

1 September 2025

Our Ref: 50197 - Rev.1

Todd Corporation
Level 4, 54 Gill Street
PO Box 8358
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New Zealand

Attn. [REDACTED]

**RE: 6591 STATE HIGHWAY 8, TWIZEL, MACKENZIE DISTRICT
DUE DILIGENCE GEOTECHNICAL REPORT**

1.0 INTRODUCTION

1.1 Terms of Reference

Engineering Design Consultants Ltd (EDC) was commissioned by Todd Corporation in August 2021 to provide a due diligence geotechnical assessment for a proposed Solar Farm at 6591 State Highway 8, Twizel, Mackenzie District (Lot 3 Deposited Plan 422901), henceforth referred to as 'the site'.

The client has indicated that the preferred method of founding the solar panels is a 2mm thick driven C-pile.

This revision is at the request of the client to confirm that the author of this report 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. No other significant updates have been applied to this report from the original issue in Sept 2021.

1.2 Objective/Scope

The objective of this report is to provide a pre-purchase geotechnical assessment of the site, highlighting potential geotechnical hazards. In order to achieve the outlined objectives this geotechnical investigation comprises the following scope:

- A geotechnical desktop study to review geological mapping and geotechnical information resources.
- A review of freely-available historical aerial photographs.
- Provision of an interpretive report summarising the above and providing recommendations for possible foundation solutions of the solar panels.

2.0 SITE DESCRIPTION

2.1 Site Location

The site is located approximately 2.0km southeast of Twizel township and approximately 950m east of Lake Ruataniwha. The site extends to the east of the Tekapo-Twizel Road, State Highway 8, covering a total area of approximately 868ha plus a 19ha lease lot.

The Google Earth coordinates of the approximate centre of the site are: 44°17'42.04"S, 170°8'33.98"E.

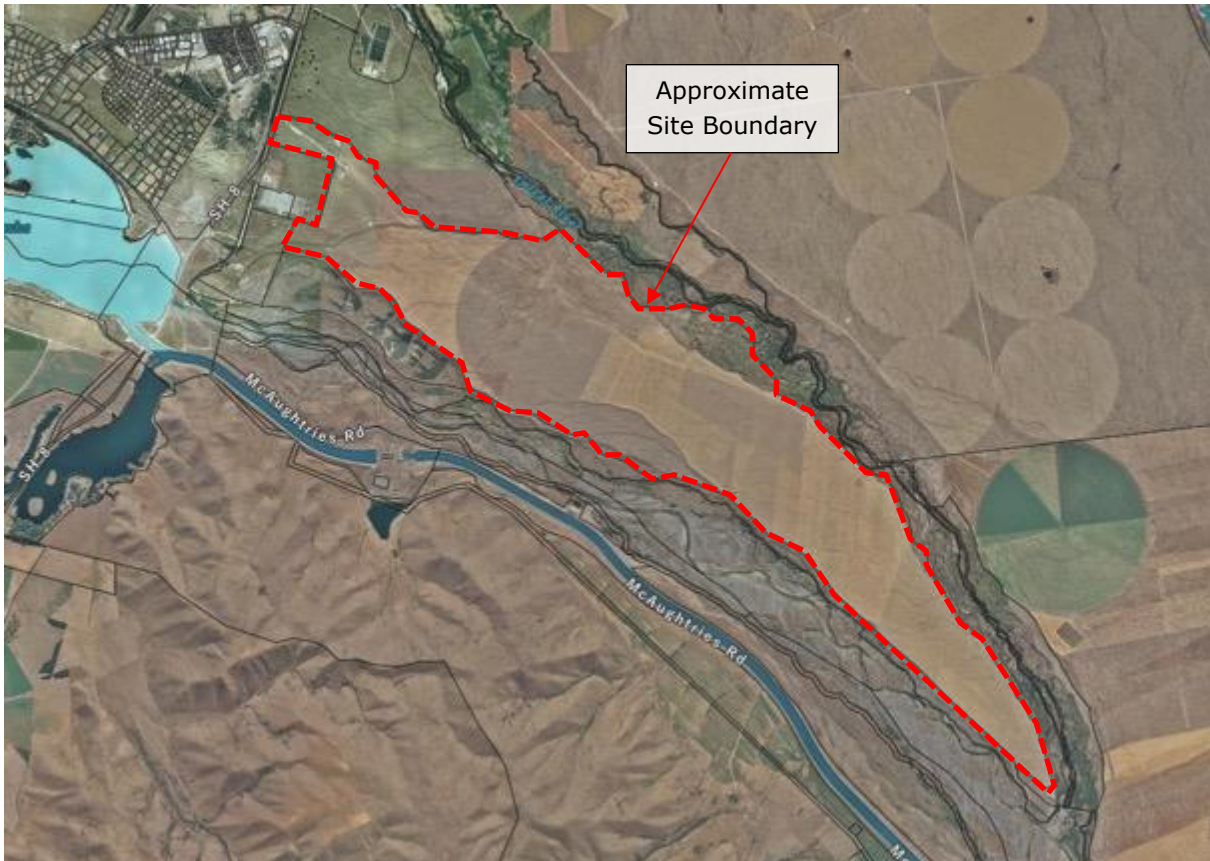


Figure 1: Site Location (Courtesy of Mackenzie Maps)

2.2 Site Features

The site is bound to the north by the Twizel River and to the south by the Ohau River and there are multiple paleochannels running through the site are visible on aerial images. The limited contour information available on indicates:

- The site generally slopes gently over several plateaux from the northwest boundary (c.460m) to southeast boundary (c.395m). The plateaux are marked by steep slopes with level changes typically between 2m and 10m and appear to correlate with inferred historic river terraces.
- Where abutting the rivers, the land beyond the northern and southern boundaries slopes steeply (approximately 1v:1.5h) to the river flood plains some 5m to 20m below the general site level.

The site is generally featureless agricultural land, except for the following:

- Two sets of high voltage electricity lines supported on pylons transect the northwest area of the site (Figure 2).
- Two quarries, understood to be operated by the SOL Group, are cut into the edge of one of the higher river terraces. It is understood that gravels are extracted and screened for the production of graded hardfill materials. The quarries are accessed via an unsealed track off State Highway 8 (Figure 2 and Figure 3).
- An approximately 36ha area on the northern side of the site appears to be at a lower level with increased vegetation than elsewhere, potentially within the flood plain to the Twizel River. This broadly coincides with an area designated on the Mackenzie District Council Map Viewer as Flood Protection Vegetation Boundary (a draft boundary line of areas of vegetation retained under the Soil Conservation and Rivers Control Act) (Figure 4).
- The NZ LINZ Topo map indicates a stream course crosses the site, which appears to be associated with Oxidation ponds to the north.

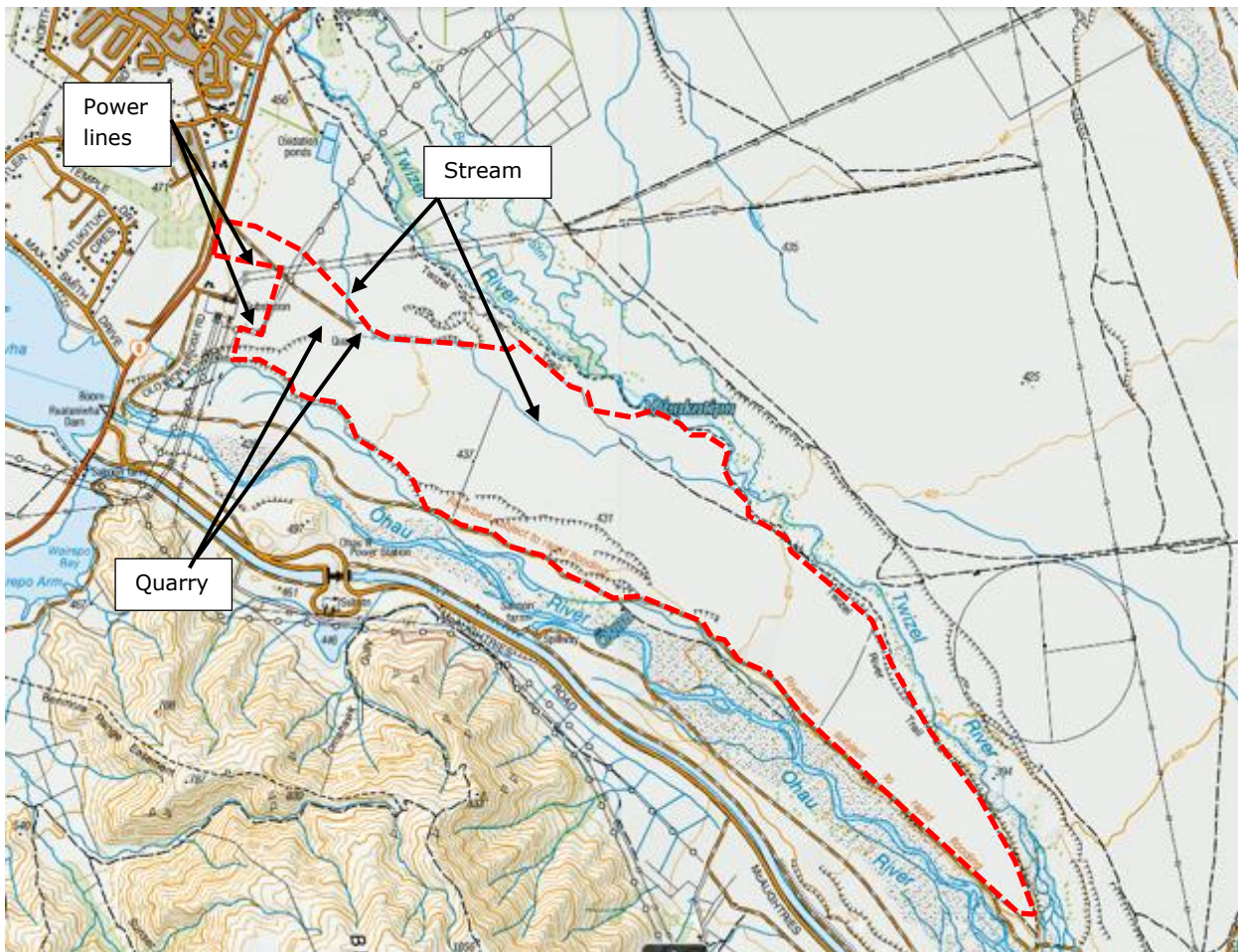


Figure 2: Excerpt from the NZ LINZ Topo Map



Figure 3: Aerial showing the Quarry Locations



Figure 4: Mackenzie District Council Map Viewer Flood Protection Vegetation Boundary

3.0 SITE HISTORY

3.1 Historical Aerial Mapping

Historical aerial photographs available on the New Zealand Historical Aerial Photo Database 'Retro Lens' and Google Earth have been reviewed by EDC for the years 1959 through to the present. Quarrying activities are not visible until 2016 and do not appear to include additional areas to the two identified on Figure 3.

In summary, the historical aerial photos do not indicate any historical (i.e. no longer present) geotechnical features that may pose an issue for the proposed development, with little change observable over the period of available aerial photos.

3.2 Historical Land Use

The Mackenzie District Council does not hold any information relating to any Hazardous Activities and Industries Lists (HAIL) activities having occurred on the site.

4.0 GEOLOGICAL DESK-BASED INFORMATION

4.1 Geological Mapping

According to the GNS Geological Unit QMap, the site is underlain by Late Pleistocene river deposits, comprising '*Generally unweathered; variable mixtures of gravel/sand/silt/clay forming extensive terraces or planes*' (Q2a). Parts of the site, toward the northern and southern rivers, may be underlain by Holocene river deposits, comprising '*Generally unweathered; variable loose gravel/sand/silt in active flood plains*' (Q1a). The aerials show numerous braided channels within the gravels, supporting this information.

The terrace edge in the area of the quarries is shown on the QMAP as the split between the Mt John Formation to the north and the Tekapo formation to the south. Both units are as described for Q2a above.

The client provided a copy of a New Zealand Geological Survey report titled 'Oahu B [0.8km south of the site] Power Project – Geological Factors Affecting Foundation Stability Along the Oahu B Canal line East of Canal Meterage 1800 (dated 1977). An excerpt of the description for the Q2a and Q1a deposits is shown below in Figure 5. This report suggests maximum safe bearing capacities of 400 – 600kPa for the Outwash gravel (Q2a) and 50 - 200kPa for the fan alluvium (Q1a). Assuming a Factor of Safety of 3 had been applied, this translates to ultimate bearing capacity of 1200kPa – 1800kPa and 150kPa – 600kPa respectively.

Q2a

2.4 Mount John Outwash Gravel: The only gravel unit identified with certainty during this investigation was Mount John Outwash Gravel - a fresh, grey, subhorizontally bedded, SANDY fine to coarse GRAVEL with rare cobbles and very rare to some silt/clay. Higher fines contents than regarded as 'typical' of Mount John Outwash Gravel were encountered in some shafts.

Q1a

2.5 Fan Alluvium: Brown or pale yellow-brown, weathered SANDY fine to coarse GRAVEL with some silt/clay and rare cobbles dominates the fan(s) investigated. The gravel is almost invariably angular to subangular. Beds of clayey SILT with rare to some angular, subangular or subrounded moderately weathered greywacke were found to be more common than anticipated from earlier work (Read, 1975, 1976) but can be readily explained as representing the outer zone (furthest from source) of the fan(s).

Figure 5: Excerpt of Description for Q2a and Q1a Deposits from a 1977 New Zealand Geological Survey report (referenced above)

Photos of the Q2a soils in the banks of the quarry were taken by the client during a visit to the site in September 2021 (Figure 6). These confirm the gravelly nature of the soils and of note indicate areas with frequent cobbles and boulders.



Figure 6: Client Photos from the Quarry Walls

An excerpt from the GNS 1:250,000 map is shown in Figure 7. The active Ostler Fault is shown approximately 4km west of the site.

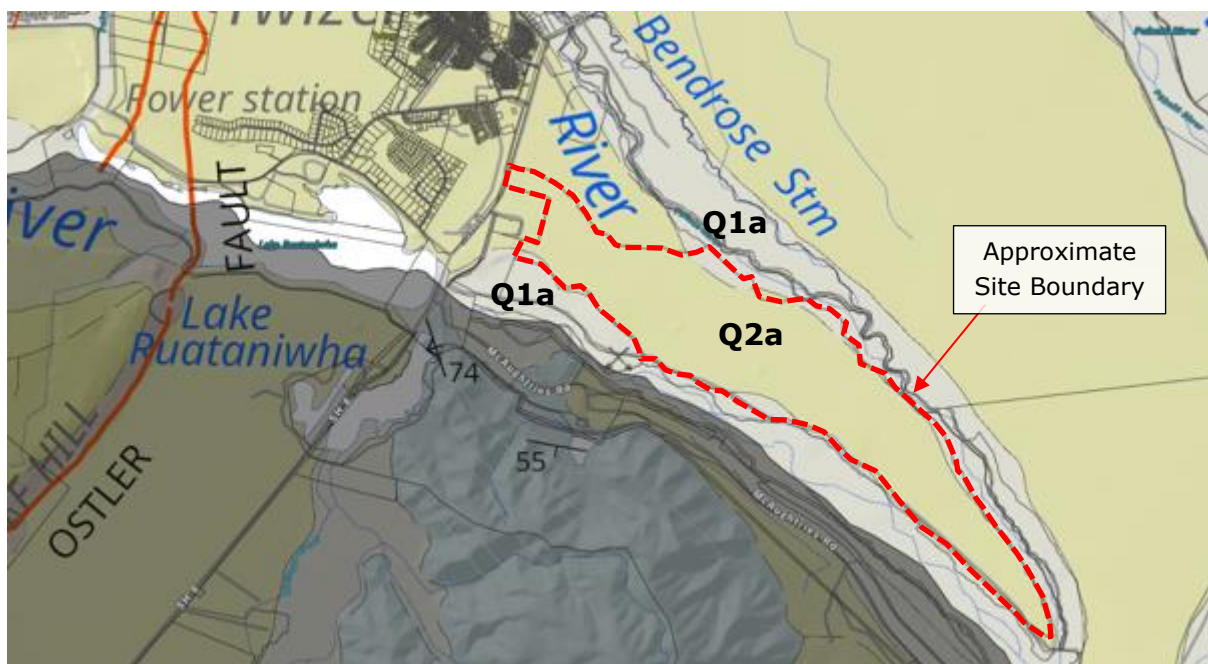


Figure 7: Excerpt from the GNS 1:250,000 Map

4.2 Geological Investigation Data

EDC is in receipt of two nearby deep investigations that were commissioned for the nearby Twizel substation. Locations for these boreholes are shown on Figure 8. The following table shows a summary of this data:

Hole Reference	Location	Depth (m)	Summary	Mapped Unit	Typical uncorrected SPT value
HD1 (MB01)	Twizel Substation	20.0	Silty /Sandy GRAVEL to 20.0m Groundwater identified at 13.7m	Q2a	
MBH101	Twizel Substation	15.0	Silty/Clayey/Sandy GRAVEL to 15.0m No Groundwater Encountered	Q2a	>50
H38/0035	1.1km northeast of site north of Twizel River	118	Sandy gravels (odd large one in upper 1.7m)	Q2a	No info
H39/0147	1.5km south (Ohau C)	27.0	Grey fresh sub-ang to sub rounded gravel (2mm to 2cm with odd up to 8cm)	Q1a	No info

Table 1: Nearby Geological Investigation Summary

4.3 Ground Water Data

The following nearby groundwater data has been sourced from the ECan GIS well records:

Bore Ref	Location	Approximate elevation of top of bore (m Lyttelton 1937)	Approx. Groundwater Depth (m)
BZ15/5014	On-site	c.442	5.7
H38/0023	700m west	465	20
H38/0024	275 west	463	19

Table 2: Ground water depth data



Figure 8: Groundwater Borehole Locations

5.0 GEOHAZARDS

5.1.1 Liquefaction Risk

The 'Waimata, Mackenzie and part Waitaki liquefaction susceptibility (2008)' map layer indicates that the site is located within an area as having 'very low' risk of liquefaction. The areas close to the Twizel River to the north, and the Ohau River, to the south, are shown to be at a 'low' risk of liquefaction (Figure 4). It is inferred that the Q2a deposits are those zoned 'very low potential' and the Q1a deposits 'low potential'.

5.1.2 Active Faults

The 'New Zealand Active Fault Database' (Institute of Geological and Nuclear Sciences Limited, 2004) indicates that the nearest active fault is the Ostler Fault, located approximately 4km west of the site (Figure 7). The fault is an oblique strike-slip, with a moderate slip rate and recurrence interval of 2000 to 3500 years.

Beyond the Ostler Fault Zone is the Alpine Fault, located approximately 88km west of the site. The Alpine Fault is capable of a magnitude 8.0 earthquake with a total displacement of over 100km over many events and a recurrence time of 191 ± 23 years. The most recent rupture occurred in 1717 and has a high probability (estimated at 30%) of rupturing in the next 50 years.

The Earthquake Hazard (Z) Factor Value for the Twizel Substation outlined in NZS 1170.5:2004, Table 3.4 is 0.27.

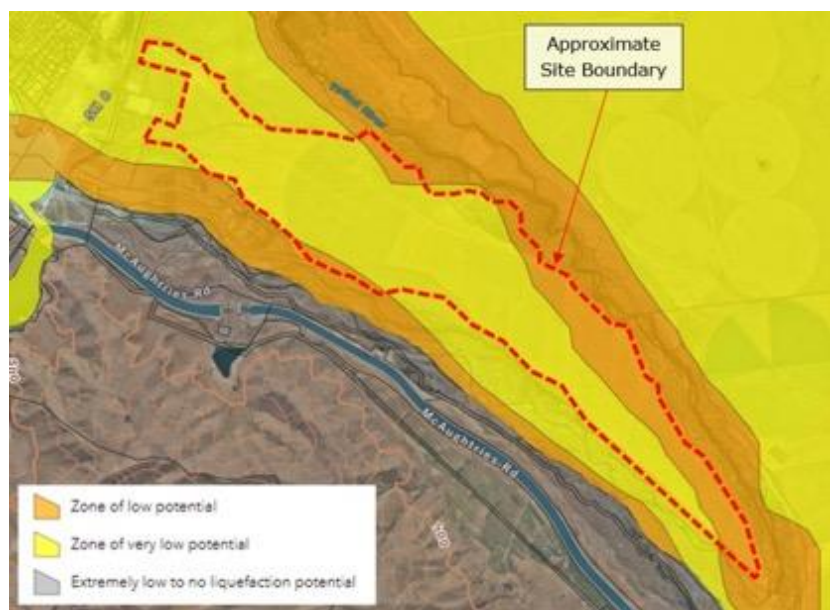


Figure 9: Map of liquefaction Susceptibility

5.1.3 Seismic Site Subsoil Classification

EDC infers the site to be 'Class D – Deep or soft soil sites' as defined by NZS 1170.

5.1.4 Erosion

Despite the site having rivers to the north and south significant erosion is not evident on the historical aerials. The risk of erosion however cannot be discounted during a flood event on these watercourses.

5.1.5 Flooding

The Mackenzie District Council Map Viewer Operative District Plan layer does not indicate a potential flooding area to be on the site, though it indicates an area of the site is within an area zoned 'Hydro Electricity Inundation Hazard Area' (Figure 10).

The District Plan indicates that 'The Hydro-electricity inundation hazard areas are for District Plan purposes only and do not identify, warrant, or guarantee the safety of any area in the unlikely event of a dam or canal breach. Best practice methods have been used to identify all potentially affected areas, however actual areas affected could differ, for example if flow paths change due to landform changes'.

In addition to the above, a stream is shown to transect the site on Figure 2. It is not known what feeds this stream (it appears to be the oxidation ponds to the north) and if it is prone to flooding or needs to be maintained post purchase of the site.

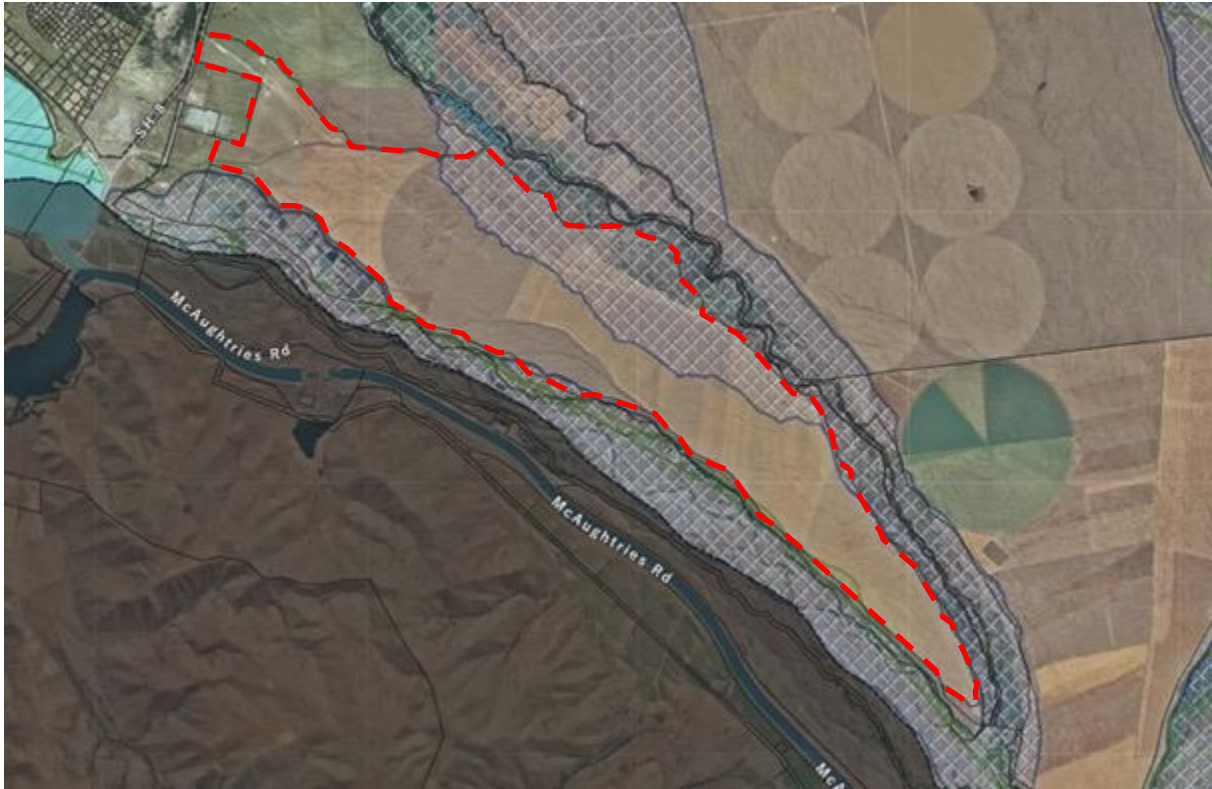


Figure 10: Excerpt from the Mackenzie District Council Map Viewer Operative District Plan Layer Showing the Hydro Electricity Inundation Hazard Areas

5.1.6 Slope instability

Despite steep slopes forming boundaries to much of the eastern two thirds of the site, the historical aerials do not indicate evidence of significant slope collapse on these slopes. This evident stability is likely due to the dense granular, and likely free draining, nature of the soils. The risk of slope instability however cannot be discounted.

6.0 CONCLUSIONS & RECOMMENDATIONS

6.1 Geotechnical Constraints

The main geotechnical constraints highlighted by EDC’s due diligence works are:

Constraint	Comment
High density ground with cobbles / boulders	<p>The limited available information suggests that the Q2a ground is likely to have high bearing capacity, which may present an abnormal constraint to the installation of driven C-piles to resist uplift on the solar panels due to the potential difficulty in driving the C-piles into a dense gravel and the probability of striking obstructions (cobbles or boulders). The Q1a material is likely to be less dense but may still contain cobbles and boulders.</p> <p>It is likely that there will be variability across the site rendering an assessment of cost risk difficult at this stage.</p>
Filled Ground	<p>No evidence of filled areas has been raised in this report. However, intrusive works have not been undertaken and it cannot however be discounted that localised unrecorded rubbish pits are possible. It is also</p>

Constraint	Comment
	noted that quarries are present on the site which, whilst not filled at this time, could potentially be filled with engineered site won material to create addition developable area.
Slopes and instability	There are a number of slopes forming the terraces across the site and there are steep high slopes at the site boundaries, to the river flood plains below. Aerial photography does not suggest these slopes are unstable though this should be more thoroughly assessed post due diligence to establish a suitable no development set back from the crest of the slopes. Remodelling of steep slopes within the site may be possible to increase developable area and mitigate any unacceptable slope risk.
Liquefaction	Based on the geological units present and information within section 5.1.1 the risk of liquefaction is considered low and site-specific analysis is not considered warranted unless intrusive test pits highlight possible issues.
Seismicity	<p>The site is in an area subject to seismic activity, though there are no active faults recorded on the site and therefore the risk of fault rupture on the site is very low.</p> <p>The nearest active fault is the Ostler Fault, located approximately 4km west of the site. Beyond this, the Alpine Fault is located approximately 88km west of the site. The Alpine Fault is capable of a magnitude 8.0 earthquake with a total displacement of over 100km over many events and a recurrence time of 191± 23 years. The most recent rupture occurred in 1717 and has a high probability (estimated at 30%) of rupturing in the next 50 years.</p> <p>The Earthquake Hazard (Z) Factor Value for the Twizel Substation outlined in NZS 1170.5:2004, Table 3.4 is 0.27.</p>
Erosion	Despite the site having rivers to the north and south, significant erosion is not evident on the historical aerials. The risk of erosion however cannot be discounted during a flood event on these watercourses
Flooding	<p>The Mackenzie District Council Map Viewer Operative District Plan layer does not indicate a potential flooding area to be on the site, though it indicates an area of the site is within an area zoned 'Hydro Electricity Inundation Hazard Area' and an area of the site is within a Flood Protection Vegetation Boundary (Figure 4). Should the hydroelectric dams fail this could present a significant risk of erosion/ground damage.</p> <p>Whilst the Flood Protection Vegetation Boundary may not present a geotechnical risk it potentially presents development constraint / risk.</p> <p>It is not known what feeds the stream mapped on-site (Figure 2) and if it is prone to flooding or needs to be maintained post purchase of the site.</p>
Groundwater	Groundwater is not generally expected to be within the upper 5.0m of ground, though it is possible in the lower lying area to the north (within the Flood Protection Vegetation Boundary).

Table 3: Geohazard Risk Summary

6.2 Development Suitability

It is considered that the site is suitable for development from a geotechnical perspective provided that the above geohazards are adequately controlled through further assessment and design.

It is not clear if the Flood Protection Vegetation Boundary presents a significant development constraint in that area (e.g. earthworks restrictions). It is also noted that this area and an additional area are within a Braided River Bird Habitat which may also restrict construction / earthworks activities.

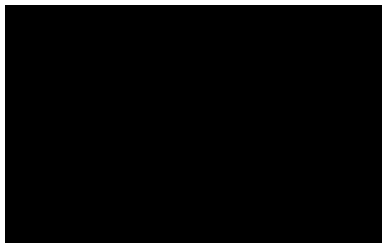
It is recommended that:

1. A series of test pits be undertaken across the site in order to assess the consistency, strength and description of the shallow soils, and if developing within the soils mapped as Q1a (Figure 7), to confirm the presence of shallow ground water.
2. Whilst bearing capacity is not anticipated to be an issue for the relatively light weight solar panels, it is considered that the preferred method of driving 2mm thick C-piles to achieve the required uplift capacity may be problematic due to the anticipated high density of the ground and presence of cobbles/boulders. Therefore, it is recommended that test piling be undertaken across areas of the site to be developed. The test piles will assess the suitability of C-piles, test the pull-out capacity per length of pile. If necessary, these investigation works can be used to confirm the suitability of an alternative foundation solution.

An appropriate alternative solution is likely to be a shallow concrete foundation solution could be adopted and no issue would be anticipated in terms of bearing capacity/ground settlement.

3. Boundary slopes should be assessed by a Geotechnical Engineer/Engineering Geologist to establish a suitable development set back from the crest of the slopes. An initial walkover assessment and test pits will determine whether boreholes and strength testing is required, should any areas of concern be identified. At this stage an allowance for a setback of 1.5 times the slope height from the slope crest is recommended.
4. Location specific geotechnical investigations will be required for any buildings to be located on the site to provide parameters for foundation design and documentation for Building Consent.

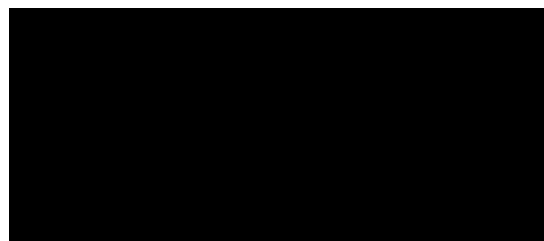
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7.0 LIMITATIONS

Except where required by law, the findings presented as part of this report are for the sole use of our client, as noted above. The findings are not intended for use by other parties, and may not contain sufficient information for the purposes of other parties or other uses. No third party (excluding the local authority) may use or rely upon this report unless authorised by EDC in writing.

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Our opinions and recommendations are based on our comprehension of the current regulatory standards and must not be considered legal opinions. For legal advice, please consult your solicitor. This opinion is not intended to be advice that is covered by the Financial Advisors Act 2010.

The recommendations and opinions contained in this report are based on our visual reconnaissance of the site, information from geological maps and upon data from the field investigation as well as the results of in situ testing of soil. Inferences are made about the nature and continuity of subsoils away from and beyond the exploratory holes which cannot be guaranteed. The descriptions detailed on the exploratory hole logs are based on the field descriptions of the soils encountered.