

Appendix J Noise and Vibration Impact Assessment Report

Resonate

Darroobalgie Solar Farm

EIS Noise and Vibration Assessment

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Glossary

EPA	Environment Protection Authority
EIS	Environmental Impact Statement
ICNG	Interim Construction Noise Guideline
NML	Noise Management Level
NPI	Noise Policy for Industry
NSW	New South Wales
OOHW	Out-of-Hours Work
PPV	Peak Particle Velocity
Project area	Refers to the solar farm, switchyard and electrical transmission line
RBL	<p>The RBL is the overall single figure background level representing each assessment period (day, evening and night) over the whole monitoring period (as opposed to over each 24-hour period used for the ABL). This is the level used for assessment purposes. It is the median value of:</p> <ul style="list-style-type: none">• All the day assessment background levels over the monitoring period for the day;• All the evening assessment background levels over the monitoring period for the evening; or• All the night assessment background levels over the monitoring period for the night.
RNP	Road Noise Policy
SPL	Sound Pressure Level
SWL	Sound Power Level
TfNSW	Transport for NSW
The Project	The Darroobalgie Solar Farm Project comprises of a solar farm site (consisting of approximately 420,000 solar photovoltaic (PV) panels and associated infrastructure), an electricity transmission line (ETL) and switchyard site (the Project).
VC	Generic Vibration Criterion
VDV	Vibration Dose Values
VML	Vibration Management Level

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Executive Summary

Resonate Consultants Pty Ltd was engaged to assess the noise and vibration impacts from the construction and operation of the proposed Daroobalgie Solar Farm and investigate appropriate mitigation options to allow for compliance with the relevant noise and vibration limits.

The proposal is to develop a large scale solar photovoltaic generation facility and associated infrastructure in the local government area of Forbes in NSW.

Construction noise and vibration

Construction activities associated with the proposed Daroobalgie Solar Farm would be carried out during standard construction daytime periods. Exceptions may be staff arriving and leaving site and the delivery of large solar farm components. Any activity outside normal construction hours would only be undertaken in accordance with approvals from relevant authorities. The predicted construction noise impacts at surrounding residential receivers (within 5 km radius from the boundaries of the Project area) are assessed to be:

- well within the Project noise management levels and the Interim Construction Noise Guideline highly noise affected level during Stages 1 to 6 construction works.
- in exceedance of the Project noise management levels during Stage 7 and Stage 8 construction works.
- well within the Interim Construction Noise Guideline highly noise affected level for all stages of the Project's construction works.

Based on this assessment, additional noise management or mitigation measures are considered to be necessary during Stages 7 and 8 construction of the Project. Stages 7 and 8 works refers to the construction of the electricity transmission line and the switchyard respectively.

Construction road traffic impacts are likely to achieve compliance with the Road Noise Policy noise criteria.

Construction vibration impacts are considered unlikely to exceed structural and human annoyance vibration limits due to the intervening distances between the Project area and surrounding receivers.

Operational noise and vibration

The predicted noise levels of the solar farm during standard operations at all surrounding residential receivers have been assessed to achieve compliance with the Noise Policy for Industry daytime, evening and night-time noise criteria.

Operational road traffic noise impacts are expected to comply with the Road Noise Policy noise criteria.

Vibration intensive activities or the usage of vibration intensive plant/equipment are unlikely to occur during standard operations. Therefore, operational vibration impacts are not anticipated.

1 Introduction

Resonate Consultants Pty Ltd (Resonate) has been engaged by SMEC Australia Pty Ltd (SMEC) on behalf of Pacific Hydro Australia Developments Pty Ltd (Pacific Hydro) to prepare a noise and vibration impact assessment for the proposed Daroobalgie Solar Farm (the Project).

1.1 Scope and objectives

The purpose of this report is to provide a noise and vibration impact assessment for the Project that addresses the Secretaries Environmental Assessment Requirements for the EIS which includes:

Noise – including an assessment of the construction noise impacts of the development in accordance with the Interim Construction Noise Guideline (ICNG), operational noise impacts in accordance with the NSW Noise Policy for Industry (2017), cumulative noise impacts (considering other developments in the area), and a draft noise management plan if the assessment shows construction noise is likely to exceed application criteria.

The objectives of this study were to:

- 1) Establish noise level design goals (criteria) for environmental noise emissions at potentially noise affected sensitive receivers surrounding the Project area;
- 2) Determine all acoustically significant plant required for the construction and operation of the solar farm to predict noise at the nearest potentially affected noise sensitive receivers within the vicinity of the solar farm; and
- 3) From results of the noise predictions, assess noise levels from proposed construction and future operations relative to the noise criteria at the nearest potentially affected receivers.
- 4) Based on the noise assessment, develop feasible and reasonable noise and vibration mitigation measures for the Project.

Specific acoustic terminology is used within this report. An explanation of common terms is included in Appendix A.

1.2 Relevant guidelines

The noise and vibration guidelines for construction and operations are based on the publications managed by the New South Wales (NSW) Environment Protection Authority (EPA). The EPA guidelines applicable to this assessment include:

- Construction Noise – *Interim Construction Noise Guideline* (DECC 2009);
- Construction Road Traffic Noise – *Road Noise Policy* (DECCW 2011); and
- Operational Noise – *Noise Policy for Industry* (EPA 2017).

2 Project Description and Locality

2.1 The proposal

The Daroobalgie Solar Farm Project comprises of a solar farm site (consisting of approximately 420,000 solar photovoltaic (PV) panels and associated infrastructure), an electricity transmission line (ETL) and switchyard site (the Project). Pacific Hydro is seeking to develop the Project which is a renewable energy development. The Project is located 11 km north-east of Forbes and 300 km north-west of Sydney in Forbes Shire Council, New South Wales.

The Project is a State Significant Development (SSD) under the State Environmental Planning Policy (State and Regional Development) 2011. As a SSD, an application for the Project is required to be submitted under Part 4, Division 4.1 of the NSW *Environmental Planning and Assessment Act 1979*. The NSW Minister for Planning (or the Minister's delegate) is the consent authority.

The Project is expected to have a generating capacity of approximately 100 Megawatts (MW), enough to power roughly 34,000 homes annually. Some of the key components of the Project relevant to the noise and vibration impact assessment are:

- The Daroobalgie Solar Farm proposal will consist of approximately 420,000 solar photovoltaic (PV) panels and associated infrastructure (i.e. substation, battery storage area, inverters, power cabling, site offices, car parking and new access tracks). Once installed the Daroobalgie Solar Farm will have a capacity to generate 100 MW.
- Transmission line extension to connect the solar farm into the NEM grid which will require potentially installing the transmission line over the Newell Highway.
- A switchyard will be constructed at a location approximately 8 km west of the solar farm site where the transmission line will connect into the Parkes-Forbes 132kV line.
- The construction of the Project will take approximately 12-18 months from commencement of site works and will involve approximately 320 personnel.
- The primary access route will be via Troubalgie Road. Troubalgie Road primarily services local traffic and agricultural operations, which is an unpaved single carriage local road.
- Troubalgie Road can be accessed from the Newell Highway (HW17) via either Back Yamma Road or Forest Road (both local roads).
- Haulage routes being considered at this stage are: from the north via Blue Mountains-Orange or from the south via Yass and Forbes, and
- The Daroobalgie Solar Farm will consider the use of rail for haulage of shipping containers to deliver solar panels and other components, via the Stockinbingal-Parkes railway line.

2.2 Locality

The Project is in the Forbes Shire Council Local Government Area (LGA) of central western New South Wales.

The proposed solar farm site is located approximately 11km northeast of Forbes. The site is approximately 300 hectares (Ha) on land legally described as Lot 77 in Deposited Plan 750183. The solar farm site will be accessed by Troubalgie Road to the immediate north of the Project area.

The topography of the proposed solar farm site is generally uniform with an average elevation of 240 metres (m) above the Australian Height Datum (AHD). The land is largely cleared, having been highly modified by past disturbances associated with land clearing, cropping, and livestock grazing. A number of dams are present within the solar farm site and a natural watercourse runs to the east of the property boundary, intersecting the site in the southeast corner. Small ephemeral waterholes, known locally as gilgai, are present in some paddocks, predominately in the south-eastern section of the site. These have been progressively ploughed and levelled by farming activities over time.

The surrounding land use is predominately agricultural, and the Forbes Livestock Exchange is located on Back Yamma Road, 2.5km to the west of the site. Back Yamma State Forest is situated 7km to the east at an elevation of 340 m AHD, and the closest National Park is Goobang National Park, 30km to the northeast. The Lachlan River runs approximately 3.5km from the southern boundary of the site.

There are no residential dwellings within the proposed site and the nearest dwelling is located approximately 600m to the northwest of the western boundary. There are eight existing dwellings within 3km of the site. The Newell Highway runs north-south, 5.5km to the west of the proposed site.

The proposed ETL connects the solar farm site to the switchyard site located near the existing Forbes-Parkes 132kV transmission line. The ETL is approximately 8.5km long and traverses a number of private properties and road reserves.

The proposed switchyard site is located approximately 5.5km north of Forbes on Lot 14 in Deposited Plan 750158. The switchyard site is adjacent to the existing Forbes-Parkes 132kV transmission line located approximately 500m west of the Newell Highway. It will be accessed from Daroobalgie Road.

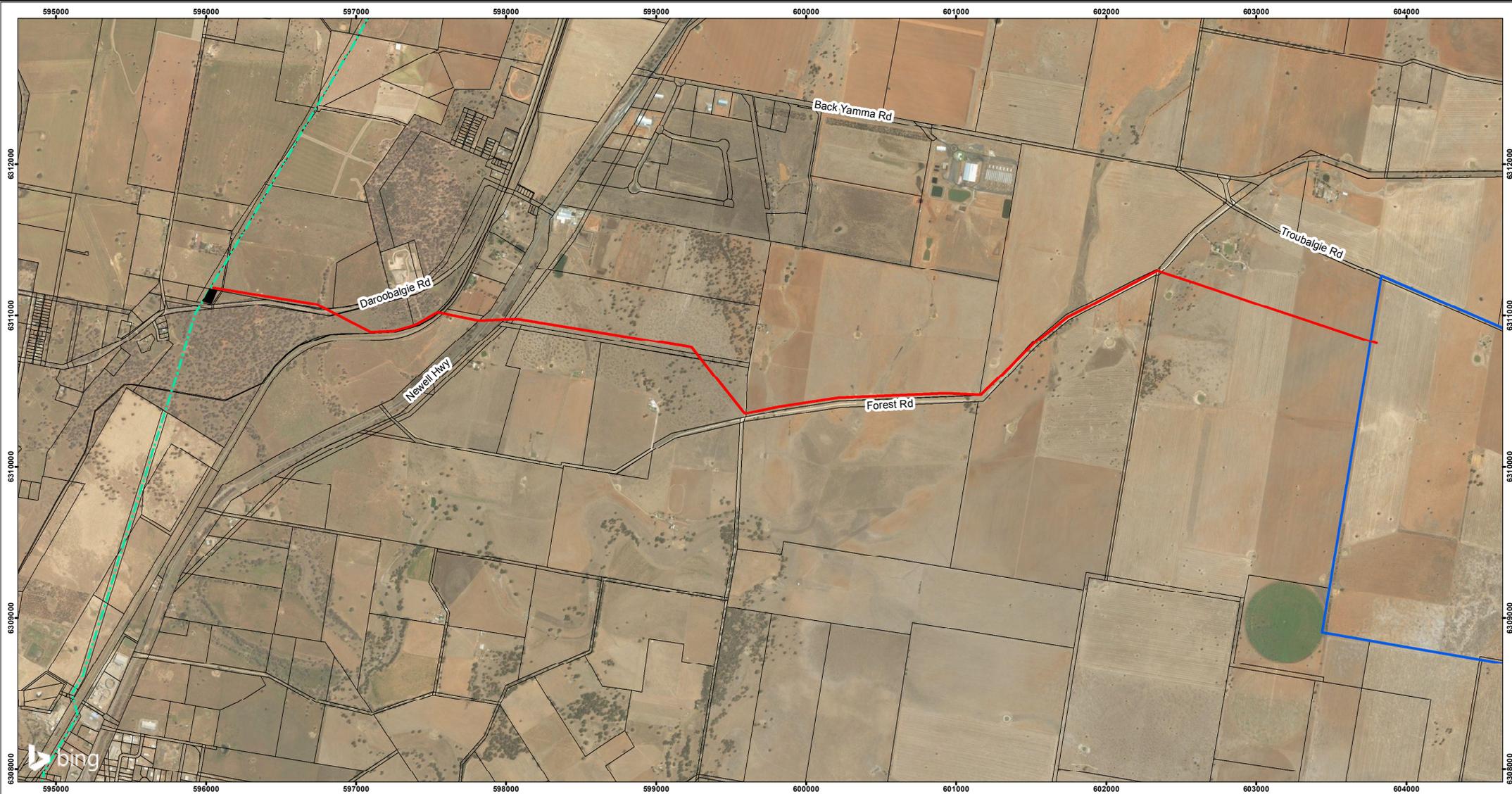
An indicative layout of the solar farm site is shown in Figure 1. Figure 2 shows the proposed ETL route and switchyard site. The project and its location to surrounding receivers are shown in Figure 3.



PROJECT		Daroobalgje, Australia	
TITLE		Project Layout: Core Development Area	
FOR EXTERNAL DISTRIBUTION			
<small>Maps marked "Internal Use Only" contain information that is of a private and confidential nature. These maps may only be distributed to, and viewed by, current Pacific Hydro Employees.</small>		CREATED	M. Yee
		CLEARED	K. Munro
<small>Maps marked "For External Distribution" have been checked and approved for release for information purposes as at the date shown on the map. A Responsible Manager must approve release of these maps on any other date.</small>		APPROVED	B. Martins
		DATE	04/03/21
		SCALE	1:10,000
		DATUM	MGA94 (z55)
		DRAWING NO.	PH-1538
		REV.	A

- Core development area boundary
- Solar PV arrays
- Substation
- Battery Energy Storage System (BESS)
- O&M Compound
- Construction Laydown Area
- Power Conversion Unit (PCU)
- Proposed Electricity Transmission Line
- Access Track
- Waterway
- Public Road
- Cadastral boundary

Figure 1 Core development area site location



- Transmission Line Route
- Solar Farm Site Boundary
- Proposed Switchyard
- - - Existing 132kV Transmission Line
- Cadastral Boundary

Figure 2 Proposed ETL route

PROJECT Daroobalgie, Australia		
TITLE Transmission Line Route FOR EXTERNAL DISTRIBUTION		
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	CLEARED K. Munro	
APPROVED B. Martins	DATE 16/02/21	
SCALE 1:25,000		A3
COORDINATE SYSTEM MGA94 (55S)		
DRAWING NO. PH-1533	REV A	

2.3 Noise sensitive receivers

The closest potentially impacted residential receivers identified in the vicinity of the Project area are listed in Table 1 and are shown in Figure 3.

Table 1 Nearest noise sensitive receivers

Receiver ID	Receiver type	Coordinates (MGA 55)	
		Easting	Northing
1	Residential	606624.65	6315387.31
2	Residential	601786.60	6315021.85
3	Residential	602185.79	6315875.08
4	Residential	604848.97	6315991.38
5	Residential	605259.35	6315878.35
6	Residential	604128.52	6315101.83
7	Residential	600351.54	6315351.01
8	Residential	600340.57	6314139.42
9	Residential	599942.52	6313618.10
10	Residential	600347.71	6313171.69
11	Residential	603529.58	6311779.02
12	Residential	602922.74	6311311.52
13	Residential	607860.54	6311736.40
14	Residential	607598.80	6312046.09
15	Residential	606207.74	6313677.07
16	Residential	607632.56	6310628.61
17	Residential	599696.50	6310915.23
18	Residential	598984.80	6310378.96
19	Residential	599030.60	6309669.11
20	Residential	597843.88	6308726.59
21	Residential	597547.00	6309004.92
22	Residential	599076.15	6307613.29
23	Residential	598391.43	6306958.41
24	Residential	598075.63	6306671.72
25	Residential	598875.56	6306472.10
26	Residential	598114.93	6306324.63

Receiver ID	Receiver type	Coordinates (MGA 55)	
		Easting	Northing
27	Residential	597773.42	6306324.63
28	Residential	598373.49	6305878.97
29	Residential	599359.16	6305648.22
30	Residential	600884.92	6304741.12
31	Residential	601457.82	6305520.91
32	Residential	600111.50	6304658.37
33	Residential	601659.40	6304802.12
34	Residential	602316.39	6304654.92
35	Residential	604351.26	6306908.34
36	Residential	603298.28	6305850.59
37	Residential	603386.41	6305424.89
38	Residential	604418.25	6305883.50
39	Residential	604956.89	6305196.28
40	Residential	606350.75	6304427.31
41	Residential	606820.37	6303833.21
42	Residential	607608.66	6302626.40
43	Residential	606375.41	6302814.95
44	Residential	606538.68	6302520.88
45	Residential	606383.35	6302069.80
46	Residential	598463.02	6310604.57
47	Residential	598463.02	6310604.57
48	Residential	596017.06	6311447.95
49	Residential	595624.136	6311264.54
50	Residential	595691.08	6310958.75
51	Residential	595603.85	6310839.83
52	Residential	595440.90	6310880.22

Daroobalgie Solar Farm

FIGURE 3 Receiver Locations in relation to the Project Area

Date: 22 July 2021
Client: Pacific Hydro Australia
Prepared by: RS



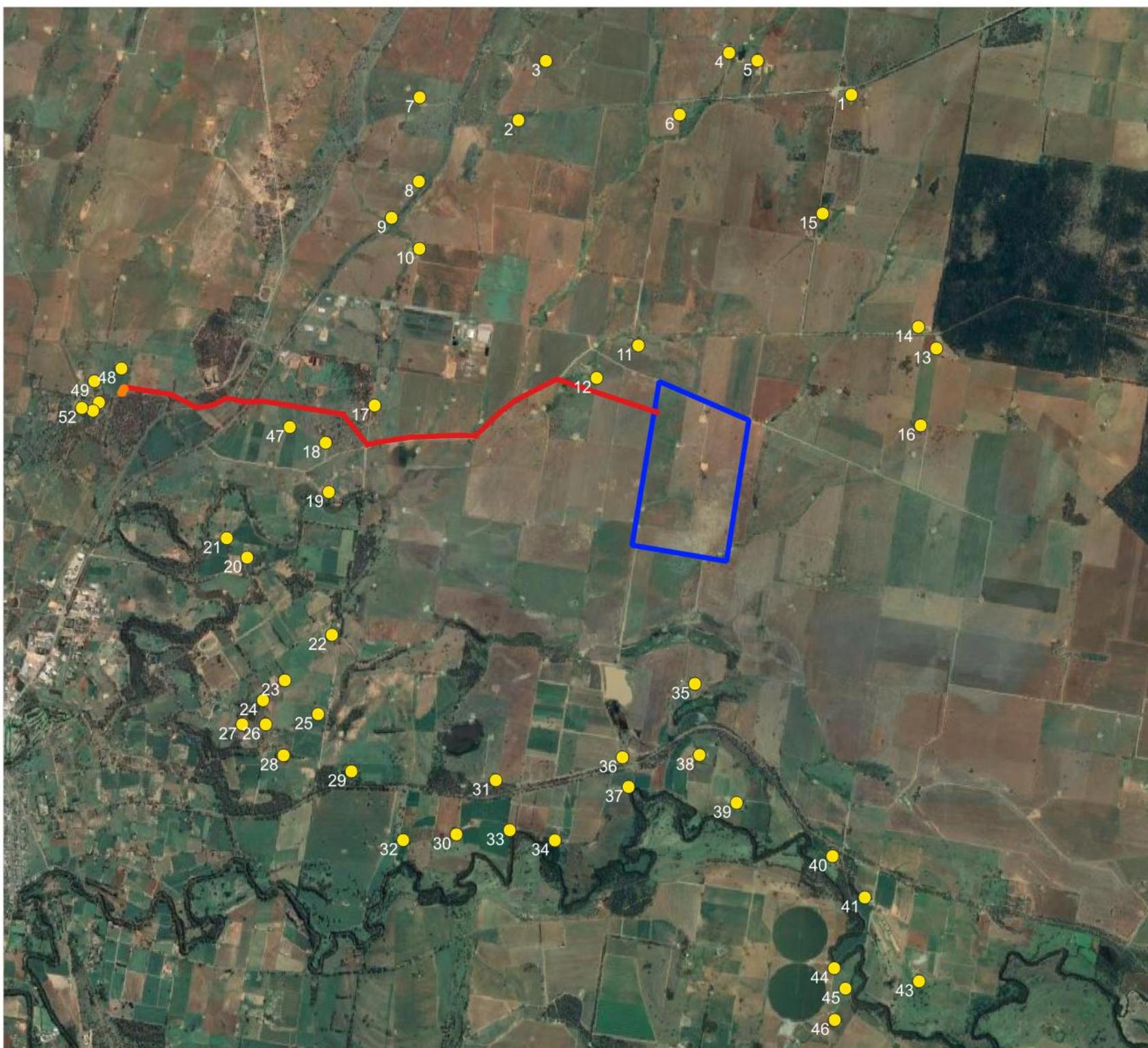
Datum GDA 94, Projection MGA ZONE 55

0 1 2 3 4 km



Legend

-  Sensitive Receivers
-  Core Development Area
-  ETL
-  Switchyard



3 Noise and Vibration Policies, Guidelines and Standards

The construction and operational assessments presented in this report have been conducted with due regard to and in general accordance with the following policy, guidelines and standards.

3.1 Secretary's Environmental Assessment Requirements (SEARs)

The Project SEARs require an Environmental Impact Statement to be prepared which addresses the following requirements in relation to noise:

- An assessment of the construction noise impacts of the development in accordance with the *Interim Construction Noise Guideline* and a draft noise management plan if the assessment shows construction noise is likely to exceed applicable criteria
- An assessment of the operational noise impacts in accordance with the *NSW Noise Policy for Industry*
- An assessment of the cumulative noise impacts (considering other operations in the area)

3.2 NSW Interim Construction Noise Guideline

The NSW Department of Environment and Climate Change – *Interim Construction Noise Guideline* (ICNG), presents an accepted method by which construction noise impacts may be assessed for a range of receptor types for works completed in NSW. It provides a set of recommended standard hours of construction, as reproduced below:

- Monday to Friday: 7 am to 6 pm.
- Saturday: 8 am to 1 pm.
- No work on Sundays or public holidays.

The ICNG encourages works to occur within the recommended standard hours of construction unless justification is provided. It focuses on minimising construction noise impacts, rather than only on achieving numeric noise levels, and recognises that some noise from construction sites is inevitable.

The ICNG encourages organisations involved with construction, maintenance or upgrading works (e.g. large scale contractors or Government agencies) to develop their best-practice techniques for managing construction noise and vibration, and implementing feasible and reasonable mitigation measures.

In this case, the ICNG is the suitable guideline document to quantitatively assess potential noise emissions and impacts associated with project construction. The ICNG assessment methodology has been adopted to develop project-specific construction noise management levels (refer Section 4.1), assess potential impacts (refer Section 5) and recommend any necessary mitigation, management measures or provisions for monitoring (refer Section 5).

Table 2 details the construction noise management levels guidance for residential noise sensitive receptors developed in accordance with ICNG.

Table 2 Construction Airborne Noise Management Levels for Residential Receivers

Time of Day	Noise Management Level, $L_{Aeq, 15 \text{ minute}} - \text{dB(A)}^1$	How to Apply
<p>Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or Public Holidays</p>	<p>Noise affected Rating Background Level (RBL) + 10 dB(A)</p>	<p>The noise affected level represents the point above which there may be some community reaction to noise.</p> <ul style="list-style-type: none"> Where the predicted or measured $L_{eq, 15 \text{ minute}}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	<p>Highly noise affected 75 dB(A)</p>	<p>The highly noise affected level represents the point above which there may be a strong community reaction to noise.</p> <ul style="list-style-type: none"> Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: <ol style="list-style-type: none"> times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences) if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
<p>Outside recommended standard hours</p>	<p>Noise affected Rating Background Level (RBL) + 5 dB(A)</p>	<ul style="list-style-type: none"> A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. For guidance on negotiating agreements see section 7.2.2 of the ICNG.

(1) Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence

3.3 Noise Policy for Industry

Responsibility for the control of noise emissions in NSW is typically vested in Local Government and the NSW Environment Protection Authority (EPA). The *Noise Policy for Industry* (NPI) and relevant application notes provide a framework and methodology for deriving limit conditions for project consent and environment protection licence conditions.

The NPI is designed for large and complex industrial sources and outlines processes designed to strike a feasible and reasonable balance between the operations of industrial activities and the protection of the community from noise levels that are intrusive or unpleasant.

The NPI measurement and evaluation methodology to quantify existing ambient and background noise levels has been adopted for this assessment, with the baseline values utilised to derive construction noise management levels. The NPI assessment terminology is outlined in more detail in Appendix A of this report.

3.3.1 Assessment of prevailing weather conditions

The NPI 'Fact Sheet D: Accounting for noise-enhancing weather conditions' states:

Two options are available to a proponent to consider meteorological effects:

1. Adopt the noise-enhancing meteorological conditions for all assessment periods for noise impact assessment purposes without an assessment of how often these conditions occur – a conservative approach that considers source-to-receiver wind vectors for all receivers and F-class temperature inversions with wind speeds up to 2 m/s at night.

Or

2. Determine the significance of noise enhancing conditions.

Noise emissions from the proposed development have been assessed in accordance with NPI Option 1 using 'noise enhancing' meteorological conditions. This ensures a conservative assessment and where compliance under 'worst-case' conditions are predicted then compliance during other scenarios is expected.

3.3.2 NPI minimum RBLs

In lieu of noise survey data, the NPI minimum recommended RBLs have been adopted for the purpose of this assessment and are presented in Table 3 below. The RBLs are considered representative of typical rural environments with few surrounding noise sources.

Table 3 Minimum RBLs in accordance with the NPI

Minimum Rating Background Noise Level – dB(A)		
Daytime (0700 am – 1800 pm)	Evening (1800 pm – 2200 pm)	Night-time (2200 pm – 0700 am)
35	30	30

3.3.3 Potential sleep disturbance issues

As stated in the NPI the potential for sleep disturbance from maximum noise level events generated by premises during the night-time period needs to be considered. The term "sleep disturbance" is considered to be both awakenings and disturbance to sleep stages.

To evaluate potential sleep disturbance or awakening issues associated with the construction of the Project the NPI screening method has been adapted as follows. There is limited potential for sleep disturbance or awakening issues to occur, where:

- The predicted project night-time noise level ($L_{eq, 15 \text{ minute}}$ in dB(A)) at any residential receptor remains below 40 dB(A) (or the prevailing night-time background noise level plus 5 dB(A)), whichever is the greater.
- The predicted project night-time noise level (L_{max} in dB(A)) at any residential receptor remains below 52 dB(A) (or the prevailing night-time background noise level plus 15 dB(A)), whichever is the greater.

These screening method features have been adopted for likely maximum noise level events from construction vehicles associated with the Project.

3.4 NSW Road Noise Policy

The *NSW Road Noise Policy* (RNP) outlines the range of measures needed to minimise road traffic noise and its impacts. It is intended for use by acoustics specialists as well as:

- Road project proponents.
- Determining authorities and regulators involved in the approval and construction of road projects and land use developments that generate additional traffic on existing roads.
- City and transport planners and policymakers dealing with issues such as route corridors, heavy vehicle transport and building codes.

The RNP aims to identify the strategies that address the issue of road traffic noise from existing roads, new road projects, road redevelopment projects and new traffic-generating developments. In this case, the RNP is considered the suitable document to qualitatively assess potential noise emissions and impacts associated with construction traffic using public roads.

The RNP target noise criteria vary based on road type and are dependent on the development being assessed. The criteria values from the RNP were considered in the assessment of potential construction noise impacts. They are used to provide guidance on potential short-term and temporary impacts associated with heavy vehicle haulage and/or other like vehicles that may be required as part of the construction.

3.5 Vibration guidelines and standards

The effects of vibration on buildings can be divided into three main categories: human comfort (annoyance), building damage (cosmetic/structural) and sensitive equipment (scientific/medical). An overview of the applicable standards and guidelines is provided below.

- **Human Comfort (annoyance):** The NSW Vibration Guideline provides guidance for assessing human exposure (comfort or annoyance issues) to vibration. The publication is based on British Standard (BS 6472–1992) – Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz), dated 1992.
- **Cosmetic and Structural Damage:** There is currently no Australian policy or guideline for assessing the potential for building damage (cosmetic and structural) from vibration. The British Standard BS 7385 Part 2-1993 'Evaluation and measurement for vibration in buildings Part 2' and the German Standard DIN4150 Part 3-1999 (DIN4150-3) – Structural Vibration - Effects of Vibration on Structures, dated 1999 are two widely used in Australia to assess structural or cosmetic damage to buildings. Both standards have been considered for this project. BS 7385 provides safe limit guideline values, below which vibration is considered insufficient to cause structural or cosmetic damage to buildings. If a heritage building or structure is found to be structurally unsound a more conservative DIN4150-3 standard has been adopted. DIN4150-3 presents a set of safe limit values below which cosmetic or structural damage is unlikely to occur for heritage building or structure
- **Sensitive Scientific and Medical Equipment:** Some scientific equipment (e.g. electron microscopes and microelectronics manufacturing equipment) can require more stringent objectives than those applicable to human comfort.



Where manufacturer's data for the identified vibration sensitive scientific and/or medical instruments are not available, generic vibration criterion (VC) curves will be adopted as vibration goals.

However, as there is no sensitive scientific and medical equipment housed in nearby buildings, the assessment of vibration impacts on sensitive scientific and medical equipment is not relevant and will not be conducted in this study.

The NSW Vibration Guideline, BS7385 and DIN 4150-3 criteria vary based on vibration type, receptor type and are dependent on the component frequency of the vibration event. The criteria values from the NSW Vibration Guideline, BS7385 and DIN 4150-3 were considered in the assessment of potential impacts but not reproduced here.

Given the distance between the proposed works and the nearest residential noise sensitive receiver, the potential vibration impacts during construction are more concerned with the impact on Human Comfort.

4 Project Specific Noise and Vibration Criteria

4.1 Construction noise and vibration

4.1.1 Construction noise management levels

The project-specific construction “Noise Management Levels” (NML), for works within and outside the recommended standard hours for construction, are presented in Table 4 below.

These NML have been established with due regard to the requirements of the ICNG for all identified residential (dwelling) and other sensitive (non-residential) receptors. NML for all periods are provided for completeness despite construction works limited to the recommended standard hours for construction presented in the ICNG.

For residential (dwelling) receptors the NML are based on the RBL values presented in Section 3.3.2.

As per Section 3.3.3 of this report, two thresholds have been considered to establish sleep disturbance criteria based on which impacts to residential receptors can be evaluated.

Table 4 Project Specific Construction Noise Management Levels (NML)

Receiver Type	Construction Noise Management Levels, $L_{eq, 15 \text{ minute}}$, dB(A)				High Noise Affected, $L_{eq, 15 \text{ minute}}$, dB(A)
	Standard Hours	Out-of-Hours			
	Day	Day	Evening	Night	
Residential	45	40	35	35	75

Construction activities would only be carried out during daytime period. Therefore, construction noise impacts will only be assessed against the daytime NMLs.

4.1.2 Construction vibration management levels

Impacts from vibration can be considered both in terms of effects on building occupants (human comfort) and the effects on the building structure (building damage). Of these considerations, the human comfort limits are the most stringent. Therefore, for occupied buildings, if compliance with human comfort limits are achieved, it will follow that compliance will be achieved with the building damage objectives.

Human Comfort

The NSW Vibration Guideline provides guidance for assessing human exposure to vibration. These documents are based on *British Standard (BS 6472–1992) – Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz) dated 1992*. The vibration dose values recommended in BS 6472-1992 for which various levels of adverse comment from occupants may be expected are presented in Table 5.

Table 5 Human Comfort – Vibration Dose Values (BS 6472)

Location	Assessment Period	Preferred Values		Maximum Values	
		z axis	x and y axes	z axis	x and y axes
Continuous Vibration (m/s^2)					
Critical Areas	Daytime or Night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Daytime or Night-time	0.020	0.014	0.040	0.028
Workshops	Daytime or Night-time	0.040	0.029	0.080	0.058
Impulsive Vibration (m/s^2)					
Critical Areas	Daytime or Night-time	0.005	0.0036	0.010	0.0072
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Daytime or Night-time	0.64	0.46	1.28	0.92
Workshops	Daytime or Night-time	0.64	0.46	1.28	0.92
Intermittent Vibration ($m/s^{1.75}$)					
Critical Areas	Daytime or Night-time	0.10		0.20	
Residences	Daytime	0.20		0.40	
	Night-time	0.13		0.26	
Offices, schools, educational institutions and places of worship	Daytime or Night-time	0.40		0.80	
Workshops	Daytime or Night-time	0.80		1.60	

- (1) Daytime is 7am-10pm and Night-time is 10pm-7am.
- (2) For continuous and impulsive vibration, the preferred and maximum values are weighted acceleration values (W_g for z-axis and W_d for x and y-axis)
- (3) For intermittent vibration, the preferred and maximum values are Vibration Dose Values (VDVs), based on the weighted acceleration values

Building Damage

German Standard DIN 4150-3-1999 Structural Vibration – Part 3 Effects of vibration on structures provides methods for evaluating the effects of vibration on structures in the absence of an Australian Standard.

The recommended limits (guide values) from DIN 4150 for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented in Table 6.

Table 6 Guideline Vibration Values for Short Term Vibration on Structures (mm/s)

Type of Building	Guideline values for velocity (mm/s)			
	1 to 10 Hz	10 to 50 Hz	50 to 100 Hz	Vibration at horizontal plane of highest floor at all frequencies
Commercial and Industrial Building	20	20-40	40-50	40
Dwellings and buildings of similar occupancy or design	5	5-15	15-20	15
Structures that, because of their particular sensitivity to vibration cannot be classified under lines 1 and 2 and are of great intrinsic value	3	3-8	8-10	8

4.2 Operational noise

The operation of the solar farm and its associated plant such as tracker motors, substation and BESS will be assessed against the *Noise Policy for Industry* (NPI). The switchyard and ETL, although part of the project operations, are not noise intensive and are unlikely to adversely impact on surrounding noise sensitive receivers. Hence, the switchyard and ETL are not considered in the operational noise impact assessment.

The NPI was released in 2017 and sets out the NSW Environment Protection Authority's (EPA) requirements for the assessment and management of noise from industry in NSW.

4.2.1 Trigger levels

The NPI describes 'trigger levels' which indicate the noise level at which feasible and reasonable noise management measures should be considered. Two forms of noise criteria are provided – one to account for 'intrusive' noise impacts and one to protect the 'amenity' of particular land uses.

- The intrusiveness of an industrial noise source is generally considered acceptable if the L_{Aeq} noise level of the source, measured over a period of 15 minutes, does not exceed the background noise level by more than 5 dB. Intrusive noise levels are only applied to residential receivers. For other receiver types, only the amenity levels apply.
- To limit continual increases in noise levels from the use of the intrusiveness level alone, the ambient noise level within an area from all industrial sources should remain below the recommended amenity levels specified in the NPI for that particular land use.

For this assessment, the area surrounding the proposal is considered to be 'rural'.

4.2.2 Project specific noise criteria

The criteria for industrial noise generated by the Project are provided in Table 7. The Project Noise Trigger Level (PNTL) is the lowest value of the intrusiveness or amenity noise level for each period and are shown below in bold.

Table 7 NPI noise criteria (rural amenity area)

Receiver	Period	Noise level – dB(A)			
		Recommended amenity noise level L_{eq}	Assumed background noise level	Project noise trigger level $L_{eq(15minute)}$	
				RBL ¹	Intrusiveness
Residential	Daytime	50	35 ⁴	40	53
	Evening	45	30 ⁴	35	48
	Night-time	40	30 ⁴	35	43

- (1) RBL = Rating Background Level
- (2) The recommended amenity noise level has been used as the Project amenity noise level as there are no other industries present or likely to be introduced
- (3) The Project amenity noise level has been converted to a 15-minute level by 3 dB
- (4) The minimum RBL as per the NPI has been adopted

4.2.3 Annoying noise characteristics corrections

Sources of industrial noise can cause greater annoyance where they contain certain characteristics, such as tonality, impulsiveness, intermittency, irregularity or dominant low-frequency content. The NPI provides the following modifying factors, shown in Table 8, which are to be applied to the predicted receiver noise levels.

Table 8 NPI modifying factor corrections

Factor	Assessment / measurement	When to apply	Correction ¹
Tonal noise	One-third octave band analysis using the objective method for assessing the audibility of tones in noise – simplified method (ISO1996.2-2007 – Annex D).	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: <ul style="list-style-type: none"> • 5 dB or more if the centre frequency of the band containing the tone is in the range 500–10,000 Hz • 8 dB or more if the centre frequency of the band containing the tone is in the range 160–400 Hz • 15 dB or more if the centre frequency of the band containing the tone is in the range 25–125 Hz 	5 dB ²

Factor	Assessment / measurement	When to apply	Correction ¹
Low-frequency noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements in the range 10– 160 Hz	Measure / assess source contribution C and A weighted $L_{eq,t}$ levels over same time period. Correction to be applied where the C minus A level is 15 dB or more and: <ul style="list-style-type: none"> where any of the one-third octave noise levels in Table C2 are exceeded by up to and including 5 dB and cannot be mitigated, a 2 dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period where any of the one-third octave noise levels in Table C2 are exceeded by more than 5 dB and cannot be mitigated, a 5-dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period and a 2 dB(A) positive adjustment applies for the daytime period. 	2 or 5 dB ²
Intermittent noise	Subjectively assessed but should be assisted with measurement to gauge the extent of change in noise level	The source noise heard at the receiver varies by more than 5 dB and the intermittent nature of the noise is clearly audible.	5 dB

- (1) Corrections to be added to the measured or predicted levels, except in the case of duration where the adjustment is to be made to the criterion.
- (2) Where a source emits tonal and low-frequency noise, only one 5 dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.
- (3) Where narrow-band analysis using the reference method is required, as outlined in column 5, the correction will be determined by the ISO1996-2:2007 standard.

4.2.4 Sleep disturbance criteria

As construction works will only be undertaken during the day period there will be no sleep disturbance or night time noise impacts as a result of these works.

Similarly, during normal operation of the solar farm there will be minimal noise impacts during the night period as the associated infrastructure will be under minimum / no load. That said, for a more conservative assessment only operational noise of the inverters and transformers, and maintenance activities from the solar farm will be assessed against the sleep disturbance and night time noise criteria. Noise from the tracker motors will not be assessed to the sleep disturbance and night time noise criteria.

In accordance with the NPI, the sleep disturbance noise criteria for assessing the Project are presented in Table 9 below.

Table 9 Sleep disturbance Noise Criteria

Receiver Type	$L_{eq, 15minute}$ dB(A)	L_{max} dB(A)
Residential receivers	40	52

4.3 Road traffic noise

The RNP provides guidance, criteria and procedures for assessing noise impacts from existing, new and redeveloped roads and traffic generating developments. The assessment of road traffic noise impacts on public roads is assessed under the RNP.

Road traffic generated by the operation of the Project will generate limited additional traffic on existing surrounding public roads, and as such, there will be minimal increase to the existing road traffic. Hence, road traffic noise impact due to operational noise is not assessed in this study.

The construction of the Project will generate additional traffic on surrounding public roads, such as construction worker car movements and delivery and construction vehicle movements. Once construction is complete, project traffic is expected to return to levels similar to the current situation.

The RNP details a number of noise assessment criteria for various road categories and land uses. Road access to the solar farm site will predominantly be via Back Yamma and Troubalgie Road from the Newell Highway. Forest Road may also be used for light traffic only. Forest Road and Troubalgie Road would be classified as local roads and Newell Highway would be classified as a freeway.

The Application Notes for the RNP state that;

‘for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion.’

If road traffic noise during the Project construction is within 2 dB(A) of current levels then the objectives of the RNP are met and no specific mitigation measures are required. Where the Project road traffic noise levels exceed 2 dB(A) of current levels then the consideration should be given to the actual noise levels associated with construction traffic and whether or not these levels comply with the RNP criteria as presented in Table 10.

Table 10 RNP Residential Road Traffic Noise Criteria

Road Category	Type of Project/Land Use	Assessment Criteria ¹ – dB(A)	
		Day 7am to 10pm	Night 10pm to 7am
Freeway/arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments.	L _{Aeq,15hr} 60 (external)	L _{Aeq,9hr} 55 (external)
Local roads	Existing residences affected by additional	L _{Aeq,1hr} 55 (external)	L _{Aeq,1hr} 50 (external)

(1) The assessment criteria for external noise levels apply at 1 metre from the facade of any affected residential receiver

5 Construction Noise and Vibration Assessment

This section details the assessment of the construction noise and vibration impacts from the Project. Construction noise impacts predicted at nearest residential receivers have been assessed against the adopted ICNG noise management levels. Road traffic noise from the construction of the Project have been assessed against the RNP noise criteria.

5.1 Construction noise

5.1.1 Construction stages

To assess the potential noise and vibration impacts during construction, a number of scenarios comprising typical plant and equipment have been developed based on Resonate's past project experiences. These are summarised in Table 11.

It is understood that construction works are proposed to be carried out during standard daytime periods (7.00 am to 6.00 pm Monday to Friday and 8.00 am to 1.00 pm on Saturdays). Exceptions may be staff arriving and leaving site and the delivery of large solar farm components. Any activity outside normal construction hours would only be undertaken in accordance with approvals from relevant authorities.

Table 11 Construction stages and equipment sound power levels

Stage	Scenario	Equipment	No. of plant per 15-minute period	Individual equipment maximum L_{eq} sound power level ⁽¹⁾ – dB(A)
1	Site preparation, clearing & demolition	Excavator	2	107
		Bulldozer 28 tonne	1	107
		Chainsaw	2	117 ^{(2),(3)}
		Tree mulcher	1	115
		Light vehicle	2	94
		Dump truck	1	106
2	Establish site compound, access roads & delivery of materials	Hand tools	2	94
		Excavator	2	107
		Light vehicle	3	94
		Delivery trucks / semi-trailers	3	100 ⁽³⁾
		Bulldozer 28 tonne	1	107
		DPU / plate compactor	2	103
		Grader	1	107
		Roller 18 tonne	1	102
		Asphalt paver & tipper lorry	1	108
		Bobcat	1	104

Stage	Scenario	Equipment	No. of plant per 15-minute period	Individual equipment maximum L_{eq} sound power level ⁽¹⁾ – dB(A)
		Telehandler	2	105
		Mobile crane	1	106
3	Installation of foundation for substation and BESS(s)	Piling rig	1	114 ^{(2),(3)}
		Bobcat	1	104
		Crane	2	106
		Excavator	2	107
		Concrete vibrating needle	2	103
		Concrete agitator truck (discharging)	1	103
		Concrete agitator (low to mid revs)	1	107
4	Installation of underground cabling	Vermeer trencher	2	105
		Cable laying trailer & tractor	2	103
		Loader	2	110
5	Assembly of panel frames, mounts & transformer units	Telehandler	2	105
		Generator	2	99
		Compressor	1	93
		Hand tools	2	94
		Ratchet gun	4	94
		Mobile crane	1	106
6	Site rehabilitation / removal of temporary construction facility	Light vehicle	2	98
		Excavator	2	106
		Bulldozer 28 tonne	1	107
		Loader	1	110
		Dump truck	2	106
		Semi-trailer	1	104
7	Installation of foundation and towers of electricity transmission line	Piling rig	1	114 ^{(2),(3)}
		Bobcat	1	104
		Crane	1	106
		Excavator	1	107
		Concrete vibrating needle	1	103
		Concrete agitator truck (discharging)	1	103
		Concrete agitator (low to mid revs)	1	107

Stage	Scenario	Equipment	No. of plant per 15-minute period	Individual equipment maximum L_{eq} sound power level ⁽¹⁾ – dB(A)
		Telehandler	1	105
		Generator	1	99
		Compressor	1	93
		Hand tools	2	94
8	Installation of foundation for switchyard	Piling rig	1	114 ^{(2),(3)}
		Bobcat	1	104
		Crane	1	106
		Excavator	2	107
		Concrete vibrating needle	2	103
		Concrete agitator truck (discharging)	1	103
		Concrete agitator (low to mid revs)	1	107
		Dump truck	1	106
		Roller 18 tonne	1	102

- (1) Sound power levels of equipment have been referenced from Transport for NSW's *Construction Noise and Vibration Strategy*, UK Government Department for Environment, Food and Rural Affairs' *Update of Noise Database for Prediction of Noise on Construction and Open Sites* and Resonate's sound database.
- (2) Denotes "annoying" item of equipment as defined in the ICNG (i.e. contains characteristics such as impulsiveness, tonality etc.), and as such includes a +5 dB penalty adjustment to predictions.
- (3) Overall SWL assumes a maximum duration of 7.5 minutes operation in any 15 minute period.

5.1.2 Construction noise assessment methodology

Construction Stages 1 to 6

Prediction of construction noise impacts from the Project has been undertaken through the use of the SoundPLAN noise propagation modelling software (Version 8.1).

The most significant factors in determining the level of noise received from construction activities are the receiver's distance from the Project area, shielding, ground absorption and source heights. The parameters used and values adopted in the noise modelling are presented in Table 12 below.

Table 12 Construction noise modelling parameters

Parameter	Input data
Receivers	<ul style="list-style-type: none"> Receivers provided by project team in shapefile format and imported into SoundPLAN Receivers have been modelled as point receivers Height of receivers modelled as 1.5 m
Terrain	1 metre ground contour from Geoscience Australia.
Ground surface / absorption	The agricultural land surrounding the site has been conservatively modelled with a ground cover factor of 0.5 representative of 'mixed' ground.

Parameter	Input data
Source heights	Construction plant and equipment heights are modelled to be 2 m above ground
Sources	All equipment has been modelled as point sources and all equipment have been modelled to operate simultaneously.
SoundPLAN module	ISO 9613 algorithm industrial module
Met condition	Neutral meteorological condition has been modelled as construction activities will only be conducted during standard daytime period.

Construction Stages 7 and 8 (construction of ETL and switchyard)

Given that the ETL and switchyard construction works are not located within the solar farm site and work sites are likely to be closer to receptors, the prediction of Stage 7 and stage 8 noise impacts would be undertaken through the following noise propagation relationship:

- $SPL_{\text{receiverd}} = SWL_{\text{source}} - 20\log(r) - 8$

Where SPL_{received} is the received sound pressure level, SWL_{source} is the source sound power level and 8 dB(A) is a constant, applied for the loss of acoustic energy resultant from hemi-spherical radiation of noise from a point source and atmospheric attenuation.

All construction plant and equipment has been treated as point noise sources where the intervening topography between source and receivers is uniform.

5.1.3 Predicted construction noise levels for Stages 1 to 6

Appendix B presents the predicted noise levels associated with each stage of works along with a comparison with the relevant construction noise management level (refer Table 4). The assessment is limited to the identified receivers within a 5 km radius from the solar farm site boundaries (refer to Figure 3). Predicted noise levels have been based on continuous operation of the noise sources identified for each construction stage. Predictions are therefore considered to represent the highest potential noise impacts. The predicted noise levels presented in Appendix B would typically be short-term, occurring for the duration of the construction period when works are conducted in the vicinity of each receiver.

The results presented in Appendix B indicate that construction activities would be unlikely to exceed the construction noise management levels at all surrounding residential receivers. The predicted noise levels also indicate that the surrounding residences would not be highly noise affected by the construction activities.

The worst case predicted construction noise levels are 40 dB(A) and 39 dB(A) at receivers 11 and 12 (refer to Figure 3) during Stage 1 “Site preparation, clearing & demolition” activities. These worst case levels are still well below the 42 dB(A) standard construction hours NML.

Based on the assessed compliance of potential construction activities, additional noise management and mitigation measures during the construction of the Project would not be required.

5.1.4 Predicted construction noise levels for Stage 7

Based on the nearest receiver to the ETL route being approximately 180 m away and the furthest receiver to be approximately 9 km, the Stage 7 construction noise levels are predicted to be between 35 dB(A) and 61 dB(A). As the Stage 7 works move along the ETL route, residential receivers nearest to the route are likely to experience the worst case noise impact of 61 dB(A) which exceeds the 42 dB(A) standard construction hours NML by 19 dB(A).

Receivers that are 1.5 km or more from the Stage 7 works would likely experience construction noise levels of 42 dB(A) or less. This means that construction noise during Stage 7 works at receivers that are 1.5 km or more away from the ETL route would be within the NML and would not be adversely impacted. Based on this understanding, receivers 11, 12¹, 17¹, 18¹, 19 and 46 which are less than 1.5 km from the ETL route would likely be adversely impacted by Stage 7 works as the works move along the route. Construction will take place at pole locations. Poles will be spaced 200-300 m apart. Impacts experienced at each pole location will be very short term (< 2 days). Overall timeframe for construction of the ETL is likely to be 6-8 weeks. The total number of poles is approximately 34.

Based on the assessed exceedance of potential construction activities, additional noise management and mitigation measures during the Stage 7 construction of the Project would need to be implemented.

5.1.5 Predicted construction noise levels for Stage 8

Based on the approximate distances of the receivers closest to the switchyard (receivers 48 to 52) to be approximately between 255 m and 570 m away, the Stage 8 construction noise levels are predicted to be between 59 dB(A) and 60 dB(A). Receivers nearest to the switchyard site are likely to experience the worst case noise impacts which exceeds the 42 dB(A) standard construction hours NML by up to 18 dB(A). It is also predicted that Stage 8 construction noise at receivers that are 1.7 km or more away from the switchyard site would likely comply with the standard construction hours NML.

Based on the assessed exceedances of potential construction activities, additional noise management and mitigation measures during the Stage 8 construction of the Project would need to be implemented.

5.1.6 Construction noise management and mitigation measures

Stages 1 to 6 construction works

Construction works are proposed to be undertaken during the ICNG standard daytime construction hours (i.e. 7.00 am to 6.00 pm Monday to Friday and 8.00 am to 1.00 pm on Saturdays) which, based on the predictions of Stages 1 to 6 works would likely result in negligible construction noise impacts.

As such, there is no requirement to apply any specific noise mitigation measures to Stages 1 to 6 works, other than standard best practice measures where appropriate.

Adoption of Universal Work Practices

- Regular reinforcement (such as at toolbox talks) of the need to minimise noise;
- Regular identification of noisy activities and adoption of improvement techniques;
- Avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby residents;
- Where possible, avoiding the use of equipment that generates impulsive noise;
- Minimising the need for vehicle reversing (particularly at night) for example, by arranging for one-way site traffic routes;
- Use of broadband audible alarms on vehicles and elevating work platforms used on site;
- Minimising the movement of materials and plant and unnecessary metal-on-metal contact; and
- Minimising truck movements.

If it is necessary to undertake Stages 1 to 6 works outside of standard hours, the noise levels may exceed the NML at some of the surrounding sensitive receivers by up to 5 dB during the evening and night-time period. Where exceedances are predicted outside of standard hours a noise management plan should be prepared to manage the impacts.

¹ Receiver is an associated receiver and will be receiving compensation for the ETL easement through their property

Stage 7 and Stage 8 construction works

Without mitigation, noise levels from Stage 7 and Stage 8 construction activities have been predicted to exceed the noise management levels nominated in the guidelines at surrounding receivers.

This section details pre-construction and construction phase management and mitigation measures proposed to reduce and control potential noise levels to where feasible to achieve the adopted noise management levels at nearest receivers. The measures recommended have been developed considering the predicted impacts, adjacent receivers and land use and duration of works. The management measures recommended have been informed from guidance provided in the ICNG which promotes principles of best management practice and community notification of likely noise impacts.

It will be important for contractors to undertake all reasonable and feasible measures to reduce noise impacts and minimise impact potential through programming works to minimise duration and liaise with affected landowners and local communities throughout the construction program. All contractors commissioned by the client to undertake construction works associated with the Project are recommended to adhere to all noise management and mitigation measures recommended.

Construction works should adopt Best Management Practice (BMP) and Best Available Technology Economically Achievable (BATEA) practices as addressed in the ICNG. BMP includes factors discussed within this report and encourages a project objective to reduce noise emissions. BATEA practices involve incorporating the most advanced and affordable technology to minimise noise emissions. The following principles and proactive noise management measures are recommended for implementation:

Table 13 Recommended noise management and mitigation measures

Construction phase	Recommended measure
Planning	Stage 7 and Stage 8 works are to be undertaken during the ICNG standard daytime construction hours (i.e. 7.00 am to 6.00 pm Monday to Friday and 8.00 am to 1.00 pm on Saturdays)
	Where possible, consider the application of alternative, low-impact construction techniques. For example, Ripping or cutting/sawing and grinding instead of rock hammering, or vacuum excavation instead of small scale earthworks
	A Construction Noise and Vibration Management Plan (CNVMP) should be developed to manage noise and vibration issues during construction.
Easement layout	Easement entry and exit points will be located as far as possible from sensitive receivers, taking into account the importance of safe access.
	Trucks will not queue up outside residential properties. No trucks will arrive on site or be permitted to queue near sensitive receivers prior to the 7:00 am start time unless required by road safety considerations.
	Training will be provided to all project personnel, including relevant sub-contractors on noise and vibration requirements from the CNVMP through inductions, toolboxes and targeted awareness training.
	All relevant staff and sub-contractors will be informed of areas and work practices where potential noise impacts have been identified.
Training	Keep horn signals between drivers to a minimum.
	Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible.

Construction phase	Recommended measure
	Truck drivers will limit compression braking as far as practicable.
Contractor management	Switch off generators when not in use.
Noise source mitigation	Dampen or line metal trays as necessary.
	Shut down or throttle down machinery when not in operation.
	Avoid simultaneous operation of noisy plant within discernible range of a sensitive receiver
	Ensure equipment is operated in the correct manner including replacement of engine covers, repair of defective silencing equipment, tightening of rattling components, repair of leakages in compressed air lines and shutting down equipment not in use.
	Direct noise sources such as vent outlets, generators, etc. will be located and orientated away from the residences
	Plant will be fitted with noise control devices, where practicable, including acoustic lining of engine bays and air intake / discharge silencers
	Ensure that all doors/hatches are shut during operation of plant and equipment.
	Check hatches/enclosures regularly to ensure that seals are in good working order and doors close properly against seals.
	Avoid dropping materials from height.
	Use residential-grade mufflers on plant.
	Use dampened bits on impulsive tools such as jackhammers to avoid 'ringing' noise.
	An acoustic shroud (skirt) should be installed on hydraulic rockbreakers when work is undertaken within 100 m of residential locations.
	Ensure truck movements are kept to a minimum, i.e. that trucks are fully loaded on each trip.
Use temporary screening around immobile plant. Acoustic screens may be constructed from either a layer of 10 kg/m ² loaded vinyl acoustic curtain (product name Wavebar from Pyrotek Noise Control) or minimum 9 mm thick plywood hoarding. Gaps at joints of the acoustic screen are to be sealed by overlapping the loaded vinyl or plywood, or with silicon mastic on the plywood hoarding.	
Community consultation	Provide at least five and not more than 14 days' notice to affected receivers prior to starting works.
	Install signage detailing who is undertaking the works and a 24-hour contact number.
	If there are complaints about noise from an identified work activity, review and implement, where feasible and reasonable, additional control measures.
	Consult with adjacent property owners regarding the minimal risk of vibration impacts associated with the proposal.
	In consultation with the community, preference may be given to avoiding cumulative impacts by avoiding the concurrent completion of phases of construction. Alternatively, impacted receivers may prefer a shorter works duration where this requires concurrent completion of construction phases.

5.2 Construction road traffic noise

Construction traffic is anticipated to travel along Troubalgie Road and Back Yamma Road before accessing the Newell Highway. Travel along Forest Road will be largely restricted but may be used by some light vehicles.

The existing traffic along Troubalgie Road, Forest Road and Back Yamma Road is minimal, with generally up to one light vehicle or heavy vehicle per hour. As there are no noise sensitive receivers along Back Yamma Road, road traffic noise prediction of Back Yamma Road has not been conducted.

As a worst case scenario, Table 14 indicates the existing and proposed traffic for these roads and the Newell Highway during their applicable periods appropriate to each classification of road.

Table 14 Construction road traffic noise predictions

Road name	Road type	Criteria (day/night)	Period	Existing traffic volume (daytime 7 am to 10 pm)		Proposed traffic volume (daytime 7 am to 10 pm)		Predicted noise level – dB(A)	
				Light	Heavy	Light	Heavy	Existing	Future
Troubalgie Road	Local Road	55/50	1 hour	1	1	10	10	36	46
Forest Road	Local Road	55/50	1 hour	1	1	10	10	36	46
Newell Highway	Arterial Road	60/55	15 hour	1075	706	30	70	58	59

Based on the above, the proposed construction traffic is predicted to increase the overall traffic noise levels along Troubalgie Road and Forest Road during the peak 1 hour traffic flows, however the absolute noise level is below the RNP base criteria meaning impacts are expected to be minimal.

The additional construction traffic along the Newell Highway is not predicted to result in an increase in traffic noise by more than 2 dB compared to existing traffic movements along this road.

5.3 Construction vibration

No vibration intensive activities are proposed to occur at the Project area and no impacts are expected to occur given the significant distance to the nearest receivers.

6 Operational Noise and Vibration Assessment

This section details the assessment of the operational noise and vibration impacts from the Project. Operational noise impacts predicted at nearest residential receivers have been assessed against the adopted NPI noise criteria.

6.1 Solar farm site operational noise

6.1.1 Solar farm site operations

The main noise sources associated with the operation of the solar farm consists of the following:

- Power conditioning units (PCUs) which contain the DC-AC inverters, medium voltage transformers, switchgear, Supervisory Control and Data Acquisition (SCADA) and communications equipment
- Tracker motors
- Maintenance activities: Staff members will be on site to operate and maintain the solar plant equipment. Maintenance activities are expected to involve low noise generating manual hand tools, be infrequent and be conducted on an as-needs basis during daytime hours.
- Substation
- BESS

Noise from the inverters with integrated transformers can be tonal in nature and therefore a 5 dB penalty has been applied to the predicted noise contributions from this source in accordance with Table C.1 of the NPI.

The L_{Aeq} sound power levels of plant and equipment from the proposed operations are given in Table 15 below.

Table 15 Operational equipment sound power levels

Equipment	Estimated number of equipment	Sound power level L_{eq} – dB(A) (Individual equipment)
PCUs	23	98 ⁽¹⁾
Tracker panel motors	2,625	74
Maintenance activities, includes trucks travelling along the access road within the site	-	103
Substation	1	98 ^{(1),(2)}
BESS	-	90

(1) Includes a +5 dB(A) adjustment for tonal characteristic as per the NPI

(2) Sound power level derived from a substation sound pressure level of 85 dB(A) at 1 metre

During the night period the tracker panel motors will not be operating. Hence, for the night-time operational assessment, only the PCUs, maintenance activities, substation and BESS have been assessed against the more stringent night-time NPI noise criterion.

6.1.2 Methodology

In order to determine the acoustic impact of the proposed solar farm, a computer model incorporating all significant noise sources; the closest potentially affected residential properties, and the intervening terrain has been prepared.

The computer model was prepared using the SoundPLAN noise propagation modelling software (Version 8.1) Industrial Module which allows the use of various internationally recognised noise prediction algorithms. The

CONCAWE algorithm, which is suitable for the assessment of large industrial plants, has been selected for this assessment because it also enables meteorological influences to be assessed.

The parameters used and values adopted in the noise modelling are presented in Table 16 below.

Table 16 Operational noise modelling parameters

Parameter	Input data
Receivers	<ul style="list-style-type: none"> Receivers provided by project team in shapefile format and imported into SoundPLAN Receivers have been modelled as point receivers Height of receivers modelled as 1.5 m
Terrain	1 m ground contour from Geoscience Australia.
Ground surface / absorption	The agricultural land surrounding the site has been conservatively modelled with a ground cover factor of 0.5 representative of 'mixed' ground.
Sources	All equipment has been modelled as point sources at a height of 2.5 m and has been modelled to operate simultaneously.
SoundPLAN module	CONCAWE industrial module
Met condition	<ul style="list-style-type: none"> Neutral meteorological condition during daytime and evening periods. Temperature inversion condition (2 m/s wind and Pasquil Stability Class F) during night-time period.

6.1.3 Predicted operational noise levels

The predicted operational noise levels for the day, evening and night-time periods are presented in Appendix D. The predicted levels show that operational noise levels from the Project are expected to comply with the NPI noise criteria at all surrounding residential receivers. The highest predicted noise levels during the daytime and evening periods are 30 dB(A) and 29 dB(A) at receivers 11 and 12 respectively (refer to Figure 3). The highest predicted noise levels during the night-time period are 35 dB(A) and 34 dB(A) at receivers 11 and 12 respectively (refer to Figure 3). The predicted night-time operational noise levels also comply with the sleep disturbance criteria. Adverse meteorological condition (i.e. temperature inversion) has been applied to the night-time operational noise modelling. Hence, the night-time predicted operational noise levels are louder than the daytime and evening levels.

Based on the assessed compliance of the operational noise impacts further noise management or mitigation measures is not considered to be necessary for the Project.

6.2 ETL and switchyard operational noise

No noise intensive plant/equipment or activities are likely to occur during the operation of the ETL and switchyard, therefore no operational noise impacts from the ETL and switchyard are anticipated.

6.3 Cumulative operational noise

Due to the extensive distances of other solar farm projects nearest to the solar farm (approximately 23 km to Parkes Solar Farm, 24 km to Goonumbla Solar Farm, 27 km to Quorn Solar Farm and 40 km to Jemalong Solar Farm) there are no expected cumulative noise effects associated with the Project.

Based on a desktop survey, other existing industries in the vicinity of the Project area include the Forbes Central West Livestock Exchange (approximately 2.5 km from the Project), Hutcheon & Pearce Tractor Dealership (approximately 5 km from the Project), Loris H Hassell Trading (tannery approximately 5.5 km from the Project) and Forbes Tip / Waste Depot (approximately 6.5 km from the Project). Noise emissions from these industries mostly consist of heavy machinery operations. Cumulative operational noise impacts with these neighbouring industries are anticipated to be minimal due to the considerable distances between these industries and the Project.

6.4 Operational road traffic noise

The existing traffic along Troubalgie Road and Forest Road are minimal, with generally up to one light vehicle or heavy vehicle per hour. The Project is expected to introduce an additional two car movements per hour associated with the general operation of the solar farm.

The additional traffic associated with the Project is not predicted to exceed the RNP based criteria for local roads at the nearest receivers along these roads.

The existing traffic volumes on Newell Highway are sufficiently high (ie >1000 cars and 700 heavy vehicles during the daytime period) for the additional vehicles associated with the Project to have a negligible impact on existing road traffic noise levels.

6.5 Operational vibration

No vibration intensive plant/equipment or activities will occur during standard operation onsite, therefore no vibration impacts are anticipated.

7 Conclusion

This report presents the results of the assessment of the potential noise impacts associated with the Project. This assessment has been carried out in accordance with NSW regulatory requirements identified in the SEARs issued for the development.

The noise and vibration assessment was based on plant and equipment representative of the likely methodologies used to construct the Project. The assessment identifies the following regarding the Project's construction activities:

- during Stages 1 to 6 construction works, no exceedances of the Project specific construction NMLs are predicted and no adverse impacts are expected due to the separation of the site to the surrounding receivers.
- during Stage 7 construction works, exceedances of the Project specific construction NMLs are predicted at receivers that are less than 1.5 km from the ETL route, but no exceedances are predicted at receivers that are 1.5 km or more away from the ETL route.
- during Stage 8 construction works, exceedances of the Project specific construction NMLs are predicted at surrounding nearby receivers (receivers 48 to 52) from the switchyard site. It is also predicted that Stage 8 construction noise at receivers that are 1.7 km or more away from the switchyard site would likely comply with the standard construction hours NML.

Based on the assessed exceedances, additional noise management and mitigation measures have been recommended in this report for implementation for the Stage 7 and Stage 8 construction works.

Operational noise and vibration assessment associated with the Project was conducted. The assessment has shown that operational noise emissions from the development are expected to comply with the relevant criteria.

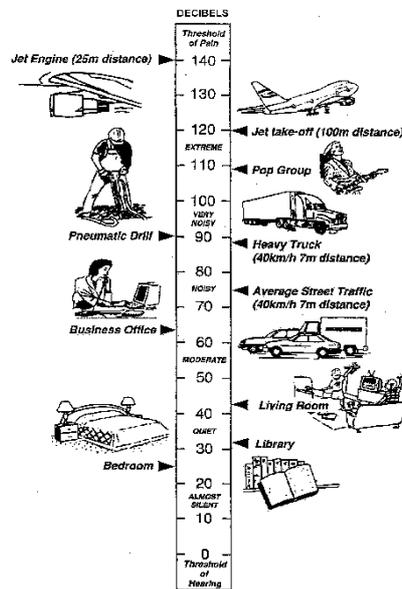
8 References

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- Transport for New South Wales. 2019. *Construction Noise and Vibration Strategy*. TfNSW

Appendix A – Acoustic Terminology

A-weighted sound pressure	The human ear is not equally sensitive to sound at different frequencies. People are more sensitive to sound in the range of 1 to 4 kHz (1000 – 4000 vibrations per second) and less sensitive to lower and higher frequency sound. During noise measurement an electronic ' <i>A-weighting</i> ' frequency filter is applied to the measured sound level <i>dB(A)</i> to account for these sensitivities. Other frequency weightings (B, C and D) are less commonly used. Sound measured without a filter is denoted as linear weighted <i>dB(linear)</i> .
Ambient noise	The total noise in a given situation, inclusive of all noise source contributions in the near and far field.
Community annoyance	Includes noise annoyance due to: <ul style="list-style-type: none"> • character of the noise (e.g. sound pressure level, tonality, impulsiveness, low-frequency content) • character of the environment (e.g. very quiet suburban, suburban, urban, near industry) • miscellaneous circumstances (e.g. noise avoidance possibilities, cognitive noise, unpleasant associations) • human activity being interrupted (e.g. sleep, communicating, reading, working, listening to radio/TV, recreation).
Compliance	The process of checking that source noise levels meet with the noise limits in a statutory context.
Cumulative noise level	The total level of noise from all sources.
dB(A)	<i>dB(A)</i> denotes a single number sound pressure level that includes a frequency weighting ("A-weighting") to reflect the subjective loudness of the sound level. The frequency of a sound affects its perceived loudness. Human hearing is less sensitive at low and very high frequencies, and so the A-weighting is used to account for this effect. An A-weighted decibel level is written as <i>dB(A)</i> .
Extraneous noise	Noise resulting from activities that are not typical to the area. Atypical activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous.
Feasible and reasonable measures	Feasibility relates to engineering considerations and what is practical to build; reasonableness relates to the application of judgement in arriving at a decision, taking into account the following factors: <ul style="list-style-type: none"> • Noise mitigation benefits (amount of noise reduction provided, number of people protected). • Cost of mitigation (cost of mitigation versus benefit provided). • Community views (aesthetic impacts and community wishes). • Noise levels for affected land uses (existing and future levels, and changes in noise levels).

Impulsiveness	Impulsive noise is noise with a high peak of short duration or a sequence of these peaks. Impulsive noise is also considered annoying.
Low frequency	Noise containing major components in the low-frequency range (20 to 250 Hz) of the frequency spectrum.
Noise criteria	The general set of non-mandatory noise levels for protecting against intrusive noise (for example, background noise plus 5 dB) and loss of amenity (e.g. noise levels for various land use).
Noise level (goal)	A noise level that should be adopted for planning purposes as the highest acceptable noise level for the specific area, land use and time of day.
Noise limits	Enforceable noise levels that appear in conditions on consents and licences. The noise limits are based on achievable noise levels, which the proponent has predicted can be met during the environmental assessment. Exceedance of the noise limits can result in the requirement for either the development of noise management plans or legal action.
Performance-based goals	Goals specified in terms of the outcomes/performance to be achieved, but not in terms of the means of achieving them.
Rating Background Level (RBL)	The rating background level is the overall single figure background level representing each day, evening and night time period. The rating background level is the 10 th percentile min L _{A90} noise level measured over all day, evening and night time monitoring periods.
Receptor	The noise-sensitive land use at which noise from a development can be heard.
Sleep disturbance	Awakenings and disturbance of sleep stages.
Sound and decibels (dB)	<p>Sound (or noise) is caused by minute changes in atmospheric pressure that are detected by the human ear. The ratio between the quietest noise audible and that which should cause permanent hearing damage is a million times the change in sound pressure. To simplify this range the sound pressures are logarithmically converted to decibels from a reference level of 2×10^{-5} Pa.</p> <p>The picture below indicates typical noise levels from common noise sources.</p>



dB is the abbreviation for decibel – a unit of sound measurement. It is equivalent to 10 times the logarithm (to base 10) of the ratio of a given sound pressure to a reference pressure.

Sound power Level (SWL)

The sound power level of a noise source is the sound energy emitted by the source. Notated as SWL, sound power levels are typically presented in $dB(A)$.

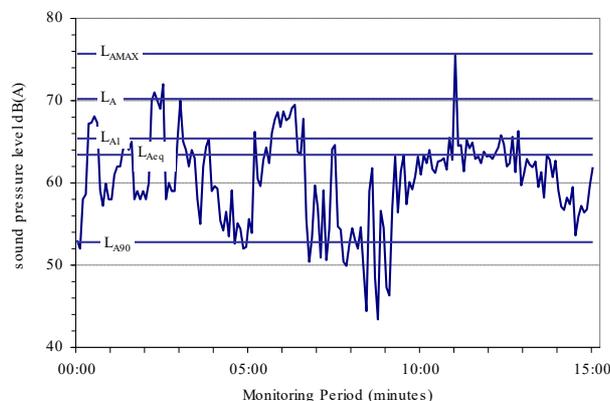
Sound Pressure Level (SPL)

The level of noise, usually expressed as SPL in $dB(A)$, as measured by a standard sound level meter with a pressure microphone. The sound pressure level in $dB(A)$ gives a close indication of the subjective loudness of the noise.

Statistic noise levels

Noise levels varying over time (e.g. community noise, traffic noise, construction noise) are described in terms of the statistical exceedance level.

A hypothetical example of A weighted noise levels over a 15 minute measurement period is indicated in the following figure:



Key descriptors:

- L_{Amax} : Maximum recorded noise level.

- L_{A1} : The noise level exceeded for 1% of the 15 minute interval.
- L_{A10} : Noise level present for 10% of the 15 minute interval. Commonly referred to the average maximum noise level.
- L_{Aeq} : Equivalent continuous (energy average) A-weighted sound pressure level. It is defined as the steady sound level that contains the same amount of acoustic energy as the corresponding time-varying sound.
- L_{A90} : Noise level exceeded for 90% of time (background level). The average minimum background sound level (in the absence of the source under consideration).

Threshold The lowest sound pressure level that produces a detectable response (in an instrument/person).

Tonality Tonal noise contains one or more prominent tones (and characterised by a distinct frequency components) and is considered more annoying. A 2 to 5 dB(A) penalty is typically applied to noise sources with tonal characteristics

Appendix B – Predicted Construction Noise Levels

Receiver ID	Predicted L_{eq} – dB(A)	Standard hours			“Highly Noise Affected”		
		NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No	NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No
Stage 1 - Site preparation, clearing & demolition							
1	< 20	45	-	Yes	75	-	Yes
2	< 20	45	-	Yes	75	-	Yes
3	< 20	45	-	Yes	75	-	Yes
4	< 20	45	-	Yes	75	-	Yes
5	< 20	45	-	Yes	75	-	Yes
6	< 20	45	-	Yes	75	-	Yes
7	< 20	45	-	Yes	75	-	Yes
8	< 20	45	-	Yes	75	-	Yes
9	< 20	45	-	Yes	75	-	Yes
10	< 20	45	-	Yes	75	-	Yes
11	39.8	45	-	Yes	75	-	Yes
12	39.1	45	-	Yes	75	-	Yes
13	< 20	45	-	Yes	75	-	Yes
14	< 20	45	-	Yes	75	-	Yes
15	< 20	45	-	Yes	75	-	Yes
16	25.0	45	-	Yes	75	-	Yes
17	< 20	45	-	Yes	75	-	Yes
18	< 20	45	-	Yes	75	-	Yes
19	< 20	45	-	Yes	75	-	Yes
20	< 20	45	-	Yes	75	-	Yes
21	< 20	45	-	Yes	75	-	Yes
22	< 20	45	-	Yes	75	-	Yes
23	< 20	45	-	Yes	75	-	Yes
24	< 20	45	-	Yes	75	-	Yes
25	< 20	45	-	Yes	75	-	Yes
26	< 20	45	-	Yes	75	-	Yes
27	< 20	45	-	Yes	75	-	Yes

Receiver ID	Predicted $L_{eq} - dB(A)$	Standard hours			“Highly Noise Affected”		
		NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No	NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No
28	< 20	45	-	Yes	75	-	Yes
29	< 20	45	-	Yes	75	-	Yes
30	< 20	45	-	Yes	75	-	Yes
31	< 20	45	-	Yes	75	-	Yes
32	< 20	45	-	Yes	75	-	Yes
33	< 20	45	-	Yes	75	-	Yes
34	< 20	45	-	Yes	75	-	Yes
35	32.0	45	-	Yes	75	-	Yes
36	< 20	45	-	Yes	75	-	Yes
37	< 20	45	-	Yes	75	-	Yes
38	20.6	45	-	Yes	75	-	Yes
39	< 20	45	-	Yes	75	-	Yes
40	< 20	45	-	Yes	75	-	Yes
41	< 20	45	-	Yes	75	-	Yes
42	< 20	45	-	Yes	75	-	Yes
43	< 20	45	-	Yes	75	-	Yes
44	< 20	45	-	Yes	75	-	Yes
45	< 20	45	-	Yes	75	-	Yes
46	< 20	45	-	Yes	75	-	Yes
Stage 2 - Establish site compound, access roads & delivery of materials							
1	< 20	45	-	Yes	75	-	Yes
2	< 20	45	-	Yes	75	-	Yes
3	< 20	45	-	Yes	75	-	Yes
4	< 20	45	-	Yes	75	-	Yes
5	< 20	45	-	Yes	75	-	Yes
6	< 20	45	-	Yes	75	-	Yes
7	< 20	45	-	Yes	75	-	Yes
8	< 20	45	-	Yes	75	-	Yes
9	< 20	45	-	Yes	75	-	Yes
10	< 20	45	-	Yes	75	-	Yes
11	34.9	45	-	Yes	75	-	Yes

Receiver ID	Predicted L_{eq} – dB(A)	Standard hours			“Highly Noise Affected”		
		NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No	NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No
12	34.2	45	-	Yes	75	-	Yes
13	< 20	45	-	Yes	75	-	Yes
14	< 20	45	-	Yes	75	-	Yes
15	< 20	45	-	Yes	75	-	Yes
16	20.1	45	-	Yes	75	-	Yes
17	< 20	45	-	Yes	75	-	Yes
18	< 20	45	-	Yes	75	-	Yes
19	< 20	45	-	Yes	75	-	Yes
20	< 20	45	-	Yes	75	-	Yes
21	< 20	45	-	Yes	75	-	Yes
22	< 20	45	-	Yes	75	-	Yes
23	< 20	45	-	Yes	75	-	Yes
24	< 20	45	-	Yes	75	-	Yes
25	< 20	45	-	Yes	75	-	Yes
26	< 20	45	-	Yes	75	-	Yes
27	< 20	45	-	Yes	75	-	Yes
28	< 20	45	-	Yes	75	-	Yes
29	< 20	45	-	Yes	75	-	Yes
30	< 20	45	-	Yes	75	-	Yes
31	< 20	45	-	Yes	75	-	Yes
32	< 20	45	-	Yes	75	-	Yes
33	< 20	45	-	Yes	75	-	Yes
34	< 20	45	-	Yes	75	-	Yes
35	27.1	45	-	Yes	75	-	Yes
36	< 20	45	-	Yes	75	-	Yes
37	< 20	45	-	Yes	75	-	Yes
38	< 20	45	-	Yes	75	-	Yes
39	< 20	45	-	Yes	75	-	Yes
40	< 20	45	-	Yes	75	-	Yes
41	< 20	45	-	Yes	75	-	Yes
42	< 20	45	-	Yes	75	-	Yes

Receiver ID	Predicted $L_{eq} - dB(A)$	Standard hours			“Highly Noise Affected”		
		NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No	NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No
43	< 20	45	-	Yes	75	-	Yes
44	< 20	45	-	Yes	75	-	Yes
45	< 20	45	-	Yes	75	-	Yes
46	< 20	45	-	Yes	75	-	Yes
Stage 3 - Installation of foundation							
1	< 20	45	-	Yes	75	-	Yes
2	< 20	45	-	Yes	75	-	Yes
3	< 20	45	-	Yes	75	-	Yes
4	< 20	45	-	Yes	75	-	Yes
5	< 20	45	-	Yes	75	-	Yes
6	< 20	45	-	Yes	75	-	Yes
7	< 20	45	-	Yes	75	-	Yes
8	< 20	45	-	Yes	75	-	Yes
9	< 20	45	-	Yes	75	-	Yes
10	< 20	45	-	Yes	75	-	Yes
11	35.5	45	-	Yes	75	-	Yes
12	34.8	45	-	Yes	75	-	Yes
13	< 20	45	-	Yes	75	-	Yes
14	< 20	45	-	Yes	75	-	Yes
15	< 20	45	-	Yes	75	-	Yes
16	20.7	45	-	Yes	75	-	Yes
17	< 20	45	-	Yes	75	-	Yes
18	< 20	45	-	Yes	75	-	Yes
19	< 20	45	-	Yes	75	-	Yes
20	< 20	45	-	Yes	75	-	Yes
21	< 20	45	-	Yes	75	-	Yes
22	< 20	45	-	Yes	75	-	Yes
23	< 20	45	-	Yes	75	-	Yes
24	< 20	45	-	Yes	75	-	Yes
25	< 20	45	-	Yes	75	-	Yes
26	< 20	45	-	Yes	75	-	Yes

Receiver ID	Predicted L_{eq} – dB(A)	Standard hours			“Highly Noise Affected”		
		NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No	NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No
27	< 20	45	-	Yes	75	-	Yes
28	< 20	45	-	Yes	75	-	Yes
29	< 20	45	-	Yes	75	-	Yes
30	< 20	45	-	Yes	75	-	Yes
31	< 20	45	-	Yes	75	-	Yes
32	< 20	45	-	Yes	75	-	Yes
33	< 20	45	-	Yes	75	-	Yes
34	< 20	45	-	Yes	75	-	Yes
35	27.7	45	-	Yes	75	-	Yes
36	< 20	45	-	Yes	75	-	Yes
37	< 20	45	-	Yes	75	-	Yes
38	< 20	45	-	Yes	75	-	Yes
39	< 20	45	-	Yes	75	-	Yes
40	< 20	45	-	Yes	75	-	Yes
41	< 20	45	-	Yes	75	-	Yes
42	< 20	45	-	Yes	75	-	Yes
43	< 20	45	-	Yes	75	-	Yes
44	< 20	45	-	Yes	75	-	Yes
45	< 20	45	-	Yes	75	-	Yes
46	< 20	45	-	Yes	75	-	Yes
Stage 4 - Installation of underground cabling							
1	< 20	45	-	Yes	75	-	Yes
2	< 20	45	-	Yes	75	-	Yes
3	< 20	45	-	Yes	75	-	Yes
4	< 20	45	-	Yes	75	-	Yes
5	< 20	45	-	Yes	75	-	Yes
6	< 20	45	-	Yes	75	-	Yes
7	< 20	45	-	Yes	75	-	Yes
8	< 20	45	-	Yes	75	-	Yes
9	< 20	45	-	Yes	75	-	Yes
10	< 20	45	-	Yes	75	-	Yes

Receiver ID	Predicted L_{eq} – dB(A)	Standard hours			“Highly Noise Affected”		
		NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No	NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No
11	32.8	45	-	Yes	75	-	Yes
12	32.1	45	-	Yes	75	-	Yes
13	< 20	45	-	Yes	75	-	Yes
14	< 20	45	-	Yes	75	-	Yes
15	< 20	45	-	Yes	75	-	Yes
16	< 20	45	-	Yes	75	-	Yes
17	< 20	45	-	Yes	75	-	Yes
18	< 20	45	-	Yes	75	-	Yes
19	< 20	45	-	Yes	75	-	Yes
20	< 20	45	-	Yes	75	-	Yes
21	< 20	45	-	Yes	75	-	Yes
22	< 20	45	-	Yes	75	-	Yes
23	< 20	45	-	Yes	75	-	Yes
24	< 20	45	-	Yes	75	-	Yes
25	< 20	45	-	Yes	75	-	Yes
26	< 20	45	-	Yes	75	-	Yes
27	< 20	45	-	Yes	75	-	Yes
28	< 20	45	-	Yes	75	-	Yes
29	< 20	45	-	Yes	75	-	Yes
30	< 20	45	-	Yes	75	-	Yes
31	< 20	45	-	Yes	75	-	Yes
32	< 20	45	-	Yes	75	-	Yes
33	< 20	45	-	Yes	75	-	Yes
34	< 20	45	-	Yes	75	-	Yes
35	25.0	45	-	Yes	75	-	Yes
36	< 20	45	-	Yes	75	-	Yes
37	< 20	45	-	Yes	75	-	Yes
38	< 20	45	-	Yes	75	-	Yes
39	< 20	45	-	Yes	75	-	Yes
40	< 20	45	-	Yes	75	-	Yes
41	< 20	45	-	Yes	75	-	Yes

Receiver ID	Predicted L_{eq} – dB(A)	Standard hours			“Highly Noise Affected”		
		NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No	NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No
42	< 20	45	-	Yes	75	-	Yes
43	< 20	45	-	Yes	75	-	Yes
44	< 20	45	-	Yes	75	-	Yes
45	< 20	45	-	Yes	75	-	Yes
46	< 20	45	-	Yes	75	-	Yes
Stage 5 - Assembly of panel frames, mounts & transformer units							
1	< 20	45	-	Yes	75	-	Yes
2	< 20	45	-	Yes	75	-	Yes
3	< 20	45	-	Yes	75	-	Yes
4	< 20	45	-	Yes	75	-	Yes
5	< 20	45	-	Yes	75	-	Yes
6	< 20	45	-	Yes	75	-	Yes
7	< 20	45	-	Yes	75	-	Yes
8	< 20	45	-	Yes	75	-	Yes
9	< 20	45	-	Yes	75	-	Yes
10	< 20	45	-	Yes	75	-	Yes
11	29.3	45	-	Yes	75	-	Yes
12	28.6	45	-	Yes	75	-	Yes
13	< 20	45	-	Yes	75	-	Yes
14	< 20	45	-	Yes	75	-	Yes
15	< 20	45	-	Yes	75	-	Yes
16	< 20	45	-	Yes	75	-	Yes
17	< 20	45	-	Yes	75	-	Yes
18	< 20	45	-	Yes	75	-	Yes
19	< 20	45	-	Yes	75	-	Yes
20	< 20	45	-	Yes	75	-	Yes
21	< 20	45	-	Yes	75	-	Yes
22	< 20	45	-	Yes	75	-	Yes
23	< 20	45	-	Yes	75	-	Yes
24	< 20	45	-	Yes	75	-	Yes
25	< 20	45	-	Yes	75	-	Yes

Receiver ID	Predicted $L_{eq} - dB(A)$	Standard hours			“Highly Noise Affected”		
		NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No	NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No
26	< 20	45	-	Yes	75	-	Yes
27	< 20	45	-	Yes	75	-	Yes
28	< 20	45	-	Yes	75	-	Yes
29	< 20	45	-	Yes	75	-	Yes
30	< 20	45	-	Yes	75	-	Yes
31	< 20	45	-	Yes	75	-	Yes
32	< 20	45	-	Yes	75	-	Yes
33	< 20	45	-	Yes	75	-	Yes
34	< 20	45	-	Yes	75	-	Yes
35	21.5	45	-	Yes	75	-	Yes
36	< 20	45	-	Yes	75	-	Yes
37	< 20	45	-	Yes	75	-	Yes
38	< 20	45	-	Yes	75	-	Yes
39	< 20	45	-	Yes	75	-	Yes
40	< 20	45	-	Yes	75	-	Yes
41	< 20	45	-	Yes	75	-	Yes
42	< 20	45	-	Yes	75	-	Yes
43	< 20	45	-	Yes	75	-	Yes
44	< 20	45	-	Yes	75	-	Yes
45	< 20	45	-	Yes	75	-	Yes
46	< 20	45	-	Yes	75	-	Yes
Stage 6 - Site rehabilitation / removal of temporary construction facility							
1	< 20	45	-	Yes	75	-	Yes
2	< 20	45	-	Yes	75	-	Yes
3	< 20	45	-	Yes	75	-	Yes
4	< 20	45	-	Yes	75	-	Yes
5	< 20	45	-	Yes	75	-	Yes
6	< 20	45	-	Yes	75	-	Yes
7	< 20	45	-	Yes	75	-	Yes
8	< 20	45	-	Yes	75	-	Yes
9	< 20	45	-	Yes	75	-	Yes

Receiver ID	Predicted $L_{eq} - \text{dB(A)}$	Standard hours			“Highly Noise Affected”		
		NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No	NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No
10	< 20	45	-	Yes	75	-	Yes
11	33.4	45	-	Yes	75	-	Yes
12	32.7	45	-	Yes	75	-	Yes
13	< 20	45	-	Yes	75	-	Yes
14	< 20	45	-	Yes	75	-	Yes
15	< 20	45	-	Yes	75	-	Yes
16	< 20	45	-	Yes	75	-	Yes
17	< 20	45	-	Yes	75	-	Yes
18	< 20	45	-	Yes	75	-	Yes
19	< 20	45	-	Yes	75	-	Yes
20	< 20	45	-	Yes	75	-	Yes
21	< 20	45	-	Yes	75	-	Yes
22	< 20	45	-	Yes	75	-	Yes
23	< 20	45	-	Yes	75	-	Yes
24	< 20	45	-	Yes	75	-	Yes
25	< 20	45	-	Yes	75	-	Yes
26	< 20	45	-	Yes	75	-	Yes
27	< 20	45	-	Yes	75	-	Yes
28	< 20	45	-	Yes	75	-	Yes
29	< 20	45	-	Yes	75	-	Yes
30	< 20	45	-	Yes	75	-	Yes
31	< 20	45	-	Yes	75	-	Yes
32	< 20	45	-	Yes	75	-	Yes
33	< 20	45	-	Yes	75	-	Yes
34	< 20	45	-	Yes	75	-	Yes
35	25.6	45	-	Yes	75	-	Yes
36	< 20	45	-	Yes	75	-	Yes
37	< 20	45	-	Yes	75	-	Yes
38	< 20	45	-	Yes	75	-	Yes
39	< 20	45	-	Yes	75	-	Yes
40	< 20	45	-	Yes	75	-	Yes

Receiver ID	Predicted L_{eq} – dB(A)	Standard hours			“Highly Noise Affected”		
		NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No	NML – dB(A)	Exceedance – dB(A)	Compliance Yes / No
41	< 20	45	-	Yes	75	-	Yes
42	< 20	45	-	Yes	75	-	Yes
43	< 20	45	-	Yes	75	-	Yes
44	< 20	45	-	Yes	75	-	Yes
45	< 20	45	-	Yes	75	-	Yes
46	< 20	45	-	Yes	75	-	Yes



Appendix C – Construction Noise Contours

Daroobalgie Solar Farm

FIGURE C1 Construction Stage 1 Noise Contours

Date: 17 February 2022
Client: Pacific Hydro Australia
Prepared by: RS



Datum GDA 94, Projection MGA ZONE 55

0 1 2 3 4 km



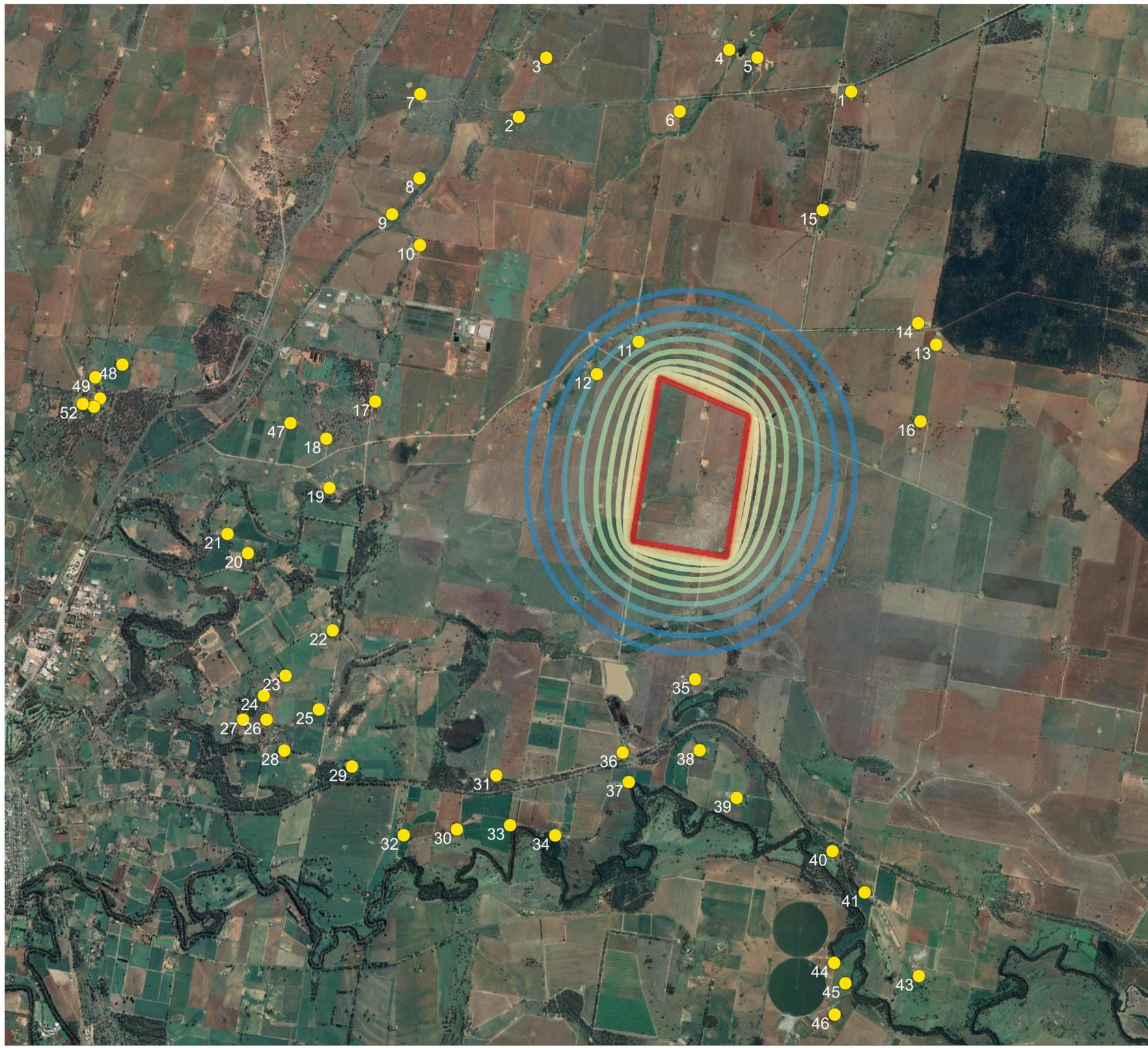
Legend

● Residential Receivers

Noise Contours - dB(A)



Resonate



Daroobalgie Solar Farm

FIGURE C2 Construction Stage 2 Noise Contours

Date: 17 February 2022
Client: Pacific Hydro Australia
Prepared by: RS



Datum GDA 94, Projection MGA ZONE 55

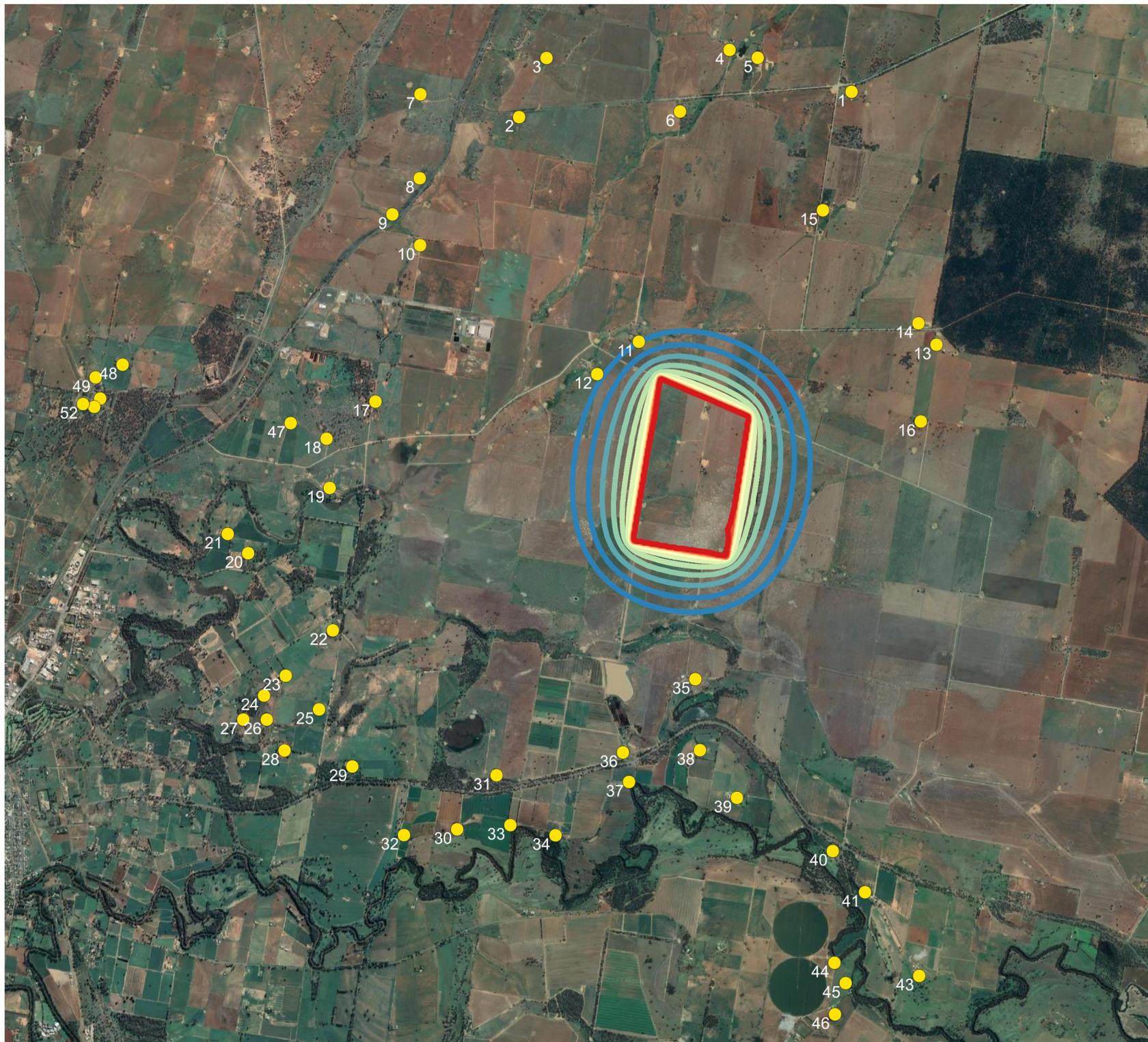
0 1 2 3 4 km



Legend

● Residential Receivers

Noise Contours - dB(A)



Daroobalgie Solar Farm

FIGURE C3 Construction Stage 3 Noise Contours

Date: 17 February 2022
Client: Pacific Hydro Australia
Prepared by: RS



Datum GDA 94, Projection MGA ZONE 55

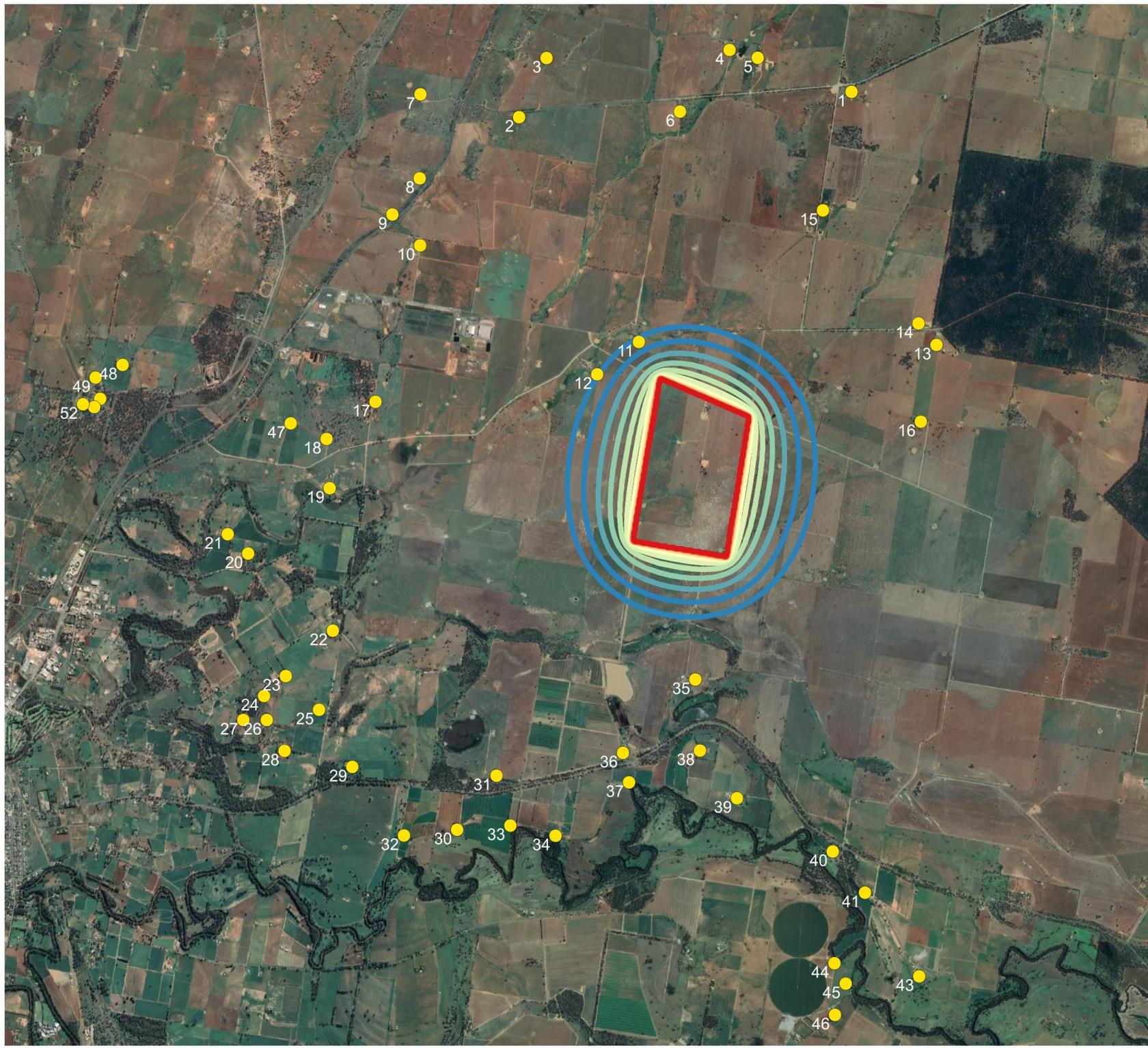
0 1 2 3 4 km



Legend

● Residential Receivers

Noise Contours - dB(A)



Daroobalgie Solar Farm

FIGURE C4 Construction Stage 4 Noise Contours

Date: 17 February 2022
Client: Pacific Hydro Australia
Prepared by: RS



Datum GDA 94, Projection MGA ZONE 55

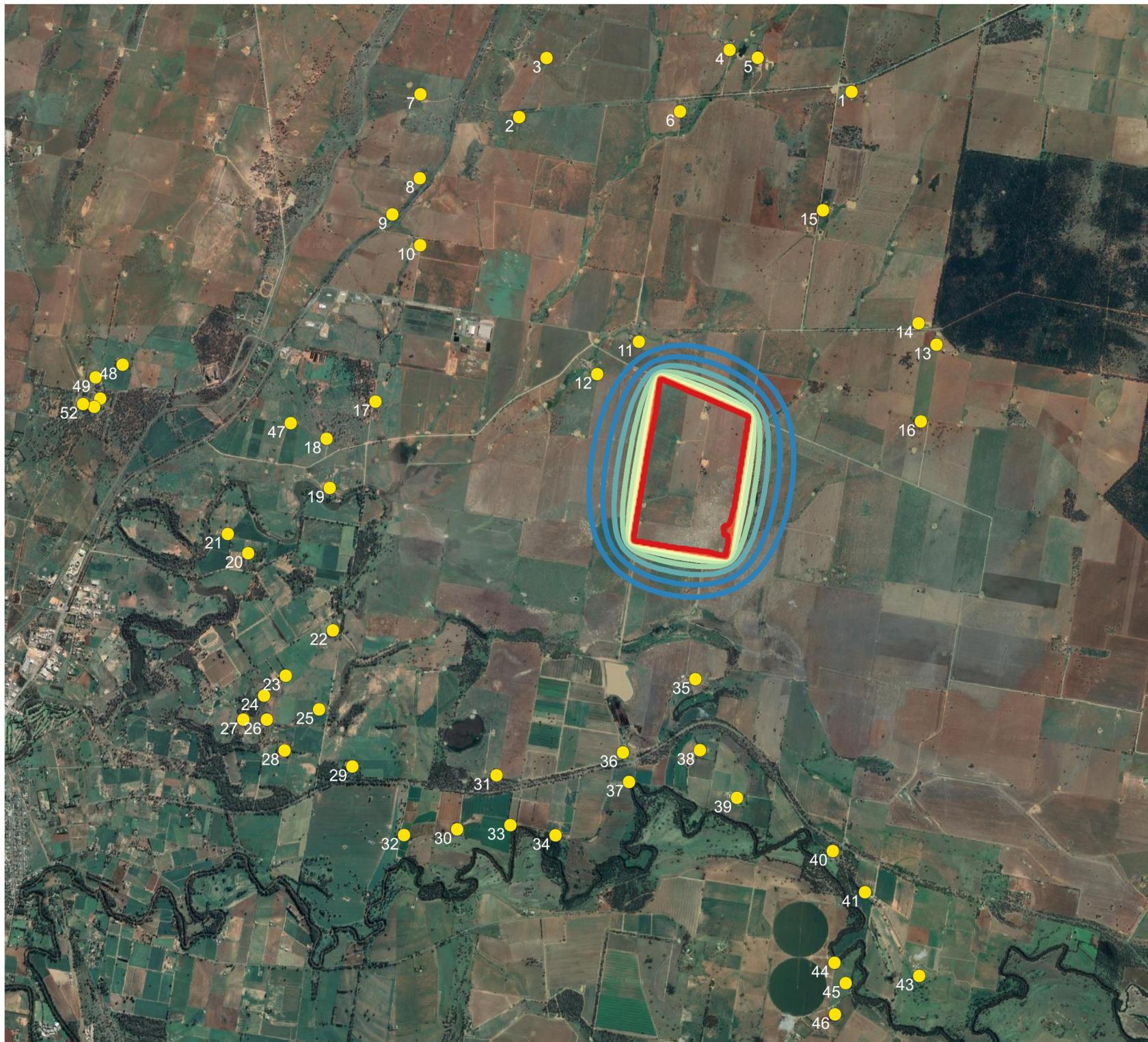
0 1 2 3 4 km



Legend

● Residential Receiver

Noise Contours - dB(A)



Daroobalgie Solar Farm

FIGURE C5 Construction Stage 5 Noise Contours

Date: 17 February 2022
Client: Pacific Hydro Australia
Prepared by: RS



Datum GDA 94, Projection MGA ZONE 55

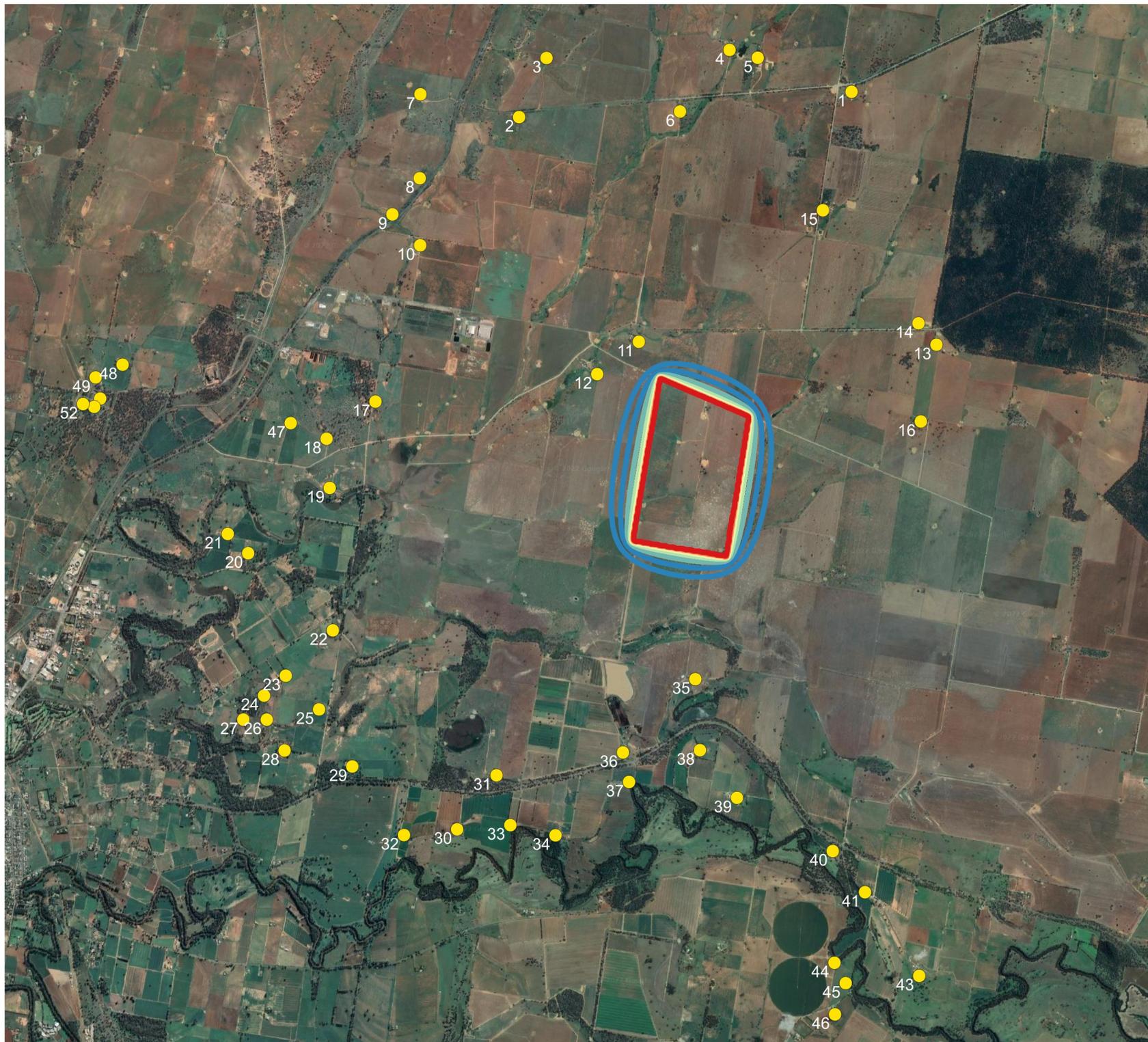
0 1 2 3 4 km



Legend

● Residential Receiver

Noise Contours - dB(A)



Daroobalgie Solar Farm

FIGURE C6 Construction Stage 6 Noise Contours

Date: 17 February 2022
Client: Pacific Hydro Australia
Prepared by: RS



Datum GDA 94, Projection MGA ZONE 55

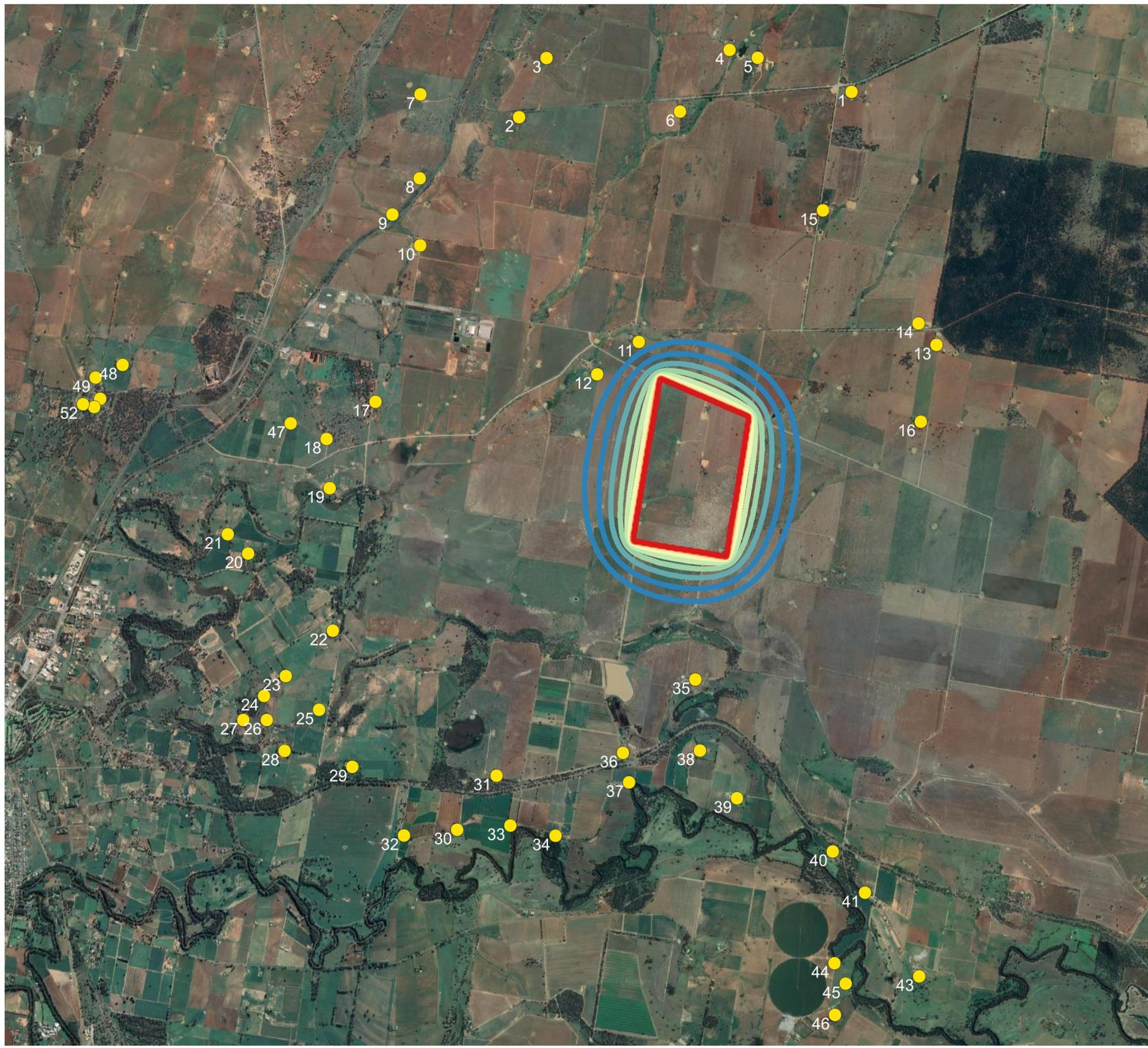
0 1 2 3 4 km



Legend

● Residential Receiver

Noise Contours - dB(A)



Appendix D – Predicted Operational Noise Levels

Receiver ID	Daytime / Evening periods (standard met condition)				Night-time period (noise-enhancing met condition)			
	Predicted – dB(A)	Criteria Day / Eve – dB(A)	Exceedance – dB(A)	Compliance? (Yes / No)	Predicted – dB(A)	Criteria Night – dB(A)	Exceedance – dB(A)	Compliance? (Yes / No)
1	< 20	40 / 35	-	Yes	<20	35	-	Yes
2	< 20	40 / 35	-	Yes	<20	35	-	Yes
3	< 20	40 / 35	-	Yes	<20	35	-	Yes
4	< 20	40 / 35	-	Yes	<20	35	-	Yes
5	< 20	40 / 35	-	Yes	<20	35	-	Yes
6	< 20	40 / 35	-	Yes	<20	35	-	Yes
7	< 20	40 / 35	-	Yes	<20	35	-	Yes
8	< 20	40 / 35	-	Yes	<20	35	-	Yes
9	< 20	40 / 35	-	Yes	<20	35	-	Yes
10	< 20	40 / 35	-	Yes	<20	35	-	Yes
11	30.1	40 / 35	-	Yes	35.0	35	-	Yes
12	29.3	40 / 35	-	Yes	34.4	35	-	Yes
13	< 20	40 / 35	-	Yes	<20	35	-	Yes
14	< 20	40 / 35	-	Yes	<20	35	-	Yes
15	< 20	40 / 35	-	Yes	<20	35	-	Yes
16	< 20	40 / 35	-	Yes	20.3	35	-	Yes
17	< 20	40 / 35	-	Yes	<20	35	-	Yes
18	< 20	40 / 35	-	Yes	<20	35	-	Yes
19	< 20	40 / 35	-	Yes	<20	35	-	Yes
20	< 20	40 / 35	-	Yes	<20	35	-	Yes
21	< 20	40 / 35	-	Yes	<20	35	-	Yes
22	< 20	40 / 35	-	Yes	<20	35	-	Yes
23	< 20	40 / 35	-	Yes	<20	35	-	Yes
24	< 20	40 / 35	-	Yes	<20	35	-	Yes
25	< 20	40 / 35	-	Yes	<20	35	-	Yes
26	< 20	40 / 35	-	Yes	<20	35	-	Yes
27	< 20	40 / 35	-	Yes	<20	35	-	Yes

Receiver ID	Daytime / Evening periods (standard met condition)				Night-time period (noise-enhancing met condition)			
	Predicted – dB(A)	Criteria Day / Eve – dB(A)	Exceedance – dB(A)	Compliance? (Yes / No)	Predicted – dB(A)	Criteria Night – dB(A)	Exceedance – dB(A)	Compliance? (Yes / No)
28	< 20	40 / 35	-	Yes	<20	35	-	Yes
29	< 20	40 / 35	-	Yes	<20	35	-	Yes
30	< 20	40 / 35	-	Yes	<20	35	-	Yes
31	< 20	40 / 35	-	Yes	<20	35	-	Yes
32	< 20	40 / 35	-	Yes	<20	35	-	Yes
33	< 20	40 / 35	-	Yes	<20	35	-	Yes
34	< 20	40 / 35	-	Yes	<20	35	-	Yes
35	22.0	40 / 35	-	Yes	27.4	35	-	Yes
36	< 20	40 / 35	-	Yes	<20	35	-	Yes
37	< 20	40 / 35	-	Yes	<20	35	-	Yes
38	< 20	40 / 35	-	Yes	<20	35	-	Yes
39	< 20	40 / 35	-	Yes	<20	35	-	Yes
40	< 20	40 / 35	-	Yes	<20	35	-	Yes
41	< 20	40 / 35	-	Yes	<20	35	-	Yes
42	< 20	40 / 35	-	Yes	<20	35	-	Yes
43	< 20	40 / 35	-	Yes	<20	35	-	Yes
44	< 20	40 / 35	-	Yes	<20	35	-	Yes
45	< 20	40 / 35	-	Yes	<20	35	-	Yes
46	< 20	40 / 35	-	Yes	<20	35	-	Yes



Appendix E – Operational Noise Contours

Daroobalgie Solar Farm

FIGURE E1 Operational Noise Contours - Day and Evening

Date: 17 February 2022
Client: Pacific Hydro Australia
Prepared by: RS



Datum GDA 94, Projection MGA ZONE 55

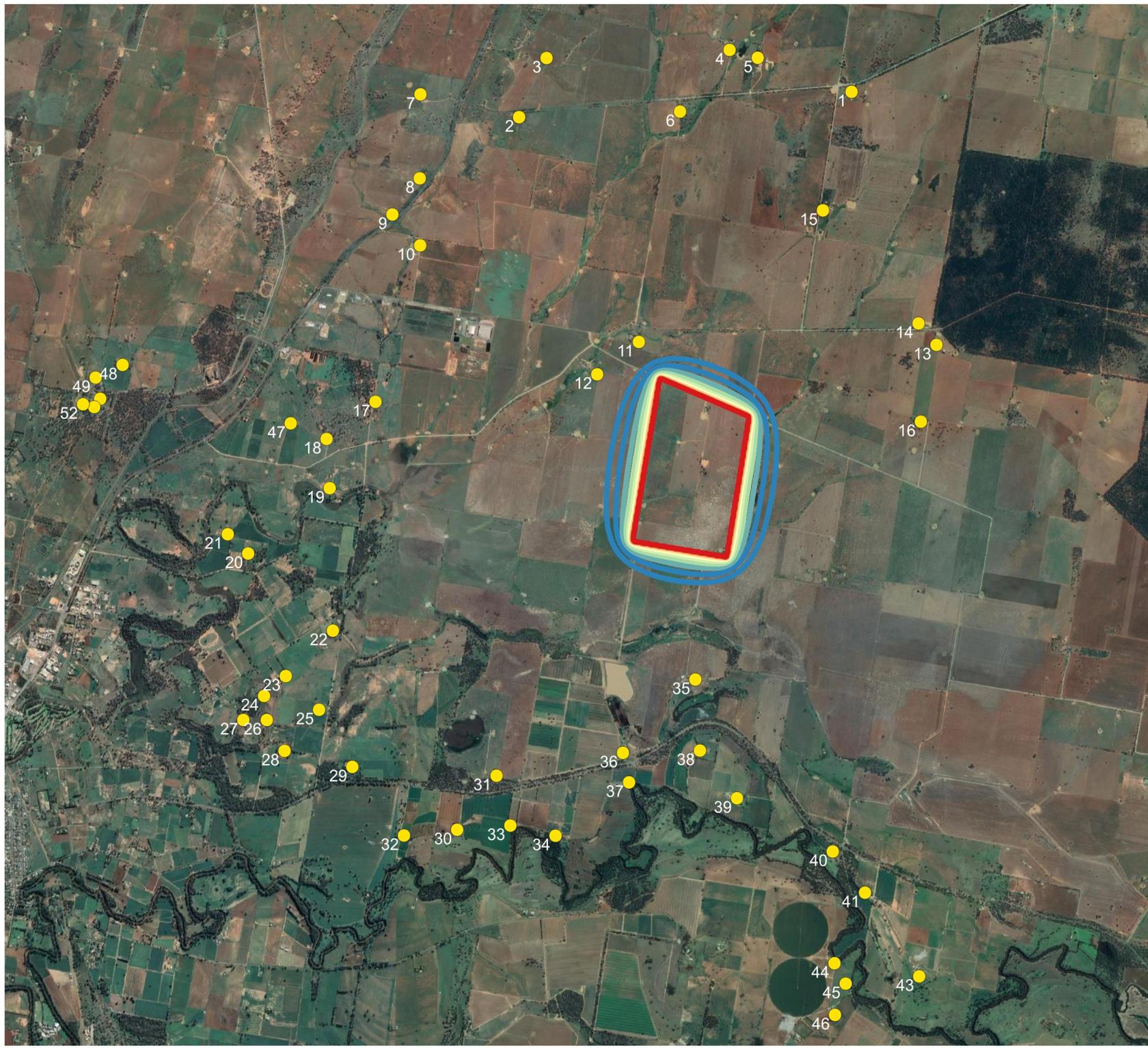
0 1 2 3 4 km



Legend

● Residential Receiver

Noise Contours - dB(A)



Daroobalgie Solar Farm

FIGURE E2 Operational Noise Contours - Night-time

Date: 17 February 2022
Client: Pacific Hydro Australia
Prepared by: RS



Datum GDA 94, Projection MGA ZONE 55

0 1 2 3 4 km



Legend

● Residential Receiver

Noise Contours - dB(A)

