West Melton Land Feasibility Assessment: Ecology

Prepared for

Environment Canterbury

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Limitations:

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Executive Summary

Canterbury Regional Council (Environment Canterbury) is investigating the feasibility of using Council-owned leasehold land for the development a solar farm. The land is situated in the West Melton Reserve Area and covers approximately 2,672 ha of predominantly farmed land split over 9 separate leasehold blocks. A component of the feasibility assessment is evaluating the ecological sensitivity of the area to the construction and operation of solar farm infrastructure.

Pattle Delamore Partners (PDP) conducted a review of existing ecological information including reports and memorandums commissioned or authored by Environment Canterbury staff. This information was supplemented by publicly available databases and third-party reports. The desktop review was followed by a two-day site walkover by PDP ecologists to verify published records. High-level ecological values were mapped and then risks to these values assigned based on construction-phase and operational effects likely to occur with instalment of solar arrays.

Broadly, the potential development area consists of land ranging in low ecological value to high ecological value. High value areas contain some of the best examples of indigenous dryland vegetation in the district including rare and threatened species that provide essential habitat to indigenous fauna. Some communities are actively managed through plant maintenance and the control of browsing mammals. Moderate value land contains threatened plant communities, but also exotic vegetation that provides habitat for indigenous fauna including indigenous reptiles. Low value land is predominantly exotic grassland but may contain small areas significant flora and fauna. Sections of the Paparua Water Race Network have been situated at the site for over 100 years and support communities of indigenous fish and invertebrates.

The construction and operation of infrastructure for the purpose of generating solar electricity can potentially cause numerous impacts on ecological values if not managed appropriately. This includes the impacts from earthworks and vegetation clearance on habitats and significant flora and fauna, and the enduring impacts of landform changes and structures on habitat availability and quality, hydrology, and wildlife movement and behaviour. These effects may occur both within the boundaries of the land area developed, but also neighbouring ecosystems that are connected to the land.

The majority of the moderate and high value land is situated in the eastern extent of the land area of interest. Development of this land should be avoided in order minimise impacts on significant flora and fauna. This also applies to adjacent low value areas to avoid the creation of adverse edge effects. Pathways for minimising and remedying adverse effects of development are highly unlikely for areas where habitats for rare and threatened species floral species are

present, whereas losses of habitat from the clearance of exotic vegetation may be able to be mitigated and/or offset. In the first instance, however, land with low ecological values in the western extent of the area should be prioritised for further investigations into the viability of developing a solar farm.

The findings of this assessment are a useful first step to evaluating the high-level viability and options for potentially developing the land. However, further investigations will require finer resolution assessments of ecological values and effects as guided by more detailed works footprints, construction methodologies and infrastructure designs. Ideally this would follow an iterative process whereby an environmentally design process is informed by the advice of ecologists.

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1.0 Background

Canterbury Regional Council (Environment Canterbury) has engaged Pattle Delamore Partners (PDP) to undertake a review of the ecological values of Environment Canterbury-owned land in West Melton in order to assess areas where having a solar farm installed may have negative impacts on ecology.

The land of interest ('the site') totals approximately 2,672 ha across nine blocks (Figure 1). These blocks are spread across multiple property parcels within the Waimakariri West Melton Reserve Area and are leased from Environment Canterbury for predominantly farming by long-term lease holders.

PDP undertook a desktop review any ecological assessments that have been carried out within the blocks, and to understand the known ecological values. The review covered several internal Environment Canterbury memorandums provided to PDP, alongside publicly available reports and biodiversity data for the West Melton Reserves and other nearby ecological features. This was then validated during a site visit to the land of interest.

This report:

- Summarises the ecological history and known ecological information for the site;
- Identifies knowledge gaps;
- Highlights potential high-level impacts and risks to indigenous habitats and species from the construction and operation of a solar farm at the site;
- Recommends further investigations required to fill knowledge gaps to adequately assess the ecological risks associated with a solar farm on the land of interest; and,
- Identifies opportunities to manage ecological impacts.

Feature class shapefiles have been created using ArcGIS Pro (v.3.6.0) and provided to the Environment Canterbury alongside this report.

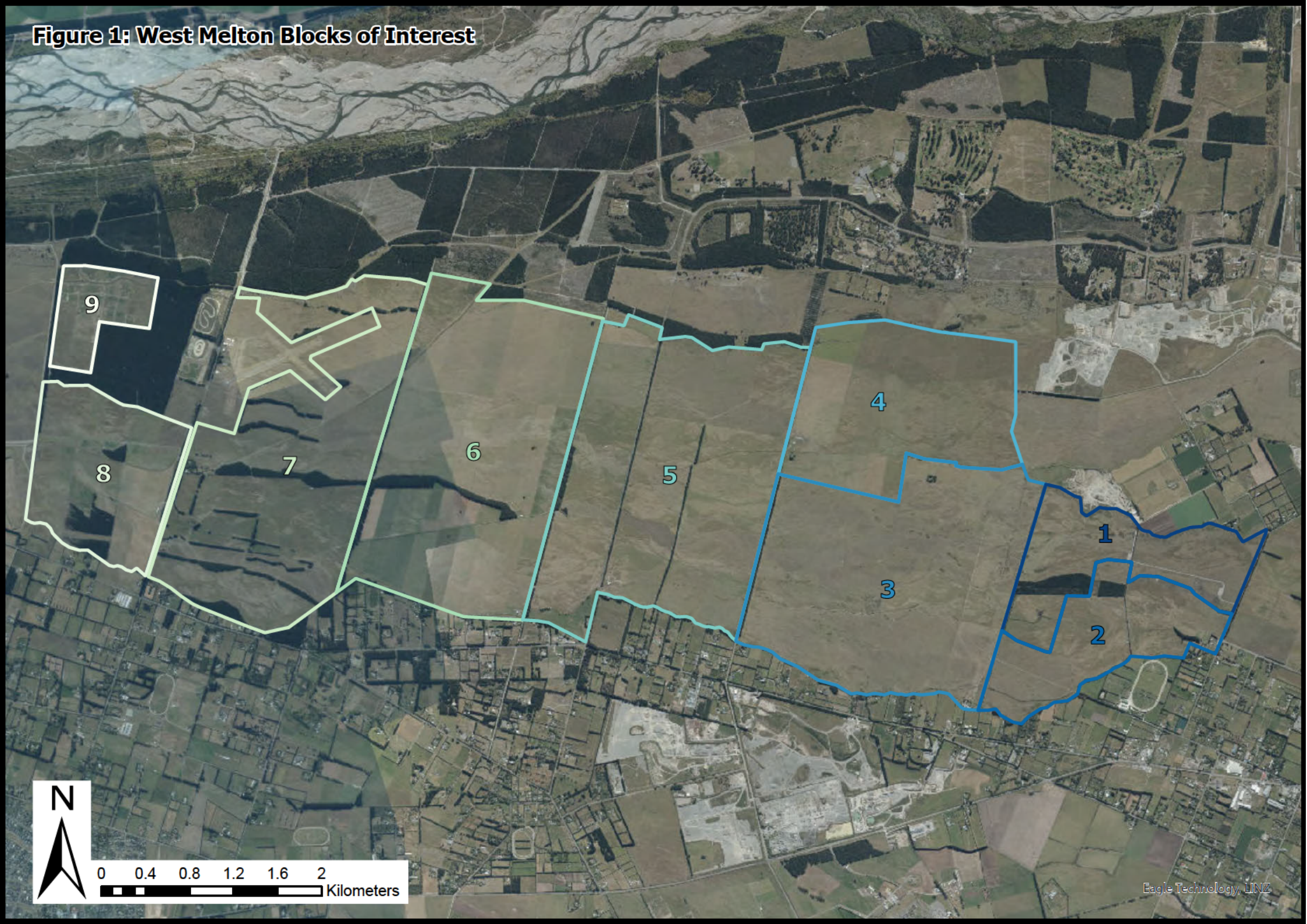
Figure 1: West Melton Blocks of Interest
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Kilometers
Eagle Technology, LINZ

2.0 Existing Information

2.1 Site Description and History

2.1.1 Overview

The site lies in the Low Plains Ecological District (McEwen, 1987), approximately 3 km south of the current extent of the Waimakariri riverbed. It was historically part of the river's floodplain (Environment Canterbury, 2010; Jack & Grove, 2024) and slopes gently from west to east (100 m to 40 m above sea level) with minimal north–south variation. Although some areas have been cultivated, historic river braid patterns, sand dunes, and terraces remain evident in aerial imagery (Figure 1).

The land blocks being investigated for potential solar infrastructure development are part of the West Melton Reserve. These, in turn, are part of the larger Waimakariri River Reserve which extends along both sides of Waimakariri River between the sea and the Gorge Bridge. The lands of both reserves are held in trust by Environment Canterbury "for the improvement of the waterways of Waimakariri River and the protection of certain land in Canterbury" (Environment Canterbury, 2010). Current land use is predominately dryland pastoral farming (sheep, with limited cattle and pigs) with some forestry and quarrying activities, and recreational clubs which have been excluded from the area being investigated.

2.1.2 Dryland features

The Low Plains Ecological District has undergone near-total loss of its original vegetation through fire, land development, and conversion to farming, forestry, and lifestyle uses. Widespread burning, clearing, and grazing has further altered the landscape. Since the 1930s, stopbanks have limited natural river processes and the area is now predominantly exotic grassland, with less than 1% of the original Low Plains plant communities remaining (Harding, 2009). Introduced animals and plants also inhibit the growth, spread, and recruitment of indigenous species. However, the shallow stony soils of the site still support indigenous vegetation and unique dryland communities among the exotic grasses and are highly significant for biodiversity.

2.1.3 Surface water features

Although river braids and associated springs were once characteristic of the site, surface water features are now largely limited to the Paparua Water Race Scheme owned and operated by Selwyn District Council (SDC). The water race network sources water from the Waimakariri River at Intake Road and supplies irrigation and stock drinking water to the surrounding area. Parts of the water race network were first constructed pre-1900 and have long supported

communities of aquatic flora and fauna (Demchick & McMurtrie, 2022). At least three branches of the race system flow west to east across the site. Christchurch City Council (CCC) also has a vested interest in the water race network, with some branches discharging into natural, spring-fed streams to the east.

2.1.4 Lease conditions

Conditions within leasehold arrangements for the land have helped protect the site from widespread agricultural and urban development. For example, indigenous trees are protected and certain activities, such as cultivation and irrigation, are regulated. Many of these conditions were based on an older school of ecological thinking and some leaseholds now considered to have low ecological value (see Section 4.0) once had higher biodiversity and indigenous species abundance when protective conditions were introduced to other blocks.

2.1.5 Protected areas

Some areas of the project site have been retired from leaseholds and fenced for hare and stock exclusion by Environment Canterbury. This was to protect the habitats and species within them. Identified in lease agreements as High-value Ecological Sites (HVES, Figure 2), these areas cover approximately 29 ha and contain a high proportion of rare and browsing-sensitive indigenous shrubs.

2.2 Ecological Values

2.2.1 Overview

The ecological context, history, and values of the blocks have been well documented in both internal and public reports. The ecological report prepared by the Environment Canterbury Land Ecology team (Jack & Grove, 2024) also provides species lists for each block (identified as “Areas” in the report). As noted by the authors, ongoing site inspections and community observations (e.g., iNaturalist records) continue to reveal additional species not previously identified in the literature. It is therefore probable that the site’s inventory of species remains incomplete.

Brief descriptions of key vegetation, habitats, and species that contribute to the site’s unique ecology, and the original assessments of ecological value (Figure 2 and Section 4.0), are provided in the sections that follow. These ecological features have varying degrees of sensitivity to activities associated with the development of solar infrastructure at the site and therefore inform the assessment of a potential impacts and risks to the ecosystem. Gaps in ecological information that require further investigation are addressed in Section 7.0.

2.2.2 Terrestrial values

Despite extensive modification, the site retains some characteristics of its original savannah-like cover (Jack & Grove, 2024; Harding, 2009) and supports

indigenous flora and fauna within a wider landscape of exotic vegetation. Historic braided river features are still evident and continue to shape vegetation community patterns despite a long period of separation from the active Waimakariri riverbed. Shallow stony areas still contain important indigenous vegetation, providing habitat for specialised species and communities adapted to harsh conditions, while deeper soils are dominated by exotic pasture grasses.

Kōwhai trees (*Sophora microphylla; S. microphylla* x *prostrata* hybrids) occur singly or in small groups scattered throughout the site. These are very old trees, originating from seed carried by the Waimakariri River from the upper catchment and deposited along historic flow paths on the plains (Jack & Grove, 2024).

New Zealand's rarest shrub, the plains olearia (*Olearia adenocarpa*), is confined to the Canterbury Plains, with most of its remaining population occurring within the West Melton Reserves, particularly inside the exclusion-fenced HVES (Figure 2). Other rare or threatened plant species known to occur within the area of interest include the Nationally Endangered *Crassula multicaulis*, and Nationally Vulnerable species *Geranium retrorsum* and dwarf broom (*Carmichaelia corrugata*) (Jack & Grove, 2024). Several species with a conservation status of Declining, and species rare or uncommon in the Canterbury plains, are also known to occur throughout the site.

Both indigenous and exotic habitats present in the areas of interest correspond to those preferred by many faunal species recorded in the area and local surrounds, particularly skinks. Canterbury grass skink (*Oligosoma* aff. *polychroma* Clade 4; Declining), southern grass skink (*Oligosoma* aff. *polychroma* Clade 5; Declining), and McCann's skink (*Oligosoma maccanni*; Not Threatened) are known to be present throughout the West Melton Reserves in dry grassland and shrublands.

Geckos have been observed in the protected kōwhai trees (Philip Grove, pers. comm.). These are likely to be Waitaha (*Woodworthia brunnea*; Declining) or jewelled gecko (*Naultinus gemmeus*; Declining) as both have been recorded in close proximity to the site (Davidge, 2025). The Nationally Vulnerable spotted skink (*Oligosoma lineoocellatum*) has been recorded from around Orana Park and may be more widespread here (Jack and Grove, 2024; Davidge, 2025). New Zealand's indigenous lizards are fully protected under the Wildlife Act 1953.

Most birds in the West Melton Reserves are introduced species, but indigenous species known to utilise the site include the Naturally Uncommon pīhoihoi (pipit, *Anthus novaeseelandiae*) and Declining tōrea (South Island pied oystercatcher, *Haematopus finschi*) and pohowera (banded dotterel, *Anarhynchus bicinctus*). Indigenous birds with a Not Threatened conservation status are common throughout the site and include pīwakawaka (fantail, *Rhipidura fuliginosa*), riroriro (grey warbler, *Gerygone igata*), tauhou (silvereye, *Zosterops lateralis*) and warou (welcome swallow, *Hirundo neoxena*).

The grassland environment and low stocking rates across the land blocks provide preferential habitat for pīhoihoi and plentiful nesting opportunities for other ground-nesting indigenous birds. Koekoeā (long-tailed cuckoo, *Eudynamys taitensis*; Nationally Vulnerable) have been also recorded near the areas of interest (Civil, 2025).

The area of interest support a range of indigenous invertebrates, particularly and particularly in stonier areas. The known species are characteristic of grasslands and cushion fields, many of which have become rare or locally extinct in many parts of their former range (Jack & Grove, 2024). Surveys of the West Melton Reserve and other reserves nearby have identified over 120 indigenous invertebrate species, including two rare species in the area of interest: the exquisite owlet moth (*Meterana exquisite*; Declining) and the flightless moth (*Eurythecta robusta*; Naturally Uncommon) (Jack & Grove, 2024).

2.2.3 Aquatic and riparian values

Extensive land modification and flood protection works have altered the surface water features present across the land blocks. Approximately four water races remain on the site that convey irrigation and stock water eastwards as sourced from the Waimakariri River which are part of the Paparua Race Network. Most of these waterways have straight channels typical of artificial races seen elsewhere in Canterbury, while others contain meanders reminiscent of a more natural stream system.

The long-standing existence of the water races onsite has meant that, over time, they have established stable, hard bottomed stream habitats capable of supporting a variety of indigenous flora and fauna. Alpine-fed Waimakariri River water in the races will also be of high quality and conducive to sustaining healthy aquatic communities. Many races are connected to downgradient stream systems that offer fish passage to and from site, and potentially include Ilam Stream, Paparua Stream, and Ōtukaikino River. However, the degree of surface water connection and presence of fish barriers between site water races and stream environments is unknown.

Few surveys of the aquatic ecological values are known to have occurred for site water races, however Demchick & McMurtrie (2022) undertook extensive field investigations of the Paparua Race Scheme including several sites on or nearby the West Melton Reserve land. Environmental DNA (eDNA) and electric fishing surveys found that upland bully (*Gobiomorphus breviceps*) are likely ubiquitous throughout the race network. This species is non-migratory and was recently classified as Naturally Uncommon (Dunn et al., 2025) but is widespread throughout Canterbury. Ōrea (long-fin eel, *Anguilla dieffenbachii*) was the other fish species found nearby with threat status of note (Declining), while tuna (short-fin eel, *A. australis*) and brown trout (*Salmo trutta*) were also caught or detected. No kākahi (freshwater mussels, *Echyridella menziesii*) have been found

in onsite water races, but these reside elsewhere within the Paparua Race Network.

In regard to vegetation values alongside the riparian margins of water races, Jack & Grove (2024) summarised the following:

"Recent surveys of water race habitats like those found with the area of interest found At-Risk-Declining plant species including Carex buchananii, Isolepis basilaris, Mentha cunninghamii, Ranunculus foliosus, Rytidosperma exiguum, and R. merum (Meurk, In Prep)[1].

More frequently observed, yet uncommon plants of riparian margins within the Low Plains context, included Centella uniflora, Schoenus pauciflorus, Carex petriei, C. breviculmis, Blechnum penna-marina, B. discolor, B. chambersii, Gonocarpus aggregatus, Lobelia angulata, Rorippa palustris, Nertera/Leptostigma, Haloragis erecta, Histiopteris incisa, Eleocharis gracilis, Glossostigma elatinoides, Plantago triandra, Polystichum spp.

Riparian areas containing naturally occurring Uncommon, At-Risk-Declining or Threatened species would be considered ecologically significant. As will all naturally occurring indigenous riparian vegetation within land environments where <10% of such vegetation remains; this includes all the Canterbury Plains (Walker et al., 2015)."

In summary, the water races present on the potential project site have been in existence for 100 years or more. Over this time, they have developed habitats that contain diverse aquatic and riparian communities that are further supported by connections to natural waterways. Despite the paucity of information that exists on water race communities, it is likely that the onsite water races contain at least moderate ecological values. This has seen them gain interest and protection from district and regional consenting authorities in the planning of recent development projects.

[1] We assume that this report is Meurk (2023)

3.0 Site Validation

A site visit was conducted on the 26th and 27th of November in order to validate the findings of the information review contained in Section 2.0 to the extent practicable. The visit also provided an opportunity to gain a first-hand understanding of the site's features and context, allowing observations of vegetation patterns, landform, and habitat conditions to inform and support conclusions and recommendations.

Photographs of key habitats and features are provided below to illustrate the site's context. In general, and noting the limited time available, the site visit confirmed the observations of reviewed surveys and assessments. These existing sources have therefore been relied upon for the ecological values mapping presented in Section 4.0 below. More detailed assessments of terrestrial and aquatic values would be required prior to, or during, the design-phase of any potential development of land within the site.



Photograph 1: Indigenous shrubs in the base of a historic river braid within a fenced HVES, Block 7.



Photograph 2: The dry grassland vegetation characteristic of the site, Block 9.



Photograph 3: Dwarf broom, Block 3.



Photograph 4: Native lizard (likely McCann's skink), observed within refugia built on the side of a river terrace to the north of Block 8.



Photograph 5: A water race bordered by black alder (*Alnus glutinosa*) and other exotic tree species, Block 8. Indigenous sedges and ferns were observed under the canopy.



Photograph 6: Mature kōwhai, observed within Waimakariri River Reserve, to the north of Block 5. This individual is characteristic of the trees found throughout the area.

4.0 Ecological Value Mapping

West Melton Reserves and the lease blocks of interest have been mapped by Environment Canterbury science staff into areas of high, moderate, and low ecological value (Figure 2; Jack & Grove, 2024). PDP acknowledges that this was not produced for the specific purposes of assessing the areas of interest for solar farm development.

A qualitative ranking approach accounts for the known ecological values as they are at a certain point in time and allows for a high-level prioritisation of the feasibility of solar farm development within the site. However, without a full Ecological Impact Assessment (EcIA), this reflects only one aspect of the potential impacts to local ecology – specifically, the value of habitat that may be lost if construction were to occur without appropriate consideration of these ecological features. The ranking infers the overall risk of development within these habitats, but it does not indicate how those risks are distributed. It may also overlook finer-scale values in areas that have not yet been surveyed in detail.

The ranking schemata on their own do not necessarily account for specific risks to more granular ecological features of the described values associated with the construction and operation of a solar farm. The 'moderate' ecological ranking in particular carries nuances not explicitly clarified in previous reports or advice. For example, some areas classified as moderate-value consist entirely of exotic vegetation, which has low-value from a native floristic community perspective, yet provides high-quality habitat for indigenous lizards. This may present opportunities for managing impacts and enhancing biodiversity in other low and moderate-value areas of the site. Conversely, effects management is increasingly challenging or unlikely in areas mapped as high-value, or in areas of moderate-value with higher vegetation and plant species values.

This report has retained the value rankings and mapping as contained in Jack & Grove (2024) as the basis for the overall feasibility assessment. In addition, it provides commentary on the potential impacts or effects to particular ecological aspects or features (e.g., lizards, habitats, birds, or invertebrates) and the risk of those impacts occurring for each aspect/feature included within each ranking.

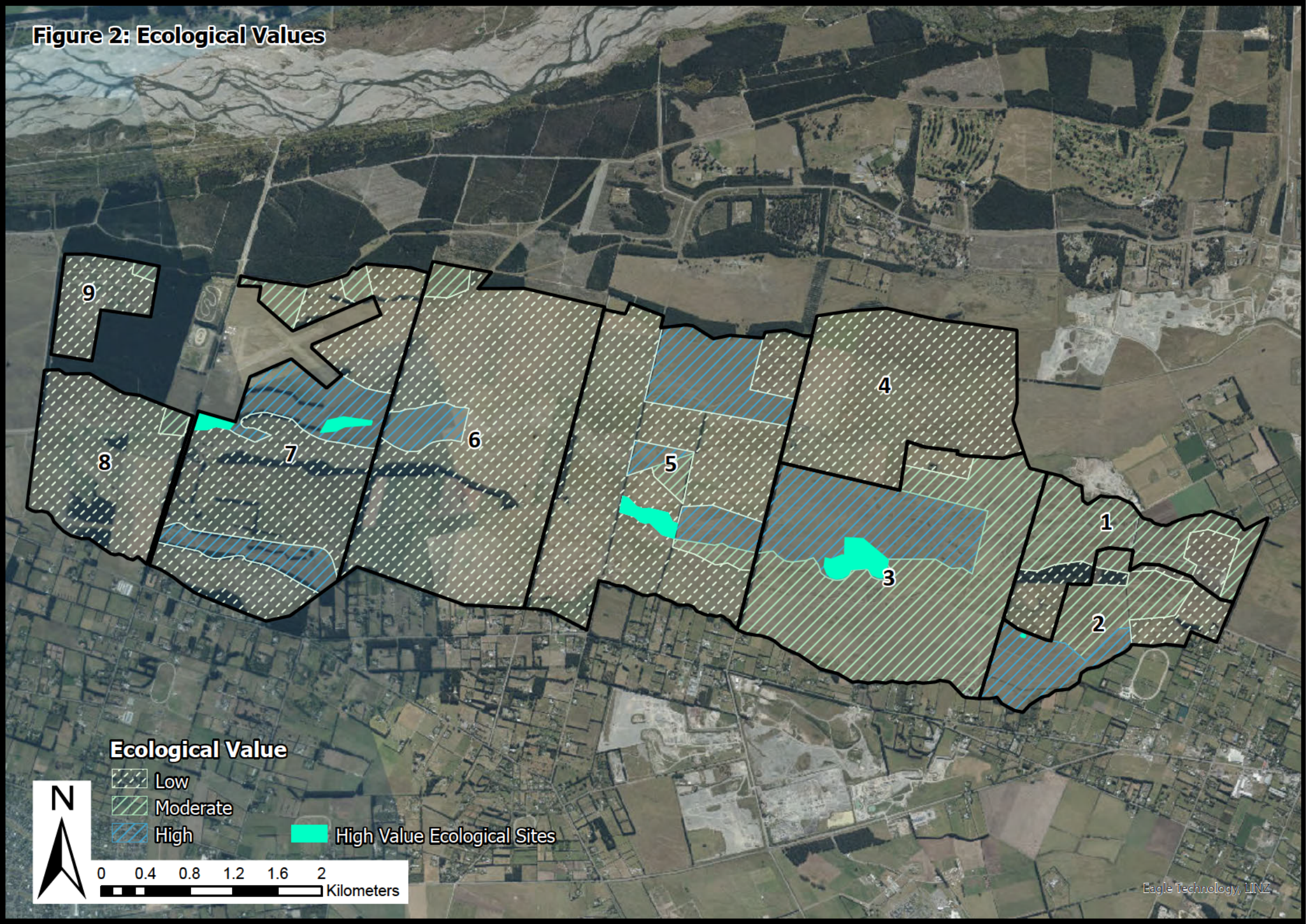
Figure 2: Ecological Values
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Ecological Value
Low
Moderate
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High Value Ecological Sites
N
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Kilometers
Eagle Technology, LINZ

5.0 Potential Impacts and Risks

5.1 Construction Phase

Solar farm construction activities may comprise of the following:

- Recontouring and stabilising land.
- Foundations for panel mounting systems, inverter stations, sub-stations, and overhead transmission lines.
- Trenching for underground cabling and infrastructure within the array and to connect the array to existing grid infrastructure.
- Site access upgrades or creation of roading.
- Stormwater controls.
- Fencing installations.
- Installation of panels to mounting systems.

These all present varying degrees of risk to indigenous ecosystems and species, irrespective of the ecological value rating of the site chosen for construction.

The range of potential ecological impacts from construction primarily include:

- Disturbance, removal, or modification of existing habitats.
- Vegetation clearing, grading, and installation of foundations, access tracks, and infrastructure. This can directly displace plants and animals, disrupt soil structure, and alter local hydrology.
- Noise, dust, and increased human activity during construction that can cause temporary disturbance to wildlife, potentially displacing birds, mammals, and invertebrates.
- Trenching for cables and other earthworks, which may fragment habitats and affect ground-dwelling fauna species.
- Accidental spills or sediment runoff that can impact water and habitat quality in aquatic systems.
- Earthworks, culverting and rerouting waterways that cause fish stranding, habitat loss and/or barriers to fish passage.

Time frames on these effects range from short-term to permanent and can become cumulative if not managed correctly.

5.2 Operational Phase

Once operational, solar farms continue to influence local ecology primarily through permanent habitat modification and altered site conditions. Panels and mounting systems can change light availability, soil moisture, and temperature beneath the arrays, affecting plant growth and invertebrate communities, and reducing habitat quality within the array. This may limit biodiversity and has cumulative effects on fauna species and assemblages which utilise those habitats, and on flora by limiting recruitment of local indigenous species. Access tracks, roads, and buildings represent permanent removal of vegetation and habitat, which cannot be recolonised to the same extent.

Permanent habitat and vegetation alteration may also cause ground nesting birds to avoid the site for breeding, increasing pressure for nesting space in nearby environments. Birds may also collide with panels, fencing, or overhead lines, and some waterbird species can be attracted to reflective surfaces, increasing strike risk (Diehl, 2024). Effects on waterways are generally confined to enduring effects of habitat loss and impedances to fish passage from instream structures (e.g., improperly installed road culverts) or permanent channel realignments.

Overall, the effects of operational solar farms on New Zealand biodiversity remain poorly understood. Ecological research from solar farm arrays internationally have highlighted the importance of avoiding construction near significant bird habitats or nesting sites, and of the need to find actions to minimise the risk of bird collisions with solar infrastructure (Diehl et al., 2024). Though there are reported benefits to birds from solar farms, there is uncertainty around that effect in a New Zealand context.

Land that is within 3 km of an aircraft runway is inside the bird strike management area as detailed in the Christchurch District Plan. In this area, land use activities (e.g., stormwater basins) that may attract birds are restricted and/or require specific bird strike risk management techniques. This will require working in consultation with Christchurch International Airport and Canterbury Aero Club to control and manage the threat of bird strikes.

5.3 Effects to Ecological Features by Ecological Value

In summary the highest risks to ecology from both construction and operational phases include, but are not limited to:

- The removal, disturbance, and/or substantial modification of indigenous habitats.
- Damage to, or loss of, protected indigenous trees or At Risk, Threatened, or locally rare plant species.
- Accidental harm to, or death of, indigenous fauna.

Effects will occur across all levels of habitat value to varying degrees. Table 1 below presents the magnitude and level of effects to ecological features.

The term 'ecological feature' used in the table refers to any component of the natural environment (e.g., vegetation, habitat, species, or ecosystem) that contributes to the ecological function, biodiversity, and/or environmental value of an area.

The terms 'magnitude' and 'level' have been used to describe the potential ecological effects before and after the application of the effects management hierarchy, respectively. As an example, the potential effect (**magnitude**) on lizards is initially considered high to very high across all habitats. However, the actual impact (**level**) is minimised through the application of the effects management hierarchy at the design, construction, and operational phases of development. Effects will also be moderated by the abundance of lizards in the immediate area, which requires more granular data for the specific site.

PDP acknowledges that this high-level assessment is based on a reasonably well-understood background on vegetation and flora at the site, but data on indigenous fauna are sparse and less comprehensive, particularly for invertebrate taxa (see Section 7.0). An EcIA would be required for development to provide more accurate assessments of the likelihood, type, and scale of impacts to ecology at local, regional, and national scales.

For this exercise, we have assumed that waterways have a uniform value of moderate to high across the entire site regardless of the high-level value rankings for each land block. Solar panel installations and associated infrastructure around waterways will likely have the same magnitude of effect on a like-for-like basis regardless of location. However, given the modified nature of the water races, it is anticipated that there will be a pathway for managing effects on aquatic values.

Low-value habitats are likely to experience an overall low to moderate magnitude of effect. These habitats are not primarily associated with indigenous vegetation, meaning the risk of losing remnants or regenerating areas of the original Low Plains communities is low. Therefore, the primary risk in these areas is to indigenous fauna, presenting opportunities to implement targeted management measures to avoid and minimise impacts.

Moderate-value habitats are more variable, reflecting either faunal values alone or a combination of indigenous vegetation and faunal values (as described in Section 4.0). These areas carry higher risk and require more detailed assessment, but careful management could enable construction in these areas.

High-value areas exhibit uniformly high ecological significance across all relevant features and are considered unsuitable for development.

Table 1: Potential magnitude and level of effects to ecology by ecological value

Ecological Value Rating	Low		Moderate		High	
Ecological Feature	**Magnitude**	**Level**	**Magnitude**	**Level**	**Magnitude**	**Level**
Indigenous terrestrial habitats*	Low to Moderate	Low	Low to High	Very Low to Moderate	Very High	Very High
Flora species	Low to Moderate	Very Low to Low	Moderate to High	Low to High	Very High	Very High
Lizards	High	Very Low to Low	High to Very High	Low to High	Very High	Very High
Birds	Low to Moderate	Very Low to Low	Moderate to High	Very Low to Moderate	Very High	High
Terrestrial invertebrates	Moderate	*Unknown*	Moderate to High	*Unknown*	Very High	Very High
Aquatic habitats and fauna	Low to High	Low	Low to High	Low	Low to High	Low

Notes:

** Risks of development to indigenous terrestrial habitat is limited to those associated with habitat loss and modification that have implications for all fauna. Habitat loss and modification is also incorporated into the risk assessment rows for individual fauna types (lizards, birds and terrestrial invertebrates), but these categories also consider the direct impacts of development on individuals including injury and mortality, behaviour etc.*

6.0 Effects Management

6.1 Overview

Effective ecological management is essential to avoid and/or minimise the impacts of solar farm developments on native habitats and species. Effects will be greatly influenced by the construction methodology, design, and layout of the solar farm. Factors that could influence the magnitude of ecological effects include the extent of vegetation removal, timing of works, spacing and arrangement of panels and rows, the type of panels used (fixed or tracking), and the angle of fixed panels.

6.2 Site-Specific Information

Because potential management options depend on both the solar farm design and the specific ecological features at risk within the chosen area, they need to be more tailored to potential effects than is possible at this stage. As highlighted in Section 7.0, there are gaps in the ecological data currently available for the blocks of interest. More detailed, site-specific data will be required once a development area is selected to enable a more robust assessment of appropriate management options.

Site specific information required would include details on:

- Lizard, bird, and invertebrate presence and abundance.
- Finer scale habitat and vegetation mapping.
- Connectivity between the site chosen and neighbouring habitats.
- Fish and invertebrate communities.
- Aquatic habitat values and connectivity to natural streams and other receptors.
- Identification of any wetlands associated with water races.

Designs and construction methods should be developed alongside ecological requirements. Results and information from other technical disciplines will also be required to fully inform the final assessment of ecological impacts.

6.3 Potential Management Options

Examples of management actions and strategies utilising the effects management hierarchy include:

- Avoid
  - Areas designated as high ecological value or those fenced as an HVES.
  - Water races.

- Any areas of high floristic value identified as a result of finer scale vegetation mapping in moderate-value environments.
- Mature indigenous trees, such as kōwhai.
- Avoidance and protection of palatable indigenous species identified within project footprints wherever possible.
- Consider pockets of open space in between arrays.

⁘ Minimise

- Production and implementation of a lizard management plan for any sites selected for development, including peripherals (e.g., substations, underground cabling to grid infrastructure, or overhead transmission lines).
- Production and implementation of a bird management plan for the construction phase.
- Include buffer zones between areas of high and moderate-value habitat and solar farm construction activities and final operational footprint.
- Include buffer zones between water races and solar farm construction activities and final operational footprint.
- Crossings over waterways should maintain fish passage in accordance with national guidelines and standards.
- Minimise sediment runoff and other discharges of contaminants to by implementing robust sediment and erosion controls.
- Limits impacts on aquatic fauna from the mechanical disturbance of waterways by implementing fauna salvage and translocation.

⁘ Remedy

- Invest in the ecological enhancement of high and moderate-value areas across the site.
- Fence and manage further areas of high and moderate-value habitat.
- Set aside additional areas from active land use where they will form a corridor between areas of high ecological value.
- Planting plans and management of indigenous species within the completed array to increase lizard and invertebrate habitat.
- If water races are to be realigned, create and enhance new habitat that is of greater value than that initially present through riparian planting and other measures.

- Offset or Compensate
  - As high-value areas should be avoided, and moderate-value areas mapped to prevent the loss of indigenous habitat, the need for offsetting or compensation measures should not arise.

7.0 Limitations and Gaps

The assessment presented in this report is indicative only and should not be considered a robust analysis of the effects of solar development within the land blocks in the absence of more detailed ecological assessments and information on detailed designs. It is based on a brief site walkover and the best information available either publicly or within Environment Canterbury.

The following highlights the limitations of the assessment and gaps in information that it is based on:

- Despite the growing number of solar projects, there is lack of New Zealand context for the operational effects of established solar infrastructure on indigenous flora and fauna species. This is of particular relevance in this ecosystem, where microclimate variables have large scale effects on plant distribution, and therefore faunal assemblages.
- Very few surveys of indigenous fauna have been conducted across the site, so more detailed knowledge of species assemblages and abundances is relatively unknown.
- There remains a notable information gap regarding the distribution and density of indigenous vegetation and species of interest within areas assessed as moderate ecological value.
- Other flora and fauna species known to be on the Canterbury plains or typically found in similar environments with wider species distributions, may be present on the site as they are known to occur in the habitats available.
- The best or most appropriate methods for restoration planting, pest control and grazing management in the harsh soil and climatic and conditions of the West Melton Reserves are still, to a large extent, uncertain. Variable success in conservation and management efforts is likely due to microclimate variables, management of competition with exotic grasses, and lack of specific data on dryland plains communities in New Zealand.
- There are significant information gaps for lesser-understood biotic communities including the values at the site associated with the diversity of bryophytes, insects, fungi or other organisms.

- Long-term impacts of solar farm infrastructure on soil compaction, structure, and moisture dynamics, especially beneath panels, remain poorly understood.
- A greater resolution of ecological detail is required to adequately quantify values at a land parcel scale. It is possible, for example, that threatened plant species are present within land blocks identified as low ecological value.
- There is uncertainty about what suitable habitats may support native and endemic breeding birds.
- Ecological values are mapped at a coarse scale. Based on the need to gain further information on site values, it is possible (or even likely) that ecological value zones may need to be remapped and updated.
- A detailed EcIA is required in all cases of where development encroaches on ecosystems or impacts connectedness to neighbouring ecosystems. This is to ensure effects are managed effectively to ensure no net loss in values. For the most part, impacts to ecosystem connectedness could not be robustly considered within this assessment.
- Assessments of risk to ecosystem values is highly dependent on the detailed design and layout of infrastructure and construction methodologies.
- The site is in close proximity to aerodromes meaning that development will likely need to manage bird strike hazards to aircraft. Specifically, CIAL is located to the east, and the Canterbury Aero Club is located to the west. These impacts have not been considered but should be in respect to district plan rules and civil aviation law.
- The values of waterways have been assumed to be uniform across the site, but in reality, are likely to be higher or lower depending on the permanence of flow, physical habitat quality and the species they support.
- There may be wetlands across the site that are associated with/induced by water races. Any within the project area will need delineation and characterisation to manage risks associated indigenous wetland flora and fauna, irrespective of wetland status under the National Policy Statement on Freshwater Management.
- There is a paucity of information on aquatic values across the site, with water races having only been surveyed in isolated reaches and on one occasion. It is possible that species of higher conservation value are present within water races, including kākahi (freshwater mussels).

- Vegetation values surveyed in association with water races have largely been confined to the margins of the sit of interest. Little information exists on riparian vegetation values alongside water races within the project site itself.
- SDC and CCC each have vested interests in the water races and how they are managed in respect to new developments. District bylaws regarding water races have not been considered in terms of managing ecological effects.
- Impacts to water races are generally considered to be manageable, including realignments if required. However, this ignores any potential engineering limitations that may result in changes to the hydrology, and therefore habitat, of race channels.

8.0 Conclusion

Within the West Melton reserves are some of the last remaining examples of Canterbury's dry plains indigenous shrubland, grassland and moss-herbfield habitats. These remnants are crucial for biodiversity on the largely cleared Canterbury Plains. Though they appear dry and sparse, they harbour specialised plant and animal communities.

The site being investigated for potential development is no exception and supports some of the best examples of indigenous dryland vegetation in the Low Plains Ecological District. These habitats provide for numerous nationally threatened and locally uncommon plants, lizards, birds and invertebrates. The site also contains water races that support communities of indigenous aquatic flora and fauna.

Construction and operation of a solar farm in these areas without regard to their unique ecological values could be highly detrimental to both the environment and the integrity of historic management objectives. Solar farms can affect local ecology in several ways, primarily through habitat loss, fragmentation or modification, altered land surfaces, shading and changes in microclimates, and the creation of new structures that can influence wildlife behaviour. Careful consideration of site selection for solar arrays and associated infrastructure, along with design principles and construction methods that are sensitive to onsite ecological values is essential for managing the impacts of any future development.

Based on the ecological values and associated sensitivities of the project site (see Figure 2 & Table 1), there are several possible risk-based scenarios for solar development:

- ‘Low’ value land still holds values for particular species and effects will still be present at varying risks depending on biodiversity at a more localised scale. However, this land is most likely the preferred option for investigating development options and should be prioritised over areas of ‘moderate’ or ‘high’ ecological value. Areas of low ecological value in the east of the site carry more inherent risk compared to those in the west, due to the prevalence of surrounding areas of moderate and high value.
- ‘Moderate’ value land contains significant biodiversity in terms of the presence of either indigenous flora, exotic flora that provide habitat for indigenous fauna (e.g., lizards), or both:
  - Pathways for managing development effects on habitats consisting of exotic vegetation are more viable and straight-forward to achieve than those for managing indigenous plant communities. There are potentially options for creating higher value habitats elsewhere to remedy individual losses, and options for translocating fauna.
  - The options for managing effects on indigenous flora are more limited and likely to result in the need to compensate losses. Given the rarity of some flora species, it may be that development in these areas cannot be managed to ensure that there is a low level of ecological effect.
- ‘High’ value land, including those actively fenced and managed to protect values, are typically those with very significant floristic species and indigenous fauna. Development in these areas should be avoided at all possible costs due to the rarity of species and the inability to viably mitigate the effects of construction and operation of the development.

The above scenarios are listed in order of increasing ecological risk and the commensurate increase in management interventions required (if feasible at all). It is also likely to correspond to the rigour of the consenting pathway.

Where possible, site selection should be weighted towards sites of the lowest ecological value during the project planning and feasibility phase. Conceptual development plans then need to be informed and refined by more detailed assessments of ecological values within and adjacent to defined construction footprints. This will enable the detailed design-phase, which should be steered in part by ecological advice to ensure that construction methodologies and permanent infrastructure have a low risk to terrestrial and aquatic ecosystems. Through this process, effects of the proposed solar farm development can be robustly managed using the effects management hierarchy to ensure there is no net loss in values across the site.

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Appendix A: Block Summaries

Table A1 below details the approximate area sizes of each block by ecological value. HVES sizes have been added to the appropriate blocks for reference.

Table A1: Area sizes by block and ecological value

Block Number	Total Block Size (ha)	Area by Ecological Value (ha)			HVES Size (ha)
		Low	Moderate	High	
1	152.87	52.18	100.65	0	0
2	152.47	36.32	61.01	55.13	0.11
3	450.13	12.85	293.03	143.95	13.27
4	267.47	267.47	0	0	0
5	501.53	363.81	19.51	118.08	7.66
6	478.58	442.63	10.60	25.31	0
7	430.64	299.36	20.41	110.94	7.52
8	178.95	173.79	5.18	0	0
9	59.10	56.03	3.07	0	0
TOTALS	**2671.75**	**1704.43**	**513.46**	**453.41**	**28.55**

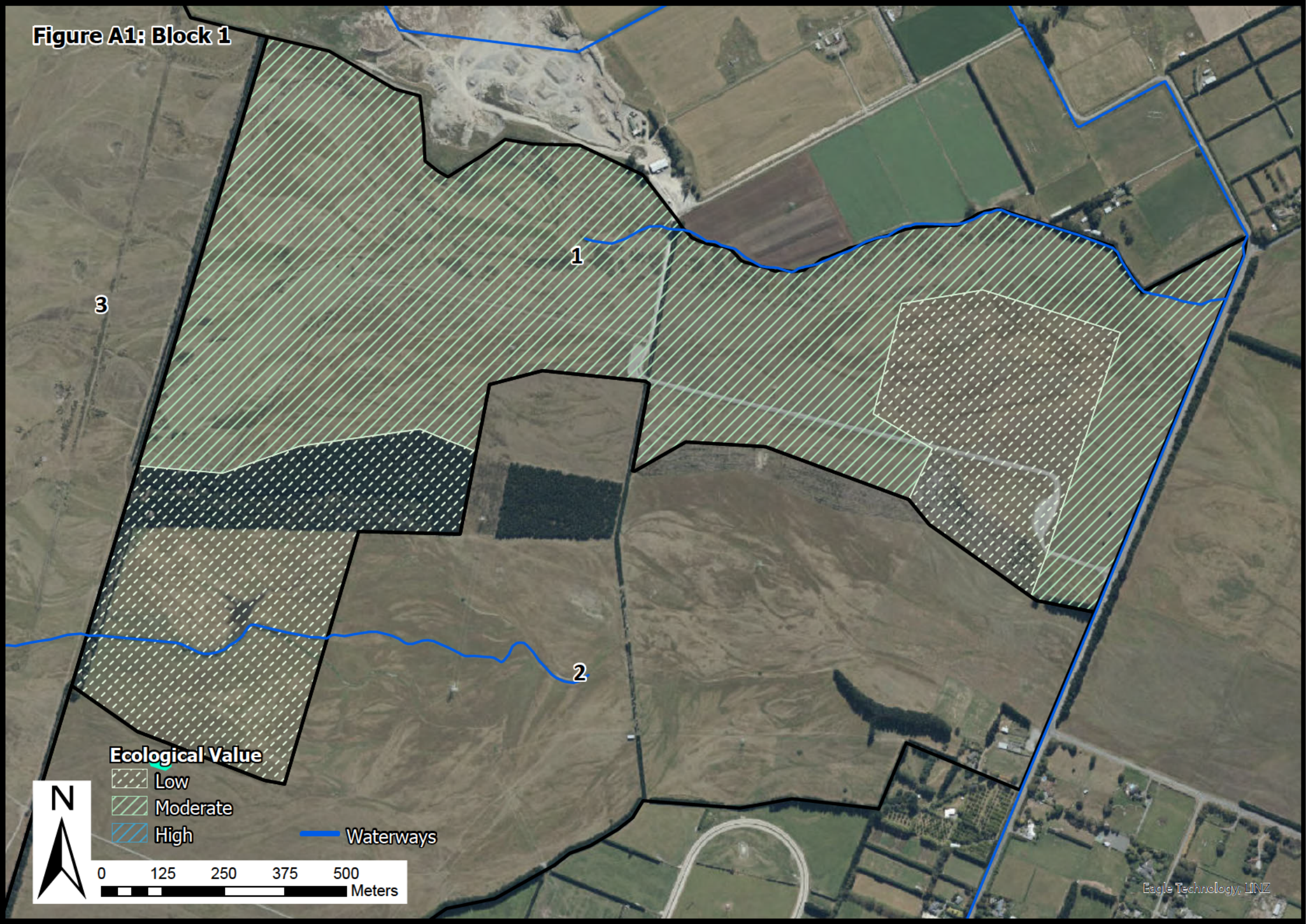
Figure A1: Block 1
1
2
3
Ecological Value
Low
Moderate
High
Waterways
N
0
125
250
375
500
Meters
Eagle Technology, LINZ

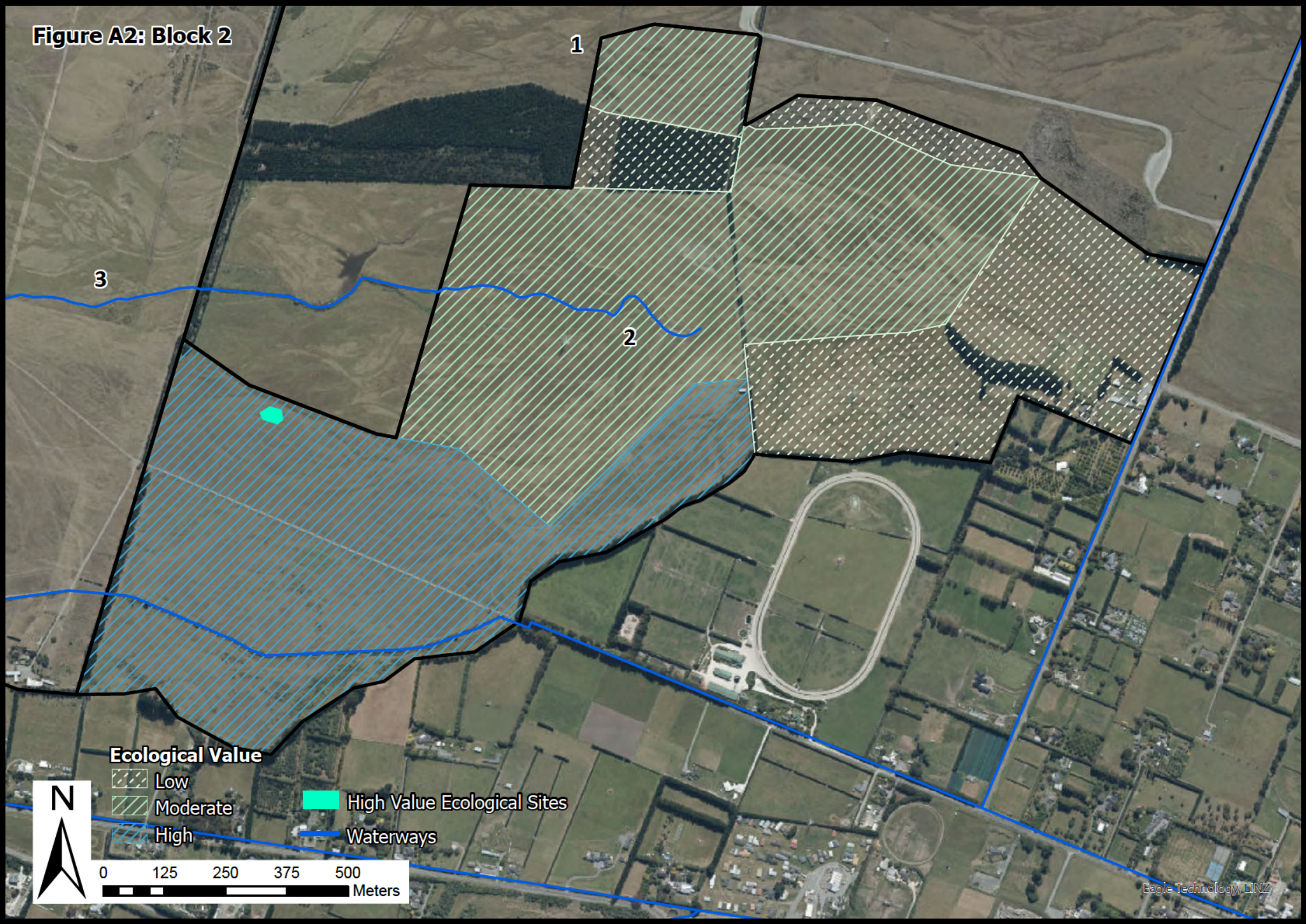
Figure A2: Block 2
1
2
3
Ecological Value
Low
Moderate
High
High Value Ecological Sites
Waterways
N
0
125
250
375
500
Meters
Eagle Technology, LINZ

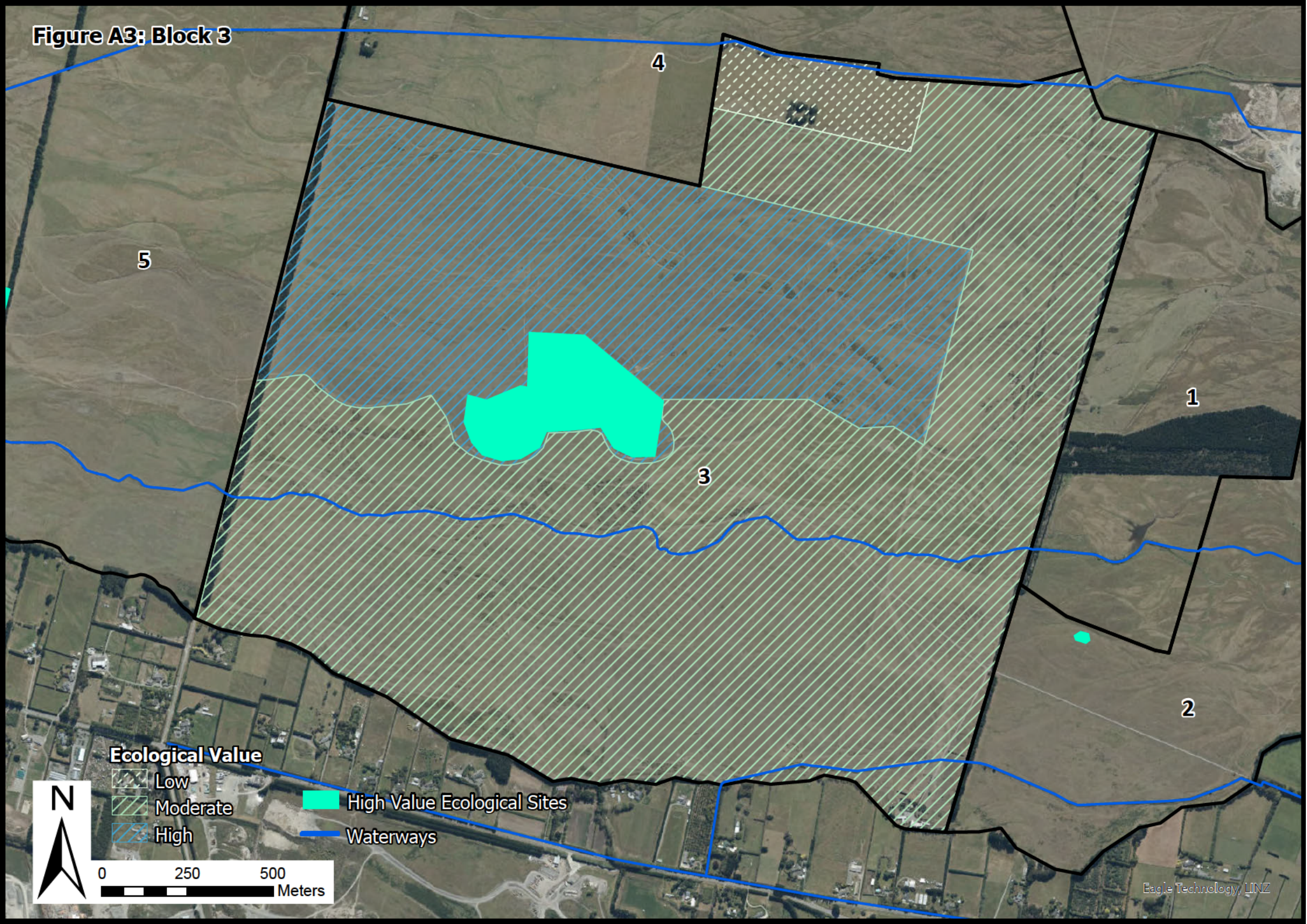
Figure A3: Block 3
4
5
1
3
2
Ecological Value
Low
Moderate
High
High Value Ecological Sites
Waterways
N
0
250
500
Meters
Eagle Technology, LINZ


Figure A4: Block 4
4
5
3
1
Ecological Value
Low
Moderate
High
Waterways
N
0
125
250
375
500
Meters
Eagle Technology, LINZ


Figure A5: Block 5
6
4
5
3
Ecological Value
Low
Moderate
High
High Value Ecological Sites
Waterways
N
0
250
500
Meters
Eagle Technology, LINZ


Figure A6: Block 6
7
6
5
Ecological Value
Low
Moderate
High
High Value Ecological Sites
Waterways
N
0
250
500
Meters
Eagle Technology, LINZ

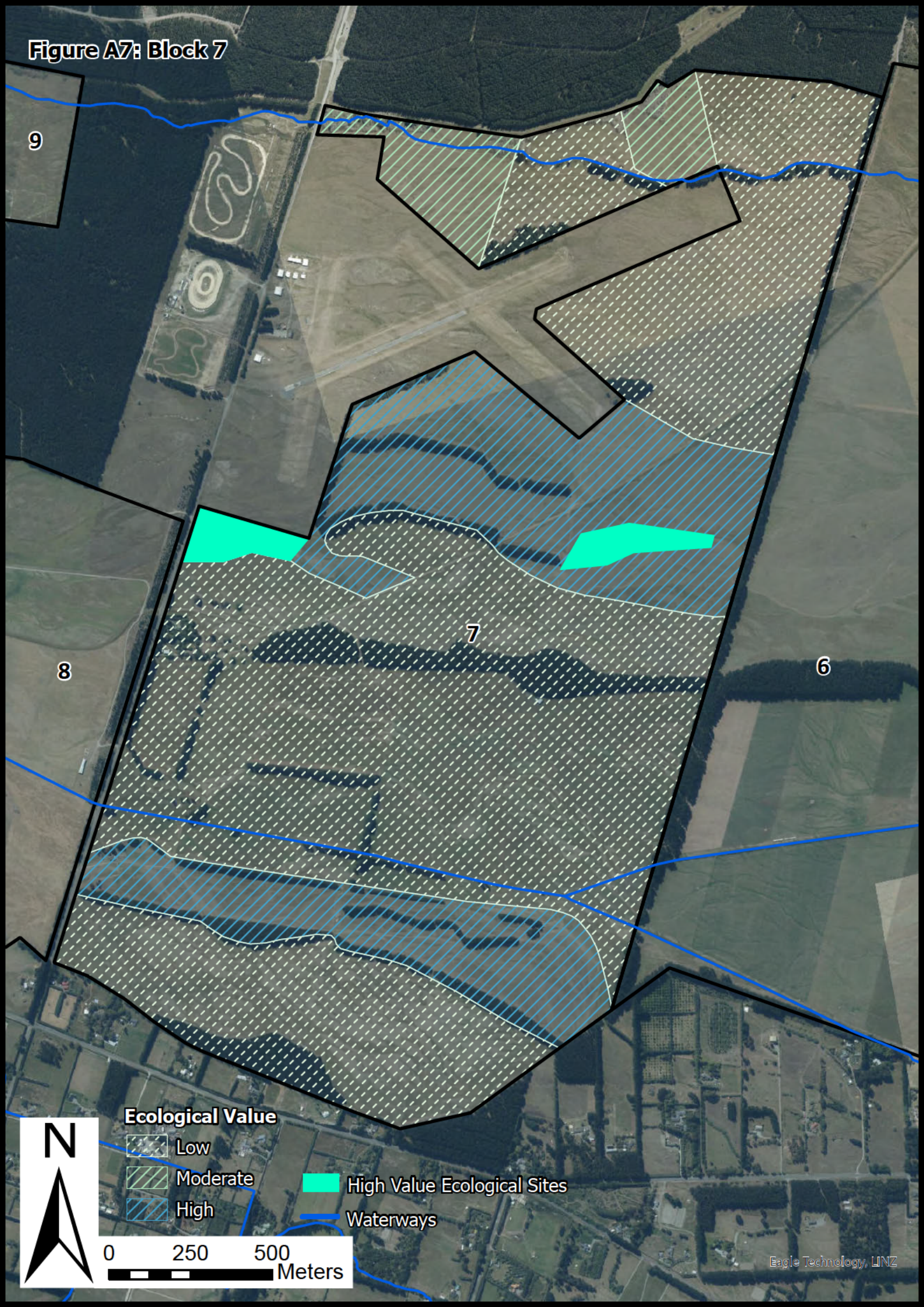
Figure A7: Block 7
9
8
7
6
Ecological Value
Low
Moderate
High
High Value Ecological Sites
Waterways
N
0
250
500
Meters
Eagle Technology, LINZ

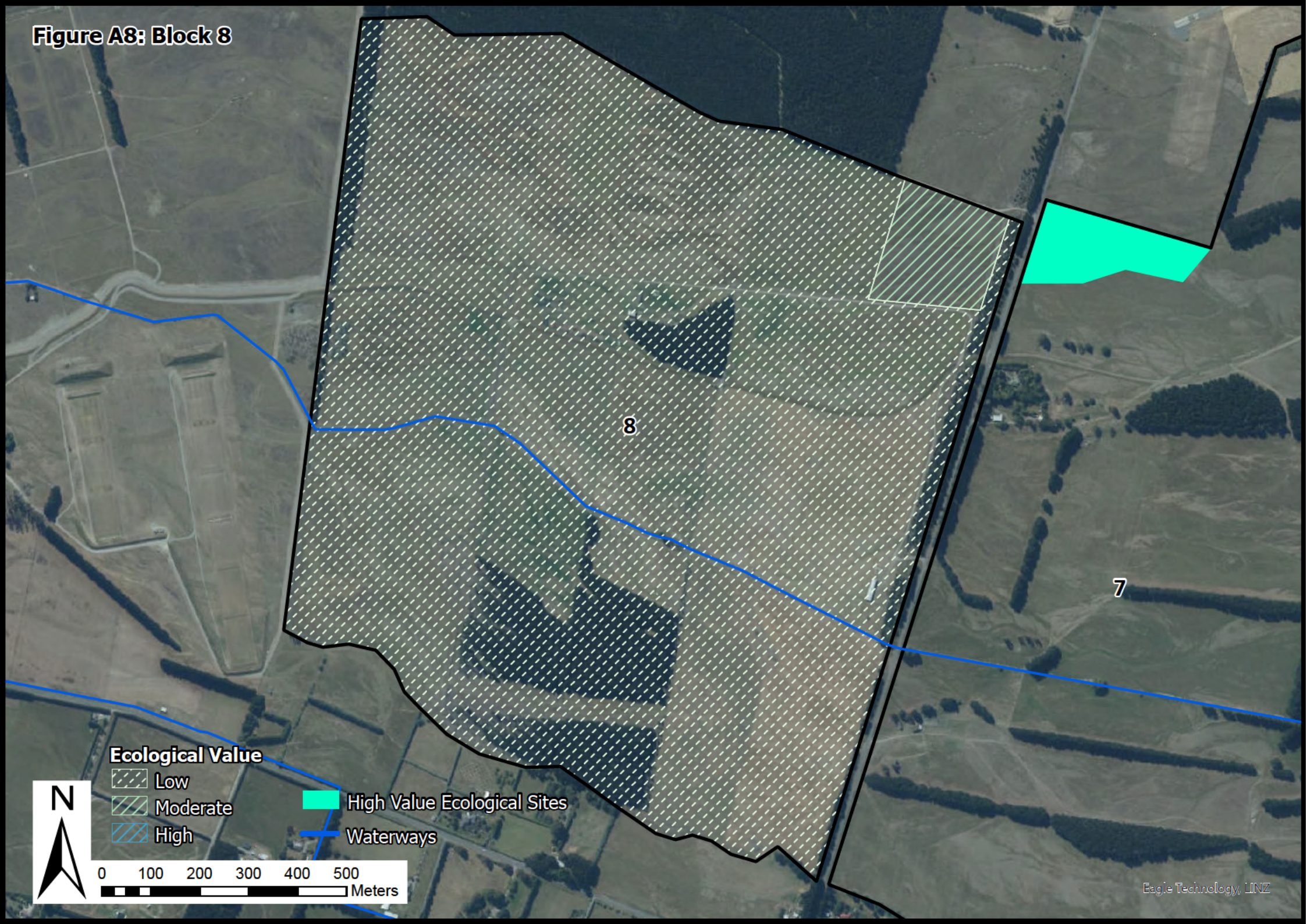
Figure A8: Block 8
8
7
Ecological Value
Low
Moderate
High
High Value Ecological Sites
Waterways
N
0
100
200
300
400
500
Meters
Eagle Technology, LINZ


Figure A9: Block 9
9
Ecological Value
Low
Moderate
High
Waterways
N
0
70
140
210
280
350
Meters
Eagle Technology, LINZ