Haldon Solar Farm – Planning Memorandum

To:	Brad Henderson	**Date:**	23 December 2024
From:	Tim Hopkins	**Our Ref:**	2867737-539056762-9730
Copy:	Daniel Cunningham		Revision 3
Subject:	Haldon Solar Farm - Substation and Lines Overview		

1 Introduction

Lodestone Energy Limited (Lodestone) is considering the development of a solar farm, of up to 200 MVA, at a new Grid Injection Point (GIP) on the Benmore - Islington (BEN-ISL-A) line in the Mackenzie District. It is proposed that a single circuit 220 kV line is used to transmit generation from the solar farm towards Twizel and Islington.

The solar arrays would be in positions around the proposed 220 kV GIP substation. The substation would be located between tower 72 and 71, on the south-west side of the BEN-ISL-A transmission line.

This document provides a high-level description of the proposed electrical infrastructure, including the Solar Farm Substation and 220 kV switchyard and transmission line connection.

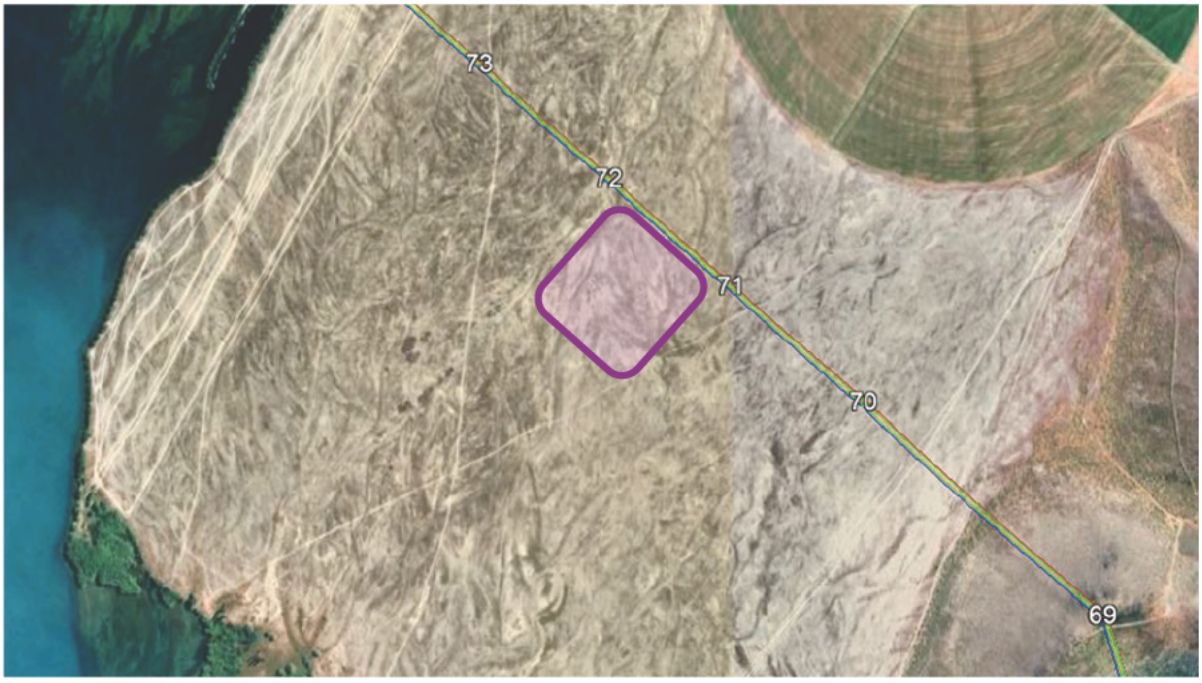


Figure 1 - Aerial image showing proposed substation location

2 Civils

2.1 Site Access

The indicative site access layout proposes a 4-meter wide, 1.5-kilometre long accessway between Haldon Arm Road and the new GIP. The track will be unsealed but designed to provide all-weather access to the site. Minimal topsoil removal will occur, with crushed aggregate surface construction to provide durability to the access road. The access road will have a minimum of 4% cross-fall and will generally follow the existing ground profile, with some grade adjustments made where necessary. Stormwater culverts or traversable fords may be required where the access road intersects the overland flow path to manage drainage effectively.

2.2 Earthwork Volumes

The elevation of the substation platform has been determined considering a 450-year Flood Return Period (FRA), with an additional 300 mm of freeboard for flood protection, in line with Transpower's design standards. Based on the findings of the assessment, the proposed substation platform is to be designed at an elevation of 371.760 meters.

At this stage of the design, no geotechnical ground investigation has been conducted. The assumption of 300 mm topsoil removal is based on a desktop study carried out by Beca (Rev 1 16/10/2024), which suggested that the existing surface primarily consists of gravel with minimal topsoil cover.

The table 1 shows the indicative cut-fill estimated between the existing ground, with an assumed 300mm topsoil strip, and the proposed finish surface of the substation. At this stage predominately fill is proposed to achieve the estimated platform levels. No allowances have been made for unsuitable material removal and backfilling, structural components (eg foundations), excavation and backfill for any tanks, pipes and manhole installations and topsoil replacement.

The access road cut and fill volumes are determined under the assumption that the topsoil is removed to a depth of 300mm with a percentage allowance for cut of unsuitable materials. An allowance has been made for a conceptual road build-up of 300mm with an additional fill to form a dual 4% road cross-fall formation and to maintain the standard longitudinal grade along the access road. The access road will be constructed with crushed aggregate.

The earthwork volumes presented in Table 1 are indicative only and do not include allowances as noted above, nor do they account for material compaction factors. Based on this we have assumed scaling factors to the earthwork volumes for resource consent. A 10% scaling factor has been applied to the access road volumes, and a 30% scaling factor applied to the substation volumes.

Table 1 - Cut and Fill Volumes

Item	Area (m²)	Bulk Cut Volume (m³)	Bulk Fill Volume (m³)
Topsoil-300mm- Substation	20,000	6,000	0
Topsoil-300mm- Access Road	8,000	2,500	0
Cut fill- substation	20,000	0	26,000
Cut fill – Access Road (including % of cut unsuitables)	8,000	1,000	5,500
Total		9,500	31,500

3 Stations

A 200 MVA connection at 220 kV is proposed for a single circuit connection into the BEN-ISL-A line. This Haldon Solar Farm Substation would serve as a new 220 kV Grid Injection Point (GIP), with the existing 220 kV BEN-TWZ circuit to be deviated into the Haldon switchyard to create new BEN-Haldon and Haldon-TWZ circuits in a Loop In - Loop Out configuration.

3.1 Solar Farm Substation

The purpose of the solar farm substation is to take power from the solar medium voltage power stations via 33 kV cables and transform this to 220 kV, suitable for Transpower's transmission network. The substation will likely be located south of the Benmore to Islington A line, with a proposed position between towers 71 and 72. The exact location, size and layout of the substation is subject to a future detailed design.

It will consist of a switchyard with an overall footprint of approximately 155 x 80 m. Refer to Figure 2, Figure 3, and Figure 4 below for indicative layouts. It will house two 33/220 kV transformers and two 33 kV containerised switchrooms (40ft shipping containers) within the Lodestone section, and in the Transpower section 220 kV switchgear along with control and facilities buildings (approx. 6m x 11m).

Haldon Solar Farm substation may also house a water storage tank, on-site wastewater treatment, small storage facilities, and car parking. The proposed wastewater management would utilise containment tank(s). The onsite wastewater production would be insufficient to support a septic tank treatment system and these containment tank(s) will be designed to accommodate the groundwater levels identified during future geotechnical investigations. There will be additional minor ancillary switchyard equipment that has not been shown. The perimeter of the facility will be enclosed with a lockable security fence, with a fence surrounding at the perimeter of the solar farm. The switchyard surface will generally consist of a 150 mm layer of crushed rock aggregate, with approximately 500 mm of basecourse and sub-base material below this. Switchyard equipment will be mounted on concrete foundations.

Transpower typically uses a chain-link fence with a height of around 2.4 metres, often topped with several rows of barbed wire, around their substations for added security.

Two 33/220 kV, 105 MVA step-up transformers will be installed, each on bunded foundations to contain any split transformer oil. An oil spill system will be installed and connect to transformer drainage sumps to block the flow of fluid, should oil be detected. An enclosure may be required to house 33 kV capacitor banks (filter banks) if deemed necessary for harmonic mitigation. The capacitor banks will not contain any oil.

The incoming 220 kV transmission line from the BEN-ISL-A line will loop in and loop out through two 20m high A-frame or steel pole gantry structures within the switchyard. Lightning spikes will be mounted on top, which will extend to 24m high within the substation to protect the equipment.

3.1.1 Solar farm Substation drawings

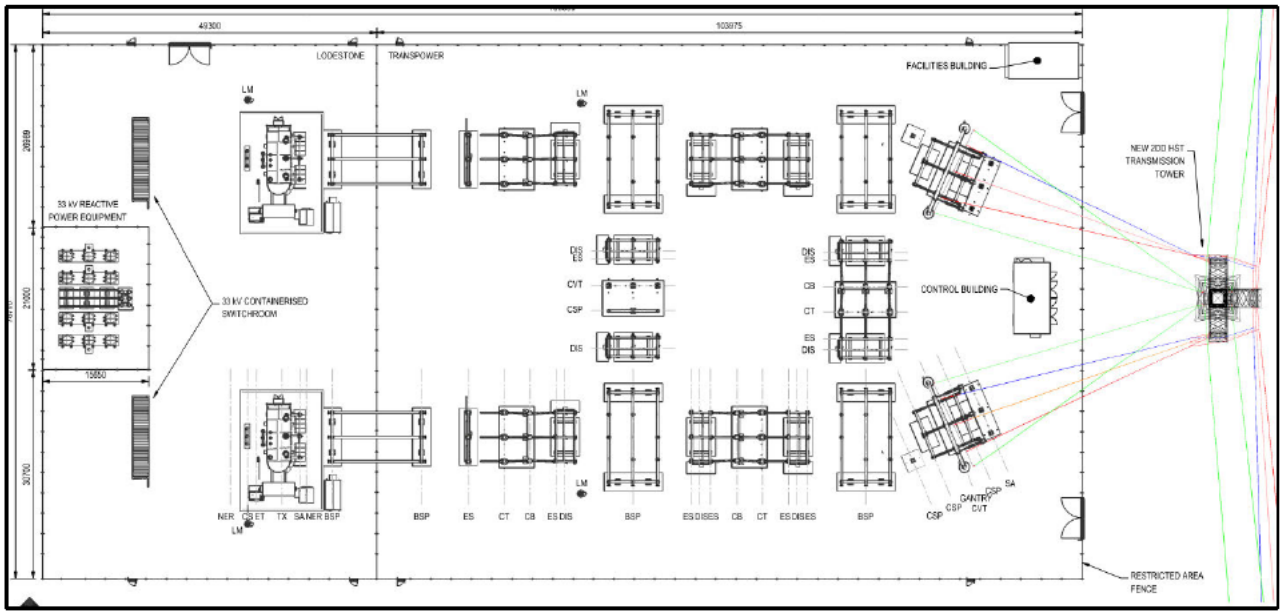


Figure 2 -Haldon collector and 220 kV substation layout drawing (refer to drawing 2429039-UP-002)

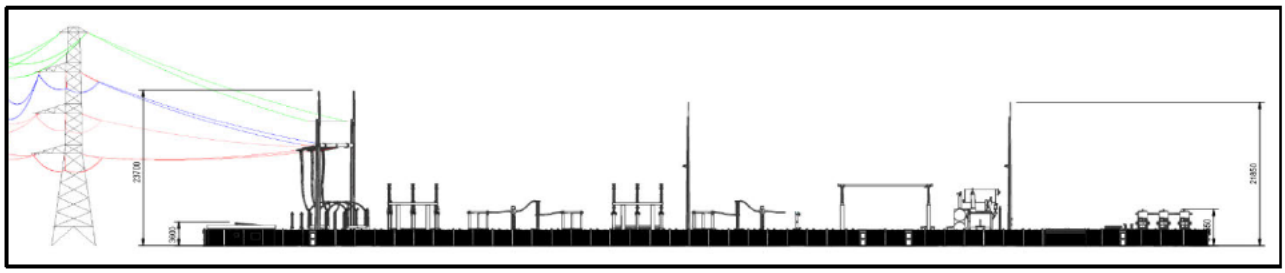


Figure 3 - Haldon collector and 220 kV substation elevation drawing (refer to drawing 2429039-UP-004)

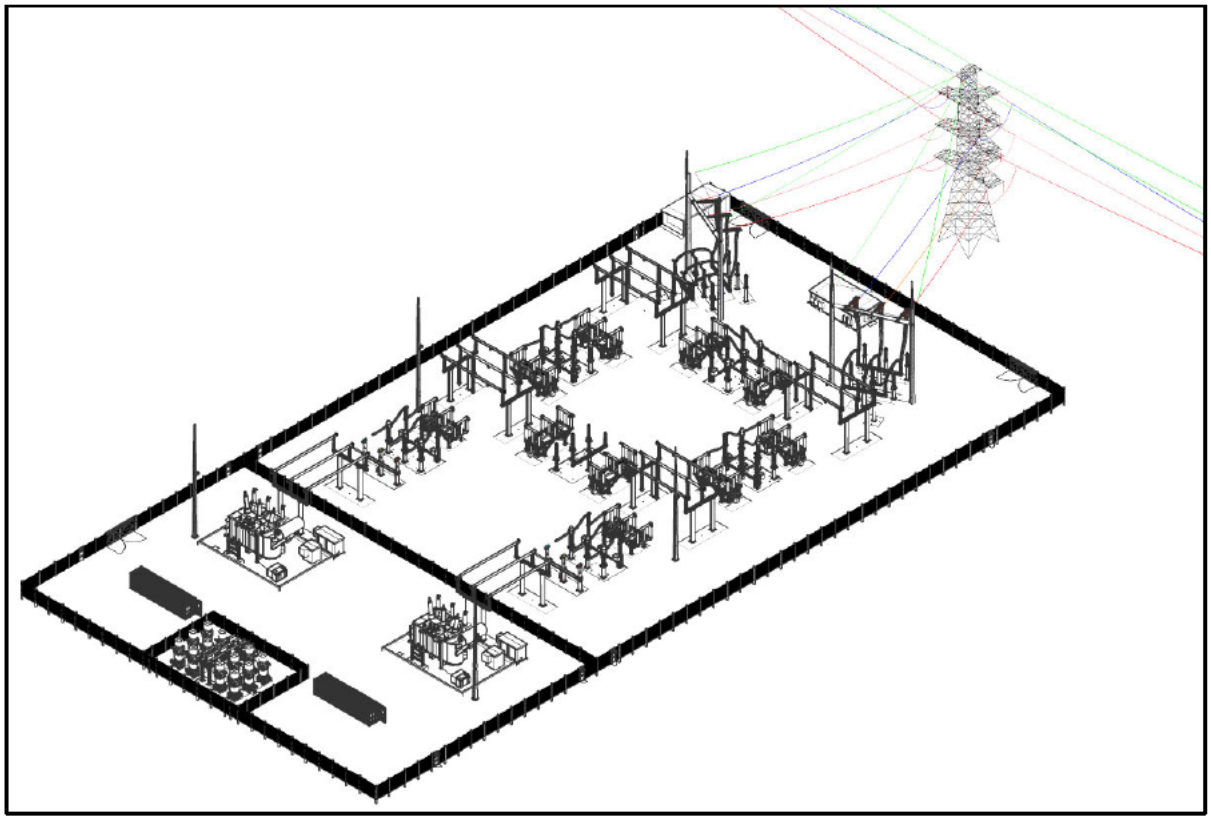


Figure 4 - Haldon collector and 220 kV substation isometric drawing (refer to drawing 2429039-UP-006)

4 Transmission Lines

The proposed transmission line connection involves single circuit in-and-out connections to the substation from the existing Benmore – Islington 220 kV transmission line (BEN-ISL-A). Various options were explored to minimise line construction and outage durations. Consequently, the proposed design includes a new double circuit 2DD-HST junction tower to allow for the cut-in connection to the substation.

4.1 Cut-in Tower Position

To enable the connection into and out of the proposed substation, the new double circuit junction tower (71A) is proposed to be installed approximately midway between existing towers 71 and 72 as depicted in the Figure 5 below.

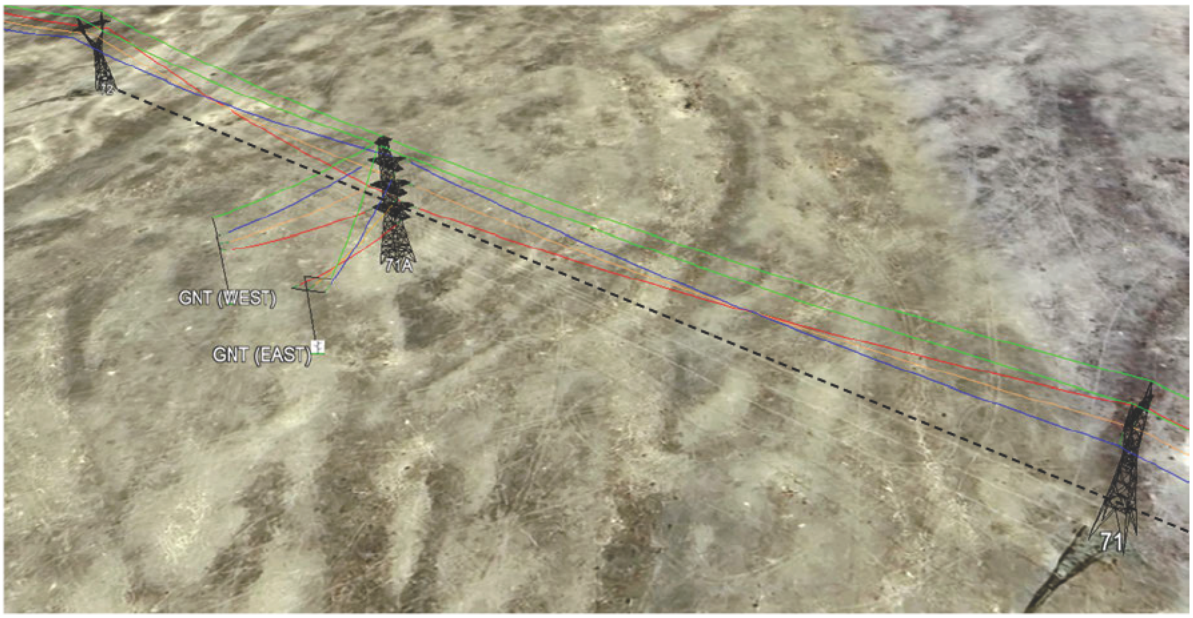


Figure 5 - Substation connection concept into and out via double circuit junction tower (71A)

It is intended tower 71A is a Transpower standard type 2DD HST tower, standing approximately 34 m in height above ground (including a 5.3m earthwire peak). The tower would have a base footprint of approximately 12.5 m by 12.5 m. The proposed tower is shown below in Figure 6.

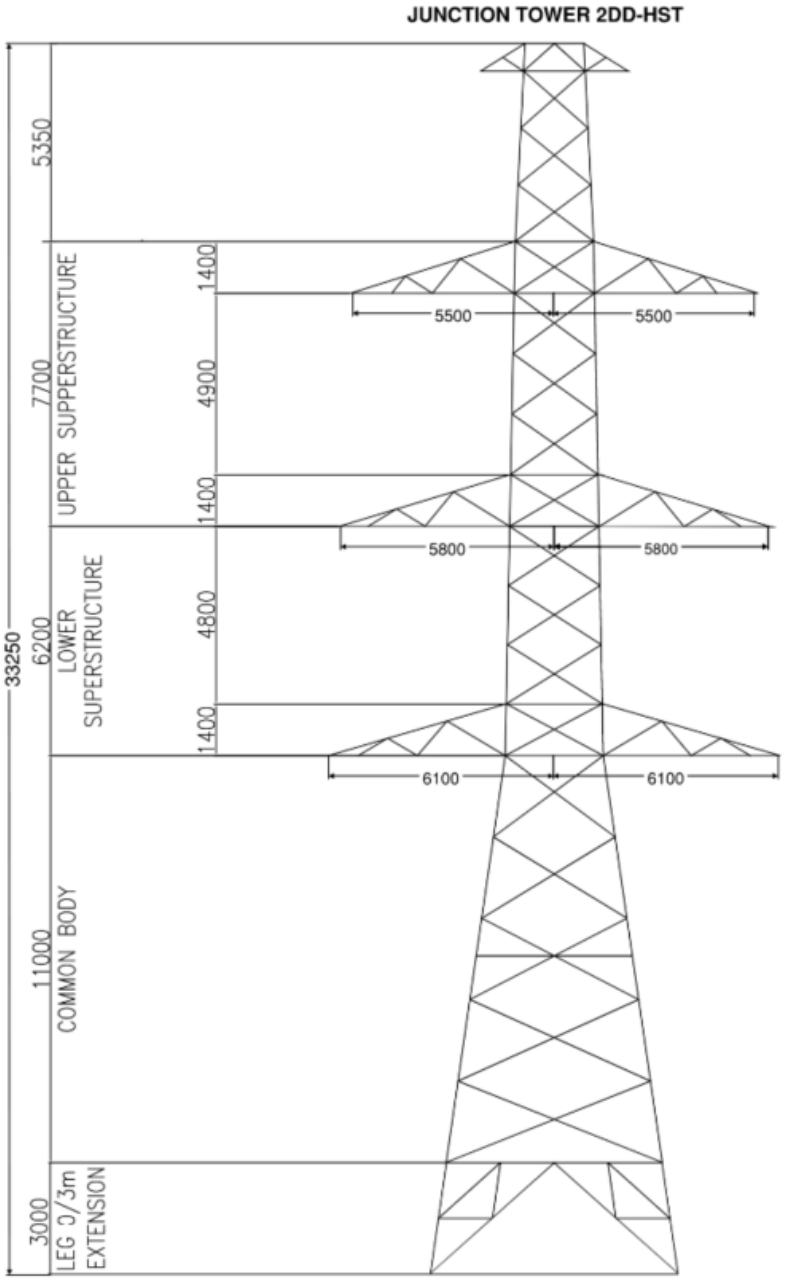


Figure 6 Elevation of the proposed new transmission structure

The exact location of the new structure (Tower 71A) is to be confirmed during detailed design. There are likely two potential location options for tower 71A:

1. Tower 71A centre peg offset approximately 5.5 m southwest of the current transmission line alignment, such that the transmission line conductors remain centred on the existing centreline (Option 1)
2. Tower 71A centre peg offset approximately 18 m southwest of the current transmission line alignment, such that foundation installation work does not occur beneath the existing transmission line (Option 2).

The substation gantries are proposed to be positioned approximately 40m southwest of tower 71A.

For plan view drawings of Option 1 and Option 2, refer to sketch 2429039-TL-K001 and 2429039-TL-K002 respectively.

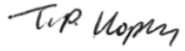
For junction tower 2DD HST elevation drawing, refer to sketch 2429039-TL-K003.

5 Design Assumptions

The development of the consent-level design is based on the following assumptions, made in agreement with Lodestone:

- The transmission line is to be a single circuit 220 kV overhead line to connect 200 MW of generation.
- Two 33/220 kV, 105 MVA step-up transformers have been allowed.
- The transformer bunds will have an ability to contain 120% of transformer oil within the associated bund following a transformer tank rupture.
- Transpower will own the 220 kV line bays, bus and transformer feeder bays.
- Lodestone will own and control all other equipment including the two 33/220 kV transformers, 33 kV solar farm substation and assets within it.
- Access requirements will be covered as part of the switchyard design.
- The size of the switchrooms and control rooms is in accordance with typical industry practice. To be optimised and revised as part of detailed design assessment.
- For consent design an area of capacitor (filter) banks has been shown, this may not be required and will be confirmed during detailed design.
- The layout is not optimised for space and is an indicative layout. Further refinement and optimisation will occur at later stages of the project.

Yours sincerely,



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