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Opunake Solar Farm




For Harmony Energy Storage Limited

Draft Ecological Effects Assessment Report

February 2023

REPORT INFORMATION AND QUALITY CONTROL

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1 INTRODUCTION

1.1 Background

Harmony Energy Storage Limited is proposing the development of a ~90MWp solar farm ('the site') near Opunake, between Opuā Road and Ihaia Road, within the South Taranaki District. A map showing the locality of the site is provided in Figure 1, below.

The solar farm infrastructure is earmarked to be located within an existing agricultural operation where the majority of landcover is pasture for cattle grazing. The proposed solar farm will comprise solar panel arrays, 28 inverter/transformer stations, perimeter fencing and security cameras.

Existing farm races are proposed to be used for access roads. Minor earthworks are required for the installation necessary infrastructure including transformers as well as the posts / poles associated with the solar panels.

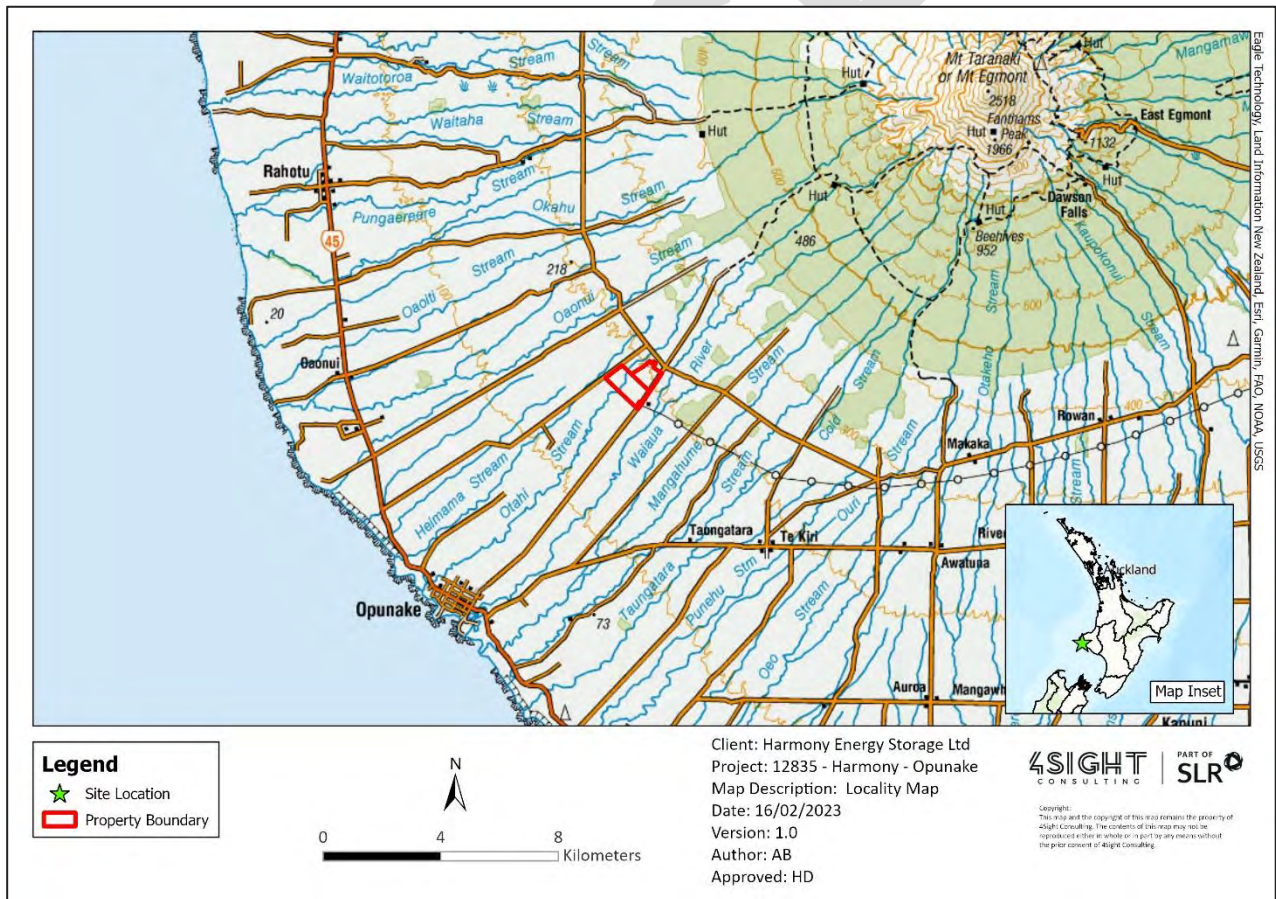


Figure 1: Locality map

1.2 Report purpose

The purpose of this report is to provide an assessment of ecological effects to accompany an application to establish a solar farm at the site under the COVID-19 Recovery (Fast-Track Consenting) Act 2020. The ecological assessment relates to the construction, operation and maintenance of a solar farm at the site.

The report details findings of an ecological assessment of the vegetation and habitats within the site. Key features and habitat values of vegetation and fauna were identified, and an assessment of ecological effects was undertaken to assess the potential effects of the proposed solar farm.

Preliminary restoration opportunities within the site extent are being investigated, the findings of which will be included in later versions of this report.

1.3 Site description

The properties earmarked for the solar farm are Lot 21 DP 792, Part Lot 8 DP 792 and Lot 2 DP 19301 wherein a total area of approximately 140 ha will be fenced for the placement of required infrastructure. The site, and the surrounding environment, are currently set in exotic pasture that is used for dairying. The site drains in a general south westerly direction, at a gradient of between 3-4%, towards the coast via both natural and modified drainage channels.

The site is situated within the Egmont Ecological District (ED), the South Taranaki District, and the Taranaki Region. The historic vegetation within Egmont ED was variable and comprised a coastal zone approximately 1km from the ocean, a semi-coastal zone up to an altitude of 150m a.s.l. (i.e. the upper altitudinal limit for kohekohe - *Dysoxylum spectabile*) and a lowland zone up to an altitude of 450m a.s.l. (or 350m a.s.l. on the western extent of Mt Taranaki) dominated by tawa (*Beilschmiedia tawa*) forest habitat. Lowland forest then extends to 760m a.s.l. with a gradual reduction in beech species complimented by emergent rimu (*Dacrydium cupressinum*) and Northern rata (*Metrosideros robusta*) over smaller trees including kamahi (*Weinmannia racemosa*), mahoe (*Melicactus ramiflorus*), Wineberry (*Aristotelia serrata*), Broadleaf (*Griselinia littoralis*), Fuchsia spp. and pate (*Schefflera digitata*). Upland forest habitat is found between 760-1095m a.s.l. comprising kamahi (*W. racemosa*), Halls totara (*Podocarpus laetus*) and kaikawaka (*Libocedrus bidwillii*). Vegetation above 1095m a.s.l. includes sub-alpine scrub (<1280m a.s.l.), red tussock grassland, moss-herbfield as well as the alpine zone. Currently, remnant vegetation is largely conserved within the Egmont Natural Park with most of the Egmont ED being utilised for agricultural purposes (primarily dairy farming) (McEwen, 1987).

The variation in topography of the ED is associated with highly variable annual rainfall ranging from 1200mm p.a. on the southern coast of the ED to 8000mm p.a. on Mt Taranaki. Winters are mild in the ED with warm summers south of Mt Taranaki and warm humid summers north and west of the mountain (McEwen, 1987).

Soils within the Egmont ED comprise primarily deep, friable and well drained volcanic ash soils derived from andesitic ashes. Large areas are underlain by shallow / 'bouldery' soils from laharcic deposition whilst gleyed soils, associated with poor drainage, are encountered in areas where the water table is near the surface (McEwen, 1987).

2 METHODOLOGY

2.1 Desktop assessment

Prior to the site visit a desktop assessment of the site was undertaken. The review of relevant background literature and databases conducted to understand the ecological values within the site and surrounding areas included:

- Relevant planning maps from South Taranaki District Council and Taranaki Regional Council;
- Threatened Environment Classification (TEC) version 2012 (Cieraad *et al.* 2015);
- S-Map online administered by Landcare Research (S-Map, 2022);
- NZ Herpetofauna Atlas database published by the Department for Conservation;
- iNaturalist and NZ Bird Atlas;
- DOC bat Database (DOC 2022); and
- NZ Plant Conservation Network (NZPCN) plant distribution database.

Any threatened species found were recorded and their threat status checked against the relevant national threatened species classification lists (O'Donnell *et al.* 2018; de Lange *et al.* 2018; Robertson *et al.* 2021; Dunn *et al.* 2017 and Hitchmough *et al.* 2016).

2.1.1 GIS mapping

The extent of the proposed project was mapped using ArcGIS Pro. Within the property, existing vegetation was mapped onto aerial imagery to allow for quantification of the areas of vegetation to be impacted by solar panel installation.

2.2 Site survey

Following a preliminary desktop assessment, the terrestrial and aquatic habitat characteristics of the site and surrounding area were assessed during a site visit on the 12th – 14th October 2022. A walkover of the site was undertaken to assess the ecological values and habitat potentially affected by the proposed works.

2.2.1 Te papa whānui - Terrestrial habitats

During the site visit, both native and exotic plant communities were recorded, and a qualitative assessment of onsite vegetation habitats was conducted. The assessment focused on the botanical and ecological value of identified plant communities. Notes were collected on areas with potential for restoration.

2.2.2 Repo - Wetlands

Potential wetland features of the site were assessed using the wetland delineation protocols developed by the Ministry for the Environment (MfE 2020) to support the National Policy Statement for Freshwater Management (NPS-FM 2020).

The site assessment was undertaken under 'normal circumstances', with weather conditions comprising showers and dry spells.

During the site assessment, 17 representative vegetation plots were established within potential wetland and non-wetland habitat in order to ascertain whether a designated area would meet the definition for a wetland per the NPS-FM. Vegetation and cover were recorded per stratum within the plots, whilst soil sampling was undertaken as an additional measure where marginal results were recorded for the wetland indicator status tests (Dominance Test and Prevalence Test). For some sites, towards the end of the survey only the rapid test was undertaken but a conservative approach was taken to ensure that wetlands meeting the definition were identified. Representative photographs and basic plot data is included in Appendix A.

2.2.3 Te wai mauri - Aquatic habitats

Qualitative instream and riparian assessments were undertaken. Characteristics of freshwater habitats were recorded during the site visit. These included descriptions of watercourses, riparian vegetation, and potential wetlands.

A single macroinvertebrate sample was collected from the Otahi Stream, near the southwestern boundary of the site. The sample was collected using a 500-micron net following Protocol C1 (Stark *et al.* 2001), preserved in ethanol, and analysed according to Protocol P1: coded abundance. Hard bottom indices (MCI and QMCI) were calculated for the samples (Stark and Maxted, 2007) as well as total macroinvertebrate taxonomic richness and number of EPT taxa.

Environmental DNA (eDNA) sampling was conducted within the Otahi Stream approximately 300m downstream of the macroinvertebrate sampling site. eDNA assessments survey cellular material of species that are dispersed into the environment and include genetic information from cells such as larvae, urine, scales and exoskeletons (David *et al.* 2021). For this survey, six replicate water samples were collected from the Otahi Stream on the 12th October 2022. Replicate sampling involved a 60ml syringe with a 1.2µm cellulose acetate encapsulated syringe filter. Water samples were repeatedly pushed through the filter until the filter was saturated with material, and no additional water could be pushed through. The sample was then preserved by transferring the filter to a 3ml syringe containing a DNA/RNA preservative. All equipment used was sterile, and samples were taken using sterile nitrile gloves.

2.2.4 Terrestrial fauna surveys

2.2.4.1 Pekapeka - Bats

No formal bat sampling was undertaken within the property boundary given the limited bat habitat available, the anticipated low level of impact of the proposal, and the lack of records in the bat database for the coastal part of the Taranaki ring plain and the southern side of Mount Taranaki.

2.2.4.2 Manu - Birds

Alongside a desktop review of online databases such as iNaturalist (2022) and NZ Bird Atlas (eBird) all manu (birds) seen and heard during the site visit were recorded.

2.2.4.3 Mokomoko – Skinks and geckos

The site was assessed for mokomoko (skink and gecko) habitat suitability as part of the field survey. Mokomoko searches were conducted by searching any present, suitable mokomoko habitats, including refugia such as deadwood, rocks, hedgerows, wood stockpiles and leaf litter.

2.3 Assessment of ecological effects

The assessment of ecological effects was informed by the Ecological Impact Assessment (EclA) guidelines of the Environment Institute of Australia and New Zealand (Roper-Lindsay *et al.* 2018).

The following steps were used for this assessment:

- Ecological values are assigned a level on a scale of Low, Moderate, High or Very High based on assessing the values of species, communities and habitats identified against criteria set out in the EclA guidelines.
- The magnitude of effect of the site works on ecological values is evaluated as either No Effect, Negligible, Low, Moderate, High, or Very High. The 'Magnitude of Effect' is based on:
 - The scale of the unmitigated effect per se (i.e. the proposed works, impacts on hydrology, impacts on wetland vegetation);
 - The proportion of habitat loss versus local availability;
 - The expected duration of effect (e.g. permanent versus temporary); and
 - The intensity of the effect (i.e. the extent to which habitat loss within the site is complete or partial).
- The overall level of effect in the absence of mitigation is determined using a matrix that is based on the ecological values and the magnitude of effects on these values in the absence of any efforts to avoid, remedy or mitigate for potential effects.

The overall level of effect is used to determine if mitigation is required. Effects assessed as 'Moderate' or greater warrant efforts to avoid, remedy and/or mitigate them.

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3 RESULTS

3.1 Desktop assessment

Based on aerial imagery, it appears that the site has been primarily under pasture since at least 1954 (Figure 2). The site is within generally low gradient relief, sloping in a south westerly direction towards the coast.

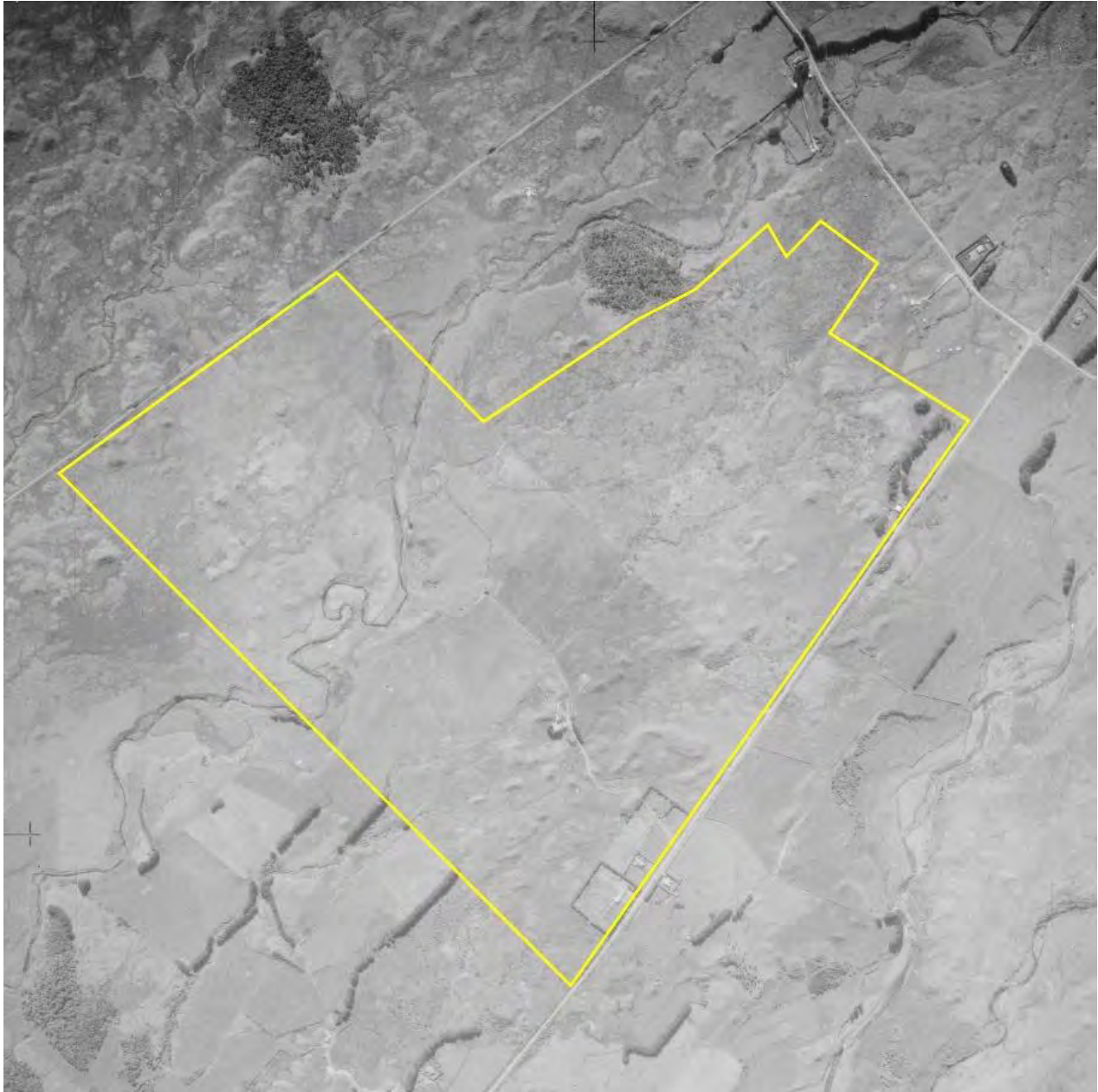


Figure 2: Historical Imagery of the proposed solar farm site 03/09/1954 (Retrolens, 2022). Approximate site boundary is shown in yellow.

Land Environments New Zealand (LENZ) classifies the vast majority of the site as the highest Threatened Environments Classification (TEC) category (<10% indigenous cover left), although a minor area within the northern extent of the site is classified as having 20-30% indigenous cover left (Figure 3). The TEC is a source of broad (i.e. national) scale background information: specifically, how much indigenous vegetation remains within land environments; its legal protection status; and how past vegetation loss and legal natural heritage protection are distributed across New Zealand’s landscape.

TEC recognises that indigenous environments in this area have been severely reduced and have no formal protection. This is in agreement with our finding of this site where the vast majority of native vegetation has been cleared for farming land use. Native species at the site are limited to the Otahi Stream and certain drains within the property.

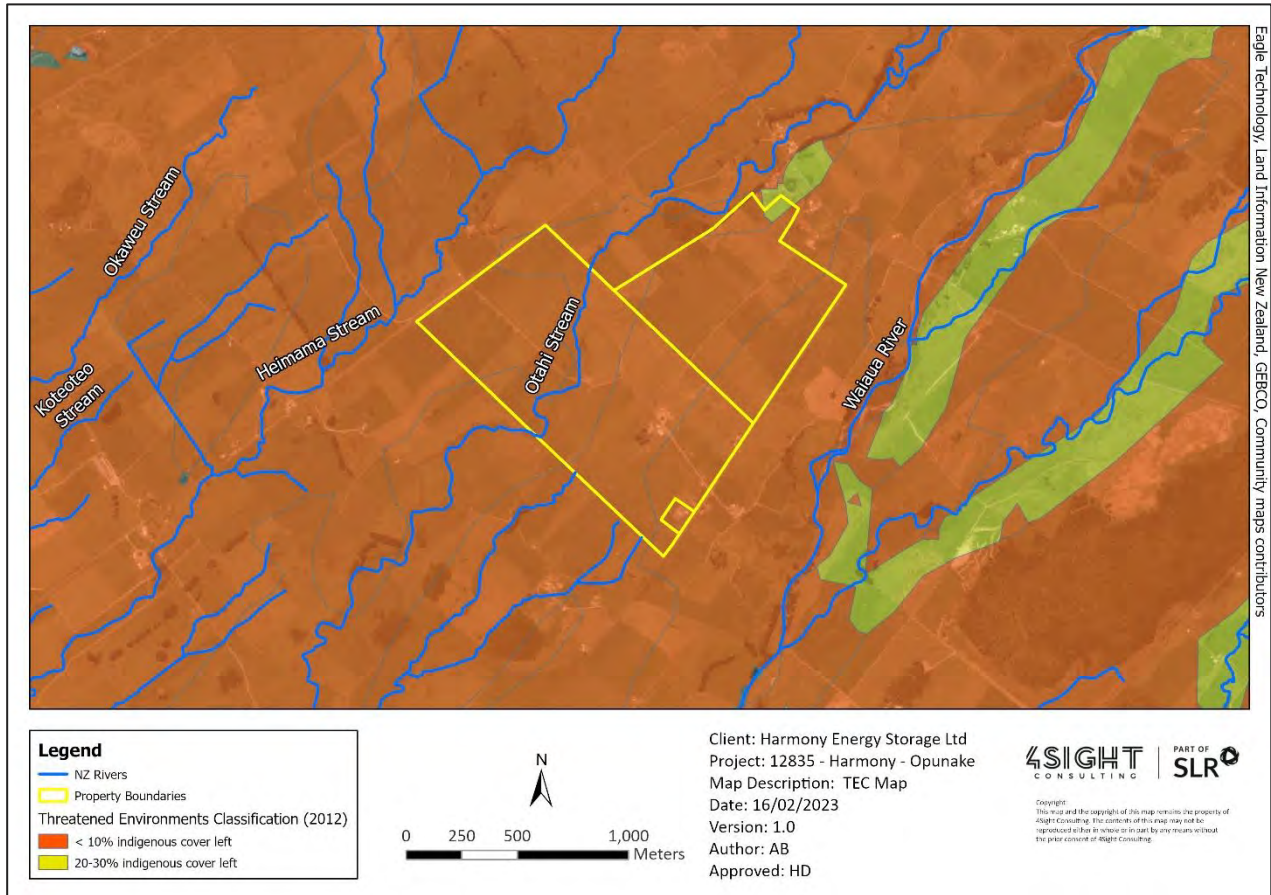


Figure 3: TEC Map for the proposed solar farm

The Singers & Rogers (2014) ecosystem classification system indicates that conditions on the site suit three main forest types, and these are likely to match historic cover at the site. These ecosystem types are as follows:

- **WF8:** kahikatea, pukatea forest;
- **WF13:** tawa, kohekohe, rewarewa, hinau, podocarp forest, and
- **MF7-3:** tawa, pukatea, podocarp forest.

3.2 Te papa whānui – Terrestrial habitat

3.2.1 General

Four primary vegetation types were identified onsite, namely, exotic pasture grass cover, hedgerows, riparian vegetation as well as two small patches of native scrub.

Pasture grass was the dominant landcover onsite which is expected given that the predominant land use within the property is dairy farming. Common pasture grasses observed within this vegetation type included rye grass (*Lolium spp.*), *Poa annua* and yorkshire fog (*Holcus lanatus*), whilst common legumes included white clover (*Trifolium repens*) and lotus (*Lotus pedunculatus*). Exotic herbaceous species within pasture included buttercup (*Ranunculus repens*) and dock (*Rumex spp.*).

Hedgerows, primarily barberry (*Berberis glaucocarpa*) and boxthorn (*Lycium ferocissimum*), were occasionally present along the edges of certain paddocks and farm races. The north-western extent of the site comprised a line of mature *Pinus* spp. trees.

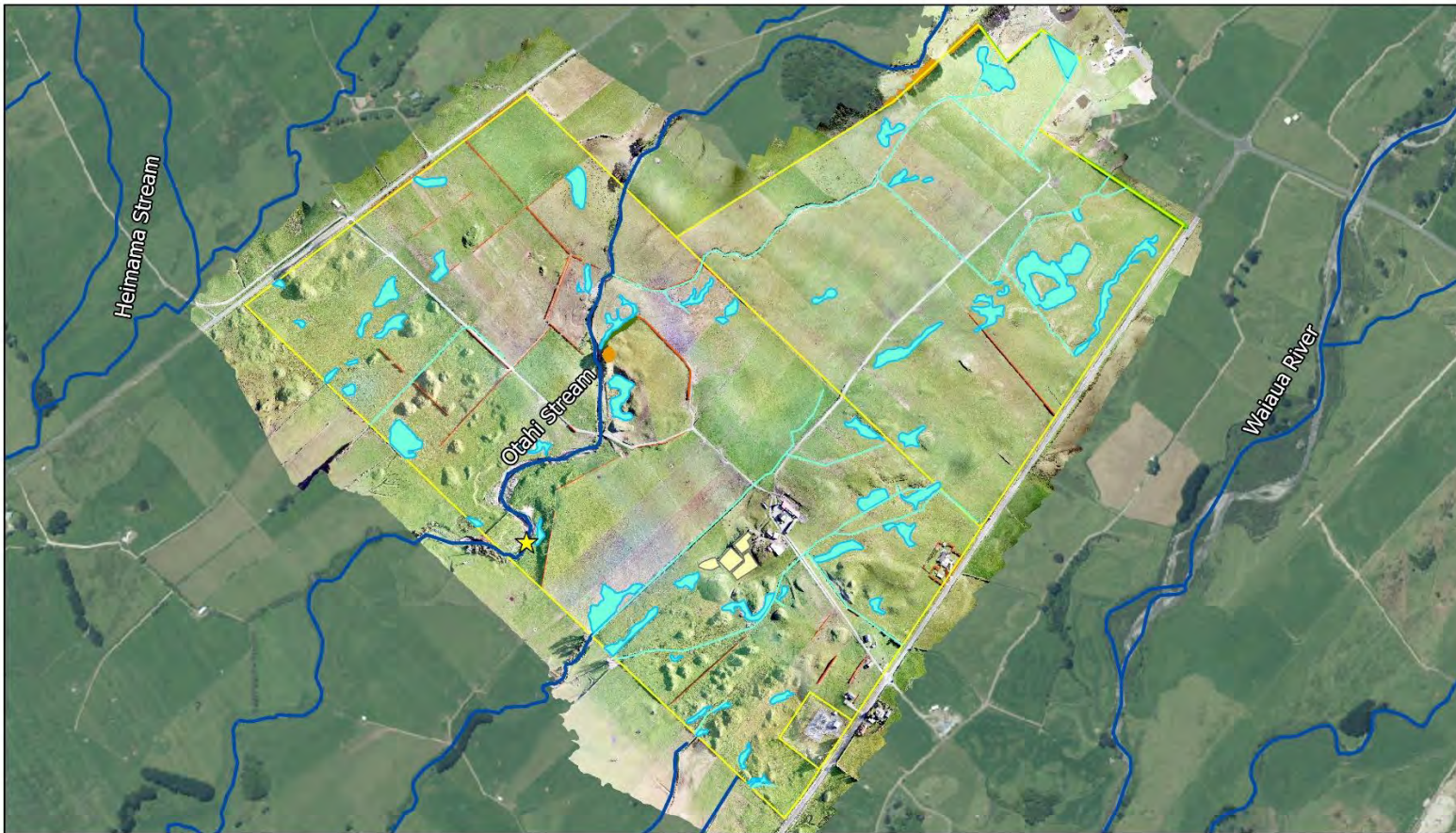
Riparian vegetation occurs along the Otahi Stream and included tī kōuka (*Cordyline australis*), harakeke (*Phormium tenax*) and willow species (*Salix* spp.), whilst common pasture grasses were also present within the riparian zone.

The small patch of native scrub was located on a steep slope, adjacent to wetland unit W21, which is largely inaccessible to cattle. Primary species within this patch included māhoe (*Melicactus ramiflorus*), porokaiwhiri (*Hedycarya arborea*), pukatea (*Laurelia novae-zelandiae*), kiekie (*Freycinetia banksia*), pohuehue (*Muehlenbeckia australis*), puawhananga (*Clematis paniculata*), puka (*Griselinia lucida*) and various ferns. A few weeds were noted within the forest area, which included climbing asparagus (*Asparagus scandens*) and blackberry (*Rubus fruticosus*).

A map showing the terrestrial and wetland vegetation is shown in Figure 5, below, whilst representative site photographs are included in Figure 4. Note that an additional map showing the labels of each wetland, stream and drain is included in Appendix B

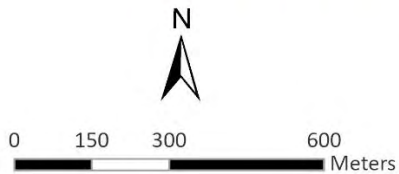


Figure 4: Representative site photos



Legend

- | | |
|-------------------------|---------------------|
| ★ eDNA Sample | Vegetative Cover |
| Watercourses and Drains | Hedgerow |
| NZ Rivers | Mature Pine |
| Wetland Delineation | Native Forest Patch |
| Farm Ponds | Tree Row |
| Property Boundary | |



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Figure 5: Vegetation cover within the proposed solar farm site. Note that, aside from infrastructure, unshaded areas constitute fields of exotic pasture.

3.2.2 Taru kino - Pest plants

Low numbers of taru kino (pest plants/weeds) were seen throughout the site. As mentioned above, the hedgerows within the property boundary comprised of taru kino such as barberry and hawthorn. Observed taru kino within the site, and their recommended control programmes, are listed in table 1, below.

Table 1. Taru kino encountered on site. Control programme options derived from the Regional Pest Management Plan for Taranaki (RPMPT, 2021).

Scientific name	Common Name	Regional Control Programme
<i>Allium triquetrum</i>	Three Cornered Garlic	N/A
<i>Asparagus scandens</i>	Climbing asparagus	N/A
<i>Berberis glaucocarpa</i>	Barberry	N/A
<i>Cortaderia selloana</i>	Pampas Grass	N/A
<i>Crocsmia x crocosmiiflora</i>	Montbretia	N/A
<i>Cytisus scoparius</i>	Wild broom	Sustained Control
<i>Iris foetidissima</i>	Stinking Iris	N/A
<i>Lonicera japonica</i>	Japanese Honeysuckle	N/A
<i>Lycium ferocissimum</i>	Boxthorn	N/A
<i>Onopordum acanthium</i>	Scotch thistle	N/A
<i>Rubus fruticosus agg.</i>	Blackberry	N/A
<i>Salix spp.</i>	Willow	N/A
<i>Ulex europaeus</i>	Gorse	Sustained Control
<i>Zantedeschia aethiopica</i>	Arum lily	N/A

3.3 Watercourse habitat

3.3.1 Repo – Wetlands

Wetland habitat comprising primarily facultative wetland (FACW) and obligate (OBL) wetland species were scattered throughout the site, primarily within low points of the landscape and at the footslopes of small hills. Wetlands were largely identified and delineated using the 'Rapid Test', however, 17 vegetation plots were implemented onsite to determine the presence of wetland systems in pasture areas where the dominant species were not clearly FACW or OBL. Wetland habitat was placed into two primary groups, namely, 'low quality' and 'moderate quality' wetlands, based largely on their connectivity to other wetlands and natural features in the landscape and, therefore, conservation potential.

Certain areas within low points onsite comprised pugged areas, interspersed with pasture and wetland grasses. These areas were, however, excluded as wetland habitat in terms of the wetland delineation protocols developed by the Ministry for the Environment (MfE 2020) as they meet the pasture exclusion criteria.

A map visually presenting the location of wetland habitat is provided in Figure 5, above, representative photographs are included as Figure 6, whilst the characteristics of each wetland is provided in Table 2.



Photo E: View from west to east looking across representative rushland wetland habitat associated with wetland W55.



Photo F: View from east to west looking across marshy hygrophilous grassland habitat within wetland W49.



Photo G: View from south to north of wetland W17 showing mixed rushland-hygrophilous grassland habitat on the floodplain of the Otahi Stream.



Photo H: Hygrophilous grassland habitat associated with seepage within wetland W51.

Figure 6: Representative photos of wetlands from throughout the site

Table 2: Wetlands identified within the proposed solar farm area.

Wetland identifier	Hydrosystem	Class	Form	Primary vegetation structure	Composition and Description	Quality	Area (m ²), within property boundary	Edge delineation	Plot	Rapid test	Dominance test	Prevalence test	Wetland?	Natural (as defined in the NPS-FM)?
W01	Palustrine	Seepage	Slope	Rushland - Hygrophilous Grassland	Mix of <i>Juncus effusus</i> , <i>Juncus articulatus</i> , <i>Lotus pedunculatus</i> and <i>Glyceria declinata</i> . Pugging evident.	Moderate	224.66	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W02	Palustrine	Marsh	Flat	Rushland - Grassland	Dominated by <i>J. effusus</i> with a moderate abundance of <i>L. pedunculatus</i> , <i>G. declinata</i> and <i>Lolium</i> spp.	Moderate	183.27	GPS	Yes	Maybe	Pass	Pass	Yes	Yes
W03	Palustrine	Seepage	Slope	Hygrophilous Grassland	Primarily a mix of <i>G. declinata</i> and <i>J. articulatus</i> with a moderate abundance of <i>J. effusus</i> , <i>R. repens</i> and <i>T. repens</i> . Pugging evident. Aerial photography suggests link to cattle trough.	Low	1545.34	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W04	Palustrine	Seepage	Slope	Hygrophilous Grassland	Mix of <i>L. perenne</i> , <i>G. declinata</i> , <i>R. repens</i> , <i>J. articulatus</i> and <i>T. repens</i> . Possibly meets updated pasture exclusion rules (Not implemented on date of site assessment).	Low	540.66	GPS	No	Maybe	Pass (from cover estimates)	Pass (from cover estimates)	Likely	Likely
W05	Palustrine	Seepage	Slope	Rushland - Hygrophilous Grassland	Dominated by <i>J. effusus</i> and <i>H. lanatus</i> with <i>J. articulatus</i> and <i>G. declinata</i> common in areas of standing water. Pugging evident.	Low	1148.39	GPS	N	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W06	Palustrine	Seepage	Slope	Hygrophilous Grassland	Dominated by <i>G. declinata</i> with <i>Lolium</i> spp. on the edges. Pugging evident.	Low	1148.37	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W07	Palustrine	Seepage	Flat	Rushland - Hygrophilous Grassland	Comprises a mix of <i>H. lanatus</i> , <i>G. declinata</i> and <i>J. effusus</i> . Pugging evident.	Low	134.87	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W08	Palustrine	Marsh	Valley Floor	Rushland - Hygrophilous Grassland	Dominated by <i>G. declinata</i> and <i>J. effusus</i> . Pugging evident.	Low	327.38	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W09	Palustrine	Marsh	Flat	Rushland - Hygrophilous Grassland	Dominated by <i>J. effusus</i> and <i>H. lanatus</i> .	Low	432.17	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W10	Palustrine	Seepage	Slope	Hygrophilous Grassland	Comprises a mix of <i>G. declinata</i> , <i>Lolium</i> spp. and <i>Agrostis stolonifera</i> with a moderate abundance of <i>J. articulatus</i> . Pugging evident.	Low	961.41	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W11	Palustrine	Marsh	Slope	Hygrophilous Grassland	Comprises a mix of <i>G. declinata</i> , <i>H. lanatus</i> and <i>Lolium</i> spp. Standing water and pugging evident.	Low	2178.68	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes

Wetland identifier	Hydrosystem	Class	Form	Primary vegetation structure	Composition and Description	Quality	Area (m ²), within property boundary	Edge delineation	Plot	Rapid test	Dominance test	Prevalence test	Wetland?	Natural (as defined in the NPS-FM)?
W12	Palustrine	Marsh	Floodplain	Rushland - Hygrophilous Grassland	Dominated by <i>G. declinata</i> and <i>J. effusus</i> . Wetland was heavily grazed. Pugging evident.	Moderate	564.55	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W13	Palustrine	Ephemeral Wetland	Floodplain	Hygrophilous Grassland, open water.	Muddy standing water, largely devoid of vegetation. Mix of <i>L. perenne</i> and <i>G. declinata</i> on fringes of standing water.	Low	88.50	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W14	Palustrine	Seepage	Flat	Rushland - Hygrophilous Grassland	Dominated by <i>J. effusus</i> and <i>H. lanatus</i> with a low abundance of <i>Callitriche stagnalis</i> (Water starwort) and <i>R. repens</i> . Pugging evident.	Low	3128.07	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W15	Palustrine	Marsh	Floodplain	Rushland - Hygrophilous Grassland	Dominated by <i>J. effusus</i> and <i>H. lanatus</i> .	Moderate	264.35	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W16	Palustrine	Marsh	Floodplain	Hygrophilous Grassland	Dominated by <i>H. lanatus</i> and <i>G. declinata</i> . Pugging evident. Possibly meets updated pasture exclusion rules (Not implemented on date of site assessment).	Moderate	609.58	GPS	No	Maybe	Pass (from cover estimates)	Pass (from cover estimates)	Likely	Likely
W17	Palustrine	Marsh	Floodplain	Rushland - Hygrophilous Grassland	Desktop derived, not delineated during fieldwork. Vegetation likely <i>J. effusus</i> and <i>G. declinata</i> mix with a low abundance of <i>H. lanatus</i> . Pugging evident.	Moderate	452.91	Desktop	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Likely	Likely
W18	Palustrine	Marsh	Floodplain	Rushland - Hygrophilous Grassland	Desktop derived, not delineated during fieldwork. Patch of <i>Weinmannia racemosa</i> - <i>Dicksonia squarrosa</i> scrub surrounded by <i>J. effusus</i> / <i>H. lanatus</i> - <i>G. declinata</i> grassland with scattered <i>Carex virgata</i> .	Moderate	2528.31	Desktop	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W19	Palustrine	Marsh	Floodplain	Hygrophilous Grassland	Oxbow wetland area dominated by <i>G. declinata</i> with a low abundance of <i>J. effusus</i> and <i>C. virgata</i> .	Moderate	1372.83	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W20	Palustrine	Seepage	Slope	Hygrophilous Grassland	Dominated by <i>G. declinata</i> with a low abundance of <i>J. effusus</i> , <i>H. lanatus</i> and <i>J. articulatus</i> .	Low	932.09	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W21	Palustrine	Seepage	Slope	Hygrophilous Grassland	Dominated by <i>G. declinata</i> with scattered <i>Lolium</i> spp. and <i>T. repens</i> .	Low	220.97	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W22	Palustrine	Seepage	Slope	Hygrophilous Grassland	Dominated by <i>G. declinata</i> with scattered <i>Lolium</i> spp. and <i>T. repens</i> .	Low	586.07	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes

Wetland identifier	Hydrosystem	Class	Form	Primary vegetation structure	Composition and Description	Quality	Area (m ²), within property boundary	Edge delineation	Plot	Rapid test	Dominance test	Prevalence test	Wetland?	Natural (as defined in the NPS-FM)?
W23	Palustrine	Seepage	Slope	Rushland - Hygrophilous Grassland	Dominated by a mix of <i>G. declinata</i> and <i>J. effusus</i> . Standing water and pugging evident.	Low	3838.69	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W24	Palustrine	Marsh	Valley Floor	Hygrophilous Grassland	Dominated by <i>G. declinata</i> with a significant area of <i>J. effusus</i> at south western extent.	Low	1701.10	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W25	Palustrine	Seepage	Slope	Rushland - Hygrophilous Grassland	Dominated by <i>J. effusus</i> and <i>H. lanatus</i> with <i>G. declinata</i> in wetter areas. Pugging evident.	Low	950.97	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W26	Palustrine	Marsh	Floodplain	Rushland - Hygrophilous Grassland	Variable vegetation although hydrophytic plants were prominent with certain areas comprising over 50% <i>J. effusus</i> cover.	Low	1704.17	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W27	Palustrine	Seepage	Slope	Hygrophilous Grassland	Dominated by <i>G. declinata</i> and <i>H. lanatus</i> with a moderate abundance of <i>T. repens</i> and low abundance of <i>J. effusus</i> , <i>L. perenne</i> , <i>J. articulatus</i> and <i>C. stagnalis</i> .	Low	259.98	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W28	Palustrine	Marsh	Floodplain	Rushland - Hygrophilous Grassland	Dominated by <i>J. effusus</i> and <i>H. lanatus</i> . Additional species include <i>G. declinata</i> , <i>A. stolonifera</i> , <i>Lolium arundinaceum</i> (Tall fescue) and <i>Lolium spp.</i>	Low	144.36	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W29	Palustrine	Marsh	Floodplain	Rushland - Hygrophilous Grassland	Primarily a mix of <i>G. declinata</i> , <i>H. lanatus</i> and <i>J. effusus</i> with a low abundance of <i>L. arundinaceum</i> , <i>Juncus planifolius</i> and <i>Eleocharis acuta</i> .	Low	402.45	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W30	Palustrine	Marsh	Floodplain	Rushland	Dominated by <i>J. effusus</i> with a low abundance of <i>G. declinata</i> and <i>H. lanatus</i> .	Low	198.67	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W31	Palustrine	Marsh	Floodplain	Rushland - Hygrophilous Grassland	Primary cover is <i>J. effusus</i> with the basal stratum comprising a mix of <i>H. lanatus</i> and <i>G. declinata</i> .	Low	195.14	GPS	Yes	Maybe	Pass	Pass	Yes	Yes
W32	Palustrine	Seepage	Slope	Rushland - Hygrophilous Grassland	Variety of species present in similar abundance including <i>J. effusus</i> , <i>H. lanatus</i> and <i>G. declinata</i> with a low abundance of <i>J. articulatus</i> and <i>C. stagnalis</i> .	Low	487.35	GPS	Yes	Maybe	Pass	Pass	Yes	Yes
W33	Palustrine	Seepage	Slope	Hygrophilous Grassland	Variety of species present in similar abundance including <i>Nasturtium officinale</i> (Watercress), <i>L. arundinaceum</i> , <i>G. declinata</i> , <i>H. lanatus</i> ,	Low	439.81	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes

Wetland identifier	Hydrosystem	Class	Form	Primary vegetation structure	Composition and Description	Quality	Area (m ²), within property boundary	Edge delineation	Plot	Rapid test	Dominance test	Prevalence test	Wetland?	Natural (as defined in the NPS-FM)?
					<i>Juncus</i> spp. and <i>Dactylis glomerata</i> .									
W34	Palustrine	Marsh	Slope	Rushland - Hygrophilous Grassland	Primary a mix of <i>J. effusus</i> , <i>G. declinata</i> , <i>H. lanatus</i> , <i>L. arundinaceum</i> , <i>Lolium</i> spp. and <i>J. planifolius</i> .	Low	529.18	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W35	Palustrine	Seepage	Slope	Hygrophilous Grassland	Variety of species present including <i>G. declinata</i> , <i>J. articulatus</i> , <i>J. effusus</i> , <i>R. repens</i> , <i>T. repens</i> , <i>H. lanatus</i> and <i>Lolium</i> spp. Standing water and pugging evident.	Low	1696.02	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W36	Palustrine	Seepage	Slope	Hygrophilous Grassland	Variety of species present including <i>G. declinata</i> , <i>J. articulatus</i> , <i>J. effusus</i> , <i>T. repens</i> and <i>A. stolonifera</i> .	Moderate	510.50	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W37	Palustrine	Seepage	Slope	Rushland - Hygrophilous Grassland	Variety of species present including <i>J. effusus</i> , <i>J. articulatus</i> , <i>G. declinata</i> , <i>R. repens</i> and <i>Rumex</i> spp. Clear topography associated with wetland. Standing water noted.	Low	1224.26	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W38	Palustrine	Marsh	Slope	Rushland	Dominated by <i>J. articulatus</i> . Additional species include <i>J. effusus</i> , <i>G. declinata</i> , <i>R. repens</i> , <i>H. lanatus</i> and <i>Lolium</i> spp. Standing water and pugging evident.	Low	1577.49	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W39	Palustrine	Marsh	Slope	Rushland - Hygrophilous Grassland	Variety of species present including <i>J. effusus</i> , <i>J. articulatus</i> , <i>C. stagnalis</i> , <i>T. repens</i> , <i>A. stolonifera</i> and <i>Lolium</i> spp. Pugging evident.	Low	1401.66	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W40	Palustrine	Seepage	Slope	Rushland	Primarily a mix of <i>J. articulatus</i> and <i>J. effusus</i> . Additional species include <i>R. repens</i> , <i>G. declinata</i> and <i>A. stolonifera</i> .	Low	1159.01	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W41	Palustrine	Seepage	Slope	Hygrophilous Grassland	Dominated by <i>G. declinata</i> . Additional species include <i>J. effusus</i> , <i>J. articulatus</i> and <i>T. repens</i> . Standing water and pugging evident.	Low	1077.44	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W42	Palustrine	Seepage	Slope	Hygrophilous Grassland	Dominated by <i>G. declinata</i> with low abundances of <i>C. stagnalis</i> , <i>J. effusus</i> , <i>H. lanatus</i> , <i>T. repens</i> and <i>R. repens</i> . Standing water and pugging evident.	Low	2441.44	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W43	Palustrine	Ephemeral Wetland	Basin	Hygrophilous Grassland	Desktop derived, not delineated during fieldwork. Vegetation likely <i>G. declinata</i> on edge of muddy areas fringed by	Low	623.59	Desktop	No	-	-	-	Likely	Likely

Wetland identifier	Hydrosystem	Class	Form	Primary vegetation structure	Composition and Description	Quality	Area (m ²), within property boundary	Edge delineation	Plot	Rapid test	Dominance test	Prevalence test	Wetland?	Natural (as defined in the NPS-FM)?
					facultative pasture species.									
W44	Palustrine	Seepage	Slope	Rushland - Hygrophilous Grassland	Primarily a mix of <i>G. declinata</i> , <i>J. effusus</i> and <i>T. repens</i> , flanked by facultative pasture species.	Low	59.13	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W45	Palustrine	Seepage	Slope	Rushland - Hygrophilous Grassland rewrite	Primarily a mix of <i>T. repens</i> , <i>J. articulatus</i> and <i>A. stolonifera</i> with a low abundance of <i>G. declinata</i> .	Low	1950.02	GPS	Yes	Maybe	Pass	Pass	Yes	Yes
W46	Palustrine	Seepage	Slope	Hygrophilous Grassland	Dominated by <i>G. declinata</i> and <i>H. lanatus</i> .	Low	257.41	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W47	Palustrine	Seepage	Slope	Hygrophilous Grassland	Dominated by <i>G. declinata</i> and <i>H. lanatus</i> .	Low	95.36	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W48	Palustrine	Marsh	Slope	Hygrophilous Grassland	Dominated by <i>G. declinata</i> with a low abundance of <i>T. repens</i> and <i>J. articulatus</i> .	Moderate	6804.39	GPS	Yes	Maybe	Pass	Pass	Yes	Yes
W49	Palustrine	Marsh	Slope	Hygrophilous Grassland	Primarily a mix of <i>G. declinata</i> and <i>H. lanatus</i> with a low abundance of <i>L. pedunculatus</i> , <i>E. acuta</i> and <i>J. planifolius</i> .	Moderate	2681.74	GPS	Yes	Maybe	Pass	Pass	Yes	Yes
W50	Palustrine	Marsh	Channel	Hygrophilous Grassland	Dominated by <i>G. declinata</i> with a low abundance of <i>T. repens</i> and <i>H. lanatus</i> .	Moderate	3396.18	GPS	Yes	Maybe	Pass	Pass	Yes	Yes
W51	Palustrine	Seepage	Slope	Hygrophilous Grassland	Seepage area dominated by <i>G. declinata</i> .	Low	317.36	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W52	Palustrine	Seepage	Basin	Hygrophilous Grassland	Primarily a mix of <i>G. declinata</i> and <i>H. lanatus</i> with a low abundance of <i>C. stagnalis</i> and <i>R. repens</i> .	Low	130.41	GPS	Yes	Maybe	Pass	Pass	Yes	Yes
W53	Palustrine	Marsh	Floodplain	Rushland - Hygrophilous Grassland	Dominated by <i>J. effusus</i> and <i>H. lanatus</i> . Clear topography and hydrology associated with wetland. Pugging evident.	Low	1314.23	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W54	Palustrine	Marsh	Slope	Rushland - Hygrophilous Grassland	Vegetation comprised a mix of <i>J. effusus</i> , <i>T. repens</i> , <i>G. declinata</i> and <i>R. repens</i> .	Moderate	3186.32	GPS	Yes	Maybe	Pass	Pass	Yes	Yes
W55	Palustrine	Marsh	Flat	Rushland	<i>J. effusus</i> rushland habitat.	Moderate	2112.01	GPS	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes
W56	Palustrine	Seepage	Slope	Hygrophilous Grassland	Dominated by <i>G. declinata</i> with a low abundance of <i>T. repens</i> .	Low	820.01	Desktop	No	Pass	Pass (from cover estimates)	Pass (from cover estimates)	Yes	Yes

3.3.2 Te wai mauri – Streams

Historical imagery of the site indicates that multiple streams and wetland-stream complexes existed within the site boundary prior to the implementation of artificial drainage channels.

The perennial Otahi Stream, which bisects the site, comprised primarily boulder / cobble-alluvial substrate within a 5-10m wide, 2m deep active channel. The diversity of rocky substrate within the river was high however limited alluvial and vegetative habitat was noted within the overall stream extent. Riffles and runs were the dominant biotopes onsite with moderate, clear flows observed on the day of assessment. The Otahi Stream is crossed by a single bridge structure, which does not appear to hinder local fish/macroinvertebrate migration.

Riparian vegetation within the Otahi Stream comprised primarily locally common pasture species such as Yorkshire fog and Perennial rye grass with interspersed trees and shrubs including tī kōuka, harakeke and willow species. The prevalence of stream bank erosion inhibits vegetation growth, and accordingly, intermittent areas of marginal vegetation were recorded onsite consisting of occasional rush and grass patches within a predominately boulder/cobble substrate. Cattle trampling was also evident along areas of the stream bank.

Streams S1-S5 appear to have been historically modified to varying degrees with certain streams being subjected to channel straightening (i.e. S3) and some being completely cut-off by artificial drains (i.e. S4). Stream S5 exhibited notably high levels of bank erosion compared to other modified streams onsite, this will require consideration during development. The modified streams are traversed by multiple pipe culvert crossings, some of which are perched above the flow level or have scoured beneath the infrastructure causing potential fish passage issues.

The modified streams were generally 3-5m wide and up to 2m deep, however stream S5 was up to 8m wide and 2.5m deep. General vegetation within the modified streams comprised a variety of herbaceous and grassland species on the banks and bed including yorkshire fog, perennial rye grass, *J. effusus*, buttercup, watercress, water starwort, blackberry and various ferns.

Representative photographs of the streams are included in Figure 7 below.



Photo I: View from south to north looking upstream from the left-hand bank of the Otahi Stream at the northern extent of the site, showing common pasture grasses within the riparian zone.



Photo J: View of cobble habitat and riffle biotopes within the Otahi Stream. Note the bank erosion on the right-hand bank.



Photo K: Erosion around a culvert crossing within stream S5.



Photo L: A perched culvert within stream S4 likely resulting from channelisation of flows, these conditions can be problematic for fish passage

Figure 7: Representative photos of the streams within the site.

3.3.3 Artificial Drains

Multiple artificial drains were observed and delineated within the site extent. The drains were primarily V-shaped and well vegetated, with generally low levels of erosion. It is likely that the drains were excavated onsite to divert natural watercourses whilst also effectively reducing the level of saturation within historic wetland areas, allowing for pasture expansion.

The drains were generally 2-3m wide and 1.5-2m deep, comprising a variety of herbaceous and grassland species that was broadly similar in composition to the modified streams. Less flow and open water was recorded within the artificial drains compared to the modified watercourses.

Representative Photographs of the drains are included in Figure 8 below.



Photo M: View from south east to north west near the top of drain 3b. Excavated material was still present adjacent to this drain.



Photo N: View from south east to north west near the top of drain D4b. Note the good vegetative cover, which characterised most drains onsite.



Photo O: View from north east to south west from the top of drain 4c.



Photo P: View from south west to north east looking upslope from the right-hand bank of drain D6. This drain exhibited comparatively higher levels of weed encroachment (mostly blackberry) although recent control via spraying was evident.

Figure 8: Representative photos of drains within the site.

3.4 Ngāi kīrehe - Fauna

3.4.1 Pekapeka – Bats

The nearest known record of pekapeka long-tailed bats was recorded in excess of 40km northeast of the site, despite recording devices being set up within 9km of the property (DOC 2021). No bat surveys were undertaken during the site visit as roosting habitat was very limited.

3.4.2 Manu – Birds

All manu (birds) seen and heard were noted during the site visit on 12-14 October 2022, which included a total of 20 bird species comprising 13 'Introduced: Naturalised' species, six 'Not Threatened' species and one 'Threatened: Nationally Vulnerable' species (see Table 3, below). The majority of recorded birds were common open country, pasture species.

Suitable nesting habitat within the site is limited, however, small areas of native bush habitat within and adjacent to the proposed solar farm are available for nesting.

Table 3: Bird records from the proposed solar farm and surrounding areas.

No.	Scientific Name	Common Name	Threat Status (Robertson <i>et al.</i> 2021)	Nearby Records		
				eBird (within 10km)	Proposed Solar Farm Site Observations	eDNA Sample (12 October 2022)
1	<i>Acanthis cabaret</i>	Lesser Redpoll	Unknown	X		
2	<i>Acridotheres tristis</i>	Common myna Maina	Introduced: Naturalised	X		
3	<i>Alauda arvensis</i>	Eurasian skylark Kairaka	Introduced: Naturalised	X	X	
4	<i>Anas gracilis</i>	Grey teal Tētē-moroiti	Not Threatened	X		
5	<i>Anas platyrhynchos</i>	Mallard Rakiraki	Introduced: Naturalised	X	X	X
6	<i>Anas superciliosa</i>	Grey Duck pāpera	Threatened: Nationally Vulnerable	X		
7	<i>Anthornis melanura</i>	Bellbird korimako	Not Threatened	X		
8	<i>Anthus novaeseelandiae</i>	New Zealand pipit Pīhoihoi	At Risk: Declining	X		
9	<i>Aythya novaeseelandiae</i>	New Zealand Scaup pāpango	Not Threatened	X		
10	<i>Branta canadensis</i>	Canada goose Kuihi	Introduced: Naturalised	X	X	X
11	<i>Callipepla californica</i>	California quail Tikaokao	Introduced: Naturalised	X		
12	<i>Carduelis carduelis</i>	European goldfinch Kōurarini	Introduced: Naturalised	X	X	
13	<i>Chloris chloris</i>	European greenfinch	Introduced: Naturalised	X	X	
14	<i>Chrysococcyx lucidus</i>	Shining cuckoo Pīpīwharaura	Not Threatened	X		
15	<i>Circus approximans</i>	Swamp harrier Kāhu	Not Threatened	X	X	
16	<i>Columba livia</i>	Rock pigeon Kererū aropari	Introduced: Naturalised	X		
17	<i>Cygnus atratus</i>	Black Swan Kakiānau	Introduced: Naturalised	X		
18	<i>Egretta novaehollandiae</i>	White-faced heron Matuku moana	Not Threatened	X	X	
19	<i>Emberiza citrinella</i>	Yellowhammer Hurukōwhai	Introduced: Naturalised	X	X	
20	<i>Falco novaeseelandiae</i>	New Zealand falcon Kārearea	Threatened: Nationally Vulnerable		X	
21	<i>Fringilla coelebs</i>	Chaffinch Pahirini	Introduced: Naturalised	X		
22	<i>Gerygone igata</i>	Grey warbler Riroriro	Not Threatened	X		
23	<i>Gymnorhina tibicen</i>	Australian magpie Makipai	Introduced: Naturalised	X	X	X
24	<i>Haematopus finschi</i>	South Island pied oystercatcher Tōrea	At Risk: Declining	X		
25	<i>Haematopus unicolor</i>	Variable oystercatcher Tōrea pango	At Risk: Recovering	X		
26	<i>Hemiphaga novaeseelandiae</i>	New Zealand Pigeon Kererū	Not Threatened	X		X
27	<i>Himantopus leucocephalus</i>	Pied stilt Poaka	Not Threatened	X		
28	<i>Hirundo neoxena</i>	Welcome swallow Warou	Not Threatened	X		
29	<i>Larus dominicanus</i>	Southern black-backed gull Karoro	Not Threatened	X	X	
30	<i>Mohoua albigilla</i>	Whitehead Pōpokotea	Not Threatened	X		
31	<i>Morus serrator</i>	Australasian gannet Tākapu	Not Threatened	X		
32	<i>Passer domesticus</i>	House sparrow Tiu	Introduced: Naturalised	X	X	X
33	<i>Petroica macrocephala</i>	Tomtit Miromiro	Not Threatened	X		
34	<i>Phalacrocorax carbo</i>	Black shag Māpunga	At Risk: Relict	X		
35	<i>Phalacrocorax melanoleucos</i>	Little shag Kawaupaka	At Risk: Relict	X		
36	<i>Phalacrocorax sulcirostris</i>	Little black shag Kawau tūi	At Risk: Naturally Uncommon	X		
37	<i>Phalacrocorax varius</i>	Pied shag Kāruhiruhi	At Risk: Recovering	X		
38	<i>Platycercus eximius</i>	Eastern rosella Kākā uhi whero	Introduced: Naturalised	X	X	
39	<i>Porphyrio melanotus</i>	Pukeko	Not Threatened	X	X	X
40	<i>Prosthemadera novaeseelandiae</i>	Tui	Not Threatened	X	X	
41	<i>Prunella modularis</i>	Dunnoek	Introduced: Naturalised	X	X	
42	<i>Rhipidura fuliginosa</i>	New Zealand fantail Pīwakawaka	Not Threatened	X		X
43	<i>Spatula rhynchotis</i>	Australasian shoveler Kuruwhegi	Not Threatened	X		
44	<i>Sturnus vulgaris</i>	Common starling Tāringi	Introduced: Naturalised	X	X	
45	<i>Tadorna variegata</i>	Paradise shelduck Pūtangitangi	Not Threatened	X		
46	<i>Todiramphus sanctus</i>	Sacred kingfisher Kōtare	Not Threatened	X		
47	<i>Turdus merula</i>	Eurasian blackbird Manu pango	Introduced: Naturalised	X	X	X
48	<i>Turdus philomelos</i>	Song thrush Manu-kai-hua-rakau	Introduced: Naturalised	X	X	
49	<i>Vanellus miles</i>	Spur-winged Plover	Not Threatened	X	X	
50	<i>Zosterops lateralis</i>	Silvereeye	Not Threatened	X		

3.4.3 Mokomoko – Skinks and geckos

Potential mokomoko habitat within hedgerows and other likely areas was identified and formally searched at four localities within the site boundary. Occasionally, a chance finds procedure was also implemented when potential skink/gecko habitat was encountered during the site walkover (i.e. leaf litter, woody stockpiles and discarded farm equipment). No mokomoko were found during the active or passive searches. The vast majority of the site comprises grazed pasture offering very limited habitat for skinks and geckos therefore it is highly unlikely that these reptiles are present in significant numbers within the proposed development site.

3.4.4 Fish

Active electrofishing for potential fish was not undertaken within the watercourses onsite although an eDNA sample was obtained from the Otahi Stream, which drains the majority of the site. Species of fish known to occur within freshwater habitat in the vicinity of the site according to the New Zealand Freshwater Fish Database (NZFFDB) have been listed in Table 4, whilst species identified in the eDNA sample are marked with an 'X'. In the absence of significant barriers to fish migration such as instream dams or weirs, most of the species listed below could occur within the Otahi Stream as these species have been recorded in rivers / streams within 3km of the eDNA sample point.

Table 4: Fish species present in the NZFFDB for the area, including eDNA results.

No.	Scientific Name	Common Name	Threat Status (Dunn <i>et al.</i> 2017)	eDNA Sample (12 October 2022)
1	<i>Anguilla australis</i>	Shortfin eel	Not Threatened	X
2	<i>Anguilla dieffenbachii</i>	Longfin eel	At Risk: Declining	X
3	<i>Anguilla</i> spp.	Unidentified eel	N/A	X
4	<i>Cheimarrichthys fosteri</i>	Torrentfish panoko	At Risk: Declining	
5	<i>Galaxias anomalus</i>	Roundhead galaxias	Threatened: Nationally Endangered	
6	<i>Galaxias argenteus</i>	Giant kokopu	At Risk: Declining	
7	<i>Galaxias brevipinnis</i>	Koaro	At Risk: Declining	
8	<i>Galaxias fasciatus</i>	Banded kokopu	Not Threatened	
9	<i>Galaxias maculatus</i>	Inanga	At Risk: Declining	
10	<i>Galaxias postvectis</i>	Shortjaw kokopu	Threatened: Nationally Vulnerable	
11	<i>Geotria australis</i>	Lamprey piharau	Threatened: Nationally Vulnerable	
12	<i>Gobiomorphus cotidianus</i>	Common bully toitoi	Not Threatened	
13	<i>Gobiomorphus gobioides</i>	Giant bully titarakura	At Risk: Naturally Uncommon	
14	<i>Gobiomorphus huttoni</i>	Redfin bully	Not Threatened	X
15	<i>Gobiomorphus</i> spp.	Unidentified bully	N/A	X
16	<i>Neochanna apoda</i>	Brown mudfish waikaka	At Risk: Declining	
17	<i>Oncorhynchus mykiss</i>	Rainbow trout	Introduced and Naturalised	
18	<i>Retropinna retropinna</i>	Common smelt pōrohe	Not Threatened	
19	<i>Salmo</i> spp.	Unidentified salmonid	N/A	
20	<i>Salmo trutta</i>	Brown trout	Introduced and Naturalised	

3.4.5 Macroinvertebrates

Active macroinvertebrate sampling was undertaken at a single locality within the Otahi Stream in the vicinity of the eDNA sampling location, according to the method described in Section 2.2.3. The stream was hard-bottomed, dominated by boulder/cobble substrate with comparatively smaller sandy alluvial sections. Marginal vegetation and shaded areas were largely absent from the assessed reach. A summary of the sampled macroinvertebrates onsite is shown in Table 5, below.

The quality class of the calculated MCI indicates that the instream habitat is in a 'fair' condition. The QMCI score, which considers the abundance of each scoring taxon, indicated 'excellent' instream habitat condition, due largely to the relatively high abundance of Deleatidium (Single gill mayfly) which is known to be sensitive to polluted environments.

Table 5: Macroinvertebrates obtained during active sampling in the stream as well as through an eDNA sample.

Taxon	MCI Score	Abundances: Proposed Solar Farm Site – Bridge Crossing	eDNA Sample (12 October 2022)
Coelenterata			
Hydra	3	0	X
Crustacea			
<i>Paranephrops</i>	5	0	X
Copepoda	5	0	X
Megaloptera			
<i>Archichauliodes</i>	7	0	X
Coleoptera			
Elmidae	6	1	
Collembola	6	1	X
Diptera			X
<i>Aphrophila</i>	5	12	
<i>Austrosimulium</i>	3	8	
Chironomidae	2	0	X
<i>Corynoneura</i>	2	0	X
<i>Limnophora</i>	3	0	X
<i>Maori diamesa</i>	3	12	
Orthocla diinae	2	104	
Tanytarsini	3	32	X
Ephemeroptera			X
<i>Austroclima</i>	9	8	
<i>Coloburiscus</i>	9	0	X
<i>Deleatidium</i>	8	532	X
<i>Nesameletus</i>	9	0	X
<i>Zephlebia</i>	7	0	X
Mollusca			
<i>Potamopyrgus</i>	4	56	X
Nematoda	3	4	
Oligochaeta	1	12	X
Platyhelminthes	3	4	
Plecoptera			
<i>Acroperla</i>	5	8	X
<i>Zelandobius</i>	5	1	
<i>Zelandoperla</i>	10	0	X
Trichoptera			X
<i>Costachorema</i>	7	0	X
<i>Helicopsyche</i>	10	0	X
<i>Hydrobiosis</i>	5	12	X
<i>Hydropsyche - Aoteapsyche group</i>	4	4	X
<i>Oxyethira</i>	2	1	X
<i>Psilochorema</i>	8	4	X
<i>Pycnocentria</i>	7	4	
<i>Pycnocentroides</i>	5	8	X
<i>Triplectides</i>	5	0	X
Total Taxa Sampled		21	28
Number of EPT taxa (incl. Hydroptilidae)		10	18
% EPT taxa (incl. Hydroptilidae)		48	64
% EPT (incl. Hydroptilidae)		70	N/A
MCI score		92	
QMCI score		6.3	
SQMCI score		6.6	

3.4.6 Pest animals

No pest animals or evidence of pest animals, such as scat or tracks, were observed during the site visit. It is likely that pest animals such as rats, possums, mustelids, hedgehogs, and feral cats are present within the general area as pest traps were noted within the site boundary (Figure 9).



Figure 9: Pest traps observed on the property.

4 ASSESSMENT OF ECOLOGICAL EFFECTS

This assessment is based broadly on the EIANZ EclA guidelines (Roper-Lindsay et al. 2018), guided by expert opinion as outlined in the EclA framework (Section 2.3) used to determine ecological values, magnitude of effects, and overall level of effect associated with the proposed works at the site. The value assessment has also been informed by the criteria for significant indigenous biodiversity within the 2010 Regional Policy Statement for Taranaki (RPST) as well as the draft National Policy Statement for Indigenous Biodiversity.

4.1 Ecological values

4.1.1 Ecosystems and Habitat

The majority of ecological values present within the proposed solar farm on site have been assessed as 'Low' based on the highly modified nature of the site comprising predominantly grazed pasture presenting predominantly exotic species. The ecological values of riparian vegetation, native forest and 'moderate' quality wetlands has been rated as 'moderate'.

Given the ecological context and value of the stream and riparian wetlands to threatened fauna, and the rarity of wetlands nationally, these specific areas are considered significant under the RPST.

A breakdown of each habitat type assessed is include in Table 6, below.

Table 6: Ecological values assessment for onsite habitat

Habitat grouping	Area (ha)	Representativeness		Rarity/distinctiveness		Diversity & Pattern		Ecological Context		Overall Ecological Value
Pasture	~145.0	Very Low	Site would likely have been dominated by native forest.	Low	Pasture is common in the area. Threatened birds have been identified within 10km of the site although this habitat is largely unsuitable. .	Low	Comprises primarily two to three common pasture species.	Very Low	General site and region dominated by pasture associated with dairy farming.	Very Low
Riparian Vegetation	~1.0	Moderate	Large sections appear to be artificially planted with representative riparian species.	Moderate	Although largely artificial, the species are common riparian species which may provided some refuge for locally common birds.	Low	<5 common riparian species planted within stream reach.	Moderate	Streams and associated riparian vegetation are important for connectivity and refuge for dependant species.	Moderate
Low quality wetlands	~4.2	Low	Highly modified grassland vegetation.	Moderate	Wetlands are under represented nationally and are a national priority for protection (MfE, 2007), however, small pockets of wetland habitat within the agricultural mosaic were common in the region.	Low	Comprises primarily facultative wetland grassland vegetation.	Low	Wetlands were grazed and largely located within, and surrounded by, pasture areas, providing limited habitat for fauna and flora.	Low
Moderate quality wetlands	~3.1	Low	Highly modified grassland vegetation.	Moderate	Wetlands are under represented nationally and are a national priority for protection (MfE, 2007), however, small pockets of wetland habitat within the agricultural mosaic were common in the region.	Low	Comprises primarily facultative wetland grassland vegetation.	Moderate	These wetlands were in similar condition to the 'low' quality wetlands, however, they are relatively large, are located in close proximity to each other and are connected to other landscape features including the Otahi Stream and various small hills.	Moderate
Hedgerows	~0.4	Very Low	Site would likely have been dominated by native forest.	Low	Hedgerows are common between pastures, could provide some refuge to mokomoko.	Very Low	Comprises primarily two to three common hedgerow species.	Very Low	Narrow and elongated, offering little faunal refuge opportunity.	Very Low
Mature Pines	~0.2	Very Low	Site would likely have been dominated by native forest.	Low	Common in the area, possible manu resting and nesting locations.	Very Low	Comprises one <i>Pinus</i> spp. species.	Very Low	Generally isolated across the site.	Very Low
Native Forest	~0.9	Moderate	Some characteristic forest and scrub species although, weedy vegetation present.	High	Increasingly rare across New Zealand, most native scrub and forest in the area conserved within the Edgemont National Park.	Moderate	Moderate diversity of native tree/scrub species noted within the habitat patch.	Moderate	Certain areas within the native scrub are dense and difficult to access. Connected to a small riparian and wetland area, but not well connected to wider site.	Moderate

4.1.2 Species

Three faunal assemblages were assessed within the study site, the values of which are discussed in sections 4.1.2.1. to 4.1.2.3.

4.1.2.1 Avifauna

The site observations and eDNA sampling confirmed that all bird species currently utilising the site were locally common and introduced. Although 'At Risk' and 'Threatened' species have been recorded within 10km of the study site, these birds likely traverse the area during flight and are not likely to utilise the habitat onsite for an extended period of time. The ecological value of Avifauna onsite is **low**.

4.1.2.2 Skinks and Geckos

The site has been anthropogenically modified, comprising limited and fragmented herpetofauna habitat as well as a likely high abundance of pest animals. It is therefore unlikely native herpetofauna species are present in significant numbers. The ecological value of onsite herpetofauna is **low**.

4.1.2.3 Fish

Watercourses within the site offer good refuge opportunities for fish and should allow for instream migration if connectivity with the ocean is adequate. It is difficult to discern whether any instream barriers exist between the site and the ocean, however, migratory species such as Longfin eel ('At Risk: Declining') were recorded within the eDNA. The ecological value of fish within the site extent is **high**.

4.2 Ecological effects and mitigation

The proposed works associated with the proposal include the construction and installation of solar panel arrays, inverter/transformer stations, fencing and security measures. The following potential construction and operational impacts associated with the proposed solar farm, may result in the following direct and indirect ecological effects:

- Construction works related to the implementation of ground-mounted solar panel arrays. This will likely involve small-scale displacement of soils for insertion of concrete footing that will house the steel poles of the solar array structures.
- Construction works to form access to the proposed structures within the proposed solar farm area (largely based on existing farm tracks);
- Construction works to implement infrastructure associated with the proposed solar farm (e.g. inverters, transformers, etc.);
- Stormwater runoff from any impervious surfaces associated with infrastructure and access tracks;
- Reflection and glare off the solar panels; and
- Lighting and noise associated with on-site infrastructure.

There are also a range of potential positive ecological effects associated with the proposal. Based on the initial design plans, positive effects would include improved aquatic habitat and water quality from reduced grazing pressure and recommended planting of riparian zones, proposed enhancement of biodiversity values through restoration plantings and enhanced connectivity of natural areas in a landscape context through buffer and corridor plantings.

This section of the report constitutes a preliminary effects assessment, with proposed mitigation, that will be updated and expanded upon once the relevant planning information has been received.

A summary of the potential ecological effects, as well as the magnitude / level of effect in the absence and presence of mitigation, is provided in Table 7, below.

Table 7: Effects assessment of ecological features considering preliminary mitigation measures.

Ecological feature	Ecological Value	Effects	No Mitigation		Proposed Mitigation	Post Mitigation	
			Magnitude of effect	Level of Effect		Magnitude of effect	Level of Effect
Pasture	Very Low	Vegetation disturbance of areas currently under pasture.	Low	Very Low	Not required	N/A	
Riparian Vegetation	Moderate	Local impact on vegetation and stream bank stability if planted within riparian area. Erosion of banks and sedimentation of watercourses is likely if constriction activities are nearby.	Low	Low	<ul style="list-style-type: none"> - Fence off riparian vegetation and proposed conservation areas according to specifications in the landscape plan (4Sight 2022). - Remove weeds from riparian zone. - Revegetate and restore riparian zone. 	Positive	Net Gain
Low Quality Wetlands	Low	Local impact on vegetation and hydrology during earthworks and placement of solar infrastructure within identified wetland habitat.	Moderate	Low	<ul style="list-style-type: none"> - Minimise machine tracking and vehicular movement in 'low quality' wetlands. - Avoid hard packing the backfill of any trenches dug through the wetland to minimise effects on wetland hydrology. - Any damaged or removed vegetation should be replaced with appropriate wetland plant species 	Low	Very Low
Moderate Quality Wetlands	Moderate	Minor indirect effects from run-off and nearby vegetation clearing are possible, no planned direct negative effects.	Low	Low	<ul style="list-style-type: none"> - Fence off the delineated 'moderate quality' wetlands and proposed conservation areas according to specifications in the landscape plan (4Sight 2022). - Restrict unnecessary vehicular and pedestrian movement within wetlands. - Remove weeds from 'moderate quality' wetlands. - Revegetate and restore wetland area. 	Positive	Net Gain
Hedgerows	Very Low	Vegetation disturbance/loss of areas currently planted as hedgerows. Disturbance of possible mokomoko habitat.	Low	Very Low	Not required	N/A	

Ecological feature	Ecological Value	Effects	No Mitigation		Proposed Mitigation	Post Mitigation	
			Magnitude of effect	Level of Effect		Magnitude of effect	Level of Effect
Mature Pines	Very Low	Disturbance/loss of mature pine trees.	Low	Very Low	Not required	N/A	
Native scrub	Moderate	Removal of native forest vegetation patch. Light and noise pollution potentially causing dispersal of resident faunal species.	Low	Low	<ul style="list-style-type: none"> - Fence off the native scrub and proposed conservation areas according to specifications in the landscape plan (4Sight 2022). - Remove weeds from scrub area. - Revegetate and restore forest area. 	Very Low	Very Low
Birds	Low	Bird mortality / injury relating to earthworks, vegetation clearing and general plant movement. Noise and vibration disturbance, reducing habitat suitability for birds.	Low	Very Low	<ul style="list-style-type: none"> - Implement a chance finds procedure onsite, where nesting habitat discovered during active construction works must be reported to the monitoring team. 	Low	Very Low
Skinks and Geckos	Low	Mortality / injury to skinks and geckos relating to earthworks, vegetation clearing and general plant movement. Noise and vibration disturbance, reducing habitat suitability for skinks and geckos.	Low	Very Low	<ul style="list-style-type: none"> - Implement a chance finds procedure onsite, where nesting habitat discovered during active construction works must be reported to the monitoring team. 	Low	Very Low
Fish	High	Fish habitat degradation due to increased turbidity of watercourses related to surface run-off from construction.	Low	Low	<ul style="list-style-type: none"> - Avoid unnecessary machine tracking and vehicular movement in watercourses by making use of existing bridges. - Implement a silt fence adjacent to watercourses near active works areas, where required (i.e. on steep slopes). 	Low	Low

5 SUMMARY

Harmony Energy Storage Limited is proposing the development of a ~90MWp solar farm ('the site') near Opunake within the South Taranaki District. A preliminary assessment of ecological effects was prepared to accompany an application to establish a solar farm at the site under the COVID-19 Recovery (Fast-Track Consenting) Act 2020. The ecological assessment relates to the construction, operation and maintenance of a solar farm at the site.

The site has been predominately under pasture since at least since 1954 and generally has a gently sloping topography with scattered hillocks throughout. Additional terrestrial vegetation within the site comprised small patches of native forest and scrub, riparian vegetation along the Otahi Stream, secondary wetland vegetation and hedgerows. Only common manu were seen or heard on site, and it was considered unlikely that mokomoko are present in high densities due to the limited habitat available. No active fish sampling was undertaken onsite, however, an assessment of eDNA results indicated the presence of a single 'At Risk' eel species. The assessment of macroinvertebrates at a single locality within the Otahi Stream indicated that the instream habitat condition is fair/excellent.

The ecological values on this site were assessed as 'Low' overall based on the predominate land use of the site, which was pasture for dairy farming. Native forest and scrubs areas onsite covered very small areas whilst wetlands, although a nationally under-represented ecosystem, comprised primarily of secondary grassland vegetation. Following the Regional Policy Statement for Taranaki, riparian vegetation, native forest and 'moderate' quality wetlands were assessed as being locally significant.

A number of potential adverse ecological effects associated with the proposed solar farm are construction works, stormwater run-off from newly created structures and impervious surfaces, reflection and glare off solar panels, and lighting and noise associated with on-site infrastructure. The magnitude and level of effects was assessed as 'Very Low' when considering proposed mitigation measures for the solar farm.

A number of positive effects are expected to occur with proposed enhancement and restoration measures, although these precise focus areas have not been accurately determined at the time of report writing. It is likely that if the proposed enhancement opportunities are implemented by the client, the overall ecological impact would result in a 'Net Gain' for the site.

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Appendix A:

Wetland Delineation Data and Photographs

Draft

Plot No.	Coordinates		Plot Results
	NZTM	DMS	
1: W01	1678834E, 5640060N	39°23'07.22''S, 173°54'55.40''E	Non-Wetland
2: W02	1678828E, 5640093N	39°23'06.15''S, 173°54'55.13''E	Non-Wetland (Pasture Exclusion)
3: W03	1678806E, 5640087N	39°23'06.35''S, 173°54'54.22''E	Wetland
4: W04	1678783E, 5640101N	39°23'05.91''S, 173°54'53.25''E	Non-Wetland (Pasture Exclusion)
5: W05	1680281E, 5640494N	39°22'52.66''S, 173°55'55.69''E	Non-Wetland (Pasture Exclusion)
6: W06	1680311E, 5640576N	39°22'49.99''S, 173°55'56.91''E	Non-Wetland
7: W08	1680261E, 5640599N	39°22'49.28''S, 173°55'54.79''E	Wetland
8: W10	1680099E, 5640381N	39°22'56.39''S, 173°55'48.13''E	Wetland
9: W11	1680044E, 5640383N	39°22'56.34''S, 173°55'45.83''E	Non-Wetland
10: W12	1679684E, 5640274N	39°23'00.02''S, 173°55'30.84''E	Non-Wetland
11: W15	1679680E, 5640096N	39°23'05.77''S, 173°55'30.74''E	Wetland
12: W16	1679775E, 5640133N	39°23'04.54''S, 173°55'34.70''E	Non-Wetland
13: W17	1680526E, 5640244N	39°23'00.69''S, 173°56'06.04''E	Wetland
14: W18	1680414E, 5640216N	39°23'01.64''S, 173°56'01.37''E	Wetland
15: W19	1680320E, 5640152N	39°23'03.74''S, 173°55'57.47''E	Wetland
16: W21	1680233E, 5640112N	39°23'05.07''S, 173°55'53.85''E	Wetland
17: W22	1680153E, 5640027N	39°23'07.85''S, 173°55'50.54''E	Non-Wetland



Photo S: Example of plot placement within the property boundary.

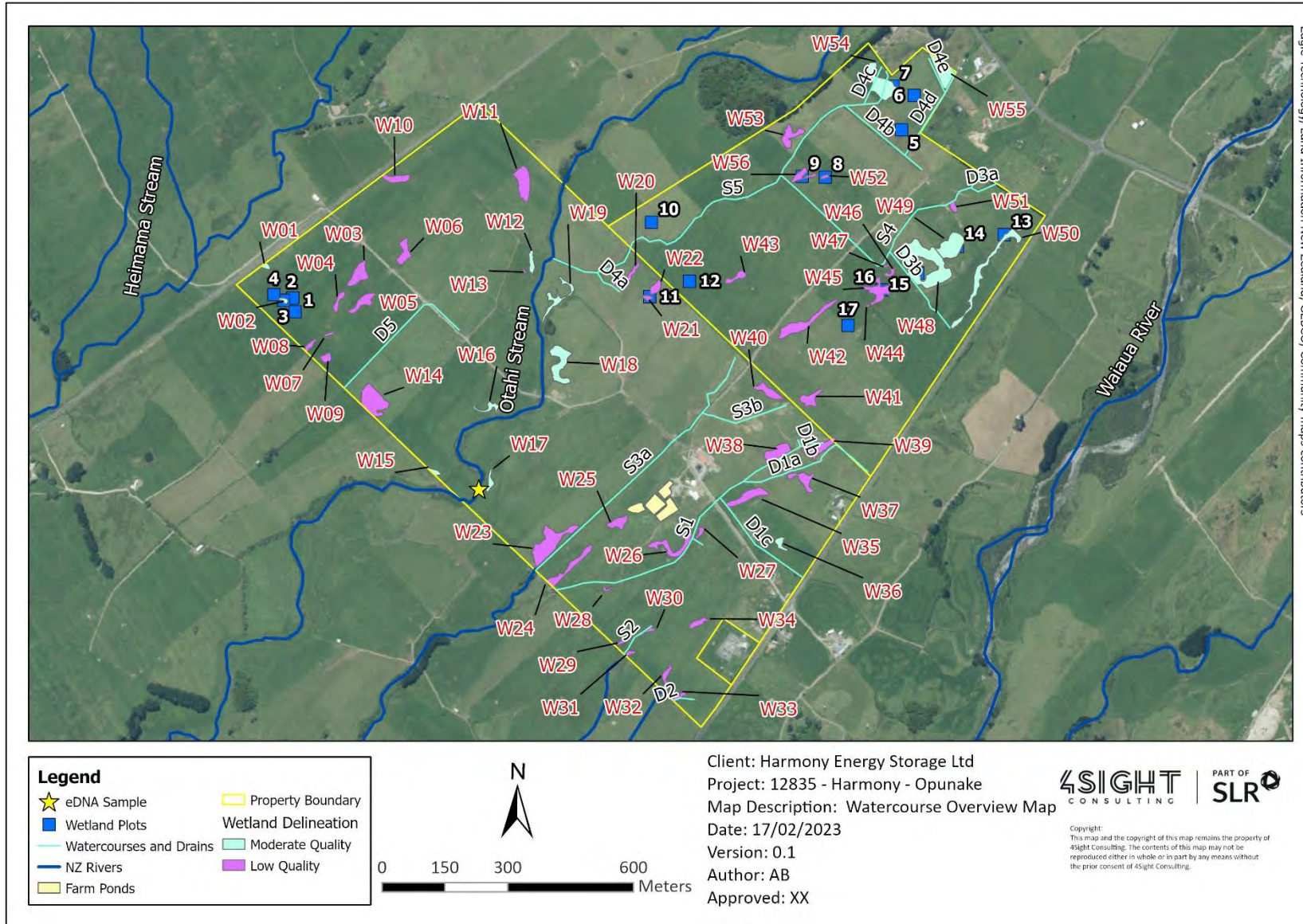


Photo T: Excavated soil sample to check wetland hydrology, which was non-wetland in this case.

Appendix B:

Wetland Overview Map with Lables

Draft



Eagle Technology, Land Information New Zealand, GIBCO, Community maps contributors

