REPORT

Preliminary Site Investigation - Twizel Solar Project

for Nova Energy Ltd.

Rev B1 - 19/12/2025






BTW COMPANY

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Preliminary Site Investigation - Twizel Solar Project

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Reviewed

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	Dave Bolger, Environment Manager CEnvP	19/12/2025 Date

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SUITABLY QUALIFIED AND EXPERIENCED PERSON STATEMENT

Report Author Statement

Seethal Sivarajan holds a PhD in Environmental Science (2022) from University of Auckland, with a focus on soil science, volcanology and agriculture. Seethal has two years of academic experience of teaching Environmental Management at the graduation level. Seethal now works at BTW as an Environmental Scientist with a primary focus on contaminated land.

Report Reviewer Statement

Dave Bolger holds a Bachelor of Science (Physical Geography and Environmental Science) from Massey University (1996). Dave is a Certified Environmental Practitioner (CEnvP) EIANZ Certification No.870. Dave has also completed the BOHS IP404 Air Monitoring, Clearance and Reoccupation following the Removal of Asbestos. Dave has over 20 years of environmental experience throughout New Zealand and manages the Environment Team for BTW Company. Dave's area of expertise is in contaminated land investigations and site remediation. Dave has presented evidence in the Environment Court for disposal and remediation of hydrocarbon waste. Dave has been involved with over 100 contaminated land projects throughout New Zealand and has an extensive knowledge of the regulatory framework.

Basis of the report and Environment Court Code of Conduct

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.

SUMMARY

The main findings of this Preliminary Site Investigation (PSI) include the following:

- The PSI was completed on the 10th of October 2024.
- The following Hazardous Activities and Industries List HAIL were assessed during this investigation and were concluded to not being applied for this site for the following reasons:
  - HAIL B4 – Power stations, substations or switchyards: The power sub-station area located adjacent to the site is listed on the ECAN's landuse registers. The activity conducted in the power sub-station is categorised under HAIL B4. It was concluded highly unlikely the power sub-station adjacent to the site would have impacted the site from soil contamination.
  - Potential HAIL I – Superphosphate application to land: There were no intensive agricultural activities identified on the site prior to 2015. Some areas of the site were used for dairy farming from 2016, which is after the limit on the use of cadmium was applied by the fertilizer association indicating that any presence of cadmium in the site soils is highly unlikely, and even more unlikely to be a risk considering the possible change of the site to a less sensitive landuse.
- This investigation concluded there are **No** HAIL activities being undertaken, have been undertaken or more likely than not been undertaken on the site therefore a resource consent under the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NESCS) is not required for the proposed development of a solar farm.

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TABLES

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1 INTRODUCTION

BTW Company Ltd (BTW) has been commissioned by Nova Energy Ltd (Nova) to undertake a Preliminary Site Investigation (PSI) for a site located between the Twizel and Ōhau Rivers, on the eastern side of State Highway 8 (SH8) and Twizel township (Figure 1.1). Nova has requested this PSI to assess the potential human health risk from soil contamination of the land for the proposed Twizel Solar Power Plant development and associated soil disturbance.

This PSI has been undertaken in accordance with the requirements of the National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health (NESCS)[1] and Ministry for the Environment (MfE) Contaminated Land Management Guidelines No. 1 – Reporting on Contaminated Sites in New Zealand (CLMG No. 1)[2].

Figure 1.1: Aerial image of the site boundary and the location. Sourced from: Nova Energy Limited.

1.1 Purpose, Objectives and Scope

This PSI aims to identify if any activities on the MfE Hazardous Activities and Industries List (HAIL) is being, or has been, or is more likely than not been, undertaken on the site. The PSI is a desktop assessment that identifies the location and significance of potential HAIL (and other potential

[1] Resource Management (National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health) Regulation 2011.

[2] Ministry for the Environment. 2021. Contaminated land management guidelines No 1: Reporting on contaminated sites in New Zealand (Revised 2021). Wellington: Ministry for the Environment.

contaminant sources) activities and assesses the likelihood of contaminant pathways presenting a risk to human health based on the proposed change of land-use.

This PSI was undertaken in general accordance with the requirements of the current edition of MfE CLMG No. 5 – Site Investigation and Analysis of Soils (CLMG No. 5)[3], and is reported in accordance with the current edition of MfE CLMG No. 1.

1.1.1 Objectives

- Establish whether it is more likely than not that an activity or industry described in the HAIL is being or has been undertaken on the site (i.e. piece of land, hereafter referred to as POL).
- Assess the likelihood of any identified HAIL sites (i.e. POL) to present a risk to human health based on the proposed development.
- Assess the activity status under the NESCS (also referred to as NES Soil)[4].

1.1.2 Scope of Work

The scope of work undertaken by this PSI included the following:

- Review of Mackenzie District Council (MDC) records.
- Review of Environment Canterbury (ECAN) records.
- Review of aerial imagery from Retrolens (1959 – 1980, 1985), Canterbury Historical Images (1984, 1989 – 2010, 2015) and Google Earth Pro (2011, 2016 – 2023).
- Review of Engineering Design Consultants, Geotechnical Due Diligence Report, September 2021.
- A site visit[5].
- A conceptual site model (CSM) as part of a risk assessment.
- A PSI report as per the MfE CLMG No. 1.
- Provide recommendations, including soil testing and or management of soil if required.

1.1.3 Proposed Activities

The proposal is to develop a renewable solar generation plant on the site, that is expected to generate approximately 300 megawatts (MW) of renewable electricity generation. This development is expected to be completed in one stage however the construction can be completed in multiple stages following site establishment and grid connections.

[3] Ministry for the Environment. 2021. Contaminated land management guidelines No 5: Site investigation and analysis of soils (Revised 2021). Wellington: Ministry for the Environment.

[4] 8 Permitted activities:
Subdividing or change of use:
(4) Subdividing land or changing the use of the piece of land is a permitted activity while the following requirements are met:
(a) a preliminary site investigation of the land or piece of land must exist:
(b) the report on the preliminary site investigation must state that it is highly unlikely that there will be a risk to human health if the activity is done to the piece of land:
(c) the report must be accompanied by a relevant site plan to which the report is referenced:
(d) the consent authority must have the report and the plan.

[5] Information was relied upon others during the site visit, was not a part of our scope.

2 SITE IDENTIFICATION AND CLASSIFICATION

The site is a large area bound between the Twizel and Ōhau Rivers, on the eastern side of the SH8 and the Twizel township. The entire site is contained within one land parcel of Lot 3 DP 422901. The site is approximately 868 Ha. The site is located under General Rural Zone[6] according to the MDC plan. See Table 2.1 for further details and Figure 1.1 for an aerial imagery of the site.

Table 2.1: Site Identification

Item	Site-Description
Location	Tekapo–Twizel Road, SH8
Legal Description	Lot 3 DP 422901
Titles	489342
Site Area	~868 Ha
IWI	Ngai Tahu
District Plan Zone	Rural Zone
Territorial Authority	Mackenzie District Council
Regional Authority	Environment Canterbury (Canterbury Regional Council)

2.1 Site Geology and Soils

Published geological information as shown on GNS Geology Maps shows that the site in underlain by two geological units throughout:

- 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.
- Holocene riverbed deposits (stratigraphic age Q1) comprising of generally unweathered; variable loose gravel/sand/silt in active flood plains.

The geotechnical due diligence report[7] provided by the client described the soils on the site (1.1 km northeast of site north of Twizel River) at a depth of 1.8 m as generally consisting of sandy gravels.

2.2 Site Topography and Hydrology

The site is relatively flat, with an elevation of 400 – 440 m above the sea level (asl) (Figure 2.1). It gently slopes towards the southeast direction. Lake Ruataniwha is located close to the western end of the site across the SH8. The site is bound between the Twizel River located in the north side of the site and the Ōhau River located in the south side of the site, both rivers run in the southeast direction of the site. These rivers join ~500 m away from the southeast tail end of the site to further fall into the Lake Benmore. An oxidation pond is located on the Mackenzie District Council Land, outside the top northwest corner of the site boundary, situated ~750 m from the nearest boundary of the site. Based on the LINZ Topo[8] online maps a stream originating from the oxidation ponds runs through the northern top part of the site to merge into the Twizel River near the mid-northern boundary of the site Figure 2.2.

[6] Renamed as 'General Rural Zone' in Mackenzie District Council Plan Chane 23, notified 04th November 2023.
[7] Engineering Design Consultants, Geotechnical Due Diligence Report, September 2021.
[8] https://data.linz.govt.nz/data/

Figure 2.1: Topographic image of the elevation contours. Sourced from ECAN.

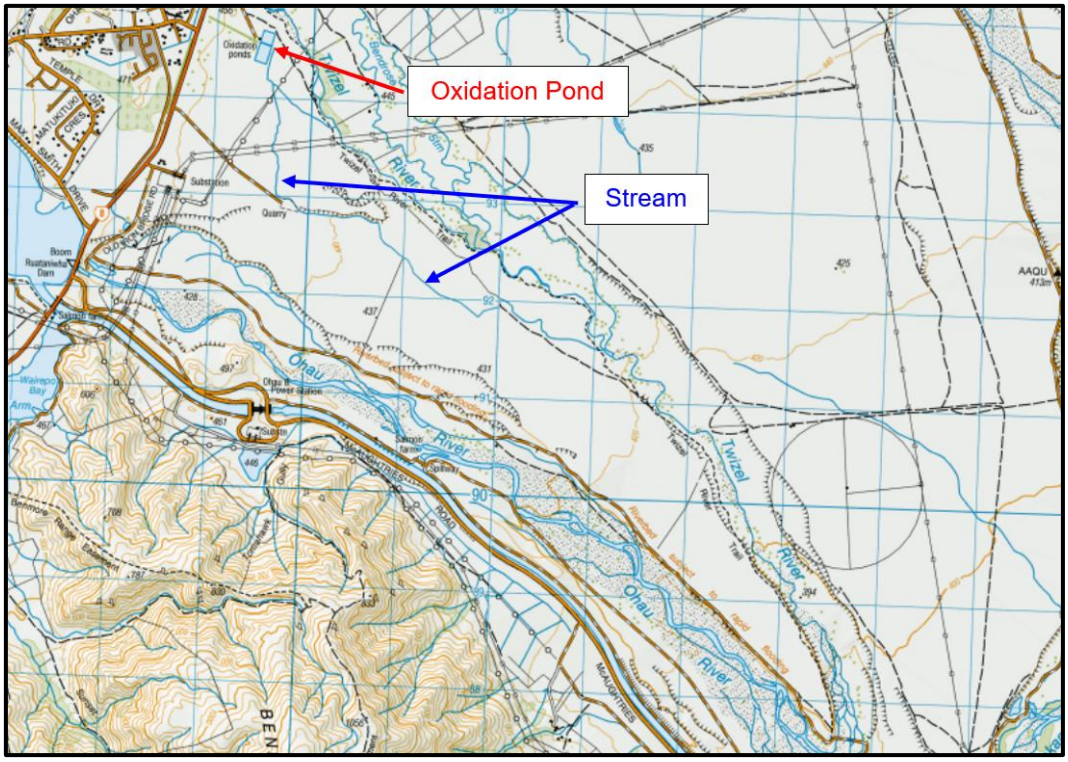


Figure 2.2: LINZ topographic image showing the stream running through the site, originating from the oxidation pond.

2.3 Groundwater

According to the ECAN's groundwater map layers, there are three groundwater bores on the site ranging from the depth on 17 to 20 m. Two bores are located within ~250 m from the site boundary with the depth of 5 m and 30.5 m. All the groundwater bores are shown in Figure 2.3. Information on the groundwater quality is given in Table 2.2.

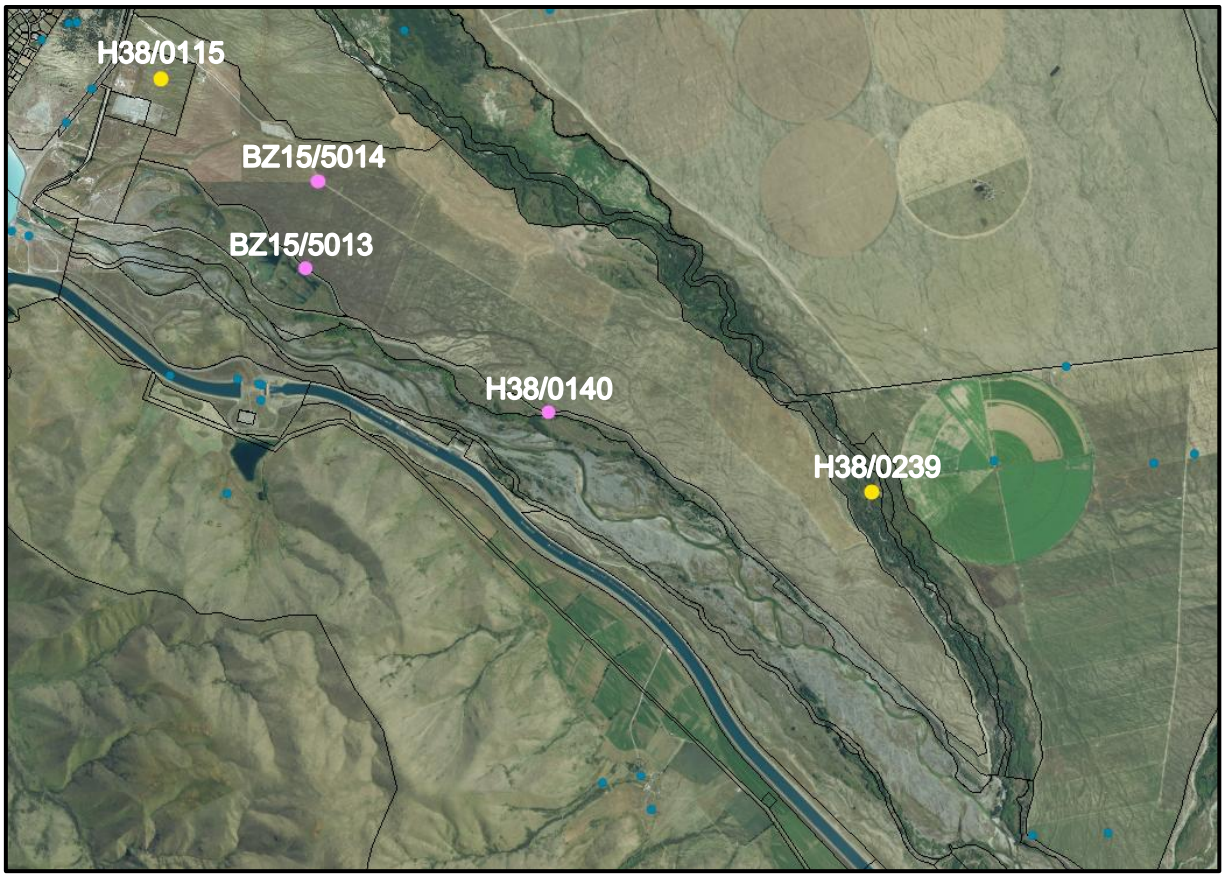


Figure 2.3: Groundwater bores sourced on the site. Bores shown in pink are located inside the site and the bores in yellow are located within ~250 m from the site boundary. Sourced from ECAN online website.

Table 2.2: Groundwater quality data for the bores present on the site[9].

Parameters	H38/0140	BZ15/5013 (Reported 23rd May 2014)	BZ15/5014 (Reported 23rd May 2014)
Groundwater Depth (m)	No Data	20	17.5
pH (field)		6.76	6.80
Temperature (°C)		11.4	12.2
Conductivity (field) (mS/m)		7.17	6.43
Dissolved Oxygen (mg/L)		7.83	7.15
Total Dissolved Nitrogen (mg/L)		0.36	0.39
Total Dissolved Phosphorus (mg/L)		<0.004	0.007
Dissolved Reactive Phosphorus (mg/L)		0.0033	0.0076

[9] https://mapviewer.canterburymaps.govt.nz/?webmap=0c3ca2ccfe1145c5849dc39864590d0b

3 HISTORICAL SITE INFORMATION

3.1 Aerial Imagery Analysis

Historical aerial imagery sourced from Retrolens (1978 – 1985) and Google Earth Pro (2011 - 2023) was reviewed (Appendix A). The description of the notable changes is provided in Table 3.1.

Notable changes from reviewing historical aerial imagery are as follows:

Table 3.1: Historical aerial imagery timeline.

Year	Source	Description
1959	Retrolens	The site looks barren with few ephemeral tributaries running from the top end of the site towards the tail end in the southeast direction.
1978		The power sub-station and the oxidation pools observed outside the site boundary. The transmission lines from the power sub-station are passing through the top northwest corner of the site. An ephemeral runoff stream from the oxidation pool flowing over the northwest corner of the site.
1979		
1980		The stream originating from the oxidation pool is observed on the site.
1984	Canterbury Historical Images	No key discernible changes. The stream originating from the oxidation pool is observed on the site.
1985	Retrolens	No key discernible changes. The stream originating from the oxidation pool is observed on the site.
1989	Canterbury Historical Images	No key discernible changes. The stream originating from the oxidation pool is observed on the site.
2004 to 2010		No key discernible changes. The stream originating from the oxidation pool is observed on the site.
2011	Google Earth Pro	No key discernible changes. The stream originating from the oxidation pool is observed on the site.
2015	Canterbury Historical Images	No key discernible changes. The stream originating from the oxidation pool is observed on the site.
2016	Google Earth Pro	A quarry is observed within the top end of the site. Some silage bales are also observed to be stored on the site making it appear like a farmland.
2018		A smaller area close to the power sub-station and near the mid-north boundary of the site observed to be a farmland. Silage bales observed to be stored on the site.
2019		Larger farmland area with livestock and silage bales observed in the centre of the site. Quary appears to be fully functioning.
2021		No farmland area or livestock observed on the site.
2023		No key discernible changes observed on the site.

3.2 Environment Canterbury Records

The ECAN Listed Land Use Register (LLUR) online map[10] was accessed on 2nd October 2024. The site was not registered in the ECAN LLUR therefore there is no ECAN record of HAIL activity associated on the site.

3.3 Mackenzie District Council Records

In the Geotechnical Due Diligence report provided by the client, it was identified that MDC does not hold any record of HAIL activity associated on the site. The complete report is provided in Appendix B.

[10] https://llur.ecan.govt.nz/home

3.4 Current Site Conditions/Operations

The observations and findings from the desktop review conducted for this PSI are summarised in the following points and the site photos are given in Appendix C.

- The site is operating as farmland. The current surface cover is approximately 85% grasslands, red clover and ryecorn.
- There is a functioning quarry located within the site, close to the northwest boundary of the site. However, the quarry is operated by a lease and does not form a part of the site for the solar farm project.
- The Twizel Power sub-station is located ~250 m outside the western boundary of the site and any proposed project work within the Twizel power sub-station is outside BTW's scope. Therefore, these works have been excluded from consideration in this PSI
- The transmission lines from the Twizel power sub-station passes through the top northwest corner of the site.
- There is a gravel road running through the centre of the entire site to the tail end of the site, giving access to vehicles on the site.
- No fill areas have been observed from the desktop review, however it cannot be discounted that localised unrecorded rubbish pits are possible.

4 HAIL ACTIVITY JUSTIFICATION AND PIECE OF LAND SUMMARY

The HAIL is referenced in the NESCS and therefore has regulatory significance. Fundamentally, it is a compilation of activities and industries that are considered more likely to cause soil contamination resulting from hazardous substance use, storage or disposal based on empirical evidence. The HAIL has been utilised during this investigation to identify any "Pieces of Land" within the investigation area that have the potential for soil contamination to be present.

Presented below is a breakdown of the HAIL activities identified by this investigation to have been undertaken within the proposed development area of the site or in the area adjacent to the site (either currently or historically) or are more likely than not' to have been undertaken.

4.1 HAIL B 4: Power stations, substations or switchyards

The site is located adjacent to a power sub-station and the activities conducted in that sub-station is listed as HAIL B 4: Power stations, substations or switchyards described as: *"Power stations transform primary energy (such as sunlight, wind, water and geothermal heat) or chemical energy (such as fossil fuels, wood or waste) into electricity for distribution to consumers. Mechanisms used to convert energy to electricity include steam turbines, gas turbines, water turbines, internal combustion engines and wind turbines. The electricity generated cannot immediately be used by consumers, because the characteristics of the electrical current must be modified to transmit it over long distances (by increasing the voltage) and distribute it to consumers at the point of use (by decreasing the voltage). Substations convert electrical current in various ways, mostly by means of electrical transformers. Transformers are used to increase or decrease voltage levels in alternating current electrical circuits. Switchyards or switching stations are a type of substation without transformers that operate at a single voltage level".*

The power sub-station is noted as HAIL on the adjoining site and is outside the investigation area. However, it is highly unlikely for this HAIL activity to have impacted the soils on the subject site.

4.2 Potential HAIL I: Any other land that has been subject to the intentional or accidental release of a hazardous substance in sufficient quantity that it could be a risk to human health or the environment

Some areas on the site were used as part of a dairy farm and use of cadmium derived fertilizers is possible to have occurred on the site. The accumulation of cadmium is listed as HAIL I: Superphosphate application to land and is described as: *"Land that is not a HAIL site but where the release of contamination could pose a risk to human health or the environment. The intentional or accidental release of a hazardous substance does not necessarily refer only to consented discharges. It can cover many types of situations, including accidental discharges of fuel or chemicals from mobile operations".*

Application of superphosphate[11] fertilizer is possible to have occurred at the site. However, based on the historical image review, it can be confirmed that some areas of the site were used for farming only after 2015 and there is a voluntary limit established by Fertilizer Association on the use of

[11] Cadmium is contained in most rock phosphates used to produce superphosphate. Cadmium is known to be toxic to humans and is a priority contaminant under the NESCS.

cadmium in farming since early 1995[12]. The cadmium report generated by the Ministry of Primary Industries[13] (2008) present a national map of New Zealand showing the topsoil cadmium levels; and soils in Twizel region is shown to be between 0 – 0.25 mg/kg (Figure 4.1) making it highly unlikely for the soils at the site to exceed the cadmium levels of NESCS commercial/industrial standards. Therefore, this activity will not be considered as HAIL in this report.

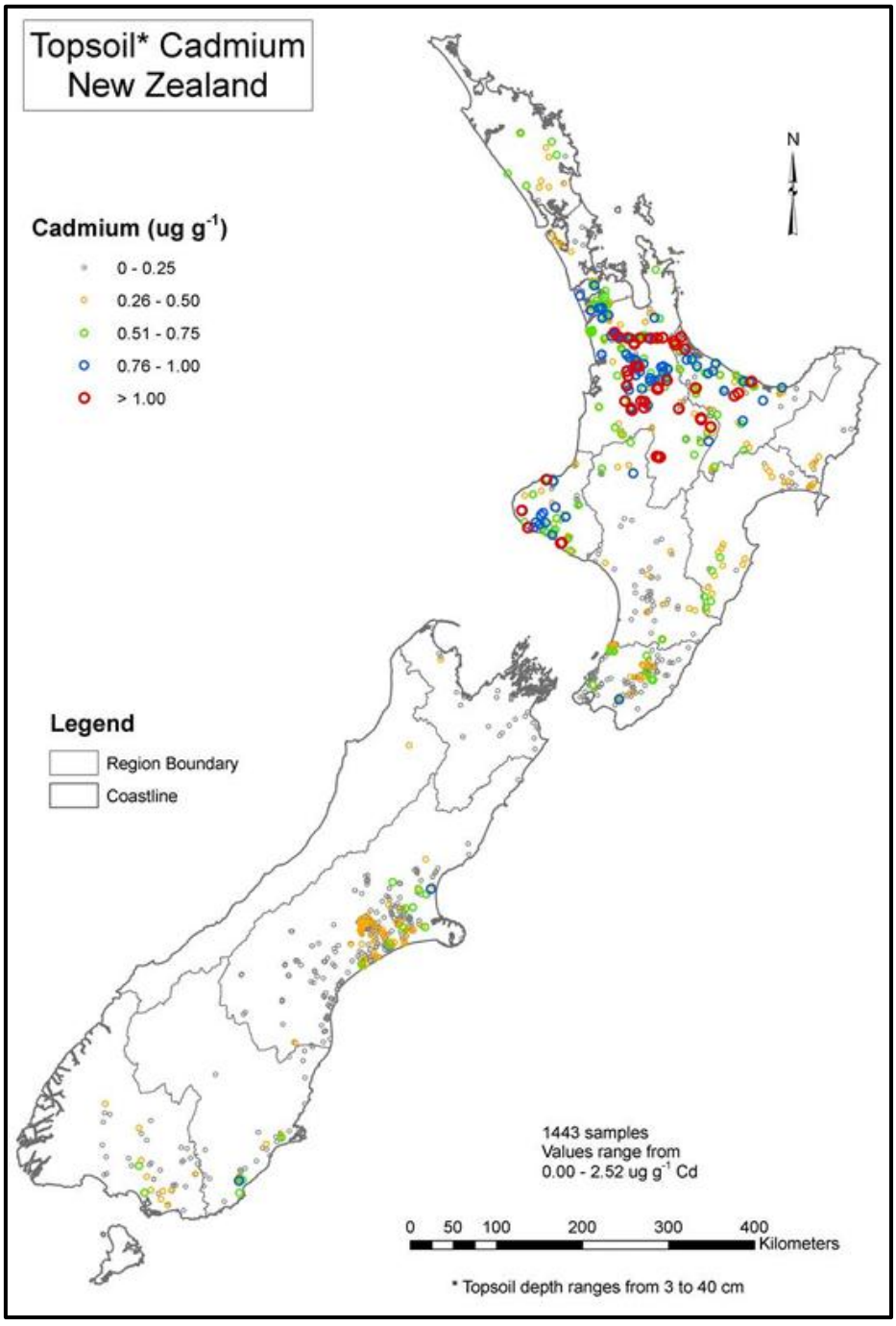


Figure 4.1: Topsoil cadmium levels in New Zealand (the unit µg g^{-1} is equivalent to mg/kg).

[12] chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.mpi.govt.nz/dmsdocument/41244-Guide-Managing-cadmium-in-food-crops-in-New-Zealand

[13] Ministry of Primary Industry, Report One: Cadmium in New Zealand Agriculture, August 2008.

5 SITE CHARACTERISATION AND EVALUATION

To evaluate the magnitude of the risk pursuant to the NESCS (i.e., determine that it is highly unlikely that there will be a risk to human health if the activity is done to the POL) the contaminated land investigation must complete a site risk assessment. Central to the requirements of the risk assessment is the development of a conceptual site model (CSM). A CSM is an evaluation of the probability of contaminant sources in an environmental system and identification and characterisation of the pathways (e.g., biological, physical, chemical vectors) to human health and environmental receptors (see Figure 5.1: and MfE CLMG No. 5 for further details). Ultimately the goal is to evaluate the source-pathway-receptor linkage. Instances where the linkage is complete presents a risk to human health that requires further assessment.

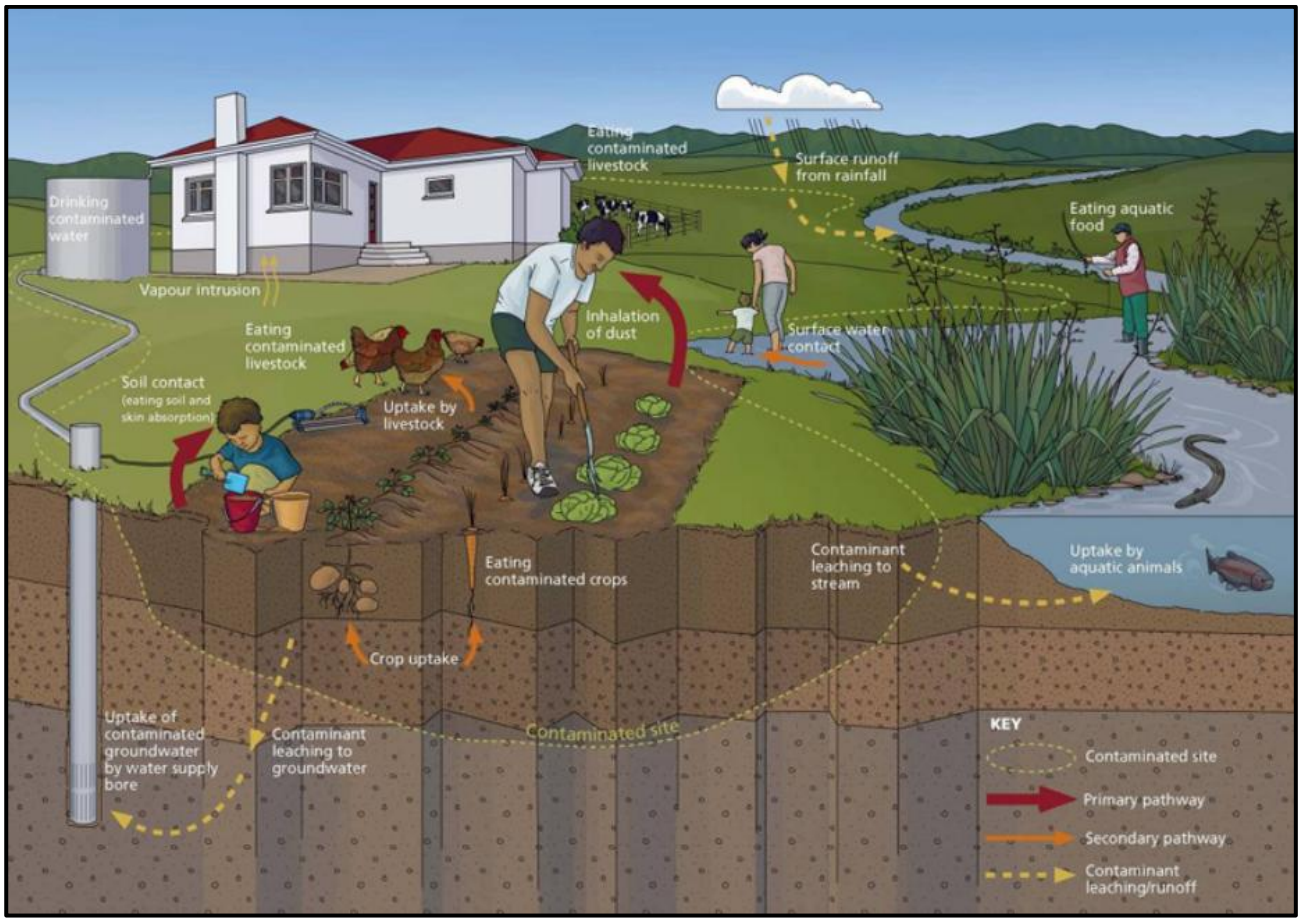


Figure 5.1: Conceptual model of contaminate sources and pathway vectors for human health risk. Source: MfE CLMG No. 5 (2021)

5.1 Land-use and Exposure Scenarios for Proposed Development

To evaluate the risk of soil contaminants to human health the MfE has developed soil contamination standards (SCSs) for a number of exposure scenarios for land-use ranging from rural residential to commercial worker[14]. The SCSs and soil guideline values (SGVs) provide guidance around the concentration of a contaminant above which further health investigation and evaluation will be required. The applicable exposure scenario for the proposed solar project is a commercial/industrial land use scenario.

[14] Ministry for the Environment. 2011. Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health. Wellington: Ministry for the Environment.

5.2 Conceptual Site Model (CSM)

MfE CLMG No.5 states that a CSM can be presented in written, pictorial or graphical format, or as a table or flow diagram, or a combination of these. This investigation presents a simplified flow diagram (Figure 5.1) and a written evaluation of potential source-pathway-linkage likelihood (Table 5.1).

Table 5.1: Conceptual Site Model (CSM) for the site.

Activity/ies	Contaminant/s	Source Risk	Pathway Likelihood	Receptors	Linkage
Superphosphate fertiliser application to land.	Cadmium	Agricultural activity occurring on the site, being a former agriculture land.	Inhalation, dermal, ingestion, particulate runoff.	Site workers and future site users.	**Incomplete**
Power sub-station	Mercury, coal ash, polychlorinated biphenyls (PCBs), fuel oil, diesel, steam or heat coming out of the transformers etc.	Converting the electrical currents using the transformers.	Inhalation, dermal, particulate runoff, skin burns etc.	Site workers and future site users.	**Incomplete**

6 CONCLUSIONS

- The site is not listed on the Environment Canterbury's (ECAN) and Mackenzie District Council's (MDC) landuse registers.
- The following HAIL were assessed during this investigation and were concluded to not being applied for this site for the following reasons:
  - HAIL B4 – Power stations, substations or switchyards: The power sub-station area located adjacent to the site is listed on the ECAN's landuse registers. The activity conducted in the power sub-station is categorised under HAIL B4. It was concluded highly unlikely the power sub-station adjacent to the site would have impacted the site from soil contamination.
  - Potential HAIL I – Superphosphate application to land: There were no intensive agricultural activities identified on the site prior to 2015. Some areas of the site were used for dairy farming from 2016, which is after the limit on the use of cadmium was applied by the fertilizer association indicating that any presence of cadmium in the site soils is highly unlikely, and even more unlikely to be a risk considering the possible change of the site to a less sensitive landuse.
- This investigation concluded there are No Hail activities being undertaken, have been undertaken or more likely than not been undertaken on the site, therefore a resource consent under the NESCS is not required for the proposed development of a solar farm.

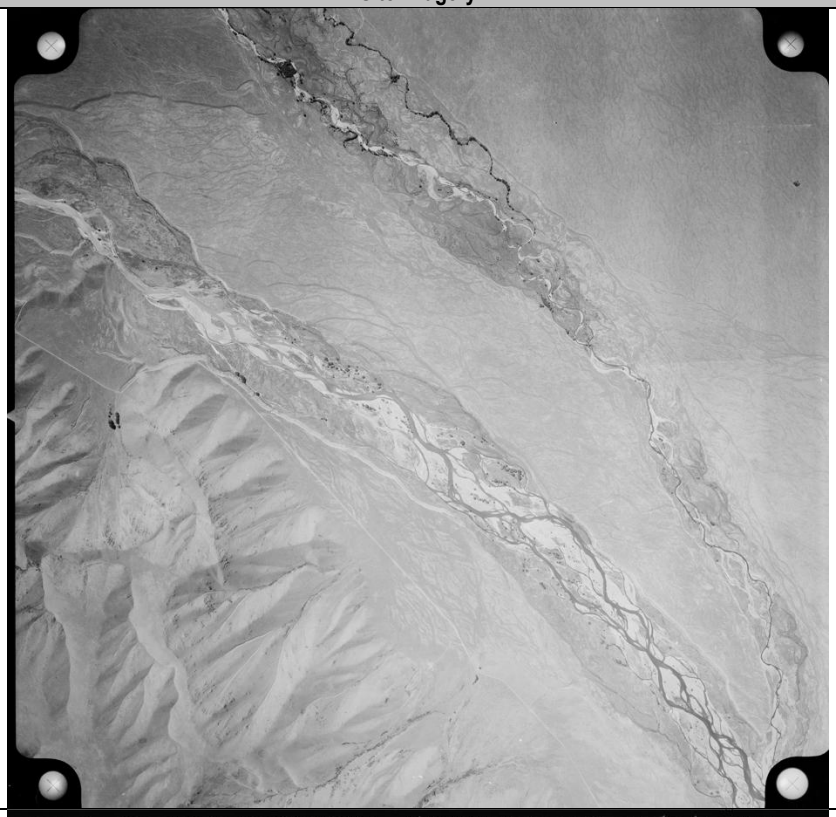
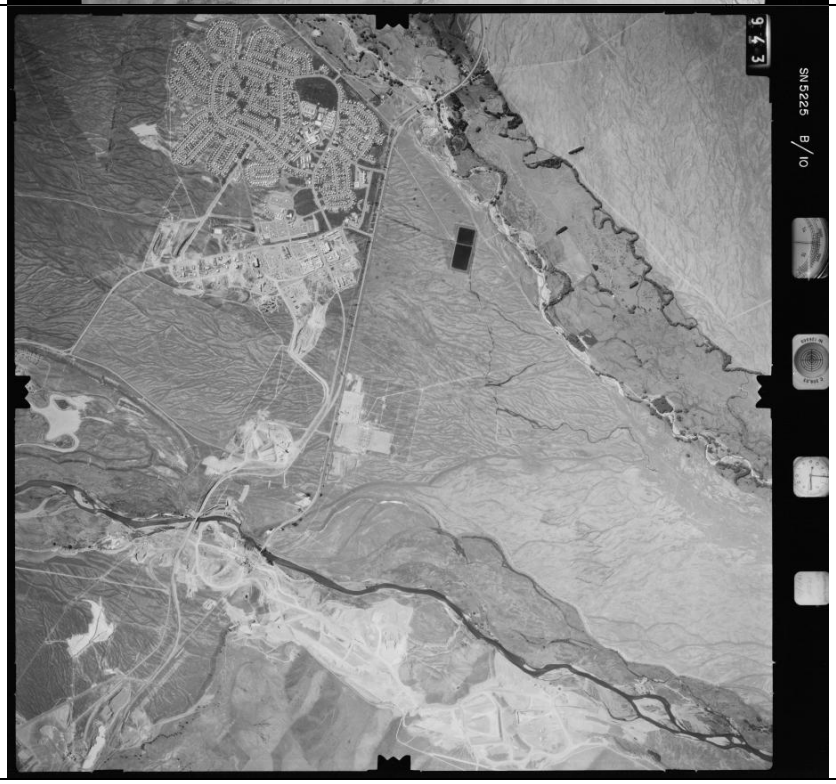
7 RECOMMENDATIONS

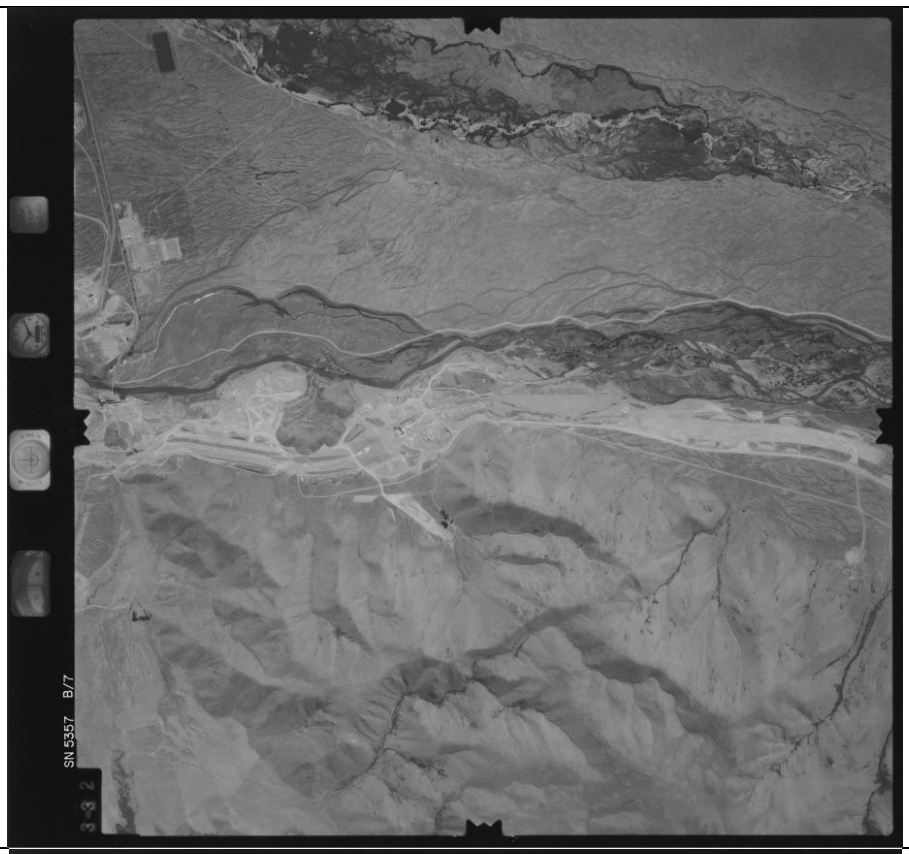
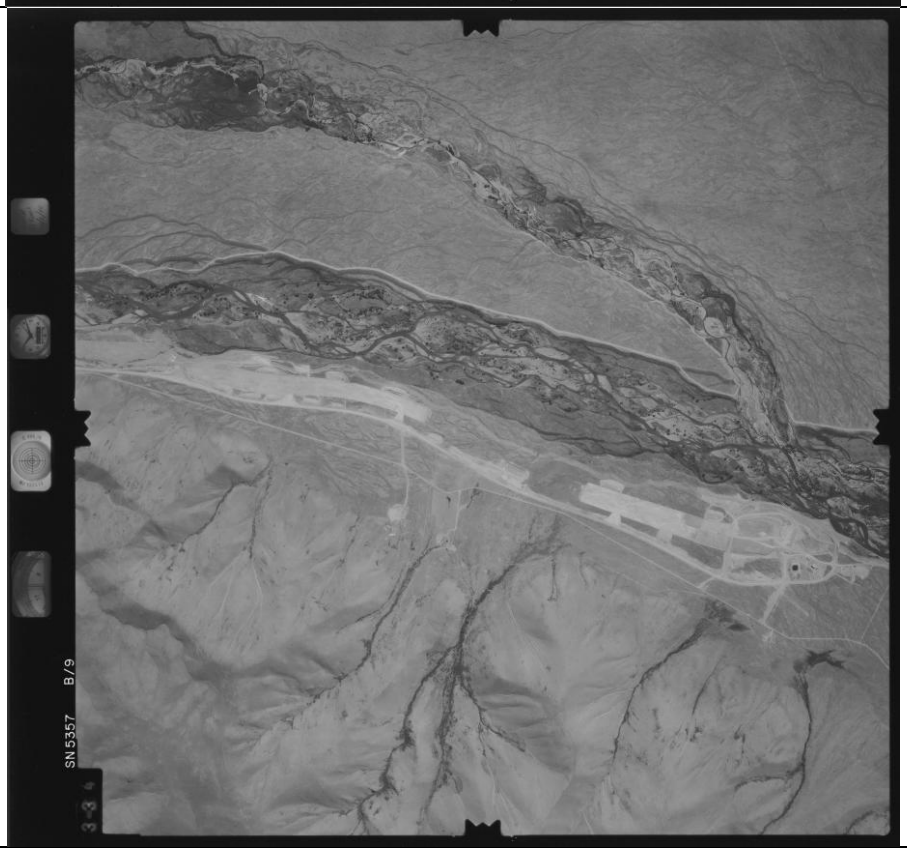
- The findings of this PSI should be submitted as a supporting document as part of the resource consent application for the proposed Twizel Solar Project development.
- As the soil is unlikely to pose a risk to human health for the proposed development, soil can be reused on the site during site works. We suggest as good practice any soil to be disposed of offsite should be tested and disposed of at a facility or site that could accept this type of soil.

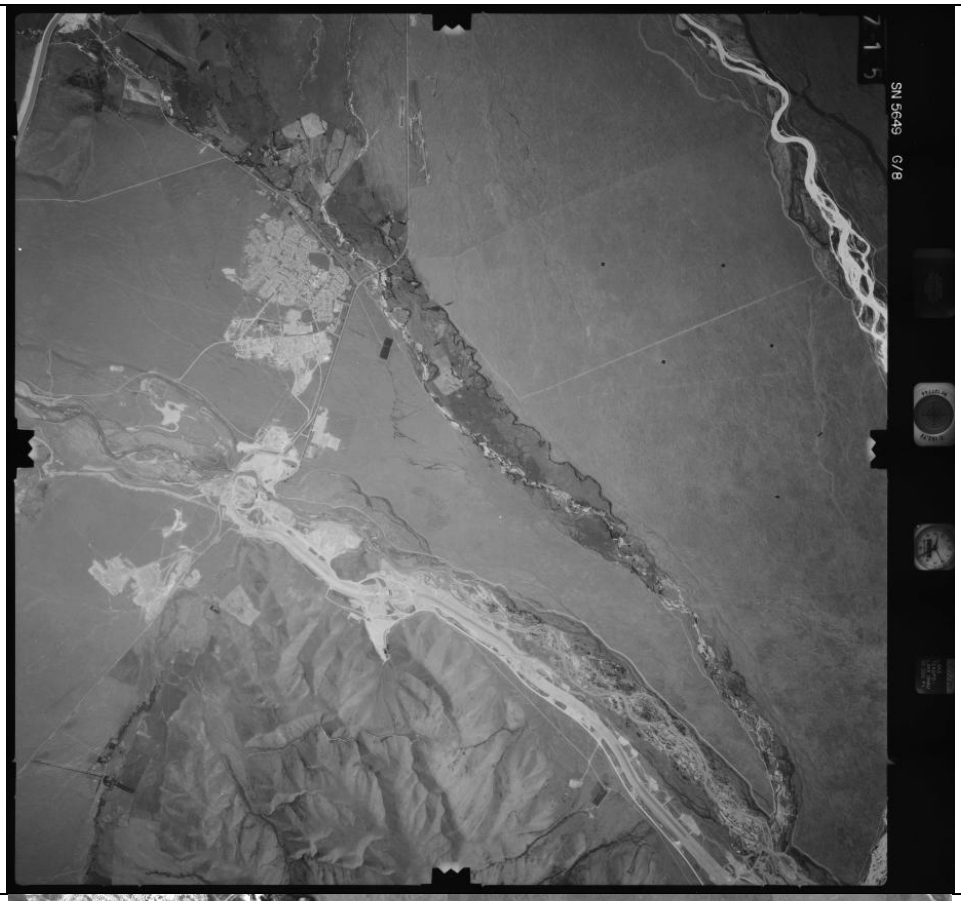
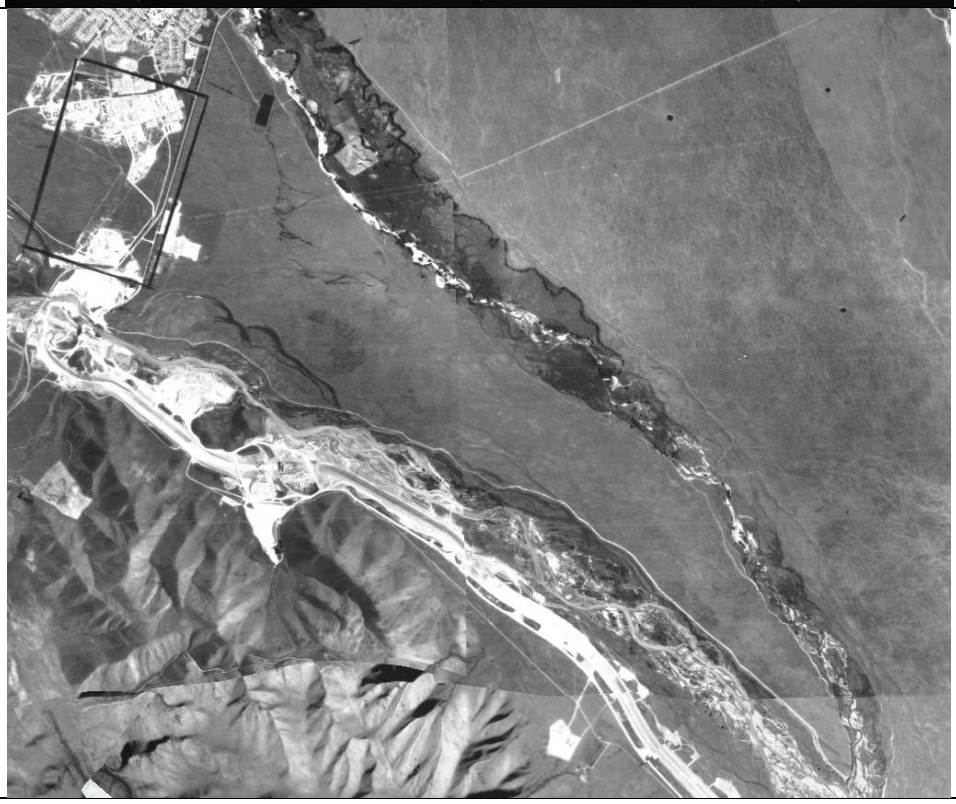
8 LIMITATIONS

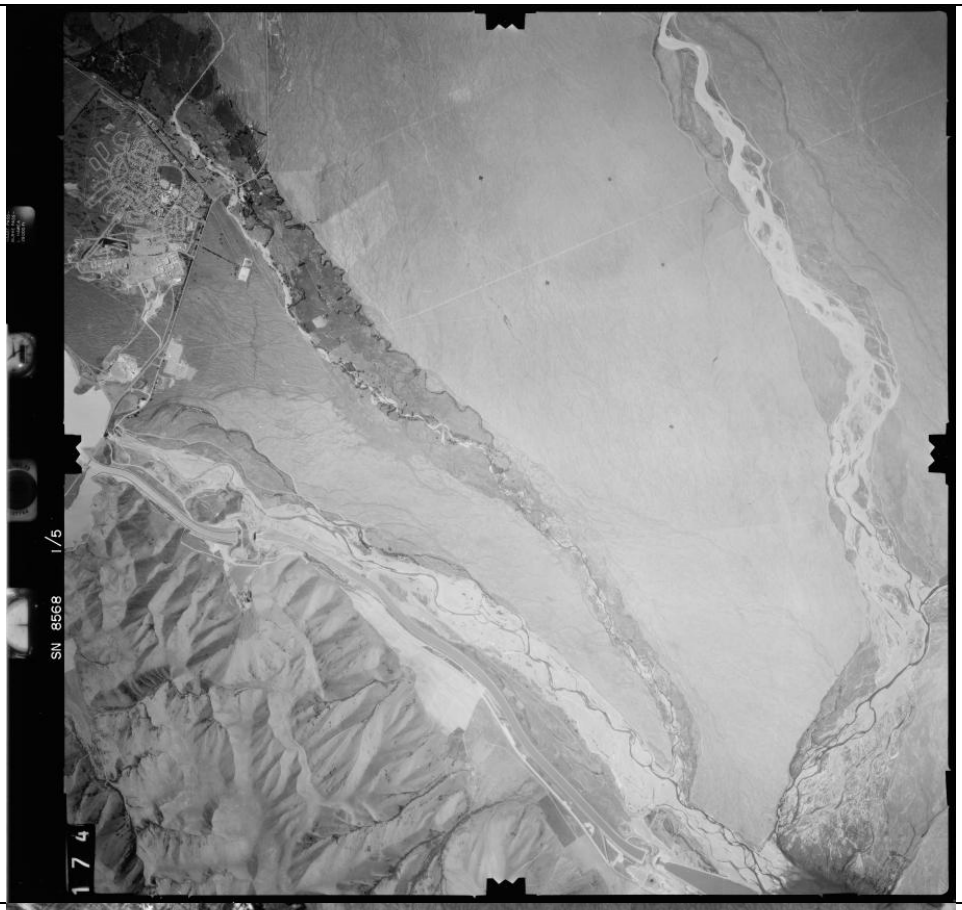
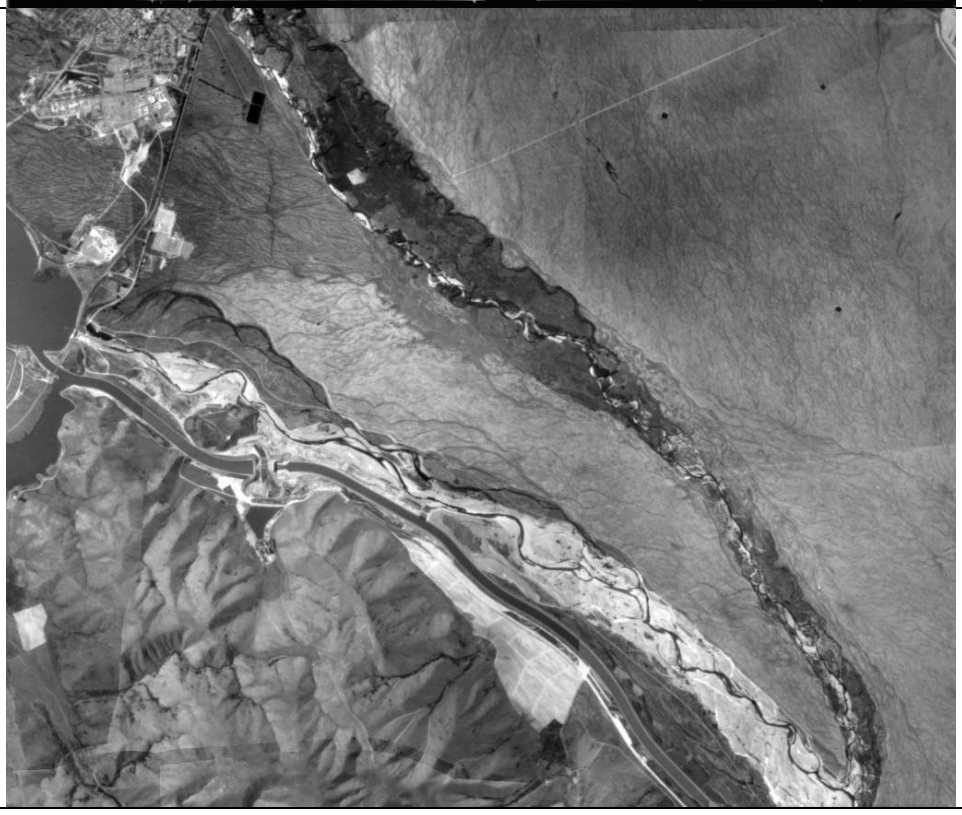
- This report has used information provided by third parties which has been taken to be accurate and correct. BTW Company is not responsible for any inaccuracies in this information.
- This report has been prepared by BTW Company to satisfy the requirements of the NESCS regulations and to deliver the objectives outlined within the report. BTW Company accepts no liability if the report is used for any other purpose or is relied on by any person(s) other than the client. Any such use or reliance will be solely at their own risk.
- No soil investigation or desktop investigation can guarantee the absence of contaminated soil as soil conditions by nature are not uniform. This report is representative of all the information available to the author, and the conclusions and recommendations made in this report are derived from that information which was available at the time the report was written.
- The services of this project are in accordance with current best practise and known professional standards for environmental site assessments at the time of investigation. Should additional information become available at a later date, BTW Company reserves the right to update this report.
- No soil sampling was carried out for this investigation.

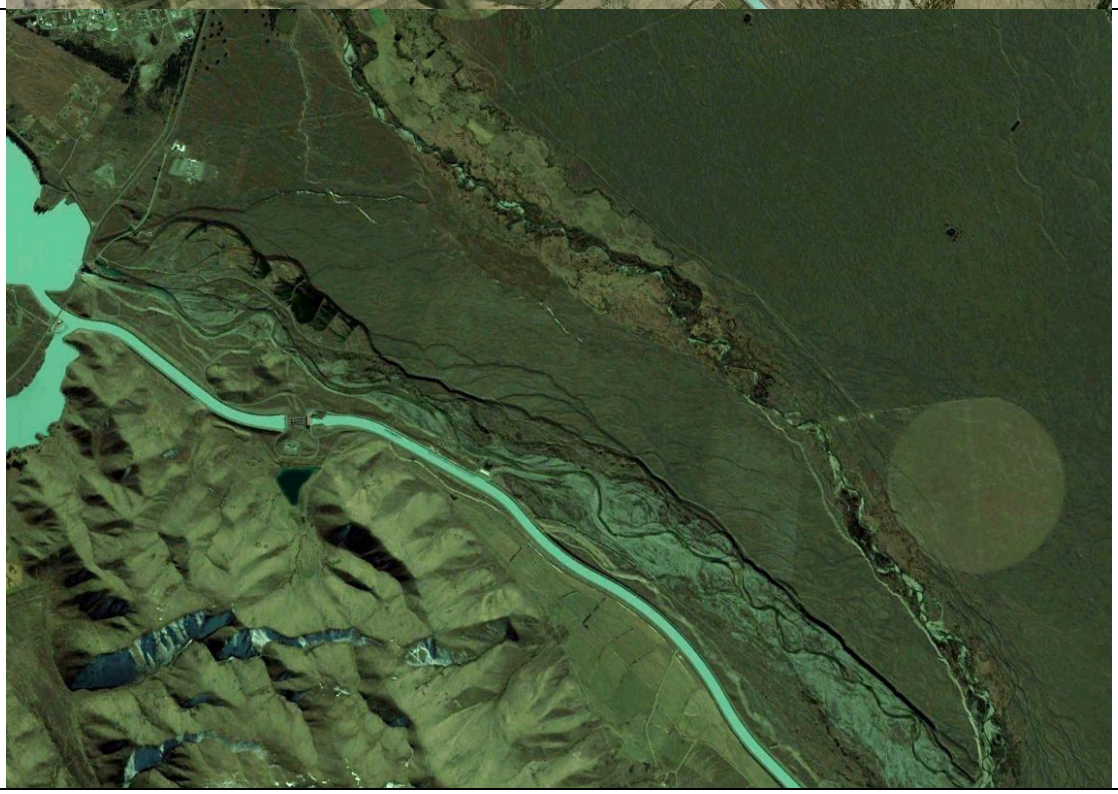
APPENDIX A HISTORICAL IMAGES

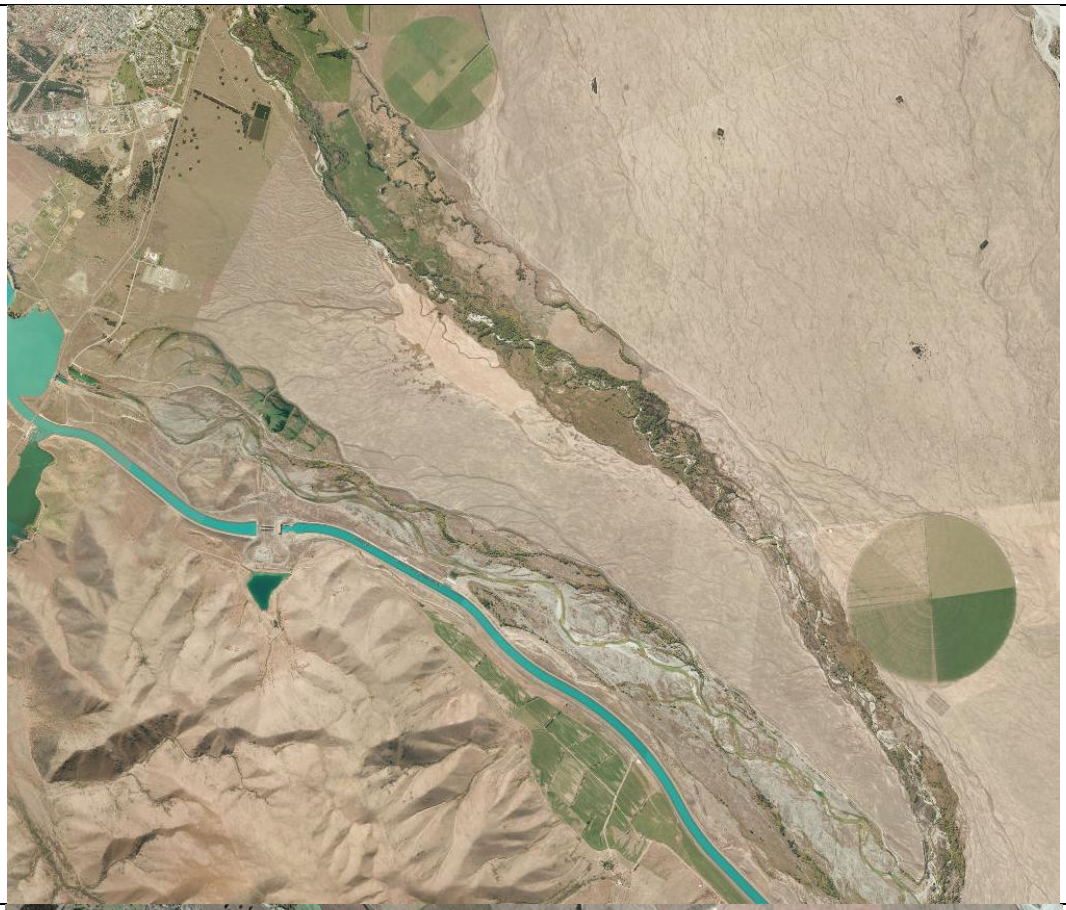
Year	Site Imagery
1959 (Retrolens)	
1978 – Site Top End (Retrolens)	

1979 – Site Top End (Retrolens)			
1979 – Site Tail End (Retrolens)			

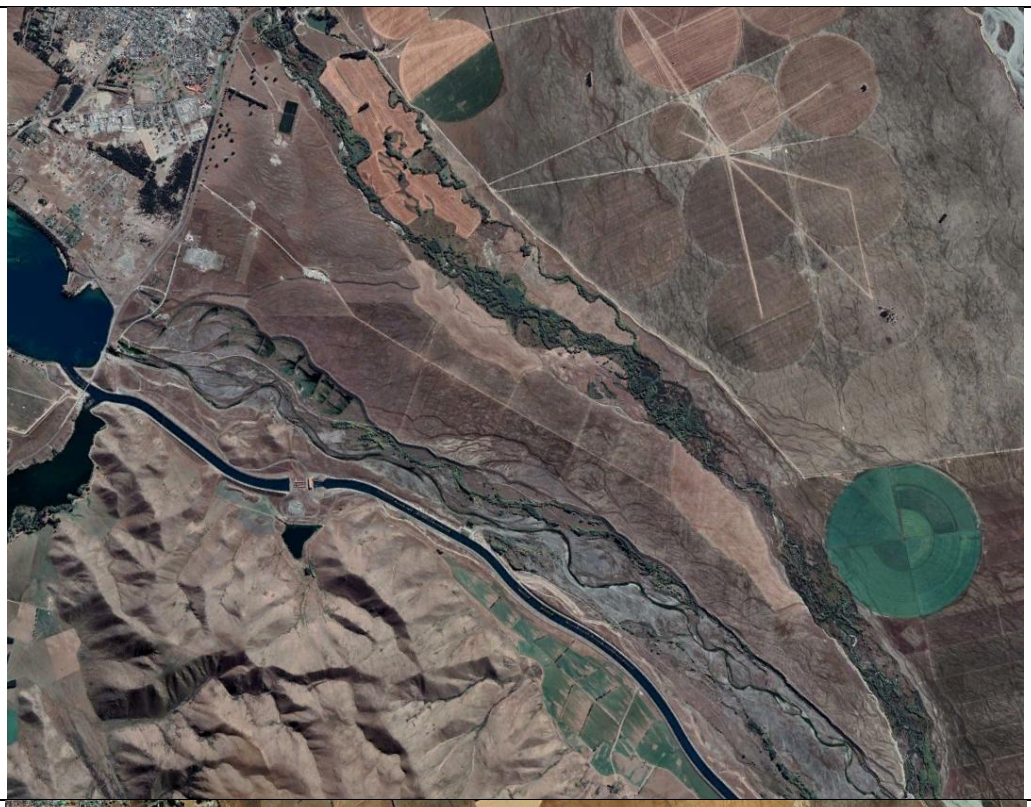
1980 (Retrolens)		
1984 (Canterbury Historical Images)		

1985 (Retrolens)			
1989 (Canterbury Historical Images)			

2004 to 2010 (Canterbury Historical Images)	
2011 (Google Earth Pro)	

2015 (Canterbury Historical Images)		
2016 (Google Earth Pro)		

2018 (Google Earth Pro)		
2019 (Google Earth Pro)		

2021 (Google Earth Pro)		
2023 (Google Earth Pro)		

APPENDIX B GEOTECH DUE DILIGENCE REPORT

APPENDIX C SITE PHOTOS

Year	Site Imagery
The tail end of the site with Twizel River on the right and Ōhau River on the left.	
Mid-section of the site.	

The tail end of the site with Lake Benmore in the background.	
Top northwest corner of the site, showing the transmission lines running in the background.	

The quarry located close to the top end of the site.	
An aerial view of the mid-section of the site.