Avifauna Management Plan for Proposed Nova Energy Solar Farm at Twizel, Canterbury

Contract Report No. 7414c

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Wildlands

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1.0 Introduction

This management plan relates to the development and operation of a proposed solar farm located near the township of Twizel in the Mackenzie Basin. The proposed solar farm site is located within the Pukaki Ecological District and covers approximately 866 hectares, with the proposed solar panel area utilising approximately 565 hectares. It is characterised by dry outwash plains between Lake Tekapo and Benmore.

Wildland Consultants Ltd (Wildlands) previously prepared an assessment of ecological effects (AEE) on the site, which identified important biodiversity values at the site (Wildland Consultants 2026). These values included Threatened or At Risk plants, birds, lizards, and terrestrial invertebrates. Wetland habitats were also identified at the site. The AEE identified a need for specific management plans to address effects on flora and fauna on-site and to inform future management strategies in the context of the development.

This Avifauna Management Plan (AMP) is one of the five ecological management plans associated with the proposed development and details the measures recommended for minimising the impacts on indigenous avifauna at the site.

This report is intended to be implemented in conjunction with the following reports:

- Wildland Consultants (2026a). *Terrestrial invertebrate management plan for proposed Nova Energy Twizel solar farm.* Wildland Consultants Contract Report No. 7414a. Prepared for Nova Energy Ltd. 28pp.
- Wildland Consultants (2026b). *Lizard management plan for proposed Nova Energy Twizel solar farm.* Wildland Consultants Contract Report No. 7414b. Prepared for Nova Energy. 40pp.
- Wildland Consultants (2026c). *Biosecurity and vegetation management plan for proposed Nova Energy Twizel solar farm*. Wildland Consultants Contract Report No. 7414d. Prepared for Nova Energy. 17pp.
- Wildland Consultants (2026d). *Pest mammal management plan for Nova Energy proposed solar farm, Twizel.* Wildland Consultants Contract Report No. 6905. Prepared for Nova Energy Ltd. 27pp.

2.0 Site Description

The project site (Lot 3/DP422901/RT489342) is a long, narrow section of land with an area of *c.*866 hectares to the east of Twizel (Appendix 1). Ōhau River is located along the eastern boundary and Twizel River to the west. The site is mostly flat with an access road through the centre and old river terraces near the boundary. It is currently used as pastoral land for farming in a Rural Zone. The proposed area for development is located on outwash plain and river terraces between the Twizel and Ōhau Rivers and includes areas of historic river channels and old oxbows.

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

Records of 66 bird species have been collated based on a site visit in December 2022, a desktop survey, and an expert evaluation of additional species that may be present. These include 48 indigenous species (10 Threatened, 14 At Risk, one Non-resident Native – Migrant, and 23 Not Threatened) and 18 exotic species (Wildland Consultants 2026).

3.0 Survey Methods and Results

A desktop survey was conducted to identify records of all birds within five kilometres of the site between January 2021 and May 2025. An expert evaluation was made to identify species not detected during the desktop assessment but that may use the site. A site visit was undertaken on 14 and 15 December 2022, during which four discrete transects were evaluated. All bird species seen or heard while walking each transect were recorded together with any incidental species detected while on-site.

Sixty-six bird species and two hybrid taxa were detected during the desktop survey and December 2022 site visit. This included 48 indigenous species (10 Threatened, 14 At Risk, one Non-resident Native – Migrant, and 23 Not Threatened) and 18 exotic species. One *Anas* sp. was not identified to species level. Of these, 38 species were seen during the 2022 field survey, including tarapirohe/black-fronted tern (*Chlidonias albostriatus*, Threatened – Nationally Endangered), pārea/grey duck (*Anas superciliosa*, Threatened – Nationally Vulnerable), pohowera/banded dotterel (*Charadrius bicinctus bicinctus*, At Risk – Declining), tarāpuka/black-billed gull (*Chroicocephalus bulleri*, At Risk – Declining), tōrea/South Island pied oystercatcher (*Haematopus finschi*, At Risk – Declining), kawaupaka/little shag (*Microcarbo melanoleucos brevirostris*, At Risk – Relict), and māpunga/black shag (*Phalacrocorax carbo novaehollandiae*, At Risk – Relict)[1].

During the survey, one tōrea/South Island pied oystercatcher was observed sitting on what appeared to be a nest on the site, though this could not be confirmed.

4.0 Ecological Values for Avifauna

Several areas on the southern margins of the site are important to avifauna, shown collectively in Appendix 1. Large numbers of waterfowl and waders, including the Threatened pārera/grey duck and At Risk pohowera/banded dotterel and tōrea/South Island pied oystercatcher were present in wetlands between the Ōhau River and the southern margin of the site (opposite the Ōhau B Power Station). The kakī/black stilt (*Himantopus novaezelandiae*, Threatened – Nationally Critical) captive breeding centre is located approximately 250 metres from the south-western edge of the proposed solar farm. The Ōhau River and its delta on Lake Benmore provide important habitat for various Threatened and At Risk species, including māpunga/black shag and kawaupaka/little shag, which were observed feeding in the river during the 2022 site visit. Wetland areas on the Ōhau River are also known habitats for the At Risk kotoreke/marsh crake (*Zapornia pusilla*, At Risk - Declining).

Matuku-hūrepo/Australasian bittern (*Botaurus poiciloptilus*, Threatened – Nationally Critical) are known to occur at several wetland patches near the site, including around the Ōhau and Pukaki rivers. While pūweto/spotless crake (*Zapornia tabuensis*, At Risk – Declining) were not identified during the desktop assessment or field visit, it is likely they could also be present in the area at similar sites to where matuku-hūrepo/Australasian bittern and kotoreke/marsh crake are found.

[1] Threat classifications are from Robertson et al. (2021).

Tōrea/South Island pied oystercatchers have also been observed feeding and roosting in the browntop-sweet vernal-grassland on site and potentially nesting. The short grasslands and open country are suitable breeding habitats for tōrea/South Island pied oystercatcher, pihoihoi/New Zealand pipit (*Anthus novaeseelandiae novaeseelandiae*, At Risk – Declining) and pohowera/banded dotterel. Tarapirohe/black-fronted terns have been observed flying over the site and foraging in the river along the site's southern border (Appendix 1).

While the identified avifauna values are near the proposed solar farm site, they are still some distance from the proposed works. For example, values to the south, south-west (including the Ōhau River and wetland area) of the property border are on Department of Conservation (DOC) land and are at a lower elevation to the site, while the kakī/black stilt captive breeding centre is several hundred metres from the south-western border. Additionally, due to the large ecological exclusion area incorporated into the concept design, setbacks ensure works will be carried out away from sensitive avifauna areas.

5.0 Potential Effects on Avifauna

There are five potential effects on avifauna from the proposed solar farm construction:

- Loss of avifauna habitat for species, such as tōrea/South Island pied oystercatcher, that forage and breed within open grassland areas.
- Disturbance to indigenous breeding avifauna during construction due to human activity, noise, vibrations, and machinery operations.
- Death or injury to indigenous breeding avifauna from ground clearance and machinery use during construction.
- Ongoing disturbance to avifauna from vehicle movements and maintenance works.
- Risk of bird strike with panel arrays, resulting in the mortality of any birds that collide with panels.

These potential effects are discussed in more detail in the AEE (Wildland Consultants 2026).

The purpose of this management plan is to avoid, minimise, and remedy adverse effects to indigenous birds, and if necessary, to implement appropriate compensation measures to address any residual effects that remain.

6.0 Management of Effects

6.1 Overview

Under the Wildlife Act 1953, Section 63 (1), it is unlawful to destroy, molest, or disturb the nests of protected birds, with nesting considered to be any stage of a bird building, occupying, or using a nest to house eggs or young. Protection encompasses active nest construction, incubation of eggs, and chick rearing, which typically occur during the main avifauna breeding season of July–March inclusive. All birds in Aotearoa New Zealand, apart from those listed in Schedule 5 of the Wildlife Act 1953, are protected. This includes Threatened and At Risk birds, most of the Not Threatened indigenous birds, and some introduced birds. Protection statuses of species recorded in the field survey and desktop assessment are summarised in Appendix 2.

6.2 Limit construction during the breeding season

The bulk of the construction work should occur between 2 March and 30 June, outside the breeding season of Threatened and At Risk birds (1 July–1 March), as construction activities could injure or kill breeding birds, eggs, and chicks. Due to the size of the project and the extended breeding season of birds likely to inhabit the area (including open country and braided river breeders), some construction work will inevitably take place during this period, which spans approximately eight months. The following management measures are designed to minimise impacts on breeding and nesting birds during, and outside of the breeding season. Table 1 provides details on the breeding seasons of the Threatened and At Risk birds identified during the site visit or noted from the desktop survey.

6.3 Pre-works surveys

A Suitably Qualified Avifauna Ecologist (SQAE) will undertake pre-works surveys no more than eight days prior to works commencing. If works cease for more than eight days, or move into a new area or stage, a further pre-works survey is required no more than eight days before recommencement. This applies for work commencing within the bird breeding season (1 July–1 March).

The purpose of the pre-works survey is to identify onsite bird foraging and breeding and will be undertaken in accordance with a methodology determined by the SQAE.

The pre-works survey shall record the following information:

- Date and time of survey.
- Location.
- The total number of birds observed across all species.
- The behaviours and habitat use of all birds present (e.g. roosting or nesting, feeding on bare ground, flying overhead).
- For birds flying overhead, the approximate height (e.g. <10 metres, 10-30 metres, >30 metres), and direction of the flight, and size of the flock (if applicable).

6.4 Setbacks

If nests of protected ground-nesting avifauna species are found, in the survey described in Section 6.3 above, or during construction:

- Nests must be avoided by establishing construction setback distances (buffer zones). In open areas, this setback must be a minimum of 100 metres for Threatened, At Risk (threat classifications as per Robertson et al. 2021) and protected species unless reduced by a SQAE, and be clearly demarcated.
- Buffer zone distances may be reduced to smaller exclusion distances for intermittent, short duration work if the nests or chicks are not visible from the source of disturbance (e.g. if vegetation or topographic features screen the source of disturbance from the nest or chicks). This adjustment is subject to approval by a SQAE, will be no less than 50 metres, and must be documented in writing.
- Construction activities must not occur within the setback area until:
    - chicks have fledged and are independent of the nesting site, or
    - the nest has been abandoned, as determined by an SQAE.

Table 1 – Breeding seasons of Threatened and At Risk bird species (✓) and potential presence within the Mackenzie Basin area (✓). *Asterisk identifies birds that could potentially be encountered breeding at the site.

Bird Species	Breeding/Nesting Habitat	Breeding Season											
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Kakī /black stilt*	Inland braided river	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pārera/grey duck	Inland braided river								✓	✓	✓	✓	✓
Ngutu pare/wrybill	Inland braided river	✓	✓	✓	✓	✓			✓	✓	✓	✓	✓
Pihoihoi/New Zealand pipit *	Open country/ tussock	✓	✓						✓	✓	✓	✓	✓
Pohowera/banded dotterel*	Inland braided river/open country/ tussock	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Tarāpuka/black-billed gull*	Inland braided river	✓	✓						✓	✓	✓	✓	✓
Tōrea/South Island pied oystercatcher *	Inland braided river/open country	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓
Kawaupaka/little shag	Roosting in overhanging trees	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓	✓
Māpunga/black shag	Roosting in overhanging trees			✓	✓	✓	✓	✓	✓				
Kawau tūī/little black shag	Roosting in overhanging trees										✓	✓	✓

Setbacks will be applied between the site and the Twizel and Ōhau Rivers to reduce disturbance of braided river birds during the breeding season. No construction is proposed in these areas (75-100 metres between the site boundary and the outermost solar panels), so this setback is readily achieved. If active construction is occurring during the breeding season within 100 metres of the Twizel River or 75 metres of the Ōhau River (for which a smaller setback distance is appropriate given the approximately 20 metre elevational distance to the site), any pre-works surveys undertaken (Section 6.3) will include the affected section of river. The purpose of the survey will be to determine whether avifauna are nesting on the river within 100 or 75 metres of the site, and to implement appropriate setback distances if required.

6.5 Avoid the creation of bare ground during construction

All efforts will be made to prevent the creation of areas of bare ground 10 square metres or larger during the construction phase, as this could attract some species to attempt to nest, e.g. poaka/pied stilt (*Himantopus himantopus*, Not Threatened), spur-winged plover (*Vanellus miles*, Not Threatened), and pohowera/banded dotterel.

If areas are being cleared for landscape plantings, then the plantings must be implemented immediately following the site preparation phase, or the area covered until planting can take place.

If creation of areas of bare ground is unavoidable and the area is left inactive for more than eight days, then passive attempts to deter birds from using them must be implemented. The following techniques may be used:

- The use of reflective tape can be very effective in the short term and will deter various bird species (Avery and Werner 2017). Reflective tape can reflect light disorienting or irritating birds and makes noise when the tape flaps in the wind. This is a short-term solution as birds can habituate to the deterrent over time. The tape must be visible to birds accessing the area.
- Barriers and screening could be implemented to restrict or remove access to bare ground. However, it is essential that barriers and screens do not pose an entrapment risk to birds, so mesh type products must not be used.

If passive attempts at deterrence are unsuccessful and protected species start nesting in the area, the setback measures identified in Section 6.4 above must be implemented.

If bare ground is created (both during and outside of the construction period), it should be enhanced with short-stature vegetation. This will help to reduce the likelihood of birds attempting to nest in these areas.

6.6 Reduce construction noise and vibration

To minimise the disturbance to avifauna from construction adjacent to the braided rivers, noise and vibration levels will be kept to a minimum. While construction noise is unavoidable, machinery must not be left running when not in use. Additionally, music from radios must not be played loudly on site as this can disturb nesting or roosting birds and their chicks.

6.7 Reduce the risk of impact trauma (bird strike)

To reduce the risk of impact trauma arising from collision with structures at the solar farm, the following have been incorporated into the project design:

- The panel design incorporates at least five-metre spacing between panel edges, depending on the degree of tilt.
- North and south development areas are segregated by access road and transmission lines.
- Service/access tracks between sections of panels range between five metres wide unpaved service roads, and a six metres wide and unpaved central arterial road.
- Panel tracking systems will vary the distances between panel edges and the angle of panels throughout the day, altering the spatial view (reducing the risk that birds perceive the solar farm as a lake).
- The PV panels include a standard anti-reflective coated front glass.
- The panels will have a 55-degree night rest position to minimise reflectivity at night. The panels will move to the proposed Glint and Glare mitigation stow position (≥5° angle) just before sunrise, to avoid glare to nearby receivers. After sunrise, the panels will track the movement of the sun (east to west) before returning to a ≥5° angle prior to sunset. After the sunset holding period, the tracks will move to the night resting position until sunrise. Tracking arrays reduce the frequency of waterbird fatalities compared to fixed arrays (Kosciuch et al. 2025).
- If practicable, the panels will be positioned in directions away from sources of polarised moonlight.

In addition to these measures, sections 6.13-6.14 outline proposed live bird and carcass monitoring for avifauna, which will inform the adaptive management process outlined in section 6.14.7, including changes to on-site protocols if specific trigger levels are met during carcass monitoring.

6.8 Manage pest mammal populations

Pest mammal control shall be implemented on site, in accordance with a Pest Mammal Management Plan (Wildland Consultants 2026d), with regular bait checks and monitoring for the lifetime of the solar farm. Pest mammal control will reduce predation pressure on avifauna and other significant taxa present within and adjacent to the site. Trapping will focus on high-value areas for avifauna, such as the wetland and along the southern border of the site.

6.9 Prevent encroachment into high-value habitat

To prevent ongoing disturbance to avifauna, including nesting birds, there shall be no encroachment into high value habitat (wetlands, rivers or river deltas bordering the site) during construction. Encroachment into adjacent wetland and river habitat will be prevented by following the setback distances set out in Section 6.4.

6.10 Reduce vehicle speed on site

To prevent disturbance to avifauna nesting on the site during the breeding season, vehicles shall drive slowly within the solar farm, as birds will breed in gravel areas and may use vehicle tracks as breeding sites. All staff on site must be advised of the need to be vigilant for the presence of birds on the site. If birds are incidentally discovered, follow the incidental discovery protocol (Section 6.11.2).

6.11 Implement incidental discovery protocol when necessary

6.11.1 Overview

The following protocols outline the steps for incidental discoveries of nesting birds, nests, and injured birds, during construction and ongoing maintenance. Trigger levels for injury or mortality are discussed in Section 6.14.6.

6.11.2 Incidental nest discovery

- If nests or nesting avifauna are discovered within the footprint of the site, all works within 100 metres of Threatened and At Risk species (as confirmed by a SQAE) must immediately stop, and the discovery must be reported to the Site Manager.
- Record the following details:
  - Date and time of discovery.
  - Location (GPS coordinate marked).
  - Description of the finding (e.g. species identification, nest type, or remains).
  - Photographs, if feasible, without disturbing the nest.
- No works shall resume within this area until a SQAE has viewed the photographs and/or assessed the nest and associated birds and determined the appropriate setback to avoid adverse effects.

6.11.3 Injured birds

- If an injured Threatened or At Risk indigenous bird is found within the site footprint, the injured bird will be placed in a cool, dark, material-lined box and taken to a vet immediately.
- The local DOC office or DOC hotline (if after hours) will be contacted no later than two hours after the injured bird is found. The DOC hotline is 0800 DOCHOTLINE (0800 362 468).

6.12 Undertake surveys during construction

A nesting bird survey must be undertaken by a SQAE no more than eight days before commencement of construction under the following circumstances:

- When a new construction phase begins.
- Works cease for a period of eight consecutive days or more during the avifauna breeding season (1 July–1 March inclusive).
- Development begins on areas of the site that were previously undeveloped, as birds may start nesting in areas of the site that have experienced less disturbance.

Any nests of Threatened, At Risk, and protected bird species found during these surveys will have the appropriate setbacks applied as discussed in Section 6.4.

6.13 Bird monitoring

6.13.1 Overview

Avifauna monitoring within the site will occur prior to, during, and post-construction, at intervals specified in Section 6.13.2. Monitoring locations will be designated by a SQAE, based on the avifauna values present. Results from the avifauna monitoring must be reported annually, with a review conducted after five years to determine whether further monitoring should be implemented.

Where possible, monitoring will occur during the early morning or late afternoon, as birds are most active at these times. Birds are typically less active during strong winds or heavy rain, so surveys will be avoided in these conditions where possible.

During monitoring, the following information will be recorded:

- Date and time of survey.
- Location.
- The total number of birds observed across all species.
- The behaviours and habitat use of all birds present (e.g. roosting on panels, feeding on bare ground under panels, flying overhead).
- For birds flying overhead, the approximate height (e.g. <10 metres, 10-30 metres, >30 metres), and direction of the flight, and size of the flock (if applicable).

6.13.2 On-site monitoring

A SQAE will undertake systematic monitoring of the birds present within the site throughout the construction period and post-construction. This will allow for proactive responses. If changes in the abundance or behaviour of Threatened, At Risk, or protected bird species are observed, construction protocols can be modified, and nesting birds or chicks can be avoided at the site.

Avifauna monitoring will be conducted at representative locations within the solar farm as determined by a SQAE. Monitoring locations must have good visibility and ensure good coverage of the solar farm site, including boundary surveys in areas of the site adjacent to important avifauna habitat, such as braided rivers.

Avifauna monitoring will occur **monthly** for the six months prior to construction commencing. This will provide baseline data about bird distributions at the site. **Weekly** monitoring will occur for the first year of the construction phase, as the most significant changes to the site will occur during this period. After this, a SQAE will review the data and recommend whether the monitoring frequency could be reduced to fortnightly for the remainder of construction, or whether it will remain weekly. Once construction is completed, monitoring will continue **fortnightly** for a minimum of five years following the completion of construction. This will be extended under recommendation from a SQAE if Threatened, At Risk, or protected bird species are frequently observed on the solar farm site or have been recorded as fatalities. As adaptive management changes are implemented, fortnightly monitoring may be recommended for the life of the solar farm.

6.14 Carcass monitoring

6.14.1 Avifauna Carcass Monitoring Programme (ACMP)

An Avifauna Carcass Monitoring Programme (ACMP) must be implemented as part of this AMP. The ACMP is attached as Appendix 4. The ACMP has been developed by a SQAE in collaboration with a suitably qualified biostatistician and has been designed in advance to ensure statistical robustness.

The ACMP outlines protocols for incidental carcass discovery, systematic carcass searches, carcass detection and persistence trials, reviewing and reporting, and mortality levels that would trigger independent reviews.

A summary of the information contained in the ACMP is set out below.

6.14.2 Incidental carcass discovery

- All incidental discoveries of dead birds at the site must be recorded, including the following details:
  - Date and time of discovery.
  - Location (GPS coordinate marked).
  - Species.
  - Signs of injury and cause of death.
  - Photographs of the carcass at multiple angles.
- If the bird is identified as a Threatened or At Risk species, the local DOC office must be contacted.
- If the carcass cannot be identified to species level, swabs will be taken for DNA identification.
- If the cause of death is unclear, the carcass will be kept for autopsy.

6.14.3 Systematic carcass searches

- Fortnightly carcass searches are proposed prior to construction. Once areas of the solar farm are completed, they will be monitored on a fortnightly basis, and fortnightly monitoring will continue for a minimum of five years after construction is fully completed.
- Carcass searches will occur across 25% of the panel area using a stratified random sampling approach, with 11 high-risk, 11 medium-risk, and six low-risk sections included for sampling.
- DNA samples from any bird carcasses that cannot be identified based on their morphology, along with any signs of bird strike on panel arrays, will be collected following the methodology outlined in Waugh et al. (2011). This involves using sterile sampling kits to collect blood or tissue samples, which are then sent to a laboratory for DNA barcoding.
- If the cause of fatality of a bird cannot be determined, the carcass will be collected and sent for autopsy, if deemed sufficiently intact.
- A Wildlife Approval (WA) from DOC will be required (and has been sought) to retain any located carcasses for identification purposes, carcass detection trials, and carcass persistence trials. While bird strike risk is considered to be low, it is important to proactively obtain a WA so that, if any carcasses are located, they can be retained for identification and sent to Massey University Wildlife Post-mortem Service for necropsy and/or identification as required. Feathers or photographs of unknown carcasses can also be taken to museums for identification by comparing them with their reference library.

6.14.4 Carcass detection and persistence trials

- Eight rounds of carcass detection trials and carcass persistence trials are proposed in the ACMP to inform the systematic carcass search procedure and provide correction factors for the analysis of bird strike fatalities. This will include a trial using a drone as a potential monitoring tool.

6.14.5 Reviewing and reporting

- A review of the ACMP and AMP will be undertaken at the end of each reporting year to determine whether the programme design and management measures are appropriate.
- Results of the ACMP will be provided annually in writing to Nova Energy, the Mackenzie District Council and DOC for a minimum of five years, with a final report provided within three months of the completion of monitoring.

6.14.6 Trigger levels

The following trigger levels apply:

- The injury or mortality of one Nationally Critical or Nationally Endangered species during the monitoring period.
- The injury or mortality of two Nationally Vulnerable or Nationally Increasing birds within one survey, or of three cumulatively within any consecutive 12-month period.
- The injury or mortality of three At Risk birds within one survey, or of five cumulatively within any consecutive 12-month period.
- The injury or mortality of five Not Threatened indigenous birds within a survey, or of 15 cumulatively within any consecutive 12-month period.

6.14.7 Adaptive management

Where a trigger level identified in Section 6.14.6 is reached, the following adaptive management protocol must be followed. Adaptive management responses should be structured as a tiered escalation rather than a single fixed threshold.

- Under such a structure, the first recorded trigger breach requires:
  - Immediate notification – DOC, Te Rūnanga o Ngāi Tahu, Te Rūnanga o Arowhenua, Te Rūnanga o Waihao, Te Rūnanga o Moeraki, and Mackenzie District Council must be notified within 48 hours of becoming aware of the breach.
  - Investigation – An SQAE must investigate the mortality event and prepare a draft report within 15 working days. The report must identify likely causes, any further monitoring required, and possible collision prevention or deterrent measures.
  - Review and certification – The draft report is circulated to DOC and Te Rūnanga o Ngāi Tahu, Te Rūnanga o Arowhenua, Te Rūnanga o Waihao, Te Rūnanga o Moeraki for comment, then submitted to Council for certification along with responses to those comments.
  - Additional mitigation – If the investigation identifies further collision prevention, deterrent, or monitoring measures, the AMP and/or ACMP will be updated within 60 working days to implement those measures.

- Should a further trigger breach occur in the same or a subsequent year despite those measures, the following is required:
  - Immediate notification, investigation and review as set out above; and
  - Additional and more substantial management changes would be required as recommended by the SQAE.

- Should a further trigger breach occur, the same approach must be implemented, including the option to cease operation of the affected part of the site, up to and including decommissioning.

- A range of options are available to adapt the site to respond to a trigger level being met. The appropriate measures to be implemented shall be determined by the SQAE in response to the specific issue identified and may include:
  - UV paint on solar arrays or other structures. UV film or UV-reflective bands can reduce bird strike on windows by breaking up the reflection (Kagan et al. 2014, Swaddle et al. 2020) and should reduce bird strike on solar panels.

- Flags, streamers, or similar visual deterrents on solar arrays. Flags and streamers can break up the reflection from the panels, reducing bird strike risk. These deterrents can also be applied to buildings and structures if bird strikes are attributed to them.
- A grid of white, orthogonal or parallel lines may be required to further reduce the reflection of polarised light if the anti-reflective coating is not sufficient (Takács et al. 2024).
- Bird-balls or other flight diverters on transmission lines to reduce bird strike with transmission lines by increasing the visibility of the wires. These typically reduce collision rates, although the effectiveness of different devices varies between species (Jenkins et al. 2010). If there are ongoing collisions with wiring in specific areas that are fitted with bird-balls or other flight diverters, these should be moved underground.
- The implementation of any panel technologies or designs that are developed during the lifespan of the solar farm that could reduce bird strike risk.
- Removal of some panels. This may be required if bird strikes remain high in a specific area of the site after implementing of other management measures. For example, if a high level of bird strike persists in an area of the site despite other management methods, targeted panel removal should occur.
- If losses persist in an area, sections of solar panels may need to be removed.

The above approach will be secured via conditions of consent and will also be complemented by compensation as outlined in the following sections.

6.14.8 Evidence-based compensation

- For all species other than Nationally Critical or Nationally Endangered species:
  - In the event that trigger levels are breached and adaptive management responses are unsuccessful, compensation payments for the affected species must be required in the following situations:
    - If a trigger level is breached two further times in a year for Nationally Vulnerable or Nationally Increasing species.
    - If a trigger level is breached three further times in a year for At Risk species.
    - If a trigger level is breached five further times in a year for Not Threatened species.
- For Nationally Critical or Nationally Endangered species:
  - Compensation is payable immediately if a trigger level (i.e. a strike of one bird, including injury and fatality) is reached and is calculated in accordance with Section 6.14.10 below.
- Funding should be allocated to projects that aim to increase reproductive success, enhance adult survival, and/or improve knowledge of these species. These include:
  - Project River Recovery (a braided river monitoring and restoration initiative) or wetland restoration initiatives.
  - Community-run conservation initiatives such as predator control and monitoring projects along braided rivers.
  - GPS tracking of the species in collaboration with DOC and universities.
  - Grants for an MSc or PhD research to increase knowledge of the affected species, especially in the Mackenzie Basin. This could include GPS tracking or studies investigating nesting success.

6.14.9 Population Viability Analyses

The quantum and form of biodiversity compensation will be explicitly linked to quantified ecological risk as determined through Population Viability Analyses (PVAs) using Vortex.

This approach ensures that compensation is:

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

PVAs can be used to model changes to a species or population over time. PVAs have been conducted using Vortex Analysis software to determine population-level affects if bird strike of Threatened and At Risk avifauna species were to occur (Wildland Consultants 2026e).

Information required to conduct PVAs includes:

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

The following list provides the bird species included in the PVA (Wildland Consultants 2026e) and their conservation status according to Robertson *et al*. (2021):

- Kakī/black stilt (*Himantopus novaezelandiae*, Threatened – Nationally Critical).
- Matuku-hūrepo/Australasian bittern (*Botaurus poiciloptilus*, Threatened – Nationally Critical).
- Kōtuku/white heron (*Ardea alba modesta*, Threatened – Nationally Critical).
- Tarapirohe/black-fronted tern (*Childonias albostriatus*, Threatened – Nationally Endangered).
- Pūteketeke/Australasian crested grebe (*Podiceps cristatus australis*, Threatened – Nationally Vulnerable).
- Māpunga/black shag (*Phalacrocorax carbo novaehollandiae*, At Risk – Relict).
- Pohowera/banded dotterel (*Charadrius bicinctus bicinctus*, At Risk – Declining).
- Tarāpuka/black-billed gull (*Chroicocephalus bulleri*, At Risk – Declining).
- Tōrea/South Island pied oystercatcher (*Haematopus finschi*, At Risk – Declining).

6.14.10 Proposed compensation calculation

Compensation funding should be calculated based on the amount of money theoretically required to recruit a bird of a similar age/quality (if known) into the population. A draft example for kakī/black stilt is provided below.

For kakī/black stilt, our formula is based on calculations of the amount spent on captive rearing, monitoring of the wild population, and pest animal and plant control. It assumes that the current population of 143 kakī/black stilt is maintained. The amount spent comes from the following reports and are inflation adjusted to address the current economic conditions:

- Raising captive kakī/black stilt to be released into the wild through the Kakī Recovery Programme (Anker et al. 2009). This report includes the expenditure for reared birds (93 birds at that time) and maintaining the wild population (82 adults at that time) through monitoring and pest/weed control.
- Estimated additional predator control and weed control, based on expenditure from Project River Recovery (Nelson et al. 2025) and Te Manahuna Aoraki (2021). These reports include maintaining the wild population of 143 birds through monitoring and pest animal and plant control.

Table 2 – Example calculations of the proposed evidence-based compensation for kakī/black stilt, with inflation adjustments updating the original costs to current economic conditions.

Task	Total Cost ($) per Annum	Cost per Kakī ($)	Cost per Kakī, Inflation Adjusted ($)
Kakī Recovery Programme (captive)	148,500.00	1,596.77	2,434.07
Kakī Recovery Programme (wild)	313,500.00	3,823.17	5,827.92
Predator control	1,351,696.00	9,452.42	10,761.30
Weed control	901,131.00	6,301.61	7,174.20
Total Cost per Kakī			**$26,197.49**

Based on these calculations, for a kakī/black stilt up to the age of approximately 1.5 years, a compensation payment of $26,200 should be provided. This will cover the estimated costs of raising a juvenile kakī/black stilt in captivity and a year's worth of predator and weed control to support it in the wild post-release.

As most kakī/black stilt are banded and their ages known by DOC, compensation payments should be increased for older birds. Older individuals are generally more experienced breeders and have already had more resources invested in them (e.g. predator control, monitoring).

For example, compensation for a four-year-old kakī/black stilt known to be an experienced breeder should be calculated by adding an additional 2.5 years of predator and weed control to the compensation amount provided above. This would equate to:

- Four-year-old kakī/black stilt = (initial compensation payment) + (2.5 years of predator control) + (2.5 years of weed control) + (2.5 years of Kakī Recovery Programme management in the wild).
- Four-year-old kakī/black stilt = 26,197.49 + (2.5 x 10,761.30) + (2.5 x 7,174.20) + (2.5 x 5,827.92) = $85,606.04.

A main limitation of this method relates to the available data. While the total expenditure of Project River Recovery and Te Manahuna Aoraki are known, it is not possible to determine the following:

i) the specific amount of expenditure from each program that was used on predator and plant control, and

ii) the amount of expenditure spent on predator and weed control that directly benefited kakī/black stilt.

As such, several assumptions have been made:

- That the full amount of Project River Recovery and 75% of Te Manahuna Aoraki expenditure benefited kakī/black stilt. This assumption was made because Project River Recovery is focused solely on braided rivers, the key habitat for kakī/black stilt. Te Manahuna Aoraki is a wider project focusing on the Mackenzie Basin and the Aoraki/Mount Cook National Park, which conducts work in areas outside of braided rivers.
- That of the amount of expenditure that benefitted kakī/black stilt from each programme, 60% was used for predator control and 40% for weed control. This estimate was based on the labour-intensive methods of predator control typically implemented in these areas. Weed control can occur aerially and may require less frequent follow-up control.

It is expected that kakī/black stilt will have the highest compensation value of the avifauna species included in the trigger levels, due to the large amounts of predator and weed control that occur to support the wild population and the effort expended in the captive rearing programme. Therefore, as

a conservative approach, the compensation quantum calculated for kakī/black stilt should be applied to other Critically Threatened and Nationally Endangered species. Linking compensation payments to the costs associated with producing an individual of similar age and/or value to the bird that was killed will assist in ensuring compensation is targeted to actual effects.

7.0 Summary of Avifauna Management and Timing

By following the prescribed recommendations (Table 3), any potential effects on indigenous avifauna arising from activities during construction and subsequent operation of the proposed solar farm can be appropriately managed.

Table 3 – Summary of avifauna management procedures to be undertaken during the development and operational phases of the solar farm development.

Action	Timing of Implementation	Reference Section
Planning Phase		
Avoid wetlands, rivers and river deltas with setbacks	Complete (solar farm design includes 20-metre setbacks for all wetlands and rivers)	6.4
Design panel array to minimise risk of bird collision	Complete (solar farm plan has incorporated several design features to minimise bird collision risk)	6.7
Plan construction to occur outside of the avifauna breeding season (1 July-1 March inclusive) where possible	During works scheduling	6.2
Identify potential areas where bare ground may be created and plan enhancement with short-stature vegetation	While planning construction	6.5
Pest mammal management	Commencing before development begins, continuing throughout the life of the project	6.8
Plan and implement speed limits	Before construction begins	6.10
Pre-works nest and chick survey	No more than eight days prior to works commencing	6.3
Development Phase		
Avifauna surveys	Between 1 July and 1 March inclusive, no more than eight days before works recommence after stopping for more than eight days, or no more than eight days before works begin in a new area/stage	6.3; 6.12
Incidental discovery protocol	Any time a nest, nesting bird, or injured bird is discovered	6.11
Establishment of setbacks for nesting birds	Any time protected nesting birds are found on site	6.4
Monitor birds on site	Monthly for six months prior to construction, then weekly during construction	6.13
Avoid creation of bare ground	During construction	6.5
Enhance any bare ground created with short-stature vegetation	Any time bare ground is created during construction	6.5
Reduce construction noise and vibration	During construction, particularly when using heavy machinery	6.6
Solar Farm Operational Phase		
Monitor birds on site	Fortnightly for at least five years post-construction	6.13
Pest mammal management	Continuing throughout the life of the project	6.8

Action	Timing of Implementation	Reference Section
Record bird carcasses	Any time a bird carcass is found throughout the life of the solar farm, it will be recorded.	6.14.2, 6.14.3
Systematic carcass monitoring	Fortnightly for a minimum of five years post-construction.	6.14.3, 6.14.4
Report injuries or mortalities to Department of Conservation	Any time an injured or dead bird from a Threatened or At Risk species is discovered.	6.14.2, 6.14.3
DOC, Te Rūnanga o Ngāi Tahu, Te Rūnanga o Arowhenua, Te Rūnanga o Waihao, Te Rūnanga o Moeraki, and Mackenzie District Council notified within 48 hours of becoming aware of the exceedance.	Any time an injured or dead bird from a Nationally Critical or Nationally Endangered species is discovered; or two or more injured or dead Nationally Vulnerable or Nationally Increasing, three or more At Risk, or five or more Not Threatened birds are discovered in one survey; or three or more injured or dead Nationally Vulnerable or Nationally Increasing, five or more At Risk, or 15 or more Not Threatened birds discovered within a 12-month period.	
Investigation and report by suitably qualified avifauna ecologist (SQAE) and adaptive management	Any time an injured or dead bird from a Nationally Critical or Nationally Endangered species is discovered; or two or more injured or dead Nationally Vulnerable or Nationally Increasing, three or more At Risk, or five or more Not Threatened birds are discovered in one survey; or three or more injured or dead Nationally Vulnerable or Nationally Increasing, five or more At Risk, or 15 or more Not Threatened birds discovered within a 12-month period.	6.14.6, 6.14.7
Adaptive management	Any time an injured or dead bird from a Nationally Critical or Nationally Endangered species is discovered; or two or more injured or dead Nationally Vulnerable or Nationally Increasing, three or more At Risk, or five or more Not Threatened birds are discovered in one survey; or three or more injured or dead Nationally Vulnerable or Nationally Increasing, five or more At Risk, or 15 or more Not Threatened birds discovered within a 12-month period.	6.14.6- 6.14.10
Update AMP and ACMP	Update the AMP and ACMP if additional collision prevention, deterrence, or monitoring measures identified as being required during review if a trigger level exceedance occurs.	6.14.7
Evidence-based compensation	Provide compensation funding if a trigger level (i.e. a strike of one bird, including injury and fatality) is reached for a Nationally Critical or Nationally Endangered avifauna species.	6.14.8

References

Anker, T., Hanson, T., Leutner, B., & Robertson, K. (2009). *Kaki (black stilt) cost-benefit analysis: When should egg pulling cease?* Wildlife Management Report Number 228. University of Otago. 29pp.

Avery, M. L., & Werner, S. J. (2017). *Frightening devices.* USDA National Wildlife Research Center – Staff Publications. University of Nebraska. 17pp.

Jenkins, A. R., Smallie, J. J., & Diamond, M. (2010). Avian collisions with power lines: A global review of causes and mitigation with a South African perspective. *Bird Conservation International, 20,* 263-278.

Kagan, R. A., Viner, T. C., Trail, P. W., & Espinoza, E. O. (2014). Avian mortality at solar energy facilities in Southern California: A preliminary analysis. *National Fish and Wildlife Forensics*, 1–28.

Kosciuch, K., Espinoza-Riser, D., & Mitchell, M. (2025). Lake effect or data mirage? How accounting for technology differences at utility scale solar energy facilities can change data interpretation. *Environmental Research Letters, 20,* 124023.

Nelson, D., Turner, S., Keys, F., Goodman, T., Hooker, T., & Schori, J. (2025). *Project River Recovery Annual Report 2025.* PRP Internal Report 2025/01. 40pp.

Robertson, H. A., Baird, K. A., Elliott, G. P., Hitchmough, R. A., McArthur, N. J., Makan, T. D., Miskelly, C. M., O'Donnell, C. J., Sagar, P. M., Scofield, R. P., Taylor, G. A., & Michel, P. (2021). *Conservation status of birds in Aotearoa New Zealand, 2021*. Department of Conservation.

Swaddle, J. P., Emerson, L. C., Thady, R. G., & Boycott, T. J. (2020). Ultraviolet-reflective film applied to windows reduces the likelihood of collisions for two species of songbird. *PeerJ, 16*, https://doi.org/10.7717/peerj.9926

Takács, P., Száz, D., Bernáth, B., Pomozi, I., and Horváth G. (2024). Polarised light pollution of fixed-tilt photovoltaic solar panels measured by drone-polarimetry and its visual-ecological importance. *Remote Sensing, 16,* 1177.

Te Manahuna Aoraki (2021). *Te Manahuna Aoraki: 2021 Annual Report.* 33pp.

Waugh, J., Evans, M. W., Millar, C. D., & Lamberts, D. M. (2011). Birdstrikes and barcoding: Can DNA methods help make the airways safer? *Molecular Ecology Resources, 11,* 38-45.

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

Wildland Consultants (2026a). Draft terrestrial invertebrate management plan for Nova Energy Twizel Solar Farm. *Wildland Consultants Contract Report No. 7414a.* Prepared for Nova Energy Ltd. 28pp.

Wildland Consultants (2026b). Draft lizard management plan for proposed Nova Energy Twizel Solar Farm. *Wildland Consultants Contract Report No. 7414b.* Prepared for Nova Energy. 40pp.

Wildland Consultants (2026c). Draft biosecurity and vegetation management plan for Twizel Solar Farm. *Wildland Consultants Contract Report No. 7414d.* Prepared for Nova Energy. 17pp.

Wildland Consultants (2026d). Pest mammal management plan for Nova Energy proposed solar farm, Twizel. *Wildland Consultants Contract Report No. 6905.* Prepared for Nova Energy. 27pp.

Wildland Consultants (2026e). Avifauna Population Viability Analysis for Nova Energy Solar Farm at Twizel, Canterbury. *Wildland Consultants Contract Report No. 7414c.iii.* Prepared for Nova Energy. 54pp.

Wildlife Act 1953 (accessed 13 August 2026). Wildlife Act 1953 | New Zealand Legislation

Appendix 1

Site of the proposed Nova Energy solar farm, with avifauna observed during field visit December 2022 and important habitats for avifauna identified (reproduced from Wildland Consultants 2023)

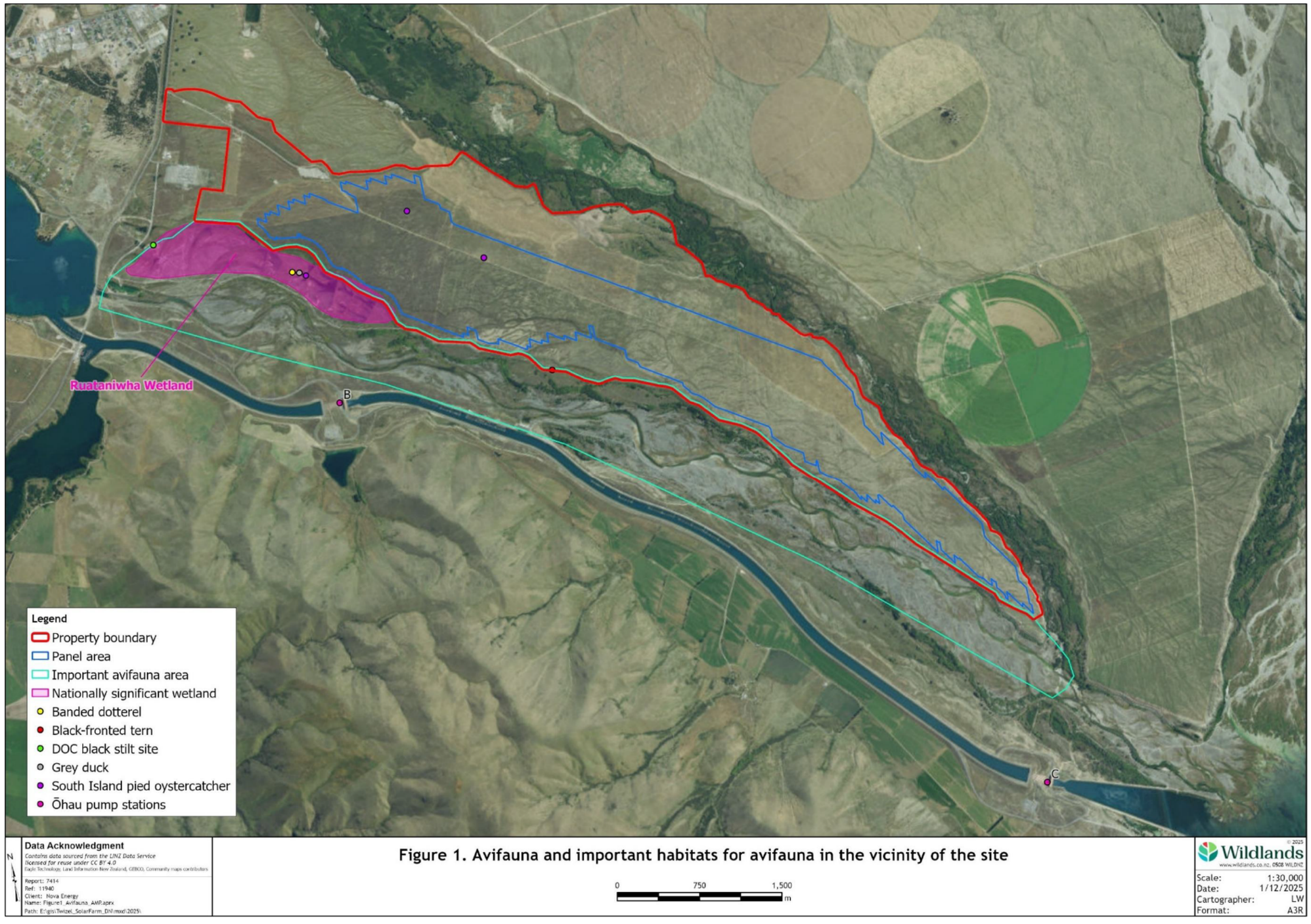

Figure 1. Avifauna and important habitats for avifauna in the vicinity of the site

Appendix 2

Bird species detected during the desktop assessment and site visit for the proposed Nova Energy solar farm

Common names, scientific names, and threat classification are from Robertson et al. (2021), and protection status from the Wildlife Act 1953.

Common Name(s)	Scientific Name	Threat Classification 2021	Likelihood of Presence at Site	Protection Status
Indigenous				
Kakī/black stilt	*Himantopus novaezelandiae*	Threatened – Nationally Critical	Highly likely	Protected
Kōtuku/white heron	*Ardea alba modesta*	Threatened – Nationally Critical	Possible	Protected
Matuku-hūrepo/Australasian bittern	*Botaurus poiciloptilus*	Threatened – Nationally Critical	Likely	Protected
Tarapirohe/black-fronted tern	*Chlidonias albostriatus*	Threatened – Nationally Endangered	Seen during visit	Protected
Kārearea/eastern falcon	*Falco novaeseelandiae novaeseelandiae*	Threatened – Nationally Vulnerable	Possible	Protected
Kawau tikitiki/spotted shag	*Phalacrocorax punctatus*	Threatened – Nationally Vulnerable	Unlikely	Protected
Pārera/grey duck	*Anas superciliosa*	Threatened – Nationally Vulnerable	Seen during visit	Protected
Pūteketeke/Australasian crested grebe	*Podiceps cristatus australis*	Threatened – Nationally Vulnerable	Unlikely	Protected
Taranui/Caspian tern	*Hydroprogne caspia*	Threatened – Nationally Vulnerable	Highly likely	Protected
Ngutu pare/wrybill	*Anarhynchus frontalis*	Threatened – Nationally Increasing	Likely	Protected
Kotoreke/marsh crake	*Zapornia pusilla affinis*	At Risk – Declining	Unlikely	Protected
Pīhoihoi/New Zealand pipit	*Anthus novaeseelandiae novaeseelandiae*	At Risk – Declining	Likely	Protected
Pohowera/banded dotterel	*Charadrius bicinctus bicinctus*	At Risk – Declining	Seen during visit	Protected
Pūweto/spotless crake	*Zapornia tabuensis*	At Risk – Declining	Possible	Protected
Tara/white-fronted tern	*Sterna striata striata*	At Risk – Declining	Unlikely	Protected
Tarāpuka/black-billed gull	*Chroicocephalus bulleri*	At Risk – Declining	Seen during visit	Protected
Tarāpunga/red-billed gull	*Chroicocephalus novaehollandiae scopulinus*	At Risk – Declining	Unlikely	Protected
Tōrea/South Island pied oystercatcher	*Haematopus finschi*	At Risk – Declining	Seen during visit	Protected
Kāruhiruhi/pied shag	*Phalacrocorax varius varius*	At Risk – Recovering	Possible	Protected

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

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

Appendix 3

Not threatened but protected ground-nesting bird species that are likely to be seen at the proposed Nova Energy solar farm

Common names, scientific name, and threat classification are from Robertson et al. (2021).

Common Name(s)	Scientific Name	Threat Classification 2021
Kāhu/swamp harrier	*Circus approximans*	Not Threatened
Pied stilt – black stilt hybrid	*Himantopus himantopus* × *novaezelandiae*	Not Threatened
Poaka/pied stilt	*Himantopus himantopus leucocephalus*	Not Threatened
Pūkeko/pukeko	*Porphyrio melanotus melanotus*	Not Threatened

Appendix 4 Avifauna Carcass Monitoring Programme

1.0 Introduction

Nova Energy is proposing to develop a solar farm east of Twizel township in the Mackenzie Basin. The site covers approximately 866 hectares, with the proposed solar panel area utilising approximately 565 hectares. The solar farm design incorporates a minimum of five-metre spacing between panel edges, anti-reflective coated front glass on panels, and 55-degree night rest position of panels. Infrastructure, such as fencing, substations, and cabling, will also be present on-site.

2.0 Rationale

A potential effect of solar farms on avifauna is the possibility of mortality or injury to birds from collision with solar panels and other on-site structures. A total of 66 bird species has been identified in the proximity of the proposed Nova solar farm based on a site visit, desktop survey, and expert evaluation. Of these, eight Threatened and 10 At Risk species are considered likely to be present on-site (Table 1). In addition, one Threatened (pūteketeke/Australasian crested grebe, *Podiceps cristatus australis*, Threatened – Nationally Vulnerable) and one At Risk (Australian coot, *Fulica atra australis*, At Risk – Naturally Uncommon) species have been included as they are likely to fly over the site while travelling between catchments and between overwintering and breeding sites. Both species fly at night, infrequently move between locations, and generally do not fly very high. This may increase their collision risk.

Table 1 – Bird species considered likely to occur within the proposed Nova solar farm near Twizel. Common names, scientific names, and threat classifications are from Robertson *et al.* (2021).

Common Name(s)	Scientific Name	Threat Classification 2021
Indigenous		
Kakī/black stilt	*Himantopus novaezelandiae*	Threatened – Nationally Critical
Kotuku/white heron	*Ardea alba modesta*	Threatened – Nationally Critical
Matuku-hūrepo/Australasian bittern	*Botaurus poiciloptilus*	Threatened – Nationally Critical
Tarapirohe/black-fronted tern	*Chlidonias albostriatus*	Threatened – Nationally Endangered
Kārearea/eastern falcon	*Falco novaeseelandiae novaeseelandiae*	Threatened – Nationally Vulnerable
Pārera/grey duck	*Anas superciliosa*	Threatened – Nationally Vulnerable
Taranui/Caspian tern	*Hydroprogne caspia*	Threatened – Nationally Vulnerable
Ngutu pare/wrybill	*Anarhynchus frontalis*	Threatened – Nationally Increasing
Pūteketeke/Australasian crested grebe	*Podiceps cristatus australis*	Threatened – Nationally Vulnerable
Kotoreke/marsh crake	*Zapornia pusilla affinis*	At Risk – Declining
Pihoihoi/New Zealand pipit	*Anthus novaeseelandiae novaeseelandiae*	At Risk – Declining
Pohowera/banded dotterel	*Charadrius bicinctus bicinctus*	At Risk – Declining
Pūweto/spotless crake	*Zapornia tabuensis*	At Risk – Declining

Common Name(s)	Scientific Name	Threat Classification 2021
Tarāpuka/black-billed gull	*Chroicocephalus bulleri*	At Risk – Declining
Tōrea/South Island pied oystercatcher	*Haematopus finschi*	At Risk – Declining
Kāruhiruhi/pied shag	*Phalacrocorax varius varius*	At Risk – Recovering
Kawaupaka/little shag	*Microcarbo melanoleucos brevirostris*	At Risk – Relict
Māpunga/black shag	*Phalacrocorax carbo novaehollandiae*	At Risk – Relict
Australian coot	*Fulica atra australis*	At Risk – Naturally Uncommon
Kōtuku ngutupapa/royal spoonbill	*Platalea regia*	At Risk – Naturally Uncommon

There are no reported studies that have undertaken collision monitoring for avian mortality at solar farms in Aotearoa New Zealand, and we are reliant on international literature (Anderson *et al.* 2025; Fleming 2025). As such, it is important that carcass monitoring is undertaken to evaluate the operational effects of solar farms on avifauna. A well-considered pre- and post-construction carcass monitoring programme is required to determine whether collisions are occurring and inform the management strategies outlined in Section 6.14.7 of the AMP.

The objectives of the Avifauna Carcass Monitoring Programme (ACMP) are to:

- Enable detection of bird collision with the solar arrays and ancillary infrastructure on-site (Section 3).

This ACMP has been prepared in collaboration between suitably qualified avifauna ecologists (SQAEs) and a suitably qualified biostatistician. It details the proposed methodology for mortality surveys, incidental carcass discoveries, and carcass detection and persistence trials. It discusses reviewing and reporting requirements, including methods for data storage and analysis, and provides mortality levels that would trigger management responses.

3.0 Proposed Methods

3.1 Mortality surveys

3.1.1 Introduction

Modelling was conducted by Proteus for the recently approved Haldon Station solar farm, situated approximately 3.5 kilometres southeast of the proposed Nova solar farm (Hamlin *et al.* 2026). Modelling was used to evaluate carcass detection rates under different scenarios, to inform the carcass monitoring regime (Hamlin *et al.* 2026). The modelling included variables such as survey coverage, timing between surveys, mortality rates, detection rates, persistence rates, and different bird size classes (Hamlin *et al.* 2026).

The statistical report prepared for Haldon Station has been reviewed by a biostatistician and assessed for this proposed site (Hamlin *et al.* 2026). The review found the modelling tested various collision monitoring scenarios appropriately, and that undertaking the same statistical modelling at a different site would produce the same results. However, upon completion of the searcher efficiency and carcass persistence trials proposed in this plan at the proposed Nova solar farm site, these data can be used

to retest the models and provide a more accurate assessment of the solar farm before construction starts. This assessment will allow for proactive changes in the monitoring plan to ensure the site is appropriately surveyed. For example, the assessment may indicate that additional survey points need to be added or relocated within the site, or that the survey frequency should be adjusted.

This monitoring plan adopts the majority of recommendations made based on the Haldon Station modelling (Hamlin *et al.* 2026). These recommendations are discussed in more detail in the remainder of this plan, but include:

- Conducting surveys at least fortnightly, across a minimum of 12.5% of the solar farm weekly or 25% fortnightly (Section 3.1.2).
- Recording the size of all carcasses found (Section 3.1.3).
- Maximising carcass detection and carcass persistence rates. This will be achieved by conducting carcass detection and persistence trials to determine whether the survey methodology requires adjusting (Sections 3.2 and 3.3).
- Reviewing monitoring processes on an annual basis (Section 4.3).
- Conducting carcass detection and carcass persistence trials prior to construction (Sections 3.2 and 3.3).
- Conducting multiple carcass detection and carcass persistence trials, each with a smaller number of carcasses (Sections 3.2 and 3.3).
- Adjusting the intensity of sampling based on expected detection and persistence levels (Section 3.5).
- Using trail cameras to obtain information about the species scavenging carcasses (Section 3.3.2).

Hamlin et al. (2026) also suggest that mortality levels should be simulated for surveys where no carcasses are detected. This recommendation is not proposed for adoption because it would not provide specific information to inform management practices and trigger levels.

3.1.2 Search area and survey timing

The Haldon Station modelling identified that between 12.5% and 25% coverage of a solar farm should be achieved per carcass monitoring survey over seven days or fortnightly, respectively (Hamlin *et al.* 2026). Search coverage and survey interval are interrelated and are dependent on surveyor availability. If weekly surveys were undertaken, more frequent surveys require greater staffing resources. Surveying 12.5% of the site in two sessions per month provides equivalent overall coverage to 25% fortnightly but may improve detection rates for small birds. For pre-construction monitoring and a robust initial assessment, we recommend 25% coverage per survey.

To maximise search efficiency and achieve a 25% coverage of Nova's site, a total area of 140 hectares should be surveyed (approximately 25% of the 565-hectare panel area) by two observers. This should be split into 28 sections, each five hectares in size.

The locations of the 28 sections selected for carcass monitoring should be determined using stratified random sampling once the solar farm plans have been finalised. This will involve dividing the total panel area into 113 five-hectare sections, each of which should be assigned a risk level (high, medium, or low) based on its location within the wider site and the presence or absence of ancillary infrastructure. Increased monitoring effort should be given to higher risk areas, with carcass monitoring proposed at 11 high-risk sections, 11 medium-risk sections, and six low-risk sections. Within each risk level, a random subsection of sampling areas will be selected.

Carcass monitoring will be conducted every 14 days to provide high-quality data throughout the pre-construction, construction, and post-construction phases (Hamlin *et al.* 2026):

a) Carcass monitoring will be completed for six months prior to construction commencing, in the same 28 sections that will be used for post-construction carcass monitoring. This will establish the baseline number of carcasses at the site, such as those resulting from bird strikes with existing fences, transmission lines, or other structures.

b) During construction, monitoring of completed sections will allow the assessment of birds being attracted to the site and of strikes on new structures or equipment. The monitored areas will be limited during construction due to practicality and health and safety constraints.

c) Following completion of construction, carcass monitoring will continue within the proposed 28 survey sections for a minimum of five years.

3.1.3 Search technique

Within each monitoring section, surveyors will walk along each row between panels, scanning for carcasses under and around each panel and other ancillary infrastructure to ensure each area is thoroughly searched (Hamlin *et al.* 2026).

All carcasses found near solar panels or other infrastructure will be considered solar farm casualties unless another cause of death is apparent. If any carcasses are detected during surveys, the location must be recorded with a handheld GPS. The carcasses will be photographed first in the position they were found in and then at multiple angles to aid in identification. Photographs of the surrounding area and infrastructure should also be taken for future reference.

The state of each carcass will be recorded using the following condition categories, following Johnson *et al.* (2002):

- **Intact** – a carcass that is completely intact, is not badly decomposed, and shows little or no sign of being predated or scavenged.
- **Scavenged** – an entire carcass showing signs of being fed on by a predator or scavenger, or a dismembered carcass (portions, e.g. wings, skeletal remains, legs, pieces of skin) in one location.
- **Feather spot** – 10 or more feathers at one location, indicating predation or scavenging. If only feathers are found, 10 or more total feathers or two or more primaries must be found to classify the observation as a casualty.

A Carcass Search Field Form (Appendix 1) will be filled out for each carcass found. This includes the following details:

- Date and time located.
- Identification number.
- Species (if known). This will also allow the size to be estimated.
- Age (if known).
- Sex (if known).
- Carcass condition (e.g. intact, scavenged, feather spot).
- Probable cause of death (if apparent).
- Distance from nearest solar panel or other infrastructure (e.g. transmission line, fence).
- Weather conditions at the time of collection.

A Wildlife Act Authorisation (WAA) will be required from the Department of Conservation (DOC) to allow for the collection and storage of any indigenous and, where applicable, exotic bird carcasses found within the Nova Solar Farm. A WAA has been applied for as part of NOVA's application. Obtaining a WAA prior to carcass monitoring commencing will ensure that any carcasses located on-site can be retained for identification and use in the carcass detection and persistence trials.

If a carcass cannot be identified *in situ*, the following options are available to identify it:

- DNA samples can be collected following the methodology outlined in Waugh *et al.* (2010). This involves using sterile sampling kits to collect blood or tissue samples, which are then sent to a laboratory for barcoding. DNA samples will also be taken if signs of bird strike are observed on panel arrays.
- Carcasses can be sent to Massey University Wildlife Post-mortem Service for necropsy and/or identification (if required) on the day of discovery or as soon as possible after the event.
- Feathers and photos of unknown carcasses can also be taken to museums for identification by comparing them with the museum's reference library.

If any carcasses of Threatened or At Risk birds are observed, the local DOC office must be contacted as soon as possible. The closest DOC office to the site is the Te Manahuna/Twizel Office (0800 275 362).

3.1.4 Incidental collision observations

There may be instances in which carcasses are found outside the search area or incidentally by other workers on-site. In these cases, the methods outlined in Section 3.1.2 will also be followed, including photographing the carcass, recording its location, and completing the Carcass Search Field Form (Appendix 1). The project avifauna ecologist (Dr Della Bennet) will be contacted immediately to assist in identifying the carcass and determining whether further action is required.

3.1.5 Data organisation

All mortality data will be recorded and stored in an Excel file, with separate tabs for carcasses detected during targeted carcass monitoring and for carcasses detected incidentally. Digital and paper copies of completed Carcass Search Field Forms will be held at the Christchurch Wildlands Office while monitoring is ongoing.

3.2 Carcass detection trials

3.2.1 Overview

International research has shown that bird size and observer efficiency are significant factors in carcass detection, with larger birds more likely to be detected and detection rates varying between observers (Ponce *et al.* 2010). Data are required to understand how bird size, observer, and environmental factors (such as vegetation type and height) affect detection rates (Morrison 2022). Detection rates from field trials are needed to accurately estimate the number of bird fatalities likely to be present and counted in surveys.

For these trials and with the granted WAA by DOC, carcasses of different-sized birds will be obtained from monthly collision monitoring at the solar farm. If insufficient wild bird carcasses are available, additional carcasses may be sourced from other places, such as poultry farms or road kills, with the source noted in the trials.

3.2.2 Search technique

Eight carcass detection trials are proposed, including four pre-construction trials within the solar farm footprint (i.e. seasonally), two trials in areas of solar farm footprint not yet under construction (e.g. summer and winter), and two trials after construction is completed within solar farm footprint but separate from the selected 28 sections used for mortality surveys (e.g. summer and winter). Each trial will include carcasses of each size class being placed in each main habitat type present.

Four pre-construction carcass detection trials are proposed to assess the variability in detection rates across different observers and different-sized bird species. These trials should be conducted quarterly to account for seasonal and temporal changes. These data will be used to retest the mortality survey models and further assess whether the proposed monitoring design will perform as expected. While completing pre-construction carcass detection trials, surveyors will also search for naturally occurring bird carcasses in the trial area. If any naturally occurring carcasses are found, their locations will be recorded using a hand-held GPS unit and, if suitable, they will be pinned to the ground and included in future detection or persistence trials.

Two additional carcass detection trials should be undertaken within the first year of construction in each habitat type within the solar farm footprint where construction has not occurred. This will help to account for the changes in the scavenging community due to changes in habitat (e.g. fencing, solar panels) and predator control at the site.

The final two carcass detection trials should occur after construction is completed, in habitat within the solar farm footprint that is not part of the fortnightly monitoring surveys. This will help account for changes in scavenging habits related to changes in habitat and predator control once disturbance from construction activity has ceased. From these results, recommendations can be made on how frequently repeat carcass detection trials should be undertaken over the life of the solar farm (e.g. annually or every five years). This may include undertaking surveys during specific months to identify changes in predator presence on site (e.g. during the breeding season). Additional carcass detection trials should be conducted at the recommended frequency.

Each trial will include 10-20 carcasses, including a combination of small, medium, and large birds. Conducting multiple trials with fewer carcasses per deployment will better reflect carcass rates at the site that are occurring before proposed solar farm development commences and will help to avoid overwhelming the local scavenger community. This approach will provide an understanding of how predators behaviour and react to carcasses and will inform how we assess any carcasses found on site if collisions occur with a solar panels or infrastructure.

Carcass detection trials will occur over three days, with each surveyor undertaking three trials during this period. Carcasses will be placed out in a random order early on the morning of the search day, and surveyors will not know the locations or exact number of carcasses present. Each surveyor will undertake the search independently, as it is important that detection rates accurately reflect the abilities of the people undertaking the fieldwork. Care will be taken to avoid leaving visible tracks, such as footprints in dirt or flattened grass, to avoid biasing the detection rates of following surveyors. Each carcass will be documented and photographed, and the location will be recorded using a handheld GPS unit. The carcass will be left in situ for the next surveyor to identify. Daily checks of the trial area will be undertaken over three days to identify any carcasses missed during the initial survey and to assess the condition of the trial carcasses that have been found. These daily assessments are part of the persistence trials (Section 3.3).

3.3 Carcass persistence trials

3.3.1 Overview

Carcass persistence trials account for losses due to decay and scavenging and are used both to estimate the number of fatalities likely to be present and counted in subsequent surveys, and to inform trial frequency.

3.3.2 Trial technique

Eight carcass persistence trials, each using 10–20 carcasses, are proposed to determine the persistence of different-sized carcasses over the course of a month, using the same carcasses used for the carcass detection trials (Section 3.2).

Once the birds used for the carcass detection trials have been located, they will be pinned to the ground. Daily checks will be completed over the first three days after placement to assess changes in carcass condition and any evidence of scavenging. Motion-sensing trail cameras will then be installed for a minimum of 25–27 days to monitor carcass persistence from Days 4–30, capturing daily data and recording any scavenging events triggered by motion. If predator control is being undertaken on-site, the camera footage will also help to assess the presence of predators. The Wildlands team will collect the cameras at the end of the month.

3.4 Drone surveys

The use of drone surveys and artificial intelligence (AI) is a promising method for carcass monitoring that could be used to supplement walk-through surveys (Section 3.1), depending on availability.

Trials using manual human analysis should be conducted to determine the feasibility and accuracy of drone usage for carcass surveys. A drone should be included in the initial carcass detection trials (Section 3.23.2) to determine detection accuracy and to assist in determining the required flight height and speed that would be required. This would involve flying pre-programmed autonomous transects across the trial area. A trained observer should monitor the live video feed on the remote-control during flight. If a potential carcass is detected, the drone operator should pause and hover above the object to take high-resolution still images and record GPS coordinates.

A trial should also be conducted during regular mortality surveys (Section 3.1) across the area of the solar farm that is not being surveyed using walk-through methods, using the methods determined during the carcass detection trials. An ecologist will retrieve any identified bird carcasses for formal identification upon the completion of the transect.

3.5 Analysis

Detection and persistence proportions will be obtained from the carcass detection and persistence trials for each size class.

As discussed in Section 3.1.1, based on modelling conducted for the Haldon Station solar farm, it is anticipated that monitoring 25% of the proposed Nova solar farm every 14 days would be suitable (Hamlin *et al.* 2026). However, once quantitative values for searcher efficiency and carcass persistence rates from the proposed trials have been assessed, the modelling will be re-evaluated. Adjustments to site coverage and sampling intervals will be made if required.

Carcass detection and persistence rates, plus associated estimates of uncertainty, can be applied to field recovery rates to predict collision rates. A Monte Carlo analysis or other appropriate analytical

approach can be used to determine the uncertainty in the mortality estimates, based on uncertainties from the trials (Boffa Miskell 2019).

4.0 Reporting and Reviews

At the end of each year (e.g. April), a review of the carcass monitoring programme will be undertaken, ensuring that the avifauna breeding season (September to March) falls within a single reporting year. The purpose of these reviews is to critically analyse results to determine if the programme designs are appropriate. This will include reviewing the spatial coverage of the programme.

Annual reviews of the monitoring programme will also allow for new technologies to be considered that may become available or more achievable part-way through monitoring. For example, advances in drone technology could enable more effective monitoring and carcass discovery through AI software.

A spatial review of the carcass monitoring programme would involve mapping the sites where mortalities have occurred. If certain areas of the solar farm or certain types of infrastructure result in more collisions than others, it may be appropriate to survey additional areas in the vicinity or to make other adjustments to the survey effort. Alternatively, as more accurate estimates of detection and carcass persistence rates are obtained, the Avifauna Carcass Monitoring Programme (ACMP) can be refined and further tailored to the Nova solar farm site.

Results of the ACMP will be provided annually in writing to Nova Energy, the Mackenzie District Council, and DOC for a minimum of five years. The annual monitoring report shall:

1. Present, summarise, and analyse the data collected in the preceding years;
2. Report on the operation of the Nova solar farm and its effects on avifauna; and
3. Outline any adaptive management measures that have been undertaken. Recommendations will also be provided if the surveying period needs to be extended.

A final report will also be provided to Nova Energy, the Mackenzie District Council, and DOC within three months of the completion of the monitoring. This final report shall outline all management measures undertaken and summarise their outcomes, including whether they were effective at reducing bird collisions or whether additional measures were required.

References

Anderson, C. M., Hopkins, A. P., & Anderson, J. T. (2025). Assessing the impact of solar farms on waterbirds: A literature review of ecological interactions and habitat alterations. *Conservation*, *5*(1). https://doi.org/10.3390/conservation5010004

Anker, T., Hanson, T., Leutner, B., & Robertson, K. (2009). *Kaki (black stilt) cost-benefit analysis: When should egg pulling cease?* Wildlife Management Report Number 228. University of Otago. 29pp.

Boffa Miskell (2019). *Waverley Windfarm bird collision monitoring plan methodology.* Prepared for Tilt Renewables Limited. Boffa Miskell Limited Contract Report No. W18053-002. 50pp.

Fleming, P. A. (2025). All that glitters – Review of solar facility impacts on fauna. *Renewable and Sustainable Energy Reviews*, *224*, 115995. https://doi.org/10.1016/j.rser.2025.115995

Hamlin, T. J., Jones, T. T., & MacKenzie, D. I. (2026). *Statistical advice for a solar power installation at Haldon Station, Canterbury, New Zealand.* Prepared for Lodestone Energy. Proteus Client Report No. 219.

Johnson, G. D., Erickson, W. P., Strickland, M. D., Shepherd, M. F., Shepherd, D. A., & Sarappo, S. A. (2002). Collision mortality of local and migrant birds at a large-scale wind-power development on Buffalo Ridge, Minnesota. *Wildlife Society Bulletin 30*(3), 879-887.

Morrison M. (2002). Searcher bias and scavenging rates in bird/wind energy studies. National Renewable Energy Laboratory. Golden, Colorado, USA. 9 pp.

Nelson, D., Turner, S., Keys, F., Goodman, T., Hooker, T., & Schori, J. (2025). *Project River Recovery Annual Report 2025.* PRP Internal Report 2025/01. 40pp.

Ponce, C., Alonso, J. C., Argandoña, G., García Fernández, A., & Carrasco, M. (2010). Carcass removal by scavengers and search accuracy affect bird mortality estimates at power lines. *Animal Conservation, 13,* 603-612. https://doi.org/10.1111/j.1469-1795.2010.00387.x

Robertson, H. A., Baird, K. A., Elliott, G. P., Hitchmough, R. A., McArthur, N. J., Makan, T. D., Miskelly, C. M., O'Donnell, C. J., Sagar, P. M., Scofield, R. P., Taylor, G. A., & Michel, P. (2021). *Conservation status of birds in Aotearoa New Zealand, 2021*. Department of Conservation. https://www.doc.govt.nz/globalassets/documents/science-and-technical/nztcs36entire.pdf

Te Manahuna Aoraki (2021). *Te Manahuna Aoraki: 2021 Annual Report.* 33pp.

Waugh, J., Evans, M. W., Millar, C. D., & Lamberts, D. M. (2011). Birdstrikes and barcoding: Can DNA methods help make the airways safer? *Molecular Ecology Resources 11:* 38-45.

Carcass Search Field Form – Nova Solar Farm

NOVA SOLAR FARM – CARCASS SEARCH FIELD FORM					
Please fill out all details above the heavy line for each site searched, even if no carcasses are found. All details below the line are required if a carcass is found; one form per carcass					
Observer:	**Date:**	**Start time:**	**Finish time:**		
Section identifier:					
Vegetation	**Description** (incl. vegetation type):				
	Average height:	**Density:** Very dense / Dense / Moderate / Sparse / Very sparse			
Temperature	**Wind direction/speed:**	**Humidity:**			
Search purpose (e.g. scavenger trial, monitoring, incidental find):		**Search completed:** Yes / No			
Ground disturbance: low, moderate, high					
Weather conditions in last 5 days:					
Comments:					
Carcass Details	**Time:**	**Coordinates:**	**Substrate:**		
Distance from nearest solar panel (and other infrastructure, if present):					
Species name:	**Age/sex:**				
Photo taken (attach to form):					
Carcass condition: Intact, Scavenged, Feather spot	**Describe:**				
Estimate the age of the carcass (tick category):	**<24 hours**	**1–3 days**	**>3 days**	**Other**	
Other notes (incl. presence of stock, or other factors affecting results):					
Further actions required: 1. Place carcass in sealable bag, write the location, date, and species on bag with marker pen, double-bag and wrap in newspaper, then take to freezer at site office as soon as possible. 2. One form will be completed for each carcass found, as well as searches that do not result in a carcass. **3.** Please attach photograph to this form.					

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