Environmental Impact Statement

Glenellen Solar Farm

Appendix G: Noise Assessment

October 2020

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Construction and Operational Noise Assessment

Glenellen Solar Farm

Prepared for CWP Renewables
Report Reference: 18SYA0054 R01_1

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1 Introduction

TTM Consulting has been engaged by Eco Logical Australia on behalf of CWP Renewables to conduct a construction and operational noise impact assessment for the proposed Glenellen Solar Farm (GSF, the Proposed Development), located approximately 20 km north of Albury in NSW. The assessment includes the following:

- Construction noise assessment:
  - Identification of construction stages and associated activities including, specialised machinery and equipment used during the works
  - Assessment in accordance with the *NSW Interim Construction Noise Guideline*[1] *(ICNG)*, and
  - Advice on practical and appropriate in-principle noise mitigation and management, where required.
- Operational noise impact assessment:
  - Assessment of inverters and other noise generating equipment in accordance with the *NSW Noise for Industry Policy (2017)*[2], and
  - Advice on practical and appropriate in-principle noise mitigation and management, where required.

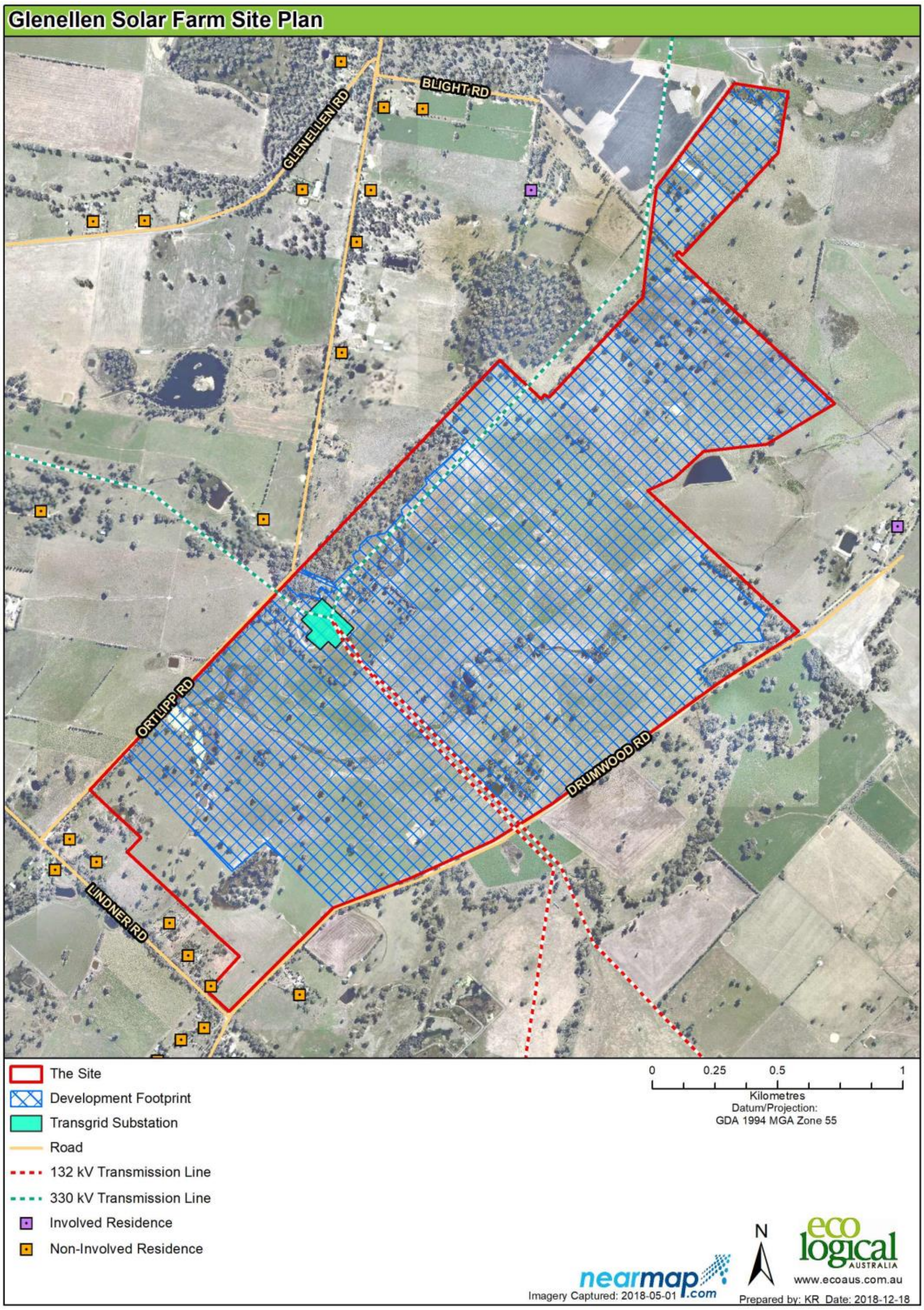
[1] NSW Department of Environment and Climate Change (DECC) (2009), Interim Construction Noise Guideline

[2] NSW Environment Protection Authority (2017), Noise Policy for Industry

2 Site Description

The Proposed Development is located approximately 20 km north of Albury, within the Greater Hume Shire Local Government Area. The GSF Site plan is shown in Figure 1.

Figure 1: GSF Site Plan



2.1 Surrounding Area

The surrounding area is generally characterised by agricultural land with local residential dwellings surrounding the Site.

Eight residential dwellings have been identified to be within 500 metres away from the Development Footprint. Fourteen dwellings have been identified to be between 500 metres and one kilometre away from the Development Footprint.

2.2 Noise Sensitive Receivers (NSRs)

Residential properties within one kilometre of the Development Footprint have been identified as shown in Figure 2 and are summarised in Table 1. These are referred to as noise sensitive receivers (NSRs) and have been the subject of this noise impact assessment to determine whether and analyse how they may potentially be adversely impacted by noise from the construction and operation of the Proposed Development. Noise impact at properties located further away will be further reduced due to increased distance attenuation. Should the derived noise limits in this report be met at the identified closest NSRs, with or without noise mitigation and management measures, compliance with the noise criteria is also expected further away, including more than one kilometre from the Development Footprint.

Table 1: List of Noise Sensitive Receivers within one kilometre from the Development Footprint

ID code	Distance to Development Footprint of GSF (m)	Direction from GSF
ORT005	244	West
LIN003	324	South
LIN005	369	West
DRM008	374	South
LIN002	381	South
LIN004	385	West
LIN001	467	South
ORT004	494	North
LIN006	512	West
DRM014	551	East
WWJ016	615	West
DRM007	636	South
ORT008	651	West
DRM006	703	South
DRM015	735	South
ORT003	736	North
WWJ006	754	West
DRM005	814	South
ORT002	849	North
WWJ020	904	West

ID code	Distance to Development Footprint of GSF (m)	Direction from GSF
DRM004	931	South
ORT009	984	North

Figure 2: Assessed Noise Sensitive Receivers

3 Proposed Development

The Proposed Development involves the installation of solar photovoltaic (PV) panels and battery energy storage facilities with a generation capacity of approximately 150 MW_{AC}.

The Proposed Development would include, but not necessarily be limited to, the following elements:

- Solar arrays: solar panels supported by a mounting system installed on piles driven, screwed, drilled and stabilised with a cement mix or ballasted to the ground;
- Battery energy storage system facilities;
- Power Conversion Units (PCUs) inclusive of Inverters/Rectifiers, Ring Main Units, Light Voltage (LV)/Medium Voltage (MV) step-up Transformers located throughout the Proposed Development;
- Collector systems: above and/or below ground onsite cabling and electrical connections between the grid connection substation and collector substations and between the substations and the respective PCUs;
- Intersection upgrades;
- Operation and maintenance (O&M) building including workshop, warehouse, offices, ablutions, and carpark;
- Site access and onsite access tracks;
- Fencing and security system;
- Meteorological stations;
- Vegetation buffers (if required) for visual screening; and
- Firebreaks.

3.1 Temporary Construction Compound

In addition to the key components outlined above, there would be a temporary construction compound and material laydown areas required to facilitate the construction, upgrading and decommissioning phases of the Proposed Development.

The construction compound would include:

- Temporary construction offices;
- Car and bus parking areas (the transport assessment has considered car transport only as a worst-case scenario);

- Staff amenity block including portable toilets, showers and a kitchen) designed for peak staff numbers during the construction period;
- Laydown areas; and
- Enclosed secure area with security fencing.

The material laydown areas would include:

- Temporary facilities;
- Plant and equipment storage areas;
- Unloading areas; and
- Enclosed secure areas with security fencing.

All land required for the temporary construction activities will be rehabilitated for agricultural use following completion of construction.

4 Noise Environment

The Site is located in a rural area with an acoustic environment that is dominated in most parts by natural sounds, generally characterised by low background noise levels.

For the assessment, the identified noise sensitive receivers are expected to experience a similar acoustic environment with low background noise levels.

The background noise levels of the area have therefore been estimated by referring to Appendix A of Australian Standard AS 1055.2[3]. The standard provides estimated average background noise levels for different residential areas in Australia, which may be used as a guideline.

In accordance with Appendix A of AS 1055.2 (extract attached in Appendix A of this report), the noise area category R1 (category with lowest background noise levels) is relevant to the Site and assessment. The corresponding average background noise levels for Category R1 are summarised in Table 2.

Table 2: Average background noise levels for a noise area category R1

Time period*	Average background noise level, L_{90}, in dB(A)
Day	40
Evening	35
Night	30
Note: * - Day-time period is from 0700 to 1800 (Monday to Saturday) and 0900 to 1800 (Sundays and Public Holidays) - Evening period is from 1800 to 2200 - Night-time period is from 2200 to 0700 (Monday to Saturday) and 2200 to 0900 (Sundays and Public Holidays)	

The above estimated background noise levels have been used to determine the applicable criteria for the assessment.

[3] AS 1055.2:1997. Acoustics - Description and measurement of environmental noise - Application to specific situations

5 Noise Criteria

The main guidelines, standards and other policy documents relevant to the construction and operational noise impact assessment include:

- NSW Department of Environment and Climate Change (DECC) (2009), *Interim Construction Noise Guideline*, and
- NSW Environment Protection Authority (2017), *NSW Noise Policy for Industry*.

5.1 DECC Interim Construction Noise Guideline

The DECC Interim Construction Noise Guideline (ICNG) provides guidelines for the assessment and management of noise from construction works. Construction activities and associated duration for the Proposed Development mean that it is considered a major construction project in accordance with the guideline. As such, the quantitative approach has been adopted for the construction noise assessment.

5.1.1 ICNG Noise Management Levels

The ICNG suggests the following standard hours for construction activities where noise is audible at residential premises:

- Monday to Friday, 7am to 6pm
- Saturday, 8am to 1pm, and
- No construction work is to take place on Sundays or public holidays.

Time restrictions on construction works are the primary management tool of the ICNG. The construction working hours of the Proposed Development are expected to be in line with the above standard hours.

The guideline also provides noise management levels for residential premises for both the recommended, and outside standard hours of construction. The noise management levels recommended for residential premises have been extracted from the ICNG and are summarised in Table 3.

Table 3: Residential – ICNG noise management levels

Time of day	Management level, $L_{Aeq,15\ min}$*	How to apply
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	Noise affected RBL# + 10 dB **= 50 dB(A)**	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq\ (15\ min)}$ 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: a. 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 b. 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 **= 40 dB(A) Evening period** **= 35 dB(A) Night-time period**	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see section 7.2.2 of the ICNG.

Note:
***** Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level. If the property boundary is more than 30m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30m of the residence. Noise levels may be higher at upper floors of the noise affected residence.
# The Rating Background Level for each period is the median value of the Assessment Background Level values for the period over all the days measured. In this case the RBL has been assumed (Refer to Table 2)

5.2 NSW Noise Policy for Industry 2017

The policy sets out the procedure to determine the project noise trigger levels relevant to assess noise from industrial developments. The project noise trigger level applies to existing NSRs.

The project noise trigger level provides a benchmark or objective for assessing a proposal or site. It is not intended for use as a mandatory requirement. The project noise trigger level is a level that, if exceeded, would indicate a potential noise impact on the community, and so ‘trigger’ a management response; for example, further investigation of mitigation measures.

The project noise trigger level is the lower (that is, the more stringent) value of the project intrusiveness noise level and project amenity noise level determined in Sections 2.3 and 2.4 of the policy.

5.2.1 Project Intrusiveness Noise Level

The Noise Policy for Industry states:

> *The intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (represented by the L_{Aeq} descriptor), measured over a 15-minute period, does not exceed the background noise level by more than 5 dB when beyond a minimum threshold. This intrusiveness noise level seeks to limit the degree of change a new noise source introduces to an existing environment.*

The intrusiveness noise level is determined as follows:

$$L_{Aeq,\ 15min} \leq \text{Rating Background Noise Level} + 5\ \text{dB}$$

5.2.1.1 Minimum Rating Background Noise Level and Intrusive Noise Levels

The rating background noise level (RBL) is the overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24-hour period used for the assessment background level). The rating background noise level is the level used for assessment purposes.

However, for this assessment, noise monitoring was not conducted and instead RBLs have been assumed from AS1055, as shown in Table 2.

Regardless of the measured or assumed RBLs, minimum RBLs apply in this policy, which result in minimum intrusiveness noise levels as follows:

Table 4: Minimum assumed RBLs and project intrusiveness noise levels.

Time of day	Minimum assumed rating background noise level, in dB(A)	Minimum project intrusiveness noise levels, in $L_{Aeq,15min}$ dB(A)
Day	35	40
Evening	30	35
Night	30	35

For the purpose of the assessment, the minimum project intrusive noise levels have been adopted.

5.2.2 Amenity noise levels and Project Amenity Noise Levels

To limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise level within an area from all industrial noise sources combined should remain below the recommended amenity noise levels specified in Table 2.2 of the Noise Policy for Industry where feasible and reasonable. The recommended amenity noise levels will protect against noise impacts such as speech interference, community annoyance and some sleep disturbance. The noise amenity area is defined as residential rural and the relevant noise amenity levels are given in Table 5.

Table 5: Amenity noise levels

Receiver/ Noise amenity area	Assessment period	Recommended amenity noise level, L_{eq} dB(A)
Residential Rural	Day	50
	Evening	45
	Night	40

Note:
- Day-time period is from 0700 to 1800 (Monday to Saturday) and 0800 to 1800 (Sundays and Public Holidays)
- Evening period is from 1800 to 2200
- Night-time period is from 2200 to 0700 (Monday to Saturday) and 2200 to 0800h (Sundays and Public Holidays)

The recommended amenity noise levels represent the objective for total industrial noise at a receiver location, whereas the project amenity noise level represents the objective for noise from a single industrial development at a receiver location.

To ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a project amenity noise level applies for each new source of industrial noise as follows:

Project amenity noise level for industrial developments = Recommended amenity noise level minus 5 dB(A)

5.2.3 Project Noise Trigger Level

The project noise trigger level (PNTL) has been determined in Table 6 and are the most stringent of the intrusiveness and amenity noise criteria.

Table 6: NSW Noise Policy for Industry evaluated criteria

Assessment period	Project Intrusiveness Noise Level $L_{eq,15min}$ dB(A)*	Project Amenity Noise Level L_{eq} dB(A)	Project Noise Trigger Level L_{eq} dB(A)
Day	40	45	**40**
Evening	35	40	**35**
Night	35	35	**35**

Note:
- Day-time period is from 0700 to 1800 (Monday to Saturday) and 0800 to 1800 (Sundays and Public Holidays)
- Evening period is from 1800 to 2200
- Night-time period is from 2200 to 0700 (Monday to Saturday) and 2200 to 0800h (Sundays and Public Holidays)

* Based on minimum intrusive noise levels in Table 4.

Table 6 shows that the PNTLs are set by the project intrusiveness noise level for all assessment periods.

By meeting the PNTLs at the identified NSRs, all other properties located further away from the Site are expected to comply with the noise requirements of this policy.

5.3 Noise-enhancing Weather Conditions

Certain meteorological/weather conditions may increase noise levels by focusing sound-wave propagation paths at a single point. Such refraction of sound waves will occur during temperature inversions (atmospheric conditions where temperatures increase with height above ground level), and where there is a wind gradient (that is, wind velocities increasing with height) with wind direction from the source to the receiver.

As meteorological data was not captured for the assessment, a range of meteorological conditions have been considered in the construction and operational noise impact assessment of the Proposed Development, to account for all conditions.

The standard meteorological conditions and noise-enhancing meteorological conditions as defined in the NSW Noise for Industry Policy, which have been considered in this assessment are summarised in Table 7.

Table 7: Standard and noise-enhancing meteorological conditions

Meteorological conditions	Meteorological parameters
Standard meteorological conditions	Day/evening/night: stability categories A–D with wind speed up to 0.5 m/s at 10 m AGL.
Noise-enhancing meteorological conditions	Daytime/evening: stability categories A–D with light winds (up to 3 m/s at 10 m AGL). Night-time: stability categories A–D with light winds (up to 3 m/s at 10 m AGL) and/or stability category F with winds up to 2 m/s at 10 m AGL.

6 Construction Noise Assessment

For the assessment, the noise impact has been assessed for each construction phase. Each construction phase is expected to occur sequentially. Although some construction phases will overlap, they are not expected to occur at the same location, thus eliminating the risk of cumulative impact.

6.1 Construction Phases

The construction phases of the Proposed Development and associated machinery and equipment required, including vehicles, are outlined in Table 8.

Table 8: Construction phases

Construction Phase	Area of Work/Task	Duration	Typical Number of Vehicles	Type of Delivery Vehicle	Types of Equipment
Site Clearing Works	Earthworks construction machinery	27 weeks	25	Low Loader	D9 Dozer 20T Excavator 35T Excavator Scraper Pad Foot Roller Water Cart Moxy Front End Loader
	Tree Removal	27 weeks (ad hoc)	6	Low Loader	Wood Chipper (tub grinder) D9 Dozer Tractor
Access Road Construction	Earthworks construction machinery	20 weeks	21	Low Loader	Grader Water Cart Drum Roller 13T Excavator 20T Excavator Bobcat Scraper
	Access Track Road Base	20 weeks	20	32T Truck and Dog Moxy	32T Truck and Dog Moxy Loader Crusher / Screener for quarry based activities, Scraper for placement of fill
Civil Construction of Benches	Construction Vehicles	10 weeks	25	Low Loader	D9 Dozer 20T Excavator 35T Excavator Scraper Pad Foot Roller Water Cart

Construction Phase	Area of Work/Task	Duration	Typical Number of Vehicles	Type of Delivery Vehicle	Types of Equipment
	Foundation Compound	10 weeks	15	32T Truck and Dog Moxy	32T Truck and Dog Moxy
Construction / Installation Activities	Site Fencing	20 weeks	20	Low Loader	Bobcat Utes and Trailer Telehandler Tractor Concrete Truck Small Excavator
	Site Offices	4 weeks for both mobilisation and demobilisation	20	Low Loader	Flatbed Truck Crane (slew or Franna) Forklift Telehandler Hiab Truck
	Concrete Foundations	Ad hoc (if required)	30	Concrete Truck	Concrete Truck Concrete Pump Sand Cart Water Cart
	Piling Works	30 weeks	15	Low Loader	Vermeer PD10 or Equivalent
	Pre-drilling works	15 weeks	10	Low Loader	Utes and Trailers Tractors, Excavators
	Tracking System Installation	40 weeks	20	Low Loader	Telehandlers Tractors & trailers for deliveries
	PV Module Installation	40 weeks	20	Low Loader	Telehandlers Tractors& trailers for deliveries Forklifts
	Onsite Logistics	40 weeks	20	Low Loader	Telehandlers Bobcat Side loaders Tractors & trailers Forklifts
	Cable and Trenching	35 weeks	20	Low Loader	Vermeer Trenchers Utes / Tractors (for MV cable) with Cables Reeler Sand Carts 20T Excavator Telehandler Backhoe Grader MR Truck Front End Loader

Construction Phase	Area of Work/Task	Duration	Typical Number of Vehicles	Type of Delivery Vehicle	Types of Equipment
					D7 Dozer (for clearing)
	OHL Construction	25 weeks	20	Low Loader	EWP Telehandler Drill Rig Concrete truck 20T Excavator HR Tuck and Hiab Mobile Crane D7 Dozer (for clearing)
Deliveries	Piling Machines	2 weeks	7	Low Loader or side loader semis with pile rigs in 40’ containers	
	Main Equipment (Tracking, Piers, Modules, Inverters)	6 months	2000 (estimated total deliveries)	Typically, A-B-Double	
	Gravel / Access Track Road Base	25 weeks	430 (estimated total deliveries)	Typically, A-B-Double	
	Sand	35 weeks	350 (estimated total deliveries)	Typically, A-B-Double	
	Mobile Crane	Ad-hoc as needed	3	180T Mobile Crane	
Waste Collection	-	14 months (Approximately 20 Trucks weekly)	20	Waste Collection Trucks	

6.2 Plant and Equipment Noise Source Levels

For each construction process, the expected plant and machinery information to be used are summarised in Table 9. The table also includes an estimated percentage of use for each equipment during each phase, which reflects the transient and changing nature of the construction noise activities, dependent upon site-conditions, timelines, delays and other unexpected occurrences.

Table 9: Plant and machinery for each phase

Construction Phase	Task	Equipment	% Use	Sound Power Level, dB(A)	Reference*
Site Clearing Works	Earthworks construction machinery	D9 Dozer	75%	102	Ref. No. 1, Table 2 in DEFRA[4]
		20T Excavator	50%	103	Ref. No. 3, Table 2 in DEFRA
		35T Excavator	50%	101	Ref. No. 15, Table 2 in DEFRA
		Scraper	75%	95	Ref. No. 8, Table 2 in DEFRA
		Pad Foot Roller	50%	105	Ref. No. 37, Table 2 in DEFRA
		Water Cart	100%	93	Ref. No. 45, Table 2 in DEFRA
		Moxy	75%	114	Ref. No. 31, Table 2 in DEFRA
		Front End Loader	75%	103	Ref. No. 28, Table 2 in DEFRA
	Tree Removal	Wood Chipper (tub grinder)	100%	113	Ref. No. 71, Table 4 in DEFRA
		D9 Dozer	75%	102	Ref. No. 1, Table 2 in DEFRA
		Tractor	50%	105	Ref. No. 34, Table 2 in DEFRA
Access Road Construction	Earthworks construction machinery	Grader	75%	106	Ref. No. 37, Table 2 in DEFRA
		Water Cart	100%	93	Ref. No. 45, Table 2 in DEFRA
		Drum Roller	75%	106	Ref. No. 37, Table 2 in DEFRA
		13T Excavator	50%	101	Ref. No. 5, Table 2 in DEFRA
		20T Excavator	50%	103	Ref. No. 3, Table 2 in DEFRA
		Bobcat	75%	103	Ref. No. 28, Table 2 in DEFRA
		Scraper	75%	95	Ref. No. 8, Table 2 in DEFRA
	Access Track Road Base	32T Truck and Dog	50%	105	Ref. No. 34, Table 2 in DEFRA
		Moxy	75%	114	Ref. No. 31, Table 2 in DEFRA
		Loader	75%	103	Ref. No. 28, Table 2 in DEFRA
		Crusher / Screener for quarry based activities	50%	109	Ref. No. 15, Table 1 in DEFRA
		Scraper for placement of fill	75%	95	Ref. No. 8, Table 2 in DEFRA
Civil Construction of Benches	Construction Vehicles	D9 Dozer	75%	102	Ref. No. 1, Table 2 in DEFRA
		20T Excavator	50%	103	Ref. No. 3, Table 2 in DEFRA
		35T Excavator	50%	101	Ref. No. 15, Table 2 in DEFRA
		Scraper	75%	95	Ref. No. 8, Table 2 in DEFRA
		Pad Foot Roller	75%	106	Ref. No. 37, Table 2 in DEFRA

[4] Department for Environment Food and Rural Affairs (DEFRA) – Update of Noise Database for Prediction of Noise on Construction and Open Sites – (2005)

Construction Phase	Task	Equipment	% Use	Sound Power Level, dB(A)	Reference*
		Water Cart	100%	93	Ref. No. 45, Table 2 in DEFRA
	Foundation Compound	32T Truck and Dog	50%	105	Ref. No. 34, Table 2 in DEFRA
		Moxy	75%	114	Ref. No. 31, Table 2 in DEFRA
Construction / Installation Activities	Site Fencing	Bobcat	75%	103	Ref. No. 28, Table 2 in DEFRA
		Utes and Trailer	50%	105	Ref. No. 34, Table 2 in DEFRA
		Telehandler	50%	96	Ref. No. 35, Table 2 in DEFRA
		Tractor	75%	107	Ref. No. 34, Table 2 in DEFRA
		Concrete Truck	75%	107	Ref. No. 34, Table 2 in DEFRA
		Small Excavator	50%	101	Ref. No. 5, Table 2 in DEFRA
	Site Offices	Flatbed Truck	50%	105	Ref. No. 34, Table 2 in DEFRA
		Crane (slew or Franna)	75%	103	Ref. No. 48, Table 5 in DEFRA
		Forklift	75%	94	Ref. No. 57, Table 4 in DEFRA
		Telehandler	75%	97	Ref. No. 35, Table 2 in DEFRA
		Hiab Truck	50%	105	Ref. No. 34, Table 2 in DEFRA
	Concrete Foundations	Concrete Truck	50%	105	Ref. No. 34, Table 2 in DEFRA
		Concrete Pump	75%	94	Ref. No. 24, Table 4 in DEFRA
		Sand Cart	75%	107	Ref. No. 34, Table 2 in DEFRA
		Water Cart	100%	93	Ref. No. 45, Table 2 in DEFRA
	Piling Works	Vermeer PD10 or Equivalent	100%	96	Ref. No. 6, Table 3 in DEFRA
	Pre-drilling works	Utes and Trailers	50%	105	Ref. No. 34, Table 2 in DEFRA
		Tractors	75%	107	Ref. No. 34, Table 2 in DEFRA
		Excavators	50%	103	Ref. No. 3, Table 2 in DEFRA
	Tracking System Installation	Telehandlers	75%	97	Ref. No. 35, Table 2 in DEFRA
		Tractors & trailers for deliveries	75%	107	Ref. No. 34, Table 2 in DEFRA
	PV Module Installation	Telehandlers	75%	97	Ref. No. 35, Table 2 in DEFRA
		Tractors & trailers for deliveries	75%	107	Ref. No. 34, Table 2 in DEFRA
		Forklifts	75%	94	Ref. No. 57, Table 4 in DEFRA
	Onsite Logistics	Telehandlers	75%	97	Ref. No. 35, Table 2 in DEFRA
		Bobcat	75%	103	Ref. No. 28, Table 2 in DEFRA
		Side loaders	50%	101	Ref. No. 28, Table 2 in DEFRA
		Tractors & trailers	75%	107	Ref. No. 34, Table 2 in DEFRA
		Forklifts	75%	94	Ref. No. 57, Table 4 in DEFRA
	Cable and Trenching	Vermeer Trenchers	75%	102	Ref. No. 64, Table 4 in DEFRA
		Utes / Tractors (for MV cable) with Cables Reeler	50%	105	Ref. No. 34, Table 2 in DEFRA
		Sand Carts	75%	107	Ref. No. 34, Table 2 in DEFRA
		20T Excavator	50%	103	Ref. No. 3, Table 2 in DEFRA

Construction Phase	Task	Equipment	% Use	Sound Power Level, dB(A)	Reference*
		Telehandler	75%	97	Ref. No. 35, Table 2 in DEFRA
		Backhoe	75%	95	Ref. No. 8, Table 2 in DEFRA
		Grader	75%	106	Ref. No. 37, Table 2 in DEFRA
		MR Truck	75%	114	Ref. No. 31, Table 2 in DEFRA
		Front End Loader	75%	103	Ref. No. 28, Table 2 in DEFRA
		D7 Dozer (for clearing)	75%	102	Ref. No. 1, Table 2 in DEFRA
	OHL Construction	EWP	75%	105	Ref. No. 59, Table 4 in DEFRA
		Telehandler	75%	97	Ref. No. 35, Table 2 in DEFRA
		Drill Rig	75%	112	Ref. No. 35, Table 6 in DEFRA
		Concrete truck	50%	112	Ref. No. 31, Table 2 in DEFRA
		20T Excavator	75%	105	Ref. No. 3, Table 2 in DEFRA
		HR Tuck and Hiab	75%	93	Ref. No. 28, Table 3 in DEFRA
		Mobile Crane	50%	112	Ref. No. 31, Table 2 in DEFRA
		D7 Dozer (for clearing)	75%	102	Ref. No. 1, Table 2 in DEFRA
Deliveries	Piling Machines	Low Loader or Side loader semis with pile rigs in 40' containers	50%	101	Ref. No. 28, Table 2 in DEFRA
	Main Equipment (Tracking, Piers, Modules, Inverters)	Typically, A-B-Double	50%	112	Ref. No. 31, Table 2 in DEFRA
	Gravel / Access Track Road Base	Typically, A-B-Double	50%	112	Ref. No. 31, Table 2 in DEFRA
	Sand	Typically, A-B-Double	50%	112	Ref. No. 31, Table 2 in DEFRA
	Mobile Crane	180T Mobile Crane	50%	112	Ref. No. 31, Table 2 in DEFRA
Waste Collection	-	Waste Collection Trucks	50%	112	Ref. No. 31, Table 2 in DEFRA

6.3 Assessment Methodology

The noise impact of each construction phase has been predicted based on the following assumptions:

- Noise source modelled as follows:
  - One point source for each construction phase.
  - All plant and equipment for each construction phase are operating simultaneously at the same location.
  - Total sound power level for each construction phase is calculated based on sound power level information and percentage use of each plant and equipment given in Table 9.
- Distance attenuation, as follows:

  a. Average impact scenario:

  - Due to the transient and changing nature of construction works, the location of the noise source can be assumed to be in the middle of the site for each construction phase on average. This scenario provides an indication to the average impact on the receivers. Impact is typically maximum when the construction works are closest to the receivers on one side of the site, and minimal when works are on the other side of the site away from receivers.

  b. Worst-case impact scenario:

  - Maximum impact is experienced when construction works occur at the closest boundary of the construction works to each respective receiver. Maximum impact will however be for a short duration until the activities move to a different location. Assessing the maximum impact ensures the right mitigation methods are implemented.
- Atmospheric, meteorological and ground attenuation using the CONCAWE[5] method (over 100 metres separation distance between source and receiver), as follows:

  a. Category 6:

  - A conservative prediction of the propagation of noise from source to receiver, which includes the effects of temperature inversions and favourable winds onto the noise.

  b. Category 4:

  - A neutral prediction based on neutral meteorological conditions.

For the construction noise assessment, noise levels have been predicted to the receivers based on the above methodology. The predicted noise levels have then been compared to the following noise targets:

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[5] CONCAWE is a noise prediction method developed for assessing environmental noise propagation, drawn from both acoustic theory and extensive field noise measurements. The CONCAWE predictions consider atmospheric, meteorological and ground attenuation. *The propagation of noise from petroleum and petrochemical complexes to neighbouring communities. Report no.4/81, 1981*

1. ICNG noise management level of 50 dB(A) day-time, and
2. ICNG highly noise affected limit of 75 dB(A) as presented in Table 3.

6.4 Predicted Noise Impact Radius

The predicted approximate noise impact radius for each construction process are provided in Table 10.

Table 10: Predicted noise impact radius for each task

Construction Process	Construction Task	Approx. noise Impact Radius (metres) to meet noise targets*			
		CONCAWE Category 6		CONCAWE Category 4	
		50 dB(A) noise target	75 dB(A) noise target	50 dB(A) noise target	75 dB(A) noise target
Site Clearing Works	Earthworks construction machinery	500	35	350	35
	Tree Removal	400	30	300	30
Access Road Construction	Earthworks construction machinery	400	25	250	25
	Access Track Road Base	500	40	350	40
Civil Construction of Benches	Construction Vehicles	350	20	250	20
	Foundation Compound	500	35	350	30
Construction / Installation Activities	Site Fencing	400	25	250	25
	Site Offices	350	20	250	20
	Concrete Foundations	300	20	200	20
	Piling Works	80	10	80	10
	Pre-drilling works	300	20	250	20
	Tracking System Installation	250	15	200	15
	PV Module Installation	250	15	200	15
	Onsite Logistics	300	20	250	20
	Cable and Trenching	550	40	400	40
	OHL Construction	550	40	400	40
Deliveries	Piling Machines	150	10	125	10
	Main Equipment (Tracking, Piers, Modules, Inverters)	400	25	300	25
	Gravel / Access Track Road Base	400	25	300	25
	Sand	400	25	300	25
	Mobile Crane	400	25	300	25
Waste Collection		400	25	300	25
Note: * Atmospheric, meteorological and ground attenuation corrections are 0 dB for predictions within 100 metres of the source.					

6.5 Impacted Receivers

6.5.1 Highly Noise Affected

The predicted construction impact for the noisiest construction task shows that the ICNG highly noise affected limit of 75 dB(A) is exceeded at any receivers located less than 40 metres from the boundary of the Development Footprint.

The closest identified noise sensitive receiver, Receiver ID ORT005, is 244 metres from the closest boundary of the Development Footprint.

Therefore, no receiver is predicted to be highly noise affected.

6.5.2 Exceedance of ICNG Noise Management Level

Based on the predicted approximate noise impact radius, receivers located within 550 metres of the noisiest construction tasks (Worst-case prediction CONCAWE Category 6) will exceed the ICNG Noise Management Level of 50 dB(A).

The approximate duration of impact for each impacted receiver has been predicted based on the duration of each construction task and the total area of the construction work (Development Footprint). The results are summarised in Table 11.

Table 11: Impacted receivers

Construction Phase	Area of Work/Task	Duration	Impacted Receivers	Approximate Duration of Impact in Working Days (Based on Worst-case prediction CONCAWE Category 6)
Site Clearing Works	Earthworks construction machinery	27 weeks	ORT005 LIN003 LIN005 DRM008 LIN002 LIN004 LIN001 ORT004	8 4 2 2 2 2 1 1
	Tree Removal	27 weeks (ad hoc)	ORT005 LIN003 LIN005 DRM008 LIN002 LIN004	Receivers will be impacted for tree removal located within 400 metres of the receivers. Each tree removal work is not expected to last for more than a couple of hours. Noise impact of tree removal work located more than 400 metres from the receivers is predicted to be less than the ICNG Noise Management Level of 50 dB(A).
Access Road Construction	Earthworks construction machinery	20 weeks	ORT005 LIN003 LIN005 DRM008 LIN002 LIN004	2 1 1 1 1 1

Construction Phase	Area of Work/Task	Duration	Impacted Receivers	Approximate Duration of Impact in Working Days (Based on Worst-case prediction CONCAWE Category 6)
	Access Track Road Base	20 weeks	ORT005 LIN003 LIN005 DRM008 LIN002 LIN004 LIN001 ORT004	6 3 2 1 1 1 1 1
Civil Construction of Benches	Construction Vehicles	10 weeks	ORT005 LIN003	1 1
	Foundation Compound	10 weeks	ORT005 LIN003 LIN005 DRM008 LIN002 LIN004 LIN001 ORT004	3 1 1 1 1 1 1 1
Construction / Installation Activities	Site Fencing	20 weeks	ORT005 LIN003 LIN005 DRM008 LIN002 LIN004	2 1 1 1 1 1
	Site Offices	4 weeks for both mobilisation and demobilisation	ORT005 LIN003	1 1
	Concrete Foundations	Ad hoc (if required)	ORT005	Impact is predicted to be of short duration, typically less than one working day.
	Piling Works	30 weeks	Nil	-
	Pre-drilling works	15 weeks	ORT005	1
	Tracking System Installation	40 weeks	ORT005	1
	PV Module Installation	40 weeks	ORT005	1
	Onsite Logistics	40 weeks	ORT005	1
	Cable and Trenching	35 weeks	ORT005 LIN003 LIN005 DRM008 LIN002 LIN004 LIN001 ORT004	15 8 5 5 4 4 1 1

Construction Phase	Area of Work/Task	Duration	Impacted Receivers	Approximate Duration of Impact in Working Days (Based on Worst-case prediction CONCAWE Category 6)
			LIN006	1
	OHL Construction	25 weeks	ORT005 LIN003 LIN005 DRM008 LIN002 LIN004 LIN001 ORT004 LIN006	10 6 4 3 3 3 1 1 1
Deliveries	Piling Machines	2 weeks	Nil	-
	Main Equipment (Tracking, Piers, Modules, Inverters)	6 months	ORT005 LIN003 LIN005 DRM008 LIN002 LIN004	3 1 1 1 1 1
	Gravel / Access Track Road Base	25 weeks	ORT005 LIN003 LIN005 DRM008 LIN002 LIN004	3 1 1 1 1 1
	Sand	35 weeks	ORT005 LIN003 LIN005 DRM008 LIN002 LIN004	4 1 1 1 1 1
	Mobile Crane	Ad-hoc as needed	ORT005 LIN003 LIN005 DRM008 LIN002 LIN004	Impact is predicted to be exceeded for works within 400 metres of receiver. Impact is predicted to be for short durations, typically for a couple of hours. As the works move further away more than 400 metres from the receiver, impact is predicted to be less than the ICNG Noise Management Level of 50 dB(A).
Waste Collection	-	30 months (Approximately 20 Trucks weekly)	ORT005 LIN003 LIN005 DRM008 LIN002 LIN004	Impact will be of very short duration for a couple of hours a day at receiver located within 400 metres of the works. As the works move further away more than 400 metres from the receiver, impact is predicted to be less than the ICNG Noise Management Level of 50 dB(A).

6.6 Discussion and Recommendations

The construction noise prediction method represents a scenario where all the plant and equipment for each construction task have been assumed to be operating at the same time and location with the source noise levels adjusted for percentage usage.

This method allows to assess maximum impact but also represents impact for a short duration of time. Plant and equipment are expected to operate at one location for a short period of time and move on the next location, away from the boundary of the Development Footprint. For instance, sensitive areas located on the western boundary of the Site will be less impacted from works conducted on the eastern boundary of the Site, and vice versa.

Furthermore, plant and equipment are usually spread out across the site conducting specific tasks. The impact of one plant or equipment will be considerably less as compared to the cumulative impact of all plant and equipment, as presented in this assessment. The approximate impact duration given in Table 11 represents maximum duration and is to be used as a guide only.

Although the construction noise is expected to be audible and there is likely to be some degree of adverse impact, as is typical with construction projects in close proximity to people, by incorporating noise control measures, the noise impact to residents and other NSRs surrounding the site can be significantly reduced.

Construction noise impact can be managed through a Construction Noise and Vibration Management Plan (CNVMP) to minimise the adverse impact to acceptable levels and manage community reaction.

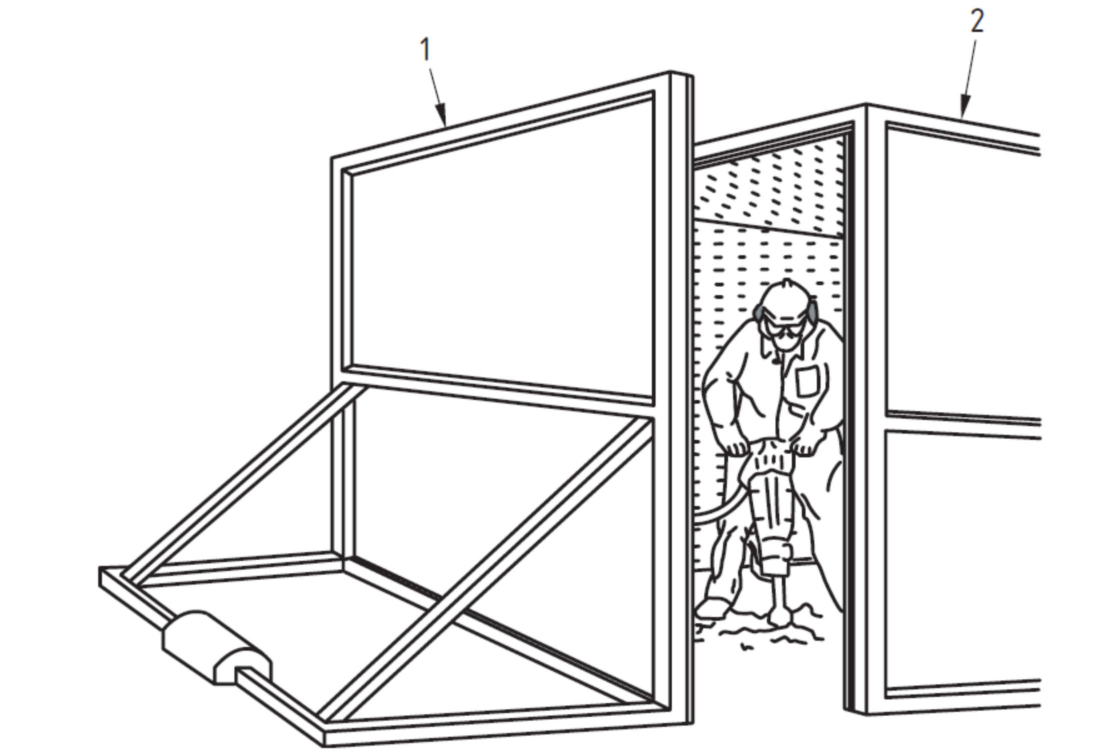
6.7 Good Practice – Mitigation and Management

As with all construction projects, noise levels can be minimised with adherence to good practice, which means following some basic procedures. Based on the results of the construction noise assessment showing that there are some exceedances of the ICNG noise management level at NSRs, suggestions and ideas to minimise construction noise have been provided below. Not all will be necessary and practical, but should there be an adverse response from the community, these mitigation and management suggestions will be helpful.

The opportunities for practical physical noise control are few given the transient and constantly moving nature of the construction work. However, mobile noise barriers/enclosures during certain construction work, such as around stationary work activities and plant, can be used to mitigate construction noise. Examples of mobile enclosure and demountable noise barriers are shown in Figure 3 and

Figure 4 respectively.

Figure 3: Illustration of a mobile enclosure and barrier



Key

1 Acoustic screen 2 m wide and 2.7 m high

2 Acoustic shed 2 m square and 2.7 m high

Figure 4: Photos demountable noise barriers

In other circumstances, management measures should be employed to minimise the construction noise impact onto residential premises. These can include:

- Informing and consulting residents and interested parties, as far as practicable, regarding impending or current events that may cause high levels of noise and how long they are expected to take. This may take the form of letter drops, or community notices.
- Provide a complaints telephone number prominently displayed where the works are taking place, and on any letter drops or community notices.
- Respite hours agreed with residents when noisy works will not take place, if necessary.
- Investigate complaints when received to establish the cause, and where possible implement a corrective action such as providing a respite period or other practical measure.
- Minimising the operating noise of machinery brought on to the Site.
- Where appropriate, obtaining acoustic test certificates for machinery brought on to the Site.
- Undertake noise monitoring at the start of a new noisy activity so noise levels can be investigated should a complaint be received.
- If there is excessive noise from any process, that process will be stopped and if possible that noise attenuated to acceptable levels. Where there is no alternative the process will be rescheduled to non-sensitive hours.
- Ensuring that plant is not left idling when not in use.
- Ensuring that plant is well maintained and in good working order and not causing unnecessary noise, such as damaged mufflers on plant.
- All access hatches for plant to be kept closed.

7 Construction Traffic Noise Assessment

During the construction period, an average of up to 45 heavy vehicles, 40 light vehicles and 13 buses are forecast to be required daily. There is potential that peak truck movements could be as high as 60 to 100 vehicles in some situations such as due to weather delays, logistical delays, where the construction schedule pace is increased, or where a particular campaign or work front requires a higher frequency of truck movements for a shorter duration. Typical construction traffic will consist of deliveries, low loader trailers, truck and dog, A-double trucks, B-double trucks and waste collection trucks.

Construction traffic is proposed to enter the Site via the Hume Highway, Olympic Highway, Main Street (Gerogery Road), Glenellen Road, Walla Walla Jindera Road (southbound), Lindner Road (western) and Ortlipp Road (southern).

Construction traffic is proposed to exit the Site through the same inbound route via Ortlipp Road (southern), Lindner Road (western), Walla Walla Jindera Road (northbound), Glenellen Road, Gerogery Road, Olympic Highway and Hume Highway.

7.1 Predicted Traffic Noise Impact and Discussion

The closest receivers to the proposed access route are approximately 25 metres from the boundary of the access road.

Typical heavy vehicles associated with deliveries have an approximate maximum pass-by noise level of **81 dB L_{Amax}** at 10 metres (Source: DEFRA database, Table 2, Ref. 33 Articulated Dump Truck). This translates to a maximum noise level incident at the façade of that closest receiver of **73 dB L_{Amax}**.

As all traffic movements associated with the site will occur during daytime hours, sleep disturbance is not expected.

With an average of approximately 90 heavy vehicle pass-by events per day (approximately 7.5 pass-by events per hour) from delivery trucks occurring during a 12-hour construction period, it follows that the impact will be noticeable but relatively minor at the closest receivers to the access road. In addition, it should be noted that **73 dB L_{Amax}** is a maximum noise level, and as such, the noise will be at this level only for a very short duration, and each pass-by will be over in a matter of seconds.

Therefore, the risk of an adverse noise impact being caused to residents is considered low.

Other construction related traffic is not expected to result in an adverse noise impact to residents.

8 Operational Noise Assessment

This section of the report addresses the operational noise impact of the Proposed Development onto sensitive receivers. The assessment includes:

- Prediction of noise emissions from the operation and maintenance of the Proposed Development
- Comparison of predicted noise emissions to noise criteria derived from the NSW Noise Policy for Industry, and
- Provide noise mitigation measures, if any, to ensure compliance with the criteria.

8.1 Operations Phase

The solar modules at the Site are to operate during daylight hours, seven days per week, 365 days per year, for a period of approximately 30 years. The Proposed Development will operate independently, and no permanent employees will be stationed on-site during the operations phase. The GSF will be monitored remotely from an off-site location and, apart from a routine maintenance program, operators will only visit the GSF when responding to any performance issues (i.e. where actual output measured by the monitoring system deviates from generation forecasts and other key performance metrics). The main operational and maintenance tasks are summarised in Table 12.

Table 12: Operation and maintenance tasks

Task	Description
Noise from the operation of Inverter stations (Including transformers)	When the solar farm is fully operational, noise from the inverter stations may impact upon nearby receivers. The inverter stations emit constant noise and are expected to be located within the module layout area. The stations are expected to operate 24/7.
Solar module washing	The solar modules are to be periodically washed to remove any excess dirt, dust or other matter (i.e. bird droppings), which may prevent sunlight from effectively reaching the solar cells and subsequently reducing the electricity production output. The solar panels are anticipated to be cleaned via means of water spray from a water truck driven through the informal roadways constructed on-site. No chemicals will be added to the water to ensure minimal impact to the surrounding environment through runoff.
Vegetation, weed, and pest management	Weed and vegetation control will be conducted throughout the project site for the duration of project operations. Weed control is likely to consist of any or, all of the following methods: biological (sheep grazing), mechanical or manual, or chemical methods. Site conditions are to be evaluated prior to the selection of the management method to ensure the method employed is the most appropriate to the environmental conditions of the Site.
Equipment maintenance and inspection	Responding to automated electronic alerts based on monitored data, including actual versus expected tolerances for system output and other key performance metrics.
Security detail	To ensure safety and security at the Site, a perimeter fence up to 2.5 m will be installed around the perimeter of the Proposed Development in accordance with the Proponent's requirements to ensure entry into the Site is controlled. Site access arrangements will be regulated for staff through identification requirements. Once operational, all access points will be gated. The Site security system may also include sensor lighting and closed-circuit television (CCTV) at several locations around the Site to act as a deterrent to possible nefarious activity. The lighting is designed not to react to birds and animals etc. entering the Site.

8.2 Operational Source Levels

For each operation phase, the expected equipment and associated sound levels are summarised in Table 13.

Table 13: Summary of operations phase and associated equipment

Operations Phase	Task	Equipment	% use per day	Sound Power Level, dB(A)	Reference*
Noise from Inverter Stations	Inverters, Transformers	-	100	92	Data provided by Eco Logical
Solar module washing	Water spraying	Water Truck	75	107	AS 2436
		Water Pump	75	93	Ref. No. 45, Table 2 in DEFRA
Vegetation, weed, and pest management	Mechanical method	Truck	75	107	AS 2436
		Pump	75	93	Ref. No. 45, Table 2 in DEFRA
Equipment maintenance and inspection	Insignificant noise impact				
Security detail	Insignificant noise impact				
Communicating with customers, transmission system operators, and other entities involved in facility operations	Insignificant noise impact				
Note: * DEFRA – Department for Environment Food and Rural Affairs (DEFRA), 2005. Update of noise database for prediction of noise on construction and open sites. Noise levels are given as a sound pressure level at 10 metres from the source. The sound pressure levels have been converted to sound power levels in the table.					

8.3 Assessment Methodology

A similar methodology to assessing construction noise has been adopted to predict operational noise. The impact of each task has been predicted based on the following assumptions:

- Noise source modelled as follows:
  - One point source for each task.
  - All plant and equipment for each task are operating simultaneously at the same location.
  - Total sound power level for each task is calculated based on sound level information and percentage use of each plant and equipment given in Table 13.
- Distance attenuation, as follows:
  a. Average impact scenario (Solar module washing and vegetation, weed, and pest management tasks only):
  - Due to the transient and changing nature of maintenance works, the location of the noise source can be assumed to be in the middle of the site for each task on average. This scenario provides an

indication to the average impact on the receivers. Impact is typically maximum when the maintenance works are closest to the receivers on one side of the site, and minimal when works are on the other side of the site away from receivers.

b. Worst-case impact scenario:

- Maximum impact is experienced when tasks occur at the closest boundary of the site to each respective receiver. Assessing the maximum impact ensures the right mitigation methods are implemented.

- Atmospheric, meteorological and ground attenuation using the CONCAWE[6] method (over 100 metres separation distance between source and receiver), as follows:

  a. Category 6:

  - A conservative prediction of the propagation of noise from source to receiver, which includes the effects of temperature inversions and favourable winds onto the noise.

  b. Category 4:

  - A neutral prediction based on neutral meteorological conditions.

8.4 Predicted Impact from Inverter Stations

Noise from the inverter stations are required to meet the Project Noise Trigger Levels of 35 dB(A) derived in Table 6.

Based on the sound levels given in Table 13, the radius of impact of one inverter station is 260 metres.

The final locations of the inverter stations are yet to be determined, therefore it is recommended to ensure all inverter stations are located at least 260 metres from the closest noise sensitive receiver.

Receiver with ID ORT005 is located at 244 metres from the Development Footprint and is the only receiver which is at risk of being impacted if the inverter stations are located within the impact radius.

It is recommended to consider the relative location of Receiver ORT005 when setting the final locations of the stations.

[6] CONCAWE is a noise prediction method developed for assessing environmental noise propagation, drawn from both acoustic theory and extensive field noise measurements. The CONCAWE predictions consider atmospheric, meteorological and ground attenuation. *The propagation of noise from petroleum and petrochemical complexes to neighbouring communities. Report no.4/81, 1981*

8.5 Predicted Operational Impact

Operational activities are expected to occur in the day-time period only. Noise from operational activities are required to meet the Project Noise Trigger Levels of 40 dB(A) Day-time as derived in Table 6.

Based on the sound levels given in Table 13, the radius of impact for the operational activities is approximately 150 metres.

No receivers have been identified with 150 metres of the Development Footprint. Therefore, impact from operational activities is predicted to be insignificant.

9 Conclusion

TTM has carried out a construction and operational noise assessment for the proposed Glenellen Solar Farm.

TTM predicted construction impact levels from the phases of construction at the nearest sensitive receivers. The predictions showed that no receivers will be highly noise affected. The impact is considered to be of short duration and manageable. Impact to the closest receivers will be maximum when the works are at the boundary of the site for a short duration until the works move away from the receivers. Good practice construction noise management procedures have been provided to minimise noise impact to the community.

Construction traffic on public roads has been assessed and the risk of an adverse noise impact to residents living beside the public roads is considered low.

Noise from the inverter stations has been assessed. It is recommended to locate the stations at least 260 metres away from the closest noise sensitive receiver.

Noise generated from the operation of the solar farm has also been assessed and found to be minimal. No additional noise mitigation measures are recommended.

Overall this noise assessment report has shown that noise associated with the construction and operation of the Proposed Development is manageable to acceptable levels.

Appendix A Extract from AS1055.2

APPENDIX A

ESTIMATED AVERAGE BACKGROUND A-WEIGHTED SOUND PRESSURE LEVELS ($L_{A90,T}$) FOR DIFFERENT AREAS CONTAINING RESIDENCES IN AUSTRALIA

(Informative)

This Appendix may only be used as a guideline. Whenever possible values of $L_{A90,T}$ shall be measured in accordance with Clause 4.2.1. Where the measured values are obtainable, this Appendix shall not be used.

Noise area category (Notes 1 and 2)	**Description of neighbourhood**	**Average background A-weighted sound pressure level, $L_{A90,T}$**					
		Monday to Saturday			**Sundays and public holidays**		
		0700–1800	**1800–2200**	**2200–0700**	**0900–1800**	**1800–2200**	**2200–0900**
R1	Areas with negligible transportation	40	35	30	40	35	30
R2	Areas with low density transportation	45	40	35	45	40	35
R3	Areas with medium density transportation or some commerce or industry	50	45	40	50	45	40
R4	Areas with dense transportation or some commerce or industry	55	50	45	55	50	45
R5 (See Note 3)	Areas with very dense transportation or in commercial districts or bordering industrial districts	60	55	50	60	55	50
R6 (See Note 3)	Areas with extremely dense transportation or within predominantly industrial districts	65	60	55	65	60	55

NOTES:

1 The division into noise area categories is necessary in order to accommodate existing sound levels encountered at residential sites in predominantly commercial or industrial districts, or in areas located close to main land transport routes, i.e. road and rail.

2 The noise area category most appropriate should be selected irrespective of metropolitan or rural zoning and will vary from location to location.

3 Some industrial and commercial sites are not predominant sources of high background sound levels.

Appendix B Glossary

In this acoustic report unless the context of the subject matter otherwise indicates or requires, a term has the following meaning:

TERM	DEFINITION
ABL	The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night-time (for each day). It is determined by calculating the 10th percentile (lowest 10th percent) background level (L_{A90}) for each period.
Adverse Weather	Weather effects that increases noise (i.e. wind and temperature inversion) that occurs at a site for a significant period of time (i.e. wind occurring more than 30% of the time in any assessment period in any season and / or temperature inversion occurring more than 30% of the nights in winter).
Ambient Noise	The all-encompassing noise associated within a given environment. It is the composite of sounds from many sources both near and far.
Assessment Period	The period in a day over which assessments are made: day (0700 to 1800h), evening (1800 to 2200h) or night (2200 to 0700h) or actual operating period if only a part of a period(s).
A – Weighting Filter	A-weighting is the most commonly used of a family of curves defined in the International standard IEC 61672:2003 and various national standards relating to the measurement of sound pressure level. A-weighting is applied to instrument-measured sound levels in effort to account for the relative loudness perceived by the human ear, as the ear is less sensitive to low audio frequencies.
Background Noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is excluded. Usually described using the L90 measurement parameter.
C – Weighting Filter	The C-weighting approximates the sensitivity of human hearing at industrial noise levels (above about 85 dB(A)). The C-weighted sound level (i.e., measured with the C-weighting) is more sensitive to sounds at low frequencies than the A-weighted sound level and is sometimes used to assess the low-frequency content of complex sound environments and entertainment noise.
Decibel	The ratio of sound pressures which we can hear is a ratio of 106 (one million:one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the 'sound pressure level' (Lp) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.
dB(A)	The unit generally used for measuring environmental, traffic or industrial noise is the A-weighted sound pressure level in decibels, denoted dB(A). An A-weighting network can be built into a sound level measuring instrument such that sound levels in dB(A) can be read directly from a sound level meter. The weighting is based on the frequency response of the human ear and has been found to correlate well with human subjective reactions to various sounds. It is worth noting that an increase or decrease of approximately 10 dB corresponds to a subjective doubling or halving of the loudness of a noise, and a change of 2 to 3 dB is subjectively barely perceptible.

TERM	DEFINITION
Equivalent Continuous Sound Level (L_{eq})	Another index for assessment for overall noise exposure is the equivalent continuous sound level, L_{eq}. This is a notional steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period, similar to the average. Hence fluctuating levels can be described in terms of a single figure level.
Extraneous Noise	Noise resulting from activities that are not typical of the area. Atypical activities may include construction, and traffic generated during holiday periods and during special events such as concert or sporting events.
Fast Time Weighting	125 ms integration time while the signal level is increasing and decreasing.
Frequency	The rate of repetition of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the Hertz (Hz), which is identical to cycles per second. A thousand hertz is often denoted kHz, e.g. 2 kHz = 2000 Hz. Human hearing ranges approximately from 20 Hz to 20 kHz. For design purposes, the octave bands between 63 Hz to 8 kHz are generally used. The most commonly used frequency bands are octave bands, in which the mid frequency of each band is twice that of the band below it. For more detailed analysis, each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.
Impulse Time Weighting	35 ms integration time while the signal level is increasing and 1.5s integration time while the signal level is decreasing.
L_{Aeq}	See equivalent continuous sound level definition above. This is the A-weighted energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environmental. This measure is also a common measure of environmental noise and road traffic noise.
$L_{Aieq,T}$	Equivalent continuous A-weighted sound pressure level over the measurement period T with impulse time weighting.
$L_{Ceq,T}$	The equivalent continuous C-weighted sound pressure level (integrated level) that, over the measurement period T, has the same mean square sound pressure (referenced to 20 µPa) as the fluctuating sound(s) under consideration.
$L_{C, Peak}$	The C-weighted Peak sound pressure level during a designated time interval or a noise event.
Low Frequency	Noise containing major components in the low-frequency range (20Hz to 250Hz) of the frequency spectrum.
Maximum Noise Levels L_{max}	The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.
Minimum Noise Levels L_{min}	The minimum noise level over a sample period is the minimum level, measured on fast response, during the sample period.
Noise Sensitive Receiver (NSR)	A noise sensitive receiver is any person or building or outside space in which they reside or occupy that has the potential to be adversely impacted by noise from an outside source, or noise not generated by the noise sensitive receiver.

TERM	DEFINITION
Octave Bands	Octave bands are frequency ranges in which the upper limit of each band is twice the lower limit. Octave bands are identified by their geometric mean frequency, or centre frequency.
Project-Specific Noise Levels	They are target noise levels for a particular noise generating facility. They are based on the most stringent of the intrusive or amenity criteria derived from the NSW Industrial Noise Policy.
RBL	The Rating Background Level for each period is the median value of the ABL values for the period over all the days measured. There is a therefore an RBL value for each period – daytime, evening and night-time.
Shoulder Periods	Where early morning (5 am to 7 am) operations are proposed, it may be unduly stringent to expect such operations to be assessed against the night-time criteria (especially if existing background noise levels are steadily rising in these early morning hours). In these situations, appropriate noise level targets may be negotiated with the regulatory/consent authority on a case-by-case basis.
Slow Time Weighting	1 second integration time while the signal level is increasing and decreasing.
Sound Level Difference (D)	The sound insulation required between two spaces may be determined by the sound level difference needed between them. A single figure descriptor, the weighted sound level difference, D_w, is sometimes used (see BS EN ISO 717-1).
Sound Power	The sound power level (L_w) of a source is a measure of the total acoustic power radiated by a source. The sound pressure level varies as a function of distance from a source. However, the sound power level is an intrinsic characteristic of a source (analogous to its volume or mass), which is not affected by the environment within which the source is located.
Sound Reduction Index (R)	The sound reduction index (or transmission loss) of a building element is a measure of the loss of sound through the material, i.e. its attenuation properties. It is a property of the component, unlike the sound level difference which is affected by the common area between the rooms and the acoustic of the receiving room. The weighted sound reduction index, R_w, is a single figure description of sound reduction index which is defined in BS EN ISO 717-1: 1997. The R_w is calculated from measurements in an acoustic laboratory. Sound insulation ratings derived from site (which are invariably lower than the laboratory figures) are referred to as the R'_w ratings.
Statistical Noise Levels	For levels of noise that vary widely with time, for example road traffic noise, it is necessary to employ an index which allows for this variation. The L_{10}, the level exceeded for ten per cent of the time period under consideration, has been adopted in this country for the assessment of road traffic noise. The L_{90}, the level exceeded for ninety per cent of the time, has been adopted to represent the background noise level. The L_1, the level exceeded for one per cent of the time, is representative of the maximum levels recorded during the sample period. A-weighted statistical noise levels are denoted L_{A10}, dBL_{A90} etc. The reference time period (T) is normally included, e.g. $dBL_{A10,\ 5min}$ or $dBL_{A90,\ 8hr}$.
L_{A1}	The L_{A1} level is the A-weighted noise level which is exceeded for 15 of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.
L_{A10}	The L_{A10} level is the A-weighted noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

TERM	DEFINITION
L_{A50}	The L_{A50} level is the A-weighted noise level which is exceeded for 50% of the sample period.
L_{A90}	The LA90 level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the LA90 level for 10% of the time. This measure is a commonly referred to as the background noise level.
Structureborne Noise	The L_{A90} level is the A-weighted noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is a commonly referred to as the background noise level.
Temperature Inversion	An atmospheric condition in which temperature increases with height above the ground.
Tonality	Noise containing a prominent frequency and characterised by a definite pitch.