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PROPOSED DUBBO SOLAR FARM

47R WELLINGTON ROAD
DUBBO
NEW SOUTH WALES

Construction and Operational Noise and Vibration Assessment

Client Details:

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1. INTRODUCTION

The proposal includes the construction and operation of a new solar farm within the boundaries of the land described as Lot 95 and Lot 190, DP 754308, 47R Wellington Rd, Dubbo.

The land associated with the proposed use is currently vacant and is generally surrounded by substantially vacant grassland including some scattered residential premises.

Equipment associated with the construction and operation of the solar farm will generate noise and vibration emissions which will have the potential to impact on the acoustic amenity of the surrounding environment including at nearby noise sensitive residential receptors.

In consideration of the above, Watson Moss Growcott Acoustics (WMG) has been engaged to undertake a noise and vibration assessment for the proposal to consider the following:

- Noise emissions associated with electrical infrastructure and associated vehicle activity at the site during general operations associated with the proposed facility.
- Noise and vibration emissions associated with the construction phase of the proposal.

This report presents a summary of the assessment, and where appropriate, includes indicative noise and vibration mitigation strategies to minimise the potential for adverse impacts at nearby noise sensitive receptor locations.

2. NOISE ASSESSMENT TERMINOLOGY

Noise assessment terminology used within this report is defined within Table 1 below.

Table 1: Noise Assessment Terminology

Terminology	Definition
dB(A)	Decibels recorded on a sound level meter, which has had its frequency response modified electronically to an international standard, to quantify the average human loudness response to sounds of different character
L_{eq}	The equivalent continuous level that would have the same total acoustic energy over the measurement period as the actual varying noise level under consideration. It is the noise measure defined by the EPA when assessing compliance with noise limits.
Sound Power Level (Lw)	The sound power level of a noise source is the inherent noise of the device. Therefore, sound power level does not vary with distance from the noise source or with a different acoustic environment. Lw = Lp + 10 log10 'a' dB, re: 1pW, (10-12 watts) where 'a' is the measurement noise-emission area (m2) in a free field.
Sound Pressure Level (Lp)	The level of sound measured on a sound level meter and expressed in decibels (dB). Where LP = 10 log10 (Pa/Po)2 dB (or 20 log10 (Pa/ Po) dB) where Pa is the rms sound pressure in Pascal and Po is a reference sound pressure conventionally chosen is 20 µPa (20 x 10-6 Pa) for airborne sound. Lp varies with distance from a noise source.

3. SUBJECT SITE AND SURROUNDING ENVIRONMENT

The site under consideration forms part of the land identified as Lot 95 and Lot 190, DP 754308, 47R Wellington Road, Dubbo and is located within the Dubbo Regional Council.

The overall site boundaries abut Wellington Road / Mitchell Highway to the north, Basalt Road to the west, Eulomongo Creek to the south and RU1 zoned land to the east.

When considering noise and vibration sensitive receptors located within proximity of the site, the closest and most noise sensitive will be as shown within Table 2 below.

Table 2: Summary of Sensitive Receptors

Receptor ID	Receptor Address	Approximate distance from Site Boundary (m)
R1	28R Wellington Rd, Dubbo	950
R2	5R Basalt Rd, Dubbo	540
R3	31L Railway Ln, Dubbo	1100
R4	42L Railway Ln, Dubbo	1100
R5	Lot 10, DP754287, 47R Wellington Rd, Dubbo	660

The receptors included within Table 2 are considered the most sensitive, and compliance with relevant criteria at these receptors will result in compliance at all other receptors located nearby.

The aerial photo shown below in Figure 1 identifies the boundaries of the site land, the area under consideration associated with the proposed solar farm, and the nearby noise sensitive receptors considered relevant for this assessment.

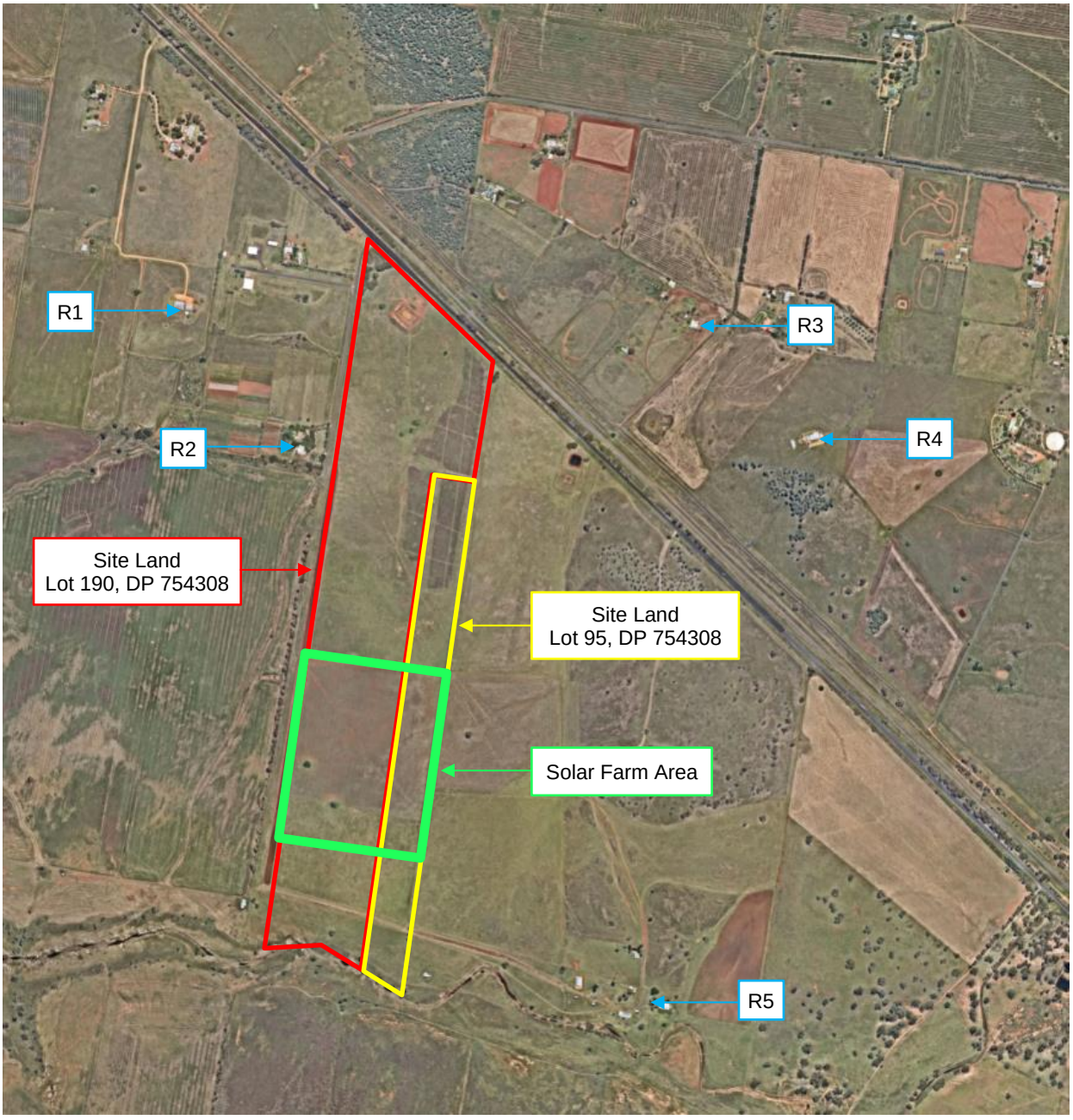


Figure 1: Aerial Photograph of Subject Site and Surrounds

4. OPERATIONAL PHASE NOISE ASSESSMENT

4.1 OPERATIONAL NOISE CRITERIA

4.1.1 Overview

The NSW Environment Protection Authority Noise Policy for Industry (NPfI) provides suitable criterion for addressing operational noise emissions associated with the proposal at sensitive receptors.

The Policy was released in 2017 and includes methodologies for assessment and management of typical operational noise emissions from industrial premises within NSW.

Within the NPfI, noise emissions are considered in various assessment periods defined as the day, evening, and night to reflect the sensitivity associated within the impacts of noise.

The assessment periods defined by the EPA are included within Table 3 below.

Table 3: EPA Defined Assessment Periods

EPA Assessment Period	Relevant Days	Relevant Time Periods
Day	Monday to Saturday	7:00am to 6:00pm
	Sunday	8:00am to 6:00pm
Evening	All Days	6:00pm to 10:00pm
Night	Monday to Saturday	10:00pm to 7:00am
	Sunday	10:00pm to 8:00am

When addressing noise emissions associated with the commercial / industrial uses, the NPfi defines project trigger levels which are used to consider potential impacts at sensitive receptors.

The levels are determined based on consideration of what the NPfI refers to as the ‘Project Intrusiveness Noise Level’, and the ‘Project Amenity Noise Levels’.

The project trigger levels then adopt the lower and more stringent of the determined values.

Fore sensitive receptors, the trigger levels are assessed at the most affected point within site boundaries, or within 30 metres of dwellings where the dwellings are setback from boundaries.

4.1.2 Project Intrusiveness Noise Criteria

The intent of the project intrusiveness noise level is to minimise the potential change in acoustic environment at sensitive receptors by ensuring that impacts associated within a new source are controlled to values 5 dB above a minimum threshold noise level.

The attributable noise levels are defined as L_{Aeq} values assessed over a 15 minute period.

As part of preparation of this report WMG has not undertaken noise measurements of the ambient noise environment at or within the vicinity of the site and nearby sensitive receptors.

It is noted that Wellington Road / Mitchell Highway is located within proximity of the site, and therefore may have some influence on the background noise levels at noise sensitive receptors located within proximity of the site, particularly during the day period when traffic volumes will be at their highest.

However, in the absence of site measured data, the minimum 'rating background levels' (RBLs) included within Table 4 below have been adopted as the basis for the assessment.

Table 4: Minimum RBLs

Descriptor	NPfi Defined Assessment Period		
	Day	Evening	Night
Minimum RBLs	35 L_{A90}	30 L_{A90}	30 L_{A90}

The project intrusiveness noise levels will then be determined based on the adopted minimum RBLs plus 5 dB and will therefore be as shown below in Table 5.

Table 5: Project Intrusiveness Noise Levels

Descriptor	NPfi Defined Assessment Period		
	Day	Evening	Night
Project Intrusiveness Noise Levels	40 L_{Aeq}	35 L_{Aeq}	35 L_{Aeq}

4.1.3 Project Amenity Noise Criteria

The intent of the project amenity noise level is to limit continuing increases in noise level at sensitive receptors through consideration of independent commercial / industrial operations in accordance with the Intrusiveness Noise Level criteria alone.

Derivation of the project amenity noise levels is based on the 'recommended amenity noise levels' contained within **Table 2.2: Amenity noise levels** of the NPfI. The values presented within the Table represent the total industrial noise which may impact on a receptor location.

The project specific amenity noise levels are then determined to represent an objective for a single commercial / industrial noise source at a receptor location.

When determining the relevant project amenity noise levels, WMG has considered the site as 'rural' as surrounding sensitive uses are generally residential type and located within RU1 and RU2 zoned land.

In consideration of the above, Table 6 provides a summary of the relevant Recommended Amenity Noise Levels for the proposed use.

Table 6: NPfI Amenity Noise Levels

Receiver	Noise Amenity Area	Time of Day	Recommended Amenity Noise Level
Residential	Rural	Day	50 L_{Aeq}
		Evening	45 L_{Aeq}
		Night	40 L_{Aeq}

It is noted that the land located to the west of the subject site is zoned for heavy industry (IN3), and therefore could include commercial / industrial noise sources as part of future development.

In consideration of the above, WMG has applied an adjustment of minus 5dB to the NPfI 'Recommended Amenity Noise Levels' to determine the project amenity noise levels as shown below in Table 7.

Table 7: Project Amenity Noise Levels

Descriptor	NPfi Defined Assessment Period		
	Day	Evening	Night
Recommended Amenity Noise Level	50 L_{Aeq}	45 L_{Aeq}	40 L_{Aeq}
Adjustment to allow for additional contributions	minus 5 dB	minus 5 dB	minus 5 dB
Adjustment to reflect 15min assessment period	plus 3 dB	plus 3 dB	plus 3 dB
Project Amenity Noise Levels	48 L_{Aeq}	43 L_{Aeq}	38 L_{Aeq}

4.1.4 Adopted Project Trigger Noise Level Criteria

In accordance with the methodologies contained within the NPfI, project noise trigger levels will be determined based on whichever of the project intrusiveness level and the project amenity level is the lower or more stringent.

In consideration of the above, the project trigger noise levels will be as shown in Table 8.

Table 8: Project Trigger Noise Levels

Descriptor	NPfi Defined Assessment Period		
	Day	Evening	Night
Project Intrusiveness Noise Levels	40 L_{Aeq}	35 L_{Aeq}	35 L_{Aeq}
Project Amenity Noise Levels	48 L_{Aeq}	43 L_{Aeq}	38 L_{Aeq}
Project Trigger Noise Levels	**40 L_{Aeq}**	**35 L_{Aeq}**	**35 L_{Aeq}**

4.1.5 Modifying Factor Corrections

When considering noise impacts on sensitive receptors, NPfI methodology includes relevant adjustment factors which account for the potential for the noise source to impact on the acoustic amenity of the noise sensitive receptor.

The relevant factors are included within Fact Sheet C of the NPfI and include:

- Tonal noise.
- Low frequency noise.
- Intermittent noise.

Clarification regarding each of the adjustments is shown below in Table 9.

Table 9: NPfI Modifying Factor Corrections

Relevant Factor	Assessment / Measurement	When to Apply	Correction
Tonal Noise	One-third octave band analysis.	Level of one-third octave band exceeds the level of the adjacent bands level on both sides by in the order of 5dB – 15dB as defined in the NPfI.	5 dB
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 Leq,t levels over same time period. Correction to be applied where the C minus A level is 15 dB or more and the level defined in Table C2 of the NPfI is exceeded.	2 or 5 dB
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(A) and the intermittent nature of the noise is clearly audible.	5 dB

The above adjustments are applied to the measured / predicted values at sensitive receptors for consideration relative to the project noise trigger levels.

A maximum of 10dB correction will be applied to the measured / predicted noise levels at the sensitive receptor, with a maximum of 5dB applicable when the tonal character is in the low frequency range below 160Hz.

4.2 PROPOSED SITE LAYOUT AND OPERATIONS

Electrical infrastructure including battery storage containers, inverter units and transformers will be installed and operate continuously 24 hours / day, 7 days / week as part of the proposal.

It is understood that equipment selections have not been finalised as this stage, however, the client has advised that equipment forming part of the proposed use will likely include:

- Central Inverter consisting of 2no.Sungrow SG2475HV and 1no. 5MVA transformer.
- 5no. SMA battery storage containers including associated air conditioning.
- 4no. Sungrow SD1250HV DC / DC Converter units.

In addition to the above, the client has advised that a total of 192 NEXTracker solar tracker motors will be installed at the site. Each tracker will accommodate in the order 84 solar panels which will be aligned as a 'row' within the boundaries of the site land.

Figure 2 below provides a site plan for the proposal including the relevant equipment locations.

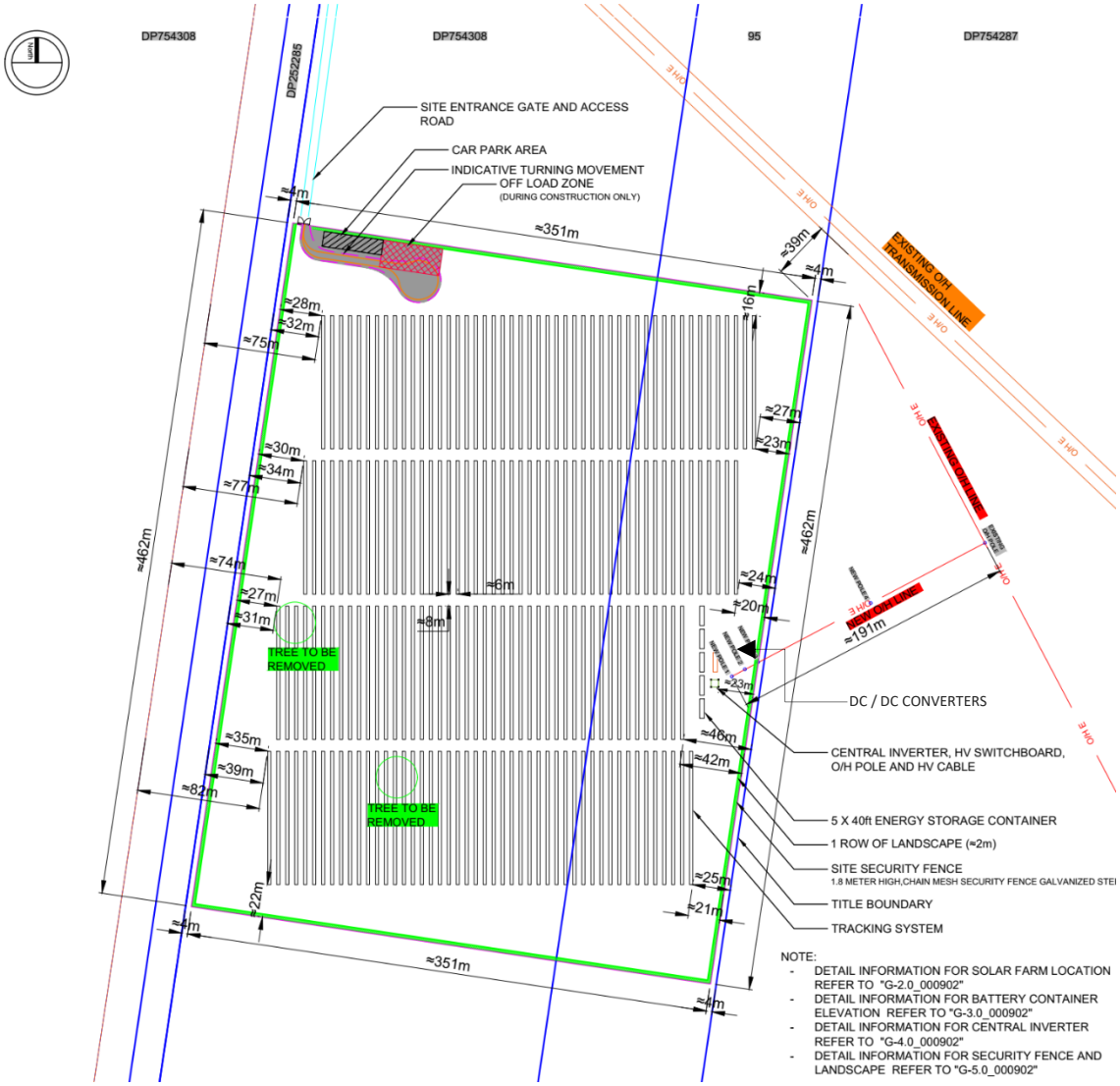


Figure 2: Proposed Site Plan

Sound level data associated with the proposed equipment has been provided by equipment suppliers and is included within Table 10 below.

Table 10: Summary of Noise Sources

Source Description	Sound Level Information Provided	Measurement Distance
Central Inverter Unit (Sungrow SG2475HV) – per unit	73 - 79 L_{Aeq}	1 metre / s
Inverter Unit Transformer – 5MVA	56 L_{WA} – sound power	N / A
Sungrow SD1250HV DC / DC Converter Unit – per unit	67 - 71 L_{Aeq}	1 metre / s
SMA Battery Storage Container Air Conditioning Unit – per unit	58 L_{Aeq}	10 metre / s
NEXTracker Motor – per unit	< 60 L_{WA} – sound power	N / A

Due to the tonal character associated with each of the noise sources forming part of the proposed use, a factor adjustment of + 5dB will be applied to the predicted noise impacts at sensitive receptor locations within proximity of the site.

4.3 NOISE PREDICTION METHODOLOGY AND RESULTS

Modeling of operational noise emissions from the proposed use has been conducted using DataKustik CadnaA 2021 environmental noise modelling software.

Relevant information regarding site elevations, site buildings and the surrounding environment has been provided by the client and sourced from online databases including Nearmaps.

The model has been developed and configured with sufficient detail for appropriate noise emission calculations to be undertaken.

For this assessment, the modelling software has implemented the calculation procedures defined within International Standard *ISO 9613-2: 1996 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation* (ISO 9613).

The described standard has been considered and approved as part of many previous projects requiring noise emission assessment works.

Through implementation of the Standard through CadnaA 2021, the noise emission modelling considers the following attenuation measures:

- Geometrical spreading.
- Atmospheric absorption.
- Ground attenuation.
- Meteorological effects.
- Source/Receiver height effects.
- Attenuation due to the surrounding environment including existing buildings / structures.

In addition to the above, and in accordance with the methodologies contained within the NPfI, noise predictions must account for noise enhancing weather conditions in the direction of sensitive receptors.

This can be addressed via two options:

- Option 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.

- Option 2

  Determine the **significance** of noise-enhancing conditions.

Option 1 has been adopted as the basis for predicting noise emissions from the proposed use and is often considered conservative as it represents a worst case operation scenario.

In consideration of the above, predicted operational noise emissions associated with the proposed use are shown below in Table 11.

The predicted values include a + 5dB adjustment to account for the potential tonal character of the noise emissions from electrical infrastructure located at the subject site.

Table 11: Predicted Operational Noise Levels

Receptor ID	Project Noise Trigger Levels			Predicted Operational Noise Levels	Compliance
	Day Period	Evening Period	Night Period		
R1	40 L_{Aeq}	35 L_{Aeq}	35 L_{Aeq}	< 25 $L_{Aeq\ (15\ minute)}$	✔
R2	40 L_{Aeq}	35 L_{Aeq}	35 L_{Aeq}	29 $L_{Aeq\ (15\ minute)}$	✔
R3	40 L_{Aeq}	35 L_{Aeq}	35 L_{Aeq}	< 25 $L_{Aeq\ (15\ minute)}$	✔
R4	40 L_{Aeq}	35 L_{Aeq}	35 L_{Aeq}	27 $L_{Aeq\ (15\ minute)}$	✔
R5	40 L_{Aeq}	35 L_{Aeq}	35 L_{Aeq}	30 $L_{Aeq\ (15\ minute)}$	✔

The predicted operational noise levels associated with the proposal comply with the project trigger noise levels at each of the noise sensitive residential receptor locations.

As a result, no further noise mitigation strategies will require implementation at the subject site.

Given that the nominated equipment selections for the proposal have not been completed at this stage, it is recommended than an acoustic consultant is engaged during detailed design to undertake a review of the final proposal and ensure that compliance with relevant criteria is achieved at each of the noise sensitive residential receptors.

5. CONSTRUCTION NOISE ASSESSMENT

5.1 PROPOSED CONSTRUCTION WORKS AND DURATION OF WORKS

It is understood that generally, construction works associated with the proposal will include:

- Site levelling / compaction as required.
- Installation of security fencing and gates.
- Construction of road and crossing for access track, carpark, unloading area & site access.
- Landscaping.
- Installation of single-axis trackers for PV solar panels.
- Installation of an inverter station container.
- Installation of the DC battery containers.
- Installation of all required cable and cable tray.
- Installation of an HV switchgear Kiosk.

The construction phase of the project is expected to span in the order of six months, with a breakdown of works as shown below in Table 12.

Table 12: Indicative Summary of Proposed Construction Timeframe

Work activities	Commencement Date	Completion Date
Civil earthing works, fencing and landscaping.	04 / 10 / 2021	05 / 11 / 2021
Delivery of long lead materials.	18 / 10 / 2021	11 / 02 / 2022
PV panel and LV cable installation.	01 / 11 / 2021	25 / 02 / 2022
HV station installation, testing and commissioning.	15 / 02 / 2022	21 / 03 / 2022
Site clean-up and demobilisation	14 / 03 / 2022	30 / 03 / 2022

The client has advised that major civil works, product materials delivery events and other heavy vehicle movements will only occur during the period 7:00am to 6:00pm Monday to Friday, and 8:00am to 1:00pm Saturday.

To maximise productivity, it is understood that less intense activities including cabling, testing, and commissioning may be conducted outside of these hours and between 7:00am to 7:00pm Monday to Sunday if deemed necessary.

5.2 INTERIM CONSTRUCTION NOISE GUIDELINE

Construction noise has been identified as a major environmental issue within NSW.

Noise sources associated with demolition, remediation, renewal, and maintenance can generate high noise levels and have the potential to impact adversely on the surrounding acoustic environment including sensitive receptor locations.

In consideration of the above, the NSW Interim Construction Noise Guideline (ICNG) was released during 2009 to provide methodologies of assessing and managing the potential impacts of construction noise on residences and other sensitive land uses.

The main objectives of the ICNG are to:

- Promote a clear understanding of ways to identify and minimise noise from construction works.
- Focus on applying all 'feasible' and 'reasonable' work practices to minimise construction noise impact.
- Encourage construction to be undertaken only during the 'recommended standard hours' unless approval is given for works that cannot be undertaken during these hours.
- Streamline the assessment and approval stages and reduce time spent dealing with complaints at the project implementation stage.
- Provide flexibility in selecting site-specific feasible and reasonable work practices in order to minimise noise impacts.

The Guideline presents two methodologies for assessing construction noise impacts expressed as either quantitative or qualitative and which vary based generally on the project duration.

For short duration projects (< 3 weeks), the qualitative assessment procedures are deemed applicable, which require the proponent to consider the Guideline's checklist of work practices to minimise noise and implement appropriate strategies.

For longer duration projects, like the Dubbo Solar Farm, the quantitative assessment procedure is recommended which includes derivation of 'noise management levels' (NML) and noise predictions to consider the potential noise impacts at sensitive receptor locations.

The NMLs are determined based on an emergence of the construction noise impacts above the RBLs defined within the NPfI for the 'recommended standard hours' as shown within Table 13.

Table 13: Hours Nominated within ICNG

Period Designation	Relevant Hours
Recommended Standard Hours	Monday to Friday – 7:00am to 6:00pm Saturday – 8:00am to 1:00pm
Outside Recommended Standard Hours	All Days – 6:00pm to 7:00am Saturday – 1:00pm to 6:00pm Sunday / Public Holidays – All Day

A summary of the methodologies associated with determining the NMLs and the methods of application are included within Table 14 below.

Table 14: Noise impacts at residences using quantitative assessment procedure.

Time of Day	NML L_{Aeq} (15 min)	How to Apply
Recommended standard hours.	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. ▪ Where the predicted or measured LAeq (15 min) 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.
	Highly noise affected 75 dB(A)	The highly noise affected 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 restricting the hours that the very noisy activities can occur, taking into account: 1. 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. 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	▪ 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.

The NMLs are not mandatory limits, however where construction noise levels are predicted to exceed the NMLs, it is considered appropriate that the proponent implement feasible and reasonable work practices to minimise the potential impacts on noise sensitive receptors.

Guidance regarding what is considered feasible and reasonable is contained within the ICNG and generally relates to practical implementation and ongoing maintenance requirements associated with the proposed treatment.

It also considers whether the overall noise benefits associated with the noise control approach outweigh the overall adverse social, economic, and environmental effects, including the cost of the measure.

In the absence of site measurement data, WMG has again adopted the minimum RBLs which form part of the NPfI as a basis for determining the relevant NMLs at residential sensitive uses.

The adopted NMLs for the project are therefore as shown below in Table 15.

Table 15: Residential Receptor Noise Management Levels for Construction

Descriptor	NPfi Defined Assessment Period		
	Day	Evening	Night
Recommended Standard Hours	45 L_{Aeq}	N/A	N/A
Outside Recommended Standard Hours	40 L_{Aeq}	35 L_{Aeq}	35 L_{Aeq}

Where appropriate, the ICNG also requires consideration of ground borne noise impacts at residential receptors as well as the potential for noise emissions to cause sleep disturbance at residential receptors during the night time periods.

For this project, given the distance setback of closest sensitive receptor to the site and the proposed construction hours, ground borne noise emissions, and sleep disturbance will not be considered further.

The ICNG also includes guidance regarding potential construction noise impacts on other commercial / industrial premises located within proximity of the subject site.

The relevant NMLs for the described uses are as shown below within Table 16 and will be apply within external spaces associated by the premises during times when the spaces are / are likely to be occupied.

Table 16: Noise impacts at commercial / industrial premises using quantitative assessment procedure.

Land Use	NML L_{Aeq} (15 min)
Commercial Premises	70
Industrial Premises	75

With distance separations greater thank 1.0km between the subject site and the nearest existing commercial / industrial premises, potential impacts at independent commercial / industrial premises will comfortably comply with relevant criteria and not require further consideration.

Potential impacts at residential receptors have therefore been the focus of the construction noise assessment and are considered further below.

5.3 DESCRIPTION OF PROPOSED CONSTRUCTION WORKS

The client has advised that construction works associated with the project will likely involve use of the following typical forms of mobile equipment within the boundaries of the site land:

- Excavator (5 to 8 tonne Caterpillar unit or equivalent).
- Telehandler / Forklift (Caterpillar unit or equivalent).
- Grader (Caterpillar or equivalent).
- Tamping rammer / compactor.
- Impact piling rig and crawler (Orteco type or equivalent).
- Water dust suppression truck.
- Power hand tools.
- Concrete truck and associated concrete pump.

In addition to the above, materials deliveries to the site over the life of the project will be provided by 15-B Double trucks, and up to 40 Semi-trucks.

An indicative breakdown of the stages during which each type of equipment will be utilised is included below within Table 17.

Table 17: Summary of Construction Activities.

Construction Stage	Location	Equipment and Activity
Entry crossover and access road	Adjacent to Basalt Rd entry.	▪ Excavator for crossover construction. ▪ Tamping rammer / compactor for backfilling crossover. ▪ Grader for gravel road construction. ▪ Water trucks for dust suppression.
Fencing and landscaping.	Within solar farm site.	▪ Excavator for landscaping. ▪ Water trucks for dust suppression. ▪ Concrete truck and associated pump for fence construction.
Delivery of long lead materials.	Within solar farm site.	▪ B-Double trucks and semi-trucks for good deliveries. ▪ Telehandler / forklift to manoeuvre goods into stock piles.
PV panel and LV cable installation.	Within solar farm site.	▪ Excavator for cable trenching. ▪ Tamping rammer / compactor for backfilling / compaction. ▪ Water trucks for dust suppression. ▪ Impact piling rig for structure installation. ▪ Telehandler for panel installation. ▪ Powered hand tools for connection. ▪ Waste truck fortnightly.
HV station installation, testing and commissioning.	Within solar farm site.	▪ Telehandler for station installation. ▪ Powered hand tools for connection. ▪ Waste truck fortnightly.
Site clean-up and demobilisation	Within solar farm site.	▪ Private vehicles. ▪ Waste truck fortnightly.

Figure 3 below provides an aerial photograph of the site and surrounds including the relevant construction areas under consideration.

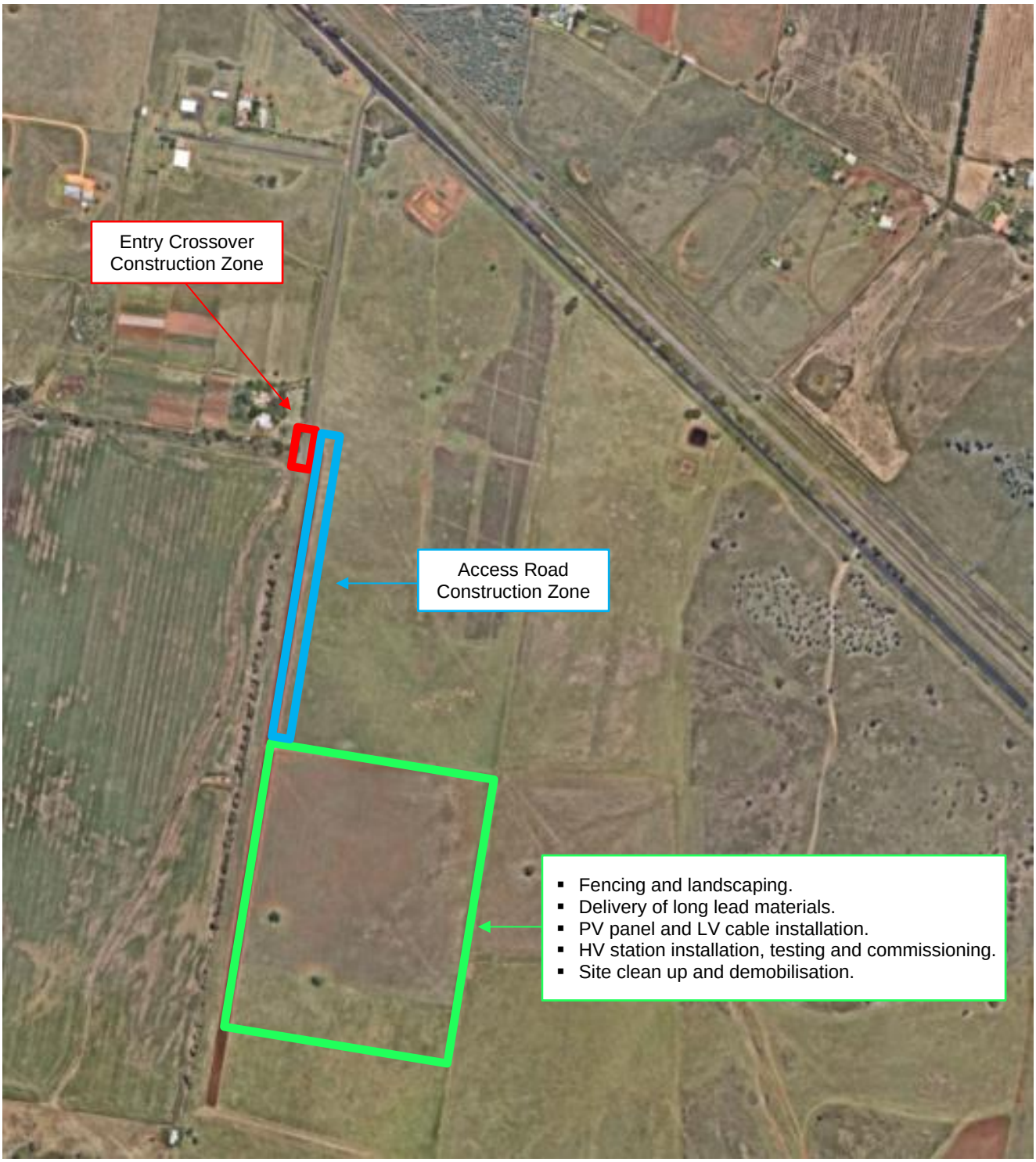


Figure 3: Aerial photograph identifying each of the construction areas.

When addressing noise emissions associated with the proposed construction activities, WMG has considered the following:

- Maximum noise levels from plant and equipment nominated within Appendix C of the Construction Noise and Vibration Strategy document issued by Transport for NSW 2019.
- Noise level data provided by the manufacturer / equipment suppliers.
- Noise level data obtained by WMG as part of previous independent investigations.

The equipment types and adopted sound power levels are included within Table 18 below.

Table 18: Summary of Equipment and Associated Sound Power Levels

Construction Stage	Equipment Type	No. of Units	Adopted Sound Power Level	Operating Time in 15min period	Adopted Lw_A per Stage (15min assessment)
Entry crossover	Excavator	1	95 dB(A)	100%	106
	Tamping Rammer	1	106 dB(A)	100%	
Access road	Grader	1	113 dB(A)	100%	113
	Water Cart	1	107 dB(A)	50%	
Fencing and Landscaping	Excavator	1	95 dB(A)	100 %	110
	Water Cart	1	107 dB(A)	50 %	
	Concrete Truck	1	109 dB(A)	50 %	
	Concrete Pump	1	109 dB(A)	50 %	
Delivery of long lead materials.	Truck Movements	5	101 dB(A)	100 %	108
	Telehandler	1	95 dB(A)	100 %	
	Forklift	1	95 dB(A)	100 %	
PV panel and LV cable installation.	Excavator	1	95 dB(A)	100 %	123
	Tamping Rammer	1	106 dB(A)	100 %	
	Water Cart	1	107 dB(A)	50 %	
	Impact Piling Rig	1	126 dB(A)	50 %	
	Telehandler	1	95 dB(A)	50 %	
	Powered Hand Tools	6	96 dB(A)	80 %	
	Waste Truck	1	101 dB(A)	50 %	
HV station installation, testing and commissioning.	Telehandler	1	95 dB(A)	80 %	104
	Powered Hand Tools	6	96 dB(A)	80 %	
	Waste Truck	1	101 dB(A)	50 %	
Site clean-up and demobilisation.	Private Vehicles.	2	86 dB(A)	50 %	98
	Waste Truck	1	98 dB(A)	50 %	

The client has advised that each phase of the project will be undertaken progressively, which will typically result in cumulative noise impacts from sources operating during each phase rather than cumulative noise impacts from multiple phases.

Given the location of the sensitive receptors surrounding the site, the most critical will be R2 which is located adjacent to the entry access roadway associated with the proposed use, and within the closest proximity of the solar farm site boundaries.

In consideration of the above, compliance with relevant NMLs at this location will also result in compliance at all other sensitive receptor locations within proximity of the site.

WMG has therefore assessed the noise impacts at the critical R2 receptor and used the results as the basis for the assessing noise impacts relative to NMLs at all sensitive receptors.

To represent a worst case scenario for the critical R2 receptor, WMG has assessed noise emissions during the construction of the new entry crossover / access road, as well as when construction activities are occurring in the north western corner of the solar farm boundary.

Figure 4 below indicates the noise source locations adopted as the basis for the assessment.

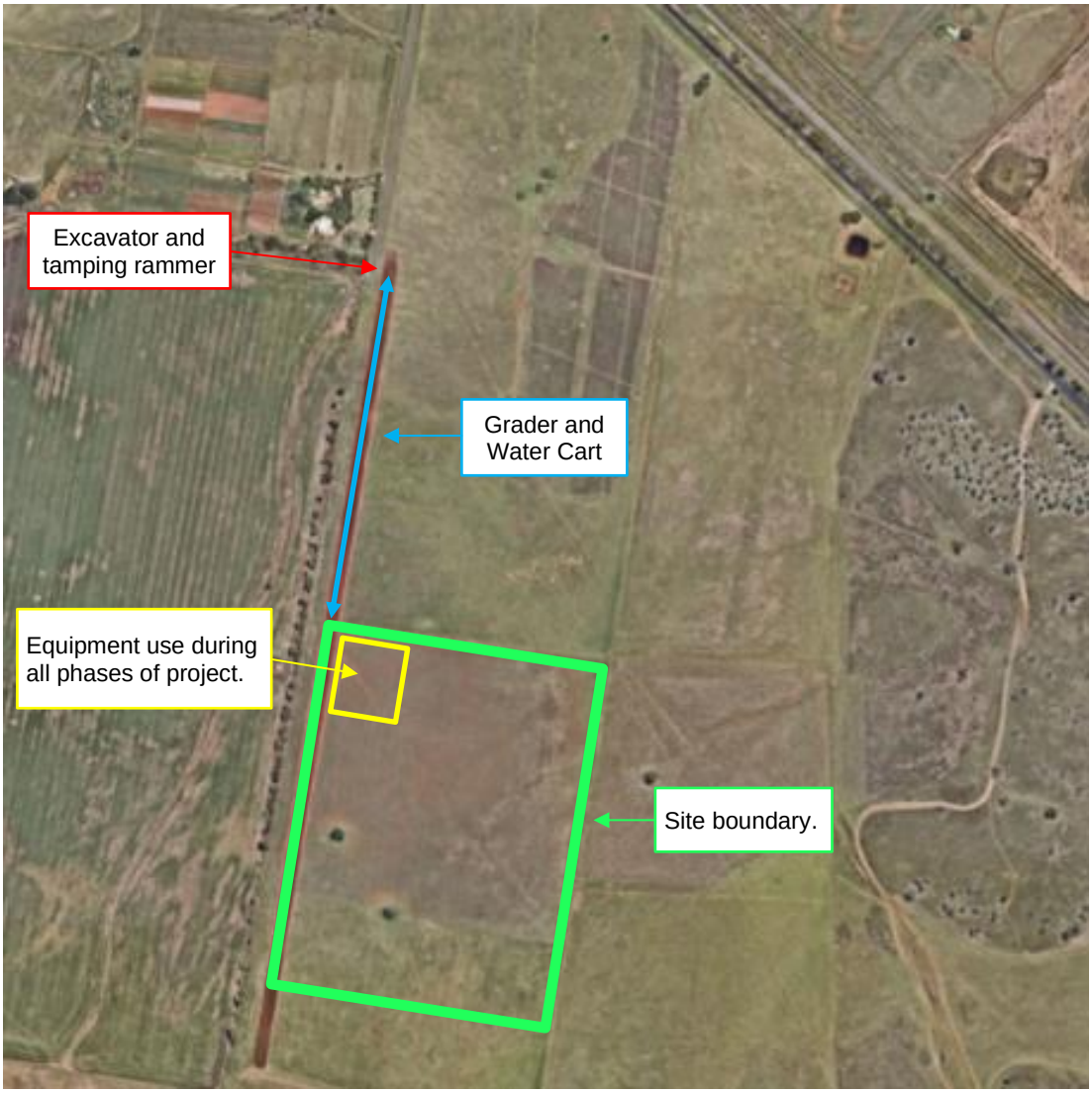


Figure 4: Aerial Photograph including Noise Source Locations

Using the adopted sound power levels and usage rates described above, Table 19 below presents a summary of the predicted noise levels at the critical R2 receptor in the absence of any noise mitigation.

Table 19: Predicted Construction Noise Levels

Construction Phase	Predicted Noise Levels $L_{Aeq\ (15\ minute)}$	Predicted Noise Levels relative to Derived Noise Management Levels $L_{Aeq\ (15\ minute)}$				Comments
		Standard Hours	Outside of Standard Hours			
			Day	Evening	Night	
Entry crossover	57	45	40	35	35	Noise impact at receptor dominated by tamping rammer operating at road edge.
Access road	56	45	40	35	35	Noise impact at receptor dominated by grader travelling along northern portion of access road.
Fencing and landscaping.	45	45	40	35	35	Noise impact at receptor is dominated by the concrete truck arrival event as it enters the site and travels along the internal access road.
Delivery of long lead materials.	45	45	40	35	35	Noise impact at receptor is dominated by the heavy vehicle arrival / departure events as they enter the site and travels along the internal access road.
PV panel and LV cable installation.	54	45	40	35	35	Noise impact at receptor dominated by impact piling rig. Predicted noise levels in the absence of the impact piling rig will be in the order of 43 $L_{Aeq\ (15\ minute)}$.
HV station installation, testing and commissioning.	42	45	40	35	35	Noise impact at receptor is dominated by the waste truck arrival event as it enters the site and travels along the internal access road. Predicted noise levels in the absence of the waste truck will be in the order of 32 $L_{Aeq\ (15\ minute)}$.
Site clean-up and demobilisation.	41	45	40	35	35	Noise impact at receptor is dominated by the waste truck arrival event as it enters the site and travels along the internal access road. Predicted noise levels in the absence of the waste truck will be < 30 $L_{Aeq\ (15\ minute)}$.

The client has advised that major civil works, product materials delivery events and other heavy vehicle movements will occur during the period 7:00am to 6:00pm Monday to Friday, and 8:00am to 1:00pm Saturday which align with the 'Recommended Standard Hours'.

The results of the noise predictions indicate that works within the following construction phases can occur during the recommended standard hours whilst complying with the relevant NMLs:

- Fencing and landscaping.
- Delivery of long lead materials.
- HV station installation, testing and commissioning.
- Site clean-up and demobilisation.

During construction of the entry crossover / access road phase, predicted noise levels at the critical R2 receptor are in the order of 56-57 $L_{Aeq\ (15\ minute)}$ and therefore exceeds the criteria for recommended standard construction hours as well as all other operating periods.

Exceedances are also predicted during the PV panel and LV cable installation construction phase and are primarily due to the impact piling rig construction methodology adopted for installing support posts for the proposed solar panels. During periods when the piling rig is not in operation, predicted noise levels are below the NMLs for the recommended standard hours.

Given the predicted exceedances, construction noise mitigation strategies have been included within Section 5.4.

5.4 CONSTRUCTION NOISE MITIGATION AND MANAGEMENT

The NSW ICNG requires that construction noise emissions be assessed against NMLs.

The NMLs are not mandatory limits, however where construction noise levels are predicted to exceed the NMLs, it is considered appropriate that the proponent implement feasible and reasonable work practices to minimise the potential impacts on noise sensitive receptors.

Guidance regarding minimisation of disturbance due to construction is included within *AS2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites'* as well as the ICNG and includes the reference to the following:

- Implementation of universal work practices relating to minimising noise.
- Selection of low noise plant and equipment.
- Consultation and transparency with the surrounding community.

In addition, due to the predicted exceedances of relevant NMLs, specific noise control for the proposed piling works, and crossover / access road works will require consideration.

5.4.1 General Work Practices

Universal work practices which should form part of a construction management plan will include:

- Regular enforcement (such as toolbox talks) of the need to minimise noise and vibration. This will include educating heavy vehicle drivers regarding expectations of vehicle use (eg. avoid engine brakes, minimising reversing etc).
- 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.
- Developing routes for the delivery of materials and parking of vehicles to minimise noise.
- Where possible avoiding the use of equipment that generates impulsive noise.
- Minimising the need for vehicles reversing at the site and within proximity of receptors.
- 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.
- Minimising truck movements.
- Scheduling respite periods (eg. noisy periods limited to 3 hours).
- Prioritise ensuring that construction works, and heavy vehicle movements occur during standard work hours between 7am and 6pm Monday to Friday, and 7am to 1pm Saturday.

5.4.2 Plant and Equipment

Work practices which will minimise the potential for noise emissions to cause disturbance at sensitive receptors will include:

- Where possible, implementing quieter techniques for high noise activities.
- Choosing quieter mobile and fixed equipment based on the site requirements.
- Operating equipment in the quietest and most efficient manner.
- Regular inspection and maintenance of equipment to ensure it is in good working order.

5.4.3 Community Relations

Communication and transparency with the surrounding community will be critical in minimising the potential for adverse impacts on the acoustic amenity at sensitive receptors.

In order to orchestrate the above, it is advised that the client implement the following:

- Appoint a relevant community relations manager prior to project commencement.
- The manager must approach and communicate with sensitive receptors information regarding the project timeline, construction methodologies, potentially noisy periods.
- Maintain contact with receptors throughout duration of project to ensure that they are up to date on when certain events will commence and finish.
- Provide a construction noise management plan to the sensitive receptors which includes site contact information for residents to call regarding complaints and other queries.

Where complaints are received, they must be recorded on a centralised system and handled in a prompt and responsive manner. This may involve noise monitoring or a review or processes.

5.4.4 Proposed Impact Piling Rig Works

The noise emission assessment has identified exceedances of NMLs at residential receptors due to the impact piling rig works which will form part of the PV panel and LV cable installation construction phase.

The proposed piling rig which will be utilised as part of the project will likely be an Orteco unit which includes a percussion hammer approximately 4.5m above ground level.

The client has advised that the piles will be in the order of 4.0m long, and through the use of the percussion hammer will installed to a depth in the order of 2.5m. It is understood that 2-3 piles will be installed during a 15-minute assessment period which will also include periods during which the rig is moved between piling locations.

In order to minimise the potential impacts on noise sensitive receptors, the client should consult with the nearby residents regarding the proposed piling process including duration, hours of operation and site contact information for correspondence during the high noise level activities.

It is recommended that the piling works be conducted during the recommended standard hours only, ensuring that early morning disturbance is avoided prior to 7:00am on weekdays and 8:00am on Saturday.

Where possible, the client should consider the use of rotary bored or vibro piling to complete the works as these types of construction methodology will typically be generate less noise emission.

Where not possible, treatments to reduce noise emissions associated with percussive hammer piling will include:

- Use resilient pad (dolly) between pile and hammerhead.
- Enclosing hammer head and top of pile in acoustic screen.

Information contained within AS2436-2010 provides an indicative noise reduction in the order of 10dB with the implementation of the above measures.

With a 10dB reduction, predicted noise impacts at sensitive receptor locations will likely only marginally exceed the NMLs for the recommended standard hours.

5.4.5 Crossover and Access Road Construction

The noise emission assessment has identified exceedances of NMLs at the critical R2 residential receptor due to the proposed crossover and access road construction works.

Predicted values at all other identified receptor locations will be < 40 L_{Aeq} during the described works which will be below the NML for the recommended standard hours at these locations.

As a result, predicted exceedances will be limited to a single dwelling.

The client has advised that the total duration of the entry crossover works will likely only be one day, with the grading works for the access road being completed within four days.

Therefore, the predicted noise exceedances associated with the works are expected to be for a very limited period.

Given the limited timeframe of the works, construction of acoustic barriers to provide noise shielding in the direction of the receptor may be feasible, however would likely not be deemed reasonable given that construction of the barrier may take longer than the works themselves.

In consideration of the above, WMG recommend that the client engage in consultation with the receptor and ensure that they are aware of the works proposed and the duration of the works.

Universal work practices as described in Section 5.4.1 must be implemented at all times.

In addition to the above, it could be considered appropriate that the client offer alternative accommodation to the resident for the brief period of the works if deemed necessary.

6. VIBRATION ASSESSMENT

6.1 ASSESSMENT CRITERIA

When addressing potential vibration impacts associated with construction activities at the site, thee following categories will require consideration:

- Human comfort at sensitive receptor locations.
- Structural damage.

Information regarding suitable assessment criteria for each category is contained within the Department of Environment and Conservation's 'Assessing Vibration: a technical guideline (2006) document.

Criteria nominated within the guideline refers to different types of vibration including:

- Continuous vibration (eg. Machinery, steady road traffic, continuous construction activity).
- Impulsive vibration including up to 3 distinct vibration events in an assessment period (eg. occasional dropping of heavy equipment, occasional loading and unloading).
- Intermittent vibration (eg. intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers).

It is envisaged that construction works associated with the proposal will generally be consistent with the definition for 'intermittent' vibration for which the technical guideline provides the following criteria for human comfort.

Table 20: Preferred and Maximum Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$)

Location	Daytime (7:00am to 10:00pm)		Night Time (10:00pm to 7:00am)	
	Preferred VDV Value	Maximum VDV Value	Preferred VDV Value	Maximum VDV Value
Residences	0.20	0.40	0.13	0.26

When addressing the potential for structural damage, impacts are generally considered relative to criteria nominated within British Standard BS 7385 Part 2-1993 Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration.

Table 15 below presents the relevant vibration criteria for assessing the potential for building cosmetic damage in response to transient vibration impacts.

Table 21: Transient Vibration Guide Values – Cosmetic Damage.

Type of Structure	Peak component particle velocity, mm/s[1]	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings.	50 mm/s at 4 Hz and above	
Unreinforced or light framed structures. Residential or light commercial type buildings.	15 mm/s at 4 Hz increasing to 20 mm/s 15 Hz.	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

6.2 CONSIDERATION OF POTENTIAL VIBRATION IMPACTS

The client has advised that no vibration intense activities will occur at the site as part of the operational phase associated with the proposed use. Therefore, it is expected that there will be no adverse impacts on sensitive receptors during this phase.

However, during the construction phase, it is understood that there will be vibratory equipment used within the boundaries of the subject site including an impact piling rig.

In addition to the providing sound power level data, The Transport for NSW – Construction Noise Strategy document also includes minimum working distances for vibration intensive activities and considers the vibration levels relative to human comfort and cosmetic damage criteria nominated above.

When considering a piling rig with a ‘hammer’ type impact component, the described document recommends a separation distance of 15 metres when addressing cosmetic response, and 50 metres when address human comfort.

With a minimum distance separation generally in the order of 500m between sensitive receptors and solar farm site boundaries, vibrations associated with the nominated equipment is not expected to impact adversely on the receptors.

7. ROAD TRAFFIC NOISE ASSESSMENT

'Barnson Pty Ltd' has prepared a traffic report for the proposal referenced 36004-TIA01_1 and dated 10.03.2021.

When considering traffic movements associated with the operational phase of the project the traffic report provides the following statements:

- There will be no permanent staff based at site and therefore no regular traffic movements.
- Inspections will be conducted quarterly which will require one or two vehicle movements within the boundaries of the site.
- Heavy vehicles may access the site to undertake repair / maintenance works as required. It is expected that this will be very rare and less than one visit per year.

Given the infrequency of the above events, noise impacts during the operational phase are expected to be negligible and not impact adversely on the acoustic environment at nearby sensitive receptors.

During the construction phase however, there will be vehicle movements which occur daily along Wellington Rd / Mitchell Hwy to the north and along Basalt Rd located to the west.

It is understood that construction vehicles will head in a west direction along Wellington Rd / Mitchell Hwy and turn left into Basalt Rd. Vehicles will then access a new driveway within the site boundaries approximately 600m to the south of the Mitchell Hwy / Basalt Rd junction and within proximity of receptor R2.

The Barnson Pty Ltd traffic report prepared for the proposal provides the following summary of expected vehicle movements associated with construction activities occurring at the site:

- **Field crew travelling to and from the site:**
  - A maximum of 50 field crew workers are expected on site during peak construction activities.
  - Majority of field crew enter the site within one hour of site opening and exit the site within one hour of site closing each day.
  - Mini vans are to be made available to transport crew to and from the site towards Dubbo throughout the peak of construction activities during PV panel installation.
  - Workers who do not utilise the mini van services will drive private vehicles to the site.
  - From the client's estimates, the maximum number of vehicle movements expected to / from the site during peak activity is 15vpd, or 12vph.
- **Material deliveries:**
  - Materials will be collected from Sydney Port and transported to the Wellington central warehouse where they are to be stored until delivery can be made to site.
  - Up to 60 total site delivery trips are anticipated throughout the construction period.
  - Major deliveries to site will originate in Wellington, hence will approach the site via Wellington Road from the south-east.
  - A maximum of five trucks may access the site on any given day.
  - The largest delivery vehicle entering the site is a semi-trailer.

When addressing the potential noise impacts associated with vehicle movements along public roads, suitable criteria is provided within the NSW Department of Environment Climate Change and Water (DECCW) Road Noise Policy, March 2011.

The Policy includes assessment criteria as shown below in Table 22 to consider the impacts at residences affected by traffic on existing roadways generated by land use developments.

Table 22: Road Traffic Noise Assessment Criteria for Residential Land Uses

Road Category	Type of Project / Land Use	Assessment Criteria L_{Aeq}	
		Day (7am to 10pm)	Night (10pm to 7am)
Freeway	Existing residences affected by additional traffic on described roadway generated by land use developments	60 (15 HOUR)	55 (9 HOUR)
Local Roads	Existing residences affected by additional traffic on described roadway generated by land use developments	55 (1 HOUR)	50 (1 HOUR)

When addressing traffic movements associated with the proposed construction phase of the project, there are two independent roadways which will require consideration.

Wellington Rd / Mitchell Hwy located to the north is a highly trafficked roadway including 9,436 daily vehicle movements (two-way), with hourly peaks in the order of 827 (two-way).

Basalt Rd however, provides access to a small number of dwellings and is expected to include very few daily vehicle movements, and likely less than 3 movements in any peak hour.

The Barnson Pty Ltd traffic report indicates that during the construction phase, the proposal will generate no more than 15 private vehicles per day, with 12 private vehicles per hour at any given time. It is understood that on average, the movements generated will be much less.

During peak materials delivery phase, a worst case scenario will include up to 5 heavy vehicles accessing the site in any one hour period. This is unlikely to occur, however may do so, and has therefore been considered as part of this assessment.

The introduction of 12 additional private vehicles and 5 additional heavy vehicles to the existing 827 vehicles which travel along the Wellington Rd / Mitchell Hwy per hour will have negligible impact on the existing traffic noise levels at sensitive receptors and will comply with the 'relative increase criteria' contained within the Road Traffic Noise Policy.

The main item requiring consideration will likely be vehicle movements along Basalt Rd, particularly as vehicles travel within proximity of receptor R2 and access the new internal road which will be constructed along the western boundary of the subject site.

The proposed 17 additional private and heavy vehicle movements along the roadway will represent a significant increase relative to the very limited number of current movements and will therefore result in an increased noise level impact at the critical receptor location.

Vehicles are expected to travel at approximately 40km/h at the northern end of Basalt Rd, however, will likely slow to in the order of 5-10km/h as the vehicles approach the site entry location within proximity of the R2 receptor.

Based on calculations, predicted noise level impacts at the critical R2 receptor will be in the order of 48-50 $L_{Aeq\ (1\ HOUR)}$ during peak traffic movement periods involving private and heavy vehicles.

The client has advised that private vehicles, mini van services and materials deliveries provided by heavy vehicles will only occur during 'recommended standard hours' and will therefore be subject to the 'Day' assessment criteria for Local Roads nominated within Table 22.

In consideration of the above, noise levels at the R2 receptor will likely increase relative to the existing acoustic environment during the peak one hour traffic flows, however the absolute noise level is predicted to be below the nominated criteria.

8. CONCLUSIONS

WMG has carried out an acoustic assessment for the Solar Farm proposed to be constructed and operated at Lot 95 and Lot 190, DP 754308, 47R Wellington Rd, Dubbo.

The purpose of the assessment has been to consider any potential impacts associated with the operational noise and vibration from the proposed use as well as noise and vibration associated with construction activities forming part of the project.

The assessment has been based on methodologies within the following documentation:

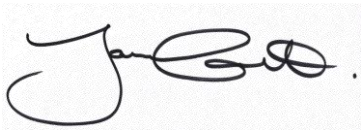
- NSW EPA Noise Policy for Industry.
- NSW Interim Construction Noise Guideline 2009.
- Department of Environment and Conservation's 'Assessing Vibration: a technical guideline.
- NSW Department of Environment Climate Change and Water Road Noise Policy 2011.

The findings of the assessment have concluded that operational noise and vibration emissions associated with the proposed use will comply with relevant criteria at sensitive receptors in the absence of any noise mitigations strategies.

When considering noise, vibration and road traffic noise associated with the construction phase of the project, the findings of the assessment concluded the following:

- Due to the significant distance separation between the site boundaries and the sensitive receptors locations, vibration levels are not expected to impact adversely on the receptors.
- The number of traffic movements associated with the construction phase of the project will have negligible impact on the existing traffic noise levels at sensitive receptors generated by vehicle movements along the highly trafficked Wellington Rd / Mitchell Hwy.
- For Basalt Rd, where existing traffic movements are very limited, the additional construction vehicle movements will likely increase the existing noise levels at the sensitive receptors during the peak one hour traffic flows. However, the absolute noise level impact is predicted to be below the criteria nominated within the Road Noise Policy.
- Specific works associated with construction of the entry crossover and site access road will achieve values below the project NMLs at all sensitive receptors other than the critical R2 receptor located to the north west of the subject site.
- Noise associated with support structure piling within the boundaries of the subject site is predicted to exceed project NMLs at several receptors pending the location of the piling within the site boundaries.

When exceedances of NMLs have been predicted, WMG has provided suitable noise mitigation strategies to minimise the potential for adverse impacts on the relevant sensitive receptors.



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