# *FLOOD HAZARD RISK ASSESSMENT*






## Twizel Solar Plant - Flood Hazard Risk Assessment

for Nova Energy Limited

Rev B - 21/04/2026

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| | Reviewed | |
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# EXECUTIVE SUMMARY

This Flood Hazard Risk Assessment has been prepared on behalf of Nova Energy to support the resource consent application for a proposed solar plant at Twizel.

This risk assessment provides analysis using a risk based proportionate approach to the proposed development in accordance with the requirements of the National Policy Statement for Natural Hazards 2025 (NPS-NH) and the Mackenzie District Plan (MDP).

The flood hazards across the site were assessed through development of a 2-dimensional (2D) model in Infoworks ICM software for several storms between 2% AEP and 0.2% AEP under an RCP 8.5 climate change scenario.

The results indicate flooding on the site is generally confined to historic river braids which are located across the site. Flows of elevated depth and velocity are limited to the more defined channels.

An assessment of the flood hazards on the site was undertaken against the MDP and the NPS-NH as summarised below:

MDP: Minor areas of the proposed solar farm (< 0.1%) are identified to meet the 'high flood hazard areas' classification.

NPS-NH: The flood risk of the site is generally considered to be low with small, localised areas of the site and solar array extent being of a medium to high risk.

The high hazard areas are highly localised and are generally caused by concentration of water within the historic river braids, and it is considered that natural hazard mitigation works could be undertaken within the assessed medium and high hazard areas to reduce the hazard classification.

It is anticipated that the hazard will be decreased to 'low - medium' with the proposed mitigations.

Maps indicating the flood water depths and flow velocities across the site are attached in Appendix C.

The following recommendations should be considered with the site development:

- Buildings and structures should be elevated a minimum of 300 mm above the modelled 500-year ARI flood level.
  - Solar panels are expected to exceed this minimum requirement due to their ability to track up to 1.85 m above ground level.
  - The workshop and operations and maintenance buildings should have a minimum finished floor level of RL 441.63 m (NZVD 2016)
  - Inverters shall be elevated 1 m above ground level; they will be elevated at least 300 mm above the modelled 500-year ARI flood level.
  - Temporary office buildings within the construction laydown area are recommended to have a minimum finished floor level of 300 mm above the 500-year ARI top water level.
- Access to the operational site should be suitably designed with mitigations to ensure the stability of the landform, and the safety of vehicles and people.

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# 1 INTRODUCTION

This Flood Hazard Risk Assessment has been prepared on behalf of Nova Energy (Nova) to support the resource consent application for a proposed solar plant at Twizel. The proposed site is on the property legally described as Lot 3 DP 4229201 located on State Highway 8, Twizel, being some 868 hectares and hereafter to be referred to as the 'project site'. The project site is situated in the General Rural Zone.

A map of the proposed project site is provided in Figure 1.1.

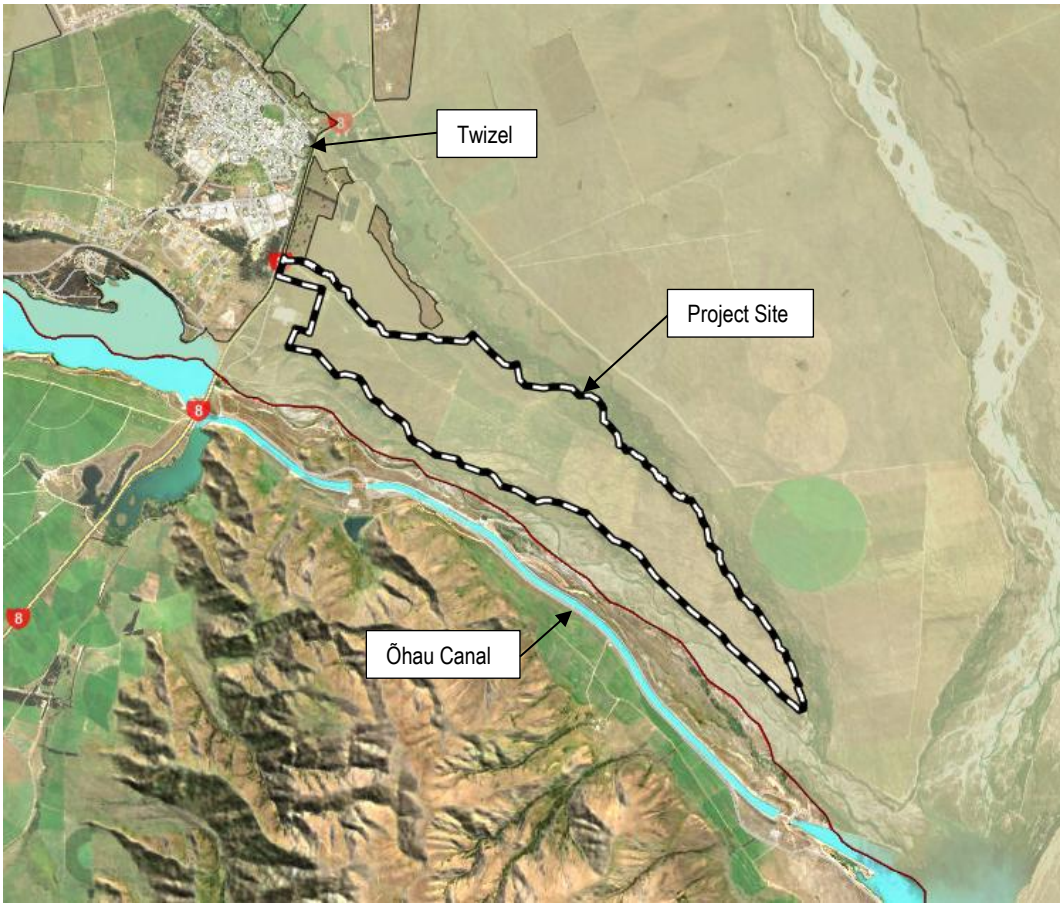



**Figure 1.1: Project Site (Source MDC District Plan Maps)**

The assessment used hydrological and hydraulic modelling to estimate flood water elevations, depths and velocities across the site, and was conducted in general accordance with the *Christchurch Wetland and Waterways Design Guide,* with guidance from other relevant standards and documents referenced within the report.

This flood hazard risk assessment provides analysis with a risk based proportionate approach for the proposed development in accordance with the requirements of the National Policy Statement of Natural Hazards (2025) (NPS-NH) and the Mackenzie District Plan.

The assessment has been developed using best available information at the time of writing of this report and considers the impact of climate change with rainfall data adjusted to reflect weather patterns 100 years into the future.

## 1.1 Project Description

Nova Energy proposes to construct and operate a 300 MW solar farm on an 868 ha site located on the southern side of State Highway 8 between the Twizel and Ōhau Rivers. The solar farm will consist of ground mounted solar panels, connected to central inverters for conversion to high voltage 33kV. The high voltage 33kV circuits will connect to the 220kV National Grid via power transformers located at the Transpower Twizel substation.

Ancillary infrastructure will also be constructed to support the solar farm, including an access track, operation and maintenance buildings, and drainage structures.

Further details are contained in the FTAA Substantive Application Report.

An example of the solar panel tracker setup is shown in Figure 1.2.

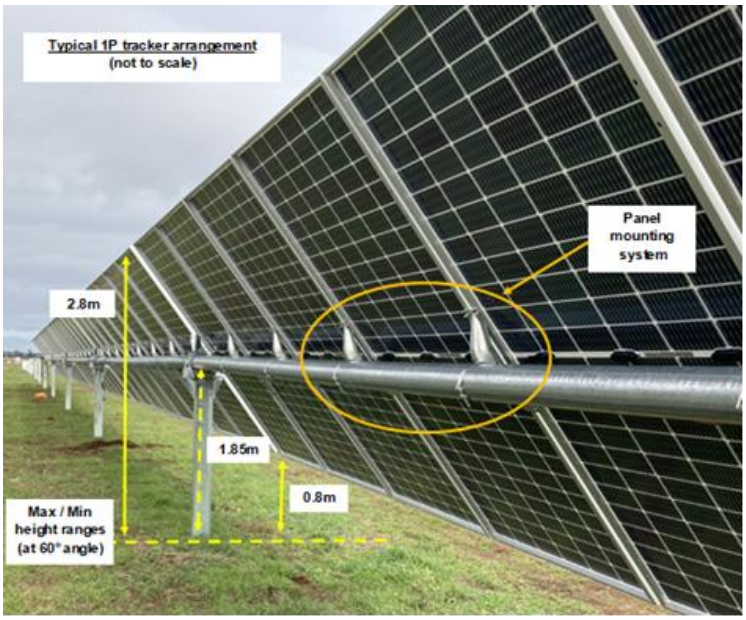



**Figure 1.2: Typical solar panel tracker arrangement (supplied by client)**

## 1.2 Assessment Objectives

The objectives of the flood hazard risk assessment are as follows:

- Identify top water levels in the 50, 100 and 500-year ARI RCP 8.5 storm event
- Identify any areas of site located in 'high flood hazard areas' as defined in the Mackenzie District Plan *(means areas where the product of water depth (metres) multiplied by velocity (metres per second) equals or exceeds 1, or where depths are greater than 1 metre, in areas subject to inundation during a 500-year ARI flood event.)*
- Undertake flood hazard risk assessment as per the NPS-NH and provide recommendations.
- Recommend a minimum finished floor level for the proposed workshop and operations and maintenance buildings.

# 2 SITE DESCRIPTION

Twizel is situated at the base of the Southern Alps, within the upper Waitaki catchment. The project site is on the eastern side of State Highway 8, south of Twizel township on a strip of land bordered by the Twizel River to the north and the Ōhau River to the south. The two rivers converge at the southeastern end of the site at the head of Lake Benmore and the Waitaki River.

Much of the site is flat with a gradual slope in an east to southeasterly direction. It is situated in the General Rural Zone in the Mackenzie District Plan. The 868 ha site is presently used for dry stock grazing farming operations, with a small gravel quarry also operating (under a third-party lease agreement) at the northern end of the site.

The site is terraced at the northern end where there is a sudden drop in elevation of 7 to 10 m across the site. The quarry operates above the precipice on the eastern boundary with an existing access track to the quarry. At various locations along the boundary with the Twizel and Ōhau Rivers there are similar cliff faces, elevating the site well above the riverbeds.

## 2.1 Historical Imagery

The area has been extensively developed over the past 80 years with the construction of the upper Waitaki hydro-electric power scheme and the Twizel settlement to service this industry. The natural Ōhau river course and other river and tributaries in the wider area have been altered with the introduction of a series of dams and canals.

Historic aerial photography from 1959, Figure 2.1, shows the project site prior to the establishment of structures for the hydro scheme development such as the Ōhau canal, power stations, and Twizel substation. Apart from the Ōhau River path, the land topography and land cover at the project site itself has largely remained unaltered in the past 65 years with the natural landscape features clearly evident and still present today.

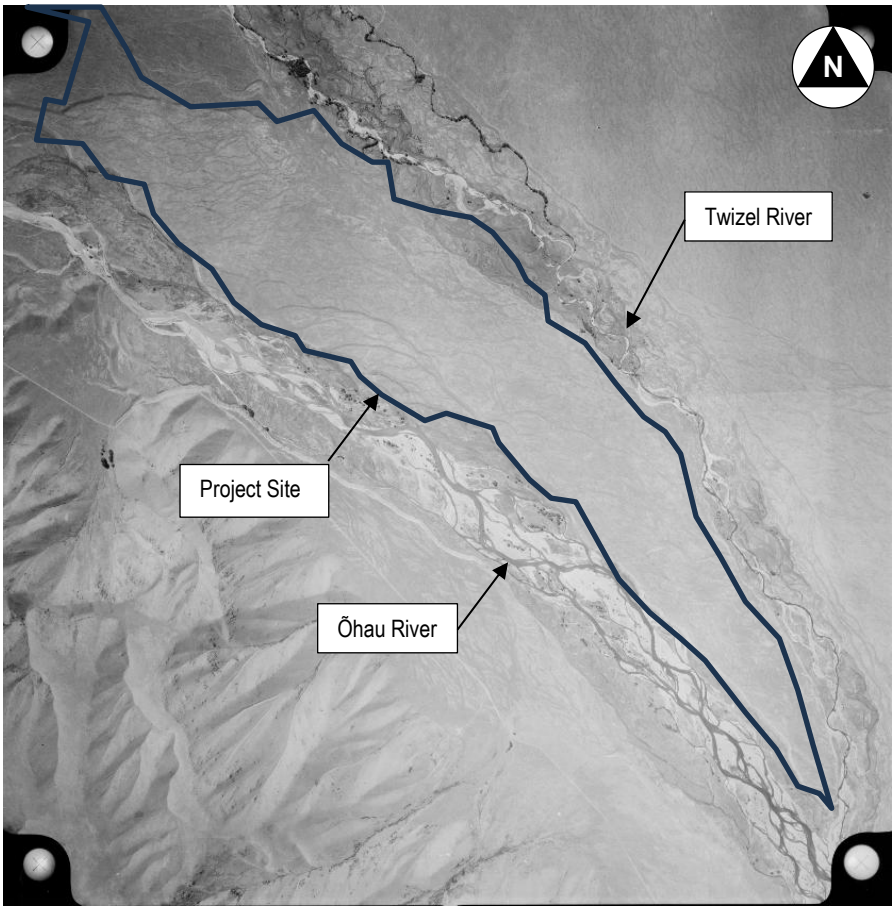



**Figure 2.1: Historical Aerial Photography taken 25/02/1959 (Source Retrolens)**

## 2.2 Ground Conditions

### *2.2.1 Geology*

Published geological information available on GNS Geology Maps (Figure 2.2) shows that the site is underlain by two geological units throughout:

- OIS2 (Late Pleistocene) outwash deposits of Tekapo formation (stratigraphic age Q2) comprise of generally unweathered; variable mixtures on gravel/sand/silt/clay forming the extensive terraces or plains.
- OIS1 (Holocene) active riverbed deposits (stratigraphic age Q1) comprising of generally unweathered; variable loose gravel/sand/silt in active flood

Client supplied photos (Figure 2.3), indicate the OIS2 soils in the banks of the quarry and show the typical site surface cover demonstrating the gravelly nature of the soils.

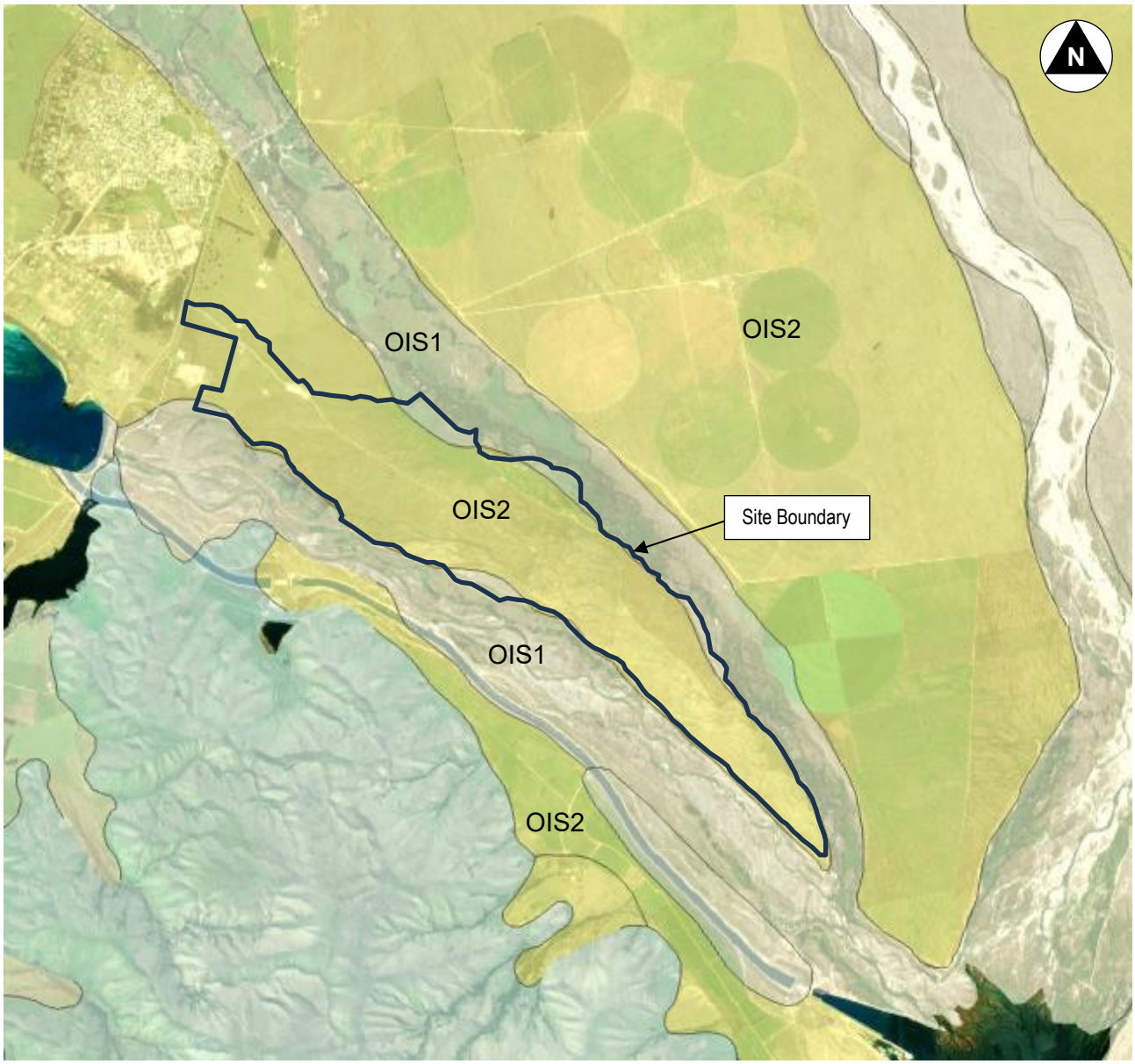



**Figure 2.2: Geological Units (Source GNS Geology Maps)**

**Figure 2.3: Cut banks at site quarry (Client Supplied Photos, September 2021)**

### *2.2.2 Soil Drainage Properties*

Wider catchment soil properties relevant to this Flood Hazard Risk Assessment were sourced from the Landcare Research maps[1] refer Table 2.1.These maps are supplied in Appendix A.

**Table 2.1: Soil characteristic summary of catchment**

| Source | Catchment Properties |
|---|---|
| Landcare Research Soil Drainage Map | Well drained |
| Landcare Research Soil Permeability Map | Rapid or moderate over rapid (site)<br>Moderate over rapid (upper catchment) |
| Landcare Research Soil Particle Size Map | Loam or loam over skeletal (at site)<br>Loam over skeletal (upper catchment) |
| Landcare Research Depth to Slowly Permeable Soil Horizon Map | Greater than 1.5 m |

### *2.2.3 Groundwater*

Three water bores are located on the site. Groundwater data sourced from the ECan GIS well records provide ground water information which is summarised in Table 2.2 with locations shown in Figure 2.4. Groundwater is not generally expected to be within the upper 5.0 m of the ground.

The underlain gravel/sand/silt/clay deposits are representative of free draining soil types and are expected to have high soakage rates.

[1] Manaaki Whenua - Landcare Research. (n.d). Retrieved from https://doi.org/10.26060/9vfz-hw43

**Table 2.2: Groundwater Depth Data (Sourced from ECan GIS)**

| Bore Ref | Location | | Use | Approx. Ground Level Elevation | Depth (m) | Diameter (mm) | Approx. Groundwater Depth (m) |
|---|---|---|---|---|---|---|---|
| | NZTMX | NZTMY | | | | | |
| BZ15/5013 | 1,370,009 | 5,091,799 | Water Level Observation | 436.07 | 20.0 | 150 | 14.72 |
| BZ15/5014 | 1,370,107 | 5,092,501 | Water Level Observation | 437.12 | 17.5 | 50 | 5.73 |
| H38/0024 | 1,372,002 | 5,090,597 | Water Level Observation | 403.86 | 7.45 | 64 | 3.60 |

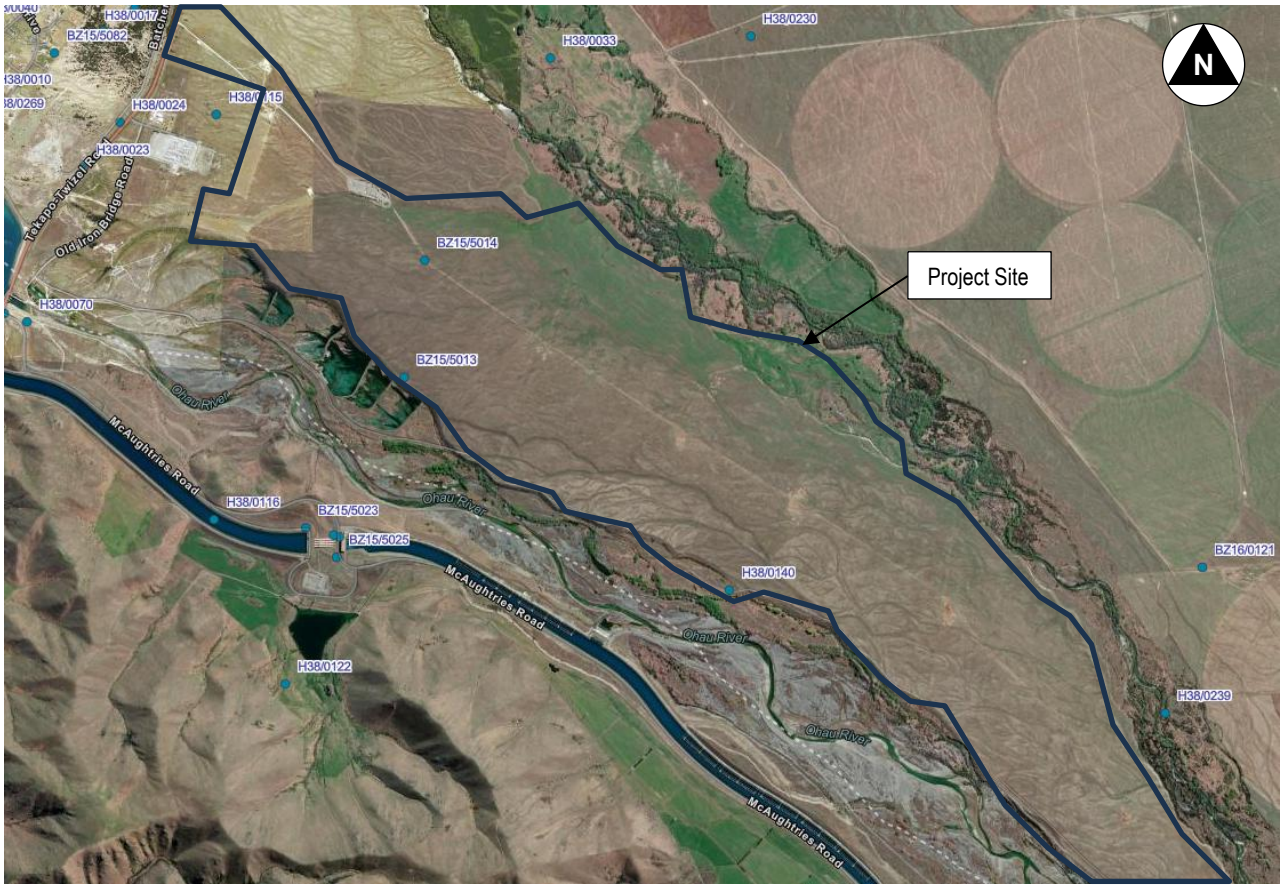



**Figure 2.4: Groundwater Bore Wells Locations (Source ECan GIS)**

## 2.3 Notable Terrain Features

### *2.3.1 Rivers*

The Ōhau River and Twizel River border the site to the south and north respectively. The Ōhau River exits Lake Ōhau and has been dammed. It is now a significantly smaller river due to the Ōhau Canal taking water from the river for hydro-electricity generation. The Twizel River has its headwaters in the Ben Ōhau Range and has a length of about 30 km. The two rivers converge at the southeastern corner of the site before entering Lake Benmore.

### *2.3.2 Upper/Lower Plateau*

The site is elevated from the surrounding riverbeds along the northern and southern boundaries. At the western end of the site is another terrace that crosses the site creating a distinct upper and lower plateau to the site.

The solar panel installation area is confined to the lower plateau.

The quarry is approximately 1.3km south-east of the current site accessway. A borrow pit is also present approximately 250 m west of the quarry. Both of these are located around the boundary between the upper and lower plateaus. Refer Figure 2.5.

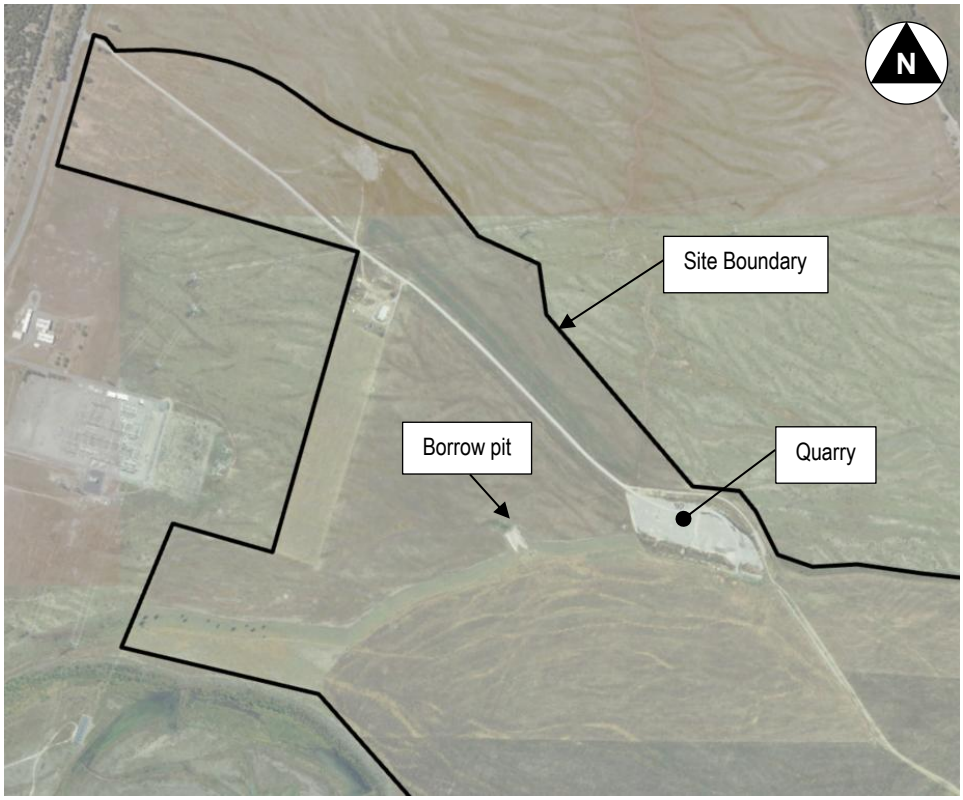



**Figure 2.5: Quarry and borrow pit locations**

### *2.3.3 Historic Wastewater Trench*

A historic wastewater disposal trench associated with the Twizel wastewater treatment plant encroaches into the site. Its landform is still observable in some areas of the site. Its location is indicated on Figure 2.6.

The path of the trench has been cut perpendicular to many historic river channels on the adjacent site, cutting off and diverting upstream flow. It is likely no longer operational for wastewater disposal but may still act as a flow diversion for stormwater, and its present landform has been incorporated into the model.

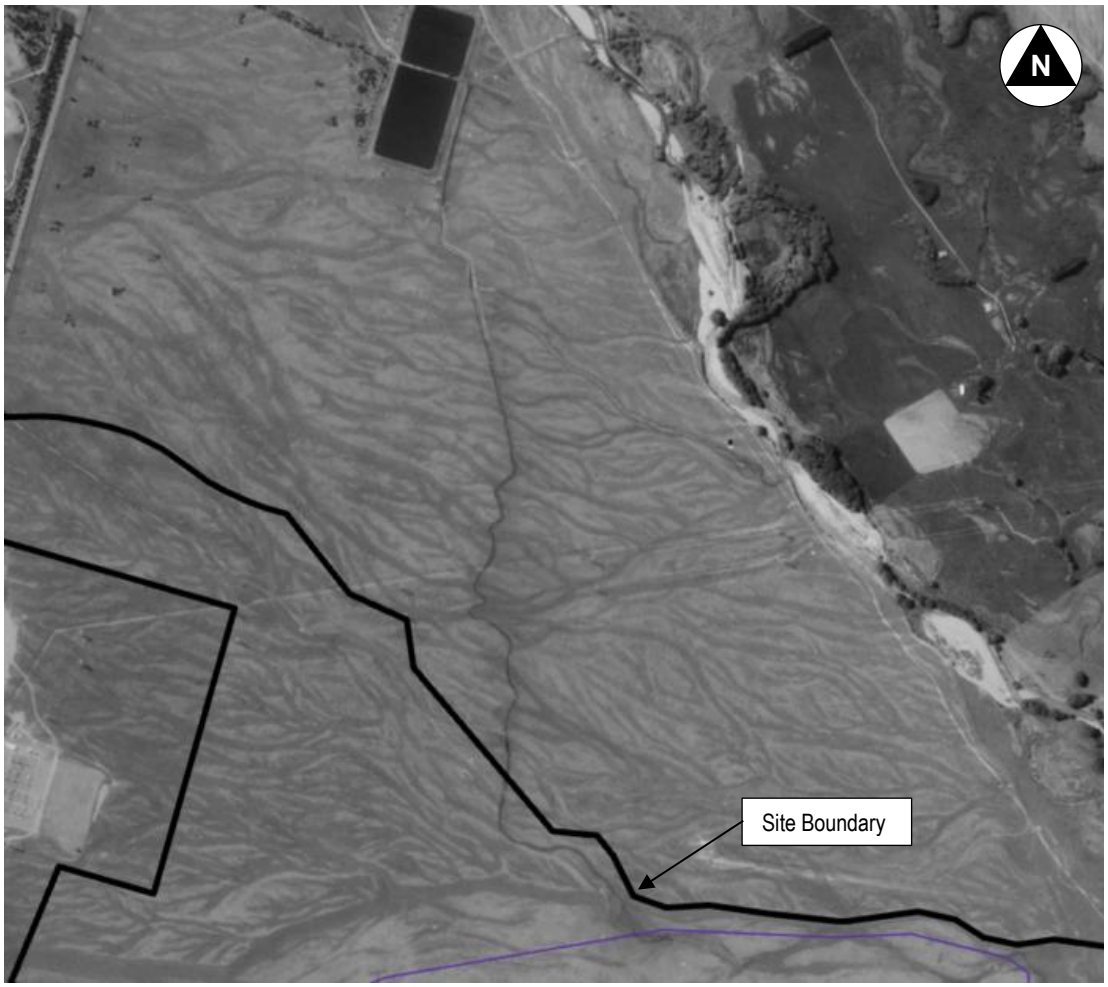



**Figure 2.6: Historic wastewater trench (Image source: LINZ basemaps, pre-1990)**

# 3 CATCHMENT ASSESSMENT

## 3.1 Hydrological Setting

The upper reaches of the Waitaki catchment have a total catchment area of approximately 97,000 km² that begins in the headwaters of the main divide of the Southern Alps near Aoraki/Mount Cook and natural glacial lakes of Ōhau, Pūkaki and Tekapo, and the Ahuriri River.

The glacial lakes of Ōhau, Pūkaki and Tekapo influence flows downstream by dampening flood peaks and modifying flood flows into the lower catchment. This natural storage, together with the control of lake levels by hydro-electricity generation, further regulates downstream flow.

Four large, braided river systems (Ōhau, Pūkaki, Tekapo and Ahuriri) cross the upper basins. Of these, only the Ahuriri, follows its natural water course. The other three rivers have been largely diverted into the canals of the upper Waitaki hydro-electricity system.

Downstream of Ōmārama, the four rivers combine to form a single channel carved through steeply sided valleys. This part of the river is dammed in three places, creating Lakes Benmore, Aviemore and Waitaki. Below the Waitaki Dam, the Waitaki River widens to become a large, braided river flanked, in places, by wetlands and with a coastal lagoon where it reaches the Pacific Ocean. The Waitaki catchment is shown in Figure 3.1. Groundwater (which frequently exchanges water with rivers and streams) is found throughout the catchment. Depth to groundwater is variable over the catchment and within specific basins. Wetlands and springs are generally associated with shallow groundwater including those associated with the Grays, Ahuriri, Twizel and Ōhau Rivers.

The larger groundwater storage areas, semi-confined or unconfined aquifers are found in the Tekapo and Twizel basins. All groundwater in the Waitaki upper catchment flows into Lake Benmore as indicated by the hatched groundwater allocation zone shown in Figure 3.2 below.

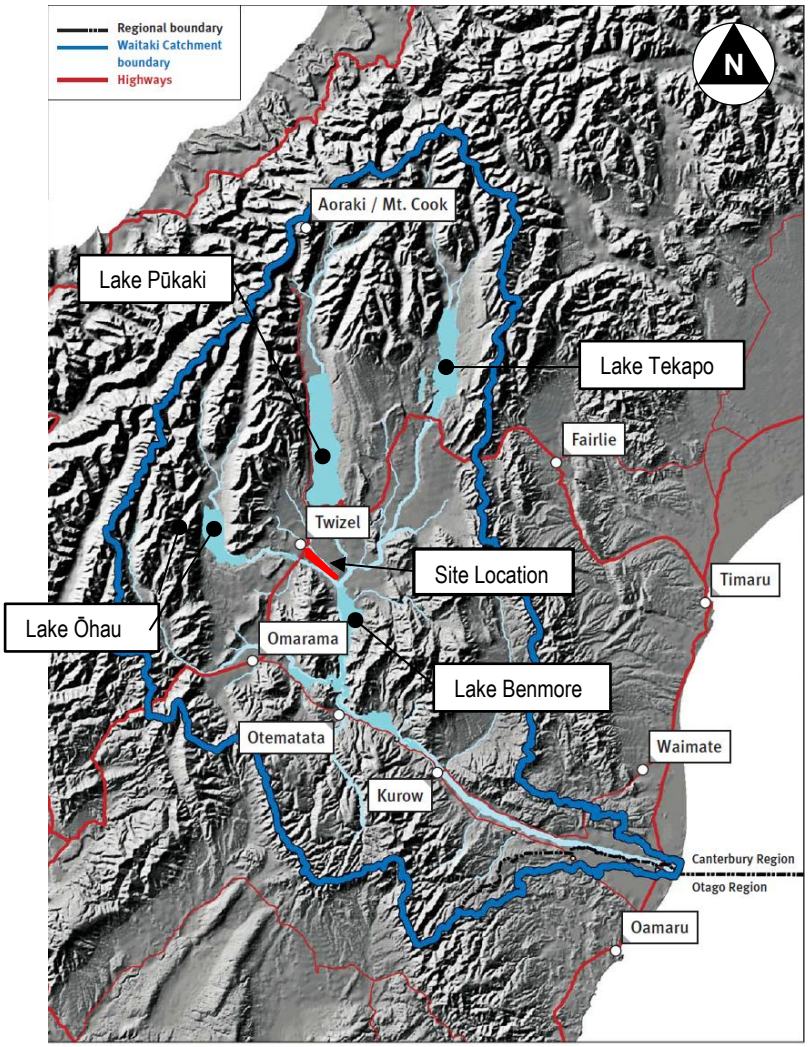



**Figure 3.1: Waitaki Catchment (Source Waitaki Catchment Water Allocation Plan)**

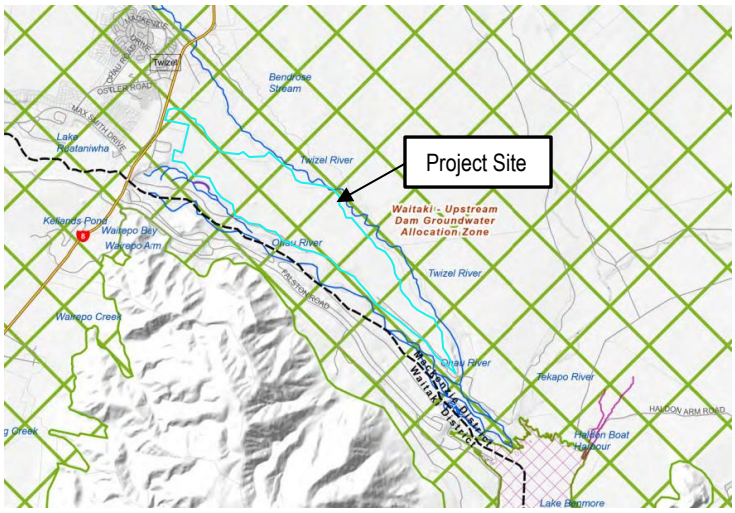



**Figure 3.2: Semi-confined or unconfined aquifers zone (Source Canterbury Land and Water Regional Plan Maps)**

## 3.2 Site Catchment

The project site area is located on the eastern side of State Highway 8 (SH 8), south of Twizel township on a strip of land bordered by the Twizel River to the north and the Ōhau River to the south.

The localised catchment area is bounded by SH 8, the Twizel and Ōhau Rivers, the two rivers confluence at the southeastern end of the site before entering the head of Lake Benmore and the Waitaki River. The catchment area is approximately 1200 ha, and the distance from SH 8 to the bottom of the site is approximately 9 km.

Upstream runoff from the Twizel township is intercepted by the SH 8 roading infrastructure and Council reticulated stormwater pipe network (primary flow) and swales or drains (secondary flow) to collect and discharge stormwater runoff into the Twizel River north of SH 8.

In larger rainfall storm events, runoff can overtop SH 8 with overland flow paths traversing the site in an east to southeasterly direction generally following historic braided river channels, overland flow paths eventually spill outwards at the site boundary into the surrounding riverbeds as shown in Figure 3.3.

The local catchment area is dominated by the project site itself with minimal catchment areas upstream of the site. Other parts of the local catchment include a block of land to the west occupied by the Twizel substation and land to the northwest where the Twizel wastewater treatment plant is the dominant feature.

The likely abandoned historic wastewater disposal trench extends into the site from the Twizel wastewater treatment plant to the north. Based on review of the best available LINZ LiDAR data, this trench appears to have a cross-section of approximately 5 m wide x 0.5-1.0 m deep. This trench appears to be at a low longitudinal gradient (approximately 0.3%) from the wastewater treatment plant to the quarry. For stormwater assessment purposes, it is assumed to present a minor concentrated overland flow path.

This ‘flow path’ enters the site at the location of the quarry, where diversion channels around the quarry have been formed to divert flow into existing braided channels. This appears to be the only recontouring of land across the site with the remainder of the site terrain largely unaltered apart from minimal grading along tracks.

In large storm events, runoff will likely enter these existing braided channels and flow generally across the site from west to east while the existing track traverses the site in a southeast direction. The existing track south of the quarry has not been graded and follows the natural contours of the channels and slopes.

Figure 3.4 illustrates flow paths through the more significant braided channels and associated catchment areas and sub-catchments. A culvert crossing or similar may be required at intersections with the proposed access track to maintain existing flow paths.

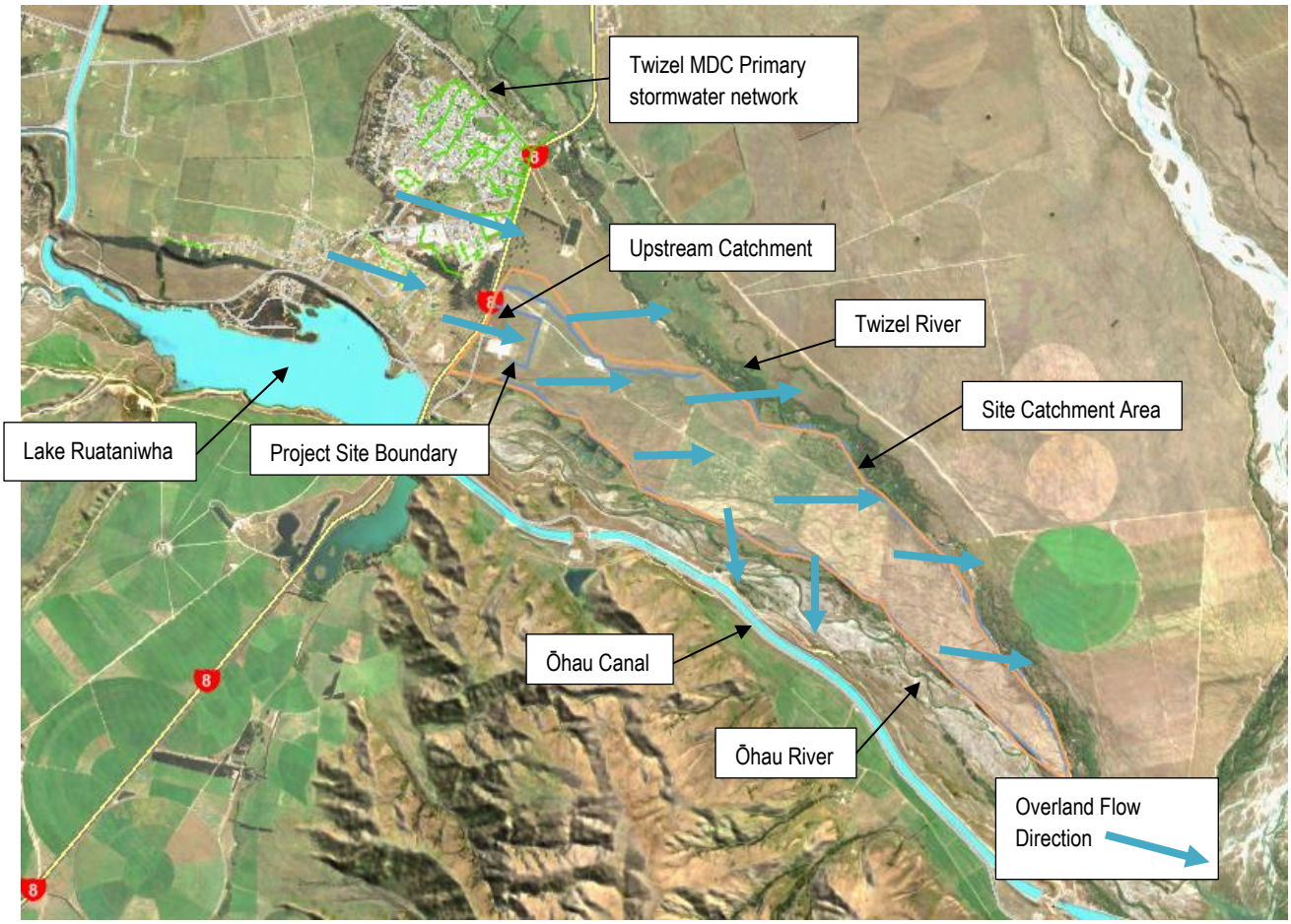



**Figure 3.3: Localised Catchment with Overland Flow Paths**

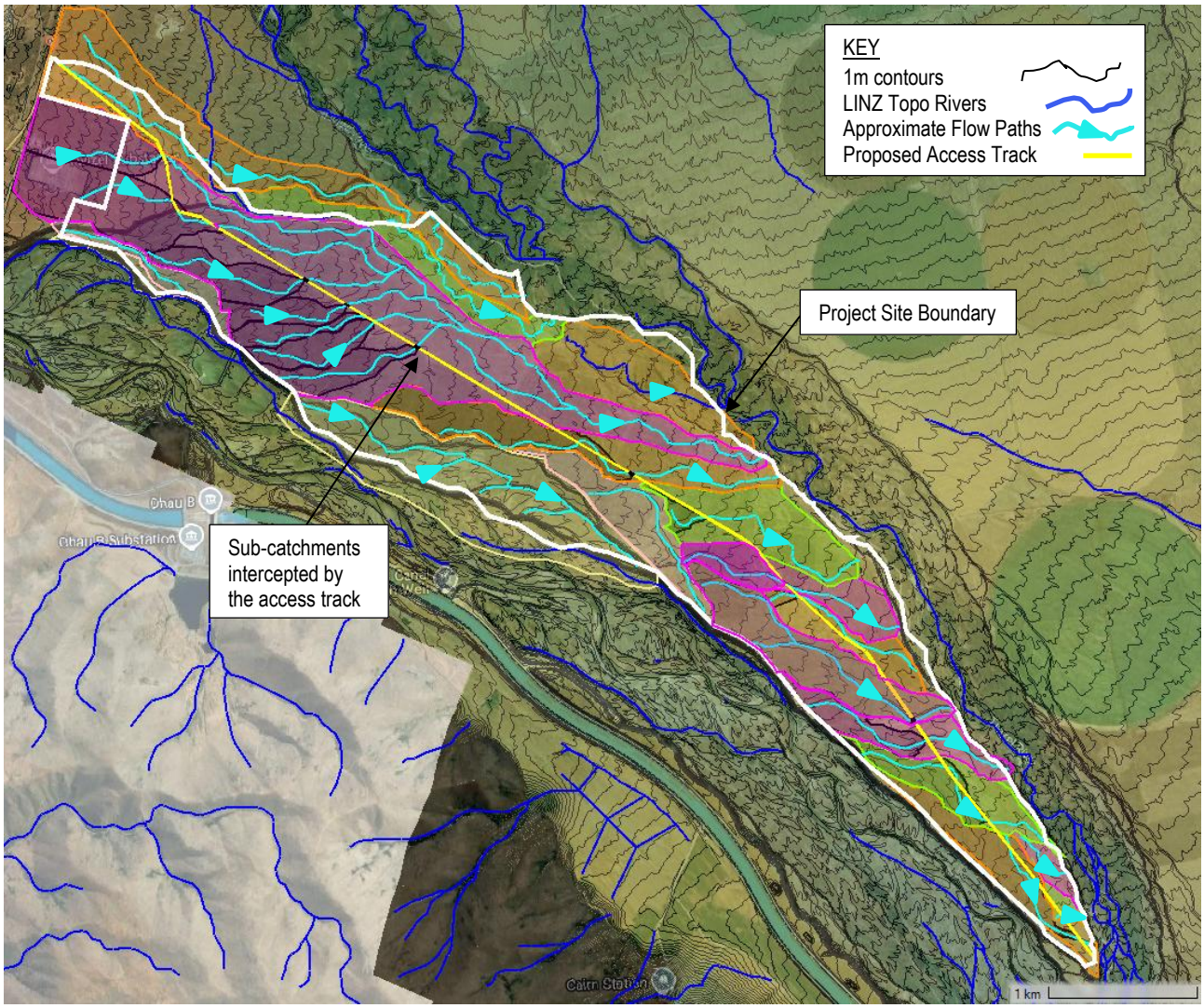



**Figure 3.4: Flow Paths and Site Catchment Areas**

## 3.3 Flood Information

The best available existing flood information was reviewed to assess any known flood hazard.

### *3.3.1 Existing Flood Modelling*

*Environment Canterbury 500 Year ARI Flood modelling*

The flood maps identify flood water depths during stormwater flooding events in the Twizel district as shown in Figure 3.5. The site is largely outside of the map extent however indicates stormwater ponding and concentrated conveyance within the historical river braids, which are still evident in the current site topology.

This modelling covers only the northwest corner of the site capturing the Twizel Substation and access track to the quarry. This demonstrates the overland flow paths in extreme storm events following existing braided channels.

The maps provided generally identify that the site is elevated and outside of the flooding extents associated with instream flooding.

The proposed development will need to consider conveyance of upstream flows and provide clear flow paths through the site to mitigate the effects of flooding.

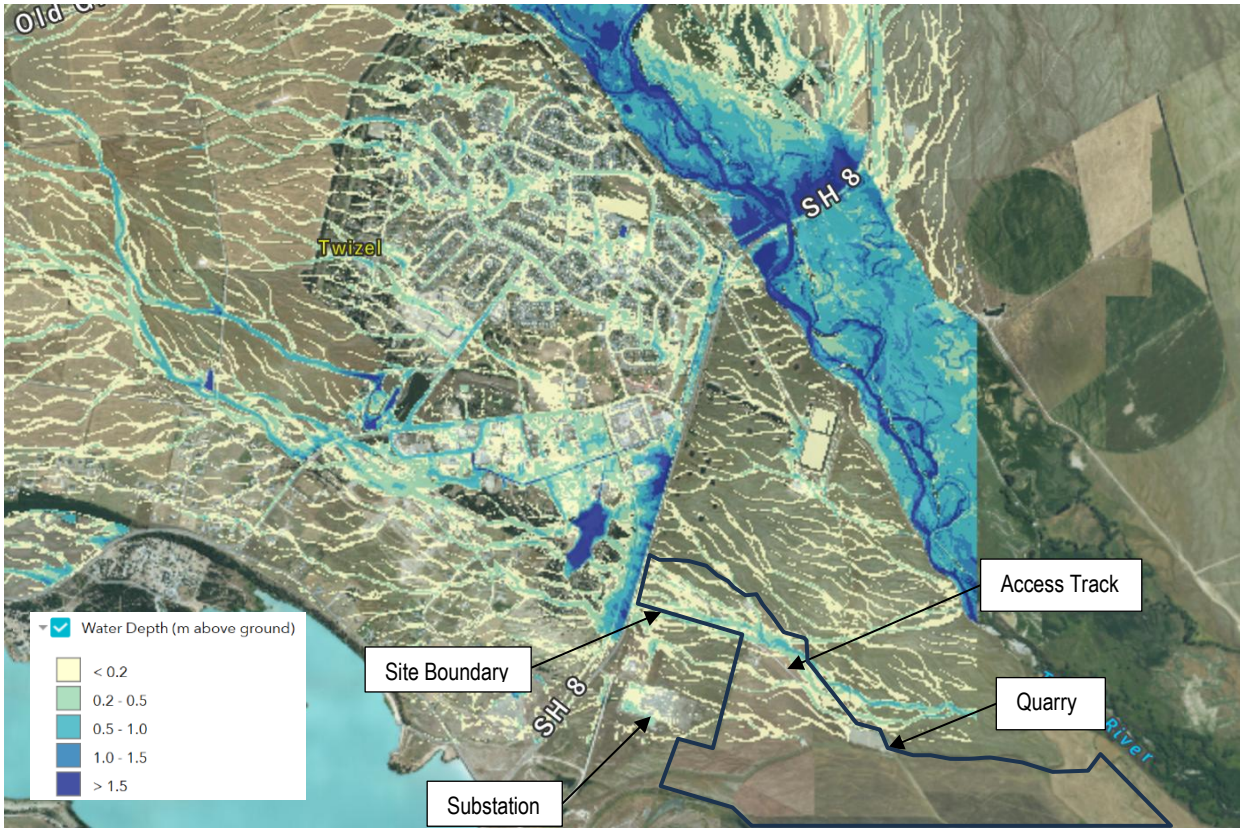



**Figure 3.5: Flood Depth Results 500 year ARI (Environment Canterbury Regional Council, 2023)**

*NIWA National Flood Hazard Viewer*

The site and its surrounds are included in the NIWA national flood hazard viewer extent which provides an indicative overview of the scope of flooding across the wider site. Refer Figure 3.6 for a screenshot of the hazard viewer.

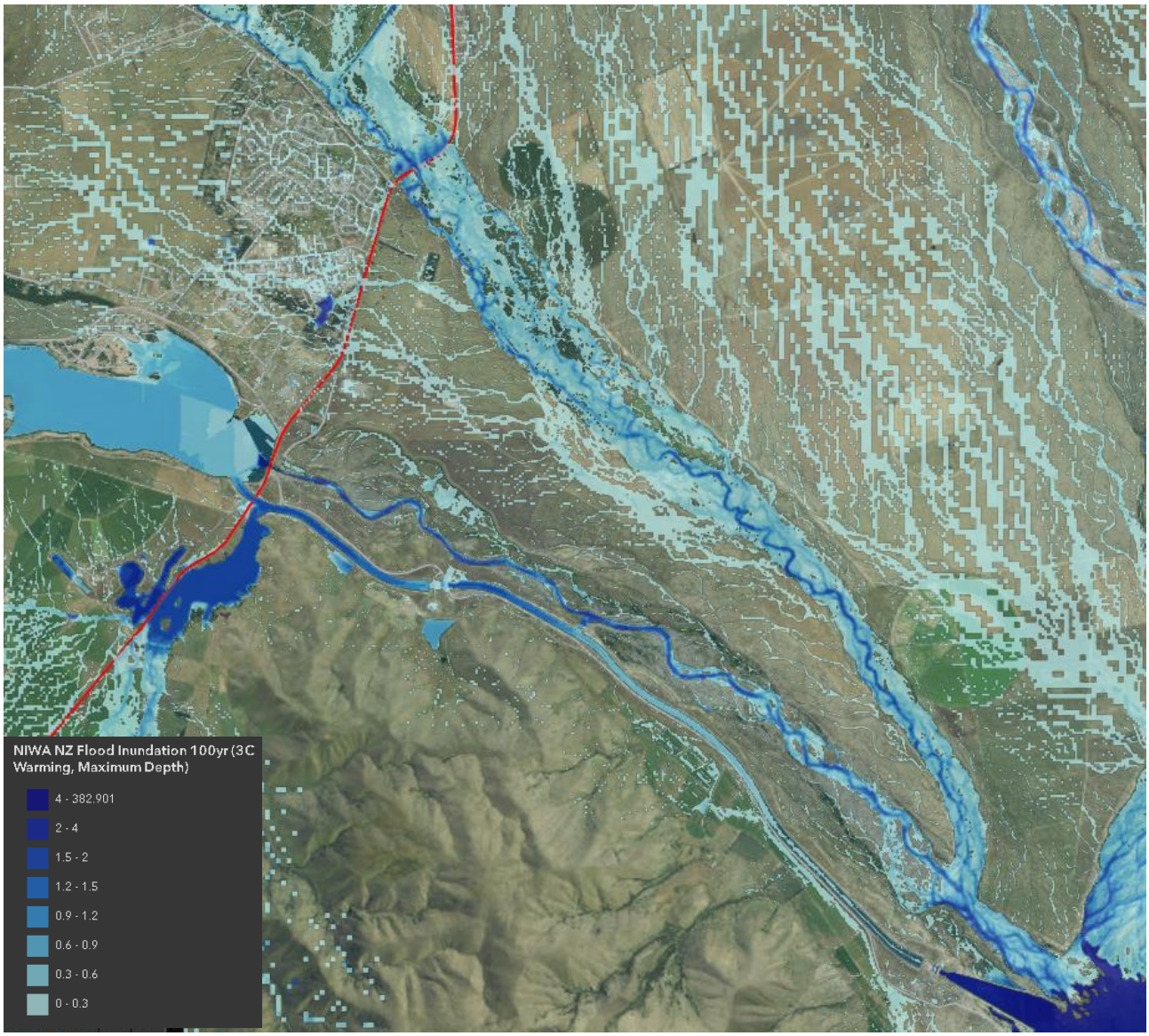



**Figure 3.6: NIWA National flood hazard viewer, 100-year ARI event, +3°C climate change**

### *3.3.2 Mackenzie District Plan*

The site is situated within the Flood Hazard Assessment Overlay shown on the Mackenzie District Plan. This shows areas in the district which may be susceptible to flooding. Site specific flood modelling would be required for confirmation.

The site is also located within the Hydro Inundation Hazard Overlay as indicated in Figure 3.7. The hydro inundation hazard area encroaches onto the site across the northern boundary and borders the southern boundary and indicates where there is potential for the site to experience inundation in the unlikely event of a dam or canal breach.

The hydro inundation hazard overlay is provided with a disclaimer *"Represents areas that could be flooded in the unlikely event of failure of any of the dams and canals associated with the Waitaki Power Scheme. While the likelihood of a structural failure of a dam or canal is very low, the consequences could be serious for people, property and the environment."*

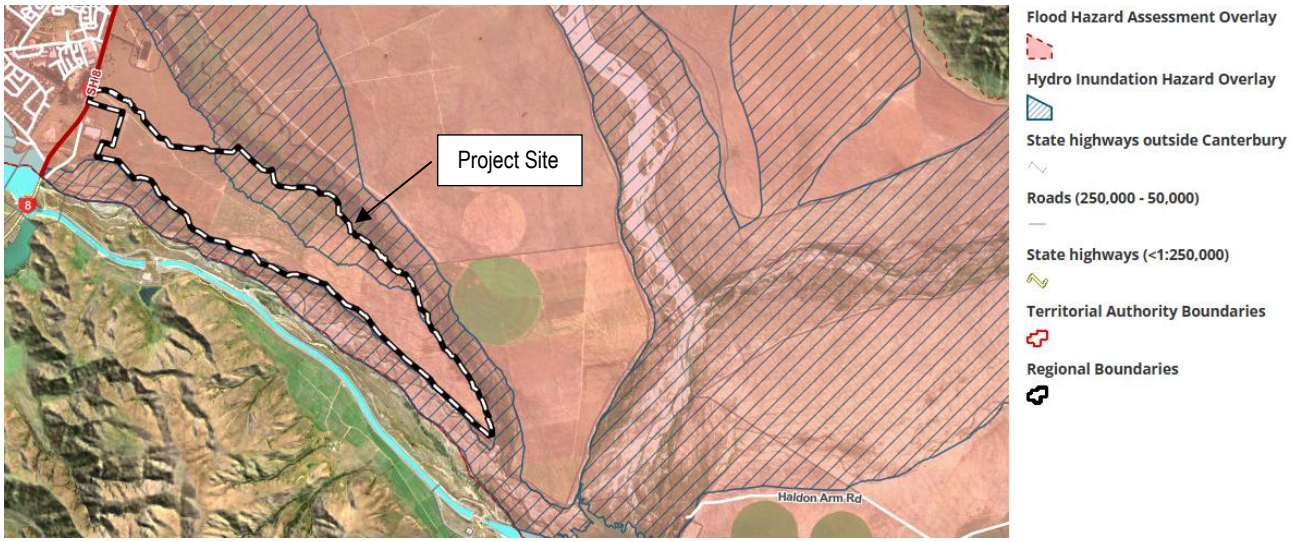



**Figure 3.7: Flood hazard assessment and Hydro-electricity inundation hazard overlay (Source Mackenzie District EPlan Maps)**

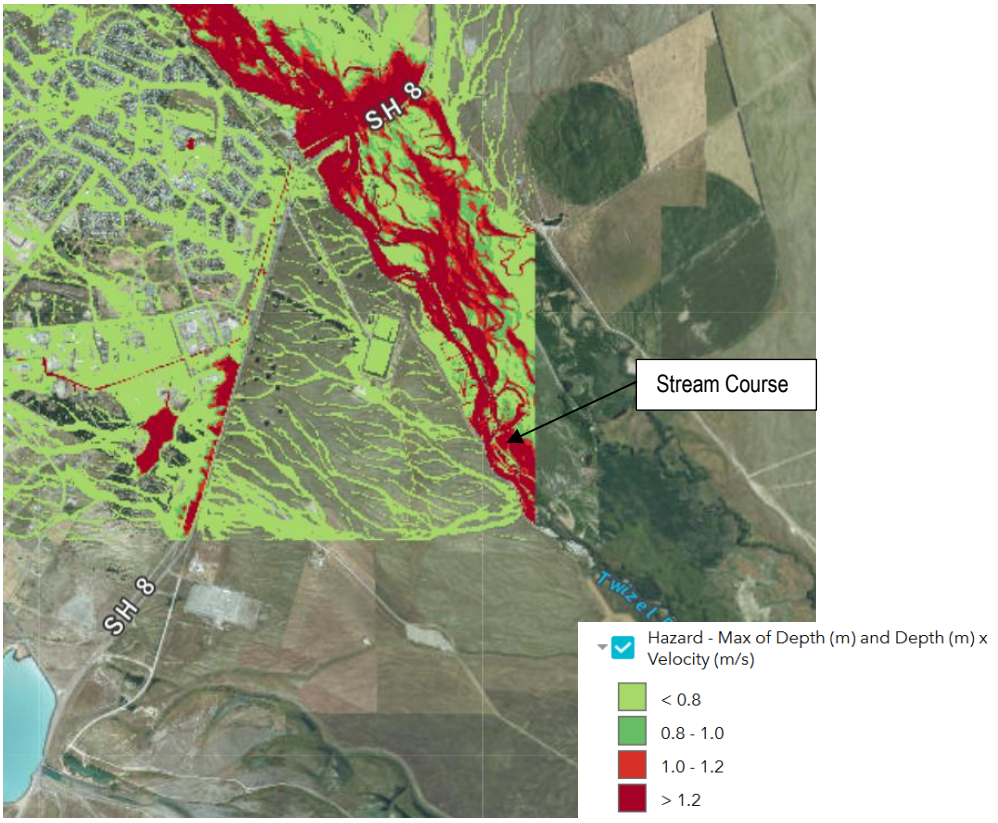



**Figure 3.8: Flood Hazard model results 500 year ARI – RCP 8.5 (Environment Canterbury Regional Council, 2023)**

## 3.4 Existing Infrastructure

The site does not have a reticulated stormwater network; stormwater is primarily conveyed through overland flow.

A primary stormwater network consisting of a mixture of pipes and open channels is present in the Twizel township upstream of the site.

# 4 FLOOD MODELLING

## 4.1 Methodology

A 2D rain on grid hydraulic model was developed within Infoworks ICM software (version 2026.3.0) to determine the peak flows, velocities and top water levels for the proposed solar farm in various storm events, with the RCP 8.5 climate change scenario applied.

A maximum ground model cell size of 25 $m^2$ was applied, and refinements were made to the mesh in key areas (including key road crossings, some channels) to reduce cell sizes to a minimum of 2 $m^2$. This provided suitable definition for the flood hazard assessment.

The existing ground surface was typically used for the modelling. The only exceptions are on the proposed access track comprising a 150 mm thick overlay, along with a 200 mm thick OEM building pad.

Model runs using historical rainfall were used to refine the input parameters prior to undertaking the final modelling using climate change adjusted rainfall. A check was also undertaken against the 500-year ARI RCP 8.5 model produced by ECan (Environment Canterbury Regional Council, 2023).

The modelled area includes the upstream catchment area northwest of State Highway 8 to enable reasonable upstream inputs into the model. A normal boundary condition (condition allowing water to exit model domain freely) was applied to the full model boundary, and no other boundary conditions were applied. The Twizel and Ōhau River beds were excluded from the model as the site is significantly elevated above them and it is assumed that they will not present a tailwater effect on the site.

The model was validated through both a sensitivity analysis and comparison of modelled flows to flows calculated using the Rational Method.

Details of the model construction and validation are provided in Appendix B.

## 4.2 Results

The hydraulic assessment has computed the peak flood water levels and peak velocities across the site for the following storm events under an RCP 8.5 2081-2100 climate change scenario.

- 2% AEP (50-yr ARI)
- 1% AEP (100-yr ARI)
- 0.2% AEP (500-yr ARI)

All result maps are provided in Appendix C**.**

### *4.2.1 Results Analysis*

The results indicate areas of high water depth and velocity are typically limited to the historic river braids which remain defined in the topography of the site. Areas of particularly high velocity are located where steep, concentrated overland flow paths flow from one historic river terrace to another, such as where the site borrow pit is located.

The flooding is located both within the solar infrastructure extent and in the location of the proposed access road to the site. The internal access route design is not yet finalised.

Outside the defined historic braided river channels, identified flooding is typically shallow and of low velocity, posing low risk to people or property.

Refer Figure 4.1 for an excerpt of the 1% AEP RCP 8.5 event results.

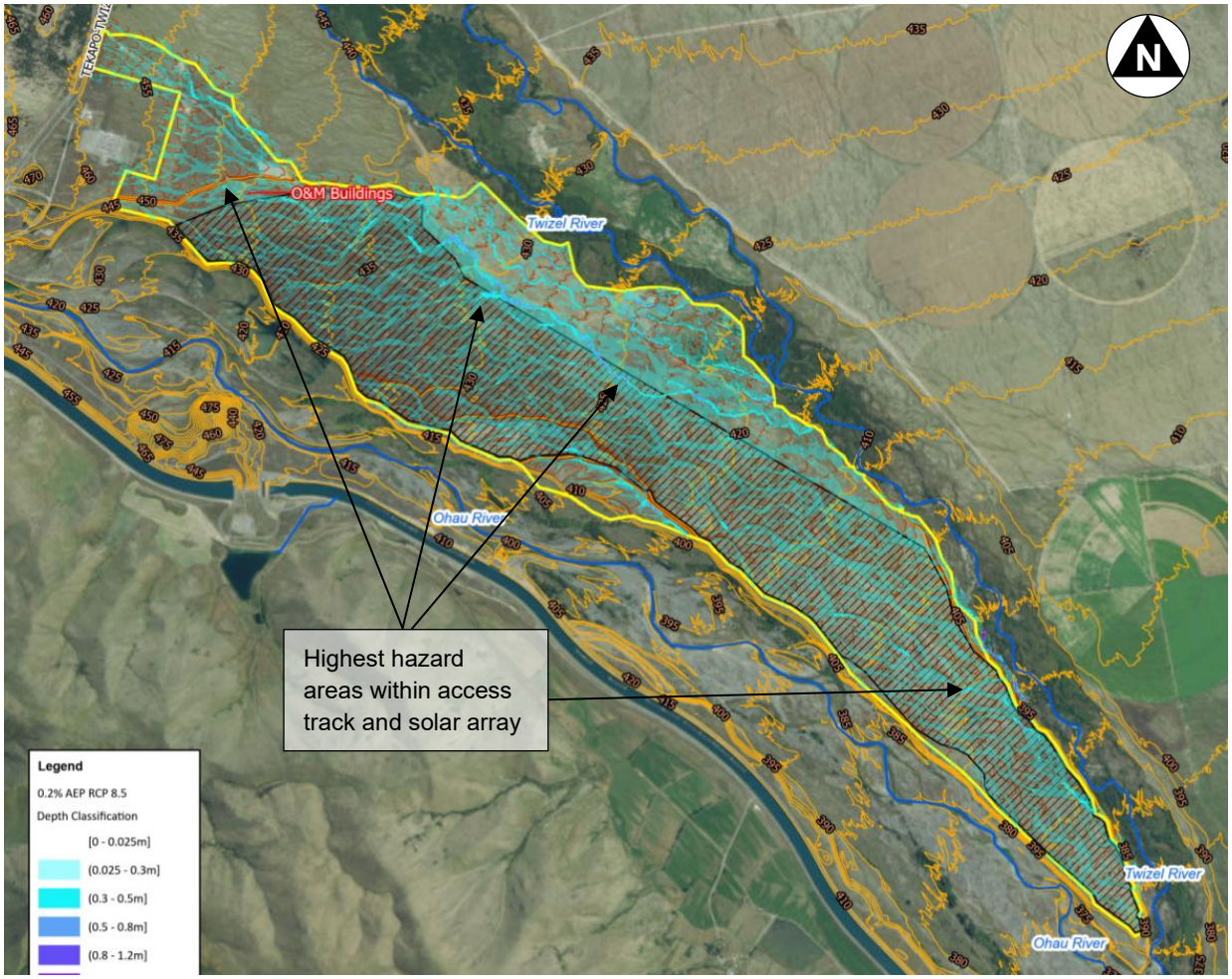



**Figure 4.1: 0.2% AEP RCP 8.5 maximum depth flooding map with site plan overlaid**

Flood velocities across the site are modelled to mostly be less than 1 m/s across the majority of the site except for limited areas of concentrated flow. Assuming good pasture cover is maintained, and specific erosion protection is installed in areas where high flow velocities are identified, scour of site soils is expected to be limited.

## 4.3 Sensitivity Analysis

A sensitivity analysis was carried out to test the sensitivity of the model to a number of input parameters to give confidence to the model outcomes. The sensitivity analysis has considered the sensitivity of the model to hydrological inputs and roughness factors. Results of the analysis are summarised in Table 4.1. The base storm used was the 1% AEP RCP 8.5 2081-2100 storm for all instances.

**Table 4.1: Sensitivity Analysis Results**

| Sensitivity Analysis Test | Sensitivity Analysis Parameters | Effects |
|---|---|---|
| Hydrological inputs | 1. Decrease rainfall by 15%<br>2. Increase rainfall by 30% | 1. Minor decrease in flood depth and velocity<br>2. (less than 100 mm)<br>3. Minor increase in flood depth and velocity<br>4. |
| Flood plain roughness (pasture) | 5. Increase Manning's n by 40% (increased roughness) to 0.05<br>6. Decrease Manning's n by 20% (decreased roughness) to 0.028 | 3. Negligible change in flow depth, minor change in flow velocity.<br>4. Negligible change in flow depth, minor change in flow velocity. |

Overall, the analysis concluded that:

- The site is not particularly sensitive to hydrological inputs. Minor changes to rainfall intensity result in only minor changes to modelled flow depths and velocities.
- Modelled water levels and depths are not sensitive to the selection of Manning's n (ground roughness). Flow velocities in stream channels and concentrated overland flow paths have some sensitivity to the selection of Manning's n. The selected Manning's n values were confirmed to be reasonable for the purpose of this assessment.

Based on this analysis, the model is deemed to be appropriate. The sensitivity analysis has generally identified that the model results are not sensitive to the input parameters.

## 4.4 Model Discussion

Climate change guidelines increasingly reference SSPs (shared socioeconomic pathways) instead of RCPs (representative concentration pathways) to account for socioeconomic context alongside physical climate changes. The RCP 8.5 climate change scenario for 2081-2100 used for the modelling represents a 'high-end' projected mean annual temperature increase of between 2.8 – 3.1 °C from the present day[2]. This approximately aligns with a SSP5-8.5 scenario. The modelled climate change scenario is consistent with a high-end estimate for the predicted design life of the solar farm of approximately 40 years.

The use of the nested HIRDS storm incorporating storms of durations between 10 minutes and 24 hours is considered conservative as it is typically unlikely a short duration storm of a given recurrence interval would occur within a longer duration storm of the same recurrence interval. The alternative would be to use the HIRDS V4 temporal design storm profile designed to represent a typical storm in the region. The use of this would have provided a less conservative model.

The modelling indicates several overland flow paths pass through the proposed solar farm infrastructure. Given the landform is intended to remain grassed and modelled velocities are less than 2 m/s, it is anticipated that ground erosion will be negligible.

This model has been generally constructed using the existing site condition and has not accounted for any effects of proposed site modifications. Based on review of the proposed solar farm panel, inverter and access road layout, it is recommended that culverts are installed at key locations on

[2] Ministry for the Environment. (2021). He kupu ārahi mō te aromatawai tūraru huringa āhuarangi ā-rohe / A guide to local climate change risk assessments. Wellington: Ministry for the Environment.

the site access road and are designed to accommodate the peak flows identified in this modelling. Flow information for design can be extracted from the model and provided upon request.

It is recommended that the flood modelling is updated once the proposed earthworks plan is created to confirm final overland flow depths and velocities in key locations. This would allow design flows for new drainage structures and erosion protection (e.g. rip rap) to be more accurately defined. Should the proposed earthworks have minor hydraulic effects, this update may not be required.

Lower terraces within the property boundary within the beds of the Twizel and Ōhau Rivers have been excluded from the model as neither river has been modelled in detail. No development is proposed within the excluded lower terraces. This means that the model boundary in some locations is located along the top of bank line.

LINZ LiDAR data from 2015-2016 has been used for the flood modelling. Subsequent changes to the landform have not been captured. Based on aerial imagery review, it appears likely that the main landform modifications have been to the quarry and borrow pit areas. The quarry area is outside the proposed solar farm scope of works.

The current topography of the borrow pit where high flood hazard risk was identified was unable to be incorporated in this model. It appears that the borrow pit was previously the location of a steep channel which is represented in the LINZ 2015-2016 LiDAR surface used for the modelling. The current topography is uncertain and therefore adds some uncertainty to the precise nature of the risk, however, it is considered likely that the medium to high flood hazard identified in the area remains as such. Nonetheless, the hazards identified in this area are expected to be able to be suitably mitigated through road grading and drainage upgrades during detailed design.

The reticulated stormwater network located in Twizel was not included in the model. It is expected that its capacity would be exceeded in large storm events and would play a negligible role in stormwater conveyance.

Results maps have been generated for the maximum modelled depth and velocity of floodwaters on the site. These maxima may not occur at the same timestep.

# 5 FLOOD HAZARD RISK ASSESSMENT

The flood hazard risk assessment has identified the majority of the site is classified as low risk, with minor localised areas classified as medium and high risk without mitigations. Hazard mitigations have been proposed to lower the hazard risk.

## 5.1 Risk Assessment Methodology

### *5.1.1 Mackenzie District Plan*

A risk assessment was conducted using the methodology outlined in the Mackenzie District Plan (MDP). The MDP provides guidance for development within High Flood Hazard Areas which it defines as:

*"areas where the product of water depth (metres) multiplied by velocity (metres per second) equals or exceeds 1, or where depths are greater than 1 metre, in areas subject to inundation during a 500 year ARI flood event."*

The flood modelling has enabled calculation of the required water depth and velocity inputs which have been utilised to prepare maps spatially demonstrating the assessed hazard rating. Flood risk assessment maps are provided in Appendix C.

### *5.1.2 National Policy Statement for Natural Hazards 2025 (NPS-NH)*

A risk assessment was conducted using the methodology outlined in the NPS-NH whereby the likelihood and consequence level of the natural hazard are assessed to determine the level of the natural hazard risk.

To support classification of the consequence level rating, the hazard classification methodology outlined in the Australian Rainfall and Runoff (ARR) Guideline (2019) was adopted which provides definition of the rating against the key indicators being severity of damage to property, and potential for injury or fatalities.

Flooded areas of the site were classified into hazard classes between H1 and H6 in the 50, 100- and 500-year ARI events based on the depth and velocity of predicted flooding. Each hazard classification allows estimate of the severity of the risk to people and property.

Refer Figure 5.1 for the flood hazard vulnerability curve from the ARR.

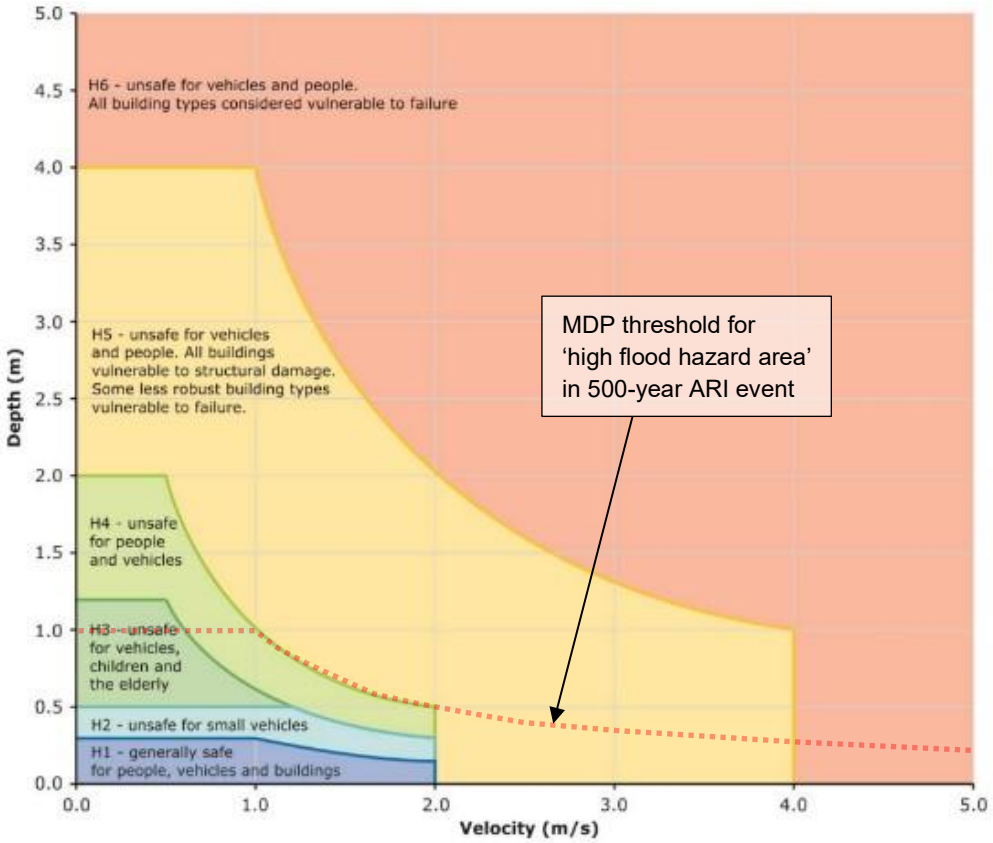



**Figure 5.1: Flood hazard vulnerability curve (ARR, 2019) with MDP high hazard threshold overlaid**

Flood hazard risk classifications in accordance with the NPS-NH were assessed against the natural landform prior to mitigations being applied. Flood risk assessment maps have been produced to spatially demonstrate the flood risk defined in the ARR methodology are provided in Appendix C.

A residual risk classification has been determined incorporating mitigations proposed to reduce the risk of damage to property or harm to people.

## 5.2 Solar Plant

### *5.2.1 Mackenzie District Plan*

The flood hazard risk assessment identified that generally the site has a low flood hazard risk.

Minor areas of the proposed solar plant (< 0.1%) are identified to be within a 'high flood hazard area' as defined by the Mackenzie District Plan (MDP), these are shown on drawing 210982-GI-4A (Appendix C). These areas are highly localised and are generally caused by concentration of water within the historic river braids. Development is only proposed in two locations where a hazard classification of H4/ H5 has been identified as shown on maps supplied in Appendix C. This includes an area of the access road to the site within the existing borrow pit, and within a small portion of the solar panel array.

Flooding on the remainder of the site is expected to be shallow and of low velocity, with the vast majority presenting a low risk to people and property.

The MDP requires that any new natural hazard sensitive building within High Flood Hazard Areas will be elevated at least 300 mm above 500-year ARI flood levels[3]. All proposed natural hazard sensitive buildings shall be designed to achieve this freeboard above the modelled surface water elevations.

### *5.2.2 National Policy Statement for Natural Hazards 2025 (NPS-NH)*

A risk assessment for the solar plant has been undertaken in accordance with the NPS-NH.

The ARR hazard classification indicates the site is generally classified as H1 (generally safe for people, vehicles and buildings) in events up to 500-year ARI. This would correlate to a 'negligible' risk under the NPS-NH risk matrix.

Minor, localised areas of the site, the internal access road and solar array extent (< 0.1%) are classified between H2 (unsafe for small vehicles) and H5 (unsafe for vehicles and people). These areas are highly localised and are generally caused by concentration of water within the historic river braids. Locations where a hazard classification of H4/ H5 has been identified include the access road to the site, and within a small portion of the solar panel array, these are indicated on drawing 210982-GI-3A to drawing 210982-GI-3C (Appendix C).

In undertaking the risk assessment, the following inputs were considered appropriate:

- The likelihood level being considered is Possible to Unlikely (50-500 years). The design life of the solar farm is considered to be at least 30 years.
- The consequence level considers the severity of damage to land and structures and also the safety of people. While the hazard classification of the site ranges from H1 to H5, the vast majority of the site is classified as H1 or less with only negligible portions classified as H2-H5. The consequence level is considered to be in the range of negligible (H1) to major (H5).

The flood risk of the site is generally considered to be low with small, localised areas of the site and solar array extent being of a medium to high risk.

**Table 5.1: Solar plant hazard assessment as per NPS-NH, without mitigations**

| Consequence Level | Likelihood Level: Almost Certain | Very Likely | Likely | Possible | Unlikely | Rare | Very Rare |
|---|---|---|---|---|---|---|---|
| ARI (years) | up to 10 | 10-20 | 20-50 | 50-100 | 100-500 | 500-5000 | > 5000 |
| AEP | 10% or more | 10% to 5% | 5% to 2% | 2% to 1% | 1% to 0.2% | 0.2% to 0.02% | < 0.02% |
| Catastrophic | Very High | Very High | Very High | High | Medium | Medium | Medium |
| Major | Very High | Very High | High | High | Medium | Medium | Medium |
| Moderate | High | High | High | Medium | Medium | Low | Low |
| Minor | Medium | Medium | Medium | Medium | Low | Low | Low |
| Negligible | Low | Low | Low | Low | Low | Low | Low |

[3] NH-S1 requires *"A minimum finished floor level for any new building or extension (or part thereof) that is 300mm above the 500 year ARI flood event level."*

### *5.2.3 Natural Hazard Mitigation Works*

It is considered that natural hazard mitigation works could be undertaken within the assessed medium and high hazard areas to reduce the hazard classification.

The following mitigations are proposed:

- Design of the solar infrastructure to be resilient to flood hazard as far as is practicable.
  - Solar panels are elevated on piles with a minimum ground clearance of 800 mm. They can be remotely tracked to increase ground clearance to up to 1.85 m in a severe weather event.
  - Inverters, the workshop and the operations and maintenance buildings will be elevated at least 300 mm above the 500-year ARI flood level.
  - Scour is anticipated to be negligible on the site as the modelled flow velocities on the site are less than 2.0 m/s.
- Undertake physical works and engineering interventions within the access track and solar array areas to reduce flow depths and velocities, and reduce the hazard classification to ensure the protection of structures, the stability of the landform and to improve safety of access for people and vehicles. Example works include:
  - Minor earthworks to level the historic river braids, spreading concentrated flows and reducing flood depths and velocities.
  - Install drainage infrastructure such as pipes and channels reducing flood depths and velocities.
  - Install culverts, drainage channels and regrading of land at proposed new access road location through borrow pit. This would decrease flow depths and velocities on the road itself.

The physical hazard mitigation works will not occur in the ecological restoration areas.

Additionally, operational health and safety controls are proposed to mitigate the risk to people.

- Whilst some trackers and panels are expected to be located in or near higher flood risk areas, there are no operational requirements for personnel to be within the vicinity of higher flood risk areas during forecast, or actual, high rainfall events.
- Operational site management plans will include hazard identification and management plans to ensure the health, safety and wellbeing of all staff, contractors, visitors and members of the public, whilst on the site. This will include external environmental effects such as weather.
- The site will be fenced and members of the public will not be able to access the site.

The proposed mitigations including drainage alterations are not expected to increase flood risk on the site or to neighbouring or downstream properties. The site and location of mitigations are of a size where drainage alterations will solely affect drainage paths on the site alone.

The proposed controls will both decrease the likelihood of damage to property, and of harm to people. Ground modifications and drainage upgrades will be required to decrease the consequence of any adverse event to reduce the depth or velocity of any flows. Refer Table 5.2 for a revised hazard assessment incorporating the proposed mitigations.

**Table 5.2: Solar plant hazard assessment as per NPS-NH, with proposed mitigations**

| Consequence Level | Likelihood Level: Almost Certain | Very Likely | Likely | Possible | Unlikely | Rare | Very Rare |
|---|---|---|---|---|---|---|---|
| ARI (years) | up to 10 | 10-20 | 20-50 | 50-100 | 100-500 | 500-5000 | > 5000 |
| AEP | 10% or more | 10% to 5% | 5% to 2% | 2% to 1% | 1% to 0.2% | 0.2% to 0.02% | < 0.02% |
| Catastrophic | Very High | Very High | Very High | High | Medium | Medium | Medium |
| Major | Very High | Very High | High | High | Medium | Medium | Medium |
| Moderate | High | High | High | Medium | Medium | Low | Low |
| Minor | Medium | Medium | Medium | Medium | Low | Low | Low |
| Negligible | Low | Low | Low | Low | Low | Low | Low |

It is anticipated that the hazard will be decreased to 'low - medium' with proposed mitigations.

## 5.3 Workshop and Operations and Maintenance Buildings

### *5.3.1 Mackenzie District Plan*

The proposed workshop and operations and maintenance buildings are located in a low hazard area.

They are located in an area of minor flooding, it is recommended the minimum finished floor level is RL 441.63 m (NZVD 2016) This is 300 mm above the identified 500-year ARI flood level.

### *5.3.2 National Policy Statement for Natural Hazards (2025)*

A risk assessment has been undertaken in accordance with the methodology specified in the NPS-NH. The nature of the hazard was quantified using the depth and velocity of the modelled flows.

An assessment was undertaken of the hazard posed to the site using the methodology in the Australian Rainfall and Runoff Guideline (2019). The location of the proposed operations and maintenance buildings generally meets the criteria for 'H1 – generally safe for people, vehicles and buildings' in a 500-year ARI event. Small areas of adjacent land outside the proposed gravel pad for the workshop and operations and maintenance buildings meet the criteria of H2 (unsafe for small vehicles), but these areas are localised and can be eliminated through site grading if required.

Therefore, a hazard assessment of 'low' was made against the NPS-NH.

**Table 5.3: Workshop and Operations and Maintenance Buildings Hazard Assessment as per NPS-NH**

| Consequence Level | Likelihood Level: Almost Certain | Very Likely | Likely | Possible | Unlikely | Rare | Very Rare |
|---|---|---|---|---|---|---|---|
| ARI (years) | up to 10 | 10-20 | 20-50 | 50-100 | 100-500 | 500-5000 | > 5000 |
| AEP | 10% or more | 10% to 5% | 5% to 2% | 2% to 1% | 1% to 0.2% | 0.2% to 0.02% | < 0.02% |
| Catastrophic | Very High | Very High | Very High | High | Medium | Medium | Medium |
| Major | Very High | Very High | High | High | Medium | Medium | Medium |
| Moderate | High | High | High | Medium | Medium | Low | Low |
| Minor | Medium | Medium | Medium | Medium | Low | Low | Low |
| Negligible | Low | Low | Low | Low | Low | Low | Low |

## 5.4 Construction Offices and Laydown Area

### *5.4.1 Mackenzie District Plan*

The proposed construction offices and laydown area is located in a low hazard area. Minor flooding and overland flow paths are modelled to be present in this area.

The location and layout of the temporary buildings will be confirmed at the detailed design stage. The minimum finished floor level of temporary office buildings shall be elevated 300 mm above the identified 500-year ARI flood level which can be identified from the results appended to this report. This recommendation is expected to provide more than sufficient flood protection considering the low risk of the flooding and the temporary nature of the buildings.

# 6 CONCLUSION AND RECOMMENDATIONS

A flood hazard risk assessment was undertaken on the site of the proposed solar plant in Twizel.

The results indicate flooding on the site is generally confined to historic river braids which are located across the site. Flows of elevated depth and velocity are limited to the more defined channels.

An assessment of the flood hazards on the site was undertaken against the Mackenzie District Plan and the National Policy Statement for Natural Hazards (2025) as summarised below:

MDP: Minor areas of the proposed solar plant (< 0.1%) are identified to meet the 'high flood hazard area' classification.

NPS-NH: The flood risk of the site is generally considered to be low with small, localised areas of the site and solar array extent being of a medium to high risk.

The high flood hazard areas are highly localised and are generally caused by concentration of water within the historic river braids, and it is considered that natural hazard mitigation works could be undertaken within the assessed medium and high hazard areas to reduce the hazard classification. Operational health and safety controls will reduce the risk posed to people.

It is anticipated that the hazard will be decreased to 'low - medium' with proposed mitigations.

## 6.1 Recommendations

The following recommendations should be considered with the site development.

- Natural hazard sensitive buildings should be elevated a minimum of 300 mm above the modelled 500-year ARI flood level.
  - Solar panels are expected to exceed this minimum requirement due to their ability to track up to 1.85 m above ground level.
  - The workshop and operations and maintenance buildings should have a minimum finished floor level of RL 441.63 m (NZVD 2016)
  - Inverters shall be elevated 1 m above ground level; they will be elevated at least 300 mm above the modelled 500-year ARI flood level.
  - Temporary office buildings within the construction laydown area are recommended to have a minimum finished floor level of 300 mm above the 500-year ARI top water level.
- Access to the site once operational should be suitably designed with mitigations to ensure the stability of the landform, and the safety of vehicles and people.

## 6.2 Distribution

This report has been prepared for Nova Energy Limited in respect of its application for all approvals under the Fast-track Approvals Act 2024 for the Twizel Solar Plant. The Panel appointed to consider the application for the Twizel Solar Plant may rely on this report for the purpose of making its decision under the Fast-track Approvals Act 2024.

The author has read the Expert Witness Code of Conduct set out in the Environment Court Practice Note 2023. The author has complied with the Code of Conduct in preparing this report. The content of the report is within the authors area of expertise, and the author has not omitted to

consider material facts known to them that might alter or detract from the opinions expressed in the report.

# 7 REFERENCES

Arcement, G. J., & Schneider, V. R. (1989). *Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains.* Denver, CO: U.S. Geological Survey Water-Supply Paper 2339.

Environment Canterbury Regional Council. (2023). *Twizel flood modelling investigation.* Christchurch: Environment Canterbury Regional Council.

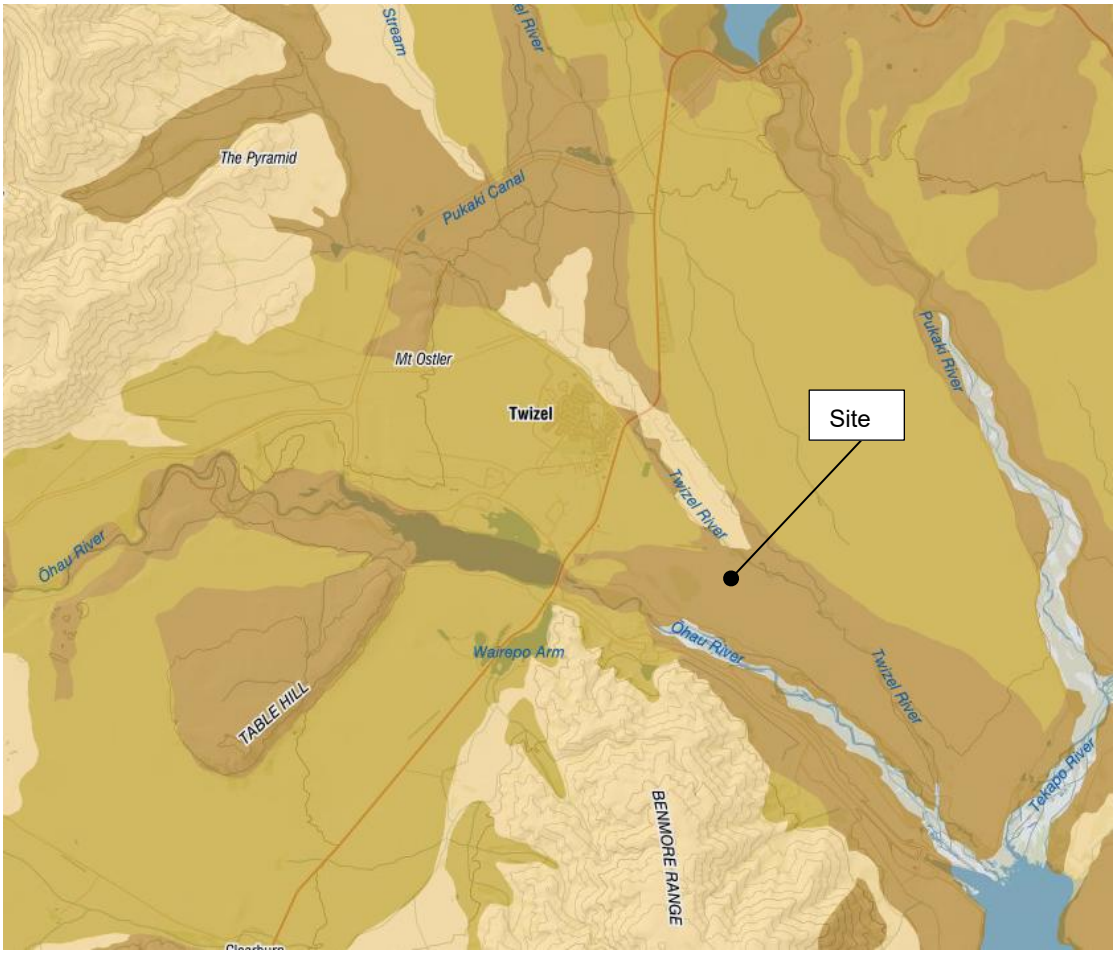
Henderson, & Collins. (2018). *New Zealand River Flood Statistics*. Retrieved from NIWA: https://niwa.maps.arcgis.com/apps/webappviewer/index.html?id=933e8f24fe9140f99dfb57173087f27d

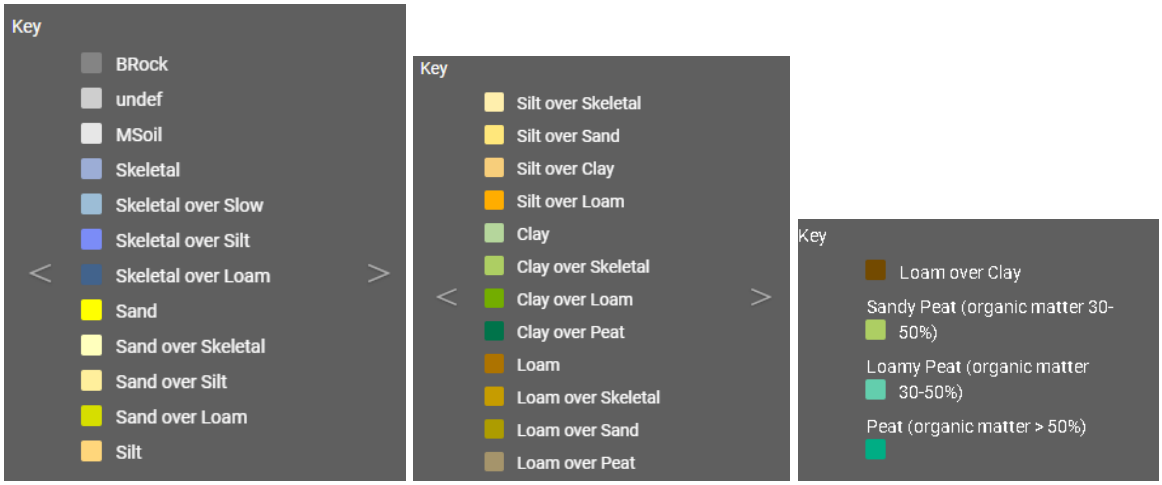
Manaaki Whenua - Landcare Research. (2024). Retrieved from https://doi.org/10.26060/9vfz-hw43

Pearson, C. P., & McKerchar, A. I. (1989). Flood Estimation - A Revised Design Procedure. *Transactions, Vol 16, No 2/CE*, 59-65.

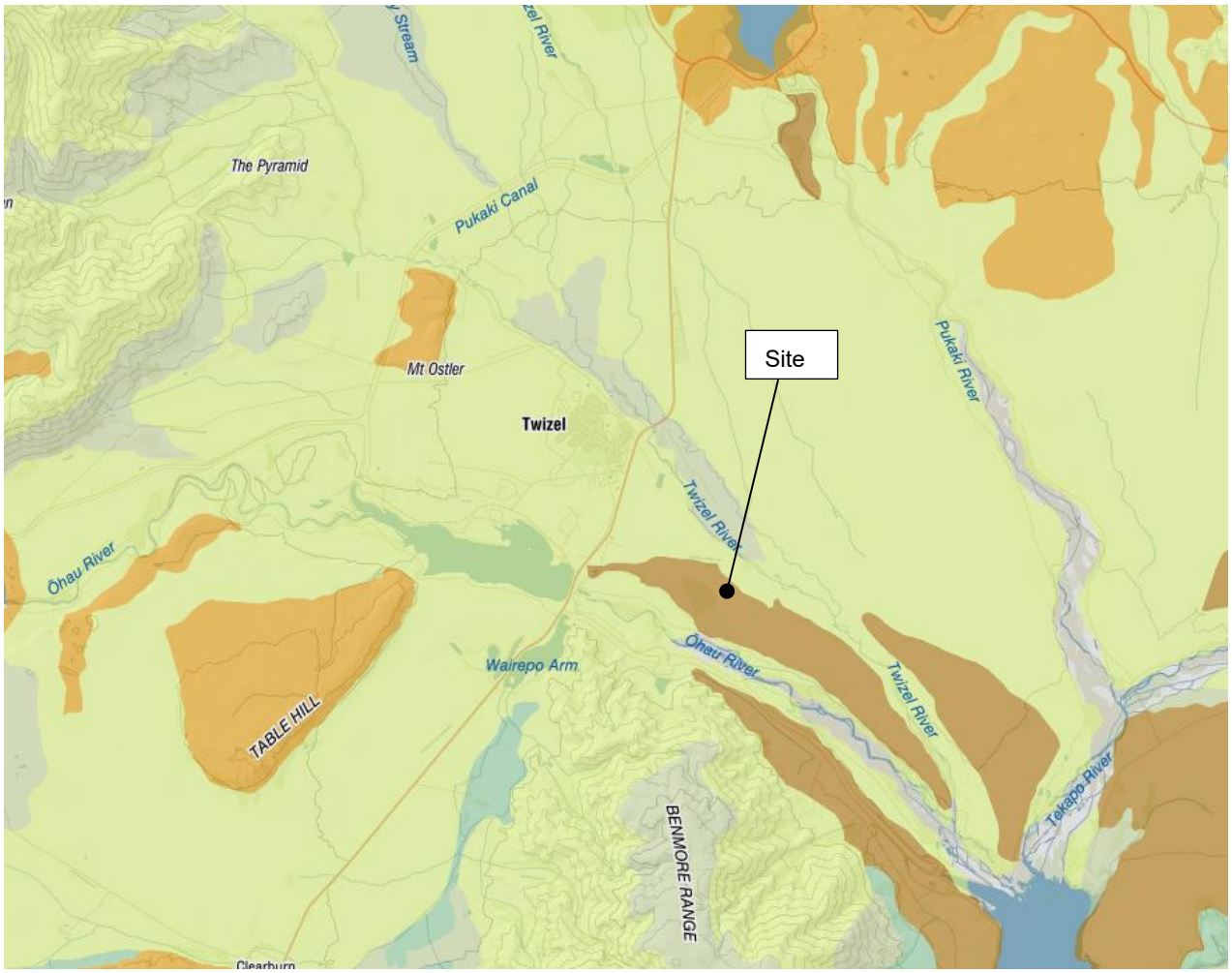
# APPENDIX A SOIL CHARACTERISTICS MAPS

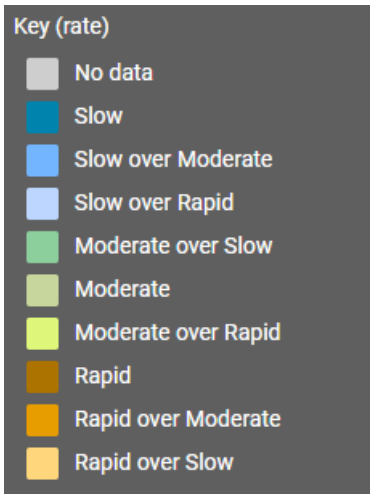
## A.1 Soil Particle Size Map (Manaaki Whenua - Landcare Research, 2024)



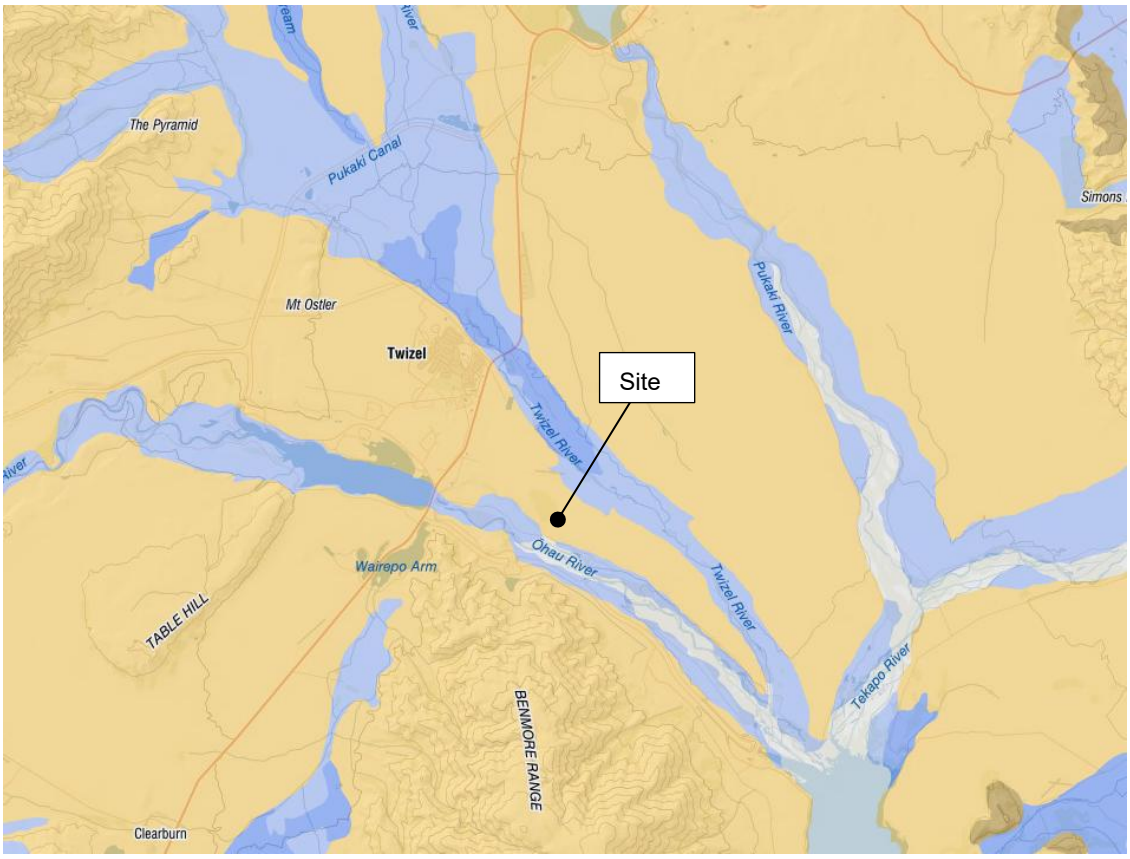



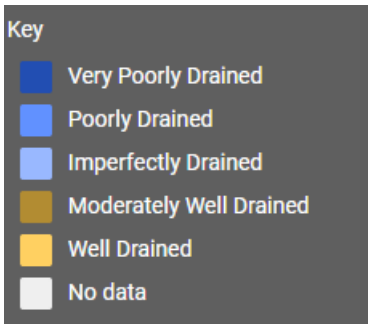
## A.2 Soil Permeability Map (Manaaki Whenua - Landcare Research, 2024)



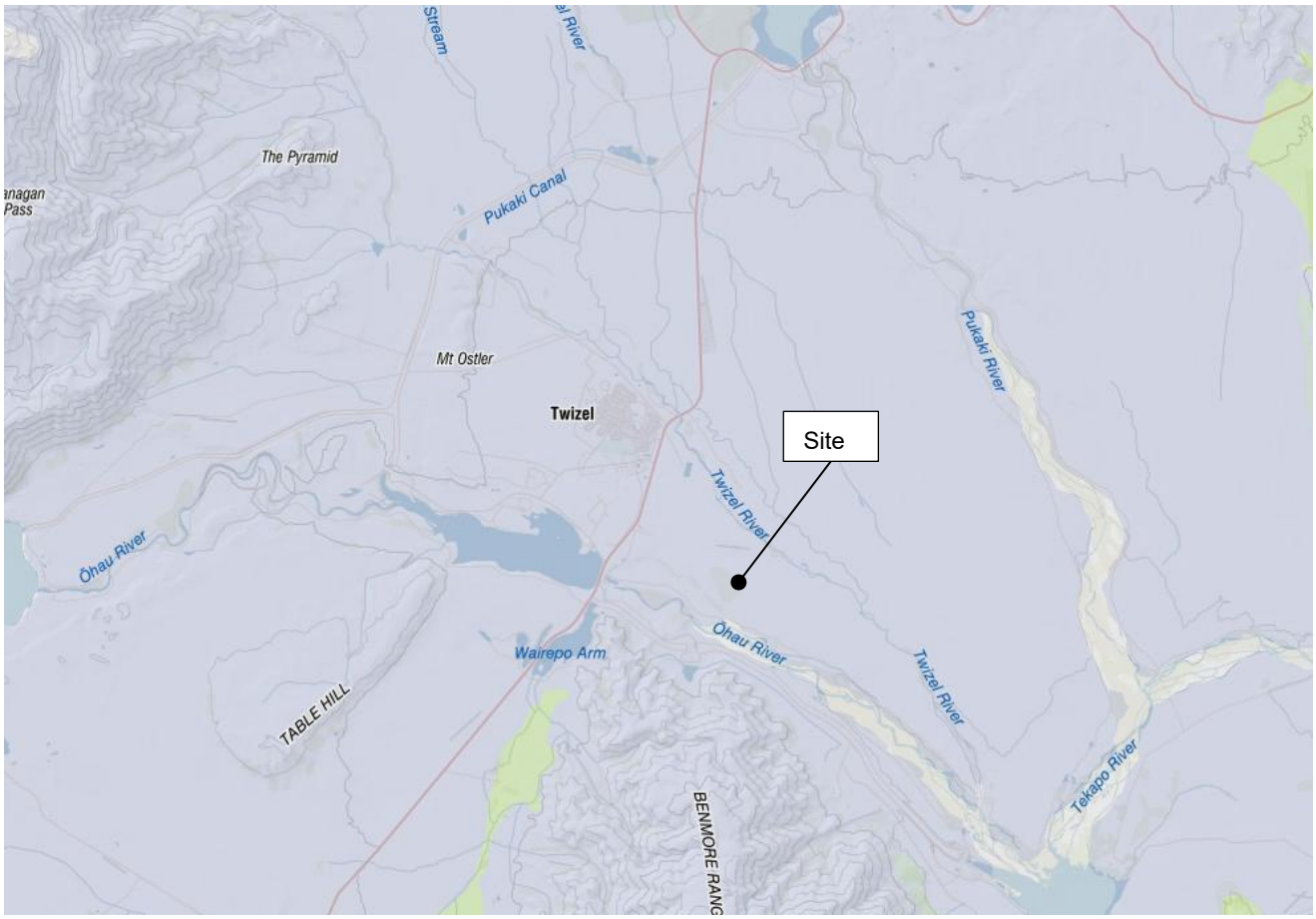



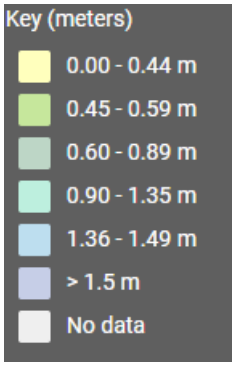
## A.3 Soil Drainage Map (Manaaki Whenua - Landcare Research, 2024)



## A.4 Depth to Slowly Permeable Soil Horizon (Manaaki Whenua - Landcare Research, 2024)



# APPENDIX B STORMWATER MODELLING

## B.1 Methodology

A 2D rain on grid model was created in Infoworks ICM (version 2026.3.0). Grid sizes between 2 $m^2$ and 25 $m^2$ were applied to the site. Terrain sensitive meshing was applied to the site to improve definition of terrain in the model.

Infoworks ICM was selected for its ability to adapt 2D mesh to terrain, automatically decreasing mesh sizes where improved mesh definition is required.

## B.2 Topography

The ground model was sourced from the New Zealand LiDAR 1m DEM, hosted on the LINZ Data Service. This is an amalgamation of the latest LiDAR survey undertaken within the model extent, including the Canterbury - Mackenzie LiDAR 1m DEM (2015) and the Canterbury LiDAR 1m DEM (2016-2017).

Minor terrain modifications were undertaken to add key features to the post-development site. These included the following:

- Addition of operation and maintenance building pad (~200 mm level increase)
- Addition of proposed new access road from site entry to connection with existing access road (150 mm level increase)

## B.3 Coordinate System and Vertical Datum

The project coordinate system is New Zealand Transverse Mercator (NZTM).

New Zealand Vertical Datum 2016 (NZVD 2016) has been used for all elevations unless otherwise stated.

## B.4 Hydrology

### *B.4.1 Catchment Parameters*

A catchment analysis was undertaken to calculate parameters for use in hydrological modelling.

The catchment areas at the site were assessed.

- Soil infiltration rates for the Horton's equation were selected from the *Christchurch Waterways Wetlands and Drainage Guide: Part B – Chapter 21 – Updated June 2020*.
- Free draining soil is noted to be present within the model extent based on the desktop review of catchment soil parameters.

Key outputs of the catchment analysis are summarised in Table B 1.

**Table B 1: Catchment hydrological model summary of properties**

| Soil Properties | Initial infiltration rate, $f_o$ (mm/hr) | Ultimate infiltration rate, $f_c$ (mm/hr) | Horton decay rate, k |
|---|---|---|---|
| Free draining<br>Loam or loam over skeletal | 15 | 5 | 3E-5 |

### *B.4.2 Rainfall*

A central location within the catchment area was used for selection of rainfall depths and intensities within HIRDS V4[4].

HIRDS V4 'historical' depth-duration-frequency and intensity-duration-frequency rainfall data was selected to represent the present-day scenario.

HIRDS V4 RCP 8.5 2081-2100 scenario depth-duration-frequency and intensity-duration-frequency rainfall data was selected to represent the future scenario. Data for the 500-year ARI RCP 8.5 event was extrapolated from the HIRDS dataset, which only extends to the 250-year ARI event.

A 24-hour duration storm hyetograph was created by constructing a nested storm event using the HIRDS data. This methodology was selected to ensure all possible storm durations from 10 minutes to 24 hours were captured in the modelling. A 24-hour storm was considered sufficient to allow for peak flows to occur during the model duration.

An areal reduction factor was not applied due to the small overall size of the catchment, any areal reduction factor would be negligible (over 99%).

## B.5 Hydraulic Modelling

A hydraulic assessment of the site was undertaken to understand the surface water elevations, depths and velocities.

The hydraulic model has been constructed using Infoworks ICM software as a 2D model with rain on grid applied uniformly across the model extent.

## B.6 Hydraulic Model Development

### *B.6.1 Model Extent*

The model extent was selected through the catchment review. The modelled area includes the upstream catchment area northwest of State Highway 8 to enable reasonable upstream inputs into the model. The Twizel and Ōhau River beds were excluded from the model as the site is significantly elevated above them and it is assumed that they will not present a tailwater effect on the site.

The hydraulic model incorporates the site, and all upstream catchments. The model extent is shown in Figure B 1.The downstream boundary was selected to be far enough downstream such that tailwater effects on the site were negligible, this was often close to the boundary of the solar array area due to its location on a terrace several metres above the Twizel and Ōhau Rivers.

The maximum grid size within the site is 2 $m^2$ to provide improved definition. Mesh grid sizes between 3 $m^2$ and 25 $m^2$ were applied to the wider model, with the smaller grid sizes applied in focal areas within the site, around roads and waterways and within concentrated flow paths.

[4] NIWA (2017). High Intensity Rainfall Design System V4. Accessed from https://hirds.niwa.co.nz/

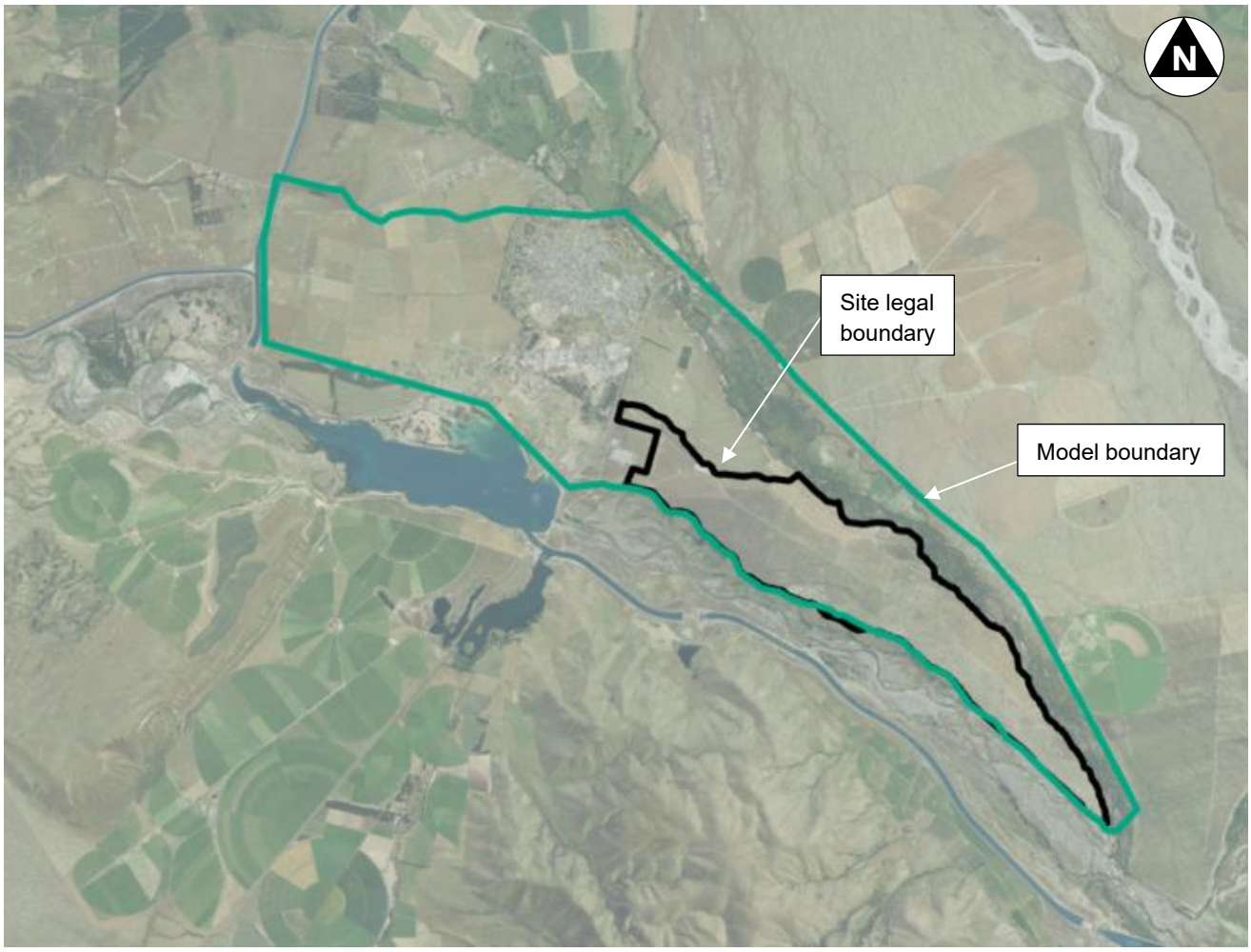



**Figure B 1: Flood model extent**

### *B.6.2 Rainfall Inputs*

Precipitation was applied across the model area using the excess rainfall from the hyetograph produced in the hydrological assessment.

### *B.6.3 Boundary Conditions*

A normal boundary condition was applied to the full model boundary; no other boundary conditions were applied.

### *B.6.4 Channel and Floodplain Roughness*

The model uses Manning's n roughness values in computation of floodplain and channel hydraulics. Refer Table B 2 for a summary of the Manning's n values, selected from the *Guide for Selecting Manning's Roughness Coefficients for Natural Channels and Flood Plains* (Arcement & Schneider, 1989) with guidance from the *Christchurch City Council Waterways, Wetlands and Drainage Guide* (Table 22-1).

It is noted that several recent flood models in the Canterbury/Otago region (Upper Opihi Model[5], Twizel Model[6],) used a Manning's n pastoral floodplain roughness of 0.05. The Selwyn Model[7] used a Manning's n ranging from 0.028 to 0.05 for 'high producing exotic grassland'[8] depending on flood depth.

Considering the results of the sensitivity analysis and the range of data sources reviewed, the selection of 0.035 for the Manning's n for the pastoral areas of the site was considered appropriate.

Building outlines within the model extent were imported from the LINZ buildings layer and a Manning's n of 1 was applied to represent limited flow through them.

**Table B 2: Manning's n values used in model**

| Item | Manning's n |
|---|---|
| Pasture | 0.035 |
| Roads | 0.02 |
| Buildings | 1 |

### *B.6.5 Structures*

No drainage structures were present on the site, therefore no structures were incorporated into the model.

Structures within the Twizel township were considered to have negligible effect on the site due to secondary flow conveying the majority of runoff in major storm events, therefore they were not modelled.

[5] DHI (2021). Upper Opihi Flood Modelling.
[6] Environment Canterbury Regional Council (2023). Twizel Flood Modelling Report.
[7] Tonkin+Taylor (2025). Selwyn District Flood Model – Hydraulic Model Build Report.
[8] As defined by the LCDB v5.0, same land cover as the majority of the model extent.

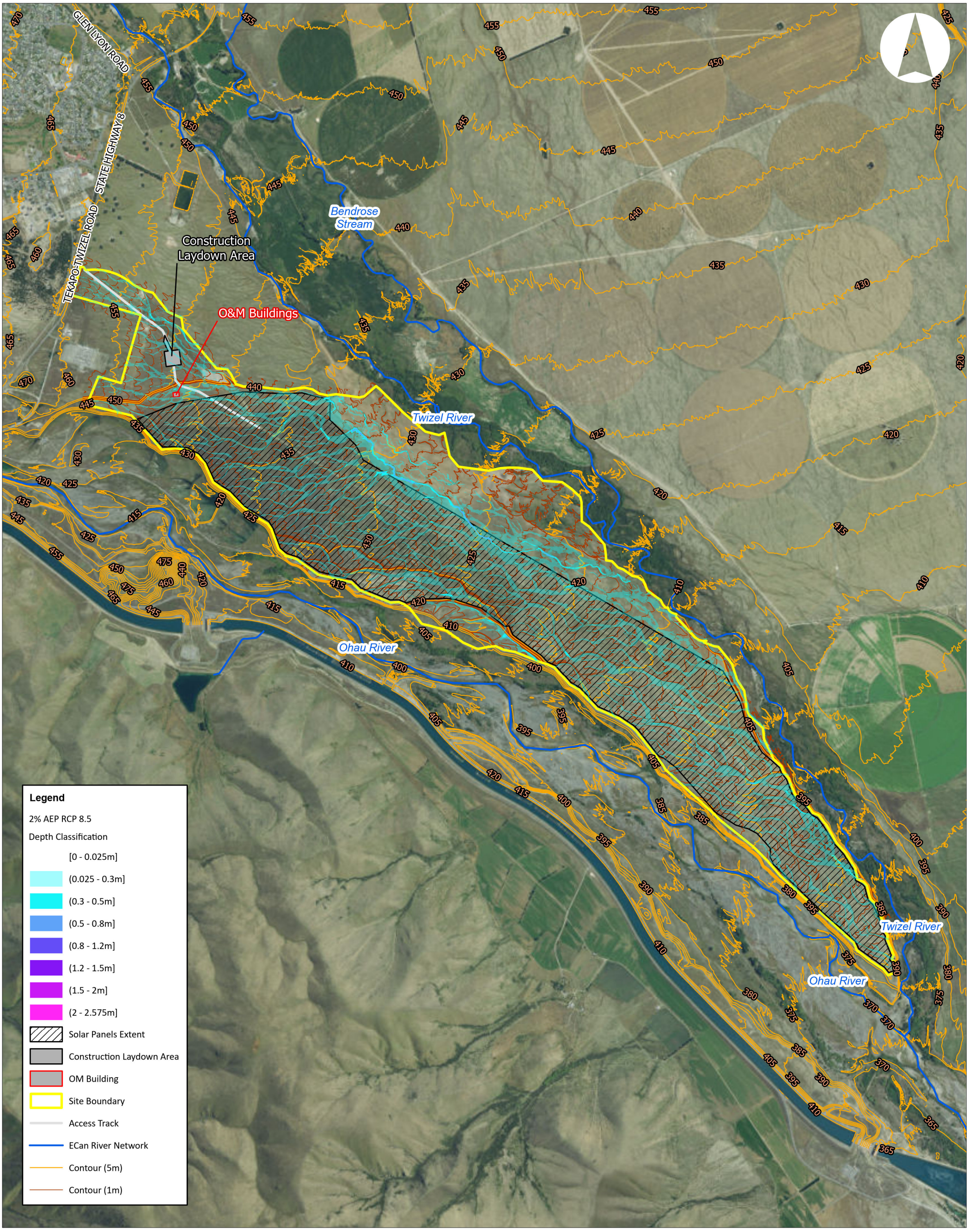
# APPENDIX C RESULTS MAPS

Maximum depth and velocity maps have been supplied for the following RCP 8.5 events:

- 2% AEP (50-yr ARI)
- 1% AEP (100-yr ARI)
- 0.2% AEP (500-yr ARI)

Hazard maps have also been supplied for the following events using the following methodologies

- 1% AEP (100-yr ARI)
  - Australian Rainfall and Runoff (2019)
- 0.2% AEP (500-yr ARI)
  - Australian Rainfall and Runoff (2019)
  - Mackenzie District Council




**GENERAL NOTES**
1. Coordinates are in terms of New Zealand Transverse Mercator
2. Elevations in terms of New Zealand Vertical Datum 2016

**DISCLAIMER**
GIS data and imagery are for indicative purposes only.
Cadastral information sourced from LINZ. Crown copyright reserved.
River and lake data sourced from Environment Canterbury.

TITLE

# NOVA ENERGY SOLAR FARM
# DEPTH FLOODING MAP
# 2% AEP (RCP 8.5)

| | | |
|---|---|---|
| DRAWN | D. MOULT | 21.04.26 |
| CHECKED | S. HUSBAND | 21.04.26 |
| PROJECT No | 210982 | |
| LOCATION | TWIZEL | |
| SCALE | 1:30,000 | |
| ORIGINAL SIZE | A3 | |

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SURVEYING
ENGINEERING
PLANNING
ENVIRONMENT

| NO | DATE | BY | CHKD. |
|---|---|---|---|

REVISIONS

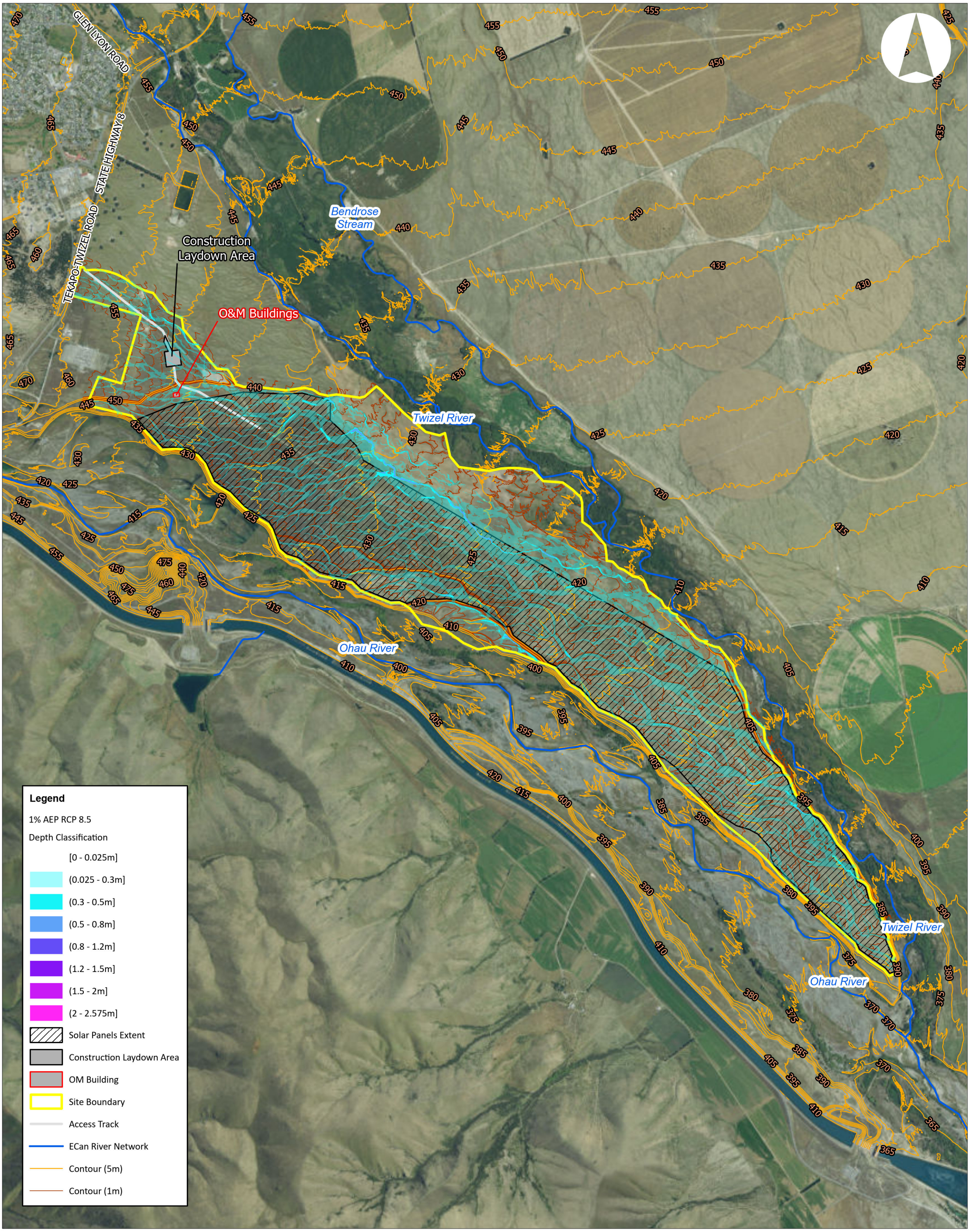
0 200 400 800 1,200 1,600 2,000 Meters

1:30,000

DRAWING No 210982-GI-1A

SHEET 1

REVISION 0




**GENERAL NOTES**
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River and lake data sourced from Environment Canterbury.

TITLE

# NOVA ENERGY SOLAR FARM
# DEPTH FLOODING MAP
# 1% AEP (RCP 8.5)

| | | |
|---|---|---|
| DRAWN | D. MOULT | 21.04.26 |
| CHECKED | S. HUSBAND | 21.04.26 |
| PROJECT No | 210982 | |
| LOCATION | TWIZEL | |
| SCALE | 1:30,000 | |
| ORIGINAL SIZE | A3 | |

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SURVEYING
ENGINEERING
PLANNING
ENVIRONMENT

| NO | DATE | BY | CHKD. |
|---|---|---|---|

REVISIONS

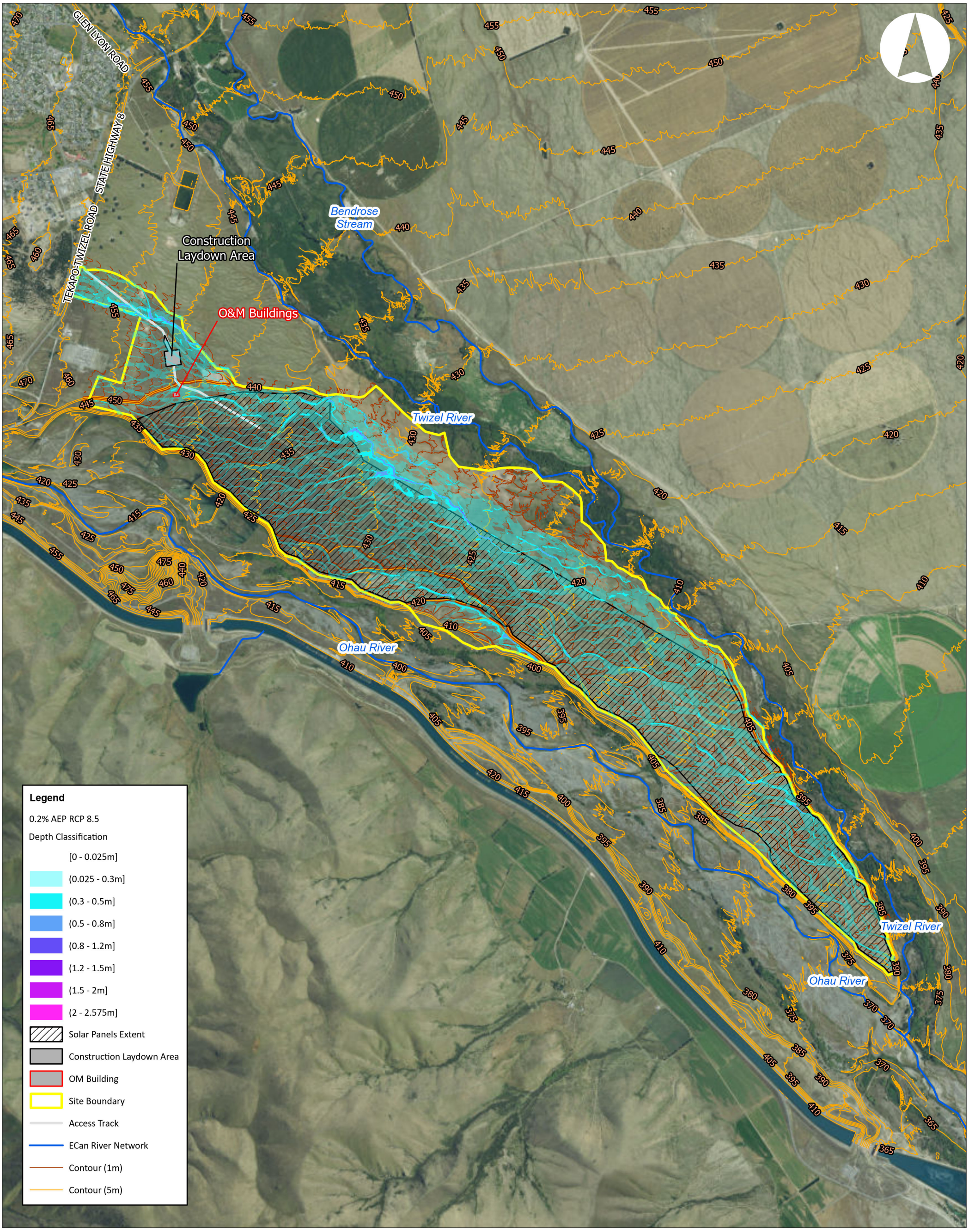
0 200 400 800 1,200 1,600 2,000 Meters

1:30,000

DRAWING No 210982-GI-1B

SHEET 1

REVISION 0

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TITLE

# NOVA ENERGY SOLAR FARM
# DEPTH FLOODING MAP
# 0.2% AEP (RCP 8.5)

| | | |
|---|---|---|
| DRAWN | D. MOULT | 21.04.26 |
| CHECKED | S. HUSBAND | 21.04.26 |
| PROJECT No | 210982 | |
| LOCATION | TWIZEL | |
| SCALE | 1:30,000 | |
| ORIGINAL SIZE | A3 | |

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SURVEYING
ENGINEERING
PLANNING
ENVIRONMENT

| NO | DATE | BY | CHKD. |
|---|---|---|---|

REVISIONS

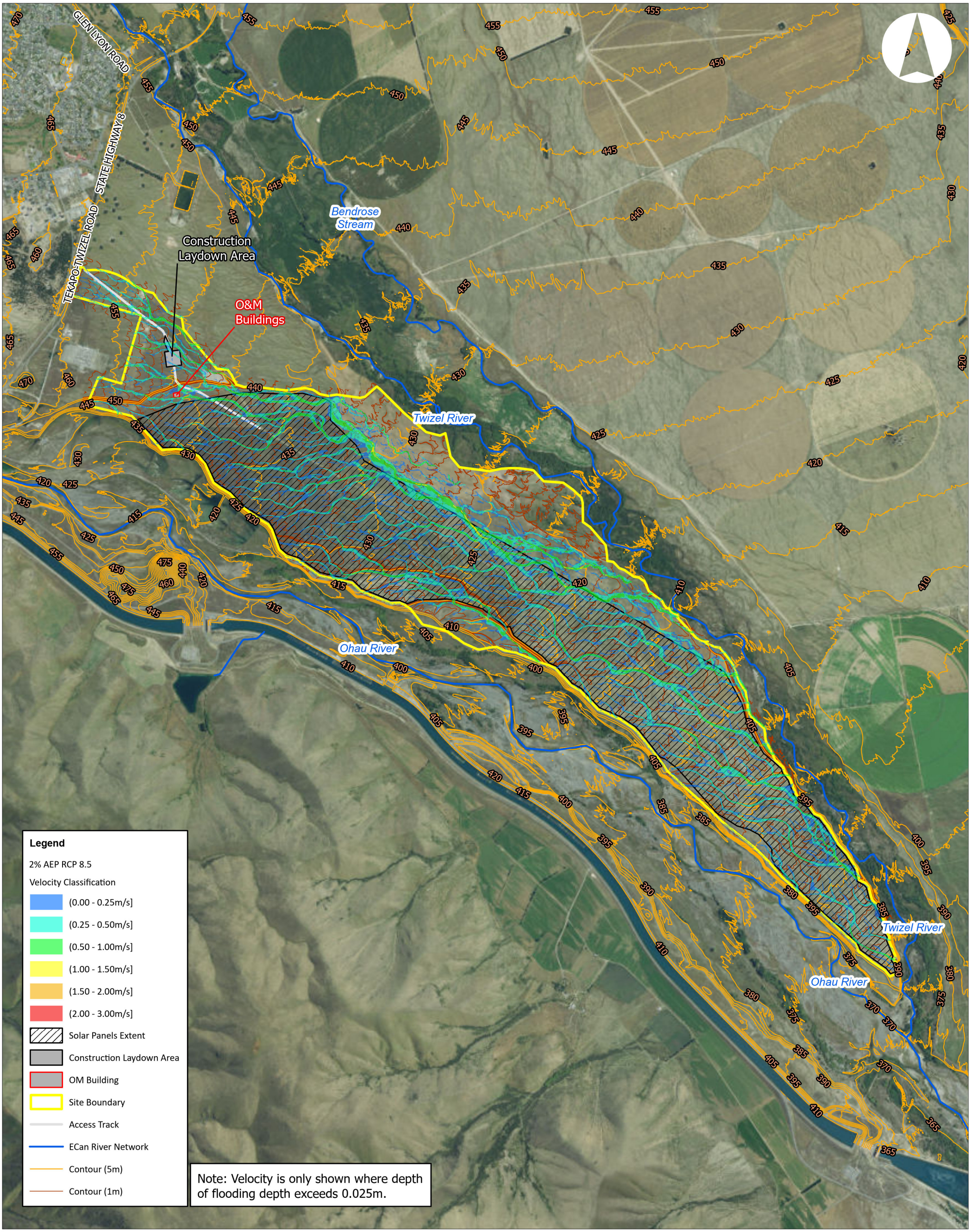
0 200 400 800 1,200 1,600 2,000 Meters

1:30,000

DRAWING No 210982-GI-1C

SHEET 1

REVISION 0

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River and lake data sourced from Environment Canterbury.

TITLE

# NOVA ENERGY SOLAR FARM
# MAXIMUM VELOCITY MAP
# 2% AEP (RCP 8.5)

| | | |
|---|---|---|
| DRAWN | D. MOULT | 21.04.26 |
| CHECKED | S. HUSBAND | 21.04.26 |
| PROJECT No | 210982 | |
| LOCATION | TWIZEL | |
| SCALE | 1:30,000 | |
| ORIGINAL SIZE | A3 | |

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ENGINEERING
PLANNING
ENVIRONMENT

| NO | DATE | BY | CHKD. |
|---|---|---|---|
| | | | |

REVISIONS

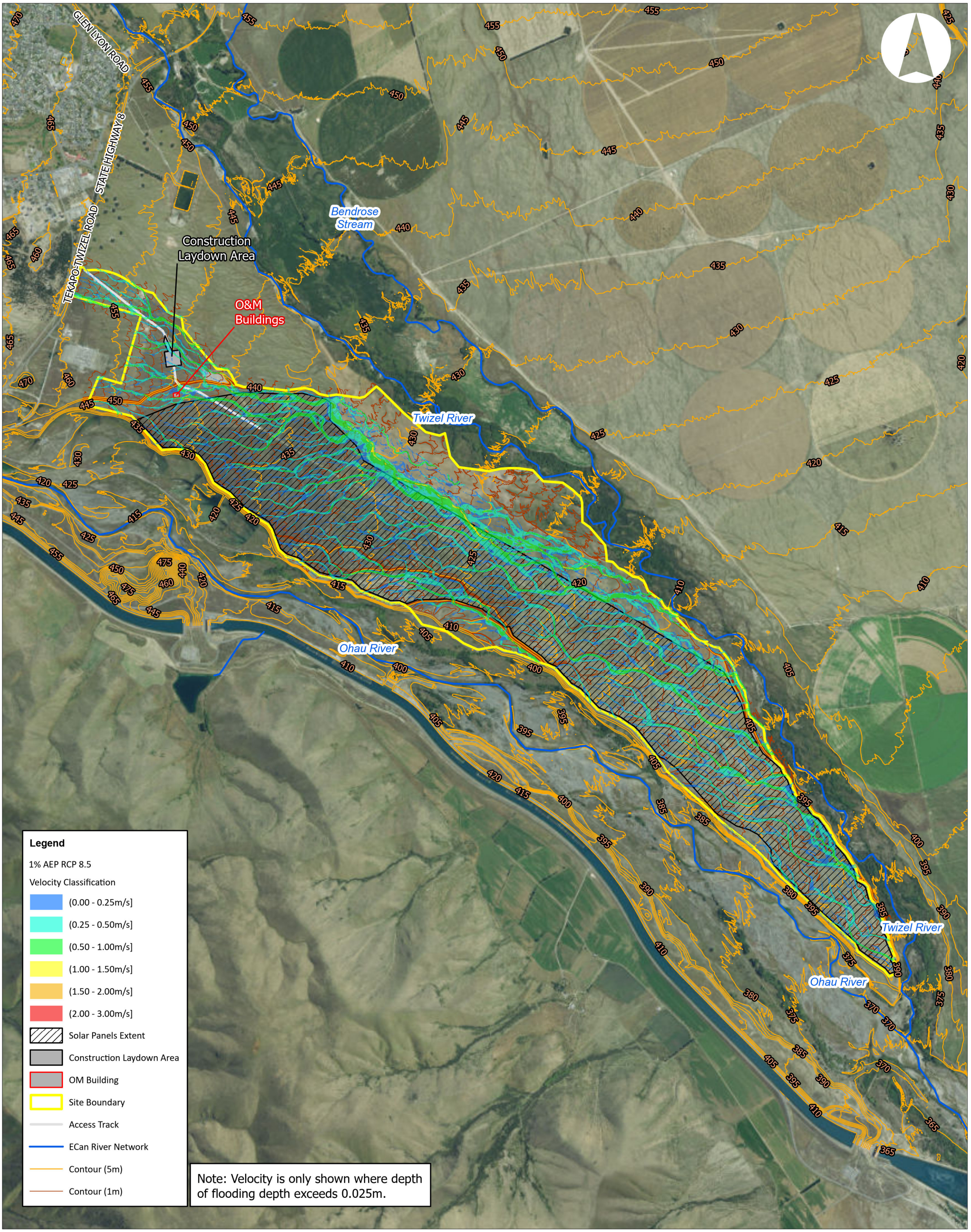
0 200 400 800 1,200 1,600 2,000 Meters

1:30,000

DRAWING No 210982-GI-2A

SHEET 1

REVISION 0

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River and lake data sourced from Environment Canterbury.

TITLE

# NOVA ENERGY SOLAR FARM
# MAXIMUM VELOCITY MAP
# 1% AEP (RCP 8.5)

| | | |
|---|---|---|
| DRAWN | D. MOULT | 21.04.26 |
| CHECKED | S. HUSBAND | 21.04.26 |
| PROJECT No | 210982 | |
| LOCATION | TWIZEL | |
| SCALE | 1:30,000 | |
| ORIGINAL SIZE | A3 | |

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ENGINEERING
PLANNING
ENVIRONMENT

| NO | DATE | BY | CHKD. |
|---|---|---|---|

REVISIONS

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1:30,000

| DRAWING No | SHEET | REVISION |
|---|---|---|
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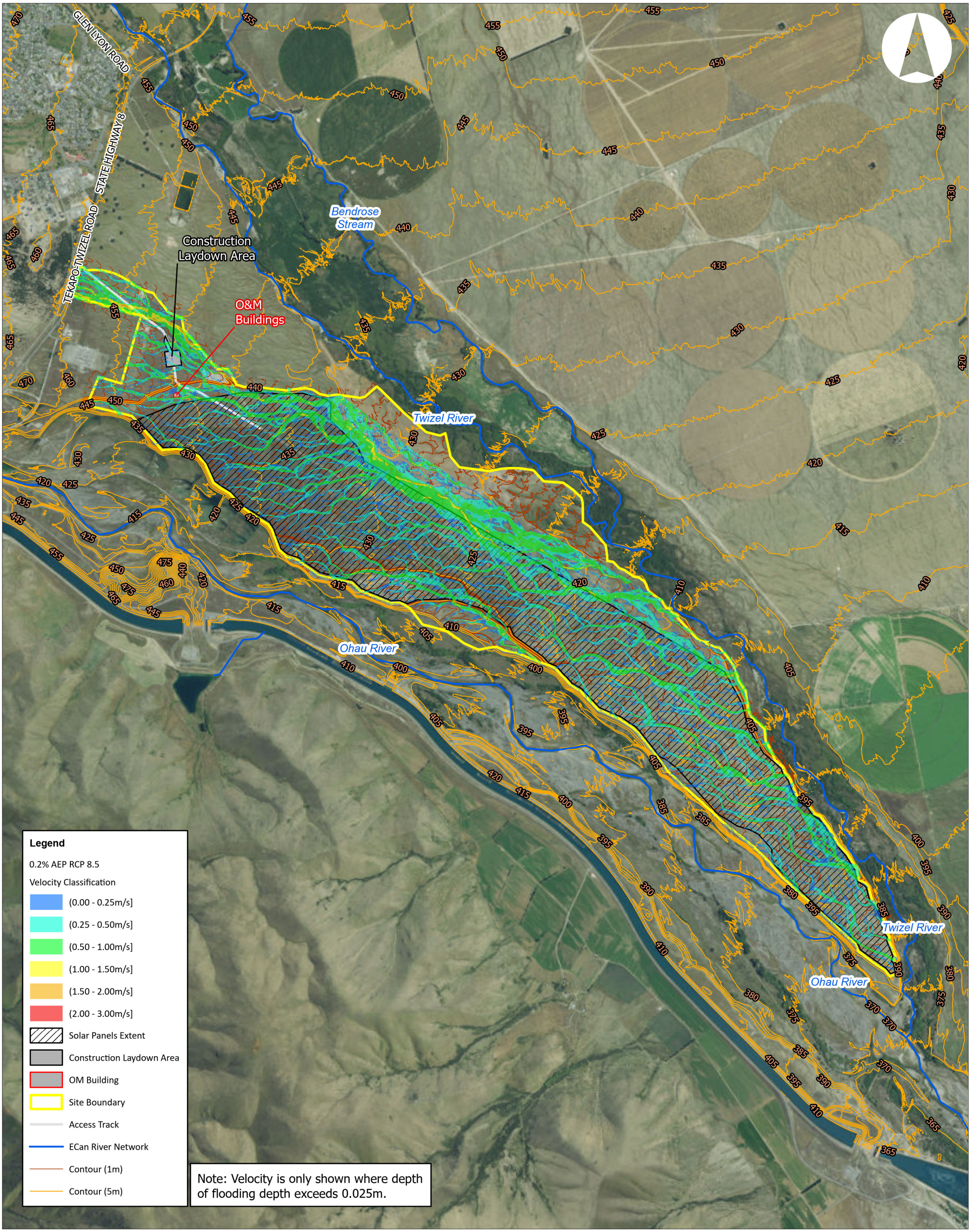


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TITLE

# NOVA ENERGY SOLAR FARM
# MAXIMUM VELOCITY MAP
# 0.2% AEP (RCP 8.5)

| | | |
|---|---|---|
| DRAWN | D. MOULT | 21.04.26 |
| CHECKED | S. HUSBAND | 21.04.26 |
| PROJECT No | 210982 | |
| LOCATION | TWIZEL | |
| SCALE | 1:30,000 | |
| ORIGINAL SIZE | A3 | |

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ENGINEERING
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ENVIRONMENT

| NO | DATE | BY | CHKD. |
|---|---|---|---|

REVISIONS

0 200 400 800 1,200 1,600 2,000 Meters

1:30,000

| DRAWING No | SHEET | REVISION |
|---|---|---|
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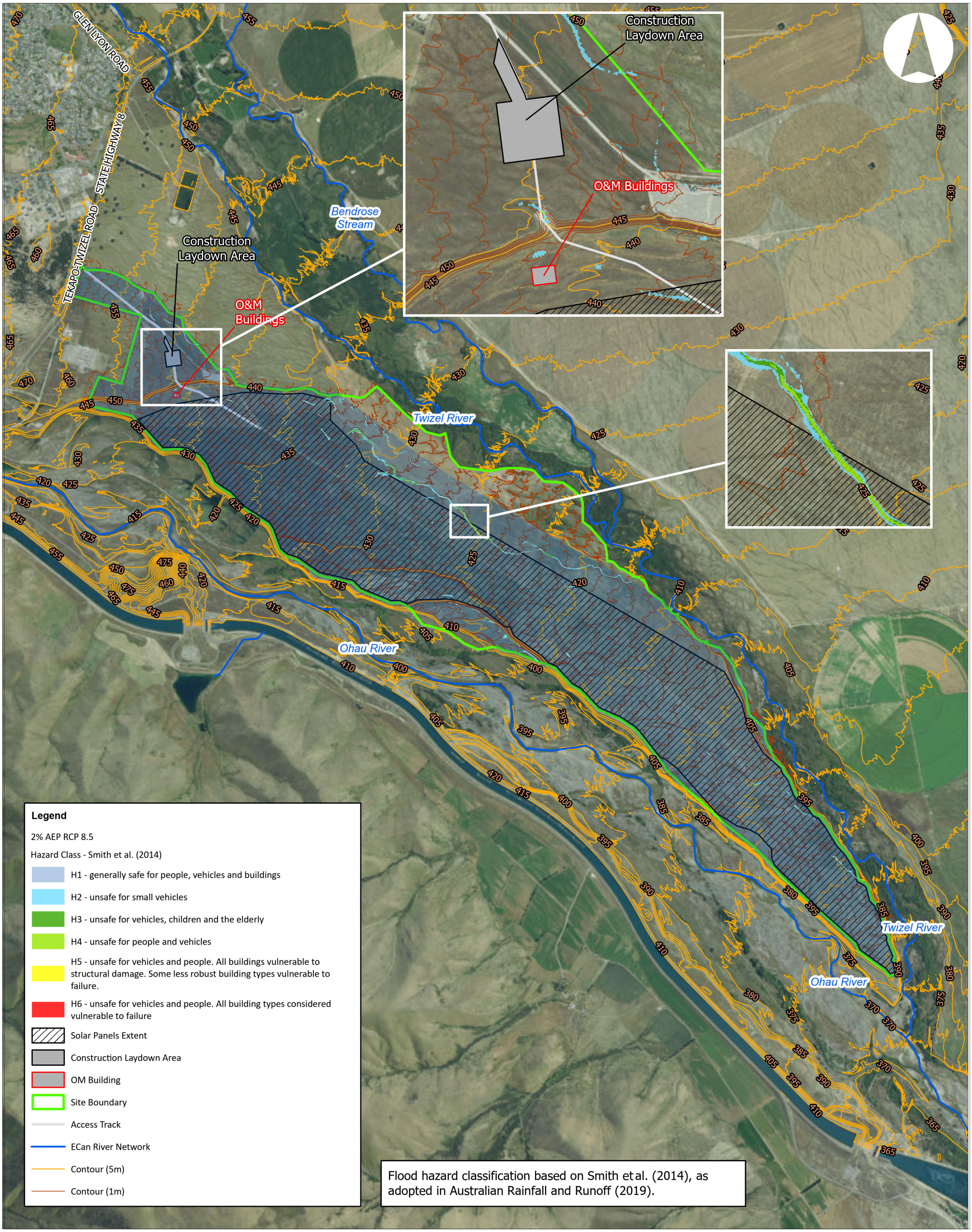


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TITLE

# NOVA ENERGY SOLAR FARM
# FLOODING HAZARD MAP
# 2% AEP (RCP 8.5)

| | | |
|---|---|---|
| DRAWN | D. MOULT | 21.04.26 |
| CHECKED | S. HUSBAND | 21.04.26 |
| PROJECT No | 210982 | |
| LOCATION | TWIZEL | |
| SCALE | 1:30,000 | |
| ORIGINAL SIZE | A3 | |

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ENVIRONMENT

| NO | DATE | BY | CHKD. |
|---|---|---|---|

REVISIONS

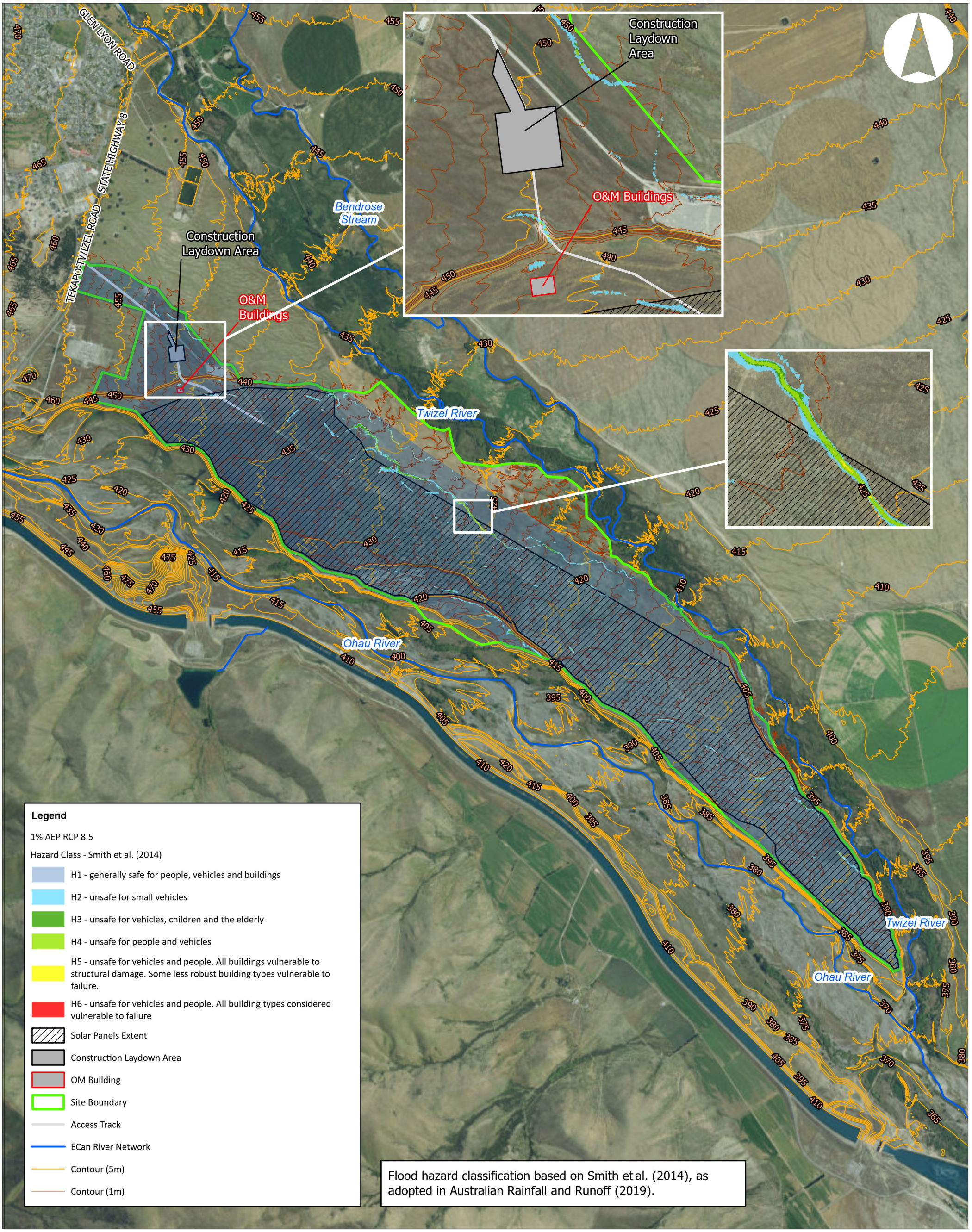
0 200 400 800 1,200 1,600 2,000 Meters

1:30,000

DRAWING No 210982-GI-3A

SHEET 1

REVISION 0

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TITLE

# NOVA ENERGY SOLAR FARM
# FLOODING HAZARD MAP
# 1% AEP (RCP 8.5)

| | | |
|---|---|---|
| DRAWN | D. MOULT | 21.04.26 |
| CHECKED | S. HUSBAND | 21.04.26 |
| PROJECT No | 210982 | |
| LOCATION | TWIZEL | |
| SCALE | 1:30,000 | |
| ORIGINAL SIZE | A3 | |

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ENVIRONMENT

| NO | DATE | BY | CHKD. |
|---|---|---|---|

REVISIONS

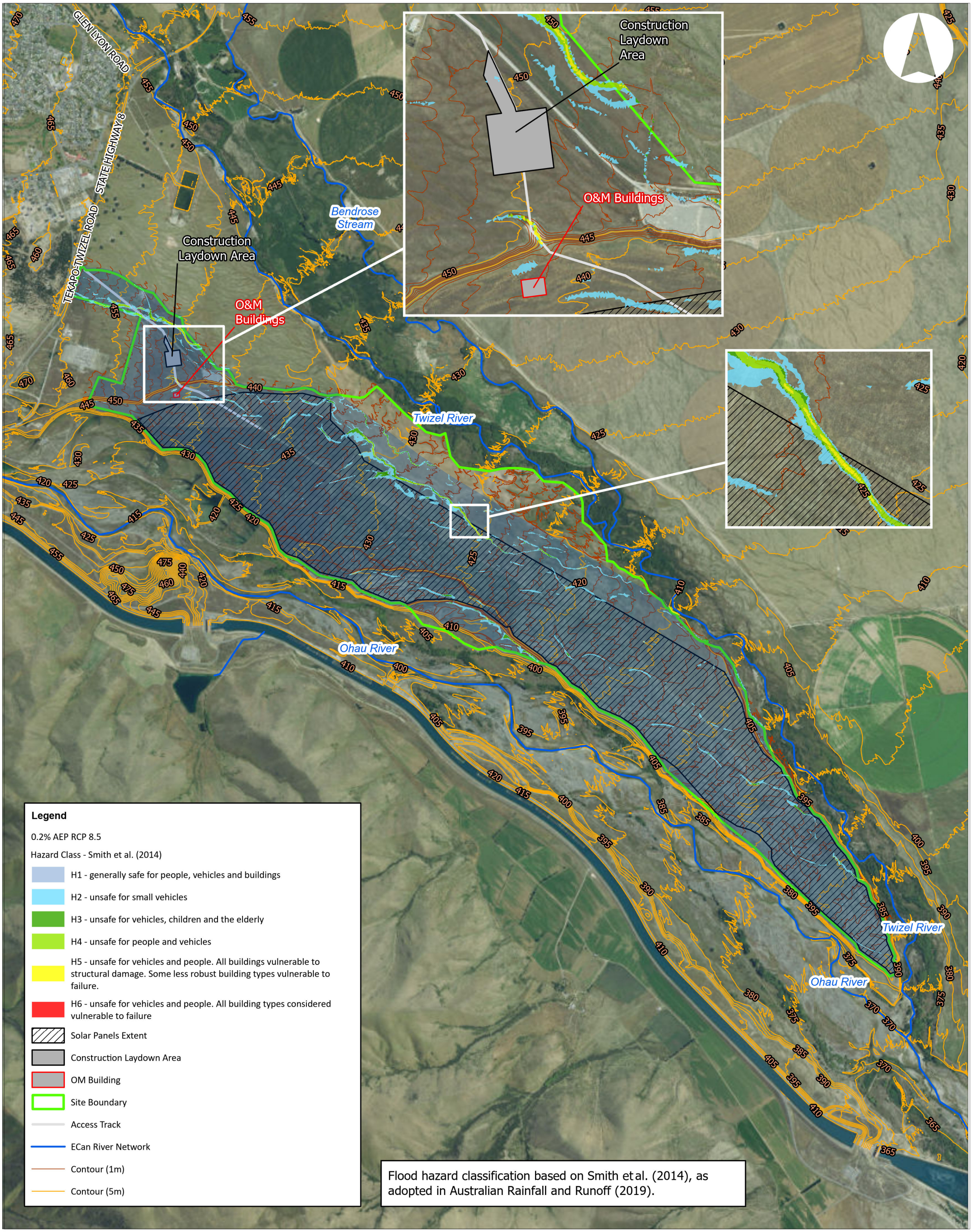
0 200 400 800 1,200 1,600 2,000 Meters

1:30,000

DRAWING No 210982-GI-3B

SHEET 1

REVISION 0

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TITLE

# NOVA ENERGY SOLAR FARM
# FLOODING HAZARD MAP
# 0.2% AEP (RCP 8.5)

| | | |
|---|---|---|
| DRAWN | D. MOULT | 21.04.26 |
| CHECKED | S. HUSBAND | 21.04.26 |
| PROJECT No | 210982 | |
| LOCATION | TWIZEL | |
| SCALE | 1:30,000 | |
| ORIGINAL SIZE | A3 | |

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ENVIRONMENT

| NO | DATE | BY | CHKD. |
|---|---|---|---|

REVISIONS

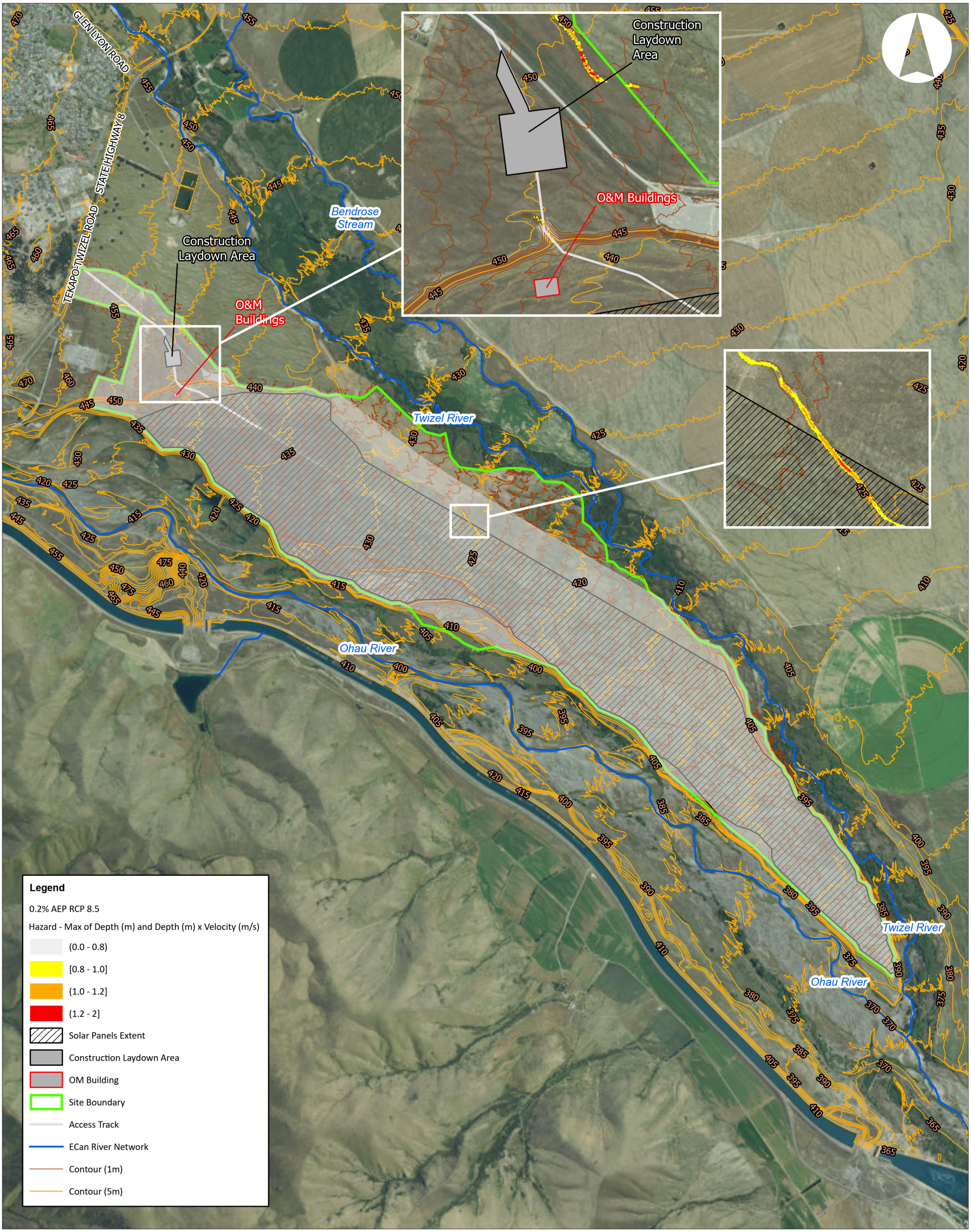
0 200 400 800 1,200 1,600 2,000 Meters

1:30,000

DRAWING No 210982-GI-3C

SHEET 1

REVISION 0

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TITLE

# NOVA ENERGY SOLAR FARM FLOODING HAZARD MAP 0.2% AEP (RCP 8.5)

| | | |
|---|---|---|
| DRAWN | D. MOULT | 21.04.26 |
| CHECKED | S. HUSBAND | 21.04.26 |
| PROJECT No | 210982 | |
| LOCATION | TWIZEL | |
| SCALE | 1:30,000 | |
| ORIGINAL SIZE | A3 | |

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| NO | DATE | BY | CHKD. |
|---|---|---|---|

REVISIONS

0 200 400 800 1,200 1,600 2,000 Meters

1:30,000

DRAWING No: 210982-GI-4A

SHEET: 1

REVISION: 0