miskell have further identified and assessed dwellings in the vicinity of the site, which are displayed within Figure 14 below.



Figure 14: Dwelling Locations (Source Boffa Miskell)

Landscape and Visual Effects

Adverse visual and landscape effects are addressed within section 6.4 of this assessment. The assessment concludes minor adverse visual and landscape effects are anticipated to be experienced by 512 Ranfurly- Naseby Road and 366 Ranfurly Back Road. Mitigation planting has been designed to reduce effects on the owners and occupiers of these properties. As part of the proposal this planting will be prioritised early in the construction period. Effects will reduce over time as planting becomes more established.

Other Actual and Potential Effects

All other actual or potential adverse effects on adjoining landowners and occupiers will be less than minor.

Step 4 – Special circumstances:

There are no special circumstances that exist relating to the application that warrant limited notification to any persons who have not been excluded as affected persons by the assessment above [s95B(10)]. There are no special circumstances that warrant limited notification under section 95B(10) because none of the circumstances of the application are exceptional or unusual.

8.3 Notification conclusion

Section 95 of the RMA sets out the requirements for the Council to consider when determining whether an application for resource consent should be notified.

The assessment in section 6 of this AEE concludes that any effects on the wider environment will be minor. An assessment of potentially affected parties has identified two adjacent sites which may be subject to effects of a minor nature, noting these effects are anticipated to reduce to less than minor (within five years) as planting becomes more established. Therefore, in accordance with the steps outlined above, the applicant would consider limited notification of the proposal to the landowner and occupiers of 512 Ranfurly – Naseby Road (Dwelling 2) and 366 Ranfurly Back Road (Dwelling 4), is required.

9. Statutory assessment

9.1 Section 104 of the RMA

Section 104

In considering an application for land use consent, the consent authority must have regard to Part 2 (Purposes and Principles) of the RMA, and to the matters to be considered as set out in section 104(1). Section 104(1) states that, subject to the provisions of Part 2, a consent authority must have regard to:

- (a) any actual and potential effects on the environment of allowing the activity; and*
- (b) any relevant provisions of –*
 - (i). a national environmental standard:*
 - (ii). other regulations:*
 - (iii). a national policy statement:*
 - (iv). a New Zealand coastal policy statement:*
 - (v). a regional policy statement or proposed regional policy statement:*
 - (vi). a plan or proposed plan; and*
- (c) any other matter the consent authority considers relevant and reasonably necessary to determine the application.*

In respect of Section 104(1)(a), an assessment of any actual or potential effects is included in section 6 of this report. Overall, it is concluded that the resulting effects will be minor and acceptable.

The higher order planning documents specified at section 104(1)(b)(i) – (vi) of the Act have been considered in Section 6 of this report. The proposal is consistent with the renewable energy strategic direction of the Otago Regional Policy Statement, which is to encourage renewable energy generation, sustainable energy use and improve energy resilience in the Otago Region. The relevant National Policy Statements and National Environmental Standards have been assessed. The proposal meets the objectives and policies in these standards, and in particular

the National Policy Statement for Highly Productive Land and National Policy Statement for Renewable Energy Generation.

In respect of Section 104(1)(b), the document that provides the relevant statutory context is the District Plan. As discussed at Section 6 above, the proposal is generally consistent with the relevant objectives and policies of the District Plan.

There are no other matters that the consent authority should consider in the determination of this application.

9.2 Resource Management Act 1991 – Part 2 Assessment

The District Plan has incorporated various plan changes in order to modernise the provisions and respond to the changing planning environment. However, the entirety of the plan is yet to be reviewed and therefore it may not have complete coverage over the proposed activities and anticipated effects. An assessment of the activity against Part 2 of the RMA is therefore considered necessary.

In achieving the purpose of the Act (Section 5) all persons exercising functions under it, shall recognise and provide for matters of national importance (Section 6), have particular regard to any other relevant matters (Section 7), and take into account the principles of the Treaty of Waitangi (Section 8).

Under Section 5 of the RMA, the proposed activity is a sustainable use of the existing rural land resource. Whilst not a primary production activity, the solar farm has a legitimate functional and operational need for its rural location. The proposal will not inhibit the land from being used for productive purposes now or in the future. The solar farm will assist in the generation of renewable energy which will provide for current and future generations without adversely affecting the life supporting capacity of the rural land resource.

The proposal will not adversely affect any matters of national importance listed under Section 6 of the RMA. The site is not within an area mapped as an outstanding natural features or landscapes and it has been established that the proposal is appropriately located within the existing rural landscape. Section 6(e) requires recognition and provision for Ngāi Tahu relationships, culture and traditions with their ancestral taonga, in decision-making. Engagement is ongoing with Aukaha.

Section 7 sets out other matters that must be had particular regard to. Of relevance to this application are the maintenance and enhancement of amenity values (s7(c)), the quality of the environment (s7(f)), the effects of climate change (s7(i)) and the benefits to be derived from the use and development of renewable energy (s7(j)). As concluded above, amenity values will be maintained while concurrently realising the benefits of renewable energy generation.

Section 8 requires that the principles of Te Tiriti o Waitangi are taken into account. Engagement with Aukaha is ongoing. A copy of the Engagement Summary with key stakeholders is included in Appendix 9.

In conclusion the proposal is in accordance with Part 2 of the RMA.

10. Conclusion

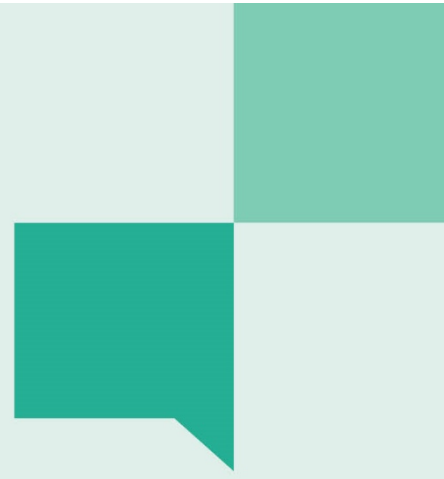
This application is being made by Helios for resource consent from Central Otago District Council for a power generation facility (solar farm) at 48 Ranfurly-Naseby Road, Naseby.

Section 6 details an assessment of effects and Section 7 and 8 outline the key planning considerations for this assessment. These assessments conclude that:

- The proposal contributes to New Zealand's renewable energy target without adversely affecting National Importance matters.
- Situating the solar farm in the Rural Resource Area aligns with the District Plan. Maintaining ground cover and periodic sheep grazing sustain primary production activities, minimising environmental impact. Construction effects are temporary and manageable through consent conditions.
- Road users may experience minor temporary effects until screen planting is established. Solar panels and structures will be low in height, with setbacks and planting to reduce visual impact. Transient viewers will encounter fleeting views, diminishing as planting matures. Operational effects align with permitted activities in the Rural Zone. Post-construction planting mitigates visual and landscape effects, enhancing water quality and biodiversity. No reverse sensitivity effects are anticipated, and the activity is reversible, with infrastructure removed upon lease expiration.
- The proposal has been designed to avoid wetlands and incorporates significant new planting, above and beyond the required mitigation, resulting in positive ecological and natural character benefits to the site and broader ecological values of the Mānīatoto.
- Overall, adverse environmental effects are no more than minor, with adverse effects on the properties identified in section 5 and 7 have the potential to be minor noting these effects are anticipated to reduce to less than minor (within five years) as planting becomes more established. Conditions of consent are recommended to ensure mitigation works reduce effects over time for the operational solar farm.
- The proposal is consistent with the relevant statutory framework, including the provisions of the District Plan, and consistent with Part 2 of the RMA.

On this basis, it is considered that consent can be processed on a limited notified basis in accordance with Sections 104 and 104B of the RMA.

We request the opportunity to review the draft conditions prior to the decision being issued.



Appendix 1

Records of Title



**RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy**




R.W. Muir
Registrar-General
of Land

Identifier **OT13D/516**

Land Registration District **Otago**

Date Issued 15 August 1991

Prior References

OT99/22

Estate	Fee Simple
Area	227.4713 hectares more or less
Legal Description	Section 33 Block II Maniototo Survey District

Registered Owners

Geoffrey Andrew Shaw, Lauren Patricia Shaw and Polson Higgs Nominees (2011) Limited

Interests

Subject to Section 3 Petroleum Act 1937

Subject to Section 8 Atomic Energy Act 1945

Subject to Section 3 Geothermal Energy Act 1953

Subject to Section 6 Mining Act 1971

Subject to Section 8 Mining Act 1971

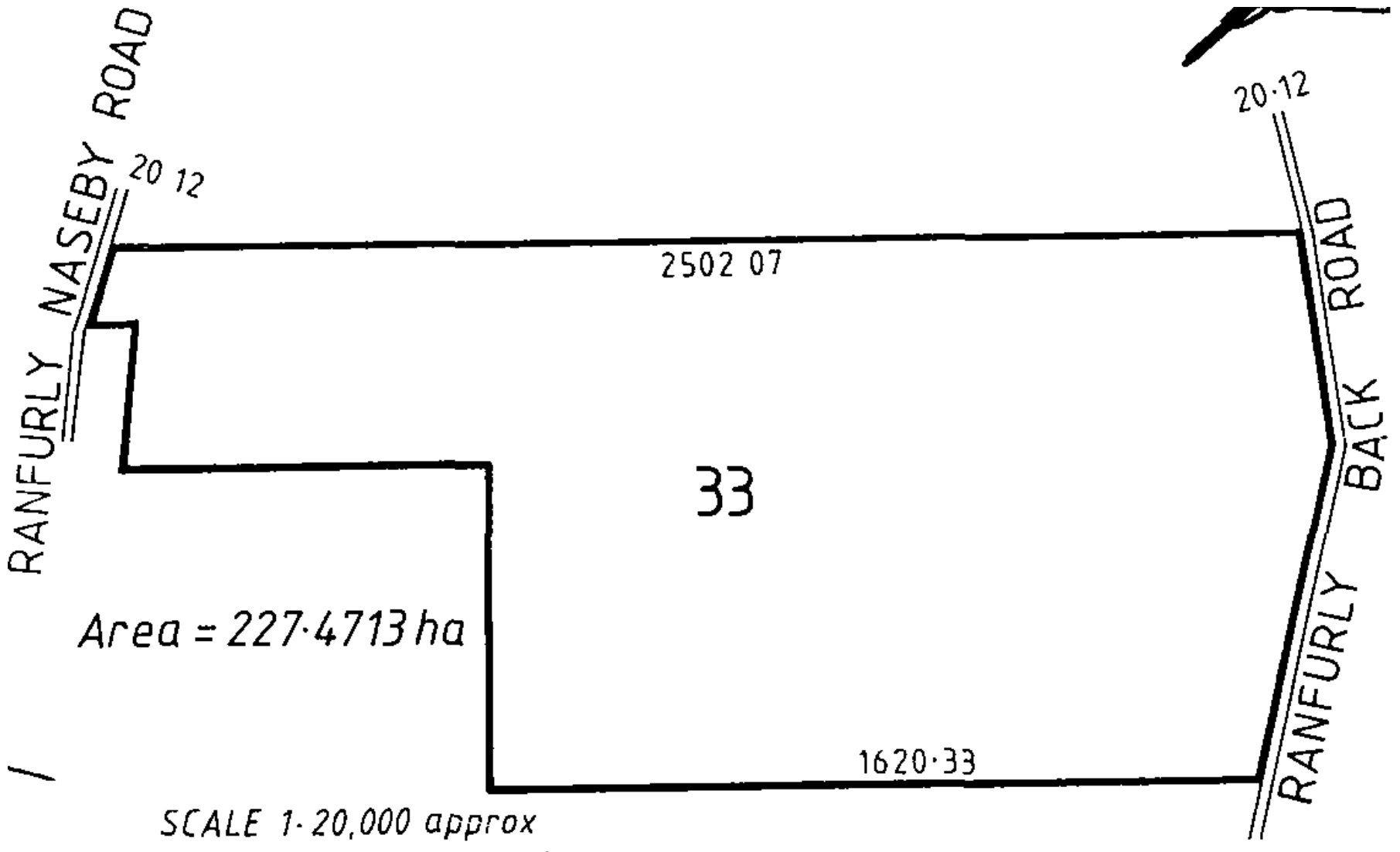
Subject to Section 5 Coal Mines Act 1979

Subject to Section 261 Coal Mines Act 1979

Subject to Part IV A Conservation Act 1987

5019452.2 Mortgage to Bank of New Zealand - 18.1.2001 at 12:37 pm

5019452.3 Mortgage to Jillian Margaret Shaw and Russell James Shaw - 18.1.2001 at 12:37 pm





RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy




R.W. Muir
Registrar-General
of Land

Identifier **OT13D/517**

Land Registration District **Otago**

Date Issued 15 August 1991

Prior References

OT123/72

Estate	Fee Simple
Area	132.0515 hectares more or less
Legal Description	Section 3 and Section 10 Block XIX Maniototo Survey District

Registered Owners

Geoffrey Andrew Shaw, Lauren Patricia Shaw and Polson Higgs Nominees (2011) Limited

Interests

Subject to Part IV A Conservation Act 1987

Subject to Section 3 Petroleum Act 1937

Subject to Section 8 Atomic Energy Act 1945

Subject to Section 3 Geothermal Energy Act 1953

Subject to Section 8 Mining Act 1971

Subject to Section 6 Mining Act 1971

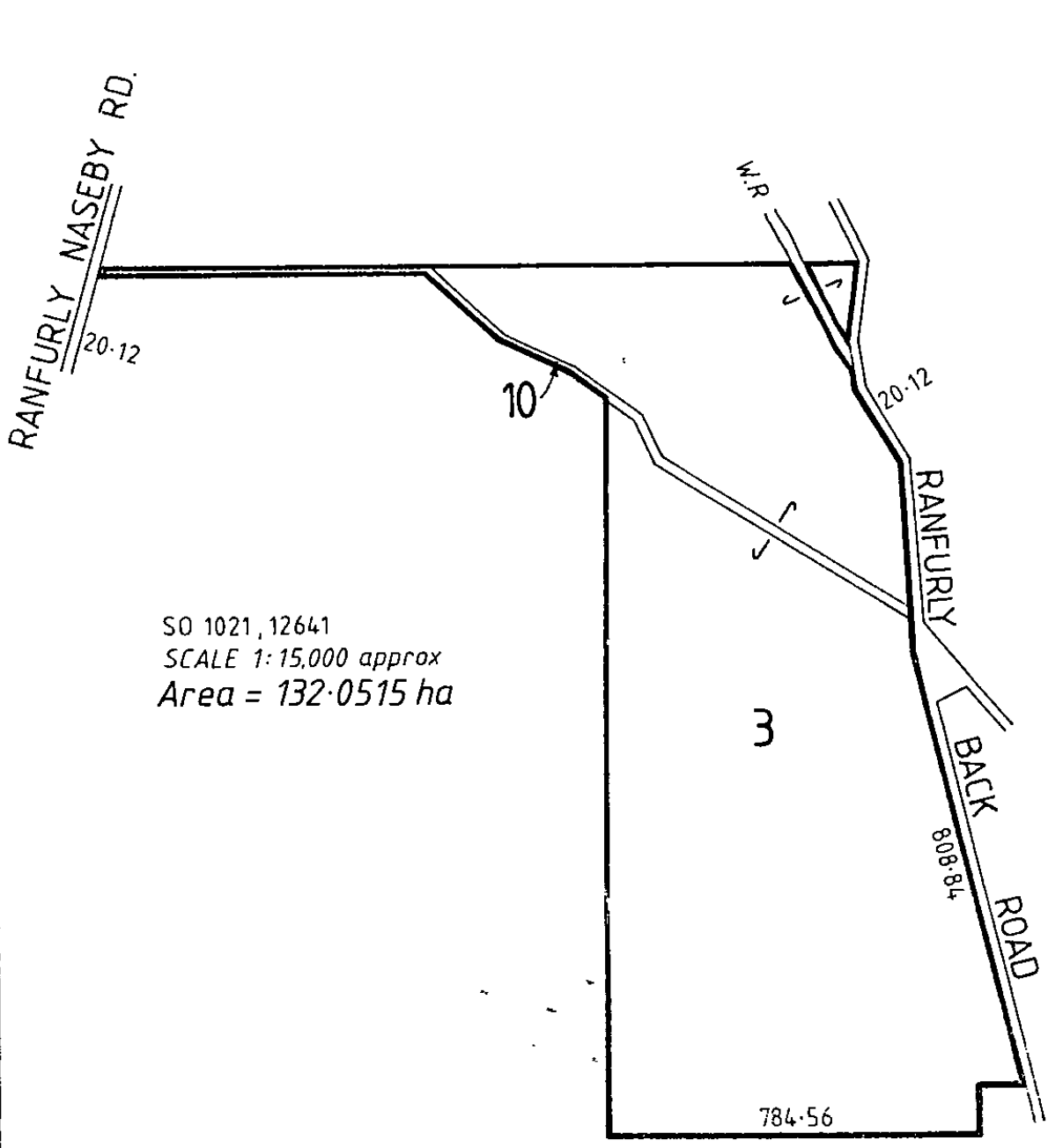
Subject to Section 261 Coal Mines Act 1979

Subject to Section 5 Coal Mines Act 1979

872264 Irrigation Notice under s4 Irrigation Schemes Act 1990 - 15.12.1994 at 9:24 am

5019452.2 Mortgage to Bank of New Zealand - 18.1.2001 at 12:37 pm

5019452.3 Mortgage to Jillian Margaret Shaw and Russell James Shaw - 18.1.2001 at 12:37 pm



NOTICE PURSUANT TO SECTION 4 IRRIGATION SCHEMES ACT 1990

The MINISTER OF AGRICULTURE HEREBY GIVES NOTICE THAT as at the date of sale of the HAWKDUN IDABURN IRRIGATION SCHEME HE had the right to enter, use, occupy, carry out work on, or Store water on, or convey water over, the land more particularly described in the Schedule hereto ("the Land") or to the support of the Land for any dam, pursuant to section 223 of the Public Works Act 1981 or the corresponding provisions of any former enactment relating to irrigation for the purposes of the above scheme OR is presumed to have had such rights by virtue of section 4 (2) of the Irrigation Schemes Act 1990 AND the attached plans show the position or course of those parts of the above scheme to which the right relates.

AND THAT pursuant to Section 4 of the Irrigation Schemes Act 1990 the right shall continue in favour of HAWKDUN IDABURN IRRIGATION COMPANY LIMITED from the date of the sale or disposition of the above scheme, being the first day of March 1990 and shall be subject to the provisions of the Irrigation Schemes Act 1990.

SCHEDULE

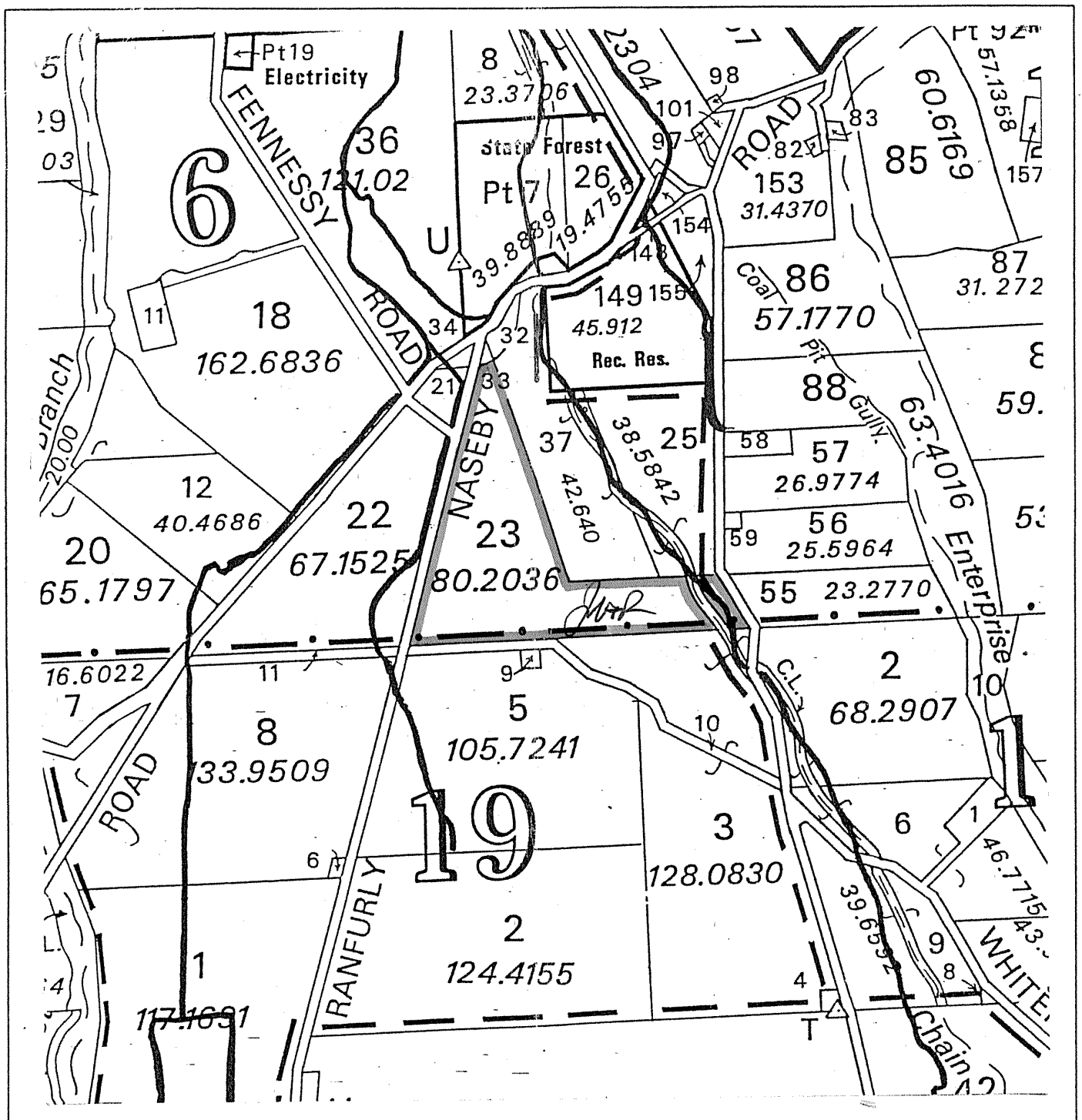
ALL THAT land containing 132.0515 ha and being Sections 3 and 10 Block XIX Maniototo Survey District and being all the land comprised and described in Certificate of Title No 13D/517 (Otago Land Registry)

Dated at Wellington this 23rd day of November 1994

SIGNED by THE MINISTER OF AGRICULTURE

Pursuant to Section 4 Irrigation Schemes Act 1990
in the presence of:

Name: Craig Sengelow
Occupation: Private Secretary
Address: cf. Hon John Falloon's Office
Parliament Buildings.

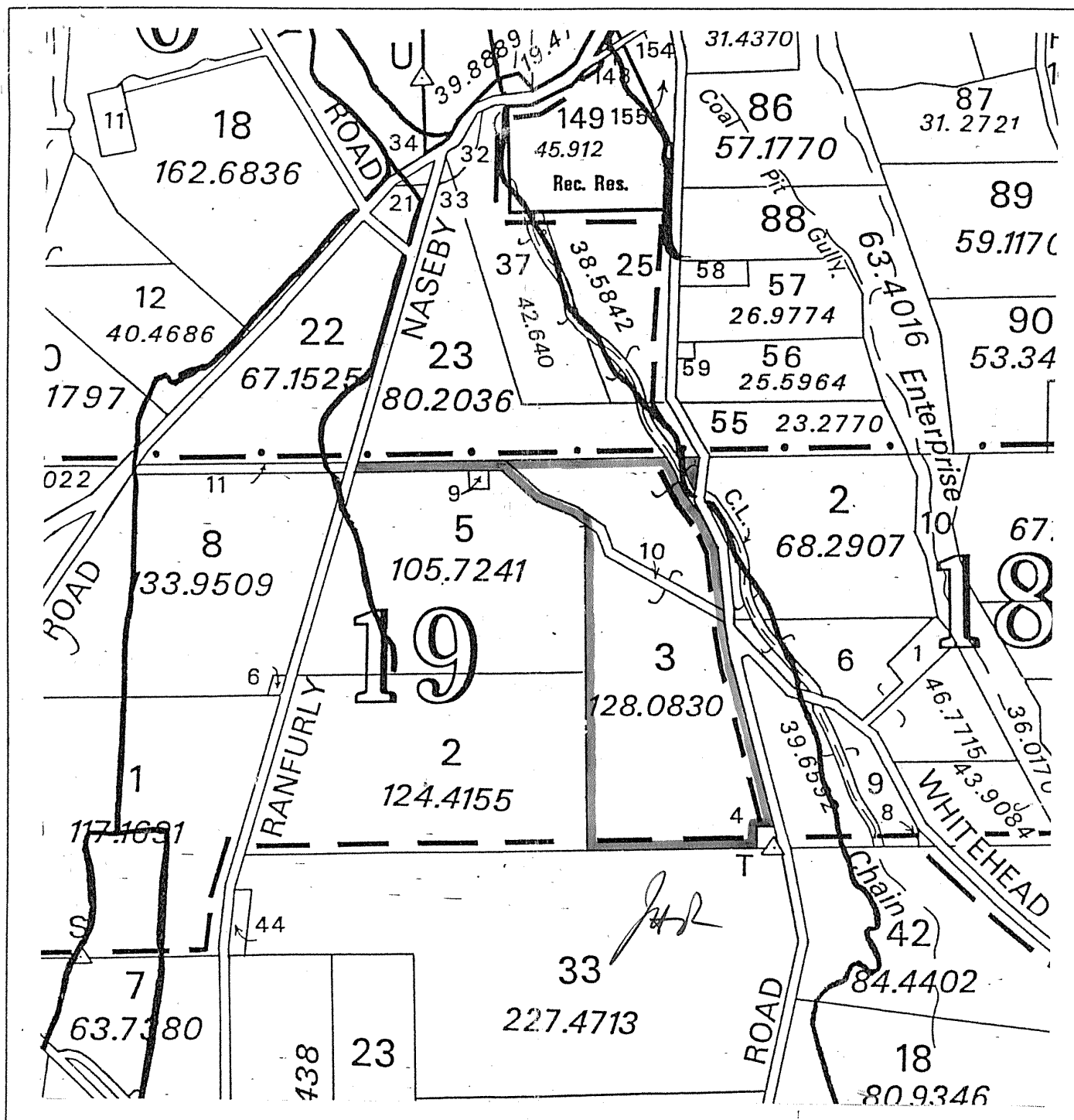


OPTIONAL EASEMENTS IN GROSS

PURPOSE	COMPRISED IN	SHOWN	SERVIENT TENEMENT	GRANTEE
Right to Convey Water	CT 10B/1337	—	Sec 23	Hawkdun-Idaburn Irrigation Company Limited

Plan of Easement Over
Sec 23 Blk VI Naseby S.D.

OTAGO LAND DISTRICT CENTRAL OTAGO DISTRICT COUNCIL	SCALE 1: 25000 DATE 27-11-91	PREPARED BY DEPT. OF SURVEY AND LAND INFORMATION
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OPTIONAL EASEMENTS IN GROSS

PURPOSE	COMPRISED IN	SHOWN	SERVIENT TENEMENT	GRANTEE
Right to Convey Water	CL 123/72	—	Sec's 3 & 10	Hawkdun-Idaburn Irrigation Company Limited

Plan of Easement Over
Sec's 3 & 10 Blk XIX Maniototo S.D.

OTAGO LAND DISTRICT
CENTRAL OTAGO DISTRICT COUNCIL

SCALE 1:25000
DATE 27-11-91

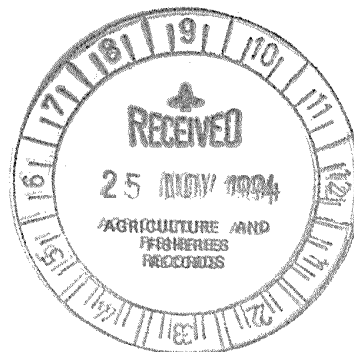
PREPARED BY
DEPT. OF SURVEY AND LAND INFORMATION

9.24 15.DEC94 872264

PARTICULARS ENTERED IN REGISTER
LAND REGISTRY OTAGO
ASST. LAND REGISTRAR

Sumner

130/917





RECORD OF TITLE
UNDER LAND TRANSFER ACT 2017
FREEHOLD
Search Copy




R.W. Muir
Registrar-General
of Land

Identifier OT9C/187
Land Registration District Otago
Date Issued 09 December 1983

Prior References
OT123/49

Estate Fee Simple
Area 106.5335 hectares more or less
Legal Description Section 5 Block XIX Maniototo Survey
District and Section 9 Block XIX Survey
District Maniototo

Registered Owners
Glenspec Holdings Limited

Interests

Subject to Section 5 Coal Mines Act 1979

Subject to Section 8 Mining Act 1971

820424 Transfer creating the following easements in gross - 16.12.1992 at 9.44 am

Type	Servient Tenement	Easement Area	Grantee	Statutory Restriction
Convey water	Section 5 Block XIX Maniototo Survey District and Section 9 Block XIX Survey District Maniototo - herein	Black line Transfer 820424	Hawkdun Idaburn Irrigation Company Limited	

880896.2 Mortgage to Bank of New Zealand - 27.4.1995 at 9.56 am

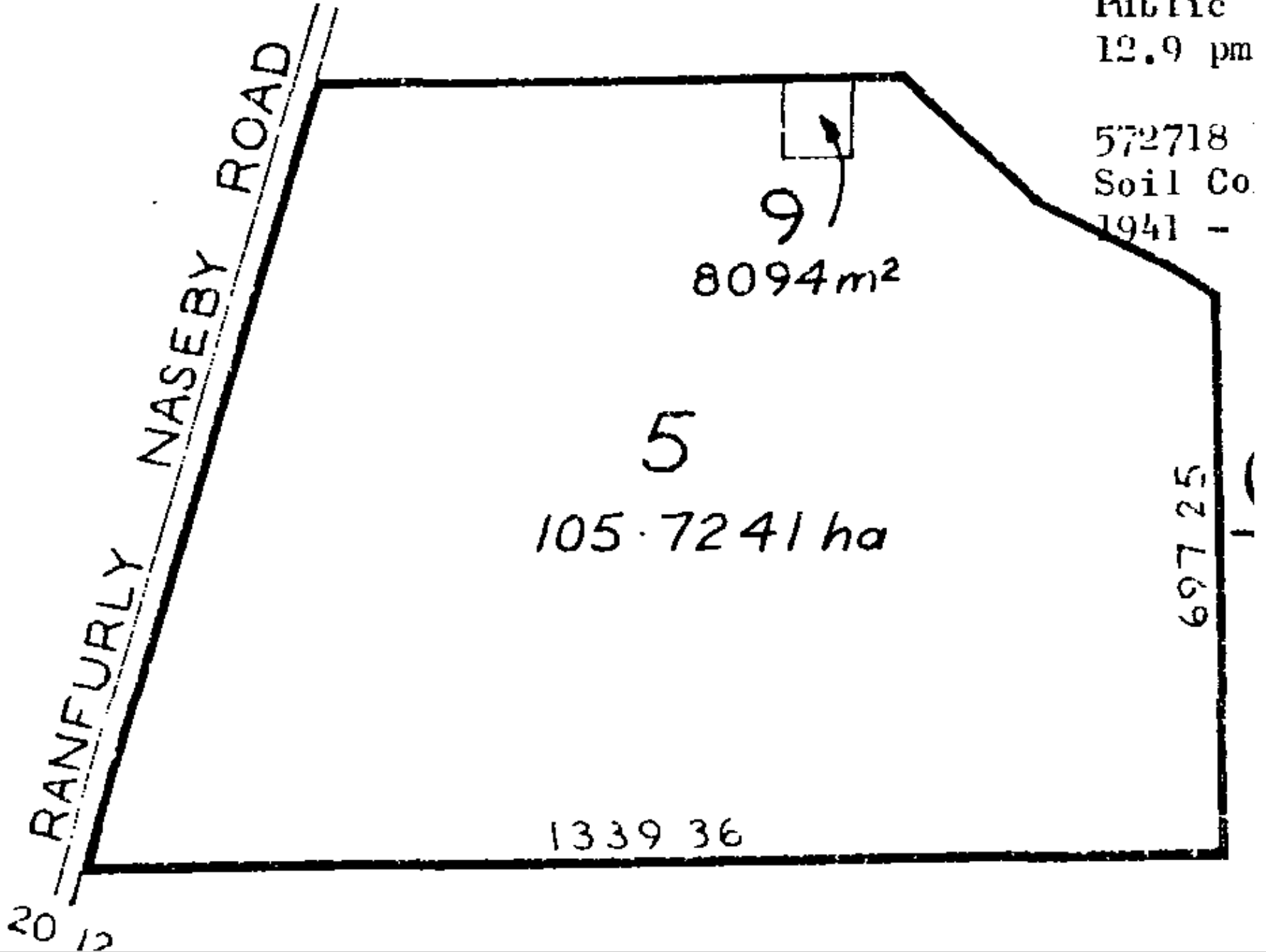
8973860.1 Variation of Mortgage 880896.2 - 21.2.2012 at 10:47 am

9397323.1 Variation of Mortgage 880896.2 - 23.5.2013 at 1:43 pm

12317685.2 Variation of Mortgage 880896.2 - 8.12.2021 at 11:18 am

Public
12.9 pm

572718
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820424

Under the Land Transfer Act 1952

Memorandum of Transfer

WILLIAM HUGH CARSON of Ranfurly Farmer and SYLVIA ELLEN CARSON of Ranfurly ✓
Married Woman (the Grantor) are

being registered as proprietor

of an estate in fee simple ✓

subject however to such encumbrances, liens and interests as are notified by memoranda underwritten
or endorsed hereon in piece of land situated in the ~~LAND DISTRICT~~ Maniototo Survey District
containing 14.1893 Ha ✓

more or less being Section 19, Block V of the said District and being all the land
comprised and described in Certificate of Title No. 13C/1112 (Otago Land Registry) Subject to Section 3 Petroleum Act 1937, Section 8 Atomic Energy Act 1945,
Section 3 Geothermal Energy Act 1953, Sections 6 and 8 Mining Act 1971, Sections 5
and 261 Coal Mines Act 1979, Part IVA Conservation Act 1987, Mortgage 530370,
Land Improvement Agreement 575799, Mortgage 733076/2 AND ALSO in all that piece of
land situate in the Maniototo Survey District containing 106.5335 Ha more or less
being Sections 5 and 9, Block XIX of the said District and being all the land comprised
and described in Certificate of Title No. 9C/187 (Otago Land Registry) Subject to
Section 8 Mining Act 1971, Section 5 Coal Mines Act 1979, Land Improvement Agreement
572718, Mortgage 785234 *q* AND ALSO in all that piece of land situate in the
Naseby Survey District containing 126.4643 Ha more or less being Section 4, Block VI
of the said District and being all the land comprised and described in Certificate
of Title No. 10A/926 (Otago Land Registry) Subject to Section 5 Coal Mines Act 1979
Section 8 Mining Act 1971, Irrigation Agreement X14044, Mortgage 530370, Land
Improvement Agreement 575799, Mortgage 733076/2, Land Improvement Agreement 712760 ✓

AND WHEREAS the HAWKDUN IDABURN IRRIGATION COMPANY LIMITED a duly incorporated company having its registered office at Ranfurly (herein called "the Grantee") is the company involved in the supply of water under an irrigation scheme purchased from the Crown by the Grantee to which Scheme the provisions of the Irrigation Schemes Act 1990 applied AND WHEREAS the Grantee is entitled pursuant to the provisions of the Irrigation Schemes Act 1990 to obtain a registered easement over and across the land of all persons or bodies over whose land the irrigation scheme water races natural gullies syphons pipelines and other structures existed at the time the irrigation scheme was purchased by the Grantee from the Crown AND WHEREAS the land owned by the Grantor as hereinbefore set out is land meeting that requirement and the Grantor has agreed to grant to the Grantee an easement in gross over that land in the terms hereinafter contained AND WHEREAS there is annexed hereto a diagram or diagrams of the land owned by the Grantor and referred to herein on which diagram or diagrams are shown the course of the irrigation races owned by the Grantee and as purchased from the Crown AND WHEREAS the term "irrigation races" whenever used herein shall mean and include all water races natural gullies ditches channels tunnels pipelines syphons measuring boxes structures and other constructions and chattels used by the Grantee as part of the Hawkdun Idaburn Irrigation Scheme NOW THEREFORE IN CONSIDERATION of the premises and pursuant to the provisions of the Irrigation Schemes Act 1990 the Grantor DOETH HEREBY TRANSFER AND GRANT unto the Grantee and its successors AS AN EASEMENT IN GROSS FOREVER:

- A. The full free uninterrupted and unimpeded right to have and maintain irrigation races over the land of the Grantor in positions shown on the diagram or diagrams annexed hereto.
- B. The full free uninterrupted and unimpeded right to convey and transport water over along and through those irrigation races across the land of the Grantor.
- C. The full free uninterrupted and unimpeded right for all or any irrigation races presently existing to remain on the land of the Grantor in such site as it may presently occupy.
- D. The full free uninterrupted and unimpeded right for the Grantee with or without its agents servants workmen engineers and employees and with or without any necessary vehicles implements tools pipes machines and equipment of any nature or kind whatsoever to enter upon the lands of the Grantor at any time and from time to time for the purpose of maintaining repairing renewing or replacing the said irrigation races owned by the Grantee and situated upon the land of the Grantor including the right to open up soil of the land as may be necessary.
- E. The full free uninterrupted and unimpeded right to occupy and use the land forming the course of the irrigation races on each side of each and every irrigation race to a reasonable distance necessary for the proper operation of the irrigation scheme and to enable access along the course of the race by people vehicles and machinery and for benching and construction of new benching as necessary and the deposit of soil and other matter removed therefrom PROVIDED THAT the area of such land shall not exceed a strip ten metres wide along the entire length of the course of the irrigation races and measured either wholly on one side of its course or partly on one side and partly on the other but so nevertheless that at no point of the course shall the total width measured on both sides exceed more than ten metres

UPON the terms and conditions appearing in the schedule annexed hereto:

SCHEDULE

1. The Grantee shall ensure that in exercising the right hereby conferred there is caused as little damage as possible to the land of the Grantor and that all necessary works undertaken shall be completed with all reasonable despatch and any damage caused to the land of the Grantor shall be promptly remedied by the Grantee at the cost of the Grantee.

2. The Parties acknowledge that any fences or gateways on or adjacent to the irrigation races on the land of the Grantor are the property of the Grantor who is solely responsible for the repair and maintenance thereof SAVE that in the event of any damage to them done by the Grantee the same shall be remedied by the Grantee at the expense of the Grantee.

3. The Grantee shall be responsible for any damage caused to the land of the Grantor by any escape of water carried in the irrigation races unless the same shall have come about as a result of the action or omission of some other person or body or by Act of God (as for example a cloudburst overflowing the race) AND in the event of any such escape of water the Grantee will immediately and at its own cost repair any damage so caused and re-instate the land the same as nearly as is reasonably possible to the condition it was in prior to such escape AND shall compensate the Grantor for any cost or damage caused to the Grantor as a result of the escape of such water save that the Grantor shall not be entitled to compensation for or in respect of or matters associated to the loss of use of land of the Grantor unless it shall be proved the Grantee has been dilatory in carrying out its obligation under this provision.

4. The Grantee and its servants agents employees contractors and workmen shall have the right at any time and from time to time without being deemed to commit a trespass and without payment of compensation or damages to enter upon the land of the Grantor as hereinbefore set out or upon any other land owned connected or associated to the Grantor and which the Grantee has in the past customarily used for the purpose of access so that the Grantee may fully exercise the rights given to it under this easement and for the operation of the irrigation scheme including (but not exclusively) the maintaining repairing cleaning replacing or reconstructing the irrigation races and all other works owned by the Grantee and the gaugeing or otherwise determining the quantity of water in or delivered by the irrigation race or races or any pipe and for the viewing of the condition of such irrigation races.

5. The Grantor shall ensure that access by the Grantee to any such irrigation race owned by the Grantee and used in the operation of the irrigation scheme is not in any way restricted or imperilled and at all times is kept available to the Grantee and to its servants agents workmen contractors employees and all or any other person or persons acting for or on behalf of the Grantee AND in respect to any future development by the Grantor alongside any such irrigation races the Grantor will ensure that such development does not impede restrict limit or otherwise in any way inhibit or impair that access AND will ensure that no trees are permitted to grow or fences erected adjacent to or in the vicinity of such irrigation races so as to cause any blocking or interference with the same or any damage thereto or impede or prevent access thereto or cleaning thereof AND will at the Grantor's own cost in all things remove any tree or tress fence or fences that may be determined by the Grantee as

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causing or contributing to any such impence or prevention of access or cleaning or blockage or interference or damage and will remedy or repair any such immediately and to the Grantee's satisfaction.

6. The Grantor will ensure that in any farming or other operation upon the land of the Grantor no damage is done to the irrigation races of the Grantee and that no interference is caused thereto or blockage impediment or limitation created in respect thereof AND in the event that any such should happen or occur the Grantor will immediately and at the cost of the Grantor in all things repair and remedy such to the satisfaction of the Grantee and in the event that the Grantor should fail or omit to do so then the Grantee shall be entitled to do so and to charge the cost of the same to the Grantor and recover the same from the Grantor as liquidated damages.

7. The Grantor and the Grantee may by mutual agreement vary these terms and conditions as applicable to the easement hereby granted.

8. All costs and expenses of and relating to the creation and registration of this easement shall be paid by the Grantee.

9. In any case where the Grantee shall be involved in maintenance and renewal or replacement of any irrigation races as presently existing and in the course of such activities should wish to increase the size of or alter the nature of (as for example by piping a presently open race) any such irrigation race from that as existing at the time of the grant of this easement then the Grantee shall be entitled to do so PROVIDED ONLY that such actions by the Grantee cause no or minimal loss of use or damage to the land of the Grantor AND in the event that any such proposed actions by the Grantee are considered as likely to cause more than a minimal loss or damage to the land of the Grantor then the same may be done with the consent of the Grantor and thereafter this easement shall be applicable fully to the same and IT IS FURTHER AGREED that in the event of any such activities being carried out by the Grantee and the Grantor failing to lodge a written objection with the Grantee within one year of the completion of such work then the Grantor shall be deemed to have consented to the same and the same shall for all purposes be deemed to be legally and properly done pursuant to this provision and to fall within the terms of the easement hereby granted.

10. The Grantee shall ensure that at all times the operation of the irrigation scheme and the cleaning maintenance repair and replacement thereof shall be done so as to cause as little interference as possible to the Grantor in the Grantor's use of the land and the Grantee will make all efforts as might be reasonable or practicable to minimise such interference and to reduce or minimise any nuisance caused by the existence or operation of the irrigation scheme on the land of the Grantor PROVIDED HOWEVER that this provision shall not require the Grantee to reduce or minimise any interference or nuisance below the level existing at the time of acquisition of the irrigation scheme by the Grantee from the Crown.

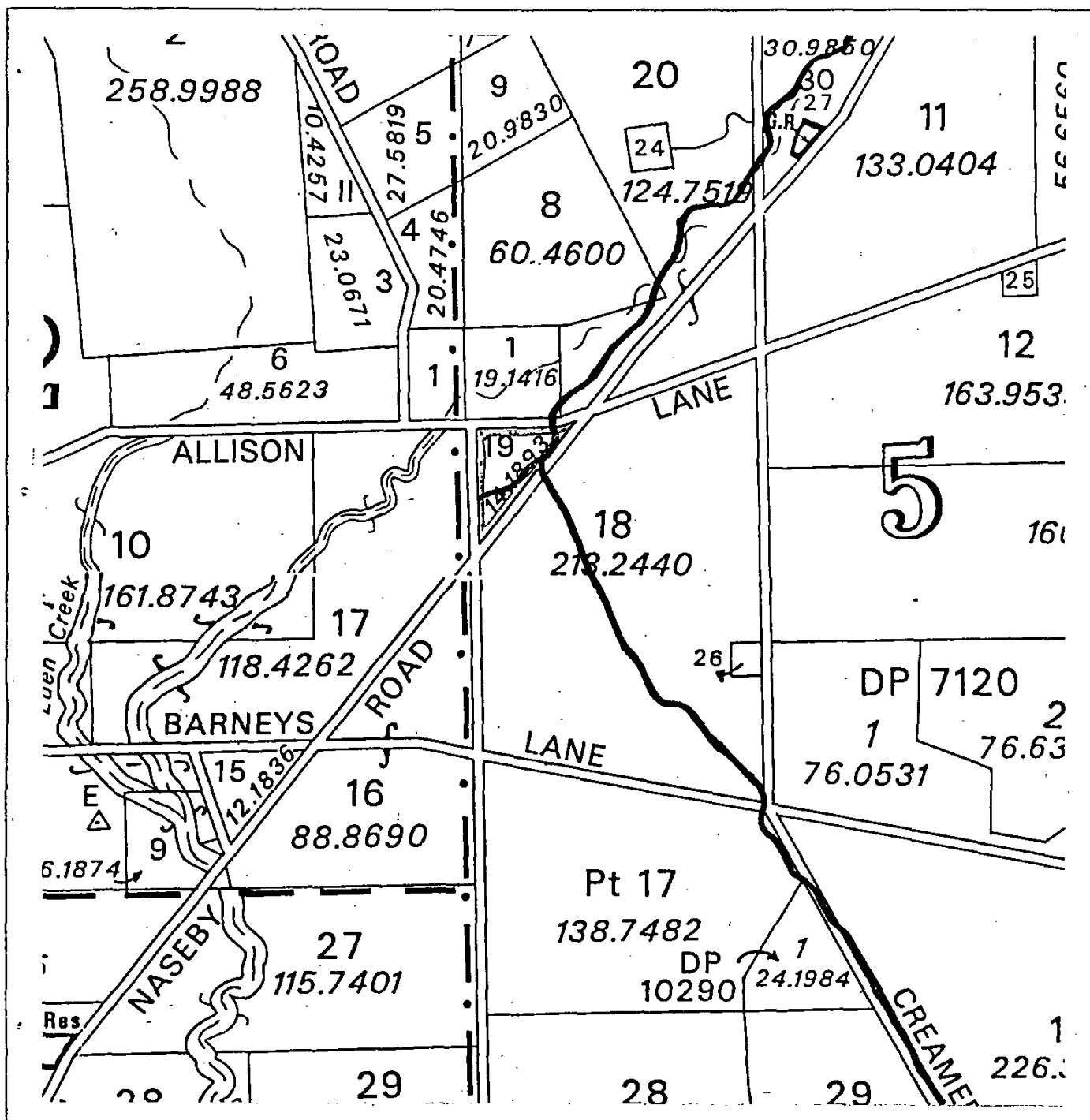
11. The Grantee shall be entitled following consultation with the Grantor and with the consent of the Grantor to undertake any major repair replacement or reconstruction works on the Scheme and to upgrade or alter the alignment of the Scheme so that following such work they would occupy a position on the land of the Grantor different from that which they occupied at the time of granting of

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this easement and in such case this easement shall be deemed to apply in all aspects to the irrigation races as they exist following completion of work by the Grantee.

12. In any case where the present area of land occupied by the Grantee forming the course of the irrigation race presently exceeds the total width authorised by this easement then such presently existing use by the Grantee shall be deemed to be within the terms granted by this easement and this easement shall apply in full to such area as if the maximum width authorised had not been exceeded and as if the irrigation races and works were existing within the maximum total width authorised by this easement. In any case of repair reconstruction or re-alignment of any irrigation race where the completed works exceed the total maximum width authorised by this easement, then this easement shall apply wholly thereto as if that total width was not exceeded if the consent of the Grantor has been obtained (either prior to or subsequent to the carrying out of such works) and which Grantors consent shall be deemed to have been given if the Grantor fails to lodge a written objection with the Grantee to such works within twelve months of the completion of same.

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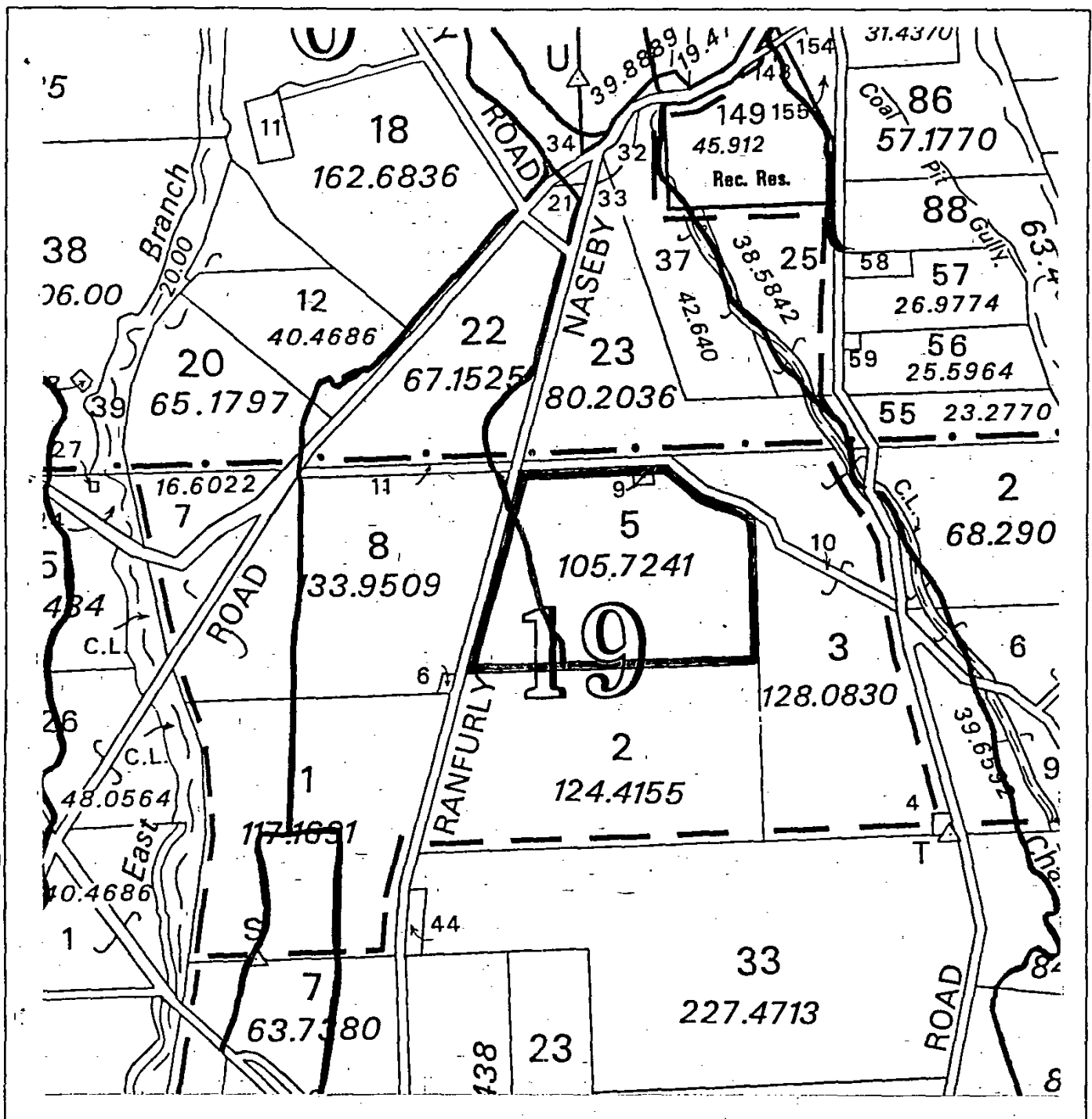
OPTIONAL EASEMENTS IN GROSS

PURPOSE	COMPRISED IN	SHOWN	SERVIENT TENEMENT	GRANTEE
Right to Convey Water	CT 13C / 1112	—	Sec 19	Hawkdun-Idaburn Irrigation Company Limited

Plan of Easement Over
Sec 19 Blk V Maniototo S.D.

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OTAGO LAND DISTRICT CENTRAL OTAGO DISTRICT COUNCIL	SCALE 1:25 000 DATE 26-11-91	PREPARED BY DEPT. OF SURVEY AND LAND INFORMATION
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OPTIONAL EASEMENTS IN GROSS

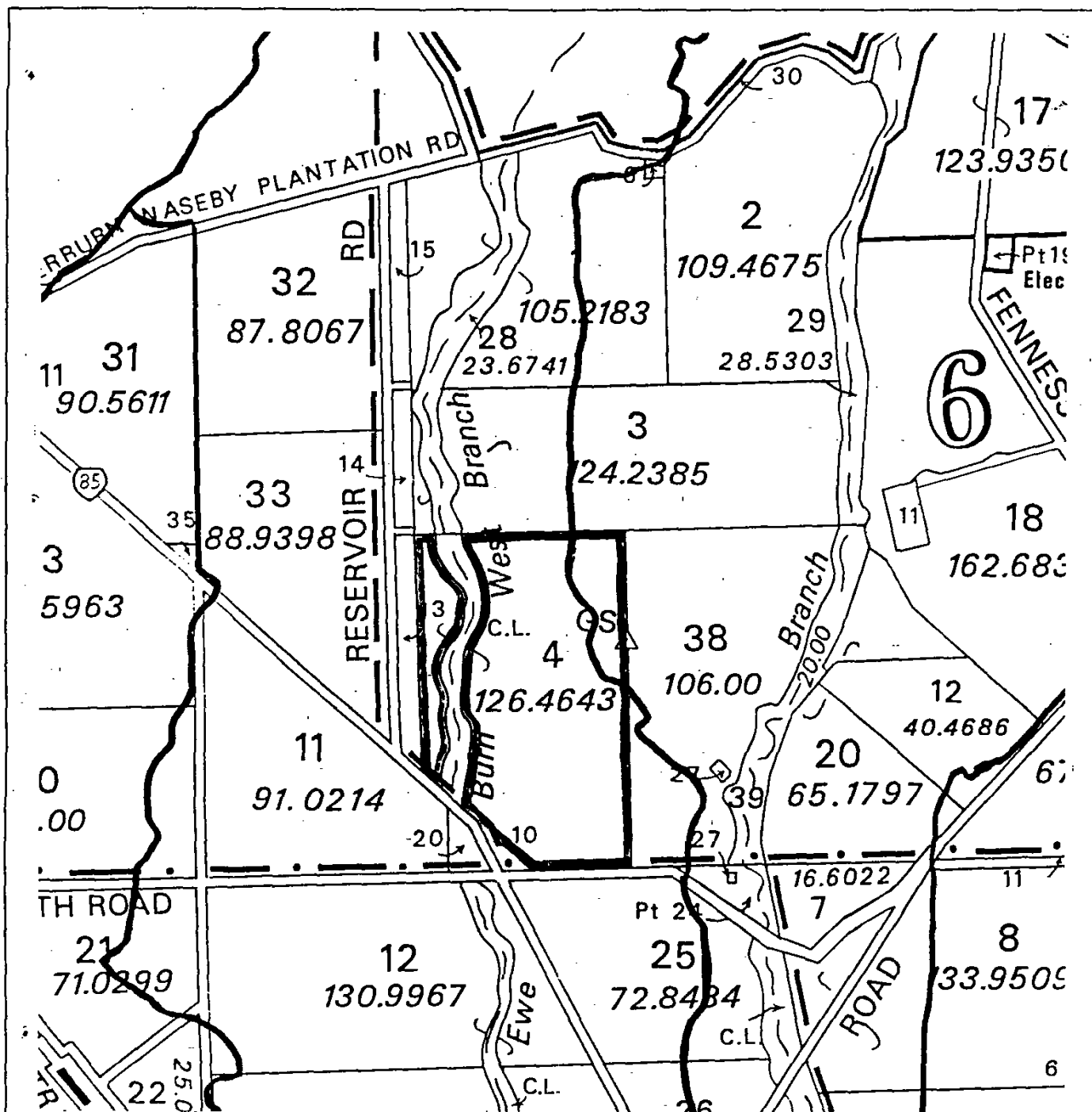
PURPOSE	COMPRISED IN	SHOWN	SERVIENT TENEMENT	GRANTEE
Right to Convey Water	CT 9C/187	—	Sec's 5 & 9	Hawkdun-Idaburn Irrigation Company Limited

Plan of Easement Over
Sec's 5 & 9 Blk XIX Maniototo S.D. *W & C*

OTAGO LAND DISTRICT
CENTRAL OTAGO DISTRICT COUNCIL

SCALE 1: 25 000
DATE 27-11-91

PREPARED BY
DEPT. OF SURVEY AND LAND INFORMATION



OPTIONAL EASEMENTS IN GROSS

PURPOSE	COMPRISED IN	SHOWN	SERVIENT TENEMENT	GRANTEE
Right to Convey Water	CT 10A/926		Sec 4	Hawkdun-Ilaburn Irrigation Company Limited

Plan of Easement Over
Sec 4 Blk VI Naseby S.D.

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OTAGO LAND DISTRICT CENTRAL OTAGO DISTRICT COUNCIL	SCALE 1: 25 000 DATE 27-11-91	PREPARED BY DEPT. OF SURVEY AND LAND INFORMATION
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In Consideration of

(the receipt of which is hereby acknowledged)

Do hereby Transfer

and

State and Province of the

said land

THE COMMON SEAL of HAWKDUN IDABURN
IRRIGATION COMPANY LIMITED was hereunto
affixed as Grantee in the presence
of:



.....Director

.....Director/Secretary

of

Ottawa

1992

Signed by the above named WILLIAM HUGH
CARSON and SYLVIA ELLEN CARSON
in the presence of:—

W H Carson
Selena

.....
Selena
Kerby

No.

TRANSFER OF
GRANT OF EASEMENT

Correct for the purposes of the Land Transfer Act.

SOLICITOR FOR THE TRANSFEREE

W.H. & S.E. CARSON

Grantor
~~Transferor~~

I hereby certify that this transaction does not contravene the provisions of Part IIA of the Land Settlement Promotion and Land Acquisition Act 1952.

SOLICITOR FOR THE TRANSFEREE

HAWKDUN IDABURN IRRIGATION
COMPANY LIMITED

Grantee

~~XXXXXX~~

I hereby certify for the purposes of the Stamp and Cheque Duties Act 1971 that no conveyance duty is payable on this instrument by reason of the application of Section 24(1) of the Act and that the provisions of subsection (2) of that section do not apply.

SOLICITOR FOR THE TRANSFEREE

Particulars entered in the Register as shown herein on the date and at the time endorsed below.

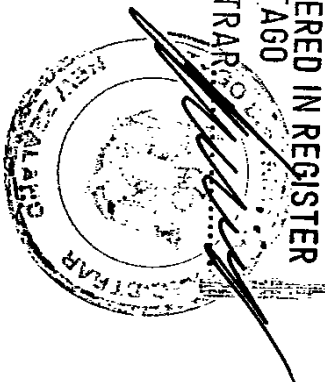
Assistant / District Land Registrar

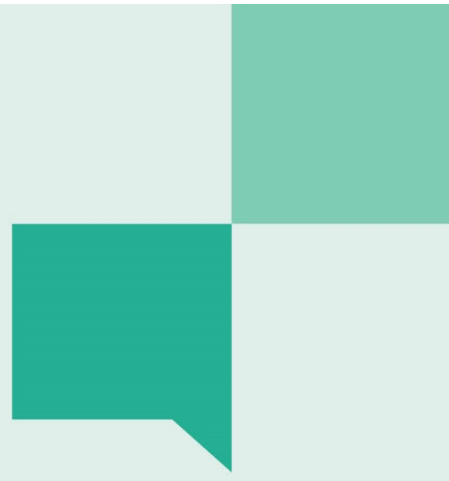
of the District of

FRASER, MACDONALD, MARTIN & CO
SOLICITORS
RANFURLY

Solicitors for the Transferee

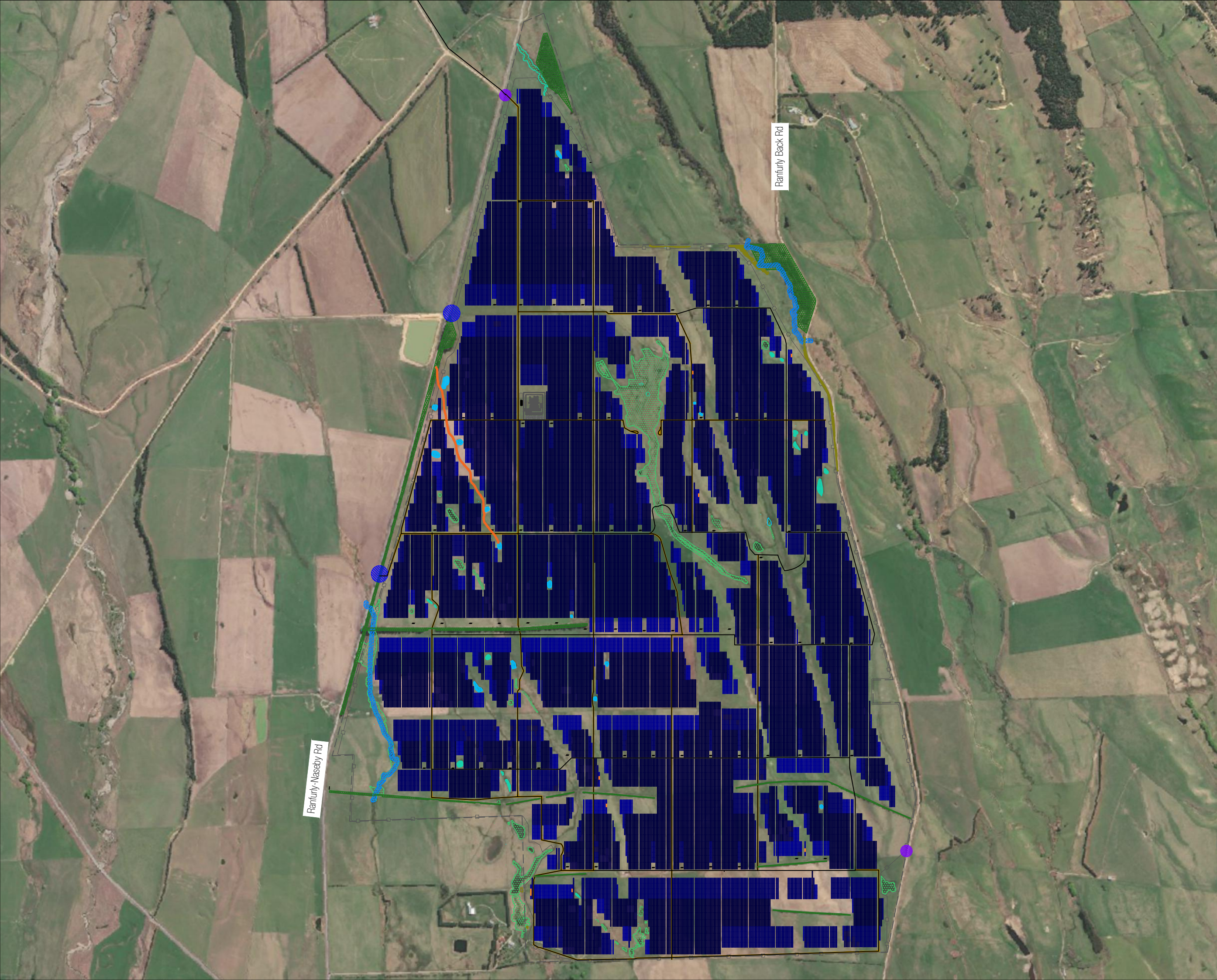
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10/1/92
18/1/92
9/1/87





Appendix 2

Site Layout Plan



Legend:

	Legal Boundary
	Site Fence & Security Cameras
	Main Site Access Track
	Solar Panel Arrays (104, 78, 52 panel tables shaded dark-light navy)
	Inverter Stations
	Indicative Substation Layout (Site office, storage and water storage adjacent)
	Indicative Battery Energy Storage Units
	Primary Site Access Point
	Secondary Site Access Point
	Wetland with Indigenous Vegetation (5+m buffer)
	Wetland with Exotic Vegetation
	Existing Constructed Pond
	Existing Vegetation to be Maintained
	Existing Waterway
	Hawkdun Idaburn Irrigation Setback

Project Details:

LATITUDE	-45.0613
LONGITUDE	170.1051
INTERCONNECTION VOLTAGE	220 kV
LEASED AREA	665.1 Ha
FENCED AREA	638.9 Ha
ARRAY AREA	562.7 Ha
FENCE LENGTH	11,692 m
DC CAPACITY	341.1 MWp
AC CAPACITY	306.6 MVA
CONNECTION CAPACITY	300 MW
DC:AC RATIO	1.11
TRACKER ROWS	(3,895*104), (1,189*78), (921*52)
GCR	36.6%
TOTAL SITE COVERAGE	23.3%
MODULE CAPACITY	625 W
MODULE QUANTITY	545,714
STRING SIZE	26
INVERTER CAPACITY	4.20 MVA (@40C)
INVERTER QUANTITY	73

Project Name:
Naseby

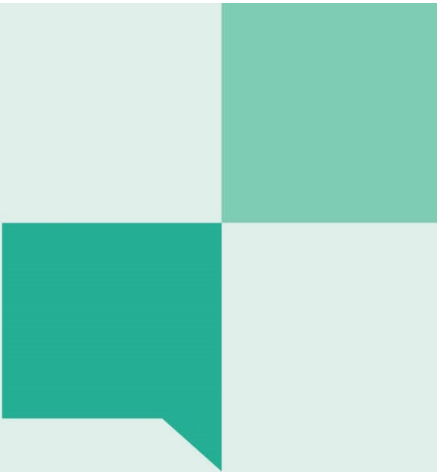
Drawing Name:
Preliminary Layout

Revisions:				
Version	Date	Created By	Reviewed By	Description & Notes
0	10/01/2024	JM	DR	Initial Release

Scale:
1:375

Date: 10/01/2024

Revision Number: 0



Appendix 3

Proposed Consent Conditions

Proposed Consent Conditions

In General Accordance

1. The activity authorised by this consent must be carried out following these conditions and otherwise in a manner that follows the application received on 29 March 2024, completed by The Property Group Limited titled 'Application for Resource Consent 48 Ranfurly-Naseby Road, Naseby: Mānīatoto Plain Solar Farm', except where modified by these conditions, and:
 - The Site Layout Plan completed by Helios Energy Limited, titled 'Naseby – Preliminary Layout', dated 10 January 2024.
 - The Acoustic Assessment completed by Marshall Day Acoustics titled 'Helios Solar Farm - Maniototo Assessment of Noise Effects', dated 17 October 2023.
 - The Integrated Transport Assessment completed by Abley, titled 'Naseby Solar Farm Development Transport Assessment', dated 23 August 2023.
 - The Landscape Effects Assessment completed by Boffa Miskell Limited, titled 'Mānīatoto Solar Farm: Landscape Effects Assessment. Report prepared by Boffa Miskell Limited for Helios Energy Ltd', dated 28 February 2024.
 - The Graphic Supplement completed by Boffa Miskell Limited, titled 'Helios Maniototo Solar Farm – Graphic Supplement', dated 28 February 2024.
 - The Ecological Impact Assessment completed by Boffa Miskell Limited, titled 'Mānīatoto Solar Farm: Ecological Impact Assessment. Report prepared by Boffa Miskell Limited for Helios Energy Limited', dated 18 December 2023.
 - The Hazardous Substance Assessment completed by Beca Limited, titled 'Hazardous Substance Assessment Naseby Solar Farm', dated 20 December 2023.
2. The consent holder must construct, operate, and maintain the Solar Farm in general accordance with all management plans submitted to, and certified by, the Manager Resource Consents, Central Otago District Council, to fulfill the conditions of this resource consent.

Construction Management

3. A minimum of eight (8) weeks before the activity commences (excluding any enabling works such as geotechnical investigations, piling tests and site surveys or testing), the consent holder must submit to the Manager Resource Consents, Central Otago District Council, for their certification, a Construction Management Plan (CMP) sufficient to meet conditions 4 and 5.

Advice Notes:

- Certification (or withholding certification) of the CMP is based on whether the CMP meets the requirements of the conditions of this resource consent, explicitly focusing on the matters outlined in condition 4.
 - Where Council is unable to certify the CMP on the basis that it does not address the matters contained within condition 4, the Council will advise the consent holder in writing, outlining the reasons why technical certification has been refused within ten (10) working days of receipt.
4. The objective of the CMP is to develop measures, and processes to manage and minimise the effects of noise and dust caused by the construction of the Solar Farm. For that purpose, the CMP must include:
- a) A final construction methodology plan.
 - b) The contact details of the construction site manager.
 - c) Methodology of dust and stockpile management.
 - d) A Construction Traffic Management Plan (CTMP) including, as a minimum the following detail:
 - Truck drivers are advised:
 - To adhere to the speed limit and drive to the conditions during periods of adverse weather.
 - Of the circulation arrangements onsite, including the requirement to access the site via Access 1 and exit the site via Access 2.
 - To stay on State Highway 85 (and travel through Ranfurly), so that they do not use Goff Road.
 - An outline of how traffic will be directed onto the site and where parking and the layby area will be located. The layby area must be set back sufficiently away from the gate to avoid vehicles queuing over the sealed access area.
 - Identifies that only Access 1 and 2 are to be used by heavy vehicles, and that the use of Access 4 (and Ranfurly Back Road) must not include heavy vehicles. Light vehicle movements may only consist of infrequent access to the rear parts of the solar farm.
 - Any temporary traffic management measures.
5. The CMP may be amended or updated without the need for certification where:
- a) The amendment is an administrative change, including nominated personnel; and
 - b) The revised CMP is provided to the Manager Resource Consents, Central Otago District Council and, within five (5) working days of receiving the revised CMP, the Manager Resource Consents has not advised in writing that the amendment does not meet the requirements of condition 5(a).

6. All construction works must be undertaken in accordance with the certified CMP and a copy of the CMP must be kept on-site for the duration of the construction period.
7. The construction activities shall only occur between Monday to Saturday 7.30am to 6.00pm (excluding public holidays).
8. A minimum of eight (8) weeks before the activity commences (excluding any enabling works such as geotechnical investigations, piling tests and site surveys or testing), the consent holder must submit to the Manager Resource Consents, Central Otago District Council, for their information, an Erosion Sediment Control Plan (ESCP) authored by a suitably qualified person. The ESCP shall identify the measures required to manage erosion and sediment arising from works on the site, and shall provide as per the following:
 - a. All earthworks must be managed to minimise any discharge of debris, soil, silt, sediment or sediment-laden water beyond the subject site to either land, stormwater drainage systems, watercourses or receiving waters.
 - b. All machinery associated with the earthworks and construction activity shall be operated in a way which ensures that spillages of hazardous substances such as fuel, oil, grout, concrete products and any other contaminants are prevented.

The ESCP may be amended throughout construction to suit the appointed Contractor's methodology and/or respond to the onsite environment.

Transport

9. Prior to commencing construction (excluding any enabling works such as geotechnical investigations, piling tests and site surveys or testing), the consent holder must upgrade Access 1, 2, 3 and 4 to be constructed in accordance with Figure 12.5 of the Central Otago District Plan. The geometry for Access 1 and 2 must be in general accordance with the vehicle tracking shown in Appendix A of the Integrated Transport Assessment completed by Abley, titled 'Naseby Solar Farm Development Transport Assessment', dated 23 August 2023.
10. Prior to commencing construction (excluding any enabling works such as geotechnical investigations, piling tests and site surveys or testing), Access 1, 2 and 3 must be sealed from the edge of Ranfurly-Naseby Road to a distance of not less than 5m inside the property boundary.
11. The consent holder must ensure that only Access 1 and 2 are to be used by heavy vehicles. The use of Access 4 (and Ranfurly Back Road) must not include heavy vehicles. Light vehicle movements may only consist of infrequent access to the rear parts of the solar farm.
12. The main internal accessways identified on the Site Layout Plan completed by Helios Energy Limited, titled 'Naseby – Preliminary Layout', dated 10 January 2024, in Condition 1 must be formed and constructed to a 4m width with an all-weather metalled surface.

Advice Note: All other internal accessways can remain unformed provided they do not result in any airborne or deposited dust beyond the site's property boundary, determined by the relevant regulatory authority to be noxious or dangerous, offensive or objectionable. If any airborne or deposited dust beyond the property boundary is noxious or dangerous, offensive or objectionable then the remaining internal accessways must be required to be formed to an all-weather metallised surface.

13. The consent holder must submit a corridor access request (CAR) to the Manager Resource Consents, Central Otago District Council, at least 10 working days before any work is required to be carried out on a public road.

Noise

14. The rating noise level from all solar farm operations shall meet the following District Plan noise limits at the notional boundary of dwellings existing at the time of consent, on another site in the Rural Resources zone:
 1. 55 dB L_{A10} from 7:00 am to 10:00 pm
 2. 40 dB L_{A10} and 70 dB L_{AFmax} from 10:00 pm to 7:00 am the following day

Advice Note: Noise levels shall be measured and assessed following NZS 6801:2008 Acoustics – Measurement of Environmental Sound and NZS 6802:2008 Acoustics – Environmental Noise (or any subsequent replacement standard).

15. That noise from construction activities shall not exceed the limits recommended in, and shall be measured and assessed in accordance with, New Zealand Standard NZS 6803: 1999 “Acoustics – Construction Noise” and German Standard DIN 41503:2016 Vibration in buildings – Part 3: Effects on structures [vibration].

Landscape and Visual

16. A minimum of eight (8) weeks before the commencement of the activity authorised by this consent (excluding any enabling works such as geotechnical investigations, piling tests and site surveys or testing), the consent holder must submit to the Manager Resource Consents, Central Otago District Council for certification:
 - A final Landscape Mitigation Plan (being any updated details to the Landscape Mitigation Plan provided as Figure 5A in the Graphic Supplement completed by Boffa Miskell Limited, titled ‘Helios Maniototo Solar Farm – Graphic Supplement’, dated 28 February 2024); and
 - A Landscape Management Plan which includes the following:
 - a) Details that are in accordance with the recommendations identified in section 6 the Māniatoto Solar Farm Landscape Effects Assessment, dated 28 February 2024, and the recommendations identified in section 8.1.2 in the Māniatoto Solar Farm Ecological Impact Assessment, dated 18 December 2023.
 - b) Monitoring and maintenance requirements for weed removal.

- c) Detailed mitigation and enhancement planting areas required for the Project including layout, species, grades, numbers, spacing, eco-sourcing, and a programme and specification for implementation and maintenance.
 - d) Replacement planting with evergreen species where there are gaps or where there are trees that are failing and need to be removed.
 - e) Inclusion of matagouri, desert broom, porcupine shrub, and pohuehue shrubs.
17. The certified final Landscape Mitigation Plan must be implemented before the solar farm is operational.
18. The landscape planting must be maintained in accordance with the certified Landscape Management Plan for the duration of this consent. Should any tree become diseased or die, it shall be replaced with the same species in the following planting season (spring or autumn).
19. The materials and colours of onsite buildings and structures will, where unless operational requirements prevent it, have a Light Reflectivity Value (LRV) of less than 30%, and be in keeping with the materials and colouring of existing infrastructure, or of a colour that will blend with the landscape such as in a natural range of browns, greens and greys to complement the tones found in the rural surroundings.
20. The consent holder shall ensure that all areas of soil disturbed by the project are rehabilitated progressively or immediately post-construction.
21. The consent holder shall ensure night lighting is minimised to the maximum extent possible (i.e., manually operated safety lighting at main component locations).

Ecology

22. A minimum of four (4) weeks before the commencement of the activity authorised by this consent (excluding any enabling works such as geotechnical investigations, piling tests and site surveys or testing), the consent holder shall provide a copy of the Wetland Enhancement Plan to the Manager Resource Consents, Central Otago District Council for their information. The Wetland Enhancement Plan shall be prepared by a suitably qualified ecologist in accordance with the recommendations identified in section 8.1.5 of the Mānīatoto Solar Farm Ecological Impact Assessment, dated 18 December 2023.
23. The wetland enhancement measures identified in the Wetland Enhancement Plan must be implemented before the solar farm is operational.
24. Any construction works occurring during the bird breeding season (1 September to 28 / 29 February) shall be undertaken in accordance with the recommendations identified in section 8.1.1.2 of the Mānīatoto Solar Farm Ecological Impact Assessment, dated 18 December 2023.

25. Six months prior to the commissioning of the solar farm, the consent holder shall engage a suitably qualified and experienced ornithologist or ecologist to undertake a bird strike literature review in accordance with the recommendations identified in section 8.1.4 of the Mānīatoto Solar Farm Ecological Impact Assessment, dated 18 December 2023. The outcome of this literature review will determine if post-construction bird strike monitoring is required at the Site.
26. If monitoring is recommended by the suitably qualified and experienced ornithologist or ecologist as an outcome of the bird strike literature review required by Condition 23, the monitoring methodology must be identified in an Avifauna Collision Risk Monitoring Plan (ACRMP), prepared by a suitably qualified ornithologist / ecologist. The ACRMP must be provided to the Manager Resource Consents, Central Otago District Council for their information prior to implementation. The ACRMP should include, but not be limited to, the following details:
- (a) Frequency and duration of surveys (e.g., one day fortnightly for one year). Due to seasonal variation in bird behaviour including migratory movements, for any monitoring to be worthwhile the minimum time period is one year.
 - (b) Survey methods (e.g., slowly drive up and down a defined subset of the solar farm rows searching for indigenous bird carcasses, noting species, number of carcasses, weather conditions, cause of death, location, etc (and sending carcasses away for autopsy if cause of death is unknown).
 - (c) Mortality thresholds for At Risk and Threatened indigenous species that if reached, trigger a management response.
 - (d) Results analyses (e.g., estimated annual mortality rates).
 - (e) Requirements for review and reporting, including making the results publicly accessible.
27. Bird strike monitoring must be undertaken in accordance with the methodology identified in the ACRMP.

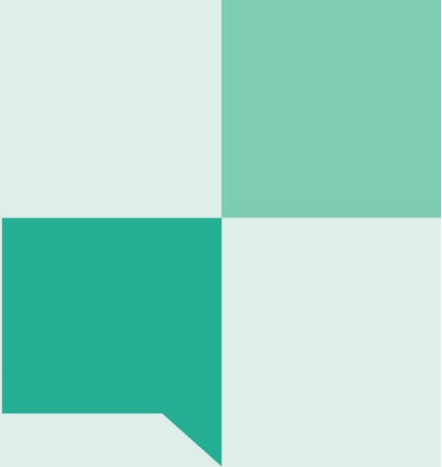
Hazardous Substances

28. Prior to the commissioning of the activity authorised by this consent, an Emergency Response Plan (ERP) based on the actual BESS facility shall be prepared in accordance with the recommendations identified in the Hazardous Substance Assessment, dated 20 December 2023. A copy of the ERP shall be provided to Fire and Emergency New Zealand for input, with a subsequent final copy to be provided to the Manager Resource Consents, Central Otago District Council for their information.
29. Prior to the commissioning of the activity authorised by this consent, the site inventory of all hazardous substances used and stored at the site shall be confirmed and remain up to date. Signage must be in place permanently that shows areas where hazardous substances are used and stored, and current safety data sheets for the hazardous substances shall be kept on site and readily available to detail the risks associated with each chemical.

30. The final design of the BESS area and battery specifications must be reviewed against the HS Regulations and signed off by a Compliance Certifier (where required under the Health and Safety at Work (Hazardous Substances) Regulations 2017). A copy of the Compliance Certification shall be provided to the Manager Resource Consents, Central Otago District Council for their information and to demonstrate compliance with this condition.

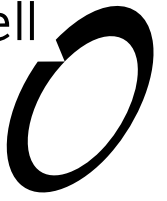
Site Decommissioning

31. A minimum of eight (8) weeks before the expiry of this consent, or before the cessation of the activity authorised by this consent, whichever is earlier, a Site Decommissioning Plan must be submitted to the Manager Resource Consents, Central Otago District Council for certification.
32. The site decommission works must be completed in accordance with the certified Site Decommissioning Plan.
33. The consent holder must notify the Manager Resource Consents, Central Otago District Council, at least ten (10) working days before completion of the decommissioning to allow Council staff to carry out site inspections to determine compliance with the certified Site Decommissioning Plan.



Appendix 4

Landscape Effects Assessment and Graphic Supplement



Māniatoto Solar Farm

Landscape Effects Assessment
Prepared for Helios Energy Ltd

28 February 2024





Boffa Miskell is proudly a
Toitū net carbonzero certified consultancy

Document Quality Assurance

Bibliographic reference for citation:

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Prepared by:	Sue McManaway Landscape Planner / Principal Boffa Miskell Limited	[Insert signature here]
Reviewed by:	[Yvonne Pfluger] Landscape Planner / Partner Boffa Miskell Limited	[Insert signature here]
Status: FINAL	Revision / version: 1	Issue date: 28 February 2024

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Template revision: 20230505 0000

Cover photograph: View towards Naseby Solar Farm Site, © Boffa Miskell, 2023

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Appendices

Appendix 1: Method Statement

Appendix 2: Visual Impact Tables from Dwellings

Appendix 3: ITP Glint and Glare Study

Graphic Supplement (bound separately)

1.0 Introduction

Helios Energy Limited (Helios) propose to develop a solar farm and substation at a site of approximately 660 ha near Naseby, in Central Otago. The development will connect to the National Grid and be capable of producing approximately 630 GWh/yr.

The solar farm and substation will be located on land leased by Helios on Ranfurly-Naseby Road between Naseby and Ranfurly (the **Site**).

The proposed solar farm would be built on land leased from two local farming families and connected into the national electricity transmission grid via the Naseby substation on Fennessy Road. The solar farm will generate enough clean electricity to power the equivalent of approximately 70,000 homes annually.

The Site is zoned Rural Resource Area and has an overlay of Other Rural Landscapes (ORL) within the Central Otago District Plan. There are no Outstanding Natural Features or Landscapes (ONFLs) or Significant Amenity Landscapes (SALs) which relate to the Site.

The key features of the project comprise the solar panels, substation and supporting electrical infrastructure/equipment, buildings, lighting, underground cabling, access and internal access tracks, fencing and landscaping.

Agricultural operations in the form of sheep grazing within the property will continue.

1.1 Scope of the report

Boffa Miskell Limited (BML) has been engaged by Helios Energy Ltd to undertake a Landscape Effects Assessment (LEA) for the proposed solar farm on Ranfurly-Naseby Road. The scope of this LEA relates only to proposed infrastructure developments within the Site itself (see **Figure 1** below). It does not include assessment of a proposed underground transmission line from the Site to the existing Naseby Grid Exit Point (substation), as we have been advised by Helios that these works are a permitted activity that would occur within a legal road reserve area.

The following Landscape (and Visual) Effects Assessment:

- Describes the Site and its landscape setting, placing the Site in the wider context of the Maniototo / Mānīatoto Plains / Mānīatoto Plain¹;
- Describes the nature of the Proposal; and
- Sets out an assessment of the landscape and visual effects of:
 - the temporary construction stages of the proposed solar development through to completion of construction; and
 - 5 years following completion of construction when proposed landscape planting is becoming established.

¹ Although frequently spelt 'Maniototo', 'Mānīatoto' or 'Maniatoto' are recognised as the preferred spelling by iwi and Central Otago District Council.

A separate **Graphic Supplement** including visual simulations, has been prepared and is attached. The location and context of the Project Site is shown in **Figure 1** of the Graphic Supplement and reproduced below.

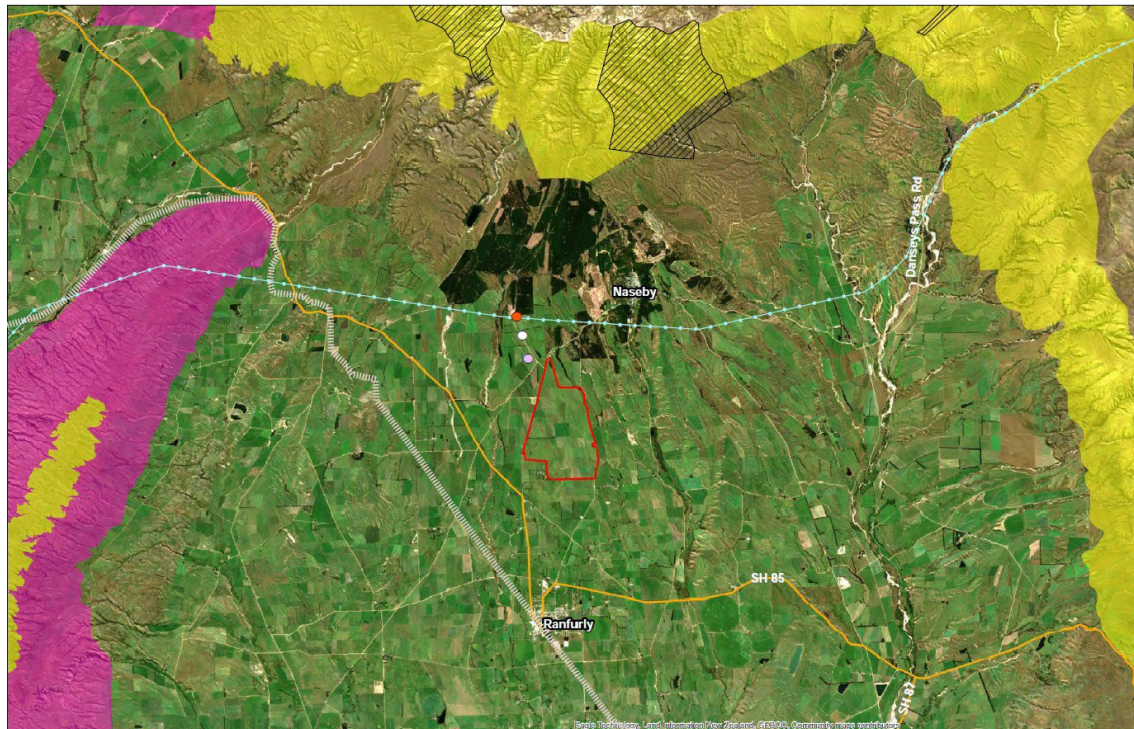


Figure 1: Location and context of proposed Project Site. The nearest Outstanding Natural Landscapes are shown in yellow and Significant Amenity Landscapes in pink. A National Grid transmission line can be seen crossing the landscape to the north of the Site in blue (Source: Boffa Miskell)

1.2 Other Technical Relevant Reports

Boffa Miskell has prepared an Ecological Impact Assessment (EclA) report to accompany the necessary resource consent applications for the proposed solar farm. The assessment is referenced and discussed throughout this report in the context of the Site description and landscape and natural character assessment.

- *Boffa Miskell Ltd, December 2023: Mānīatoto Solar Farm: Ecological Impact Assessment. Prepared by Boffa Miskell for Helios Energy Ltd.*

This report has also drawn information from the 1998 regional landscape study and the 2008 landscape assessment of Central Otago:

- *Boffa Miskell Ltd, 1998: Investigations into Otago's Natural Character, Landscape and Significant Natural Areas. Prepared by Boffa Miskell for Otago Regional Council.*
- *Robson Garland, Ian Brown Consultants and LA4 Landscape Architects, 2008: Central Otago District Rural Review Landscape Assessment Report and Recommendations. Prepared for Central Otago District Council*

This report also relies on and should be read in conjunction with information provided in:

- *ITP Renewables, 2023: Naseby Solar Farm: Glint and Glare Study. Report prepared for Helios Energy.*

This report and the issue of glint and glare are described further below. The full report is attached as **Appendix 3**.

Glint and Glare Study

A Solar Photovoltaic Glint and Glare Study (the Glint and Glare Study) has been undertaken by ITP (September 2023). This report determined the impact of glint and glare from the proposed Solar Farm on the adjacent roads (nine road routes) and nearby houses (16 observation points). The model used for the Glint and Glare Study was constructed taking into account 'existing vegetation within the Site as well as some key external shelterbelts outside the Site'², all modelled with an upper edge height of 10 m as a conservative estimate (Figure 7 in the Glint and Glare Study identifies the location of existing vegetation modelled).

Glint is typically defined as a momentary flash of bright light, often caused by a reflection off a moving source. A typical example of glint is a momentary solar reflection from a moving car. Glare is defined as a continuous source of bright light. Glare is generally associated with stationary objects, which, due to the slow relative movement of the sun, reflect sunlight for a longer duration. The difference between glint and glare is duration.

In explaining glare and its potential impacts, the Study states that severity of ocular hazard caused by glint and glare can be divided into three levels:

- **Green glare**, which has low potential to cause temporary afterimage
- **Yellow glare**, which has potential to cause temporary afterimage
- **Red glare**, which can cause retinal burn and is not expected for photovoltaic systems

The Study finds there are two potential levels of glare for this Site – green and yellow.

The limit for glint/glare which creates unreasonable nuisance has been defined in several international guidelines. In Germany the Light-Guideline (Licht-Leitlinie) issued by the Ministry of Environment defines the limits for glare duration at 30 minutes per day and 30 hours per year. In Austria the same values were determined in their national guidelines OVE R11-3. Australian guidance³ defines glare of high impact as that which is greater than 30 minutes per day and 30 hours per year. Table 1 below, has been adapted from these guidelines with reference to effects of solar glare.

In the United Kingdom, photovoltaic glint and glare guidance⁴ states that if visible glint and glare is predicted for a surrounding dwelling for longer than 60 minutes per day, for three or more months of the year, then the impact should be considered significant with respect to residential amenity. **For the purposes of this assessment, limits for glare duration greater than 30 minutes per day and 30 hours per year have been defined as high impact.** This duration of effect has been chosen as it is in line with international best practice for solar glare, but also aligns with the limits defined by international guidelines for addressing the effects of shadow flicker caused by wind turbines. **Table 1** below outlines the level of impact in relation to glare for residential dwellings.

Table 1: Glare Impact in relation to residential dwellings

² Glint and Glare Study, section 3.3.2, p14

³ New South Wales Department of Planning and Environment. Large-Scale Solar Energy Guidelines, August 2022

⁴ Pager Power Ltd. Solar Photovoltaic and Building Development Glint and Glare Guidance, Fourth Edition, September 2022.

High glare impact	Moderate glare impact	Low glare impact
> 30 minutes per day	< 30 minutes & > 10 minutes per day	< 10 minutes per day
> 30 hours per year	< 30 hours & > 10 hours per year	< 10 hours per year
Significant amount of glare that should be avoided by solar layout and/or mitigation measures.	Implement mitigation measures to reduce impacts as far as practicable.	No mitigation required.

Solar Glare for road users

A review of international best practice guidance for assessing effects of solar glare from roads finds that reflections which originate in front of the road user require mitigation. Local roads are generally considered to not require mitigation, however as the majority of roads in New Zealand would qualify for what internationally would be considered a 'local road', the assessment has considered all roads.

A road user travelling on surrounding roads where a solar reflection is geometrically possible would experience a solar reflection that is fleeting in nature. The nature of the view is dependent on the speed of the road user travelling past the solar farm at a time when a solar reflection is geometrically possible. Therefore, the location of the solar reflection is more significant than its duration because the road user is moving. Because of this, the length of time a solar reflection is present is not considered when determining its significance. Instead, the location of the solar reflection and road type are considered. Major roads such as State Highways would be considered more sensitive to the effects of glare than local roads where the speed of travel is reduced.

Mitigation is considered necessary for all roads where the road user is aligned directly with the area of glare. For glare which is oblique to the road user's direction of travel, mitigation can also be considered, but is not necessary.

An assessment of glint and glare based on the study findings, in relation to both dwellings and road users is included in the visual effects assessment section (**section 5.3.3**).

1.3 Assessment Approach

This assessment follows the concepts and principles outlined in *Te Tangi a te Manu: Aotearoa New Zealand Landscape Assessment Guidelines*⁵. A full method is outlined in **Appendix 1** of this report. In summary, the effects ratings are based upon a seven-point scale which ranges from very low to very high.

Te Tangi a te Manu recognises the term 'landscape effects' as all-encompassing, and that visual effects and natural character effects are a subset of landscape effects. This assessment discusses landscape, visual and natural character effects separately for clarity, but the overall process is a Landscape Effects Assessment (LEA) in accordance with the Guidelines.

It is noted that Ngāi Tahu are the iwi who have mana whenua rights over this area. No separate cultural assessment or appraisal has been considered as part of this assessment. It is therefore recognised that this LEA is reflective of the western concept of landscape which does not

⁵ *'Te Tangi a te Manu: Aotearoa New Zealand Landscape Assessment Guidelines'*, Tuia Pito Ora New Zealand Institute of Landscape Architects, July 2022.

incorporate mana whenua cultural aspects. Helios will be engaging with mana whenua to understand any potential impacts on cultural values.

1.4 Assessment Process

The first stage of the assessment process consisted of providing high level landscape advice in relation to this proposal⁶ (High-level Landscape and Visual Constraints and Mitigation Memo, April 2023). The primary focus was to provide an overview of key landscape and visual constraints and options for mitigation.

More detailed site investigations were undertaken including creation of a digital model representing the blocks of solar panels combined with existing terrain (at 1m contours) and intervening vegetation represented by point cloud data. The assessment was undertaken, and mitigation recommendations made, using this digital model as a fine-grained analysis tool.

The assessment process is outlined below:

- Familiarisation of the project proposal.
- Desktop review of the existing environment and landscape values.
- Site visits to understand the Site, its context, and nature of existing views, including views from closest neighbours.
- Coordinating the preparation of and utilising a digital model. The model includes the arrays and proposed mitigation planting (bulk, height and location only), added to the existing terrain (within the Site and immediate surrounds including the five nearest dwellings) together with point cloud data representing the intervening vegetation within the site boundary.
- Review of relevant statutory provisions.
- Assessment of landscape and visual effects of the proposed solar farm.
- Recommended mitigation measures to avoid, remedy, and mitigate potential adverse effects including working iteratively with the landscape architect developing the landscape mitigation plan and cross sections, to continually 'test' the recommendations.

A graphic supplement accompanies this written assessment. The Graphic Supplement illustrates the Figures, plans and photographs of the Site and includes the Landscape Mitigation Plan, Cross-sections and screen-shots from the 3D model.

A method statement is provided in **Appendix 1** of this report.

Landscape, natural character and visual assessments are closely related and, in part, overlapping. A brief explanation of the assessments made for this proposal is provided below.

⁶ High-level Landscape and Visual Constraints and Mitigation Memo, April 2023

1.4.1 Natural Character Assessment

The solar farm is located outside the coastal environment however this assessment considers natural character insofar as this applies to freshwater bodies and their margins, (as defined in RMA Section 6(a)).

Natural character is described in terms of the natural elements, patterns and processes of such areas and how they are perceived and experienced. The level of natural character (naturalness) is determined by the level of human-induced modification, where the highest degree of natural character occurs where there is the least amount of modification.

This assessment describes and assesses the existing level of natural character of the relevant waterbodies within the Site and then assesses the effects of the proposed solar farm on natural character.

1.4.2 Landscape Assessment

The assessment has identified the extent of the relevant landscape and described and analysed its character and values in terms of physical, sensory and associative attributes and how they combine. The condition of the landscape (i.e. the state of an individual area of landscape or landscape feature) is also described.

The assessment has considered the sensitivity of the physical landscape features to the proposed change, together with the magnitude of change.

1.4.3 Visual Assessment

Landscapes are experienced visually and therefore, visual effects are considered to be the consequences of change on landscape values, as experienced in views.⁷

The visual assessment considers where the proposal will be seen from (including the nature of the view), who will see it, and the nature and scale of visual change that would result from the proposal.

For the purpose of this assessment, visual effects are largely assessed based on desktop analysis and the nearest available public viewpoint from which representative views were obtained. However, access to four nearby private properties was obtained and GPS located photographs taken to represent potential views from the vicinity of dwellings.

1.4.4 Site Visit

A visit to the site and its surroundings was undertaken on 5 April 2023 by Yvonne Pfluger and Sue McManaway (Landscape Architects at Boffa Miskell Ltd). The assessors visited the Site and travelled through the wider area to gain an understanding of the landscape context, the character of the landscape and the potential visual catchment and viewing audience. Weather conditions were largely fine with variable cloud cover.

⁷ TTTM, pp61-62

The proposed mitigation planting which is part of the proposal is shown in **Figure 3** below and can be seen in more detail with the legend provided in the Graphic Supplement (**Figure 5A**).

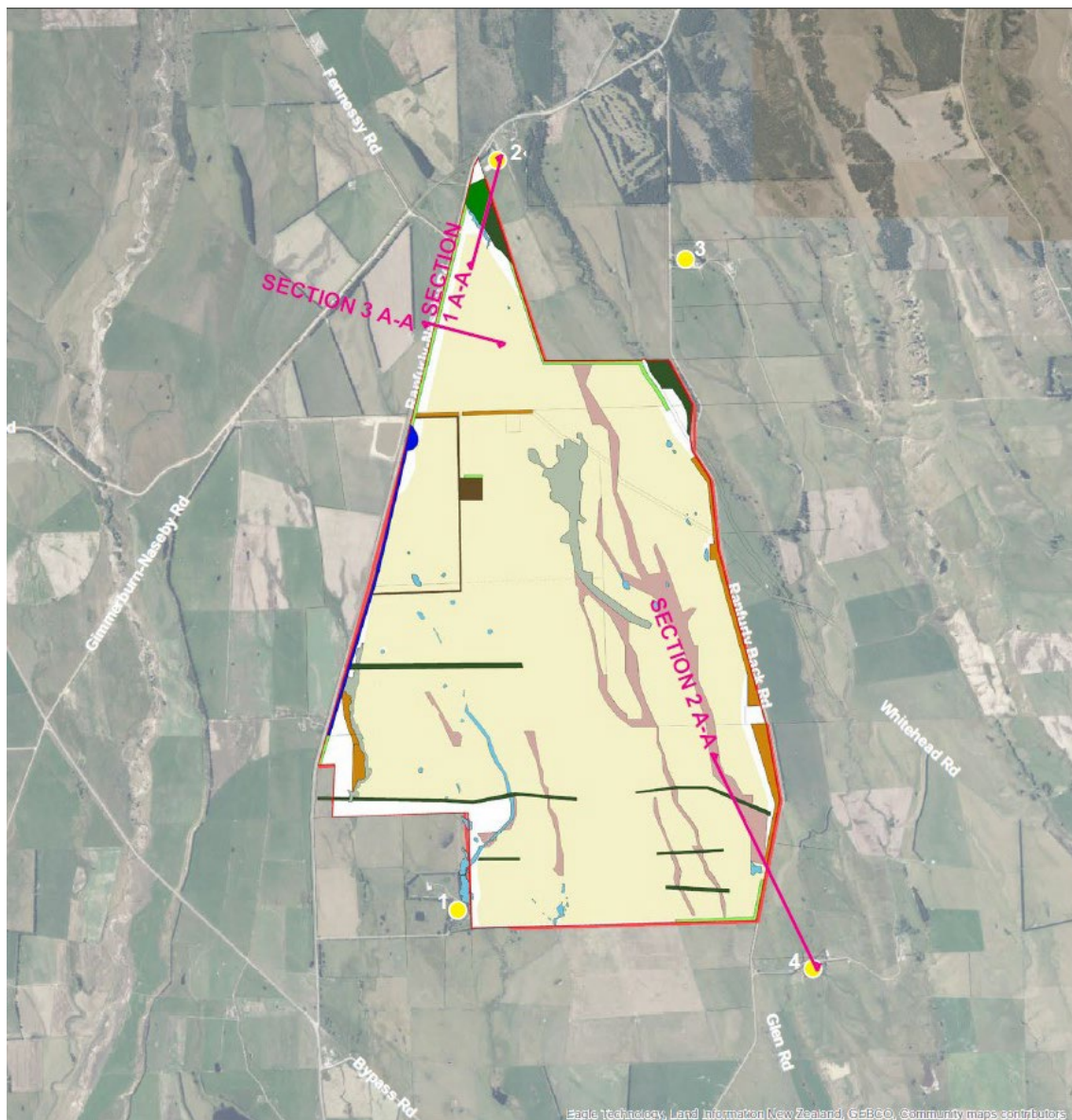


Figure 3: Landscape Mitigation Plan showing general layout, no build areas including setbacks, and planting (Source: Boffa Miskell)

The site will continue to be grazed by sheep (fenced from plantings and wetlands).

The predicted energy output from the Project is approximately 630 GWh/year, which will be supplied into the National Grid.

2.1 Infrastructure associated with the solar farm

Infrastructure associated with the Project will include the solar arrays, internal accessways, fencing, security cameras, lighting, site office, electrical infrastructure and cabling, a substation, a Battery Energy Storage System (BESS) and a transmission line connecting the substation to

the National Grid via Fennessy Road. A brief outline of the key components is provided below. A more detailed project description is provided in the AEE.

Solar Panels and cabinetry

The solar farm is proposed to comprise tilting bifacial monocrystalline panels (1P Trackers) mounted on a tracking system aligned in north-south rows that will rotate east-west to follow the movement of the sun during the day.

The solar panels (when fully flat and parallel to the ground) and all infrastructure will cover approximately 36.6% of the Site (231 ha in total). The solar panel dimensions will be:

- a maximum height above ground of approximately 2,800 mm (when tilted to the maximum angle);
- a panel width of 2,382 mm;
- a minimum height above ground of approximately 500 mm (when tilted to the maximum angle).

A central axis (post/pole holding the panels above the ground) will be approximately 1.5 m-1.8 m above ground. They will be pole driven into the ground, so no concrete foundations are required.

The panels will be arranged in north-south orientated rows within array blocks of approximately 250 m x 285 m. The rows will be spaced approximately 6 m-8 m apart (pole to pole) which allows at least a 3.6 m horizontal gap between the panels when positioned horizontally. There will be 12 m gaps between array blocks to allow for access tracks.

Figure 4 below provides an indication of the proposed panel design and dimensions.

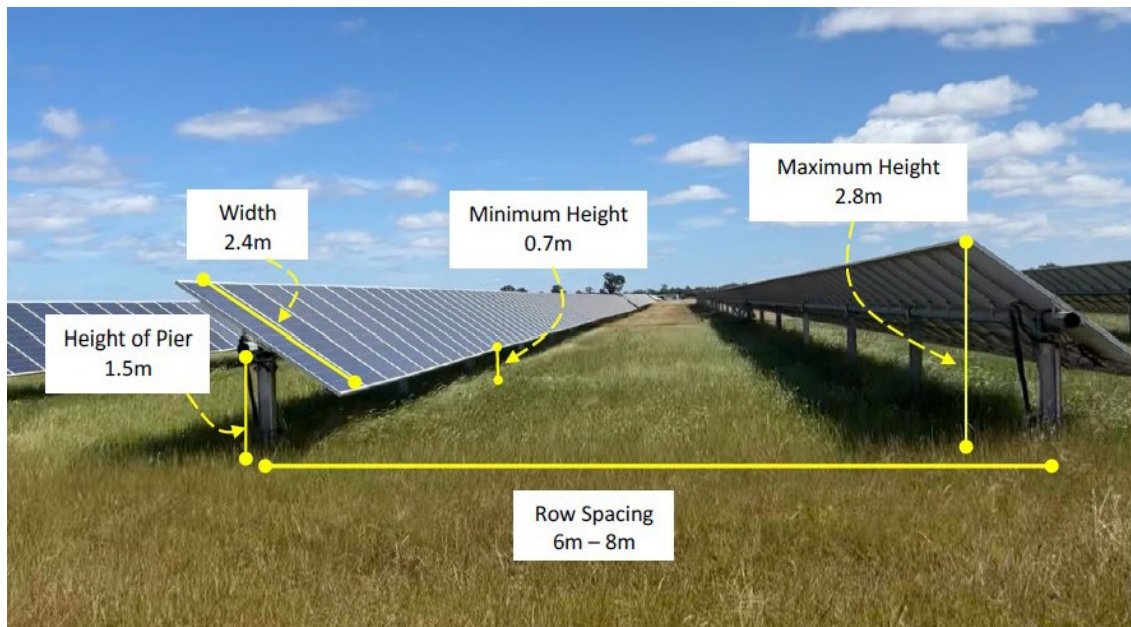


Figure 4: Typical 1P Tracker Arrangement – photograph not to scale (Source: Helios)

On an average day, the following occurs in terms of maximum solar panel height (with approximate timing):

- From sunset to sunrise, the panels are at their lowest, with an approximate 1.6m-1.7 m height.

- From sunrise to approximately 3 hours post sunrise, the panel height slowly increases, peaking at an approximate height of 2.5 m-2.8 m around 8am – 10am (depending on season).
- From 3 hours post sunrise to midday, the panel height decreases to an approximate height of 1.75 m.
- From midday to 2 hours prior to sunset, the panel height increases, peaking at an approximate height of 2.5 m -2.7 m at around 4-6pm (depending on season).
- From approximately 4-6pm to sunset, the panels decrease in height to a 1.6 m-1.7 m height.

Solar angles and irradiances vary during the year, and therefore there are also slight variations to maximum solar panel heights and when they occur during the day because of seasonality. For example, on an average January day, the maximum height of panels occurs around 8am and 6pm. On an average day in July, the maximum height of panels occurs around 10am and 3pm. This relationship between panel height and timing is illustrated in **Figure 5** below.

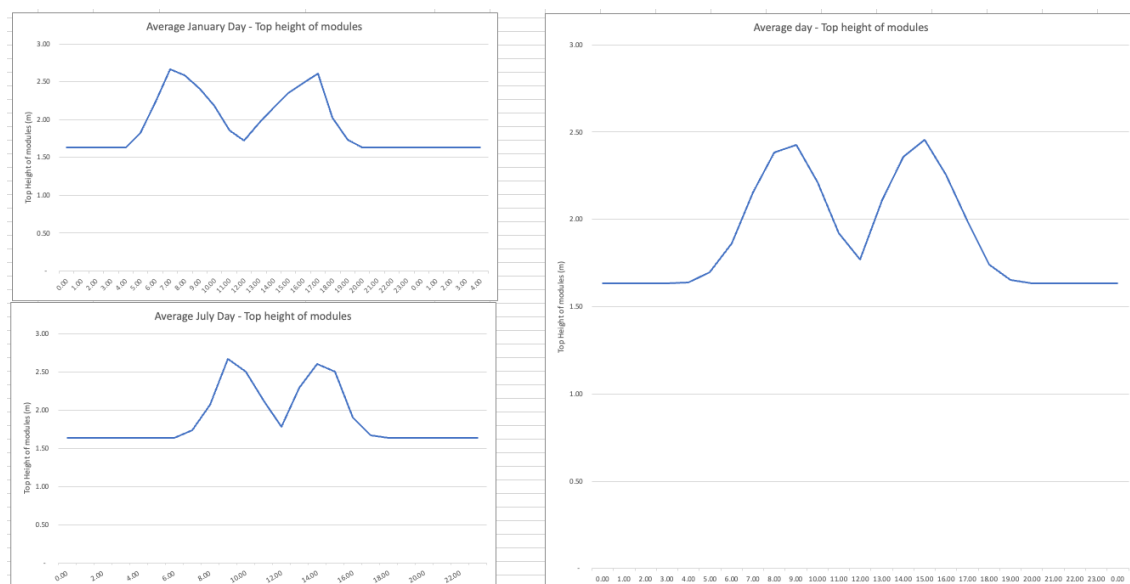


Figure 5: Solar Panel Height and Timing (Source: Helios)

Inverters

Amongst the solar panel arrays will be 74 decentralised inverter structures distributed throughout the farm to be used in the generation of power from the solar arrays. The dimensions of each inverter cabinet will be confirmed through detailed design, but are anticipated to be approximately 2.9 m high, 6.0 m long and 2.5 m wide. These prefabricated structures will sit on piles approximately 600 mm above ground level. The underlying ground will comprise compacted soil and stone.

Underground cabling will be installed across the site (route shown in the drawings in the AEE) to connect the solar panel arrays with the cabinet structures and the substation.

Substation design

A new 33 / 220kV substation will be constructed within the solar farm to connect to the National Grid at the Naseby substation on Fennessy Road. The purpose of the solar farm substation is to

take power from the solar medium voltage power stations via 33 kV cables and transform this to 220kV, suitable for transmission on the National Grid.

While the substation's exact location and layout is subject to future detailed design, it will consist of the following:

- A switchyard with an overall footprint of approximately 100 m x 110 m, approximately 11,100 m² (1.1 ha) in area.
- Up to two 33 kV switchrooms (each approx. 6 m x 20 m); and
- Six lightning masts

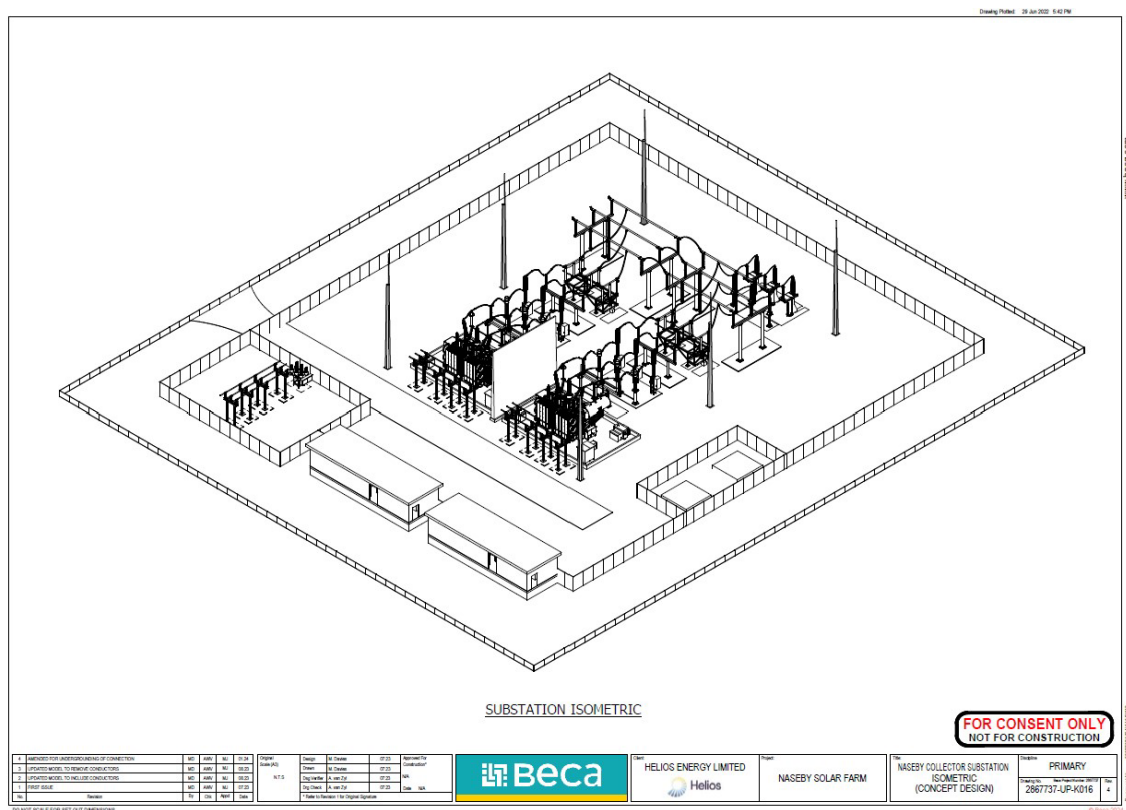


Figure 6: Indicative Substation Design (Source: Helios)

The substation may also house a water storage tank, on-site wastewater treatment, small storage facilities and car parking. There will be additional minor ancillary switchyard equipment that has not been shown. Access will be via internal Site access tracks off Ranfurly-Naseby Road.

The perimeter of the facility will be enclosed with a lockable security fence and a stock fence. The switchyard surface will generally consist of a 150 mm layer of crushed rock aggregate, with approximately 500 mm of basecourse and sub-base material below this. Switchyard equipment will be mounted on concrete foundations.

Two 33/220 kV 150 MVA transformers will be installed on banded foundations to contain the possibility of leaked transformer oil. An oil treatment facility will be installed within a separate enclosure on site to treat stormwater before discharging it to the environment. An enclosure may be required over the capacitor banks. The capacitor banks will not contain any oil.

The new 220 kV transmission line cables connecting the onsite substation to the Transpower Naseby substation will terminate at the cable sealing end stand within the switchyard.

Lighting will be provided in accordance with Transpower's Switchyard and Grounds Lighting Approved Standard (TP.DS 40.03) and will only be used where emergency work/inspections are required. The Site will not otherwise be lit at night, unless there are urgent fault repairs that must be carried out at night.

Battery Energy Storage System

A Battery Energy Storage System (BESS) will be situated within a fenced off area within the substation and will be an area of 2000 m² (0.2 ha) for BESS packs that are each 3 m high.

Runoff from the substation platform area will enter a stormwater drain, to discharge to land. There is an unlikely need for any pre-treatment of the stormwater as a comprehensive oil tank system and bunding for oil in transformers means there is distinct containment which would be emptied via a sucker truck from that containment system on an as required basis.

Transmission infrastructure

The solar farm will be connected to the Naseby substation via underground cabling in the road reserve outside the Site, traversing along Fennessy Road.

2.2 Other Works

Earthworks

Earthworks will be required for the installation of cables (AC and DC Cables), internal access roads, establishing a flat surface for the substation and inverter foundations, BESS. No cut and fill will be undertaken to make areas easier to install panels.

Earthworks will be completed in stages and progressively rehabilitated to minimise the amount of soil exposed at any one time.

A total of approximately 48,230m³ of earthworks will be undertaken. This will be a mix of cut and fill works and all material is to be reused on-site. Approximately 9,274 m³ of thermal sand will be imported to the Site for trenching purposes, as well as approximately 25,044 m³ of gap 20 gravel to create flat and stable areas for the inverters, substation, BESS and roading.

DC trenches will have a width of 0.6 m and depth of 0.8m. AC trenches will have a width of 0.8 m and depth of 1.2 m. Trenches will be remediated in exotic grass. Directional boring / Horizontal Directional Drilling (**HDD**) will enable cabling beneath the central wetland without requiring surface disturbance or works within the wetland.

The estimated total area and volume of earthworks per project component is broken down as follows:

Table 2. Estimated Earthworks Quantities

Component	Area of Earthworks	Volume of Earthworks
DC Cable trenching	21,000	12,600
AC Cable Trenching	10,743	8,595
HV Cable Trench	1,660	1,992
Inverters	1,270	381
Roading	109,116	21,823
Substation	6,300	2,520
BESS Area	1,600	320
Total:	151,689	48,230.34

All site works will be undertaken in accordance with the Construction Methodology as outlined in the AEE, including appropriate sediment and erosion control measures.

Site access

The Site will be fenced and gated for security/insurance purposes. A 2 m high deer-fence type perimeter fence is proposed to be constructed using wooden posts and wire mesh and will be located on the inward side of the proposed mitigation planting.

A total of four site accesses are proposed. Three will be from Ranfurly-Naseby Road and the fourth will be from Ranfurly Back Road as shown in **Figure 7**.

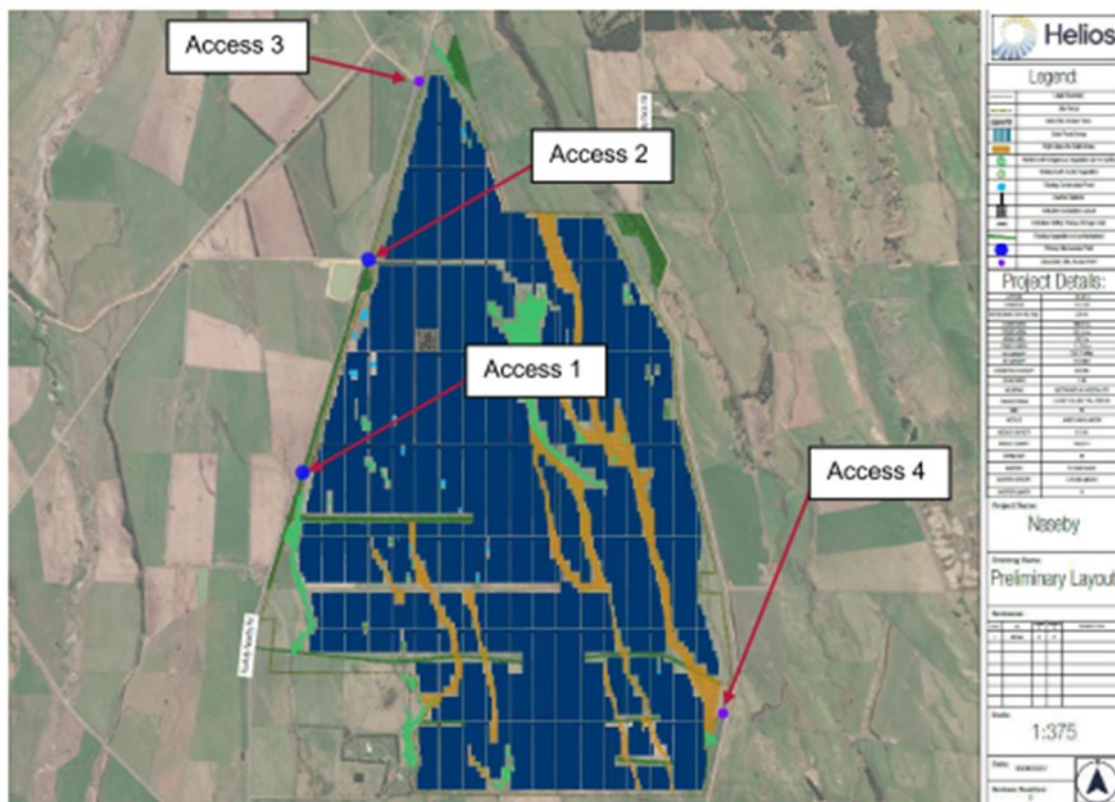


Figure 7: Proposed Access Locations (Source: Helios)

Accesses 1 and 2 will be the primary access points to be used by heavy vehicles during construction. It is proposed to establish an entry and exit access configuration so that construction vehicles enter the site via Access 1, unload materials onsite, and subsequently exit the site via Access 2.

Accesses 3 and 4 are to be secondary access points which will primarily be used to gain more direct access to other parts of the site to reduce the amount of travel through the site. Accesses 3 and 4 will not be used by heavy vehicles.

All accesses will be retained once construction is completed to allow for easier access to all parts of the site when required (although Accesses 1 and 2 will remain the primary accesses and Accesses 3 and 4 will receive minimal use).

New sections of access track will be required which will be formed by the placement of subbase aggregate, approximately 4 m wide. Together with upgrades to existing access tracks, the total length of internal access tracks (new and existing) will be approximately 27 km.

Existing waterway crossings central within the Site will be utilised for construction and operational vehicle access (predominantly construction). At time of detailed design, these will be further inspected to confirm whether any upgrade or new waterway crossings will be required, and additional resource consents sought if required. Therefore, for the purpose of this assessment, and at time of consent lodgement, we have assumed⁸ that there will be no works undertaken within or near waterways, including in relation to existing vehicle crossings.

2.3 Mitigation and Restoration Strategy

The Project has been designed in a manner so as to minimise its impact on the landscape and natural character values of the site as far as practicable through the retention of all mature trees/vegetation and the avoidance of wetland areas and waterways.

To assist with screening views of the solar panels and integrating the proposed development with the surrounding landscape, a combination of setbacks, screen planting and wetland restoration are proposed.

Setbacks

Setbacks are proposed from the Site boundaries, wetlands and waterways as part of the Project. The boundary setbacks vary around the Site in response to different character and sensitivities and can be seen in **Figure 5A** of the Graphic Supplement.

Large setbacks from the boundary to the panel arrays are provided from the boundaries with road interfaces, typically of 20 m-50 m, and 350 m to the substation. At the southwestern corner, a greater boundary setback is proposed of approximately 200 m (300 m to the road), to accommodate the existing waterway in the foreground and reduce visibility. Along the quieter, unsealed road on the eastern boundary (Ranfurly Back Road), where there are fewer shelterbelts, the minimum setback is less, varying from 20 m-30 m up to approximately 130 m. The nearest panels from the northern Site boundary will be approximately 300 m to allow for visual mitigation planting and a setback from the waterway at the foot of the slope. Further large setbacks of up to approximately 150 m are proposed along sections of the Ranfurly Back Road interface to reduce visibility and retain legibility of shallow gully landforms in this area.

⁸ Based on information provided to Boffa Miskell by Helios on 1 November 2023.

Setbacks from wetlands and waterways and mitigation planting are discussed further in the sections below and in the Mitigation Analysis provided in the Graphic Supplement (**Figures 7-7D**).

Boundary treatment and screening planting

New strategic blocks of planting, together with boundary setbacks are proposed as part of the Project (refer to the Graphic Supplement, **Figure 5A: Landscape Mitigation Plan, Figure 5B: Proposed Planting Palette, Figure 5C-5D: Indicative Sections and Figure 5E-5F: Section Elevations**).

The proposed planting strategy varies in species and coverage in response to varying landscape characteristics such as existing vegetation, landform and landscape features as well as the nature and extent of mitigation required.

A mix of dryland native species is proposed in some locations, predominantly along Ranfurly Back Road where there are existing indigenous shrubs present. At Risk-Declining species identified at the Site (matagouri, desert broom and scrub pohuehue) are proposed to form part of the native palette as recommended by the Project Ecologists⁹ to remediate any loss as a result of the development and provide a positive impact in the long term (>20 years).

While the proposed width of boundary planting varies, an indicative cross section is provided (**Figure 5C**) to demonstrate 'drifts' of tree and shrub planting intertwined with a mix of species and plant sizes. It is proposed that new plantings be implemented at spaces that allow for established plant sizes while achieving this varied, natural outcome. The aim is to avoid an 'avenue' effect and to ensure the planting looks as natural as possible.

Detailed planting plans will be developed later as part of a Landscape Management Plan which is described further in **section 6: Recommendations**.

Faster growing exotic evergreen shelterbelt species are proposed in other locations where there are existing shelterbelts such as along Ranfurly-Naseby Road and where additional height is needed. A stand of exotic trees is proposed on the slopes at the northern tip of the Site due to the extra height needed for visual mitigation from elevated locations and is consistent with an existing neighbouring stand of pine trees.

It is also proposed to fill gaps in existing shelterbelts.

This boundary planting will provide screening for year-round visual mitigation and enhance biodiversity on the Site.

It is important that the species selected can grow well in relatively harsh conditions as well as providing a level of visual screening required to reduce visual effects. The use of indigenous species is also considered an opportunity to enhance natural character. Therefore, the species selection process has been carefully considered, and recommends a mix of evergreen species endemic to this ecological district, tolerant of the environment (based on ecologist recommendations), that will retain a degree of tolerance to fire.

Regular watering/irrigation over the first 5 years following planting will be essential for plant growth in this environment. Protective wind shelters are also recommended.

The existing shelterbelts on Site will be retained and regular monitoring and maintenance will be required for their long-term health and survival, which is coupled with their effectiveness to act as a screen. This may require occasional pruning and 'spot' planting to 'fill in any gaps' that may be evident at ground level in between the trunks of the individual trees. Replacement planting

⁹ EclA, section 8.12. (p60) and Table 15, section 8.2 (p63)

with evergreen species will be undertaken where there are gaps or where there are trees that are failing and need to be removed.

As noted above, while the Landscape Mitigation Plan provides the high level plan, a Landscape Management Plan is also recommended to set out and schedule all these details and is described further in **section 6: Recommendations**.

The planting will be located just inside the property boundary with a security fence on the inward side of the planting.

Wetland management and restoration

A number of project shaping recommendations were provided from the Project's Ecologists (in relation to ecological effects) and Landscape Architects. Ecology recommendations are outlined in a separate Ecological Impact Assessment also attached to the AEE.

To summarise the process, ecological surveys were carried out early in the development of the Project. Following completion of the surveys, the field data was analysed, and the boundaries of wetlands and waterways were mapped. As a result of the ecological values identified, a number of 'no-build' areas were recommended and adopted as part of the Project Design. Other recommendations included methods for cable laying and options for construction setbacks.

Setback distances from all wetlands were also adopted to ensure they will be fully avoided by construction works¹⁰. The two natural inland wetlands (the central wetland and the wetland/waterway in the southwest of the Site) and the waterway in the northeast of the Site will have a minimum 10m setback from solar farm development. All other wetlands will have a minimum of a 5m setback.

As part of the project shaping process, it was also proposed that the two large wetlands (the central and southwest wetlands) be fenced off from grazing stock and planted with appropriate native wetland species. Recommended wetland species identified in the planting palette (**Figure 5B** of the Graphic Supplement) include At Risk-Declining species identified at the Site (Sedge and Spaniard (*Carex kaloides* and *Aciphylla subflabellata*)) by the Project Ecologists.

Proposed Mitigation Planting Summary

Proposed planting species are detailed in **Figure 5B** in the Graphic Supplement. The total areas of planting proposed are set out in Table 3 below:

Table 3: Areas of proposed planting

Location / type of planting	Area of planting proposed (ha)
All proposed terrestrial native mitigation planting	11.4 ha
All proposed wetland enhancement planting	14.0 ha
Total area of native planting proposed	25.4 ha
All proposed exotic shelterbelt planting	7.0 ha
Total area of planting proposed	32.4 ha

¹⁰ Refer to Table 1 in the EclA

2.4 Construction

A draft construction methodology for the project is provided in the AEE. The total construction period is anticipated to take approximately 24 months, which includes enabling works, site preparation and construction.

2.5 Operation

Once the solar farm is operational, activity will be very limited. No on-site staff will be required as the componentry is operated/monitored remotely. However, should componentry need to be replaced, it will need to be accessed. This is likely to be infrequent. Vehicle movement within the Site will typically be by quad bike or small, farm utility vehicle.

Typical day-to-day operation of the substation will also largely occur remotely. Infrequent visits by maintenance / inspection teams will be undertaken. There may be 5-6 staff visiting the site office once per week.

Agricultural activity will continue on the Site, utilising remaining existing infrastructure. The panels will be raised off the ground sufficiently to enable sheep grazing.

The grazing of sheep not only continues productive use of the rural site but also removes the need for grass mowing and weed management.

2.6 Decommissioning

At the end of the intended 35-year operational lifespan of the solar panels, the solar farm, including the substation building and all ancillary equipment, will be dismantled and removed from the site. As no concrete foundations are required, the panels can be completely removed quite easily.

Materials will be reused or taken to an appropriate location for recycling or disposal. The site will be reinstated to its original pre-construction condition.

3.0 Existing Environment

This section provides a description of the Site followed by an analysis of the landscape and natural character attributes of the existing context at both a broad and local scale, as well as potential viewing audiences, providing the baseline for the assessment of landscape effects.

Photographs (**Site Appraisal Photographs A - D**) were taken from within the Site to illustrate the current landscape character of the site. **Site Context Photographs (1 – 18)** were taken from outside the Site to represent the character of the local and wider landscape, and visibility of the Site from the surrounding landscape. The locations of these photographs are shown in **Figure 4** of the Graphic Supplement.

3.1 Broader Landscape Context

The Site is located in the Maniototo / Mānīatoto Plains, Central Otago, approximately 3.3 km southwest of Naseby and some 4.3 km north of Ranfurly.

The Maniototo Plains are identified as part of Character Area 16 in the 1998 landscape study for the Otago Regional Council (BML)¹¹ and described as an elevated inland alluvial basin with areas of glacial terracing and meandering rivers, characterised by extensive farming, roads, pasture, shelterbelts and small towns.

In the more recent 2008 landscape assessment of Central Otago (LA4 et al), the Maniototo is identified as part of landscape unit 23 and the broader Sub Category C, 'Valleys and Open Plains'.¹² These landscapes are described as having a rural nature, an open, expansive quality and an almost complete lack of screening which 'means that they are highly sensitive to any change because changes would be visible for miles across the flat plains'. However, the report does note that some additional development could be accommodated on the outskirts of existing towns such as Naseby. It also describes the landscape character of the Maniototo as highly modified and the accompanying maps identify the area as having 'limited landscape sensitivity'.

The Site is not considered to be adjacent to or form part of any significant or outstanding natural feature or landscape. It lies within an overlay of Other Rural Landscapes (ORL) in the Central Otago District Plan. ORLs are all those landscapes in the Rural Resource Area that are not otherwise identified as Outstanding Natural Landscape (ONL), Outstanding Natural Features (ONF), or Significant Amenity Landscapes (SAL), or in the Upper Manorburn / Lake Onslow Landscape Management Area.

The landscape is described below in terms of each of the three landscape dimensions – physical, associative and perceptual, however it is not intended that they be considered separately. The landscape as a whole is greater than the sum of its parts.¹³

3.1.1 Physical

Landform

The Maniototo / Mānīatoto is a large inland basin consisting of broad flat plains, low undulating ridges and steep river terraces. The basin is located to the west of the Taieri Plain and to the east of the Manuherikia and Ida Valleys and is defined by five surrounding mountain ranges: the Hawkdun and Ida Ranges to the north, the Kakanui Mountains to the northeast, Rough Ridge to the northwest, and the Rock and Pillar Range to the south. These block-faulted schist mountains provide a legible, scenic backdrop to the Maniototo / Mānīatoto Basin, characteristic of the range-and-basin landscape of Central Otago. Numerous small rivers and tributaries drain these mountains southwards into the Taieri River.

Between Ranfurly and Naseby the elevation of the plains gradually rises from approximately 430masl to 600masl, steepening up along terraced landforms in the vicinity of the north end of the Site as the basin transitions to the foothills of the surrounding ranges.

¹¹ BML (1998) Investigations into Otago's Natural Character, Landscape and Significant Natural Areas, p45

¹² LA4 et al (2008) Central Otago District Rural Review Landscape Assessment Report and Recommendations pp11, 12, 21-23

¹³ TTATM, p34



Figure 8: Photo from SH85 looking northeast towards the Site in the mid-ground with Naseby Forest and the Ida Ranges beyond.

At typical elevations of 1500-1600masl, the mountains influence the sub-continental climate of the Maniototo / Mānīatoto Plains which has very cold winters, hot summers and low precipitation.

Ecological context

The solar farm Site is within the Maniototo Ecological District (ED) in the Central Otago Ecological Region.

Vegetation at the time of European settlement would have comprised dense shrublands and tussock grassland with extensive areas of wetland likely along the Taieri River. Land cover surrounding the Site today primarily consists of exotic pasture species, exotic shelterbelts and forest dominated by *Pinus species*, and few areas of remaining indigenous vegetation.¹⁴

The Site falls within an area identified as the 'Central Otago Drylands/Manuherikia Place' in the Otago Conservation Management Strategy (CMS)¹⁵. This area is described as being characterised by semi-natural and agricultural landscapes and wide open spaces set amongst rolling hills and the backdrop of the Central Otago uplands. Here, the indigenous dryland ecosystems and landscapes have been:

*'...modified extensively due to human settlement, gold mining, pastoral farming, and more recently new activities such as cropping, viticulture, horticulture, dairying and lifestyle blocks.'*¹⁶

Land use

Land use in this plains landscape, and specifically the land to the east, west and south of the Site is characterised by its agricultural use. Other land uses include forestry, tourism, recreation, conservation, as well as residential. There are also existing energy-related land uses nearby.

North of the Site, at the foot of the ranges is the Naseby Golf Club, township of Naseby, and the surrounding Naseby Forest. Naseby is the closest settlement to the Site and lies predominantly in a hollow, largely surrounded by the exotic conifer forest. The 2,500 hectare Naseby Forest is both a working exotic forestry plantation and recreation area with walking and biking tracks. The

¹⁴ EclA, p22

¹⁵ Conservation Management Strategy Otago 2016 (Incorporating the July 2022 partial review) Volume 1, published March 2023, NZ Department of Conservation

¹⁶ Ibid, p89

trees and forestry operations are a distinctive large, industrial-scale rural activity associated with Naseby and characteristic of this northern edge of the Maniototo / Mānīatoto Plains landscape.

The permanent population of Naseby is relatively small (120 in the 2018 census), however conversation with the land-owner during the site visit suggests the town may be growing. It is also a recognised holiday destination. Nearby Ranfurly is the main service town in the Maniototo / Mānīatoto Plains and there are many other small settlements scattered across the basin.

However overall, dwellings are sparsely located and at some distance to the Site with five residential buildings (including one of the Project landowners) within approximately 1km of the Site boundary.

State Highway 85 is the main route traversing the area to the south of the Site. The Roxburgh to Livingstone 220 kV transmission line, part of the National Grid, crosses to the north of the Site with the Naseby Transpower Substation located nearby on Fennessy Road. LeoLabs Kiwi Space Radar, an international facility for tracking space debris, is also on Fennessy Road.

Solar Bay Energy has been granted consent for a 50MW solar farm on a 54.5 ha site located off Fennessy Road (see **Figure 6** in the Graphic Supplement), which once developed, will introduce another type of agro-industrial character to this rural landscape.

3.1.2 Associative

Associative means the intangible things that influence how places are perceived, such as shared and recognised values of a community, history, identity, creation stories, and activities specifically associated with a landscape.

Tāngata whenua have a holistic relationship with whenua that integrates physical, associative, and perceptual dimensions. As set out in landscape guidance, Te Tangi a Te Manu, while described under the heading of 'Associative', it is intended that consideration of tāngata whenua landscape attributes will overlap with the physical and perceptual.¹⁷ Helios will be engaging with mana whenua to understand any potential impacts on cultural values.

The wider area has significant cultural and historic values with many notable heritage buildings and sites. There is a widespread network of Māori cultural and archaeological sites throughout the Maniototo / Mānīatoto Plains. Early Māori used the Taieri River and major valley systems and passes such as the route over Danseys Pass to access the area, establishing semi-permanent seasonal campsites (kaika nohoaka) while collecting food (mahika kai).

The Ngai Tahu Atlas also notes that Mānīatoto is the correct spelling for Maniototo:

One possible explanation of the name Mānīatoto is that Mānia means "plain" and Buchanans Sedge (Carex buchananii) – the reddish brown native sedge that is widespread throughout Te Waipounamu. In certain light the Buchanans Sedge on the plain resembles a huge red blanket, or a sea of red blood (toto).¹⁸

The first European settlers in the Maniototo / Mānīatoto Plains were pastoral farmers and goldminers. Naseby was established following the discovery of gold nearby in 1863 and as a result contains a unique collection of 19th Century heritage buildings and trees. Heritage New Zealand has registered the town centre as a Historic Area, recognising these heritage values.

¹⁷ TTATM, p33

¹⁸ <https://kahurumanu.co.nz/atlas>

While the plains and area in the vicinity of the Site is not considered wild or notably remote, the surrounding mountain ranges comprise large areas of public conservation land with these attributes. Visitors enjoy a wide range of experiences in these parks (Oteake Conservation Park is centred on the ranges to the north and Kakanui Conservation Area to the east) including recreational hunting and four wheel driving. However, in winter many roads are closed to vehicles and it is a time when the park is described as a peaceful Backcountry destination where natural quiet and a sense of isolation are high¹⁹. Away from four wheel drive routes and during winter it is a place of solitude and challenge for recreationalists and people have few encounters with others.

Other attractions include the extensive network of mountain bike trails throughout the forestry area nearby and within the wider locality such as the popular Central Otago Rail Trail, which passes through Ranfurly and for which Naseby and the wider Central Otago area is known. The Rail Trail passes some 3km southwest of the Site at the nearest point.

The conservation areas also coincide with areas of Significant Natural Value and a large area identified as Outstanding Natural Landscape in the CODP. Refer to **Figure 1** (Landscape Context) in the Graphic Supplement which identifies the location of Outstanding Natural Landscapes, Significant Amenity Landscapes and areas of Significant Natural Value in the wider landscape.

While they are very distant from the Site (approximately 6 km between the nearest boundaries) there is a strong visual relationship between the plains and these distinctive ranges as noted in the 1998 landscape study:

‘...the broad flat landscape of the Maniototo Plains sets a dramatic stage for the surrounding steep and rugged mountainous backdrops.’

Paintings of the Maniototo / Mānīatoto Plains by well-known artist Graham Sydney have made these hills, open plains and big skies more widely renowned and recognisable.

3.1.3 Perceptual

As touched on in the section above, openness, big skies and long views to the backdrop of ranges are key characteristics and values of the Maniototo / Mānīatoto Plains landscape. The simplicity and scale of these landscapes in terms of their landform and landcover means they have a high degree of visual coherence and legibility. Mt Kyeburn is a particularly noticeable feature in views from the vicinity of the Site due to its conical shape and appearing to stand alone.

There are also transient but pronounced seasonal changes and a quality of light that are distinctive attributes associated with the Maniototo / Mānīatoto Plains basin landscape. While shelterbelts within the Site are almost entirely evergreen, there are deciduous species present in the surrounding area that noticeably lose their leaves through Winter.

At the finer scale, there are noticeable features and variations in topography such as the Eweburn river terrace scarps, and shelterbelts and other large stands of trees that form part of local views. These features add an impression of linearity to the landscape.

¹⁹ CMS, p51

3.2 Site Description

Roughly triangular in shape, the Site is bounded by Ranfurly-Naseby Road to the west, the more undulating, unsealed Ranfurly Back Road to the east, and is set back approximately 1km from Bypass Road, the nearest road to the south.

The Ranfurly-Naseby Road provides the main, sealed connection between State Highway 85 (Ranfurly-Wedderburn Road) to the south and Naseby to the north. The other main road in and out of Naseby is Danseys Pass Road which provides a connection north to the Waitaki Valley.

Ranfurly-Naseby Road and Ranfurly Back Road provide the access points to the Site.

An application for a 54.5 ha solar farm (Solar Bay Naseby) has been approved (February 2023) nearby at 216 Fennessy Road. Fennessy Road is a low volume, unsealed, no exit road that intersects with Ranfurly-Naseby Road opposite the north end of the Site.

The Site itself has been modified through agricultural use, cultivation, and the prevalence of exotic vegetation and is presently used for sheep and beef grazing on intensively improved exotic pastures and short rotation cropland. The Site is characterised by flat to undulating paddocks partially divided by evergreen shelterbelts (refer to **Site Appraisal Photographs A-B**). These include a roadside shelterbelt screening views along part of Ranfurly-Naseby Road.

The solar farm Site is located at approximately 500 m-560 m elevation; the topography broadly comprises a gentle fall from north to south over approximately 4.5 km and a series of long folds, the ridges and gullies orientated northwest to southeast (refer to **Site Appraisal Photograph C-D**). Some of these slopes and crests are moderately steep and elevated and are a feature of the Site.



Figure 9: View east from near the centre of the Site showing undulating ridges and wet area with *Juncus* spp. in foreground.

The Site contains numerous small depressions (dozens) that in currently available imagery contain ponded water; all of these locations were visited as part of the Boffa Miskell Ecological Impact Assessment to determine their wetland status. There are two large natural inland wetlands at the centre ('Central Wetland', refer to **Site Appraisal Photograph C**) and southwest of the Site ('Southwest Wetland').

The small wetlands/depressions, the Southwest Wetland and the large Central Wetland area are dominated by exotic species but also contain indigenous wetland species which contribute

to natural character. Species identified as part of the ecology investigations include occasional indigenous wīwī (*Juncus edgariae*), sedge / *Carex* spp and waoriki (*Ranunculus glabrifolius*).²⁰

Elsewhere, vegetation predominantly consists of improved pasture and short rotation cropland that is regularly mechanically cultivated and grazed by sheep and beef cattle. All indigenous vegetation has been removed from the paddocks. Remaining indigenous dryland plants persist as sparse isolated shrubs only along fencelines and include tūmatakuru / matagouri, mākaka / desert broom, and pōhuehue and porcupine shrub.²¹

A well-established shelterbelt (predominantly *Pinus species*) with occasional gaps and deciduous species, lines approximately half the length of the perimeter of the Site along the Ranfurly-Naseby Road. There is also a stand of exotic evergreens on the slopes at the northeast tip of the Site. Several internal east-west orientated shelterbelts partially divide the southern end of the Site.



Figure 10: Group of trees at northeast tip of the Site.

There are no buildings or other large structures on the Site and a small number of residential dwellings and farm buildings are in the immediate surrounding landscape.

3.3 Summary

While the Site is not located in an ONL, SAL or SNL, there are many important physical, associative and perceptual values in the wider landscape. These include cultural landscape values, the historic heritage and recreation values at Naseby, and the shared and recognised qualities of light, vast skies, scenic mountain backdrops and extreme seasonal changes characteristic of the wider range-and-basin landscape of Central Otago.

The character of the Maniototo / Māniatoto Plains is also recognised as highly modified. The Otago CMS describes this area as part of a chain of dryland ecosystems that contain some of the most threatened and least protected indigenous ecosystems and species.²² This is an open,

²⁰ Ibid, pp26-27

²¹ Boffa Miskell EclA, p23

²² CMS, p88

modified rural landscape characterised by its agricultural use; a landscape where natural systems continue to operate but in which rural activities prevail.

The Site is also in proximity to features that are not associated with traditional farming land use with a more industrial scale or appearance such as the LeoLabs Kiwi Space Radar, Naseby Transpower Substation, the consented Solar Bay solar farm and the Earnslaw One Naseby forestry operations nearby.

Key rural landscape and amenity values that relate to the Site and immediate surrounds include:

- Expansive areas of pasture which creates a sense of openness with vast skies and opportunities for long views to the wider plains and mountain backdrops.
- The exotic forestry which is characteristic of this northern edge of the Maniototo / Māniatoto Plains landscape.
- Legibility of landform such as the undulating folded landscape within the Site as well as the contrast between the plains and surrounding ranges.
- Two large natural inland wetlands.
- A low density of structures and buildings that are predominantly used for rural activities.

3.4 Visual Catchment

In addition to the Site visit, to determine the visual catchment and viewing audience of the proposal, a study of aerial photography was undertaken and the use of a 3D digital terrain model.

Private properties likely to be affected have been visually surveyed from nearby publicly accessible locations where possible and analysed using the terrain model. The four closest dwellings (with the exception of Dwelling 1, a Project landowner residence) have also been visited (15 November 2023) to assist with understanding the nature of these potential private views.

The nearest areas of concentrated settlement are located at Naseby, approximately 3.3 km north of the Site and Ranfurly, 4.3 km south of the Site. There are no views of the Site from these residential areas.

The visual catchment is relatively contained to the immediate context of the Site. While the total size of the proposed Site is 660 ha, it is broken up into smaller areas by topography and vegetation; the folded landform and existing shelterbelts restrict views to the whole development.

Most available views to the Site are from local roads including Ranfurly-Naseby Road, Ranfurly Back Road, and Bypass Road. There is also potential for visibility of parts of the Site from a short section of State Highway 85 (Ranfurly-Wedderburn Road). The viewing audience will typically be transitory and travelling at speed.

The northern portion of the Site is without existing screening along the road boundary and therefore open to potential views from Ranfurly-Naseby Road while also enabling views across the Site to the mountain ranges beyond. By comparison, the lower, southern portion of the Site is partially broken up by shelterbelt plantings and set well back from the closest road to the south. Open views across the Site are also possible from along much of the Ranfurly Back Road between the gully at the north end and the shelterbelts at the southern end.

There are a small number of residential dwellings where views into the Site can be obtained. Of the closest properties (excluding the Project landowner), Dwelling 2 on Ranfurly-Naseby Road and Dwelling 4 on Ranfurly Back Road will be the most visually affected, due primarily to their elevated location and the lack of screening at the north end of Ranfurly-Naseby Road and along Ranfurly Back Road.

Other more distant dwelling locations include those on Bypass Road, Ranfurly-Wedderburn Road, Gimmerburn-Naseby Road, and Brinsdon Road.

The visual catchment for public and private viewing audiences is outlined below.

Long-distance views (over 1 km from nearest Site boundary):

- Elevated publicly accessible views such as from Ridge Road (approximately 4.5 km away) and further away in the surrounding foothills and ranges.
- Views from State Highway 85, travelling east or west at distances of approximately 1 km away at the closest viewpoint.
- Views from Bypass Road, travelling southeast or northwest at distances of approximately 1 km at the closest viewpoint.

Views from recreational areas:

- Central Otago Rail Trail (3 km)
- Naseby Forest Trails (2 km)
- Naseby Golf Course (700 m)

Views from the west: *(panels typically set back some 20 m-50 m from boundary; substation set back approximately 350 m)*

- Naseby Link Road and Gimmerburn Naseby Road (unsealed, 300 m-1500 m away)
- Fennessy Road (intersects with Ranfurly-Naseby Road which borders the Site)
- Ranfurly-Naseby Road (borders Site)
 - Approach from south
 - Central section
 - Northern section, travelling north
 - Northern section, travelling south

Views from the east: *(panels typically set back some 20 m-30 m but up to 130 m from boundary, substation set back approximately 1250 m)*

- Ranfurly Back Road (unsealed, borders site)

Views from private dwellings:

There are a small number of dwellings in the local area surrounding the Site up to a distance of approximately 3 km from the nearest Site boundary (refer to the **Figure 7 below** and **Figure 4** in the Graphic Supplement).

- Views from Dwellings 5 - 17 (1 km-3 km)

- Views from Dwelling 1 (45 m). The residents are one of the two Project landowners leasing land to Helios for this development so this dwelling has been excluded from the visual assessment.
- Views from Dwelling 2 (130 m)
- Views from Dwelling 3 (580 m)
- Views from Dwelling 4 (400 m).



Figure 11: Dwelling locations (source: Boffa Miskell)

3.4.1 Site Appraisal and Site Context Photographs

To assist the assessment of available views and understand the landscape of the Site and immediately surrounding context, panoramic photographs were taken on Site (**Site Appraisal Photographs A-D**, refer **Figure 4** in **Graphic Supplement** for photograph locations). These are described in Table 4 below:

Table 4: Description of Site Appraisal Photographs

Photo Ref#	Location	Description
SA Photo A	Ridge, southwest corner	View looking southeast showing the undulating landform and layers of vegetation to the south including linear shelterbelts within the Site.

SA Photo B	Ridge, southwest corner	View looking west showing one of the tall east-west pine shelterbelts that break up the Site
SA Photo C	Central	View looking northeast showing the identified wetland area located between low ridges near the centre of the Site.
SA Photo D	Centre-east	View looking south showing undulating landform and linear shelterbelts. Dwelling 4 can be seen in the distance in a gap between trees.

Site Context Photographs were also taken from publicly available vantage points surrounding the Site. Available views occur at a range of distances and directions looking towards the Site (**Site Context Photographs 1-18**, refer **Figure 4** in Graphic Supplement for photograph locations). The Site Context Photographs are described in Table 5 below:

Table 5: Description of Site Context Photographs

Photo Ref#	Catchment	Approx. Distance to Site boundary	Description
SC Photo 1	Long-distance views (Ridge Road)	4560 m	From Ridge Road looking southwest, showing expansive view over Maniototo / Māniatoto Plains with Ranges in the background. Naseby dwellings amongst trees to the right of the photograph and transmission line in the midground. The Site is in the distance, largely screened by intervening vegetation
SC Photo 2	Long-distance views (Ranfurly-Wedderburn Road/ SH85)	1055 m	From Ranfurly-Wedderburn Road (SH85) looking northeast. Ranfurly-Naseby Road is in the midground with the Site beyond, backdropped by the Hawkdun Ranges, Mt Kyeburn and the Kakanui Mountains to the right of the photograph.
SC Photo 3	Long distance views Ranfurly-Wedderburn Road (SH85)	1105 m	From Ranfurly-Wedderburn Road (SH85) looking northeast showing the layers of intervening vegetation. Broadly representative of views from Dwelling 5.
SC Photo 4	Long distance views Ranfurly-Wedderburn Road (SH85)	1625 m	From Ranfurly-Wedderburn Road (SH85) looking northeast showing the layers of intervening vegetation.

SC Photo 5	Views from the west (Ranfurly-Naseby Road Southern)	100 m	From Ranfurly-Naseby Road looking northeast towards the highly visible slopes of the undulating landform. One of the two large wetlands identified at the Site is in the foreground.
SC Photo 6	Views from the west (Ranfurly-Naseby Road Central)	Borders Site	From Ranfurly-Naseby Road showing the existing shelterbelt that screens the Site for part of this western road boundary and the prominent slopes of the undulating landform in this part of the Site.
SC Photo 7	Views from the west (Ranfurly-Naseby Road Northern)	Borders Site	From Ranfurly-Naseby Road looking east showing the open views available across the north end of Site to the mountain ranges beyond.
SC Photo 8	Views from the west (Ranfurly-Naseby Road Elevated northern)	135 m	From Ranfurly-Naseby Road looking south, showing a high level of visibility to the north end of Site due to this elevated viewpoint and the lack of vegetation within the northern end of the Site. The central shelterbelt breaks up views to the south end of the Site.
SC Photo 9	Views from the west (Ranfurly-Naseby Road Elevated northern – potential cumulative)	Borders Site	From Ranfurly-Naseby Road – looking southwest towards Fennessy Road and the location of the approved Solar Bay solar farm. LeoLabs Kiwi Space Radar is also visible to the right of the photograph.
SC Photo 10	Views to approved solar farm from Ranfurly-Naseby Road	Borders Site	From Ranfurly-Naseby Road – looking west down Fennessy Road towards the location of the approved Solar Bay solar farm.
SC Photo 11	Views to existing substation from Fennessy Road	1845m	From Fennessy Road to the existing substation illustrating the characteristics of the infrastructure.
SC Photo 12	Views from the east (Ranfurly Back Road)	20m	From Ranfurly Back Road looking southwest across the gully to the nearest Site boundary, broadly representative of the angle (but not distance) of view from Dwelling 3.

SC Photo 13	Views from the east (Ranfurly Back Road)	Borders Site	From Ranfurly Back Road looking north towards Naseby Forest and Hawkdun Range with Site in the foreground to the left of the road. Hedging around Dwelling 3 visible to right of photograph.
SC Photo 14	Views from the east (Ranfurly Back Road)	Borders Site	From Ranfurly Back Road looking northeast across the Site with Hawkdun Range and Rough Ridge in the distance.
SC Photo 15	Views from the east (Ranfurly Back Road)	Borders Site	From Ranfurly Back Road looking south. Dwelling 4 is partially visible to left of photograph.
SC Photo 16	Views from the east (Ranfurly Back Road)	Borders Site	From Ranfurly Back Road looking northwest in one of the folds between ridges showing the legibility of the landform and the linear shelterbelts that visually break up the Site.
SC Photo 17	Views from the east (Ranfurly Back Road)	670 m	From Ranfurly Back Road looking north towards Site with the elevated location of Dwelling 4 to the right of the photograph.
SC Photo 18	Long distance views (Bypass Road)	1070 m	From Bypass Road looking north, showing layers of intervening vegetation. There is a partial shelterbelt along the southern boundary of the Site towards the southwest corner, however much of the boundary is not currently planted.

Private Viewpoint Photographs (**Viewpoint Photographs 19-23**, refer **Figure 4** in **Graphic Supplement** for photograph locations) were taken from Dwellings 2-5 as set out in Table 6 below:

Table 6: Description of Private Viewpoint Photographs

Photo Ref#	Location	Approx. Distance to Site boundary	Description

VP Photo 19	Dwelling 2 (outside dwelling)	130 m to nearest Site boundary 360 m to nearest panel arrays 1200 m-1400 m to nearest visible part of Site	View from immediately outside dwelling, looking south. Site is in mid-ground, partially screened by vegetation within the Site as well as shelterbelts/hedging within the Dwelling 2 property and backdropped by ranges.
VP Photo 20	Dwelling 2 (driveway)	50 m to nearest Site boundary	View from driveway (approximately 130 m from dwelling), looking south. The Site boundary is in the foreground with the nearest panel arrays set back approximately 280 m beyond. The approved Solar Bay solar farm site is approximately 450 m to the southwest.
VP Photo 21	Dwelling 3 (outside dwelling)	580 m to nearest Site boundary	View adjacent to dwelling, looking southwest. Glimpse of Site possible between trees however largely screened by shelterbelts/hedging within Dwelling 3 property.
VP Photo 22	Dwelling 4 (outside bedroom window)	400 m to nearest Site boundary 900 m to nearest visible part of Site	View outside dwelling (bedroom window) looking north. Northeast of Site is in mid-ground, backdropped by Ida and Hawkdun Ranges. The south end of the Site is screened by shelterbelts/hedging within the Dwelling 4 property. The north end of Site is partially visible, broken up by an existing shelterbelt within the Site.
VP Photo 23	Dwelling 4 (garden/ carpark)	370 m to nearest Site boundary 800 m to nearest visible part of Site	View from edge of garden entrance/carpark area, looking northwest. North end of Site is in mid-ground, backdropped by ranges. The south end of the Site is screened by shelterbelts/hedging within the Dwelling 4 property. Visibility of the northeast corner is broken up by an existing shelterbelt and undulating landform partially screens the western and eastern-most edges. There are open views to the balance of the north end of the Site. The LeoLabs Kiwi Space Radar is visible beyond the Site.

VP Photo 24	Dwelling 5	1080 m	View from immediately outside dwelling, looking northeast. Occasional glimpses of Site are possible between layers of intervening vegetation. Visibility is difficult to discern in the photograph with vegetation in leaf but will be greater in Winter when deciduous trees such as the willows and poplars will be bare.
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4.0 Relevant Statutory Provisions

As part of this assessment, there are a number of planning provisions that are relevant to this project. Specifically, they include:

- The Resource Management Act (RMA)
- Partially Operative Otago Regional Policy Statement (Otago RPS)
- Proposed Regional Policy Statement (PRPS)
- Operative Central Otago District Plan (CODP)

Resource Management Act

The assessment of landscape, natural character and visual effects primarily addresses the following relevant RMA matters:

- Section 6(a): Preserving the natural character of wetlands, streams, rivers and their margins.
- Section 6 (b) – the protection of outstanding natural features and landscapes from inappropriate subdivision, use and development.
- Section 7(c): Maintain and enhance amenity values.
- Section 7(f): Maintain and enhance the quality of the environment.

The Site is not within the coastal environment nor part of any outstanding natural feature or landscape or significant amenity landscape. However, due to the potential (albeit limited) for elevated views from surrounding ranges that are identified as outstanding, the protection of these under s6(b) from inappropriate use and development is also considered.

A number of wetlands have been identified within the Site and therefore an assessment of natural character under s6(a) will be undertaken.

Proposed RPS

The RPS provides the current framework for the sustainable management of the Region's natural and physical resources.

Central Otago District Plan

The site is located within the Rural Resource Area (RRA) in the CODP and within an overlay of Other Rural Landscapes (ORL).

The ORL is described as being *'those landscapes in the Rural Resource Area not identified as Outstanding Natural Landscape (ONL), Outstanding Natural Features (ONF), or Significant Amenity Landscapes (SAL), or in the Upper Manorburn / Lake Onslow Landscape Management Area.'*²³

The site does not lie adjacent to or within a Significant Amenity Landscape (SAL), Outstanding Natural Landscape (ONL), or Outstanding Natural Feature (ONF). Refer to **Figure 1** of the Graphic Supplement.

Nevertheless, the unique landscape of the Central Otago District has been identified as an important resource of the District that is renowned internationally. Ensuring adverse effects on its values are avoided, remedied or mitigated is identified a significant resource management issue.

The sections most relevant to the landscape and visual effects assessment of the proposed development are Section 4 – Rural Resource Area and Section 13 – Infrastructure, Energy and Utilities. The proposed solar farm development is being considered as a Discretionary Activity.

The landscape issues most relevant to this Proposal are:

- The landscape and amenity values associated with the open character of rural land, which is a key element that can be vulnerable to degradation from subdivision, development, and non-farming activities. In particular:
 - The prevalence of large farms and landholdings.
 - The predominance of open space over housing and related domestic elements.
- Amenity values of neighbouring properties.
- Areas of fill and excavations.
- Removal of vegetation.
- The natural character of water bodies, including wetlands, and their margins.
- Promoting and encouraging the co-siting of utilities and the location of utilities in “corridors” where this is possible.

4.1 Non- statutory Documents

The Kāi Tahu ki Otago Natural Resources Management Plan 2005 (NRMP) policies express the cultural importance of water to Kāi Tahu and the importance of protecting and restoring the mauri of all water. The policies cover the protection and enhancement of existing wetlands as well as the reinstatement of wetlands that have been neglected.

²³ Central Otago District Plan (July 2013), Rural Resource Area, Page 4:36

5.0 Assessment of Effects

Landscape and visual impacts result from natural or induced change in the components, character or quality of the landscape. Usually these are the result of landform or vegetation modification or the introduction of new structures, facilities or activities. All these impacts are assessed to determine their effects on character and quality, amenity as well as on public and private views.

In this study, the assessment of potential effects is based on a combination of the landscape's sensitivity and visibility together with the nature and scale of the development proposal.

In this study, the assessment of potential effects is based on a combination of the landscape's sensitivity and visibility together with the nature and scale of the development proposal.

Particular effects considered relate to the following:

- Natural Character effects.
- Landscape character effects.
- Visual effects from public and private locations.
- Potential cumulative effects.
- Effects in relation to statutory provisions.

The principal elements of the Project that have potential to give rise to landscape and visual effects are:

- Earthworks and movement of vehicles and machinery during the construction process.
- New access tracks.
- The overall scale of built form.
- The linear patterning of the panel array rows.
- Visibility of the tall elements of the substation.
- Glint and glare.

5.1 Natural Character Effects

Within the RMA, sustainable management of natural and physical resources requires the preservation of natural character of wetlands, rivers and their margins.

In terms of natural character, the highest degree of naturalness occurs where there is the least amount of human induced modification. Structures, such as solar panels can adversely change and alter the natural character of an area. The significance of this effect is determined by the size and location of the proposal and sensitivity of the receiving environment.

The waterways and wetland areas within the Site have been modified through its current agricultural land use for pastoral grazing and are not highly visible or publicly accessible so that experiential aspects of natural character are low. However, the Ecological Impact Assessment finds that all wetlands at the Site are considered ecologically significant.

In regard to wildlife, the Site is largely dominated by exotic bird species, but does provide foraging, roosting and / or nesting habitat for indigenous bird species. The Site does not provide suitable habitat for indigenous lizards or assemblages of indigenous terrestrial invertebrates.²⁴

Therefore, overall it is considered that there are low levels of natural character values present at the Site, albeit highly modified.

As part of the proposal, setback distances from all wetlands have been adopted to ensure they will be fully avoided by construction works. The two natural inland wetlands (the central wetland and the wetland/waterway in the southwest of the Site) and the waterway in the northeast of the Site will have a minimum 10m setback from solar farm development. All other wetlands will have a minimum of a 5m setback.

It is also proposed that the two large wetlands (the Central and Southwest Wetlands) be fenced off from grazing stock and planted with an appropriate mix of native wetland species, including At Risk-Declining species of sedge and spaniard identified at the Site (refer to **Figure 5B: Proposed Planting Palette** of the Graphic Supplement). Together these two wetland areas account for approximately 14 ha of wetland enhancement.

In addition, approximately 11.4 ha of mixed dryland native planting is proposed, primarily for visual mitigation purposes however the use of indigenous species will enhance biodiversity on the Site, contributing to natural character.

The Ecological Impact Assessment considers that there would be no net loss of significant shrub values following proposed mitigation planting and in the long-term, the greater numbers of shrubs would provide a positive impact. All wetlands at the Site would be fully avoided by Site works, with setbacks applied; and existing rainfall runoff patterns and other hydrological inputs to wetlands would be unaffected by the proposal. Fencing and enhancement of the Central and Southwest Wetlands 'represents a net gain in terms of significant wetland values at the Site'²⁵. However the Assessment notes that construction works may temporarily disturb and displace indigenous birds on Site to a very low to low and temporary level.

Overall, the Ecological Impact Assessment concludes that the potential adverse ecological effects of the solar farm have been avoided, or else would be remedied where possible, with no residual adverse effects identified as being greater than low-level.

While the size and scale of the proposed development is large, the design incorporates setbacks so that the wetlands are avoided and when considering the Site's existing modified level of natural character, the biotic and abiotic attributes (particularly of existing wetland areas) will undergo improvement through fencing out stock and undertaking planting.

Experiential attributes associated with the natural character of the Site and area will reduce due to the presence of built form over the landscape. While visibility is limited, where visible, wetland margins will be surrounded with panel structures rather than open space. However, there may also be a perception of healthier, restored wetland habitat and indigenous shrublands due to the extensive native planting and regeneration proposed.

5.1.1 Summary of Natural Character Effects

A number of wetlands have been identified within the Site. They contribute natural character values to the Site at different levels; many are constructed ponds, and all are modified through agricultural land use. Nevertheless, all wetlands at the Site are considered ecologically

²⁴ EcIA, p65

²⁵ EcIA, Executive Summary

significant as wetlands have been reduced to less than 20% of their original cover regionally and nationally and some support At Risk species.

During construction, effects on natural character are assessed as **very low** to **low** due to potential for temporary, localised levels of activity in the vicinity of these wetlands. However, no identified wetland will be built on and due to the proposed setback buffers and fencing, any disturbance will be minimised.

While there will be some reduction in experiential aspects of natural character, it is considered that natural character values will improve overall on completion of the Project due particularly to the scale of fencing off and enhancement planting proposed in the central and southwest wetlands comprising a total area of some 14 ha. The estimated 11.4 ha of additional native planting proposed elsewhere as part of the landscape and visual mitigation will also contribute positively to natural character.

Overall, following completion, the adverse effects on natural character values will be **very low**. While new built modification will be apparent, modified rural activities already prevail at the Site. The proposed removal of stock and scale of indigenous dryland and wetland planting, will result in **positive** effects on the natural systems, characteristics and qualities of the Site that will become increasingly beneficial over time.

5.2 Landscape Effects

5.2.1 Landscape Character Effects

Landscape character is derived from the distinct and recognisable pattern of elements that occur consistently in a particular landscape. It reflects particular combinations of geology, landform, soils, vegetation, land use and features of human settlement. It creates the unique sense of place defining different areas of the landscape.

The existing character of the Site is comprised of expansive, open pastoral farmland with an underlying folded landform, the ridges and gullies following a northwest/southeast orientation. The existing shelterbelts create linear patterns similar to others in the surrounding landscape. The wider setting is part of an elevated inland alluvial basin with areas of glacial terracing and meandering rivers and the distinctive ranges and skyline that backdrop the Site; it is also characterised by extensive farming, roads, pasture, shelterbelts and small towns and includes the productive character of the Naseby Forest.

During Construction

Impacts on landscape character during construction have the potential to occur as a result of disturbance to the ground and exposure of bare earth, the movement of construction vehicles to and from the Site and people working on the Site, and the erection of solar panels and ancillary equipment, including construction of the substation.

The construction of the substation is likely to involve the largest-scale machinery. However the location is well set back and partially screened or backdropped by vegetation from most public and private viewpoints.

During the construction period there will be earthworks associated with the construction of the solar panels, access tracks, substation and battery storage areas including cabling (trenching) and the fencing around the Site.

Construction of the substation and BESS area will also involve groundworks to create a level platform for the construction of foundations and building platforms. The substation site is fairly flat, therefore earthworks to establish foundations for the inverters, substation and the battery storage area will be limited in scale.

A small level of earthworks may be required to establish the solar panels on sloping or undulating ground. Typically, the solar panels are able to follow the natural topography however there may be a few locations where some subtle localised contouring is required.

All loading and unloading of materials will be limited to laydown areas located adjacent to the primary access points.

Parking will be contained within the Site. All internal access, parking, and loading areas will be constructed to an all-weather, metallised surface with necessary stormwater control.

The piles will be galvanized steel with a matte finish and pile driven so no concrete foundations are required.

Due to the size of the Site, construction will occur sequentially, and one phase (e.g. pile driving of panels) will not need to be completed across the whole site prior to the next stage commencing.

The proposed planting should begin implementation at the first planting season (April / May or September / October) following commencement of construction and be completed by the end of the construction period.

The construction phase for the project is anticipated to take 24 months.

Construction effects will be temporary in nature and are unlikely to occur all at the same time in the same location during the construction phase. Overall, it is considered that there would be no more than temporary **moderate-high** adverse effects on the landscape character of the area during the construction phase.

Operation

On completion of the construction phase, there will be a broad change in landscape character from open, pastoral farmland to a landscape containing energy related infrastructure. The proposed solar farm will introduce numerous linear structures into a rural farming landscape that is currently open and expansive in character and that has been modified by extensive agricultural land use and forestry.

While the structures are relatively low in height, at less than 3 m, the scale of the overall proposal is very large. Potential landscape character effects will largely be related to the change from a predominately open, rural landscape to an energy landscape with a high density of built form.

At the same time, opportunities for the enhancement of the key wetlands and extensive blocks of additional planting as part of an agri-industrial environment have the potential to improve aspects of the existing modified landscape character.

The sensitivity of the Site to land use change of the nature proposed is considered to be low given it is a modified landscape, not identified as an ONL or ONF and contains no features that are character-defining when compared to the wider context.

The Site is located in the vicinity of other utilities with which it shares some characteristics such as the existing transmission line, Naseby substation and LeoLabs Kiwi Space Radar as well as the large scale, productive activity and dense coverage associated with the Naseby Forest.

However, the site is an open and expansive landscape, which will experience a high degree of change as the large expanse of open space within the Site boundaries will be reduced and the density of built structures, increased. One of the key features of the Proposal that will assist with its integration into the surrounding landscape character are through the dimensions and distribution of the panels and panel arrays which enable multi-layered use of the Site, including farming. The proposed solar panels will also have a relatively low profile with opportunities to be visually contained within and backdropped by the gently undulating topography.

Each solar panel has an approximate 1.6 m-1.7 m height when at its lowest, closest to horizontal (from sunset to sunrise). The panel height slowly increases and decreases over the day, peaking at an approximate height of 2.5 m-2.7 m around 8am – 10am and again at 4-6pm (depending on season). The solar panels are on piles which have a relatively small footprint and there are gaps of 6 m-8 m between rows of panels and larger gaps of 12 m between arrays. Pasture is to be maintained and sheep grazing will be used to manage the grass underneath the panels and frames, breaking up the density of built form and retaining key elements of a rural productive character as well as a degree of landform legibility.

The substation will introduce an area of taller, more densely located infrastructure. Its location reflects a balance between achieving generous boundary setbacks and visual screening by the existing shelterbelt, alongside proximity of the Site to the existing substation and high voltage line to the north. The taller elements within the switchyard will be viewed somewhat against the scale and context of this existing infrastructure.

Another key feature which will help integrate the Proposal into the landscape is through the proposed landscape mitigation that has been designed to respond to the different character and sensitivity of the Site and its frontages.

For example, the underlying folded landform of ridges and gullies will continue to be legible with large no-build areas on steep slopes and in the channels and depressions of the surveyed wetlands and waterways. Also, large development setbacks are provided from the road interfaces. Along the northwestern section of boundary, further exotic shelterbelt planting is proposed, in keeping with the existing shelterbelt along this Site boundary. However, it is recommended that this new section of planting be maintained at a lower height. While the proposed solar panels and mountain backdrop will largely become screened, a lower hedge height will retain qualities of light and vast skies and some opportunities for skyline views.

Along the eastern boundary with Ranfurly-Back Road where there are existing isolated indigenous dryland plants, the Mitigation Strategy recommends a native planting buffer. These lower plantings will also assist in maintaining opportunities for long views valued in this landscape. Existing shelterbelts will be monitored and maintained with infill and replacement planting as required.

Nevertheless, the proposed development would result in the modification of landscape character, primarily from open farmland to a predominance of structures associated with renewable energy infrastructure. The scale of landscape change would not be entirely uncharacteristic within the receiving landscape, such as the nearby example of the Naseby Forest, although the type of change will introduce new built elements.

Due to their relatively low height, road setbacks, no build areas and the ability for existing and proposed planting to considerably limit close views to the panels means that the overall impact upon landscape character will be largely limited to the Site. There will be a greater influence across the wider landscape where elevated views are available. However, where access to these views is available, the level of change will be experienced at long distances within a very broad landscape context.

The proposed solar farm is sited in proximity to other activities with similar characteristics, at the edge of the plains where they transition to the foothills and ranges beyond. It is considered that the proposed solar farm would have a **moderate** adverse effect on local landscape characteristics without mitigation, with effects reducing beyond the immediate Site context. When taking the large scale of proposed mitigation and enhancement planting into consideration, effects on landscape character within the immediate context will reduce to **low-moderate** as planting becomes established over the first 5 years. Effects on landscape character at the wider Basin context will reduce to **very low**.

5.2.2 Direct Landscape Effects / Biophysical effects

The assessment of biophysical effects has considered the nature and significance of modifications to landform, the wetlands and waterways, vegetation and natural systems.

Most of the topography within the Site will remain unchanged, with development on steeper, visually prominent slopes being avoided, helping the folded character of the landform to remain legible. However, there will be earthworks involved to construct the Site access tracks, to enable access across the site for the construction of the solar panels, substation and BESS areas and to enable trenching for the cabling required to connect the arrays. The solar panels will be installed via driven piles which will entail minimal earthworks.

The project will take a balanced approach to cut and fill. All cut material will be re-used within the site, and primarily compacted within access tracks or at the base of structures. In the event that any soil remains, this will be spread thinly across the site. No import or export of fill (excluding aggregate) will be required.

The adverse biophysical effects of the earthworks on the landscape during the construction will be **low** and temporary. The earthworks will occur progressively as the site is constructed. Where disturbance occurs in areas where no permanent above ground infrastructure is required (i.e cable trenching), the landform would be easily restored over a short timeframe and once revegetated (i.e with grass) there would be little perceptible change. Once completed, effects of the development of the Site on the topography or landform will reduce to **very low**.

Existing shelterbelts on the Site will be retained as part of the Proposal. If any other vegetation is required to be removed this would be in locations required to accommodate accessways or cable trenching and is expected to be minimal. The solar arrays and associated earthworks will be set back from the surveyed wetlands and waterways.

Large blocks of planting are proposed to assist with softening and screening views to help integrate the development within the surrounding landscape. The large blocks of proposed mitigation planting together with the enhancement/regeneration of the key wetland areas will greatly increase the indigenous vegetation in the area, creating **beneficial** biophysical landscape effects once established.

5.2.3 Summary of Landscape Effects

The Site is not located within or adjacent to an ONL or SAL in the CODP but is part of the wider 'Other Rural Landscapes'.

The wider area has recreational, cultural and historic values with many notable heritage buildings and sites which are spatially and topographically separated from the Site and will not be impacted. While the plains and area in the vicinity of the Site is not considered wild or

notably remote, the surrounding mountain ranges comprise large areas of public conservation land, including areas identified as Outstanding Natural Landscapes, with these attributes.

The nearest area of ONL is approximately 6 km from the Site at the closest point. Due to the elevation of these ranges, visibility of the Site may be possible from some locations.

Where these elevated, long distance views to the Site are available, perimeter mitigation planting will provide minimal screening due to the angle of view and there is potential for the whole site to be visible. However, by avoiding development and planting in large internal areas such as around the central wetland and on several of the key faces, the coverage of built form is broken up and the folded landscape pattern is emphasised.

The contrast of the dark colour of the panels against the lighter pasture increases its prominence but the bands and layers of coniferous shelterbelts provide a similar contrast and form part of the landscape context.

The scale of the Site and the area proposed for solar farm development are large in the context of other existing built form in the area; the future conversion of the Site from a traditional rural land use to a renewable energy landscape will lead to a large shift in the character at the Site.

The magnitude of change within the Site and local area will be high as activity on the Site changes from rural, extensive pastoral to large scale renewable energy infrastructure land use.

The Site's proximity to the approved Solar Bay farm and Naseby Forest means that the Proposal occurs in an area where there is an existing utilitarian/working character that occurs at a large scale. However, the proposal introduces built form rather than exotic vegetation.

The distribution of the panels across the Site includes a level of response to the character of the Site itself, its landform and its boundary interfaces.

The panels, spacing between the arrays and no build areas also enables the landscape to continue to flow under and through the Site somewhat. The proposed solar farm will not compromise the ability to undertake agricultural activities on the Site or within the wider area and the mitigation planting will soften and largely screen the appearance of the built form on the Site. The scale of indigenous planting proposed, both dryland and wetland species, will increase biodiversity landscape values to this Site.

The surrounding mountain ranges are identified as ONL and the values of the basin landscape have been described as providing the stage for appreciating them as a backdrop. Therefore, while exotic shelterbelts are part of this landscape, open landscapes with the ability for long views to the ranges, are also key attributes and the mitigation strategy recommends planting that will ensure opportunities to enjoy these views across the Site to continue in places while also enhancing biodiversity.

Overall, adverse effects of the solar farm on the Site and local landscape without mitigation are considered **moderate**, reducing to **low** in the context of the wider Maniototo Basin. With the proposed mitigation and enhancement planting, landscape effects within the immediate context will reduce to **low-moderate** overall and **very low** in the context of the wider Basin.

5.3 Visual Effects

Visual amenity effects are influenced by a number of factors including the nature of the proposal, the landscape absorption capability and the character of the site and the surrounding area. Visual amenity effects are also dependent on distance between the viewer and the proposal, the complexity of the intervening landscape and the nature of the view.

While the proposed Site area is extensive, covering some 660 ha, the nature of the development is such that visual impacts are likely to be relatively contained within the Site and local area.

A number of publicly accessible representative viewpoints were selected within the visual catchment to assist with the assessment. They are shown in **Site Context Photographs 1-18** in the Graphic Supplement.

Views from private dwellings within approximately 3km of the Site have been assessed however at this distance, where visible, the Project will either typically be very difficult to discern or viewed within a wider context.

An additional specific site visit was undertaken to four neighbouring properties (Dwellings 2-5) with the purpose of helping to better understand the nature of available views. Representative photographs are included as **Private Viewpoint Photographs 19-24** in the Graphic Supplement.

A digital model has also been prepared to assist with determining the level of visual effect. The model includes the location of the proposed rows of panels and some key sections of proposed mitigation planting; both features have been extruded up as solid blocks to their respective heights (2.8m for the arrays and varying heights to test the screen planting). These have been added to the existing terrain, together with point cloud data which provides a representation of the existing intervening vegetation.

All these viewpoint locations are mapped on **Figure 4** of the Graphic Supplement.

A visual analysis was undertaken to inform development of a landscape mitigation strategy (refer to **Figures 7, and 7A-D** in the Graphic Supplement for detail). The key visual sensitivities and opportunities identified with this Site are:

- Some existing shelterbelts are aligned with Site boundaries while others are internal. They break up the Site, preventing views to full extent of the Proposal. They also provide dark backdrops that will help to visually integrate panels in some views.
- There are gaps and thin areas in some shelterbelts where trees are failing or have failed, enabling close partial glimpses of the Site.
- A high level of visibility to the undulating slopes in the southwest corner due to a gap in vegetation/shelterbelts and the elevation within the Site, including from a short section of SH85.
- A high level of visibility to and from the north end of Site on Ranfurly-Naseby Road, due to elevation, proximity to Site, and openness of views extending across a large area of the Site, including the proposed substation.
- Potential cumulative visual effects due to proximity of approved solar farm on Fennessy Road close to northern end of the Site (refer to **section 5.4** below for the assessment of cumulative effects).
- There is limited existing screening vegetation within the Site along Ranfurly Back Road with the exception of some internal east-west orientated shelterbelts towards the southeast corner. Together with the rolling landform, these internal shelterbelts prevent views to the full extent of the Proposal.
- The rolling, folded topography on the Site means there are some ridges with visually prominent faces. The undulating topography also creates screening in the central low-lying areas.

In response to this analysis, mitigation has been proposed as part of the development design and is taken into account in the assessment, and includes:

- Planting up the northern slopes at the tip of the triangular Site to extend the existing exotic tree planting and help restrict visibility from the elevated viewpoint on Ranfurly-Naseby Road (north of intersection with Fennessy Road).
- Adding further shelterbelt planting along Ranfurly-Naseby Road to screen views from the road including from elevated viewpoints north of the Site. It is proposed to maintain this new northern planting at a height of approximately 3m to balance effective screening of the panel arrays with retaining a sense of the vast skies that are valued in this landscape.
- Establishing native planting along much of the boundary with Ranfurly Back Road. The purpose of the planting is not to provide continuous tall screening but to break up views so that only small parts of the Site can be seen at a time, to ensure the built pattern and form does not dominate the landscape while ensuring a sense of openness is retained. By planting a section of the Ranfurly Back Road boundary, it will also provide a backdrop to visually integrate panels on the more elevated ridge in views from the Ranfurly-Naseby Road.
- Establishing native planting and wetland enhancement planting at the southwest corner to improve natural character and biodiversity values at the Site and screen and break up views from Ranfurly-Naseby Road and SH85. The purpose of this planting in this location is to reduce the potential viewshaft into the Site while ensuring a sense of openness and a distant viewing opportunity is retained. Close views will be screened by the proposed planting while more distant views on prominent slopes will be broken up and softened by the taller species to ensure the built pattern and form does not dominate the landscape.
- Setting back the solar panels at least 50 m-60 m from the Ranfurly-Naseby Road at the north end of the Site so that the panels become less visually apparent and integrate more readily into the wider setting, regardless of the time it may take to establish any screening vegetation.
- Filling any gaps where trees have failed in the existing perimeter shelterbelt along Ranfurly-Naseby Road with replacement trees and maintaining other existing shelterbelts on Site.
- Setting back the solar panels at least 20 m-30 m from the Ranfurly Back Road, particularly towards the southeast corner of the Site due to the topography increasing the prominence of panels in views from the road in this location.

5.3.1 Effects from public vantage points

To assess the overall nature and level of visual effects, the potential visual sensitivity of identified viewing audiences was considered together with the overall magnitude of change resulting from the proposed development.

When assessing visual effects, it is important to highlight that views of a development do not necessarily equate to adverse visual effects. Visual impact is not always negative and a change in view is not automatically unacceptable. Views of the solar farm development will also change throughout the day as the panels tilt to follow the sun.

To help understand the effects of the proposed development, the assessment has included the preparation of a cross section from a representative viewpoint on Ranfurly-Naseby Road (see **Figure 5F** in the Graphic Supplement), showing the proposed solar farm in its landscape context with mitigation (year 5).

There are a relatively limited number of roads and recreation areas where views towards the proposed solar farm may be available:

Long-distance views (over 1km from nearest Site boundary):

The topography and vegetation within and surrounding the Site is such that visual impacts are likely to be relatively contained to within the Site and area surrounding the Site boundary, out to approximately 1 km.

Nevertheless, long-distance publicly accessible views such as from Ridge Road (approximately 4.5 km away) and from further away in the surrounding foothills and ranges, may be possible due to their elevation above the Site. In these views, while the Site is extensive, it will appear as part of a much wider view due to the distance (refer to **Site Context Photograph 1** in the Graphic Supplement). Layers of vegetation form the middle ground of the view from Ridge Road, with a narrow band of the Site partially visible beyond and between. The dark panels of the proposed solar farm development may appear as a large, dark mass with gaps of pasture and wetland planting where there are larger no-build areas. Adverse visual effects from these elevated distant views are considered to range from **very low** to **low** (from those most elevated viewpoints where a greater extent of the Site is likely to be visible).

Other potential long-distance publicly accessible views include roads in the wider plains such as State Highway 85, travelling east or west at distances of approximately 1 km away at the closest viewpoint (refer to **Site Context Photographs 2-4** in the Graphic Supplement) and views from Bypass Road, travelling southeast or northwest at distances of approximately 1 km at the closest viewpoint (refer to **Site Context Photograph 18** in the Graphic Supplement). These viewpoints are located at a similar elevation to the Site and therefore the proposed solar development would not be seen in its entirety.

In these views, there are multiple layers of shelterbelts and other vegetation that form the mid-ground, largely screening the Site. Where views comprise prominent slopes such as from the SH85 viewpoint in **Site Context Photograph 2** in the Graphic Supplement, those steep slopes will largely remain undeveloped, reducing the visual density of the blocks of structures so that where the solar farm is visible in gaps, it will typically appear as a narrow strip of built form, replacing the existing pasture, viewed against a backdrop of shelterbelts.

SH85 is a key, highly frequented transport route. However, viewers will be travelling at speeds of up to 100 km / hour, and in views from these distances the detail of individual solar panels will not be visible but will appear as dark bands amid the bands and layers of surrounding shelterbelts, partially screened and broken up by the lower native planting mix in the midground.

Occasional glimpses to the proposed solar farm will be possible from Bypass Road at distances greater than approximately 1 km. However, the layers of intervening vegetation including existing shelterbelts within the Site, limit visibility.

Overall, adverse visual effects are considered to range from **very low** to **low** from these transient viewpoints.

Views from recreational areas:

The ranges to the north and east comprise large areas of public conservation land. However they are quiet, backcountry destinations, more than 6 km from the Site. Any views will typically

be in the context of the range of land uses across the wider Maniototo Basin and would comprise a small and distant part of the view. The dark panels of the proposed solar farm development may appear as a dark mass with gaps of pasture and wetland planting where there are larger no-build areas. The dark colour will contrast with the light pasture but is similar to the dark appearance of exotic coniferous vegetation such as the nearby forestry, helping to visually absorb and tie the proposed solar farm to this landscape.

There are unlikely to be views available from the Central Otago Rail Trail which is approximately 3 km to the south at the closest point, with intervening vegetation and landform screening the Site.

Views from the Naseby Forest Trails, approximately 2 km to the northeast, and the Naseby Golf Course (approximately 700 m away) will be largely screened due to the topography and the tall trees within these areas.

Should any glimpses be possible such as in winter when any deciduous vegetation will be more transparent, the dark panels of the solar farm will be very difficult to discern at these distances.

Adverse visual effects are considered to be **very low** from these viewpoints.

Views from the west:

- Naseby Link Road and Gimmerburn Naseby Road (unsealed, 300 m-1500 m away)

The proposed solar farm will largely be screened in views from these local gravel roads due to intervening shelterbelts, including the shelterbelt (consisting mostly of evergreen conifers) along part of the western Site boundary. Partial glimpses may be available towards the north end of the Site, primarily when approaching the intersection with Fennessy Road. Once the proposed mitigation planting becomes established at this end of the western boundary, views to the proposed panels will be softened and become screened over time. Maintaining this exotic shelterbelt at a height of approximately 3 m is preferred for this section to retain opportunities for long views to the skyline of the ranges beyond.

- Fennessy Road (intersects with Ranfurly-Naseby Road which borders the Site, refer to **Site Context Photograph 9-11** in the Graphic Supplement).

Views to the north end of the solar farm will be largely screened from Fennessy Road, by intervening vegetation such as the shelterbelts along Gimmerburn Naseby Road. Where partial views or glimpses are available for short distances, travelling southeast towards the Site, they will not appear out of context in this location where it will be viewed amongst the other existing infrastructure along this road.

Overall, adverse visual effects from Naseby Link Road, Gimmerburn Naseby Road and Fennessy Road are considered to be **very low**.

- Ranfurly-Naseby Road (borders Site)
 - Approach from south (refer to **Site Context Photograph 5** in the Graphic Supplement)

The existing photograph illustrates a view from **Ranfurly-Naseby Road** looking northeast, representing views approaching the Site when travelling north. The immediate foreground of the view is outside the Site boundary, which is set back approximately 100 m from this viewpoint. A waterway/wetland crosses the midground just beyond the small grouping of trees in the centre of the

photograph. Beyond this feature, the southwest facing slopes and low rise of the nearest ridge landform are visible, backdropped by shelterbelts and the mountain ranges beyond.

A large setback to the nearest panels of an additional approximately 200 m-300 m is proposed, beyond the identified wetland, to avoid close, foreground views of the development from Ranfurly-Naseby Road, regardless of the time it may take for mitigation planting to mature.

Native planting is proposed to provide screening in the midground of views from Ranfurly-Naseby Road. Planting will represent a mixed palette with the tallest species capable of reaching approx. 8 m-12 m in height on maturity to break up and largely screen views to the panel arrays, particularly those on the closer lower slopes. Views to panels on higher, more distant slopes will be screened and broken up by the taller planting species. Some open glimpses will remain above the lower plant species, retaining views from this location to the distant mountains and skyline.

Planting will enhance the waterway/wetland area, with positive effects for natural character and landscape.

- Central section (refer to **Site Context Photographs 6** in the Graphic Supplement)

Views from the central section of the Ranfurly-Naseby Road will be screened by the existing shelterbelt along part of this western boundary. However there are gaps and thin areas where trees are failing or have failed, enabling close partial glimpses of the Site.

Replacement planting will be undertaken where there are gaps or where there are trees that are failing and need to be removed.

- Northern section, travelling north (refer to **Site Context Photograph 7** in the Graphic Supplement)

The western shelterbelt stops some 1.3 km before the northern end of the Site where there are currently open views across the Site, whether travelling both north or south.

It is proposed to extend the existing exotic shelterbelt northward along the Naseby-Ranfurly Road/Site boundary. These exotics will provide quicker screening and are consistent with the existing character of this roadside. However it is recommended that this section of shelterbelt planting be maintained at a height of approximately 3 m. While the extent of existing open views to the distant mountains will be reduced, maintaining the hedge to a lower height will retain a sense of openness, big skies and the mountain backdrop to the north.

A large setback from road is proposed at unplanted north end of Site (approx. 50 m-60 m) to avoid close, foreground views of the development from Ranfurly-Naseby Road regardless of time required to establish mitigation vegetation.

- Northern section, travelling south (refer to **Site Context Photograph 8-9** in the Graphic Supplement)

The existing photograph illustrates a view from Ranfurly-Naseby Road looking south, showing a high level of visibility to the north end of the Site, including the

substation location and transmission line route, due to this elevated viewpoint and the lack of vegetation within the northern end of the Site. The central shelterbelt breaks up views to the south end of the Site and will provide a dark backdrop to absorb taller infrastructure elements.

It is proposed to plant exotic trees on the hill slopes to screen views to the closest panels from this viewpoint. Distant panels are likely to remain visible but softened and broken up the intervening planting once established. These elevated views will be available for a short section of less than 200 m while typically travelling at speed.

Overall, visual effects from Ranfurly-Naseby Road, travelling north or south, are assessed as varying between **very low to moderate-high** temporary effects during construction, reducing to **moderate** once the construction phase is complete. It is considered that visual effects will reduce to **low to low-moderate** overall once planting is established. The highest effects will be from the northern elevated section of road, while travelling south.

Views from the east:

- Ranfurly Back Road (unsealed, borders site)

The existing photograph illustrates the view from a location towards the north end of **Ranfurly Back Road** looking southwest across a gully to the nearest Site boundary, broadly representative of the angle (but not distance) of view from Dwelling 3 (refer to **Site Context Photograph 12** in the Graphic Supplement).

There is an existing stand of exotic trees on the terrace and gully slopes at this northeast corner of the Site. The trees partially screen views to the Site from Ranfurly Back Road. These planted gully slopes and terrace area will not be developed as part of the proposal other than through further planting. This will retain a large visual buffer of 200 m from Ranfurly Back Road and ensure views continue to be screened.

A strip of planting is proposed along the Site boundary to the west of the existing vegetation, as an extension of the existing pocket of trees, to increase the level of screening.

- The existing photographs from the central section of Ranfurly Back Road illustrate views looking north/northeast towards Naseby Forest and Hawkdun Range with the Site in the foreground to the left of the road (refer to **Site Context Photographs 13-14** in the Graphic Supplement).

There is limited existing screening vegetation within the Site along Ranfurly Back Road with the exception of some internal east-west orientated shelterbelts towards the southeast corner of the Site.

The typical setback proposed from the Ranfurly Back Road boundary is approximately 20 m-30 m. This will allow space for the proposed planting and reduce the level of visibility in close, foreground views of the development from the road, regardless of the time it may take to establish mitigation vegetation.

The proposed setback increases towards the southern end of the Site to some 130 m, creating a large visual buffer from the road and retaining the legibility of the shallow gully landform.

Native planting is proposed to provide screening along the boundary in the foreground of views from Ranfurly-Back Road. Planting will predominantly represent a dryland

palette with the tallest species capable of reaching approximately 8 m-12 m in height on maturity, with positive landscape and amenity effects.

- Views towards the Site from the southern end of Ranfurly Back Road are illustrated in **Site Context Photographs 15-17** showing undulating character of the topography in this part of the Site. Linear shelterbelts help to visually break up the extent of the Site.

There is no existing screening vegetation between the Site boundary and adjacent Ranfurly Back Road in this location so open views into parts of the Site are possible. However, there are several existing east-west orientated exotic shelterbelts within the southeast corner of the Site including a shelterbelt along part of the southern boundary. While there are small gaps in most of the shelterbelts, overall they provide effective visual screens, breaking up the Site.

Together with the rolling landform, these internal shelterbelts prevent views to the full extent of the Proposal from Ranfurly Back Road. They also provide dark backdrops that will help to visually integrate the panels from some views.

The existing shelterbelt along the southern Site boundary will screen views from Ranfurly Back Road for users approaching the Site as they travel north.

Development will typically be set back some 30 m inside the shelterbelt along the southern boundary. Along the Ranfurly Back Road boundary, setbacks will increase to between 120 m-250 m, to avoid development on the wetland and adjacent steep slope and reduce visibility. Additional shelterbelt planting is proposed within the Site for a length of approximately 300 m along Ranfurly Back Road.

Overall, visual effects from Ranfurly Back Road, travelling north or south, are assessed as varying between **very low** to **moderate-high** temporary effects during construction, reducing to **moderate** once the construction phase is complete. It is considered that visual effects will reduce to **low** to **low-moderate** overall once planting is established.

5.3.2 Effects from private vantage points

An assessment of the visual prominence of the proposal from several houses on properties adjoining the site or within proximity of the Site was undertaken. This assessment assigned a degree of effect, based on the following: visibility and proximity to the Site (to the nearest built-up edge within the Site); the apparent orientation of the house and the nature of the view, including any existing or proposed vegetation that might provide full or partial screening of views.

The assessment is based on observations from public roads, use of aerial photos and also use of photographs taken from publicly accessible viewpoints.

The findings are presented in an appended table (**Appendix 2**) which also provides reference to the Glint and Glare Study (**Appendix 3**) undertaken for the Site by ITP. A summary of the findings in relation to individual properties is provided below.

A map showing the locations of the properties is provided in **Figure 4**.

The majority of dwellings surrounding the proposed solar farm are between 1 km-3 km away and either set back from the adjacent roads, orientated away from the main direction of view or have a number of intervening buildings or vegetation that assist to curtail or truncate views. Visual effect from these properties is assessed as **very low**. Refer to **Appendix 2** for the full assessment.

The closest properties (up to approximately 1 km away) are assessed below. Dwelling 1 has been excluded due to the residents being one of the two Project landowners leasing land to Helios for this development. Through their support for the development, distance of the dwelling and natural features in between the dwelling and the solar farm, no concerns were raised by the Project landowners on the need for the screening of the solar farm from their dwelling.

Dwelling 2 (see Private Viewpoint Photograph 19 in the Graphic Supplement):

Dwelling 2 is located immediately north, approximately 130 m from the nearest Site boundary. Site with a deck enabling elevated views to the south. The dwelling is elevated but set back from the edge of the slope so that close views to the Site are screened. The dwelling and gardens are partially enclosed by mature hedging, also limiting views. Existing vegetation within the Site (a large stand of trees on slope at northern end and internal shelterbelts) adds further screening.

From southeast orientated windows, decking and garden area, a portion of the northwest extent of the Proposal will be visible (to the right of the intervening trees). A narrow viewshaft to the left of these trees will also be available towards a central portion of the Site.

In views further from the dwelling such as the adjacent front paddock, the available viewshaft will widen with distant views available incorporating the eastern extent of the Site. While a broad 'width' or east-west horizontal extent of the Site will be visible from this location, the north-south vertical 'depth' will appear as a foreshortened band, reducing the apparent proportion of visible change within the view.

The substation will be largely screened from these views.

Views will be long-distance with the nearest visible panels approximately **1200 m** away so that the panels will appear as a thin dark band with gaps of pasture and wetland planting between arrays where there 'no-build' areas. Panels will typically be backdropped by distant shelterbelts and the ranges beyond.

Planting to further reduce this level of visibility is proposed (see the cross section in **Figure 5E Section Elevation 1** in the Graphic Supplement) along sections of the northern Site boundary (including the northeast corner) to screen closer panel arrays over time. Views to some central and more distant panels will remain but are not likely to be readily noticeable due to their small proportion of the overall view and distance, particularly from the dwelling/immediate outdoor living viewpoint location. It is recommended that trees planted on the Ranfurly-Naseby Road boundary and lower hill slopes at this northwest corner should be allowed to grow to mature height to provide maximum screening for those travelling south on Ranfurly-Naseby Road. However, trees planted at the top of the slope, closest to Dwelling 2 can be maintained to a lower height if requested.

Final details regarding location of pines and the height to which they are maintained in the vicinity of the shared Site boundary can be worked through with these landowners when developing the Landscape Management Plan (see **section 6.0 Recommendations**).

There is potential for **low-moderate** to **moderate** temporary visual effects on Dwelling 2 during construction, primarily associated with movement on Site and construction of the substation and switchyard area. Effects will reduce to **low-moderate** at most on completion and reduce to **low** once mitigation planting has established.

Dwelling 3: (see Private Viewpoint Photograph 21 in the Graphic Supplement):

Dwelling 3 is located approximately 580 m from the northeast corner of the Site. The dwelling is largely surrounded by mature hedging to the north, west and south, almost entirely screening potential views to the Site.

Existing vegetation on the east side of the gully (within the northeast corner of the Site) and proposed planting on the west side of the gully (extending west for approximately 380 m along the Site boundary) will continue to ensure views are largely screened should hedging be removed. Topography screens views further west.

Visual effects are assessed as **very low** due to the limited visibility and distance.

Dwelling 4: (see Private Viewpoint Photographs 22 and 23 in the Graphic Supplement)

Dwelling 4 is located approximately 400m from the southeast corner of Site. The dwelling is elevated but set back from the edge of the slope so that close views to the Site are screened. Substantial mature hedging surrounds much of the dwelling and garden, also screening potential views particularly to the southwest extent of the Site. However, in the vicinity of the dwelling, views will be available to the north /northwest from a north facing window (understood to be the main bedroom window) and as you move north, away from the dwelling such as from the carpark/entrance garden area.

From the vicinity of the window location, glimpses of a portion of the northeast extent of the Proposal will be visible in the gaps between and just above the existing intervening on-site shelterbelt. Effects during the construction phase will typically be reduced through a combination of distance and screening from this shelterbelt.

In views from further north such as the northeastern edge of the carpark/entrance area, the available viewshaft will widen to the west with distant views available incorporating the central and north-western extent of the Site. On-site rolling topography will screen some of the westernmost panel arrays and the lower components of the substation. The taller elements of the substation are likely to be visible and will be backdropped by the western shelterbelt and vegetation and hills beyond. Views to the arrays to the northeast will be glimpsed in the gaps between and just above the existing intervening on-site shelterbelt.

While a broad 'width' or east-west horizontal extent of the Site will be visible from this carpark/garden location, the north-south vertical 'depth' will appear as a foreshortened band, reducing the apparent proportion of visible change within the view.

Views from both locations will be long-distance with the nearest visible panels approximately **900 m** away. The panels will appear as a thin dark band with gaps of pasture between arrays where there 'no-build' areas. The 'band' will typically be backdropped by distant vegetation and the ranges beyond.

Planting to further soften and reduce the level of visibility is proposed (see the cross section in **Figure 5E Section Elevation 2** in the Graphic Supplement) along the eastern Site boundary to screen closer arrays over time. Due to the lower contour level at the southeast Site boundary, planting will need to reach at least 8 m-10 m to begin to screen panels from the carpark/garden viewing location. At this height, glimpses to distant panels will remain above the proposed planting but will appear as a small proportion of the overall view and distance. As the existing intervening trees continue to grow, they will also screen more of the panels, including appearing above the intervening hill crest.

Screening could be achieved more quickly through planting on the property such as along the garden fence line should the owners wish. It is estimated that plants would need to reach heights of approximately 1.8 m-2.4 m to largely screen the Site from views in this location.

There is potential for up to **low-moderate to moderate** temporary visual effects on Dwelling 4 during construction. Effects will be **low to low-moderate** on completion and reduce to **low** after 5 years with additional growth of the existing shelterbelt and proposed mitigation infill planting.

Dwelling 5 (see Private Viewpoint Photograph 24 in the Graphic Supplement)

Dwelling 5 is located approximately 1150 m southwest of the Site. The dwelling is orientated broadly northwest in an open garden setting. There are multiple intervening shelterbelts and stands of trees including within the Site. Oblique glimpses to the Site may be available, primarily in winter due to deciduous trees. Views would be at very long distances and it is likely that the panel arrays would not be readily noticeable, particularly as proposed infill shelterbelt planting becomes established.

Visual effects are assessed as **very low** due to the limited visibility and distance.

5.3.3 Glint and Glare

The Glint and Glare Study concludes that no significant impacts are predicted upon road safety or residential amenity.

Road safety

The summary table of modelling shows that glare potential is possible towards four of the identified road receptors and five observation points.

Low or no impact is predicted for seven of the road receptors identified in the Study. A high impact is predicted for Ranfurly-Naseby Road and Ranfurly Back Road which means that mitigation is not required but is recommended to reduce impacts. This mitigation can be provided either in the form of a change in tracking operation of the panels (refer section 3.4.2 of the Glint and Glare Study) or implementing screening in the form of planting (refer section 3.4.3 of the Glint and Glare Study).

In this case, boundary planting is proposed along Ranfurly-Naseby Road and Ranfurly Back Road as part of the wider Mitigation Strategy (described in **section 2.3 Mitigation and Restoration Strategy** and set out in **Figure 5** of the Graphic Supplement) to both screen and break up views and reduce impacts of glint and glare.

Residential amenity

Of the 16 dwelling observation points, 11 are predicted to have no glare issues.

For five dwellings, potential glare has been identified:

- For Dwelling Nos. 9 and 10 (OP12 and OP14 in the Glint and Glare Study) low potential for glare has been identified for durations of 10-11mins on some winter mornings. The effect is considered Low.
- For Dwelling Nos. 5 and 11 (OP13 and OP15 in the Glint and Glare Study), mainly green / low potential for glare was recorded (approximately 6-8 hours per year). However there was also some yellow / potential glare recorded of up to 5 minutes in mid-May between 08:15hrs and 08:45hrs and again between mid-June to early August between 08:15hrs and 09:30hrs for Dwelling 5. The effect is considered Low.
- For one dwelling, No. 4 (OP05), yellow / potential for glare durations of up to 15mins per day have been recorded during late afternoon in winter, between 6 May and 7 July. However, the model indicates an annual total of 566 mins of green glare including 408mins of yellow glare which is less than 10 hours a year overall. Based on the Table

provided (Table 1) in **section 1.2 Other Technical Reports** of the Study, this level of effect is considered low-moderate.

Some existing vegetation (as mapped in the Study) was included in the modelling however the existing vegetation around Dwelling 4 (OP05) was not accounted for. The extent of existing hedging considerably truncates views from the dwelling, reducing glint and glare effects to **low**.

5.3.4 Summary of Visual Effects

Overall, adverse visual effects resulting from the proposal are relatively contained to roads and private properties within the Site and area which surrounds the Site boundary, out to approximately 1 km.

Where occasional long distance views of more than 6 km to the Site may be available from distant elevated hill slopes, the benefits of perimeter mitigation screening will be limited due to the angle of view and there is potential for the whole site to be visible. However, by avoiding development in large internal areas such as around the central wetland and on several of the key faces, and infill planting within internal shelterbelts, the coverage of built form is broken up. Any views will typically be in the context of the range of land uses across the wider Maniototo/ Māniatoto Basin and would comprise a small and distant part of the view.

Middle distance views towards the Site are typically broken up and largely screened from southerly (southwest to southeast) directions.

At the scale of the immediate local landscape, the tall vegetation largely appears as bands and layers, partially enclosing and separating large open spaces and giving a perception of distance and scale. While the dark colour of the panels contrasts with the surrounding lighter pasture, the colour will visually integrate with surrounding coniferous vegetation.

However, just as it doesn't require a big change in level to provide effective screening in an otherwise relatively flat landscape, the inverse is also the case. With a small increase in elevation such as the low ridges folded across the Site, their slopes can be visible above the surrounding flatter landscape.

Within this setting, the finer, folded grain of the Site comprises a series of low, broad backed ridges and gullies. The southwest and east of the site are most undulating with a broad central north-south 'spine' of flatter, lower-lying land, including a large wetland area.

The southern portion of the Site is partially broken up by layers of multiple shelterbelts, predominantly orientated east-west. A well-established shelterbelt also lines approximately half the western perimeter of the Site along the Ranfurly-Naseby Road. *Juncus* spp. have been identified in the wetland areas with grey scrub in some of the gullies and along the boundaries.

This means views from close to the Site:

- Will be screened where established shelterbelt trees are in place such as from parts of Ranfurly-Naseby Road;
- Will be partially screened and broken up where there is undulating topography such as from parts of Ranfurly Back Road;
- Will be possible where there are gaps in the shelterbelt and where vegetation is limited and there are elevated viewing opportunities such as the north end of Ranfurly-Naseby Road and from much of Ranfurly Back Road.

Where views are possible, development on flat land lower slopes will be screened through low mitigation planting along the perimeter.

Where views are possible towards elevated ridge slopes, development will be avoided as much as possible on these slopes; where panels are located on or partially on these slopes, the slopes will be planted to soften and screen the panels.

Where adverse visual effects are possible from public vantage points, these range from **very low** to **moderate-high** from for views from local roads during the construction phase where large machinery and site activity would be visible, prior to the establishment of mitigation planting along the Site boundaries. Once the construction phase is complete and mitigation is established, effects will reduce to **very low** to **low**.

For private dwellings located within 1 km of the site (excluding Project landowners), it is considered that adverse visual effects during construction will range between **low-moderate** to **moderate** at times from the vicinity of two properties (Dwellings 2 and 4) reducing to **low-moderate** in views from immediately outside the dwelling once the construction phase is completed.

Visual effects from Dwellings 3 and 5 will be **very low** during construction and in the operational phase due to the level of screening and distance from the Site.

For all other properties assessed within approximately 3 km of the site, visual effects are considered to be **very low** at most due to distance and oblique, screened or filtered views.

Once becoming established (at 5 years) proposed planting will result in **low** visual effects from Dwelling 2 and 4. In views away from the dwellings, closer to the Site such as from the adjacent paddock and garden/carpark area, views will widen and visual effects are likely to increase.

Based on the assessment of visual effects above, a summary of the identified level of visual effects during construction and at completion is set out in Table 7 below:

Table 7: Visual assessment summary

Photo Ref #	Viewing Audience	Level of Visual Effects ²⁶ during construction	Level of Visual Effects after completion (5 yrs)
Views from public vantage points			
1,2, 18	Long distance	Very low to Moderate	Very low to Low
1	Recreation areas	Very low to Low-moderate	Very low to Low
10A, 10B	Naseby Link Road, Gimmerburn Naseby Road and Fennessy Road	Very low to Moderate-high	Very low
5-8	Ranfurly-Naseby Road	Very low to Moderate-high	Low
12-17	Ranfurly Back Road	Very low to Moderate-high	Low

²⁶ Level of Effect: Very Low, Low, Moderate-Low, Moderate, Moderate-High, High, Very High

Views from private dwelling vantage points within approximately 1km (excluding landowners)			
19	Dwelling 2	Low-moderate to Moderate	Low
21	Dwelling 3	Very Low	Very Low
22	Dwelling 4	Low-moderate to Moderate	Low
24	Dwelling 5	Very Low	Very Low

5.4 Potential Cumulative Effects

One other solar farm has recently been granted consent in proximity to the proposed development that is the subject of this assessment.

The approved Solar Bay solar farm site is located on a 54.5 ha site at the intersection of Gimmerburn Naseby Road and Fennessy Road (approximately 330 m from the closest point to the Site (see **Figure 8** below and **Figure 6** in the Graphic Supplement) and would comprise 105,150 solar panels at a maximum tilted height of 4.53 m above ground level. Ten inverters will also be located within the site. Planting is to be established around the perimeter of the site.

There is potential for cumulative landscape and visual effects to occur as a result of the proposal.

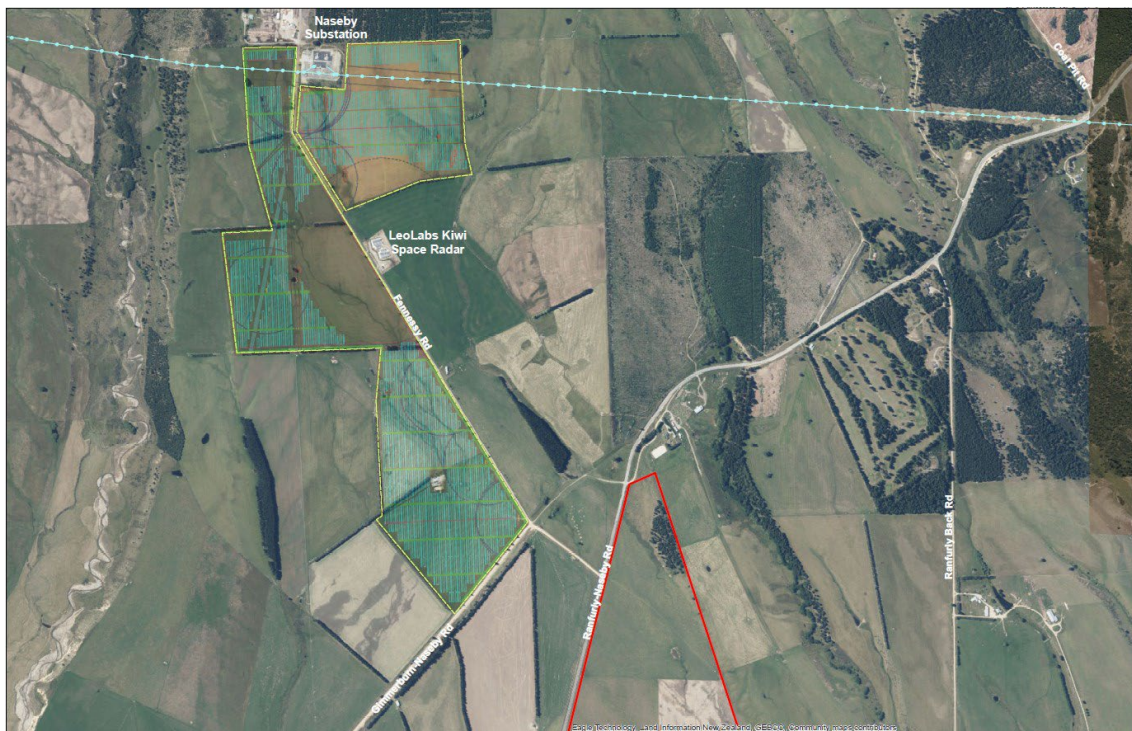


Figure 8: Location of approved Solar Bay solar farm (source: Boffa Miskell)

5.4.1 Cumulative effects on landscape values

Should the consented Solar Bay development be constructed, it would introduce solar farms as an occasional land use within the rural environment surrounding the proposed solar farm Site. Development of the Helios Proposal would further reinforce this character but would not materially change the defining characteristics of the receiving rural landscape. This is due in part to the containment of each solar farm by existing and proposed screen planting so that once established, their influence does not extend across large areas of landscape and to the linear configuration of the Solar Bay site which extends away from the proposed Site, separated by rural landscape. The continuation of sheep grazing beneath the panels at both sites further assists in maintaining agricultural activities that form part of this rural landscape. The cumulative effect on the character of the landscape is considered to be **low-moderate**.

5.4.2 Cumulative visual effects

Views into the site are currently across fenced paddocks and surrounding shelterbelts to Mount Ida and the Ida Range. Should the approved solar farm be established, there are conditions of the Solar Bay resource consent that no development is to be undertaken within this area until the proposed native planting is fully established and attains a minimum height of 3 m. Glimpses of the solar panels may be possible above the native planting in places. The landscape assessment for the now consented solar farm notes that once fully established, and over 5m in height, the proposed landscape mitigation will ensure complete screening, with views dominated instead by evergreen native plantings.²⁷

The solar farms will have most potential to be visible together, within the immediate surrounds of the local access roads, Ranfurly-Naseby Road, Gimmerburn-Naseby Road and Fennessy Road. There will also be views from the driveway to Dwelling 2 (refer to **Private Viewpoint Photograph 20** in the Graphic Supplement)

Ranfurly-Naseby Road and Dwelling 2 driveway

Opportunities for the most extensive cumulative views are likely from a short section of this road and from the driveway access to Dwelling 2 in elevated locations north of Fennessy Road. Brief views incorporating parts of both solar farms on either side of the road will be possible while travelling south. The extent of views quickly diminishes as the viewer proceeds south, downhill.

In addition, the proposed mitigation planting at both solar farms will, once fully established, provide substantial screening from this location as demonstrated by the numerous existing *Pinus species* shelterbelts throughout both sites and wider surrounds.

The degree of potential adverse cumulative effects from these locations will be **low-moderate**, once planting is established.

Gimmerburn-Naseby Road and Fennessy Road

Views to the proposed Helios Site are largely screened from Gimmerburn-Naseby Road until arrival at the intersection with Fennessy Road. Views from this location are oblique so the two farms will not be viewed together but seen when turning from one direction to the other.

When travelling on Fennessy Road towards the Solar Bay farm, the Helios Site will be behind the viewer. When travelling towards the Helios Site, there is potential to see both solar farms when west of the Gimmerburn-Naseby Road intersection. However, the extent of visibility is

²⁷ Rough Milne Mitchell Landscape Architects Limited. Landscape Assessment Report. Proposed Solar Farm, 216 Fennessy Road, Naseby. Date: 08 July 2022

limited due to the panels being set back from the northern Site boundary and the intervening shelterbelts. In addition, the proposed mitigation planting at both solar farms will provide substantial screening over time.

The consented and proposed solar farm developments will not appear out of context in this location where they will adjoin or be viewed against existing infrastructure such as the substation and transmission lines.

Consequently, the degree of cumulative effects from this location will be **low**, reducing to **very low** once planting is established.

5.5 Response to Statutory Provisions

The landscape effects are interpreted against the following outcomes sought in the key relevant CODP Section 4 provisions.

Section 4 – Rural Resource Area

4.3.3 Objective - Landscape and Amenity Values

To maintain and where practicable enhance rural amenity values created by the open space, landscape, natural character and built environment values of the District's rural environment, and to maintain the open natural character of the hills and ranges.

Policy 4.4.2 – Landscape Amenity Values

To manage the effects of land use activities and subdivision to ensure that adverse effects on the open space, landscape, natural character, and amenity values of the rural environment are avoided, remedied, or mitigated through:

- (a) - The design and location of structures and works, particularly in respect of the open natural character of hills and ranges, skylines, prominent places, and natural features.*
- (b) - Development which is compatible with the surrounding environment including the amenity values of adjoining properties.*
- (e) - The location of tree planting, particularly in respect of landscape values, natural features, and ecological values.*

Policy 4.4.10 – Rural Subdivision and Development

4.4.10 Policy – Rural Subdivision and Development

To ensure that the subdivision and use of land in the Rural Resource Area avoids, remedies or mitigates adverse effects on:

- (a) - The open space, landscape and natural character amenity values of the rural environment in particular the hills and ranges,*
- (b) - The natural character and values of the District's wetlands, lakes, rivers and their margins,*
- (c) - The production and amenity values of neighbouring properties,*
- (d) - The safety and efficiency of the roading network,*
- (e) - The loss of soils with special qualities,*
- (f) - The ecological values of significant indigenous vegetation and significant habitats of indigenous fauna,*

(g) - *The heritage and cultural values of the District,*

(h) - *The water quality of the District's surface and groundwater resources, and*

(i) - *Public access to or along the rivers and lakes of the District, particularly through the use of minimum (and average) allotment sizes, particularly through the use of minimum (and average) allotment sizes.*

Assessment Response

The proposed solar farm is located on low, slightly undulating topography that comprises typical farmland, not on the district's hills, ranges, skylines, prominent places, or natural features.

The Site will transition from a rural productive landscape to that of a landscape containing energy infrastructure. The large expanse of open space will be reduced to areas between solar panels and enclosed to a greater extent by the recommended planting. Grazing animals, such as sheep, will continue to manage the pasture underneath the panels and frames. The presence of grazing animals maintains a sense of the rural character of the Site. Nevertheless, the proposed solar farm will reduce rural amenity values of the rural environment, particularly those related to open space within the immediate context of the Site. However, the topography and vegetation within and surrounding the Site is such that visibility is relatively contained to within the Site and area surrounding the Site boundary, out to approximately 1km. Where there are wider publicly accessible, elevated views such as from the surrounding foothills and ranges, access is limited and views are from long distances, typically upwards of 6km. There is also a degree of compatibility with the context of other utilities in the vicinity of the Site such as the existing transmission line, substation and radar as well as the large scale, productive activity and dense coverage associated with the Naseby Forest.

In addition, mitigation planting is proposed which once fully established, will soften, break up and over time, substantially screen the development from neighbouring public and private viewpoints. The proposed exotic planting will be seen in the context of existing shelterbelts while the proposed native planting may have beneficial effects on rural amenity over time. Planting has been chosen and will be maintained as required so as to maintain views of the hills, ranges and skylines.

The proposed native planting and wetland enhancement planting will enhance the level of natural character and physical landscape values on the Site.

Once planting is established, the proposal will adversely affect landscape values to **no more than low-moderate overall**.

Section 13 – Infrastructure, Energy and Utilities

13.3.35 Objective - Landscape and Amenity Values

To maintain and where practicable enhance rural amenity values created by the open space, landscape, natural character and built environment values of the District's rural environment.

Policy 13.4.4 – Development of Utilities

To ensure that the design, location, and operation of utilities including the transmission network, having regard to specific locational and operational efficiency requirements, recognises and provides for the following matters, where relevant:

(a) *The avoidance, remedying or mitigation of the adverse effects of noise, vibration, lightspill and glare on the environment.*

(b) *The avoidance, remedying or mitigation of adverse effects on landscape values.*

- (c) *The protection of areas of significant indigenous vegetation and significant habitats of indigenous fauna and statutorily managed sports fish and game, water bodies and their margins.*
- (d) *The avoidance, remedying or mitigation of any significant increase in risk to the safety of the public.*
- (e) *The maintenance of the efficient operation of other utilities and infrastructure.*
- (f) *The protection of the integrity of significant heritage values.*
- (g) *The protection of the integrity of sites of importance to Kai Tahu ki Otago.*

Assessment Response

Solar farms represent a type of production activity that features a grid pattern of built form directly associated with electricity infrastructure; it is not yet a traditional form of development in rural New Zealand landscapes but it is not uncommon for them to be located within a rural environment. Solar farms do need to be located in proximity to or with the ability to connect to the National Grid. There is approval for another solar farm (Solar Bay) nearby.

The proposed solar farm is not located within an area identified as an ONL or with high landscape and amenity values, significant indigenous vegetation and habitats, or identified heritage and cultural values. These values are present in the wider receiving environment and from a landscape perspective, will not be impacted. There will be beneficial effects on localised natural character values due to the scale of proposed wetland planting and other large areas of native screen planting proposed.

The appended Glint and Glare Study concludes that no significant impacts are predicted upon road safety or residential amenity. A high impact is predicted for Ranfurly-Naseby Road and Ranfurly Back Road and a moderate impact predicted for Dwelling 4. However these will be reduced through proposed mitigation screen planting.

CODP Rural Resource Area - Assessment Matters

3. Other Rural Landscapes

Other rural landscapes are described by CODC as *‘those landscapes in the Rural Resource Area that are not identified as being in any other landscape category, as listed above or in the Upper Manorburn/Lake Onslow Landscape Management Area.’*

CODP Rural Resource Area - Other Rural Landscapes.

Significant Issue - *Central Otago’s Unique and Distinctive Landscape. The Central Otago District contains many unique and distinctive landscapes. While those landscapes are constantly evolving through natural processes, farming and other land use activities the semi-arid, rocky nature of the landscape means it can be vulnerable to visual effects of new structures (including telecommunication masts, wind farms, transmission line pylons, and other large structures), cultivation of tussock grasslands, large scale earthworks, new roads, residential built development on elevated land, establishing woodlots, production forestry or shelter belts on elevated land and wilding tree spread. Subdivision is often the precursor of land use activities such as those listed above. The District’s built heritage, particularly in the form of cottages and ruins, and remnants of the early goldmining era, has also made a significant contribution to the landscape values of Central Otago.*

The following assessment matters for Discretionary Activities under Rule 4.7.4(iii) are considered in regard to the proposed solar farm development.

1. The effects of subdivision and future development on:

- *Open space, landscape, natural character and amenity values.*
- *Reserves, all public conservation land managed by the Department of Conservation and recreation facilities, including the provision and maintenance of such facilities.*
- *Heritage sites, including archaeological sites and waahi tapu, and heritage landscapes.*
- *Sites, lakes and rivers and their margins and other features of cultural value to Kai Tahu ki Otago.*
- *Notable trees, and areas of significant indigenous fauna, and*
- *The natural character of water bodies and their margins.*

Assessment Response

The Site is located at the edge of the basin landscape and is not within an ONL or SAL in the CODP. There are no reserves, recreational activities, heritage sites, notable trees, or significant habitats within the Site. Those in the vicinity such as the Historic Town Centre at Naseby, are spatially and topographically separated from the Site and will not be impacted. The proposed development of the Site will lead to a large shift in the level of open space and in the landscape character from a traditional rural land use to a productive energy landscape. The magnitude of change within the Site and local area will be high.

However, while the scale of new built modification will be apparent, modified rural activities already prevail at the Site and there is a degree of compatibility with the existing characteristics of other activities in the vicinity of the Site such as the existing transmission line, substation and radar as well as the approved solar farm and large scale, productive activity and dense coverage associated with the Naseby Forest.

The distribution of the panels across the Site includes a level of response to the character of the Site itself, its landform and its boundary interfaces. The proposed solar farm will not compromise the ability to undertake rural agricultural activities on the Site or within the wider area and the mitigation planting will soften and largely screen the appearance of the built form on the Site. The proposed mitigation planting will ensure opportunities to enjoy open views across the Site remain.

No identified wetland will be built on and due to the proposed setback buffer and fencing, any disturbance will be minimised. The large scale of proposed mitigation planting together with the enhancement/regeneration of the key wetland areas will greatly increase the indigenous vegetation in the area, creating beneficial landscape effects once established.

The visual catchment is relatively contained to the immediate context of the Site. While the total size of the proposed Site is 660 ha, it is broken up into smaller areas by topography and vegetation; the folded landform and existing shelterbelts restrict views to the whole development, limiting visibility and potential effects on visual amenity.

2. Potential for visual absorption of future built development with particular attention being given to those areas identified as outstanding natural landscapes and significant amenity landscapes on the planning maps.

The site is not identified as, or adjacent to an ONL or SAL. The nearest area of ONL is approximately 6km from the Site at the closest point. Due to the elevation of these ranges, visibility of the Site may be possible from some locations within areas of ONL. These ranges comprise large areas of public conservation land, however they are quiet, backcountry destinations. Any views will typically be in the context of the range of land uses across the wider Maniototo Basin and would comprise a small and distant part of the view.

The dark panels of the proposed solar farm development may appear as a large, dark mass with gaps of pasture and wetland planting where there are larger no-build areas. The dark

colour will contrast with the light pasture but is similar to the dark appearance of exotic coniferous vegetation such as the nearby forestry, helping to visually tie the proposed solar farm to this landscape.

3. Capability for sustainable use of the productive land and soil resource.

The Site predominantly consists of improved pasture and short rotation cropland that is regularly mechanically cultivated and grazed by sheep and beef cattle. Aside from a small number of scattered plants, indigenous vegetation has been fully removed from the paddocks. The proposed solar farm will allow for the production of solar energy within an area of high recorded mean sunshine hours while rural productive activity will continue in the form of sheep grazing under the solar panels. It is understood that at the end of the intended 35-year operational lifespan, the solar farm will be dismantled and the site will be reinstated to its original pre-construction condition.

4. The potential for reverse sensitivity effects and methods to address such effects on existing rural production activities and on existing infrastructure, including the use of separation distances and yards.

Properties surrounding the Site are used largely for similar agricultural grazing purposes. Other land uses include forestry, tourism, recreation, conservation, as well as residential. Overall, dwellings are sparsely located and at some distance to the Site with five residential buildings (including one of the Project land-owners') within approximately 1km of the Site boundary. There are also existing energy-related land uses nearby including a consented but not yet built Solar Bay 50MW solar farm on Fennessy Road.

To assist with screening views of the solar panels and integrating the proposed development with the surrounding rural landscape, a combination of setbacks, screen planting and wetland restoration are proposed.

5, 6. Not applicable.

7. The location, design and construction of access, and its adequacy for the intended use of the allotments.

A total of four site accesses are proposed. Three will be from Ranfurly-Naseby Road and the fourth will be from Ranfurly Back Road as shown in **Figure 7**. Accesses 1 and 2 will be the primary access points to be used by heavy vehicles during construction. Accesses 3 and 4 are to be secondary access points and will not be used by heavy vehicles.

New sections of internal access tracks will be required which will be formed by the placement of subbase aggregate, approximately 3.5 m-4.0 m wide.

Together with upgrades to existing access tracks, the total length of internal access tracks (new and existing) will be approximately 27 km. Earthworks will be completed in stages and progressively rehabilitated to minimise the amount of soil exposed at any one time. All access tracks will be finished in an all-weather metallised surface. For the purpose of this assessment, it is assumed²⁸ that there will be no works undertaken within or near waterways, including in relation to existing vehicle crossings.

All site works will be undertaken in accordance with the Construction Methodology as outlined in the AEE **Appendix 6**

²⁸ Based on information provided to Boffa Miskell by Helios on 1 November 2023.

8. The provision of an adequate utility services, (including roading), and in particular the location, design, and construction of these services.

The Site is located close to the Transpower Naseby Substation and the Roxburgh to Livingstone 220 kV transmission line which is part of the National Grid. Access and roading on Site is described above.

9. Earthworks necessary to prepare the site for occupation and/or use.

Most of the topography within the Site will remain unchanged, however there will be earthworks involved to construct the access tracks, to enable construction of the substation and BESS areas and to enable trenching for the cabling required to connect the arrays. The solar panels will be installed via driven piles which will entail minimal earthworks. The solar arrays and associated earthworks will be set back from the surveyed wetlands and waterways.

The earthworks will occur progressively as the site is constructed and where disturbance occurs in areas where no permanent above ground infrastructure is required (i.e., cable trenching), the landform will be restored and grassed with little perceptible change.

10, 11, 12, 13. Not applicable.

14. The identification of potential building platforms that are encouraged in locations that will maintain the open Central Otago District Plan 20 February 2019 Page 4:56 Rural Resource Area natural character of hills and ranges, without compromising the landscape and amenity values of prominent hillsides and terraces.

Refer to above response 4.3.3 Objective - Landscape and Amenity Values and Policy 4.4.2 – Landscape Amenity Values.

15. Not applicable.

16. Whether or not the applicant will commit or has committed to work or services as environmental compensation (such as the control of wilding pines) and if so committed, whether it is or will be:

- to remedy at least in part any adverse effects of onsite works; or
- on the site or within the same general area, landscape, or environment as the proposed activity; and/or
- effective by way of conditions, bond, or covenant; and/or
- the product of public consultation or participation.

New strategic blocks of screen planting and wetland restoration are proposed as part of the Project (refer to the Graphic Supplement, **Figure 5A: Landscape Mitigation Plan**).

The proposed planting will be a mix of native species in some locations and faster growing exotic evergreen shelterbelt species in other locations where additional height is needed and to infill existing shelterbelts. This will provide screening for year-round visual mitigation and enhance biodiversity and natural character on the Site. Together these areas account for approximately 25 ha of the Site.

17. The appropriate size of any allotment bearing in mind any of the above factors.

The proposed solar farm will introduce a high density of linear structures into a rural farming landscape that is currently open and expansive. While the structures are relatively low in height, at less than 3 m, the scale of the overall proposal is very large. This will lead to broad change in landscape character from open, pastoral farmland to a landscape containing energy related infrastructure.

However, the sensitivity of the Site to land use change of the nature proposed is considered to be low given it is a modified landscape at the edge of the basin landscape, not identified as an ONL or ONF and contains no features that are character-defining when compared to the wider context. The Site is also located in the vicinity of other utilities with which it shares some characteristics including the large scale, productive activity and dense coverage associated with the Naseby Forest.

At the same time, the Project has been designed in a manner so as to minimise impacts of its scale on the landscape and natural character values as far as practicable. This will be done through opportunities for the enhancement of the key wetlands and extensive blocks of additional planting. As part of an agri-industrial environment, this has the potential to improve aspects of the character of the landscape.

One of the key features of the Proposal that will assist with its integration into the surrounding landscape character are through the dimensions and distribution of the panels and panel arrays which enable multi-layered use of the Site, including farming. This helps retain key elements of a rural productive character as well as a degree of landform legibility.

6.0 Recommendations

As described throughout the assessment, mitigation planting is proposed at the Site as part of the Project, with both a native palette and exotic shelterbelt species. Refer to **section 2.3** under the Proposal Description and the Landscape Mitigation Plan and proposed planting palette (**Figures 5A-5F** of the Graphic Supplement) for details.

Where feasible, the following recommendations are made in relation to the proposed ecological/mitigation planting:

- The existing Site boundary shelterbelts and vegetation should all be retained to provide screening for the proposal. It is understood that this planting is associated with the ownership of the Site.
- Mitigation planting should begin within the first planting season (April / May or September / October) following commencement of construction and completed by the end of the construction period. The timeframe for planting should prioritise planting along boundaries closest to dwellings 2 and 4 and along the Ranfurly-Naseby Road.
- In regard to the proposed native planting, locally appropriate indigenous species will be used where possible and practicable. Species selected are also tolerant of dry and extreme conditions and have a low fire-prevalence.
- Irrigation and ongoing monitoring and maintenance of the proposed and existing planting including the fenced wetland areas will be required to promote the continued health, growth and longer-term stability of plants, particularly in this environment. Regular watering/irrigation over first 5 years following planting will be essential for plant growth in this environment. Protective wind shelters are also recommended.
- While the Landscape Mitigation Plan in **Figure 5A** of the Graphic Supplement provides the high level plan, the preparation of a Landscape Management Plan is also recommended as part of the Proposal. The Landscape Management Plan should set out both the establishment phase and the ongoing routine monitoring and maintenance

necessary such as weed removal. The Plan should also detail mitigation and enhancement planting areas required for the Project, including details of layout, species, grades, numbers, spacing, eco-sourcing, and a programme and specification for implementation and maintenance. This may include requirements for occasional pruning to maintain viewshafts and 'spot' planting to 'fill in any gaps' that may be evident at ground level in between the trunks of the individual trees. Replacement planting with evergreen species will be undertaken where there are gaps or where there are trees that are failing and need to be removed.

- The intent with the native mixed planting is to achieve 'drifts' of tree and shrub planting intertwined with a mix of species and plant sizes. It is proposed that new plantings be implemented at spaces that allow for established plant sizes while achieving this varied, natural outcome. The aim is to avoid an 'avenue' effect and to ensure the planting looks as natural as possible.

The following additional recommendations are made to reduce the adverse landscape and visual effects of the proposal:

- The materials and colour of onsite buildings and structures will, where practical, have a Light Reflectivity Value (LRV) of less than 30% and be in keeping with the materials and colouring of existing infrastructure or of a colour that will blend with the landscape such as in a natural range of browns, greens and greys to complement the tones found in the rural surroundings;
- Areas of soil disturbed by the project would be rehabilitated progressively or immediately post-construction, reducing views of bare soil;
- Night lighting would be minimised to the maximum extent possible (i.e., manually operated safety lighting at main component locations).

7.0 Conclusions

Helios seek land use consent from Central Otago District Council for the construction, operation, and maintenance of a solar farm at a site of approximately 660 ha between Ranfurly-Naseby Road and Ranfurly Back Road, Naseby. The Site comprises an area of improved, grazed farmland which is zoned Rural Resource Area within the Central Otago District Plan. The Site is within an overlay of Other Rural Landscapes which signifies there are no Outstanding or Significant landscapes or features which relate to the Site.

The key features of the project comprise the solar panels, substation and supporting electrical infrastructure/equipment, buildings, lighting, underground cabling, access and internal roading, fencing and landscaping.

Agricultural operations in the form of sheep grazing within the property will continue.

As identified in the relevant statutory provisions of the CODP, the policies and objectives seek to maintain and enhance rural character and amenity values in rural areas.

A number of modified wetlands have been identified within the Site which contribute natural character values to the Site at different levels. The solar arrays and associated earthworks will be set back from the surveyed wetlands and waterways and a total of some 14 ha of

enhancement planting is proposed within the two large wetland areas. Overall, following completion, the adverse effects on natural character values will be **very low** and the proposed removal of stock from the wetlands and restoration planting will result in **beneficial** effects on the natural systems, characteristics and qualities of the Site over time.

There would be no more than temporary **moderate-high** adverse effects on the landscape that will be internal to the Site during the construction phase due to the progressive disturbance to the Site and level of activity such as the movement of construction vehicles and people working on the Site, to install the structures. There would be localised direct **very low** adverse effects on the physical landscape due to the earthworks required within the site. These effects would be highly localised to areas within the Site. Once any disturbed areas have been rehabilitated and proposed mitigation planting established, this would offset any loss to site vegetation resulting in **beneficial** physical landscape effects.

Overall, adverse effects of the solar farm on the Site and local landscape without mitigation are considered **moderate**, reducing to **low** in the context of the wider Maniototo Basin. The large blocks of planting including wetland fencing and improvements proposed, will greatly increase the indigenous vegetation and biophysical landscape values in the immediate area (with an estimated total of 25 ha additional native dryland and wetland planting). As this becomes established, while a degree of landscape change will continue to be experienced, landscape effects within the immediate context will reduce to **low-moderate** overall and very low in the context of the wider Basin.

The main viewing audience includes a small number of private properties and road users of sections of Ranfurly-Naseby Road, Ranfurly Back Road, Fennessy Road, Bypass Road and SH85 located within approximately 1 km of the Site. There will also be occasional longer distance views such as from Ridge Road.

During construction, adverse visual effects on views from roads range between **very low** and **moderate** and are temporary in nature. Over time, mitigation planting will gradually reduce these effects to **low-moderate** to **very low** as the proposed development would be softened and at least partially screened in views from the road.

For private dwellings located within 1 km of the site (excluding Project landowners), it is considered that adverse visual effects during construction will range between **low-moderate** to **moderate** at times from the vicinity of two properties (Dwellings 2 and 4) reducing to **low-moderate** in views from immediately outside the dwelling once the construction phase is completed.

Visual effects from Dwellings 3 and 5 will be **very low** during construction and in the operational phase due to the level of screening and distance from the Site.

For all other properties assessed within approximately 3 km of the site, visual effects are considered to be **very low** at most due to distance and oblique, screened or filtered views.

Once becoming established (at 5 years) proposed planting will result in **low** visual effects from Dwelling 2 and 4. In views away from the dwellings, closer to the Site such as from the adjacent paddock and garden/carpark area, views will widen and visual effects are likely to increase.

Appendix 1:

Method Statement

22 November 2023

This assessment method statement is consistent with the methodology (high-level system of concepts, principles, and approaches) of 'Te Tangi a te Manu: Aotearoa New Zealand Landscape Assessment Guidelines', Tuia Pito Ora New Zealand Institute of Landscape Architects, July 2022. The assessment provides separate chapters to discuss landscape, visual and natural character effects where relevant, but is referred to throughout as a Landscape Effects Assessment in accordance with these Guidelines. Specifically, the assessment of effects has examined the following:

- *The existing landscape;*
- *The nature of effect;*
- *The level of effect; and*
- *The significance of effect.*

The Existing Landscape

The first step of assessment entails examining the existing landscape in which potential effects may occur. This aspect of the assessment describes and interprets the specific landscape character and values which may be impacted by the proposal alongside its natural character where relevant as set out further below. The existing landscape is assessed at a scale(s) commensurate with the potential nature of effects. It includes an understanding of the visual catchment and viewing audience relating to the proposal including key representative public views. This aspect of the assessment entails both desk-top review (including drawing upon area-based landscape assessments where available) and field work/site surveys to examine and describe the specific factors and interplay of relevant attributes or dimensions, as follows:

Physical – relevant natural and human features and processes;

Perceptual – direct human sensory experience and its broader interpretation; and

Associative – intangible meanings and associations that influence how places are perceived.

Engagement with *tāngata whenua*

As part of the analysis of the existing landscape, the assessment should seek to identify relevant mana whenua (where possible) and describe the nature and extent of engagement, together with any relevant sources informing an understanding of the existing landscape from a Te Ao Māori perspective.

Statutory and Non-Statutory Provisions

The relevant provisions facilitating change also influence the consequent nature and level of effects. Relevant provisions encompass objectives and policies drawn from a broader analysis of the statutory context and which may anticipate change and certain outcomes for identified landscape values.

The Nature of Effect

The nature of effect assesses the outcome of the proposal within the landscape. The nature of effect is considered in terms of whether effects are positive (beneficial) or negative (adverse) in the context within which they occur. Neutral effects may also occur where landscape or visual change is benign.

It should be emphasised that a change in a landscape (or view of a landscape) does not, of itself, necessarily constitute an adverse landscape effect. Landscapes are dynamic and are constantly changing in both subtle and more dramatic transformational ways; these changes are both natural and human induced. What is important when assessing and managing landscape change is that adverse effects are avoided or sufficiently mitigated to ameliorate adverse effects. The aim is to maintain or enhance the environment through appropriate design outcomes, recognising that both the nature and level of effects may change over time.

The Level of Effect

Where the nature of effect is assessed as ‘adverse’, the assessment quantifies the level (degree or magnitude) of adverse effect. The level of effect has not been quantified where the nature of effect is neutral or beneficial. Assessing the level of effect entails professional judgement based on expertise and experience provided with explanations and reasons. The identified level of adverse natural character, landscape and visual effects adopts a universal seven-point scale from **very low** to **very high** consistent with Te Tangi a te Manu Guidelines and reproduced below.

VERY LOW	LOW	LOW-MOD	MODERATE	MOD-HIGH	HIGH	VERY HIGH
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Landscape Effects

A landscape effect relates to the change on a landscape’s character and its inherent values and in the context of what change can be anticipated in that landscape in relation to relevant zoning and policy. The level of effect is influenced by the size or spatial scale, geographical extent, duration and reversibility of landscape change on the characteristics and values within the specific context in which they occur.

Visual Effects

Visual effects are a subset of landscape effects. They are consequence of changes to landscape values as experienced in views. To assess where visual effects of the proposal may occur requires an identification of the area from where the proposal may be visible from, and the specific viewing audience(s) affected. Visual effects are assessed with respect to landscape character and values. This can be influenced by several factors such as distance, orientation of the view, duration, extent of view occupied, screening and backdrop, as well as the potential change that could be anticipated in the view as a result of zone / policy provisions of relevant statutory plans.

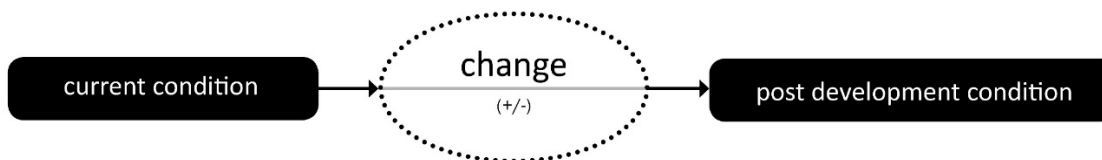
Natural Character Effects

Natural Character, under the RMA, specifically relates to ‘*the preservation of the natural character of the coastal environment (including the coastal marine area), wetlands, and lakes and rivers and their margins, and the protection of them from inappropriate subdivision, use, and development*’. Therefore, the assessment of natural character effects only involves examining the proposed changes to natural elements, patterns and process which may occur in relevant landscape / seascape contexts.

As with assessing landscape effects, the first step when assessing natural character effects involves identifying the relevant physical and experiential characteristics and qualities which occur and may be affected by a proposal at a commensurate scale. This can be supported through the input of technical disciplines such as geomorphology, hydrology, marine, freshwater, and terrestrial ecology as well as input from tāngata whenua. An understanding of natural character considers the level of naturalness and essentially reflects the current condition of the environment assessed in relation to the seven-point scale. A higher level of natural character means the waterbody and/or margin is less modified and vice versa.

A natural character effect is a change to the current condition of parts of the environment where natural character occurs. Change can be negative or positive. The resultant natural character effect is influenced by the existing level of naturalness within which change is proposed; a greater level of effect will generally occur when the proposal reduces the naturalness of a less modified environment. In short, the process of assessing natural character effects can be summarised as follows:

- Identify the characteristics and qualities which contribute to natural character within a relevant context and defined spatial scale(s), including the existing level of naturalness;
- Describe the changes to identified characteristics and qualities and the consequent level of natural character anticipated (post proposal); and
- Determine the overall level of effect based on the consequence of change.



The Significance of Effects

Decision makers assessing resource consent applications must evaluate if the effect on individuals or the environment is less than minor²⁹ or if an adverse effect on the environment is no more than minor³⁰. For non-complying activities, consent can only be granted if the s104D 'gateway test' is satisfied, ensuring adverse effects are minor or align with planning objectives. In these situations, the assessment may be required to translate the level of effect in terms of RMA terminology.

This assessment has adopted the following scale applied to relevant RMA circumstances³¹ (refer to diagram below), acknowledging low and very low adverse effects generally equate to 'less than minor' and high / very high effects generally equate to significant³².



²⁹ RMA, Section 95E

³⁰ RMA, Section 95E

³¹ Seven-point level of effect scale. Source: Te tangi a te Manu, Pg. 15

³² The term 'significant adverse effects' applies to specific RMA situations, including the consideration of alternatives for Notices of Requirement and AEEs, as well as assessing natural character effects under the NZ Coastal Policy Statement.

Appendix 2: Visual Impact Tables from Dwellings

Dwellings

Ref.	Dwelling address	Distance to Site / panel arrays (approx. metres)	Apparent extent of visibility ³³ and orientation	Glint and glare ³⁴	During construction	Completion		Notes
					Level of Visual Effect ³⁵	Level of Visual Effect at Year 1	Level of Visual Effect at Year 5	
1	48 Ranfurly-Naseby Road, Ranfurly, Central Otago	45 m / 80 m	Glimpse; East/Northeast	No glare predicted	Landowner - Excluded	Landowner - Excluded	Landowner - Excluded	Property located near the southwest corner of the Site with dwelling/s surrounded by substantial hedging and garden planting. Potential close views of the Site will be largely screened by this intervening vegetation. However there may be wider more distant views to the northeast between trees. The residents are one of the two landowners leasing land to Helios for this development. No concerns were raised by the landowners on the need for the screening of the solar farm from their dwelling and as a result, no screening is proposed and the property is excluded from the Assessment.
2	512 Ranfurly-Naseby Road	140 m / 450 m	Small amount to	No glare predicted	Low-moderate	Low-moderate	Low	Property is located immediately north of Site with a deck enabling elevated views to the south. The steep drop away of the intervening terrace

³³ Extent of visibility: Full (almost all the Site is visible), Partial (up to half of the Site is visible), Small Amount (approximately 20% of the Site is visible), Glimpse (very small, i.e. less than 10% of the Site is visible), Truncated (or no views)

³⁴ See Appendix 3 Naseby Solar Farm Glint and Glare Study

³⁵ Significance of Effects: Very Low, Low, Moderate-Low, Moderate, Moderate-High, High, Very High

Ref.	Dwelling address	Distance to Site / panel arrays (approx. metres)	Apparent extent of visibility ³³ and orientation	Glint and glare ³⁴	During construction	Completion		Notes
					Level of Visual Effect ³⁵	Level of Visual Effect at Year 1	Level of Visual Effect at Year 5	
			Partial; South		to Moderate			landform screens views to the closest panels. Dwelling and gardens are partially enclosed by mature hedging, also limiting views. Existing vegetation within the Site (a large stand of trees on slope at northern end and internal shelterbelts) adds further screening. From southeast orientated windows, decking and garden area, a portion of the northwest extent of the Proposal will be visible (to the right of the intervening trees). A narrow viewshaft to the left of these trees will also be available towards a central portion of the Site. In views further from the dwelling such as the adjacent front paddock, the available viewshaft will widen with distant views available incorporating the eastern extent of the Site. While a broad 'width' or east-west horizontal extent of the Site will be visible from this location, the north-south vertical 'depth' will appear as a foreshortened band, reducing the apparent proportion of visible change within the view. The substation will be largely screened from these views. Views will be long-distance with the nearest visible panels approximately 1200 m away so that the panels will appear as a thin dark band with gaps of pasture and wetland planting between arrays where there 'no-build' areas. Panels will typically be backdropped by distant shelterbelts and the ranges beyond. Planting to further reduce this level of visibility is proposed along sections of the northern Site

Ref.	Dwelling address	Distance to Site / panel arrays (approx. metres)	Apparent extent of visibility ³³ and orientation	Glint and glare ³⁴	During construction	Completion		Notes
					Level of Visual Effect ³⁵	Level of Visual Effect at Year 1	Level of Visual Effect at Year 5	
								boundary (including the northeast corner) to screen panel arrays. Views to some central and more distant panels may remain but are not likely to be readily noticeable due to their small proportion of the overall view and distance, particularly from the dwelling/immediate outdoor living viewpoint location.
3	788 Ranfurly Back Road	580 m / 660 m	Truncated (no view) to glimpses; Southwest	No glare predicted	Very Low	Very Low	Very Low	Property is located near the northeast corner of the Site. The dwelling is largely surrounded by mature hedging to the north, west and south, screening potential views to the Site. Existing vegetation on the east side of the gully (within the northeast corner of the Site) and proposed planting on the west side of the gully (extending west for approximately 380m along the Site boundary) will continue to ensure views are largely screened should hedging be removed. Topography screens views further west.
4	366 Ranfurly Back Road	380 m / 440 m	Small amount to partial; North/ Northwest	Low-moderate (up to 15 minutes of yellow glare between 3:45pm and 5:30pm, from 6 May to 7 July)	Low-Moderate to Moderate	Low-Moderate	Low	Property is located near southeast corner of Site. The steep drop away of the intervening landform screens views to the closest panels. Substantial mature hedging surrounds much of the dwelling and garden, also screening potential views particularly to the southwest extent of the Site. However, in the vicinity of the dwelling, views will be available to the north /northwest from a north facing window (understood to be the main bedroom window) and as you move north, away from the dwelling such as from the carpark/entrance garden area. From the vicinity of the window location, glimpses of a portion of the northeast extent of the Proposal will be visible in the gaps between and just above the

Ref.	Dwelling address	Distance to Site / panel arrays (approx. metres)	Apparent extent of visibility ³³ and orientation	Glint and glare ³⁴	During construction	Completion		Notes
					Level of Visual Effect ³⁵	Level of Visual Effect at Year 1	Level of Visual Effect at Year 5	
								existing intervening on-site shelterbelt. Effects during the construction phase will typically be reduced through a combination of distance and screening from this shelterbelt. In views from further north such as the northeastern edge of the carpark/entrance area, the available viewshaft will widen to the west with distant views available incorporating the central and north-western extent of the Site. On-site rolling topography will screen some of the westernmost arrays and the lower components of the substation. The taller elements of the substation are likely to be visible and will be backdropped by the western shelterbelt and vegetation and hills beyond. Views to the panel arrays to the northeast will be glimpsed in the gaps between and just above the existing intervening on-site shelterbelt. While a broad 'width' or east-west horizontal extent of the Site will be visible from this carpark/garden location, the north-south vertical 'depth' will appear as a foreshortened band, reducing the apparent proportion of visible change within the view. Views from both locations will be long-distance with the nearest visible panels approximately 900 m away. The panels will appear as a thin dark band with gaps of pasture between arrays where there 'no-build' areas. The 'band' will typically be backdropped by distant vegetation and the ranges beyond. Planting to further soften and reduce the level of visibility is proposed along the eastern Site boundary to screen closer panel arrays over time. Due to the

Ref.	Dwelling address	Distance to Site / panel arrays (approx. metres)	Apparent extent of visibility ³³ and orientation	Glint and glare ³⁴	During construction	Completion		Notes
					Level of Visual Effect ³⁵	Level of Visual Effect at Year 1	Level of Visual Effect at Year 5	
								lower contour level at the southeast Site boundary, planting will need to reach at least 8 m-12 m to begin to screen panels from the carpark/garden viewing location. At this height, glimpses to distant panels will remain above the proposed planting but will appear as a small proportion of the overall view and distance. As the existing intervening trees continue to grow, they will also screen more of the panels, including appearing above the intervening hill crest. Screening could be achieved more quickly through planting on the property such as along the garden fence line. It is estimated that plants would need to reach heights of approximately 1.8 m-2.4 m to largely screen the Site from views in this location.
5	5 Bypass Road	1150 m/ 1200 m	Truncated (no view) to glimpses;	Low Up to 5 minutes of yellow glare - 8am and 8:45am, from 15-18 May; Up to 5 minutes of yellow glare 8am to 9.30am from 16 June to 5 August (OP15)	Very Low	Very Low	Very Low	Property is located southwest of the Site. Dwelling is orientated broadly northwest in an open garden setting. There are multiple intervening shelterbelts and stands of trees including within the Site. Oblique glimpses to the Site may be available, primarily in winter due to deciduous trees. Views would be at very long distances and it is likely that the panel arrays would not be readily noticeable, particularly as proposed infill shelterbelt planting becomes established.
6	793 Channel Road and 788 Ranfurly Back Road		None	Excluded because in				Dwelling appears screened from Site by intervening landform.

Ref.	Dwelling address	Distance to Site / panel arrays (approx. metres)	Apparent extent of visibility ³³ and orientation	Glint and glare ³⁴	During construction	Completion		Notes
					Level of Visual Effect ³⁵	Level of Visual Effect at Year 1	Level of Visual Effect at Year 5	
				valley below array				
7	8365 Ranfurly-Wedderburn Road, Ranfurly	2600 m/	None to glimpse	No glare predicted	Very Low	Very Low	Very Low	Dwelling appears orientated broadly north. There are intervening shelterbelts including within the Site. Potential glimpses to the Site may be available, however views would be at very long distances and the panel arrays would be very difficult to discern, particularly as proposed infill shelterbelt planting becomes established.
8	8358 Ranfurly-Wedderburn Road, Ranfurly	2800 m/	None to truncated glimpse	No glare predicted	Very Low	Very Low	Very Low	Dwelling appears orientated broadly northeast in a planted garden setting. Views would be at very long distances beyond SH85 with intervening vegetation. It is likely that the panel arrays would be very difficult to discern, particularly as proposed infill planting reinforces the southern boundary shelterbelt.
9	8268 Ranfurly-Wedderburn Road, Ranfurly	2400 m/	None to truncated glimpse	Low Up to 11 minutes of Green glare (OP12)	Very Low	Very Low	Very Low	Dwelling appears orientated broadly northeast in a planted garden setting. Any views would be at very long distances beyond SH85 with intervening vegetation. It is likely that the panel arrays would be very difficult to discern. This will be reinforced as proposed infill shelterbelt planting reinforces the southern boundary.
10	8249 Ranfurly-Wedderburn Road, Ranfurly	1500 m/	None to truncated glimpse	Low Up to 10 minutes of green glare (OP14)	Very Low	Very Low	Very Low	Dwelling/s appear orientated broadly north within a treed setting. Views are likely to be screened by this vegetation however glimpses may be possible in winter due to deciduous trees. Views would be at very long distances and there are other intervening shelterbelts, including within the Site which would further curtail any glimpses, particularly as proposed infill shelterbelt planting becomes established.
11	8236 Ranfurly-Wedderburn Road, Ranfurly	1600 m/	None to truncated glimpse	Low Up to 2 minutes of	Very Low	Very Low	Very Low	Dwelling/s appear orientated broadly north within a partially treed setting. Any views would be oblique, at very long distances beyond SH85 with intervening vegetation. It is likely that the panel arrays would be

Ref.	Dwelling address	Distance to Site / panel arrays (approx. metres)	Apparent extent of visibility ³³ and orientation	Glint and glare ³⁴	During construction	Completion		Notes
					Level of Visual Effect ³⁵	Level of Visual Effect at Year 1	Level of Visual Effect at Year 5	
				yellow glare and 6.4 hours per year of green (OP13)				very difficult to discern and this will be reinforced as proposed infill shelterbelt planting reinforces the southern boundary.
12	205 Gimmerburn-Naseby Road, Ranfurly	2300 m	None to truncated glimpse	No glare predicted	Very Low	Very Low	Very Low	Dwelling appears orientated broadly northeast and surrounded by substantial hedging and garden planting. Views of the Site are likely to be screened due to this intervening vegetation, reinforced by further intervening shelterbelts including those on the west and southern boundary. Any potential glimpses would be from a very long distance and very difficult to discern.
13	256 Gimmerburn-Naseby Road, Ranfurly	3000 m	None to truncated glimpse	Not identified (none from road)	Very Low	Very Low	Very Low	Dwelling appears orientated broadly northeast with garden trees nearby, further groupings of trees to the northeast and other intervening vegetation, including shelterbelts on the west and southern boundary. The panels are not likely to be discernible.
14	73 Brinsdon Road, Ranfurly	2300 m	None to truncated glimpse	Not identified (none from road)	Very Low	Very Low	Very Low	Dwelling appears orientated broadly north and northwest but with open views to the east available. Views would be largely screened by intervening shelterbelts including along the western site boundary. This will be reinforced with proposed planting at the southwest corner. While there may be potential visibility to the elevated slopes/crests on the site, any views would be oblique, at very long distances beyond SH85 and it is likely that the panel arrays would be very difficult to discern.
15	146 Brinsdon Road, Ranfurly	3000 m	None to truncated glimpse	Not identified (none from road)	Very Low	Very Low	Very Low	Dwelling appears orientated broadly northwest, away from the Site. Stands of trees to the east, including proposed reinforced planting on the western site boundary are likely to curtail potential views. While there may be potential visibility to the elevated slopes/crests on the site, any views would

Ref.	Dwelling address	Distance to Site / panel arrays (approx. metres)	Apparent extent of visibility ³³ and orientation	Glint and glare ³⁴	During construction	Completion		Notes
					Level of Visual Effect ³⁵	Level of Visual Effect at Year 1	Level of Visual Effect at Year 5	
								be at very long distances beyond SH85 and the panel arrays are not likely to be discernible.
16	885 Ranfurly Back Road, Naseby	1100 m	None	Excluded because of intervening trees and topography				Appears screened by multiple intervening layers of evergreen vegetation and landform.
17	581 Ranfurly-Naseby Road	1100 m	None to truncated glimpse	No glare predicted				Appears screened by multiple intervening layers of evergreen vegetation and landform.

Appendix 3: ITP Glint and Glare Study



Naseby Solar Farm

Glint and glare study

Final Report



DOCUMENT CONTROL

Report Title		Naseby Solar Farm – Glint and glare study			
Client Contract No.		n/a	ITP Project Number	23048	
File Path		https://itprenewables.sharepoint.com/sites/Projects/External/23048 - Helios Energy Glint & Glare/Project/4 Work/4 Reports/23053 - Naseby Solar Farm Glare Study Draft.docx			
Client		Helios Energy	Client Contact	Sarah Brooks	
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1	24/08/2023	Draft	Drew Thompson	N Logan	N Logan
2	26/09/2023	Final	N Logan	S Dedman	N Logan

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ABOUT THIS REPORT

This report assesses the glint and glare impact of the proposed Naseby Solar Farm located between Naseby and Ranfurly, in Central Otago. It was commissioned by Helios Energy.

ABBREVIATIONS

AC	Alternating current
CASA	Civil Aviation Safety Authority
DC	Direct current
FAA	Federal Aviation Administration (United States)
ha	Hectare
ITP	ITP Renewables
MW	Megawatt, unit of power (1 million Watts)
MWp	Megawatt-peak, unit of power at standard test conditions; used to indicate PV system capacity
OP	Observation point
PV	Photovoltaic
SGHAT	Solar Glare Hazard Analysis Tool

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1 INTRODUCTION

1.1 Overview

Helios Energy (Helios) has requested a glint and glare assessment for a proposed solar photovoltaic (PV) installation located between Naseby and Ranfurly, in Central Otago. This assessment will be submitted as part of the resource consent process for the project. It includes:

- Identification of potential receptors of glint and glare from the proposed solar farm
- Assessment of the glint and glare hazard using the Solar Glare Hazard Analysis Tool (SGHAT) GlareGauge analysis

1.2 Glint and Glare

The United States Federal Aviation Administration (FAA) defines glint and glare as follows:¹

- **Glint** is a momentary flash of bright light
- **Glare** is a continuous source of excessive brightness relative to ambient lighting.

Glint and glare can occur when light reflected off a surface (reflector) is viewed by a person (receptor). Glint typically occurs when either the receptor or the reflector is moving, while glare typically occurs when the reflector and receptor are completely, or nearly, stationary. For a transparent material (e.g., glass, water) the quantity of light reflected depends on the surface itself (i.e., material and texture), and the angle at which the light intercepts it (angle of incidence). More light is reflected at higher angles of incidence as shown in Figure 1.

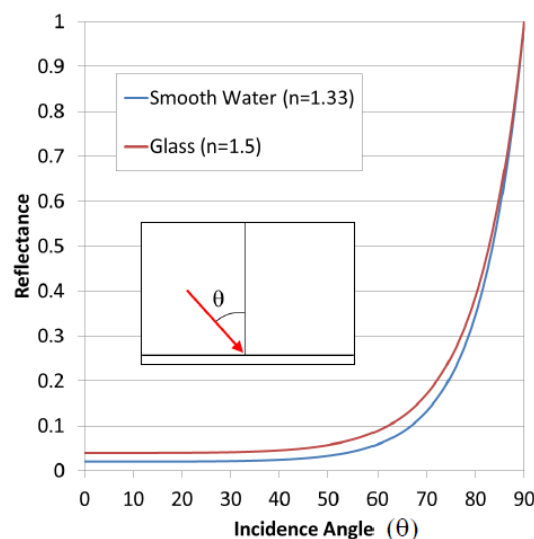


Figure 1: Angles of incidence and increased levels of reflected light

¹ Federal Aviation Administration [FAA], 2018

Potential visual impacts from glint and glare include distraction and temporary afterimage; at its worst, it can cause retinal burn. The ocular hazard caused by glint or glare is a function of:

1. The intensity of the glare upon the eye (retinal irradiance)
2. The subtended angle of the glare source (i.e., the extent to which the glare occupies the receptor's field of vision; dependent on size and distance of the reflector).

The severity of the ocular hazard can be divided into three levels, as shown in Figure 2:

- **Green glare**, which has low potential to cause temporary afterimage
- **Yellow glare**, which has potential to cause temporary afterimage
- **Red glare**, which can cause retinal burn and is not expected for PV.

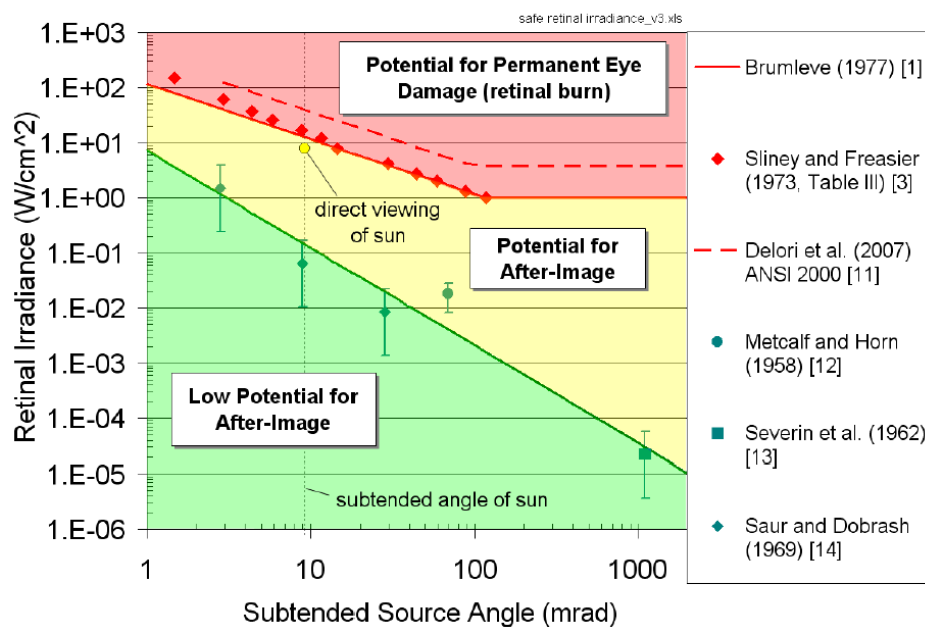


Figure 2: Classification of glare based on severity of ocular effects

1.3 Glare from Solar PV

Solar photovoltaic (PV) cells are designed to absorb as much light as possible to maximise efficiency (generally around 98% of the light received). To limit reflection, solar cells are constructed from dark, light-absorbing material and are treated with an anti-reflective coating. PV modules generate less glare than many other surfaces, as shown in Figure 3.

The small percentage of light reflected from PV modules varies depending on the angle of incidence. Figure 4 shows an example of this with a solar module. A larger angle of incidence will result in a higher percentage of reflected light.

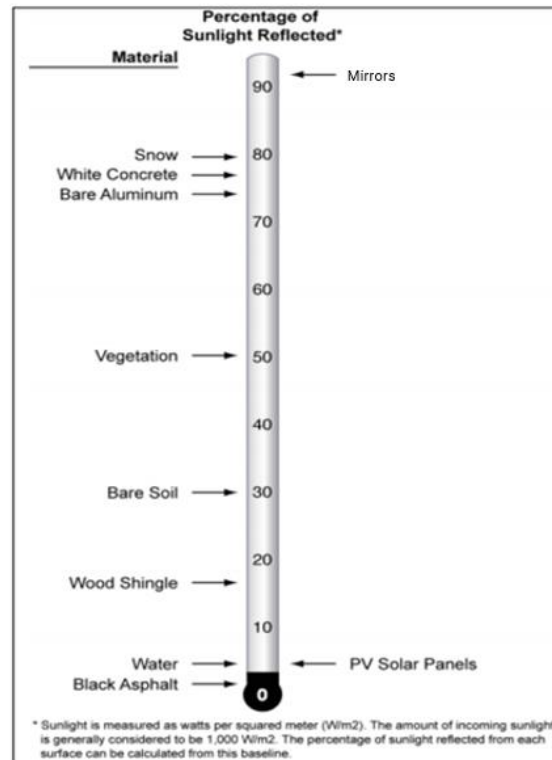


Figure 3: Typical percentage of sunlight reflected from different surfaces (Source: Adapted from Journal of Airport Management, 2014)

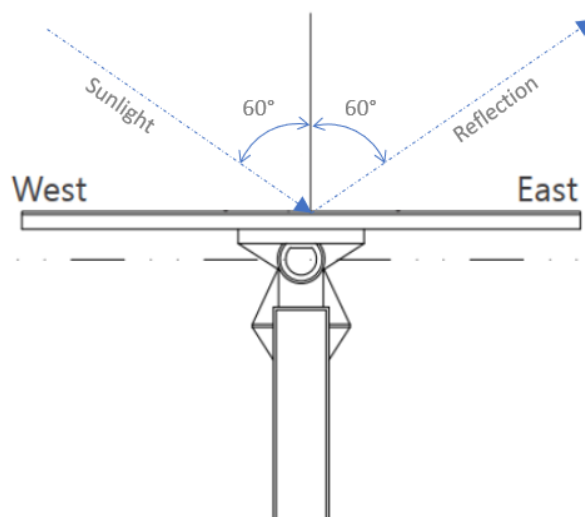


Figure 4: Typical sunlight reflection off the surface of a solar module

The two most common PV mounting structures are fixed tilt and single axis tracking. Fixed tilt arrays are stationary, while single axis tracking arrays rotate the receiving surface of the modules from east to west throughout the day as the sun moves across the sky.

In a fixed tilt PV array, since the sun is moving but the modules are stationary, the angle of incidence varies as the sun moves across the sky. It is smallest around noon when the sun is overhead and largest in the early morning and late afternoon when the sun is near the horizon. There is therefore a higher potential for glare at these times.

The angle of incidence for a single axis tracking system varies less as the reflective surface of the modules rotates on a horizontal axis to follow the sun. Single axis tracking arrays therefore generate less glare than fixed tilt arrays. The tracking varies throughout the year to match seasonal changes in the sun's path (see Figure 5).

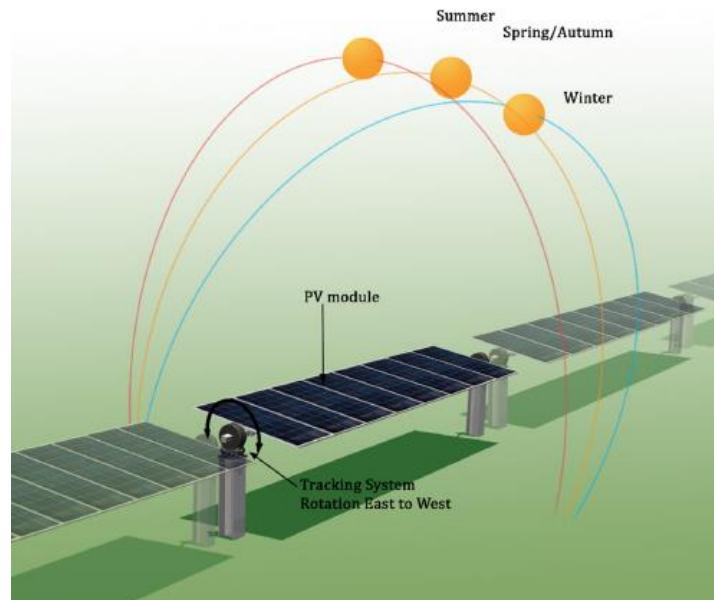


Figure 5: Sun position relative to PV modules on a horizontal single-axis tracking system

2 PROJECT DESCRIPTION

2.1 Site Overview

Helios is proposing a solar farm at the location described in Table 1. The site is located approximately 3.5 km southwest of the town of Naseby and 5 km north of the town of Ranfurly. An indicative layout is displayed in Figure 6.

Table 1: Site Information

Parameter	Description
Title No.	OT10B/11337, OT9C/187, OT13D/517, OT9C/619, OT13D/516
Address	Ranfurly-Naseby Road, Naseby New Zealand 9396
Council	Central Otago District Council
Project area	661 ha

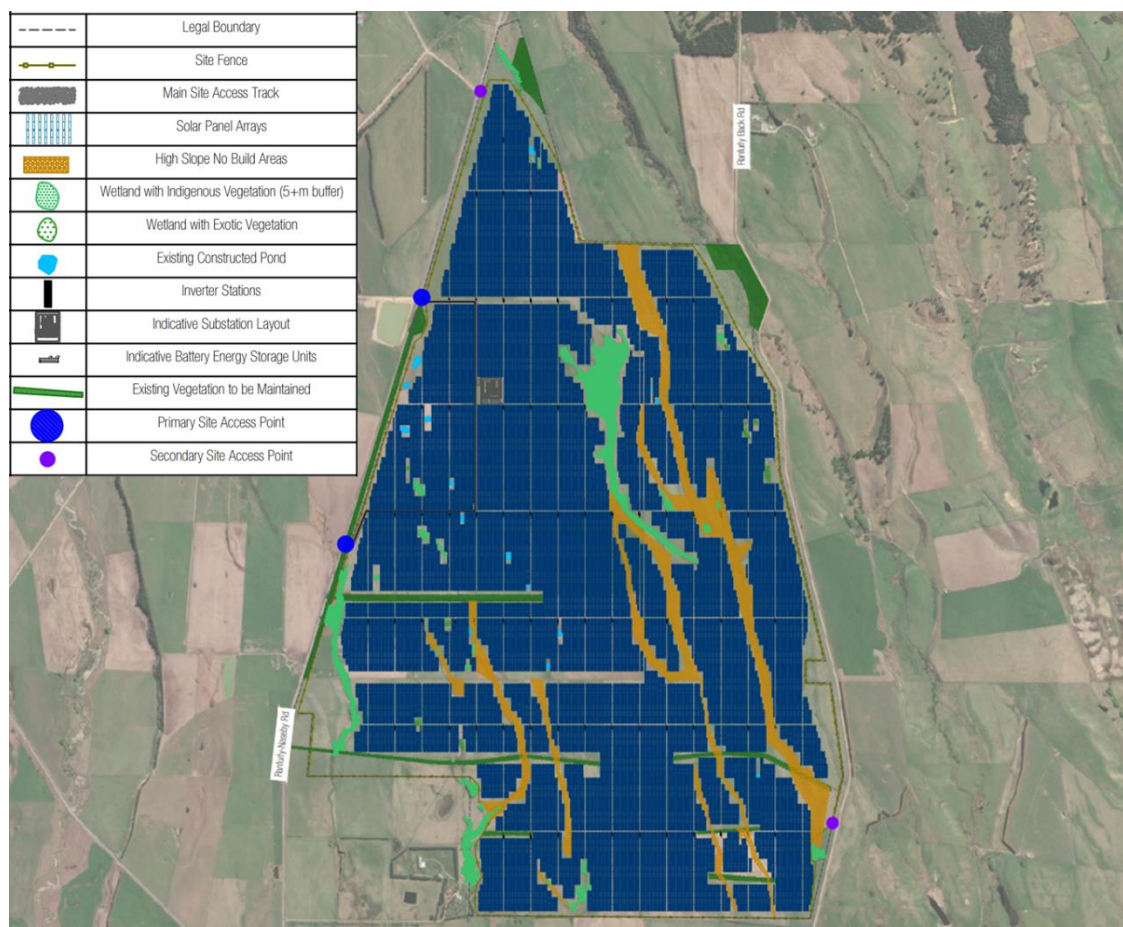


Figure 6: Naseby Solar Farm Preliminary PV layout

2.2 Solar Farm Details

Table 2 summarises the details of the proposed solar farm.

Table 2: Solar farm information

Parameter	Description
Solar farm name	Naseby Solar Farm
Capacity	339 MWp
Mounting system	Single-axis tracking

Helios is proposing to construct a solar farm with a DC capacity of 339 MWp on a 661 ha site. There will be approximately 551,000 solar modules installed in single-axis tracking tables running north to south. Panels are arranged in a portrait configuration, with tracker rows ranging from 52-104 modules in length. The solar farm will include 74 medium voltage (MV) inverters with a capacity of 4.2 MVA.

3 ANALYSIS

3.1 Overview

The Solar Glare Hazard Analysis Tool (SGHAT) was developed by Sandia National Laboratories to evaluate glare resulting from solar farms at different viewpoints, based on the location, orientation, and specifications of the PV modules. This tool was required by the United States FAA for glare hazard analysis near airports until 2021 and is also recognised by the Australian Government Civil Aviation Safety Authority (CASA).

The GlareGauge software uses SGHAT to provide an indication of the type of glare expected at each potential receptor. It runs with a simulation timestep of one minute. Glint lasting for less than one minute is unlikely to occur from the sun on PV modules due to their slow movement.

3.2 Assumptions

The visual impact of solar farms depends on the scale and type of infrastructure, the prominence and topography of the site relative to the surrounding environment, and any proposed screening measures to reduce visibility of the site. Our model includes selected obstructions² as described in Section 3.3.2.

Atmospheric conditions such as cloud cover influence light reflection and the resulting impact on visual receptors. GlareGauge does not model varying atmospheric conditions; instead, the model assumes clear sky conditions, with a peak direct normal irradiance (DNI) of 1,000 W/m² which varies throughout the day.

Table 3 details the parameters used in the SGHAT model. GlareGauge default settings were adopted for the analysis time interval, direct normal irradiance, observer eye characteristics and slope error. The height of the observation points for road users was assumed to be 1.5 m. The height for a person standing was assumed to be 1.65 m.

Table 3: SGHAT specification inputs

Parameters	Input
Time zone	UTC+12:00
Module surface material	Smooth glass with ARC (anti-reflective coating)
Module tracking	Single Axis Tracking with backtracking
Maximum tilt angle	±60°

² In the GlareGauge model, obstructions are opaque barriers that block the transmission of incident and reflected light

Parameters	Input
Module axis orientation	0°
Height of modules above ground	1.7 m (height from the ground to the table centre)

3.3 Model construction

3.3.1 Study area

This assessment considers potential visual receptors (e.g., residences and road users) within 3 km of the site. There is no formal guidance on the maximum distance for glint and glare assessments; however, the significance of a reflection decreases with distance for two main reasons:

1. The solar farm appears smaller (smaller subtended angle), and glare has less impact
2. Visual obstructions (e.g., terrain, vegetation) may block the view of the solar farm

Glint and glare impacts beyond 3 km are highly unlikely. This choice of distance is conservative and is based on existing studies and assessment experience.

3.3.2 Model components

The model (see Figure 7) was constructed as follows:

- The array was divided into 13 separate PV objects based on the general arrangement and significant changes in topography (see Figure 8).
- Receptors were placed at 16 observation points and nine road routes (see Figure 9).
- Six observation points and two road routes were excluded (see Figure 10, and Appendix A).
- Obstructions included many lines of existing trees. All obstructions included in the model are displayed in Figure 9. The vegetation was modelled with an upper edge height of 10 m, a conservative estimate of mature tree height.

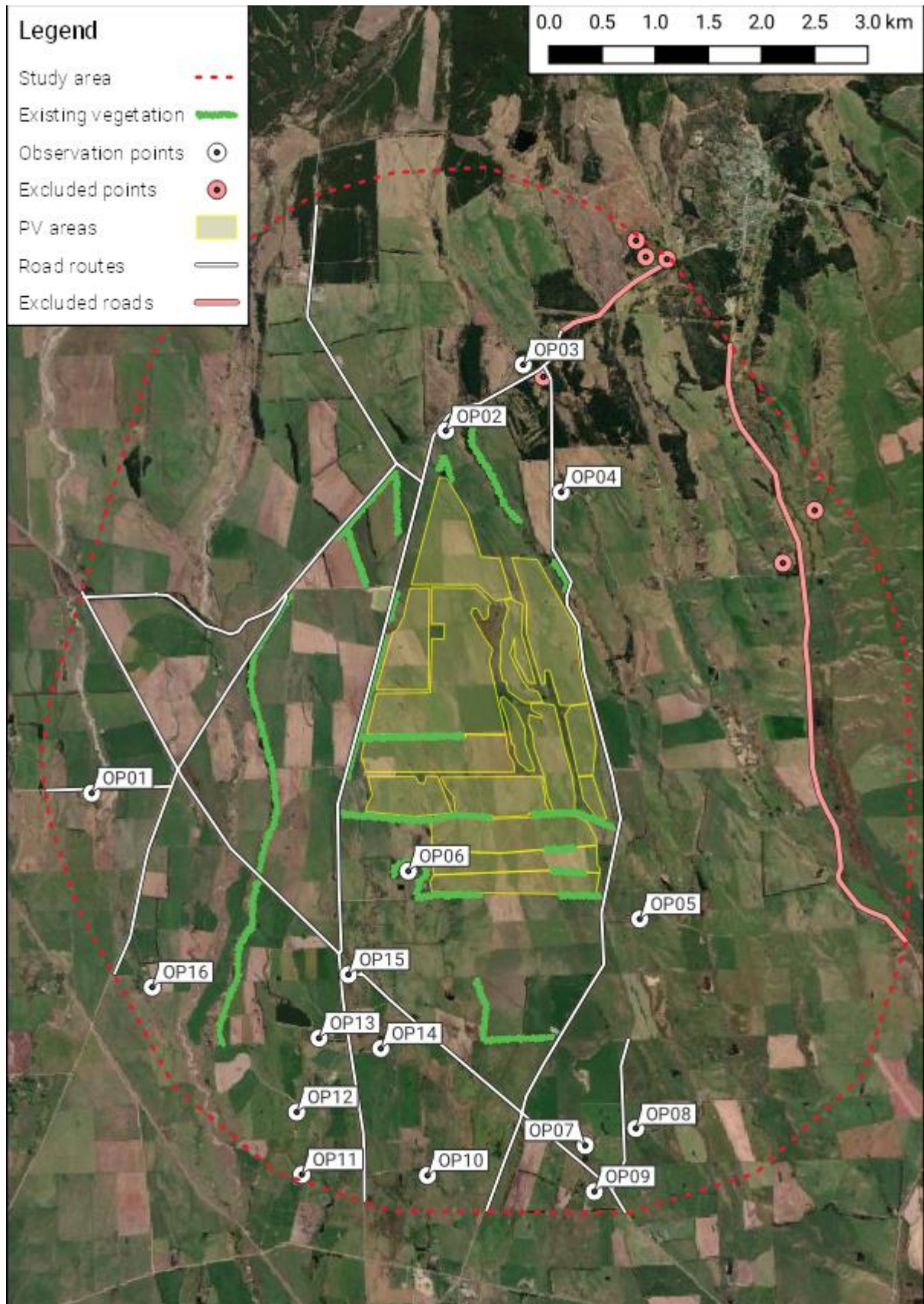


Figure 7: Model showing study area, arrays, receptors, and obstructions.

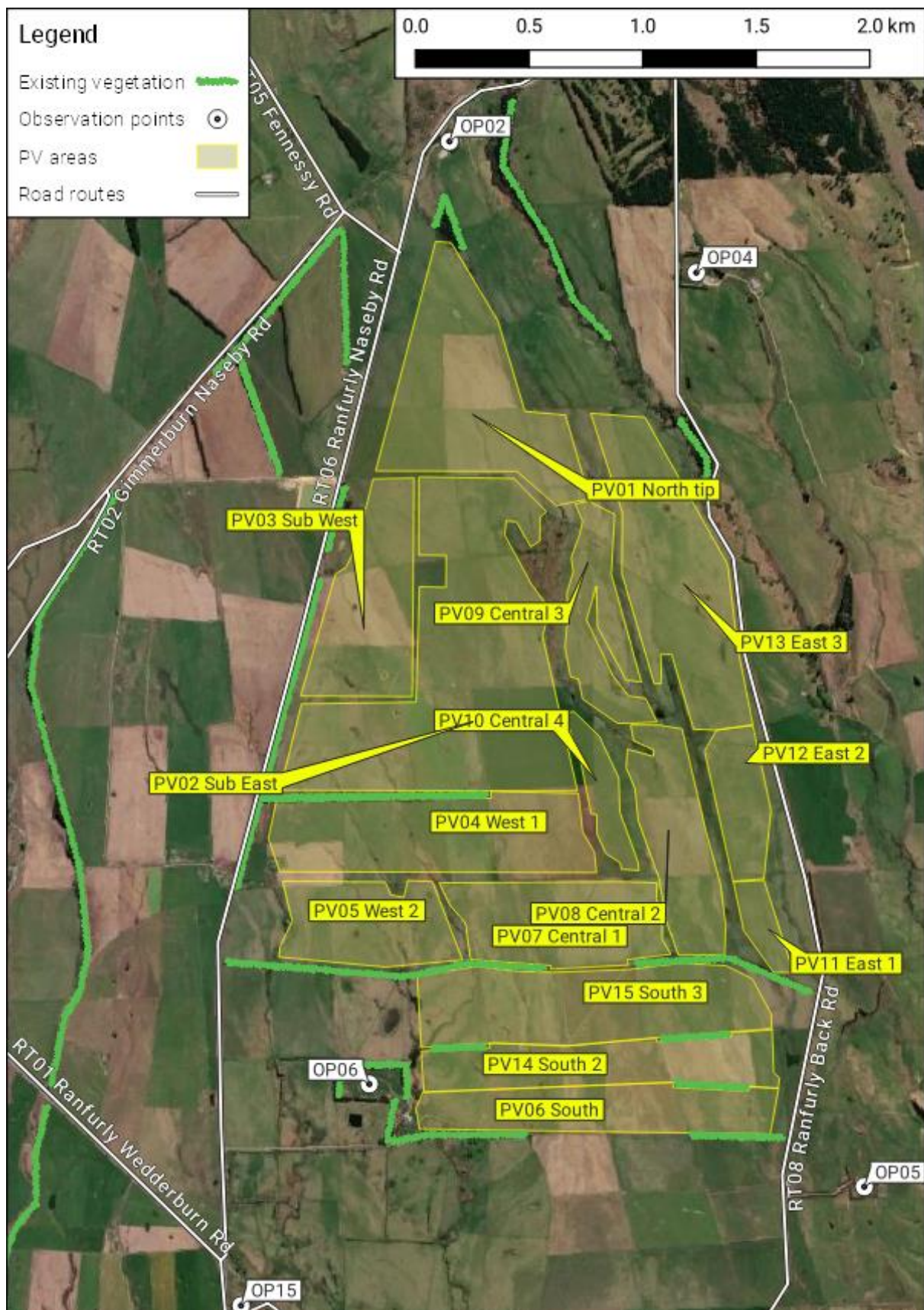


Figure 8: PV array sections

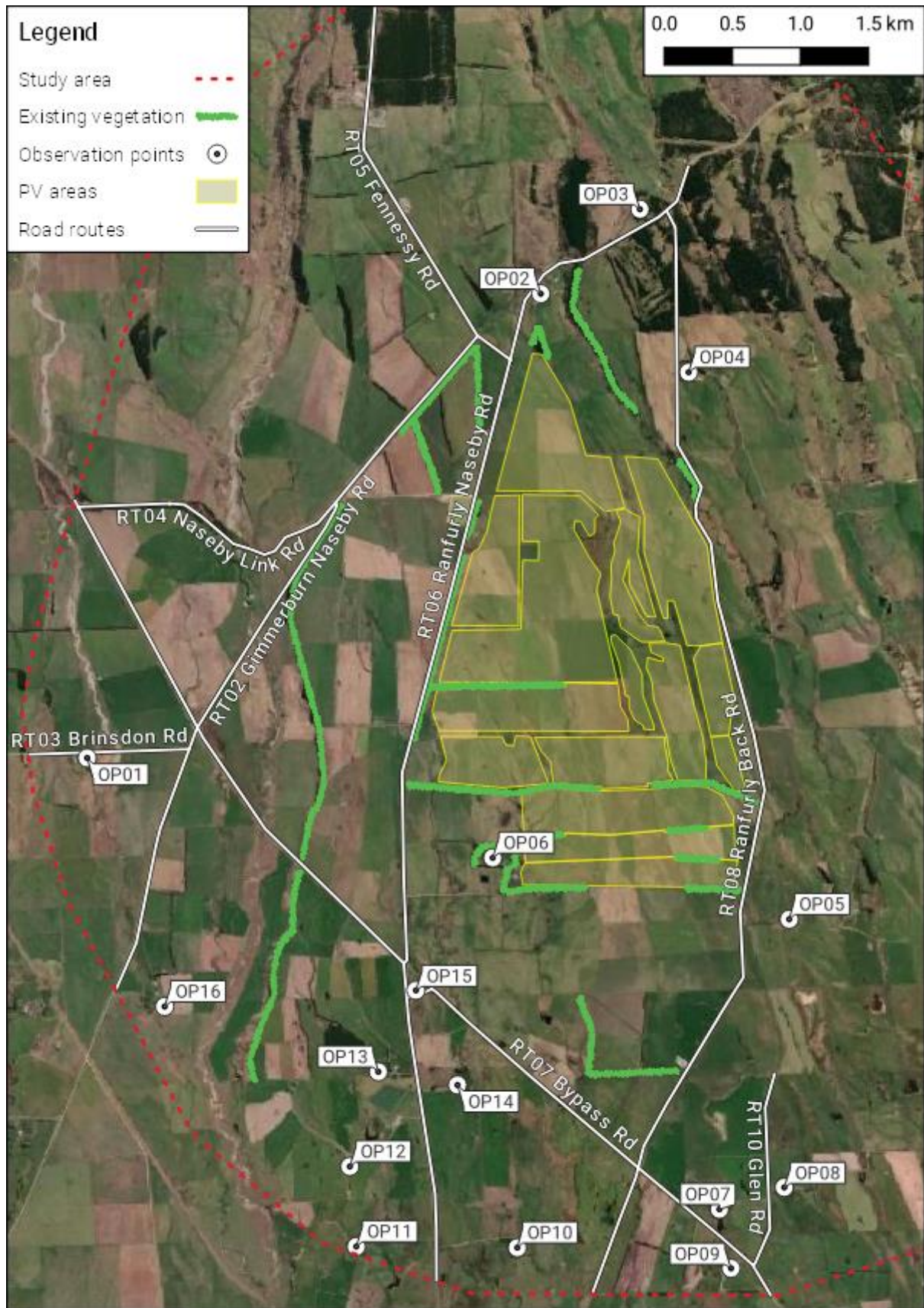


Figure 9: Receptors and obstructions

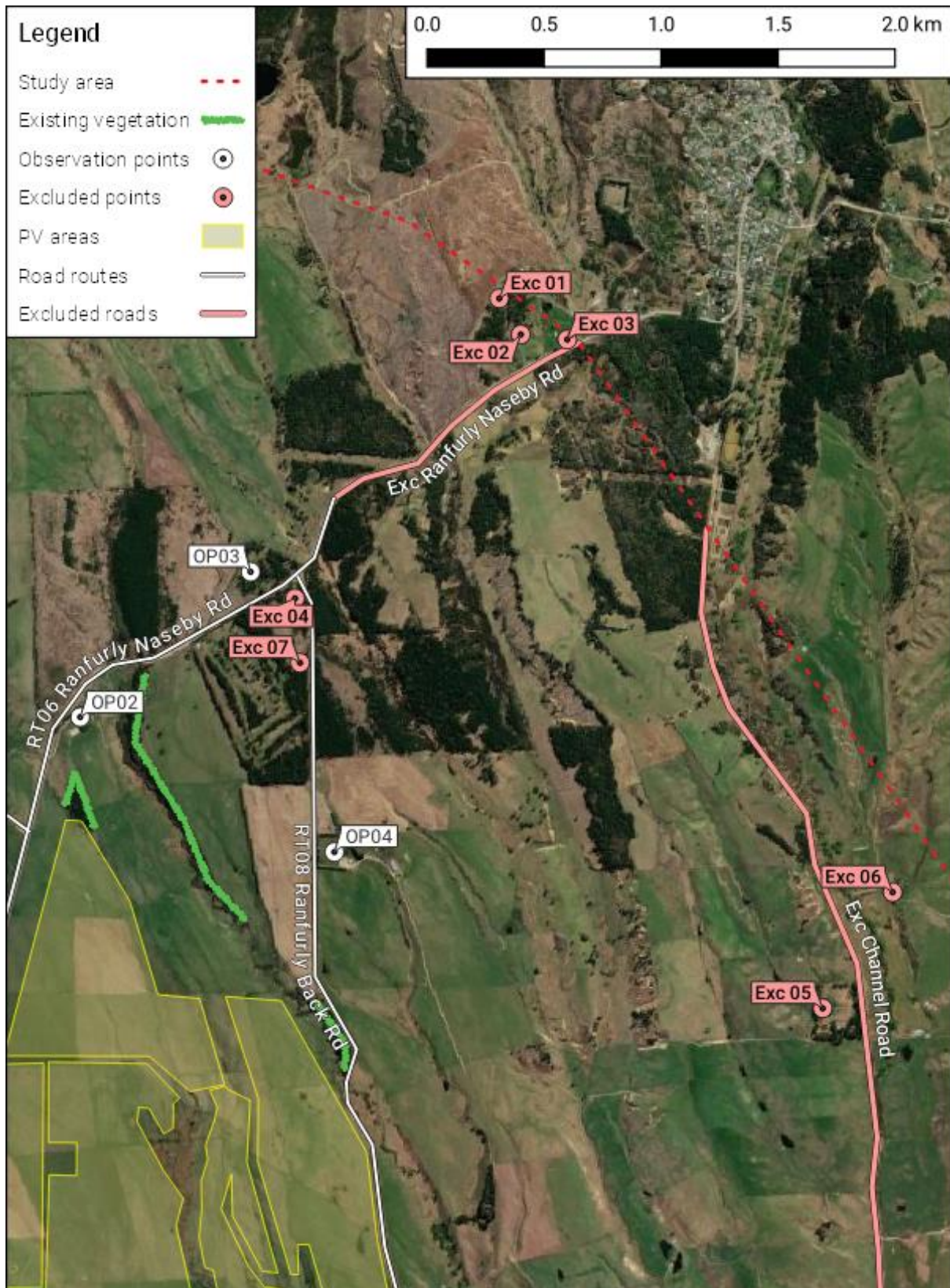


Figure 10: Excluded receptors. Exc 01 - Exc 04, Exc 07 and Ranfurly Naseby Rd were excluded because of intervening trees and topography. Exc 05, Exc 06 and Channel Rd were excluded because they are in a valley below the array.

3.4 Results

Our results are presented below for three cases:

1. **Base case:** mitigation measures
2. **Mitigation option 1:** Backtracking rest angle limits
3. **Mitigation option 2:** Additional vegetation screening

3.4.1 Base case

The results of the GlareGauge analysis are summarised in Table 4. The analysis identified 7,859 minutes (131 hours) of cumulative green glare, and 9,403 minutes (157 hours) of cumulative yellow glare spread across multiple routes and observation points.

The glare received each day varied across the year. For observation points where some glare occurred, the impact is described qualitatively. No observation points or routes received more than 55 minutes of glare in any single day. The time of day at which glare was observed varied between observation points and across the year. In general, most glare occurred in the early mornings or late evenings, when the array is backtracking.

Table 4: Glare potential at each receptor.

Receptor	Coordinates / Location	Green (min/yr)	Yellow (min/yr)	Daily glare potential
OP01	146 Ranfurly-Wedderburn Road	0	0	None
OP02	512 Ranfurly-Naseby Road	0	0	None
OP03	581 Ranfurly-Naseby Road	0	0	None
OP04	788 Ranfurly Back Road	0	0	None
OP05	366 Ranfurly Back Road	566	408	Up to 15 minutes of yellow glare between 3:45 pm and 5:30 pm, from 6 May to 7 July.
OP06	48 Ranfurly-Naseby Road	0	0	None
OP07	305 Bypass Road, Ranfurly	0	0	None
OP09	306 Bypass Road, Ranfurly	0	0	None
OP10	8365 Ranfurly-Wedderburn Road	0	0	None
OP11	8358 Ranfurly-Wedderburn Road	0	0	None
OP12	8268 Ranfurly-Wedderburn Road	349	0	Up to 11 minutes of green glare between 8:15 am and 9:00 am, from 14 May to 19 May. Up to 11 minutes of green glare between 8:15 am and 9:30 am, from 16 June to 27 July.
OP13	8236 Ranfurly-Wedderburn Road	382	41	Up to 2 minutes of yellow glare between 8:00 am and 8:45 am, from 15 May to 18 May. Up to 2 minutes of yellow glare between 8:00 am and 9:30 am, from 16 June to 5 August.
OP14	8249 Ranfurly-Wedderburn Road	361	0	Up to 10 minutes of green glare between 8:00 am and 9:00 am, from 15 May to 20 May. Up to 10 minutes of green glare between 8:15 am and 9:30 am, from 12 June to 26 July.

Receptor	Coordinates / Location	Green (min/yr)	Yellow (min/yr)	Daily glare potential
OP15	5 Bypass Road, Ranfurly	495	124	Up to 5 minutes of yellow glare between 8:00 am and 8:45 am, from 15 May to 18 May. Up to 5 minutes of yellow glare between 8:00 am and 9:30 am, from 16 June to 5 August.
OP16	205 Gimmerburn-Naseby Road	0	0	None
RT01	Ranfurly Wedderburn Rd	88	143	Up to 6 minutes of yellow glare between 8:45 am and 9:30 am, from 3 June to 9 July.
RT02	Gimmerburn Naseby Rd	0	0	None
RT03	Brinsdon Rd	0	0	None
RT04	Naseby Link Rd	0	0	None
RT05	Fennessy Rd	0	0	None
RT06	Ranfurly Naseby Rd	2,195	2,806	Up to 28 minutes of yellow glare between 7:00 am and 10:00 am, from 3 April to 8 September.
RT07	Bypass Rd	1,623	426	Up to 9 minutes of yellow glare between 7:15 am and 9:30 am, from 11 April to 31 August.
RT08	Ranfurly Back Rd	1,800	5,455	Up to 55 minutes of yellow glare between 10:30 am and 11:45 am, from 22 May to 22 July. Up to 55 minutes of yellow glare between 3:45 pm and 6:45 pm, from 1 April to 10 September.
RT10	Glen Rd	0	0	None
Total		7,859	9,403	

Ranfurly-Naseby Road received approximately 47 hours of cumulative yellow glare from several sources. The glare occurred on sections of the road adjacent to the solar farm that were not screened by existing vegetation. Selected plots of glare on the route are shown in Figure 11. Because Ranfurly-Naseby Road receives less than half an hour of yellow glare on any given day, and is a relatively low traffic road, we consider this glare to be low to moderate impact. Mitigation is not required but could be considered to reduce impact on local road users.

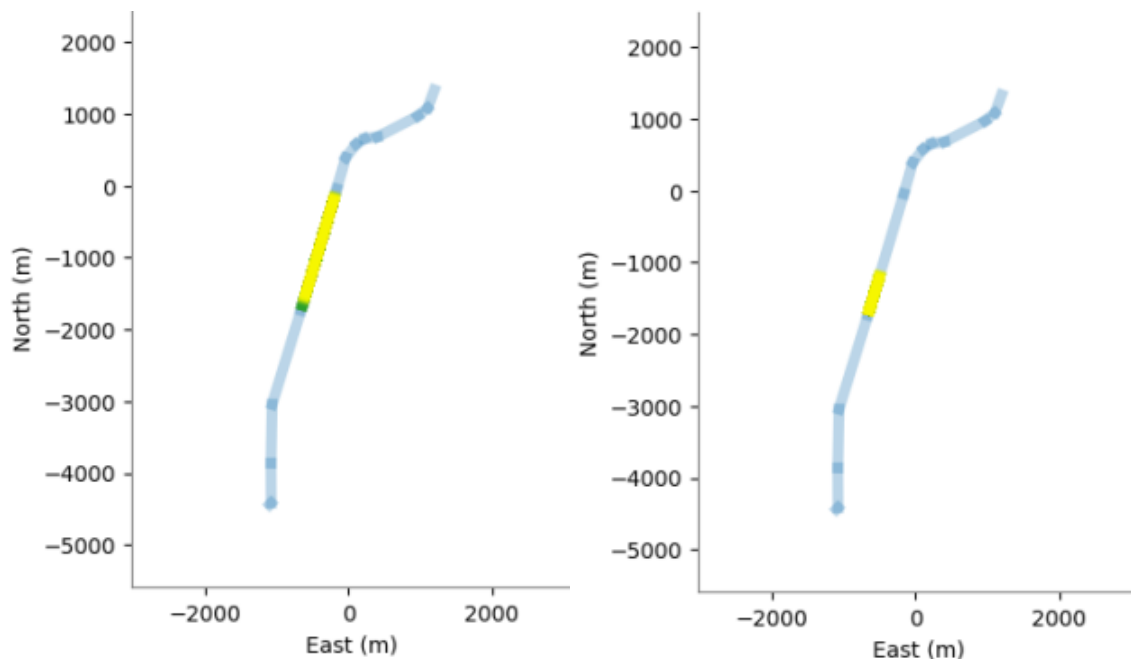


Figure 11: Yellow glare on Ranfurly-Naseby Road from PV01 North Tip (left), and PV03 Sub West (right). Other PV arrays caused additional glare on overlapping sections of the route. Full results are provided in Appendix A.

Ranfurly Back Road received about 91 hours of yellow glare from multiple sources. The glare occurred on several different sections of the route that were not screened by existing vegetation. Selected plots of glare on the route are shown in Figure 12. Because Ranfurly Back Road is a rural road with relatively low traffic volumes, we consider this glare to be low to moderate impact. Mitigation is not required but could be considered to reduce impact on local road users.

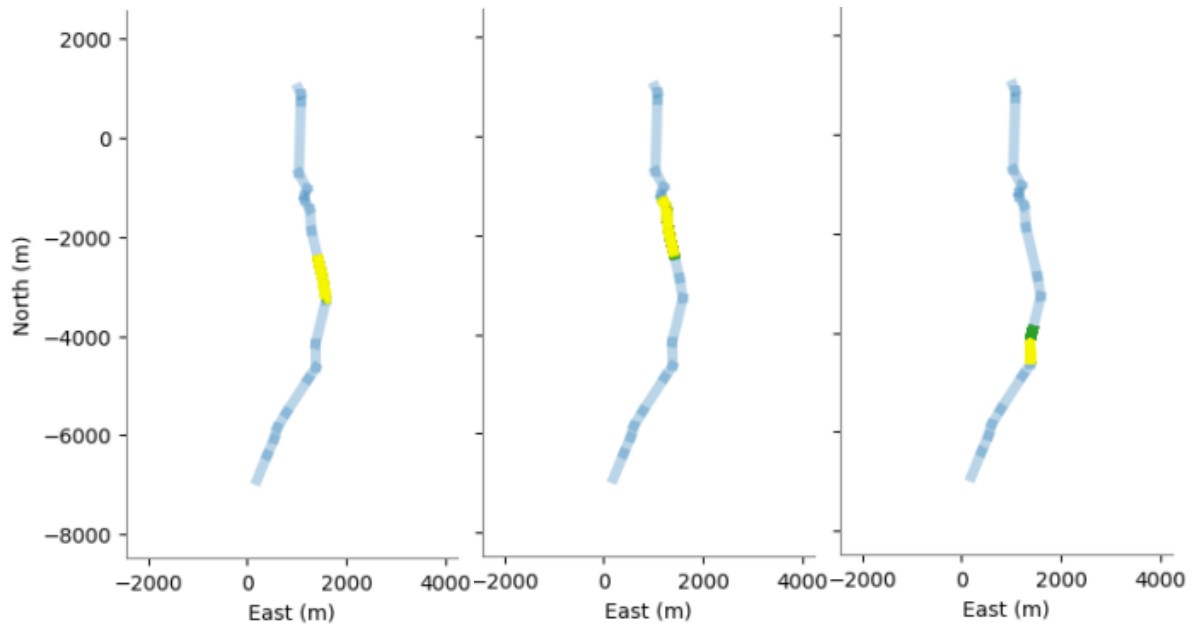


Figure 12: Yellow glare on Ranfurly Back Rd from PV08 (left), PV13 (centre), and PV06 (right). Other PV arrays caused additional glare on overlapping sections of the route. Full results are provided in Appendix A.

3.4.2 Backtracking rest angle mitigation

Most of the glare impact from single-axis tracking arrays occurs during backtracking. Limiting the minimum backtracking angle can significantly reduce glare. Assuming the chosen tracking system allows We modelled the array with several rest angles, and the glare results are summarised in Table 5 for a rest angle of 5° and in Table 6 for a rest angle of 10°. A rest angle of 10° eliminates all yellow glare.

Table 5: Glare results with 5 degree rest angle

Receptor	Coordinates / Location	Green (min/yr)	Yellow (min/yr)	Daily glare potential
OP05	-45.0868, 170.1291	151	4	Up to 1 minute of yellow glare between 4:30 pm and 5:30 pm, from 10 May to 9 June.
RT06	Ranfurly Naseby Rd	987	2,294	Up to 33 minutes of yellow glare between 7:30 am and 10:00 am, from 27 April to 16 August.
RT08	Ranfurly Back Rd	1,412	4,289	Up to 47 minutes of yellow glare between 10:30 am and 11:45 am, from 21 May to 23 July. Up to 47 minutes of yellow glare between 3:45 pm and 6:00 pm, from 20 April to 22 August.

Table 6: Glare results with 10 degree rest angle

Receptor	Coordinates / Location	Green (min/yr)	Yellow (min/yr)	Daily glare potential
RT08	Ranfurly Back Rd	1,266	0	Up to 30 minutes of green glare between 10:30 am and 11:45 am, from 21 May to 23 July.

3.4.3 Screening mitigation

Planting vegetation screens is an alternative mitigation measure. We built a model with selected receptors and a different set of obstructions³ as shown in Figure 13. The model included about 5 km of new vegetation. The results of this model are summarised in Table 7 below and show that the proposed screens will provide effective mitigation. The residual glare is very low impact and does not require further mitigation.

Table 7: Glare results with additional screening

Receptor	Coordinates / Location	Green (min/yr)	Yellow (min/yr)	Daily glare potential
OP05	-45.087, 170.129	0	0	None
RT06	Ranfurly Naseby Rd	944	0	Up to 13 minutes of green glare between 7:45 am and 9:45 am, from 27 April to 16 August.
RT07	Bypass Rd	629	0	Up to 12 minutes of green glare between 8:30 am and 10:00 am, from 17 May to 27 July.
RT08	Ranfurly Back Rd	105	0	Up to 3 minutes of green glare between 4:45 pm and 6:15 pm, from 17 April to 24 May. Up to 3 minutes of green glare between 5:00 pm and 6:15 pm, from 19 July to 23 August.

³ ForgeSolar allows a maximum of 10 obstruction objects in a single model

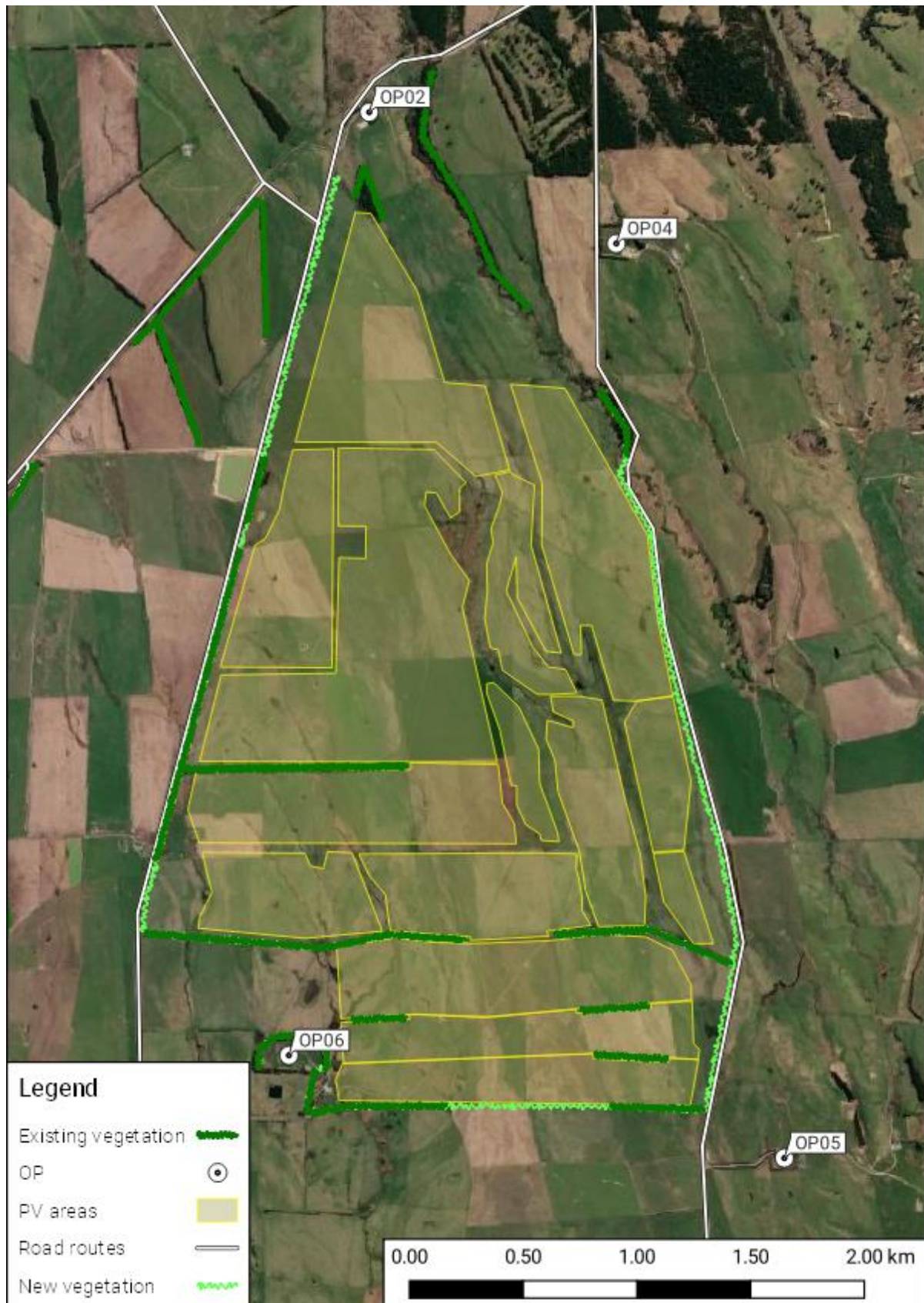


Figure 13: Extended vegetation screens with approximately 5 km new plantings. The plantings include 1,750 m on the western edge, 2,200 m on the eastern edge, and 1,200 m on the southern edge.

4 SUMMARY

The results of the GlareGauge analysis indicated three observations points and four road routes received yellow glare. Yellow glare has the potential to cause afterimage to observers, while green glare has low potential to cause after image.

Ranfurly-Naseby Road and Ranfurly Back Road received the most glare, with up to 28 minutes and 55 minutes of yellow glare in a single day respectively. This glare is low to moderate impact due to the relatively low volume of local traffic. Mitigation is not required but could be considered to reduce the impact on local road users.

We assessed two mitigation options: limiting the backtracking angle, and planting vegetation screens. Limiting the backtracking angle significantly reduced the received glare. A rest angle of 10° eliminated all yellow glare. Vegetation screening could also be used to reduce glare. About 5 km of screening will substantially reduce received glare. Both options provide effective mitigation.

5 REFERENCES

Federal Aviation Administration (FAA), 2018. Solar Guide: Technical Guidance for Evaluating Selected Solar Technologies on Airports. Retrieved from the FAA website:

<https://www.faa.gov/airports/environmental/>

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Barrett, S., Devita, P., Ho, C. and Miller, B., 2014. Energy technologies' compatibility with airports and airspace: Guidance for aviation and energy planners. *Journal of Airport Management*, 8(4), pp.318-326.

APPENDIX A. EXCLUDED ADDRESSES

Table 8: Excluded receptors

Receptor	Location	Justification
Exc 01	47 Wet Gully Road, Naseby	View of solar farm obscured by forest and topography
Exc 02	763 Ranfurly-Naseby Road	View of solar farm obscured by forest and topography
Exc 03	1 Wet Gully Road, Naseby	View of solar farm obscured by forest and topography
Exc 04	885 Ranfurly Back Road	View of solar farm obscured by forest and topography
Exc 05	793 Channel Road, Naseby	In a valley below the level of the array
Exc 06	788 Ranfurly Back Road	In a valley below the level of the array
Exc 07	873 Ranfurly-Naseby Road	View of solar farm obscured by forest and topography

APPENDIX B. FORGESOLAR GLARE ANALYSIS

We have attached the following analysis reports exported from ForgeSolar:

- **ForgeSolar – base case:** base case results described in 3.4.1
- **ForgeSolar – 5 deg rest angle:** analysis results for selected receptors with backtracking rest angle set to 5 degrees as described in 3.4.2
- **ForgeSolar – 10 deg rest angle:** analysis results for selected receptors with backtracking rest angle set to 10 degrees as described in 3.4.2
- **ForgeSolar – screening mitigation:** analysis results for selected receptors with vegetation screening as described in 3.4.3



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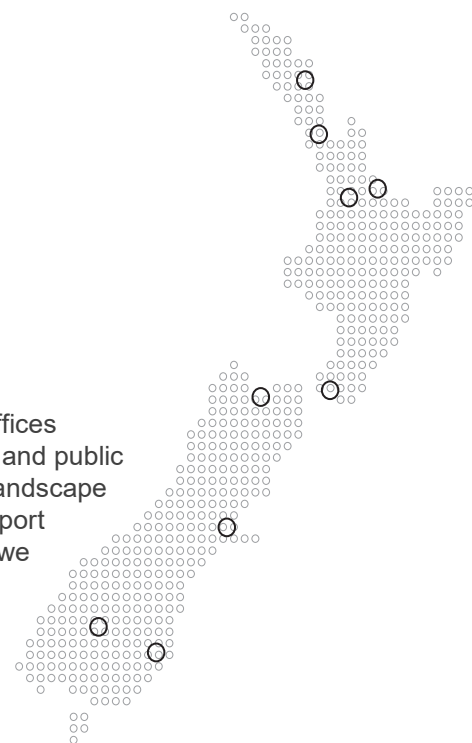
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HELIOS MĀNIATOTO SOLAR FARM

GRAPHIC SUPPLEMENT

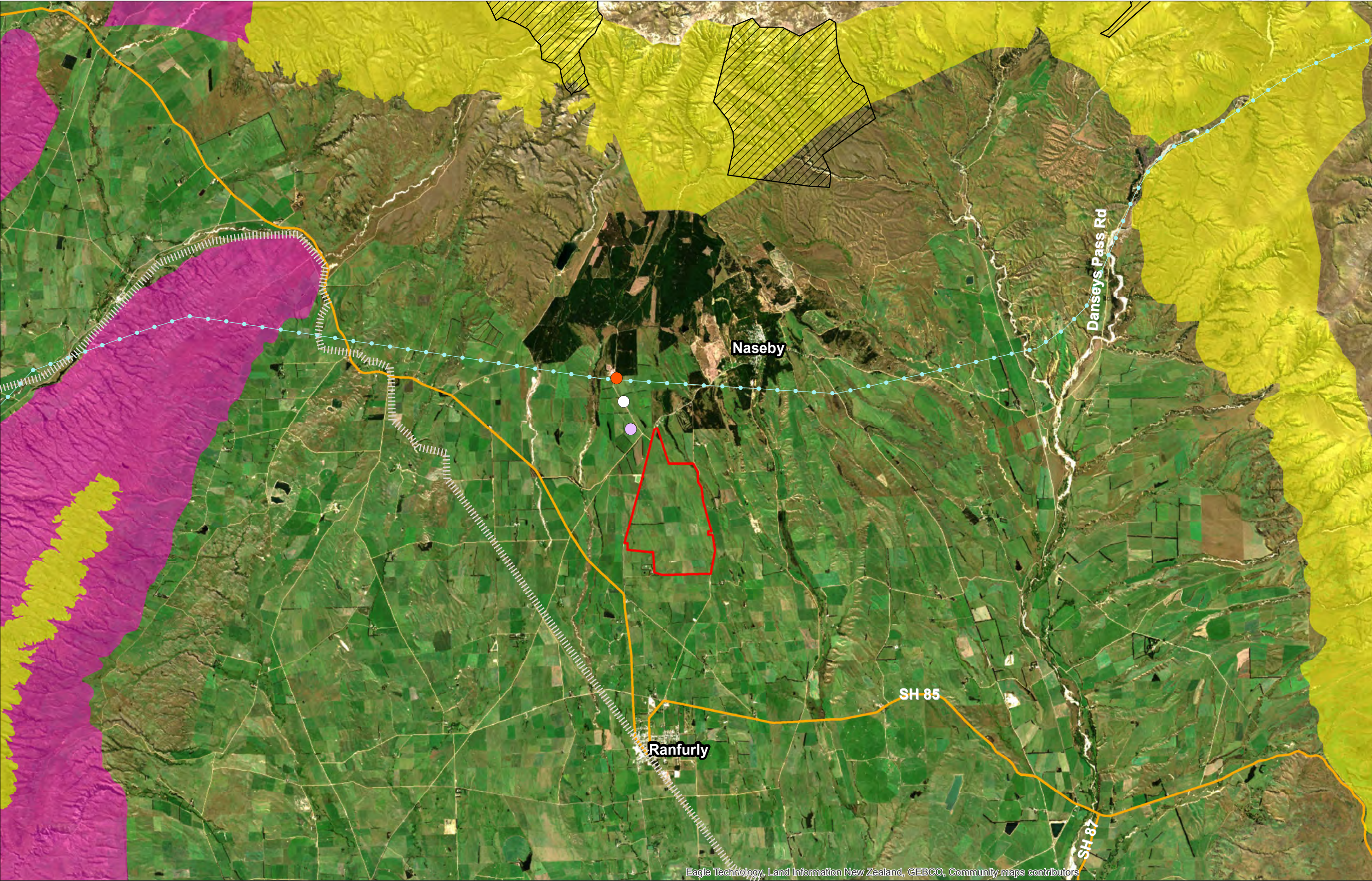
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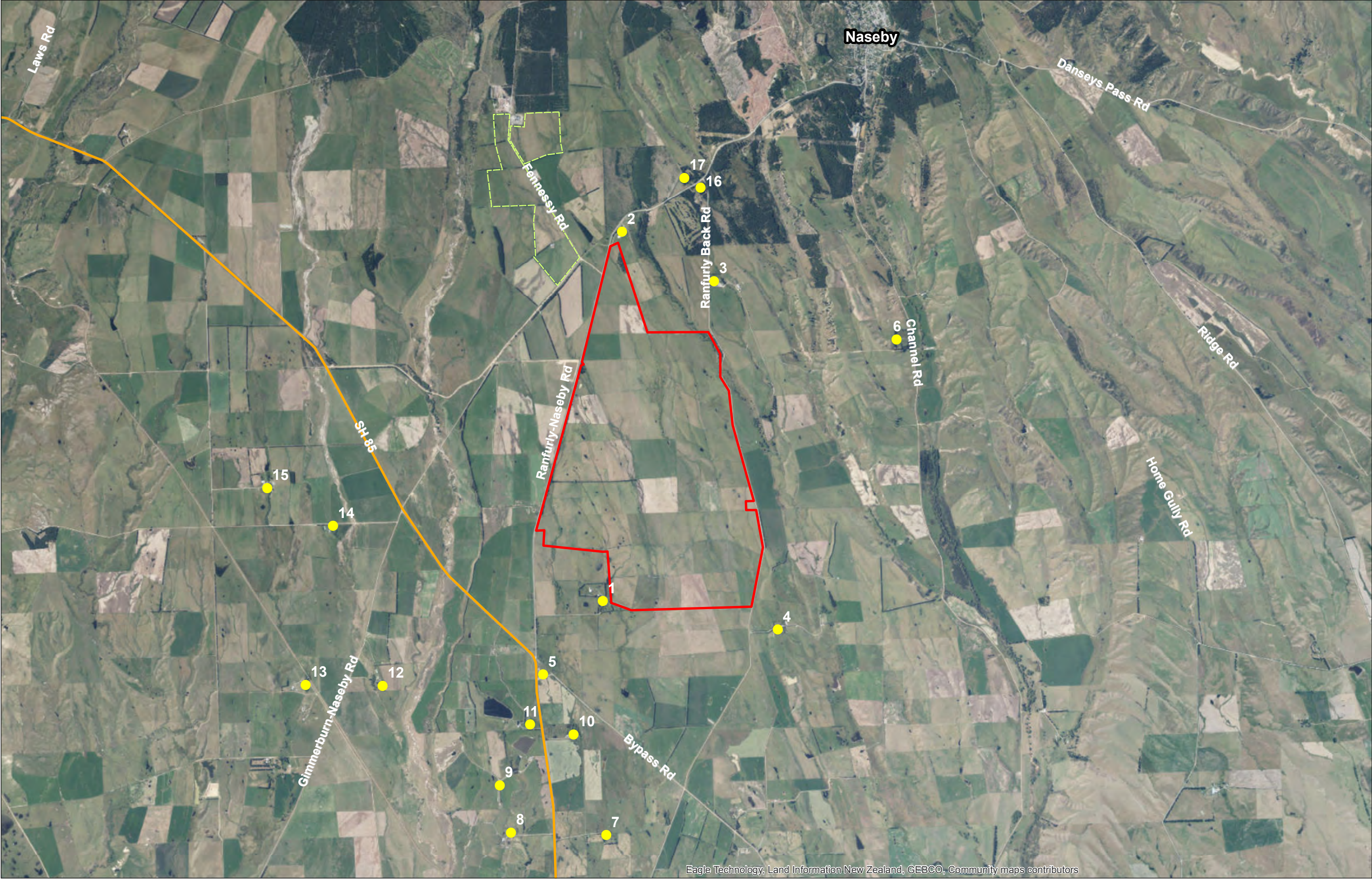


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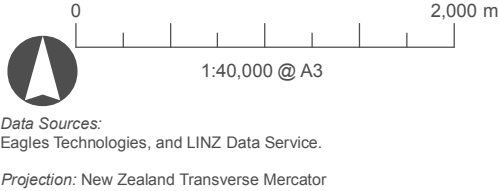






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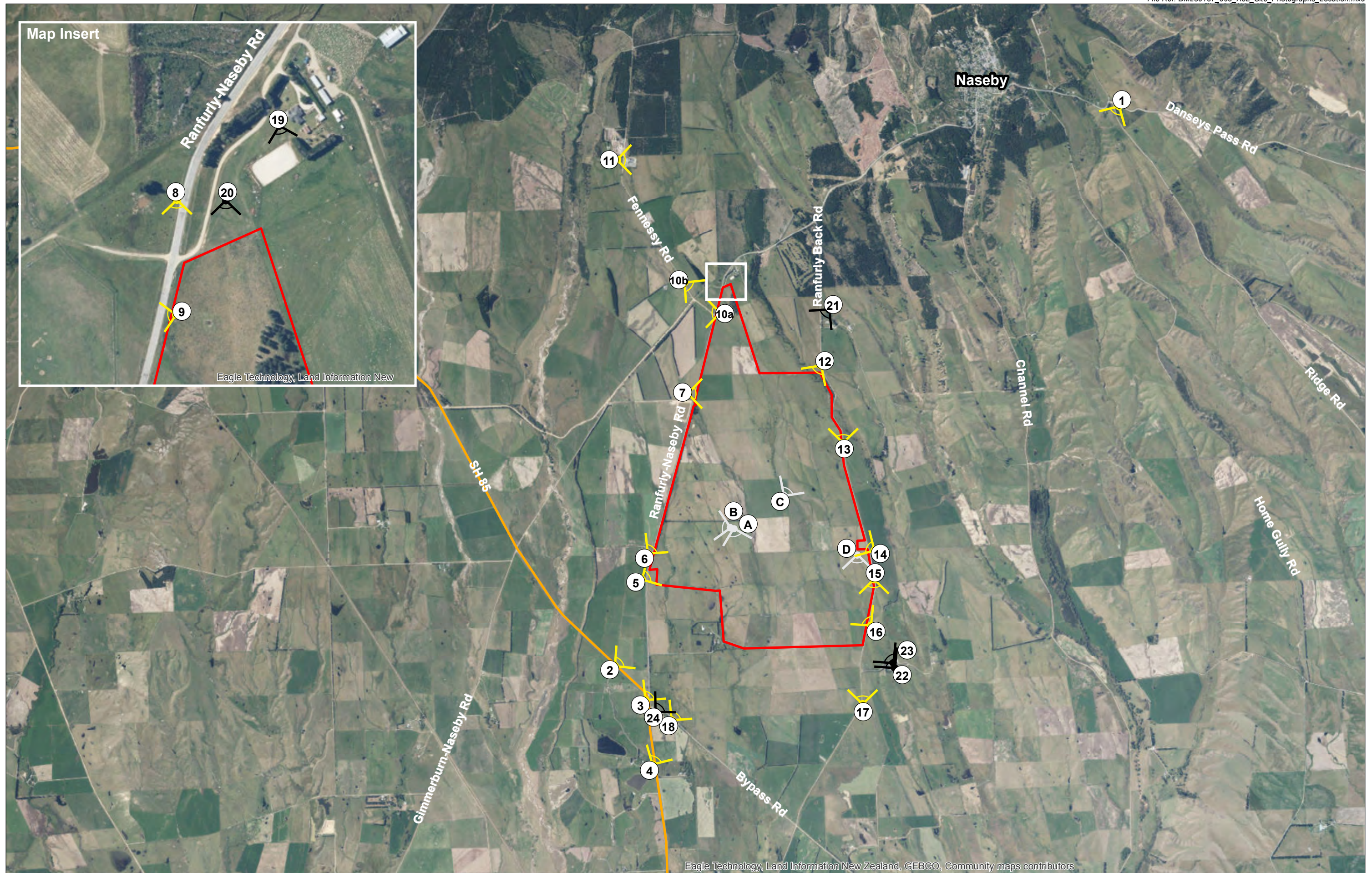
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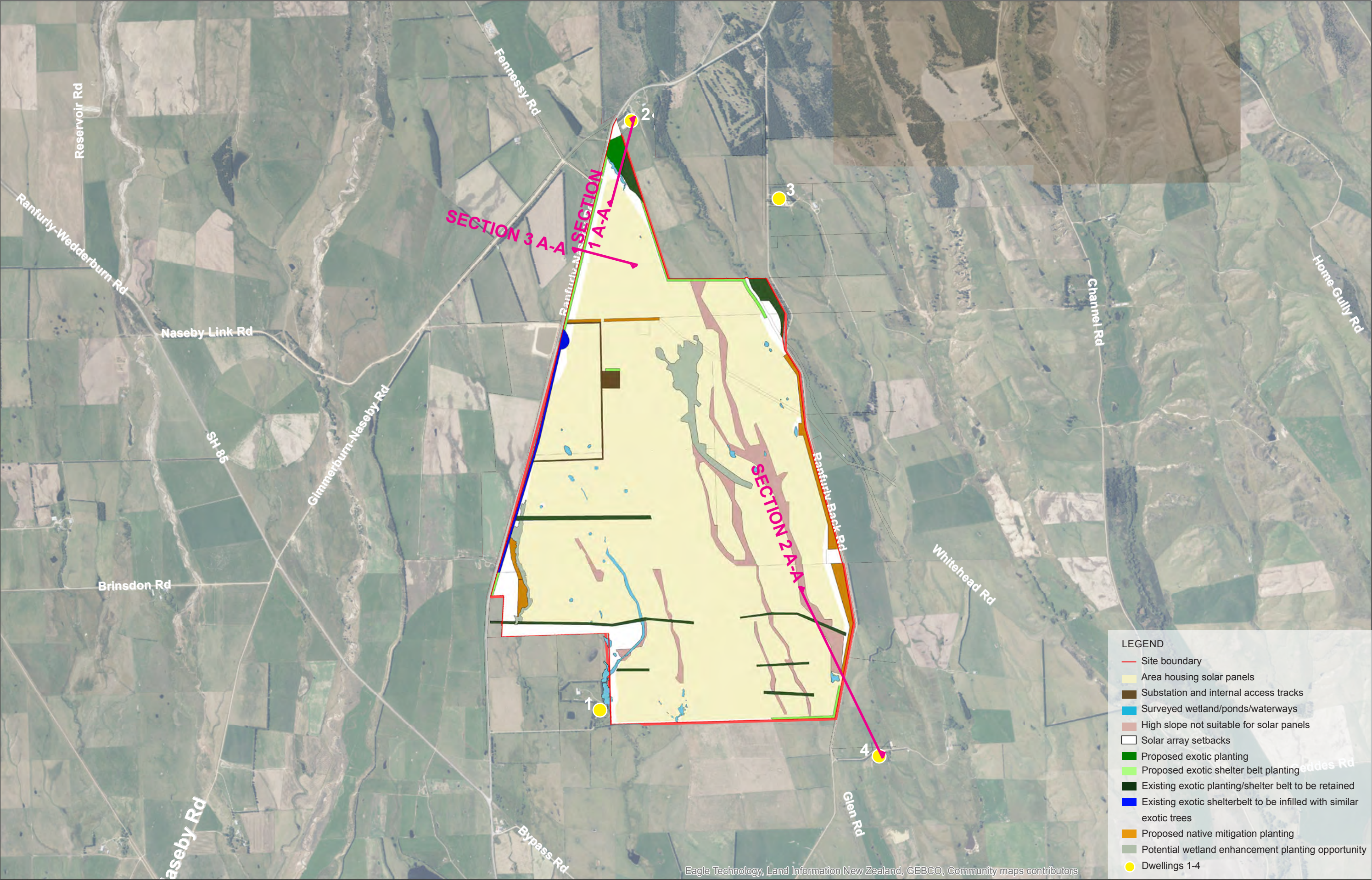


- LEGEND**
- Site Boundary
 - Approved Solar Bay Solar Farm
 - State Highway 85
 - Dwellings 1 - 17

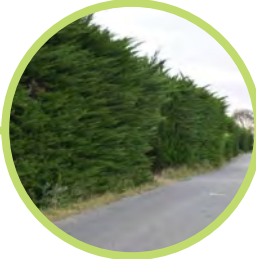
Figure 3

Page 3





POTENTIAL
EXOTIC SHETLER BELTS



Cedrus atlantica
Atlantic Cedar
H: 8m
W: 5m
Root size: 8m max spread approx

Cupressus macrocarpa
Macrocarpa
H: 25m
W: 7m
Root size: 15m max spread approx

POTENTIAL MIXED HEIGHT NATIVE
MITIGATION PLANTING



Coprosma crassifolia
Coprosma
H: 4m
W: 2m

Coprosma intertexta
Tangled Coprosma
H: 2m
W: 2m

Coprosma propinqua
Minigmingi
H: 5m
W: 2.5m

Chionochloa rubra
Red Tussock
H: 1.5m
W: 1.5m

Chionochloa rigida
Narrow-leaved Snow Tussock
H: 1.5m
W: 1.5m



Corokia cotoneaster
Korokia
H: 3m
W: 2m

Carmichaelia petriei
Desert broom
H: 2.5m
W: 2m

Discaria toumatou
Matagouri
H: 5m
W: 3m

Griselinia littoralis
Kapuka
H: 6m
W: 2.5m

Leptospermum scoparium
Manuka
H: 4m
W: 3m



Muehlenbeckia complexa
Shrub pohuehue
H: 2m
W: 3m

Ozothamnus leptophyllus
Cottonwood
H: 2m
W: 2m

Pittosporum tenuifolium
Kōhūhū
H: 6m
W: 3m

Plagianthus regius
Ribbonwood
H: 12m
W: 4m



Psuedopanax crassifolius
Horoeka
H: 12m
W: 3m

Sophora microphylla
Kowhai
H: 8m
W: 3m

Veronica salicifolia
Koromiki
H: 2m
W: 2m

POTENTIAL
WETLAND PLANTING



Aciphylla subflabellata
Grassland spaniard
H: 0.6m
W: 0.6m

Carex coriacea
NZ Swamp Sedge
H: 0.6m
W: 2m



Carex kaloides
Kaloides Sedge
H: 1m

Carex secta
Purei
H: 1.5m
W: 1.5m

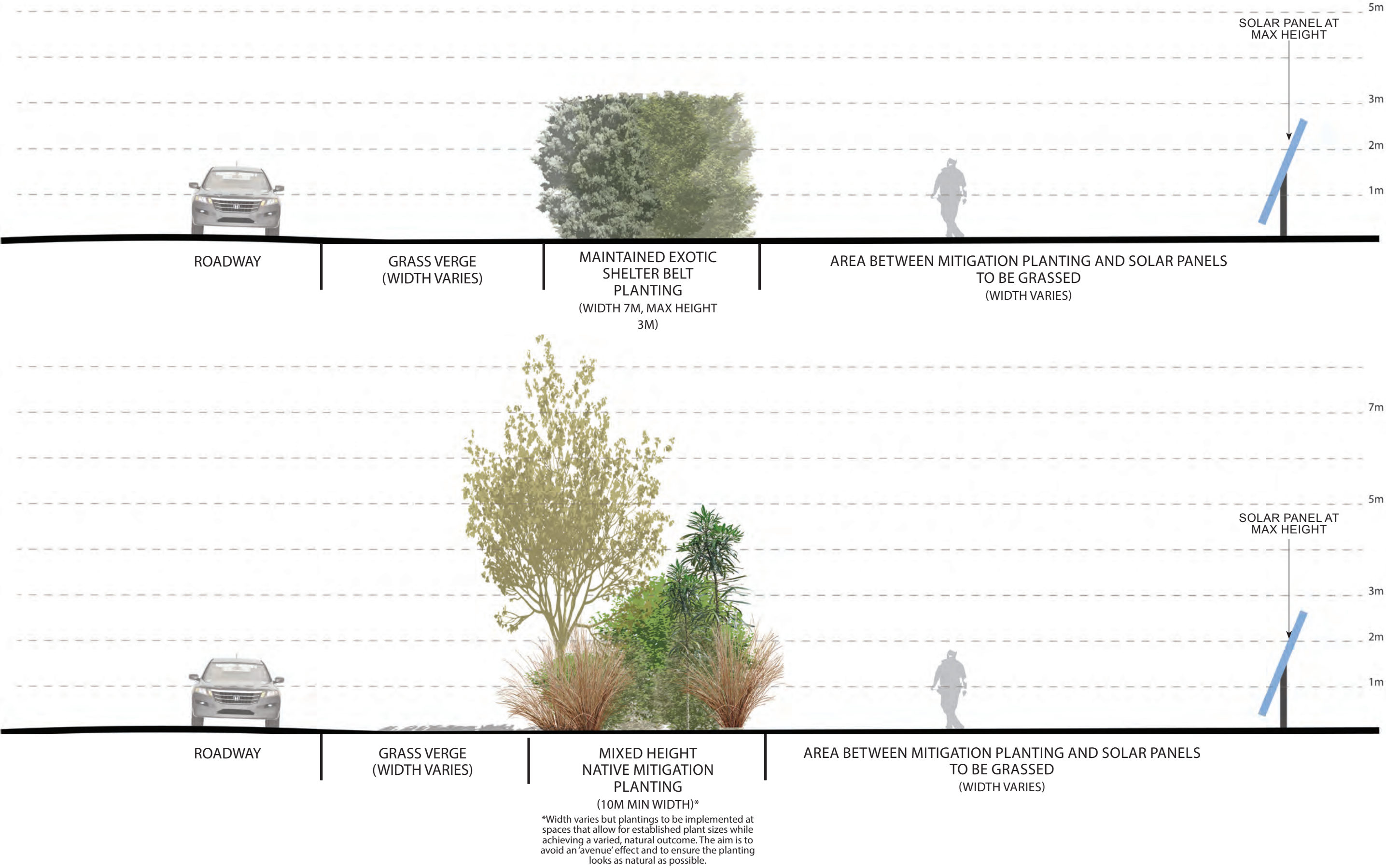


Juncus distegus
Wiwi
H: 0.75m

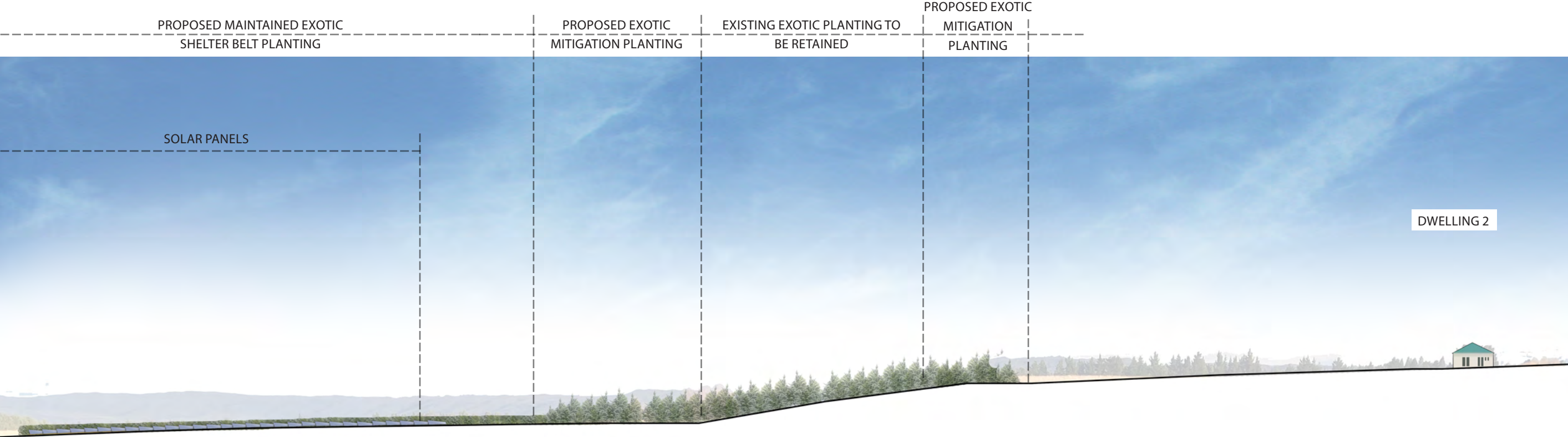
Phormium tenax
Harakeke
H: 2m
W: 3m



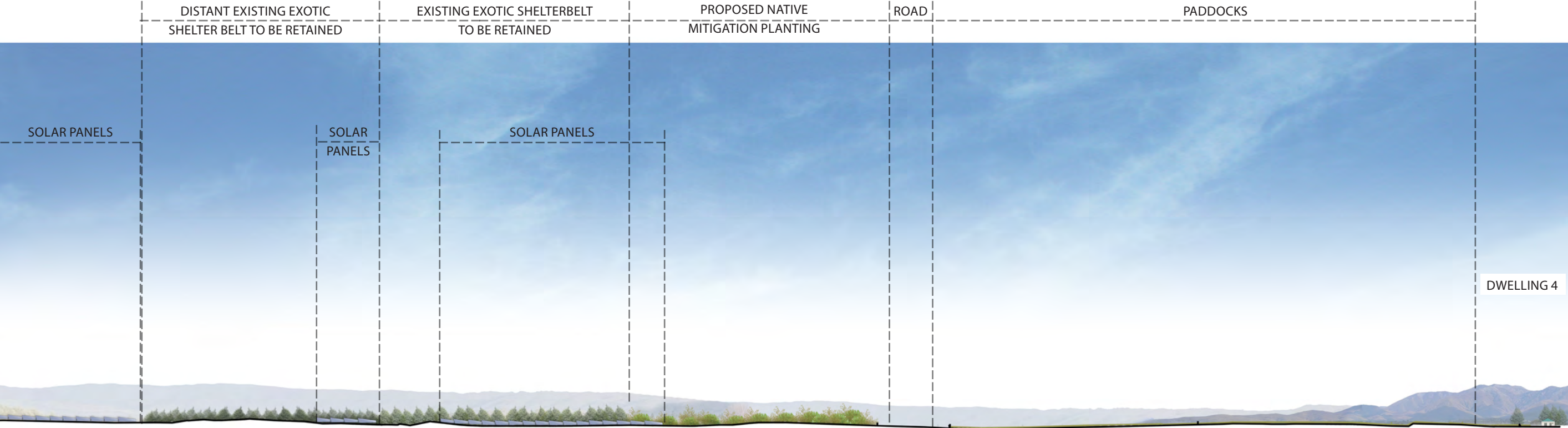
Schoenus pauciflorus
Bog Rush
H: 0.5m
W: 0.5m



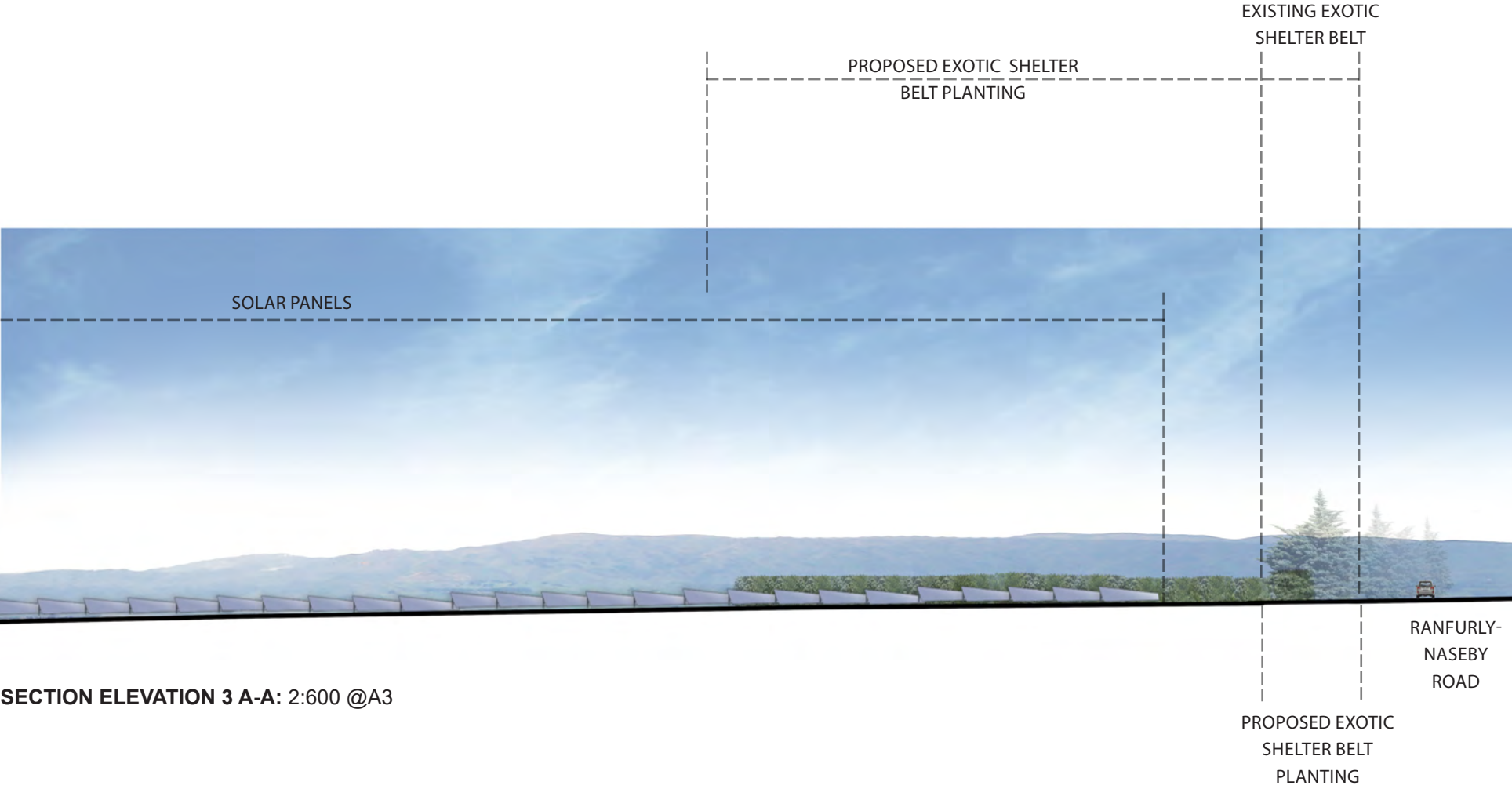




SECTION ELEVATION 1 A-A: 2:2,000 @A3



SECTION ELEVATION 2 A-A: 2:4,000 @A3





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Site Appraisal Photograph A: View looking southeast showing the undulating landform and layers of vegetation to the south including linear shelterbelts within the Site.



Site Appraisal Photograph B: View looking west showing one of the tall east-west pine shelterbelts that break up the Site.



Site Appraisal Photograph C: View looking northeast showing the identified wetland area located between low ridges near the centre of the Site.



Site Appraisal Photograph D: View looking south showing undulating landform and linear shelterbelts. Dwelling 4 can be seen in the distance in a gap between trees.



Site Context Photograph 1: View from Ridge Road, approximately 4.5 kilometres northeast of the Site. Naseby dwellings amongst trees to the right of the photograph and Transmission line in the midground. The Site can be glimpsed in the distance, largely screened by intervening vegetation.



Site Context Photograph 2: View from Ranfurly-Wedderburn Road (SH85), approximately 1 kilometre southwest of the Site. Ranfurly-Naseby Road is in the midground with the Site beyond.



Site Context Photograph 3: View from Ranfurly-Wedderburn Road (SH85), approximately 1.1 kilometres southwest of the Site.



Site Context Photograph 4: View from Ranfurly-Wedderburn Road (SH85), approximately 1.6 kilometres southwest of the Site.



Site Context Photograph 5: View from Ranfurly-Naseby Road, approximately 100 metres west of the Site.



Site Context Photograph 6: View from Ranfurly-Naseby Road immediately west of the Site.



Site Context Photograph 7: View from Ranfurly-Naseby Road, immediately west of the Site.



Site Context Photograph 8: View from Ranfurly-Naseby Road, approximately 135 metres northwest of the Site.



Site Context Photograph 9: View from Ranfurly-Naseby Road, immediately northwest of the Site, looking towards Fennessy Road with the LeoLabs Kiwi Space Station visible to the right of the photograph.



Site Context Photograph 10a: View from Ranfurly-Naseby Road, immediately northwest of the Site, looking down Fennessy Road.

Ranfurly-Naseby Road

Western boundary of the Site

Rock and Pillar Range



Site Context Photograph 10b: View from Fennessy Road, approximately 375 metres northwest of the Site.



Site Context Photograph 11: View from Fennessy Road to the existing substation, approximately 1.8 kilometres northwest of the Site.



Site Context Photograph 12: View from Ranfurly Back Road, approximately 20 metres northeast of the Site, looking across the gully to the nearest Site boundary.



Site Context Photograph 13: View from Ranfurly Back Road, immediately east of the Site, looking towards Naseby Forest and Hawkdun Range with Site in the foreground to the left of the road.



Site Context Photograph 14: View fom Ranfurly Back Road, immediately southeast of the Site, looking across the Site with Hawkdun Range and Rough Ridge in the distance.



Site Context Photograph 15: View from Ranfurly Back Road, immediately southeast of the Site. Dwelling 4 partially visible to left of photograph.



Site Context Photograph 16: View from Ranfurly Back Road, immediately southeast of the Site, looking towards one of the folds between ridges showing the legibility of the landform and the linear shelterbelts that visually break up the Site.



Site Context Photograph 17: View from Ranfurly Back Road, approximately 670 metres southeast of the Site, looking towards the Site showing the elevated location of Dwelling 4 to the right.



Site Context Photograph 18: View from Bypass Road, approximately 1 kilometre southwest of the Site.



Private Viewpoint Photograph 19: View immediately outside Dwelling 2, approximately 140 metres north of the Site. The Site is partially screened by existing vegetation both within the Site and the property.

— Approximate outline of the Site
— Approximate extent of solar panel



Private Viewpoint Photograph 20: View from driveway of Dwelling 2, approximately 50 metres north of the Site.

— Approximate outline of the Site
— Approximate extent of solar panel

Ranfurly Back Road



Private Viewpoint Photograph 21: View from Dwelling 3, approximately 600 metres northeast of the Site. The Site is largely screened by the existing vegetation within the property.

- Approximate outline of the Site
- Approximate extent of solar panel

Existing shelterbelt within the Site Ranfurly Back Road



Private Viewpoint Photograph 22: View immediately outside bedroom window of Dwelling 4, approximately 370 metres southeast of the Site.

- Approximate outline of the Site
- Approximate extent of solar panel



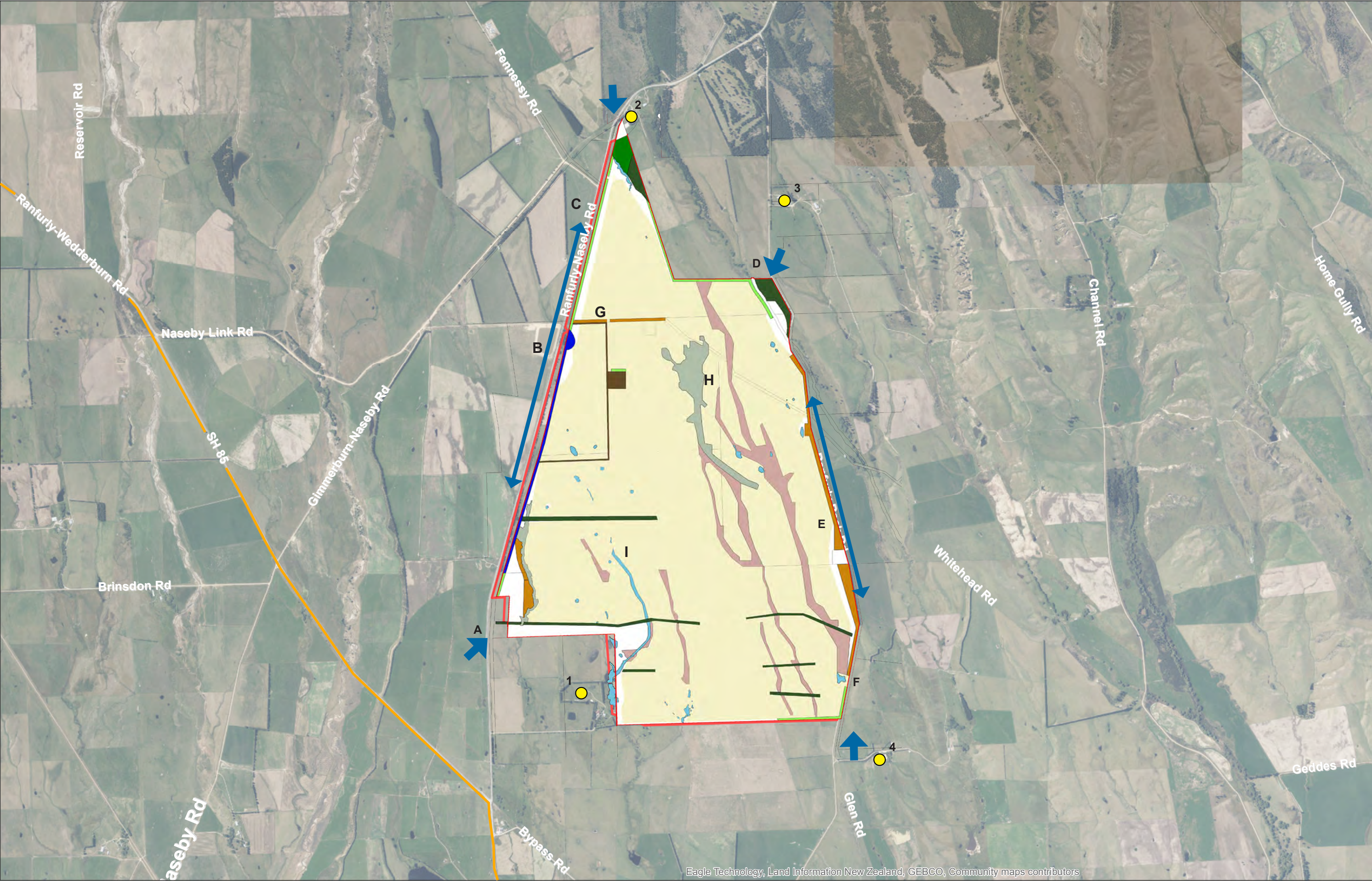
Private Viewpoint Photograph 23: View towards the Site is more visible from carpark area of Dwelling 4, approximately 365 metres southeast of the Site.

Approximate outline of the Site
Approximate extent of solar panel
Bypass Road



Private Viewpoint Photograph 24: View from Dwelling 5, approximately 1 kilometre southwest of the Site. The Site is largely screened by existing vegetation.

Approximate outline of the Site
Approximate extent of solar panel



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Data Sources:
Eagles Technologies, and LINZ Data Service.

Projection: New Zealand Transverse Mercator



LEGEND

-  Site Boundary
-  State Highway 85

HELIOS MĀNIATOTO SOLAR FARM
Landscape Mitigation Analysis

Date: 24 November 2023 | Revision: 0

Plan prepared for Helios Energy Ltd by Boffa Miskell Limited

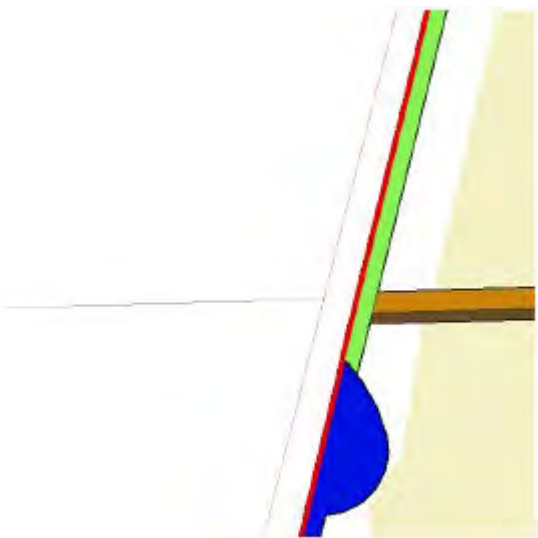
Project Manager: Yvonne.Pfluger@boffamiskell.co.nz | Drawn: HBI | Checked: SMC

Figure 7

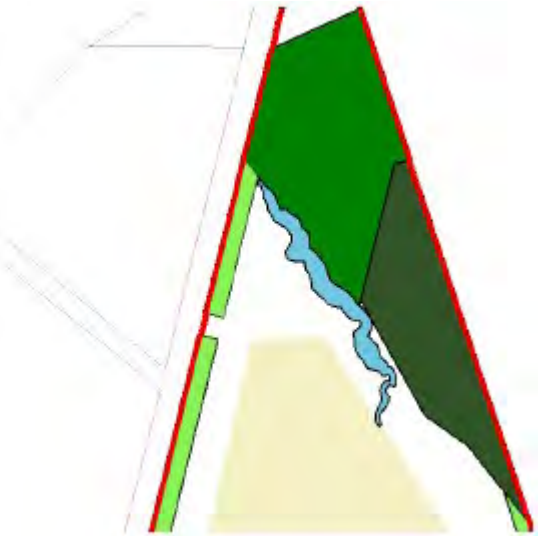
AREA A: Southwest corner



AREA B: Ranfurly-Naseby Road



AREA C: Northwest boundary



VISUAL ANALYSIS

Existing Vegetation:

- Some existing shelterbelts are aligned with Site boundaries while others are internal. They break up the Site, preventing views to full extent of the Proposal. They also provide dark backdrops that will help visually integrate panels in some views.
- Existing north-south orientated shelterbelt along Ranfurly-Naseby Road boundary will largely screen adjacent views from road. However there are gaps and thin areas where trees are failing or have failed, enabling close partial glimpses of the Site.
- East-west shelterbelt on southern boundary also screens views to Site from Ranfurly-Naseby Road for users approaching the Site as they travel north.
- These shelterbelts also partially screen and break up views from SH 85.
- There is a gap of approximately 330m between shelterbelts at the southwest corner where open views to part of the Site are possible.
- A waterway/wetland area follows the foot of the slope in this southwest corner.

Existing Vegetation:

- The existing shelterbelt on the Ranfurly-Naseby Road boundary stops some 1.3km before the northern end of the Site where there are currently open views across the Site, whether travelling both north or south.

Existing Vegetation:

- There is an existing stand of exotic trees on slope at the northern tip of the Site, above the location of proposed development. The top of this slope is approximately 20m above the waterway/wetland at the base.
- The stand of exotic trees partially screen the Site in views southeast from Ranfurly-Naseby Road and Dwelling 2.
- The trees also provide dark backdrops that will help to visually integrate the panels and tie the landscape into the forested setting beyond in northbound views from Ranfurly-Naseby Road.

MITIGATION STRATEGY

Existing Shelterbelts

- Existing gaps in shelterbelts will be infilled and existing north-south shelterbelt will be extended south to reduce viewshaft.

Setback and no-build areas:

- A large road setback of approx. 200m-300m is proposed, beyond the identified wetland, to avoid close, foreground views of the development from Ranfurly-Naseby Road, regardless of the time it may take for mitigation planting to mature.

Planting:

- Mixed native planting is proposed to provide screening in the midground of views from Ranfurly-Naseby Road. A higher proportion of tall species is recommended in this location, capable of reaching 8m-12m to screen views to low slopes and break up and soften views to more distant panels on higher slopes while maintaining glimpses to mountain backdrop.
- Wetland enhancement planting is also proposed to enhance the waterway/wetland area, with positive effects for natural character and landscape.

Existing Shelterbelts:

- Replacement planting will be undertaken where there are gaps or where there are trees that are failing and need to be removed.

Setback and no-build areas:

- Setbacks of 20m-50m from road are proposed along the Ranfurly-Naseby Road interface and 350m from the substation to avoid close, foreground views of the development, regardless of time required to establish mitigation vegetation.

Planting:

- Exotic shelterbelt planting is proposed along this northern Site boundary to screen views to proposed development. The proposed planting will appear as a continuation of the existing shelterbelt however it is recommended that the new planting be maintained at a height of approximately 3m to retain a sense of big skies and long distance views where possible.

Existing Trees:

- Existing stand of trees will be retained.

Setback and no-build areas:

- The area comprises a wetland and sloping hillside which will not be developed as part of the proposal. This provides a buffer for neighbours at Dwelling 2 of approximately 450m to the nearest panels.

Planting:

- Exotic pine planting is proposed to continue all the way east along the northern shared boundary with the Dwelling 2 neighbours, at their request (also see Area D below). It is recommended that trees planted on the Ranfurly-Naseby Road boundary and lower hill slopes at this northwest corner should be allowed to grow to mature height to provide maximum screening for those travelling south on Ranfurly-Naseby Road. However trees planted at the top of the slope, closest to Dwelling 2 can be maintained to a lower height if requested.

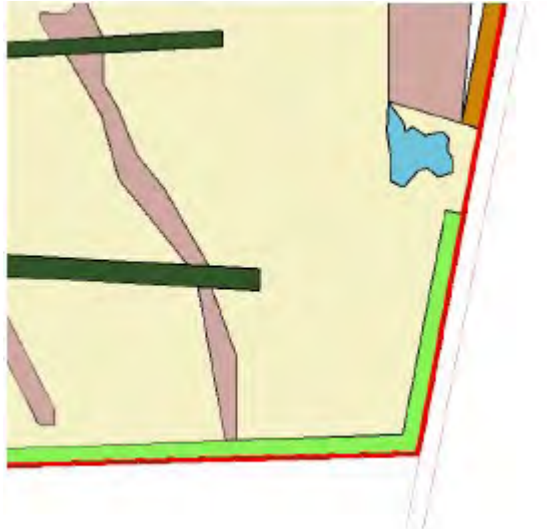
AREA D: North and northeast corner



AREA E: Ranfurly Back Road



AREA F: Southeast corner



VISUAL ANALYSIS

Existing Vegetation:

- There is an existing stand of exotic trees on a terrace and gully slopes at the northeast corner of the Site.
- The trees partially screen views to the Site from Ranfurly Back Road and in potential southwest views from Dwelling 3 and will be retained.
- The Site and the neighbouring northern Dowling property (Dwelling 2) are at a similar elevation at this northeast corner. However much of the Site further to the west is at the base of a terrace scarp, some 10-20m below the northern property. There is limited existing vegetation along the shared northern boundary between this northeast corner and the stand of exotic trees at the northwest corner (see Area C) allowing open views to the Site from the wider Dowling property.

Existing Vegetation:

- There is limited existing screening vegetation within the Site along Ranfurly Back Road with the exception of some internal east-west orientated shelterbelts towards the southeast corner of the Site which are described further in the following section (Mitigation Area F).
- There are sparse, isolated indigenous dryland shrubs along the fencelines.

Existing Vegetation:

- There is no existing screening vegetation along the adjacent Ranfurly Back Road boundary in this location so open views into parts of the Site are possible.
- However, there are several existing east-west orientated exotic shelterbelts within the southeast corner of the Site including a shelterbelt along part of the southern boundary. While there are small gaps in most of the shelterbelts, overall they provide effective visual screens, breaking up the Site.
- Together with the rolling landform, these internal shelterbelts prevent views to the full extent of the Proposal from Ranfurly-Back Road and in potential views from Dwelling 4. They also provide dark backdrops that will help to visually integrate the panels from some views.
- The existing shelterbelt along the southern Site boundary will screen views from Ranfurly Back Road for users approaching the Site as they travel north.

MITIGATION STRATEGY

Setback and no-build areas:

- These planted gully slopes and terrace area will not be developed as part of the proposal other than through further planting. This will retain a large visual buffer of 200m from Ranfurly Back Road and ensure views continue to be screened.

Planting:

- A strip of planting is proposed along the Site boundary to the west of the existing vegetation, as an extension of the existing pocket of trees, to increase the level of screening from Ranfurly Back Road and in potential views from Dwelling 3.
- Exotic pine planting is proposed to continue west all the way along the northern shared boundary with the Dwelling 2 neighbours, at their request (see Area C above) to assist with screening from their wider property. A section of this planting will be 10-12m below the neighbouring northern property, limiting the effectiveness of screening from this location.

Setback and no-build areas:

- The typical setback proposed from the Ranfurly Back Road boundary is approx. 20m-30m. This will allow space for the proposed planting and reduce the level of visibility in close, foreground views of the development from the road, regardless of the time it may take to establish mitigation vegetation.
- The proposed setback increases towards the southern end of the Site to approx. 130m, creating a large visual buffer from the road and retaining the legibility of the shallow gully landform.

Planting:

- Native planting is proposed to provide screening along the boundary in the foreground of views from Ranfurly-Back Road. Planting will predominantly represent a dryland palette to complement existing sparse dryland shrubs with positive landscape effects. Species will largely be between 3m-4m but will include taller species capable of reaching approximately 12m in height on maturity.

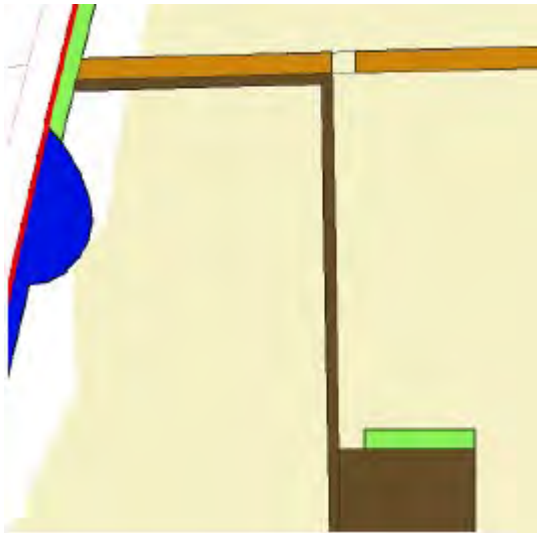
Setback and no-build areas:

- Development will be set back some 12-25m inside the shelterbelt along the southern boundary. Along the Ranfurly Back Road boundary, setbacks will increase to between 120m-250m, to avoid development on the wetland and adjacent steep slope and reduce visibility.

Planting:

- Infill planting of existing shelterbelts within the Site is proposed to reduce gaps. An additional shelterbelt is also proposed to extend for a length of approximately 300m along Ranfurly Back Road. The shelterbelt will extend from the existing shelterbelt on the southern boundary north to approximately the wetland to increase the level of screening over time from garden viewpoints at Dwelling 4.

AREA G: Internal shelterbelt



AREA H: Central Wetland



VISUAL ANALYSIS

Existing Vegetation:

- There is limited existing screening vegetation within the northern end of the Site so there is potential for open views to a large extent of the Proposal, including the substation site, from Ranfurly-Naseby Road.
- Proposed mitigation planting along the road boundary (Mitigation Area B) will largely screen these close, level views.

Existing Vegetation:

- A large wetland area with existing indigenous vegetation has been identified towards the centre of the Site and will not be developed.
- This large, undeveloped area will not typically be visible from immediately surrounding vantage points however it is of a scale that has potential to be discernible from potential elevated viewing areas such as recreational areas (including Outstanding Natural Landscapes) in the very distant but elevated ranges.

MITIGATION STRATEGY

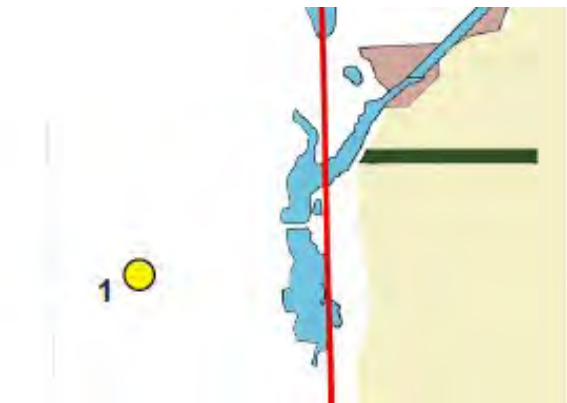
Planting:

- Further screening or breaking up of the Site is proposed where there is potential for views above or between the proposed roadside planting, primarily for south-bound travellers at the elevated viewing location north of the Site.
- Therefore, an internal strip of native planting, orientated east-west, is proposed along the south side of Access 2 between Ranfurly-Naseby Road and the Central Wetland to break up these potential expansive views, and create positive landscape effects.
- A short row of tall exotic trees is also proposed along the north side of the proposed substation to screen views to, and reduce the sense of scale of the taller substation infrastructure.

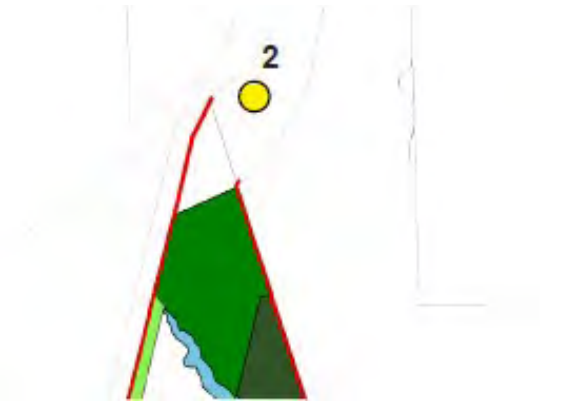
Planting:

It is proposed to further utilise this opportunity to fence the waterway from stock and enhance with appropriate wetland planting to create positive natural character and landscape effects. The wetland area provides a large (11 ha) no-build area within the Site and retains some legibility of the landform and wetland feature.

DWELLING 1



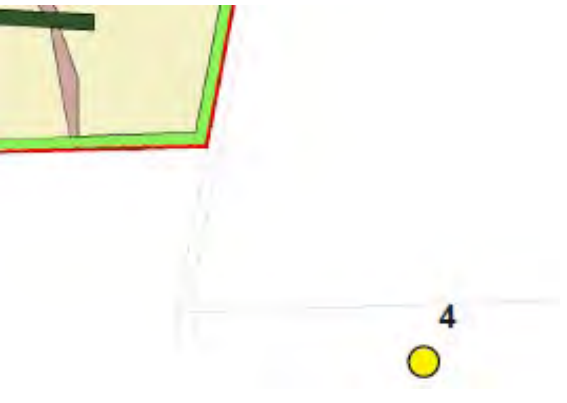
DWELLING 2



DWELLING 3



DWELLING 4



VISUAL ANALYSIS

- Approximately 250m to nearest panels to the east and 500m to nearest panels to the north. - Dwelling 1 appears to be surrounded by mature hedging, screening views to the Site. - Should the hedging be removed, views to the north would be distant and largely screened by on-site shelterbelts while development to the northeast and east would be visible in medium to distant views.
- Approximately 450m to nearest panels to the southwest. - Dwelling 2 is partially enclosed by mature hedging, screening some views to the Site. A portion of the northeast extent of the Proposal will be visible.
- Approximately 650m to nearest panels to the southwest. - Dwelling 3 is surrounded by mature hedging, screening views to the Site.
- Approximately 450m to nearest panels to the northwest. - Dwelling appears to be surrounded by mature hedging, screening views to the Site. - Should the hedging be removed, views to the northwest would be distant with the full extent of the Site broken up by on-site shelterbelts.

MITIGATION STRATEGY

No specific mitigation is proposed. The residents are one of the two landowners leasing land to Helios for this development. Through their support for the development, distance of the dwelling and natural features in between the dwelling and the solar farm, no concerns were raised on the need for the screening of the solar farm from their dwelling.
Exotic pine planting is proposed on the hillside to break up and screen elevated southbound views from both Ranfurly-Naseby Road and Dwelling 2. It is recommended that trees planted on the Ranfurly-Naseby Road boundary and lower hill slopes at this northwest corner should be allowed to grow to mature height to provide maximum screening for those travelling south on Ranfurly-Naseby Road. However trees planted at the top of the slope, closest to Dwelling 2 can be maintained to a lower height if requested.
- Additional planting is proposed on the west side of the gully, extending west along the Site boundary for approx. 280m to the crest of the ridge. This is primarily a response to mitigate closer views from Ranfurly Back Road but will also serve as mitigation for Dwelling 3 if required. - Planting is currently shown in the form of continuous exotic shelterbelt planting but a native planting mix could also be suitable in the vicinity of the gully.
Planting to fill gaps in existing shelterbelts and additional exotic shelterbelt planting is proposed within the Site. The new section of planting will extend for a length of approximately 300m along Ranfurly Back Road. This is primarily a response to mitigate closer views from the road but over time, will also screen views from some garden areas for Dwelling 4.

Together. Shaping Better Places.

Boffa Miskell is a leading New Zealand environmental consultancy with nine offices throughout Aotearoa. We work with a wide range of local, international private and public sector clients in the areas of planning, urban design, landscape architecture, landscape planning, ecology, biosecurity, Te Hīhiri (cultural advisory), engagement, transport advisory, climate change, graphics and mapping. Over the past five decades we have built a reputation for creativity, professionalism, innovation and excellence by understanding each project’s interconnections with the wider environmental, social, cultural and economic context.



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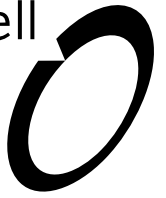
Whangarei	Auckland	Hamilton	Tauranga	Wellington	Nelson	Christchurch	Queenstown	Dunedin
09 358 2526	09 358 2526	07 960 0006	07 571 5511	04 385 9315	03 548 8551	03 366 8891	03 441 1670	03 470 0460



Appendix 5

Ecological Impact Assessment

Boffa Miskell



Mānīatoto Solar Farm

Ecological Impact Assessment
Prepared for Helios Energy Limited

18 December 2023



Document Quality Assurance

Bibliographic reference for citation:

Boffa Miskell Limited 2023. *Mānīatoto Solar Farm: Ecological Impact Assessment*. Report prepared by Boffa Miskell Limited for Helios Energy Limited.

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Reviewed by:	Scott Hooson Senior Ecologist / Senior Principal Boffa Miskell Limited	
	Dr Leigh Bull Ecologist BlueGreen Ecology Limited	
Status: FINAL	Revision / version: 3	Issue date: 18 December 2023

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Executive Summary

Helios Energy Limited (**Helios**) are proposing to establish and operate a photovoltaic (PV) solar farm, battery energy storage, substation, and transmission line infrastructure (**solar farm**) for renewable electricity generation at an c.660 ha site between the Ranfurly-Naseby Road and Ranfurly Back Road between Naseby and Ranfurly (the **Site**). The Site is located on the Mānīatoto Plain¹ in the Central Otago District (see Figure 1). The proposed solar farm would be built on land leased from two local farming families and connected into the national electricity transmission grid via the Naseby Substation on Fennessy Road. The solar farm will generate enough clean electricity to power the equivalent of approximately 70,000 homes annually.

Helios commissioned Boffa Miskell Limited (**Boffa Miskell**) to undertake a survey of the ecological values at the proposed solar farm site, and to provide an Ecological Impact Assessment (**EclA**) report to accompany the necessary resource consent applications for the proposed solar farm.

As part of the EclA process, ecological project shaping advice was provided by Boffa Miskell to Helios that:

- Identified the location of natural inland wetlands and waterways at the Site, and recommended construction setbacks to fully avoid adverse effects to wetlands and waterways.
- Provided recommendations to change the draft solar farm layout, and recommendations regarding the methods for cable laying (i.e., the use of horizontal drilling), to avoid or minimise effects on wetlands and waterbodies.

In terms of existing environments at the Solar Farm Site, this report has found that:

- The proposed Solar Farm Site comprises dryland exotic pastures used for sheep and beef grazing; these are of negligible ecological value. The original indigenous vegetation has been fully removed via pastoral conversion, aside from a small number of scattered matagouri, desert broom, porcupine shrub, and scrub pohuehue shrubs, located solely along fence lines. At Risk – Declining shrubs at the Site are of high ecological value and are ecologically significant based on the applicable statutory criteria in the Partially Operative Regional Policy Statement 2019 (POORPS), the Proposed Otago Regional Policy Statement 2021 (PrORPS), and the National Policy Statement for Indigenous Biodiversity 2023 (NPS-IB).
- Two moderately large ‘central’ and ‘southwest’ wetlands support indigenous wetland vegetation, including At Risk – Declining sedge and spaniard species; they are of moderate ecological value. Other

¹ Although frequently spelt ‘Maniototo’, ‘Mānīatoto’ or ‘Maniatoto’ are recognized as the preferred spelling by iwi and Central Otago District Council.

small wetlands occupying depressions in the landform are essentially wet pasture of negligible ecological value.

- Because wetlands have been reduced to less than 20% of their original cover regionally and nationally (and additionally because some wetlands support At Risk species), all wetlands at the Site are considered ecologically significant.
- The Site is largely dominated by exotic bird species, but does provide foraging, roosting and / or nesting habitat for 22 indigenous bird species, including one Threatened, five At Risk and 16 Not Threatened species. These species range from low to very high ecological value.
- The Site does not provide suitable habitat for indigenous lizards or assemblages of indigenous terrestrial invertebrates. Because no works in waterways are anticipated or proposed (and works would be set back by >10 m from all streams and water races within the Site), the proposal would have no adverse effects to waterways, and no assessment of freshwater ecology values in these waterways have been undertaken.

In relation to ecological effects of the solar farm proposal; this report finds that:

- Vegetation clearance to install solar panel piles, cable trenches, gravel access roads, a substation, pre-assembled inverter cabinets, and for temporary construction laydown areas would affect exotic pastures of negligible ecological value. Following construction, the Site would remain in grazed exotic pasture. **No adverse ecological effects are relevant to pasture vegetation.**
- Clearance of relict indigenous shrubs along fence lines would comprise a **high** level adverse effect at the Site scale, but a **very low** level adverse effect at the Mānīatoto ED scale. At Risk – Declining shrubs are considered significant, and remedial plantings of all indigenous shrubs that would be lost is recommended, with at least double the numbers of plants being provided. There would be **no residual impacts** at the Site / ED scale to indigenous shrubs following remedial plantings, equating to **no net loss of significant shrub values**. In the long-term (>20 years), the greater numbers of shrubs would provide a positive impact (a **net gain**) for these values.
- All wetlands at the Site would be fully avoided by Site works, with setbacks applied. Horizontal Directional Drilling (HDD) would be used to direct cabling beneath the central wetland, specifically to avoid any potential effects. Fencing and enhancement of the central and southwest wetlands represents a **net gain in terms of significant wetland values** at the Site.
- Existing rainfall runoff patterns and other hydrological inputs to wetlands would be unaffected by the proposal, meaning that there would be **no adverse indirect effects to wetlands**.
- Construction works will result in permanent habitat loss / modification for indigenous avifauna species utilising exotic pasture and

indigenous shrubs; the level of residual effects has been assessed as **very low to low** for pasture areas, but **very low to low adverse effects would be remedied in the long term** for indigenous shrub habitat.

- Construction works may temporarily disturb and displace indigenous birds on Site; the level of effect has been assessed as **very low to low**, and temporary. No residual effects will occur and no impact management is required.
- Construction works may disturb, displace, injure or kill nesting indigenous birds (and nest contents) if conducted during the bird breeding season; the level of effect has been assessed as **very low to low**. With impact management (pre-construction survey and construction setbacks), potential injury or mortality effects can be **avoided**.
- The solar panels may pose a collision risk for indigenous water and wetland birds traversing the Site; the level of effect has been assessed as **very low**. We consider that further information is necessary in relation to this effect and propose a 'reappraisal' in the form of a further bird strike literature review to be undertaken prior to solar farm commissioning (which will not occur for several years). This exercise would allow for the findings of any further research (ideally, including New Zealand specific research) to be applied, noting that post-construction monitoring or similar measures may yet be recommended.

In summary, the potential adverse ecological effects of the solar farm have been avoided, or else would be remedied where possible, with no residual adverse effects identified as being greater than low-level. In particular, there would be no net loss in relation to the significant features of the Site. There would also be a net gain for wetland habitats and indigenous shrubs. This is due to the general avoidance of all wetlands coupled with the enhancement of the two larger wetlands on the Site, as well as further indigenous shrub plantings that would exceed the number of indigenous shrubs that would be lost along fence lines.

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1.0 Introduction

1.1 Background

Helios Energy Limited (**Helios**) are proposing to establish and operate a photovoltaic (PV) solar farm, energy storage, substation, and transmission line infrastructure (**solar farm**) for renewable electricity generation at an c.660 ha site between the Ranfurly-Naseby Road and Ranfurly Back Road between Naseby and Ranfurly (the **Site**). The Site is located on the Mānīatoto Plain² in the Central Otago District (see Figure 1). The proposed solar farm would be built on land leased from two local farming families and connected into the national electricity transmission grid via the Naseby Substation on Fennessy Road. The solar farm will generate enough clean electricity to power the equivalent of approximately 70,000 homes annually.

1.2 Purpose and Scope

Helios commissioned Boffa Miskell Limited (**Boffa Miskell**) to undertake a survey of the ecological values at the proposed solar farm site, and to provide an Ecological Impact Assessment (**EclA**) report to accompany the necessary resource consent applications for the proposed solar farm.

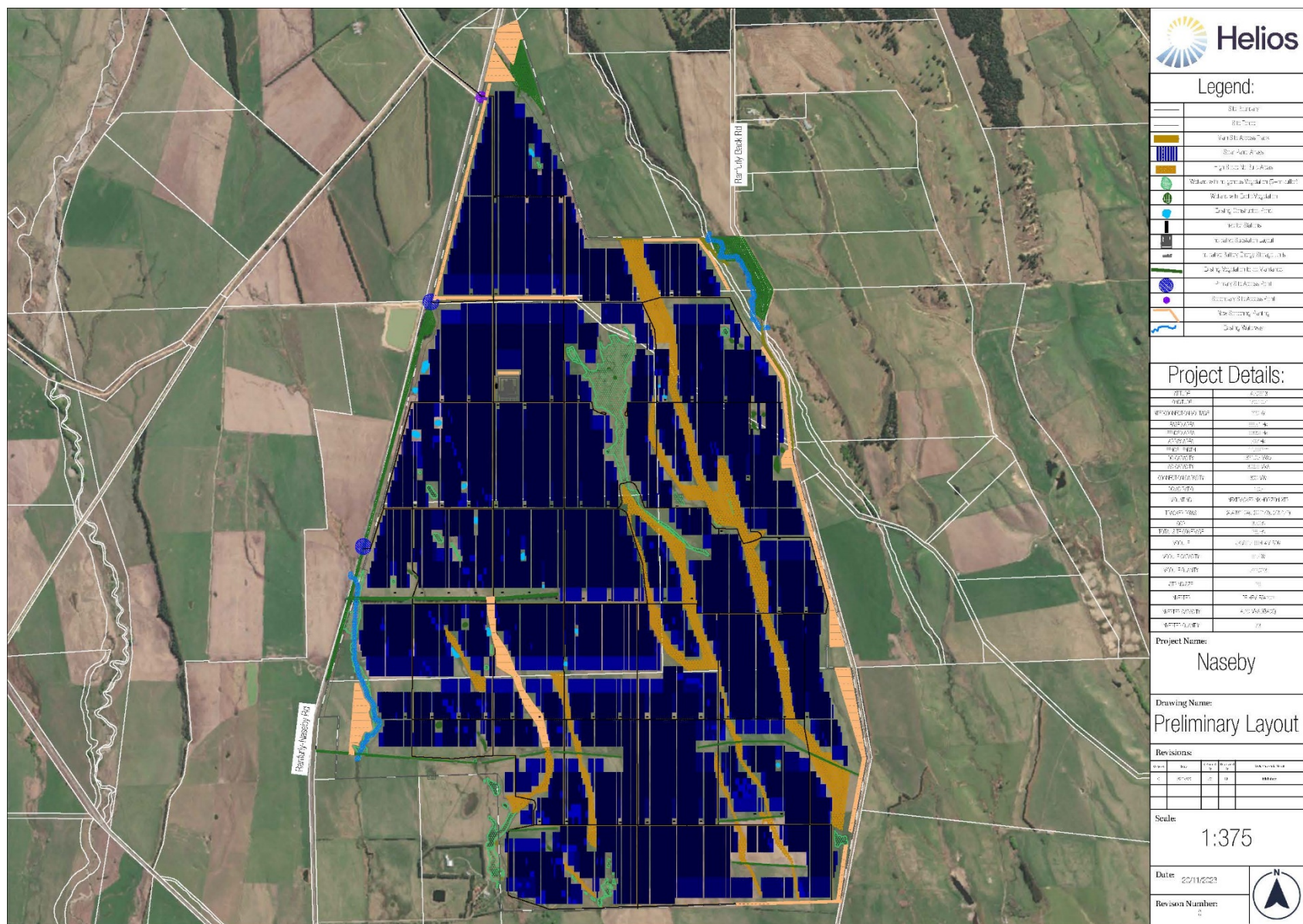
This EclA has been prepared to:

- Describe the existing ecological environment at the solar farm site;
- Assess the ecological significance and ecological value of the existing environment;
- Assess the ecological effects of the construction and operation of the proposed solar farm on ecology values; and
- Make recommendations to manage potential adverse effects of the construction and operation of the proposed solar farm on ecology values.

This EclA report focuses on terrestrial ecology values (including a description of wetlands at the Site that are to be avoided by the solar farm proposal, with setbacks applied). Setbacks would also apply from a waterway (water race / stream) in the southwest of the Site, with existing waterway crossings to be used during construction. The proposal and resource consents sought do not include any works in or near waterways; therefore, freshwater ecology assessments do not form part of the scope of this EclA.

The scope of this EclA relates only to proposed infrastructure developments within the Site itself (see Figure 1). It does not include assessment of a proposed underground transmission line from the Site to the existing Naseby Grid Exit Point (substation), as we have been advised by Helios that these works are a permitted activity that would occur within a legal road reserve area.

² Although frequently spelt 'Maniototo', 'Mānīatoto' or 'Maniatoto' are recognized as the preferred spelling by iwi and Central Otago District Council.



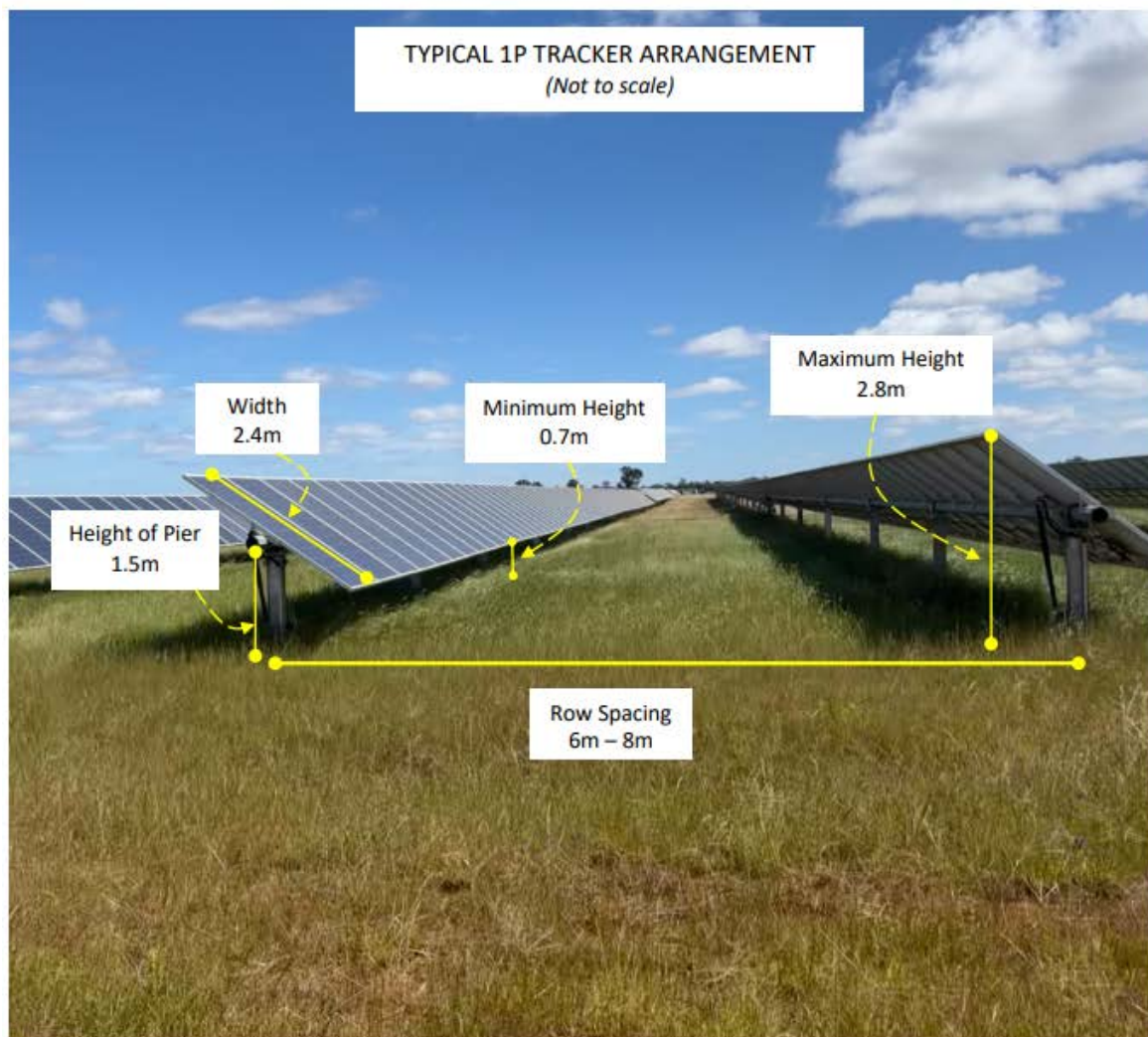
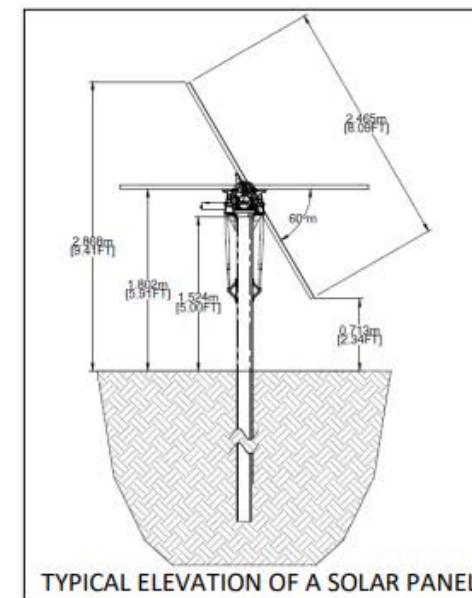


Figure 2. Typical mounted PV modules (source: Helios).



2.0 Proposal Description

The following Proposal Description is based on details provided to Boffa Miskell by Helios. It is summarised from the Assessment of Effects (**AEE**), to which this report is attached.

The solar farm project comprises the construction, operation and maintenance of an approximately 300MWac photovoltaic solar farm. It will consist of approximately 550,810 solar panels and other associated infrastructure including a substation, battery energy storage, substation, and transmission line infrastructure (see Figure 1; hereafter the **Proposal**). A more detailed description of the Proposal is found in the AEE.

The Proposal will also include native and exotic screening planting.

The Site will continue to be grazed by sheep in and around the solar panels (fenced from plantings and wetlands) for Site pasture maintenance purposes.

The predicted energy output from the Proposal is approximately 630 GWh/year, which will be supplied into the National Grid via the Naseby Substation on Fennessy Road.

2.1 Infrastructure

Infrastructure associated with the Proposal will include the solar arrays, internal accessways, fencing, security cameras, lighting, site office, electrical infrastructure and cabling, a substation, a Battery Energy Storage System (**BESS**) and a transmission line connecting the Site substation to the national grid via Fennessy Road. A brief outline of the key components is provided below. A more detailed project description is provided in the AEE / consent application.

Solar Panels and Cabinetry

The solar farm is proposed to comprise rows of tilting bifacial monocrystalline panels (1P Trackers) mounted on a tracking system aligned in north-south rows that will rotate from east to west to follow the movement of the sun during the day (Figure 2). Tracking details are provided in Appendix 1.

The solar panels (when fully open) and all infrastructure will cover approximately 36.6% of the Site (231 ha in total). The solar panel dimensions will be:

- A maximum height above ground of approximately 2,800 mm (when tilted to the maximum angle);
- A panel width of 2,382 mm; and
- A minimum height above ground of approximately 500 mm (when tilted to the maximum angle).

A central axis (post / pole holding the panels above the ground) will be approximately 1.5-1.8 m above ground (Figure 2).

Inverters

Amongst the solar panel arrays will be 74 decentralised inverter structures. An inverter turns Direct Current (**DC**) created by the photovoltaic cells to alternating current (**AC**) current used in

the electricity grid. These inverters would be distributed throughout the farm and would be used in the generation of power from the solar arrays.

The dimensions of each inverter cabinet will be approximately 2.9 m high, 6.0 m long and 2.5 m wide; similar in scale and appearance to a standard container unit. These prefabricated structures will sit on piles approximately 600 mm above ground level. The underlying ground will comprise compacted soil and stone.

Underground cabling will be installed across the Site (route shown in the drawings in the AEE) to connect the solar panel arrays with the inverters and the substation.

Substation Design

A new 33 / 220 kV substation will be constructed within the Site to connect to the National Grid at the Naseby Substation on Fennessy Road (Figure 3). The purpose of the solar farm substation is to take power from the solar medium voltage power stations via 33 kV cables and transform this to 220 kV, suitable for transmission to Naseby Grid Exit Point (**GXP**). The substation's exact location and layout is subject to future detailed design.

It will consist of a switchyard with an overall footprint of approximately 100 m x 110 m, approximately 11,100 m² (1.1 ha) in area, and will be accessed via internal Site access tracks via Ranfurly-Naseby Road.

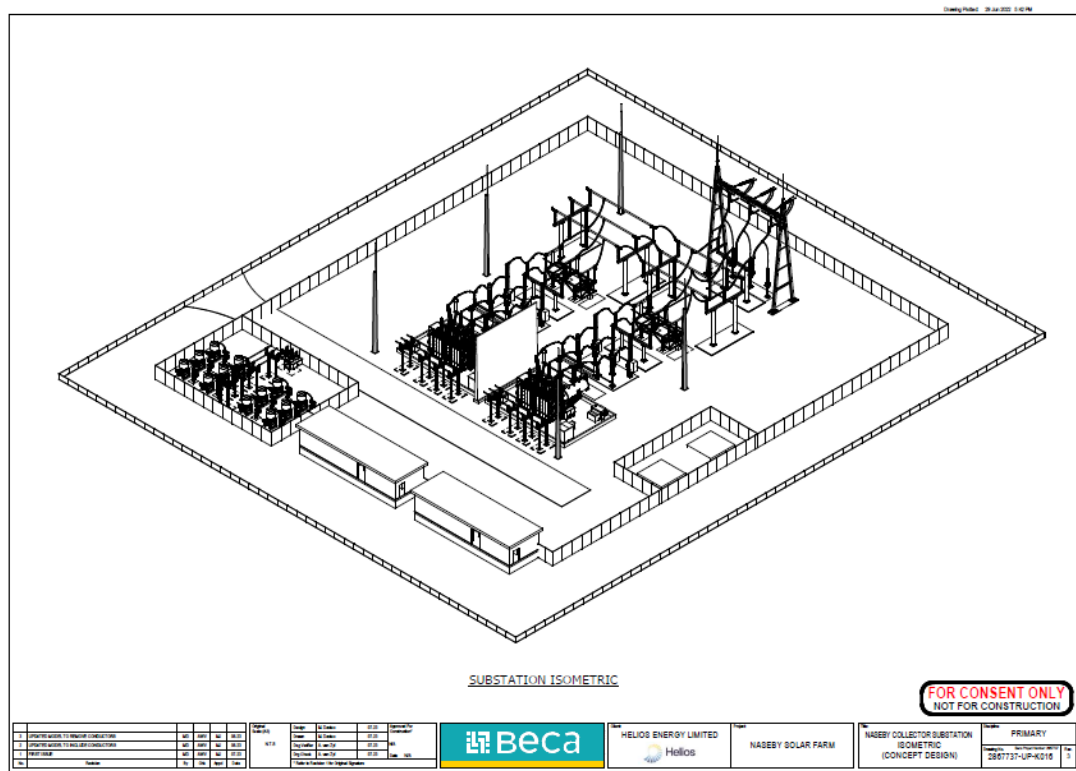


Figure 3. Indicative substation design.

It will house up to two 33 kV switchrooms (each approx. 6 x 20 m) and the site office (approx. 10.6 m x 6.6 m x 3.6 m). The perimeter of the facility will be enclosed with a lockable security fence and a stock fence. The switchyard surface will generally consist of a 150 mm layer of

crushed rock aggregate, with approximately 500 mm of basecourse and sub-base material below this. Switchyard equipment will be mounted on concrete foundations.

Two 33/220 kV 150 MVA transformers will be installed on bunded foundations to contain the possibility of leaked transformer oil. An oil treatment facility will be installed within a separate enclosure on site to treat stormwater before discharging it to the environment. An enclosure may be required over the capacitor banks if deemed necessary for harmonic mitigation. The capacitor banks will not contain any oil.

The incoming 220 kV transmission line from Naseby GXP will terminate onto one 20 m high A-frame or steel pole gantry structure within the switchyard, with lightning spikes mounted on top which will extend to 24 m high.

Lighting will be provided in accordance with Transpower's Switchyard and Grounds Lighting Approved Standard (TP.DS 40.03) and will only be used where emergency work / inspections are required. The Site will not otherwise be lit at night, unless there are urgent fault repairs that must be carried out at night.

Battery Energy Storage System

A BESS will be situated in the central west area of the Site within a fenced off area within the substation that can accommodate an area of 2000 m² (0.2 ha) for BESS packs that are each 3 m high. This is likely to comprise a series of 3 MW packaged battery units. This may comprise the following:

- 32 x Tesla Megapack; or
- 14 Power Electronics FS4390K 4.39 MW inverters with 10 banks of GridSolv Quantum Units; or
- Other battery storage units as determined during detailed design.

The purpose of the BESS is to help manage the flows of energy generated by the solar panels and enable energy to be released into the National Grid overnight when solar energy is not being generated.

Runoff from the substation platform area will enter a stormwater drain, to discharge to land. There is an unlikely need for any pre-treatment of the stormwater as a comprehensive oil tank system and bunding for oil in transformers means there is distinct containment which would be emptied via a sucker truck from that containment system on an as required basis.

2.2 Other Works

Earthworks

Earthworks will be required for the installation of cables (AC and DC cables), internal access roads, establishing a flat surface for the substation and inverter foundations, battery storage area, and small areas of cut and fill to enable efficient installation of solar panels in some areas. All site works will be undertaken in accordance with the Construction Methodology as outlined in the AEE.

Directional boring / Horizontal Directional Drilling (**HDD**) will enable cabling beneath the central wetland without requiring surface disturbance or works within the wetland. Two boreholes with cables in triplex (6 cables) of approximately 100 mm thickness will be drilled to approx. 2 m depth with entry and exit holes >10 m from the wetland boundary (Figure 4).

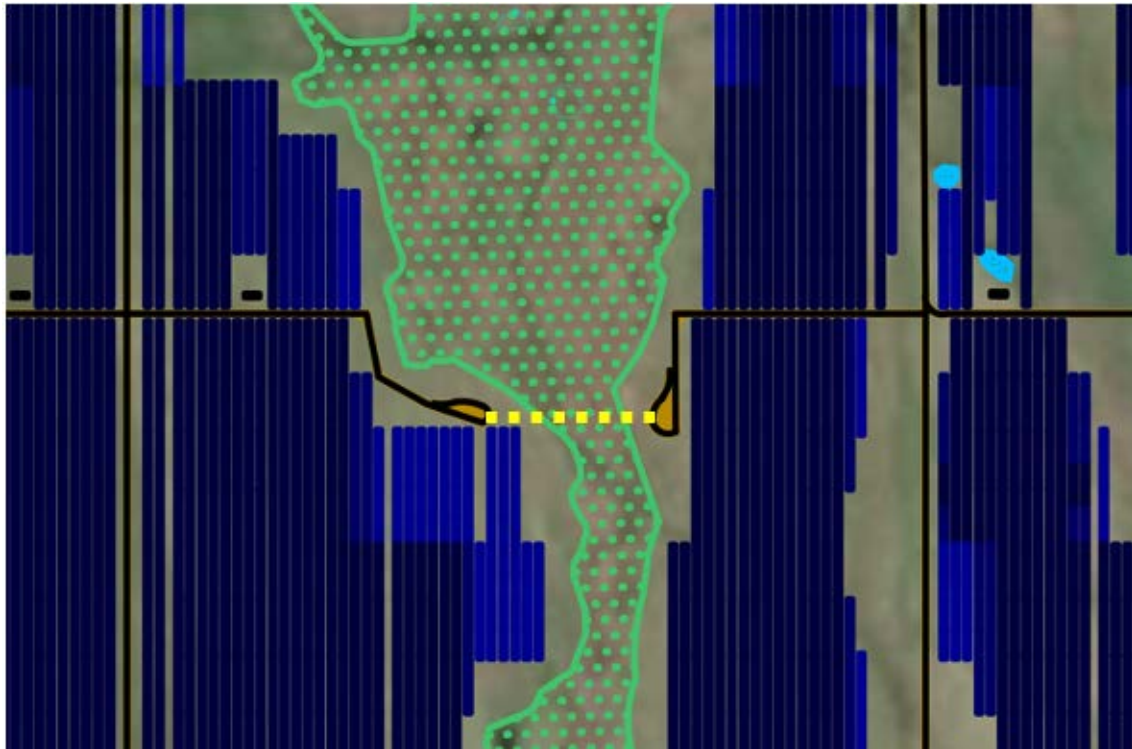


Figure 4. Horizontal directional drilling indicative location, with entry and exit points >10 m from wetland habitat (green).

Earthworks will be completed in stages and progressively rehabilitated to minimise the amount of soil exposed at any one time. All access tracks will be finished in an all-weather metallised surface.

A total of approximately 48,230m³ of earthworks will be undertaken across an approximate 15 ha area. This will be a mix of cut and fill works and all material is to be reused on-site

DC trenches will have a width of 0.6 m and depth of 0.8m. AC trenches will have a width of 0.8 m and depth of 1.2 m. Trenches will be remediated in exotic grass.

Approximately 9,274 m³ of thermal sand will be imported to the Site for trenching purposes, as well as approximately 25,044 m³ of gap 20 gravel to create flat and stable areas for the inverters, substation, BESS and roading.

The estimated total area and volume of earthworks per project component is broken down as follows:

Table 1. Estimated Earthworks Quantities

Component	Area of Earthworks	Volume of Earthworks
DC Cable trenching	21,000	12,600
AC Cable Trenching	10,743	8,595
HV Cable Trench	1,660	1,992
Inverters	1,270	381
Roading	109,116	21,823
Substation	6,300	2,520
BESS Area	1,600	320
Total:	151,689	48,230.34

All earthworks will be undertaken in accordance with appropriate sediment and erosion control measures.

Site Access

The Site will be fenced and gated for security / insurance purposes. A 2 m high deer-fence type perimeter fence is proposed to be constructed using wooden posts and wire mesh.

A total of four site accesses are proposed. Three will be from Ranfurly-Naseby Road and the fourth will be from Ranfurly Back Road. Accesses 1 and 2 will be the primary access points to be used by heavy vehicles during construction. It is proposed to establish an entry and exit access configuration so that construction vehicles enter the Site via Access 1, unload materials onsite (including the use of temporary laydown areas), and subsequently exit the Site via Access 2.

Accesses 3 and 4 are to be secondary access points, primarily used to gain more direct access to other parts of the Site to reduce the amount of travel through the Site. Accesses 3 and 4 will not be used by heavy vehicles.

Figure 5 below shows the locations of these accesses. All accesses will be retained once construction is completed to allow for easier access to all parts of the Site when required (although Accesses 1 and 2 will remain the primary accesses and Accesses 3 and 4 will receive minimal use).

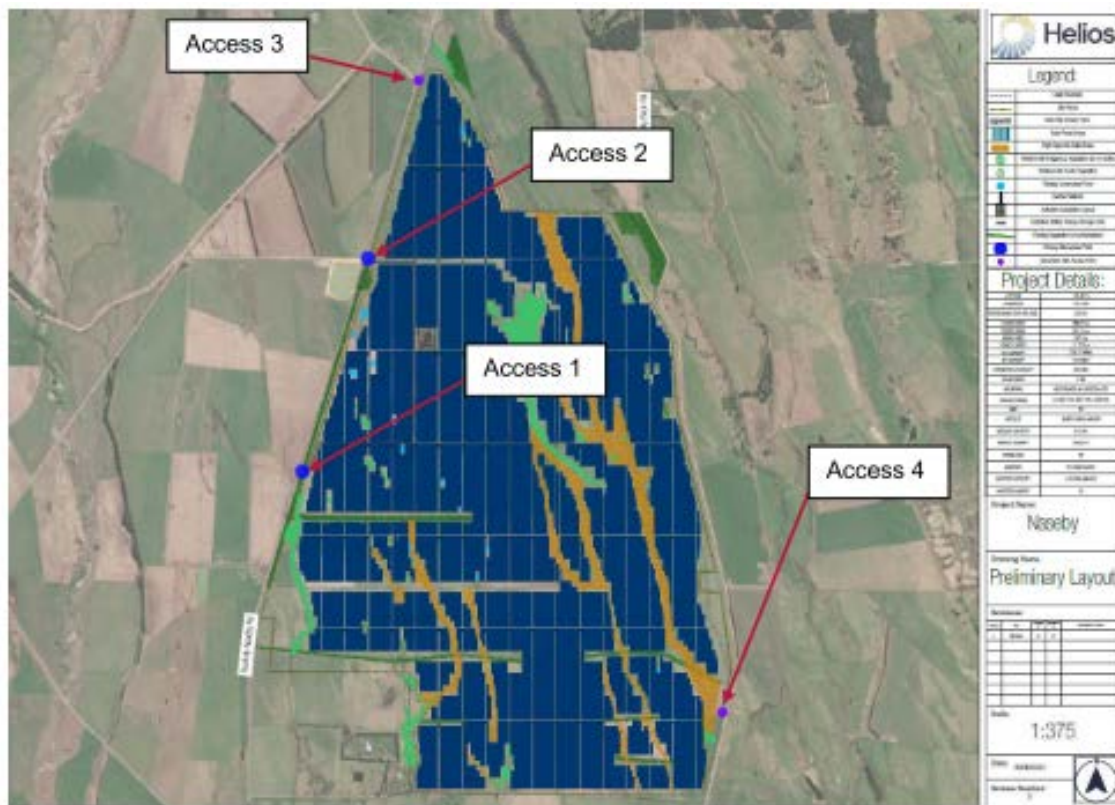


Figure 5. Proposed access locations.

New sections of internal access tracks will be required (see route in Figure 5 above) which will be formed by the placement of sub-base aggregate, approximately 3.5-4.0 m wide. Together with upgrades to existing access tracks, the total length of internal access tracks (new and existing) will be approximately 27 km.

Existing waterway crossings used to access the Site will be utilised for construction and operational vehicle access (predominantly construction). At time of detailed design, these will be further inspected to confirm whether any upgrade or new waterway crossings will be required, and additional resource consents sought if required. Therefore, for the purpose of this assessment, and at time of consent lodgement, we have assumed³ that there will be no works undertaken within or near waterways, including in relation to existing vehicle crossings.

2.3 Mitigation and Restoration Strategy

The Proposal has been designed in a manner to minimise its impact on the landscape and ecological values of the Site as far as practicable through the retention of all mature trees / vegetation and the avoidance of wetland areas and waterways.

To assist with screening views of the solar panels and integrating the proposed development with the surrounding landscape, a combination of setbacks and screen planting are proposed:

³ Based on information provided to Boffa Miskell by Helios on 1 November 2023.

Setbacks

- Boundary setback: boundary to fence (planting buffer) – 10 m, fence to arrays – 6 m
- Vegetation – 15 m either side
- Waterways – 10 m (see Section 3.0)
- Wetlands – 5-10 m (see Section 3.0)
- Constructed farm ponds – 2 m (see Section 3.0)
- High slope areas – 15 m
- Substation – 6 m
- Gen-tie line – 10 m
- Internal fence line – 5 m

Screening Planting

The proposed planting will be a mix of native species in some locations and may include faster growing exotic shelterbelt species in other locations where additional height is needed and to infill existing shelterbelts. The indicative locations and extent of this proposed planting are shown in the Landscape Planting Plan prepared in association with the Landscape and Visual Effects Assessment.

The plant species list in the Landscape Planting Plan was prepared with ecological input from the authors of this report, to ensure that locally appropriate indigenous species are used. In addition, the need to remedy losses of indigenous shrubs via replanting (see Section 8.1.2) has been discussed with the authors of the Landscape and Visual Effects Assessment / Landscape Planting Plan. The required remedial shrub planting (see Section 8.1.2) has therefore been accounted for in these plans / assessments.

2.4 Construction

A draft construction methodology for the Proposal is provided in the AEE. The total construction period is anticipated to take approximately 24 months, which includes enabling works, site preparation, construction, and commissioning prior to operation.

2.5 Operation

Once the solar farm is operational, activity will be very limited. No staff will live onsite as the componentry is operated / monitored remotely. However, should componentry need to be replaced, it will need to be accessed. This is likely to be infrequent. Vehicle movement within the Site will typically be by quad bike or small farm utility vehicle.

The panels have a silicon based non-stick surface and are cleaned adequately via rain.

Typical day-to-day operation of the substation will also largely occur remotely. Infrequent visits by maintenance / inspection teams will be undertaken. There may be 5-6 staff visiting the Site office once per week.

Agricultural activity will continue on the Site. The panels will be raised off the ground sufficiently to enable sheep grazing. The grazing of sheep not only continues productive use of the rural Site but also removes the need for grass mowing and weed management.

2.6 Decommissioning

At the end of the operational lifespan of the solar panels, the solar farm, including the substation building and all ancillary equipment, will be dismantled and removed from the Site.

Materials will be reused or taken to an appropriate location for recycling or disposal. The Site will be reinstated to its original pre-construction condition.

3.0 Project Shaping

The ecological surveys (see Section 4.3) were carried out based on a draft solar farm layout. Following completion of the surveys, the field data was analysed, and the boundaries of wetlands and waterways were mapped during a project shaping process. In this process, ecological project shaping advice was provided by Boffa Miskell to Helios that:

- Provided recommendations to change the draft solar farm layout, and recommendations regarding the methods for cable laying (i.e., the use of horizontal drilling), to avoid or minimise effects on wetlands and waterways.
- Identified the location of natural inland wetlands and waterways, and provided options for construction setbacks to avoid adverse effects and in relation to planning rules. Setbacks adopted by Helios and incorporated into the Proposal are provided below in Table 2.
- In particular, wetland setback distances were discussed by Helios and Boffa Miskell, and a minimum 5 m construction setback was agreed. This setback distance strikes a balance between the need to:
 - o Avoid any possible hydrological effects on wetlands (we do not foresee that the piling works to install solar arrays could have any effect on adjacent wetland water supply and hydrology; but out of an abundance of caution advised the applicant of at least some setback); and
 - o Maintaining an economically viable solar farm size: blanket application of 10 m setbacks was considered⁴, but would reduce the potential build area of the Solar Farm Site, for no benefit to the specific wetlands.

What this means is that within the Site, all wetlands (plus at least a 5 m buffer from the delineated edge of the wetlands) would be fully avoided by construction works. A fence would be erected at least 10 m from the boundary (as determined following the methodology outlined in Section 4.3.1 and 4.4) of the large central wetland and southwest waterway / wetland (Table 2), and these areas would be excluded from solar farm development, retired from grazing, allowed to regenerate, and deliberately enhanced.

Separate project shaping recommendations from the project's Landscape Architects (in relation to landscape and visual effects) are outlined in a separate Landscape and Visual Effects Assessment also attached to the AEE.

Table 2. Setback distances in relation to wetlands, constructed farm ponds, and waterways.

Feature	Locations within Site	Construction Setback (min.)	Notes
Natural inland wetlands	Central wetland	10 m	Would also be fenced and enhanced
	Wetland and waterway in southwest of Site	10 m	Setback applies from the outermost of either the wetland or waterway boundary. Would also be fenced and enhanced

⁴ Under the National Environmental Standards for Freshwater 2020, non-complying rules generally apply to earthworks outside but within 10 m of natural inland wetlands.

Feature	Locations within Site	Construction Setback (min.)	Notes
	Small wetlands with indigenous vegetation (various locations)	5 m	Generally small features (c.<1000 m ²) - unfenced
	Small wetlands without indigenous vegetation (various locations)	5 m	Generally small features (c.<1000 m ²) - unfenced
Constructed farm ponds	Various locations	2 m	Not 'natural inland wetlands'. Unfenced
Waterways	Wetland and waterway in southwest of Site	10 m	Setback applies to the bank of the waterway
	Waterway in northeast of Site	10 m	Waterway located on lower terrace. Actual setback distance is c.>50 m

Note: Setbacks relate to construction, i.e., of solar panels, cable trenches, accessways, inverters, and the like. Setbacks do not apply to proposed plantings for the purpose of ecological enhancement, or to perimeter fencing of wetlands.

4.0 Methods

This EclIA report has been based on desktop investigation methods and ecological field survey, as follows:

4.1 Definitions and Naming Conventions

The terms used to refer to the project locations and activities are:

- The 'Solar Farm Site' or 'Site' which refers to property on which the project will occur (Figure 1).
- The 'solar farm footprint', which encompasses the maximum extent of all works associated with the solar farm, both permanent and temporary, and therefore defines the limit of direct effects on the Solar Farm Site's ecology.

Where possible, common names for plants and animals have been used in this report. Where a species does not have a common name, or its common name cannot be used to identify the species without ambiguity, scientific names have been used.

4.2 Desktop Review

4.2.1 Terrestrial Vegetation and Habitats

Desktop information on terrestrial ecology values (indigenous vegetation, habitats of terrestrial fauna and terrestrial species) likely to occupy habitats within and adjacent to the proposed solar farm footprint were gathered included the following key sources:

- Aerial imagery, including high-resolution drone imagery obtained for the Solar Farm Site by Helios in May 2023;
- Geographic Information System (GIS) databases including:
 - o Topographical (Topo50) data (Land Information New Zealand);
 - o Threatened Environment Classification (Cieraad et al., 2015; Walker et al., 2015);
 - o Ecological Region and Ecological District GIS layers; and
- Otago Regional Council's Regionally Significant Wetlands maps and Central Otago District Plan (**CODP**) 'Area of Significant Natural Value' maps.

4.2.2 Avifauna

A desktop investigation was conducted and included a review of scientific literature, relevant statutory documents, relevant published and unpublished reports, and reputable websites (including eBird) to find information on avifauna within, and in the vicinity of, the Solar Farm Site. Data were also collated from the two 10x10 km grid squares (228,556 and 228,557; Appendix 3) of the Ornithological Society of New Zealand's (OSNZ) Atlas of Bird Distribution in

New Zealand that encompasses the Solar Farm Site (Robertson et al., 2007), as well as from the appropriate grid squares (DP29 and DO29; Appendix 3) in the NZ Bird Atlas online effort map that shows bird records to date for the data collection process for the new Atlas⁵.

4.2.3 Lizards

Desktop records of indigenous lizard species within 10 km of the Solar Farm Site were obtained from the Department of Conservation (**DOC's**) Herpetofauna Database.

4.3 Site Investigations

Jaz Morris and Cara-Lisa Schloots (Ecologists, Boffa Miskell) visited the Solar Farm Site on 12 - 15 June 2023 to undertake a survey of terrestrial and wetland vegetation / habitats across the Site.

Karin Sievwright and Cara-Lisa Schloots (Ecologists, Boffa Miskell) visited the Solar Farm Site on 16 - 19 October 2023 to undertake bird surveys and a further detailed survey of wetland vegetation / habitats including wetland plot measurements.

Field assessments and surveys were carried out as described below.

4.3.1 Terrestrial and Wetland Vegetation / Habitats

4.3.1.1 Initial Site Visit

The vegetation and habitats within the Solar Farm Site were surveyed by 4WD and on foot by Jaz Morris and Cara-Lisa Schloots (Ecologists, Boffa Miskell) on 12 - 15 June 2023. Although the vast majority of the Site comprises improved pastures, short rotation cropland and shelterbelts, all parts of the Solar Farm Site were visited. Particular locations of interest (e.g., possible wetlands) were targeted based on aerial imagery. The Site contains numerous (dozens) small depressions that, in the most recent currently available imagery, contain ponded water; all of these locations were visited to determine wetland status. During the initial site visit:

- The plant communities at the Solar Farm Site were classified using the classification system and naming conventions developed by Atkinson (1985). A handheld Garmin Global Positioning System (GPS) and ArcGIS Field Maps were also used to mark plant community boundaries where necessary.
- Plant species, and their cover (using the 'DAFOR' scale) was recorded in each of the plant communities (a list of the plant species recorded during the site visit is provided in Appendix 4, Table 21-Table 22). This focused on wetlands; not all exotic pasture grasses and exotic pasture herbs within exotic improved pastures were recorded.
- General notes were made on the condition of the plant communities and habitats present.

Because this site visit occurred during winter conditions outside the typical growing season and when some plant species had seasonally died off, vegetation plots to delineate wetland extent (Ministry for the Environment 2022b) were not undertaken during this site visit.

⁵ Atlas Effort Map – New Zealand Bird Atlas (ebird.org). Accessed October 2023.

4.3.1.2 Wetland Delineation Site Visit

All wetlands identified during the June 2023 Site visit along with all depressions containing ponded water in aerial imagery were revisited by Cara-Lisa Schloots on 16 - 18 October 2023, during the growing season. Wetland delineation plots (Ministry for the Environment 2022b) were measured in all of these wetlands (excluding constructed ponds with standing water and no surrounding hydrophytic vegetation) to confirm wetland status (based on the presence of hydrophytic vegetation and wetland hydrology), as well as wetland boundaries.

For determining the presence and extent of 'natural inland wetlands', the wetland delineation method followed the *Wetland delineation protocols* (Ministry for the Environment 2022b) which are incorporated within the National Policy Statement for Freshwater Management 2020 (**NPS-FM**; Ministry for the Environment, 2023b). This method uses 2 m x 2 m vegetation plot sampling and hydrophytic vegetation determination. The protocols enable determination of the 'rapid test,' 'dominance test' and 'prevalence index' as originally proposed for New Zealand by Clarkson (2013). The *Wetland delineation protocols* also include an assessment of the presence of hydric soils and wetland hydrology when the outcome of the 'rapid test,' 'dominance test' and 'prevalence index' are uncertain (Fraser et al., 2018; Ministry for the Environment, 2021). The wetland indicator rating status for each plant species follows Clarkson et al. (2021)⁶. The meaning of these classifications are as follows (reproduced from Clarkson (2021):

- OBL: Obligate. Almost always is a hydrophyte, rarely in uplands (estimated probability >99% occurrence in wetlands);
- FACW: Facultative Wetland. Usually is a hydrophyte but occasionally found in uplands (estimated probability 67–99% occurrence in wetlands);
- FAC: Facultative. Commonly occurs as either a hydrophyte or non-hydrophyte (estimated probability 34–66% occurrence in wetlands);
- FACU: Facultative Upland. Occasionally is a hydrophyte but usually occurs in uplands (estimated probability 1–33% occurrence in wetlands); and
- UPL: Obligate Upland. Rarely is a hydrophyte, almost always in uplands (estimated probability <1% occurrence in wetlands).

Based on the *Wetland delineation hydrology tool for Aotearoa New Zealand* (Ministry for the Environment, 2021), a site has wetland hydrology if it has :

- Evidence of at least one primary wetland hydrology indicator; or
- Evidence of at least two secondary wetland hydrology indicators.

In relation to the *Pasture exclusion methodology* (Ministry for the Environment, 2022a), we note that:

- The entire Site comprises areas of pasture that are used for grazing; and
- To our knowledge, the Site is not mapped as a location of a habitat of a threatened species as identified under clause 3.8 of the NPS-FM. Regardless of whether any threatened species may use the Site, the Site needs to be mapped by a regional council following clause 3.8 for the 'exemption to the exemption' in the 'natural inland wetland' definition in 3.21 e iii to apply.

⁶ The indigenous sedge species *Carex kaloides* is present in some wetlands at the Site but does not have a wetland indicator status ranking in Clarkson et al. (2021). For the purposes of wetland delineation, it was assigned the status 'FACW' based on the experience and opinion of the authors of this report.

Finalised mapping of wetland extents (Appendix 5) used the plot information, hydrology indicators, contours, and vegetation types to delineate wetlands.

4.3.2 Avifauna

4.3.2.1 Desktop Investigation

4.3.2.2 Field Investigation

A nesting bird survey, 20-minute point counts and five-minute bird counts (**5MBCs**) were conducted by Karin Sievwright (Ornithologist, Boffa Miskell) between 16 and 19 October 2023. Incidental observations of other birds observed outside the formal survey periods were also recorded. Survey methods are described below.

4.3.2.2.1 Nesting Bird Survey

The nesting bird survey period was timed to coincide with the breeding season of At Risk indigenous species identified in the desktop review that could potentially nest on Site (South Island pied oystercatcher, New Zealand pipit and banded dotterel). The survey involved walking and slowly driving over the Site and searching for any nesting birds. Records were kept of the species, number, and location of nesting birds observed. Records were also kept of nesting birds (including Not Threatened species) observed while conducting other surveys on site.

4.3.2.2.2 Point Counts

Twenty-minute point counts were conducted at four locations spanning the Site (Figure 6). Each survey involved recording all indigenous species observed, their abundances, direction from the observer, direction of movement, behaviour, their location (e.g., pasture, pond, wetland, shelterbelt, etc) and any other observations of note. Weather conditions were also recorded. Each survey location was surveyed twice, once in the morning and once in the afternoon to account for temporal variation in bird activity. The purpose of the point counts was to collect some data on how indigenous bird species were using the Site (e.g., habitats, behaviourally, etc).

4.3.2.2.3 Five-Minute Bird Counts (5MBCs)

Five-minute bird counts were conducted at 12 locations across Site, up to 1 km apart (Figure 6). Sites were selected that provided good coverage of the Site and encompassed different vegetation types and habitat features present on Site (e.g., pasture, shelterbelts, wetlands, ponds, other vegetation). Each survey location was surveyed twice, once in the morning and once in the afternoon to account for temporal variation in bird activity. The surveys were preceded by a five-minute stand down period and followed the standard 5MBC count methodology (Dawson & Bull, 1975). The purpose of the 5MBCs was to provide context on both exotic and indigenous species present on Site and their relative abundances.

4.3.2.2.4 Incidental Observations

Records were also kept of any bird species incidentally observed outside of the formal bird survey periods.

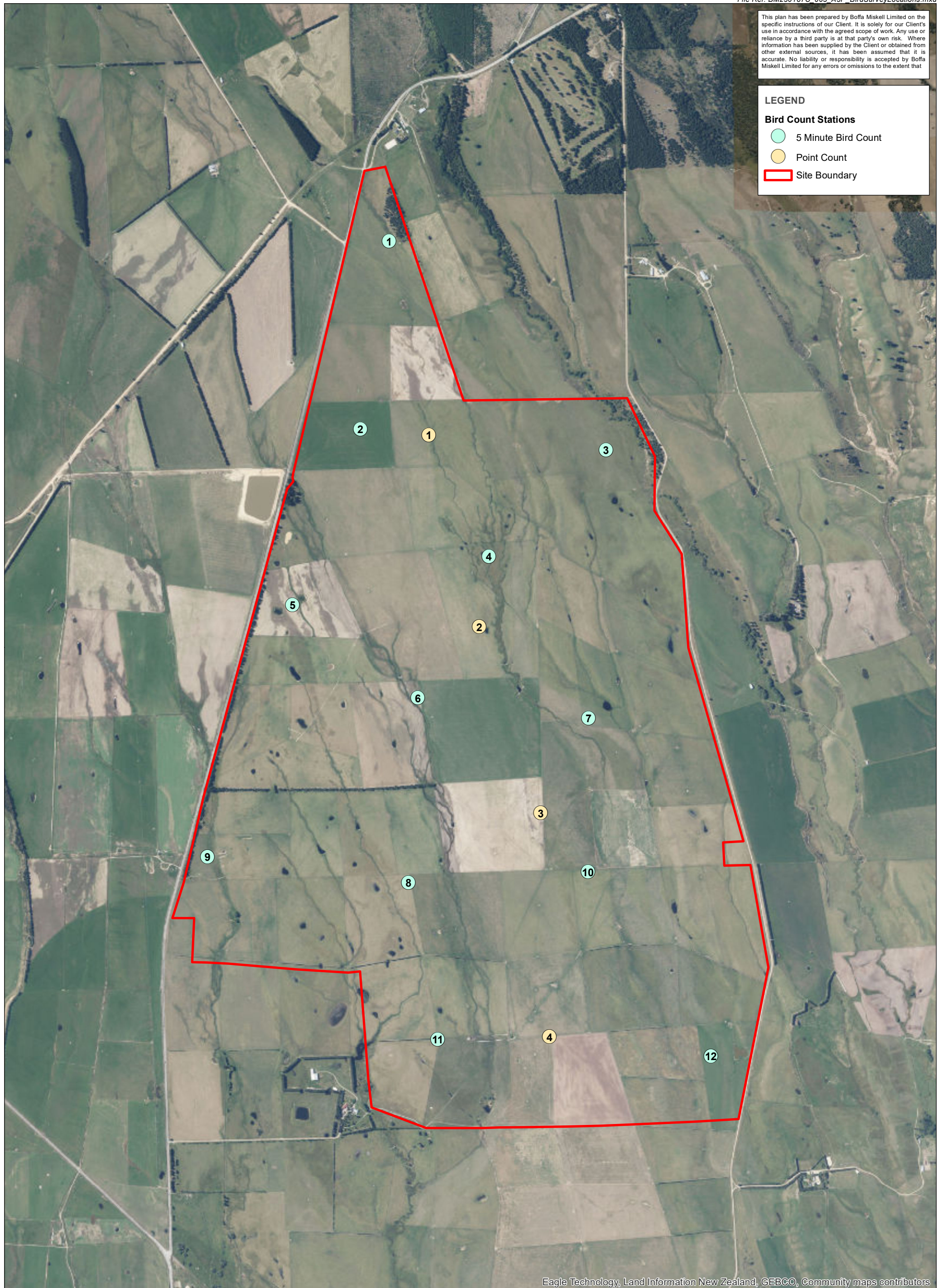
A roaming inventory was also compiled of all bird species seen and heard during the botanical surveys, including species observed on the ground and overflying the Solar Farm Site.

This plan has been prepared by Boffa Miskell Limited on the specific instructions of our Client. It is solely for our Client's use in accordance with the agreed scope of work. Any use or reliance by a third party is at that party's own risk. Where information has been supplied by the Client or obtained from other external sources, it has been assumed that it is accurate. No liability or responsibility is accepted by Boffa Miskell Limited for any errors or omissions to the extent that

LEGEND

Bird Count Stations

- 5 Minute Bird Count
- Point Count
- Site Boundary



Previous page: *Figure 6. Bird survey locations*

4.4 Vegetation Mapping

The plant communities and wetlands within the Solar Farm Site were mapped in ArcMap. Detailed aerial imagery collected from the Solar Farm Site, and information collected during the site investigations (GIS waypoints and photographs) was used to map plant communities.

4.5 Conservation Status

The conservation status of nationally Threatened and At Risk indigenous species used in this report are from the most current versions of their respective New Zealand Threat Classification System⁷ status reports:

- Plants: de Lange et al. (2018);
- Birds: Robertson et al. (2021); and
- Reptiles: Hitchmough et al. (2021).

4.6 Assessing Ecological Significance

Section 6(c) of the RMA requires identification of sites of significant vegetation and significant habitats of indigenous fauna. The Site is not identified as being 'significant' in the CODP. Three separate statutory significance assessment criteria are relevant to this Site. The significance of terrestrial communities and habitats was assessed against the statutory criteria in:

- Schedule 4 of the Partially Operative Regional Policy Statement 2019 (**POORPS**; Otago Regional Council, 2021)
- Appendix 2 of the Proposed Otago Regional Policy Statement 2021 (**PrORPS**; Otago Regional Council, 2022)
- Appendix 1 of the National Policy Statement for Indigenous Biodiversity 2023 (**NPS-IB**; Ministry for the Environment, 2023a⁸)

Under each of the respective criteria, a site is significant if it meets any one of the applicable criteria.

4.7 Evaluation of Ecological Effects

To determine the level of ecological effects associated with the Proposal, we have followed the Environment Institute of Australia and New Zealand's (**EIANZ**) EclA guidelines (Roper-Lindsay et al. 2018).

In summary, the EclA method requires assessments of:

⁷ <https://nztns.org.nz/>

⁸ The NPS-IB does not apply to renewable energy projects (such as the proposed solar farm). However, local councils will ultimately need to give effect to the significance criteria in the NPS-IB, and so these criteria are considered relevant to a section 6(c) assessment. At the time of preparation of this report, the incoming government has signaled an intention to 'urgently review' the NPS-IB.

- The values of communities, habitats / ecosystems and species (Appendix 2, Table 16 - Table 18);
- The magnitude of impact (Appendix 2, Table 19); and
- The level of ecological effect based on a decision matrix of ecological effect and magnitude of impact (Appendix 2, Table 20).

The EIANZ EcIA guidelines (Roper-Lindsay et al. 2018) note that the level of effect can then be used as a guide to the extent and nature of the ecological management response required (including the need for biodiversity offsetting). For example:

- **'Very High'** represents a level of effect that is unlikely to be acceptable on ecological grounds alone (even with compensation proposals). Activities having very high adverse effects should be avoided.
- **'High' and 'Moderate'** represent a level of effect that requires careful assessment and analysis of the individual case. Such an effect could be managed through avoidance, design, or extensive offset or compensation actions.
- **'Low' and 'Very Low'** should not normally be of concern, although normal design, construction and operational care should be exercised to minimise adverse effects. If effects are assessed taking impact management measures developed during project shaping into consideration, then it is essential that prescribed impact management is carried out to ensure low or very low-level effects.
- **'Very Low'** level effects can generally be classed as 'not more than minor' effects.

Further details are provided in Appendix 2.

4.8 Limitations and Assumptions

The following limitations apply to this ecological impact assessment:

- *Lizards*: During the initial Site visit, a qualitative assessment of habitat suitability for indigenous lizards was undertaken. This included checking for areas of rank grass, rock piles or outcrops, and complex vegetation providing possible lizard food and refugia habitat. No lizard habitat was identified within the solar farm footprint. Based on this habitat assessment, no detailed lizard survey methods were undertaken.
- *Works in waterways / freshwater ecology*: As described in Section 2.2, it is understood that no works in waterways are anticipated or proposed, and on this basis no freshwater ecology investigations have been undertaken. The Site contains two waterways (a largely channelised stream / water race, in the southwest of the Site, and a stream in the northeast; both would be fully avoided by proposed works. At the time of detailed design, existing crossings of these waterways (likely only the southwest stream / race) will be further inspected to confirm whether any upgrade or new waterway crossings will be required, and additional resource consents sought if required. For the sake of completeness, we also note that the Site also contains former (decommissioned) water races; these were dry during the time of ecology site investigations and contained no freshwater habitat values whatsoever.
- *Terrestrial invertebrates*: The solar farm footprint was found not to contain areas of indigenous vegetation, other than scattered individual indigenous plants (e.g., matagouri shrubs along fence lines). Widespread clearance of the existing habitats (i.e.,

exotic pastures) at the Solar Farm Site is not proposed as part of solar farm construction (other habitats, i.e., wetlands, would be fully avoided). Extensive exotic pasture habitat would be maintained, except for relatively minor areas of hardstand e.g., the proposed substation). For these reasons, no surveys for indigenous terrestrial invertebrates have been undertaken, and we consider it is highly unlikely that any indigenous terrestrial invertebrate species or communities are present that would be subject to adverse effects requiring specific impact management responses. Accordingly, no further discussion or assessment in relation to terrestrial invertebrates is provided in this report.

- *Avifauna surveys*: It is acknowledged that there will be a degree of seasonal variability in the avifauna assemblage on Site. Based on project timeframes, bird surveys were undertaken in only one season (spring), but survey timing was deliberately targeted at the peak of the indigenous bird breeding season. To account for this single survey, this assessment has been conservative and assumed presence of some key indigenous bird species that were not recorded on Site but that may be present at times due to availability of suitable habitats on Site; desktop information has also been relied on to inform this assessment.
- *Bird strike*: As discussed in Section 7.2.4, no large-scale solar farms have been built in New Zealand therefore the potential impact of bird strike with panels has not been studied in New Zealand; accordingly, this assessment relies on data from overseas studies where solar farms have been established for many years.
- *Assessment framework*: It is acknowledged that the EIANZ EcIA methods (Roper-Lindsay et al. 2018) are non-statutory and are not intended to replace a separate significance assessment using RMA policy instruments (hence, see statutory significance assessment methods and findings in Sections 4.6 and 6.1 respectively). The EIANZ guidelines have not been formally endorsed or adopted by councils, DOC, or the Ministry for the Environment. However, it is relevant that the EIANZ guidelines have recently been substantively adopted as part of Waka Kotahi's ecological impact assessment approach (Waka Kotahi, 2023), and that no other nationally consistent methodology are available. We also note that the EIANZ guidelines provide a transparent method for the determination of magnitude and level of ecological *effects*, whereas statutory significance assessments only determine the *significance* of a site and not effects. Other relevant guidance (e.g., Davis et al., 2016; Maseyk et al., 2018) relate only to discrete parts of the EcIA process, such as significance assessment, or offsetting best practice in response to effects. The recently gazetted NPS-IB 2023 provides EcIA information requirements, but not effects assessment methods. In summary, the EIANZ method is considered an appropriate methodology for determining ecological effects and to guide impact management.

5.0 Existing Ecological Environment

5.1 Ecological Context

The Solar Farm Site is within the Mānīatoto Ecological District (**ED**) in the Central Otago Ecological Region (**ER**; McEwen, 1987), on the Mānīatoto Plain. The historic (pre-human) vegetation of the ED / ER is not well understood but is likely to have included open, cool forests of species such as Hall's tōtara, mountain celery pine, broadleaf, and bog pine (see Wildland Consultants Ltd, 2020, and references therein). By the time of European settlement, the district was dominated by tall tussock grassland with areas of short tussockland and often extensive scrub with matagouri, mikimiki (*Coprosma* spp.), porcupine shrub and tree daisies (*Olearia* spp.). Within the Mānīatoto ED, areas of wetland were likely extensive along the Taieri River; while large examples of these habitats remain, many of these have been drained or modified by crack willow (McEwen, 1987). In general, wetlands in the region have reduced in extent (Ausseil, Gerbeaux, et al., 2008).

The existing (present day) vegetation reflects further modification following the Otago gold rush and European pastoralism. The extent of pre-European scrub, short tussock, and tall tussock communities has been severely reduced by pastoral conversion including years of grazing by sheep and cattle, as well as rabbits. Gold workings and construction of water races have modified freshwater habitats in the area, and extensive plantation forests between the Site and Naseby have been established since c.1900.

Geologically, the Solar Farm Site comprises gentle undulating downlands and terraces on Tertiary aged rocks, schist, and greywacke with good to moderate drainage. The southwest part of the Site has many small depressions which hold water after rainfall and this part of the Site lies on Tertiary aged sandstone, mudstone, weakly indurated conglomerate, or calcareous rocks with a loess cover less than 0.8 m thick.

The Solar Farm Site is located at 500-560 m elevation with a cool semiarid climate, meaning hot and dry summers and cold frosty winters and snow on the ground at times. There are high vapour pressure deficits and annual water deficits.

In terms of the Threatened Environment Classification⁹, the Solar Farm Site is within a land environment (N5.1a), where <10% indigenous vegetation remains nationally (Cieraad et al., 2015). There are no naturally uncommon ecosystems on the Site (Williams et al., 2007).

The Solar Farm Site is presently used for sheep and beef grazing on intensively improved exotic pastures and short rotation cropland. It is not irrigated. Surrounding land use is generally pastoral farming, aside from large areas of plantation conifer forest to the northeast. In the vicinity of the Site, very few areas of indigenous vegetation remain. Based on recent desktop ecosystem mapping (Wildland Consultants Ltd, 2020), the nearest indigenous habitats are areas of riparian shrubland at the Ewe Burn, c. 2 km from the Site.

⁹ The Threatened Environment Classification is a combination of three national databases: Land Environments of New Zealand, Land Cover Database (Version 2) and the Protected Areas Network. The Threatened Environment Classification shows how much indigenous vegetation remains within land environments, how much is legally protected, and how the past vegetation loss and legal protection are distributed across New Zealand's landscape.

5.2 Vegetation and Terrestrial Habitats

5.2.1 Exotic Grassland / Cropland (Pasture)

The main vegetation type across the Solar Farm Site is exotic grassland / cropland (improved pasture and short rotation crops) that is grazed by sheep and cattle. Many if not all areas are regularly mechanically cultivated. All indigenous vegetation has been removed from the paddocks (Figure 7). All remaining indigenous plants persist as sparse isolated shrubs along internal and external fence lines (Figure 8). Within the Site, i.e., along internal fence lines¹⁰, there are approximately 20 locations with small patches of shrubs including:

- Tūmatakuru / matagouri (At Risk – Declining; approximately and conservatively, <250 plants are present along internal fence lines);
- Mākaka / desert broom (At Risk – Declining; as above, <100 plants are present);
- Scrub pōhuehue (<100 plants are present);
- Porcupine shrub (<25 plants are present).

At one location on an external fence line the At Risk – Declining bidibid (*Acaena buechananii*), as well as another indigenous herb *Gonocarpus micranthus* subsp. *micranthus* are present, outside the proposed solar farm footprint. Golden spaniard and narrow-leaved snow tussock were also found on the western and eastern Site boundary (respectively), also outside the solar farm footprint. Another At Risk – Declining species, *Coprosma intertexta*, was recorded in a wetland / stream area in the northeast of the property, but the only locations of this species are located well outside the solar farm footprint (10s – 100s of m). None of these indigenous species are considered further in this assessment.

An overall species list for dryland habitats is provided in Appendix 4, Table 21.

Following construction of the solar farm, the Site will continue to be maintained as exotic pasture for sheep grazing. Temporary clearance and permanent loss¹¹ of exotic pasture is not of ecological concern (other than providing habitat for indigenous birds; see Sections 5.3 and 7.2) and, in terms of vegetation, is not discussed further in this assessment¹².

¹⁰ Helios have informed Boffa Miskell (on 29 November 2023) that design parameters for the Site assume a 6 m setback from the existing site boundary (i.e., external fence lines) before the new security fence. It is therefore understood and assumed for the purposes of this assessment that no indigenous shrubs on external fence lines will be cleared or lost.

¹¹ Because solar panel arrays are installed via piling there is no need to clear the Solar Farm Site except for relatively minor works (minor in terms of the scale of the Site) to install cabling trenches, create temporary laydown areas, create gravel access roads, to build a substation, and to install a number of pre-assembled inverter stations. The total area of these works, and hence direct vegetation clearance is understood to be in the vicinity of 15 ha (Section 2.0). Following further detailed design, the precise layout of works may vary slightly from what is indicated in Figure 1.

¹² We note that given the overall similarity of exotic pastures across the Site, layout changes following e.g., detailed design (compared to Figure 1), if any, would not alter this conclusion.



Figure 7: Typical pasture vegetation found on the Site.



Figure 8: Typical isolated matagouri shrubs along a fence line.

5.2.1.1 Ecological Value of Exotic Grassland / Cropland (Pasture)

The ecological value of the overall exotic grassland / cropland area (improved pastures, with isolated / patchy indigenous shrubs on fence lines) has been assessed below, following the

methodology of Roper-Lindsay et al. (2018). The assessment scale is the Mānīatoto ED for 'representativeness', and the ED and national scale for 'rarity'.

- **Representativeness:** Exotic pasture areas are not representative of the original and remnant indigenous vegetation in the Mānīatoto ED. Whilst scattered indigenous shrubs of species typical of the ED remain in places along fence lines, these represent relict individual plants that do not form functioning plant communities. Pasture areas support largely exotic bird assemblages (see Section 5.3) and do not support a representative range of indigenous fauna species reflecting original / remnant habitat areas. Dryland vegetation at the Site scores very low for representativeness.
- **Rarity and Distinctiveness:** Exotic pastures do not support distinct or naturally uncommon indigenous habitat types. In terms of the Threatened Environment Classification, the Site occurs on a landform on which <10% indigenous vegetation remains nationally, meaning that indigenous species are of greater ecological value in this context. The Site contains small populations of three At Risk – Declining species: matagouri, desert broom, and *Acaena buehneri*¹³. No evidence of recruitment (seedlings / young plants) of matagouri or desert broom was noted (all individuals were observed to likely be many decades old or more), and it is considered likely the individual plants are relict, and survive only because they are present on fence lines where they have not been removed by cultivation and are less accessible to grazing. No indigenous species considered or known to be uncommon in the ED were recorded. The area provides foraging habitat for mobile At Risk indigenous bird species such as pīhoihoi / New Zealand pipit and tōrea / South Island pied oystercatcher as well as potential nesting habitat for tōrea / South Island pied oystercatcher but is not core or rare habitat for these species. Clearly, exotic pastures themselves are not rare habitat types locally or nationally (nor the feeding / breeding opportunities that they may provide for mobile bird species). On this basis, and because the Site supports indigenous species that are nationally At Risk and occur on a landform on which <10% indigenous vegetation remains nationally, the overall habitat is conservatively considered to score moderate for rarity and distinctiveness.
- **Diversity and Pattern:** Indigenous flora and fauna diversity / pattern within pasture areas is very low; exotic species are dominant in terms of cover and species composition, and it is uniformly exotic pasture or exotic shelterbelts (aside from wetland areas assessed separately).
- **Ecological Context:** The ecological integrity of this vegetation type is very low, and it does not play an important function in terms of ecological networks, linkages or pathways. Whilst it is likely to be transiently used by highly mobile fauna species, it is highly unlikely to be an important Site for feeding, roosting, breeding, or resting of any indigenous fauna species.
- In summary, we consider that dryland vegetation (pastures, with occasional indigenous species on fence lines) at the Site scores very low for representativeness, moderate for rarity / distinctiveness, very low for diversity and pattern, and very low in terms of ecological context (see Table 16).
- Overall, exotic pasture areas are of **negligible** ecological value (see Table 18).

¹³ As noted above, this species occurs only at the northern boundary of the Site, outside the solar farm array.

5.2.2 Wetland Habitats

Three wetland types / locations within or at the margins of the proposed solar farm are discussed. Based on the Site investigations and plot results in Appendix 4, Table 23, all wetland areas described below are considered to meet the definition of 'natural inland wetland' in the NPS-FM (2020). Their type / location is described in Table 3 and below.

Table 3. Wetland areas within the Site.

Wetland name (for descriptive purposes)	Extent	Location	Wetland Type / Hydrosystem / Vegetation Structural Class*	Comment
'Central wetland'	8.49 ha	Centre of the Site	Marsh / Palustrine / Rushland and Grassland	Water emerges from and soaks to ground – does not connect to a waterway
'Southwest wetland'	4.61 ha	Southwest of the Site	Marsh / Palustrine / Rushland and Sedgeland	Includes a stream / water race that has been deliberately channelised in places
'Small wetlands'	<i>Features in Total: 46¹⁴ Size Range: 0.008 ha-0.69 ha¹⁵ Average Size: 0.13 ha¹⁵ Total Extent: 8.86 ha¹⁴</i>	Scattered across site	Ephemeral & Marsh ¹⁶ / Palustrine / Herbfeld and Grassland	All are generally located within areas of exotic pasture in small hollows or narrow linear features

These wetland vegetation types are described broadly below, and species lists for these areas are provided in Appendix 4, Table 22. Their locations are mapped in Appendix 5. They are not within the build footprint of the solar farm. The 'central wetland' and 'southwest wetland' are to be fenced as part of the solar farm Proposal.

Central wetland

The 'central wetland' is a palustrine marsh wetland (some areas could possibly be considered swamp) at the approximate centre of the Site (Figure 9). It is a broadly triangular feature at a topographical low point that includes depressions linked by both apparently natural and historically dug / straightened channels. In places, and during wet conditions, water visibly seeps in places, but thereafter goes to ground (i.e., it is not, nor is it connected to, a stream or

¹⁴ Includes two wetland areas totaling approx. 3.11 ha that are located substantially outside the Site.

¹⁵ Only includes wetland areas that are fully within the Site.

¹⁶ Many areas are considered marsh wetlands on the basis of likely highly variable water levels (that are not ordinarily above ground level or above ground level for long periods), and mineral soil substrates (Johnson & Gerbeaux, 2004). Some of these wetland locations could be considered ephemeral wetlands, in that they are likely inundated only seasonally or after heavy rains and lack a natural outlet. However, this wetland classification ordinarily applies to wetlands with clear zonations of indigenous vegetation types (often including specialist species) reflecting adaptation to differing periods of inundation throughout the year (Johnson & Gerbeaux, 2004). Ephemeral wetlands typically (but not exclusively) occupy kettleholes and similar features in moraine landforms, which do not occur at the Site. Although indigenous ephemeral wetlands are considered a critically endangered naturally uncommon ecosystem type (Holdaway et al., 2012; Williams et al., 2007), it is not appropriate to apply this rating to the exotic and entirely modified wet pasture habitats at the Site. For the avoidance of doubt, we consider that it would be highly inappropriate to compare these features (in terms of ecological values) to indigenous ephemeral wetland habitats such as kettleholes or saline ephemeral wetlands elsewhere in the Mānīatoto.

waterway). Hydrologically, it is likely to be driven by rainfall inputs and seasonally variable groundwater levels.

The central wetland is largely a *Juncus* spp. – exotic grass rushland and grassland. Important species in terms of cover include various *Juncus* spp. rushes (occasional indigenous wīwī *J. edgariae*, occasional exotic soft rush *J. effusus*, occasional-frequent exotic jointed rush *J. articulatus*, and occasional toad rush *J. bufonius*), exotic grass species (including creeping bent, Timothy, kneed foxtail, and blue sweet grass). Other indigenous species of note included the At Risk – Declining sedge *Carex kaloides* (dozens of plants are present), purei (*C. secta*), pūkio (*C. virgata*), rautahi (*C. coriacea*), sharp spike sedge, bog rush, and square sedge.

This wetland will be fenced and set back from Site works by ≥ 10 m. However, an existing established vehicle crossing at a narrow point of the wetland will be used for construction and ongoing operational access.

Southwest wetland

The 'southwest wetland' is a marsh and lies along a stream / water race that has been partially excavated and straightened in places (Figure 10). It runs roughly north-south and crosses onto the site north of the stockyards within the Site adjacent to Ranfurly-Naseby Road. Within the Site, the downstream reaches of the stream are highly modified, and the riparian vegetation is primarily pasture. There are three culverts providing vehicle crossing points, but these do not appear to alter or impede flow. Hydrologically, some areas will receive water from the water race / stream, but in channelised areas the wetland is perched c.>0.5 m above the waterway, suggesting that these areas are driven by rainfall inputs and seasonally variable groundwater levels.

The wetland is variable in width and vegetation composition along the water race / stream length. North of the stockyards the wetland is dominated by rautahi (*Carex coriacea*) with wīwī, exotic soft rush, and two large patches of the At Risk – Declining sedge *Carex kaloides*. A small, raised area within the wetland supports a cluster of the At Risk – Declining grassland Spaniard. Other indigenous species present in this section of the wetland include blinks, waoriki (*Ranunculus glabrifolius*) and sharp spike sedge. Adjacent to the stockyards the wetland is largely a *Juncus* spp. – exotic grass rushland and grassland dominated by wīwī and exotic soft rush, overtopping dense exotic grass. Exotic grass species (including creeping bent, kneed foxtail, and blue sweet grass) dominate the lower sections of the wetland, with some rushes scattered throughout, and a patch of *Carex kaloides*.

This wetland will be fenced and set back from Site works by ≥ 10 m. However, existing established vehicle crossings over the water race will be used for construction and ongoing operational access.

Small wetlands

Numerous 'small wetlands' are described together for convenience, based on their high degree of similarity in terms of habitat type and vegetation cover. All are generally located within areas of exotic pasture in small hollows or narrow linear features (Figure 11). Most (if not all) appear to only accumulate standing water following heavy rain events. Many occupy depressions on higher ground meaning that there is no / little catchment to provide overland flows / runoff. For all the 'small wetlands,' rainfall is likely the only important hydrological driver.

All of these features are dominated in terms of cover and species composition by exotic grass species (including creeping bent, kneed foxtail, Yorkshire fog, and blue sweet grass). In some areas, rushes have established, particularly on the margins. Rush species include indigenous wīwī and leafless rush (*J. australis*), and exotic soft rush. Exotic herbs (particularly white clover dandelion and hawkbit species, and celery leaved buttercup) were common in some locations.

Of the 44 small wetland features, 25 contained a low percentage cover of wīwī, leafless rush, sharp spike sedge, or rautahi. The indigenous plant species that are present are common and widespread species that are likely to have opportunistically established and are tolerant of grazing. The remaining 19 small wetland features do not support any indigenous plant species.

These features are essentially areas of wet pasture. They are identified as 'natural inland wetlands' on the basis of wetland delineation methods (Ministry for the Environment, 2022b) that do not differentiate wetland status based on factors such as size or the presence or absence of indigenous flora or fauna values.

All of these wetlands would be excluded from the solar farm footprint and set back from Site works by ≥ 5 m.

Constructed farm ponds

For completeness, we note that the Site contains several constructed farm ponds (Figure 12); these are not considered wetlands. These ponds contain obvious signs of excavation and / or bunding via earthworks. Many lack vegetated margins and all have presumably been created for stock water purposes. On the basis that they have been deliberately constructed (noting exceptions 'b' and / or 'c' in the 'natural inland wetland' definition in section 3.21 in the NPS-FM 2020), none of these ponds are considered 'natural inland wetlands.'

They are proposed to be excluded the solar farm footprint and set back from works by ≥ 2 m).



Figure 9. 'Central wetland' showing indigenous sedges and rushes over a generally prevailing cover of exotic grasses.



Figure 10. 'Southwest wetland' showing (from left) the channelised stream / water race, areas of rautahi sedgeland, and *Juncus* spp. rushland.



Figure 11. A typical 'small wetland' at the Site, occupying a low lying area surrounded by exotic pasture. These features either fully lacked indigenous wetland plant species or contained very little indigenous vegetation cover comprising a small number (generally 1-5) of common and widespread indigenous species.



Figure 12. Constructed pond, showing evidence of excavation and bunding from historic earthworks.

5.2.2.1 Ecological Value of Wetland Areas

The ecological value of wetland areas has been assessed below, following the methodology of Roper-Lindsay et al. (2018). The assessment scale is the Mānīatoto ED for 'representativeness', and the ED and national scale for 'rarity'.

- **Representativeness:** No wetland areas at the Site are considered highly representative of the former (pre-human or pre-European) wetland areas in the Mānīatoto ED. Original wetlands likely included tall *Carex* spp. sedgelands, raupō reedlands, and bog rush and *Carex* spp. tussocklands and scattered shrubs in larger palustrine and riparian wetlands. Ephemeral / saline wetlands with indigenous turf species may have occupied depressions (see also Section 5.3.1, which briefly describes examples of regionally significant wetlands in the wider area). Whereas wetlands at the Site are generally dominated by exotic wetland species common in farmlands, such as jointed rush, sweetgrass (*Glyceria declinata*), soft rush, kneed foxtail and creeping bent. The central and southwest wetland include dug channels for drainage, modifying their hydrology. All are surrounded by intensively managed pastures that have been modified and improved over many years. Small wetlands lack indigenous plant assemblages and score very low for representativeness. On the other hand, the larger central and southwest wetland at the Site contain a small numbers of typical indigenous wetland species for the area. Not all species tiers are present (indigenous shrubs are absent, and exotic rather than indigenous herbs and low-stature species dominate), and indigenous plant cover is not high (<50% on average, in many areas much less). The indigenous species present are generally widespread and common species tolerant of grazing. Nevertheless, in the context of the degree of modification that all lowland palustrine wetlands in the area have likely experienced since European settlement, these wetlands score moderate for representativeness.

- **Rarity and Distinctiveness:** The current extent of palustrine wetlands (such as those at the Site) in the ED and Otago is not well understood¹⁷. Several very large areas of riparian 'scroll plain' wetlands are present in the ED along the Taieri River (100s-1000s of ha in extent), with other large wetlands associated with scroll plains of tributaries. Small poorly draining circular depressions that 'pockmark' the pastoral landscape are a notable feature of the area, with 44 at the Site and many hundreds or thousands nearby that are obvious in aerial imagery, especially west of Ranfurly. Considering that wetlands have been reduced to less than 20% of their former extent nationally (Ausseil, Gerbeaux, et al., 2008), all wetlands at the site should be considered at least moderately rare. Habitats that have been reduced to less than 20% of their former extent are one of four national priorities for protection on private land (Ministry for the Environment & Department of Conservation, 2007). The central and southwest wetland, which contain substantial areas of indigenous vegetation and two At Risk – Declining species on a landform on which <10% indigenous vegetation remains nationally are considered highly rare.
- **Diversity and Pattern:** Indigenous species diversity and pattern in small wetlands is very low, with very few indigenous species (almost half lack indigenous species altogether), and generally uniform habitat surrounded by exotic pasture. Diversity in the central and southwest wetlands is low-moderate, with a small number of a similar suite of indigenous species present in each location. Habitat pattern is low, with some variation in wetter pools / depressions linked by linear features but otherwise abrupt transitions to exotic habitat.
- **Ecological Context:** The small wetlands are not important in terms of their ecological context. They are too small (the average size is 0.13 ha), modified, and poorly buffered to support important indigenous fauna assemblages or to contribute to ecological linkages or networks. They score very low for ecological context. The central and southwest wetland are large enough (8.5 and 4.6 ha respectively) and sufficiently buffered to support larger indigenous plant assemblages that may contribute to gene flow of wetland plant populations in the area and provide fauna habitat permanently or seasonally. They score moderate for ecological context.
- **Overall, small wetlands are of **negligible** ecological value. The central and southwest wetlands are of **moderate** ecological value.**

5.2.3 Threatened, At Risk Plants or Locally Uncommon Plants, and Ecological Value

Dryland exotic pastures within the solar farm footprint contain matagouri and desert broom along fence lines. Conservatively, it is estimated that <250 individual matagouri plants and <100 desert broom plants (At Risk – Declining) are present in the solar farm footprint. Following the EIANZ EcIA method, At Risk – Declining species are of **high** ecological value.

No nationally Threatened species are present, and no species that are nationally Not Threatened but considered locally uncommon are present. Other At Risk plant species outside the solar farm footprint have been noted in Sections 5.2.1 and 5.2.2 above, but as they would not be affected by the Proposal they are not discussed further.

¹⁷ Neither detailed desktop mapping based on aerial imagery nor ground-truthed wetland mapping, other than for a small number of 'regionally significant' wetlands, is available in Otago Region. Previous desktop / modelling approaches based on climate and landform / soils data (Ausseil, Gerbeaux, et al., 2008; Ausseil, Newsome, et al., 2008; Wildland Consultants Ltd, 2020) are considered unlikely to classify small features such as those at the Site as wetlands.

5.3 Avifauna

5.3.1 Avifauna Habitat Context

At a broad scale, the Solar Farm Site is located in the Mānīatoto Plain between Naseby and Ranfurly in Central Otago. It is situated between the Waitaki River (~45 km northeast of the Site) and the Clutha River (~60 km southwest of the Site) and is surrounded by many mountain ranges. The main Naseby Forest block (plantation pine) is approximately 2 km north of the Site and the Taieri River and wetland complex is approximately 12 km south of the Site (Appendix 6).

There are a number of wetland areas of varying size in Central Otago, including a number of inland saline wetlands (Figure 13).

- **Eden Creek Marsh Complex** - 20.8 ha shallow water wetland complex containing both ephemeral and spring-fed wetlands. The complex is valued for the high diversity of wetland habitat types present.
- **Laws Road Swamp** – 1.4 ha inland saline wetland valued for its rarity.
- **Timber Creek Seepage** – 1.0 ha seepage wetland that is valued for its high degree of wetland naturalness.
- **Taieri Wetlands Complex** – 2,727 ha freshwater wetland complex comprising three sub-areas, the Styx (Paerau) Basin Wetlands, the Mānīatoto Basin Wetlands and Taieri Lake Wetlands. These wetlands are on the floodplains of the Taieri River and are of national importance for wildlife values, including providing habitat for a large number of bird species, including At Risk and Threatened species. The wetlands are regionally significant habitat for waterfowl, including as nesting habitat.

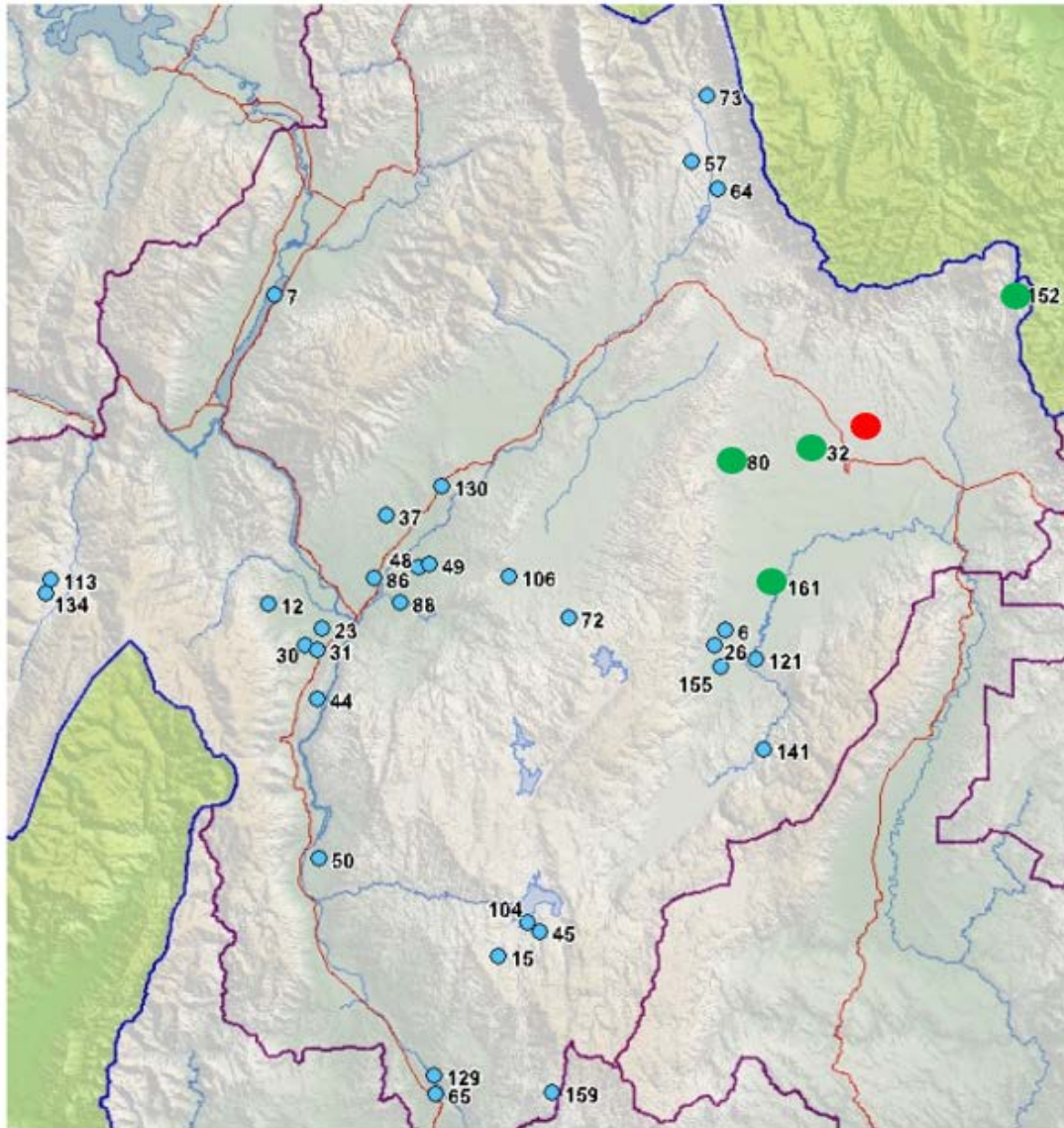


Figure 13. Central Otago District Wetlands¹⁸ around the project Site (red dot). The green dots represent the wetlands closest to the site. 32 is Cross Eden Creek Marsh Complex, 80 is Laws Road Swamp, 152 is Timber Creek Seepage and 161 is Taieri Wetlands Complex.

5.3.2 Avifauna Species and Habitats

The main habitat available for avifauna at the Solar Farm Site is grazed pasture and short rotation cropland (c.95% of the Site). Other habitats present on Site include shelterbelts, wetlands, constructed stock ponds and small areas of indigenous shrubland. These habitats variously provide foraging, roosting and / or nesting opportunities for avifauna.

The desktop and site investigations provided a base list of 52 indigenous and exotic avifauna species that use, or potentially use, habitat on Site and / or in the wider surrounding area (Appendix 7). Twenty-five of these species were observed during the Site visit, including 12

¹⁸ Sourced from [Central Otago District wetlands \(orc.govt.nz\)](https://orc.govt.nz)

indigenous species and 13 exotic species (Appendix 7)¹⁹. As expected, based on the open, farmed habitats within the Site, exotic birds are very common and made up 91% of all observations during the 5MBC. Goldfinch was the most common species with large flocks observed foraging on seeding crops. High numbers of skylarks and starlings were also observed (Table 4). The most common indigenous birds observed during the 5MBCs were spur-winged plovers, South Island pied oystercatchers and harrier hawks (Table 4).

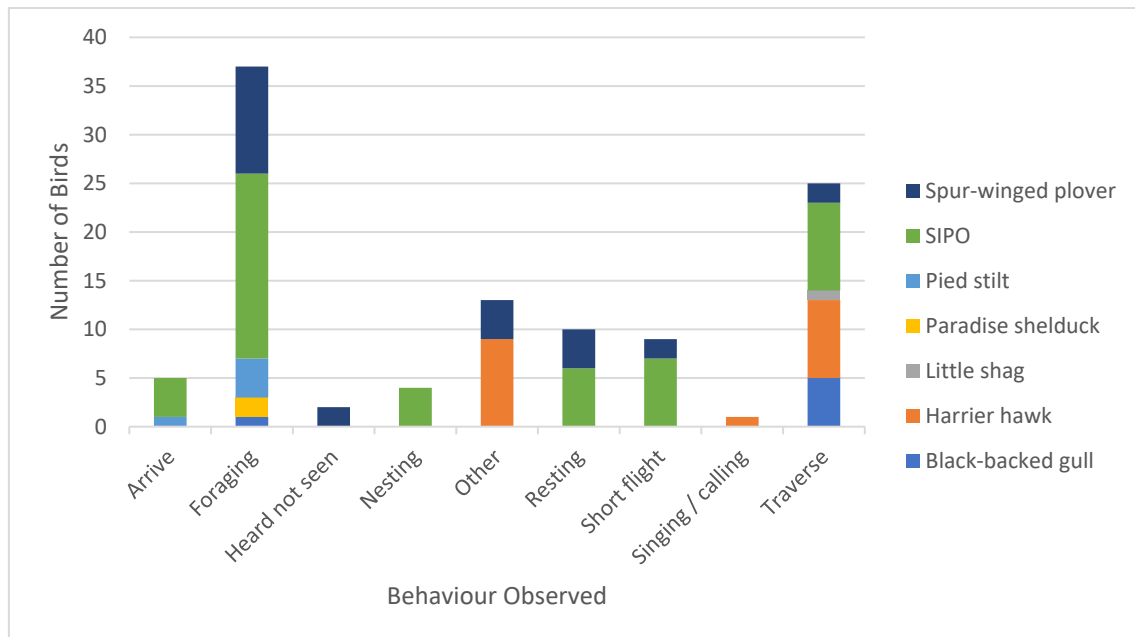
Table 4. Bird species observed during the 5MBCs conducted on Site.

Species	Exotic / Indigenous	Number Observed	Proportion Observed (%)
Goldfinch	Exotic	894	58.3
Skylark	Exotic	148	9.6
Starling	Exotic	132	8.6
Magpie	Exotic	53	3.5
Spur-winged plover	Indigenous	51	3.3
Unidentified small passerine	Exotic	50	3.3
Yellowhammer	Exotic	42	2.7
South Island pied oystercatcher / Tōrea	Indigenous	42	2.7
Redpoll	Exotic	33	2.2
Harrier hawk / Kāhu	Indigenous	29	1.9
Greenfinch	Exotic	13	0.8
Pied stilt / Poaka	Indigenous	10	0.7
Rock pigeon	Exotic	8	0.5
Blackbird	Exotic	7	0.5
Mallard duck	Exotic	6	0.4
Song thrush	Exotic	5	0.3
Paradise shelduck / Pūtangitangi	Indigenous	4	0.3
Chaffinch	Exotic	3	0.2
Black-backed gull / Karoro	Indigenous	2	0.1
Canada goose	Exotic	2	0.1
Total		1534	100%

The six indigenous species recorded during the 5MBCs (Table 4) were also observed during the point counts, as well as one additional species, little shag. In total 106 observations of indigenous birds were made during the point counts and like the 5MBCs, tōrea / South Island pied oystercatcher (**SIPO**), spur-winged plover and kāhu / harrier hawk were the most common species observed, constituting c.87% of all observations of indigenous birds. A variety of behaviours were observed during the point counts; most common were foraging, traversing, other (chasing / fighting interactions and soaring), resting and short flights, respectively constituting 35%, 24%, 12%, 9% and 8.5% of all observations (Figure 14). Pasture was the most used habitat on Site (85% of observations), followed by wetlands (10% of observations).

¹⁹ A number of species in the base list were not observed given that the Site does not provide primary habitat for them, they are vagrant species, or only rarely use the Site.

Figure 14. Indigenous bird behaviours recorded during the point counts conducted on Site.



No nesting birds were observed during the nesting bird survey conducted on Site, however five pairs of territorial SIPO were observed in suitable nesting habitat suggesting that they are likely preparing to nest (the survey was conducted in October and egg laying can occur between August and December²⁰). SIPO are classified as At Risk – Declining (Robertson et al. 2021). Four pairs were observed in grassland habitat adjacent to wetlands and one in cropland (Figure 15). Two non-territorial pairs were also observed foraging in grassland and could potentially nest later in the breeding season. Two pairs of poaka / pied stilt (classified as Not Threatened) were also opportunistically observed in grassland adjacent to wetlands; territorial behaviours were not observed but such habitat is suitable for nesting and they could do so later in the breeding season (egg laying can occur between June and November²¹) (Figure 15). Based on the Site surveys and assessment of the available habitats, it was concluded that it did not provide suitable nesting habitat for tūturiwhatu / banded dotterel or pīhoihoi / New Zealand pipit (the two other species targeted during the nesting survey).

²⁰ Sagar, P.M. 2013 [updated 2023]. South Island pied oystercatcher | Tōrea. In Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

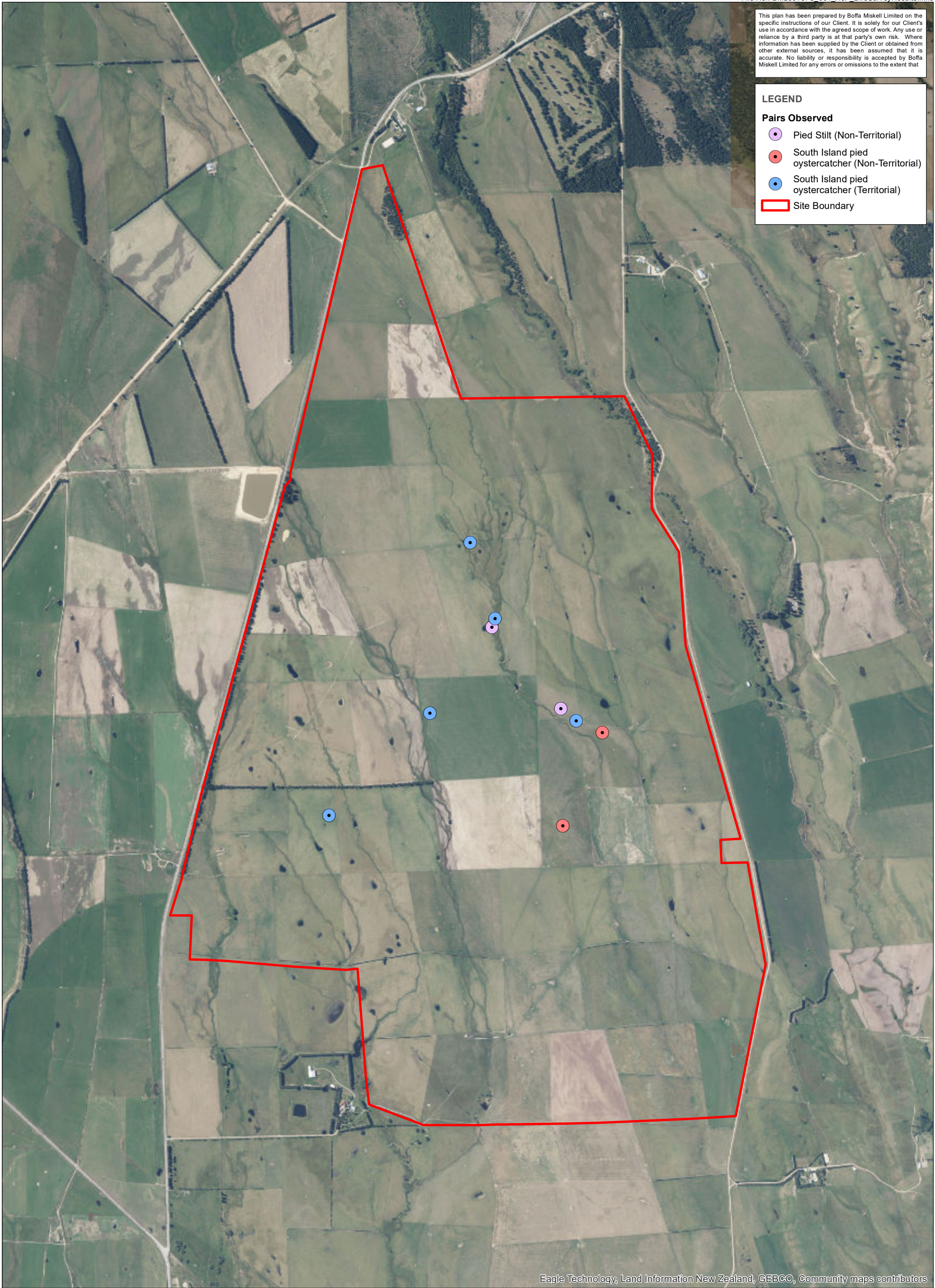
²¹ Adams, R. 2013 [updated 2022]. Pied stilt | poaka. In Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

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LEGEND

Pairs Observed

-  Pied Stilt (Non-Territorial)
-  South Island pied oystercatcher (Non-Territorial)
-  South Island pied oystercatcher (Territorial)
-  Site Boundary



Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors

Previous page: *Figure 15. Nesting bird survey results.*

Five other additional indigenous species were observed incidentally on Site outside of the formal survey periods. These included: Australasian shoveler (Not Threatened), grey teal (Not Threatened), banded dotterel (At Risk – Declining), New Zealand pipit (At Risk – Declining) and grey warbler (Not Threatened) (Table 5). Two shovelers and two teal were observed swimming on a pond, one banded dotterel and two New Zealand pipit were observed foraging in pasture, and two grey warblers were heard calling, one in a shelterbelt and one in a matagouri shrub.

Based on the desktop and Site investigations, we conclude that there are 21 key bird species of interest to be considered in this assessment (Table 5). This list has been derived by excluding exotic species, species that do not have primary habitat within the Solar Farm Site or immediate surrounds, vagrant species, and species that are likely to visit the Site only rarely (i.e. the key species include all indigenous species (irrespective of conservation status) that are likely to use, or potentially use, the Site more than rarely for foraging, roosting and / or nesting activities).

The key species include one Threatened species (karearea / eastern falcon), five At Risk species (New Zealand pipit, SIPO, banded dotterel, little shag, black shag) and 15 Not Threatened species (Table 5).

Table 5. Key bird species that use, or potentially use, the Project Site. At Risk and Threatened species shaded grey. Cells shaded dark green represent primary habitat/s used by each species and cells shaded light green represent secondary habitat/s used. Nat. Vul. stands for Threatened - Nationally Vulnerable, Dec. stands for At Risk – Declining and Rel. stands for At Risk - Relict.

SPECIES		CONSERVATION STATUS - Robertson et al. 2021	HABITAT USE								RECORD		
			Native forest	Exotic Forest	Scrub / shrubland	Farmland / open country	Freshwater / wetlands	Coastal / Estuary	Oceanic	Urban/Residential	eBird Atlas Effort Map - Squares DO29 & DP29	Bird Atlas 1999-2004 - Squares 228,557 & 228,556	Site Visit Observation
South Island fantail / Pīwakawaka	<i>Rhipidura f. fuliginosa</i>	Not Threatened									✓	✓	
Bellbird / Korimako	<i>Anthornis m. melanura</i>	Not Threatened									✓		
Kingfisher / Kotare	<i>Todiramphus sanctus vagans</i>	Not Threatened									✓		
Silvereye / Tauhou	<i>Zosterops lateralis lateralis</i>	Not Threatened									✓	✓	
Grey warbler / Riroriro	<i>Gerygone igata</i>	Not Threatened									✓	✓	✓
Spur-winged plover	<i>Vanellus miles novaehollandiae</i>	Not Threatened									✓	✓	✓
Swamp harrier / Kāhu	<i>Circus approximans</i>	Not Threatened									✓	✓	✓
Eastern falcon / Kārearea	<i>Falco n. novaeseelandiae</i>	Threatened – Nat. Vul.									✓		
Welcome swallow / Warou	<i>Hirundo n. neoxena</i>	Not Threatened									✓	✓	

NZ pipit / Pīhoihoi	<i>Anthus n. novaeseelandiae</i>	At Risk – Dec.										✓	✓	✓
South Island pied oystercatcher / Tōrea	<i>Haematopus finschi</i>	At Risk – Dec.										✓	✓	✓
Little shag / Kawaupaka	<i>Phalacrocorax melanoleucos brevirostris</i>	At Risk – Rel.										✓	✓	✓
Black shag / Māpunga	<i>Phalacrocorax carbo novaehollandiae</i>	At Risk – Rel.										✓	✓	
Australasian shoveler / Kuruwhengu	<i>Anas rhynchotis</i>	Not Threatened										✓	✓	✓
Grey teal / Tete	<i>Anas gracilis</i>	Not Threatened										✓	✓	✓
Pied stilt / Poaka	<i>Himantopus h. leucocephalus</i>	Not Threatened										✓	✓	✓
Pukeko	<i>Porphyrio m. melanotus</i>	Not Threatened										✓	✓	
Paradise shelduck / Pūtangitangi	<i>Tadorna variegata</i>	Not Threatened										✓	✓	✓
White-faced heron / Matuku	<i>Egretta novaehollandiae</i>	Not Threatened										✓	✓	
Black-backed gull / Karoro	<i>Larus d. dominicanus</i>	Not Threatened										✓	✓	✓
Banded dotterel / Tūturiwhatu	<i>Charadrius bicinctus bicinctus</i>	At Risk – Dec.												✓

Table 6 summarises observed, and likely habitat use on Site by the 21 key indigenous species, as well as other information of relevance.

Table 6. Habitat use and other relevant information for the key indigenous bird species identified for the Site.

Species	Conservation Status	Habitat Use / Other Relevant Information
Eastern falcon / Kārearea	Threatened – Nationally Vulnerable	Not observed but could potentially forage and roost on Site. The Site does not provide suitable nesting habitat.
Banded dotterel / Tūturiwhatu	At Risk - Declining	One bird observed foraging in pasture on Site. The Site provides foraging and roosting habitat for this species but does not provide suitable nesting habitat.
NZ pipit / Pīhoihoi	At Risk – Declining	Two observations of birds foraging in pasture. The Site provides foraging and roosting habitat for this species but not nesting habitat as the Site is grazed (their preferred nesting habitat is rank grassland, tussocks and ferns).
South Island pied oystercatcher / Tōrea	At Risk – Declining	Forty-two observations during the 5MBCs. Forty-nine observations during the point counts including seven short flights, nine traverses, six resting, 19 foraging, four arrivals and four territorial birds likely preparing to nest. Five territorial pairs were observed adjacent to wetland habitat during the nesting bird survey indicating they may nest on Site soon. The Site provides foraging, nesting and roosting habitat.
Black shag / Māpunga	At Risk – Relict	Not observed on Site but the Site may be traversed while travelling between other habitats in the landscape. The Site is unlikely to provide foraging, nesting or roosting habitat for this species as the wetlands lack structural complexity and roosts / nesting spots.
Little shag / Kawaupuka	At Risk - Relict	One observation of a bird traversing the Site. The Site is unlikely to provide foraging, nesting or roosting habitat for this species as the wetlands lack structural complexity and roosts / nesting spots, however it may be traversed while travelling between other habitats in the landscape.
South Island fantail / Pīwakawaka	Not Threatened	Not observed but could potentially forage, roost and nest in vegetation on Site.
Bellbird / Korimako	Not Threatened	Not observed but could potentially forage and roost in vegetation on Site. Unlikely to nest given the lack of indigenous vegetation on Site.
Kingfisher / Kotare	Not Threatened	Not observed but could potentially forage in wetland habitat and roost on structures on Site. Unlikely to nest on Site.
Silvereye / Tauhou	Not Threatened	Not observed but could potentially forage, roost and nest in vegetation on Site.

Species	Conservation Status	Habitat Use / Other Relevant Information
Grey warbler / Riroriro	Not Threatened	Two observations of birds calling, one in a shelterbelt and one in a matagouri shrub. The Site provides foraging, nesting (shelterbelts and shrublands) and roosting habitat.
Spur-winged plover	Not Threatened	Fifty-one observations during the 5MBCs. Twenty-five observations during the point counts including 11 foraging in wetlands or paddocks, two traversing, two heard not seen, four resting, two short flights and four chasing a harrier. The Site provides foraging, roosting and potential nesting habitat (pasture).
Harrier hawk / Kāhu	Not Threatened	Twenty-nine observations during the 5MBCs. Eighteen observations during the point counts including eight traversing, one calling, four interacting with magpies, spur-winged plovers and SIPO, and five circling in thermals. The Site provides foraging and roosting habitat for this species. It is unlikely to provide nesting habitat.
Welcome swallow / Warou	Not Threatened	Not observed but could potentially forage and roost on Site. The Site does not provide suitable nesting habitat.
Australasian shoveler / Kuruwhengu	Not Threatened	Two observations of birds swimming in a pond on Site. The Site provides foraging and roosting habitat for this species and potential nesting habitat at one vegetated pond on the southeast margin of Site.
Grey teal / Tete	Not Threatened	Two observations of birds swimming in a pond on Site. The Site provides foraging and roosting habitat for this species and potential nesting habitat at one vegetated pond on the southeast margin of Site.
Pied stilt / Poaka	Not Threatened	Ten observations during the 5MBCs. Five observations during the point counts, four foraging in wetlands, one arrival on Site. Not observed nesting on Site, but the Site does provide suitable nesting habitat adjacent to wetlands.
Pukeko	Not Threatened	Not observed on Site but could potentially forage, nest and roost in wetland and pasture habitats on Site.
Paradise shelduck / Pūtangitangi	Not Threatened	Four observations during the 5MBCs. Two observations during the point counts of birds foraging in pasture. The Site provides foraging, roosting and potential nesting habitat (grassland) for this species.
White-faced heron / Matuku	Not Threatened	Not observed on Site but could potentially forage in wetland and pasture on Site. Unlikely to nest on Site given the lack of large pine trees growing near water (their preferred nesting habitat).

Species	Conservation Status	Habitat Use / Other Relevant Information
Black-backed gull / Karoro	Not Threatened	Two observations during the 5MBCs. Six observations during the point counts, five were traversing the Site and one foraging in a paddock. The Site provides foraging and roosting habitat for this species but is unlikely to provide nesting habitat.

5.4 Lizards

A desktop review of the DOC Bioweb database found 22 lizard records comprising up to 4 species within 10 km of the Solar Farm Site (Table 7). During the site investigations, qualitative assessment of habitat suitability for indigenous lizards took place. This included checking for areas of rank grass, rock piles or outcrops, and complex vegetation that may provide lizard food and refugia habitat. No lizard habitat was identified on Site within the solar farm footprint and subsequently no detailed lizard survey methods were used.

Therefore, while Table 7 lists the species that may be expected in suitable habitats in the wider Maniatoto Basin – Hawkdun Range area, no lizards are expected to occupy the solar farm footprint itself. Possibly, lizards (most likely southern grass skink or McCann's skink) may be present within the larger central and southwest wetland areas at the Site, but these possible habitats are isolated and small, and the likelihood is low. Further, these areas are outside the footprint of all proposed works that have the potential to adversely affect lizards. Therefore, indigenous lizard species are not considered further in this assessment.

Table 7. Lizard species recorded within 10 km of the solar farm footprint.

Common Name	Scientific Name	Conservation Status	Closest Record (from Site Boundary)	Year (of Closest Record)	Recorded Location / Likelihood of Presence at Site (Central / Southwest Wetland Areas Only)
Unidentified Skink	<i>Oligosoma</i> sp.	-	2.5 km	1968	Hog Burn / Unlikely*
McCann's skink	<i>Oligosoma maccanni</i>	Not Threatened	10 km	1985	Hawkdun Range / Unlikely
Scree Skink	<i>Oligosoma waimatense</i>	Threatened – Nationally Vulnerable	8.3 km	1985	Hawkdun Range / None
Unidentified Gecko	<i>Woodworthia</i> sp.	-	8.3 km	1985	Hawkdun Range / None

*It is likely that unidentified skink records within 10 km of the Site are of McCann's skink or southern grass skink (the records available pre-date the taxonomic revision of these species); no other *Oligosoma* species are remotely likely.

5.5 Summary of Ecological Values

Table 8 summarises our assessment of ecological values following the EIANZ guidelines (Roper-Lindsay et al. 2018; see Appendix 2).

Table 8. Summary of ecological values assigned to vegetation, habitats and indigenous fauna within the Solar Farm Site.

Ecosystem Component	Representativeness	Rarity / Distinctiveness	Diversity and Pattern	Ecological Context	Overall Ecological Value
Vegetation and Terrestrial Habitats (Including Wetlands)					
Exotic grassland / cropland (pasture)	Very Low	Moderate	Very Low	Very Low	Negligible
Central wetland	Moderate	High	Low	Moderate	Moderate
Southwest wetland	Moderate	High	Low	Moderate	Moderate
Small wetlands	Very Low	Moderate	Very Low	Very Low	Negligible
Threatened and At-Risk Plant Species					
Dryland species: Matagouri, desert broom, <i>Acaena buehananii</i>	At Risk – Declining				High
Wetland species: <i>Carex kaloides</i> , grassland spaniard	At Risk – Declining				High
Avifauna					
Eastern falcon	Threatened – Nationally Vulnerable				Very High
New Zealand pipit, South Island pied oystercatcher, banded dotterel	At Risk – Declining				High
Little shag, black shag	At Risk - Relict				Moderate
All other key indigenous bird species	Not Threatened				Low

6.0 Ecological Significance

6.1 Significant Sites

The operative CODP does not identify any Sites that are ecologically significant under S6(c) of the RMA (Sites of Natural Significance) within or immediately adjacent to the Solar Farm Site. However, the CODP (Appendix I) does not include a complete list of all the Sites in the District that are ecologically significant under S6(c) of the RMA.

Three separate statutory significance assessment criteria are relevant to this Site, being the partially operative and proposed Otago RPS (POORPS and PrORPS respectively) and the NPS-IB²². The scale of assessment is the entire Site, including both exotic grassland / cropland and wetlands.

Following these criteria, a site is either significant or not. There are no degrees or scores of significance, although some sites may more clearly meet a criterion than others. The 'binary' outcome of the significance assessment is the primary reason for the additional step of determining ecological value (see Sections 4.7, 5.2.1.1, and 5.2.2.1), in order to guide evaluation of the levels of impact.

The assessment in Table 9 concludes that the Solar Farm Site is ecologically significant in terms of the POORPS, PrORPS, and NPS-IB criteria. The significant features based on all three assessments are matagouri and desert broom shrubs (meeting rarity criteria), and the central and southwest wetland (meeting more than one rarity criteria, and ecological context criteria). Small wetlands that support indigenous wetland vegetation are also considered significant, purely based on meeting wetland definitions and hence rarity criteria under each assessment approach.

²² The NPS-IB does not apply to renewable energy in terms of policies and objectives. However, local councils will need to give effect to the significance criteria in the NPS-IB, and so these criteria are considered relevant to a section 6(c) assessment. At the time of preparation of this report, the incoming government has signaled an intention to 'urgently review' the NPS-IB, meaning that both the significance criteria and the duties of local councils may be subject to change.

Table 9: Significance assessment for proposed Solar Farm Site.

Partially Operative Otago RPS 2019 Criteria (PORPS)	Proposed Otago RPS 2021 Criteria (PrORPS)	NPS Indigenous Biodiversity 2023 Criteria (NPS-IB)	Assessment	Meets PORPS	Meets PrORPS	Meets NPS-IB
1. Representativeness: <i>An area that is an example of an indigenous vegetation type or habitat that is typical or characteristic of the natural diversity of the relevant ecological district or coastal marine biogeographic region. This may include degraded examples of their type or represent all that remains of indigenous vegetation and habitats of indigenous fauna in some areas.</i>	Representativeness: <i>(a) An area that is an example of an indigenous vegetation type or habitat that is typical or characteristic of the original natural diversity of the relevant ecological district or coastal marine biogeographic region. This may include degraded examples of their type or represent all that remains of indigenous vegetation and habitats of indigenous fauna in some areas.</i> <i>(b) An indigenous marine ecosystem (including both intertidal and sub-tidal habitats, and including both faunal and floral assemblages) that makes up part of at least 10% of the natural extent of each of Otago's original marine ecosystem types and reflecting the environmental gradients of the region.</i> <i>(c) An indigenous marine ecosystem, or habitat of indigenous marine fauna (including both intertidal and sub-tidal habitats, and including both faunal and floral components), that is characteristic or typical of the natural marine ecosystem diversity of Otago.</i>	Representativeness: <i>An area that qualifies as an SNA under this criterion has at least one of the following attributes: (a) indigenous vegetation that has ecological integrity that is typical of the character of the ecological district:</i> <i>(b) habitat that supports a typical suite of indigenous fauna that is characteristic of the habitat type in the ecological district and retains at least a moderate range of species expected for that habitat type in the ecological district.</i>	Exotic pasture areas are not representative of the original and remnant indigenous vegetation in the Mānīatoto ED. Whilst scattered indigenous shrubs of species typical of the ED remain in places along fence lines, these represent relict individual plants that do not form functioning plant communities. Ecological integrity is very low, including in comparison to other areas within the ED. No wetland areas at the Site are considered highly representative of the former (pre-human or pre-European) wetland areas in the Mānīatoto ED. Original wetlands likely included tall Carex spp. sedgelands, raupō reedlands, and bog rush and Carex spp. tussocklands and scattered shrubs in larger palustrine and riparian wetlands. Ephemeral / saline wetlands with indigenous turf species may have occupied depressions. Whereas wetlands at the Site are generally dominated by exotic wetland species common in farmlands, such as jointed rush, sweetgrass, soft rush, kneed foxtail and creeping bent. The indigenous species present are generally widespread and common species tolerant of grazing. The central and southwest wetland include dug channels for drainage, modifying their hydrology. All are surrounded by intensively managed pastures that have been modified and improved over many years. The ED includes numerous larger wetlands with greater ecological integrity than the small wetlands at this site that are vulnerable to ongoing modification. The Site supports largely exotic bird assemblages (see Section 5.3) and do not support a representative range of	No	No	No

Partially Operative Otago RPS 2019 Criteria (PORPS)	Proposed Otago RPS 2021 Criteria (PrORPS)	NPS Indigenous Biodiversity 2023 Criteria (NPS-IB)	Assessment	Meets PORPS	Meets PrORPS	Meets NPS-IB
			indigenous fauna species reflecting original / remnant habitat areas in the ED. The Site does not meet any of these criteria.			
2. Rarity An area that supports: a. An indigenous species that is threatened, at risk, or uncommon, nationally or within an ecological district or coastal marine biogeographic region; b. Indigenous vegetation or habitat of indigenous fauna that has been reduced to less than 20% of its former extent nationally, regionally or within a relevant land environment, ecological district, coastal marine biogeographic region or freshwater environment including wetlands; c. Indigenous vegetation and habitats within originally rare ecosystems	Rarity (d) An area that supports: (i) An indigenous species that is threatened, at risk, or uncommon, nationally or within an ecological district or coastal marine biogeographic region, or (ii) Indigenous vegetation or habitat of indigenous fauna that has been reduced to less than 20% of its former extent nationally, regionally or within a relevant land environment, ecological district, coastal marine biogeographic region or freshwater environment including wetlands, or (iii) Indigenous vegetation and habitats within originally rare ecosystems, or (iv) The site contains indigenous vegetation or an indigenous species that is endemic to Otago or that are at distributional limits within Otago.	Rarity and Distinctiveness An area that qualifies as an SNA under this criterion has at least one of the following attributes: (a) provides habitat for an indigenous species that is listed as Threatened or At Risk (declining) in the New Zealand Threat Classification System lists: (b) an indigenous vegetation type or an indigenous species that is uncommon within the region or ecological district: (c) an indigenous species or plant community at or near its natural distributional limit: (d) indigenous vegetation that has been reduced to less than 20 per cent of its prehuman extent in the ecological district, region, or land environment: (e) indigenous vegetation or habitat of indigenous fauna occurring on naturally uncommon ecosystems: (f) the type locality of an indigenous species: (g) the presence of a distinctive assemblage or	The Site contains At Risk – Declining matagouri and desert broom and meets significance criteria on this basis. Wetlands have reduced to less than 20% nationally and regionally, and also meet criteria. The Site supports indigenous species that are nationally At Risk and occur on a landform on which <10% indigenous vegetation remains nationally. The Site provides habitat for At Risk – Declining SIPO (for nesting, although it is not a core nesting habitat), low numbers of NZ pipit (foraging / roosting habitat), and banded dotterel (foraging / roosting habitat), and it could provide foraging and roosting habitat for Threatened – Nationally Vulnerable falcon. No originally rare indigenous ecosystems (Williams et al., 2007) are present. No indigenous species considered or known to be uncommon in the ED were recorded. The Site meets several of these criteria.	Yes	Yes	Yes
4. Distinctiveness An area that supports or provides habitat for: a. Indigenous species at their distributional limit within Otago or nationally;	Distinctiveness (f) An area that supports or provides habitat for: (i) Indigenous species at their distributional limit within Otago or nationally, or	(f) the type locality of an indigenous species: (g) the presence of a distinctive assemblage or	No habitats are considered distinctive, of restricted occurrence, or the result of an unusual environmental factor or combinations of factors. No species are endemic to Otago or at their distribution limit.	No	No	

Partially Operative Otago RPS 2019 Criteria (PORPS)	Proposed Otago RPS 2021 Criteria (PrORPS)	NPS Indigenous Biodiversity 2023 Criteria (NPS-IB)	Assessment	Meets PORPS	Meets PrORPS	Meets NPS-IB
<i>b. Indigenous species that are endemic to the Otago region;</i> <i>c. Indigenous vegetation or an association of indigenous species that is distinctive, of restricted occurrence, or has developed as a result of an unusual environmental factor or combinations of factors.</i>	<i>(ii) Indigenous species that are endemic to the Otago region, or</i> <i>(iii) Indigenous vegetation or an association of indigenous species that is distinctive, of restricted occurrence, or has developed as a result of an unusual environmental factor or combinations of factors.</i>	<i>community of indigenous species:</i> <i>(h) the presence of a special ecological or scientific feature.</i>	The Site and surrounding area is not known to be the type locality of any indigenous species present at the Site. The Site is not considered to contain any special ecological or scientific features. The Site does not meet any of these criteria.			
3. Diversity <i>An area that supports a high diversity of indigenous ecosystem types, indigenous taxa or has changes in species composition reflecting the existence of diverse natural features or gradients.</i>	Diversity <i>(e) An area that supports a high diversity of indigenous ecosystem types, indigenous taxa or has changes in species composition reflecting the existence of diverse natural features or gradients.</i>	Diversity and Pattern <i>An area that qualifies as a significant natural area under this criterion has at least one of the following attributes:</i> <i>(a) at least a moderate diversity of indigenous species, vegetation, habitats of indigenous fauna or communities in the context of the ecological district:</i> <i>(b) presence of indigenous ecotones, complete or partial gradients or sequences.</i>	Indigenous flora and fauna diversity / pattern within pasture areas is very low; exotic species are dominant in terms of cover and species composition, and there is no pattern of indigenous habitat. The Site is exotic pasture, exotic shelterbelts, or else generally small and scattered wetlands with very few indigenous species if any (almost half lack indigenous species altogether). In the larger wetlands, habitat pattern is low, with some variation in wetter pools / depressions linked by linear features but otherwise abrupt transitions to exotic habitat. Diversity in the central and southwest wetlands is low-moderate (but not moderate), with a small number of a similar suite of indigenous species present in each location. No indigenous ecotones, gradients, or sequences are present; vegetation types are either fully exotic or abruptly shift from exotic dry pastures to wetlands. The Site does not meet any of these criteria.	No	No	No
5. Ecological Context <i>The relationship of the area with its surroundings, including:</i>	Ecological Context <i>(g) The relationship of the area with its surroundings (both within Otago and</i>	Ecological Context <i>An area that qualifies as an SNA under this criterion has at</i>	The ecological integrity of this vegetation type is very low, and it does not play an important function in terms of ecological networks, linkages or pathways. Whilst it is	Yes	Yes	Yes

Partially Operative Otago RPS 2019 Criteria (PORPS)	Proposed Otago RPS 2021 Criteria (PrORPS)	NPS Indigenous Biodiversity 2023 Criteria (NPS-IB)	Assessment	Meets PORPS	Meets PrORPS	Meets NPS-IB
a. An area that has important connectivity value allowing dispersal of indigenous vegetation and fauna between different areas; b. An important buffering function that helps to protect the values of an adjacent area or feature; c. An area that is important for indigenous fauna during some part of their life cycle, either regularly or on an irregular basis, e.g. for feeding, nesting, breeding, or refuges from predation.	between Otago and the adjoining regions), including: (i) An area that has important connectivity value allowing dispersal of indigenous flora and fauna between different areas, or (ii) An area that has an important buffering function that helps to protect the values of an adjacent area or feature, or (iii) An area that is important for indigenous fauna during some part of their life cycle, either regularly or on an irregular basis, e.g. for feeding, resting, nesting, breeding, spawning or refuges from predation, or (iv) A wetland which plays an important hydrological, biological or ecological role in the natural functioning of a river or coastal ecosystem.	least one of the following attributes: (a) at least moderate size and a compact shape, in the context of the relevant ecological district: (b) well-buffered relative to remaining habitats in the relevant ecological district: (c) provides an important full or partial buffer to, or link between, one or more important habitats of indigenous fauna or significant natural areas: (d) important for the natural functioning of an ecosystem relative to remaining habitats in the ecological district.	likely to be transiently used by highly mobile fauna species, it is highly unlikely to be an important Site for feeding, roosting, breeding, or resting of any indigenous fauna species. The small wetlands are not important in terms of their ecological context. They are too small (the average size is 0.13 ha), modified, and poorly buffered to support important indigenous fauna assemblages or to contribute to ecological linkages or networks in the context of the ED, and do not meet the criteria. The central and southwest wetland and are large enough (8.5 and 4.6 ha respectively) and sufficiently buffered to support larger indigenous plant assemblages that may contribute to gene flow of wetland plant populations in the context of the ED and provide fauna habitat permanently or seasonally. The wetlands are too small to provide important hydrological roles for any river ecosystems, and there are no river ecosystems connected to the wetlands. The Site meets some of these criteria.			
6. Coastal Environment An area identified in accordance with Policy 11 of the NZCPS.	n/a	n/a	The Site is not within the coastal environment and the PORPS criterion does not apply.	No	n/a	n/a

7.0 Assessment of Ecological Effects

This section assesses the potential effects on the ecology values of the proposed solar farm. To do this, we assess the magnitude of the effect (**without** implementation of the specific recommendations contained in Section 8.0), which is a measure of the extent or scale of the impact, its duration and the degree of change that the impact will cause (Roper Lindsay et al. 2018, see Table 19). A typical scale of magnitude ranges from **very high** to **negligible** (see Table 20).

We then assess the level of effect which considers both the magnitude of the effect and the ecological value of the plant community / habitat / ecosystem or species affected. The level of effect, as well as the ecological significance (see Section 6.1) of the ecological features affected, provides guidance on the extent and nature of the impact management response required, as outlined in Section 4.7.

7.1 Vegetation and Terrestrial Habitats

7.1.1 Vegetation Clearance

7.1.1.1 Loss of indigenous shrubs including At Risk – Declining species

Although Site preparation and clearance would (in terms of area) almost exclusively affect exotic pastures of negligible ecological value (see Section 5.2.1.1, it is likely that many or all indigenous matagouri and desert broom (and scrub pohuehue and porcupine shrub, which are Not Threatened species) shrubs along internal fence lines would be cleared. As described in Section 5.2.3, it is conservatively estimated that <250 individual matagouri plants and <100 desert broom plants are present along internal fence lines, along with <100 porcupine shrub and <25 scrub pohuehue. Greater numbers of these species are present along external fence lines on the Site boundary, beyond the solar farm footprint. As noted in Footnote 10, it is understood that these shrubs on the Site boundary (external fence lines) will not be cleared during installation of an internal security fence.

Although many fence lines, terraces, hillslope and river terrace habitats in the wider area support matagouri, desert broom, porcupine shrub and scrub pohuehue (matagouri and porcupine shrub are common and widespread in places), these are likely to include a large component of relict individuals (i.e., older plants that are unlikely to be able to replace themselves, as is likely the case at the Site), and matagouri and desert broom are nationally classified as At Risk. The magnitude of effect at the scale of the Site (assuming that none are cleared on external Site boundaries is **moderate**²³; but **negligible**²⁴ at the scale of the ED. This

²³ A moderate magnitude of effect means a loss or alteration to one or more key elements / features of the existing baseline conditions, such that the post-development character, composition and/or attributes will be partially changed; AND / OR loss of a moderate proportion of the known population or range of the element / feature (emphasis added; Roper-Lindsay et al. 2018).

²⁴ A negligible magnitude of effect means a very slight change from the existing baseline condition. Change barely distinguishable, approximating to the 'no change' situation; AND / OR having negligible effect on the known population or range of the element / feature (emphasis added; Roper-Lindsay et al. 2018).

translates to a **high** level impact at the scale of the Site (based on high ecological values of significant / At Risk – Declining species), and a **very low** level effect at the scale of the ED.

These shrubs are an ecologically significant feature of the Site (following Section 6.1) and therefore remediation of all losses is recommended in Section 8.1.2 to achieve no net loss (and preferably a net gain) in significant shrub values.

7.1.2 Wetlands

7.1.2.1 Wetland Avoidance and Fencing

As described in Section 2.0, the solar farm layout has been designed to avoid all wetlands, including constructed farm ponds that are not 'natural inland wetlands'. This means that there would be no earthworks or vegetation clearance within any wetlands, and no loss of wetland extent at the Site. Earthworks or vegetation clearance would occur only beyond at least 5 m setbacks (for small wetlands) or at least 10 m setbacks (for the central and southwest wetlands).

In other words, there will be no vegetation clearance or earthworks within, or within a 5 m setback from any wetland at the Site. However, vegetation clearance or earthworks would occur between 5-10 m from the small wetlands, including piling for solar panel array, cabling, and internal road construction. None of these works would lead to the complete or partial drainage of any wetlands at the Site.

Cabling through (beneath) the central wetland would be via HDD, again requiring no vegetation clearance. Entry and exit points for HDD will be c.20 m outside the wetland edge (Jackson White, Helios, *pers. comm.* 14 November 2023). This construction approach has been adopted specifically to enable cabling underneath the central wetland without requiring any permanent or temporary vegetation clearance or surface earthworks within wetlands. Other options that were considered, but ultimately ruled out, included above ground (overhead) powerlines, and trenching through the wetland; these were not adopted for landscape / visual and ecological effect reasons respectively.

The 8.49 ha and 4.61 ha central and southwest wetlands would form part of fenced, destocked areas of c.20.5 and c.9.8 ha respectively (c.31.3 ha, accounting for a minimum 10 m buffer). Existing grazing is likely to lead to a variety of ongoing existing impacts to wetland vegetation, and in the absence of grazing it is likely that palatable indigenous species would recolonise or expand, and wetland condition will improve. Whilst a flush of exotic grass growth is likely to occur in at least the first few years following destocking (due to release from grazing pressure), the positive benefits to indigenous wetland plants would outweigh any issues of rank grass growth.

Under the Resource Management (Stock Exclusion) Regulations 2020, stock (including cattle, but excluding sheep) must be excluded from wetlands under certain conditions, none of which apply to the Site²⁵. Even if stock exclusion rules did currently apply, under the solar farm Proposal the only grazing will be by sheep. On this basis, there is no obligation for wetlands at the site to be fenced under the status quo or under the solar farm Proposal. Therefore, the fencing and 10 m buffer approach represents an additional benefit compared to existing (understood to be non-existent) landowner obligations.

²⁵ The Site does not contain wetlands that were identified in a regional or district plan or a regional policy statement that was operative on the commencement date, no threatened species are present, and the Site is not identified as low slope land based on being over 500 m in elevation (and based on MfE's Stock Exclusion Low Slope Land 2022 GIS layer).

Because of these avoidance, setback and fencing measures, and the lack of works in wetlands, the Proposal would not result in any direct adverse effects to any wetlands at the Site. Fencing of the southwest and central wetland (enabling wetland vegetation recovery) means that overall impacts to wetland habitats at the Site are of a **positive** magnitude, i.e. a **net gain** level of effect (Roper-Lindsay et al., 2018). This equates to a net gain for ecologically significant wetland values at the Site.

Note also that Helios have also adopted an additional recommendation to undertake wetland restoration at the central and southwest wetlands (see Section 8.1.5). This means that the Proposal achieves a greater benefit (**net gain**) for wetlands compared to the null outcome of simply avoiding them.

7.1.2.2 Hydrological Effects to Wetlands

As described in Section 5.2.2, hydrological drivers of wetlands at the Site are rainfall (for small wetlands), and a combination of rainfall and groundwater for the central and southwest wetlands (with additional stream / water race inputs, in the southwest wetland only). The majority of wetlands at the Site are small depressions where direct rainfall accumulates. It is noteworthy that many depressions are located within overall elevated areas. This clearly indicates that these features do not rely on conveyance of overland flows / rainfall runoff over long distances.

Whilst solar panel piling, trenching works, and works to construct internal accessways and inverters would occur within 100 m of wetland areas, none of these structures or works types would be expected to alter existing hydrological sources to any existing wetlands, even when they occur ≥ 5 m from small wetlands or ≥ 10 m from the central and southwest wetlands.

This is because the land contours would be generally maintained, meaning that existing rainfall would run off from solar panels and follow existing drainage patterns, including whatever existing drainage to wetlands currently occurs. Direct rainfall to wetlands would remain, because no solar panels or other structures would be placed over (or within 5 m) of wetlands. Trenching works for cabling are shallow and highly unlikely to intercept or alter groundwater flow paths or patterns. Therefore, no adverse hydrological effects to wetlands would arise due to solar farm construction. There would be no complete or partial drainage of all or part of any wetland extent, nor any changes in the water level range or hydrological function of the wetlands.

No hydrological effects to wetlands would occur as a result of the Proposal.

7.1.3 Other

No other ecological impacts to vegetation typically associated with large infrastructure projects (e.g., introduction and spread of weeds) are considered of concern in the context of this proposal. The solar farm footprint comprises exotic pastures that would continue to be maintained and grazed following installation of the solar array and associated infrastructure.

Other possible impacts from solar farm proposals, such as the potential for microclimatic change (shading, soil moisture changes due to the solar panel arrays) to alter vegetation composition and growth rates are not of concern in relation to exotic pasture of negligible ecological value that does not support any indigenous plant species.

7.2 Avifauna

The following potential effects on avifauna through the construction and operation of the project are considered in this assessment:

- Permanent habitat loss / modification;
- Disturbance and temporary displacement;
- Impacts on nesting birds; and
- Bird strike with solar panel arrays.

7.2.1 Permanent Habitat Loss / Modification

Installation of the solar panel arrays and associated infrastructure (substation, site office, access tracks, transmission infrastructure, a battery energy storage system, transformers, etc) will result in permanent loss of grassland habitat across the Site (c.15 ha; see Section 2.0). It will also result in permanent habitat modification as the pasture will be covered / shaded by the panels and this could in turn result in effective habitat loss for avifauna. This is because some species may find the habitat less desirable for feeding, roosting and / or nesting (because of changes to the physical habitat, i.e., the presence of the structures, rather than any changes to the pasture itself). This effective habitat loss may be temporary or permanent and depends on species' tolerances to modified habitats and whether or not they habituate to the change.

Grassland areas immediately adjacent to wetlands that provide potential nesting habitat for pied stilt and SIPO will remain (at least a 5-10 m strip around the boundary of the wetlands) and wetland habitat will be avoided. Fences will be installed to protect the central and southwest wetland areas and these areas will be excluded from grazing. Although this habitat will remain as potential foraging habitat for SIPO, it, is unlikely to provide nesting habitat after fencing, given that they prefer open areas with good visibility all around them²⁶.

At Risk or Threatened species that use, or may use, pasture on Site for foraging and /or roosting include New Zealand pipit, eastern falcon, SIPO and banded dotterel. The grassland does not provide nesting habitat for eastern falcon or banded dotterel and in its grazed state, it is also not suitable nesting habitat for New Zealand pipit (they prefer rank grassland). The grassland does provide potential nesting habitat for a small number of SIPO. No SIPO were observed nesting on Site during the survey period, however five pairs observed in grassland / cropland habitat (two adjacent to wetland habitat) displayed territorial behaviours, indicating that they were likely preparing to nest. Two other pairs were also observed foraging in grassland habitat; they did not display territorial behaviours at the time of survey, but they could potentially use the Site for nesting later in the breeding season.

Pasture is a very abundant habitat in the wider area, and if solar panel installation modifies the habitat on Site in such a way that it is less desirable to New Zealand pipit, eastern falcon, banded dotterel and SIPO for foraging and roosting then these highly mobile species can disperse elsewhere and utilise the prevalent grassland habitat available nearby in the surrounding area. With regards to nesting, there will be loss / modification of grassland nesting habitat on Site for a very small proportion of the SIPO population (seven pairs / 14 birds were observed on Site this breeding season²⁷ and the national population size is estimated to be

²⁶ Sagar, P.M. 2013 [updated 2023]. South Island pied oystercatcher | Tōrea. In Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

²⁷ Although none were observed nesting at the time of survey.

~100,000 birds)²⁸. However, grassland is prevalent in the wider area and these pairs can utilise these areas for nesting when grassland habitat is lost / modified on Site.

Not Threatened species that use, or may use, grassland habitat on Site include spur-winged plover, welcome swallow, harrier hawk, kingfisher, grey teal, pied stilt, pukeko, paradise shelduck and white-faced heron (Table 5). Like New Zealand pipit, eastern falcon, South Island pied oystercatcher and banded dotterel, these species are all highly mobile species that can disperse into and use the abundant alternative grassland habitat that is available in the surrounding area upon loss or modification of grassland habitat on Site.

The only other habitat type that will be lost on Site as a result of the solar farm Proposal is scattered indigenous shrubs. As discussed in Section 7.1.1, it is likely that many or all indigenous shrubs along internal fence lines on Site (matagouri, desert broom, scrub pohuehue and porcupine shrub) will be cleared, totalling c.500 plants across the Site. This vegetation may provide foraging, roosting and nesting habitat for Not Threatened species such as grey warbler and silvereye. Given the sparse, small-scale, and linear nature of this vegetation, we consider that it does not provide core habitat for these species. Similar vegetation exists in the wider landscape (including along external fence lines that will not be cleared), which these highly mobile species can use when this habitat is temporarily lost on Site. Post-construction, indigenous shrubs will be re-planted at the Solar Farm Site at a 2:1 ratio (see Section 8.1.2), remedying the loss of this habitat for these species.

Accordingly, we consider that permanent habitat loss and modification associated with the project will have a negligible magnitude of effect on indigenous avifauna. A **negligible** magnitude of effect on low to very high value species results in a **very low to low** overall level of effect (Table 10).

Table 10. Potential ecological effect of habitat loss / modification on avifauna species that use, or potentially use, the Site.

Species	Ecological Value	Magnitude of Effect	Level of Effect Without Mitigation
Eastern falcon	Very High	Negligible	Low ²⁹
South Island pied oystercatcher (SIPO)	High	Negligible	Very Low
New Zealand pipit	High	Negligible	Very Low
Banded dotterel	High	Negligible	Very Low
Little shag	Moderate	N/A	N/A
Black shag	Moderate	N/A	N/A
Not Threatened species	Low	Negligible	Very Low

7.2.2 Disturbance and Temporary Displacement

This section assesses the potential effects of disturbance and displacement on birds on Site as a result of construction activities. Operational disturbance and displacement are not assessed given that the proposal description (Section 2.0) states that once the solar farm is operational,

²⁸ Sagar, P.M. 2013 [updated 2023]. South Island pied oystercatcher | Tōrea. In Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz. We note that the national population size has been used as a regional SIPO population size was not found during the desktop investigation.

²⁹ Following the EIANZ EclA guidance, the lowest possible level of effect on a very high value is 'low' (see Appendix 2, Table 20).

activity will be very limited and restricted to replacing componentry (this is expected to be infrequent, and similar in frequency, or less frequent, than existing farming activities). Effects on nesting birds, including disturbance are assessed in the following section.

People, activities and noise associated with construction activities on Site may disturb foraging and roosting and traversing birds and displace them from the project area. Construction will gradually progress across Site and is anticipated to take approximately 24 months; as such, disturbance and displacement effects will be temporary.

The habitats present on the Solar Farm Site (pasture, wetland, shelterbelts, ponds, indigenous shrubland) are all present and abundant in the surrounding area. Given that the indigenous species observed on Site are all flighted and highly mobile, if disturbed during construction activities they will be able to disperse into other areas on Site that are not being disturbed or into suitable alternative habitats in the wider area.

Available flight initiation distance information for some key bird species that may use the Solar Farm Site (e.g. SIPO, and wetland species such as pied stilt) are likely in the vicinity of c.40 m (Glover et al., 2011). These measurements are from an Australian study that assessed a very closely related species and the same species respectively); these birds are therefore moderately tolerant of human approaches (compared to sensitive species, such as goose or swan species that may initiate flight hundreds of metres from an approaching predator). Furthermore, given the Site is a working farm, we assume birds regularly present on Site will have some habituation to human activity, vehicles, stock movement, dogs, quad bikes / all-terrain vehicles, and as such may have a higher tolerance to construction-induced disturbances.

Based on these factors, we consider that the construction-induced disturbance and displacement associated with the project will have a **negligible** magnitude of effect on indigenous avifauna. A negligible magnitude of effect on low to very high value species results in **very low to low** overall levels of effect (Table 11).

Table 11. Potential ecological effect of construction activities on indigenous avifauna species present, or potentially present, in the Solar Farm Site.

Species	Ecological Value	Magnitude of Effect	Level of Effect Without Mitigation
Eastern falcon	Very High	Negligible	Low ²⁹
South Island pied oystercatcher (SIPO)	High	Negligible	Very Low
New Zealand pipit	High	Negligible	Very Low
Banded dotterel	High	Negligible	Very Low
Little shag	Moderate	Negligible	Very Low
Black shag	Moderate	Negligible	Very Low
Not Threatened species	Low	Negligible	Very Low

7.2.3 Impacts on Nesting Birds

If construction activities occur during the avifauna breeding season (broadly September to the end of February), nesting birds (and nest contents) may be disturbed, displaced, injured or killed.

Bird species that could potentially nest in grassland habitat within the construction footprint are SIPO, pied stilt, pūkeko and spur-winged plover. During the surveys conducted on Site during

the breeding season, no nesting birds were observed, however five pairs of SIPO displayed territorial behaviours indicating that they were likely preparing to nest. Four of the pairs were observed in grassland adjacent to wetland habitat, and one in cropland (Figure 15). Two other SIPO pairs were also observed on Site (Figure 15). They were observed foraging in pasture and did not display territorial behaviour at the time of survey, but they could potentially use the Site for nesting.

Two pied stilt pairs were observed foraging on Site in wetland and associated grassland habitat (Figure 15). Although no territorial behaviours were observed, such habitat is suitable for nesting. Likewise, although no spur-winged plovers were observed nesting, the grassland and wetland margins on Site are suitable for nesting and they may do so later in the breeding season. Pukeko were not observed during the surveys conducted but could also potentially use grassland habitat on Site for nesting.

Given that the Site is grazed and the wetlands (and grassland margins) where territorial birds were observed are not fenced, it is likely that nesting success on Site is currently low due to disturbance / potential stock trampling. We note that the large wetland areas (including a 10 m grassland buffer zone) will be fenced as part of the project, and so if wetland birds are not displaced by the solar farm, they will still have opportunity to nest on Site and may potentially have increased nesting success as a result of the stock exclusion. We expect however that SIPO will not nest on Site when the solar farm is established, given that they prefer open areas with good visibility all around them³⁰.

The shelterbelts on Site may provide nesting habitat for Not Threatened species (e.g., grey warbler, however this habitat will not be removed, and such species are generally tolerant of nesting near areas of anthropogenic disturbance.

The indigenous shrubs on Site may provide nesting habitat for Not Threatened species (e.g., silvereye, grey warbler). Removal of these individual, scattered shrubs will remove this potential nesting habitat, albeit temporarily, given that shrubland will be re-planted at a 2:1 ratio post-construction (see Section 8.1.2). The shrubs along the perimeter fence lines will likely remain and shrubs are present in the wider area in which these species can nest in when vegetation clearance occurs.

Australasian shoveler, paradise shelduck and grey teal (Not Threatened species) were observed swimming on a pond directly adjacent to the southern-eastern margin of Site. Unlike other ponds on Site, this pond had vegetated margins (*Carex secta*) and this habitat complexity may provide potential nesting habitat for these species. This pond is outside of the solar farm footprint, but if nesting occurs these species may be disturbed or potentially displaced.

Only a small number of birds nest or potentially nest at the Site, and nesting success is likely low due to disturbance factors as a result of current Site use (farming). The Site does not provide core nesting habitat for any species³¹, and ample alternative nesting habitat is present in the wider area if birds are displaced by the solar farm. We consider that if construction works are undertaken during the breeding season, the magnitude of effect on nesting birds will be **negligible**. A negligible magnitude of effect on low to high value species results in a **very low** overall level of effect (Table 12).

Although effects are assessed as very low, if works commence during the breeding season (broadly, 1 September to 28/29 February), or are paused for 8 successive days or more and then resumed during the breeding season, a pre-construction check for nesting indigenous birds

³⁰ Sagar, P.M. 2013 [updated 2023]. South Island pied oystercatcher | Tōrea. In Miskelly, C.M. (ed.) *New Zealand Birds Online*. www.nzbirdsonline.org.nz

³¹ E.g., core nesting habitat for South Island pied oystercatchers is braided river beds.

is required. This will need to be undertaken by a suitably qualified and experienced ecologist to ensure that nesting birds are absent prior to construction or that setbacks (of 100 m radius, or a lesser distance, being no less than 25 m, as deemed appropriate by a suitably qualified and experienced ecologist) from any nesting areas are applied until nesting activities are completed³².

We note that two NZ pipits were incidentally observed on Site and although they nest in grassland habitat, we do not consider that the Site is suitable for nesting. NZ pipit prefer rank rather than grazed grass; accordingly nesting effects have not been assessed for this species.

Table 12. Potential ecological effect of construction on indigenous avifauna nesting in the Solar Farm Site if construction occurs during the breeding season.

Species	Ecological Value	Magnitude of Effect	Level of Effect Without Mitigation
Eastern falcon	Very High	N/A	N/A
South Island pied oystercatcher	High	Negligible	Very Low
New Zealand pipit	High	N/A	N/A
Banded dotterel	High	N/A	N/A
Little shag	Moderate	N/A	N/A
Black shag	Moderate	N/A	N/A
Not Threatened species	Low	Negligible	Very Low

7.2.4 Bird Strike with Solar Panel Arrays

There is some evidence in the scientific literature, albeit limited, that bird mortality can occur as a result of collision with large-scale solar panel arrays. It is hypothesised that birds, particularly water and wetland birds migrating to and from breeding grounds, may perceive reflected light from solar panels as a lake or water body, and attempt to land on the panels, resulting in collision and potential injury or mortality (Chock et al., 2021; Kagan et al., 2014). This hypothesis is called the “lake effect”. For example, ~20 bird mortalities were recorded at an ~1600 ha solar farm in California over an unspecified time period (Kagan et al., 2014). It was noted that this effect appeared to largely affect overflying migratory water bird species attracted by actual ponds at the solar farm desert location, or may have arisen because the uniformly shaped layout and dense panel arrays possibly appeared as an uninterrupted water feature (Kagan et al., 2014). Another study conducted at ten solar farms in California and Nevada over 13 years did document mortalities, however cause of death could not be determined for ~61% of intact carcasses found and ~54% of all mortalities recorded were feather spots introducing uncertainty as to whether the mortalities were panel-induced or not (Kosciuch et al., 2020). Other studies have observed no obvious evidence of bird mortality caused by large-scale solar farms. For example, no mortalities were detected at solar farm sites at various airports in the United States of America despite conducting 515 bird surveys (DeVault et al., 2014).

There is a paucity of research on the lake effect, so no definitive conclusions can be made as to whether it is a hypothetical or a real effect, and given that no large-scale solar farms have been built and monitored for bird strike in New Zealand to date, there is no research in a New Zealand context on which to base a precise assessment of this potential effect on New Zealand

³² Timeframes, 8 day check recurrence, and indicative setback distances are based on Canterbury Regional Council guidance for braided river bird species, including SIPO (Environment Canterbury, 2022).

water and wetland bird species. Consequently, we are conservative in our assessment and consider this effect as best we can, based on the available data.

The Solar Farm Site could be traversed by water birds moving between wetlands habitats in the wider landscape. During the point counts conducted, the only key indigenous water and wetland bird species observed traversing the Site were South Island pied oystercatcher (nine observations were made) and little shag (one observation was made). Other key indigenous water and wetland bird species that could also traverse the Site include banded dotterel, pied stilt, black shag, paradise shelduck, grey teal and Australasian shoveler.

In terms of a possible lake effect on water and wetland birds that traverse the Site, there are a number of factors in relation to the design of the solar panel array and Site location that are likely to mitigate this potential effect. These factors include the following:

- The Site has no large water bodies on it, so it is unlikely to attract large concentrations of water and wetland birds.
- The Site is not close to any main rivers (the Taieri River and wetland complex is ~12 km south of the Site, the Waitaki River is ~45 km northeast of the Site and the Clutha River is ~60 km southwest of the Site). These rivers are likely to be the main flight corridors for many water and wetland birds, therefore it is not expected that large numbers of these species will traverse the Site.
- Although surveys were not conducted during the migratory periods for national migrant water and wetland birds (winter and summer), it is considered unlikely that the Site would be traversed by high numbers of such species as it is not on the predicted migration route (Figure 16) of these species (Southey, 2009).
- The solar arrays will cover 36% of the Site, will be clustered into blocks, and some of the blocks will be separated by existing, established shelterbelts (Figure 1) as well as additional shelterbelts that will be planted for screening purposes (up to 5 km of new screen plantings are proposed as mitigation in the glint and glare study prepared for this project (ITP Renewables, 2023). Large existing wetlands on Site will also remain and be fenced with a 10 m buffer, with smaller wetlands and constructed farm ponds also remaining with a 5 m and 2 m minimum buffer. Other slopes totalling many tens of hectares will also remain unbuilt. This design will break up the uniform shape of the Site and the shelterbelts will screen the panels making the Site look less like a lake, therefore minimising the potential for the lake effect to occur. Visual interruption is a key recommendation for mitigation of this potential effect (Bennun et al., 2021; Harrison et al., 2017).
- To limit reflection, solar panels are constructed from dark, light absorbing material and are treated with an anti-reflective coating. Solar panels are also designed to absorb rather than reflect light and generally absorb ~98% of the light received (ITP Renewables, 2023). The solar panels on Site will be mounted on a single axis tracking system (rather than a fixed system); the solar panel units on such systems rotate on a horizontal axis to follow the sun and therefore generate less glare than fixed tilt arrays. The tracking varies throughout the year to match seasonal changes in the sun's path (ITP Renewables, 2023). These factors therefore minimise the reflective conditions that could cause a potential lake effect.

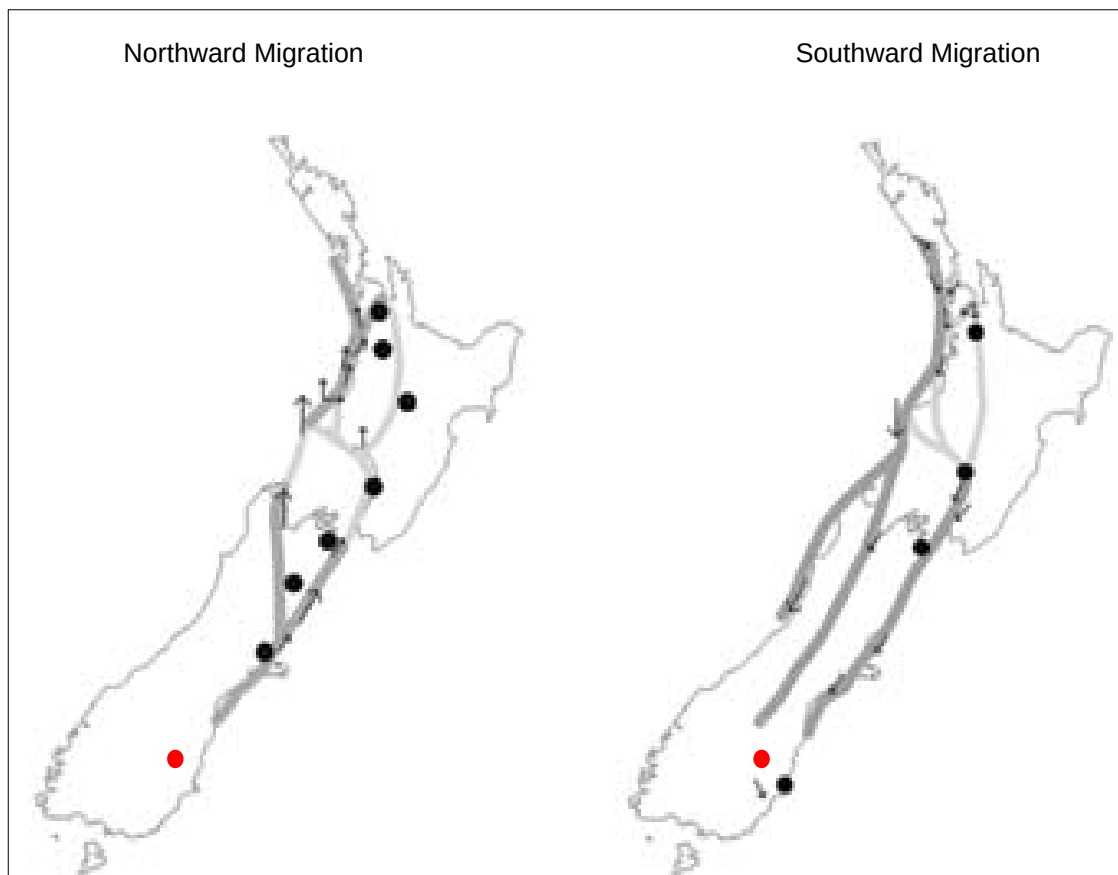


Figure 16. Predicted migration routes for national migrants (Southey, 2009). These indicative maps were prepared based on observations from ornithologists throughout the country during migration events. The red circles indicate the approximate location of the Solar Farm Site.

In summary, there is a lack of international research on the lake effect and uncertainty as to whether it is a real effect or only a hypothetical effect. Based on the absence of research of this potential effect in a New Zealand context, we have taken a conservative approach and considered that the lake effect could be a potential effect at this Site. Taking into consideration the mitigating factors listed above, we consider that this potential effect is likely to have a **negligible** magnitude of effect on wetland and water bird species that traverse the site (in terms of impact to local or national populations). A negligible magnitude of effect on low to high value species results in a **very low** overall level of effect (Table 13).

Although effects are assessed as very low, we recommend that operational bird strike is considered further, prior to solar farm commissioning. By the time of construction at the Site (in at least several years), there may well be additional research / data available on bird strike, on which a reappraisal of this effect could be based. We recommend that this involves a further bird strike literature review (based on international studies, and New Zealand studies if any), with review and resulting recommendations to be prepared by a suitably qualified ornithologist / ecologist no earlier than 6 months prior to solar farm commissioning. The outcome of this literature review would determine if post-construction bird strike monitoring is required at the Site or not. It is expected that a conservative outcome would be a requirement to undertake post-construction monitoring, either because research suggests there is indeed an effect, or because there may still be insufficient evidence applicable to the local context. Any post-construction monitoring for this potential effect will contribute to a better understanding of whether this effect is real or not and provide specific research on water and wetland birds found in New Zealand.

Table 13. Potential ecological effect of the lake effect on indigenous avifauna species traversing the Solar Farm Site.

Species	Ecological Value	Magnitude of Effect	Level of Effect Without Mitigation
Eastern falcon	Very High	N/A	N/A
South Island pied oystercatcher	High	Negligible	Very Low
New Zealand pipit	High	N/A	N/A
Banded dotterel	High	Negligible	Very Low
Little shag	Moderate	Negligible	Very Low
Black shag	Moderate	Negligible	Very Low
Not Threatened species	Low	Negligible	Very Low

7.3 Summary of Assessment of Effects on Terrestrial Ecology Values

Table 14 summarises the potential level of effect (assuming no mitigation) of the proposed activities on each of the ecological components.

Table 14. Assessment of level of effect *without mitigation* (i.e., without implementation of the further recommendations in 8.1, but assuming implementation of project shaping and Site management recommendations as described in Section 8.0), for terrestrial ecology components. Where multiple scales of assessment (e.g., the Site, ED, or national scale) have been used in Section 7.1 and 7.2 above, the magnitude of effect below is at the larger scale of those assessed.

Ecosystem Component	Ecological Value	Magnitude of Effect	Level of Effect
Vegetation and Terrestrial Habitats (Including Wetlands)			
Vegetation clearance – Loss of indigenous shrubs including At Risk – Declining species	High	Negligible	Low
Effects to wetlands – avoidance, fencing, and planting	Negligible-Moderate	Positive	Net Gain
Avifauna			
Habitat modification / loss	Low – Very High	Negligible	Very Low - Low
Disturbance and temporary displacement	Low – Very High	Negligible	Very Low - Low
Nesting birds	Low - High	Negligible	Very Low
Bird strike with solar panel arrays	Low - High	Negligible	Very Low

8.0 Recommendations and Residual Effects

8.1 Recommendations

The following impact management measures are recommended to avoid, minimise, remedy or mitigate any adverse effects of the proposed solar farm. These recommendations are in addition to the changes made to the solar farm layout and other Site management changes recommended and adopted during the project shaping stage of the project (see Section 3.0).

8.1.1 Avoid and Minimise

8.1.1.1 Terrestrial Vegetation

- Where practicable, avoid clearance of indigenous shrubs (matagouri, desert broom, porcupine shrub, and scrub pohuehue) along internal fence lines during Site preparation, and avoid clearance of these species along external fence lines during installation of the security fence. Whilst being generally sparse and relict individuals, At Risk – Declining shrubs are considered a significant feature of the Site.

8.1.1.2 Birds

- Construction works should ideally commence outside of the main bird breeding season to avoid potential adverse effects to indigenous birds breeding on Site, particularly tōrea / South Island pied oystercatcher, an At Risk species. The breeding season broadly spans between 1 September and 28 / 29 February, therefore ideally construction works should commence between 1 March and 31 August. If this is not possible and works commence during the bird breeding season, then a pre-construction survey for any indigenous breeding birds should be conducted by a suitably qualified and experienced ecologist within 48 hours of works commencing to determine if any indigenous birds are nesting on Site within or close to the construction area/s. If nesting birds, eggs and / or chicks are found, then works should not commence until an exclusion zone has been established around each of the nests in which works cannot proceed until nesting activities are completed. The size of the exclusion zone/s shall be 100 m radius, or a lesser distance as deemed appropriate by the suitably qualified and experienced ecologist, being no less than 25 m. If no nesting birds, eggs and / or chicks found, construction works can commence. If works are paused for 8 successive days or more and are then resumed during the breeding season, a further survey (as above) is required.

8.1.2 Remediation

- To remediate the loss of <250 matagouri, <100 desert broom, <100 porcupine shrub, and <25 scrub pohuehue shrubs within the Site, plantings of greater numbers of these species should be incorporated into ecological enhancement and landscape (boundary / screening) planting at the Site.
 - o To account for time lags in the growth of new plantings and interim loss of existing shrubs that provide occasional feeding opportunities for (e.g.) indigenous birds such as grey warbler, at least double the number of plants

should be established (>500, >200, >200, and >50 matagouri, desert broom, porcupine shrub, and scrub pohuehue respectively).

- o Binding measures to undertake ongoing weed release, survival monitoring, and replacement of plants that do not establish / survive are also required, such as via a Vegetation Management Plan arising out of recommendations in the project's Landscape and Visual Effects Assessment and associated Landscape Planting Plan.
- o Because time lags and survival monitoring have been accounted for above, small grade (e.g., RX90) nursery plants could be used if larger plants cannot be obtained and provided that survival monitoring and replacement occurs.

8.1.3 Mitigation

8.1.4 Additional Research / Monitoring

The following additional research is **required** for effects management:

- We have identified a potential risk of avifauna collisions with the solar panel arrays. Based on available data and a number of mitigating factors, we have assessed the level of effect on indigenous birds that use (or potentially use) the Site as being very low. However, given the lack of research in New Zealand on this potential effect and the expansion of this renewable energy source in New Zealand, we think that it is important to better understand this potential risk, particularly in the context of New Zealand bird species, prior to commissioning of the solar farm.

By the time of construction (in at least several years), there may well be additional research / data available on bird strike, on which a reappraisal of this effect could be based. We recommend that this involves a further bird strike literature review (based on international studies, and New Zealand studies if any), with review and resulting binding recommendations to be prepared by a suitably qualified ornithologist / ecologist no earlier than 6 months prior to solar farm commissioning. The outcome of this literature review would determine if post-construction bird strike monitoring is required at the Site or not. It is expected that a conservative outcome would be a requirement to undertake such monitoring during the first year the solar farm is operational, either because research suggests there is indeed an effect, or because there may still be insufficient evidence applicable to the local context.

If monitoring is recommended, the purpose of it would be to detect and assess the impact (if any) on indigenous avifauna due to panel collision, with a particular focus on At Risk and Threatened species. If monitoring is implemented, we recommend that the methodology is developed in the form of an 'Avifauna Collision Risk Monitoring Plan' prepared by a suitably qualified ornithologist / ecologist. Any such plan should include, but not be limited to, the following details:

- o Frequency and duration of surveys (e.g., one day fortnightly for one year). Due to seasonal variation in bird behaviours including migratory movements, for any monitoring to be worthwhile the minimum time period is one year.
- o Survey methods (e.g., slowly drive up and down a defined subset of the solar farm rows searching for indigenous bird carcasses, noting species, number of

carcasses, weather conditions, cause of death, location, etc (and sending carcasses away for autopsy if cause of death is unknown).

- o Mortality thresholds for At Risk and Threatened indigenous species that if reached, trigger a management response.
- o Results analyses (e.g., estimated annual mortality rates).
- o Requirements for review and reporting, including making the results publicly accessible.

If the monitoring confirms that the level of effect on indigenous birds that use the Site is very low as assessed, then no further action will be required. However, if the monitoring indicates that the operation of the solar farm has (or potentially has) given rise to a more than very low level of effect on indigenous avifauna species, an Avifauna Management Plan should be developed to provide the methods and any ongoing monitoring required to reduce the level of ecological effect on indigenous avifauna to no more than a very low level of effect. One such response may be the implementation of potential collision deterrent / prevention intervention methods.

Any post-construction monitoring for this potential effect will contribute to a better understanding of whether this effect is real or not and provide specific research on water and wetland birds found in New Zealand.

Any literature review and Avifauna Collision Risk Monitoring Plan should be provided to the consenting authority prior to implementation.

8.1.5 Recommendations Not Required In Relation to Effects

The following general recommendations are intended to achieve improved ecological outcomes. They are not required in order to avoid, minimise, remedy, offset, or compensate adverse effects. Instead, they represent positive opportunities that we understand Helios has committed to implementing.

- Remove crack willow and common alder from within the southwest wetland. Because of a risk of ongoing spread of these species from existing boundary plantings into wetlands, it is also recommended that these species are gradually replaced with natives or non-spreading exotic species along the existing boundary along Naseby-Ranfurly Road. We understand that for visual effects reasons, this will need to wait until new replacement screen plantings have established and grown, to ensure screening is maintained.
- Fencing the southwest and central wetlands and undertaking supplementary planting within these wetlands and setbacks areas (total area c.31.3 ha).
 - o Appropriate wetland species to achieve ecological benefits include red tussock, purei, pūkio, *Carex kaloides*, grassland Spaniard, and bog rush.
 - o Planting of indigenous shrubs within fenced 10 m wetland setback areas would also provide ecological benefits, with recommended species including matagouri, desert broom, scrub pohuehue, porcupine shrub, mikimiki (*Coprosma propinqua* var. *propinqua* and *C. intertexta*), and indigenous tree daisies (*Olearia odorata* and *O. bullata*).
 - o It is recommended that these are planted in scattered nodes of 5-10 plants (rather than mass planted across the entire wetland and setback area) of no less than 1% coverage (assuming 1 m spacings). This will allow and accelerate

natural spread based on habitat suitability. Based on a combined central and southwest wetland and setback area totalling c. 31.3 ha, 1% coverage at 1 m spacings equates to c.3100 plants.

- o Maturation of shrubs and wetland species will take many years or decades. In the interim, ongoing weed release, survival monitoring, and replacement of plants that do not establish / survive is also generally recommended.
- Ongoing removal of woody weeds within the southwest and central wetlands and setback areas as necessary during the lifetime of the solar farm. Occasional and ongoing invasion by willows, alder (etc.) will no longer be suppressed by grazing once these areas are fenced. However, in spite of this, and as described in Section 7.1.2.1, the Proposal still results in overall positive (net gain) outcomes for wetlands.
- Predator control within the southwest and central wetlands (targeting mustelids and cats) may increase survival rates of bird species using these habitats.

The above measures could be detailed in a simple 'Wetland Enhancement Plan' to be prepared by a suitably qualified and experienced ecologist and implemented by Helios during construction and operation of the solar farm. However, it is reiterated that these measures are not required in respect of adverse effects, because fencing of the central and southwest wetlands already represents a positive (net gain) outcome of the Proposal. Therefore, implementation of the above measures represents an even greater net gain outcome of the Proposal.

8.2 Assessment of Residual Effects

The following table summarises the results of Sections 4, 5, 6, 7, and 8. It provides an assessment of the residual impact with the recommended impact management measures implemented for adverse ecological effects, with emphasis on effects assessed as being greater than 'very low.'

Table 15. Summary of predicted impacts, proposed mitigation and residual effects after the implementation of impact avoidance, minimisation and mitigation measures.

Subject or Location of Impact	Predicted Impact Without Impact Management Measures	Summary of Impact Management Measures Recommended	Residual Effects After Implementation of Impact Management Measures
Terrestrial Vegetation			
Loss of indigenous shrubs including At Risk – Declining species	Removal of up to <250 matagouri, <100 desert broom, <100 porcupine shrub, and <25 scrub pohuehue shrubs within the Site is considered a moderate level effect at the Site scale, and a very low level effect at the ED scale. At-Risk Declining shrubs at the Site are considered ecologically significant.	Clearance avoided / minimised where practicable. Remedial plantings of at least double the number of individuals removed would be included in boundary / screening and ecological enhancement plantings.	Effects would be fully remedied, with no residual effects . There would be no net loss of significant values (At Risk – Declining) shrubs. In the long-term (>20 years), the greater numbers of shrubs would provide a positive impact (a net gain) for these values.
Avifauna			

Subject or Location of Impact	Predicted Impact Without Impact Management Measures	Summary of Impact Management Measures Recommended	Residual Effects After Implementation of Impact Management Measures
Habitat modification / loss	Very low to low impacts to indigenous bird species on Site due to Site-wide changes (from panel array installation) and from clearance of indigenous shrubs.	Clearance avoided / minimised where practicable. Remedial plantings of indigenous shrubs cleared as described above.	Habitat loss due to clearance of indigenous shrubs would be remedied in the long-term following landscape plantings. Residual effects due to loss of pasture habitat remain very low-low .
Disturbance and temporary displacement	Temporary very low to low impacts to indigenous bird species on Site arising from construction activities	No specific management is required.	No permanent / ongoing effects.
Nesting birds	Very low level impacts to nesting indigenous birds if construction activities occur in the vicinity of nesting indigenous birds.	Works conducted subject to a pre-construction nesting bird survey and establishment of nest exclusion zones as required.	Adverse injury / mortality effects avoided if either recommendation is adopted.
Bird strike with solar panels	Unknown but possible bird strike with panels, likely affecting very small numbers of birds if any, but potentially affecting wetland and water bird species. Based on a number of factors, this effect is assessed as having a very low level of effect on wetland and water birds that use, or potentially use or traverse the Site.	Conduct additional literature review closer to the time of solar farm commissioning. Implement recommendations based on literature review, potentially including post-construction solar panel bird strike monitoring at the Site and any further measures based on the results of the study and any resulting monitoring.	Residual effects may at worst remain at very low levels. Improved knowledge about this potential effect may be transferable to new projects and may enable impact management responses (e.g., bird deterrent options)

9.0 Summary and Conclusion

In terms of existing environments at the Solar Farm Site, our assessment has found that:

- The proposed Solar Farm Site comprises dryland exotic pastures used for sheep and beef grazing; these are of negligible ecological value. The original indigenous vegetation has been fully removed via pastoral conversion, aside from a small number of scattered matagouri, desert broom, porcupine shrub, and scrub pohuehue shrubs, located solely along fence lines. At Risk – Declining shrubs at the Site are of high ecological value and are ecologically significant based on the applicable statutory criteria in the POORPS, PrORPS, and NPS-IB.
- Two moderately large ‘central’ and ‘southwest’ wetlands support indigenous wetland vegetation, including At Risk – Declining sedge and spaniard species; they are of moderate ecological value. Other small wetlands occupying depressions in the landform are essentially wet pasture of negligible ecological value.
- Because wetlands have been reduced to less than 20% of their original cover regionally and nationally (and additionally because some wetlands support At Risk species), all wetlands at the Site are considered ecologically significant.
- The Site is largely dominated by exotic bird species, but does provide foraging, roosting and / or nesting habitat for 22 indigenous bird species, including one Threatened, five At Risk and 16 Not Threatened species. These species range from low to very high ecological value.
- The Site does not provide suitable habitat for indigenous lizards or assemblages of indigenous terrestrial invertebrates. Because no works in waterways are anticipated or proposed (and works would be set back by >10 m from all streams and water races within the Site), the Proposal would have no adverse effects to waterways, and no assessment of freshwater ecology values in these waterways have been undertaken.

In relation to effects of the solar farm Proposal; this report finds that:

- Vegetation clearance to install solar panel piles, cable trenches, gravel access roads, a substation, pre-assembled inverter cabinets, and for temporary construction laydown areas would affect exotic pastures of negligible ecological value. Following construction, the Site would remain in grazed exotic pasture. **No adverse ecological effects are relevant to pasture vegetation.**
- Clearance of relict indigenous shrubs along fence lines would comprise a **high** level adverse effect at the Site scale, but a **very low** level adverse effect at the Māniatoto ED scale. At Risk – Declining shrubs are considered significant, and remedial plantings of all indigenous shrubs that would be lost is recommended, with at least double the numbers of plants being provided. There would be **no residual impacts** at the Site / ED scale to indigenous shrubs following remedial plantings, equating to **no net loss of significant shrub values**. In the long-term (>20 years), the greater numbers of shrubs would provide a positive impact (a **net gain**) for these values.
- All wetlands at the Site would be fully avoided by Site works, with setbacks applied. HDD would be used to direct cabling beneath the central wetland, specifically to avoid any potential effects. Fencing and enhancement of the central and southwest wetlands represents a **net gain in terms of significant wetland values** at the Site.

- Existing rainfall runoff patterns and other hydrological inputs to wetlands would be unaffected by the Proposal, meaning that there would be **no adverse indirect effects to wetlands**.
- Construction works will result in permanent habitat loss / modification for indigenous avifauna species utilising exotic pasture and indigenous shrubs; the level of residual effects has been assessed as **very low to low** for pasture areas, but **very low to low adverse effects would be remedied in the long term** for indigenous shrub habitat.
- Construction works may temporarily disturb and displace indigenous birds on Site; the level of effect has been assessed as **very low to low**, and temporary. No residual effects will occur and no impact management is required.
- Construction works may disturb, displace, injure or kill nesting indigenous birds (and nest contents) if conducted during the bird breeding season; the level of effect has been assessed as **very low to low**. With impact management potential injury or mortality effects can be **avoided**.
- The solar panels may pose a collision risk for indigenous water and wetland birds traversing the Site; the level of effect has been assessed as **very low**. We consider that further information is necessary in relation to this effect and propose a 'reappraisal' in the form of a further bird strike literature review to be undertaken prior to solar farm commissioning (which will not occur for several years). This exercise would allow for the findings of any further research (ideally, including New Zealand specific research) to be applied, noting that post-construction monitoring or similar measures may yet be recommended.

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Appendix 1: Further Details – Proposal Description

The bird strike assessments in Section 7.2.4 have been generally informed by the following proposal description details provided by Helios but not included in Section 2.0.

Solar Panel Arrays and Tracking:

The panels will be arranged in north-south orientated rows within array blocks of approximately 250 m x 285 m. The rows will be spaced approximately 6.8 m apart (pole to pole). There will be 12 m gaps between array blocks to allow for access tracks.

On an average day, the following occurs in terms of maximum solar panel height (with approximate timing):

- From sunset to sunrise, the panels are at their lowest, with an approximate 1.6-1.7 m height;
- From sunrise to approximately 3 h post sunrise, the panel height slowly increases, peaking at an approximate height of 2.5-2.7 m around 8 am – 10 am (depending on season);
- From 3 h post sunrise to midday, the panel height decreases to an approximate height of 1.75 m;
- From midday to 2 h prior to sunset, the panel height increases, peaking at an approximate height of 2.5-2.7 m at around 4-6 pm (depending on season)
- From approximately 4-6 pm to sunset, the panels decrease in height to a 1.6-1.7 m height.

Solar angles and irradiances vary during the year, and therefore there are also slight variations to maximum solar panel heights and when they occur during the day because of seasonality. For example, on an average January day, the maximum height of panels at approximately 2.5-2.7 m occurs around 8 am and 6 pm. On an average day in July, the maximum height of panels at approximately 2.5-2.7 m occurs around 10 am and 3 pm.

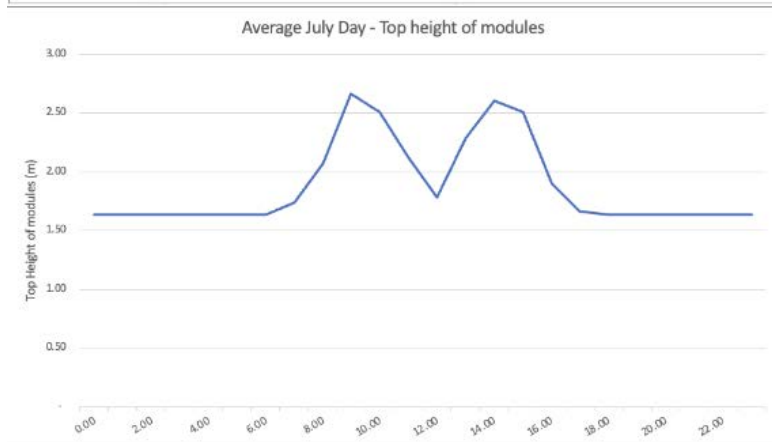
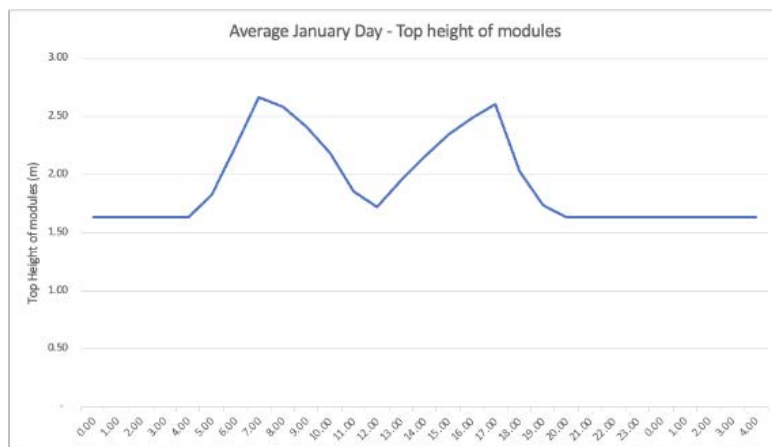
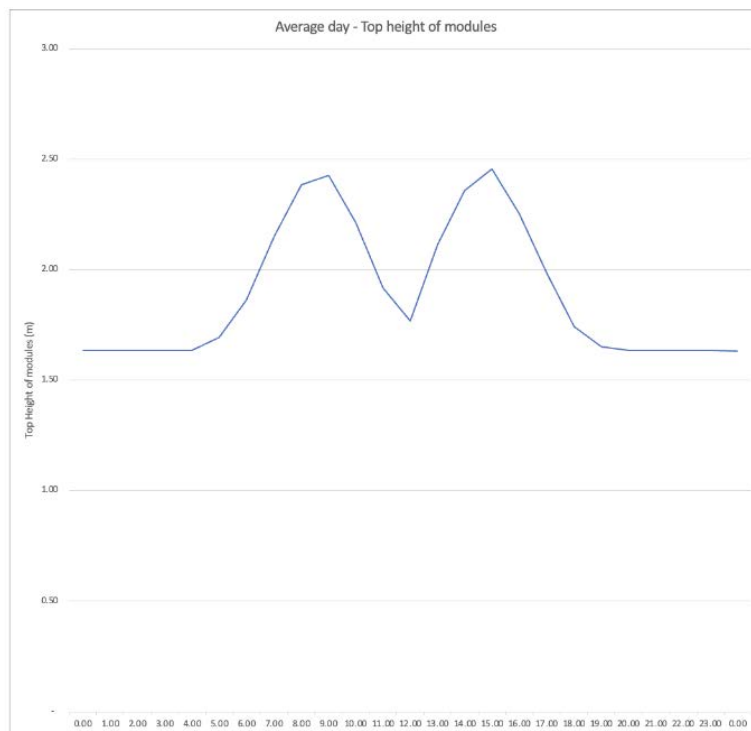


Figure 17. Solar panel height and timing over an average day, an average January day, and an average July day (figure provided by Helios).

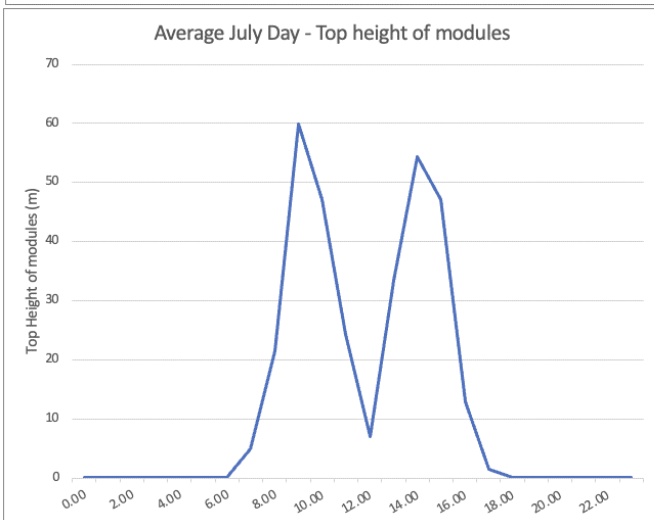
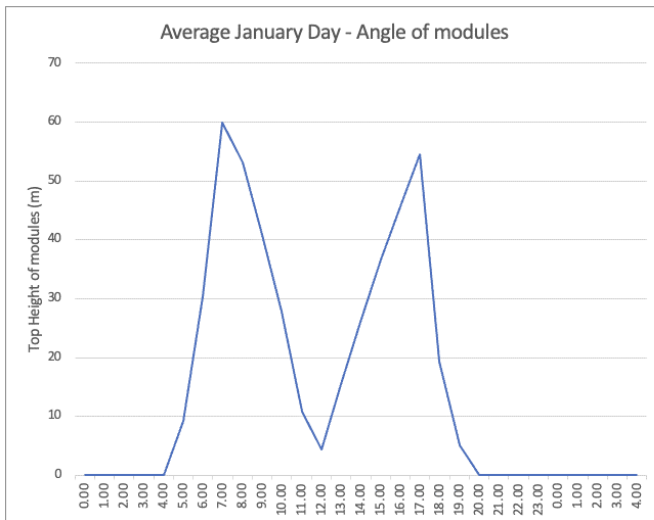
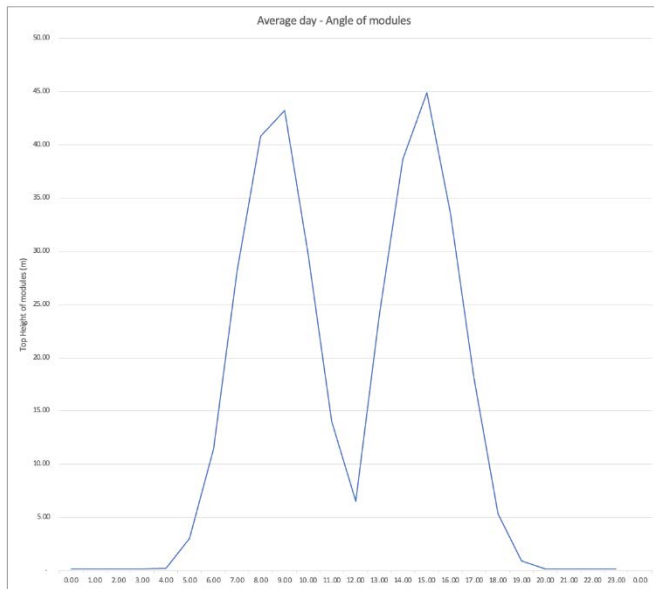


Figure 18. Solar panel angle and timing over an average day, an average January day, and an average July day (figure provided by Helios).

Appendix 2: Further Details – Methodology

As described in Section 4.7, this EclA has followed the EIANZ EclA guidelines to determine ecological value, magnitude of impact, and level of impact, based on the following tables:

Table 16. Attributes to be considered when assigning ecological value or importance to a Site or area of vegetation / habitat / community for terrestrial ecosystems (from Roper-Lindsay et al. 2018).

MATTERS	ATTRIBUTES TO BE CONSIDERED
Representativeness	Criteria for representative vegetation and aquatic habitats: - Typical structure and composition - Indigenous species dominate - Expected species and tiers are present - Thresholds may need to be lowered where all examples of a type are strongly modified Criteria for representative species and species assemblages: - Species assemblages that are typical of the habitat - Indigenous species that occur in most of the guilds expected for the habitat type
Rarity/distinctiveness	Criteria for rare/distinctive vegetation and habitats: - Naturally uncommon, or induced scarcity - Amount of habitat or vegetation remaining - Distinctive ecological features - National priority for protection Criteria for rare/distinctive species or species assemblages: - Habitat supporting nationally Threatened or At Risk species, or locally uncommon species - Regional or national distribution limits of species or communities - Unusual species or assemblages - Endemism
Diversity and pattern	- Level of natural diversity, abundance and distribution - Biodiversity reflecting underlying diversity - Biogeographical considerations – pattern, complexity - Temporal considerations, considerations of lifecycles, daily or seasonal cycles of habitat availability and utilisation
Ecological context	- Site history, and local environmental conditions which have influenced the development of habitats and communities - The essential characteristics that determine an ecosystem's integrity, form, functioning, and resilience (from "intrinsic value" as defined in RMA) - Size, shape and buffering - Condition and sensitivity to change - Contribution of the site to ecological networks, linkages, pathways and the protection and exchange of genetic material - Species role in ecosystem functioning – high level, key species identification, habitat as proxy

Table 17. Criteria for assigning ecological value to species (Roper-Lindsay et al., 2018).

ECOLOGICAL VALUE	SPECIES CLASSIFICATION
Negligible	Exotic species, including pests, species having recreational value.
Low	Nationally and locally common indigenous species.
Moderate	Species listed as any other category of <i>At Risk</i> (Recovering, Relict, Naturally Uncommon) found in the 'zone of influence' (ZOI) either permanently or seasonally; or Locally (ED) uncommon or distinctive species.
High	Species listed as <i>At Risk – Declining</i> found in the ZOI either permanently or seasonally.
Very High	<i>Nationally Threatened</i> (Nationally Critical, Nationally Endangered, Nationally Vulnerable) species found in the ZOI either permanently or seasonally.

Table 18. Assigning overall value to areas (refer to Table 16 for the matters to be considered for terrestrial communities) (Roper-Lindsay et al., 2018).

VALUE	DESCRIPTION
Negligible	Area rates Very Low for three matters and Moderate, Low or Very Low for remainder.
Low	Area rates Low or Very Low for majority of assessment matters and Moderate for one. Limited ecological value other than as local habitat for tolerant native species.
Moderate	Area rates High for one matter, Moderate and Low for the remainder, or Area rates Moderate for two or more assessment matters Low or Very Low for the remainder Likely to be important at the level of the Ecological District.
High	Area rates High for two of the assessment matters, Moderate and Low for the remainder, or Area rates High for one of the assessment matters, Moderate for the remainder. Likely to be regionally important and recognised as such.
Very High	Area rates High for three or all of the four assessment matters. Likely to be nationally important and recognised as such.

Table 19. Criteria for describing magnitude of effect (Roper-Lindsay et al., 2018).

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

Table 20. Criteria for describing the level of effect (Roper-Lindsay et al., 2018).

		ECOLOGICAL VALUE				
		Very High	High	Moderate	Low	Negligible
MAGNITUDE	Very High	Very High	Very High	High	Moderate	Low
	High	Very High	Very High	Moderate	Low	Very Low
	Moderate	High	High	Moderate	Low	Very Low
	Low	Moderate	Low	Low	Very Low	Very Low
	Negligible	Low	Very Low	Very Low	Very Low	Very Low
	Positive	Net Gain	Net Gain	Net Gain	Net Gain	Net Gain

Appendix 3: OSNZ Squares

This plan has been prepared by Boffa Miskell Limited on the specific instructions of our Client. It is solely for our Client's use in accordance with the agreed scope of work. Any use or reliance by a third party is at that party's own risk. Where information has been supplied by the Client or obtained from other external sources, it has been assumed that it is accurate. No liability or responsibility is accepted by Boffa Miskell Limited for any errors or omissions to the extent that

LEGEND

- Site Boundary
- Ornithological Society of NZ Grid
- New Zealand Bird Atlas online label
- OSNZ Bird Distribution book label

DO29
228, 557

DP29
228, 556

85

bing

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Appendix 4: Plant Species List and Wetland Plots

Overall Species List

Table 21. Plant species list for exotic pastures (including indigenous shrubs along fence lines).

Indigenous species	Common name	Threat Status	Growth Form
<i>Acaena buechananii</i> ³³	Bidibid	At Risk - Declining	Dicot Herb
<i>Aciphylla aurea</i> ³³	Golden Spaniard	Not Threatened	Dicot Herb
<i>Carex coriacea</i>	Cutty Grass	Not Threatened	Grass
<i>Carmichaelia petriei</i>	Desert Broom	At Risk - Declining	Shrub
<i>Chionochloa rigida</i>		Not Threatened	Grass
<i>Coprosma intertexta</i> ³³		At Risk - Declining	Shrub
<i>Discaria toumatou</i>	Matagouri	At Risk - Declining	Tree
<i>Eleocharis acuta</i>	Sharp Spike Sedge	Not Threatened	Grass
<i>Gonocarpus micranthus subsp. micranthus</i> ³³		Not Threatened	Low Shrub
<i>Juncus australis</i>	Leafless Rush	Not Threatened	Grass
<i>Juncus edgariae</i>	Wiwi	Not Threatened	Grass
<i>Muehlenbeckia complexa</i>	Scub Pohuehue	Not Threatened	Vine
<i>Melicytus alpinus</i>	Porcupine Shrub	Not Threatened	Shrub
<i>Styphelia nesophila</i> ³³		Not Threatened	Shrub
Exotic species	Common name	Threat Status	Growth Form
<i>Achillea millefolium</i>	Yarrow	n/a	Dicot Herb
<i>Agrostis capillaris</i>	Browntop	n/a	Grass
<i>Agrostis stolonifera</i>	Creeping Bent	n/a	Grass
<i>Alopecurus geniculatus</i>	Knead Foxtail	n/a	Grass
<i>Anthoxanthum odoratum</i>	Sweet Vernal	n/a	Grass
<i>Brassica species</i>		n/a	Dicot Herb
<i>Cerastium fontanum</i>	Mouse-ear Chickweed	n/a	Dicot Herb
<i>Chenopodium species</i>		n/a	
<i>Cirsium arvense</i>	Californian Thistle	n/a	Dicot Herb
<i>Cirsium vulgare</i>	Scotch Thistle	n/a	Dicot Herb
<i>Crataegus monogyna</i>	Hawthorn	n/a	Tree
<i>Crepis species</i>		n/a	Dicot Herb
<i>Cynosurus cristatus</i>	Crested Dogstail	n/a	Grass
<i>Dactylis glomerata</i>	Cocksfoot	n/a	Grass
<i>Festuca rubra</i>	Chewings Fescue	n/a	Grass
<i>Grass species</i>	Unidentified Exotic Grass	n/a	Grass
<i>Glyceria declinata</i>	Blue Sweet Grass	n/a	Grass

³³ All locations of this species are outside the Solar Farm Footprint.

<i>Hesperocyparis macrocarpa</i>		n/a	Tree
<i>Holcus lanatus</i>	Yorkshire Fog	n/a	Grass
<i>Hypochaeris radicata</i>	Catsear	n/a	Dicot Herb
<i>Juncus articulatus</i>	Jointed Rush	n/a	Grass
<i>Juncus effusus</i>	Leafless Rush	n/a	Grass
<i>Lepidium species</i>		n/a	Dicot Herb
<i>Lolium perenne</i>	Perennial Rye Grass	n/a	Grass
<i>Malva species</i>	Mallow Species	n/a	Dicot Herb
<i>Marrubium vulgare</i>	Horehound	n/a	Dicot Herb
<i>Medicago sativa</i>	Lucerne	n/a	Dicot Herb
<i>Pinus radiata</i>	Radiata Pine	n/a	Tree
<i>Poa pratensis</i>	Kentucky Bluegrass	n/a	Grass
<i>Rumex acetosella</i>	Sheeps Sorrel	n/a	Dicot Herb
<i>Rumex crispus</i>	Curled Dock	n/a	Dicot Herb
<i>Sagina procumbens</i>	Procumbent Pearlwort	n/a	Dicot Herb
<i>Senecio vulgaris</i>	Groundsel	n/a	Dicot Herb
<i>Taraxacum officinale</i>	Dandelion	n/a	Dicot Herb
<i>Trifolium repens</i>	White Clover	n/a	Dicot Herb
<i>Trifolium subterraneum</i>	Subclover	n/a	Dicot Herb
<i>Veronica species</i>		n/a	

Table 22. Plant species list for wetlands, including the central wetland, southwest wetland and a combined species list for all small wetlands surveyed. All wetlands are outside the Solar Farm Footprint.

Indigenous Species						
Species Name	Common Name	Threat Status	Growth Form	Central Wetland	Southwest Wetland	Small wetlands
<i>Aciphylla subflabellata</i>	Spaniard	At Risk - Declining	Dicot Herb		✓	
<i>Austroderia richardii</i>	Toetoe	Not Threatened	Grass		✓	
<i>Azolla rubra</i>	Pacific Azolla	Not Threatened	Fern			✓
<i>Carex secta</i>	Pūrei	Not Threatened	Grass	✓		
<i>Carex species</i>	Unidentified Sedge or Hook-grass		Grass	✓	✓	✓
<i>Carex virgata</i>	Pūkio / Swamp Sedge	Not Threatened	Grass	✓		
<i>Eleocharis acuta</i>	Sharp Spike Sedge	Not Threatened	Grass	✓	✓	✓
<i>Eleocharis species</i>			Grass	✓	✓	
<i>Juncus australis</i>	Leafless Rush	Not Threatened	Grass	✓	✓	✓
<i>Juncus edgariae</i>	Wīwī	Not Threatened	Grass	✓	✓	✓
<i>Lemna disperma</i>	Common Duckweed	Not Threatened	Dicot Herb	✓	✓	✓
<i>Lepidosperma australe</i>	Square Sedge	Not Threatened	Grass	✓		
<i>Montia fontana</i>		Not Threatened	Dicot Herb		✓	
<i>Moss species</i>	Unidentified Moss		Non Vascular	✓	✓	✓

<i>Phormium tenax</i>	Harakeke	Not Threatened	Grass		✓	
<i>Ranunculus glabrifolius</i>	Wairiki	Not Threatened	Dicot Herb	✓	✓	✓
<i>Schoenus pauciflorus</i>	Bog Rush	Not Threatened	Grass	✓	✓	
Exotic Species						
Exotic Species	Common name	Threat Status	Growth Form	Central Wetland	Southwest Wetland	Small wetlands*
<i>Achillea millefolium</i> *	Yarrow	n/a	Dicot Herb	✓	✓	✓
<i>Agrostis stolonifera</i> *	Creeping Bent	n/a	Grass	✓	✓	✓
<i>Alopecurus geniculatus</i> *	Kneed Foxtail	n/a	Grass	✓	✓	✓
<i>Anthoxanthum odoratum</i> *	Sweet Vernal	n/a	Grass	✓	✓	✓
<i>Bellis perennis</i> *	Bellis Daisy	n/a	Dicot Herb	✓		✓
<i>Callitriche stagnalis</i> *	Water Starwort	n/a	Dicot Herb	✓		✓
<i>Carex leporina</i> *	Oval Sedge	n/a	Grass	✓	✓	✓
<i>Cerastium fontanum</i> *	Mouse-ear Chickweed	n/a	Dicot Herb	✓	✓	✓
<i>Crepis species</i> *		n/a	Dicot Herb	✓	✓	✓
<i>Dactylis glomerata</i> *	Cocksfoot	n/a	Grass	✓	✓	✓
<i>Festuca rubra</i> *	Chewings Fescue	n/a	Grass	✓	✓	✓
<i>Glyceria declinata</i> *	Blue Sweet Grass	n/a	Grass	✓	✓	✓
<i>Holcus lanatus</i> *	Yorkshire Fog	n/a	Grass	✓	✓	✓
<i>Hypochaeris radicata</i> *	Catsear	n/a	Dicot Herb	✓	✓	✓
<i>Juncus articulatus</i> *	Jointed Rush	n/a	Grass	✓	✓	✓
<i>Juncus bufonius</i> *	Toad Rush	n/a	Grass	✓		
<i>Juncus effusus</i> *	Leafless Rush	n/a	Grass	✓	✓	✓
<i>Leontodon species</i> *		n/a	Dicot Herb	✓	✓	✓
<i>Lolium arundinaceum</i> *	Tall Fescue	n/a	Grass	✓	✓	✓
<i>Lolium perenne</i> *	Perennial Rye Grass	n/a	Grass	✓	✓	✓
<i>Myosotis laxa</i> *	Water Forget-Me-Not	n/a	Dicot Herb			✓
<i>Nasturtium officinale</i> *	Watercress	n/a	Dicot Herb		✓	✓
<i>Phleum pratense</i> *	Timothy	n/a	Grass	✓	✓	✓
<i>Poa pratensis</i> *	Kentucky Bluegrass	n/a	Grass	✓	✓	✓
<i>Ranunculus acris</i> *	Giant Buttercup	n/a	Dicot Herb		✓	
<i>Ranunculus sceleratus</i> *	Celery-leaved Buttercup	n/a	Dicot Herb	✓		✓
<i>Rumex crispus</i> *	Curled Dock	n/a	Dicot Herb	✓	✓	✓
<i>Sagina procumbens</i> *	Procumbent Pearlwort	n/a	Dicot Herb			✓
<i>Salix species</i> *		n/a	Tree or Shrub		✓	✓
<i>Taraxacum officinale</i> *	Dandelion	n/a	Dicot Herb	✓	✓	✓
<i>Trifolium repens</i> *	White Clover	n/a	Dicot Herb	✓	✓	✓
<i>Trifolium species</i> *		n/a	Dicot Herb			✓
<i>Trifolium subterraneum</i> *	Subclover	n/a	Dicot Herb			✓
<i>Veronica serpyllifolia</i> *	Turf Speedwell	n/a	Dicot Herb			✓

Wetland Plot Summary

Table 23. Wetland plot summary including 'natural inland wetland' determination test results. This includes the 'pasture exclusion test' and if the plot was classified as a wetland or not (overall).

Plot	Rapid Test	Rapid Test	Prevalence Index Test	Pasture Exclusion' Applies	Natural Inland Wetland? (NPS-FM)
197	Pass	Pass	1.6	No	Yes
200	Fail	Fail	3.5	n/a	No
202	Pass	Pass	1.6	No	Yes
203	Fail	Fail	2.9	Yes	No
204	Pass	Pass	1.7	No	Yes
205	Fail	Fail	2.3	No	Yes
207	Pass	Pass	1.6	No	Yes
208	Pass	Pass	2	No	Yes
209	Pass	Pass	2.1	No	Yes
210	Pass	Pass	2	No	Yes
211	Fail	Fail	2.9	No	Yes
212	Fail	Fail	3.6	n/a	No
214	Pass	Pass	2.6	No	Yes
215	Fail	Fail	2.7	No	Yes
216	Pass	Pass	2	No	Yes
217	Pass	Pass	2	No	Yes
218	Pass	Pass	2.2	No	Yes
219	Pass	Pass	2	No	Yes
224	Pass	Pass	1.8	No	Yes
225	Pass	Pass	2.1	No	Yes
226	Pass	Pass	1.9	No	Yes
227	Pass	Pass	2	No	Yes
228	Fail	Fail	3	No	Yes
229	Fail	Fail	2	No	Yes
230	Fail	Fail	2.1	No	Yes
231	Pass	Pass	2.7	No	Yes
232	Pass	Pass	2	No	Yes
233	Fail	Fail	3.7	n/a	No
234	Pass	Pass	1.2	No	Yes
235	Pass	Pass	1.7	No	Yes
236	Pass	Pass	1.8	No	Yes
237	Pass	Pass	2	No	Yes
238	Fail	Fail	2.8	No	Yes
239	Pass	Pass	2	No	Yes
240	Fail	Pass	2.5	No	Yes
241	Fail	Fail	4	n/a	No
242	Fail	Fail	3.1	n/a	No

243	Pass	Pass	1.9	No	Yes
244	Pass	Pass	2	No	Yes
245	Fail	Fail	3.6	n/a	No
246	Pass	Pass	1.7	No	Yes
251	Pass	Pass	2.1	No	Yes
252	Pass	Pass	1.7	No	Yes
253	Pass	Pass	2.5	No	Yes
254	Fail	Pass	2.1	No	Yes
255	Pass	Pass	2.4	No	Yes
256	Pass	Pass	2.1	No	Yes
257	Pass	Pass	1.5	No	Yes
258*	Fail	Fail	1.2	No	Yes

* Vegetation cover in this plot exceeded 50% cover of a moss species with no wetland indicator ranking and hence plot results are considered unreliable. The plot was considered wetland.

Appendix 5: Vegetation Map and Wetland Plot Location Map

This plan has been prepared by Boffa Miskell Limited on the specific instructions of our Client. It is solely for our Client's use in accordance with the agreed scope of work. Any use or reliance by a third party is at that party's own risk. Where information has been supplied by the Client or obtained from other external sources, it has been assumed that it is accurate. No liability or responsibility is accepted by Boffa Miskell Limited for any errors or omissions to the extent that

LEGEND

Vegetation Type

 Indigenous Shrubland

 Pond (Constructed)

 Wetland with Indigenous Vegetation

 Wetland without Indigenous Vegetation

At Risk Plant Locations

 Acaena buchananii

 Carex kaloides

 Coprosma intertexta

 Matagouri

 Indigenous Shrubs

 Site Boundary

 Cadastre

 Primary Road Parcels

Eagle Technology, Land Information New Zealand, GEBCO, Community maps contributors

Boffa Miskell



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0400 m

1:12,638 @ A3

Data Sources:

Cadastre sourced from LINZ data service

Projection: NZGD 2000 New Zealand Transverse Mercator

HELIOS NASEBY SOLAR FARM

Vegetation Map

Date: 25 November 2023 | Revision: 1

Plan prepared for Helios Energy Ltd by Boffa Miskell Limited

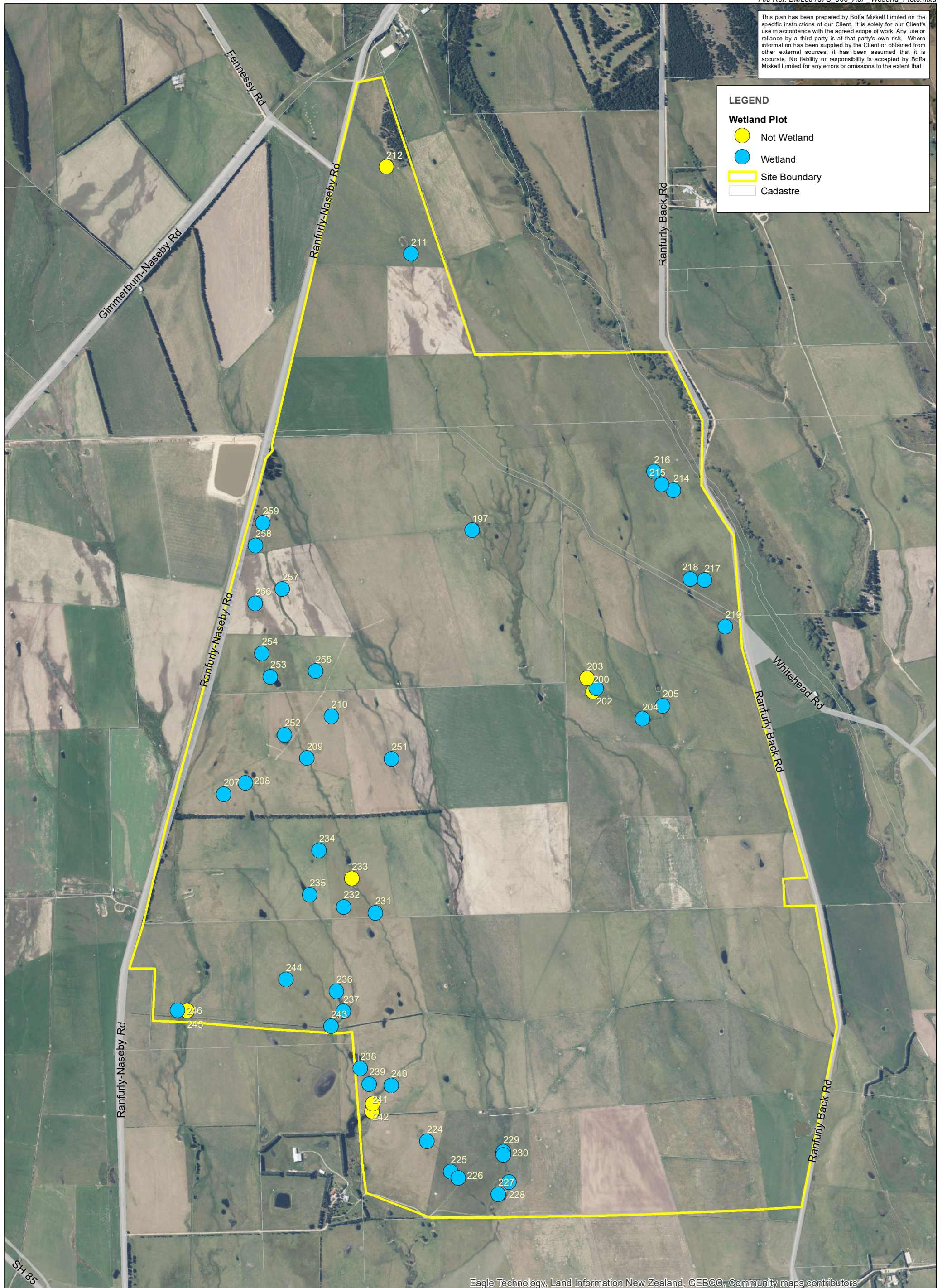
Project Manager: jaz.morris@boffamiskell.co.nz | Drawn: CSc | Checked: JMo

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LEGEND

Wetland Plot

- Not Wetland
- Wetland
- Site Boundary
- Cadastre

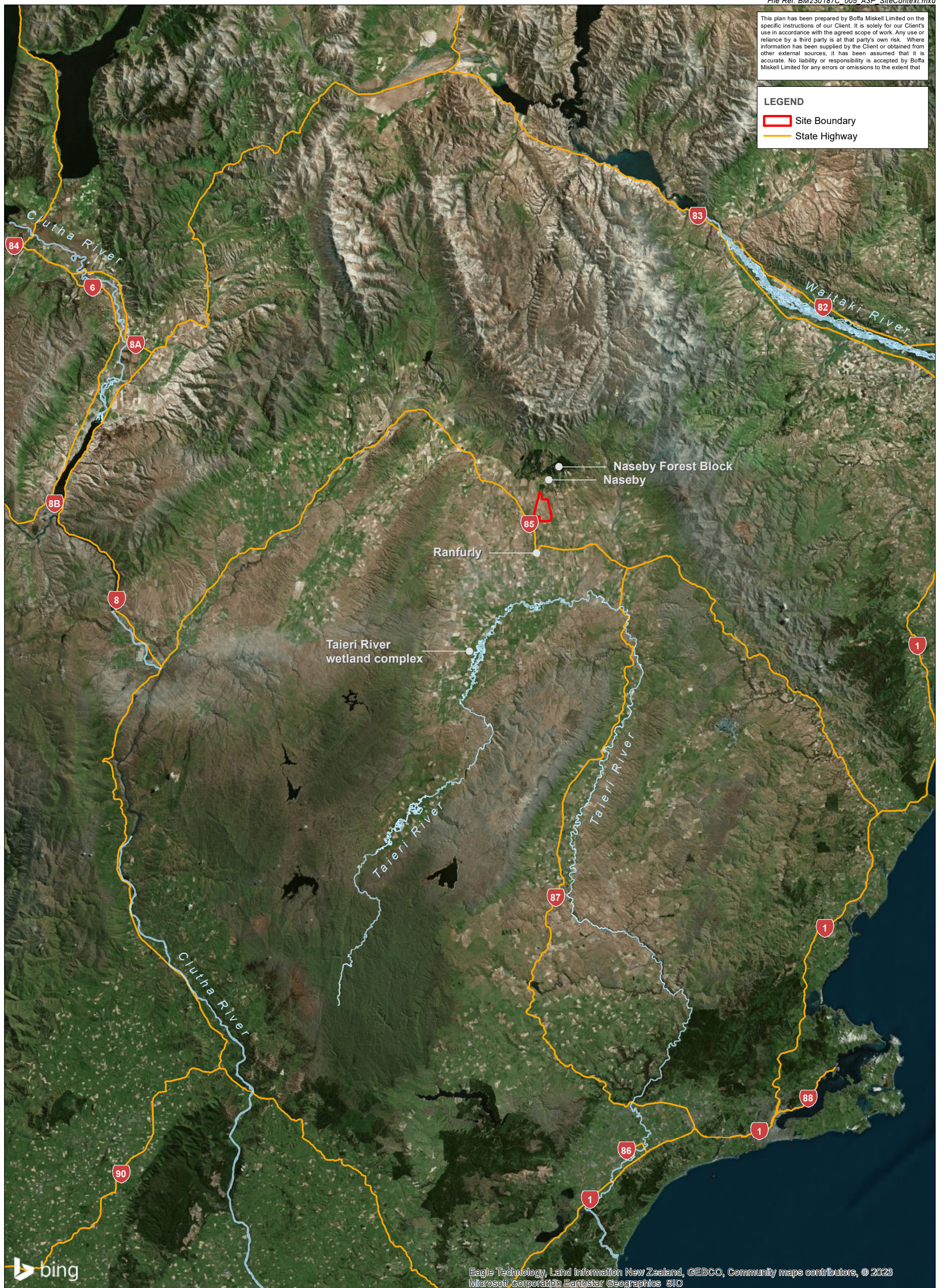


Appendix 6: Site Context Map

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LEGEND

- Site Boundary
- State Highway



Appendix 7: Full Avifauna Species List

Table 24. Full, unfiltered list of avifauna species noted during the desktop and field investigations for the Site. Cells shaded dark green represent primary habitat/s used by each species and cells shaded light green represent secondary habitat/s used. Nat. Vul. stands for Nationally Vulnerable, Nat. Unc. stands for Nationally Uncommon, Dec. stands for Declining and Rel. stands for Relict.

SPECIES		CONSERVATION STATUS - Robertson et al. 2021	HABITAT USE								RECORD				
			Native forest	Exotic Forest	Scrub / shrubland	Farmland / open country	Freshwater / wetlands	Coastal / Estuary	Oceanic	Urban/Residential	eBird Atlas Effort Map - Square DP29	eBird Atlas Effort Map - Square DO29	Bird Atlas 1999-2004 - Square 228,556	Bird Atlas 1999-2004 - Square 228,557	Site Visit
Tui	<i>Prosthemadera n. novaeseelandiae</i>	Not Threatened									✓	✓			
Kereru	<i>Hemiphaga novaeseelandiae</i>	Not Threatened									✓	✓		✓	
South Island fantail	<i>Rhipidura f. fuliginosa</i>	Not Threatened										✓		✓	
South Island tomtit	<i>Petroica macrocephala macrocephala</i>	Not Threatened										✓		✓	
Bellbird	<i>Anthornis m. melanura</i>	Not Threatened										✓			
Shining cuckoo	<i>Chrysococcyx l. lucidus</i>	Not Threatened										✓			
Kingfisher	<i>Todiramphus sanctus vagans</i>	Not Threatened										✓			
Brown creeper	<i>Mohoua novaeseelandiae</i>	Not Threatened												✓	
Silvereye	<i>Zosterops lateralis lateralis</i>	Not Threatened									✓	✓	✓	✓	

Grey warbler	<i>Gerygone igata</i>	Not Threatened										✓	✓	✓	✓
Spur-winged plover	<i>Vanellus miles novaehollandiae</i>	Not Threatened									✓	✓	✓	✓	✓
Swamp harrier	<i>Circus approximans</i>	Not Threatened									✓	✓	✓	✓	✓
Eastern falcon	<i>Falco n. novaeseelandiae</i>	Threatened – Nat. Vul.									✓				
Welcome swallow	<i>Hirundo n. neoxena</i>	Not Threatened									✓	✓	✓	✓	
NZ pipit	<i>Anthus n. novaeseelandiae</i>	At Risk – Dec.										✓	✓	✓	✓
South Island pied oystercatcher	<i>Haematopus finschi</i>	At Risk – Dec.									✓	✓	✓	✓	✓
NZ scaup	<i>Aythya novaeseelandiae</i>	Not Threatened									✓	✓			
Australian coot	<i>Fulica atra australis</i>	At Risk – Nat. Unc.									✓	✓			
Australian shoveler	<i>Anas rhynchotis</i>	Not Threatened									✓	✓	✓	✓	✓
Grey teal	<i>Anas gracilis</i>	Not Threatened									✓	✓	✓	✓	✓
Pied stilt	<i>Himantopus h. leucocephalus</i>	Not Threatened									✓	✓	✓	✓	✓
Pukeko	<i>Porphyrio m. melanotus</i>	Not Threatened									✓		✓		
Black swan	<i>Cygnus atratus</i>	Not Threatened									✓	✓	✓		
Paradise shelduck	<i>Tadorna variegata</i>	Not Threatened									✓	✓	✓	✓	✓
Southern crested grebe	<i>Podiceps cristatus australis</i>	Threatened – Nat. Vul.										✓			
Little shag	<i>Phalacrocorax melanoleucos brevirostris</i>	At Risk – Rel.										✓		✓	✓
White heron	<i>Ardea modesta</i>	Threatened										✓			
Black shag	<i>Phalacrocorax carbo novaehollandiae</i>	At Risk – Rel.										✓		✓	
Grey duck	<i>Anas superciliosa</i>	Threatened – Nat. Vul.										✓		✓	
White-faced heron	<i>Egretta novaehollandiae</i>	Not Threatened									✓	✓	✓	✓	
Black-backed gull	<i>Larus d. dominicanus</i>	Not Threatened									✓	✓	✓	✓	✓
Banded dotterel	<i>Charadrius bicinctus bicinctus</i>	At Risk – Dec.													✓
Little owl	<i>Athene noctua</i>	Introduced									✓	✓			
Mallard	<i>Anas platyrhynchos</i>	Introduced									✓	✓	✓	✓	✓

Rock pigeon	<i>Columba livia</i>	Introduced										✓	✓	✓	✓	✓
Magpie	<i>Gymnorhina tibicen</i>	Introduced										✓	✓	✓	✓	✓
Song thrush	<i>Turdus philomelos</i>	Introduced										✓	✓	✓	✓	✓
Dunnoek	<i>Prunella modularis</i>	Introduced										✓	✓	✓	✓	
Chaffinch	<i>Fringilla coelebs</i>	Introduced										✓	✓	✓	✓	✓
Skylark	<i>Alauda arvensis</i>	Introduced										✓	✓	✓	✓	✓
Greenfinch	<i>Carduelis chloris</i>	Introduced										✓	✓	✓	✓	✓
Blackbird	<i>Turdus merula</i>	Introduced										✓	✓	✓	✓	✓
House sparrow	<i>Passer domesticus</i>	Introduced										✓	✓	✓	✓	
Redpoll	<i>Carduelis flammea</i>	Introduced										✓	✓	✓	✓	✓
Goldfinch	<i>Carduelis carduelis</i>	Introduced										✓	✓	✓	✓	✓
Yellowhammer	<i>Emberiza citrinella</i>	Introduced										✓	✓	✓	✓	✓
Starling	<i>Sturnus vulgaris</i>	Introduced										✓	✓	✓	✓	✓
California quail	<i>Callipepla californica</i>	Introduced										✓	✓		✓	
Canada goose	<i>Branta canadensis</i>	Introduced											✓		✓	✓
Mallard x grey duck (hybrid)	<i>Platyrhynchos x Anas hybrid</i>	N/A										✓	✓			
Wild turkey	<i>Meleagris gallopavo</i>	Introduced												✓		
Rook	<i>Corvus frugilegus</i>	Introduced												✓		

Appendix 8: Additional Site Photos



Figure 19. Exotic grassland pasture at the Site, showing evidence of cutting and baling (or similar).



Figure 20. Matagouri shrubs along a fence line.



Figure 21. Typical paddocks and a fence line.



Figure 22. Improved exotic pastures surrounding the central wetland.



Figure 23. Central wetland.



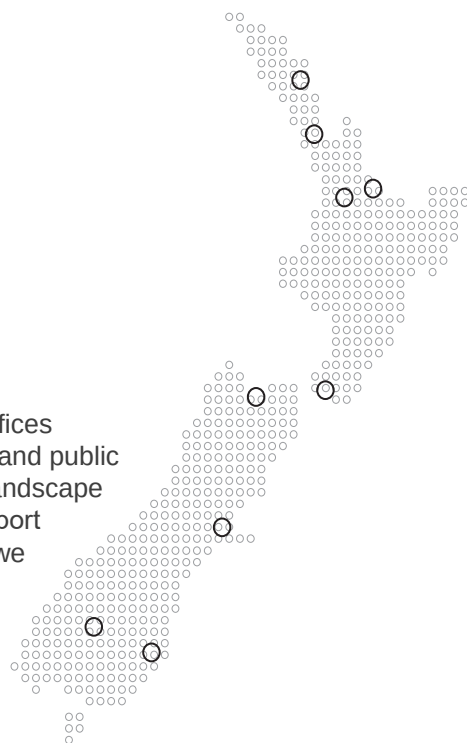
Figure 24. Wetland habitat fringing a water race / stream in the southwest wetland.



Figure 25. 'Small wetland' occupying a depression, with exotic sweetgrass, kneed foxtail, and creeping bent surrounded by Juncus spp. rushes grading to exotic pasture.

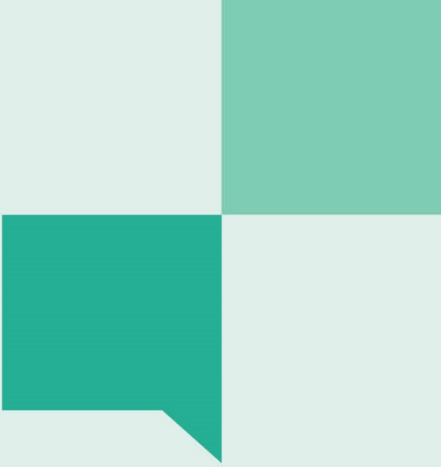
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Appendix 6

Construction Methodology

Construction Methodology

This document outlines the construction methodology for the Mānīatoto Plain solar farm.

1. Pre Construction Activities

The following activities are generally required to be completed prior to commencement of the construction works:

- Obtaining of all required approvals including resource consent and/or building consent
- Geotechnical testing
- Topography survey
- Pile testing
- Detailed engineering studies, design and drawings

Once these pre-construction activities are complete to the satisfaction of Helios and its investors, Helios will exercise the Option to Lease, and officially enter the lease arrangement, at which point the 35 year term of Lease will commence.

2. Construction Activities

Construction will occur over a period of approximately 24 months generally following the sequence described below.

- Site preparation including removal of existing farm infrastructure and marking out the site. The property is relatively flat and therefore no major earthworks are required to prepare the site for the installation of the solar arrays.
- Erecting the security fence (deer fencing with an approx height of 2m consisting of timber posts and mesh wire)
- Installing CCTV cameras
- Creating the internal access tracks and laydown area
- Driving steel piles into the ground
- Installing mounting frames and solar panels
- Trenching and cable laying for direct current (DC) cables and medium voltage alternating current (AC) cables
- Preparing areas for the inverters, switchgear, transformer, substation and battery storage area
- Installation of the housing/ cabinets for the above infrastructure
- Connect all cables and energise the facility

The planting plan will be implemented as part of the construction activities during the planting seasons.



In the event that, during earthworks, an archaeological find is made or koiwi uncovered, work shall stop immediately, the appropriate iwi authority shall be advised and an appropriate course of action shall be determined in accordance with the Heritage New Zealand Pouhere Taonga Act 2014 and the appropriate iwi protocols.

3. Commissioning Activities

The process of commissioning is the final stage in establishing a solar farm and involves a series of tests to ensure all components including solar panels, inverters, transformers, switchgear and associated systems are installed and functioning correctly. It also involves grid connection testing to ensure the power generated by the solar farm can be safely and effectively integrated into the electricity grid. While there are a number of electrical contractors required on site during this time, all components outlined in Section 2 will have already been installed prior to the commissioning stage.

4. Decommissioning of Solar Farm

At the end of the intended 35-year life span of the solar panels, the solar farm, including the substation building and all ancillary equipment, will be dismantled and removed from the site.

Materials will be reused or taken to an appropriate location for recycling or disposal. As per the terms of agreement with the landowners, the site will be reinstated to its original pre-construction condition.



Appendix 7

Integrated Transport Assessment

Naseby Solar Farm Development

Transport Assessment

Prepared for	Helios Energy Ltd
Job Number	HEL-J001
Revision	Final
Issue Date	23 August 2023
Prepared by	Logan Copland, Senior Transportation Planner
Reviewed by	Jay Baththana, Principal Transportation Engineer

1. Introduction

Abley has been engaged by Helios Energy Ltd to prepare a Transportation Assessment (TA) in respect of a proposed Solar Farm development to the south-west of Naseby, in the Central Otago district. This TA considers the existing transport network in the vicinity of the site, assesses the proposal against the transport requirements of the Central Otago District Plan, and assesses the effects of the proposal on the safety and efficiency of the transport network.

2. Existing Site

The site is located in Naseby, Central Otago district, and has an approximate area of 660ha. The site is a rural zoned property currently being used as pastoral grazing. The site location is shown in Figure 2.1, and is located approximately half way between Ranfurly and Naseby, requiring a drive length of approximately 5 minutes from the site to each township.

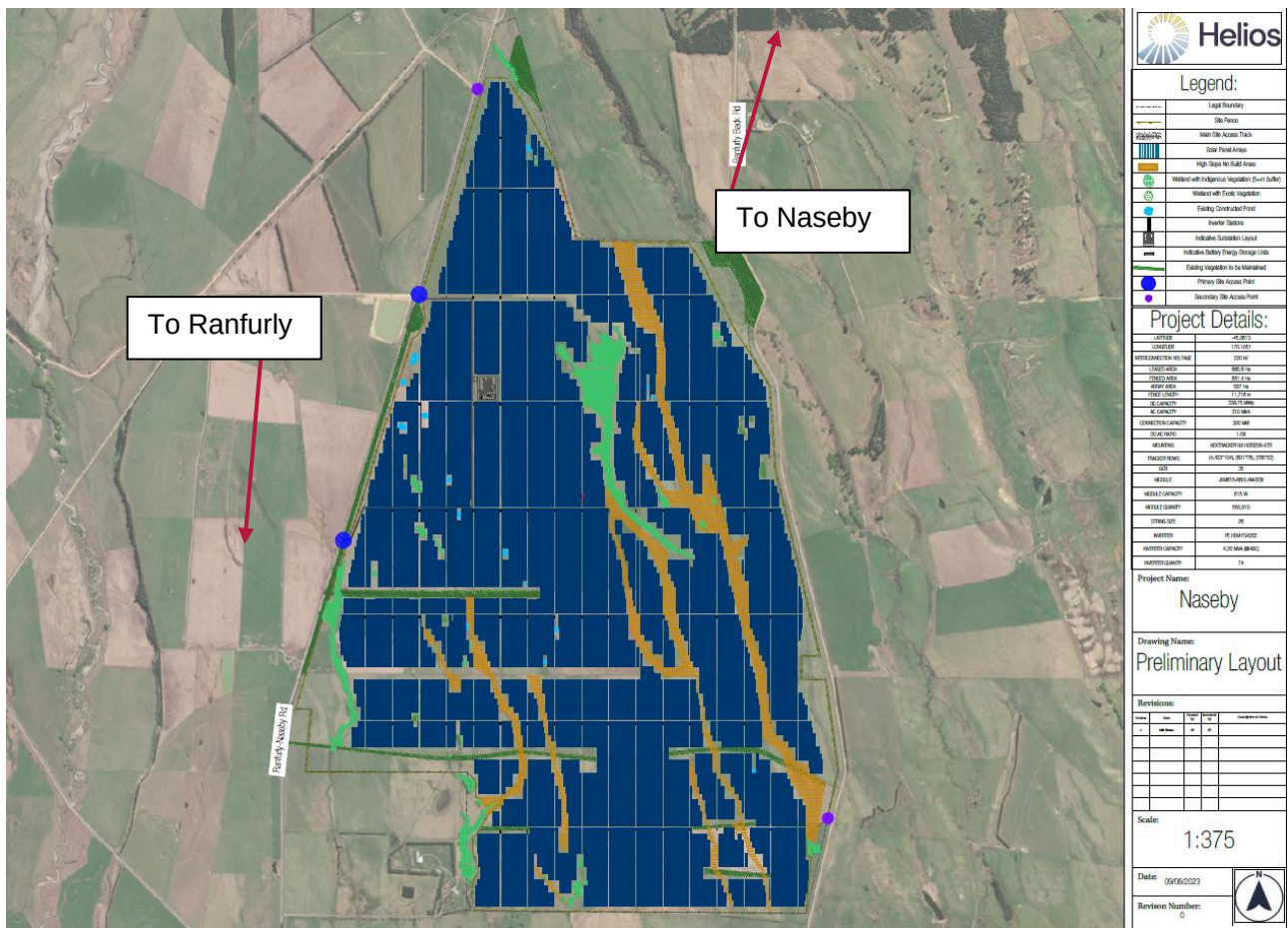


Figure 2.1 Site location. (Source: Helios Energy Ltd).

3. Existing Transport Network

The site has frontage to Ranfurly-Naseby Road along its western boundary and Ranfurly Back Road along its eastern boundary.

3.1 Road Description

Ranfurly Naseby Road

Ranfurly-Naseby Road is a two lane / two-way road that connects Ranfurly with Naseby via State Highway 85 at the Ranfurly end. It becomes Ramor Street and then Derwent Street as the road transitions into Naseby. It intersects with State Highway 85 at its southern end via a priority GIVE WAY controlled T-intersection. This intersection is configured with an auxiliary right turn lane on the southern approach of SH85 for vehicles turning right onto Ranfurly-Naseby Road and a channelised lane for vehicles turning left onto Ranfurly-Naseby Road. There is a short seagull lane for vehicles turning right onto State Highway 85. Refer to Figure 3.1.

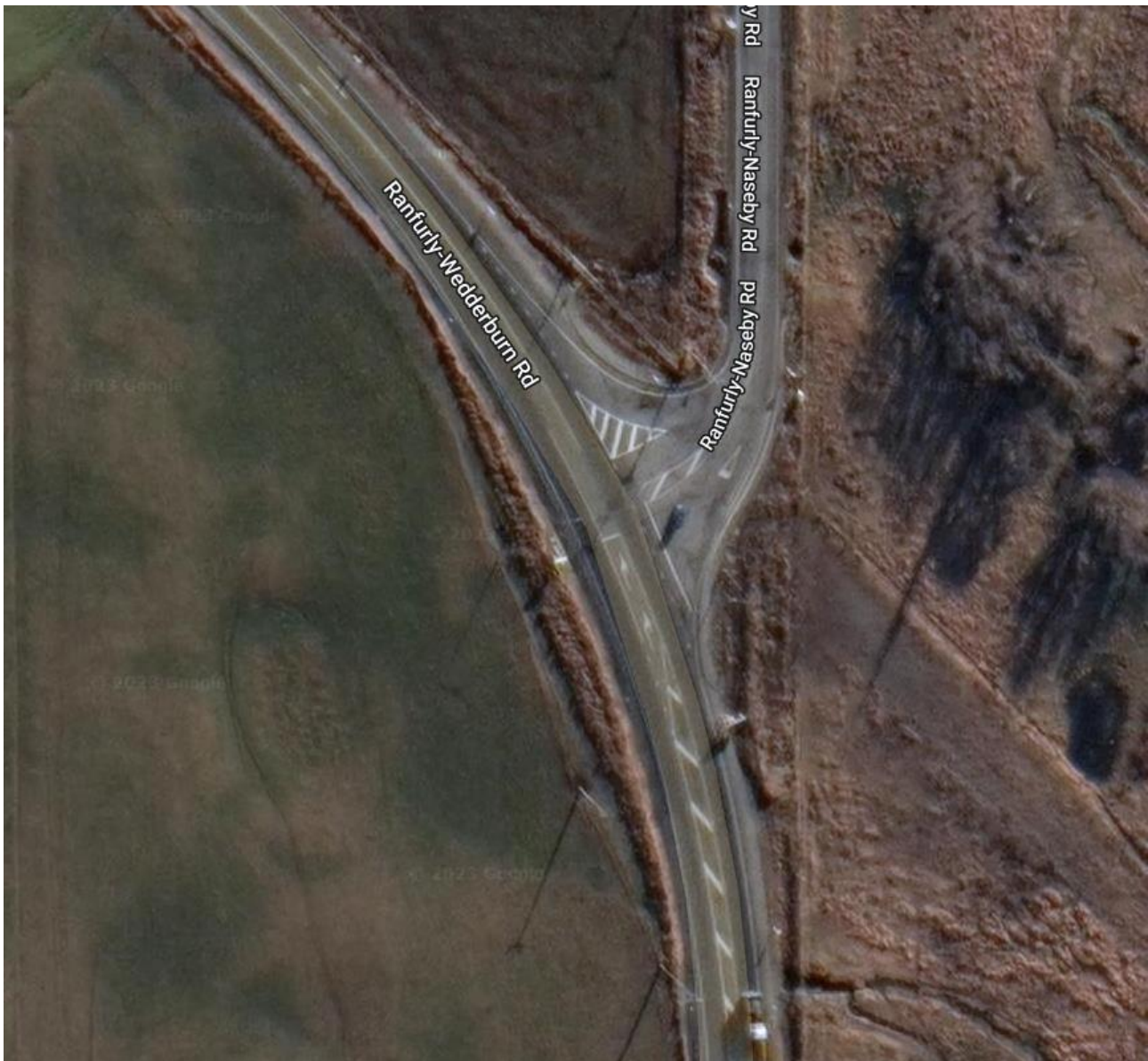


Figure 3.1 State Highway 85 / Ranfurly Naseby Road intersection. (Source: Google Maps).

Ranfurly-Naseby Road has a posted speed limit of 100km/h and is classified as a Rural Connector in the Waka Kotahi NZ Transport Agency (Waka Kotahi) One Network Framework (ONF). It is classified as a Rural Collector Road in the Central Otago District Plan. The mean operating speed is 86km/h as it passes the site¹. The safe and appropriate speed as per MegaMaps is 80km/h.

The road has a chip-sealed surface approximately 6.0m wide and narrow shoulders. It has painted edge-lines and a dashed centre line. Side drainage is provided by way of grassed swale drains and the remainder of the space is typically grassed berms on both sides. Refer to Figure 3.2.

¹ MegaMaps



Figure 3.2 Ranfurly-Naseby Road

Ranfurly Back Road

Ranfurly Back Road intersects with Goff Road near the Goff Road / State Highway 85 intersection. It provides a form of secondary access to Naseby, intersecting with Ranfurly-Naseby Road at its northern end. It is primarily used to access farm paddocks.

It has a posted speed limit of 100km/h and is classified as a Rural Road in the Waka Kotahi ONF. It is classified as a Local Road in the Central Otago District Plan. It has a mean operating speed of 25km/h as it passes the site. The safe and appropriate speed as per MegaMaps is 60km/h.

The road is sealed for approximately 20m back from Goff Road and also Ranfurly Naseby Road, with painted limit lines on the Ranfurly Back Road approaches (as the minor road). Beyond this, the road is unsealed to a width in the order of 4.0m, which is not suitable for regular two-way traffic movement. Refer to Figure 3.3.



Figure 3.3 Ranfurly Back Road

3.2 Traffic Flows

Traffic flow information has been sourced from MobileRoads. Ranfurly-Naseby Road is a low volume road with an estimated Average Daily Trip (ADT) of 300 vehicle movements per day (2016). Ranfurly Back Road is similarly a low volume road with an estimated ADT of 40 vehicle movements per day (2016). Peak hour flows are unknown but are estimated to be in the order of 30 vehicle movements per hour for Ranfurly-Naseby Road and approximately 5 per hour for Ranfurly Back Road.

3.3 Pedestrians and Cyclists

There are no dedicated pedestrian or cycling facilities on either of the frontage roads. This is to be expected given the rural nature of the surrounding environment, and given the type of development proposed combined with the distance from nearby centres. The development is not expected to generate any new demand for walking or cycling in the area.

It is noted that the Otago Rail Trail passes through nearby at Wedderburn and Ranfurly south of the site. This is a popular route for tourists and recreational cyclists, but for completeness it is noted that it does not pass the subject site (which is located to the northeast). Figure 3.4 shows the Otago Rail Trail route as it passes through Wedderburn and Ranfurly. This site is approximately 9km north of the Otago Rail Trail as it passes through Ranfurly.

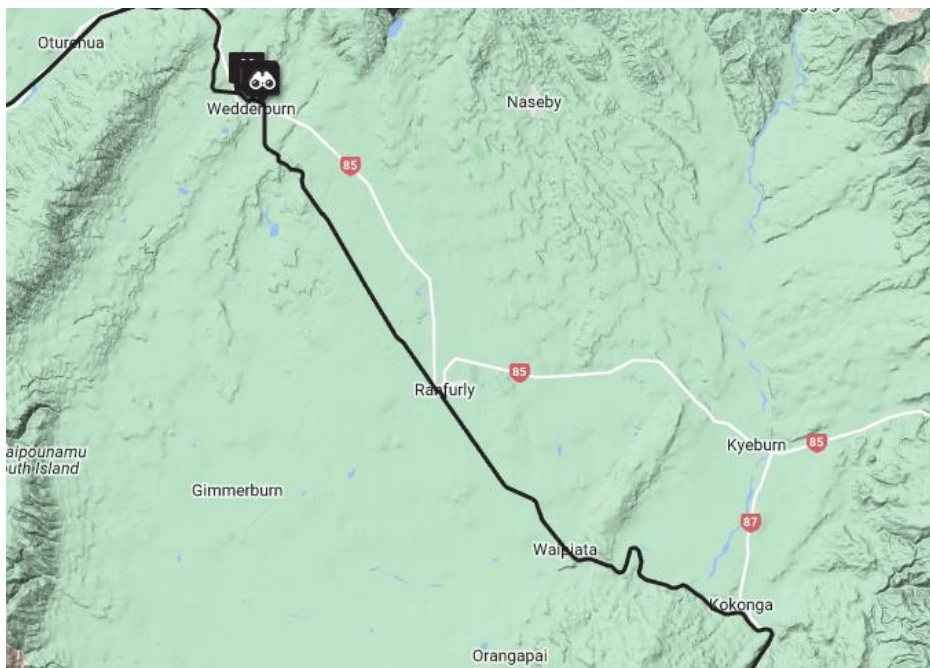


Figure 3.4 Otago Rail Trail Route (black line). (Source: Otago Rail Trail Website).

3.4 Public Transport

Given the rural location, there are no public transport services operating near the site. However given there are no schools in Naseby, school students residing in Naseby and other more remote locations may catch the school bus into Ranfurly where there are two schools (Maniototo Area School (Composite), St Johns School (Full Primary)). The Ministry of Education website states that Maniototo Area School has a roll size of 141 students and St Johns School has a roll size of 58 students. It is noted that Route D130119 runs along Ranfurly-Naseby Road servicing both schools during the AM and PM school pickup & dropoff times. The patronage is 15 students from Years 1-13². It is not considered

² <https://moenz.maps.arcgis.com/apps/dashboards/9f200f5c371a47feaf68941dc2637b22>

that construction traffic flows arising from the Solar Farm development would have any notable effect on the operation of school bus routes given the low volume of school buses using Ranfurly-Naseby Road.

3.5 Road Safety

The Waka Kotahi Crash Analysis System was used to review the reported crash history on the public roads surrounding the sites over the past 5-year period inclusive (2018-2023). A total of four crashes were reported within that time period in the search area, which is shown in Figure 3.5. One crash was fatal, one resulted in minor injuries and the remaining two did not result in any injuries.

The fatal crash occurred on Ranfurly-Naseby Road where a southbound motorcyclist travelling at excessive speeds lost control and fell off the motorcycle.

The minor injury crash occurred on State Highway 85 where the driver hit loose material on the left hand side of the road, and then swerved back onto the road and hit a bank on the opposite side. The crash report indicates that the driver may have fallen asleep.

Despite the fatal crash having occurred within the study area, this was due to excessive speeding and is unrelated to a road geometry problem. Overall, there are no crash trends evident that would suggest that there is an existing road safety deficiency in the vicinity of the site.

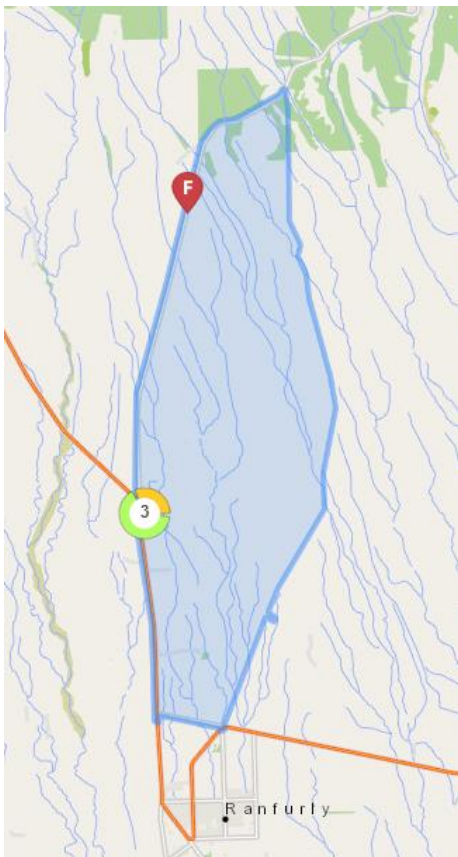


Figure 3.5 Crash Search Area. (Source: Waka Kotahi).

4. Future Transport Network

There are no known planned changes to the transport network that would affect the ability of this proposal to successfully integrate with the existing road network.

5. Proposed Development

It is proposed to establish a 300MWac³ solar farm at the 660ha site. Once operational, activity at the site will be very low, with 5-6 staff expected to visit the site once per week for repairs and maintenance. However, during the construction period there will be an increase in traffic activity on the surrounding road network which will include movement of 40ft container trucks to and from the site and light vehicles transporting staff.

5.1 Construction

The construction period will result in a significantly higher level of activity when compared to the site once operational. Construction activities will occur across an approximate 24-month period, and will include:

- Site preparation, including removal of some of the existing farm infrastructure including existing fencing and marking out the site. It is noted that the property is relatively flat and therefore no major earthworks are required to prepare the site for the installation of the solar arrays.
- Erection of security fencing (deer fencing with an approximate height of 2m consisting of timber posts and mesh wire)
- Installation of CCTV cameras
- Constructing internal access tracks and laydown area
- Trenching & cable laying for medium voltage cables
- Driving steel piles into the ground
- Trenching & cable laying for direct current (DC) cables
- Installation of mounting frames and solar panels
- Preparation of areas for the switchgear, transformer, substation and battery storage area
- Installation of the housing / cabinets for the above infrastructure
- Connection of all cables and energising the facility

As noted, earthworks will be minimal but will be completed in stages to minimise the amount of soil exposed at any one time. Access tracks will be constructed with an all-weather metallised surface. The contractor will deploy appropriate measures to manage any dust issues.

Solar panels and racking will be transported to the site in shipping containers, and then assembled onsite.

Supporting electrical infrastructure will be required to connect the proposed solar farm with the Naseby Substation. The exact locations of the new electrical lines will be confirmed during later design stages.

If excavation in the legal road corridors is required, it is recommended that the contractor follow appropriate processes to ensure disruption to the transport network is minimised and that any road reinstatement is completed to the satisfaction of Central Otago District Council. This will include the preparation of and Council approval of a temporary traffic management plan (TMP), and obtaining an approved corridor access request from the road controlling authority.

³ This translates to a 332MW peak.

5.3 Design Vehicle

The design vehicle used for the vehicle access design (for Accesses 1 and 2) is an RTS 18 Semi-Trailer vehicle. Refer to Figure 5.2.

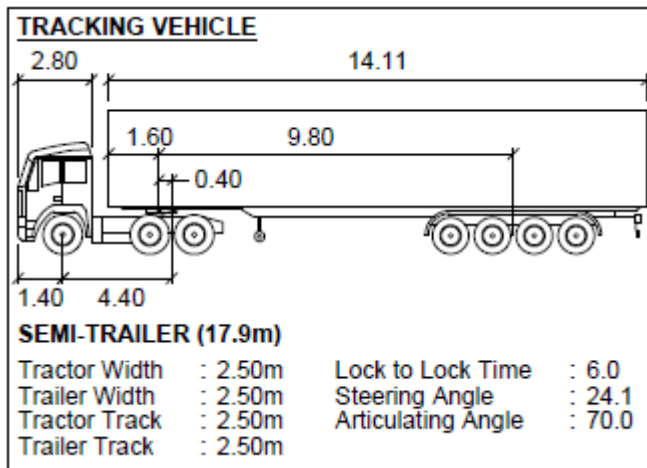


Figure 5.2 RTS 18 Semi-Trailer – Design Vehicle.

Accesses 3 and 4 will not be used by heavy vehicles and so vehicle tracking has not been undertaken at these proposed access points.

5.4 Access to Ranfurly-Naseby Road

Sight distances at each access to Ranfurly-Naseby Road will be at least 160m in all directions as required by the Central Otago District Plan for an access connecting to a Rural Collector Road with a posted speed limit of 100km/h. At a minimum, the accesses will be constructed in accordance with Figure 12.5 of the Central Otago District Plan, which for completeness is shown in Figure 5.3.

Figure 12.5 - Non-Residential Access to Rural Collector Roads (see Schedule 19.7)

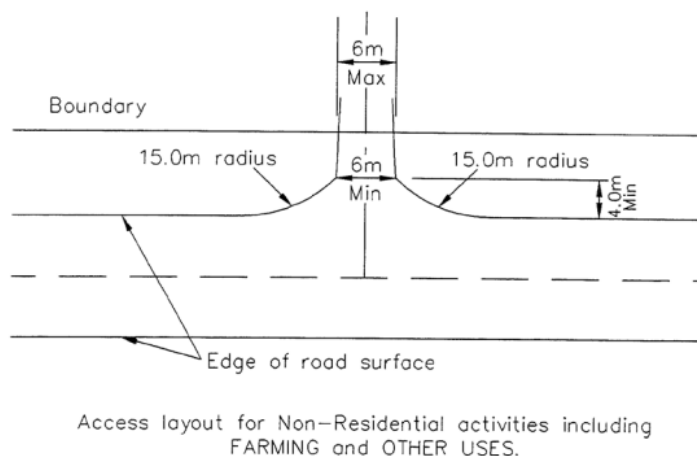


Diagram - Not to Scale

Figure 5.3 Minimum access design requirement for accesses onto Ranfurly-Naseby Road. (Source: Central Otago District Plan).

A specific breakdown of each access is set out below.

Access 1

Sight distances at Access 1 are uninterrupted and significantly exceed the minimum requirement of 160m in both directions (Figure 5.4 and Figure 5.5).



Figure 5.4 Sight lines looking north along Ranfurly-Naseby Road adjacent to Access 1 (in view on right).



Figure 5.5 Sight lines looking south along Ranfurly-Naseby Road adjacent to Access 1 (in view on left).

Access 2

Sight distances at Access 2 were measured using a combination of an onsite and desktop assessment. The sight distance to the south is constrained due to a vertical curve in the Ranfurly-Naseby Road alignment approximately 215m south of the proposed Access 2 location (Figure 5.6).



Figure 5.6 Access 2 location.

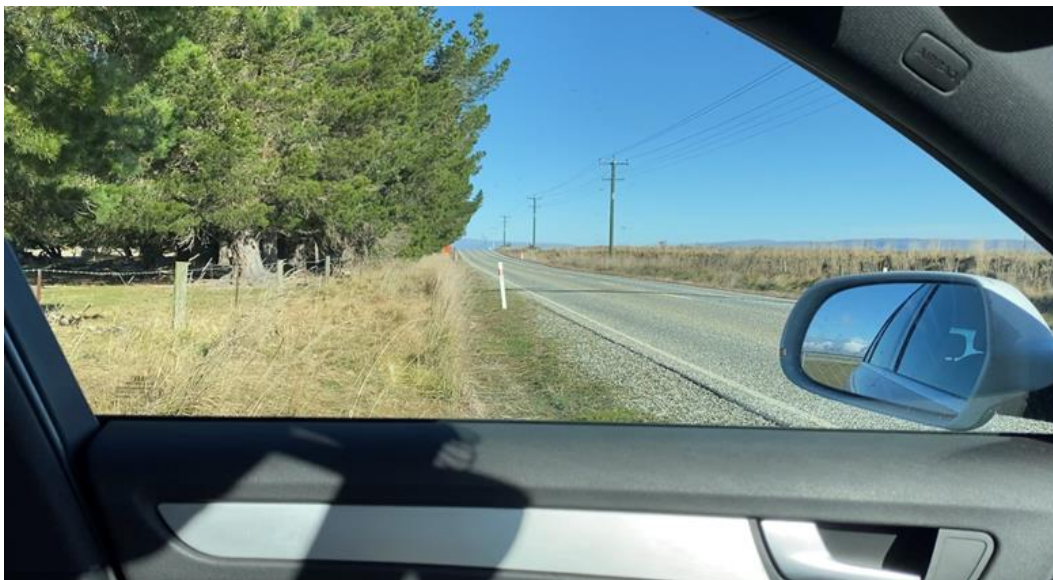


Figure 5.7 Available sight distance from Access 2, looking south.

The available sight distance of approximately 215m exceeds the minimum requirement in the Central Otago District Plan and the location of the access can therefore be supported from a traffic safety perspective (Figure 5.7). The sight distance to the north is uninterrupted and significantly exceeds the minimum requirements. It is, however, recommended that the tree canopies are trimmed back and

maintained so that they do not impact on sight distances in the future. It is noted that vehicles will be exiting in this location via a left turn only, and as such, sight distances to the north are of lesser importance (but still comply).

5.5 Access Design Requirements

Since Accesses 1 and 2 require access for large vehicles, vehicle tracking has been undertaken to determine the likely geometric requirements to accommodate the swept-path of a semi-trailer. The results are set out in Appendix A for each access.

The vehicle tracking has been based on Access 1 being used for entry only and Access 2 being used for egress only, and depicts a semi-trailer turning right into the site via Access 1 and left out of the site via Access 2 (travelling to and from the south). The left turn in and right turn out movements have not been depicted as these are not expected to occur given the trucks will be accessing the state highway network to the south. The tracking shows that for the left turn out movement at Access 2, that trucks will need to use the full width of Ranfurly-Naseby Road, and therefore cross the centre line of the road.

Since the sight distances at each entrance exceed the minimum requirements, and noting there are low traffic flows on Ranfurly-Naseby Road as well as a relatively low number of turning movements expected at the vehicle accesses, this approach is considered acceptable from a traffic safety perspective. It is noted that given the low hourly traffic flows on Ranfurly Naseby Road, low number of turning movements into Access 1, and excellent sight distances, that dedicated turning facilities are not deemed necessary to support safe access in this location. Following (and opposing) traffic will be able to see a truck turning right from a large distance and react accordingly without significant effects on safety or efficiency given the low frequency. Furthermore, it is expected that 'trucks turning' signage will be installed as part of any future traffic management plan which will provide advanced warning to other drivers.

The tracking diagrams show that seal widening is required at each access in order to accommodate the check vehicle. However, the exact requirements will need to be confirmed at the detailed design stage, at which point more advanced topographical information will be available to inform the tracking requirements.

6. Traffic Generation

Construction activities will be the primary traffic generator of this development, with the number of vehicle movements reducing significantly once site establishment has been completed.

6.1 Construction Traffic

Abley has been provided with construction traffic generation data for a previously established 100MWp solar farm and have extrapolated this to assess the likely trip generation of the proposed 332MWp farm in Naseby.

The data provided shows that construction vehicle movements operate generally as a bell curve, with vehicle movement activity ramping up significantly to its peak in the fourth month of construction, and staying at this level for approximately 5 months. Activity then tails off of in the remaining three months⁴. Table 6.1 sets out a comparison of the vehicle numbers between the two sized solar farms. Note that the table takes into account that the 332MWp farm has a 24 month construction period, and so it is assumed that only half of the total number of vehicles will occur over each 12 month period.

⁴ Note that the data provided was for a 100MWp solar farm which has a 12-month construction period, whereas the proposed Naseby Solar Farm will be a 332MWp solar farm with a 24-month construction period.

Table 6.1 Annual construction vehicle comparison between two different sized solar farms.

Solar Farm Size	Number of Trucks Per Year ⁵	Number of Light Vehicles Per Year
100MWp	644	508
332MWp (proposed)	1069	843

Note that the busiest month for the 100MWp solar farm was month 7, where there were 110 heavy vehicles and 66 light vehicles.

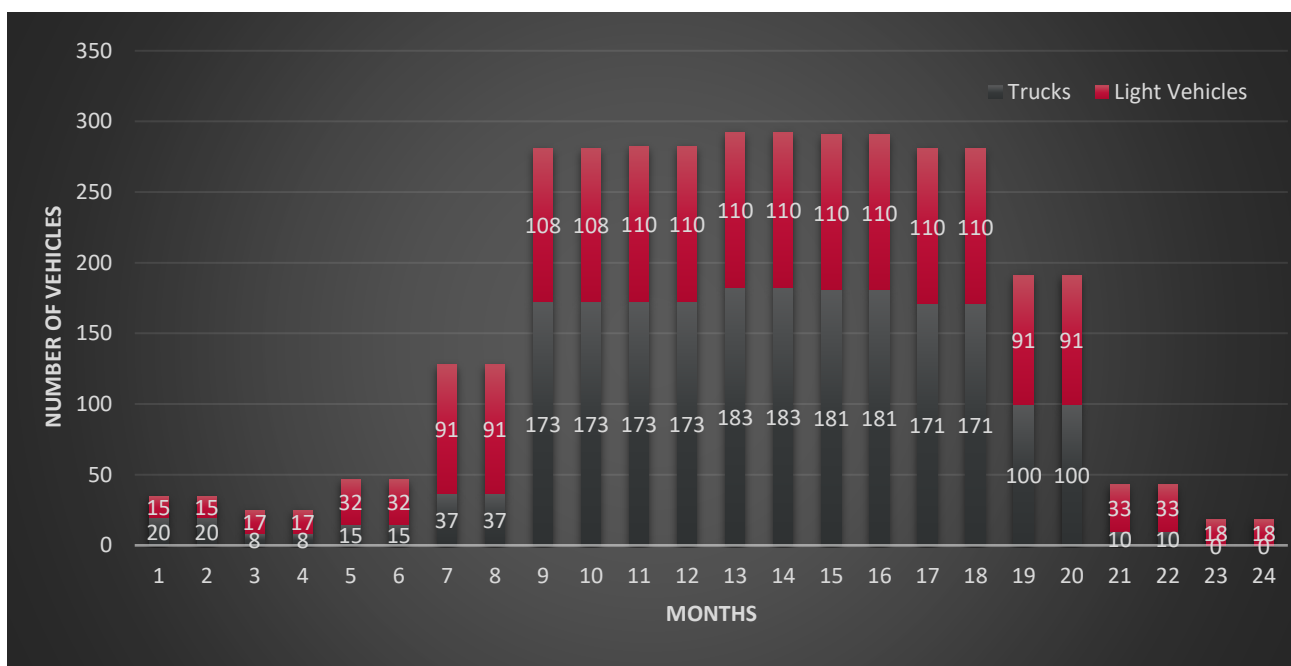


Figure 6.1 Construction vehicle movement breakdown by month for Naseby.

Figure 6.1 shows the construction traffic profile over the 24 months of construction. This shows that months 9-18 will be the busiest months and will have a relatively consistent profile across each month. The busiest months will be 13 and 14 where 183 trucks and 110 light vehicles will visit the site (or 366 heavy vehicle movements and 220 light vehicle movements). It is assumed that each month will have four 6-day working weeks, and that there will typically be 24 working days per month. The resulting average daily trip generation is shown in Table 6.2. It is noted that there will be some months that will have less than 24 working days due to holidays and other unforeseen reasons like weather. However 24 days has been used to approximate the likely traffic generation.

Table 6.2 Average daily trips during peak months for Naseby solar farm.

Heavy vehicles (trips per day)	Light vehicles (trips per day)	Total (trips per day)
15	9	24

⁵ Note that truck movements will consist of 40 foot container trucks.

Construction activities are likely to occur from 7am to 5pm Monday to Saturday. As such construction workers are likely to arrive on site between 7-9am, and leave between 4-6pm, which equates to up to five vehicles per 2-hour period. In terms of delivery vehicles, up to 3 truck movements are anticipated within any given working hour.

Since Primary Construction Accesses 1 and 2 will operate as one-way accesses (with Access 1 being for entry only and Access 2 being egress only), it is not necessary to design the access to accommodate two-way movement of vehicles.

6.2 Operational Traffic

Traffic levels during operation of the solar farm (once constructed) will be very low. Abley has been advised that there may be 5-6 staff visiting the site office once per week, which equates to 12 trips per week. While there may be instances where a slightly higher level of activity occurs, this will not be significant, and there will be no capacity or safety issues arising from any fluctuations during operation (noting that on a typical day there would only be two trips generated from the site).

7. Traffic Distribution

The site will have four vehicle accesses. Accesses 1 and 2 will be the primary accesses and Accesses 3 and 4 will be secondary accesses that would rarely be used both during construction and once the site is operational. There will be no heavy vehicle use of Accesses 3 and 4.

Access 1 will be an entry only and so all heavy vehicles will enter the site using Access 1. Access 2 will be for egress only and so all heavy vehicles will exit the site using Access 2. It is assumed that all vehicles would turn right into Access 1 when entering the site and that all vehicles would turn left onto Ranfurly Naseby Road when exiting the site.

On this basis, it is assumed that 84% of traffic (both during construction and operation) would use Accesses 1 and 2 and that use of these would be evenly split, equating to 42% of trips occurring at each access. The remaining 16% of trips would be evenly split between Accesses 3 and 4. The resulting daily trip rate during a peak construction month is shown in Table 7.1.

Table 7.1 Distribution of Trips During Construction on a Typical Day in the Peak Month.

Access	Distribution	Number of Movements (Per Day, including HVs)
1	84% (inward only)	20 (one way)
2	84% (outward only)	20 (one way)
3	8% (in and out)	2 (in and out)
4	8% (in and out)	2 (in and out)
Total	100%	24

It is expected that all traffic will approach the site from the south from State Highway 85 (which will be the case if trucks come from Christchurch or Dunedin). This results in trucks entering the site via a right turn and exiting the site via a left turn. Refer to Figure 7.1 for a spatial illustration of peak construction daily trip generation and distribution.

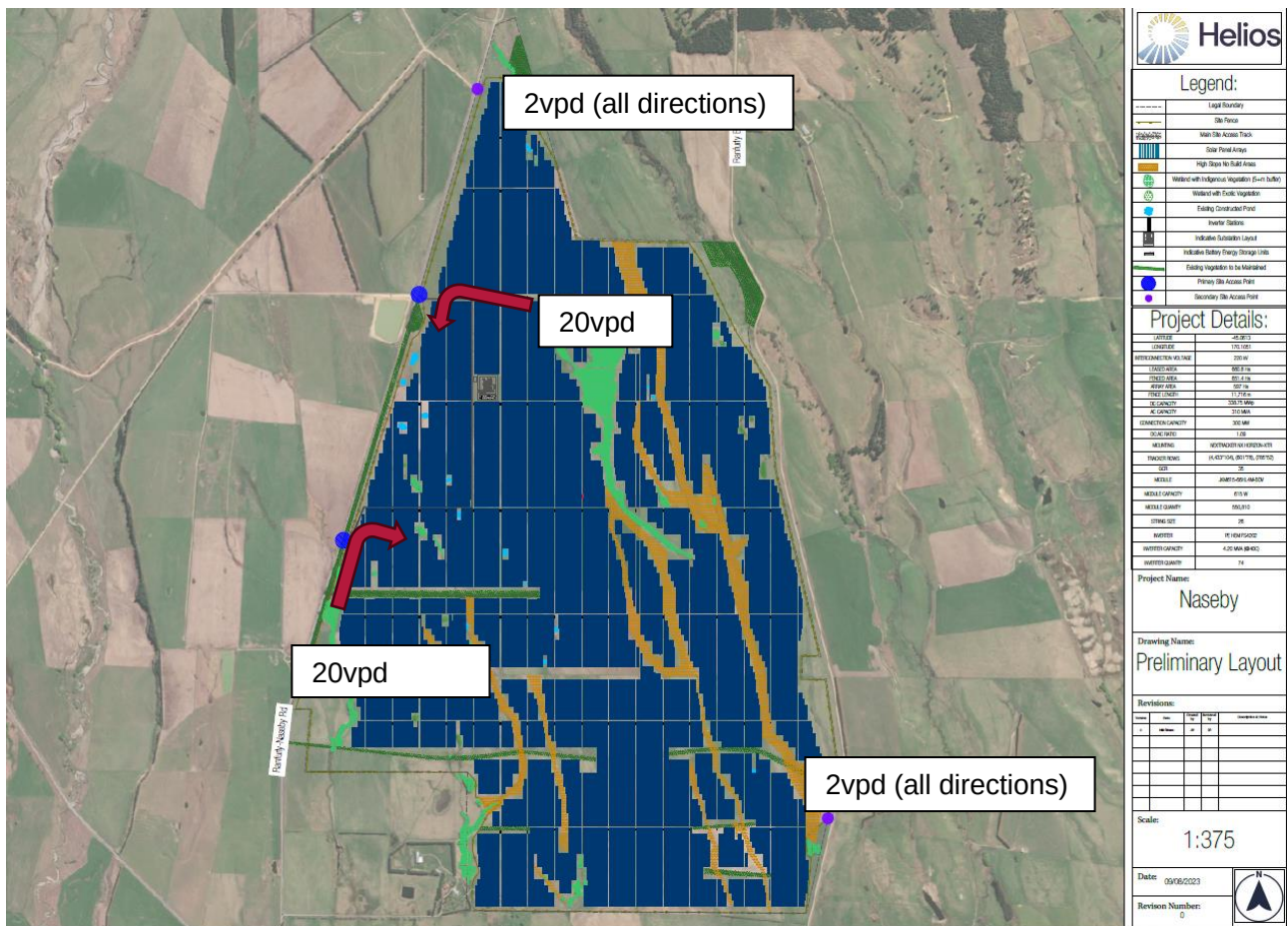


Figure 7.1 Trip distribution during peak construction period.

From a wider network perspective, it is possible that trucks would choose to bypass Ranfurly (and instead travel down Goff Road since this is a more direct route to the site) (Figure 7.2).

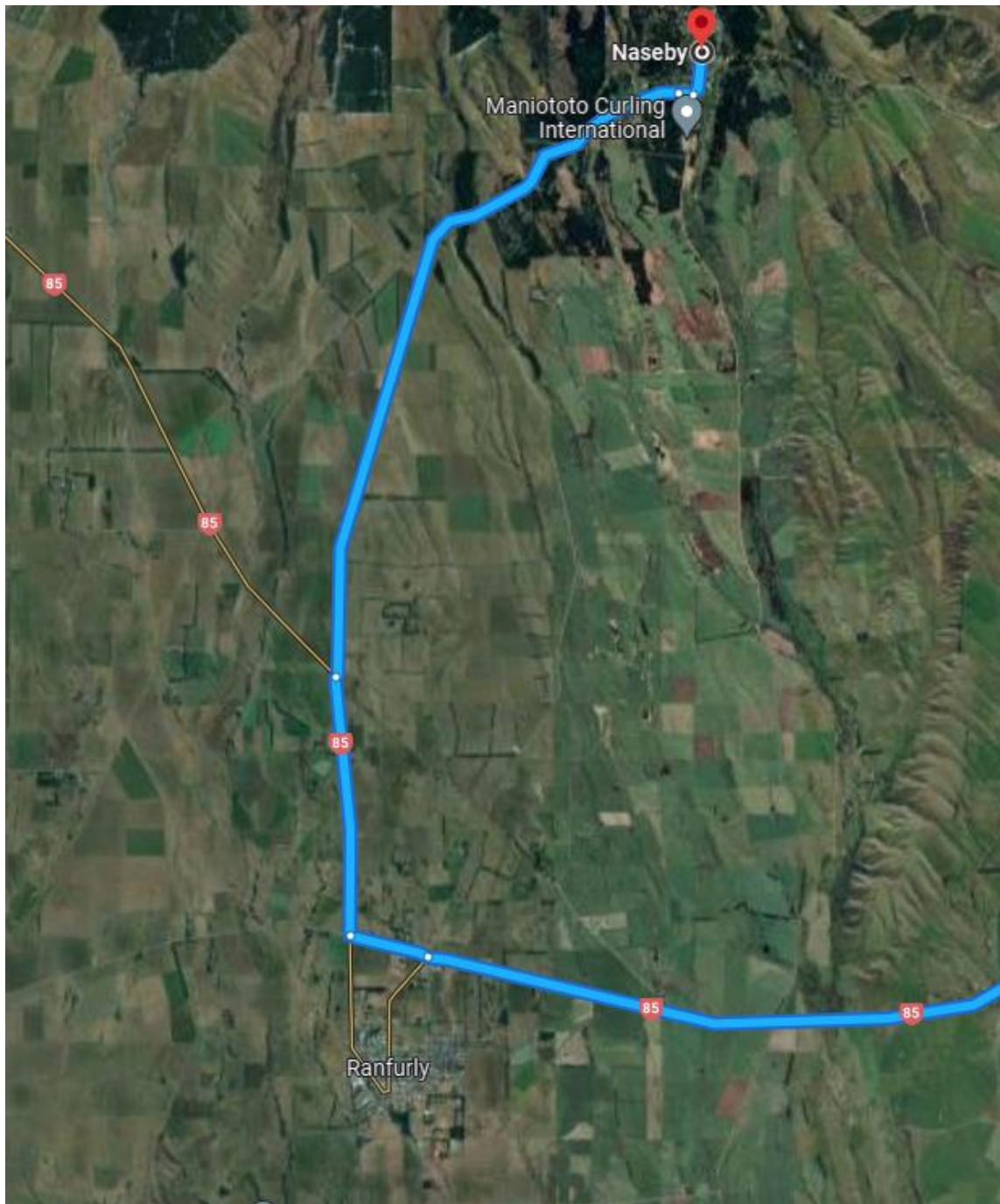


Figure 7.2 Likely route that bypasses Ranfurly. Source: Google Maps.

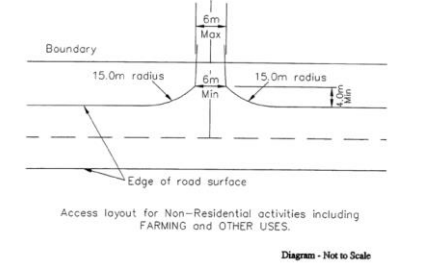
It is noted that neither of the SH86/Goff Road intersections have any dedicated turning facilities, and it is therefore recommended that trucks are directed to stay on State Highway 85 before turning onto Ranfurly Naseby Road. The Ranfurly-Naseby Road / State Highway 85 intersection is constructed to a higher standard and will be able to safely and efficiently accommodate the increase in truck movements. Subject to the above, it is considered that the additional traffic generated by the proposed development can be safely and efficiently accommodated on the existing network and no network improvements are deemed necessary.

8. District Plan Assessment

The proposal has been assessed against the Transport requirements of the Central Otago District Plan. Section 12.7.1-12.7.3 set out transport performance standards with which any development is expected to comply. The results of this assessment are set out in Table 8.1.

Table 8.1 Central Otago District Plan Compliance Assessment

District Plan Rule	Assessment	Compliance Status
12.7.1 Access Standards from Roads		
Construction and Maintenance – access from a road shall be designed, constructed, and maintained to ensure that:		
1. They are able to be used in all weather conditions	- The vehicle accesses connecting to Ranfurly-Naseby Road will be sealed for a distance of not less than 5.0m from the property boundary to ensure that loose material does not migrate onto the road carriageway. - The access from Ranfurly Back Road will be constructed to an adequate all-weather metalled surface. - Internal accessways will be constructed to an adequate all-weather surface.	Will comply.
2. They have no adverse impact upon road drainage systems.	The accesses will be designed to ensure that they do not adversely affect road drainage systems. Accesses 1 and 2 have existing culverts.	Will comply.
3. Stormwater and detritus (including gravel and silt) do not migrate on to the road.	As above.	Will comply.
4. They intersect with the property boundary within 15 degrees of a right angle.	All vehicle crossings intersect with the property boundary at a 90-degree angle.	Will comply.
Sight Distances – Clear visibility along the road in both directions from intersections and vehicular access shall comply with Table 12.1		
Where the frontage road is a Rural Collector Road with a speed limit of 100km/h, a minimum sight distance of 160m is required.	All vehicle accesses meet this minimum sight distance requirement.	Complies.
Access to Rural Collector Roads		
Access for non-residential activities shall conform with the standards set out in Figure 12.5.	Accesses 1 and 2 have been designed to accommodate the swept-path of a semi-trailer, which is the largest vehicle expected to use the	Will comply.

District Plan Rule	Assessment	Compliance Status
Figure 12.5 - Non-Residential Access to Rural Collector Roads (see Schedule 19.7) 	access ways. It is expected that any changes to the vehicle crossings will need to be reviewed and approved by Central Otago District Council and constructed in accordance with Council's vehicle crossing standards.	
Access distance from any road intersection for activities that attract a low level of vehicles (30 or less vehicle movements equivalent per day) shall not be less than 30m.	Access 3 does not meet this requirement because it is directly opposite the Fennessy Road / Ranfurly-Naseby Road intersection. All other accesses comply.	Does not comply.
12.7.2 Parking		
(i) Every activity shall make sufficient provision for vehicular parking in accordance with Table 12.3 (page 12:30) and the minimum dimensions stated in Figures 12.7 and 12.8 on pages 12:36 and 12:37.	N/A - there is no minimum car parking requirement for a solar farm. However, parking will be provided onsite in the form of at grade metalled areas. Vehicles will be able to turn around onsite and enter the road network in a forward gear.	N/A
(ii) Construction of parking areas to accommodate in excess of 3 car spaces included vehicle access and turning spaces, shall be constructed in accordance with the following standards		
(a) Parking areas shall be formed and sealed or otherwise constructed, so as not to create a dust nuisance or permit vehicles to carry deleterious materials such as mud, stone, chip or gravel onto the road or footpath.	As noted, accesses connecting to Ranfurly-Naseby Road will be sealed within the site for a distance of not less than 5.0m from the property boundary and will have an adequate all-weather surface beyond that point. This will ensure that any loose material is contained within the site. Dust will be managed by application of dust suppressant where required.	Will comply.
(b) Stormwater originating from the parking areas shall be disposed of to an approved outfall either within the confines of the site or by pipe (of adequate diameter given the size of the parking area), to a road channel or stormwater drain.	Stormwater management will be managed by the client.	Can comply.
(c) Traffic safety is to be ensured by: 1. Vehicles using the parking area being prevented from entering or leaving the site except by the vehicle access and crossing provided. 2. The parking area and turning spaces shall be laid out with	The site is large and within a rural area. Parking onsite will be self-managed by the contractor and site operator once construction is completed. Parking plans are not currently available, but the site is large enough such that onsite manoeuvring will be provided and no vehicles will	Will comply.

District Plan Rule	Assessment	Compliance Status
sufficient manoeuvring space so that access can be obtained to the required parking space without the necessity for reversing onto or off the site. 3. Any part of the parking area which cannot be used for the parking shall be landscaped.	be required to reverse onto or off the road.	
(d) Privacy of neighbours is to be protected by ensuring that where the parking area adjoins a residential property, a solid fence, no less than 1.5 metres in height, shall be erected and maintained by the developing owner provided that the height of the fence shall be reduced at access points to enable adequate visibility on adjoining roads.	N/A – the site is within in a rural area.	N/A
(e) Queuing space is to be provided within the site for vehicles entering or leaving a private or public carpark on the following basis: 1. No less than 6 metres length in both directions for car parks of 20-100 car capacity. 2. No less than 15 metres length in both directions for car parks greater than 100 car capacity.	Any car parking areas on site will not be greater than 100 spaces in capacity. At least 6.0m of queuing space will be provided at each access.	Will comply.
(f) Any lighting associated with the parking area shall be directed to avoid adverse effects on adjoining properties or roads.	Car parking areas will not be artificially lit, due to them being within a rural area.	N/A
(g) All areas of carparking in excess of 100m² shall provide a strip of not less than 1.5 metres in width adjacent to any boundary that is not built up to except where a solid fence has been erected.	Car parking layouts are not yet available, however, we are not aware of any reason why this cannot be complied with.	Can comply.
(h) The strip referred to in (g) shall not be paved and shall create the opportunity for landscaping to provide visual enhancement or screening. Landscaping shall not impede traffic visibility and shall be maintained in a healthy and tidy condition at all times.	Car parking layouts are not yet available, however, we are not aware of any reason why this cannot be complied with.	Can comply.
(i) 12.7.3 Loading and Manoeuvring		
(j) Servicing Activities: Where the loading and unloading of goods is an integral part of an activity,	Loading and deliveries will form an integral component of the activity. Layby areas will be constructed within	Will comply.

District Plan Rule	Assessment	Compliance Status
loading facilities are to be provided. All such loading areas shall be so located that no vehicle or machinery engaged in any loading or unloading operation shall stand on or be required to manoeuvre on any part of the formed road or cause vehicles to reverse onto State highways or any other road nominated in the rules that apply to a particular Resource Area. Design shall be appropriate to the type of vehicles that have occasion to visit the site.	the site to enable loading to occur within the property. There will be no requirement for loading to occur on the road, and loading vehicles will be able to turn around onsite and exit in a forward gear with the proposed one way in and one way out utilising Access 1 and Access 2 during construction. Layby areas will be positioned such that they are outside of the minimum 6.0m queuing space area at the accesses.	

9. Assessment of Non-Compliances

9.1 12.7.1 (iv)(c) – Access Standards From Roads

This rule is breached since Access 3 is within 30m of the Fennessy Road intersection. The location of the access was assessed onsite, and the following is noted:

- The access will be secondary access, with predicted average daily traffic flows of one-two vehicle movements per day.
- The access is existing and being used as a farm access, and the predicted use of Access 3 is akin to that of a farm access (and there have been no reported accidents associated with its use).
- There are excellent sight distances in all directions, with good intervisibility between Access 3 and Fennessy Road.
- The traffic flows on Fennessy Road are very low (less than 200vpd as per Mobile Roads), and so the likelihood of a vehicle being present at Fennessy Road at the same time as a vehicle as is present at Access 3 is very low.

Overall, the above factors together act as sufficient mitigation to this rule breach and the location of Access 3 can therefore be supported from a traffic safety and efficiency perspective.

10. Summary and Recommendations

This TA has assessed the transport effects relating to a proposed Solar Farm development on the outskirts of Naseby. The key points are as follows:

- The level of trip generation associated with construction of the facility will be low, such that no capacity issues are anticipated. The level of trip generation during operation of the solar farm will be even lower.
- The vehicle accesses will be constructed to at least the standards required by the Central Otago District Plan, including sealing for a distance of at least 5.0m back from the property boundary for Accesses 1, 2 and 3.
- Access 4 does not require sealing since it connects to an unsealed road (Ranfurly Back Road). A new vehicle crossing will need to be established between Ranfurly Back Road and the property boundary, and this will need to be constructed in accordance with Council's vehicle entrance specifications.
- The sight distances at all accesses comply with the minimum requirements of the Central Otago District Plan.

- Access 3 is closer to the Fennessy Road / Ranfurly-Naseby Road intersection than is permitted by the Central Otago District Plan. However, an assessment of this has concluded that this arrangement is unlikely to create a road safety problem.

The following is recommended:

- The contractor must follow appropriate processes to ensure disruption to the transport network is minimised during construction, and that any road reinstatement is completed to the satisfaction of Central Otago District Council. This will include preparation and approval of a temporary traffic management plan (TMP) by a suitably qualified and experienced professional and obtaining an approved corridor access request from the road controlling authority (Central Otago District Council). At a minimum, the TMP must address the following:
 - a) Ensure that truck drivers are advised to adhere to the speed limit and drive to the conditions during periods of adverse weather.
 - b) Ensure that truck drivers are advised of the circulation arrangements onsite, including the requirement to access the site via Access 1 and exit the site via Access 2.
 - c) Ensure that truck drivers are advised to stay on State Highway 85 (and travel through Ranfurly), so that they do not use Goff Road.
- Accesses 1, 2, 3 and 4 must be constructed in accordance with Figure 12.5 of the Central Otago District Plan, with the geometry for Accesses 1 and 2 being in general accordance with that shown in the vehicle tracking.
- Accesses 1, 2 and 3 must be sealed from the edge of Ranfurly-Naseby Road to a distance of not less than 5.0m inside the property boundary.
- Only Access 1 and 2 are to be used by heavy vehicles.
- The layby area is set back sufficiently away from the gate to avoid vehicles queuing over the sealed access area.
- The use of Access 4 (and Ranfurly Back Road) must not include heavy vehicles and light vehicle movements may only consist of infrequent access to the rear parts of the solar farm.

Subject to the above, there is no traffic or transport related reason why consent should not be granted.

Appendix A. Vehicle Tracking



Rev	Date	By	Chk	Description
1	21/08/2023	BB	RK	FOR CONSENT
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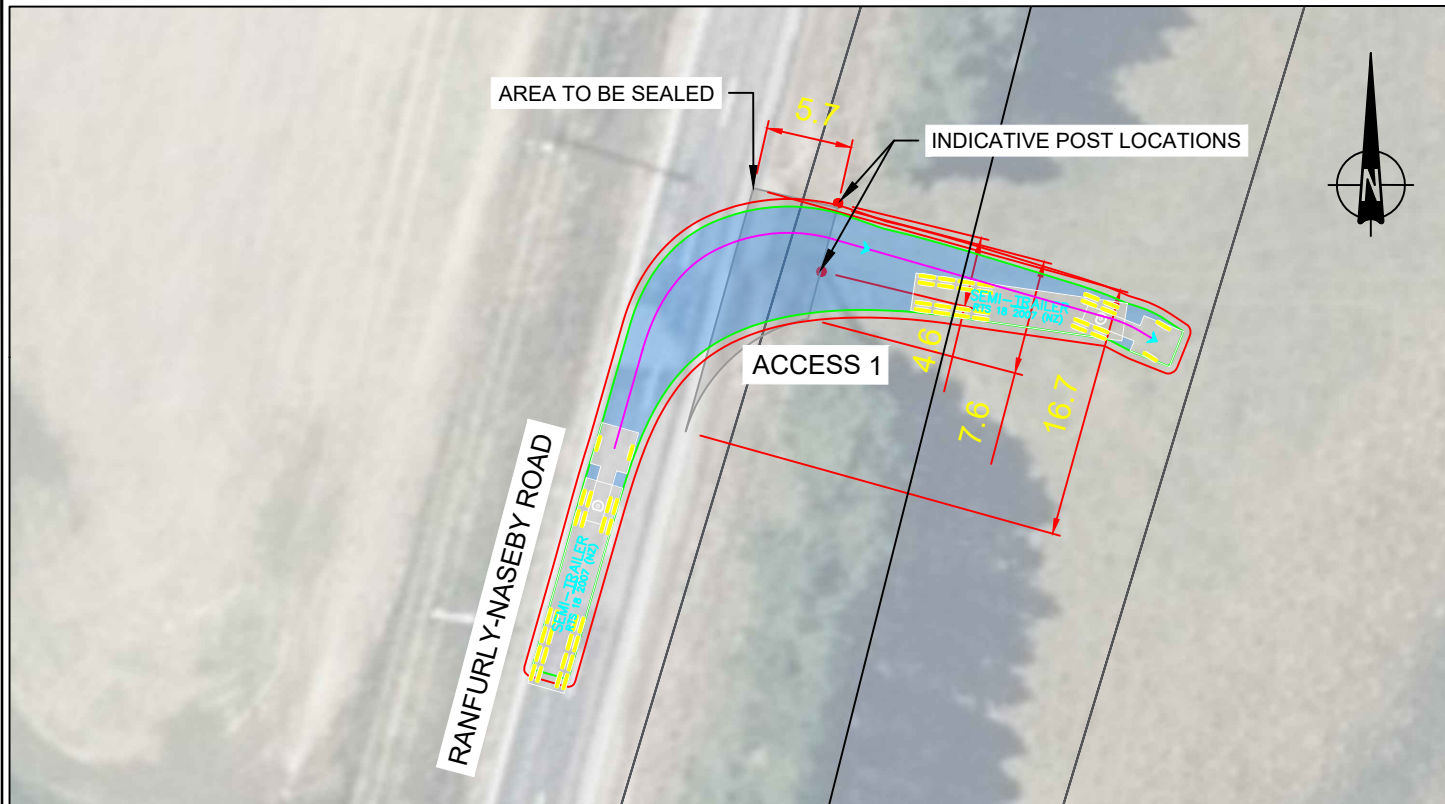


Design	LC
Drawn	CM
Checked	BB
Issued	31/07/2023
Scale	1:10000 @ A3

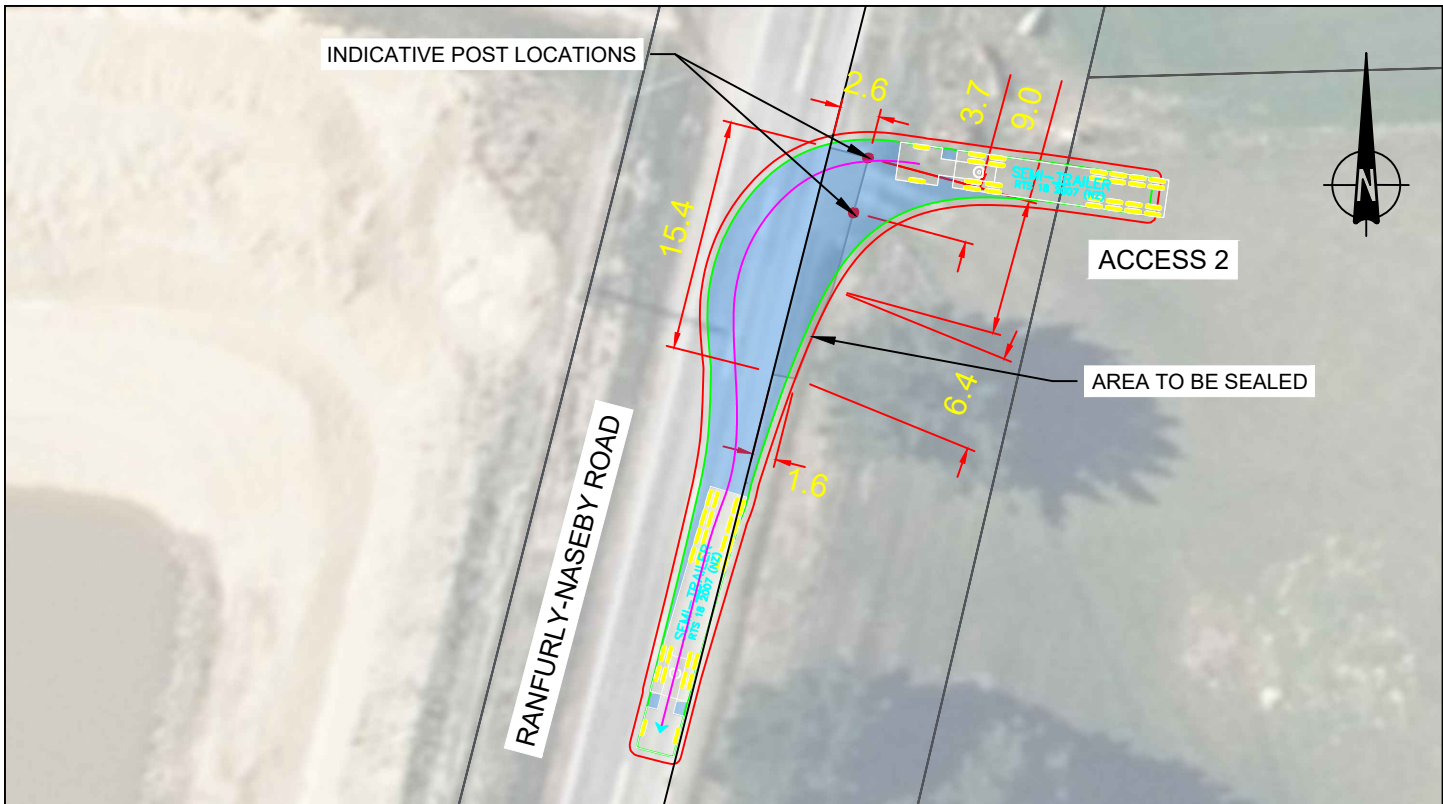
South Island Solar Farm ITA
Vehicle Tracking Plan
Overview plan

DRAFT

Project No.	HEL-J001
Dwg #	C1200
Sheet	1 of 2
Revision	1



RIGHT TURN ENTRY MOVEMENT (ACCESS 1)
Scale 1:500 @ A3



LEFT TURN EXIT MOVEMENT (ACCESS 2)
Scale 1:500 @ A3

TRACKING LEGEND

- VEHICLE BODY OUTLINE
- BODY CLEARANCE (0.5m)
- BODY HATCH (FORWARDS)
- BODY HATCH (REVERSE)
- VEHICLE CENTRELINE

TRACKING NOTES

1. TRACKING SPEED IS 10 km/h

TRACKING VEHICLE

SEMI-TRAILER (17.9m)

Tractor Width	: 2.50m	Lock to Lock Time	: 6.0
Trailer Width	: 2.50m	Steering Angle	: 24.1
Tractor Track	: 2.50m	Articulating Angle	: 70.0
Trailer Track	: 2.50m		

FOR CONSENT

Rev	Date	By	Chk	Description
1	31/07/2023	CM	BB	FOR CONSENT
2	21/08/2023	BB	RK	EXIT/EXIT MOVEMENTS UPDATED
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Design	LC
Drawn	CM
Checked	BB
Issued	31/07/2023
Scale	AS SHOWN

South Island Solar Farm ITA
Vehicle Tracking Plan
RTS 18 Semi-Trailer Transport Truck
Right Turn Entry and Left Turn Exit Movements

Project No.	HEL-J001
Dwg #	C1201
Sheet	1 of 2
Revision	2

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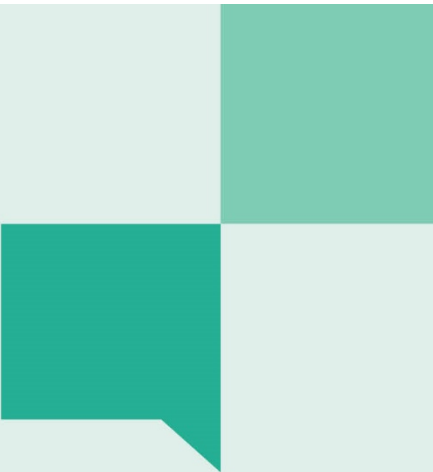
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Appendix 8

Assessment of Noise Effects



Project: **HELIOS SOLAR FARM - MANIOTOTO**

Prepared for: **Helios Energy Ltd
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Attention: **Sarah Brooks and Sabrina Young**

Report No.: **Rp 001 20230480**

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Document Control

Status:	Rev:	Comments	Date:	Author:	Reviewer:
Approved	-	-	19 Sep 2023	Peter Ibbotson	Mary Hamilton
Approved	1	Minor amendments	17 Oct 2023	Peter Ibbotson	Helios

SUMMARY

Marshall Day Acoustics has been engaged by Helios Energy Limited (Helios) to assess noise for a proposed solar farm. The proposal involves the construction and operation of a large photovoltaic (PV) solar farm, energy storage and a substation / transmission line. The location is Ranfurly-Naseby Road, Central Otago.

The key elements of the proposal are detailed below.

- 74 decentralised inverters. These inverters would be distributed throughout the farm and would be used in the generation of power from the solar arrays.
- 5,819 tracker motors associated with the solar panel arrays.
- A battery energy storage system situated in the central west area of the site. This is likely to comprise a series of packaged battery units.
- An electricity transmission line. Energy would be transferred to Transpower's nearby Naseby substation.

The proposed solar farm is well removed from the nearest rural dwelling receivers. The nearest proposed inverter is around 700 metres from the nearest dwelling, though most inverters are more than a kilometre away. The battery and substation area is proposed around two kilometres from the nearest dwelling.

Our overall conclusions are given below.

- Rating noise levels are expected to be 15 to 30 dBA during general operation, and up to 32 dBA during the highest possible periods of operation. These are low overall noise levels.
- The proposed solar farm would readily comply with the permitted Central Otago District Plan (District Plan) daytime noise limit of 55 dB L_{A10} . Noise levels are typically expected to be at least 25 decibels below the daytime noise limit and would be at least 22 decibels below the limit during the maximum possible noise emission situation. These are significant margins of compliance.
- The proposed solar farm would readily comply with the permitted Central Otago District Plan night noise limit of 40 dB L_{A10} . Noise levels are typically expected to be around 14 decibels below the night-time noise limit and would be at least 8 decibels below the limit under the maximum possible noise emission scenario. These are appreciable margins of compliance.
- Typical noise levels are expected to be below the existing ambient (L_{A10}) noise levels in the area, especially when there is elevated wind. Under windy conditions, the calculated noise levels would be in the order of 10 to 20 decibels quieter than the existing ambient noise generated by occasional traffic and/or wind in treetops and grasses. During low wind conditions, generated solar farm noise levels are expected to be similar to or slightly above the existing ambient noise levels when received on the eastern side of the farm (i.e. on Ranfurly Back Road).
- Typical noise levels are expected to be below the existing background (L_{A90}) noise levels when there is elevated wind. Noise levels are expected to be similar to or below the existing background noise levels during low wind periods. Based on the quietest measured background noise levels, typical noise levels from the solar farm may be 5 to 10 decibels above background noise levels during very quiet periods.
- The solar farm is expected to be audible (i.e. a perceptible source of noise) during times of low wind. Overall, noise levels are low and are considered reasonable in terms of the RMA.
- Construction would readily comply with the permitted District Plan construction noise rules and New Zealand Standard guidelines. Construction traffic may intermittently increase road noise for a limited period, but road traffic noise levels will remain low.

Overall, the location of the solar farm is well chosen with respect to noise. Significant distances between the sources of noise and the nearest receivers plus existing topographical screening would result in noise from the solar farm being low overall, complying with the permitted District Plan noise limits, and resulting in reasonable noise effects in terms of the RMA.

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APPENDIX A GLOSSARY OF TERMINOLOGY

APPENDIX B SITE LAYOUT PLAN (REFERENCE ONLY, NOT TO SCALE)

APPENDIX C DISTRICT PLAN ZONE MAP

APPENDIX D DISTRICT PLAN NOISE RULES

APPENDIX E NOISE LOGGING RESULTS

APPENDIX F CONSTRUCTION NOISE RULES (NZS6803:1999)

1.0 INTRODUCTION

Marshall Day Acoustics has been engaged by Helios Energy to undertake a noise assessment for a proposed solar farm between Naseby and Ranfurly, in the Central Otago District.

This report addresses noise from the proposed operation of the solar farm and from construction. It is intended to form part of an application for resource consent from Central Otago District Council.

A glossary of terminology is included in Appendix A.

2.0 APPLICATION SITE

The proposed solar farm is located at Ranfurly-Naseby Road, Naseby. The 660-hectare site is currently being used for pastoral grazing (sheep and beef) with ownership by two families.

Surrounding land use is also rural / farming. Naseby township is located approximately 3.2 km to the northeast of the site and Ranfurly township is around 4.5 km to the south. The site is approximately 1.8 km to the southeast of Transpower's Naseby Substation on Fennessy Road.

The majority of the site and surrounding hinterland is flat, although there is some topographical undulation on the eastern and northern sides of the site. The land rises to foothills of Mount Buster to the north.

The proposed solar farm is well removed from the nearest rural dwelling receivers. The nearest proposed inverter is around 700 metres from the nearest dwelling, and most inverters are more than a kilometre from any dwelling. The proposed battery storage and substation area is located around two kilometres from the nearest dwelling.

Surrounding receivers are listed in Table 1 and depicted in Figure 1.

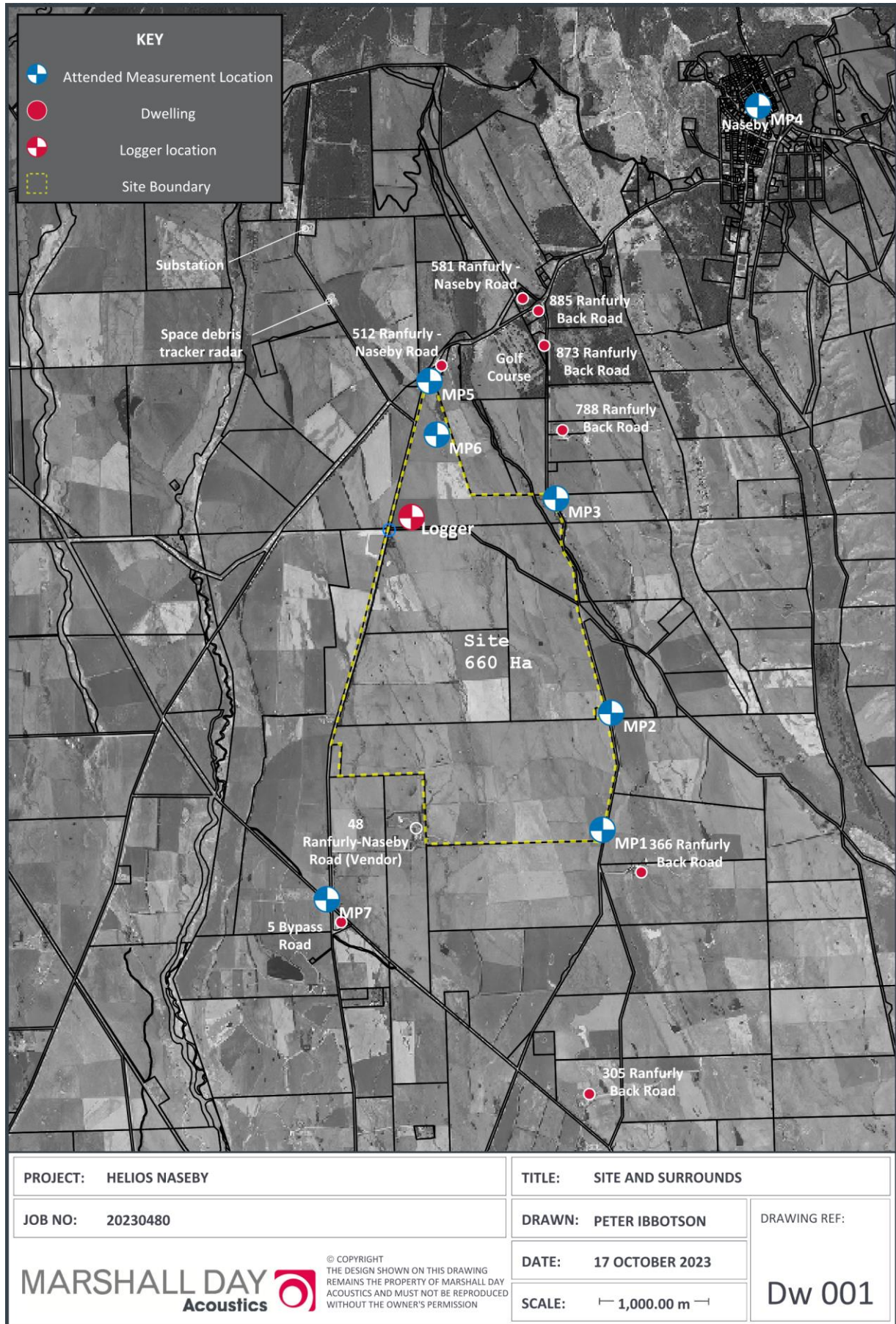
Table 1: Surrounding Receivers

Receiver Location	Address	Use ¹	Approx distance of closest dwelling notional boundary (m)	
			To solar farm boundary	To nearest inverter
A	512 Ranfurly – Naseby Road	Rural	168	1000
B	581 Ranfurly – Naseby Road	Rural	1100	1600
C	885 Ranfurly Back Road	Rural	1100	1600
D	873 Ranfurly Back Road	Rural	1000	1400
E	788 Ranfurly Back Road	Rural	650	800
F	366 Ranfurly Back Road	Rural	390	760
G	5 Bypass Road	Rural	1100	1400
H	305 Ranfurly Back Road	Rural	2500	2500
I	Ranfurly Township	Town	4500	4500
J	Naseby Township	Village	3400	3800
H	48 Ranfurly-Naseby Road ²	Rural	83	360

Note 1: Existing land use and distances have predominantly been determined from aerial photography and are indicative. The noise model uses specific distances between source and receiver.

Note 2: 48 Ranfurly-Naseby Road is the landowner from whom the land for the solar farm will be leased. Noise at this dwelling is discussed in this report for reference.

Figure 1: Site (shown in yellow outline), Surrounds and Noise Measurement Locations (refer Section 4.0)



3.0 PROPOSAL

We understand that most of the approx. 660-ha site would be used for the solar farm arrays. The proposed site location in relation to the surrounding area is given in Figure 1.

3.1 Facility Description

Solar panel arrays would be installed across the site in rows spaced six to eight metres apart to allow access by equipment for maintenance.

The key operational noise sources would be from the following plant.

- **74 decentralised inverters¹**. An inverter turns Direct Current (DC) created by the photovoltaic cells to alternating current (AC) current used in the electricity grid². These inverters would be distributed throughout the farm and would be used in the generation of power from the solar arrays. The total generation power rating of the farm would be around 300 MW³.
- **5,819 tracker motors** associated with the solar panel arrays. The individual solar panel arrays would be attached to tracker motors⁴.
- **Battery Energy Storage System BESS** situated in the central west area of the site. This is likely to comprise a series of 3 MW packaged battery units. This may comprise the following:
 - 32 x Tesla Megapack; or
 - 14 Power Electronics FS4390K 4.39MW inverters with 10 banks of GridSolv Quantum Units; or
 - Other battery storage units as determined during detailed design.
- **An electricity transmission line.** Energy would be fed from the solar farm to Transpower's existing Naseby substation located at Fennessy Road. This would likely be via a new 220kV overhead line. At this stage, it is likely an existing pole structure would be replaced with a new larger pole structure which would accommodate existing lower voltage transmission lines plus the new 220kV line.

Refer to Appendix B for a site map illustrating the above.

Power generation at the solar farm would occur during daylight/sunshine hours. In summer, operating daylight hours could begin earlier than the prescribed⁵ daytime period that begins at 7am, though this will be at low solar and inverter loads.

The battery storage component of the farm may operate during the night period (as well as during the daytime). The battery storage may operate to both export and import AC energy to and from the grid. It is likely that during periods of low demand, AC energy will be imported from the grid and stored in the batteries for later export – this can occur at night, normally for a period of a few hours.

¹ The majority of inverters are located at least 1000 metres from any dwellings (excluding the dwelling at 48 Ranfurly-Naseby Road which is a Helios Landowner partner and is assumed to have given written approval to the application).

² No specific inverter supplier has been selected at this stage of the project. There are two major manufacturers of inverters that are used on most solar projects (SMA and Power Electronics), although other manufacturers may be considered.

³ This is the alternating current generation power. The power of each inverter is nominally 4200 kVA.

⁴ Trackers consist of many solar panels on a frame that tilts vertically to align the panels to the sun throughout the day. The trackers are rotated around a central horizontal axis by a small DC motor (approximately 300 watts running at 24V DC). The motor is the main noise source associated with each tracker. The tracker motors are understood to operate intermittently during daylight hours and only for a short period as they are only required to make small incremental adjustments to the trackers. DC motors are quiet, even under continuous load and operation, and the collective sound power level of many tracker motors is not normally significant when considered over the total area of a solar farm site.

⁵ Refer to Section 5 for discussion of the District Plan noise rules and statutory timeframes.

It is generally understood that inverters associated with the battery storage do not operate at full load during the charging and discharging of energy storage systems, nevertheless we have allowed for 100% load at times during the daytime.

Batteries are unlikely to charge at 100% load when higher daytime temperatures occur. We have provided for a 50% fan load scenario which we consider to be a reasonable assumption for this environment, given the general low temperatures⁶.

3.2 Written Approvals

It is understood that written approval will be obtained from the two landowners of the solar farm site, with one landowner residing at the dwelling at 48 Ranfurly-Naseby Road⁷. The other landowner does not have a dwelling on the land they will be leasing to Helios.

3.3 Acoustic Mitigation

Acoustic mitigation such as enclosure or attenuation of the inverters is not considered necessary on this project to meet the night-time noise limits or to provide a reasonable level of acoustic amenity.

However, we note that attenuation options for the inverters are available if needed, for example, some inverter manufacturers have shrouds / lined bends that can be provided to the inverter intake and discharge ventilation openings. These result in modest attenuation of overall A-weighted noise levels⁸.

4.0 EXISTING NOISE ENVIRONMENT

Site visits were carried out to measure existing ambient and background noise representative of the site and surrounding area, over a period of two days from 18 July 2023. Attended measurements were taken at seven locations and a logger was installed on site, as detailed below and in Figure 1.

- Twelve attended noise measurements were carried out in 15-minute intervals between 18:00 hrs on 18 July and 13:00 hrs on 20 July 2023.
- Approximately 44 hours of logged data was collected, from 16:45 hrs on 18 July to 13:00 hrs on 20 July 2023.

The area was observed to have a background and ambient noise character that was typically quiet during periods of light wind, although it was noted that winds were at times high during the monitoring period which generated elevated background and ambient noise levels. There was little insect noise or bird noise audible. Insect noise may be more present during warmer months.

⁶ Mean daily temperatures in this location are low, with mean summer temperatures in the order of around 16 degrees C and mean winter temperature in the order of around 5 degrees C. Mean daily maximums are around 24 degrees in summer and around 8 degrees in winter (source: NIWA graphs). The typically cooler temperatures are likely to mean that fans will not need to operate at high speeds for cooling. We note that Otago does receive higher temperatures by New Zealand standards occasionally in summer and in these conditions, fans will likely need to operate at higher speeds than they do in winter. BESS manufacturers will be able to model fan flow rates over the hottest and typical days to determine how fast fans will operate to cool the batteries, but this information is not available until detailed design. Based on data reviewed for other applications, it appears that all fans would not operate to 100% at all times of the day, even on the hottest days of the year, but this needs to be confirmed with the final BESS and/or inverter supplier(s).

⁷ Council must not, when considering the application, have regard to any effect on a person who has given their written approval to the application (Section 104 (3) of the Resource Management Act 1991).

⁸ These solutions likely attenuate higher frequencies and may be effective at reducing tones from the inverter bridge circuit, therefore potentially having the added benefit of reducing the 'annoying' (special audible character) nature of the noise source. However, this information is not provided in the manufacturer's data.

Attended and logged (unattended) noise measurements results are summarised in the following sections.

4.1 Logger Data

The logger measurement position was located at the north-western part of the site (MP5, refer Figure 1). This location was approximately 75 metres east of Ranfurly-Naseby Road.

The logger results provide an indication of the variation in noise over the day and night periods at the logger location. While the logger location was near Ranfurly-Naseby Road and received noise from traffic passing by on this road, this road was observed to carry generally few vehicles.

As the solar farm may operate outside the prescribed daytime period, logged data has been analysed for the prescribed daytime, and night-time periods⁹.

Refer to Appendix E for the noise level variation over the logging period.

The following table summarises noise levels at the logger position.

Table 2: Measured Ambient Noise Levels (logged)

Date	Overall Measured Level (dB) ¹				Observed meteorological conditions
	Daytime hours ²		Night hours		
	L _{A10}	L _{A90}	L _{A10}	L _{A90}	
18-Jul (from late afternoon)	45	33	45	36	Winds increasing through night
19-Jul (all day)	48	32	38	31	Elevated winds, easing later in day to calmer conditions in the evening and night
20-Jul (to early afternoon)	44	29	-	-	Relatively calm conditions

Notes to Table 2:

(1) An explanation of technical terms is provided in Appendix A

(2) Daytime is given as 07:00 to 22:00 hours in this table

The logger data shows that average daytime noise levels are fairly typical of a rural area that receives some traffic (between 44 to 48 dB L_{A10}). Average background noise levels are low (29 to 33 dB L_{A90}), indicating that there are periods of quiet during the daytime where there is little noise (e.g. during gaps between vehicle pass-bys, low insect activity, and calm wind conditions). Background noise levels during the daytime are low comparative to some other rural areas in New Zealand. Such lower daytime noise levels typically occur where there are little birds, insects, vegetation or road/air traffic.

The logger data does not show a clear diurnal fluctuation in noise, likely due to relatively high wind conditions at times during the first night-time logging period. During still periods, ambient noise could be expected to be below 35 dB L_{A10} and below 25 dB L_{A90} during the evening and night hours. During periods of higher winds, noise levels will be elevated irrespective of the time of day or night.

⁹ Prescribed daytime hours are: 7am to 10pm. Prescribed night-time hours are: 10pm to 7am.

4.2 Attended Measurements

Attended measurements were carried out to establish the existing level of environmental noise in the area and to identify the main sources of noise that occur at nearby dwellings. Table 3 summarises the attended measurement results. Refer to Figure 1 for a map showing the measurement locations.

Table 3: Measured Ambient Noise Levels (attended)

Meas. Position	Measurement		Measured Level (dB) ¹				Noise Source ²
	Date Start time (hh:mm)	Duration min:sec	L _{Aeq}	L _{A10}	L _{A90}	L _{AFmax}	
MP1	18/07/2023 17:56pm	09:57	29	31	24	44	Ranfurly Back Road. Distant traffic typically audible, likely on SH85 or possibly on Ranfurly-Naseby Rd. Otherwise fairly quiet. Constant NW wind, some distant wind noise and wind noise in grass but no wind noise on microphone. Birds and distant horses audible.
MP5	18/07/2023 18:26 hrs	10:09	40	41	36	58	Ranfurly-Naseby Road, north end. Wind is brisker here and wind-foliage noise dominates noise level. Mostly wind noise generated by grass and trees. Some traffic: one nearby pass-by (paused out of measurement to better represent noise level at dwelling)
MP5	19/07/2023 02:28 hrs	10:01	54	58	43	62	Ranfurly-Naseby Road, north end. Wind is higher at this location. Wind in pine-tops dominates. Little other noise, no traffic.
MP3	19/07/2023 02:46hrs	11:03	36	38	34	50	Ranfurly Back Road, north end. Wind is higher at this location. Wind in pines dominates. Little other noise.
MP1	19/07/2023 03:11 hrs	10:01	25	27	22	43	Ranfurly Back Road, south end. Wind is much lower here, almost still. Noise levels considerably reduced as a consequence. Background and ambient noise levels are still dominated by distant noise in treetops, but close to inaudible. Distant bird call, no traffic noise.
MP1	19/07/2023 09:19 hrs	10:01	45	49	37	63	Ranfurly Back Road, south end Wind noise is fairly constant at this location during this measurement. Little other noise is audible. No distant traffic noise over the wind.

Meas. Position	Measurement		Measured Level (dB) ¹				Noise Source ²
	Date Start time (hh:mm)	Duration min:sec	L _{Aeq}	L _{A10}	L _{A90}	L _{AFmax}	
MP4	19/07/2023 10:02 hrs	10:36	48	49	29	68	Naseby Church Yard. Light wind. Little human activity but occasional vehicle visits to the nearby cafe. Some construction noise on the south side of the domain. During periods of quiet background, distant wind and distant traffic might dominate, but little noise at those times. Around five vehicle pass-bys occur to and from the cafe and building site. Noise level representative of quiet still day in Naseby. Background likely representative of daytime background around site during still conditions.
MP6	19/07/2023 11:18 hrs	10:06	56	58	51	72	North end of farm, within farm paddock at similar distance from road to 512 Ranfurly-Naseby Road. Wind is still relatively high here, noise level dominated by wind in treetops. Five cars passed by during measurement, not really dominant over wind.
MP3	19/07/2023 11:42 hrs	10:01	46	48	40	60	Ranfurly Back Road, middle. Wind is still elevated. Wind noise in adjacent pines and in roadside grasses. Distant traffic noise is only occasionally audible between windy periods.
MP3	19/07/2023 15:28 hrs	10:01	33	35	28	51	Ranfurly Back Road, north end. Distant traffic audible. Distant traffic is 30 to 35 dB L _p as it passes along Ranfurly- Naseby Road and up to 37 dB L _p past golf course. Traffic noise is audible around 50 % of the time. Distant loud bird call at times. Sheep graze constantly in the adjacent paddock. Little foliage-wind noise, but gust late in the period generating noise in tree tops.
MP5 Logger Location	19/07/2023 16:25 hrs	16:06	51	56	28	68	Logger Location, near Ranfurly-Naseby Rd. Light winds, almost still with few gusts. Traffic pass-bys on road fairly frequent due to Naseby event, bird calls: plover and field birds audible, distant aircraft audible at start of measurements

Meas. Position	Measurement		Measured Level (dB) ¹				Noise Source ²
	Date Start time (hh:mm)	Duration min:sec	L _{Aeq}	L _{A10}	L _{A90}	L _{AFmax}	
MP2	20/07/2023 09:13 hrs	10:01	33	32	25	59	Ranfurly Back Road, mid position Cold with light winds, and very light drizzle. Measurement taken with slight cover from car. Regular bird activity. Distant traffic being carried by wind
MP7	20/07/2023 15:53 hrs	10:01	53	57	31	69	Corner SH85 and Ranfurly-Naseby Rd. Traffic dominates, but quiet between pass-bys. Traffic typically audible but few pass-bys. Quiet between cars, like the rest of area.

Note to Table 3:

- (1) An explanation of technical terms is provided in Appendix A.
 (2) Dominant sources are underlined.

The results show that ambient noise levels depend largely on wind speed and the proximity to Ranfurly-Naseby Road. Other than occasional traffic movements between Ranfurly and Naseby (and distant SH85 traffic) there is little other human produced noise in this area.

As shown by the noise logger data, background noise levels can be below 25 dB L_{A90} during both the daytime and evening period when the wind speed drops. When the wind speed increases, background noise levels are typically 40 dB L_{A90} or above. Like many high-country environments, Naseby is understood to get regular periods of elevated winds but will also experience still periods.

5.0 NOISE PERFORMANCE STANDARDS

The site is subject to the operative Central Otago District Plan (District Plan), which identifies zoning and noise assessment standards for the site.

5.1 Zoning

The application site is situated on land zoned *Rural Resources*. Surrounding sites are also zoned *Rural Resources*. Refer to the zoning map provided in Appendix C.

5.2 Noise Limits

Section 4, Rule 4.7.6E(a) of the District Plan provides permitted activity noise standards for the *Rural Resources* zone. They are summarised below and reproduced in Appendix D.

E. Noise

- (a) *All activities shall be conducted so as to ensure the following noise limits are not exceeded at any point within the notional boundary of any dwelling, resthome or hospital, or at any point within any Residential Resource Area or any Rural Settlements Resource Area:*

<i>On any day 7:00am to 10:00pm</i>	<i>55 dBA L₁₀</i>
<i>10:00pm to 7:00am the following day</i>	<i>40 dBA L₁₀</i>
	<i>70 dBA L_{AFmax}</i>

Provided that the above noise limits shall not apply to:

- any temporary activity (as defined)*

2. devices used to protect crops from birds or frost (see (b)-(c) below

3. sirens associated with emergency service activities. 4.7.6E(a) (cont'd)

“Notional boundary” is defined as a line 20 metres from part of any living accommodation or the legal boundary where this is closer to the living accommodation.

The relevant limits apply at the notional boundary¹⁰ of another site in the *Rural Resources* zone.

The constraining limit is 40 dB L_{A10} as power will be generated during the prescribed night period. Inverters may also operate at night as part of the battery storage operation. The L_{AFmax} limit will not constrain this operation as any solar farm noise emissions will be fairly constant in level and will not generate loud noise “events”.

5.3 Measurement and Assessment Standards

The District Plan states the following with regard to assessment:

12.7.4 NOISE

- (i) *Measurement and Assessment of Noise Except where expressly provided elsewhere in this Plan, noise shall be measured in accordance with the provisions of NZS 6801:1991 Measurement of Sound and assessed in accordance with the provisions of NZS 6802:1991 Assessment of Environmental Sound. For the purposes of this Plan the following additional provisions shall limit the application of NZS 6802:1991.*
 - (a) *Adjustments for special audible characteristics, if present, as provided for in clause 4.3 and 4.4 of the Standard, shall apply and will have the effect of imposing a numerical noise limit 5 dB more stringent than those L_{10} numerical limits stated in the plan.*
 - (b) *Where measured noise levels are averaged as provided for in Clause 4.5 of the Standard, the L_{10} value shall be determined by an energy average (inverse logarithmic mean) of any four L_{10} measurement sample time intervals on the same day. Sample time intervals must include the sound of interest. The total measurement period should be representative of any variations in the character and range of sound levels for the noise of interest during any period of concern. Such a period may relate to a specific time of day when a noise is alleged to be a problem, or to a particular type of noise source. The total time interval over which measurements for the purpose of determining an average sound level are made shall not exceed four consecutive hours in any 24 hour period including night-time.*
 - (c) *Measurement time intervals as provided for in Clause 5.1 of the Standard shall be limited to 10-15 minutes excluding pause times. For steady noise received at a particular location, a period of two hours will usually be adequate if compliance monitoring is the purpose. Where the noise of interest is cyclic or occurs for time intervals less than 15 minutes in duration, the sample intervals may be less than 10-15 minutes excluding pause times and an average level shall be determined by the method described in (b) but at least ten events should be measured.*

Recommended Assessment Standards

The above provisions relate to old versions of the noise standard (the 1991 versions of the standard). These have been superseded by New Zealand Standard NZS 6801:2008 *Acoustics – Measurement of environmental sound* and New Zealand Standard NZS 6802:2008 *Acoustics - Environmental Noise*. We consider that the more recent versions have several advantages and should be applied to solar farm noise assessments. One key difference between the versions of the noise standards is that any

¹⁰ The line 20 metres from part of any living accommodation or the legal boundary where this is closer to the living accommodation.

special audible character penalty is applied as an addition to the assessed noise level, rather than as a reduction of the noise limit. This has the same outcome (noise limits are effectively 5 dBA more stringent for tonal sources), but is more logical. A secondary advantage is that the tonality provisions of NZS 6802:2008 *Acoustics - Environmental Noise* are more sophisticated.

5.4 Construction Noise

The District Plan states that any construction work activity must be measured and assessed in accordance with the requirements of New Zealand Standard *NZS 6803P:1984 The Measurement and Assessment of Noise from Construction, Maintenance, and Demolition Work*. This is also a superseded noise standard that has been replaced with New Zealand Standard *NZS 6803: 1999 Acoustics - Construction Noise*. We recommend consent be granted using the more modern version of the standard. NZS6803 construction noise guidelines are given in Appendix F.

5.5 Resource Management Act 1991

Under the provisions of the Resource Management Act 1991 (RMA) there is a duty to adopt the best practicable option to ensure that noise (including vibration¹¹) from any development does not exceed a reasonable level. Specifically, Sections 16 and 17 reference noise effects as follows.

Section 16 states that "every occupier of land (including any premises and any coastal marine area), and every person carrying out an activity in, on, or under a water body or the coastal marine area, shall adopt the best practicable option to ensure that the emission of noise from that land or water does not exceed a reasonable level".

Section 17 states that "every person has a duty to avoid, remedy, or mitigate any adverse effect on the environment arising from an activity carried on by or on behalf of the person, whether or not the activity is in accordance with –

- (a) Any of sections 10, 10A, 10B and 20A; or
- (b) A national environmental standard, a rule, a resource consent, or a designation".

6.0 OPERATIONAL NOISE LEVELS

6.1 Noise Sources and Modelling Methodology

The main noise sources from the proposed solar farm would be the decentralised generation inverters (distributed across the farm with the photovoltaic panels) and the inverters at the energy storage area. Cooling ventilation fan noise from the containerised battery storage units would also contribute to the overall emitted noise level.

We prepared a noise model using SoundPLAN® environmental noise modelling which considers factors such as the terrain, screening by buildings, and ground effect. Calculations have been carried out using ISO 9613-2:1996 "*Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation*". Noise levels have been calculated under meteorological conditions that are favourable to sound propagation¹² and represent the 'worst case' propagation situation¹³.

The following sound power data has been used in the preparation of this noise model. Data has relied on advice given by a range of manufacturers or from previous measurements carried out by

¹¹ RMA 1991 Part 1 Section 2 Interpretation: Noise includes vibration.

¹² These are set out in ISO9613-2 and represent downwind or temperature inversion conditions.

¹³ Under most daytime metrological conditions, noise levels will be lower than calculated. This is because when the solar farm is operating at full generation, it will be during periods of high solar gain (typically during the middle part of the day). In general, high solar gain conditions correspond with conditions that are not favourable to sound propagation, as sound will refract upward when air temperatures reduce with increasing altitude (temperature lapse). In temperature lapse conditions, noise levels are expected to be around five decibels lower than calculated for the temperature inversion condition.

Marshall Day Acoustics. The applicant must confirm this data with suppliers prior to final procurement of power infrastructure.

Manufacturers data shows that the solar farm central inverters and battery energy storage systems (BESS) have tonal characteristics at various frequencies. The assessment of environmental noise effects for resource consent allows for tonal character¹⁴.

The assumed BESS generated noise levels have been derived from data from several manufacturers. There is wide variability in noise data between manufacturers. We have assessed noise levels based on both a 'typical' level of noise emission from the BESS and a worst-case noise emission (100% fan load for the loudest BESS unit, reviewed). Inverter and BESS noise levels will reduce at low fan speeds¹⁵.

Table 4 sets out the sound power levels used in this assessment.

Table 4: Sound Power Levels

Noise Source	Sound Power Level dBA re 10 ⁻¹² Watts	Number of Units	Directivity	Operation time
Decentralised inverters (associated with the PV panels)				
DC / AC inverter 4 MVA	93 dB L _{WA} (AC end) 88 dB L _{WA} (DC end)	74	Included	Sunshine hours, mostly day
Tracker modules	74 dB L _{WA} (emission when moving) = 102 (total L _w for all trackers across total farm)	5,819 ¹⁶	None	Sunshine hours, mostly day
Centralised Energy Storage				
Containerised Battery Storage	Fan load (50 to 100%): 94 dB L _{WA} Highest fan load: 101 dB L _{WA} ¹⁷	32	None	Daytime and night- time (normally for a few hours at night)
Auxiliary Transformers	90 dB L _{WA} (up to 135 MW transformers operating ODAF)	2	None	All times

¹⁴ Tonality (from inverters or the BESS) is expected to occur at higher frequencies. Higher frequencies are attenuated with distance due to air and ground absorption, as well as topographical screening. Given the distances involved, tonality may not be audibly present at the receivers as any tones may be below the background level. Nonetheless, we have conservatively allowed for tonality to be present at low levels at the receiver locations.

¹⁵ The simplified relationship between fan speed and noise is 50*log(RPM1/RPM2). Data from manufacturers typically shows a strong correlation between reduced fan speeds and reduced noise levels.

¹⁶ Note that up 7,900 have been allowed for in calculations which adds a slight conservatism.

¹⁷ BESS units show a very wide range of noise emissions. The highest fan load noise level in this table represents the very loudest possible noise emission for the loudest BESS units reviewed. Many manufacturers indicate lower noise levels, even at 100% fan load. Even if the highest fan loads occur, it is likely they would only occur for short periods during the hottest times. This is considered a very conservative worst case.

6.2 Calculation Methodology

Noise levels have been calculated at the notional boundaries of the receivers surrounding the solar farm.

Inverter units will likely have directivity. We have calculated these for north directivity (the noisiest side, north facing). Other orientations may change noise emissions, for example, depending on the orientation of the air intake/outlet on the final units selected. Orienting inverter units with the noisiest side “inward” towards the central part of the site would be beneficial in terms of noise emissions.

The calculations have been carried out based on the following assumptions.

- Inverter source heights and battery enclosure HVAC fans at around 4 metres above ground. There will likely be a variation in source heights across the farm for inverters and batteries relative to ground level, but this is not expected to appreciably affect noise level predictions.
- Inverter and energy storage facility distributed across the site as shown in Figure 1 of this report.
- For this assessment, we have calculated “daytime” and “night-time” noise levels on the assumption that the decentralised inverters will not typically operate at night, but that the BESS plant will operate at night (and during the day), for periods of more than an hour. During the longest days of the year, the decentralised inverters may potentially begin operation prior to 7am, however this will typically be at low inverter loads (and likely low cooling fan speeds). In this scenario, noise levels may be slightly higher than the calculated “night” noise level, though are likely to be lower than the “daytime” scenario.
- We have applied special audible characteristics (SAC) corrections of 5 dBA to all calculated noise levels on the assumption that noise generation could generate noise that is subjectively or objectively tonal in accordance with the simplified method of NZS6802:2008.
- We have not applied a duration correction to the daytime or night-time noise levels.

6.3 Calculated Noise Levels from Proposed Solar Farm

The following Table 5 summarises the results of our calculations.

Table 5: Calculated Noise levels

Receiver Location	Noise Limits [daytime / night] (dB L _{A10})	Calculated Rating Noise Level (dB L _R)			
		“Typical” expected BESS fan load		“Maximum” possible BESS fan load	
		Day	Night	Day	Night
512 Ranfurly-Naseby Road, Naseby	55 / 40	30	26	32	31
581 Ranfurly-Naseby Road, Naseby	55 / 40	24	20	27	26
885 Ranfurly Back Road, Naseby	55 / 40	24	21	27	26
873 Ranfurly Back Road Naseby	55 / 40	25	22	29	28
788 Ranfurly Back Road, Naseby	55 / 40	29	26	33	32
366 Ranfurly Back Road, Ranfurly	55 / 40	25	21	26	24
5 Bypass Road, Ranfurly	55 / 40	21	19	24	23
305 Bypass Road Ranfurly	55 / 40	15	13	17	16

Receiver Location	Noise Limits [daytime / night] (dB L _{A10})	Calculated Rating Noise Level (dB L _R)			
		“Typical” expected BESS fan load		“Maximum” possible BESS fan load	
		Day	Night	Day	Night
Other areas					
48 Ranfurly-Naseby Road, Ranfurly (Landowner leasing to Helios)	55 / 40	32	30	33	31
Maniototo Golf Club	-	26	22	29	28
Naseby Township	55 / 40	15	13	17	16
Ranfurly Township	55 / 40	<0	<0	c. 0	c. 0

7.0 RESULTS SUMMARY

Our calculations show that for the compliance receivers:

- Rating noise levels are expected to be 15 to 30 dBA during general operation, and up to 32 dBA during the highest possible periods of operation. These are low overall noise levels.
- The proposed solar farm would readily comply with the permitted District Plan daytime noise limit of 55 dB L_{A10}. Noise levels are typically expected to be at least 25 decibels below the daytime noise limit and would be at least 22 decibels below the limit during the maximum possible noise emission situation. These are significant margins of compliance.
- The proposed solar farm would readily comply with the permitted District Plan night noise limit of 40 dB L_{A10}. Noise levels are typically expected to be at least 14 decibels below the night-time noise limit and at least eight decibels below the limit during the maximum possible noise emission situation. These are appreciable margins of compliance.
- Typical noise levels from the solar farm are expected to be below the existing ambient (L_{A10}) noise levels in the area, especially when there is elevated wind. In these situations, the calculated noise levels would be in the order of 10 to 20 decibels quieter than the existing ambient noise generated by occasional traffic and/or wind in treetops and grasses. Generated solar farm noise levels may be similar to or slightly above the existing ambient noise levels during periods of low wind speeds when received on the eastern side of the farm (i.e. on Ranfurly Back Road).
- Typical noise levels from the solar farm are expected to be below the existing background (L_{A90}) noise levels when there is elevated wind. Noise levels may be similar to or below the existing background noise levels during still periods when there are few other noise sources (such as traffic, insects, birds). Based on the quietest measured background noise levels, typical noise levels from the solar farm may be 5 to 10 decibels above background noise levels at times.
- The solar farm is expected to be audible during times of low wind. Overall, noise levels are low, able to meet the permitted day and night time noise limits of the District Plan, and are considered reasonable in terms of the RMA.

8.0 CONSTRUCTION NOISE LEVELS

8.1 On-site construction

Construction of the solar farm is likely to involve the following:

- Delivery of panels, inverters and other infrastructure, requiring trucks and small cranes.
- Earthworks would occur using trucks, loaders and excavators.
- A 'Vermeer PD10 Pile Driver' to impact drive the support piles into the ground.

The total duration of solar farm construction on this site is expected to be approximately 24 months and to take place between 7:30 to 18:00 hours, Monday to Saturday. The total duration of piling is likely to be longer than 20 weeks, however the activity will not be stationary during this time and piling in any one location will occur for shorter than 20 weeks. Based on section c7.2.1 of NZS 6803:1999, the appropriate NZS 6803 noise limit is 75 dB L_{Aeq} .

The noise limits apply at 1 metre outside the façades of occupied buildings.

All significant equipment likely to be used on the project is listed in Table 6. The sound levels given are based on measurements we have made of similar plant or from BS 5228-1:2009 *Code of practice for noise and vibration control on construction and open sites* Part 1: Noise.

Table 6: Activity Specific Noise Levels at 1m from a building façade (without screening)

Item/Activity	Operating Sound Power Level (dB L_{WA})	Noise Level (dB L_{Aeq})				75dBA Limit Setback (m)
		100m	250m	500m	750m	
Large earthmoving trucks (operating within the site)	108	60	50	43	38	25m
Excavators and other earthmoving plant	103	55	45	38	33	14m
Vermeer PD10 Pile Driver (impact piling)	123	75	65	58	53	100m
Concrete truck & pump	103	55	45	38	33	14m
Truck idling	91	43	33	26	21	4m

The closest dwelling to the piles is around 400 metres from the site. Noise levels would be below 60 dB L_{Aeq} at the closest dwelling. Construction activity would therefore readily comply with the 75 dB L_{Aeq} noise limit. There would be no perceptible vibration.

8.2 Construction vehicles on public roads

Truck and construction passenger vehicle movements will occur on both Ranfurly-Naseby Road, Bypass Road and Ranfurly Back Road. These are public roads and the Central Otago District Plan construction noise and vibration limits do not technically apply to activities on these roads, although we note that vehicles using these roads would generate noise levels that largely comply with NZS6803 guidelines.

We expect that during construction, the number of vehicle movements on local roads would increase perceptibly. This is because there are currently few vehicles using these roads.

Existing traffic noise levels are relatively low. Average noise levels of 45 to 48 dB L_{A10} were measured over the daytime period at 75 metres from Ranfurly-Naseby Road. It is possible that significant volumes of construction traffic could increase traffic noise levels on these roads perceptibly, however traffic noise levels would still remain low on these roads. It is noted that construction traffic

accessing the site from Naseby would have to pass few dwellings that are located close to roads. The only dwelling close to the road is at 5 Bypass Road, however this dwelling already receives elevated noise from the adjacent State Highway and additional traffic to and from the solar farm is likely to only increase traffic noise levels by a small amount.

8.3 Construction noise and vibration management

A Construction Noise and Vibration Management Plan (CNVMP) is often recommended as a condition where activity cannot comply with the guidelines in NZS 6803:1999 or to manage effects even when compliance with the standard is expected to be achieved. In this case, compliance will readily occur and due to substantial separation distances, effects on nearby properties from construction activities on site are not anticipated. Therefore, a CNVMP is not necessarily required.

9.0 RECOMMENDED NOISE CONDITIONS

1. The noise level from all operation of the solar farm shall meet the following noise limits at the notional boundary of dwellings existing at the time of consent on another site in the *Rural Resources* zone:

On any day 7:00am to 10:00pm	55 dB L_{A10}
10:00pm to 7:00am the following day	40 dB L_{A10} 70 dBA L_{AFmax}

Noise levels shall be measured and assessed in accordance with NZS 6801:2008 Acoustics – Measurement of Environmental Sound and NZS 6802:2008 Acoustics – Environmental Noise.

2. Construction activities shall not exceed the limits recommended in, and shall be measured and assessed in accordance with, New Zealand Standard NZS 6803: 1999 “Acoustics – Construction Noise” and German Standard DIN 41503:2016 Vibration in buildings – Part 3: Effects on structures [vibration]

APPENDIX A GLOSSARY OF TERMINOLOGY

Background sound	The sound that is continuously present in a room or outdoor location. Often expressed as the A-weighted sound level exceeded for 90 % of a given time period i.e. L_{A90} .
Emission	Sound that is generated by, and propagates away from a source.
Frequency	Sound occurs over a range of frequencies, extending from the very low (e.g. thunder) to the very high (e.g. mosquito buzz). Measured in units of Hertz (Hz). Humans typically hear sounds between 20 Hz and 20 kHz. High frequency acuity naturally reduces with age: most adults can hear up to 15 kHz.
Hertz (Hz)	The unit of frequency, named after Gustav Hertz (1887-1975). One hertz is one pressure cycle of sound per second. One thousand hertz – 1000 cycles per second – is a kilohertz (kHz).
Immission	Sound received at one location from a source(s) at another location(s).
Initial sound	Total sound present in an initial situation before a change to the existing situation occurs. This definition is from ISO 1996.
Noise	A subjective term used to describe sound that is unwanted by, or distracting to, the receiver.
Notional boundary	A line 20 metres from any side of a dwelling, or the legal boundary where this is closer to the dwelling. This definition is from NZS 6802:2008.
Octave band	The interval between one frequency and its double. Sound is divided into octave bands for analysis. The typical octave band centre frequencies are 63 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz and 4 kHz.
Prescribed time frame	‘Daytime’, ‘night-time’, ‘evening’, or any other relevant period specified in any rule or national environmental standard. This definition is from NZS 6802:2008.
Rating level	A derived level used for comparison with a noise limit. Takes into account any and all corrections described in NZS 6801 and NZS 6802, e.g. duration, special audible character, residual sound etc. This definition is from NZS 6802:2008.
Reference time interval	The time interval over which the time average A-weighted sound pressure levels is determined. Typically 15 minutes. This definition is from NZS 6802:2008.
Residual sound	The total sound remaining at a given position in a given situation when the specific sounds under consideration are suppressed or are an insignificant part of the total sound. This definition is from NZS 6802:2008.
Special audible characteristics	Distinctive characteristics of a sound that make it more likely to cause annoyance or disturbance. A penalty of up to 5 decibels can be applied when

assessing sounds with SAC Examples are tonality – a hum or a whine) and impulsiveness – bangs or thumps.

Specific sound

A component of total sound that can be identified as associated with a specific source. Specific sound is the ‘sound of interest’ in an assessment.

This definition is from NZS 6802:2008.

A-weighting

A set of frequency-dependent sound level adjustments that are used to better represent how humans hear sounds. Humans are less sensitive to low and very high frequency sounds.

Sound levels using an “A” frequency weighting are expressed as dB L_A . Alternative ways of expressing A-weighted decibels are dBA or dB(A).

C-weighting

A frequency weighting used to approximate the response of the human ear to sounds with strong low frequency components (typically between 25 and 125 Hz) at high noise levels (typically greater than 85 decibels).

dB

Decibel. The unit of sound level.

L_{A10}

The A-weighted sound level exceeded for 10% of the measurement period, measured in dB. Commonly referred to as the average maximum noise level.

L_{A90}

The A-weighted sound level exceeded for 90 % of the measurement period, measured in dB. Commonly referred to as the background noise level.

L_{A95}

The A-weighted sound level exceeded for 95 % of the measurement period, measured in dB. Commonly referred to as the background noise level.

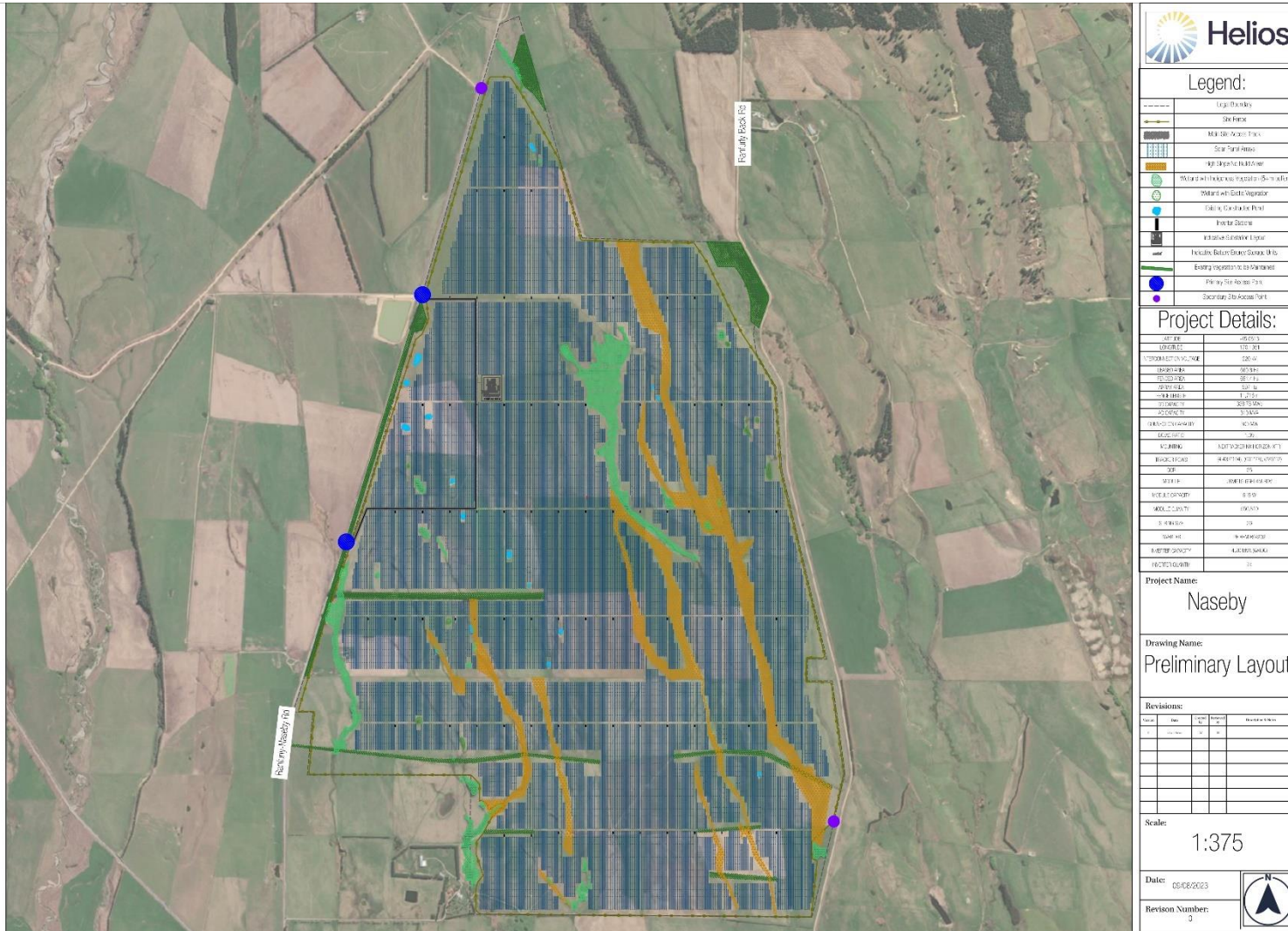
L_{Aeq}

The equivalent continuous A-weighted sound level. Commonly referred to as the average sound level and is measured in dB.

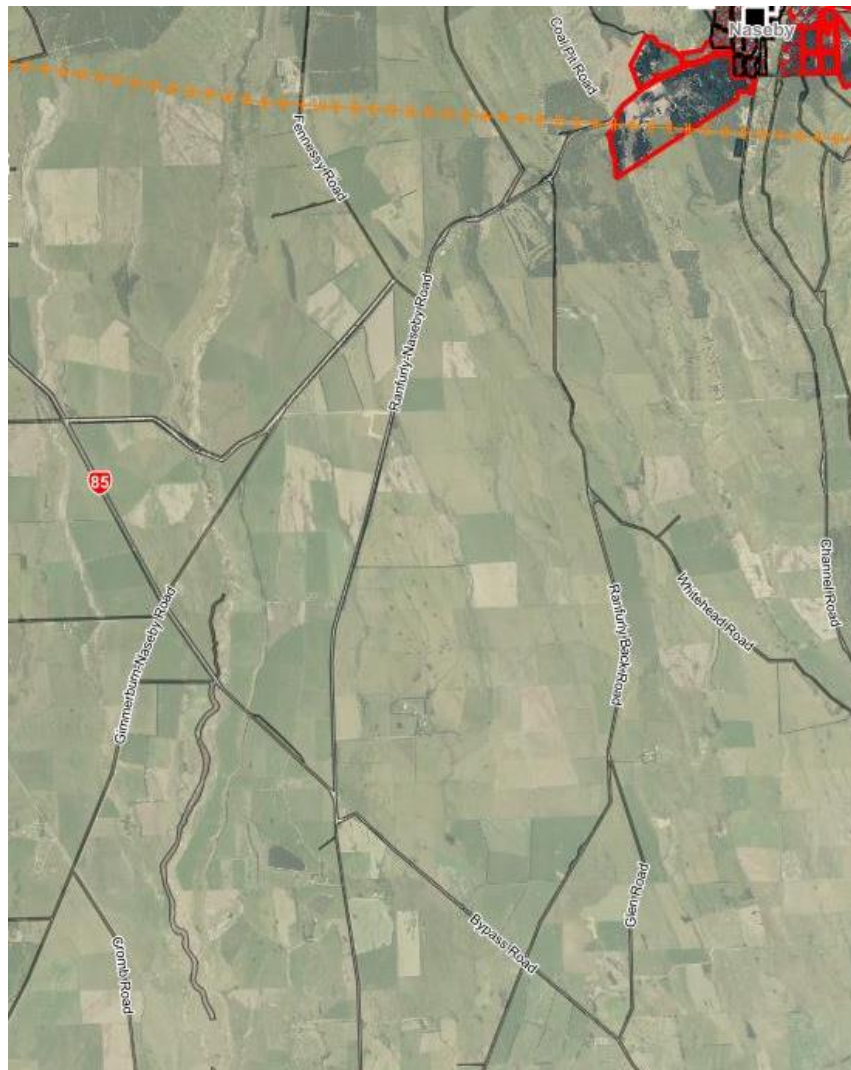
L_{Amax}

The A-weighted maximum sound level. The highest sound level which occurs during the measurement period. Usually measured with a fast time-weighting i.e. L_{AFmax}

APPENDIX B SITE LAYOUT PLAN (REFERENCE ONLY, NOT TO SCALE)



APPENDIX C DISTRICT PLAN ZONE MAP



Resource Areas

- ☒ RA_B
- ☒ RA_BA
- ☒ RA_I
- ☒ RA_R
- ☒ RA_RRA
- ☒ RA_RR
- ☒ RA_RS
- ☒ RA_RSlope
- ☒ RA_RuRA
- ☒ RA_RU
- ☒ RA_W

APPENDIX D DISTRICT PLAN NOISE RULES

9.1 Section 4 - Rural Resources

E. Noise

- (a) All activities shall be conducted so as to ensure the following noise limits are not exceeded at any point within the notional boundary of any dwelling, resthome or hospital, or at any point within any Residential Resource Area or any Rural Settlements Resource Area:

On any day 7:00am to 10:00pm	55 dBA L_{10}
10:00pm to 7:00am the following day	40 dBA L_{10}
	70 dBA L_{max}

Provided that the above noise limits shall not apply to:

1. any temporary activity (as defined)
2. devices used to protect crops from birds or frost (see (b)-(c) below
3. sirens associated with emergency service activities.

“Notional boundary” is defined as a line 20 metres from part of any living accommodation or the legal boundary where this is closer to the living accommodation.

9.2 Section 12 - District wide rules and standards

12.7.4 NOISE

(i) Measurement and Assessment of Noise

Except where expressly provided elsewhere in this Plan, noise shall be measured in accordance with the provisions of NZS 6801:1991 *Measurement of Sound* and assessed in accordance with the provisions of NZS 6802:1991 *Assessment of Environmental Sound*. For the purposes of this Plan the following additional provisions shall limit the application of NZS 6802:1991.

- (a) Adjustments for special audible characteristics, if present, as provided for in clause 4.3 and 4.4 of the Standard, shall apply and will have the effect of imposing a numerical noise limit 5 dB more stringent than those L_{10} numerical limits stated in the plan.
- (b) Where measured noise levels are averaged as provided for in Clause 4.5 of the Standard, the L_{10} value shall be determined by an energy average (inverse logarithmic mean) of any four L_{10} measurement sample time intervals on the same day. Sample time intervals must include the sound of interest. The total measurement period should be representative of any variations in the character and range of sound levels for the noise of interest during any period of concern. Such a period may relate to a specific time of day when a noise is alleged to be a problem, or to a particular type of noise source. The total time interval over which measurements for the purpose of determining an average sound level are made shall not exceed four consecutive hours in any 24 hour period including night-time.

- (c) Measurement time intervals as provided for in Clause 5.1 of the Standard shall be limited to 10-15 minutes excluding pause times. For steady noise received at a particular location, a period of two hours will usually be adequate if compliance monitoring is the purpose. Where the noise of interest is cyclic or occurs for time intervals less than 15 minutes in duration, the sample intervals may be less than 10-15 minutes excluding pause times and an average level shall be determined by the method described in (b) but at least ten events should be measured.

Reason

Recognised noise assessment and measurement techniques are to be used to ensure that consistency and certainty is achieved.

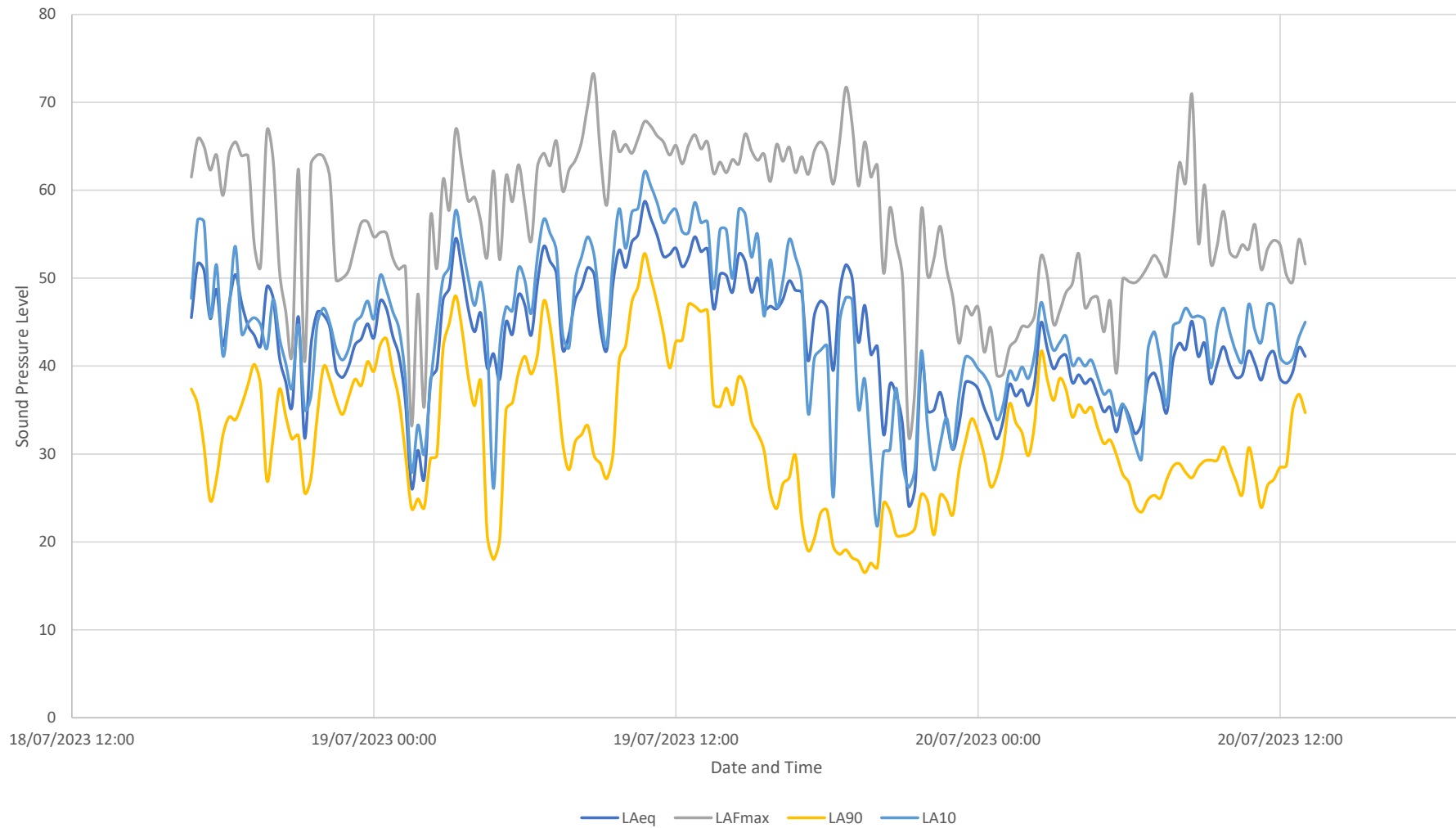
(ii) Construction Noise

Construction noise within the district which is ancillary to the principal use of the site shall not exceed the recommended limits in and shall be measured and assessed in accordance with the provisions of NZS 6803P:1984 *The Measurement and Assessment of Noise from Construction, Maintenance, and Demolition Work*. Discretionary adjustments provided in Clause 6.1 shall be mandatory within the district.

Construction noise is permitted to occur only between the hours of 7:00am and 6:00pm within an urban area (as defined on page 18:11).

Any activity that does not comply with this rule shall be considered as a discretionary (restricted) activity. Council shall restrict the exercise of its discretion to the effect on the amenity values of the neighbourhood.

APPENDIX E NOISE LOGGING RESULTS



APPENDIX F CONSTRUCTION NOISE RULES (NZS6803:1999)

NZS6803:1999 sets out the following noise limits:

“Residential zones and dwellings in rural areas:

Table 2 – Recommended upper limits for construction noise received in residential zones and dwellings in rural areas

Time of week	Time period	Duration of work					
		Typical duration (dBA)		Short-term duration (dBA)		Long-term duration (dBA)	
		L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}
Weekdays	0630-0730	60	75	65	75	55	75
	0730-1800	75	90	80	95	70	85
	1800-2000	70	85	75	90	65	80
	2000-0630	45	75	45	75	45	75
Saturdays	0630-0730	45	75	45	75	45	75
	0730-1800	75	90	80	95	70	85
	1800-2000	45	75	45	75	45	75
	2000-0630	45	75	45	75	45	75
Sundays and public holidays	0630-0730	45	75	45	75	45	75
	0730-1800	55	85	55	85	55	85
	1800-2000	45	75	45	75	45	75
	2000-0630	45	75	45	75	45	75

“Industrial or commercial areas:

Table 3 – Recommended upper limits for construction noise received in industrial or commercial areas for all days of the year

Time period	Duration of work		
	Typical duration	Short-term duration	Long-term duration
	L_{eq} (dBA)	L_{eq} (dBA)	L_{eq} (dBA)
0730-1800	75	80	70
1800-0730	80	85	75

Notes in the standards to the tables above:

7.2.5

The night time limits in Table 2 shall apply to activities carried out in industrial or commercial areas where it is necessary to prevent sleep interference, specifically where there are residential activities, hospitals, hotels, hostels, or other accommodation facilities located within commercial areas. The limits in Table 2 may also be used to protect other specific noise sensitive activities at certain hours of the day.

7.2.6

One major factor which should be considered is whether there is a relatively high background sound level (L_{90}) due to noise from sources other than construction work at the location under investigation. In such cases limits should be based on a determination of the existing level of noise in the area (a “background plus” approach).

7.2.7

Where there is no practicable method of measuring noise outside a building, the upper limits for noise measured inside the building shall be the levels stated in tables 2 and 3 minus 20 dBA. This is considered to be a typical value for the sound reduction normally achieved in New Zealand buildings with doors and windows closed.”



Appendix 9

Engagement Summary

Mānīatoto Plain Solar Farm - Stakeholder Engagement Summary

1. Introduction

This document outlines the stakeholder engagement strategy for the solar farm on Ranfurly-Naseby Road, located between Naseby and Ranfurly. Helios has undertaken a comprehensive pre-application engagement programme to proactively inform and engage early with the local community and key stakeholders.

In summary, to date this has involved the following:

- Aukaha were contacted directly in July 2023 to provide an overview of the proposal and introduce the appropriate people at Helios to contact throughout the project. Helios also sought their services for engaging with mana whenua. Correspondence has been ongoing, with the most recent from Kate Timms-Dean (Aukaha General Manager Mana Taiao) confirming that a draft AEE would be required before they are able to commence consideration and engagement activities on the proposal. A full copy of the AEE has been provided to Aukaha for review and feedback.
- There have been ongoing discussions with landowners of properties on Naseby-Ranfurly Road, and Ranfurly Back Road which is outlined in section 4.3 below.
- Key stakeholders (refer to list in section 3.0 below) were informed of the proposal via email including the local MP, Mayor, District and Regional Councillors, Fire and Emergency NZ, Department of Conservation, Forest and Bird, and many others. All of these key stakeholders were invited to engage with Helios to discuss the proposal and attend the community drop-in session.
- A community drop-in information session was held Thursday 5 October 2023 at the Maniototo Golf Club from 3pm-7pm. Approximately 35-40 people attended the informal drop-in information session. Two feedback forms were completed at the event, and that feedback has been summarised as well as verbal feedback in section 6.2 below.

More detail on the Helios stakeholder engagement process is provided below.

2. Engagement Strategy

The aim of undertaking stakeholder engagement was to inform and engage with the local community and stakeholders early, to ensure local people were aware of the proposal, had the chance to find out more and express any initial views well ahead of a formal resource consent application.

Helios's key objectives were to:

- Inform the local community and key stakeholders of the proposal and to ensure they heard about it from the landowner and developer first and directly.
- Provide accurate information about the proposal and solar energy generation. This is especially important given large-scale solar farms are relatively new in New Zealand (but not globally)
- Provide information in several formats (brochure, information boards, website, conversation)
- Answer queries regarding the proposal specifically, and solar technology more generally
- Provide an opportunity for the local community and key stakeholders to provide their opinions about the proposal; and
- Take on board feedback from the local community in shaping the proposal.

3. Engagement with Mana Whenua

Te Rūnanga o Moeraki, Kāti Huirapa Rūnaka ki Puketeraki, Te Rūnanga o Ōtākou and Hokonui Rūnanga are mana whenua within the Otago region.

Aukaha is a mana whenua-owned consultancy that Helios have engaged with. Aukaha are owned by five papatipu rūnaka:

- Te Rūnanga o Waihao
- Te Rūnanga o Moeraki
- Kāti Huirapa Rūnaka ki Puketeraki
- Te Rūnanga o Ōtākou
- Hokonui Rūnanga

The Aukaha team works across Otago providing a range of services including resource management and planning on behalf of Kāi Tahu as a Treaty Partner. Aukaha has protocols with the Otago Regional Council and all district councils in Otago, which set out the process for facilitating Kāi Tahu engagement in the councils' resource consent and plan change processes. Aukaha are the relevant organisation to consult with the relevant rūnaka on behalf of consent applicants who are seeking written approval or feedback on their proposed activities.

In July 2023 Helios formally applied to Aukaha's 'consent application process' and provided an overview of the project and preliminary plans. Correspondence has been ongoing, with the most recent from Kate Timms-Dean (Aukaha General Manager Mana Taiao) confirming that a draft AEE would be required before they are able to commence consideration and engagement activities on the proposal. A full copy of the AEE has been provided to Aukaha for review and feedback.

Helios is committed to open and transparent communication with Aukaha and Kāi Tahu throughout the Project, and our project's development will be guided by ongoing discussions.

4. Engagement with Key Stakeholders

4.1 Central Otago District Council

Planning

The first pre-application meeting was held in person on 14 June 2022 with Ann Rodgers (Principal Policy Planner) and Louise van der Voort (General Manager Planning). Their feedback of note included the following (without prejudice):

- Supportive of the idea of solar in principle noting that the development format removes some the usual consenting challenges, notably:
 - Land holdings don't need to be fragmented / subdivided to achieve the development and land can be returned to agriculture at the end of the development (not permanent modification)
 - Land around the panels can continue to be grazed.
 - Has sustainability advantages – and related to this Ms. van der Voort was interested in the idea of significant generation potential. Ms. Rodgers also acknowledged the benefits of being able to maintain sheep grazing.
 - Not a high visual impact relative to other formats – notably wind which CODC have recent experience with
- Suggested projects with positive sustainability impacts are 'generally' supported in the district, and the District Plan.

- Overall landscape issues were noted as the key environmental effect to overcome, whether applications are located in or out of Outstanding or Significant Natural Landscapes or Features. Noted that landscape assessments (including glint and glare) will be required.
- The primary rule trigger will be in Chapter 13 (district wide infrastructure rules) with solar being defined as a “power generating” activity with a discretionary activity status.
- Notification – noted that this will be assessed on its merits.

On 8 November 2023, a second pre-application meeting was held with Ann Rodgers and Adam Vincent (Intermediate Planning Officer) to provide an overview of the progress of the project, discuss and confirm the required technical assessments, and timing of lodgement of the resource consent application. The main feedback from CODC provided without prejudice was:

- The technical assessments to accompany a planning application were confirmed as being:
 - Acoustic
 - Ecology
 - Landscape and Visual
 - Glint and Glare
 - Integrated Transport
- Helios confirmed an assessment against the National Policy Statement for Highly Productive Land will be included in the application due to the presence of very small areas of LUC 3 soils on the eastern and south eastern boundaries.
- A report from a suitably qualified specialist is required to address the transformer and inverter oil and outline how any potential effects could be managed. Report should specifically cover the risk of oil spill and risk of combustion.

The lodged resource consent application is consistent with the pre-application feedback provided by Central Otago District Council.

Paula Penno, Communications and Engagement Manager

Helios provided Paula with a copy of the Engagement Action Plan to seek feedback on any additional key stakeholders that Helios should engage with. Paula's feedback was:

- The Engagement Action Plan looked good and she thought the key stakeholders identified were covered well.
- Good to see Naseby Vision included as they have good connection with the Naseby community.
- Liked that the community drop-in session goes into the evening as a number of people work in Ranfurly and further afield so this will give them an opportunity to pop in on their way home.
- Suggested advertising the community drop-in session to the wider Mānīatoto community via The Burn radio station (based in Ranfurly) as an option as well as Positively Maniototo (but unsure of timing working given it's produced on a six-weekly rotation)

Peter Kelly (Chief Executive), Tim Cadogan (Mayor), Neil Gillespie (Deputy Mayor), Stuart Duncan (Mānīatoto ward Councillor)

An introductory email with letter and brochure was sent on 20 September 2023 with an offer to meet in person, and invitation to attend the community drop-in information session.

Nick Lanham, Economic Development Manager

An email was sent to Mr Lanham on 26 September 2023 along with a brochure. The purpose of the email was to invite him to the community drop-in session. Mr Lanham did attend the community drop-in session and spoke to Sarah Brooks (Helios Energy) to understand details of the construction period, number of staff required and potential opportunities to utilise local suppliers. Helios will

continue discussions with Mr Lanham prior to the construction period to understand how to facilitate positive local economic benefits.

4.2 Otago Regional Council

Planning

Pre-application communications with Otago Regional Council occurred via email in August 2023 where Helios reached out detailing the project and seeking feedback on an initial planning assessment against the provisions of the Regional Water Plan.

Helios will be submitting a resource consent application to Otago Regional Council as detailed design progresses. Based on our current understanding regional consent will be required for land disturbance and distance of structures to a wetland.

The following feedback was provided by Zoe Flockton (Consents Public Enquiries team) from Otago Regional Council on 3 August 2023:

- There are a few water courses around the area including the Hog Burn River. As a result, the Regional Plan: Water (RPW) will be relevant. If the activity can comply with the distances and all of the criteria specified in the relevant permitted activity rule, then no consent will be required.
- The minor earthworks proposed are unlikely to trigger the residential earthworks rule in the RPW as the activity does not meet the definition of earthworks for residential development.
- There is a significant indigenous fish habitat for brown trout around this area. A screenshot was provided to identify the location of this identified area in relation to the area of Ranfurly-Naseby Road. In the attached link to the RPW, this outlines the schedule of natural values: <https://www.orc.govt.nz/media/1247/schedules-1.pdf>
- The NES-FM will be applicable if you are going to work within the vicinity of natural inland wetlands. As you are yet to decide on a way forward with this in relation to possible setback areas, ORC has offered to provide comments on any solutions you come up with.
- Offer of a formal pre-application meeting

Richard Saunders, Chief Executive and Councillors Robertson, Kelliher, Forbes and Laws

A letter outlining the Project and invitation to attend the community drop-in session was sent on 20 September 2023 to Richard and Councillors Gretchen Robertson (chair), Gary Kelliher, Alexa Forbes, and Michael Laws. Richard acknowledged the letter and said he would pass onto the Councillors. Councillors Gretchen Robinson and Alexa Forbes also acknowledged receipt of the letter.

4.3 Other Key Stakeholders

The table below summarises additional key stakeholders Helios has engaged with throughout the preparation of the resource consent application.

Organisation	Method of Contact	Date of Contact	Summary of Consultation
Transpower	Various	Ongoing since May 2022	Helios and its external Transmission engineering consultants Beca have been working with Transpower since early 2022 to explore the feasibility of a connection to their Naseby substation to the north-west of the Project site. On 26 May 2022, Helios requested via email (with follow up later on 31 May 2022) to formally investigate the connection of the proposed Project at this location, and on the 29 November 2022, Helios submitted a formal Generation Connection Application under Transpower's new Connection Management Framework which was subsequently accepted as complete on 15 December 2022. On 26 April 2023, Helios and Transpower executed a Services Agreement and the connection application for the Project moved into 'Investigation Stage' with the appointment of a dedicated Transpower project manager. Investigations will include formal validation of the connection methodology, detailed grid studies and execution of a Works Agreement with Transpower for their aspect of the Project connection works within Transpower's Naseby substation compound. A detailed investigation will confirm any works required within the Naseby substation and these will be subject to a separate resource consent application (if resource consent is required).
PowerNet	Various	July 2023 - ongoing	Helios has been in contact with Powernet since July 2023 to further understand the local electricity distribution assets.
Department of Conservation Sarah Owen Marie Long	Email	20 September 2023	An introductory email with letter and brochure was sent with an offer to meet in person, and invitation to attend the community drop-in information session.
Forest and Bird Chelsea McGaw	Email	20 September 2023	An introductory email with letter and brochure was sent with an offer to meet in person, and invitation to attend the community drop-in information session. Chelsea McGaw was provided with this letter and has provided feedback to Helios via email. She has identified a point of concern with the project will be the wetlands on site, depending on their ecological value. She has asked whether an ecological survey will be undertaken. Helios has responded to confirm: • The engagement of Boffa Miskell to undertake ecological surveys for the proposal and a full Ecological Impact Assessment will accompany the future resource consent application. • Preparation of the EIA is underway, and Helios will be working closely with Boffa Miskell through the design of the solar farm, including through undertaking vegetation surveys to obtain

			detailed information about any potential wetland areas onsite. Through site design we have prioritised providing suitable setbacks from wetlands onsite, as agreed with Boffa Miskell. The ecologists are also undertaking a nesting bird survey and general bird survey in October 2023. The executive summary of the EIA was provided to Forest and Bird on 14 March 2024.
Naseby Vision	Email	20 September 2023	An introductory email with letter and brochure was sent with an offer to meet in person, and invitation to attend the community drop-in information session.
Leolabs	Email Letter	20 September 2023	An introductory email with letter and brochure was sent with an offer to meet in person, and invitation to attend the community drop-in information session. A hard copy letter was also sent to their lawyers.
Federated Farmers Otago Luke Kane	Email	20 September 2023	An introductory email with letter and brochure was sent with an offer to meet in person, and invitation to attend the community drop-in information session.
Maniototo Community Board	Email	20 September 2023	An introductory email with letter and brochure was sent with an offer to meet in person, and invitation to attend the community drop-in information session.
Business South Incorporated Mike Collins	Email	20 September 2023	An introductory email with letter and brochure was sent with an offer to meet in person, and invitation to attend the community drop-in information session.
Maniototo Lions Club Tony O'Neill	Email	20 September 2023	An introductory email with letter and brochure was sent with an offer to meet in person, and invitation to attend the community drop-in information session.
Tiaki Maniototo Janine Smith	Email	22 September 2023	An introductory email with letter and brochure was sent with an offer to meet in person, and invitation to attend the community drop-in information session.
Central Otago Environmental Society Matthew Sole	Email	20 September 2023	An introductory email with letter and brochure was sent with an offer to meet in person, and invitation to attend the community drop-in information session. Matthew acknowledged receipt of the email and advised they will be discussing it and hopefully have someone attend the drop-in session.
Fire and Emergency New Zealand (FENZ)	Phone call Email Video meeting	Ongoing since July 2023	Helios has spoken with James Knapp (Senior Advisor Risk Reduction) and Bobby Lamont (Group Manager) regarding the solar farm proposal, and background information and a site layout plan was provided via email initially on 20 July 2023. Helios met with James and Bobby (as well as their Beca Planners) via video meeting on 8 August 2023. The feedback from this meeting was as follows: - Helios needs to consider adequate access to the site, suitable turnaround and hardstand areas for trucks - FENZ needs to know what Helios would have available onsite in a response, what structures

			would want to be protected, or whether FENZ are just looking at protecting exposure to other properties as opposed to saving structures. Would like more information about what a fire incident would look like and the measures Helios and/or contractor during construction would have in place. This information would be good to train up FENZ staff so they have an understanding of the solar farm components and activity. • Helios should consider plants with low flammability. A list of suitable species capable of growing in the locality was provided by James. • The FENZ Code of Practice for water supply is what Helios needs to take into account when calculating the amount of onsite water supply if proposed. The Code of Practice is quite technical, so they are happy to work with Helios to help determine what amount of water supply could be adequate once the battery type/specification is more firmed up. FENZ identified it's not feasible to store millions of litres of water onsite if it's not warranted based on the proposed incident response and risk acceptability if a fire were to occur • Overall, FENZ appreciated the early engagement and would be happy to work with Helios on fire safety measures including the development of a Fire and Emergency Management Plan, and receiving information that could help train their responders for the solar farm site. An email to Bobby and James was sent on 20 September 2023 with a brochure and invitation to attend the community drop-in information session. Neither James nor Bobby was available to attend. Bobby requested an Information Pack to be able to be shared with the local brigades. Helios prepared the following documents and provided these on 27 September 2023: • Solar and Fire Risk frequently asked questions sheet (refer to <i>Appendix B</i>) – the frequently asked questions Helios receives on fire and fire contamination risk, and our response. • Lithium-Ion Battery Emergency Response Guide (Tesla) – this guide is useful to understand the specs and what to do with the batteries in an emergency. Refer to Section 5 Firefighting measures. Whilst we have not yet confirmed we will be using Tesla batteries; we expect most batteries to be similar. • A poster advertising the community drop-in session.
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			• A brochure we've put together to provide an overview of the solar farm project. Further email correspondence with Bobby regarding fire safety measures and onsite water storage has resulted in this most recent feedback being provided by Bobby on 27 October 2023: • FENZ wants to know about critical risks that would impact us during operations and any hazards on the site and how they are managed by the company. Such as how things would be isolated if there was a fire, how we would confirm things have been isolated etc. • As well as any dangerous goods on site (if any), what they are, how they are managed during BAU and how they would be managed in an emergency. If you do have dangerous goods that meet the threshold for a MHF (Mass Hazard Facility) then you would be required by WorkSafe to complete an Emergency Plan which would be submitted to us for comment. • Other things we would like to know might include: 1. How the site would be evacuated in an emergency. 2. Any risks on the site during construction, what they are and how they are managed and what control measures they would have to mitigate risks such as working in confined spaces, working at heights, hot work. 3. How we could obtain specialist advice during an emergency 4. Overhead Hazards 5. Procedures for dealing with things such as damaged panels or other specialised equipment. • Overall, we should know about any hazards or potential hazards, how they are managed during BAU and how they would be managed in an emergency. The main thing is that our responders are safe and that the company has a plan in place to deal with situations that could arise other than just calling 111 and hoping that FENZ will have the resources and specialist knowledge to deal with emergency situations. • All the info about ERP's can be found on the FENZ website https://fireandemergency.nz/hazardous-substances/emergency-response-plans/
Jacqui Dean, Labour MP for Waitaki (outgoing)	Meeting	2 August 2023	Helios met with Jacqui in July 2023 to introduce Helios and the project.

		20 September 2023	When the project was announced publicly, a copy of the brochure was sent with an invitation to attend the community drop-in information session.
Miles Anderson, National MP for Waitaki (incoming)	Letter/email	2 November 2023	A short introductory letter was emailed to Miles, introducing Helios and the project within his electorate.

5. Adjoining Landowners

Initial phone calls to the four landowners closest to the solar farm were undertaken by Helios on 18 September 2023 introducing the project, and an offer for a face-to-face meeting in advance of the community drop-in session. A site layout plan and brochure were then emailed to the landowners. The landowner also dropped a copy of the brochure to the owners of 5 Bypass Road ahead of the community drop- in information session.

Helios is committed to ongoing discussions with adjoining landowners and has proactively responded to questions as they have arisen following the community drop-in information session.

As a result of visual impact concerns raised by two adjoining landowners, Helios engaged landscape architect consultants Boffa Miskell to visit the four closest residential dwellings on 15 November 2023 to take photographs from their sites to understand their views to the Project Site, as well as understand if the landowners have any planting screening preferences to incorporate into the landscape and visual assessment and landscape/planting plan.

Specific further engagement with landowners has occurred, as summarised in the below table.

Address	Summary of Engagement to date
512 Ranfurly-Naseby Road	Phone call to introduce the Project. In person meeting 5 October 2023. Follow up discussions to arrange a landscape site visit to the property and to discuss landscaping on boundaries.
366 Ranfurly Back Road	Phone call to introduce the Project Attendance at community drop-in information session, sit down discussion with Jeff Schlichting (Co-Founder and Director, Helios Energy) and Sarah Brooks (Senior Environmental Planner, Helios Energy). Follow up discussions to arrange a landscape site visit to the property and to discuss landscaping on boundaries.
788 Ranfurly Back Road	Phone call to introduce the Project. In person meeting 5 October. Follow up discussions to arrange a landscape site visit to the property and to discuss landscaping on boundaries.
146 Ranfurly-Wedderburn Road	Phone call to introduce the Project. Landowner confirmed there were no further questions.
5 Bypass Road	Project landowner dropped off a copy of brochure and verbal invitation to community drop in information session. Attendance at community drop in information session, sit down discussion with Jeff Schlichting (Co-Founder and Director, Helios Energy) and Sarah Brooks (Senior Environmental Planner, Helios Energy) . Follow up discussions to arrange a landscape site visit to the property and to discuss landscaping on boundaries.

6. Local Engagement

6.1 Information Brochure Mail Drop

A brochure introducing the project was emailed or dropped to landowners of adjacent properties on Naseby-Ranfurly Road and Ranfurly Back Road. The brochure provided an introduction to the project and to Helios, a draft site layout plan, and details on how to contact the Helios team for further information. A copy of the brochure is included in *Appendix A*.

6.2 Community drop-in information session

To engage with the local community and to inform them of Helios's intended plans and gain feedback on the proposal, Helios organised a community drop-in information session. This was held at the Maniototo Golf Club on Thursday 5 October 2023. This event was structured as a casual drop-in session where the community could visit any time between 3pm-7pm.

At the event the following information was available:

- Display boards provided information about the proposal including an indicative layout and information about the key components of a solar farm.
- Feedback forms.

Representatives from Helios and the project landowner were available to provide information and answer questions, as well as take note of any concerns raised.

There were approximately 35 attendees over the four-hour session. Two feedback forms were completed, both noted support for the project.

Helios received largely positive feedback, with attendees being a mix of local farmers and residents and Ida Valley, farm consultants wanting to know more about solar so they could advise clients on similar proposals, suppliers from the South Island coming to discuss opportunities to work on the project (i.e., cabling, hospitality).

Questions were largely on housing workers; how long construction would take and whether the infrastructure at Naseby substation could take the additional power/ what happens in the event Tiwai closes.

It was a resounding positive event with the exception of four adjoining landowners who provided verbal feedback primarily on concerns about visual impact and glint and glare, and who asked a range of questions generally on solar. Discussions have continued with these landowners post the consultation event.

7. Media and website

Helios provided a media release announcing the project, the seeking of resource consent and the date/time of the community drop-in information session to the following media outlets to enable this to be communicated to the community:

- Otago Daily Times
- The News
- Energy News
- Positively Maniototo

Helios' Communications Advisor Jonathan Hill has been fielding enquiries from media outlets, and several news articles have been published as a result.

Helios will continue to work with the media should they have any questions as the resource consent process progresses.



A project website with information on this project is also live on the Helios website – Helios | Helios Energy - Maniototo Project.

8. Conclusion

Helios committed to early engagement with the local community to inform them of the proposed solar farm on Naseby-Ranfurly Road, on the Mānīatoto Plain. The intention is to listen to feedback, thus enabling due consideration to be given to matters of importance to the local community.

It was anticipated that there would be questions and concerns raised, given how new solar developments are to Aotearoa. Helios has been transparent, accessible and direct in its engagement with the local community and, overall, has received a generally positive response.

We have responded to the feedback received in several ways, including responding directly to queries at the October community drop-in information session and meetings with key stakeholders prior to and following the community event. We have also addressed the comments raised through the technical assessments which will accompany the planning application and in the design of the solar farm and associated landscaping plan. Feedback from the closest neighbour has been incorporated into the planting plan, with an additional line of exotic shelterbelt being included for the length of the boundary.

Appendix A: Maniototo Plain Project Overview Brochure

Proposed Solar Farm

Ranfurly-Naseby Road, Maniototo Plain

Community Information

Helios Energy is proposing a solar farm between Naseby and Ranfurly, on the Maniototo Plain in Central Otago. This brochure provides an overview of the project, as well as contact details for you to provide feedback or to ask any questions.

Solar generation projects are becoming more common in New Zealand as we remove fossil fuels from our energy mix and require more clean, renewable electricity to power our economy.

Our selected site has a strong solar resource and can be readily connected into the electricity transmission grid. The solar farm will be located on approximately 660 hectares of land and will generate enough clean electricity to power the equivalent of 70,000 homes annually.

We are taking great care in the planning phase to develop a world-class project that provides clean, renewable electricity for the region and the country while minimising impacts and protecting the character and heritage of the area.

Who is Helios?

Helios Energy is a Kiwi company established in early 2020 to develop large-scale solar projects across New Zealand.

We are led by renewable energy specialists from New Zealand and internationally. We bring extensive experience and a track record of success in the commercial development and delivery of renewable power projects, including over 50 large-scale solar projects globally.

We are committed to delivering responsible, high-quality solar energy projects for New Zealand's future generations and to building genuine partnerships with local communities where our projects are based.

Indicative plan of proposed solar farm

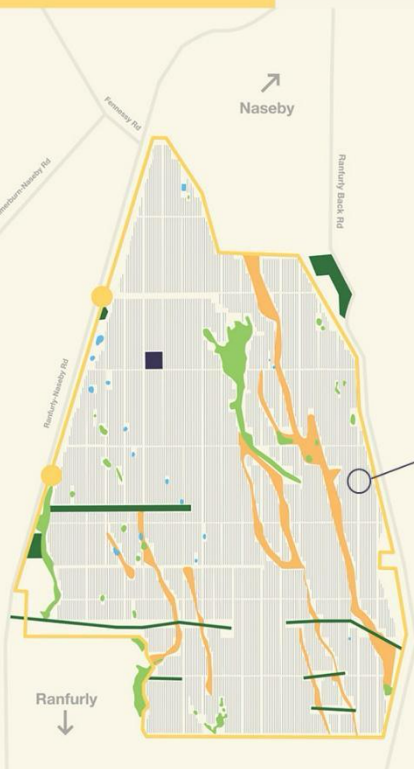
Location and land

The proposed development is on 660 hectares of land, off Ranfurly-Naseby Road.

Helios will lease land for the solar farm which enables landowners to diversify their farming operations while generating clean electricity.

Land will remain in farming

The solar farm will be grazed by sheep under and around the solar panels.



Solar farm design

Approximately 60% of a solar farm is open pasture land and new planting, as spacing is required between the rows of panels.

We have worked with ecologists to make sure panels are suitably set back from wetlands, streams, and other natural features.



Solar panels

The solar panels slowly track the sun throughout the day to capture as much solar energy as possible.

Protecting soil and water

Solar farms produce no emissions and have no impact on the soil or groundwater. Rain can sufficiently clean the panels.



Construction and connection

Solar farms are relatively quick to build. Construction of the solar farm will take approximately 24 months. The project will connect into Transpower's existing Naseby substation at Fennessy Road.

We will use local contractors and suppliers in the construction phase wherever possible.

Site selection

We've selected unirrigated land which is flat and located well outside of the Naseby and Ranfurly townships.

New planting

As part of the project we will develop a detailed planting plan for the solar farm incorporating local feedback. Solar panels are low-lying with a maximum height of 2.8 metres and new planting will be established to screen the solar farm.

Quick Facts



300 megawatts of clean electricity



The lowest impact source of renewable energy



Complementary to continued farming operations



Enough to power ~70,000 homes annually



Quiet, sustainable and safe energy production



Additional planting to increase biodiversity and provide screening

Get in touch

Solar farms are new to New Zealand but are common internationally as a safe, passive way to generate clean energy.

Helios will answer any questions about this project openly and honestly. We're committed to making this a development that locals are proud to have in their district.

If you have any questions about Helios or solar farms more generally, there is more information available on our website www.heliosenergy.co.nz. Please feel free to get in touch with us directly on projects@heliosenergy.co.nz and we will come back to you.

Map Legend

- Proposed solar farm site boundary
- Substation and batteries
- Indicative solar panels
- Sloped areas - no panels installed
- Existing vegetation retained
- Wetland area
- Existing constructed pond
- Main access



Appendix B: Solar and Fire Risk frequently asked questions sheet

Frequently Asked Questions

As we've been advancing solar projects across different parts of the country, certain questions have come up consistently. Here are some answers to these frequently asked questions:

Is solar safe?

Yes. Completely. Large-scale solar developments have been common around the world for decades. They cause no harm to people's health. They do not produce emissions or discharge pollutants into the natural environment.

What is the typical lifespan of a solar farm and what happens at the end of a solar farm's life?

At the end of a solar farm's operational life (~35 years) the site can readily be returned back to its original state by removing structures and equipment from the site. Materials will be reused or taken to an appropriate location for recycling or disposal. The site will be reinstated to its pre-construction condition.

Who pays for decommissioning?

We do. There's no liability on the taxpayer or ratepayer. Our project land agreements ensure funds are set aside specifically to cover removal of the solar farm equipment and reinstatement of the site.

Will solar farms create glare?

Solar panels are designed to absorb sunlight rather than reflect it. Solar panels incorporate anti-reflective coatings to maximise the absorption of energy. Glare is not a safety issue, as evidenced by the prevalence of solar farms being developed inside and around airports in New Zealand and overseas.

What about the impact on views?

The panels we use are typically no taller than 2.8 metres above the ground, so the visual impact is low, especially when compared to other renewables. We develop solar farms in flat areas where they can be readily screened from view by tailored boundary planting. Of all large-scale renewable energy technologies, solar farms have the lowest visual impact.

Will solar farms affect property values?

There is little evidence internationally of solar farms negatively impacting property values. Once installed, solar farms are low-lying, quiet, produce no emissions and can be effectively screened with boundary planting.

Helios are developing high-quality solar projects and do not expect there will be a significant change in neighbouring property values.

How much water do they use?

Almost none. We are typically developing solar farms on unirrigated land. The solar panels have a non-stick surface, are rinsed by the rain and there is very little operational need for water use.



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Are the panels recyclable?

Yes. The solar industry is in its infancy here but 80 percent of a solar panel consists of aluminium and glass, which can be recycled. We expect specific solar panel recycling facilities will be established in New Zealand as the industry grows here, as is currently occurring in more mature solar markets like North America and Europe.

Do solar farms create a fire risk?

There is no increased risk of fire with a solar farm. Solar panels are not flammable. The components are encapsulated in glass and cannot support a fire. All major electrical components such as inverters and transformers will be containerised. Electrical wiring from panels to inverters is undergrounded.

All our projects are developed in consultation with Fire and Emergency New Zealand. There may be requirements for water to be stored at a site for fire control – for example, if the grass around the panels should catch fire (as is possible on any farm). Fire risk mitigation and associated measures form part of each detailed project design.

Are there increased flood risks with a solar farm?

No, there is no heightened flood risk. The panels are elevated with wide spacing and the ground beneath the panels is permeable farmland. Flood risk assessments are a part of initial site selection and will also inform detailed project design.

What about human rights considerations from where the panels are made?

We work with tier one suppliers of solar panels who are committed to ensuring the ethical production of solar panels for our sites. We engage on-the-ground experts to investigate supply chains, conduct research and provide documented assurance that panels are ethically sourced.

What about the local community?

We develop sites that we believe support the local community. Wherever possible we will use local skills, labour and contractors to build, operate and maintain the site. During construction there will be significant economic benefits for local suppliers. Helios is also developing a Community Trust model whereby local representatives will help determine how an amount of annual funding can be deployed to best support the initiatives of importance within the local community.



Helios



Fire risk and solar

Helios Energy is a grid-scale solar developer advancing solar farm projects across the country, including in both the North and South Islands.

With solar relatively new in New Zealand, one of the challenges we routinely encounter is around misunderstanding of solar's safety, including around its fire risk. In some cases we believe there is deliberate misinformation occurring around fire risk in solar developments.

We engage directly with FENZ, as a matter of course, on every solar development project we work on. Typically this engagement occurs in the preliminary design stages to ensure FENZ input on matters like truck turning circles, access to site and water storage.

Below are some of the questions we get asked around fire risk and our standard responses to them. We are sharing these FAQs with you a.) in the event they are helpful in preparing for questions you may be asked; and b.) to request any feedback on how we might provide more useful, objective information.

Helios tend to start any discussion around safety by stating that solar farms are proven to be entirely safe. Large-scale solar farms have become common around the world over the past two decades. They are passive, extremely quiet, can be well screened from view and have no negative impact on soil or water.

Solar is the lowest impact form of renewable energy, and our world needs much more of it as our planet increasingly struggles with the impacts of a changing climate.

Frequently asked questions around fire and fire contamination risk

Don't solar farms contain a range of heavy metal contaminants?

No. Modern solar panels are predominantly glass, aluminium and silicon. The supporting pillars are galvanised steel.

Silicon, glass and aluminium are non-toxic and inert. Every panel is also sealed and, on their own, individual panels generate very low levels of electricity. There are tiny trace amounts of lead in each panel as this is used in electrical soldering. This soldering is tightly sealed and is highly unlikely to exit the solar panel in any way.

Can solar panels self combust?

No. There is nothing in modern solar modules that is flammable.

Won't a solar fire generate a huge toxic plume?

No. A solar fire is highly unlikely and the vast majority of a panel's composition is inert and non-toxic.

**What about a grass fire on a solar farm?**

With or without a solar farm, grass fires are always possible. Each of the solar farms Helios are developing will continue to be grazed by sheep, which reduces the risk of grass fire, and the shade provided to the ground by the panels can help with moisture retention.

But there's plenty of web site content about solar fires

There have been fires at solar farms in different parts of the world over the years. Solar was an emerging technology 20 years ago but it is not any more. It is modern, safe and proven. One of the advantages of New Zealand adopting solar now is that it is using the latest, proven technology which is safer than the technology over the preceding decades.

What plans do you have to manage fires?

All Helios developments will have comprehensive fire management plans that will be developed in conjunction with, and signed off by, FENZ. This is a condition of seeking resource consent.

Where required, we will ensure there is water stored on site to extinguish a fire.

What about FENZ using toxic foam that will pollute the ground and water?

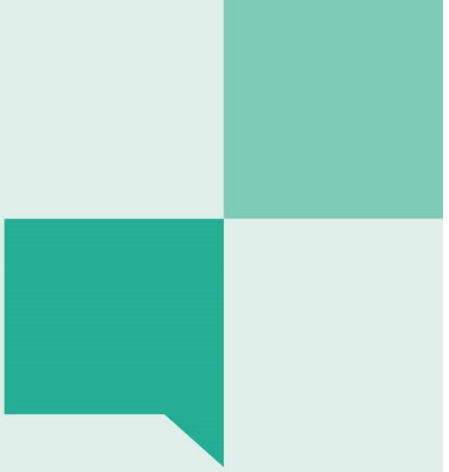
FENZ have not given us any reason to believe any chemicals would be needed in any fire suppression scenario. Ninety-five percent of Fire and Emergency's fire-fighting foam use is Class A foam, which is primarily a wetting agent and does not contain toxic chemicals.

Don't solar panels create 'heat islands' that make fire more likely?

Not really. Inside a solar farm, standing next to a panel, there may be a one or two degree Celsius increase in temperature. But the shade created by panels also makes a fire less likely. Studies have also found that any small heat island effect that may exist is limited to the areas within the solar farm and not beyond the site boundary.

But what about rooftop solar fires?

There have been a number of rooftop solar fires around the world over the last 20-30 years and it's important that rooftop solar is not confused with a solar farm. These rooftop fires were not started by the solar panels, but rather were typically caused by disconnection switches filling with water and arcing. These components are not used in modern solar farm installations.



Appendix 10

Hazardous Substance Assessment

Hazardous Substance Assessment

Naseby Solar Farm

Prepared for Helios Energy Limited

Prepared by Beca Limited

20 December 2023



**make
everyday
better.**

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Appendices

- Appendix A – Site Boundary
- Appendix B – Proposed Site Layout
- Appendix C – Safety Data Sheets

Revision History

Revision N°	Prepared By	Description	Date
0	Nicole Rubio	Draft Issue	13 December 2023
1	Nicole Rubio	Final Issue	20 December 2023

Document Acceptance

Action	Name	Signed	Date
Prepared by	Nicole Rubio		20 December 2023
Reviewed by	Sarah Shepherd		20 December 2023
Approved by	Mark Jacob		20 December 2023
on behalf of	Beca Limited		

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1 Introduction

Beca Limited (Beca) has been commissioned by Helios Energy Limited (Helios) to undertake a Hazardous Substance Assessment (HSA) for a proposed solar farm of up to 322 MWp located at 48 Ranfurly-Naseby Road, Naseby, Otago (referred to as 'the site'). Refer to **Appendix A** for the site boundary.

1.1 Relevance

Hazardous substances are defined and classified in the Hazardous Substances and New Organisms Act 1996 (HSNO). HSNO defines hazardous substances as any substance with one or more of the following intrinsic properties: explosiveness, flammability, a capacity to oxidise, corrosiveness, toxicity (including chronic toxicity), ecotoxicity, with or without bioaccumulation; or which on contact with air or water (other than air or water where the temperature or pressure has been artificially increased or decreased) generates a substance with any one or more of the listed properties. The Health and Safety at Work (Hazardous Substances) Regulations 2017 (HS Regulations), regulated by WorkSafe New Zealand, set minimum requirements for the management of these substances in the workplace.

The Resource Legislation Amendment Act 2017 (RLAA) removed the explicit function of regional and territorial authorities under Sections 30 and 31 to control the adverse effects of the storage, use, disposal and transportation of hazardous substances to ensure Resource Management Act 1991 (RMA) controls do not duplicate controls in HSNO and the HS Regulations. RLAA also introduced a procedural principle to ensure that council plans and policy statements include only matters relevant to the purpose of the RMA (ss18A).

While councils do retain a broad power under the RMA to manage hazardous substances through their plans and policy statements to achieve the purpose of the RMA and to carry out the function of integrated management of natural and physical resources in their region/district, this should only be exercised where the potential environmental effects are not adequately addressed by other legislation.

Schedule 19.14 of the Central Otago District Plan (CODP) sets out the rules related to hazardous facilities and the use, storage and disposal of hazardous substances. The quantity of hazardous substances to be used and stored will determine the consent requirements for the activity.

1.2 Documentation Reviewed

A list of substances proposed to be stored on the site, including hazardous substances, were provided by Helios for this assessment. As the design of the new facility has not been finalised, information about specific batteries will need to be confirmed by Helios as design progresses. In addition, the quantities of hazardous substances have been estimated by Helios at the current design stage and are considered conservative estimates.

1.3 Assumptions and Limitations

The proposed hazardous substance storage will have to comply with the HS Regulations. This report is not intended to review or replace specific considerations associated with the HS Regulations.

The assessment contained within this report is based on a review of provided information for the new facility. It is not possible to fully review potential environmental risks associated with the operation of the proposed site as it is not currently operational. Hence, the recommendations contained in this report are developed on corporate procedures put in place by Helios at their sites and must be confirmed for the new facilities prior to commissioning of the facility.

2 Description of Proposal

The proposal involves the construction and operation of a solar farm and associated battery energy storage system (BESS). It is proposed that the solar farm would connect directly at Naseby Substation via a single circuit 220 kV line. Refer to **Appendix B** for the proposed site layout received from the client.

The key elements of the proposal are:

- Two 150 MVA 33/220 kV step-up transformers within the central substation. The transformer units will have an oil containment facility.
- 32 Megapack 2 XL batteries located in the central substation with 90 33kV transformers.

3 Environmental Setting

3.1 Sensitive Land Use

The site is zoned in the CODP as ‘Rural Resource Area’ as shown on **Figure 3-1**. The site is currently used as grazing land. Surrounding area is also zoned Rural Resource Area.

The nearest residential dwelling is located 800m to the north of the site.

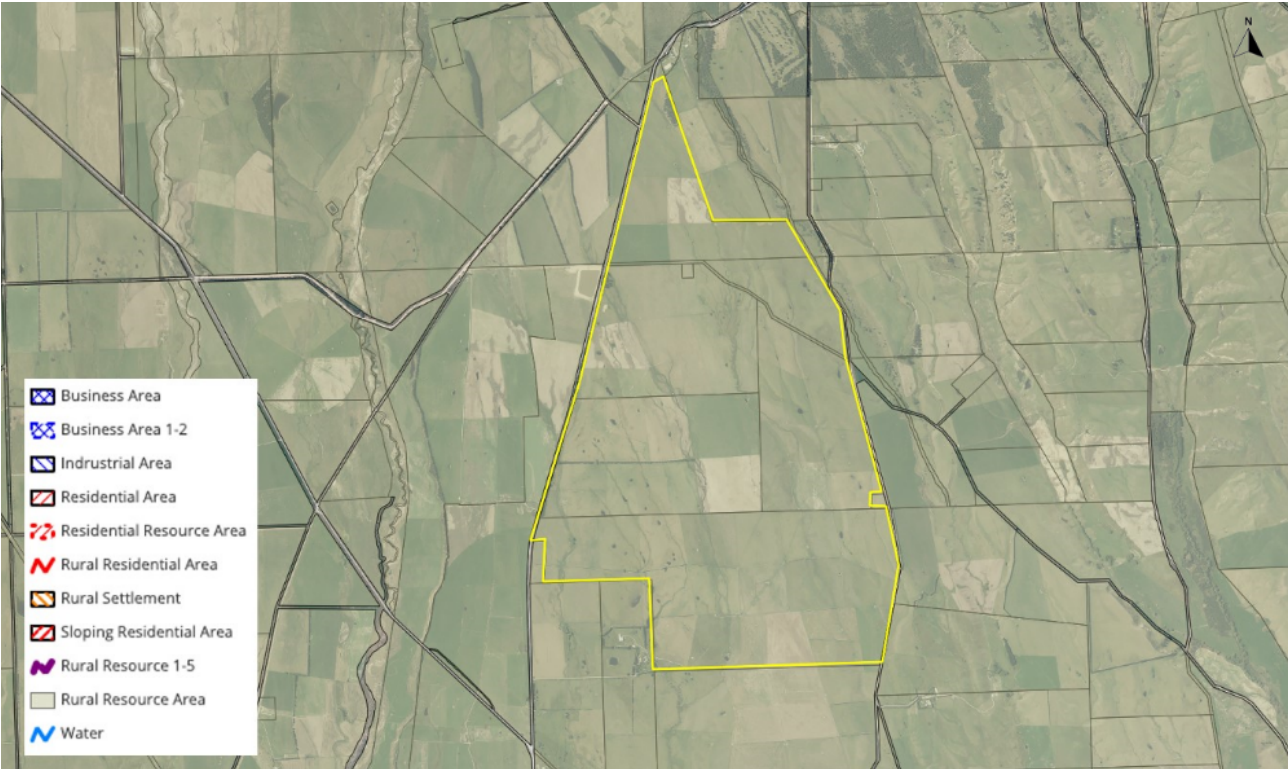
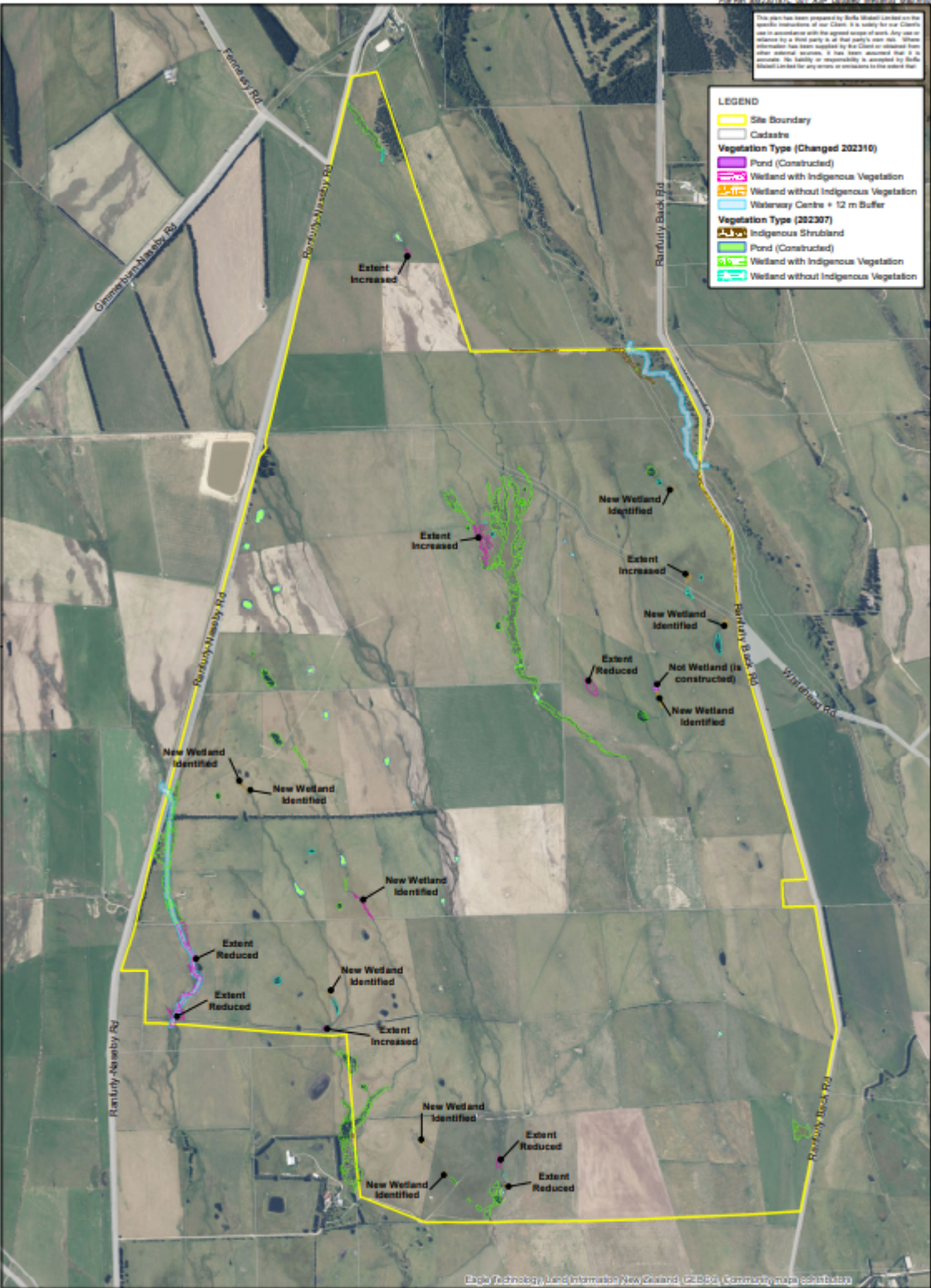


Figure 3-1. Zoning of the site (outlined in yellow) and the surrounding area (Source: Central Otago District Plan Geomaps).

3.2 Natural Receiving Environment

Waterways and wetlands have been identified on the site as shown on **Figure 3-2**. According to the Central Otago District Council and the Otago Regional Council (ORC) geomaps the site is not subject to any natural hazards including flood risk.

The site is not located within a groundwater protection zone as indicated by the ORC geomaps.



4 Reviewed Hazardous and Non-Hazardous Substances

The main hazardous substances that will be used and stored at the site have been provided by Helios and are set out in **Table 4-1Table** . The table details the substance type, maximum expected quantities, the corresponding HSNO and Globally Harmonised System (GHS 7) classification², and storage location for the hazardous substances at the site. The hazards classifications were identified from SDSs obtained from a general internet search. Refer to **Appendix C** for the SDSs.

Table 4-1. Potential hazardous substances used and stored at the site.

Substance	Max Quantities	HSNO Classification	GHS 7 Classification	Physical Form	Storage Location
Dimethyl Carbonate ³ (wt%: 10)	113,751 L	3.1B	Flammable liquids Category 2	Liquid	Electrolyte in 32 BESS
Ethylene Glycol (400 litres (L) per container)	12,800 L	6.1D	Acute toxicity, oral (Category 4)	Liquid	Coolant in 32 BESS
		6.9B	Specific target organ toxicity – repeated exposure, oral (category 2), kidney		
Transformer Oil ⁴	325,400 L	6.1E	Aspiration hazard Category 1	Liquid	107,600 L in two power transformers and 217,800 L in 90 inverter transformers ⁵
		9.1C	Hazardous to the aquatic environment chronic Category 3		

² In April 2021, New Zealand adopted the seventh revised edition of the Globally Harmonised System (GHS). A HSNO to GHS correlation table can be found at https://epa.govt.nz/assets/Uploads/Documents/Hazardous-Substances/GHS2/HSNO-GHS7_Correlation_Table.pdf

³ A range of electrolytes can be present depending on the specific BESS. This can include Ethylene Carbonate, Diethyl Carbonate, Ethyl Methyl Carbonate and Dimethyl Carbonate which as been used in Table 1. Dimethyl Carbonate was selected for the assessment as it is the most hazardous (flammable) to cover the worst-case scenario.

⁴ There are different types of transformer oils. Traditional mineral based transformer oils have class 6 and class 9 classifications. Modern ester-based transformer oils are not considered hazardous. As it is not yet known which kind of oil will be used, classifications associated with traditional transformer oils have been applied.

⁵ Total of 90 inverter transformers comprising of inverters around the site and the inverters associated with the BESS.

5 Resource Consent Requirements

Schedule 19.14 of CODP sets out the volumes of hazardous substances that are Permitted (P) (i.e. resource consent is not required) and Discretionary (D) activities when stored and/or used in hazardous facilities in the Rural Resource Area. **Table 5-1** identifies the activity status based on the volumes of hazardous substances (refer Table) and the CODP thresholds for the Rural Resource Area.

Table 5-1. Hazardous substances and quantities against HSNO classifications in Schedule 19.14 of the CODP.

Substance	Flammable Liquids	Health Hazards			Environmental Hazards
HSNO classification	3.1B	6.1D	6.9B	6.1E	9.1C
Dimethyl Carbonate	113,751 L	-	-	-	-
Ethylene Glycol	-	12,800 L	12,800 L	-	-
Transformer Oil	-	-	-	325,400 L	325,400 L
Total Quantity	113,751 L	12,800 L	12,800 L	325,400 L	325,400 L
Permitted activity quantity limit	10,000 L	No limit in Schedule 19.14 for Class 6			No limit in Schedule 19.14 for Class 9
Activity status	D	Not applicable			Not applicable

Note the classification of substances in Schedule 19.14 is inconsistent with the superseded HSNO classification. In the HSNO classification, Class 6 relates to health hazards however in Schedule 19.14 Class 6 is corrosives. In the HSNO classification, Class 8 relates to corrosives however in Schedule 19.14 Class 8 is Miscellaneous. There are no corrosives proposed to be stored.

Under Section 4.7.4 part ii of the CODP any activity that:

- a) “uses, stores or generates quantities of hazardous substances that exceeds the limits specified in Schedule 19.14, or
- b) requires a licence as an offensive trade within the meaning of the Third Schedule of the Health Act 1956, or
- c) provides less than 120% spill containment where hazardous substances are stored within 50 metres of any surface water body and within the Ettrick or Roxburgh groundwater protection zones as defined by the Regional Plan: Water,

is a discretionary activity.”

The following assessment is made against Section 4.7.4 part ii of the CODP:

- Storage of the proposed quantities of dimethyl carbonate exceeds the limit specified in Schedule 19.14.
- A solar farm and BESS are not an office trade limited in the Third Schedule of the Health Act 1956.
- The hazardous substances will not be stored or used within 50 m of a surface water body or above a groundwater projection zone.

Therefore, the storage of the proposed quantities of dimethyl carbonate (the electrolyte in BESS) is a **Discretionary Activity**. There are no limits on ethylene glycol or transformer oil.

6 Risk Assessment for Hazardous Substances

Risk is defined as the chance or probability that a person or the environment will be harmed or experience an adverse health effect if exposed to a hazard. A hazardous substance risk assessment involves the consideration of hazards related to the storage and use of hazardous substances and the potential for unintended exposure or release that may lead to a consequence of any people, infrastructure, or the environment.

The identified hazards related to hazardous substances above permitted limits are as follows:

- Fire and explosion

Based on the proposed substances to be used and stored, a qualitative risk assessment was undertaken. A hazard rating was applied to each substance based on the physical and chemical characteristics and quantities stored and used. Where the hazards would result in a negative consequence, design and management controls are considered and applied to lower the risk related to the hazard rating. Refer to **Table** for the identified hazards, risks and existing mitigation controls proposed to reduce the risk.

Table 6-1. Qualitative risk assessment.

Hazardous properties	Hazardous substance	Hazards Classification	Potential Receptors	Risks	Controls Proposed to minimise risks
Fire and explosion	Dimethyl Carbonate	- Flammable liquids (3.1B) - Flammable liquids Category 2	- People - Property	- Exposure to workers during fire/ explosion associated with thermal runaway or electrical fire. - Exposure to workers due to loss of containment of liquid or volatile hazardous substances.	- The substances are contained within the manufactured battery so there will be no day-to-day handling exposure under routine operation. - Training will be provided for site staff, operators and workers. - Appropriate Personal protective equipment (PPE) is mandatory when handling or in close proximity to the substances. - Emergency response plan will be in place in accordance with the HS Regulations. - BESS unit is to be disconnected from the rest of the system in the event of hazardous event (i.e., fire, short-circuit etc). Design to consider separation distance between BESS units. - Fire extinguishers will be placed in appropriate locations as required by the HS Regulations. - Separation distance between the BESS and public spaces is at least 350m. This is well above the minimum separation distance required by Schedule 12 of the HS Regulations. - Substances such as coolants to the batteries will be topped up if found leaking. It is unlikely that the coolant will require replacing as it is contained in a closed-circuit system. - BESS will comply with Underwriters Laboratory (UL) Standard 9540: Energy Storage Systems and Equipment.

Hazardous properties	Hazardous substance	Hazards Classification	Potential Receptors	Risks	Controls Proposed to minimise risks
					Spill kits will be located at appropriate points.

7 Design and Management Controls

Site design controls and environmental management plans should set out protocols and procedures that identify and manage the risks related to the storage and used of hazardous substances.

7.1 Site Design Controls

Based on the proposed storage of hazardous substances and information received from Helios, the facility will use appropriate measures to mitigate against the potential effects to people and the environment.

Each containerised battery unit typically consists of the following components:

- Battery modules
- Battery management system (BMS)
- Fire suppression system (FSS)
- Thermal management system (TMS)
- Auxiliary power supply.

The BMS is the most important control unit of the containerised system. It is able to manage the energy absorption and release of individual cells, monitor the TMS and low voltage power supply, including the cell voltage level, current and temperature. The BMS is split across two subcomponents, the master control box and sub control box. The master control box is located at the end of the containerised unit and each rack has a sub control box located at the base. The BMS is also connected to an uninterruptible power supply, external to the BESS container.

The FSS associated with the batteries has the key function of monitoring for abnormal conditions that may cause potential fire hazards (e.g., thermal runaway), through the detectors installed within the container.

Should a fire event arise, the FSS will engage fire suppression measures to keep the potential loss to a minimum. The FSS is independent of all systems within the container and has its own auxiliary power supply to continue to operate during the loss of external power. The FSS consists of the following components:

- Smoke detectors
- Temperature detectors
- Hydrogen (H2) detectors
- Active ventilation system including explosion-proof fan
- Fire control panel
- Aerosol fire suppression
- Dry pipe and hydrant interface
- Auxiliary uninterruptible power supply (UPS).

Each unit has a TMS, to maintain the battery cells within ideal operating temperature. The system utilises an ethylene glycol mixture as a heat transfer fluid. At one end of the container is a chiller unit and positive temperature coefficient heating element, with internal piping distributed across each module of the container.

7.2 Emergency Response Plan

An emergency response plan (ERP) will be prepared for the site. The plan will provide and maintain the emergency control structure, directions, and preparation and responses to minimise loss or harm in the event of an emergency. Providing the ERP to Central Otago District Council for information based on the actual layout of the BESS facility prior to commissioning is recommended as a condition of consent.

Consistent with Clause 5.11 of the HS Regulations which states: Fire and Emergency New Zealand (FENZ) may review an emergency response plan to—

- (a) assess whether the role proposed for the service is—
 - (i) achievable; and
 - (ii) consistent with the operational policies of the service; and
- (b) identify anything that may adversely affect service operations during an emergency.

Helios have engaged with FENZ and a summary of the engagement is provided in the associated Assessment of Environmental Effects (AEE) report. Helios will provide the ERP to FENZ for comment prior to submission to Central Otago District Council.

7.3 Inventory, SDS and Signage

Additional management controls include an inventory of all hazardous substances used and stored at the site. The site inventory shall be confirmed prior to the proposed facilities being commissioned and remain up to date. Signage will be used to indicate areas where hazardous substances are used and stored, and current SDSs for the hazardous substances shall be readily available to detail the risks associated with each chemical.

8 Conclusions

The site is zoned as Rural Resource Area in the CDDP. Hazardous substances will not be stored or used within 50 m of a surface water body or over a groundwater protection zone.

The proposed quantities of dimethyl carbonate contained in the batteries exceed the quantities permitted in a Rural Resource Area; therefore, resource consent is required for a Discretionary Activity. Based on the quantities of substances to be stored and the associated risk classification of the substances, the risks relate to fire and explosion, associated with the electrolyte in the batteries. The other hazardous substances, being coolant in the batteries and transformer oil, have no limits in the CDDP.

Potential risks are related to:

- Exposure to workers during fire/ explosion associated with thermal runaway or electrical fire.
- Exposure to workers due to loss of containment of liquid or volatile hazardous substances.

The potential effects on people and property can be managed through appropriate design and maintenance of the BESS, considering minimum separation distances from protected and public places, placing fire extinguishers in appropriate locations, and appropriate PPE for workers (as required by the HS Regulations).

Prior to commissioning the facility, it is recommended that:

- The final design of the BESS area and battery specifications is reviewed against the HS Regulations and signed off by a Compliance Certifier (where required).
- The hazardous substances inventories, hazardous substances location plan, current SDSs obtained, and maintenance schedules are updated by Helios to reflect the final site layout and design.
- An ERP be prepared for the site based on the actual layout of the BESS facility prior to commissioning and be submitted to Central Otago District Council for information as a condition of the consent.
- ERP is provided to FENZ prior to submission to Central Otago District Council.

Based on these recommendations being actioned prior to the commencement of the operations at the BESS facility, it is considered that the risks associated with the storage of hazardous substances at the new facility will be appropriately managed through the HS Regulations.

9 Limitations

This report has been prepared by Beca Ltd solely for Helios Energy Limited (Helios). Beca Ltd has been requested by the Client to provide an assessment of resource consenting requirements for use or storage of hazardous substances (Scope). The contents of this report may not be used by the Client for any purpose other than in accordance with the stated Scope.

This report is confidential and is prepared solely for the Client. Beca Ltd accepts no liability to any other person for their use of, or reliance on, this report, and any such use or reliance will be solely at their own risk.

Unless specifically stated otherwise in this report, Beca Ltd has relied on the accuracy, completeness, currency and sufficiency of all information provided to it by, or on behalf of, the Client or any third party, including the information listed above, and has not independently verified the information provided. Beca Ltd accepts no responsibility for errors or omissions in, or the currency or sufficiency of, the information provided. Publicly available records are frequently inaccurate or incomplete.

The contents of this report are based upon our understanding and interpretation of current legislation and guidelines (Standards) as consulting professionals and should not be construed as legal opinions or advice. Unless special arrangements are made, this report will not be updated to take account of subsequent changes to any such Standards.

This report should be read in full, having regard to all stated assumptions, limitations and disclaimers.



Appendix A – Site Boundary

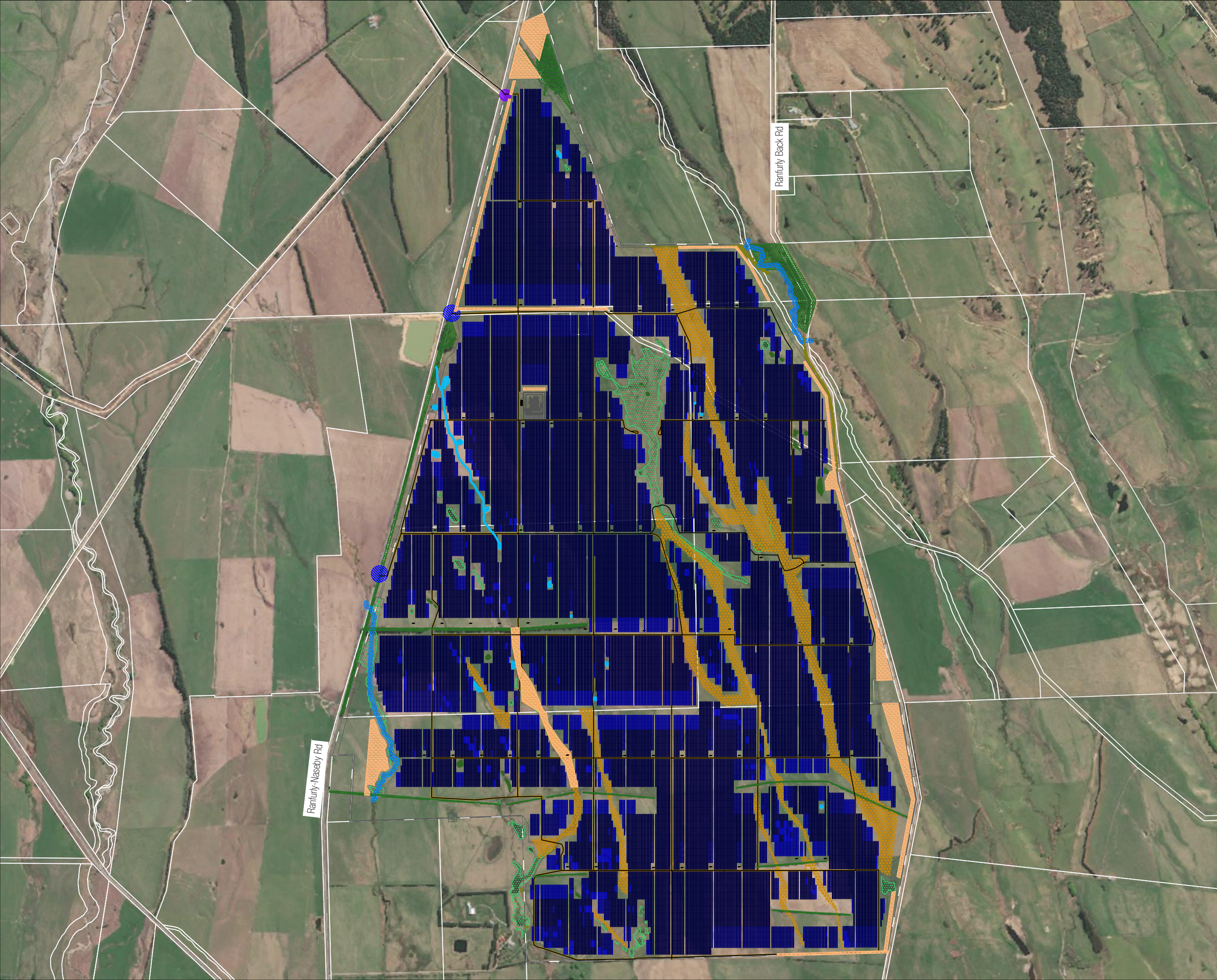


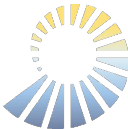


A- 1. Site plan sourced from the Naseby Design Basis Report prepared by Beca on 27 July 2023.

B

Appendix B – Proposed Site Layout





Helios

Legend:

	Site Boundary
	Site Fence
	Main Site Access Track
	Solar Panel Arrays
	High Slope No Build Areas
	Wetland with Indigenous Vegetation (5+m buffer)
	Wetland with Exotic Vegetation
	Existing Constructed Pond
	Inverter Stations
	Indicative Substation Layout
	Indicative Battery Energy Storage Units
	Existing Vegetation to be Maintained
	Primary Site Access Point
	Secondary Site Access Point
	New Screening Planting
	Existing Waterway

Project Details:

LATITUDE	-45.0613
LONGITUDE	170.1051
INTERCONNECTION VOLTAGE	220 kV
LEASED AREA	665.1 Ha
FENCED AREA	638.9 Ha
ARRAY AREA	597 Ha
FENCE LENGTH	11,692 m
DC CAPACITY	322.4 MWp
AC CAPACITY	306.6 MVA
CONNECTION CAPACITY	300 MW
DC/AC RATIO	1.05
MOUNTING	NEXTRACKER NX HORIZON-XTR
TRACKER ROWS	(3,955*104), (909*78), (809*52)
GCR	35.0%
TOTAL SITE COVERAGE	26.5%
MODULE	JKM615-66HL4M-BDV
MODULE CAPACITY	615 W
MODULE QUANTITY	524,290
STRING SIZE	26
INVERTER	PE HEM FS4202
INVERTER CAPACITY	4.20 MVA (@40C)
INVERTER QUANTITY	73

Project Name:

Naseby

Drawing Name:

Preliminary Layout

Revisions:

Version	Date	Created By	Reviewed By	Description & Notes
0	21/11/2023	JW	DR	Initial Release

Scale:

1:375

Date:

21/11/2023

Revision Number:

0





Appendix C – Safety Data Sheets

SAFETY DATA SHEET

Version 6.3
Revision Date 08.09.2022
Print Date 05.12.2023

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifiers

Product name : Dimethyl carbonate

Product Number : 517127
Brand : Sigma-Aldrich
CAS-No. : 616-38-6

1.2 Other means of identification

DMC

1.3 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : For R&D use only. Not for pharmaceutical, household or other uses.

1.4 Details of the supplier of the safety data sheet

Company : SIGMA-ALDRICH NEW ZEALAND CO.
PO Box 106-406
1143 AUCKLAND
NEW ZEALAND

Telephone : 0800 936 666
Fax : 0800 937 777

1.5 Emergency telephone

Emergency Phone # : 0800 928 888 (NZ)
+64 9 801 0034 (Int'l CHEMTREC)

SECTION 2: Hazards identification

2.1 GHS Classification

Flammable liquids (Category 2), H225

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 GHS Label elements, including precautionary statements

Pictogram



Signal Word : Danger

Hazard statement(s)
H225 : Highly flammable liquid and vapor.

Precautionary statement(s)

Prevention
P210 : Keep away from heat, hot surfaces, sparks, open flames and other ignition sources. No smoking.

P233	Keep container tightly closed.
Response P303 + P361 + P353	IF ON SKIN (or hair): Take off immediately all contaminated clothing. Rinse skin with water.
P370 + P378	In case of fire: Use dry sand, dry chemical or alcohol-resistant foam to extinguish.
Storage P403 + P235	Store in a well-ventilated place. Keep cool.
Disposal P501	Dispose of contents/ container to an approved waste disposal plant.

2.3 Other hazards - none

SECTION 3: Composition/information on ingredients

Substance / Mixture : Substance

3.1 Substances

Synonyms : DMC

Formula : $C_3H_6O_3$
Molecular weight : 90.08 g/mol
CAS-No. : 616-38-6
EC-No. : 210-478-4
Index-No. : 607-013-00-6

No components need to be disclosed according to the applicable regulations.

For the full text of the H-Statements mentioned in this Section, see Section 16.

SECTION 4: First aid measures

4.1 Description of first-aid measures

General advice

Show this material safety data sheet to the doctor in attendance.

If inhaled

After inhalation: fresh air.

In case of skin contact

In case of skin contact: Take off immediately all contaminated clothing. Rinse skin with water/ shower.

In case of eye contact

After eye contact: rinse out with plenty of water. Remove contact lenses.

If swallowed

After swallowing: make victim drink water (two glasses at most). Consult doctor if feeling unwell.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media

Water Foam Carbon dioxide (CO₂) Dry powder

Unsuitable extinguishing media

For this substance/mixture no limitations of extinguishing agents are given.

5.2 Special hazards arising from the substance or mixture

Carbon oxides

Combustible.

Pay attention to flashback.

Vapors are heavier than air and may spread along floors.

Development of hazardous combustion gases or vapours possible in the event of fire.

Forms explosive mixtures with air at ambient temperatures.

5.3 Advice for firefighters

In the event of fire, wear self-contained breathing apparatus.

5.4 Further information

Remove container from danger zone and cool with water. Prevent fire extinguishing water from contaminating surface water or the ground water system.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Advice for non-emergency personnel: Do not breathe vapors, aerosols. Ensure adequate ventilation. Keep away from heat and sources of ignition. Evacuate the danger area, observe emergency procedures, consult an expert.

For personal protection see section 8.

6.2 Environmental precautions

Do not let product enter drains. Risk of explosion.

6.3 Methods and materials for containment and cleaning up

Cover drains. Collect, bind, and pump off spills. Observe possible material restrictions (see sections 7 and 10). Take up with liquid-absorbent material (e.g. Chemisorb®). Dispose of properly. Clean up affected area.

6.4 Reference to other sections

For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Advice on protection against fire and explosion

Keep away from open flames, hot surfaces and sources of ignition. Take precautionary measures against static discharge.

Hygiene measures

Change contaminated clothing. Wash hands after working with substance.

For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Storage conditions

Keep container tightly closed in a dry and well-ventilated place. Keep away from heat and sources of ignition.

Air sensitive.

Storage class

Storage class (TRGS 510): 3: Flammable liquids

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Ingredients with workplace control parameters

Contains no substances with occupational exposure limit values.

8.2 Exposure controls

Appropriate engineering controls

Change contaminated clothing. Wash hands after working with substance.

Personal protective equipment

Eye/face protection

Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU). Safety glasses

Skin protection

This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN374 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).

Splash contact

Material: butyl-rubber

Minimum layer thickness: 0.7 mm

Break through time: 240 min

Material tested: Butoject® (KCL 898)

Body Protection

Flame retardant antistatic protective clothing.

Respiratory protection

required when vapours/aerosols are generated. Our recommendations on filtering respiratory protection are based on the following standards: DIN EN 143, DIN 14387 and other accompanying standards relating to the used respiratory protection system.

Control of environmental exposure

Do not let product enter drains. Risk of explosion.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

a) Physical state	liquid
b) Color	colorless
c) Odor	No data available
d) Melting point/freezing point	Melting point/range: 2 - 4 °C - lit.
e) Initial boiling point and boiling range	90 °C - lit.
f) Flammability (solid, gas)	No data available
g) Upper/lower flammability or explosive limits	Upper explosion limit: 12.87 %(V) Lower explosion limit: 4.22 %(V)
h) Flash point	16 °C - closed cup
i) Autoignition temperature	No data available
j) Decomposition temperature	No data available
k) pH	No data available
l) Viscosity	Viscosity, kinematic: No data available Viscosity, dynamic: 0.585 mPa.s at 25 °C - OECD Test Guideline 114
m) Water solubility	114.7 g/l at 20 °C - OECD Test Guideline 105- completely soluble
n) Partition coefficient: n-octanol/water	log Pow: 0.354 at 20 °C - Bioaccumulation is not expected.
o) Vapor pressure	24 hPa at 21.1 °C
p) Density	1.069 g/cm ³ at 25 °C - lit.
Relative density	1.06 at 25 °C - OECD Test Guideline 109
q) Relative vapor density	3.11 - (Air = 1.0)
r) Particle characteristics	No data available
s) Explosive properties	No data available
t) Oxidizing properties	No data available

9.2 Other safety information

Surface tension	31.92 mN/m at 0 °C
Relative vapor density	3.11 - (Air = 1.0)

SECTION 10: Stability and reactivity

10.1 Reactivity

Vapors may form explosive mixture with air.

10.2 Chemical stability

The product is chemically stable under standard ambient conditions (room temperature) .

10.3 Possibility of hazardous reactions

Violent reactions possible with:

Reducing agents

Oxidizing agents

Acids

Bases

potassium tert-butanolate

10.4 Conditions to avoid

Air

Warming.

10.5 Incompatible materials

rubber, various plastics, Strong oxidizing agents

10.6 Hazardous decomposition products

In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

LD50 Oral - Rat - male and female - > 5,000 mg/kg

(OECD Test Guideline 401)

LC50 Inhalation - Rat - male and female - 4 h - > 5.36 mg/l - vapor

(OECD Test Guideline 403)

LD50 Dermal - Rabbit - male and female - > 2,000 mg/kg

Remarks: (ECHA)

Skin corrosion/irritation

Skin - Rabbit

Result: No skin irritation - 4 h

(OECD Test Guideline 404)

Serious eye damage/eye irritation

Eyes - Rabbit

Result: No eye irritation

Remarks: (ECHA)

Respiratory or skin sensitization

Freund's complete adjuvant test - Guinea pig

Result: negative

(OECD Test Guideline 406)

Germ cell mutagenicity

Test Type: Chromosome aberration test in vitro

Test system: lymphocyte

Metabolic activation: with and without metabolic activation

Method: OECD Test Guideline 473
Result: negative
Test Type: Ames test
Test system: Escherichia coli/Salmonella typhimurium
Metabolic activation: with and without metabolic activation
Result: negative
Remarks: (ECHA)
Test Type: gene mutation test
Test system: Chinese hamster lung cells
Metabolic activation: with and without metabolic activation
Method: OECD Test Guideline 476
Result: negative

Test Type: Chromosome aberration test
Species: Mouse

Application Route: Oral
Method: OECD Test Guideline 483
Result: negative

Carcinogenicity

No data available

Reproductive toxicity

No data available

Specific target organ toxicity - single exposure

No data available

Specific target organ toxicity - repeated exposure

No data available

Aspiration hazard

No data available

11.2 Additional Information

RTECS: FG0450000

To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish	flow-through test LC50 - Danio rerio (zebra fish) - $\geq$ 100 mg/l - 96 h (OECD Test Guideline 203)
Toxicity to daphnia and other aquatic invertebrates	static test EC50 - Daphnia magna (Water flea) - $>$ 100 mg/l - 48 h (OECD Test Guideline 202)
Toxicity to algae	static test ErC50 - Pseudokirchneriella subcapitata (green algae) - $>$ 100 mg/l - 72 h (OECD Test Guideline 201) static test NOEC - Pseudokirchneriella subcapitata (green algae) - $\geq$ 100 mg/l - 72 h

(OECD Test Guideline 201)

Toxicity to bacteria static test EC50 - activated sludge - > 1,000 mg/l - 3 h
(OECD Test Guideline 209)

12.2 Persistence and degradability

Biodegradability aerobic - Exposure time 28 d
Result: 86 % - Readily biodegradable.
(OECD Test Guideline 301C)

12.3 Bioaccumulative potential

No data available

12.4 Mobility in soil

No data available

12.5 Results of PBT and vPvB assessment

PBT/vPvB assessment not available as chemical safety assessment not required/not conducted

12.6 Endocrine disrupting properties

No data available

12.7 Other adverse effects

No data available

SECTION 13: Disposal considerations

13.1 Waste treatment methods

Product

Waste material must be disposed of in accordance with the national and local regulations. Leave chemicals in original containers. No mixing with other waste. Handle uncleaned containers like the product itself.

SECTION 14: Transport information

14.1 UN number

ADR/RID: 1161 IMDG: 1161 IATA-DGR: 1161

14.2 UN proper shipping name

ADR/RID: DIMETHYL CARBONATE
IMDG: DIMETHYL CARBONATE
IATA-DGR: Dimethyl carbonate

14.3 Transport hazard class(es)

ADR/RID: 3 IMDG: 3 IATA-DGR: 3

14.4 Packaging group

ADR/RID: II IMDG: II IATA-DGR: II

14.5 Environmental hazards

ADR/RID: no IMDG Marine pollutant: no IATA-DGR: no

14.6 Special precautions for user

None

14.7 Incompatible materials

rubber, various plastics, Strong oxidizing agents

Other regulations

SECTION 15: Regulatory information**15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture****National regulatory information**

HSNO Approval Code: HSR001252

HSNO Group Standard Approval: HSR002596 - Laboratory Chemicals and Reagent Kits
Group Standard 2006

Tracking Required: not required

Approved Handler Cert.: not required

SECTION 16: Other information**Full text of H-Statements referred to under sections 2 and 3.**

H225 Highly flammable liquid and vapor.

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the present state of our knowledge and is applicable to the product with regard to appropriate safety precautions. It does not represent any guarantee of the properties of the product. Sigma-Aldrich Corporation and its Affiliates shall not be held liable for any damage resulting from handling or from contact with the above product. See www.sigma-aldrich.com and/or the reverse side of invoice or packing slip for additional terms and conditions of sale.

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SAFETY DATA SHEET

according to Regulation (EC) No. 1907/2006

Version 6.9

Revision Date 18.03.2023

Print Date 05.12.2023

GENERIC EU MSDS - NO COUNTRY SPECIFIC DATA - NO OEL DATA

SECTION 1: Identification of the substance/mixture and of the company/undertaking**1.1 Product identifiers**

Product name : Ethylene glycol

Product Number : 324558

Brand : Sigma-Aldrich

Index-No. : 603-027-00-1

REACH No. : 01-2119456816-28-XXXX

CAS-No. : 107-21-1

1.2 Relevant identified uses of the substance or mixture and uses advised against

Identified uses : Laboratory chemicals, Manufacture of substances

1.3 Details of the supplier of the safety data sheet

Company : SIGMA-ALDRICH NEW ZEALAND CO.
PO Box 106-406
1143 AUCKLAND
NEW ZEALAND

Telephone : 0800 936 666
Fax : 0800 937 777

1.4 Emergency telephone

Emergency Phone # : 0800 928 888 (NZ)
+64 9 801 0034 (Int'l CHEMTREC)

SECTION 2: Hazards identification**2.1 Classification of the substance or mixture****Classification according to Regulation (EC) No 1272/2008**

Acute toxicity, Oral (Category 4), H302

Specific target organ toxicity - repeated exposure, Oral (Category 2), Kidney, H373

For the full text of the H-Statements mentioned in this Section, see Section 16.

2.2 Label elements**Labelling according Regulation (EC) No 1272/2008**

Pictogram



Signal Word

Warning



Hazard statement(s)	
H302	Harmful if swallowed.
H373	May cause damage to organs (Kidney) through prolonged or repeated exposure if swallowed.
Precautionary statement(s)	
P260	Do not breathe mist or vapors.
P264	Wash skin thoroughly after handling.
P270	Do not eat, drink or smoke when using this product.
P301 + P312	IF SWALLOWED: Call a POISON CENTER/ doctor if you feel unwell.
P314	Get medical advice/ attention if you feel unwell.
P501	Dispose of contents/ container to an approved waste disposal plant.
Supplemental Hazard Statements	none

Reduced Labeling (<= 125 ml)

Pictogram 

Signal Word	Warning
Hazard statement(s)	none
Precautionary statement(s)	none
Supplemental Hazard Statements	none

2.3 Other hazards

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

SECTION 3: Composition/information on ingredients

3.1 Substances

Synonyms	:	1,2-Ethanediol
Formula	:	C ₂ H ₆ O ₂
Molecular weight	:	62,07 g/mol
CAS-No.	:	107-21-1
EC-No.	:	203-473-3
Index-No.	:	603-027-00-1

Component	Classification	Concentration
ethylene glycol		
CAS-No.	107-21-1	Acute Tox. 4; STOT RE 2; H302, H373
EC-No.	203-473-3	
Index-No.	603-027-00-1	
		<= 100 %

For the full text of the H-Statements mentioned in this Section, see Section 16.



SECTION 4: First aid measures

4.1 Description of first-aid measures

General advice

Show this material safety data sheet to the doctor in attendance.

If inhaled

After inhalation: fresh air. Call in physician.

In case of skin contact

In case of skin contact: Take off immediately all contaminated clothing. Rinse skin with water/ shower.

In case of eye contact

After eye contact: rinse out with plenty of water. Remove contact lenses.

If swallowed

After swallowing: immediately make victim drink water (two glasses at most). Consult a physician.

4.2 Most important symptoms and effects, both acute and delayed

The most important known symptoms and effects are described in the labelling (see section 2.2) and/or in section 11

4.3 Indication of any immediate medical attention and special treatment needed

No data available

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media

Water Foam Carbon dioxide (CO₂) Dry powder

Unsuitable extinguishing media

For this substance/mixture no limitations of extinguishing agents are given.

5.2 Special hazards arising from the substance or mixture

Carbon oxides

Combustible.

Vapors are heavier than air and may spread along floors.

Forms explosive mixtures with air on intense heating.

Development of hazardous combustion gases or vapours possible in the event of fire.

5.3 Advice for firefighters

Stay in danger area only with self-contained breathing apparatus. Prevent skin contact by keeping a safe distance or by wearing suitable protective clothing.

5.4 Further information

Prevent fire extinguishing water from contaminating surface water or the ground water system.



SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

Advice for non-emergency personnel: Do not breathe vapors, aerosols. Avoid substance contact. Ensure adequate ventilation. Evacuate the danger area, observe emergency procedures, consult an expert.
For personal protection see section 8.

6.2 Environmental precautions

Do not let product enter drains.

6.3 Methods and materials for containment and cleaning up

Cover drains. Collect, bind, and pump off spills. Observe possible material restrictions (see sections 7 and 10). Take up with liquid-absorbent material (e.g. Chemizorb®). Dispose of properly. Clean up affected area.

6.4 Reference to other sections

For disposal see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

For precautions see section 2.2.

7.2 Conditions for safe storage, including any incompatibilities

Storage conditions

Tightly closed.

Hygroscopic.

Storage class

Storage class (TRGS 510): 10: Combustible liquids

7.3 Specific end use(s)

Apart from the uses mentioned in section 1.2 no other specific uses are stipulated

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

Ingredients with workplace control parameters

Derived No Effect Level (DNEL)

Application Area	Routes of exposure	Health effect	Value
Workers	Inhalation	Long-term local effects	35 mg/m ³
Workers	Skin contact	Long-term systemic effects	106mg/kg BW/d
Consumers	Inhalation	Long-term local effects	7 mg/m ³
Consumers	Skin contact	Long-term systemic effects	53mg/kg BW/d

Predicted No Effect Concentration (PNEC)

Compartment	Value
Soil	1,53 mg/kg
Sea water	1 mg/l
Fresh water	10 mg/l
Sea sediment	3,7 mg/kg
Fresh water sediment	37 mg/kg



8.2 Exposure controls

Personal protective equipment

Eye/face protection

Use equipment for eye protection tested and approved under appropriate government standards such as NIOSH (US) or EN 166(EU). Safety glasses

Skin protection

This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN374 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).

Full contact

Material: Nitrile rubber

Minimum layer thickness: 0,11 mm

Break through time: 480 min

Material tested: KCL 741 Dermatrill® L

This recommendation applies only to the product stated in the safety data sheet, supplied by us and for the designated use. When dissolving in or mixing with other substances and under conditions deviating from those stated in EN374 please contact the supplier of CE-approved gloves (e.g. KCL GmbH, D-36124 Eichenzell, Internet: www.kcl.de).

Splash contact

Material: Nitrile rubber

Minimum layer thickness: 0,11 mm

Break through time: 480 min

Material tested: KCL 741 Dermatrill® L

Body Protection

protective clothing

Respiratory protection

Recommended Filter type: Filter A (acc. to DIN 3181) for vapours of organic compounds

The entrepreneur has to ensure that maintenance, cleaning and testing of respiratory protective devices are carried out according to the instructions of the producer. These measures have to be properly documented.

Control of environmental exposure

Do not let product enter drains.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

- | | |
|-------------------|-----------------------------|
| a) Physical state | liquid |
| b) Color | colorless |
| c) Odor | odorless |
| d) Melting | Melting point/range: -13 °C |



	point/freezing point	
e)	Initial boiling point and boiling range	196 - 198 °C
f)	Flammability (solid, gas)	No data available
g)	Upper/lower flammability or explosive limits	Upper explosion limit: 15,3 %(V) Lower explosion limit: 3,2 %(V)
h)	Flash point	115 °C - open cup
i)	Autoignition temperature	412 °C at 1.013 hPa
j)	Decomposition temperature	No data available
k)	pH	No data available
l)	Viscosity	Viscosity, kinematic: No data available Viscosity, dynamic: No data available
m)	Water solubility	at 20 °C completely miscible
n)	Partition coefficient: n-octanol/water	log Pow: -1,36 - Bioaccumulation is not expected.
o)	Vapor pressure	1 hPa at 51,1 °C
p)	Density	1,113 g/mL at 25 °C
	Relative density	No data available
q)	Relative vapor density	No data available
r)	Particle characteristics	No data available
s)	Explosive properties	No data available
t)	Oxidizing properties	none

9.2 Other safety information

Surface tension	48,4 mN/m at 20 °C
Relative vapor density	2,14 - (Air = 1.0)

SECTION 10: Stability and reactivity

10.1 Reactivity

Forms explosive mixtures with air on intense heating.
A range from approx. 15 Kelvin below the flash point is to be rated as critical.

10.2 Chemical stability

The product is chemically stable under standard ambient conditions (room temperature) .



10.3 Possibility of hazardous reactions

Risk of explosion with:

Aluminum

perchloric acid

Risk of ignition or formation of inflammable gases or vapours with:

chromyl chloride

Strong oxidizing agents

chlorates

Peroxides

potassium permanganate

Exothermic reaction with:

chlorosulfonic acid

Sodium hydroxide

fuming sulfuric acid

sulfuric acid

10.4 Conditions to avoid

Strong heating.

10.5 Incompatible materials

various plastics, Strong oxidizing agents

10.6 Hazardous decomposition products

In the event of fire: see section 5

SECTION 11: Toxicological information

11.1 Information on toxicological effects

Acute toxicity

LD50 Oral - 500,1 mg/kg

Oral: (Regulation (EC) No 1272/2008, Annex VI)

LC50 Inhalation - Rat - male and female - 6 h - > 2,5 mg/l - aerosol

Remarks: (ECHA)

LD50 Dermal - Mouse - male and female - > 3.500 mg/kg

Remarks: (ECHA)

Skin corrosion/irritation

Skin - Rabbit

Result: No skin irritation - 20 h

Remarks: (ECHA)

Serious eye damage/eye irritation

Eyes - Rabbit

Result: No eye irritation - 24 h

Remarks: (ECHA)

Respiratory or skin sensitization

Maximization Test - Guinea pig

Result: negative

(OECD Test Guideline 406)

Germ cell mutagenicity

Test Type: Ames test

Test system: Escherichia coli/Salmonella typhimurium



Metabolic activation: with and without metabolic activation

Method: OECD Test Guideline 471

Result: negative

Test Type: dominant lethal test

Species: Rat

Application Route: Oral

Result: negative

Carcinogenicity

This product is or contains a component that is probably not carcinogenic based on its IARC, ACGIH, NTP, or EPA classification.

Reproductive toxicity

Laboratory experiments have shown teratogenic effects.

Overexposure may cause reproductive disorder(s) based on tests with laboratory animals.

Specific target organ toxicity - single exposure

No data available

Specific target organ toxicity - repeated exposure

Oral - May cause damage to organs through prolonged or repeated exposure.

- Kidney

Aspiration hazard

No data available

11.2 Additional Information

Endocrine disrupting properties

Product:

Assessment

The substance/mixture does not contain components considered to have endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at levels of 0.1% or higher.

RTECS: KW2975000

When ingested early symptoms mimic alcohol inebriation and are followed by nausea, vomiting, abdominal pain, weakness, muscle tenderness, respiratory failure, convulsions, cardiovascular collapse, pulmonary edema, hypocalcemic tetany, and severe metabolic acidosis. Without treatment, death may occur in 8 to 24 hours. Victims who survive the initial toxicity period usually develop renal failure along with brain and liver damage., Exposure to and/or consumption of alcohol may increase toxic effects. To the best of our knowledge, the chemical, physical, and toxicological properties have not been thoroughly investigated.

After absorption:

agitation

CNS disorders

Systemic effects:

After a latency period:



Tiredness
ataxia (impaired locomotor coordination)
Unconsciousness

Other dangerous properties can not be excluded.

Handle in accordance with good industrial hygiene and safety practice.

Central nervous system - Irregularities - Based on Human Evidence

SECTION 12: Ecological information

12.1 Toxicity

Toxicity to fish	static test LC50 - Pimephales promelas (fathead minnow) - > 72.860 mg/l - 96 h (US-EPA)
Toxicity to daphnia and other aquatic invertebrates	static test EC50 - Daphnia magna (Water flea) - > 100 mg/l - 48 h (OECD Test Guideline 202)
Toxicity to algae	IC5 - Scenedesmus quadricauda (Green algae) - > 10.000 mg/l - 7 d Remarks: (Lit.)
Toxicity to bacteria	static test EC20 - activated sludge - > 1.995 mg/l - 30 min (ISO 8192)
Toxicity to fish(Chronic toxicity)	flow-through test LC50 - Menidia peninsulae (tidewater silverside) - > 1.500 mg/l - 28 d Remarks: (in analogy to similar products) (ECHA) The value is given in analogy to the following substances: triethylene glycol

12.2 Persistence and degradability

Biodegradability	aerobic - Exposure time 10 d Result: 90 - 100 % - Readily biodegradable. (OECD Test Guideline 301A)
Biochemical Oxygen Demand (BOD)	780 mg/g Remarks: (IUCLID)
Chemical Oxygen Demand (COD)	1.190 mg/g Remarks: (IUCLID)
Theoretical oxygen demand	1.290 mg/g Remarks: (IUCLID)
Ratio BOD/ThBOD	60 % Remarks: (IUCLID)

12.3 Bioaccumulative potential

Does not bioaccumulate.



No data available

This substance/mixture contains no components considered to be either persistent, bioaccumulative and toxic (PBT), or very persistent and very bioaccumulative (vPvB) at levels of 0.1% or higher.

Product:

Assessment	: The substance/mixture does not contain components considered to have endocrine disrupting properties according to REACH Article 57(f) or Commission Delegated regulation (EU) 2017/2100 or Commission Regulation (EU) 2018/605 at levels of 0.1% or higher.
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12.7 Other adverse effects

13.1 Waste treatment methods

No data available

14.1 UN number

ADR/RID: - IMDG: - IATA: -

ADR/RID: Not dangerous goods
IMDG: Not dangerous goods
IATA: Not dangerous goods

ADR/RID: - IMDG: - IATA: -

ADR/RID: - IMDG: - IATA: -

ADR/RID: no IMDG Marine pollutant: no IATA: no

No data available

Further information

Not classified as dangerous in the meaning of transport regulations.

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

This material safety data sheet complies with the requirements of Regulation (EC) No. 1907/2006.



Other regulations

Observe work restrictions regarding maternity protection in accordance to Dir 92/85/EEC or stricter national regulations where applicable.

Take note of Dir 94/33/EC on the protection of young people at work.

15.2 Chemical Safety Assessment

A Chemical Safety Assessment has been carried out for this substance.

SECTION 16: Other information

Full text of H-Statements referred to under sections 2 and 3.

H302	Harmful if swallowed.
H373	May cause damage to organs through prolonged or repeated exposure if swallowed.

Full text of other abbreviations

ADN - European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways; ADR - Agreement concerning the International Carriage of Dangerous Goods by Road; AIIC - Australian Inventory of Industrial Chemicals; ASTM - American Society for the Testing of Materials; bw - Body weight; CMR - Carcinogen, Mutagen or Reproductive Toxicant; DIN - Standard of the German Institute for Standardisation; DSL - Domestic Substances List (Canada); ECx - Concentration associated with x% response; ELx - Loading rate associated with x% response; EmS - Emergency Schedule; ENCS - Existing and New Chemical Substances (Japan); ErCx - Concentration associated with x% growth rate response; GHS - Globally Harmonized System; GLP - Good Laboratory Practice; IARC - International Agency for Research on Cancer; IATA - International Air Transport Association; IBC - International Code for the Construction and Equipment of Ships carrying Dangerous Chemicals in Bulk; IC50 - Half maximal inhibitory concentration; ICAO - International Civil Aviation Organization; IECSC - Inventory of Existing Chemical Substances in China; IMDG - International Maritime Dangerous Goods; IMO - International Maritime Organization; ISHL - Industrial Safety and Health Law (Japan); ISO - International Organisation for Standardization; KECI - Korea Existing Chemicals Inventory; LC50 - Lethal Concentration to 50 % of a test population; LD50 - Lethal Dose to 50% of a test population (Median Lethal Dose); MARPOL - International Convention for the Prevention of Pollution from Ships; n.o.s. - Not Otherwise Specified; NO(A)EC - No Observed (Adverse) Effect Concentration; NO(A)EL - No Observed (Adverse) Effect Level; NOELR - No Observable Effect Loading Rate; NZIoC - New Zealand Inventory of Chemicals; OECD - Organization for Economic Co-operation and Development; OPPTS - Office of Chemical Safety and Pollution Prevention; PBT - Persistent, Bioaccumulative and Toxic substance; PICCS - Philippines Inventory of Chemicals and Chemical Substances; (Q)SAR - (Quantitative) Structure Activity Relationship; REACH - Regulation (EC) No 1907/2006 of the European Parliament and of the Council concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals; RID - Regulations concerning the International Carriage of Dangerous Goods by Rail; SADT - Self-Accelerating Decomposition Temperature; SDS - Safety Data Sheet; TCSI - Taiwan Chemical Substance Inventory; TECI - Thailand Existing Chemicals Inventory; TSCA - Toxic Substances Control Act (United States); UN - United Nations; UNRTDG - United Nations Recommendations on the Transport of Dangerous Goods; vPvB - Very Persistent and Very Bioaccumulative

Further information

The above information is believed to be correct but does not purport to be all inclusive and shall be used only as a guide. The information in this document is based on the



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