MARSHALL DAY Acoustics

TWIZEL SOLAR FARM ACOUSTIC ASSESSMENT

Rp 001 20240874 | 26 March 2026

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Project: **TWIZEL SOLAR FARM**

Prepared for: **BTW Company**
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Report No.: **Rp 001 20240874**

The Authors

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 authors have read the Expert Witness Code of Conduct set out in the Environment Court Practice Note 2023. The authors have complied with the Code of Conduct in preparing this report. The content of the report is within the authors' area of expertise and the authors have not omitted to consider material facts known to them that might alter or detract from the opinions expressed in the report.

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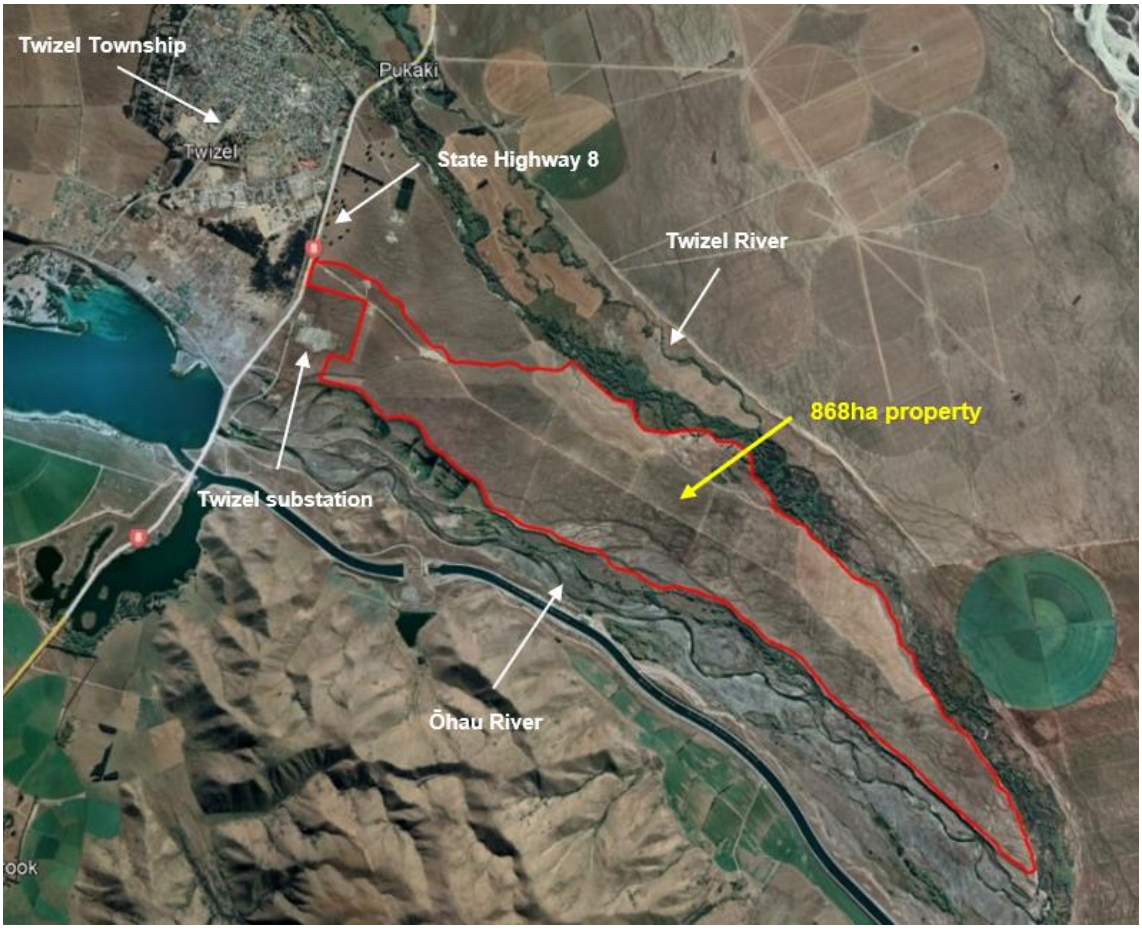
1.0 SUMMARY

Marshall Day Acoustics has been engaged by Nova Energy Limited to assess construction and operational noise of a new 300 MW solar farm at Twizel. The 868ha site is located to the southeast of Twizel on the opposite side of State Highway 8. The site runs parallel between the Twizel and Ōhau Rivers. Figure 1 illustrates this.

Figure 1: Site relative to Twizel (Image source: BTW Company Ltd)



The development will include some minor construction works to make the ground suitable, create cable trenches, and to install the solar panel piles. When complete, the site will, via a number of inverters located throughout the site, connect directly into the existing Transpower substation via a 33 kV switchyard located east of the existing substation, and within the site's boundary.

There are no residential dwellings within 1.5 kilometres of any part of the site that emits any noise. Figure 2 illustrates this.

The Department of Conservation (DOC) Kakī recovery sanctuary building is approximately 1 kilometre from the nearest part of the application development (see Figure 2). Although the DOC Kakī sanctuary site does not contain a dwelling, or any other noise sensitive activities as defined by the Mackenzie District Plan, we have predicted construction noise levels at the façade of the building. We understand Nova Energy has been consulting with DOC on construction noise and other matters.

Council issued their decision on Plan Change 29 (PC29) on 24 July 2025. PC29 involved review of noise provisions in the district plan. We understand that there are no appeals relating to the noise provisions and therefore, we will treat them as operative.

Figure 2: Distance to nearest house (Image source: Google Earth)

In summary, we conclude that:

- Construction noise and vibration can readily comply with the District Plan limits at all receivers outside the site.
- Operational noise can readily comply at all receivers outside the site at all times.

In our opinion, the proposed solar farm can be considered a permitted activity with respect to noise.

Appendix A provides a glossary of terminology.

2.0 CONSTRUCTION NOISE

2.1 Construction Noise Performance Standard

Rule NOISE-R6 of the McKenzie District Plan (MDP) states that construction is a permitted activity where:

> *"Noise from any construction activity complies with the relevant noise limits set out in Tables 2 and 3 of NZS 6803:1999* Acoustics – Construction Noise*, when measured and assessed in accordance with that standard."*

We understand that construction works will only occur during the daytime (0700 – 1700 hrs Monday to Saturday) and for longer than 20 weeks. Sunday and public holidays would have no work unless where required by exception for health and safety or construction requirements.

This means that the long-term duration (works greater than 20 weeks) limits shown in NZS 6803 would technically apply. However, we consider that the typical duration limits (works greater than 15 days but less than 20 weeks) shown in Table 1 would be more appropriate given that the construction works will be spread out over a large area. This means that construction work would affect any one receiver for a much shorter duration than the overall construction works. Given this, Table 1 provides the construction noise limits that we consider appropriate. The limits apply at 1m from the façade of an occupied building.

Table 1: Construction noise limits

Time of week	Time period	dB L_{Aeq}	dB L_{AFmax}
Weekdays	0630-0730	60	75
	0730-1800	75	90
	1800-2000	70	85
	2000-0630	45	75
Saturdays	0630-0730	45	75
	0730-1800	75	90
	1800-0630	45	75
Sundays and public holidays	0630-0730	45	75
	0730-1800	55	85
	1800-0630	45	75

2.2 Construction Noise Assessment

We understand that construction will be separated into high level phases:

- Phase 1:
  - Main road construction
  - Main plant used will be excavators, graders, trucks, and cranes
- Phase 2:
  - Solar farm access roads, inverter foundations, trenching and piling operations
  - Access roads construction as required between sections of the solar farm
  - Inverter foundation construction as required by sections

- Trenching as required by section
- Piling operations from the substation working outwards to boundaries in stages. There will be up to four work fronts (i.e. up to four impact piling rigs working within an estimated 200m radius).
- Main plant used will be piling rigs, excavators, graders, trucks, and directional drills

For the construction phase, we understand that the general plant in Table 2 will be used (note this list is not exhaustive but illustrates the typical high noise plant). The sound power levels have been sourced from British Standard BS 5228-1:2009 "*Code of practice for noise and vibration control on construction and open sites – Part 1: Noise"* or from previous measurements that Marshall Day Acoustics has carried out using similar equipment that would be used for a solar farm construction project.

Table 2: Plant sound power level and compliance distances with no mitigation

Equipment	Typical Operating Sound Power (dB L_{wA})	Noise Level (dB L_{Aeq}) at a distance (m)				Setback distance to comply with	
		20	40	80	160	75 dB L_{Aeq}	45 dB L_{Aeq}
Small impact piling rig	114	83	76	68	61	44	692
Grader	110	79	72	64	57	30	479
Directional drilling	105	74	67	59	52	18	302
Excavator (30T)	105	74	67	59	52	18	302
Loader	103	72	65	57	50	14	251
Excavator (20T)	103	72	65	57	50	14	251
Concrete truck and pump	103	72	65	57	50	14	251
Roller	103	72	65	57	50	14	251
Mobile Crane (200T) operating	102	71	64	56	49	13	229

The closest residential dwelling outside the site is more than 1.5 km from the work at the closest location (refer Figure 2).

Appendix D shows our predicted noise contour for construction noise during piling which is the loudest activity.

2.2.1 Phase 1 construction works

We predict that construction noise from all Phase 1 works can readily comply with the daytime limit of 75 dB L_{Aeq} at all receivers outside of the site.

At the DOC Kakī sanctuary, we predict grader noise level of 34 dB L_{Aeq}. This type of noise at this level would be similar to the distant traffic noise from State Highway 8.

2.2.2 Phase 2 construction works

We predict that construction noise from all Phase 2 works can readily comply with the daytime limit of 75 dB L_{Aeq} at all receivers outside of the site, with the highest predicted noise level less than 50 dB L_{Aeq} at the closest dwelling.

At the DOC Kakī sanctuary, we predict piling noise level of 38 dB L_{Aeq}. This level would be similar to the noise in a large unoccupied conference room or a library reading room, although the type of noise would be characterised by intermittent spikes in sound pressure level. This noise level readily complies with the night-time noise limit of 45 dB L_{Aeq} as well.

Piling would not occur for the entire construction period, or at all times during the day. Piling noise would be loudest when working at the closest position to the sanctuary and would decrease as the piling activity moves away.

3.0 CONSTRUCTION VIBRATION

There are no rules related to construction vibration in the MDP. However, we consider that the German Standard DIN 41503:2016 "*Vibrations in buildings – Part 3: Effects on structures"* can be applied in the absence of any specific rule. It is widely used in other New Zealand districts. This standard provides vibration limits to avoid cosmetic building damage (i.e. cracking plaster or similar cosmetic damage). For impact piling vibration, the limit at buildings is frequency dependent. As a pragmatic approach, 5mm/s peak particle velocity (PPV) is typically selected as the limit.

Table 3 below shows the vibration setback distances for the high vibration plant proposed for this project. They are sourced from our measurement databases.

We have also provided a 2mm/s PPV setback distance. 2mm/s can be clearly felt and is tolerable with prior communication. We have provided this to indicate when the consent holder should engage with the receiver. This applies only to those within the site as receivers off site are outside of the setback distances.

Table 3: Vibration setback distances[1]

Equipment	Setback (m)	
	Building protection – Residential (5 mm/s PPV)	Amenity (2 mm/s PPV)
Vibratory roller	14	39
Impact piling	19	61

Given the setback distances to the closest residential dwelling is greater than 1,500m we have no concerns with respect to construction vibration and compliance with DIN 4150 during impact piling.

Further, we predict construction vibration would be imperceptible at all times at the DOC Kakī sanctuary.

[1] Includes a 100% safety margin to allow for different ground conditions

4.0 OPERATIONAL NOISE

4.1 Operational Noise Performance Standard

The site and surrounds are mostly zoned *General Rural* in the MDP. Across State Highway 8 to the north-west is land zoned *Low Density Residential* or *Large Lot Residential* which is buffered from State Highway 8 by a thin strip of land zoned *Open Space*.

Appendix B shows a zoning map that illustrates the above.

Rule NOISE-R1 provides the noise limits. It refers to NOISE-TABLE 1 and states that noise is permitted where:

> *"The noise generated by any activity does not exceed the limits set out in NOISE-TABLE 1, measured at the location set out in NOISE-TABLE 1."*

Table 4 shows the relevant noise limits from NOISE-TABLE 1.

Table 4: Noise limits that apply based on the receiving zone

Zone of the Site Receiving Noise	Measurement Location	Noise limits		
		Daytime 0700 – 2200 hrs	Night-time 2200 – 0700 hrs	L_{AFmax} [2]
Any Residential Zone	At any point within the boundary of another site	50 dB $L_{Aeq\ (15min)}$	40 dB $L_{Aeq\ (15min)}$	70 dB L_{AFmax}
General Rural Zone	At any point within the notional boundary[3] of any noise sensitive activity within the site	55 dB $L_{Aeq\ (15min)}$	45 dB $L_{Aeq\ (15min)}$	70 dB L_{AFmax}

The MDP also states:

> ***"Note for Plan Users:** Other than where expressly provided for, noise levels arising from activities shall be measured in accordance with NZS 6801:2008 Acoustics - Measurement of Environmental Sound and assessed in accordance with NZS 6802:2008 Acoustics - Environmental Noise."*

The solar farm will only be operational during daylight hours. During the summer months, this means that generation would begin in the early morning (i.e. from 0600 hrs). Therefore, the relevant noise limits to assess against during this period are the night-time noise limits of 40 and 45 dB L_{Aeq}.

There would be no power generation when there is no daylight, so the inverters would not be operational after sunset and before sunrise.

[2] No time specified – we assume it applies to the night-time period as per NZS 6802

[3] A position 20m from the façade of an existing noise sensitive building (i.e. dwelling) or the site boundary, whichever is closer to the noise sensitive building

4.2 Operational Noise Assessment

We have prepared a 3D computer noise model of the site using the sound modelling software SoundPLAN. This software uses the algorithms contained in International Standard ISO 9613-2:1996 *Acoustics - Attenuation of sound during propagation outdoors – Part 2: General method of calculation*. The noise inputs we used are given in Appendix B. Note, we have not modelled the switchyard because it does not emit noise that would materially affect the site's overall noise emissions.

An +5dB SAC adjustment is applied if a noise source has a specific characteristic that means it is perceived as more annoying, e.g. if it generates a tone. This characteristic must be audible at the assessment position. Given that the predicted noise level from the solar farm is very low at the closest receivers (i.e. less than 25 dB L_{Aeq}), it is unlikely to be audible over normal daytime noise, and it is likely that no SAC would need to be applied.

We predict the solar farm can readily comply with the relevant daytime noise limits, even if a SAC adjustment of +5 decibel was applied. We predict ready compliance with the night-time noise limits as well, during early morning operation (approximately 0600 - 0700), even if a +5dB SAC adjustment was included.

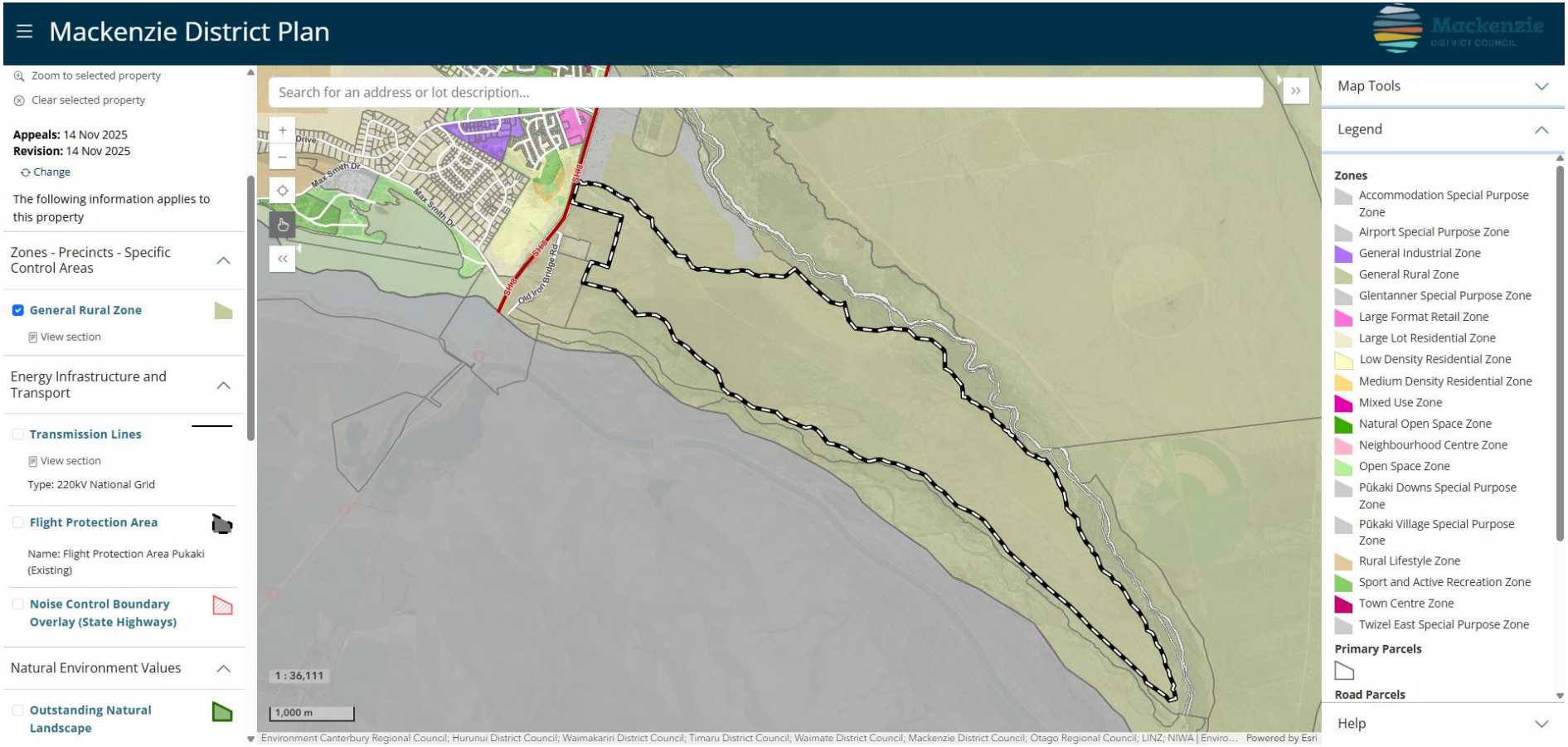
As noted previously, no load is generated at night-time. Therefore compliance with the night-time noise limit of 40 dB L_{Aeq} can readily be achieved.

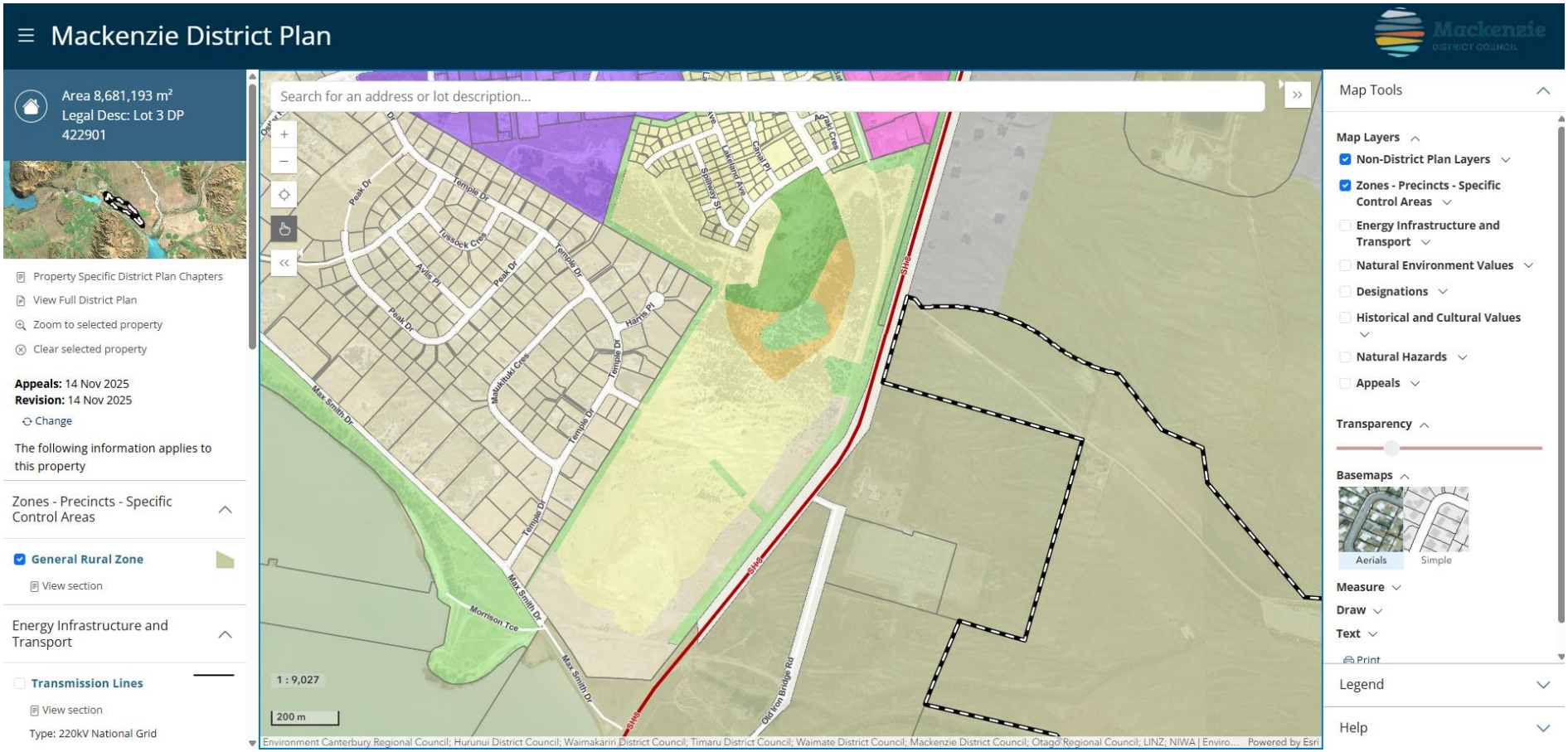
Appendix E shows our predicted noise contour for generation operations.

APPENDIX A GLOSSARY OF TERMINOLOGY

A-weighting	The process by which noise levels are corrected to account for the non-linear frequency response of the human ear.
dB	Decibel The unit of sound level. Expressed as a logarithmic ratio of sound pressure P relative to a reference pressure of Pr=20 μPa i.e. dB = 20 x log(P/Pr)
dBA	The unit of sound level which has its frequency characteristics modified by a filter (A-weighted) so as to more closely approximate the frequency bias of the human ear.
$L_{Aeq\,(t)}$	The equivalent continuous (time-averaged) A-weighted sound level. This is commonly referred to as the average noise level. The suffix "t" represents the time period to which the noise level relates, e.g. (8 h) would represent a period of 8 hours, (15 min) would represent a period of 15 minutes and (2200-0700) would represent a measurement time between 10 pm and 7 am.
L_{A10}	The A-weighted sound level exceeded for 10% of the measurement period, measured in dB. Commonly referred to as the average maximum noise level.
L_{Amax}	The A-weighted maximum noise level. The highest noise level which occurs during the measurement period.
Noise	A sound that is unwanted by, or distracting to, the receiver.
NZS 6801:1991	New Zealand Standard NZS 6801:1991 *"Measurement of sound"*
NZS 6802:1991	New Zealand Standard NZS 6802:1991 *"Assessment of Environmental Sound"*
NZS 6803:1999	New Zealand Standard NZS 6803: 1999 *"Acoustics - Construction Noise"*
PPV	Peak Particle Velocity For Peak Particle Velocity (PPV) is the measure of the vibration aptitude, zero to maximum. Used for building structural damage assessment.
SPL or L_P	Sound Pressure Level A logarithmic ratio of a sound pressure measured at distance, relative to the threshold of hearing (20 μPa RMS) and expressed in decibels.
SWL or L_W	Sound Power Level A logarithmic ratio of the acoustic power output of a source relative to 10^{-12} watts and expressed in decibels. Sound power level is calculated from measured sound pressure levels and represents the level of total sound power radiated by a sound source.
Vibration	When an object vibrates, it moves rapidly up and down or from side to side. The magnitude of the sensation when feeling a vibrating object is related to the vibration velocity. Vibration can occur in any direction. When vibration velocities are described, it can be either the total vibration velocity, which includes all directions, or it can be separated into the vertical direction (up and down vibration), the horizontal transverse direction (side to side) and the horizontal longitudinal direction (front to back).

APPENDIX B ZONING MAP





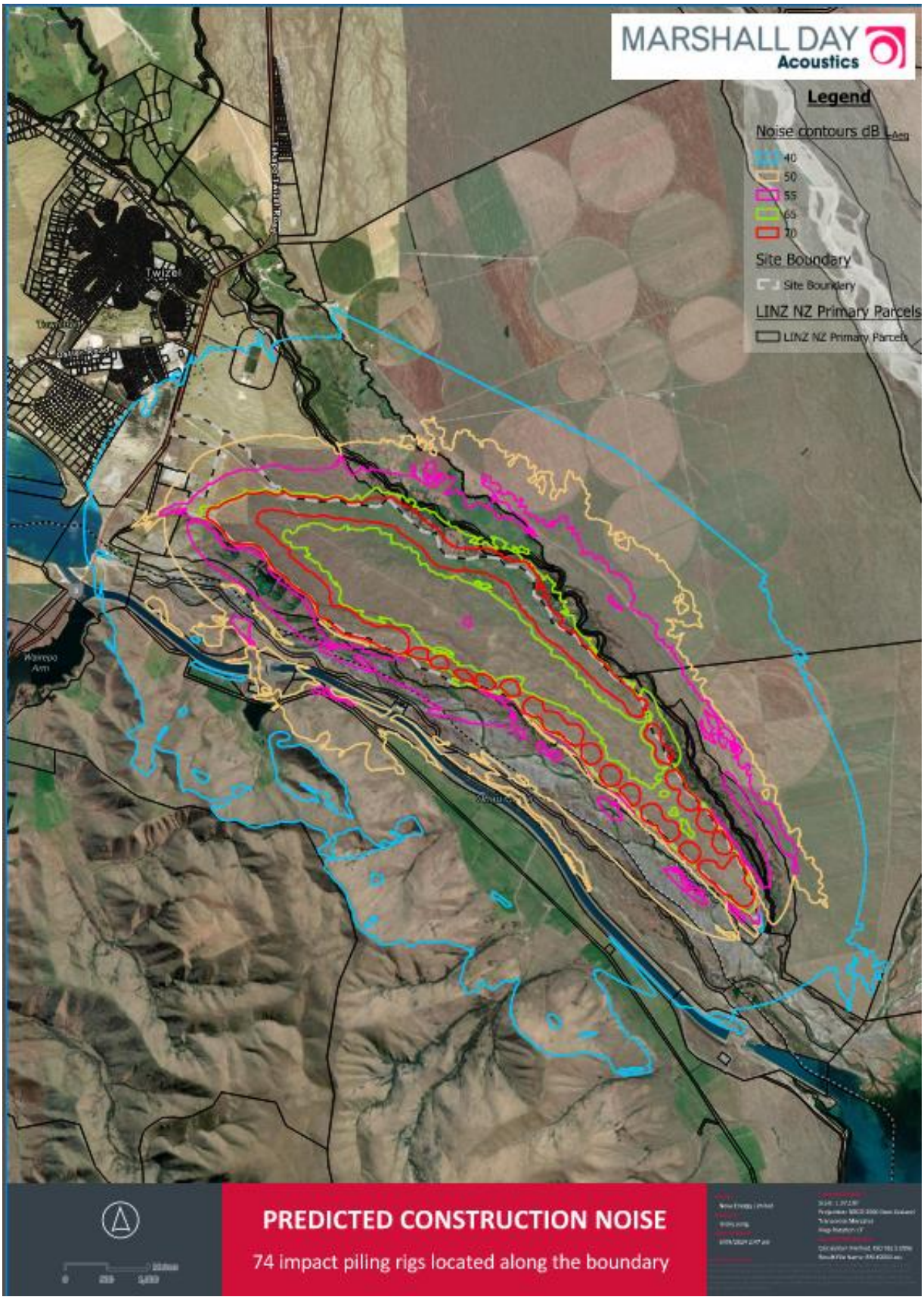
APPENDIX C SOLAR FARM NOISE SOURCES

	Octave Band Centre Frequency, Hz									
	31.5	63	125	250	500	1000	2000	4000	8000	dB L_{WA}
Inverter (SC 4600 UP)	81	98	110	84	78	71	67	63	59	91
Transformer (180 MVA, ODAN)	78	95	106	81	74	67	63	59	56	88

Notes:

- Inverter: Sound power level provided by supplier test document titled '*White Paper BU-LS-001 performed by SMA Solar Technology AG*' dated 23 September 2019. The spectrum was not provided. Therefore, we have used a representative spectrum. 98 inverters were included at locations supplied by the project team.
- Transformer: Sound power level and spectrum provided by supplier test document (*Wilson Transformer Co Pty Ltd, test serial number P1919-01*, test date 8 June 2020). 180 MVA, ODAN operation is the loudest operating mode.
- We consider that there are no other significant noise sources during day-to-day operation.

APPENDIX D PREDICTED NOISE CONTOUR – CONSTRUCTION PILING



APPENDIX E PREDICTED NOISE CONTOUR – DAYTIME OPERATION