WEST WYALONG SOLAR FARM

Noise Impact Assessment

Prepared for:

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BASIS OF REPORT

This report has been prepared by SLR Consulting Australia Pty Ltd with all reasonable skill, care and diligence, and taking account of the timescale and resources allocated to it by agreement with Lightsource Development Services Australia Pty Ltd (the Client). Information reported herein is based on the interpretation of data collected, which has been accepted in good faith as being accurate and valid.

This report is for the exclusive use of the Client. No warranties or guarantees are expressed or should be inferred by any third parties. This report may not be relied upon by other parties without written consent from SLR

SLR disclaims any responsibility to the Client and others in respect of any matters outside the agreed scope of the work.

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.18343-R02-v3.0	21 January 2019	Nicholas Vandenberg	Antony Williams	Antony Williams
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CONTENTS

CONTENTS

DOCUMENT REFERENCES

TABLES

FIGURES

APPENDICES

1 Introduction

SLR Consulting Australia Pty Ltd (SLR) has been engaged by Lightsource Development Services Australia to prepare a noise and vibration impact assessment for the proposed West Wyalong Solar Farm.

This report addresses the Secretary's Environmental Assessment Requirements (SEARs) relevant to the Project (State Significant Development 9504).

This report presents the study methodology, assessment criteria, assessment of noise emissions and noise mitigation recommendations, where applicable, in relation to the following specific areas:

- Potential noise and vibration emissions during the construction stage
- Operational noise emissions from transformers, inverters and general onsite vehicle activity.

1.1 Terminology

The assessment has used specific acoustic terminology. An explanation of common terms is included in **Appendix A**.

2 Project Description, Site and Surrounds

2.1 Proposed Project Description

The Project Site is located within the Bland Shire Local Government Area (LGA) in Western NSW, approximately 15 km north-west of West Wyalong and is located at 228-230 Blands Lane, West Wyalong. The Project site is located on Lot 17 and 18 DP753081 and is a total of 560 Ha.

The proposal is for a 90 MW AC solar farm to be located on the southern portion of the Project Site as identified in **Figure 1** and utilises 280 Ha primarily for solar farm infrastructure. The proposal area is presently used for agriculture and is bounded to the north, south, east and west by flat, grassy rural areas and will be accessed via an access road along Gordon's Lane from Blands Lane.

Key features of the project that have been considered within this assessment are:

- Solar arrays mounted on frames, with associated underground cabling
- Electrical substation/transformer and connection to transmission line
- battery storage and transformers and inverters
- Construction of site access roads
- Site facilities/office
- Temporary laydown area during the construction phase

The proposed arrangement of infrastructure and facilities is shown in **Figure 1**.

Figure 1 Proposed Site Layout

2.2 Noise Sensitive Receivers

Noise sensitive receivers surrounding the Project site are shown in **Figure 2**.

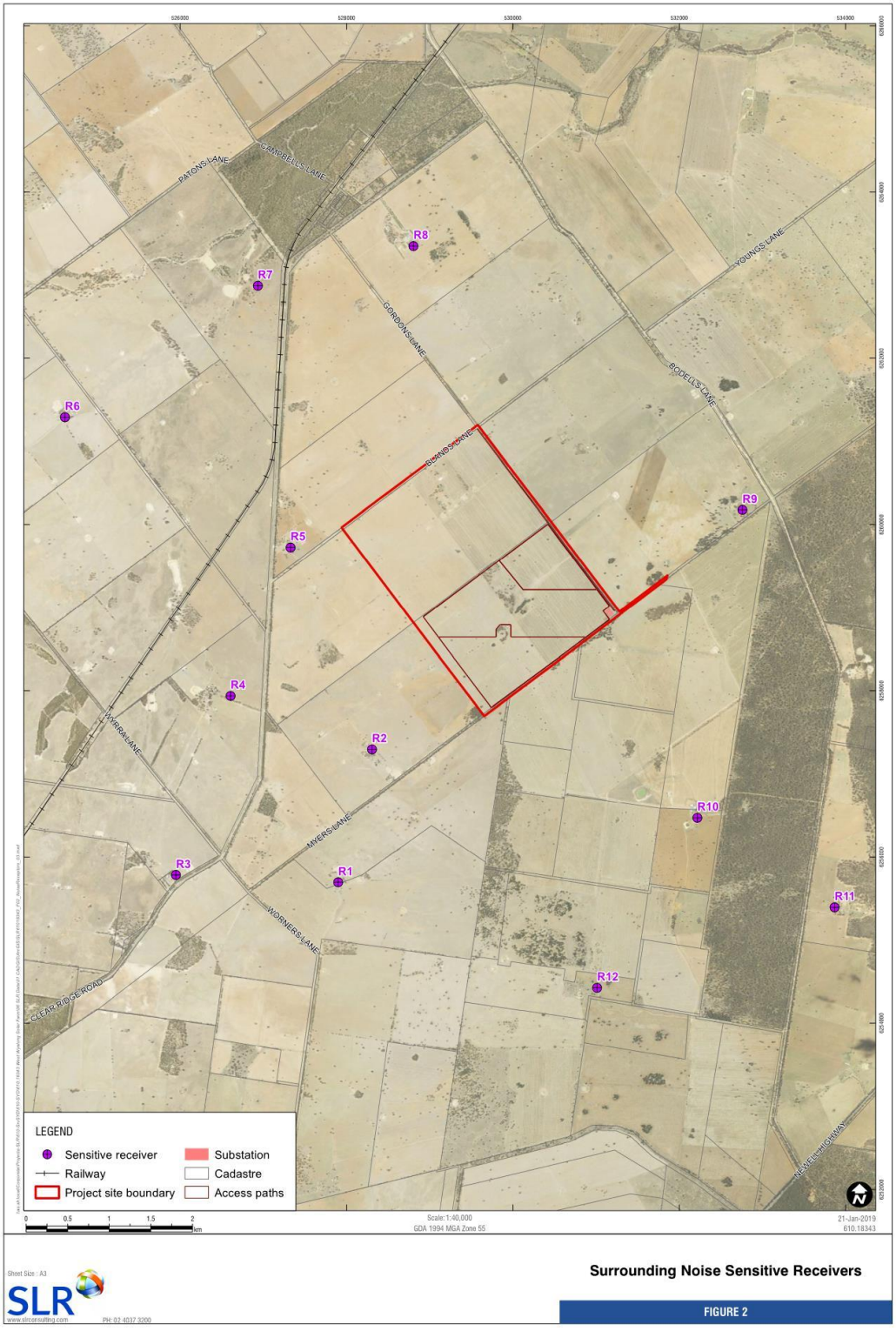
The closest and potentially impacted residential receivers identified in the vicinity of the Project are listed in **Table 1**.

Table 1 Nearest Noise Sensitive Receivers

Receiver ID	Address	Approximate Distance from the Proposal area inc access road (m)
R1	84 Myers Lane, Wyalong	2700
R2	1390 Clear Ridge Road, Wyalong	1300
R3	1049 Clear Ridge Road, Wyalong	4100
R4	1389 Clear Ridge Road, Wyalong	2300
R5	1590 Clear Ridge Road, Wyalong	1700
R6	114 Patons Lane, West Wyalong	4800
R7	1049 Clear Ridge Road, Wyalong	3000
R8	2060 Clear Ridge Road, Wyalong	2300
R9	839 Bodells Lane, Wyalong	1900
R10	179 Bodells Lane, Wyalong	2500
R11	324 Bodells Lane, Back Creek	4400
R12	175 Bodells Lane, Wyalong	3600

The nearest noise sensitive receiver to the proposed site boundary is approximately 1300 m to the north-east.

Figure 2 Surrounding Noise Sensitive Receivers to Project Site



3 Assessment Criteria

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* 2017
- An assessment of the cumulative noise impacts (considering other operations in the area including the nearby airstrip).

3.2 Operational Noise – Noise Policy for Industry

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

3.2.1 Trigger Levels

The NPfI 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 NPfI for that particular land use.

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

In Lieu of noise survey data, the NPfI minimum recommended RBLs have been adopted for the purpose of this assessment and are presented in **Table 2**.

Table 2 Minimum RBLs in accordance with the NPfI

Minimum Rating Background Noise Level (dBA)		
Daytime	**Evening**	**Night-time**
35	30	30

The RBLs are considered representative of typical rural environments with few surrounding noise sources.

3.2.2 Project Specific Criteria

The criteria for industrial noise generated by the facility are provided in **Table 3**. 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 3 NPfI Assessment Criteria (Rural Amenity Area)

Receiver	Period	Noise Level (dBA)			
		Recommended Amenity Noise Level L_{Aeq}	Assumed Background Noise Level	Project Noise Trigger Levels $L_{Aeq(15minute)}$	
			RBL[1]	Intrusiveness	Amenity[2,3]
Residential	Daytime	50	35[4]	**40**	53
	Evening	45	30[4]	**35**	48
	Night-time	40	30[4]	**35**	43

Note 1: RBL = Rating Background Level.

Note 2: The recommended amenity noise levels have been used as the project amenity noise levels as there are no other industries present or likely to be introduced

Note 3: The project amenity noise levels have been converted to a 15 minute level by adding 3 dB.

Note 4: The minimum RBL as per the NPfI has been adopted.

3.2.3 Modifying Factors

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 NPfI provides the following modifying factors, shown in **Table 4**, which are to be applied to the predicted receiver noise levels.

Table 4 NPfI Modifying Factors

Factor	Assessment/Measurement	When to Apply	Correction[1]
Tonal noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by levels defined in the NPfI.	5 dB[2]
Low-frequency noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements	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 the level to which thresholds defined in the NPfI are exceeded.	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

Note 1: Corrections to be added to the measured or predicted levels.

Note 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.

3.2.4 NPfI Assessment of Prevailing Weather Conditions

The NPfI '*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 NPfI 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 Construction Noise

3.3.1 NSW Interim Construction Noise Guideline (ICNG)

The NSW *Interim Construction Noise Guideline* (ICNG) sets out ways to assess and manage the impacts of construction noise on residences and other sensitive land uses. It does this by presenting assessment approaches that are tailored to the scale of the construction works.

The ICNG requires project specific Noise Management Levels (NMLs) to be established for noise affected receivers. The NMLs are not mandatory limits, however in the event construction noise levels are predicted to be above the NMLs, feasible and reasonable work practices are to be investigated to minimise noise emissions.

3.3.1.1 Residential Receivers

The ICNG provides an approach for determining NMLs at sensitive receivers based on RBL for the area, as described in **Table 5**.

Table 5 Determination of NMLs for Residential Receivers

Time of Day	NML $L_{Aeq(15minute)}$	How to Apply
Standard hours Monday to Friday 7:00 am to 6:00 pm Saturday 8:00 am to 1:00 pm No work on Sundays or public holidays	RBL + 10 dBA	• The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured LAeq(15minute) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practises 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.

Time of Day	NML $L_{Aeq(15minute)}$	How to Apply

	Highly Noise Affected 75 dBA	• The Highly Noise Affected (HNA) level represents the point above which there may be strong community reaction to noise.
		• Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restructuring the hours that the very noisy activities can occur, taking into account:
		  • 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.

Outside recommended standard hours	RBL + 5 dBA	• 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 practises have been applied and noise is more than 5 dBA above the noise affected level, the proponent should negotiate with the community.

Note 1 The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW *Noise Policy for Industry*.

3.3.1.2 Commercial and Industrial Premises

The ICNG notes that due to the broad range of sensitivities that commercial or industrial land can have to noise from construction, the process of defining management levels is separated into three categories:

- Industrial premises: external $L_{Aeq(15minute)}$ 75 dBA
- Offices, retail outlets: external $L_{Aeq(15minute)}$ 70 dBA
- Other businesses that may be very sensitive to noise, where the noise level is project specific as discussed below.

The external noise levels should be assessed at the most-affected occupied point of the premises.

3.3.2 Residential NML Summary

Using the minimum background noise levels established in accordance with the NPfI (refer to **Section 3.2**), the residential NMLs derived for the project are detailed in **Table 6**.

Table 6 Residential Receiver NMLs for Construction

Standard Construction (RBL+10dB)	Out of Hours (RBL+5dB)			Sleep Disturbance Screening (RBL+15 dB)
Daytime	Daytime	Evening	Night-time	
45	40	35	35	45

3.4 Construction Road Traffic Noise Guidelines

When trucks and other vehicles are operating within the boundaries of construction sites, road vehicle noise contributions are included in the predicted $L_{Aeq(15minute)}$ noise emissions and assessed against the ICNG criteria in **Section 3.3.1**.

When construction related traffic moves onto the public road network a different noise assessment methodology is appropriate, as vehicle movements are regarded as 'additional road traffic' rather than as part of the works and are assessed under the NSW *Road Noise Policy* (RNP).

As required by the RNP, an initial screening test should first be applied by evaluating whether noise levels would increase by more than 2 dB (an increase in the number vehicles of approximately 60%) due to construction traffic or a temporary reroute due to a road closure.

Where noise levels increase by more than 2 dB (ie 2.1 dB or greater) further assessment is required using the criteria presented in the RNP, as reproduced below to in **Table 7**.

Table 7 RNP Criteria for Assessing Construction Vehicles on Public Roads

Road Category	Type of Project/Land Use	Assessment Criteria (dBA)	
		Daytime (7 am - 10 pm)	**Night-time (10 pm - 7 am)**
Freeway/ arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	$L_{Aeq(15hour)}$ 60 (external)	$L_{Aeq(9hour)}$ 55 (external)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq(1hour)}$ 55 (external)	$L_{Aeq(1hour)}$ 50 (external)

3.5 Construction Vibration Guidelines

The effects of vibration on buildings can be divided into three main categories:

- Those in which the occupants or users of the building are inconvenienced or possibly disturbed
- Those where the building contents may be affected
- Those in which the integrity of the building or the structure itself may be prejudiced.

3.5.1 Human Comfort Vibration

The Department of Environment and Conservation's (DEC) *Assessing Vibration: a technical guideline* (2006) provides guideline values for continuous, transient and intermittent events that are based on a Vibration Dose Value (VDV) rather than a continuous vibration level. The VDV is dependent upon the level and duration of the vibration event, as well as the number of events occurring during the daytime or night-time period.

The VDVs recommended in the guideline for vibration that is intermittent nature are presented in **Table 8**.

Table 8 Preferred and Maximum Vibration Dose Values for Intermittent Vibration

Building Type	Vibration Dose Value ($m/s^{1.75}$)	
	Preferred	**Maximum**
Critical Working Areas (eg hospital operating theatres, precision laboratories)	0.10	0.20
Residential Daytime	0.20	0.40
Residential Night-time	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80
Workshops	0.80	1.60

Note: Daytime is 7:00 am to 10:00 pm and night-time is 10:00 pm to 7:00 am.

3.5.2 Effects on Building Contents

People can perceive floor vibration at levels well below those likely to cause damage to building contents or affect the operation of typical equipment found in most buildings that is not particularly vibration sensitive. For most receivers, the controlling vibration criterion is the human comfort criterion, and it is therefore not normally required to set separate criteria in relation to the effect of construction vibration on typical building contents.

Where appropriate, objectives for the satisfactory operation of vibration senstive critical instruments or manufacturing processes should be sourced from manufacturer's data and/or other published objectives.

3.5.3 Structural Damage Vibration

Structural damage vibration limits are based on Australian Standard AS 2187: Part 2-2006 *Explosives - Storage and Use - Part 2: Use of Explosives* and British Standard BS 7385 Part 2-1993 *Evaluation and measurement for vibration in buildings Part 2*. These standards provide frequency-dependent vibration limits related to cosmetic damage, noting that cosmetic damage is very minor in nature, is readily repairable and does not affect the structural integrity of the building.

The recommended vibration limits from BS 7385 for transient vibration for minimal risk of cosmetic damage to residential and industrial buildings are shown in **Table 9**.

Table 9 Transient Vibration Guide Values – Minimal Risk of Cosmetic Damage

Line	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	**15 Hz and Above**
1	Reinforced or framed structures. Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures. Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

4 Operational Noise and Vibration Assessment

4.1 Onsite Operations

A noise model has been developed in SoundPLAN to predict the proposed operational noise impacts from the project. Calculations were undertaken based on the CONCAWE methodology, with meteorological conditions set to 'worst-case' in accordance with the NPfI guidance outlined in **Section 3.2.4**.

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

- Transformers and inverters systems:
  - A series of 30 Power Electronics transformers/inverter configurations are proposed to be positioned around the project site as indicated in the proposed site plan (refer to **Figure 1**)
- Substation:
  - The substation is proposed to consist of:
    - 2 x 40/50MVA Ground Mounted Transformer
    - 2 x 45/50MVA Ground Mount Transformer
    - 1 x 150KVA Earthing Transformer
- Maintenance activities:
  - A limited number of up to 20 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.
- Noise from the tracking mechanism on the solar panels is expected to be insignificant in comparison to that of the above identified sources.

The corresponding sound power levels used in the assessment are outlined in **Table 10**.

Table 10 Sound Power Levels

Noise Source	Sound Power Level (dBA)
Transformers/Inverters	100 dBA [1,2]
Substation - 2 x 40/50MVA Ground Mounted Transformer - 2 x 45/50MVA Ground Mounted Transformer - 1 x 150KVA Earthing Transformer	 70 dBA[2,3] 70 dBA[2,3] 55 dBA[2,3]
Truck – travelling along the access road around the site	106 dBA

Note 1 Based on the manufactures specification.

Note 2 includes 5 dB penalty for potential tonal noise

Note 3 Based on SWL's used for a previous substation noise assessment provided by Lightsource proposed to be utilizing the same units.

4.1.1 Predicted Noise Levels

Operational noise levels have been predicted to all residential receivers surrounding the project site and are presented in **Table 11**.

Table 11 Predicted Operational Noise Level

Receiver ID	Noise Level (dBA)			Predicted Noise Level ($L_{Aeq(15minute)}$) (dBA)
	PNTL Critieria ($L_{Aeq(15minute)}$)			
	Daytime	Evening	Night-time	
R1	40	35	35	<25
R2	40	35	35	<25
R3	40	35	35	<25
R4	40	35	35	<25
R5	40	35	35	<25
R6	40	35	35	<25
R7	40	35	35	<25
R8	40	35	35	<25
R9	40	35	35	<25
R10	40	35	35	<25
R11	40	35	35	<25
R12	40	35	35	<25

4.2 Traffic

The existing traffic along Blands Lane and Bodell Lane 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 facility.

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 on existing road traffic noise levels.

4.3 Cumulative Impacts

Due to the extensive distance from the project site to other nearby projects (approximately 14 km from Wyalong Airport, 17 km from the Lake Cowal Gold Mine and 7km from the proposed Wyalong Solar Farm currently on exhibition) there are no expected cumulative noise effects associated with the proposal.

4.4 Vibration

No vibration intensive activities are proposed to occur during the standard operation onsite and no impacts are anticipated.

5 Construction Noise and Vibration Assessment

Airborne noise modelling was undertaken using the ISO 9613 algorithms as implemented in SoundPLAN V8.0.

The three-dimensional model includes source noise levels, ground topography (obtained from Google Earth as no LIDAR was available), location of sources and receivers, acoustic shielding provided by ground topography, air absorption, ground effects and the duration of equipment usage within the assessment period.

Construction noise levels have been predicted the receivers surrounding the proposed project.

5.1 Working Hours

Where possible, the majority of construction works would be undertaken in accordance with the ICNG during the standard daytime working hours of:

- 7.00 am to 6.00 pm Monday to Friday
- 8.00 am to 1.00 pm on Saturdays.

Limited works may be conducted outside of these hours provided they are managed so as to generate noise levels below the relevant ICNG Noise Management Levels.

The proposed solar farm is anticipated to take 6 to 7 months to complete.

5.2 Construction Activity Source Noise Levels

Sound power levels for the typical operation of construction equipment used in the modelling are listed in **Table 12**. These noise levels have been taken from verified test data and global standards that form part of SLR's noise database.

Table 12 Sound Power Levels for Construction Equipment

ID	Construction Activity	Equipment	Operating minutes in 15-min period[1]	No of items in same location	Sound Power Level LWA (dB)	
					Item	Activity
W.0001	Early Works – Site Establishment	Ute (5mins)	5	4	98	108
		Truck (12-15 tonne)	15	2	103	
		Hand Tools (electric)	15	2	96	
W.0002	Earthworks – Main Earthworks	Ute (5mins)	5	2	98	112
		Truck (12-15 tonne)	15	1	103	
		Hand Tools (electric)	15	1	96	
		Excavator (30 tonne)	15	2	104	
		Grader	15	1	108	
W.0003	Earthworks – Easement excavation/utilities work	Excavator (30 tonne)	15	1	104	105
		Truck (25t)	15	1	98	
W.0004	Earthworks - Concrete Works	Concrete Pump	8	1	106	108
		Concrete Truck / Agitator	8	1	106	
		Concrete Vibrator	15	1	102	
		Ute (5mins)	5	2	98	
		Hand Tools (electric)	15	2	96	
W.0005	Construction – piling Activities	Piling Rig (Bored)	8	2	108	110
		Truck (12-15 tonne)	15	2	103	
		Ute (5mins)	5	2	98	
W.0006	Construction – Installation of Solar Panels, transformers, etc	Truck (12-15 tonne)	15	2	103	108
		Crane Truck	15	2	100	
		Hand Tools (electric)	15	2	96	
W.0007	General Works - Landscaping	Bobcat	15	1	104	107
		Truck (12-15 tonne)	15	1	103	
		Hand Tools (electric)	15	1	96	
		Ute (5mins)	5	2	98	

Note 1: This refers to the amount of time in minutes that individual items of equipment would be in use for during the worst-case 15 minute assessment period, based on site observations. Some items of plant, such as Concrete Pumps, are not typically used in a continuous manner.

5.3 Predicted Worst-case Noise Levels – Proposal Overview

A summary of the predicted noise levels (without additional mitigation) for each of the closest residential receivers for the various work activities is presented in **Table 13**.

A qualitative description of the NML exceedance bands is given below, noting that the impact of these potential exceedances would depend on the period in which they were to occur:

- Noise levels 1 to 10 dB above NML – impact would typically be marginal to minor
- Noise levels 11 dB to 20 dB above NML – impact would typically be moderate
- Noise levels >20 dB above NML – impact would typically be high

For most construction activities, it is expected that the construction noise levels would frequently be lower than predicted at the most-exposed receiver, as the noise levels presented in this report are based on each scenario occurring at the site boundary.

Table 13 Predicted Worst-case Noise Levels from Proposal – All Works

Receiver ID	Noise Management Levels (NML)				Predicted $L_{Aeq(15minute)}$ Noise Level (dBA)[1]						
	Standard Daytime	DayOOH	Evening	Night-time	W.0001- Early Works – Site Establishment	W.0002- Earthworks – Main Earthworks	W.0003- Earthworks – Easement excavation/utilities	W.0004- Earthworks - Concrete Works	W.0005- Construction – piling Activities	W.0006- Construction – Installation of Solar Panels, transformers, etc	W.0007- General Works - Landscaping
					Operating Period						
					DAY	DAY	DAY	DAY	DAY	DAY	DAY
Residential											
R1	45	40	35	35	<30	<30	<30	<30	<30	<30	<30
R2	45	40	35	35	31.0	35.0	<30	31.0	33.0	31.0	<30
R3	45	40	35	35	<30	<30	<30	<30	<30	<30	<30
R4	45	40	35	35	<30	<30	<30	<30	<30	<30	<30
R5	45	40	35	35	<30	32.0	<30	<30	30.0	<30	<30
R6	45	40	35	35	<30	<30	<30	<30	<30	<30	<30
R7	45	40	35	35	<30	<30	<30	<30	<30	<30	<30
R8	45	40	35	35	<30	<30	<30	<30	<30	<30	<30
R9	45	40	35	35	33.0	37.0	<30	33.0	35.0	33.0	32.0
R10	45	40	35	35	<30	<30	<30	<30	<30	<30	<30
R11	45	40	35	35	<30	<30	<30	<30	<30	<30	<30
R12	45	40	35	35	<30	<30	<30	<30	<30	<30	<30

5.4 Discussion

No exceedances of the NML's during Standard daytime hours are predicted at any of the surrounding residential receivers during any of the works. This is due to the significant distance between the works and the receivers.

The highest noise level is predicted to be 37 dBA at the nearest residential receiver (R9) located approximately 1200 metres from the works proposed in the easement to the transmission lines.

5.5 Construction Mitigation Measures

The 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, results in the construction impacts from the project being expected to be negligible.

As such, there is no requirement to apply any specific noise mitigation measures, 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 for example (particularly at night), 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.

Where it is necessary to undertake works outside of standard hours, the noise levels may exceed the NML at some of the surrounding sensitive receivers up to 6dB 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.

5.6 Construction Traffic

The proposed construction traffic is anticipated to travel east along Blands Lane, then south on Bodell Lane before accessing the Newell Highway.

The existing traffic along Blands Lane and Bodell Lane are minimal, with generally up to one light vehicle or heavy vehicle per hour.

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 Traffic Noise Predictions

Road Name	Road Type	Criteria (Day/Night)	Assessment Period	Existing Traffic Volume (Daytime 7am to 10pm)		Proposed Traffic (Daytime 7am to 10pm)		Predicted Noise Level (dBA)	
								Existing	Future
				Light	Heavy	Light	Heavy		
Blands Lane	Local Road	55/50	1 hour	1	1	10	10	<30	35
Bodell Lane	Local Road	55/50	1 Hour	1	1	10	10	<30	44
Newell Highway	Arterial Road	60/55	15 Hour	1075	706	20	70	54	54

Based on the above, the proposed construction traffic is predicted to increase the overall traffic noise levels along Blands Lane and Bodell Lane 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 from the additional traffic movements along this road.

5.7 Construction Vibration

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

6 Conclusion

An assessment of the potential noise impacts associated with the proposed West Wyalong Solar Farm has been completed. This assessment has been carried out in accordance with NSW regulatory requirements identified in the SEARs issued for the development.

An assessment has been undertaken using plant and equipment representative of the likely methodologies used to construct the project. The assessment identifies that no exceedances of the management levels are predicted and no adverse impacts are expected due to the separation of the site to the surrounding receivers.

An assessment has been undertaken of the operational noise associated with the Project. The assessment has shown that noise emissions from the development are expected to comply with the relevant criteria.

APPENDIX A

Acoustic Terminology

1 Sound Level or Noise Level

The terms “sound” and “noise” are almost interchangeable, except that in common usage “noise” is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or LP are commonly used to represent Sound Pressure Level. The symbol LA represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2E-5 Pa.

2 “A” Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an “A-weighting” filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People’s hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dBA or 2 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120 110	Heavy rock concert Grinding on steel	Extremely noisy
100 90	Loud car horn at 3 m Construction site with pneumatic hammering	Very noisy
80 70	Kerbside of busy street Loud radio or television	Loud
60 50	Department store General Office	Moderate to quiet
40 30	Inside private office Inside bedroom	Quiet to very quiet
20	Unoccupied recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A weighting. Sound Levels measured without any weighting are referred to as “linear”, and the units are expressed as dB(lin) or dB.

3 Sound Power Level

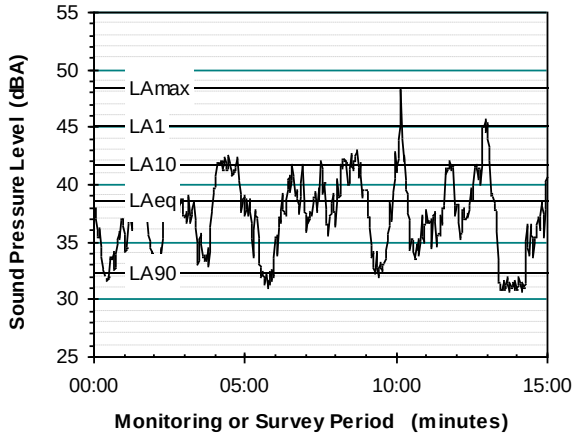
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 1E-12 W.

The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels L_{AN}, where L_{AN} is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the L_{A1} is the noise level exceeded for 1% of the time, L_{A10} the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating the statistical indices.



Of particular relevance, are:

LA1 The noise level exceeded for 1% of the 15 minute interval.

LA10 The noise level exceed for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

LA90 The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

LAeq Is the A-weighted equivalent continuous noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the “repeatable minimum” L_{A90} noise level over the daytime and night-time measurement periods, as required by the DECCW. In addition the method produces mean or “average” levels representative of the other descriptors (L_{Aeq}, L_{A10} etc).

5 Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than “broad band" noise.

6 Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

7 Frequency Analysis

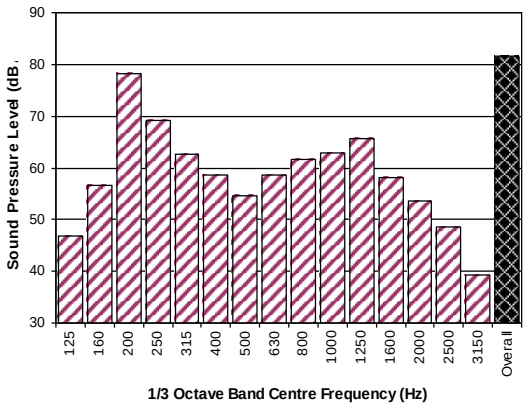
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (3 bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



8 Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of “peak” velocity or “rms” velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as “peak particle velocity”, or PPV. The latter incorporate “root mean squared” averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) and transverse.

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/Vo), where Vo is the reference level (1E-6 mm/s). Care is required in this regard, as other reference levels are used by some organisations.

9 Human Perception of Vibration

People are able to “feel” vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as “normal” in a car, bus or train is considerably higher than what is perceived as “normal” in a shop, office or dwelling.

10 Overpressure

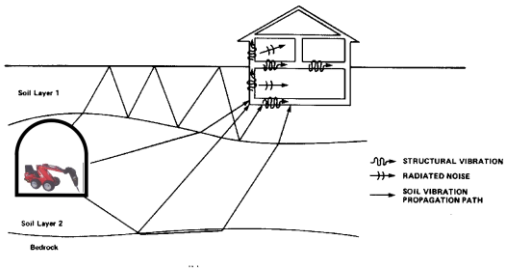
The term “over-pressure” is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

11 Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed “regenerated noise”, “structure borne noise”, or sometimes “ground-borne noise”. Regenerated noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of regenerated noise include tunnelling works, underground railways, Demolition plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents the various paths by which vibration and regenerated noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.



The term “regenerated noise” is also used to describe other types of noise that are emitted from the primary source as a different form of energy. One example would be a fan with a silencer, where the fan is the energy source and primary noise source. The silencer may effectively reduce the fan noise, but some additional noise may be created by the aerodynamic effect of the silencer in the airstream. This “secondary” noise may be referred to as regenerated noise.

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