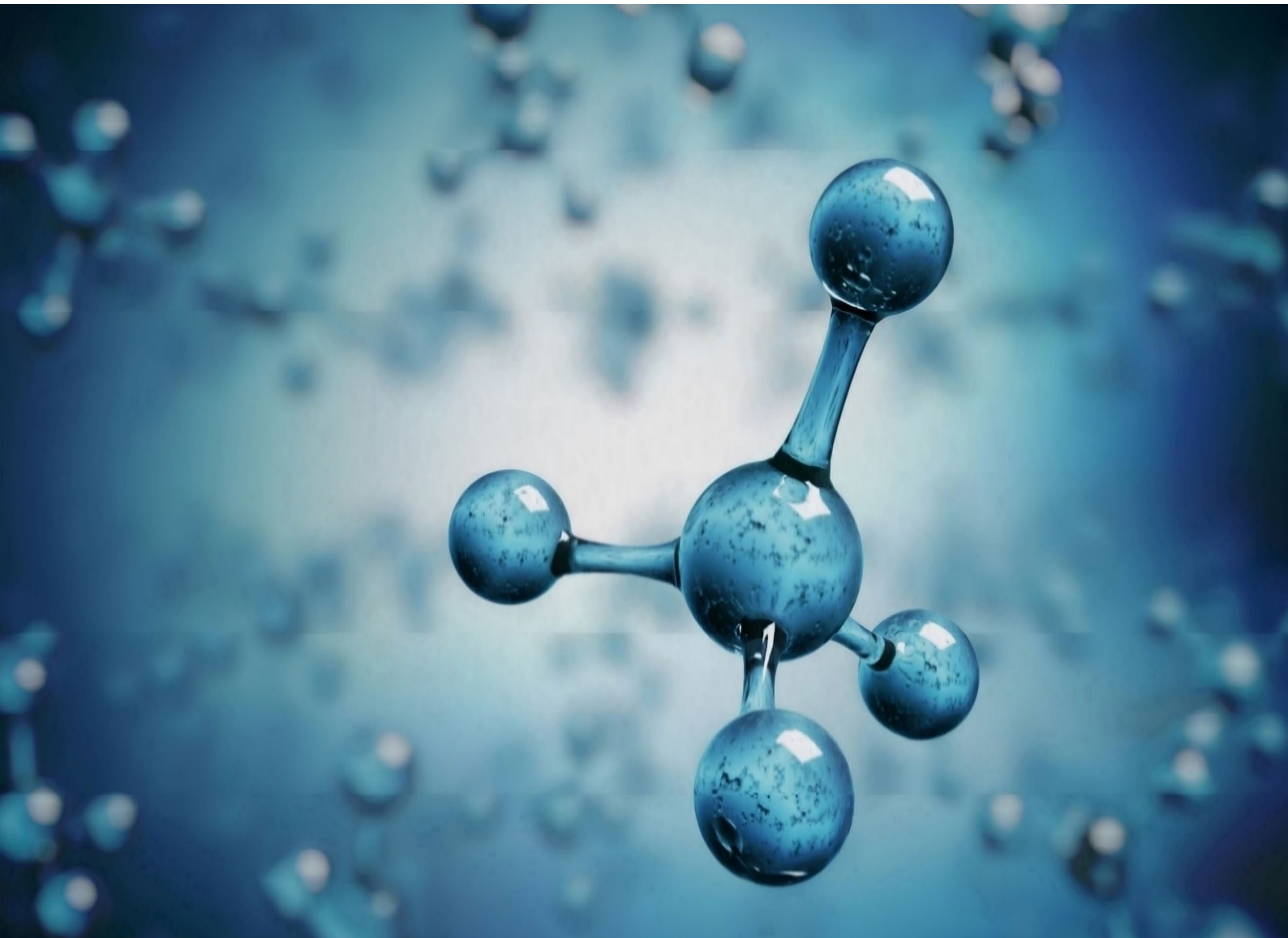
Lucas Heights Bioenergy Facility

Noise Impact Assessment

LMS Energy Pty Ltd

October 2025

→ The Power of Commitment



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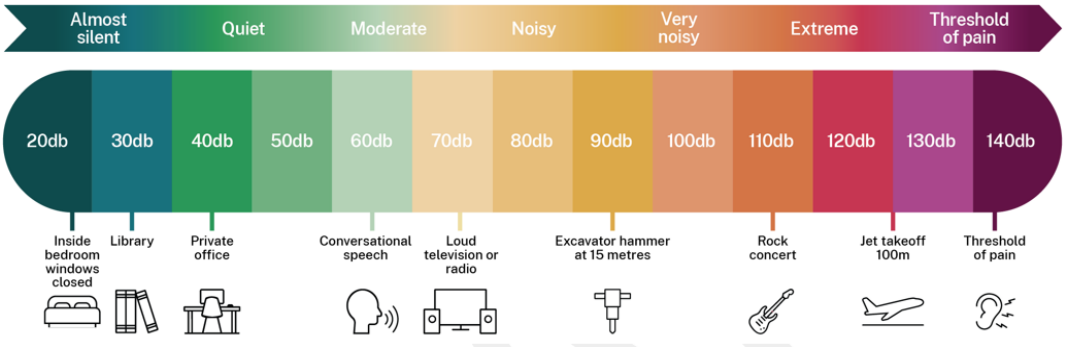
GHD Pty Ltd | ABN 39 008 488 373
Contact: Marco Velasco, Acoustic Engineer | GHD
133 Castlereagh Street, Level 15
Sydney, New South Wales 2000, Australia
T +61 2 9239 7100 | **F** +61 2 9239 7199 | **E** sydmail@ghd.com | **ghd.com**

Glossary of acoustical terms

Term	Definition
Ambient Noise	Background noise present in an environment, excluding the specific noise sources of interest.
A-frequency weighting (dBA)	An adjustment made to sound level measurement, by means of an electronic filter, in line with international standards. This approximates the response of the human ear at lower sound pressure levels.
dB	Decibel, which is 20 times the logarithm (base 10) of the ratio of a given sound pressure to a reference pressure; used as a measure of sound.
$L_{Aeq(period)}$	Equivalent A-weighted sound pressure level – the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring. Typical sound pressure levels are provided below for reference: 
Sound Power Level (SWL)	The total sound energy emitted by a source, measured in decibels (dB).
Sound Pressure Level (SPL)	The pressure variation caused by sound waves, measured in decibels (dB).
Ambient Noise	Background noise present in an environment, excluding the specific noise sources of interest.
A-frequency weighting (dBA)	An adjustment made to sound level measurement, by means of an electronic filter, in line with international standards. This approximates the response of the human ear at lower sound pressure levels.
dB	Decibel, which is 20 times the logarithm (base 10) of the ratio of a given sound pressure to a reference pressure; used as a measure of sound.

Key terms, acronyms and abbreviations

Term	Definition
AS	Australian Standard
AWS	Automatic weather station
BoM	Bureau of Meteorology
CEMP	Construction Environmental Management Plan
DA	Development Application
dBA	A-weighted decibel scale, adjusted for human hearing sensitivity across different frequencies.
EPA	Environment Protection Authority
ICNG	Interim Construction Noise Guideline (DEC, 2009)
ISO 9613-2	ISO 9613-2: 2024 Acoustics — Attenuation of sound during propagation outdoors Part 2: Engineering method for the prediction of sound pressure levels outdoors
km	Kilometres
LFN	Low frequency noise
LGA	Local government area
LHRRP	Lucas Heights Resource Recovery Park
LMS	LMS Energy Pty Ltd
m	Metres
m^2	Metres square
M^3	Metres cubed
NML	Noise management level
NSW	New South Wales
NPfI	Noise Policy for Industry (EPA, 2017)
OEMP	Operations Environmental Management Plan
POEO Act	Protection of the Environment Operations Act 1997
RBL	Rating Background Level
SEARs	Secretary's Environmental Assessment Requirements
SSD	State Significant Development
SWL	Sound Power Level

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1. Introduction

1.1 Project overview

LMS Energy Pty Ltd (LMS) proposes to upgrade the landfill biogas management infrastructure at the Lucas Heights Resource Recovery Park (LHRRP), by upgrading the existing power station (the project) to produce renewable energy from landfill gas generated at the LHRRP.

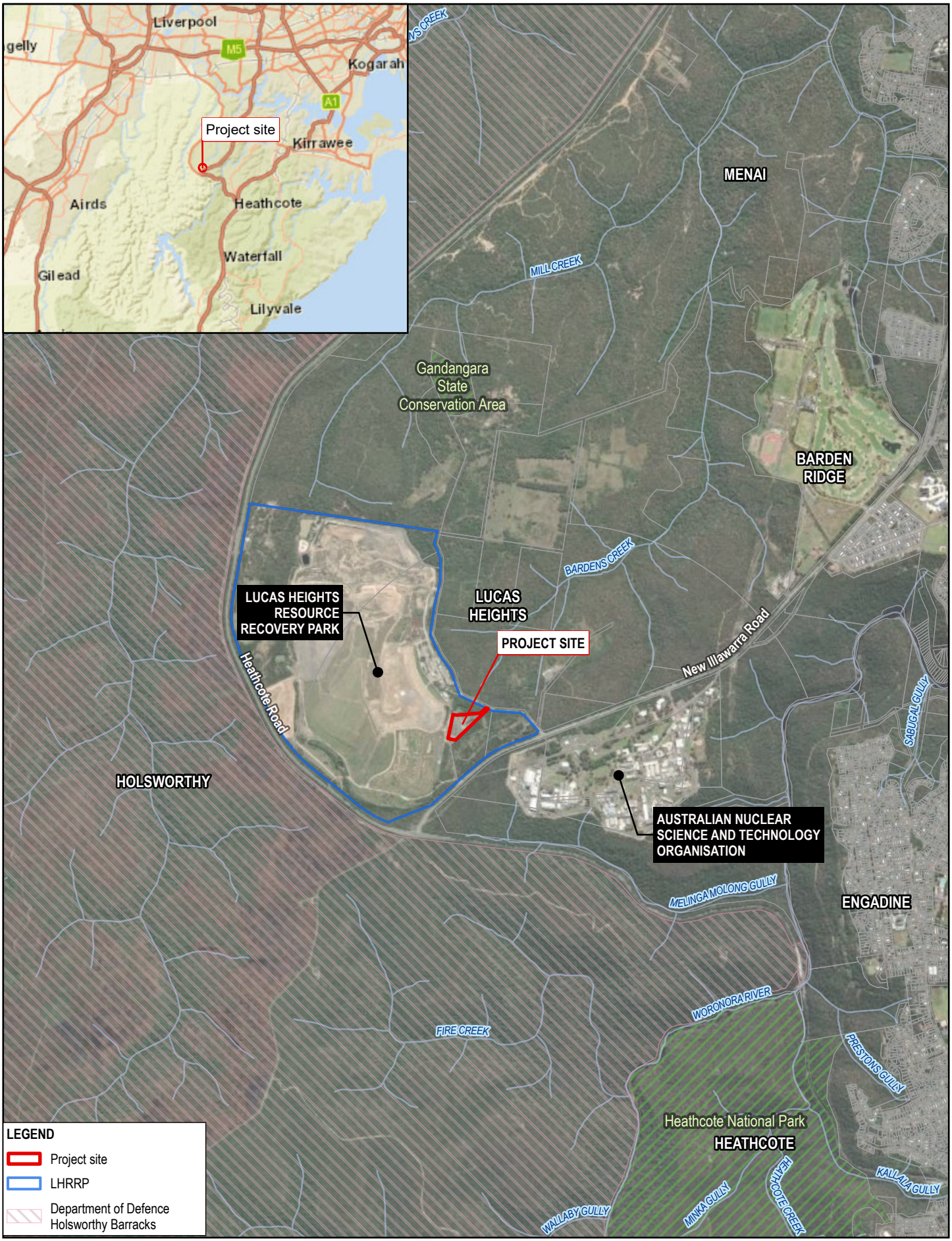
The new bioenergy facility would be a like for like replacement of the existing power station landfill biogas generators within the existing power station site, with improvements that comply with modern standards and regulations and forecasted biogas generation capacity requirements. The project ensures appropriate capacity to manage forecast peak recoverable biogas and renewable energy generation would effectively continue through the remaining landfilling and post closure periods for the landfill.

1.2 Site location

The project is located within the Sutherland Shire local government area (LGA), about 30 kilometres southwest of the Sydney central business district within the suburb of Lucas Heights. Lucas Heights sits between the Royal National Park, Heathcote National Park and the Cubbitch Barta National Estate Area, which is managed by the Department of Defence as a part of the Holsworthy Barracks.

The bioenergy facility would be located on Lot 102 DP 1009354 (existing power station site) which has an area of approximately 1.80 hectares.

The project site is accessed via Little Forest Road, off New Illawarra Road. An overview of the site context is shown on Figure 1.1.



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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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LMS Energy
Lucas Heights Bioenergy facility

Regional context

Project No. **12649882**
Revision No. **0**
Date **17/09/2025**

FIGURE 1.1

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Data source: LPMA: DTDB/DCDB, 2019. World Imagery: Maxar
World Street Map: Esri, HERE, Garmin, NGA, USGS
Created by: dbbanatin

1.3 Key features

The key features of the project are summarised in Table 1.1.

Table 1.1 Key features of the project

Project element	Summary
Output capacity	20 x 1.1 MW modular lean burn generator sets to provide a total output of approximately 22 MW.
Proposed built infrastructure	**New proposed infrastructure** – Gas delivery and metering system – Transformers to step up the electrical output voltage from LV to HV to match the local grid voltage – Electricity metering, protection and communication equipment – Covered storage bund for chemical and coolant storage – HV Switchroom / Control room – Lightning poles – External lighting – Safety showers **Retained/ upgraded infrastructure** – Gas delivery, metering and condensate removal system – Lunchroom / Toilet – Offices / Workshop – Car parking for on site operators – Security fencing – External lighting – Waste oil and clean oil tanks **Buildings to be decommissioned** – Workshop x 2 – Existing generators – Existing flare facility – Cooling towers.
Utilities connections	**Proposed new connections** – New underground HV electricity line to the Ausgrid 33 kilovolt (kV) distribution network as an extension of the connection from the existing on site electrical infrastructure to the Lucas Heights Zone Substation. **Existing utilities** – Fibre connection to the Lucas Heights Zone Substation – Potable water connection from LHRRP.
Hours of operation	– 6am to 6pm for operational staff – Remote operation 24 hours per day, 7 days per week outside of operational hours.
Workforce	– 6 full time equivalent (FTE) staff during operation – 15 FTE staff during construction.

1.4 Purpose of this report

GHD Pty Ltd (GHD) has prepared this Noise and Vibration Impact Assessment (NVIA) to support an Environmental Impact Statement (EIS) for the SSD application of the project.

This report addresses the relevant noise and vibration criteria in the NSW Secretary's Environmental Assessment Requirements (SEARs) for the project issued on 6 March 2025 (as outlined in Table 1.2) and assesses noise and vibration impacts associated with the construction and operation of the project.

Table 1.2 Noise and vibration SEARs requirement (SSD-79933225)

SEAR Requirement	Where addressed
Noise and Vibration – a quantitative noise and vibration impact assessment undertaken by a suitably qualified acoustic consultant in accordance with the relevant Environment Protection Authority guidelines and Australian Standards which includes:	This report
Background noise levels, noise source inventory and worst-case emissions scenarios	Background noise levels: section 3.3 Noise source inventory (construction): section 5.1 Noise source inventory (operational): section 5.3 Worst-case emission scenarios (construction): section 5.1 Worst-case emission scenarios (operational): section 5.3
Modelling the impacts from operation for comparison with relevant criteria at sensitive receivers, including future recreational users on adjacent land	Section 7
A cumulative impact assessment	Cumulative impact assessment (Construction): section 6.3 Cumulative impact assessment (Operational): section 7.4
Proposed mitigation and management measures and details of residual noise and vibration impacts	Section 8
Details of any proposed compliance monitoring programs	Section 8.2

1.5 Limitations

This report: has been prepared by GHD for LMS Energy Pty Ltd and may only be used and relied on by LMS Energy Pty Ltd for the purpose agreed between GHD and LMS Energy Pty Ltd as set out in section 1.4 of this report.

GHD otherwise disclaims responsibility to any person other than LMS Energy Pty Ltd arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

The services undertaken by GHD in connection with preparing this report were limited to those specifically detailed in the report and are subject to the scope limitations set out in the report.

The opinions, conclusions and any recommendations in this report are based on conditions encountered and information reviewed at the date of preparation of the report. GHD has no responsibility or obligation to update this report to account for events or changes occurring subsequent to the date that the report was prepared.

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in section 1.6 of this report. GHD disclaims liability arising from any of the assumptions being incorrect.

1.6 Assumptions

This report was prepared using the following assumptions:

- Traffic generation during construction is expected to comprise up to:
  - 10 heavy vehicle movements per day
  - 30 light vehicle movements per day.
- All construction traffic would access the bioenergy construction compound site via the main site entrance to LHRRP from Little Forest Road in Lucas Heights. Due to high existing traffic volumes on this route, traffic generation from the project is not expected to increase road traffic noise levels at receivers and has not been considered in this assessment.
- Sound Power Levels (SWLs) for construction equipment have been sourced from Australian Standards *AS2436 – Guide to noise and vibration control on construction, demolition and maintenance sites.*
- Source location and noise level of noise generating equipment for operation of the project have been provided by LMS Energy as outlined in section 5.3.

2. Project description

2.1 Construction phase

2.1.1 Construction staging

Construction of the project would commence in Q1 of 2026, with an estimated duration of 6-8 months (weather permitting and subject to approvals). The construction staging is summarised in Table 2.1.

Table 2.1 Construction staging

Construction stage	Activities
Early works (site establishment)	– site compound set-up including fencing to isolate bioenergy facility development footprint from existing power station operations and set-up of environmental controls – minor civil works for site levelling and compaction
Mobilisation and structure installations (project construction)	– construction of concrete pads and piles – generator assembly and placement onto piles using cranes – installation of ancillary packages (gas conditioning, HV switch room, transformers etc.) – new ancillary connections (electricity through trenching) and connections to existing fibre and water connections
Testing and commissioning	– test and commission of generators and ancillary equipment – demobilisation

2.1.2 Construction hours

Construction hours would be in accordance with the existing approved hours for construction at the LHRRP which include:

– Monday to Friday: 7am to 5pm
– Saturday to Sunday: 8am to 5pm.

Construction activities may be undertaken outside the standard construction hours, which may include safety critical works when the site contains minimal staff, deliveries of oversized loads to avoid peak traffic times and emergency works.

2.2 Operational phase

2.2.1 Facility design

The generator sets would comprise a reciprocating lean burn gas engine purpose built for landfill gas combustion (refer to Figure 2.1 and Figure 2.2).

Installation of the generators would comprise a modernised, fully fenced secure area that includes separate self-contained modules and associated ancillary equipment including high voltage switchgear for the export of the electricity generated to the local Ausgrid distribution network.

The custom designed generator enclosures are fully insulated to attenuate noise, with engine exhaust emitted through stainless steel stacks located on top of the modules, approximately 10.2 metres from ground level. Each generator module would house all the components required to operate as a stand-alone unit and are specially designed as fully enclosed bunded systems.

The modularised generator equipment is scalable both from a development perspective, and operationally, allowing flexibility to operate mixed modes (i.e. combination of either flaring and / or generation) as required. This ensures the ability to combust the maximum available gas, 24 hours per day is seamless with Programmable Logic Controller (PLC) controls and remote monitoring ensuring round the clock tracking.

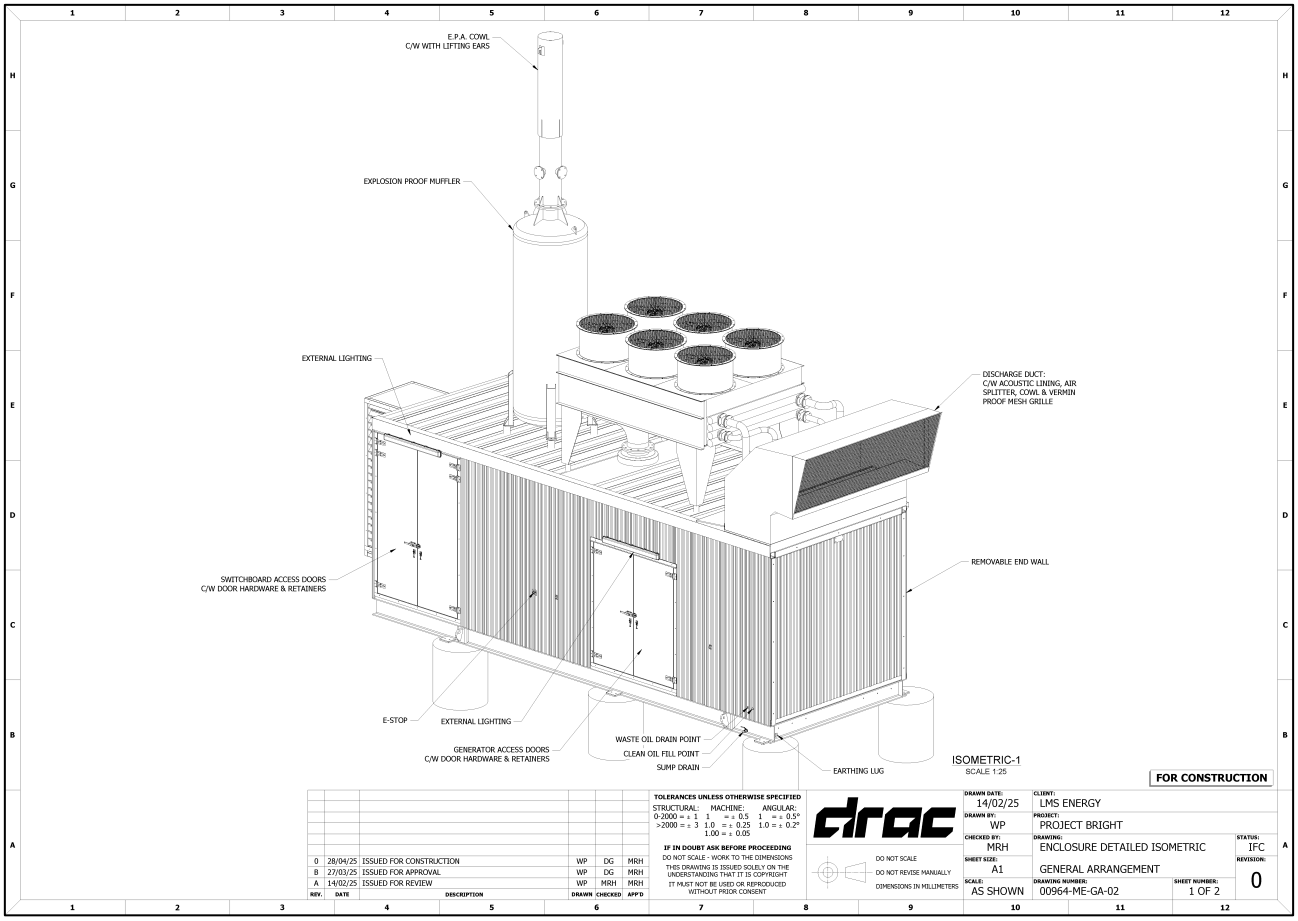

Figure 2.1 G3516 LE Generator enclosure: Isometric view 1

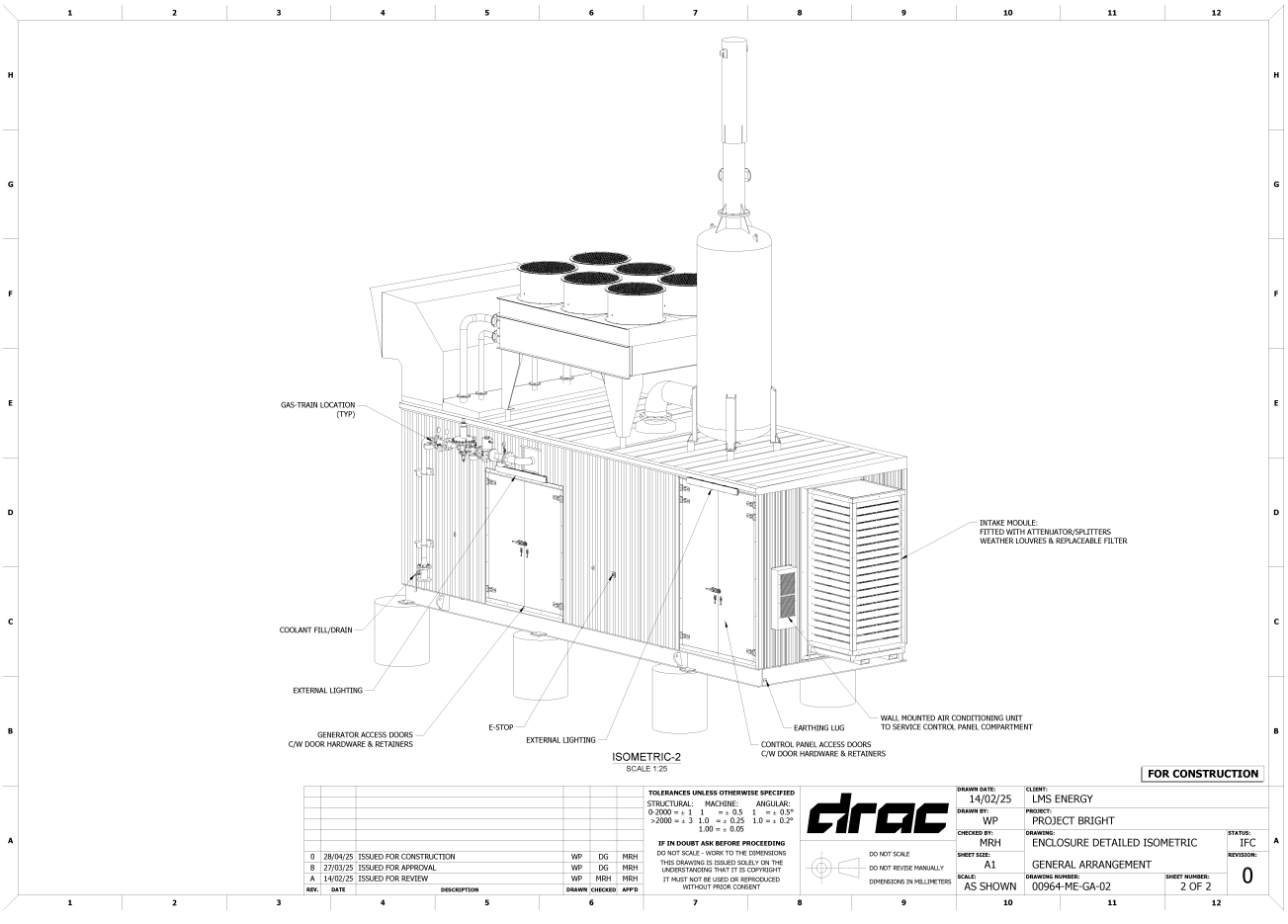

Figure 2.2 G3516 LE Generator enclosure: Isometric view 2

2.2.2 Operational hours

The facility is designed for continuous operation, meaning it will function 24 hours per day, 7 days per week to meet operational demands.

The layout plan of the proposed bioenergy facility is shown on Figure 2.3.

Figure 2.3 Bioenergy facility layout plan (LMS Energy, 2025)

3. Existing environment

3.1 Study area

The immediate surrounding area is undeveloped with the exception of the LHRRP and supports substantial areas of vegetated land. There is also minimal heavy industry or commercial use in the surrounding area.

Special land use activities are key features of the local area which include Defence activities, ANSTO and its associated facilities and the LHRRP. These activities correspond to land zoning of RE1 Public Recreation, SP1 – Research and Technology and SP2 Defence. Furthermore, ANSTO also applies a 1.6-kilometre buffer around its reactors, within which residential development is not permitted. The project is a permitted use within this buffer zone and is consistent with the established locational context of the site.

A study area has been established to be approximately 2.5 kilometres from the project site and sensitive receivers within this distance have been identified in section 3.2.

3.2 Sensitive receivers

3.2.1 Noise sensitive land uses

Noise sensitive land uses are defined based on the type of occupancy and the activities performed in the land use. Receivers sensitive to noise and vibration can be categorised as:

– residential dwellings
– non-residential land uses:
    - educational institutes and classrooms at schools
    - hospital wards and operating theatres
    - places of worship
    - passive and active recreational areas such as parks, sporting fields, golf courses. Note that these recreational areas are only considered sensitive when they are in use or occupied
    - hotels and other temporary accommodation buildings
    - commercial buildings including businesses, retail, offices, sports centres, bars/cafes etc.
    - industrial premises.

Sensitive land uses in the study area include both residential and non-residential based on a desktop review using aerial imagery. Non-residential land uses include educational institutes, passive and active recreation, temporary accommodation and commercial premises.

3.2.2 Future land use

The LHRRP is planned to be progressively rehabilitated and transformed into a community parkland following the cessation of landfilling, as outlined in Chapter 3 of the EIS, LHRPP post closure decommissioning, which is forecast to be completed sometime between around 2037 to the early 2040’s contingent upon the approval of the planned western extension to the landfill.

Up to 149 hectares of open space for passive recreation would be created incorporating broad open grassed and treed areas with integrated cycling paths and vehicular access. An indicative layout of the recreational area is shown on Figure 3.1.

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Proposed parkland master plan

Project No. **12649882**
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FIGURE 3.1

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Data source: GHD: Site Boundary (2025), Site Features (2025). NSWSS: SVTM (2025), NPWSR (2025), Cadastre (2025). Nearmap WMS Server: .
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3.2.3 Residential noise catchment areas

A noise catchment area (NCA) refers to a geographical area with relatively uniform acoustic characteristics, where similar noise influences and environmental conditions apply. These areas are typically defined based on factors such as land use, terrain, and dominant noise sources.

Within the study area, there are two main existing residential noise catchment areas:

– NCA1: the Engadine North area
– NCA2: The Ridgeway residences in Barden Ridge.

Noise monitoring was conducted in both of these areas, as detailed in Section 3.3, to establish the Rating Background Level (RBL) and characterise the existing acoustic environment.

The areas flagged for future residential development, Gandangara and Gandangara North, would, if developed, experience considerable changes in their background acoustic environment over time due to future land use modifications and potential industrial or transport-related noise influences. These areas have been categorised as NCA3.

The areas flagged for future residential development, Gandangara and Gandangara North, would, if developed, experience significant changes in their acoustic environment over time due to future land use modifications and potential industrial or transport-related noise influences. These areas have been categorised as **NCA3**, reflecting their potential transition and exposure to industrial or transport-related noise sources associated with future urban development.

While the shift to residential land use would represent a significant change in the character of the area, the incremental contribution of the project itself is expected to remain minor in this context. Importantly, this distinction highlights that the primary driver of future acoustic change in these locations is the underlying land use transition, rather than any potential noise impacts from the proposed facility.

3.2.4 Identified sensitive receivers

A total of ten (10) sensitive receivers have been identified with the study area. These receivers are listed in Table 3.1 and shown in Figure 3.2.

Table 3.1 Key sensitive receivers and most-stringent criteria

ID	Location	Type	Source-to-receiver direction
R01	Engadine residences (NCA1)	Residential (suburban)	ESE
R02	The Ridgeway residences (NCA2)	Residential (suburban)	NE
R03	Lucas Heights Community School	Educational institute	NE
R04	Gandangara (NCA3)	Existing: Passive recreation area Future: potential residential development	NE
R05	The Ridge Sports Complex	Active recreation	NE
R06	Gandangara North (NCA3)	Existing: Passive recreation area Future: potential residential development	NNE
R07	Lucas Heights Motel	Temporary accommodation	E
R08	Future recreational use	Passive recreation	NW
R09	Sutherland PCYC MiniBike Club	Active recreation	SW
R10	ANSTO, Lucas Heights	Commercial	SE

3.3 Background noise monitoring

Long-term noise monitoring was undertaken at two residential locations to quantify and characterise the existing ambient noise environment across the study area. Monitoring was undertaken on the following dates:

– between Tuesday 12 March 2025 and Wednesday 25 March 2025 at M2
– between Wednesday 25 March 2025 and Sunday 6 April 2025 at M1.

The long-term noise monitoring program was undertaken in accordance with the *Approved methods for measurement and analysis of environmental noise* (EPA, 2022) and rating background noise levels (RBLs) were calculated in accordance with the NPfI. The noise monitoring locations are shown on Figure 3.2 and the unattended noise monitoring results are presented in Table 3.2.

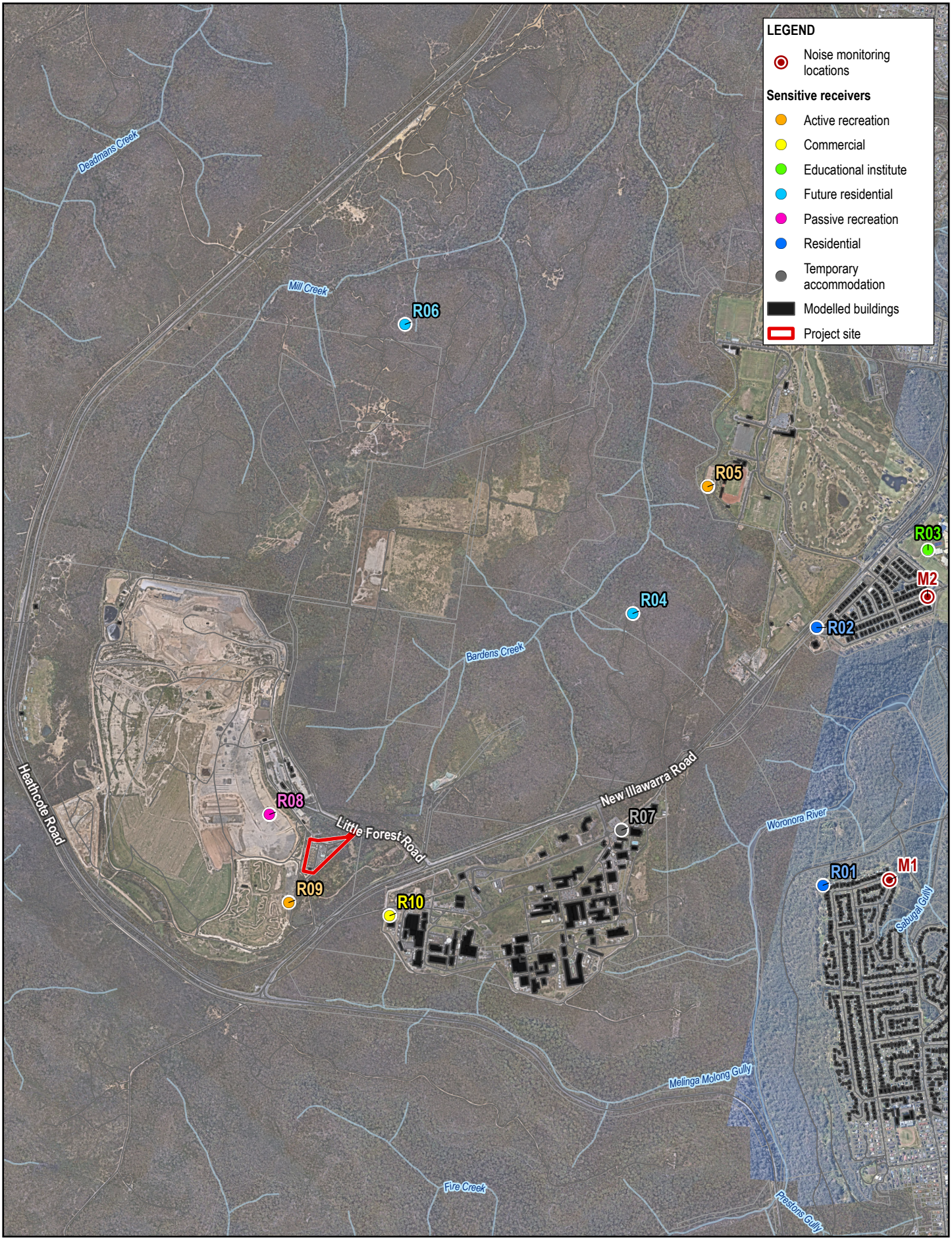
The full noise monitoring methodology is outlined in Appendix A along with the results of the attended noise monitoring survey at each location.

Table 3.2 Unattended noise monitoring results

Location	Monitoring dates	Address	Rating Background Level[1] $L_{A90(Period)}$, dBA			Ambient noise descriptors[1] $L_{Aeq(period)}$, dBA		
			Day	Evening	Night	Day	Evening	Night
M1	25/03/2025 – 06/04/2025	28 Andromeda Crescent, Engadine	35 (34)[2]	31	30 (28)[2]	54	51	52
M2	12/03/2025 – 25/03/2025	56 Namatjira St, Barden Ridge	37	37	33	55	53	45

Notes: 1. The *Noise Policy for Industry (NPfI)* (EPA, 2017) defines day, evening and night-time periods as:
- Day: 7am to 6pm Monday to Saturday and 8am to 6pm Sunday
- Evening: 6pm to 10pm
- Night: 10pm to 7am Monday to Saturday and 10pm to 8am Sunday.

2. Where the measured background level is above the minimum RBL provided in Table 2.1 of the NPfI, the minimum RBL is adopted in accordance with the NPfI



Paper Size ISO A4

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Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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Sensitive receivers

FIGURE 3.2

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Data source: LPMA: DTDB/DCDB, 2019. Nearmap WMS Server: .
Created by: dbbanatin

3.4 Meteorological conditions

A review of meteorological conditions at the Holsworthy Aerodrome Automatic Weather Station (AWS) (2020 – 2024) was undertaken to determine the significance of noise-enhancing meteorological conditions and atmospheric conditions on noise propagation in accordance with the *Noise Policy for Industry (NPfI) Fact Sheet D*.

Noise-enhancing meteorological conditions are defined in the NPfI as periods where:

– the atmospheric stability is unstable or neutral (categories A – D) and the source-to-receiver wind speed is 3 m/s or less, or
– during the night-period, the atmospheric stability is moderately to extremely stable (category F) and the source-to-receiver wind speed is 2 m/s or less.

The NPfI determines a 30% threshold of occurrence for noise-enhancing conditions to be significant. Analysis was performed to determine the percentage occurrence of noise-enhancing conditions for all wind directions. Temperature inversions, which occur with stable atmospheric conditions (stability category F) can enhance noise propagation during night-time. The Turner Scheme was used with hourly cloud cover data and wind speed to calculate the atmospheric stability. Wind effects were assessed using vector components of hourly wind data, where the percentage occurrence is determined for each of 16-compass directions as the sum of the reporting direction and the closest four directions.

The analysis identified that, during atmospheric stability categories A – D, source-to-receiver wind speeds of 3 m/s or less occurred for more than 30% of the time during the day period in summer, autumn and winter. During autumn and winter these winds are from the western quadrant, affecting receivers located to the east, northeast and southeast of the site. While during summer prevalent light winds are from the east and southeast, affecting receivers to the west and northwest. The presence of moderate (F) and strong (G) stability categories with source-to-receiver wind speeds of less than 2 m/s were found to occur more than 30% of the time in all seasons. Receivers located to the east and northeast would be affected by these conditions during autumn, winter and spring and receivers to the north would be affected during summer.

As a result, noise-enhancing conditions are significant for receivers located east, northeast, southeast, west, northwest and north of the site, during the day and night assessment periods, and warrant consideration in the noise assessment.

Atmospheric conditions, including temperature and humidity, influence sound absorption. A decrease in humidity or an increase in temperature can reduce sound attenuation over distance. Based on local climate data, an average temperature of 10°C and relative humidity of 70% were adopted as representative conditions for environmental noise propagation in this assessment.

Details of the meteorological analysis is provided in Appendix C.

4. Assessment criteria

4.1 Overview

This chapter summarises the guidelines and policies driving the approach to the assessment, including the relevant criteria used in the assessment. The relevant assessment guidelines and standards referenced in this report are summarised in Table 4.1.

Table 4.1 Relevant guidelines and standards

Relevant guideline / standard	Purpose
Interim Construction Noise Guideline (DECCW 2009)	To assess potential noise impacts at sensitive receivers during the construction and decommissioning phase of the project.
Assessing vibration: A Technical Guideline (DEC, 2006)	To assess potential human comfort vibration impacts during the construction phase of the project.
BS 7385-2:1993 Evaluation and measurement for vibration in buildings Part 2 – Guide to damage (British Standards, 1993)	To assess potential cosmetic damage vibration impacts at sensitive receivers during the construction phase of the project.
Noise Policy for Industry (EPA, 2017)	To assess operational noise impacts as well as potential sleep disturbance impacts at sensitive receivers from the ongoing use of the project.

4.2 Construction criteria

4.2.1 Construction noise

Construction hours

The *Interim Construction Noise Guideline* (DECC, 2009) (ICNG) recommends the following standard hours for construction work:

– Monday to Friday: 7am to 6pm
– Saturday: 8am to 1pm
– no works on Sundays or public holidays.

Outside of standard construction hours works

The ICNG acknowledges that the following activities have justification to be undertaken outside the recommended standard construction hours assuming that all reasonable and feasible mitigation measures are implemented to minimise the impacts to the surrounding sensitive land uses:

– the delivery of oversized plant or structures that police or other authorities determine to require special arrangements to transport along public roads
– emergency work to avoid the loss of life or damage to property, or to prevent environmental harm
– maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours
– public infrastructure works that shorten the length of the project and are supported by the affected community
– works where a proponent demonstrates and justifies a need to operate outside the recommended standard construction hours.

Noise management levels

The Noise Management Levels (NMLs) during recommended standard hours represent a noise level that, if exceeded, would require management measures including:

– reasonable and feasible work practices
– contact with the residences to inform them of the nature or works to be carried out, the expected noise levels and durations and contact details.

The management measures are aimed at reducing noise impacts at the residential receivers. However, it may not be reasonable and feasible to reduce noise levels to below the noise affected management level.

The noise affected construction NMLs during recommended standard hours are not intended as a noise limit but rather a level where noise management is required and as such should not be included as a noise limit in the environmental protection license or Consent Condition.

The determination of the NML is dependent on the time of day and the RBL at the residential receiver locations. This is explained in detail in Table 4.2 including a description of each relevant NML.

Table 4.2 Residential construction noise management levels

Time of day	Noise management level, $L_{Aeq,15\ min}$	Application notes
Recommended standard hours	Noise affected: RBL + 10 dB(A)	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: – times identified by the community when they are less sensitive to noise (such as before and after school, or mid-morning or mid-afternoon for works near residences) – if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected: RBL + 5 dB(A)	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 measures have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

The construction noise management levels for all sensitive receiver types are presented in Table 4.3.

Table 4.3 Construction noise management levels

Receiver type	Receivers	Standard construction hours		Outside standard construction hours[1]		
		Noise affected	Highly noise affected	Day	Evening	Night
Engadine residences (NCA1)	R01	45	75	40	36	35
Ridgeway Residences (NCA2)	R02	47	75	42	42	37
Lucas Heights Community School	R03	55 (external – when in use) for classrooms				
The Ridge Sports Complex Sutherland PCYC Minibike Club	R05 R09	65 (when in use) for active recreation areas				
Gandangara Gandangara North	R04 R06	60 (when in use) for passive recreation areas				
Lucas Heights Motel ANSTO, Lucas Heights	R07 R10	70 (when in use) for commercial premises				

Note: 1. Works outside standard construction hours are not proposed during the evening or night period.

4.2.2 Construction vibration

Human comfort

Guidance for acceptable vibration levels for human comfort is based on *Assessing Vibration: A Technical Guideline* (AVTG) (DEC, 2006) which references *BS6472-1: Guide to Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)* (British Standards, 1992).

AVTG provides three assessment methods, depending on whether the vibration source is continuous, impulsive, or intermittent. These can be defined as:

– Continuous vibration – normally generated by fixed plant (such as generators and fans) where the vibration emissions could continue uninterrupted throughout the day and night periods.
– Impulsive vibration – normally generated by short duration (i.e. less than two seconds) events with no more than three occurrences in an assessment period (e.g. ground compaction by dropping a large mass).
– Intermittent vibration – normally generated by continuous vibration sources that may be interrupted (e.g. vibratory rolling, rock breaking and truck movements) or continuous periods of impulsive vibration (e.g. impact piling). For intermittent vibration, human comfort levels are assessed on the basis of Vibration Dose Value, or VDV, based on the level and duration of the vibration events.

For construction works related to the modification, construction vibration is considered to be intermittent and assessed using VDV. The acceptable VDV values are shown in Table 4.4.

Table 4.4 Acceptable Vibration Does Values for Human Comfort (BS 6472-2008)

Receiver	Assessment Period	x, y and z axes	
		Preferred values	Maximum values
Critical areas	Day or night	0.10 $m/s^{1.75}$	0.20 $m/s^{1.75}$
Residential	Day	0.20 $m/s^{1.75}$	0.40 $m/s^{1.75}$
	Night	0.13 $m/s^{1.75}$	0.26 $m/s^{1.75}$
Offices, schools, educational institutes and places of worship	When in use	0.40 $m/s^{1.75}$	0.80 $m/s^{1.75}$
Workshops	When in use	0.80 $m/s^{1.75}$	1.60 $m/s^{1.75}$

Cosmetic damage to buildings

BS 7385-2:1993 Evaluation and measurement for vibration in buildings Part 2 – Guide to damage (British Standards, 1993) sets guide values for building vibration bases on the lowest vibration levels above which damage has been credibly demonstrated. The use of BS7385 is the preferred standard in NSW to assess potential vibration impacts to standard structures and is consistent with the *Construction Noise and Vibration Strategy* (TfNSW 2019).

The guide values from BS7385 for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented in Table 4.5.

Table 4.5 Transient vibration guide values – minimal risk of cosmetic damage

Type of building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse[1]	
	4 Hz to 15 Hz	15 Hz and above
Reinforced or framed structures industrial and heavy commercial building	50 mm/s at 4 Hz and above	
Unreinforced or light framed structures residential or light commercial type buildings[2]	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Notes: 1. Values referred to are at the base of the building.
2. At frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) should not be exceeded.

BS7385 also states that the guide values relate predominantly to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings. The standard states that '*where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, then the guide values in Table 16 may need to be reduced by up to 50%*'. Construction activities such as vibratory rolling have the potential to cause dynamic loading in some structures.

As such, a conservative vibration damage screening level is given below:

– reinforced or framed structures: 25 mm/s
– unreinforced or light framed structures: 7.5 mm/s.

4.3 Operational criteria

4.3.1 Operational noise

Applicability of the NPfI

A key purpose of the NPfI is to establish project noise trigger levels (PNTLs) with the aim of assessing the potential for noise impacts from industrial site or processes in NSW at sensitive receivers. The *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Protection of the Environment Operations Act 1997* (POEO Act) require that regulatory authorities examine and consider matters affecting the environment when making decisions about development and activities. In circumstances where the PNTLs cannot be achieved, residual noise levels are used to assess noise impacts and manage noise from the site with negotiation between the regulatory authority and the affected community. The regulatory authority then sets statutory compliance levels that reflect the achievable and agreed noise limits from the development.

To ensure these objectives are met, the EPA provides two separate noise trigger levels: intrusiveness and amenity. The intrusiveness noise levels apply over 15 minutes in any period (day, evening, or night) and aim to control the relative audibility of operational noise compared to the background level at residential receivers.

The amenity noise level limits the total level of extraneous noise for all receiver types and is assessed over the entire assessment period (day, evening, or night). Both the intrusiveness and amenity noise levels are calculated and the lower of the two in each time period is set as the PNTL. For the purposes of assessment to standardise the approach the NPI recommends that the $L_{Aeq(15min)} = L_{Aeq(period)} + 3$ dBA unless an alternative approach can be justified.

Intrusiveness noise level

The intrusiveness noise level is determined by a 5 dB addition to the RBL with a minimum intrusiveness noise level of 35 dBA for the evening and night period and 40 dBA for the day period. The NPI recommends that the intrusiveness noise level for the evening and night period should not exceed the daytime period. The intrusiveness noise levels are only applicable to residential receivers.

Project amenity noise level

The recommended amenity noise level applies to all industrial noise sources in the area which when combined should remain below the recommended amenity noise level. The recommended amenity noise level represents the total industrial noise at a receiver location and a project amenity noise level is set at 5 dBA below the recommended amenity noise level. A plus 3 dB correction factor has been applied to the project amenity noise level to convert the L_{Aeq} noise level descriptor to an $L_{Aeq(15min)}$ noise level.

Residential receiver areas are characterised into 'urban', 'suburban', 'rural' or other categories based on land uses and the existing level of noise from industry and road traffic. With consideration to the NPI 'noise amenity area' classification, the residential receivers identified are classified as 'suburban residential' as per the NPI.

Summary of project noise trigger levels (residential receivers)

The Rating Background Level (RBL) at NCA1 was found to be below the minimum RBLs outlined in the Noise Policy for Industry (NPfI) during the day and night periods. As a result, the minimum RBL has been applied in accordance with the NPfI guidelines. Consequently, the intrusive noise level, which is determined based on the RBL plus 5 dB, has also been set at the minimum intrusiveness levels in the NPfI. This ensures a conservative approach in defining project noise trigger levels for the study area, particularly in environments with very low background noise levels.

Noise levels at NCA3 (future suburban residential areas) are anticipated to be similar to those at NCA1, given the comparable suburban residential land use and acoustic environment expected in the future. As a result, the project noise trigger levels for NCA3 have been set consistently with those established for NCA1 to ensure a uniform approach to noise management across all residential areas.

A summary of the project noise trigger levels is provided in Table 4.6.

Table 4.6 Project noise trigger levels (residential receivers)

NCA / Receivers	Assessment period	Intrusive noise level, $L_{Aeq(15min)}$, dBA	Project amenity noise level, $L_{Aeq(15min)}$ dBA	Project noise trigger level, $L_{Aeq(15min)}$, dBA
NCA1 (suburban residential): R01 Engadine residences	Day	40	48	**40**
	Evening	36	43	**36**
	Night	35	38	**35**
NCA2 (suburban residential): R02 Ridgeway residences.	Day	42	48	**42**
	Evening	42	43	**42**
	Night	37	38	**37**
NCA3 (Future suburban residential): R04 Gandangara & R06 Gandangara North	Day	40	48	**40**
	Evening	35	43	**35**
	Night	35	38	**35**

Given the bioenergy facility is proposed to operate 24 hours a day, 7 days a week, the operational noise level has been set at 35 dBA for residential receivers in NCA1 and NCA3 and 37 dBA for residential receivers in NCA2 during the night period, aligning with the lowest project noise trigger levels for residential areas and ensuring compliance with noise criteria for continuous operations.

Summary of project noise trigger levels (residential receivers)

Project noise trigger levels have been established for non-residential receivers, including educational institutions, commercial premises, active and passive recreation areas, and temporary accommodations. These noise trigger levels have been determined based on the Noise Policy for Industry (NPfI) and relevant amenity noise criteria to ensure acceptable acoustic conditions for various land uses.

Table 4.7 Project noise trigger levels (non-residential receivers)

Receiver	Receiver type	Recommended amenity noise level, $L_{Aeq(period)}$ dBA	Project amenity noise level, $L_{Aeq(15min)}$ dBA
R03: Lucas Heights Community School	Classrooms	45 (external)[1]	43
R05: The Ridge Sports Complex R09: Sutherland PCYC Minibike Club	Active recreational area	55	53
R07: Lucas Heights Motel	Temporary accommodation	45 (night)	43 (night)
R08: Future recreational area	Passive recreational area	50	48
R10: ANSTO, Lucas Heights	Commercial premises	65	63

Notes: 1. Correction applied to internal noise level assuming a reduction of 10 dB is achieved through an open window.

Modifying factor corrections

The NPfI requires that corrections for annoying characteristics are to be considered if:

– the contribution noise level from the premises when assessed/measured at a receiver location, and

– the nature of the noise source and its characteristics contain tonal, intermittent, or low frequency characteristics, which have the potential to increase annoyance.

The modifying factor adjustments are detailed in Table 4.8.

Table 4.8 NPfI modifying factor corrections

Factor	Assessment/ measurement	When to apply	Correction[1,2]
Tonal noise	One-third octave or narrow band analysis	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: – 5 dB or more if the centre frequency of the band containing the tone is in the range of 500 to 10,000 Hz – 8 dB or more if the centre frequency of the band containing the tone is in the range 160 to 400 Hz – 15 dB or more if the centre frequency of the band containing the tone is in the range 25 to 125 Hz.	5 dBA[2]
Low frequency noise	Measurement of C-weighted and A-weighted level	Measure/assess C and A weighted Leq,T levels over same time period. Correction to be applied if the difference between the two levels is 15 dB or more and: – Where any of the one-third octave noise levels in Table C2 are exceeded by up to and including 5 dB and cannot be mitigated, a 2 dBA positive adjustment to measured/predicted A-weighted levels for the evening/night period. – Where any of the one-third octave noise levels in Table C2 are exceeded by more than 5 dBA and cannot be mitigated, a 5 dBA positive adjustment to measured/predicted A-weighted noise levels applies for the evening/night period and a dBA positive adjustment for the daytime period.	5 dBA[2]
Intermittent noise	Subjectively assessed	When the night-time noise level drops to that of the background noise level with a noticeable change in noise level of at least 5 dBA.	5 dBA

Notes: 1. Where two or more modifying factors are present the maximum correction is limited to 10 dBA.
2. Where a source emits a tonal and low-frequency noise, only one 5 dB correction should be applied if the tone is in the low frequency range.

4.3.2 Sleep disturbance

The NPfI provides guidance for assessing sleep disturbance due to short-term maximum noise events. Sleep disturbance is considered to be both awakenings and disturbance to sleep stages. To assess potential disturbance during night time hours of operation for the proposed modification, the NPI recommends the following as a screening criterion:

– $L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or

– L_{AFmax} 52 dBA or the prevailing RBL plus 15 dB, whichever is greater.

Assuming the minimum night time RBL of 30 dBA, the sleep disturbance screening criterion is $L_{Aeq,15min}$ 40 dB(A) and L_{AFmax} 52 dBA.

5. Assessment methodology

5.1 Construction noise sources

The noise levels for the construction equipment have been sourced from the *AS2436 – Guide to Noise Control on Construction, Maintenance and Demolition Site* (Australian Standard, 2010). The plant and equipment modelled for each construction scenario are shown in Table 5.1 with corresponding sound power levels (SWL), and the total sound power level of the construction scenarios used in the noise model. To generate a sound power level for each construction activity, a worst-case scenario was adopted assuming all equipment are operating simultaneously.

Additional construction works within the project boundary, such as decommissioning of existing infrastructure on site, is expected to have similar or less noise emission than the considered construction scenarios. Equipment required for decommissioning of the existing infrastructure would be similar to testing and commissioning of the project.

Table 5.1 Indicative construction equipment list

Equipment	Equipment SWL, dBA	Site establishment	Project construction	Testing and commissioning
Excavator	113	X	-	X
Grader	113	X	-	-
Dump truck	112	X	-	X
Compactor / roller	110	X	-	-
Concrete agitator truck	109	X	-	-
Concrete pump truck	108	X	-	-
Dozer	106	X	-	X
Mobile crane	105	-	X	X
Road truck	108	-	X	X
Powered hand tools	105	X	X	X
Scenario sound power level (SWL), dB(A)		**119**	**111**	**117**

5.2 Vibration safe working distances

The method for the construction vibration assessment included:

– Identifying safe working distances to comply with the human comfort (refer to Section Table 4.4) and the cosmetic damage criteria (refer to Table 4.5). These buffer distances have been adopted from Construction Noise and Vibration Strategy (TfNSW 2019).

– Safe working distances for vibration intensive equipment are shown in Table 5.2. The vibratory equipment associated with the modification would be the use of vibratory rollers.

– Buildings within the safe working distances have been identified for consideration of management measures.

Compactors and rollers have been identified as vibration-intensive equipment with the greatest ground vibration levels. Table 5.2 provides the recommended safe working distances required to meet both human comfort criteria, as per the OH&E Vibration Guideline, and cosmetic damage criteria, as defined in BS 7385.

Additional considerations include the ANSTO facility which have raised concerns of a zero tolerance to vibrations at their site.

Table 5.2 Vibration safe working distances

Equipment	Human comfort (OH&E Vibration guideline)	Cosmetic damage (BS 7385)
Vibratory roller (13-18 tonnes)	100 m	20 m
Vibratory roller (7-13 tonnes)	100 m	15 m
Vibratory roller (4-6 tonnes)	40 m	12 m
Vibratory roller (2-4 tonnes)	20 m	6 m
Vibratory roller (1-2 tonnes)	15 m	5 m

5.3 Operational noise sources

5.3.1 Source noise levels

The octave-band sound power levels of the key noise-generating sources: the CAT G3516LE genset; the internal noise level within the enclosure; and the unmitigated generator exhaust are provided in Table 5.3.

Table 5.3 Octave band sound power levels

Equipment	Source type	Octave-band sound power levels, Lw (dBA re 1pW) / Hz								Overall, dBA
		63	125	250	500	1000	2000	400	8000	
CAT G3516LE genset	SWL	76	87	90	85	101	102	98	90	106
CAT G3516LE enclosure	Internal SPL	70	81	84	88	95	95	91	84	100
Exhaust (no mitigation)	SWL	91	104	115	117	121	122	123	117	128
Chiller/blower	SWL	68	71	81	92	92	88	80	71	96

Noise source inventory

The operational noise source inventory provides an overview of the key equipment contributing to noise emissions within the facility.

Mitigation measures have been incorporated into the design of the project and form the basis of the noise modelling assessment. These measures include the use of acoustically treated enclosures for the generators, intake and discharge attenuators, and custom silencers to reduce noise emissions the generator exhaust. The applied mitigation strategies are designed to reduce both occupational noise and environmental noise impacts.

The noise model reflects these implemented controls, providing a representation of expected noise levels under operational conditions.

The data used for this noise inventory is derived from the following documents:

– 00964-ME-CAL-02_C – Acoustic Calculations (Noise assessment and calculation methodologies)
– 00964-ME-CAL-03_B – Exhaust Calculations (Exhaust noise characteristics and mitigation strategies)
– 00964-ME-GA-01_G – G3516 LE - GEN ENCLOSURE (General arrangement and enclosure specifications).

Table 5.4 lists the various noise-generating components, their respective quantities, and the mitigation applied (if applicable).

Table 5.4 Operational noise source inventory

Equipment	Quantity	Modelled height (m)	Mitigation applied
Generator enclosure	20 (1 per unit)	3.2	Enclosure is constructed from standard mild steel members with Colourbond-coloured external cladding and is acoustically lined with 32 kg/m³ fiberglass, 100mm thick, 11% open area perforated sheeting, covering 63 m² on walls and ceiling
Intake attenuator	20 (1 per unit)	2.7	Inlet attenuator DSA 20/38/700 (from 00964-ME-CAL-03_B)
Discharge attenuator	20 (1 per unit)	5.1	Discharge attenuator 1x 90° bend + 1 45° bend (from 00964-ME-CAL-03_B)
Radiator fans	20 (6 per unit)	5.6	No mitigation applied
Exhaust opening	20 (1 per unit)	10.5	Custom silencer
Transformer	11	2	No mitigation applied
Gas Conditioning skid	2 (Each contains 1x chiller, 1x blower)	2	No mitigation applied (NB: Selection of units at 85 dBA at 1m or lower)

Mitigation applied

The sound reduction values for the noise control measures incorporated into the project design are presented in Table 5.5. These measures have been factored into the noise modelling and have been incorporated into the design to reduce the potential for environmental noise and occupational noise impact.

Table 5.5 Mitigation applied and sound reduction values

Equipment	Octave-band attenuation levels, dB / Hz							
	63	125	250	500	1000	2000	400	8000
Intake attenuator	3	5	11	20	23	17	13	10
Discharge attenuator	6	10	12	18	16	17	11	10
Custom silencer	29	32	38	39	36	35	34	26
Generator enclosure	14	23	39	48	54	55	57	55

Following the application of mitigation measures, the resultant octave-band sound power levels for the key noise sources are provided in Table 5.6.

Table 5.6 Octave band sound power levels

Equipment	Input type	Octave-band sound power levels, Lw (dBA re 1pW) / Hz							Overall, dBA
		63	125	250	500	1000	2000	400	8000
Generator enclosure	dB / m^2	56	58	45	40	41	40	34	29	60
Intake attenuator	dB / m^2	76	85	83	78	81	88	88	83	93
Discharge attenuator	dB / m^2	72	80	82	80	88	88	89	83	94
Radiator fans (6x)	dB / unit	75	80	85	90	87	83	78	72	93
Exhaust opening w silencer	dB / unit	62	72	77	78	85	87	89	91	95
Transformer	dB / unit	58	63	68	71	68	61	55	48	75
Chiller/blower	dB / unit	68	71	81	92	92	88	80	71	96

5.4 Noise modelling methodology

5.4.1 Noise propagation algorithm

The *ISO 9613-2:2024 'Acoustics – Attenuation of sound during propagation outdoors'* (ISO, 2024) standard is an internationally recognised method for predicting environmental noise propagation in outdoor conditions. In simple terms, the ISO 9613-2 method calculates the sound level at a receiver location as follows:

$$Lp = Lw + D_c - (A_{div} + A_{atm} + A_{gr} + A_{bar})$$

Where:

- **L_p** is the predicted octave-band sound pressure level at the receiver in decibels.
- **L_w** is the octave-band sound power level produced by the point sound source relative to a reference sound power of one picowatt (1 pW), expressed in decibels.
- **D_c** is the directivity correction, in decibels, that describes the extent by which the equivalent continuous sound pressure level from the point sound source deviates in a specified direction from the level of an omnidirectional point sound source producing the sound power level L_W, expressed in decibels.
- **A_{div}** is the attenuation due to distance from the source to a receiver (geometric divergence).
- **A_{atm}** is the attenuation due to atmospheric absorption, which depends on distance, temperature, humidity, and the frequency of the sound.
- **A_{gr}** is the attenuation due to the absorptive/reflective properties of the ground cover between the source and receiver (e.g., soft vs. hard ground).
- **A_{bar}** is the attenuation from screening/barriers such as ground terrain, buildings and physical structures, which reduce sound by blocking and diffracting it (depends on relative barrier height, material, and the source/receiver location).

Meteorological conditions

A review of prevailing meteorological conditions in the study area, described in Section 3.4, found that noise enhancing conditions are a significant feature for some receivers in the study area. The NPfI requires that where noise enhancing conditions are significant, consideration of these conditions should be taken in the noise modelling. The ISO 9613-2 method assumes noise-enhancing conditions, such as a light source to receiver wind or a moderate temperature inversion. This conservative method has been used for all receivers in the study area and is deemed appropriate to capture the effect of noise enhancing weather conditions.

Noise modelling program

Noise modelling was undertaken using CadnaA 2024. CadnaA is a computer program for the calculation, assessment and prognosis of noise exposure. The software calculates environmental noise propagation according to ISO 9613-2:2024. General parameters used in the CadnaA noise model are listed in Table 5.7 and the arrangement of noise sources is provided in Appendix B.

Table 5.7 CadnaA noise modelling parameters

Input / Assumption	Description
Model settings	
Prediction algorithm	ISO 9613-2:2024
Weather conditions	Based on an average temperature of 10 °C and an average humidity of 70 % (conservative)
Meteorological conditions	A moderate temperature inversion or downwind meteorological conditions is considered in the ISO 9613-2 prediction algorithm.

Input / Assumption	Description
Model inputs	
Topography	5 m interval - Digital Elevation Model of Australia derived from LiDAR
Buildings	Estimated based on a review of google street view
Receiver height	1.5 m above ground level
Ground absorption	0.25 for the project site assuming hard ground cover 1.0 for all other areas assuming soft/porous ground cover

6. Construction phase impacts

6.1 Construction noise

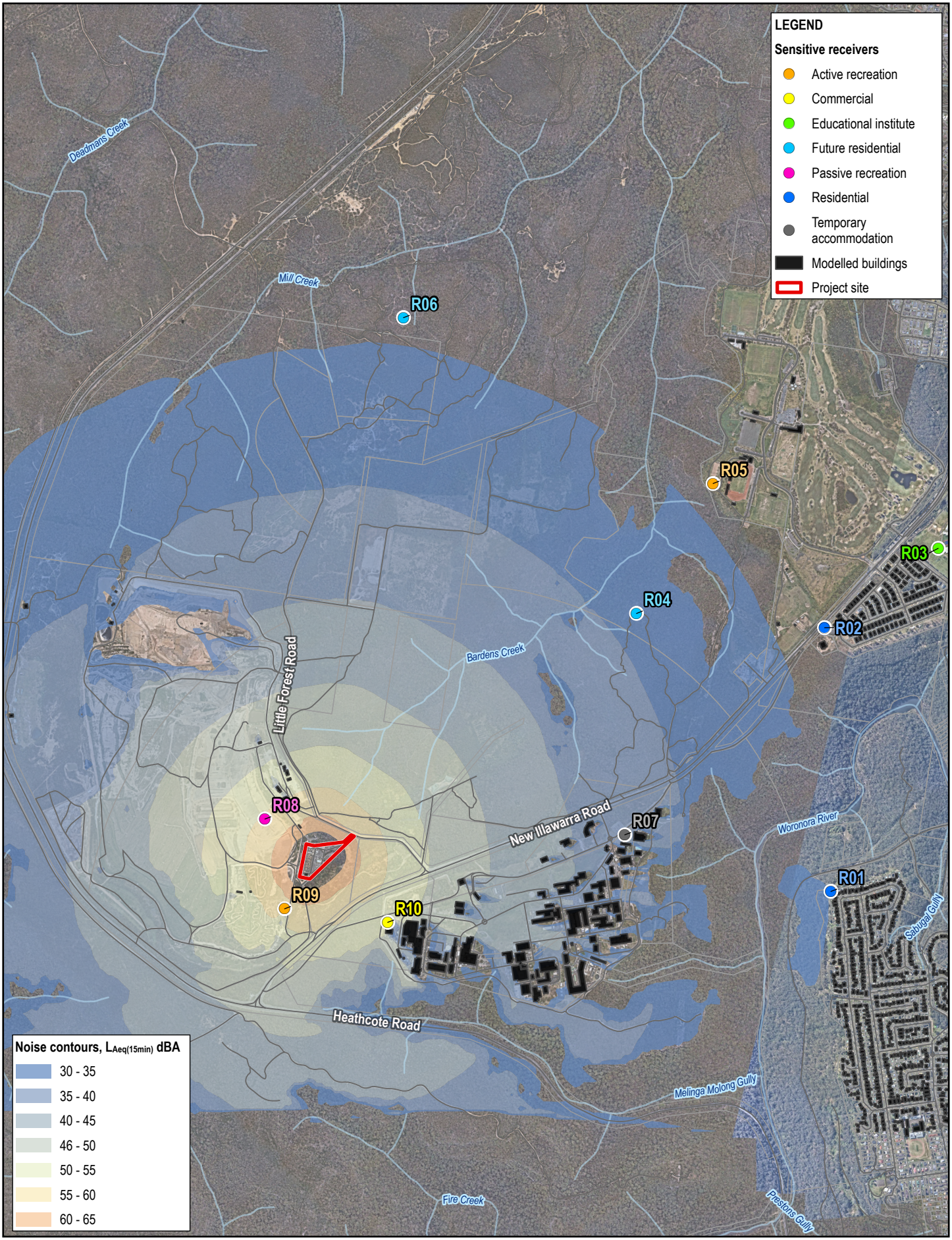
The predicted noise levels from the modelled construction scenarios are presented in Table 6.1. The results indicate that construction works are not predicted to exceed the standard hours NML or out-of-hours (OOH) day NML at any sensitive receiver. Figure 6.1 presents noise contours of the site establishment construction scenario, illustrating the spatial distribution of noise levels across the study area.

As the assessed worst-case scenarios are not predicted to exceed the standard hours NML or OOH day NML at any of the receivers, additional work with similar or less noise emission, such as decommissioning of existing infrastructure, would not exceed the NMLs.

Nevertheless, standard environmental noise safeguards are provided in Table 6.1 to minimise the potential for noise impacts and ensure noise levels can be maintained below the noise management levels.

Table 6.1 Predicted construction noise levels

Receiver ID	Location	Noise affected NML, $L_{Aeq,15min}$, dBA	Predicted noise level, $L_{Aeq,15min}$, dBA		
			Site establishment	Project construction	Testing and commissioning
R01	Engadine residences	45 (Standard) 40 (Day OOH)	30	22	28
R02	The Ridgeway residences	47 (Standard) 42 (Day OOH)	28	20	27
R03	Lucas Heights Community School	55	25	17	23
R04	Gandangara	60	34	26	32
R05	The Ridge Sports Complex	65	29	21	27
R06	Gandangara North	60	29	21	27
R07	Lucas Heights Motel	70	36	28	34
R08	Future recreational use	60	56	48	54
R09	Sutherland PCYC MiniBike Club	65	56	48	54
R10	ANSTO, Lucas Heights	70	51	43	49



Paper Size ISO A4

0 250 500 750 1,000

Metres

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

GHD

LMS Energy
Lucas Heights Bioenergy Facility

Project No. 12649882
Revision No. D
Date 20/10/2025

Construction noise contours - site establishment, $L_{Aeq(15min)}$ dBA

FIGURE 6.1

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Data source: LPMA: DTDB/DCDB, 2019. Nearmap WMS Server: .
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6.2 Construction vibration

No sensitive receivers are located within 100 metres of the project site. Given that the safe working distances for human comfort, as outlined in Table 5.2, indicate a safe working distance of 100 metres for the largest vibratory rollers, no exceedances of human comfort vibration criteria are anticipated.

Additionally, the safe working distances for cosmetic damage to structures range from 5 to 20 metres, which further confirms that no buildings or sensitive receivers will be affected by structural vibration damage during construction. As a result, the proposed works are not expected to generate any adverse vibration impacts in terms of structural damage.

The boundary of the ANSTO facility is located more than 400 metres from the project site. Additionally, the facilities are separated by New Illawarra Road and undeveloped area. Considering the separation distance, it is expected that ground vibrations from the proposed construction activities are attenuated to such an extent that the ANSTO facilities would not experience increased vibration levels from what is currently experienced.

6.3 Cumulative impacts

In assessing cumulative impacts, the worst-case scenario would involve the flare modification works directly to the west of the project site (SSD 6835 Mod 3) occurring simultaneously with this project. Under these conditions, construction noise levels could increase by up to 3 dB beyond the greater of the predicted noise level from either project due to the combined noise contributions from both projects.

However, even under these worst-case conditions, the cumulative construction noise levels would still remain below the NMLs at all sensitive receivers. As a result, no additional mitigation or management measures would be required to manage cumulative noise impacts.

7. Operational phase

7.1 Operational noise levels

7.1.1 Overall noise levels

The predicted operational noise levels for the project have been compared against the project noise trigger levels (PNTLs) to assess compliance at all identified sensitive receivers. The results indicate that all receivers meet the project noise trigger level, except for the future recreational area (R08). At this location, the receiver point is situated in an area close to the project site where localised exceedances are predicted. However, for the majority of this area, the project noise trigger level is met.

Figure 7.1 presents noise contours for a worst-case scenario, illustrating the spatial distribution of noise levels across the study area. The worst-case scenario represents the noise generation from the facility operating at peak output. It is expected that the performance, and therefore the noise generated, will decline throughout its operational lifetime which is consistent with the expected decline in landfill biogas generated from the landfill over time and through the post closure period.

Noise levels at R08

The NPfI requires "*the noise level to be assessed at the most-affected point within the area that is reasonably expected to be used by people, for example, picnic areas or walking tracks."* As such the receiver point R08 was chosen at the worst affected location based on proposed future walking tracks. Noise levels across the future recreational area range from 68 dBA at the nearest boundary to 31 dBA at the farthest points from the project. During finalisation of the design of the future parkland area (R08), noise buffering from the project should be considered as part of the final master plan. Areas where noise levels are likely to be higher, closer to the project, can be used as vegetated buffer and open space buffer zones.

Noise contours for this area are provided in Figure 7.2 showing the distribution of noise levels across the future parkland area.

Modifying factors

As third-octave noise levels were not available for the proposed equipment, noise modelling was completed using whole octave band levels.

Without third-octave source levels a numerical check in accordance with the NPfI is unable to be completed. A review of the octave band source spectra and experience of noise levels from similar equipment indicates that tonal noise is not expected from the project at the receiver locations.

A check for low frequency noise contribution from the project has been completed using the levels calculated in whole octave bands. The difference in the A- and C-weighted noise level has been calculated and the unweighted levels in the 63 Hz and 125 Hz octave bands have been divided evenly into three third-octave bands and compared to the thresholds.

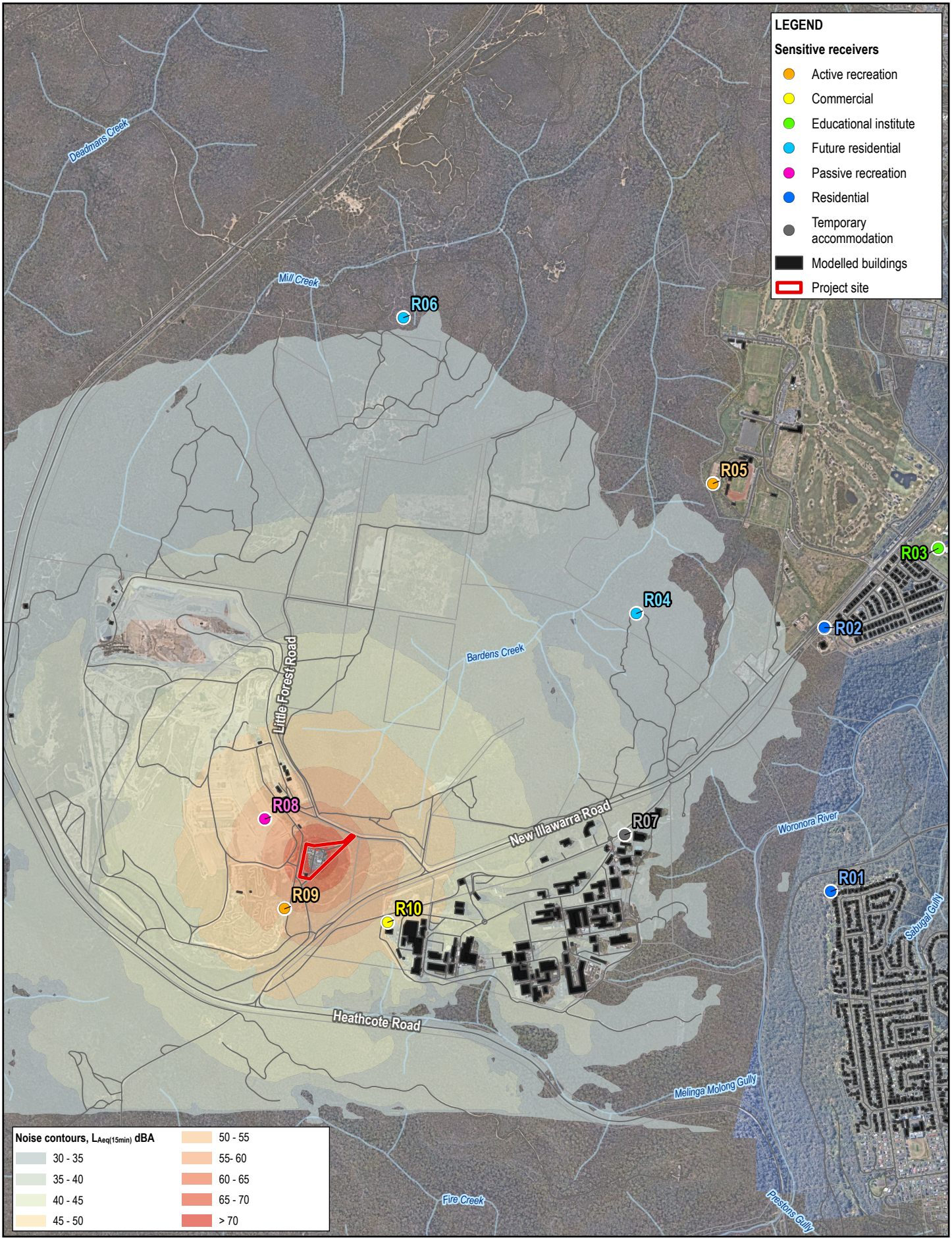
An exceedance of both triggers was identified at seven receivers with levels at R07 and R10 exceeding the threshold by more than 5 dB. The low frequency noise correction factors applied and corrected receiver noise levels are shown in Table 7.1.

No additional exceedances of the PNTLs are predicted with the inclusion of the modifying factor corrections.

Table 7.1 Predicted construction noise levels

Receiver ID	Location	PNTL	Predicted noise level, $L_{Aeq,15min}$, dBA	LFN Correction, dB	Corrected predicted noise level, $L_{Aeq,15min}$, dBA	Compliance[1]
R01	Engadine residences	35	29	+2	31	Yes
R02	The Ridgeway residences	37	29	+2	31	Yes
R03	Lucas Heights Community School	43	27	0	27	Yes
R04	Gandangara	35	33	+2	35	Yes
R05	The Ridge Sports Complex	53	29	+2	31	Yes
R06	Gandangara North	35	30	+2	32	Yes
R07	Lucas Heights Motel	43	35	+5	40	Yes
R08	Future recreational use	48	53	0	53	No
R09	Sutherland MiniBike Club	53	52	0	52	Yes
R10	ANSTO, Lucas Heights	63	49	+5	54	Yes

Note: 1. Compliance is at peak capacity, worst-case noise scenario. Operating at peak capacity is not expected to occur after post landfill closer period due to declining gas generation potential from the landfill.



Paper Size ISO A4

0 250 500 750 1,000

Metres

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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

GHD

LMS Energy
Lucas Heights Bioenergy Facility

Operational noise contours - site establishment, $L_{Aeq(15min)}$ dBA

Project No. **12649882**
Revision No. **0**
Date **20/10/2025**

FIGURE 7.1

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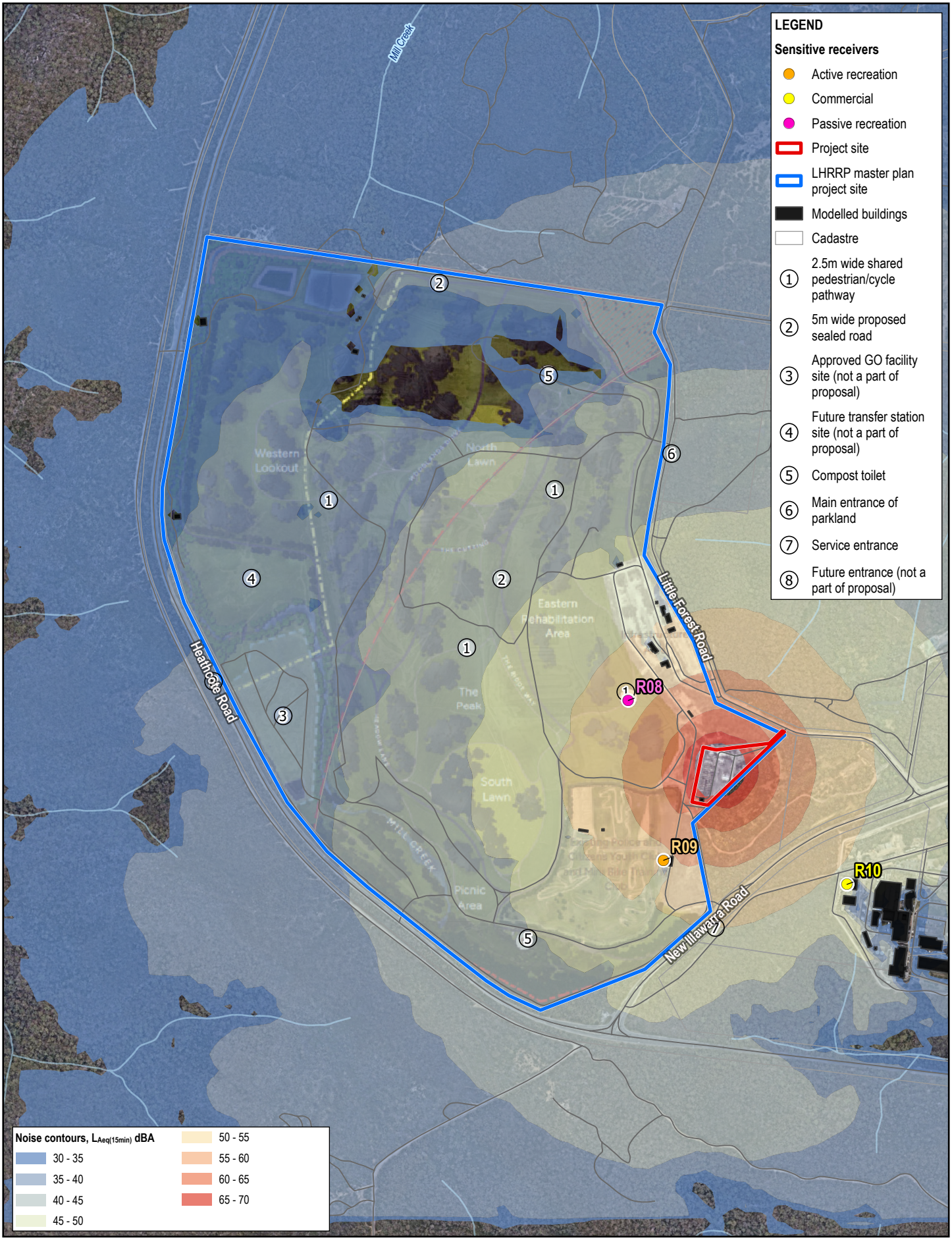
Print date: 20 Oct 2025 - 13:26

Data source: LPMA: DTDB/DCDB, 2019. Nearmap WMS Server: .
Created by: dbbanatin



Paper Size ISO A4

0 100 200 300 400

Metres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 56

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LMS Energy
Lucas Heights Modification Project

Operational noise contours - recreational areas, $L_{Aeq(15min)}$ dBA

Project No. **12649882**
Revision No. **0**
Date **20/10/2025**

FIGURE 7.2

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Data source: LPMA: DTDB/DCDB, 2019. Nearmap WMS Server: .
Created by: dbbanatin

7.2 Partial noise levels

The dominant noise source at each receiver varies depending on the location of the receiver relative to the project site. However, for the majority of the receivers, the most significant contributors to noise levels are the intake attenuator, radiator fans, and discharge attenuators. The contribution from each noise source is presented in Figure 7.3, demonstrating how different components of the project influence noise levels at various receiver locations.

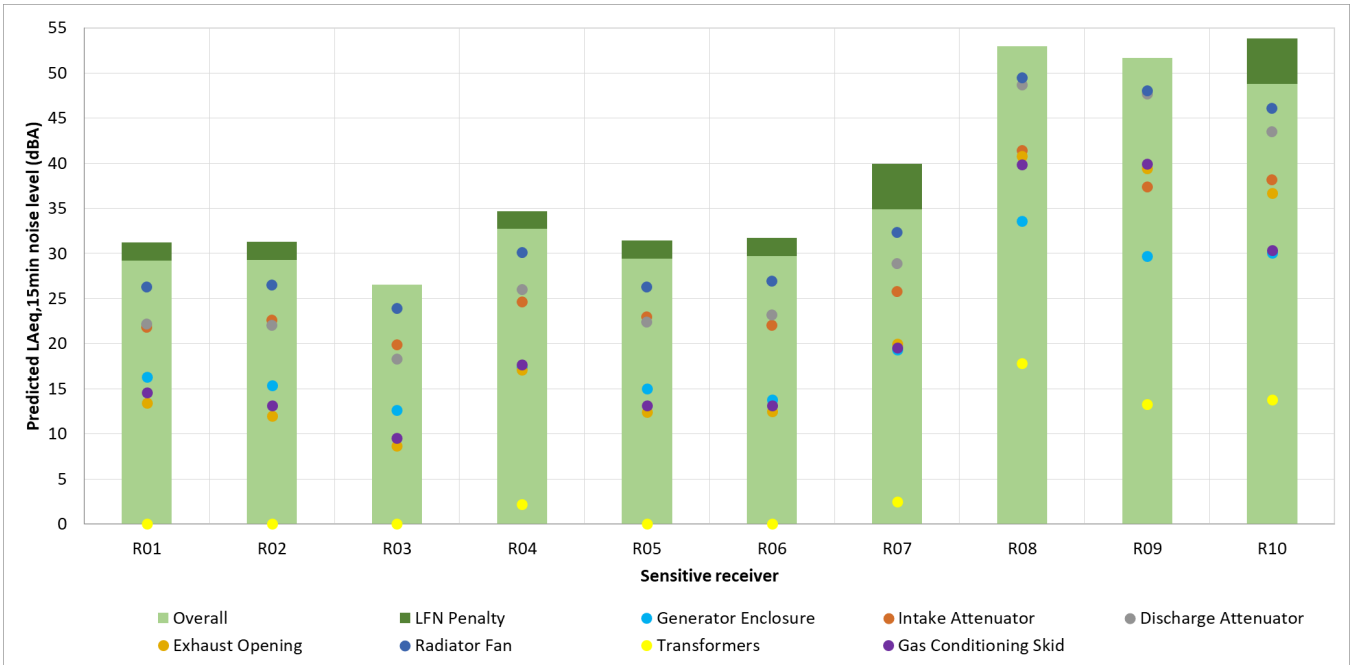

Figure 7.3 Partial noise levels

7.3 Sleep disturbance

The assessment of potential sleep disturbance impacts considers L_{max} (maximum noise level) and $L_{Aeq,15min}$ (continuous noise levels over a 15-minute period). There are no significant transient events associated with the project that would result in high L_{max} levels. The $L_{Aeq,15min}$ noise levels at all residential receivers remain below the 40 dBA sleep disturbance screening criterion, ensuring that the project does not pose a risk of sleep disruption at residential areas in the study area.

7.4 Cumulative impacts

The NPfI project amenity noise level is set to account for potential cumulative noise impacts from other industrial sites in the vicinity. This is achieved by setting the PNTL at 5 dBA below the recommended amenity noise level to ensure that any given receiver is not exposed to excessive industrial noise from multiple sources. This approach allows for the potential cumulative contribution of up to three industrial sites while ensuring that the combined noise exposure does not exceed the recommended amenity noise level, maintaining an acceptable acoustic environment for surrounding land uses. The NPfI states that "*where the project amenity noise level can be met, no additional consideration of cumulative industrial noise is required.*"

Given that the project noise trigger level is set at the lower of the intrusiveness noise level and the project amenity noise level, this approach is conservative and effectively accounts for both individual industrial site and cumulative industrial noise impacts, ensuring the 'recommended amenity noise level' can be achieved at all sensitive receivers.

8. Mitigation and management measures

8.1 Construction phase

The assessment outcomes indicate that compliance with the construction NMLs is achieved across all sensitive receivers. However, the safeguards outlined in Table 8.1 are provided to ensure that compliance is maintained throughout the construction phase, particularly by limiting activities to approved LHRRP site working hours and ensuring that equipment operates efficiently with minimal noise emissions.

Table 8.1 Construction phase environmental noise safeguards

Control type	Environmental Safeguard	Responsibility	Timing
Management measures			
Schedule activities to minimise noise impacts	Construction activities should be confined between the approved hours of construction from 7am to 5pm from Monday to Friday and 8am to 5pm on Saturdays. Activities undertaken outside of the standard hours would not exceed out-of-hours protocols.	Contractor	Pre-construction / Construction
At-source mitigation measures			
Plant noise levels	The noise levels of plant and equipment should have an operating sound power lower than the levels presented in Table 5.1 or similar.	Contractor	Pre-construction / Construction
Maintain equipment	Regularly inspect and maintain equipment to ensure it is in good working order. Also check the condition of mufflers. Equipment must not be operated until it is maintained or repaired, where maintenance or repair would address the annoying character of noise identified.	Contractor	Construction

8.2 Operational phase

For the operational phase, the assessment predicts that compliance with the project noise trigger levels will be achieved at most sensitive receivers. However, this prediction assumes that key noise mitigation measures are implemented as part of the project design. These mitigation measures are summarised in Table 8.2.

Table 8.2 Operational phase environmental noise safeguards

Control type	Environmental safeguard	Responsibility	Timing
Plant noise levels	Selection and design of low-noise equipment to ensure operational sound power levels remain at or below the reference levels used in the assessment. This includes the following design measures: – Acoustic enclosure for CAT G3516LE generators – Intake attenuators – Discharge attenuators – Silencers on generator exhausts – Selection of low-noise radiator fans	LMS Energy	Detailed design
Maintain equipment	Regular maintenance of equipment to prevent excessive noise emissions from deteriorating or faulty components, particularly for critical noise sources such as radiator fans, attenuators, and exhaust openings.	LMS Energy	Operational phase

Control type	Environmental safeguard	Responsibility	Timing
Noise monitoring	Compliance noise monitoring to be completed within 12-months of commencement of operation. Noise monitoring undertaken at the boundary of the power station would be compared to the predicted noise levels presented in Table 8.3 and used to validate predicted noise levels at sensitive receivers presented in this report.	LMS Energy	Operational phase

Table 8.3 Predicted noise levels at site boundary, $L_{Aeq(15\ min)}$ dBA

Location	Coordinates, MGA Zone 56 m		Predicted noise level, $L_{Aeq(15\ min)}$ dBA
	X	Y	
Eastern boundary	313052	6230670	69
Southern boundary	313006	6230610	72
Northern boundary	313036	6230710	75

9. Conclusion

This Noise Impact Assessment (NIA) has evaluated the potential noise and vibration impacts associated with both the construction and operational phases of the proposed bioenergy facility. The assessment has been conducted in accordance with the NSW Noise Policy for Industry (NPfI), the Interim Construction Noise Guideline (ICNG), and relevant Australian and international standards.

For the construction phase, the assessment confirms that predicted noise levels at all sensitive receivers are below the construction noise management levels (NMLs), and therefore no project-specific mitigation and management measures have been recommended. Additionally, no sensitivity receivers are located within the threshold ranges for cosmetic damage or for structural damage from construction vibrations and the ANSTO facility would experience no additional vibrations impacts.

Never-the-less, environmental safeguards have been identified to manage construction-related noise, including scheduling restrictions, equipment selection, and maintenance procedures. These safeguards will ensure that noise emissions can remain below the NMLs during the construction period.

For the operational phase, noise predictions indicate compliance with PNTLs at all sensitive receivers, except for localised areas within the future recreational area (R08). Noise contours presented in Figure 7.1 and Figure 7.2 illustrate the worst-case spatial distribution of operational noise for the future recreational areas. The bioenergy facility is unlikely to operate at full capacity during the post closure period reducing the predicted impact and mitigation measures are included in the design of the project to reduce noise level as much as reasonably and feasibly possible at all receivers. Additionally, the assessment of sleep disturbance impacts confirms that $L_{Aeq,15min}$ levels remain below the 40 dBA sleep disturbance criterion, ensuring no adverse effects on residential amenity during night-time operations.

The alternative to the proposed project is the continued operation of the existing facility using older technology. This proposed bioenergy facility is expected to reduce noise or vibration emissions in comparison to the existing power station.

To ensure ongoing compliance with operational project noise trigger levels, mitigation measures have been incorporated into the project design, including:

– Acoustic enclosures for the generator sets
– Attenuators for air intake and discharge systems
– Custom silencers for generator exhausts
– Regular maintenance programs to prevent excessive noise emissions.

Based on the outcomes of this assessment, the proposed development is expected to operate at noise levels below the NPfI project noise trigger levels and maintain an acceptable acoustic environment for all surrounding sensitive receivers. By implementing the recommended mitigation and management measures, the project can be developed and operated in a manner that effectively minimises noise impacts, ensuring compliance with regulatory requirements and maintaining community amenity.

10. References

Australian Standard. (2010). *AS2436 - Guide to Noise Control on Construction, Maintenance and Demolition Site.*

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Appendices

Appendix A

Background noise monitoring

Long-term noise monitoring was undertaken between Tuesday 12 March 2025 and Wednesday 25 March 2025 at 56 Namatjira Street, Bardon Ridge and between Wednesday 25 March 2025 and Monday 7 April 2025 at 28 Andromeda Crescent, Engadine.

The methodology for the noise monitoring program included the following:

– Noise monitoring was undertaken using 2 Svan 977 Type 1 environmental noise loggers. All noise loggers were programmed to accumulate LA90, LA10 and LAeq noise descriptors continuously over the entire monitoring period. Details and results of the noise monitoring equipment are provided in the tables below.
– A calibration check was performed on the noise monitoring equipment using a sound level calibrator. At completion of the measurements, the meter's calibration was re-checked to ensure the sensitivity of the noise monitoring equipment had not varied. The noise loggers were found to be within the acceptable tolerance of ± 0.5 dBA.
– All monitoring activities were undertaken with consideration of the specifications outlined in Australian Standard AS1055 (1997) Description and Measurement of Environmental Noise and the NSW EPA's Approved methods for measurement and analysis of environmental noise (EPA, 2022).
– Meteorological data (wind speed, wind direction, rainfall, temperature and humidity) was sourced from the Bureau of Meteorology's Holsworthy Aerodrome automatic weather station (AWS) (station number 066161).
– The data collected by the noise loggers was downloaded and analysed to determine invalid data due to adverse weather conditions. Invalid data generally refers to periods of time where average wind speeds at microphone height were greater than 5 m/s, or when rainfall occurred. Periods where wind speeds, measured at 10 m above the ground at the BoM AWS, are greater than 7 m/s have been excluded to account for the wind speed gradient at height.
– Whilst in attendance during the setup and retrieval of the noise loggers, observations were made to characterise the noise environment and identify dominant sources of noise contributing to background noise levels.

The monitoring details and results are presented in Table A1 and Table A2 for M1 and M2 respectively.

Table A.1 Logger M1 – 28 Andromeda Cresent, Engadine Logger

Equipment details	Equipment settings	Observations
Svan 977 Type 1 SN: 45744 1.5 m above ground Free field IEC 61672-3:2013 Compliant Manufactured prior 2019	A-weighted Fast time response 15 minute intervals Pre and post calibration variation: -0.5 dBA Svantek SV30A Class 1 Sound level calibrator SN: 29030 AS 60942:2003 Compliant Manufactured prior 2017	The area is a quiet residential area, the observations of the noise environment are: – Environmental noises: birds, insects, breeze in trees predominant – Planes / helicopter overhead – Distant hum of road traffic noise – Noise from lawn mower while in attendance

Logger photo	Logger location
	

Ambient and background noise monitoring results

Period	Noise level								
	RBL			$L_{Aeq(15\ min)}$			L_{A10}		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
Tuesday 25/03/2025	37	55	52	37	53	49	33	45	43
Wednesday 26/03/2025	33	31	27	52	57	42	47	54	36
Thursday 27/03/2025	32	31	28	46	57	42	46	49	37
Friday 28/03/2025	33	30	29	47	50	33	47	47	34
Saturday 29/03/2025	33	34	33	46	45	45	46	43	44
Sunday 30/03/2025	38	38	34	50	49	44	51	50	43
Monday 31/03/2025	41	33	28	62	47	39	57	46	36
Tuesday 01/04/2025	41	33	28	62	47	39	57	46	36
Wednesday 02/04/2025	39	32	24	56	46	42	54	43	35
Thursday 03/04/2025	33	29	26	54	44	41	52	46	38
Friday 04/04/2025	34	31	25	50	45	43	47	46	37
Saturday 05/04/2025	34	30	28	49	46	37	49	47	36
Overall	**36**	**29**	**25**	**54**	**42**	**63**	**50**	**43**	**35**

Table A.2 Logger M2 – 56 Namatjira Street, Bardon Ridge

Equipment details	Equipment settings	Observations
Svan 977 Type 1 SN: 45744 1.5 m above ground Free field IEC 61672-3:2013 Compliant Manufactured prior 2019	A-weighted Fast time response 15 minute intervals Pre and post calibration variation: 0.5 dBA Svantek SV30A Class 1 Sound level calibrator SN: 29030 AS 60942:2003 Compliant Manufactured prior 2017	The area is a quiet residential area, the observations of the noise environment are: – Plane noise overhead – Environmental noises: birds, wind in trees – Noise from children playing

Logger photo	Logger location
	

Ambient and background noise monitoring results

Date	Noise level								
	RBL			$L_{Aeq(15\ min)}$			L_{A10}		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
Wednesday 12/03/2025	36	37	39	51	50	48	51	51	49
Thursday 13/03/2025	37	38	40	55	51	48	52	52	48
Friday 14/03/2025	39	41	37	52	54	45	52	52	45
Saturday 15/03/2025	37	38	37	57	61	47	51	47	47
Sunday 16/03/2025	41	40	35	52	49	46	52	49	45
Monday 17/03/2025	39	33	27	51	47	43	52	47	39
Tuesday 18/03/2025	36	37	30	54	50	46	52	50	43
Wednesday 19/03/2025	40	37	32	51	53	43	52	51	41
Thursday 20/03/2025	37	37	36	57	49	45	52	50	43
Friday 21/03/2025	36	35	32	53	54	42	52	49	38
Saturday 22/03/2025	36	33	33	49	46	45	50	47	43
Sunday 23/03/2025	40	38	27	61	49	44	51	50	39
Monday 24/03/2025	36	32	27	53	50	42	53	48	35
Tuesday 25/03/2025	39	-	-	51	-	-	53	-	-
Overall	**37**	**37**	**33**	**55**	**53**	**45**	**52**	**50**	**43**

Appendix B

Modelled source arrangement

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Figure B.1 Proposed bioenergy facility site layout

Figure B.2 Modelled site layout – 2D

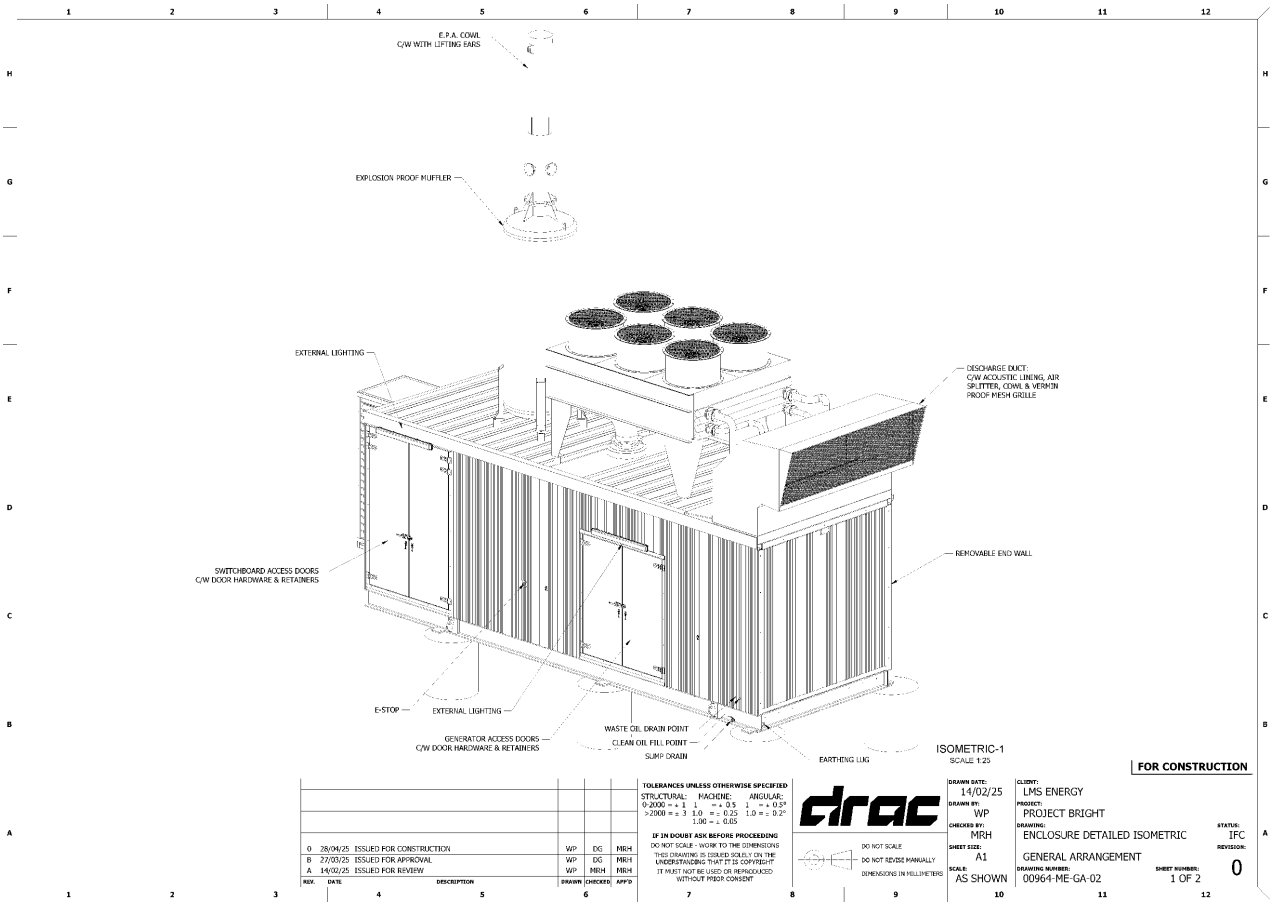

Figure B.3 Generator enclosure general arrangement

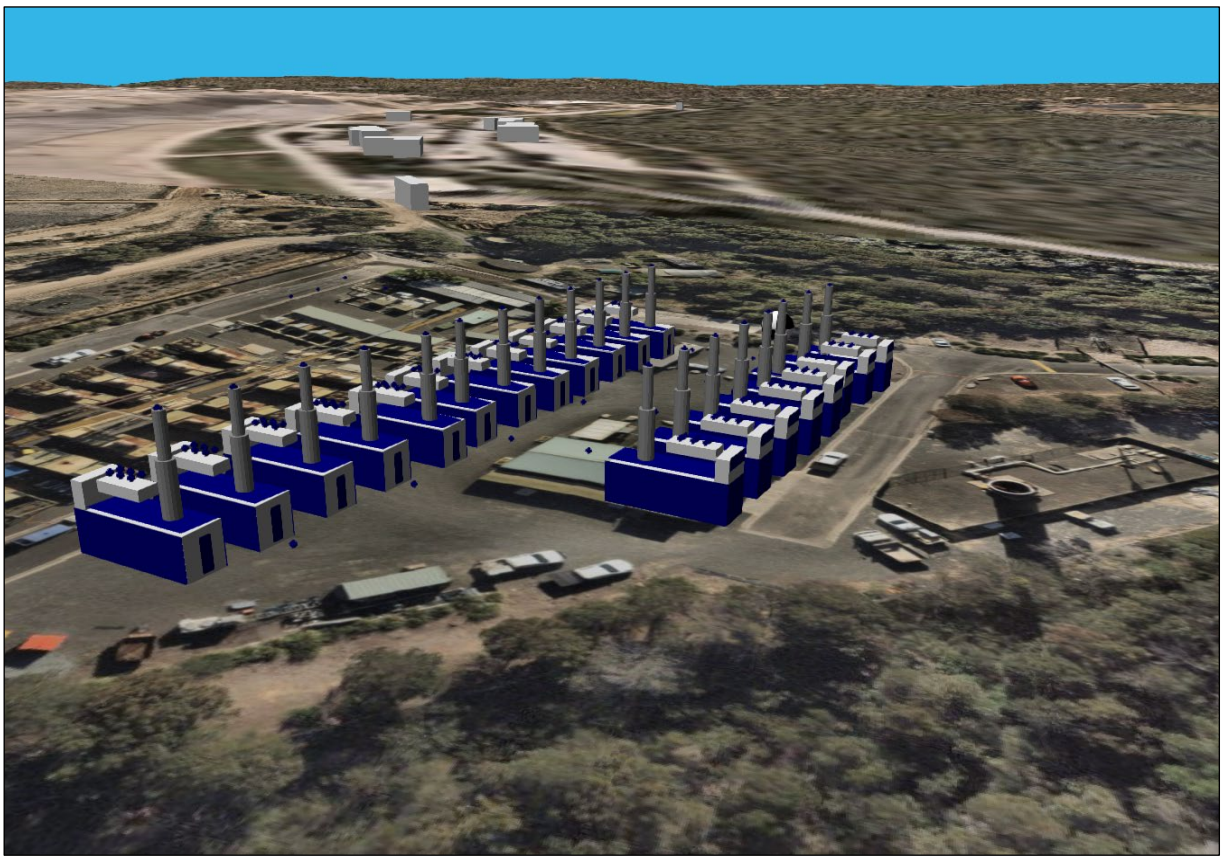

Figure B.4 Modelled site layout – 3D

Appendix C

Meteorological conditions

Certain meteorological/weather conditions can increase noise levels at a receiver by focusing wave propagation paths towards a single point. This 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. These conditions are defined in the following way in the NPfI:

– Wind gradients when the atmospheric stability is unstable or neutral (categories A – D) and the source-to-receiver wind speed is 3 m/s or less, or
– Temperature inversions, during the night-period, when the atmospheric stability is moderately to extremely stable (category F) and the source-to-receiver wind speed is 2 m/s or less.

A review of meteorological conditions at the Holsworthy Aerodrome Automatic Weather Station (AWS) (2020 – 2024) was undertaken to determine the significance of noise-enhancing meteorological conditions and atmospheric conditions on noise propagation in accordance with the NPfI.

Atmospheric stability

The atmospheric stability is defined in the NPfI using the Pasquill-Gifford stability scheme, where stability categories A – C represent unstable atmospheric conditions, category D is representative of neutral conditions and categories E – F represent stable conditions. Stability categories have been determined using the Turner Scheme, as described in Fact Sheet D1 of the NPfI.

Temperature inversions occur during the night-time period in moderate to extreme stable atmospheric conditions (category F) and when combined with light winds (less than 2m/s) have the potential to increase noise levels from ground operations. Wind gradients can occur during unstable or neutral conditions (categories A – D) and when combined with light winds (less than 2m/s) have the potential to increase noise levels from ground operations.

Frequency of winds

To determine the significance of noise-enhancing meteorological conditions the wind speed and wind direction is required. Noise-enhancing conditions occur during light winds, up to 3 m/s, in the source to receiver direction. To determine the significance of these conditions the vector component of the wind is analysed .

A thorough review of the vector components of hourly wind data from 2020 – 2024 was undertaken for data from the Bureau of Meteorology (BoM) Holsworthy Aerodrome AWS (number 066161). The BoM observations are approximately 6 km northwest of the site. Figure C.1 shows the wind roses (2020 – 2024) for wind speeds less than 3 m/s and 2 m/s in each NPfI assessment period and for each season. The wind roses show significant portion of light winds from the southwest during autumn and winter and spring, shifting to the east during summer.

Assessment of significance

The NPfI recommends consideration of the effects of temperature inversions and wind gradients with wind direction from the source to the receiver if they are “significant”. The NPfI defines “significant” as occurring for 30% of the time in any assessment period and season in the direction of sensitive receivers.

Table C.1 provides a summary of the percentage occurrence of noise-enhancing conditions for 16 wind compass directions. The analysis indicates that noise-enhancing conditions are significant during sometime in all seasons. The following receivers would be affected:

– receivers located to west and northwest of the site during the summer daytime,
– receives located to the north of the site during summer and autumn nights,
– receiver located to the east and northeast of the site during autumn and winter day and nights and spring nights, and
– receivers located to the southeast of the site during winter daytime.

As the analysis identified that significant noise-enhancing effects are a feature of the area, as per the NPfI and occur in different directions during different times of the year this should be considered.

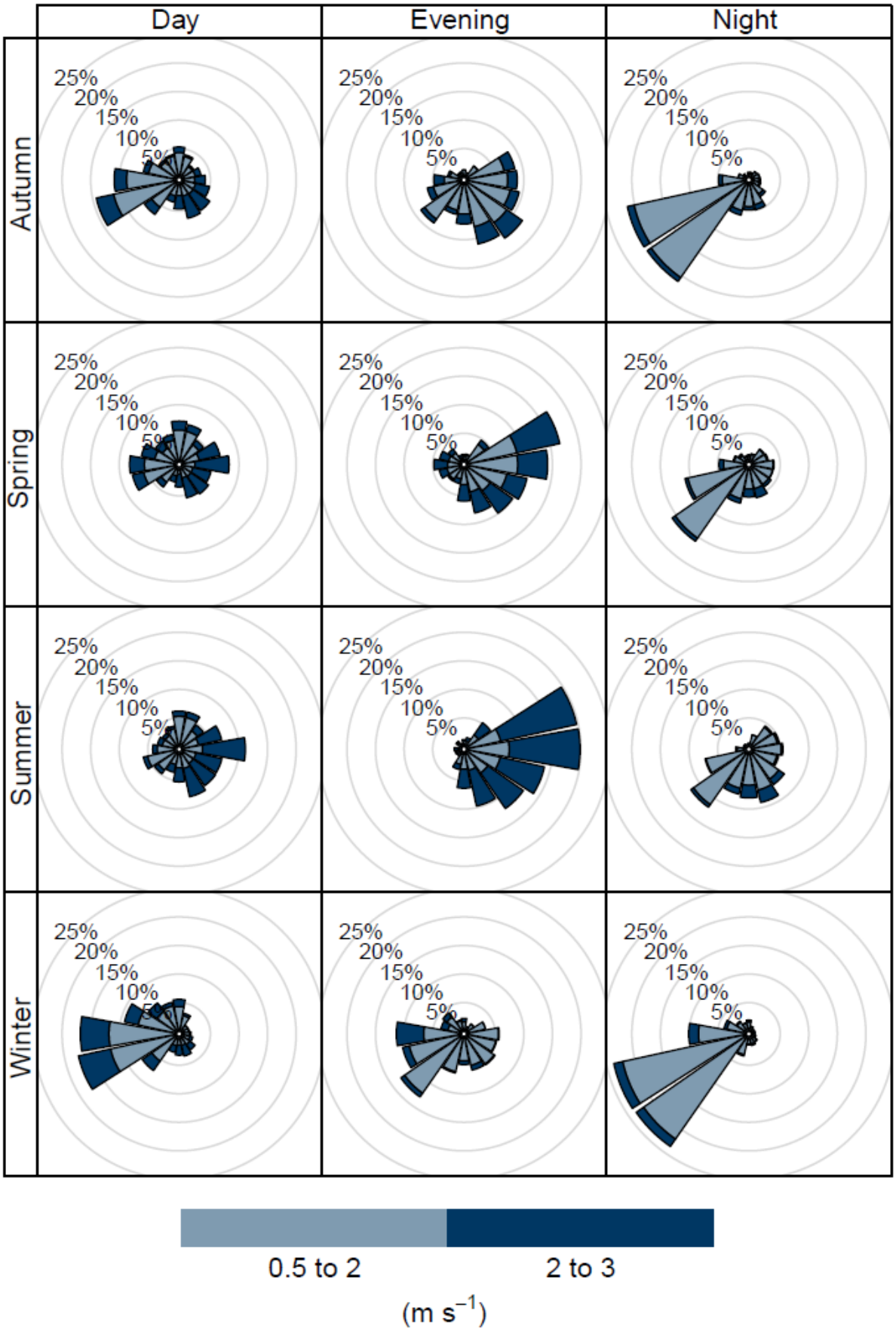

Figure C.1 *Wind roses – frequency of counts by wind direction (%) – Holsworthy Aerodrome AWS 2020 – 2024*

Table C.2 Significant noise-enhancing conditions analysis – Holsworthy Aerodrome AWS 2020 – 2024

Wind direction	Summer				Autumn				Winter				Spring			
	Day	Evening	Night		Day	Evening	Night		Day	Evening	Night		Day	Evening	Night	
	A – D	A – D	A – D	F	A – D	A – D	A – D	F	A – D	A – D	A – D	F	A – D	A – D	A – D	F
N	20%	3%	0%	6%	18%	1%	0%	4%	19%	0%	0%	6%	24%	3%	0%	7%
NNE	23%	9%	1%	10%	18%	2%	0%	4%	15%	0%	0%	5%	26%	9%	0%	8%
NE	30%	19%	1%	14%	18%	4%	0%	5%	12%	1%	0%	4%	28%	14%	0%	11%
ENE	30%	24%	1%	18%	18%	6%	0%	6%	9%	1%	0%	3%	27%	18%	0%	13%
E	**32%**	28%	1%	21%	20%	8%	0%	7%	8%	1%	0%	4%	26%	21%	1%	16%
ESE	**35%**	30%	2%	24%	23%	8%	0%	10%	10%	1%	0%	4%	27%	22%	1%	17%
SE	**33%**	24%	2%	25%	24%	7%	0%	12%	12%	1%	0%	5%	24%	17%	1%	17%
SSE	27%	15%	3%	26%	23%	6%	0%	16%	13%	1%	0%	8%	19%	12%	1%	19%
S	25%	10%	4%	**32%**	24%	4%	0%	**35%**	16%	1%	0%	28%	18%	8%	2%	30%
SSW	24%	6%	5%	**33%**	30%	2%	0%	**52%**	27%	0%	0%	**48%**	20%	5%	2%	**36%**
SW	21%	3%	5%	28%	**34%**	2%	0%	**53%**	**38%**	0%	0%	**55%**	22%	4%	2%	**36%**
WSW	19%	2%	4%	23%	**35%**	1%	0%	**50%**	**43%**	0%	0%	**57%**	25%	4%	2%	**34%**
W	19%	2%	3%	18%	**35%**	1%	0%	**46%**	**46%**	1%	0%	**56%**	26%	4%	2%	**31%**
WNW	18%	2%	2%	8%	**34%**	1%	0%	26%	**46%**	1%	0%	**36%**	27%	4%	1%	18%
NW	18%	2%	0%	3%	27%	1%	0%	7%	**37%**	0%	0%	16%	26%	4%	0%	9%
NNW	19%	2%	0%	3%	21%	1%	0%	4%	26%	0%	0%	9%	25%	3%	0%	6%

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