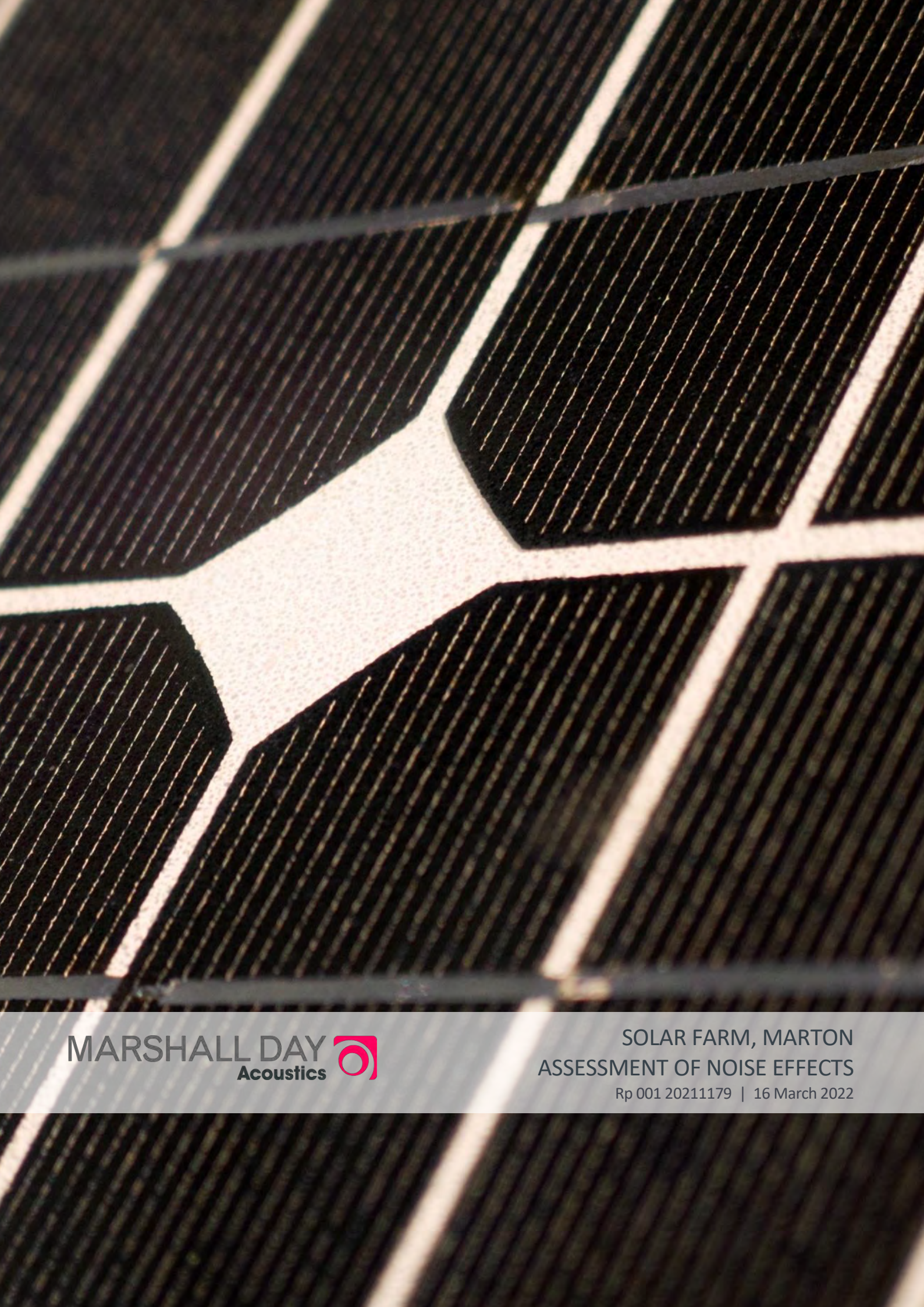


MARSHALL DAY Acoustics

SOLAR FARM, MARTON
ASSESSMENT OF NOISE EFFECTS

Rp 001 20211179 | 16 March 2022

84 Symonds Street
PO Box 5811
Victoria Street West
Auckland 1142 New Zealand
s 9(2)(a) F: +64 9 309 3540
www.marshallday.com

Project: **SOLAR FARM, MARTON**

Prepared for: **Energy Farms Ltd**
c/- Reyburn and Bryant
PO Box 191
Whangarei 0140

Attention: **Thomas Keogh**

Report No.: **Rp 001 20211179**

Document Control

Status:	Rev:	Comments	Date:	Author:	Reviewer:
Approved	-	-	16 Mar. 2022	Mary Hamilton	Peter Ibbotson

SUMMARY

Marshall Day Acoustics has been engaged by Energy Farms Ltd. to undertake a noise assessment for a proposal to construct and operate a solar farm at 1618 Wellington Road, Marton, Rangitikei District, Manawatū-Whangnui (Horizons) Region.

The key operational noise sources would be from fifteen inverters installed predominantly central to the site and a battery energy storage system. The minimum separation distance between these key operational noise sources and the nearest receiver notional boundary is approximately 250 metres.

The solar farm would primarily operate during daylight hours but would also operate during the night period.

The proposed solar farm is calculated to comply with the Rangitikei District Plan noise rules at all existing notional boundaries for both the daytime and night-time periods.

Noise from the solar farm would be low overall and within all national and international guidelines for environmental noise levels that are typically applied within New Zealand.

Calculated noise levels from the solar farm were compared with logged ambient and background daytime and night-time noise levels.

During the daytime, it is likely that the solar farm would be just audible at times at near receivers. However, given the low overall noise level from the solar farm, daytime solar farm noise levels are considered reasonable and would have little effect on acoustic amenity.

During the night-time, calculated solar farm noise levels are expected to be audible / readily audible at near receivers, particularly: 45 Whales Line, 1574 Wellington Rd, and 1671 Wellington Road.

We consider that final selection of the inverters should avoid and/or mitigate tonal characteristics and have proposed a condition of consent in this regard. If the tonality of the units is well controlled, there is considered little risk of annoyance arising.

We consider that during final design of the battery energy storage system, an assessment to confirm adequate attenuation of the system should be undertaken. We have proposed a condition of consent in this regard.

Taking into account the above discussion and provided that the tonal character of the proposed mechanical plant (including the inverters) can be avoided and/or mitigated, we consider that overall, the solar farm would be reasonable in terms of the RMA.

Construction noise is expected to generally comply with the construction noise limits. One receiver is within the set-back distance for impact pile driving. Depending on the final construction schedule and equipment, a construction noise and vibration management plan may be necessary to assess and manage construction effects on near receivers.

Conditions of resource consent have been recommended.

TABLE OF CONTENTS

1.0 INTRODUCTION

Marshall Day Acoustics has been engaged by Energy Farms Ltd. to undertake a noise assessment for a proposal to construct and operate a solar farm at 1618 Wellington Road, Marton, Rangitikei District, Manawatū-Whangnui (Horizons) Region.

This report addresses noise from the proposed operation and from construction. It is intended to form part of an application for resource consent.

A glossary of terminology is included in Appendix A.

2.0 APPLICATION SITE

The proposed solar farm would be located at 1618 Wellington Road, a 195-ha property. The site is located approximately 4-km south of Marton town centre. The site boarders three roads: Wellington Road to the north, Read Road to the southeast and Kilkern Road to the southwest. The site is currently used as grazing land for dry stock (sheep and beef cattle). Surrounding land uses are rural. The site and surrounds are predominantly flat/sloping at an elevation of approximately 100 to 110m.

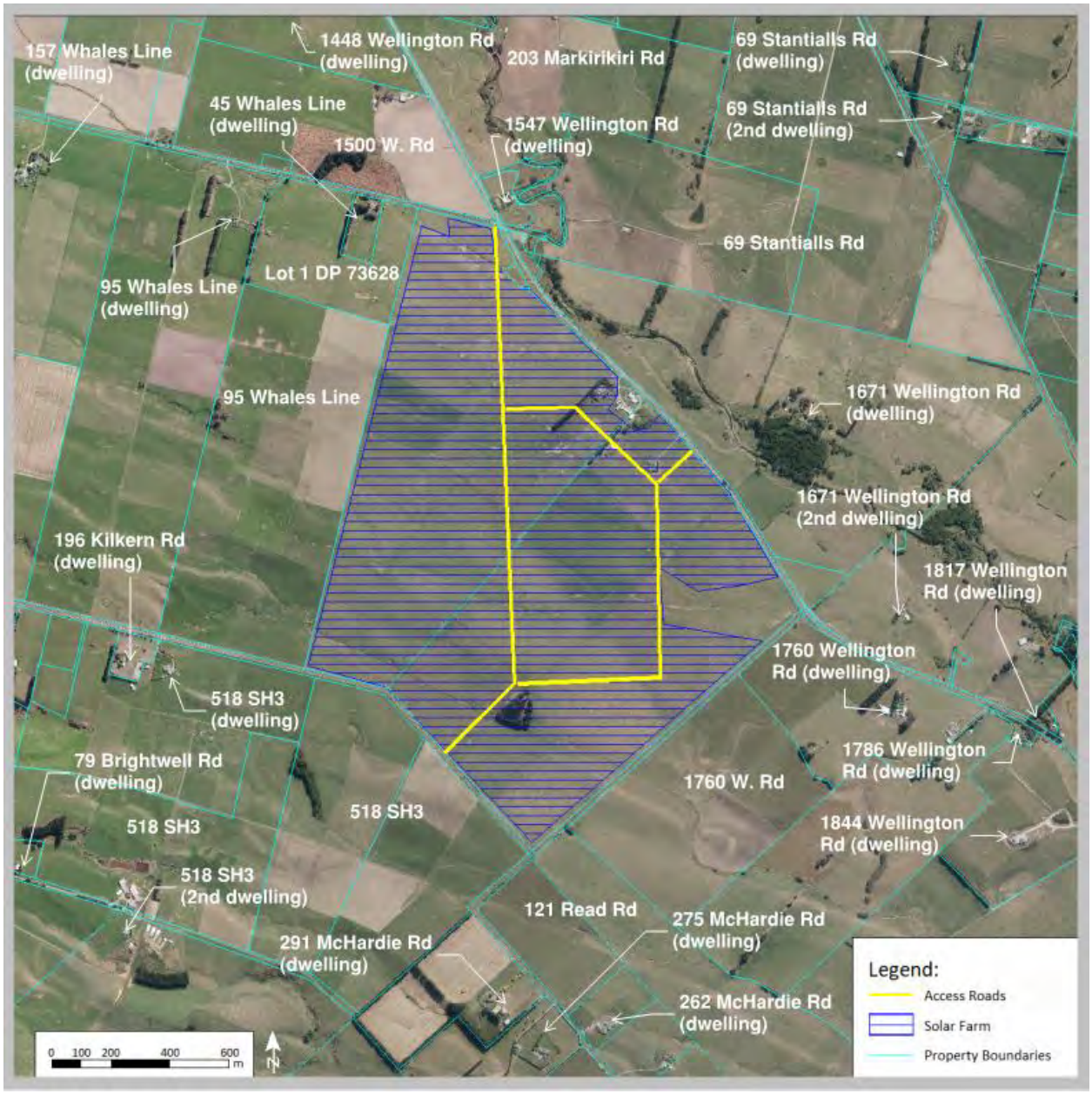
Surrounding receivers are listed in Table 1 and depicted in Figure 1.

Table 1: Surrounding Receivers

Receiver Address	Existing Use[1]	Estimated distance (m)[1]
45 Whales Line	Rural residential	120
95 Whales Line	Farm with dwelling	565
157 Whales Line	Farm with dwelling	1240
Lot 1 DP 73628	unbuilt	25m to legal boundary
1448 Wellington Rd	Farm with dwelling	970
1500 Wellington Rd	Shed only - unbuilt	25m to legal boundary
1547 Wellington Rd	Rural residential	70
1671 Wellington Rd	Farm with two dwellings	280 and 450
1760 Wellington Rd	Farm with dwelling	460
1786 Wellington Rd	Rural residential	870
1817 Wellington Rd	Rural residential	950
1844 Wellington Rd	Rural residential	1060
203 Markirikiri Rd	unbuilt	210m to legal boundary
69 Stantialls Rd	Farm with two dwellings	1360 and 1470
121 Read Rd	unbuilt	40m to legal boundary
518 SH3	Farm with two dwellings	410 and 1040
79 Brightwell Rd	Rural residential	1130
196 Kilkern Rd	Rural residential	580
262 McHardie Rd	Rural residential	610
275 McHardie Rd	Rural residential	650
291 McHardie Rd	Rural residential	500

Note 1: Existing land use and distances have been determined from aerial photography. Distances are from the nearest proposed solar farm boundary to the identified notional boundary (unless stated otherwise). Refer to Section 5.0 for a discussion regarding the notional boundary.

Figure 1: Site and Surrounds



3.0 PROPOSAL

3.1 Facility Description

The solar farm would be installed over approximately 180 hectares. Solar panels (4.8 metres high approx.) would be installed in rows spaced about 5.5 metres apart to allow access by agricultural machinery / grazing animals. Access to the site would be via Wellington Road and Kilkern Road.

The key operational noise sources are summarised below:

- **15 inverters** – situated predominantly central to the site - an inverter turns Direct Current (DC) created by the photovoltaic cells to alternative current (AC) current used in the grid. [1]
- **up to seven Tesla 3MW powerpack battery storage blocks (BESS**) – situated near the switchyard at the eastern site corner and enclosed within a building/structure. The battery blocks store AC or DC power for later use. [2]
- **one transformer** – situated in the switchyard at the eastern site corner - a transformer changes the current and voltage of AC electricity.

The minimum separation distance between these key operational noise sources and the nearest receiver notional boundary is approximately 250 metres.

The individual solar panel arrays would be attached to trackers[3]. For this assessment, we have assumed a total of 2360 trackers (and associated motors) could be installed as part of the project.

The solar farm would primarily operate during daylight hours but would also operate during the night period. During the night, electricity may be discharged from the batteries to the grid and the solar farm may also import electricity from the grid for storage within the battery units. In summer, operating daylight hours could begin earlier than the prescribed daytime period of 7am to 10pm.

Refer to the site layout in Appendix B.

3.2 Written Approvals

To our knowledge, written approvals have not been obtained for any of the nearby properties[4].

3.3 Acoustic Mitigation

Acoustic mitigation, such as acoustically rated fencing, is not considered necessary and is not proposed as part of the project.

---

[1] Final selection of the inverters is yet to be made. This assessment is based on manufactures' data for inverters that have been proposed at other solar farms around New Zealand. We have assumed that the inverters would have tonal and directivity properties. To our knowledge, limited manufacture's data is available for solar farm inverters, but all show tonal characteristics at various frequencies. We consider it essential for final selection of the inverters to include a detailed analysis of the tonal character. Final selection should be made to avoid and/or mitigate tonal characteristics as even at low noise levels, tonal properties can have a negative effect on acoustic amenity at neighbouring sites.

[2] Manufactures data for the Tesla 3MW powerpack units was unable to be obtained. This assessment is based on data derived from other battery storage units. Energy Farms Ltd. must confirm this data with suppliers prior to final procurement of power infrastructure. The battery storage system building is yet to be designed. We have assumed that it would provide a minimum sound attenuation of 10 decibels.

[3] Trackers consist of many solar panels on a frame that tilts vertically to align the panels to the sun throughout the day. The trackers are rotated around a central horizontal axis by a small motor (approximately 300 watts). The motor is the main noise source associated with each tracker. The tracker motors are understood to operate intermittently during daylight hours and only for a short period as they are only required to make small incremental adjustments to the trackers. Refer to Appendix D for an image showing the solar tracker with tilt actuator mechanism.

[4] Council must not, when considering the application, have regard to any effect on a person who has given their written approval to the application (Section 104 (3) of the Resource Management Act 1991).

4.0 EXISTING NOISE ENVIRONMENT

A site visit was carried out on Sunday 19 December 2021, during which time an attended noise measurement was taken, and a noise logger was installed on site. The logger collected reliable data until Friday 7 January 2022.

Weather conditions were varied during the December period of data collection but were stable in January. Logged data collected between the 2nd and 7th of January has been analysed for this assessment.

The purpose of the measurements was to establish ambient noise levels representative of the site and surrounding sites. The attended and logger measurement position was located central to the property and approximately 600m from Wellington Road. It is considered representative of the area generally, particularly sites distant from roads. Refer to Appendix C for a map showing the measurement position.

During the attended measurement, a fresh breeze (gusting above 5 m/s) was blowing from the north. Thus, the wind conditions were slightly outside the normal parameters for measuring noise.

Tables 2 and 3 summarise the attended and logged measurement results. Refer to Appendix C for sample logged data, including a graph depicting the 24-hour period for 5 January 2022.

Table 2: Measured Ambient Noise Levels (attended)

Measurement Position	Measurement		Measured Level (dB) (1)			Noise Source (2)
	Start Date / Times	Duration min:sec	L_{Aeq}	L_{A90}	L_{AFmax}	
600m SW of Wellington Rd	19 Dec 2021 6:22 pm	7:20(3)	42	34	61	Breeze, birds, distant traffic, electric fence, cattle, and voices (occasional)

Notes to Table 2:

(1) An explanation of technical terms is provided in Appendix A
(2) The controlling noise sources are underlined
(3) The measurement stabilised but was cut short due to wind gusts outside the normal parameters for measuring noise.

As shown in Table 2, the attended measured ambient noise level was 42 dB L_{Aeq} and the background level was 34 dB L_{Aeq}. At the time of the measurement, the dominant noise sources were a fresh breeze and birds. Other noise sources were distant traffic, an electric fence clicking, voices (occasional) and cattle (occasional).

Table 3: Measured Ambient Noise Levels (logged) - Analysed period: 2 to 7 January 2022 (5 days)

Overall Measured Levels (dB) by Period											
0700 to 2200 hours			2200 to 0700 hours			2200 to 0500 hours			0500 to 0700 hours		
L_{Aeq}	L_{A95}	L_{AFmax}	L_{Aeq}	L_{A95}	L_{AFmax}	L_{Aeq}	L_{A95}	L_{AFmax}	L_{Aeq}	L_{A95}	L_{AFmax}
45	30	80	53	26	74	36	25	59	59	34	74

As shown in Table 3, the daytime logged ambient level was 45 dB L_{Aeq} and the background level was 30 dB L_{A95}. These levels correlate with the attended measurement. The prescribed District Plan night-time (2200 to 0700) ambient noise level was eight decibels higher than the daytime noise level. This is explained by the dawn chorus occurring from approximately 5am. This was confirmed by sample audio recordings made by the logger. Refer to Appendix C for 15-minute summary data for the night-time period.

For assessing effects, we consider that data for the period 2200 to 0500 hours better represents the prescribed night-time period. We have used the following ambient and background noise data (derived from the logged data) in this assessment.

- Daytime: 45 dB L_{Aeq} and 30 dB L_{A95}.
- Night-time: 36 dB L_{Aeq} and 25 dB L_{A95}.

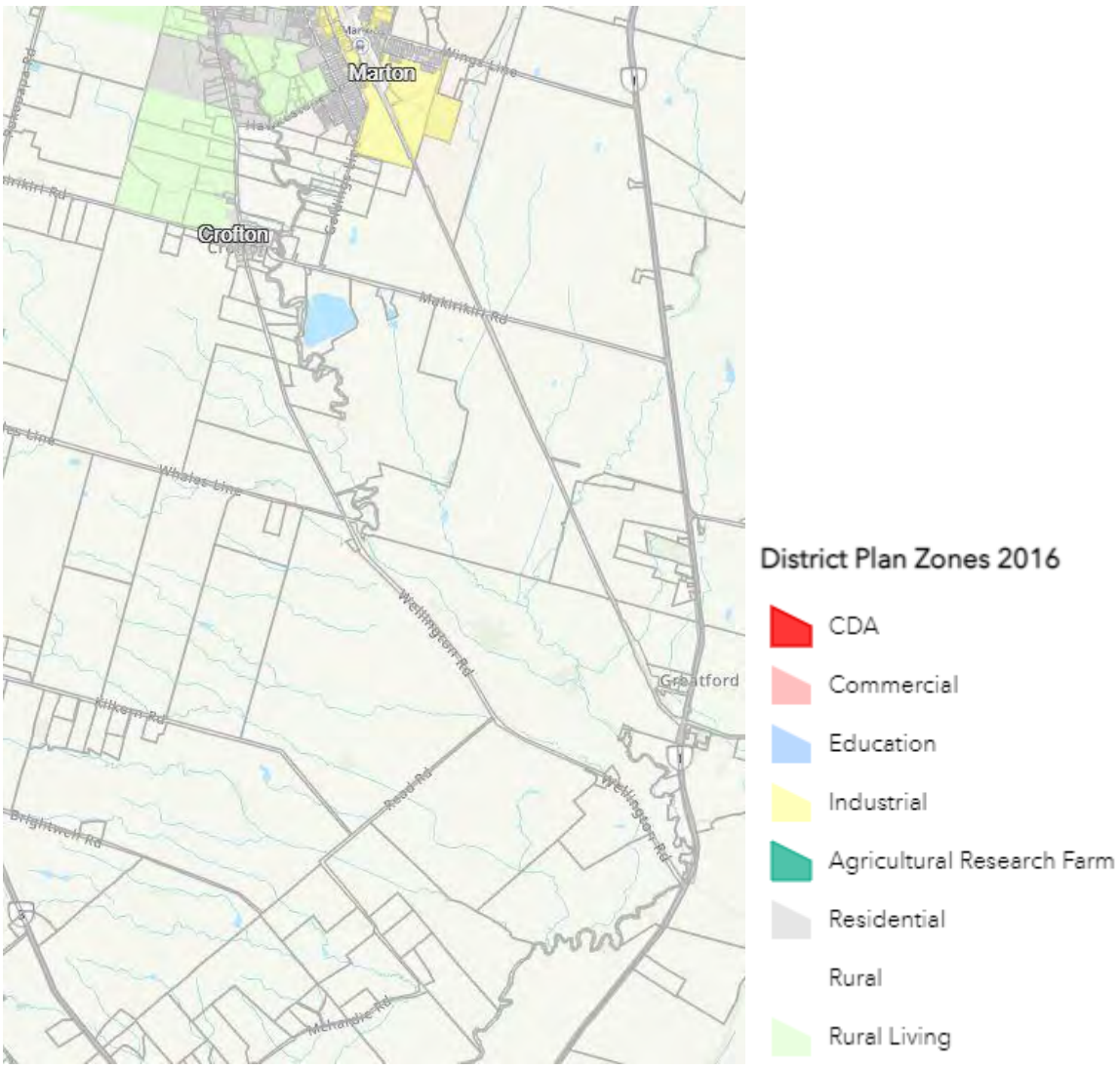
5.0 NOISE PERFORMANCE STANDARDS

The Rangitikei District Council – Operative District Plan – Updated 6 July 2018 (District Plan) provides the appropriate zoning and noise assessment standards for the site.

5.1 Zoning

Figure 3 shows zoning at the application and neighbouring sites. The application site is situated on land zoned *Rural* (depicted without a colour), as are the surrounding sites.

Figure 3: Site Zoning



5.2 Noise Standards

Section B1.7 of the District Plan provides permitted activity noise standards for the *Rural* zone. They are summarised below and reproduced in Appendix E.

The relevant limits are:

- 50 dB $L_{Aeq(15min)}$ from 0700 to 2200 hours
- 45 dB $L_{Aeq(15min)}$ and 70dB L_{AFmax} from 2200 to 0700 hours.

The relevant limits apply at the notional boundary of another site in the *Rural* zone.

5.3 Measurement and Assessment Standards

The District Plan states that sound levels shall be measured and assessed in accordance with *NZS 6801:2008 Acoustics – Measurement of Environmental Sound* and *NZS 6802:2008 Acoustics – Environmental Noise.*

The District Plan states that construction noise should comply with NZS 6803: 1999 *Acoustics - Construction Noise*.

5.4 Resource Management Act

Under the provisions of the Resource Management Act (RMA) there is a duty to adopt the best practicable option to ensure that noise (including vibration[5]) from any development does not exceed a reasonable level. Specifically, Sections 16 and 17 reference noise effects as follows.

Section 16 states that "every occupier of land (including any premises and any coastal marine area), and every person carrying out an activity in, on, or under a water body or the coastal marine area, shall adopt the best practicable option to ensure that the emission of noise from that land or water does not exceed a reasonable level".

Section 17 states that "every person has a duty to avoid, remedy, or mitigate any adverse effect on the environment arising from an activity carried on by or on behalf of the person, whether or not the activity is in accordance with –

(a) Any of sections 10, 10A, 10B and 20A; or

(b) A national environmental standard, a rule, a resource consent, or a designation".

6.0 OPERATIONAL NOISE LEVELS

6.1 Noise Sources and Modelling Methodology

The main noise sources from the proposed solar farm would be the inverters and the battery storage system. Tracker motors and the transformer have also been considered for this assessment, although these sources would generate lower noise levels.

We prepared a noise model using SoundPLAN® environmental noise modelling which takes into account factors such as the terrain, screening by buildings, and ground effect. Calculations have been carried out using ISO 9613-2:1996 "*Acoustics - Attenuation of sound during propagation outdoors - Part 2: General method of calculation*".

The following sound power data (Table 4) has been used in the preparation of our noise model. Data has relied on advice given by the manufacturers or from previous measurements carried out by Marshall Day Acoustics. Energy Farms Ltd. must confirm this data with suppliers prior to final procurement of power infrastructure.

[5] RMA 1991 Part 1 Section 2 Interpretation: Noise includes vibration

As discussed in Section 3.1, limited manufacture's data is available for solar farm inverters, but all show tonal characteristics at various frequencies. We consider it essential for final selection of the inverters to include a detailed analysis of the tonal character. Final selection should be made to avoid and/or mitigate tonal characteristics as far as practicable as even at low noise levels, tonal properties can have a negative effect on acoustic amenity at neighbouring sites.

We understand that inverter noise levels will reduce at low loads. A reduction in sound power level of four decibels has been allowed for at 10% power output.

When the solar farm is generating electricity, we expect that the inverters will work at low power during times of low solar gain (early morning / evening) and at full power during times of high solar gain. When the solar farm is importing / exporting electricity between the battery storage system and the grid (including during the night), we have allowed for the inverters to operate at full power.

As discussed in Section 3.1, manufactures data for the Tesla 3MW powerpack units (or other measurement data specific to these units) was unable to be obtained. This assessment is based on data derived from other types of battery storage units. Energy Farms Ltd. must confirm this data with suppliers prior to final procurement of power infrastructure.

A battery storage system building is part of the proposal but is yet to be designed. We have assumed that it would provide a minimum sound attenuation of 10 decibels.

Table 4: Sound Power Levels

Noise Source	Sound Power Level dBA re 10^{-12} Watts	Number of Units	Directivity	Operation time
DC / AC inverter	**AC end** 92 @ 100% load 88 @ 10% load **DC end** 86 @ 100% load 82 @ 10% load	15	Included	Daylight and Night-time hours
Tracker modules	76 (emission when moving) = 98 (total L_w for all trackers)	2360	None	68 seconds movement every 15 minutes – daylight hours
Transformer	78	1	None	Daylight and night-time hours
Batteries	92	7	None	Daylight and night-time hours

6.2 Noise Level Calculations

Noise levels have been calculated at the notional boundaries of the nearest compliance receivers.[6] The noise levels have been calculated under meteorological conditions that are favourable to sound propagation[7] and represent the 'worst case' situation.

[6] Noise levels for properties that are unbuilt (without a dwelling) have been calculated near the legal boundary. As these properties do not have a dwelling, they are not compliance locations. Results are reported for informational purposes.

[7] These are set out in ISO9613-2 and represent downwind or temperature inversion conditions.

It is important to note that under most daytime metrological conditions, noise levels will be lower than calculated. This is because when the solar farm is operating at full generation, it will be during periods of high solar gain (typically during the middle part of the day). In general, high solar gain conditions correspond with conditions that are not favourable to sound propagation as sound will refract upward when air temperatures reduce with increasing altitude (temperature lapse). In temperature lapse conditions, noise levels are expected to be around five decibels lower than calculated for the temperature inversion condition.

Inverter units will likely have appreciable directivity; however, as their orientation is unknown, we have undertaken calculations for all directions (north, south, east, and west) and have reported the worst-case result for each receiver position.

Calculations take into consideration a special audible character[8] correction in accordance with NZS 6802:2008. In accordance with the District Plan $L_{Aeq(15min)}$ noise rule, as the solar farm could potentially operate for more than 80% of the prescribed daytime period (particularly during summer), and as it would also operate at night, no duration correction has been applied.

Results are given in Table 5.

Table 5: Calculated Noise Levels

Receiver Location	District Plan daytime / night-time Noise Limit dB $L_{Aeq(15-min)}$	100% LOAD Calculated Noise Level dB $L_{Aeq(15-min)}$	10% LOAD Calculated Noise Level dB $L_{Aeq(15-min)}$
Compliance Receivers:			
45 Whales Line	50 / 45	35	31
95 Whales Line	50 / 45	30	26
157 Whales Line	50 / 45	24	20
1448 Wellington Rd	50 / 45	25	21
1547 Wellington Rd	50 / 45	38	34
1671 Wellington Rd	50 / 45	37	33
1760 Wellington Rd	50 / 45	32	28
1786 Wellington Rd	50 / 45	27	23
1817 Wellington Rd	50 / 45	26	22
1844 Wellington Rd	50 / 45	28	24
69 Stantialls Rd	50 / 45	24	20
518 SH3	50 / 45	31	27
79 Brightwell Rd	50 / 45	23	19
196 Kilkern Rd	50 / 45	30	26
262 McHardie Rd	50 / 45	29	25
275 McHardie Rd	50 / 45	28	24
291 McHardie Rd	50 / 45	31	27

[8] Spectral data shows potential tonality; therefore, a five-decibel special audible character penalty has been applied.

Receiver Location	District Plan daytime / night-time Noise Limit dB $L_{Aeq(15\text{-}min)}$	100% LOAD Calculated Noise Level dB $L_{Aeq(15\text{-}min)}$	10% LOAD Calculated Noise Level dB $L_{Aeq(15\text{-}min)}$
Other Receivers (results report for informational purposes only):			
Lot 1 DP 73628	50 / 45	40	36
1500 Wellington Rd	50 / 45	38	34
203 Markirikiri Rd	50 / 45	34	30
121 Read Rd	50 / 45	35	31

As per Table 5, our calculations show that for the compliance receivers:

- the proposal would readily comply with the daytime limit of 50 dB $L_{Aeq(15\ min)}$
- the proposal would readily comply with the night-time limit of 45 dB $L_{Aeq(15\text{-}min)}$
- calculated noise levels are less than the measured average daytime ambient level (45 dB L_{Aeq}) by at least seven decibels
- calculated noise levels are higher than the measured daytime background noise level (30 dB L_{A95}) at six receivers
- calculated noise levels are less than the measured night-time ambient noise level (36 dB L_{Aeq}) at most receivers but one or two decibels higher at two receivers
- calculated noise levels are within range of, or higher than, the measured night-time background noise level (25 dB L_{A95}) at most receivers
- dwellings receiving the highest noise levels are: 45 Whales Line, 1574 Wellington Rd, and 1671 Wellington Road.

Operational traffic is not expected to be significant. Occasional movements to the solar farm would not risk breaching the day-time noise rule. Heavy vehicle movements are not expected to occur during the night period.

7.0 NOISE LEVEL DISCUSSION

Noise from the solar farm would be low overall and within all national and international guidelines for environmental noise levels that are typically applied within New Zealand.

The proposed solar farm is expected to operate during the daytime and night-time and is calculated to comply with the Rangitikei District Plan noise rules at all existing notional boundaries.

During the daytime, calculated solar farm levels are substantially less than the measured ambient noise level but are higher than the measured background noise level at six receivers. It is likely that the solar farm would be just audible at times at near receivers during the daytime. However, given the low overall noise level from the solar farm, daytime solar farm noise levels are considered to be reasonable and would have little effect on amenity.

During the night-time, calculated solar farm levels are within range of or slightly higher than the measured ambient noise level at three receivers (45 Whales Line, 1574 Wellington Rd, and 1671 Wellington Road), and within range of, or higher than, the measured background noise level at most near receivers. Therefore, the solar farm is expected to be audible / readily audible at night particularly at the closest three receivers. Noise from the solar farm would be more noticeable and annoying if the sound sources (e.g., inverters) are appreciably tonal. As discussed in Sections 3.0 and 7.0, we consider that final selection of mechanical plant should avoid and/or mitigate tonal

characteristics as far as practicable. If tonality is well controlled, there is considered to be little risk of annoyance arising.

Taking into account the above discussion and provided that the tonal character of the proposed mechanical plant (including the inverters) can be avoided and/or mitigated, we consider that overall, the solar farm would be reasonable in terms of the RMA.

8.0 CONSTRUCTION NOISE LEVELS

Construction of the solar farm is likely to involve the following:

- delivery of panels, inverters and other infrastructure, requiring trucks and small cranes
- some earthworks using trucks, loaders and excavators
- a piling rig to drive the support piles into the ground. These may be hammered, vibropiled or bored depending on ground conditions.

We have assumed that construction would take place over a period greater than 20-weeks and between the hours 7:30 to 18:00, Monday to Saturday. Therefore, the 'long-term duration' construction noise limits: 70dB L_{Aeq} and 85 dB L_{AFmax} would apply. The noise limits apply at 1m outside the façades of occupied buildings.

All significant equipment likely to be used on the project is listed in Table . The sound levels given are based on measurements made by Marshall Day Acoustics of similar plant or from BS 5228-1:2009 *Code of practice for noise and vibration control on construction and open sites* Part 1: Noise.

Table 6: Activity Specific Noise Levels at 1m from a building façade (without screening)

Item/Activity	Operating Sound Power Level (dB L_{WA})	Noise Level (dB L_{Aeq})				70dBA Limit Setback (m)
		90m	140m	200m	500m	
Large Trucks	108	61	56	52	43	40
Excavators and other earthmoving plant	106	59	54	50	41	33
Impact piling (no mitigation)	123	76	71	67	58	158
Impact piling (small or with dolly)	114	67	62	58	49	69
Vibropiling (excavator driving small piles)	106	59	54	50	41	33
Bored or screw piles (small rig)	103	56	51	47	38	25
Concrete truck & pump	103	56	51	47	38	25
Truck idling	91	44	39	35	26	6

The site area (works area) is at least 90 m from the façades of surrounding sensitive receivers (dwellings). Approximate distances to sensitive façades closer than 160m are listed below:

- 1547 Wellington Road ~ dist. 90m
- 45 Whales Line ~ 140m

Table 6 shows that impact piling is within the 70 dB L_{Aeq} limit setback distance for one receiver. If impact piling is required, mitigation (a small piler or a dolly) should be used.

If any of the following are proposed, a construction noise and vibration management plan may be necessary to assess and manage construction effects on near receivers:

- impact piling within the setback distances given in Table 6
- construction outside the hours 07:30 to 18:00, Monday to Saturday
- significant construction equipment additional to that listed in Table 6.

9.0 RECOMMENDED NOISE CONDITIONS

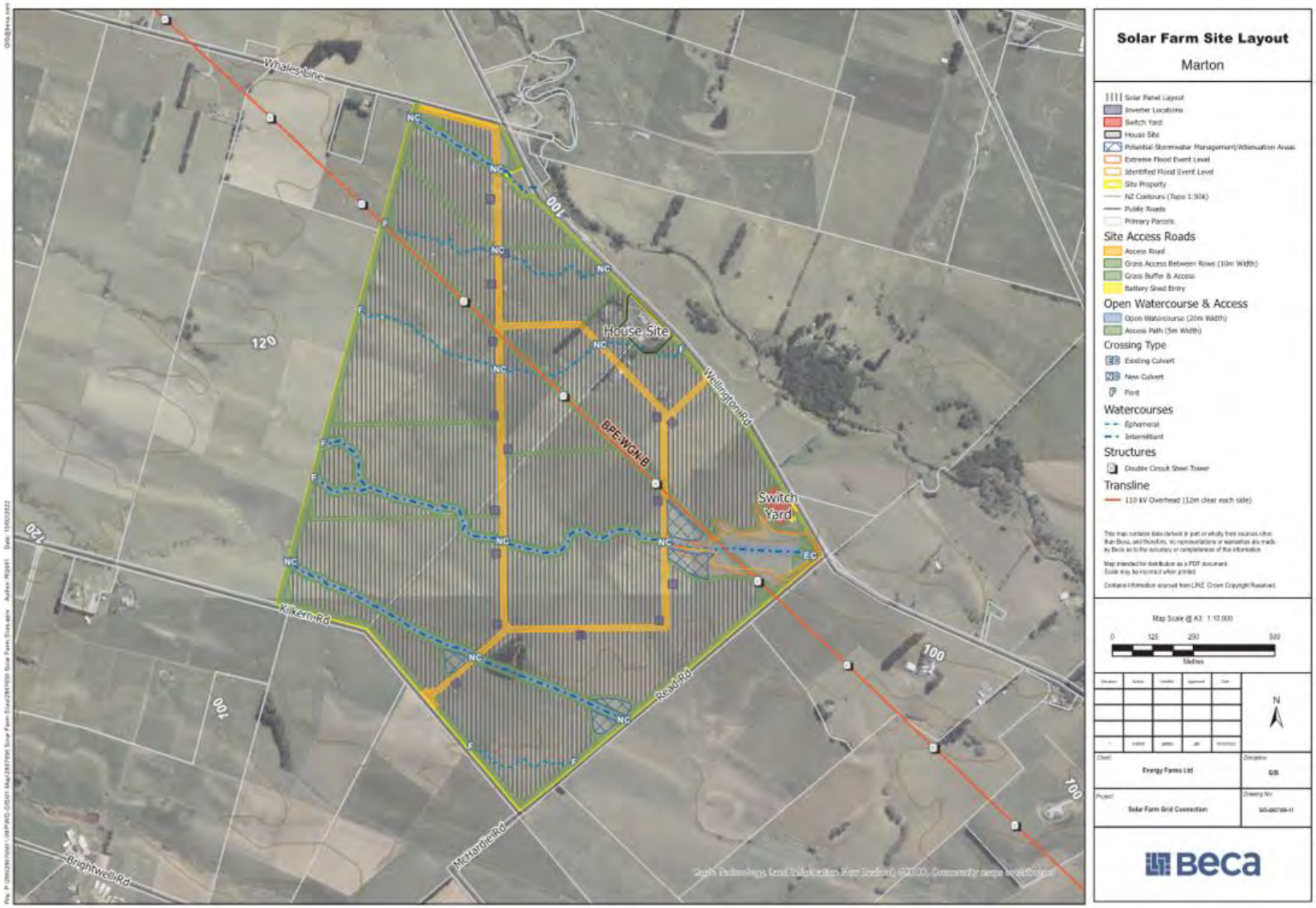
It is recommended that the following noise conditions are imposed on any consent granted.

1. The noise level from all operation of the solar farm shall meet the following District Plan noise limits at the notional boundary of any existing dwellings on another site in the *Rural* zone:
   - 50dB $L_{Aeq(15min)}$ from 0700 to 2200 hours
   - 45dB $L_{Aeq(15min)}$ and 70dB L_{AFmax} from 2200 to 0700 hours
2. Noise levels shall be measured and assessed in accordance with *NZS 6801:2008 Acoustics – Measurement of Environmental Sound* and *NZS 6802:2008 Acoustics – Environmental Noise.*
3. Noise from construction activities shall, as far as practicable, not exceed the limits recommended in, and shall be measured and assessed in accordance with, New Zealand Standard NZS 6803: 1999 *"Acoustics – Construction Noise".* Where exceedances of the guidelines in this standard are identified as likely to occur, they shall be managed through a construction noise and vibration management plan and all practicable noise attenuation measures shall be implemented to reduce noise.
4. Upon final selection of the inverters, an assessment of noise tonality (as defined by NZS 6802:2008) and attenuation options (as necessary to mitigate tonality as far as practicable) shall be undertaken. The assessment shall be undertaken by a recognised acoustician and approved by council prior to commencement of construction.
5. During final design of the battery energy storage system (BESS), an assessment to confirm adequate attenuation of the BESS shall be undertaken. The assessment shall be undertaken by a recognised acoustician and approved by council prior to commencement of construction.

APPENDIX A GLOSSARY OF TERMINOLOGY

Ambient Noise	Ambient Noise is the all-encompassing noise associated with any given environment and is usually a composite of sounds from many sources near and far.
dBA	A measurement 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_{eq}	The time averaged sound level (on a logarithmic/energy basis) over the measurement period (normally A-weighted).
L_{90}	The sound level which is equalled or exceed for 90% of the measurement period. L_{90} is an indicator of the mean minimum noise level and is used in New Zealand as the descriptor for background noise (normally A-weighted).
L_{10}	The sound level which is equalled or exceeded for 10% of the measurement period. L_{10} is an indicator of the mean maximum noise level and is used in New Zealand as the descriptor for intrusive noise (normally A-weighted).
L_{AFmax}	The maximum sound level recorded during the measurement period (normally A-weighted).
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*"
Prescribed time frame	'Daytime', night-time', 'evening', or any other relevant period specified in any rule or national environmental standard or in accordance with 8.3.2 in NZS 6802:2008.

APPENDIX B PROPOSED SITE PLAN



Solar Farm Site Layout

Marton

Solar Panel Layout
Inverter Locations
Switch Yard
House Site
Potential Stormwater Management/Attenuation Areas
Extreme Flood Event Level
Identified Flood Event Level
Site Property
NZ Contours (Topo 1:50k)
Public Roads
Primary Parcels

Site Access Roads
Access Road
Grass Access Between Rows (10m Width)
Grass Buffer & Access
Battery Shed Entry

Open Watercourse & Access
Open Watercourse (20m Width)
Access Path (5m Width)

Crossing Type
Existing Culvert
New Culvert
Ford

Watercourses
Ephemeral
Intermittent

Structures
Double Circuit Steel Tower

Transline
110 kV Overhead (12m clear each side)

This map contains data derived in part or wholly from sources other than Beca, and therefore, no representations or warranties are made by Beca as to the accuracy or completeness of the information.

Map intended for distribution as a PDF document.
Scale may be incorrect when printed.

Contains information sourced from LINZ. Crown Copyright Reserved.

Map Scale @ A3: 1:12,000

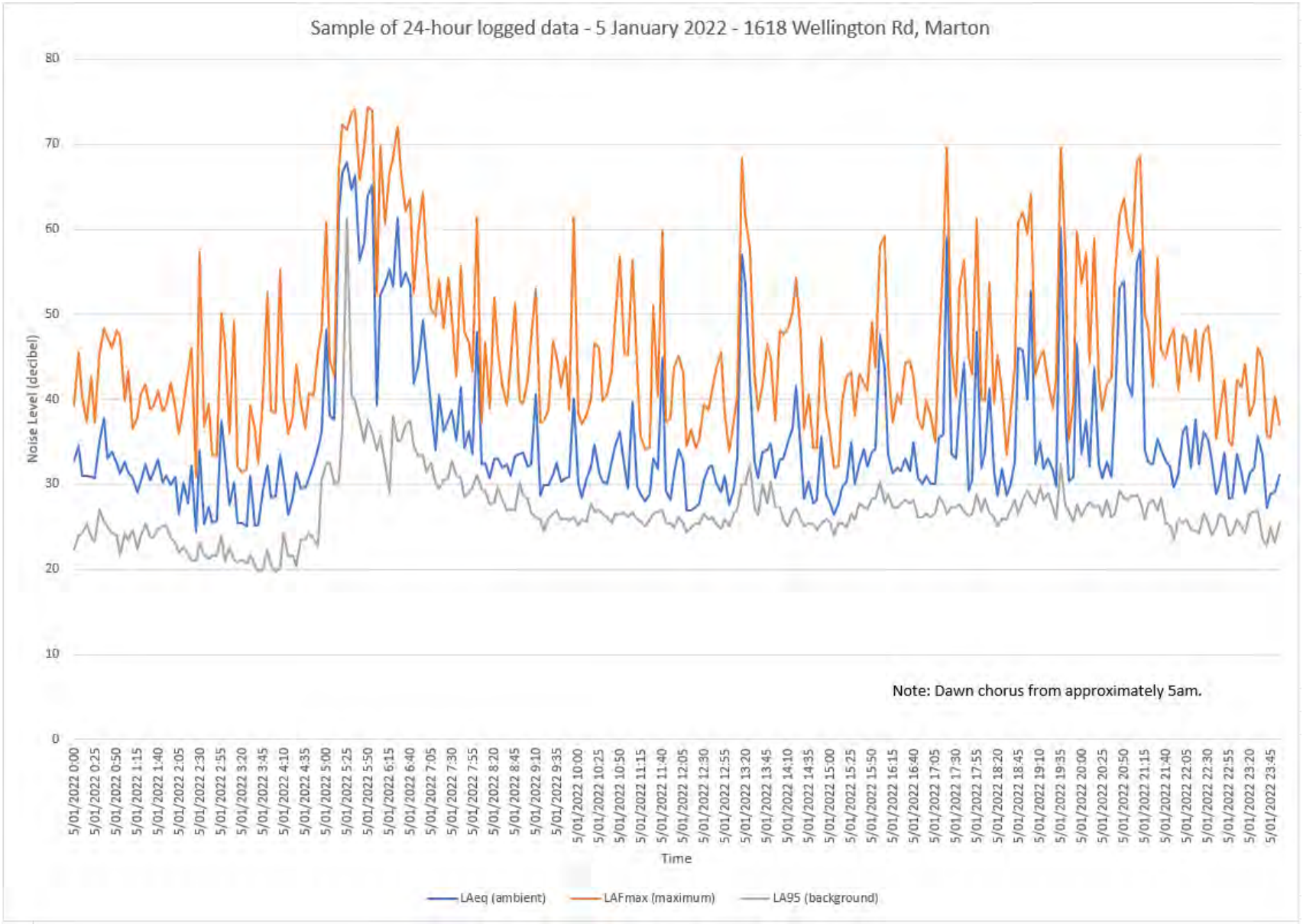
0 125 250 500
Metres

N

Client: Energy Farms Ltd
Discipline: GIS
Project: Solar Farm Grid Connection

Beca

APPENDIX C NOISE MEASUREMENT POSITION AND SAMPLE OF LOGGED RESULTS



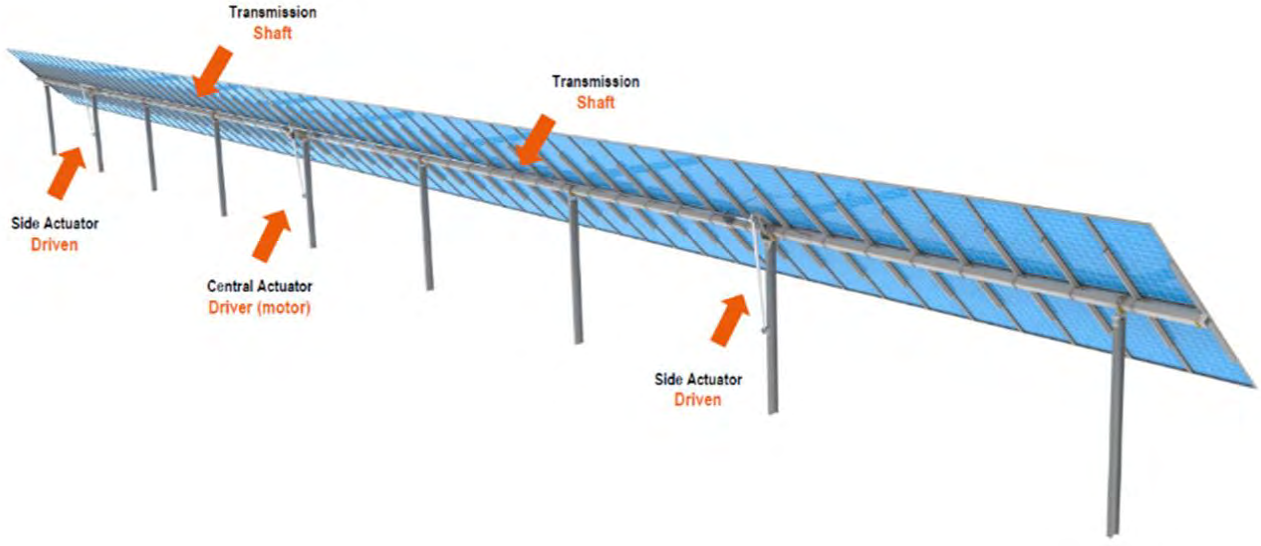
Prescribed District Plan Night (2200 to 0700) sample data for the 3/4, 4/5 and 5/6 of January 2022. Note that the dawn chorus significantly increases noise levels from approx. 0500 hours.

Period start	Leq	Lmax	L95
3/01/2022 22:00	31.8	44	24.4
3/01/2022 22:15	34	53.4	25.6
3/01/2022 22:30	34.3	47.2	25.4
3/01/2022 22:45	32	41.2	23.8
3/01/2022 23:00	35.4	48.2	23.7
3/01/2022 23:15	33.1	44.4	24.3
3/01/2022 23:30	33.2	48.5	24.8
3/01/2022 23:45	31.1	45.7	22.9
4/01/2022 0:00	35.5	48	23.6
4/01/2022 0:15	32.6	48.3	21.9
4/01/2022 0:30	31.4	45.3	20.7
4/01/2022 0:45	33.1	47.5	22.1
4/01/2022 1:00	30.6	43.6	22.7
4/01/2022 1:15	29.5	37.7	24.4
4/01/2022 1:30	34.1	48.7	24.8
4/01/2022 1:45	30.8	46.4	22.1
4/01/2022 2:00	37.7	56.7	23.7
4/01/2022 2:15	34.6	47.6	25.1
4/01/2022 2:30	30.7	42.1	21.8
4/01/2022 2:45	32.2	45.1	21.5
4/01/2022 3:00	32.3	40.9	24.3
4/01/2022 3:15	38.6	49.6	25.2
4/01/2022 3:30	35	48.9	22.9
4/01/2022 3:45	33.3	47.7	23.9
4/01/2022 4:00	33.1	50.3	22.9
4/01/2022 4:15	35.9	52.3	25.2
4/01/2022 4:30	33.3	44.5	25.8
4/01/2022 4:45	46.8	60.7	32.7
4/01/2022 5:00	50.7	63.2	29.6
4/01/2022 5:15	60.2	69.5	40.6
4/01/2022 5:30	64	75.2	38.4
4/01/2022 5:45	60.5	71.1	38.2
4/01/2022 6:00	56.7	73.6	35.8
4/01/2022 6:15	58.2	71.1	35.4
4/01/2022 6:30	55.3	69.9	36.1
4/01/2022 6:45	54.1	70.5	34.5
Overall	52.7	75.2	23.8

Period start	Leq	Lmax	L95
4/01/2022 22:00	30.3	39	25.4
4/01/2022 22:15	32.1	41.7	27
4/01/2022 22:30	31	42.9	26.7
4/01/2022 22:45	29.9	40.8	24.6
4/01/2022 23:00	31.8	41.9	26.5
4/01/2022 23:15	30.3	40.4	24.7
4/01/2022 23:30	32.9	43.5	25.3
4/01/2022 23:45	33.3	47.3	25
5/01/2022 0:00	33	45.5	23.4
5/01/2022 0:15	30.9	42.6	23.9
5/01/2022 0:30	35.7	48.4	25.5
5/01/2022 0:45	32.7	48.1	22.6
5/01/2022 1:00	31.7	43.4	23.9
5/01/2022 1:15	30.8	41.7	23.2
5/01/2022 1:30	31.7	41.1	24.3
5/01/2022 1:45	30.4	42	24.5
5/01/2022 2:00	29.6	39.3	22.4
5/01/2022 2:15	29.3	46.1	21.2
5/01/2022 2:30	30.5	57.3	21.7
5/01/2022 2:45	33.3	50.1	21.9
5/01/2022 3:00	31.1	49.2	21.2
5/01/2022 3:15	25.4	32.1	20.9
5/01/2022 3:30	28	39.3	20.2
5/01/2022 3:45	30.3	52.7	20.3
5/01/2022 4:00	31.3	55.2	20.3
5/01/2022 4:15	29.2	44.2	20.8
5/01/2022 4:30	30	40.7	23.6
5/01/2022 4:45	34.5	48.2	23.8
5/01/2022 5:00	44.2	60.8	31.1
5/01/2022 5:15	66.2	72.4	34.3
5/01/2022 5:30	64	74.1	38.3
5/01/2022 5:45	63.3	74.4	35.9
5/01/2022 6:00	51.2	69.7	33.5
5/01/2022 6:15	58	72.1	30.3
5/01/2022 6:30	53.9	66.7	36.2
5/01/2022 6:45	46.2	64.4	33.5
Overall	54.4	74.4	22.8

Period start	Leq	Lmax	L95
5/01/2022 22:00	35.5	47.6	25.2
5/01/2022 22:15	35.9	48.2	24.8
5/01/2022 22:30	33	48.6	24.8
5/01/2022 22:45	31.3	42.3	24.7
5/01/2022 23:00	31.6	42.2	24.7
5/01/2022 23:15	30.9	44.1	25.2
5/01/2022 23:30	33.4	46	23.5
5/01/2022 23:45	29.8	40.4	24.1
6/01/2022 0:00	28	36.1	23.1
6/01/2022 0:15	30.3	40.9	22.9
6/01/2022 0:30	29.6	40.5	23.6
6/01/2022 0:45	29.7	43.2	20.8
6/01/2022 1:00	31.3	44.9	24.4
6/01/2022 1:15	34.7	44.8	25.3
6/01/2022 1:30	33.7	44.4	26.5
6/01/2022 1:45	29.2	44.5	23.9
6/01/2022 2:00	29.6	42.2	23.1
6/01/2022 2:15	27.7	41.4	21.3
6/01/2022 2:30	29.9	46.5	22.8
6/01/2022 2:45	29.1	40.4	21.8
6/01/2022 3:00	29.1	42.4	22.2
6/01/2022 3:15	34	46.4	23.1
6/01/2022 3:30	32	44.7	24.3
6/01/2022 3:45	31.1	43.8	25.1
6/01/2022 4:00	32.4	42.9	26.6
6/01/2022 4:15	32.8	47	26.4
6/01/2022 4:30	33.5	41.8	28.2
6/01/2022 4:45	34.1	44.1	26.9
6/01/2022 5:00	50.2	65.2	29.1
6/01/2022 5:15	60.6	67.8	30.6
6/01/2022 5:30	63	70	32.2
6/01/2022 5:45	60.6	70.6	33.9
6/01/2022 6:00	57.1	73.1	35.2
6/01/2022 6:15	61.5	73.1	36.2
6/01/2022 6:30	44.2	60.5	34.2
6/01/2022 6:45	59.5	71.9	31.9
Overall	53.1	73.1	23.9

APPENDIX D TRACKER ARRANGEMENT



APPENDIX E RANGITIKEI DISTRICT PLAN NOISE RULES

B1.7 Noise

B1.7-1 Noise limits in the District are as follows:

ZONE	TIME	NOISE LIMITS
Rural, Rural Living and Residential Zones	Day time 7am – 10pm	50 dB LAeq(15min)
	Night time 10pm – 7am	45 dB LAeq(15min) 70 dB LAFmax
Education, Commercial and Industrial Zones	Day time 7am – 10pm	65 dB LAeq(15min)
	Night time 10pm – 7am	55 dB LAeq(15min) 75 dB LAFmax

B1.7-2 In the above table, noise from residential activities and from non-residential activities shall not exceed the tabulated noise limits –

a) At any point within any other site, other than a site in the Rural or Rural Living Zone.

b) At any point within the notional boundary* of any dwelling in the Rural or Rural Living Zone.

B1.7-3 Sound from any zone that is received in any other zone shall comply with the noise limits in the most sensitive noise zone.

B1.7-4 Sound 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. Noise from sources outside the scope of these standards shall be measured and assessed in accordance with the relevant New Zealand Standards.

B1.7-5 The above noise limits do not apply to the noise from the following sources:

a) Sounds from mobile primary production* related noise sources, stationary primary production* equipment such as pumps and generators and all animal sounds (excluding those arising from intensive farming and animal boarding activities or percussive bird scaring devices or wind machines used for frost damage mitigation.)

b) Warning devices used by emergency services.

c) In any part of the District, a recreational or entertainment event, limited to one event per year per site, that is open to the public and held between the hours of 8am and 11pm.

d) Temporary military activities which are provided for in section B 1.13.

e) In the Residential Zone, activities of a normal domestic nature including recreational activities such as sporting events, provided that these activities do not involve powered motorsport, powered aviation, gunfire or amplified music.

B1.7-6 All noise emitted in the course of construction work must comply with NZS6803:1999 Acoustics – Construction Noise.

APPENDIX F CONSTRUCTION NOISE RULES (NZS6803:1999)

NZS6803:1999 sets out the following noise limits:

"Residential zones and dwellings in rural areas:

Table 2 – Recommended upper limits for construction noise received in residential zones and dwellings in rural areas

Time of week	Time period	Duration of work					
		Typical duration (dBA)		Short-term duration (dBA)		Long-term duration (dBA)	
		L_{eq}	L_{max}	L_{eq}	L_{max}	L_{eq}	L_{max}
Weekdays	0630-0730	60	75	65	75	55	75
	0730-1800	75	90	80	95	70	85
	1800-2000	70	85	75	90	65	80
	2000-0630	45	75	45	75	45	75
Saturdays	0630-0730	45	75	45	75	45	75
	0730-1800	75	90	80	95	70	85
	1800-2000	45	75	45	75	45	75
	2000-0630	45	75	45	75	45	75
Sundays and public holidays	0630-0730	45	75	45	75	45	75
	0730-1800	55	85	55	85	55	85
	1800-2000	45	75	45	75	45	75
	2000-0630	45	75	45	75	45	75

"Industrial or commercial areas:

Table 3 – Recommended upper limits for construction noise received in industrial or commercial areas for all days of the year

Time period	*Duration of work*		
	Typical duration	***Short-term duration***	***Long-term duration***
	L_{eq} (dBA)	*L_{eq} (dBA)*	*L_{eq} (dBA)*
0730-1800	*75*	*80*	*70*
1800-0730	*80*	*85*	*75*

Notes in the standards to the tables above:

7.2.5

The night time limits in Table 2 shall apply to activities carried out in industrial or commercial areas where it is necessary to prevent sleep interference, specifically where there are residential activities, hospitals, hotels, hostels, or other accommodation facilities located within commercial areas. The limits in Table 2 may also be used to protect other specific noise sensitive activities at certain hours of the day.

7.2.6

One major factor which should be considered is whether there is a relatively high background sound level (L_{90}) due to noise from sources other than construction work at the location under investigation. In such cases limits should be based on a determination of the existing level of noise in the area (a "background plus" approach).

7.2.7

Where there is no practicable method of measuring noise outside a building, the upper limits for noise measured inside the building shall be the levels stated in tables 2 and 3 minus 20 dBA. This is considered to be a typical value for the sound reduction normally achieved in New Zealand buildings with doors and windows closed."