Bioelektra Australia Pty Ltd

West Nowra Resource Recovery Park Stage 2

Noise and Vibration Assessment

May 2021

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1. Introduction

1.1 Purpose of this report

Bioelektra Australia Pty Ltd (Bioelektra) proposes to construct and operate an integrated resource recovery facility at West Nowra (referred to in this report as 'the project'). This report has been prepared by GHD Pty Ltd (GHD) to provide an assessment of noise and vibration associated with the project as an input to the environmental impact statement (EIS). Bioelektra is the proponent of the project and the EIS is being prepared by GHD in accordance with the requirements of Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (the EP&A Act).

The report addresses the requirements of the Secretary of the NSW Department of Planning, Industry and Environment (the Secretary's Environmental Assessment Requirements (SSD 9887)) dated February 2021.

1.2 Staged project approval

In 2016 Shoalhaven City Council (Council) sought approval for a Concept Proposal for a resource recovery park with a combined capacity of 130,000 tonnes per year (the West Nowra Resource Recovery Park). The Concept Proposal included:

- Stage 1 – clearing of land and provision of basic infrastructure on the nominated site, which would be undertaken by Council or contractors appointed by Council as part of early construction works.
- Stage 2 – construction and operation of a resource recovery park which would be undertaken by an alternative waste technology provider/facility operator, selected through a tendering process to provide the specialised resource recovery facilities.

Council sought Project Approval for stage 1 as part of the same application.

A staged approach was adopted to enable Stage 1 to commence (subject to planning approval) while a contractor was appointed and the details of Stage 2 were determined via the tendering and design process.

Council received Concept Approval and Stage 1 Project Approval for the West Nowra Resource Recovery Park on 25 August 2016 (SSD 7015). The approved Stage 1 works included:

- Demolition of the existing animal shelter
- Site preparation and clearing of the site
- Construction of perimeter, entry/exit and service roads and line marking
- Installation of perimeter/boundary fencing
- Weighbridge and weighbridge office
- Staff and visitor car parking, including line marking
- Detention and sedimentation dams/basins
- Identification of asset protection zones

Council subsequently awarded Bioelektra with the contract to construct and operate Stage 2 of the works.

1.3 Project overview

The project is defined as the construction and operation of a resource recovery facility with pre-treatment for mixed municipal waste of up to 130,000 tonnes per year, comprising:

- A waste reception hall
- A processing building for shredding and sterilisation operations using 16 autoclaves to pre-treat and sterilise the waste
- A materials recovery facility for sorting all processed waste minus organic matter separated from autoclave pre-treatment
- A boiler room, transformer hall and liquid petroleum gas (LPG) station supplying utilities and electricity for site operations

The project also includes ancillary infrastructure, including offices, amenities, staff and visitor parking, internal roadways, weighbridges and weighbridge offices, fencing, and a pumping station and firefighting tanks.

The Concept Approval (SSD 7015) included construction and demolition waste processing and an alternative waste treatment/materials recovery facility. However, construction and demolition waste processing is no longer proposed as part of the project. In addition, the waste processing technology proposed by Bioelektra includes sterilisation of waste through autoclaving and materials recovery through various sorting operations.

Other ancillary infrastructure not included as part of the Concept Approval (SSD 7015) but proposed as part of this project includes the boiler room, transformer hall, LPG station and pumping station and firefighting tank.

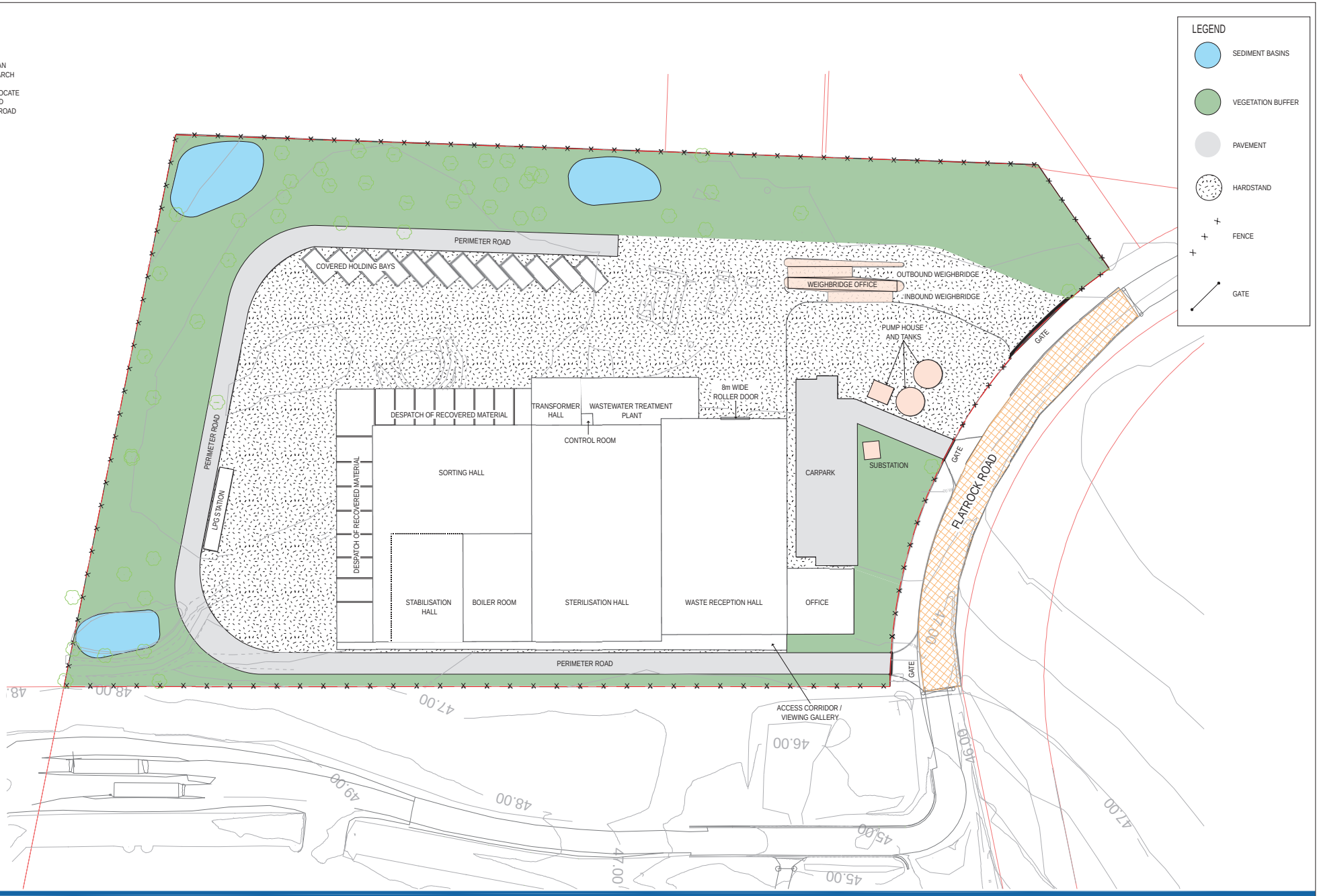
The site layout is shown in Figure 1-1.

1.4 Location of the project

The project site is approximately five kilometres to the west of the Nowra Central Business District and is accessed from Flatrock Road, off Yalwal Road in West Nowra (refer to Figure 1-2).

The site is adjacent to the existing landfill and is located on an approximate 3.6 ha parcel of land (Lot 342 DP 257515).

BASED ON PROPOSED SITE PLAN PREPARED BY BECA, DATED MARCH 2019 (REF: 2440823-ar-0501-a) AND AMENDED BY GHD TO RELOCATE LPG STATION, ADJUST COVERED HOLDING BAYS AND INTERNAL ROAD ALIGNMENTS AND REMOVE TRANSFER STATION.



Bioelektra Australia Pty Ltd
West Nowra Resource Recovery Park Stage 2

Site Plan

Job Number 12536311
Revision A
Date December 2020

Figure 1-1

Level 15, 133 Castlereagh Street, Sydney NSW 2000 Australia **T** 61 2 9239 7100 **F** 61 2 9239 7199 **E** sydmail@ghd.com **W** www.ghd.com

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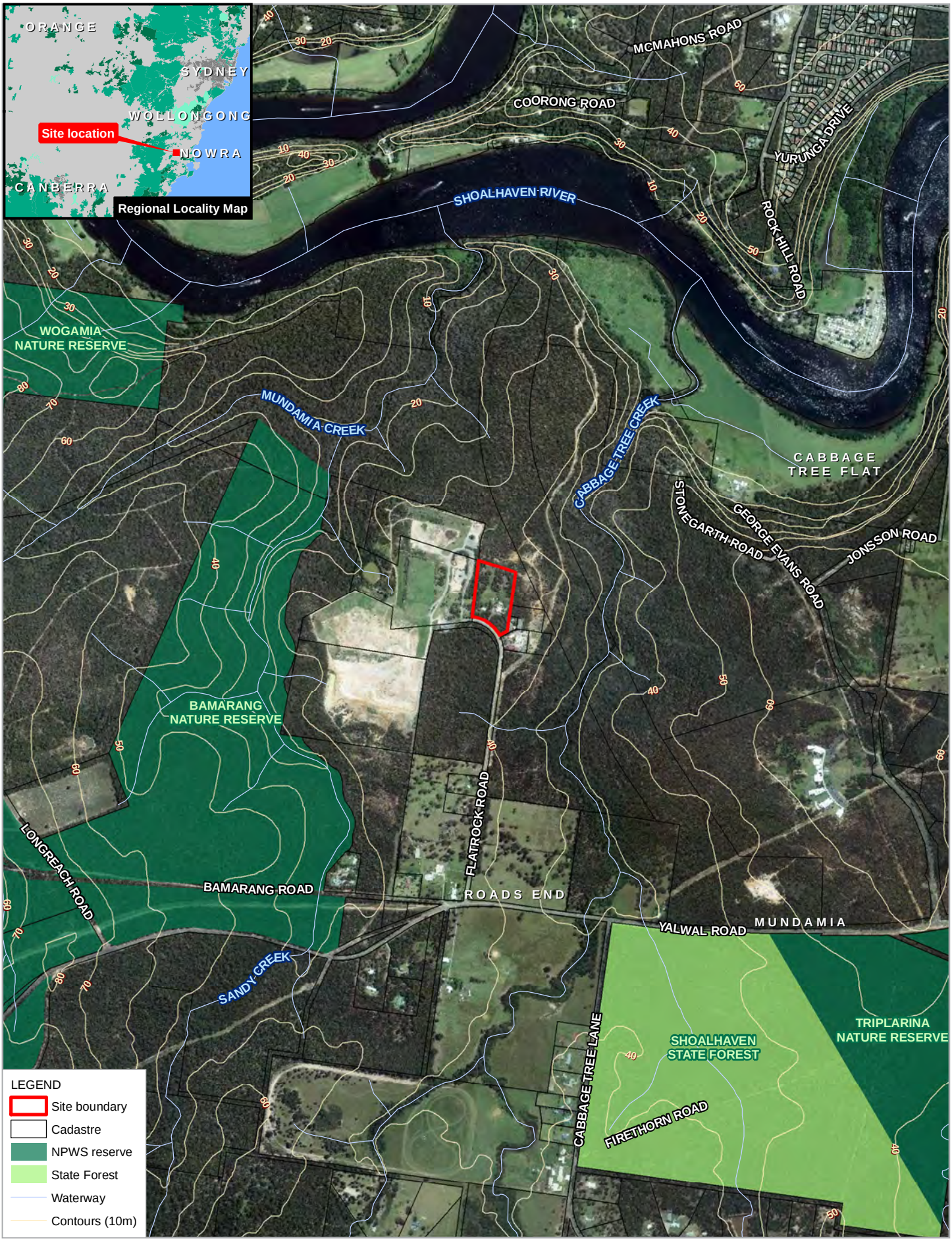

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Bioelektra Australia Pty Ltd
West Nowra Resource Recovery Park Stage 2

Site **Location**

Project No. 12536311
Revision No. -
Date 28 Sep 2020

FIGURE 1-2

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Data source: Aerial imagery - Sixmaps 2020 (© Department of Customer Service 2020); General Topo: NSW LPI DTDB 2020 & 2015; Cadastre: NSW LPI DCDB 2020; Inset map - Geoscience Australia. Created by: jrprice

1.5 Secretary's Environmental Assessment Requirements and agency requirements

The Secretary's Environmental Assessment Requirements (SEARs), and agency requirements that relate to noise and are addressed in this report are summarised in Table 1-1.

Table 1-1 Secretary's Environmental Assessment Requirements and agency requirements

Assessment requirements	Where addressed in report
• A quantitative assessment of potential construction, operational and transport noise and vibration impacts in accordance with relevant Environment Protection Authority guidelines; and	Section 6
• Details and justification of the proposed noise mitigation and monitoring measures.	Section 7
Policies, guidelines and plans	
Noise	
• Noise Policy for Industry (NPfI) (EPA 2017) • Environmental Criteria for Road Traffic Noise (EPA 1999) (superseded by the NSW Road Noise Poilcy RNP (EPA 2011)) • Interim Construction Noise Guideline (ICNG) (DEC 2006)	Section 5.3 Section 5.4 Section 5.1
Vibration	
• Assessing Vibration: A Technical Guideline (DEC 2006) • Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration (ANZECC 1990)	Section 5 (Blasting not required)
Agency requirements	
NSW EPA	
See Appendix B	Addressed throughout the report

1.6 Scope and structure of the report

1.6.1 Scope of the report

The key tasks undertaken in this assessment are as follows:

- Identify the key sensitive receivers in the study area and the type of land use
- Undertake baseline noise monitoring at two residential receivers for a period of a week to establish construction noise management levels in accordance with the ICNG and the intrusiveness noise levels in accordance with the NPfI
- Undertake an assessment of potential construction noise impacts based on indicative construction scenarios against the requirements of the ICNG
- Undertake and assessment of potential construction vibration impacts (human comfort and cosmetic damage to structures) against the adopted guideline vibration guideline values
- Based on information provided at the time of this assessment, prepare a 3D computer noise model representing maximum noise emission operations during the day and night period and predict noise levels at the sensitive receivers in the study area
- Undertake an assessment of operational noise impacts at sensitive receivers against the requirements of the NPfI, including an assessment of potential sleep disturbance impacts

- Undertake an assessment of potential construction and operational traffic noise impacts due to additional traffic generation on public roads against the requirements of the RNP
- Where required, provide mitigation measures to reduce the potential for noise and vibration impacts during the construction and operational phases of the project

2. Methodology

The key tasks to assess the potential noise and vibration impacts on sensitive receivers are detailed below.

2.1 Project description

- Provide an overview of the key features of the project
- Identify all noise sources during the construction and operational phases of the project
- Specify the proposed construction hours and worst-case times of operation for noisy equipment/activities during operation
- Specify the additional traffic generated on public roads during the construction and operational phases of the project

2.2 Existing environment

- Identify all sensitive receivers potentially affected by noise and vibration associated with the project
- Determine the existing background (L_{A90}) and ambient (L_{Aeq}) noise levels at two residential premises in the study area in accordance with the requirement of the NPfI and provide noise monitoring charts. Existing noise levels may include noise from existing industry (landfill adjacent to the project site) that has been operating in excess of 10 years and is considered part of the acoustic environment.
- Determine the existing road traffic noise levels at the nearest affected residence along Flatrock Road in accordance with the requirements of the RNP
- Undertake attended noise measurements in the study area and provide a description of the dominant, background and intermittent noise sources
- Describe whether temperature inversions or wind inversions are a feature of the environment at sensitive receivers

2.3 Criteria

- Establish the construction noise management levels at sensitive receivers in accordance with the ICNG
- Establish the project noise trigger levels at sensitive receivers in accordance with the NPfI
- Establish the road traffic noise criteria during construction and operation of the project in accordance with the RNP
- Establish the human comfort and cosmetic damage vibration goals at sensitive receivers during the construction of the project, with reference to:
  - Assessing Vibration: A Technical Guideline (DEC 2006)
  - British Standard 7385-2:1993 Evaluation and measurement for vibration in buildings. Guide to levels from groundborne vibration
- No blasting as proposed as part of the project. As such, an assessment of potential blasting impacts is not required.
- Vibration impacts are anticipated to be negligible during the operational phase of the project. As such, an assessment of potential vibration impacts during operation is not required.

2.4 Impact assessment

- List the number and type of noise sources during the construction and operation of the project
- Specify the increase in traffic generation on public roads during construction and operation
- State any assumptions made in the prediction methodology, including references
- Predict the noise levels at sensitive receivers during construction and operation using 3D noise modelling software
- Predict the increase in road traffic noise levels at sensitive receivers during construction and operation using 3D noise modelling software
- Assess the potential noise impacts in accordance with the requirements of the ICNG, NPfI and the RNP
- Undertake an screening assessment of potential maximum noise level impacts during the night period
- Assess potential human comfort and cosmetic damage vibration impacts at sensitive receivers during construction
- Where construction noise and vibration management levels are predicted to be exceeded, recommend feasible and reasonable mitigation measures in accordance with the ICNG
- Where project noise trigger levels are predicted to be exceeded, recommend additional feasible and reasonable mitigation measures to reduce noise levels, including a discussion of the effectiveness of the measures

2.5 Mitigation measures

- Provide reasonable and feasible mitigation measures including noise controls and management measures during the construction and operation of the project, where required
- Provide reasonable and feasible mitigation measures to reduce traffic noise impacts during the construction and operation of the project, where required

3. Project description

3.1 Construction phase

3.1.1 Staging

Construction of the project is expected to commence in 2021 and is predicted to take approximately 12-15 months to complete. The project is anticipated to follow the work methodology and staging provided in Table 3-1. These construction scenarios have been modelled to determine the potential construction noise and vibration impacts on the environment.

Table 3-1 Construction scenarios

Scenario ID	Scenario name/activity	Working hours
CS1	Phase 1 Site establishment	Standard construction hours
CS2	Phase 2 - Ground works and excavation works	
CS3	Phase 3 - Structural construction works	
CS4	Phase 4 - Landscaping works	
CS5	Phase 5 - Testing and commissioning	

3.1.2 Construction hours

Construction working hours would be undertaken during the standard construction hours periods specified in the Interim Construction Noise Guidelines (DECC, 2009). Those are:

- 7 am to 6 pm Monday to Friday
- 8 am to 1 pm Saturdays
- No work on Sundays or Public Holidays.

3.2 Operational phase

3.2.1 Operational noise sources

Operational noise sources include the following:

- A waste reception hall, including a shredder
- A processing building for shredding and sterilisation operations using 16 autoclaves to pre-treat and sterilise the waste
- A materials recovery facility for sorting all processed waste minus organic matter separated from autoclave pre-treatment
- A boiler room, transformer hall and LPG station supplying utilities and electricity for site operations

The project also includes ancillary infrastructure including offices, amenities, staff and visitor parking, internal roadways, weighbridges and weighbridge offices, fencing, and a pumping station and firefighting tanks. All noise sources are presented in Table 6-10.

3.2.2 Maximum capacity operational scenarios

Day and early morning shoulder (EMS) operations (6 am to 6 pm)

For the purposes of noise modelling the worst-case conditions during the day period has been assumed to be:

- All equipment within the waste reception hall, sterilisation hall, sorting hall, boiler room operating at maximum capacity
- Transformer and wastewater treatment plant operating
- Roller door is open for 50% of the time (30 minutes per hour)
- A maximum of 4 trucks arriving and 4 trucks departing from the site per hour (This will be 2 trucks arriving and 2 truck departing between 6 am and 7 am)
- Conveyors sorting material into a maximum of four of the external despatch bins on the northern façade of the sorting hall at any given time
- Conveyors sorting material into a maximum of four of the external despatch bins on the eastern façade of the sorting hall at any given time

Evening and night operations (6 pm to 6 am)

For the purposes of noise modelling the worst-case conditions during the day period has been assumed to be:

- All equipment within the waste reception hall, sterilisation hall, sorting hall, boiler room operating at maximum capacity
- Transformer and wastewater treatment plant operating
- Roller door is closed
- No truck movements and no sorting of material into the external despatch bins

3.3 Traffic generation

3.3.1 Haulage routes

Based on the expected access routes, it has been assumed that 100 percent of vehicles will travel to/from the Princes Highway to the site on Flatrock Road via Kalandar Street, Albatross Road and Yalwal Road. From the Princes Highway, it is assumed that 50 percent travel to the north and 50 percent would travel to the south. The haulage routes during construction and operational stages are shown in Figure 3-1. The traffic generation and the haulage routes have been sourced from the *125236311 West Nowra Traffic Impact Assessment* (GHD 2020).

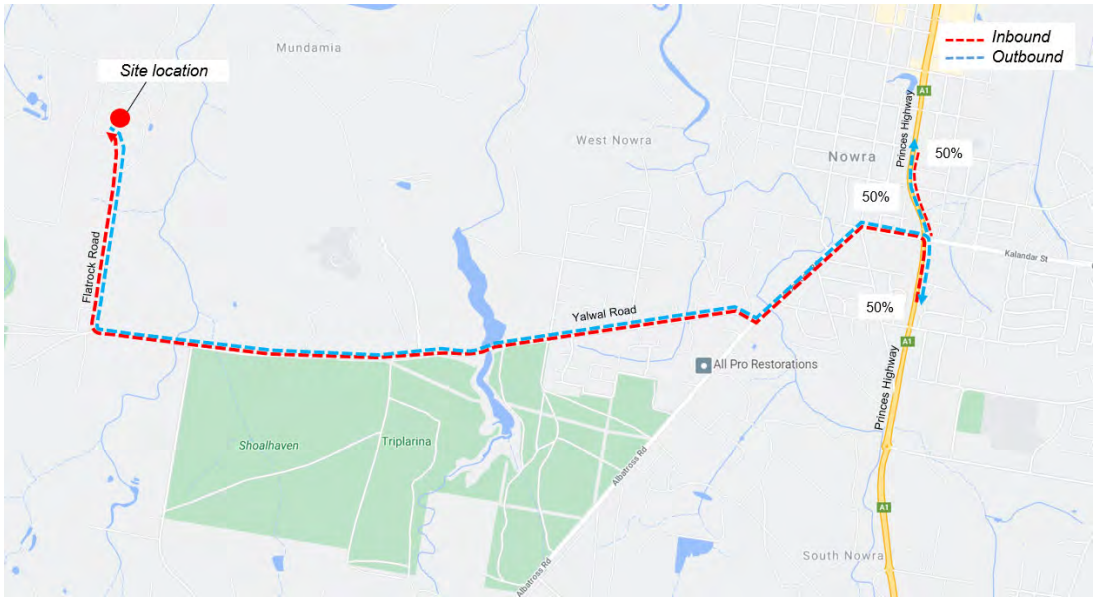


Figure 3-1 Haulage routes

3.3.2 Traffic generation during construction

The anticipated traffic generation during the construction period is shown in Table 3-2.

Table 3-2 Traffic generation during construction on haulage routes

Activity	Vehicle movements per day[1]	Vehicle movements per hour (AM or PM peak)[1]
Heavy vehicles	40	4
Light vehicles	50	25
Total vehicles	**90**	**29**

Notes:
1 Based on GHD's EIS traffic impact assessment

3.3.3 Traffic generation during operation

The anticipated traffic generation during the operation are shown in Table 3-3.

Table 3-3 Traffic generation during operation on haulage routes

Activity	Vehicle movements per day[1]		Peak vehicle movements per hour (2030)	
	2020 (vpd)*	2030 (vpd)*	Day (7am to 6pm)[1]	Night (6am to 7am)[2]
Additional heavy vehicles	26	42	8	4
Additional light vehicles	96	170	54	27
Total additional vehicles	**122**	**212**	**62**	**31**

Notes:
1 Based on GHD's EIS traffic impact assessment
2 Hourly vehicle movements between 6 am and 7 am assumed to be half of the peak hour volumes as a worst-case

Based on the above volumes, it has been assumed that a maximum of four trucks arriving and four trucks departing the facility for a one hour period, or a maximum of 42 trucks movements during the RNP day period, being 7 am to 10 pm (there would be no truck movements between 6 pm and 10 pm). It has also been assumed that a maximum of two trucks would arrive and two trucks would depart from the facility during the RNP night period, being 10 pm to 7 am (there would be no truck movements between 10 pm and 6 am).

4. Existing environment

4.1 Project location and surrounding land uses

A summary of the project location is presented in Table 4-1.

Table 4-1 Site summary

Information	Site details
Street address:	Flatrock Road, Mundamia, NSW
Title identification:	Lot 342 DP257515
Site area (approx.):	3.6 hectares
Zoning:	SP2 – Infrastructure under the Shoalhaven City Council Local Environment Plan (LEP) 2014
Local government area:	Shoalhaven
Proposed land use:	Resource recovery facility
Current land use:	Animal shelter and pound
Adjoining land uses:	North: moderate to high dense bushland. South: low density residential housing and moderate to high dense bushland. East: moderate to high dense bushland West: West Nowra Landfill
Grid coordinates (GDA 2020):	276415 m E. 6137386 m N, Zone 56 H (approximate centre of site)

4.2 Sensitive receivers

Noise and vibration sensitive receivers are defined based on the type of occupancy and the activities performed in the land use. Sensitive noise and vibration receivers could include:

- Residences (existing and potential future)
- Classrooms
- Hospitals
- 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
- Commercial or industrial premises.

The study area has been defined as approximately 1.2 kilometres from the project as noise impacts are not anticipated beyond this distance. The sensitive receivers, land uses and planning zones are listed in Table 4-2 and shown in Figure 4-1. The residential receivers have been categorised into two discrete noise catchment areas (NCAs) based on their proximity to the dominant noise source in the area being road traffic along Yalwal Road.

NCA1 has been defined as residences within 200 metres of Yalwal Road and NCA2 has been defined as all other residences within the study area. Future residential receivers at the Mundamia Urban Release Area (R12 to the east) and at the Cabbage Tree Lane Urban Release Area (R13 and R14 to the south) have also been included in the assessment as potential sensitice receivers as these subdivisions do not yet have development consent.

Table 4-2 Sensitive receivers and land uses

Land use	Receiver ID	Address	NCA	Planning zone	Direction to project site
Residential	R01	43 Flatrock Road, Mundamia	NCA1	RU2 – Rural Landscape	South
	R02	41 Flatrock Road, Mundamia	NCA1	R1 – General Residential	South
	R03	3 Flatrock Road, Mundamia	NCA1	R1 – General Residential	South
	R04	3 Flatrock Road, Mundamia	NCA2	R1 – General Residential	South
	R05	3 Flatrock Road, Mundamia	NCA2	R1 – General Residential	South
	R06	3 Flatrock Road, Mundamia	NCA2	R1 – General Residential	South
	R07	18 Bamarang Road, Mundamia	NCA2	R1 – General Residential	South
	R08	38A Old Bamarang Road, Mundamia	NCA2	SP2 – Infrastructure	South
	R09	56 Stonegarth Road, Mundamia	NCA2	E3 – National Parks and Nature Reserves	North East
Educational	R10	University of Wollongong, Shoalhaven campus	-	SP2 – Infrastructure	South East
Commercial	R11	National Parks and Wildlife Service office	-	SP2 – Infrastructure	South East
Future residential	R12	Mundamia Urban Release Area	NCA2	R1 – General Residential	East
	R13	Cabbage Tree Lane Urban Release Area (west of Cabbage Tree Lane)	NCA2	R1 – General Residential	South
	R14	Cabbage Tree Lane Urban Release Area (east of Cabbage Tree Lane)	NCA2	E2 – Environmental Conservation	South

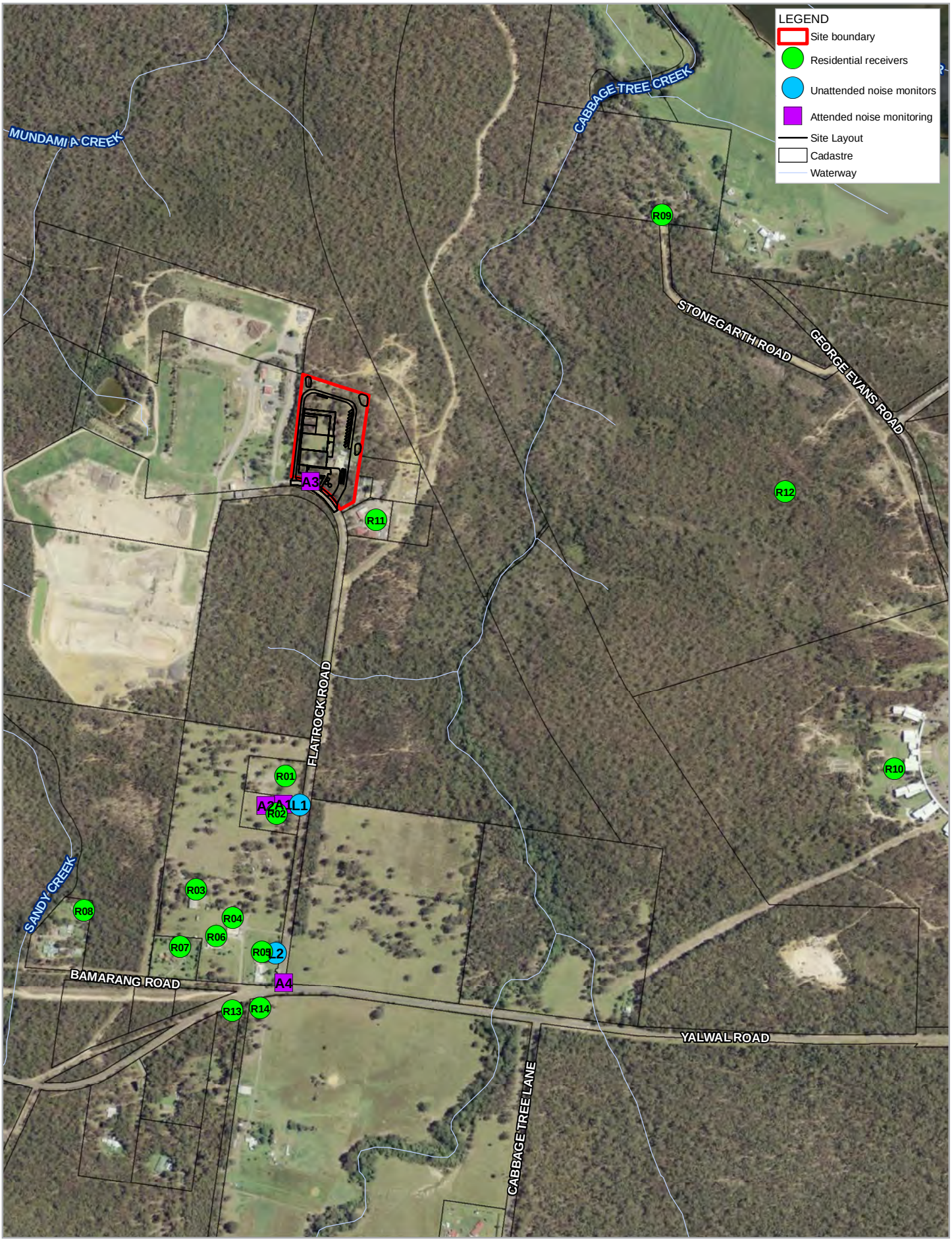
4.3 Noise monitoring

Background noise monitoring was undertaken to establish the construction noise management levels in accordance with the ICNG and the intrusiveness noise levels in accordance with the NPfI. The methodology for the noise monitoring program included the following:

- Noise monitoring was conducted between Thursday 3 September and Monday 14 September 2020.
- A calibration check was performed on the noise monitoring equipment using a sound level calibrator with a sound pressure level of 94 dBA at 1 kHz. 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 ± 1 dBA
- Noise monitoring was undertaken using two Svan 977 environmental noise loggers. The noise logger was programmed to accumulate L_{A90}, L_{A10}, and L_{Aeq} noise descriptors

continuously over the entire monitoring period. Details of the noise monitoring equipment are provided in Table 4-3

- The data collected by the logger was downloaded and analysed, and any invalid data removed. Invalid data generally refers to periods of time where average wind speeds were greater than 5 m/s at microphone height (which corresponds to approximately 7 m/s at 10 m above ground level), or when rainfall occurred. Meteorological data was sourced from the Bureau of Meteorology's Nowra RAN Air Station AWS (number 068072) and is located within 30 kilometres of the noise monitoring site in accordance with the NPfI.



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Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
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Bioelektra Australia Pty Ltd
West Nowra **Resource Recovery Park - Stage 2**

Project location, sensitive receivers and noise monitoring locations

Project No. 12536311
Revision No. -
Date 06 May 2021

FIGURE 4-1

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4.4 Summary of unattended noise monitoring results

Details of the noise monitoring equipment and location are provided in Table 4 3. Noise logger data results are summarised in able 4-4 and Table 4-5. Noise monitoring charts are presented in Appendix C. The noise logging results are typical of a rural noise environments with the dominant noise sources being the nearby road network and natural sounds.

The L_{A90} background noise levels are generally consistent with the noise logging undertaken as part of the Stage 1 EIS during the day period. The measured background noise levels in 2020 during the evening and night are lower than what was measured as part of the Stage 1 EIS (2014).

Noise levels between 6 am and 7 am are elevated when compared to the rest of the night period and is likely due to the existing truck movements along Flatrock Road. As the operations between 6 am and 7 am are different to the operations for the rest of the night period (10 am to 7 am), the early morning shoulder period noise levels have also been presented to establish the intrusiveness noise criteria between 6 am and 7 am.

It should be noted that the existing noise levels may include noise from the existing landfill that is located adjacent to the project site. As the landfill has been operating for a period in excess of 10 years, noise from the landfill site is considered a normal part of the acoustic environment (see A1 of Fact Sheet A – Noise Policy for Industry (EPA 2017)).

Table 4-3 Noise monitoring details

Location (GDA94 Zone 56)	Equipment details	Equipment photo	Equipment settings
L1: 41 Flarock Rd, Mundamia, NSW Coordinates: X = 276349 Y = 6136568	Svan 977 SN: 45743		A-weighted Fast time response 15 minute intervals Pre/post cal variance: 0.9 dB
L2: 3 Flarock Rd, Mundamia, NSW Coordinates: X = 276293 Y = 6136236	Svan 977 SN: 45733		A-weighted Fast time response 15 minute intervals Pre/post cal variance: 0.0 dB

Table 4-4 Summary of ambient and background noise monitoring results

Location	NCA	Background noise descriptors $L_{A90(Period)}$, dBA				Ambient noise descriptors $L_{Aeq(period)}$, dBA			
		EMS	Day	Eve	Night	EMS	Day	Eve	Night
L1: 41 Flarock Rd, Mundamia, NSW	NCA1	38	36	25	23	54	58	42	47
L2: 3 Flarock Rd,	NCA2	39	37	28	24	53	55	44	50
Mundamia, NSW									

Notes 1: EMS refers to the early morning shoulder period – 6 am to 7 am

Table 4-5 Summary of road traffic noise monitoring results

Location	NCA	$L_{Aeq(15\ hr)}$ day	$L_{Aeq(9\ hr)}$ night	Peak $L_{Aeq(1hr)}$ day	Peak $L_{Aeq(1hr)}$ Early morning shoulder
L1: 41 Flarock Rd, Mundamia, NSW[1]	NCA1	58	46	60 (11 am to 12am)	50 (6 am to 7 am)
L2: 3 Flarock Rd, Mundamia, NSW[2]	NCA2	55	49	57 (11 am to 12am)	53 (6 am to 7am)

Note 1: Dominant traffic noise source is Flatrock Road and Yalwal Road
Note 2: Dominant traffic noise source is Flatrock Road only

4.5 Summary of attended noise monitoring results

Attened noise measurements (15 minute) were undertaken at several locations in the surrounding area to characterise the existing noise environment in the area. The results of the noise measurements are presented in Table 4-6.

Table 4-6 Summary of ambient and background noise monitoring results

ID	Location	Time	$L_{A90(15\ min)}$	$L_{Aeq(15\ min)}$	$L_{Amax(15\ min)}$	Notes
A1	41 Flatrock Road (near road)	14:15	40	58	79	Trucks on Flatrock Road, birds, dog barking, helicopters nearby
A2	41 Flatrock Road (backyard)	14:30	39	49	63	Site (landfill) noise Birds and road noise
A3	Site entrance	15:00	39	63	89	Cars and trucks entering and the exiting landfill site
A4	3 Flatrock Road (near road)	15:30	46	63	83	Trucks and cars on Yalwal Road. Dogs, sheep and cows audible

4.6 Local meteorology

The NPfI states that when there is greater than a 30% occurrence of wind of up to 3 m/s, in any period (day, evening, night) in any season, from source to receiver, wind should be considered in noise prediction calculations. Wind conditions at the site are based on weather data obtained from the Bureau of Meteorology's Nowra RAN Air Station AWS (SN: 068076), located approximately 7 km to the south of the site.

Figure 4-2 presents seasonal wind roses periods for 2017 - 2019 at the site. Analysis of the seasonal wind rose data indicates that, during the evening and night time period, winds up to 3 m/s occur more than 30% of the time in a westerly, west-northwesterly and west-southwesterly direction as shown in Table 4-7[1]. Temperature inversions are likely to occur for more than 30% of the time during the night time winter period.

[1] The NPfI specifies for a 16-direction wind compass to use the arithmetic sum of the direction being reported and the four closest directions

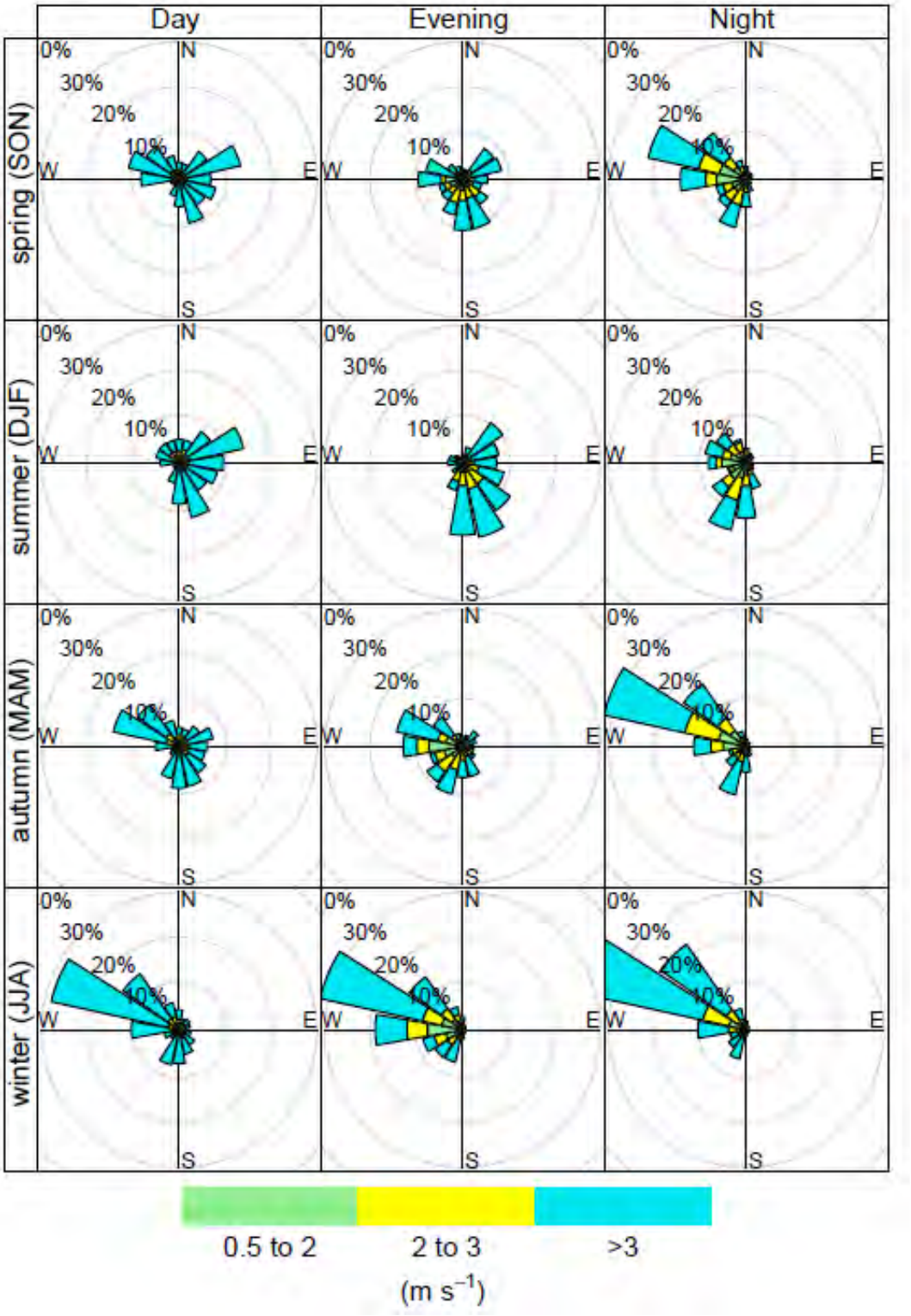


Figure 4-2 3 year wind roses – frequency of counts by wind direction (%)

Table 4-7 Significant wind effects analysis

Wind direction[1]	Summer			Autumn			Winter			Spring		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
N	10%	4%	13%	10%	7%	10%	9%	10%	8%	7%	7%	11%
NNE	9%	5%	9%	8%	5%	3%	7%	5%	3%	6%	7%	6%
NE	9%	6%	5%	8%	6%	1%	5%	2%	1%	6%	8%	3%
ENE	8%	9%	4%	7%	5%	1%	4%	1%	0%	5%	8%	2%
E	7%	13%	3%	8%	6%	1%	4%	0%	0%	5%	11%	2%
ESE	7%	17%	5%	7%	7%	1%	4%	1%	0%	5%	13%	2%
SE	6%	20%	9%	8%	8%	3%	4%	1%	0%	4%	16%	4%
SSE	6%	22%	17%	8%	12%	5%	5%	3%	1%	4%	18%	9%
S	5%	20%	22%	7%	17%	8%	5%	6%	3%	3%	20%	14%
SSW	3%	15%	24%	5%	21%	10%	5%	12%	4%	3%	20%	18%
SW	3%	11%	28%	5%	29%	17%	5%	24%	7%	2%	20%	26%
WSW	3%	7%	28%	6%	**32%**	29%	6%	**32%**	16%	3%	18%	**34%**
W	4%	4%	25%	8%	29%	**33%**	7%	**35%**	20%	4%	14%	**34%**
WNW	6%	3%	23%	8%	24%	**32%**	9%	**34%**	20%	5%	12%	**31%**
NW	8%	3%	22%	10%	19%	30%	10%	30%	20%	6%	10%	28%
NNW	10%	4%	17%	11%	11%	23%	10%	18%	17%	7%	7%	20%

Notes:

1) The percentages shown are the frequency of counts by wind direction and include the arithmetic sum of the direction being reported and the four closest directions

5. Criteria

5.1 Construction noise

The *Interim Construction Noise Guideline* (DECC 2009) is used to assess noise impacts associated with construction works. The guideline recommends standard hours for construction activities as Monday to Friday: 7 am to 6 pm, Saturday: 8 am to 1 pm and no work on Sundays or public holidays.

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

- The delivery of oversized plant or structures that police or other authorities 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.
- Works where a proponent demonstrates and justifies a need to operate outside the recommended standard construction hours.
- Works which maintain noise levels at receivers to below the noise management levels outside of the recommended standard construction hours.

Construction noise management levels for residential premises are provided in Table 5-1. The method to determine the noise management levels for residential receivers is in accordance with the ICNG.

Table 5-1 Noise management levels for residential receivers

Time of day	Noise management level, $L_{Aeq(15\ min)}$	Application notes
Recommended standard hours	Noise affected: RBL[1] + 10 dBA	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured LAeq(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 dBA	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 proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level. If no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and discuss respite periods for noisy works.

Time of day	Noise management level, $L_{Aeq(15\ min)}$	Application notes
Outside recommended standard hours	Noise affected: RBL + 5 dBA	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable measures have been applied and noise is more than 5 dBA above the noise affected level, the proponent should consult with the community. For guidance on negotiating agreements see Section 7.2.2 of the *Interim Construction Noise Guideline*.

Note 1: RBL – Rating Background Level, as defined by the NSW EPA *Noise Policy for Industry* (NPfI)

Noise management levels for other sensitive land uses are provided in Table 5-2.

Table 5-2 Noise management levels for other sensitive land uses

Land use	Noise management level, $L_{Aeq(15m)}$ (External)
Commercial	70 dBA
Classrooms	55 dBA (based on 45 dBA internal)
Industrial premises	75 dBA

A summary of the project construction noise management levels for each identified sensitive receiver type is provided in Table 5-3. An assessment of potential construction noise impacts has been undertaken in Section 6.1.

Table 5-3 Project construction noise management levels

Receiver Type	Time of day	Noise Management Level (NML)
Residential – NCA1	Standard construction hours	46 dBA
Residential – NCA 2	Standard construction hours	47 dBA
Commercial	When in use	70 dBA
Industrial	When in use	75 dBA (external)

5.2 Construction vibration

5.2.1 Human comfort

Humans are capable of detecting vibration at levels which are well below those causing risk of damage to a building. Acceptable vibration levels for human comfort are assessed in NSW with consideration to *Assessing Vibration: a technical guideline (DEC, 2006).*

Typically, construction activities generate ground vibration of an intermittent nature. Intermittent vibration is assessed using the vibration dose value. Acceptable values of vibration dose are presented in Table 5-4 for sensitive receivers.

Table 5-4 Human comfort intermittent vibration limits

Receiver type	Period	Intermittent vibration dose value ($m/s^{1.75}$)	
		Preferred value	Maximum value
Residential	Day (7 am and 10 pm)	0.2	0.4
	Night (10 pm and 7 am)	0.13	0.26
Offices, schools, educational institutes and places of worship	When in use	0.4	0.8

For construction related vibration, it is often more appropriate to provide assessment and guidance in terms of a unweighted peak particle velocity (PPV) vibration level, as this parameter is more routinely measured based on the more usual concern over potential building damage. Source data from literature is generally presented as an unweighted peak particle velocity (PPV) vibration level.

The degrees of perception for humans are suggested by the vibration level categories given in British Standard, BS 5228.2 – 2009, Code of Practice Part 2 Vibration for noise and vibration on construction and open sites and are shown below in Table 5-5. An assessment of potential construction vibration impacts associated with human comfort has been undertaken in Section 6.2.3.

Table 5-5 Guidance on effects of vibration levels for human comfort

Vibration level	Effect
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction.
0.3 mm/s	Vibration might be just perceptible in residential environments.
1.0 mm/s	It is likely that vibration at this level in residential environments will cause complaints, but can be tolerated if prior warning and explanation has been given to residents.
10 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure.

5.2.2 Guidelines for cosmetic damage to general structures

The effects of transient vibration on structures is considered in *BS 7385 Part 2 – 1993 Evaluation and measurement for vibration in buildings*. The criteria provided in BS 7385 are presented in Table 5-6. The guide values in for transient vibration assumes there are no resonant responses in structures and low-rise buildings. Where the dynamic loading caused by continuous vibration may give rise to dynamic magnification due to resonance, especially at lower frequencies, then the guide values are reduced by up to 50 per cent.

Table 5-6 Vibration guide values – minimal risk of cosmetic damage

Line	Type of structure	Peak component particle velocity in frequency range of predominant pulse – transient vibration		Peak component particle velocity in frequency range of predominant pulse – continuous vibration1	
		4 Hz to 15 Hz	15 Hz and above	4 Hz to 15 Hz	15 Hz and above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above		25 mm/s at 4 Hz and above	

Line	Type of structure	Peak component particle velocity in frequency range of predominant pulse – transient vibration		Peak component particle velocity in frequency range of predominant pulse – continuous vibration1	
		4 Hz to 15 Hz	15 Hz and above	4 Hz to 15 Hz	15 Hz and above
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above	7.5 mm/s at 4 Hz increasing to 10 mm/s at 15 Hz	10 mm/s at 15 Hz increasing to 25 mm/s at 40 Hz and above

Note: These values are based on section 7.4.3 *Guide values for continuous vibration relating to cosmetic damage* from BS 7385-2

The predominant vibration for most construction activities involving intermittent vibration sources such as rock breakers, piling rigs, vibratory rollers and excavators occurs at frequencies greater than 4 Hz (and usually in the 10 Hz to 100 Hz range). However, a conservative vibration damage screening level per receiver type is given below:

- Reinforced or framed structures: 25.0 mm/s
- Unreinforced or light framed structures: 7.5 mm/s

An assessment of potential construction vibration impacts associated with cosmetic damage to buildings has been undertaken in Section 6.2.4 using safe working distances from vibratory intensive equipment.

5.3 Operational noise

5.3.1 Noise policy

The Noise Policy for Industry (NPfI) provides guidance on the assessment of operational noise impacts. The guideline includes both intrusiveness and project amenity noise levels that are designed to protect receivers from noise significantly louder than the background level, and to limit the total noise level from industry near a receiver.

The NPfI project noise trigger levels provide an objective for assessing a project and are not mandatory limits required by legislation. The project noise trigger levels assist the regulatory authorities to establish licensing conditions. Where project noise trigger levels are predicted to be exceeded, feasible and reasonable noise mitigation strategies should be considered. In circumstances where noise criteria cannot be achieved, residual noise impacts are used to assess noise impacts and manage noise from the site in negotiation between the regulatory authority and community. The regulatory authority then sets statutory compliance levels that reflect the achievable and agreed noise limits from the development.

The intrusiveness noise level controls 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. Both levels are calculated and the lower of the two in each time period is set as the project noise trigger level. The intrusiveness noise level is assessed over a 15 minute period however the amenity noise level is assessed over the day, evening or night time period. For the purposes of assessment to standardise the approach the NPfI recommends that the $L_{Aeq(15min)} = L_{Aeq(period)} + 3$ dBA unless an alternative approach can be justified.

5.3.2 Intrusiveness noise level

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

5.3.3 Project amenity noise level

The recommended amenity noise level applies to all industrial noise 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.

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 NPfI 'noise amenity area' classification, the residential receivers identified for this assessment should be classified as 'Rural Residential'. 'Industrial premises' and 'Commercial premises' have also been identified within the study area.

When land uses in an area undergo significant change, such as the potential Mundamia Urban Release Area and the Cabbage Tree Lane Urban Release area, the background noise levels would be expected to change. As such, the impact of nose from an existing industry on a proposed new residential areas should generally be made using the recommended amenity noise level, not the project intrusiveness noise level. As additional industry is proposed in the area, the lower of the project amenity and the project intrusiveness noise levels have been used for R12, R13 and R14 and is considered conservative.

5.3.4 Summary of project noise trigger levels

For residential receivers, the project noise trigger levels are provided in Table 5-7. The project noise trigger levels reflect the most stringent noise level requirements derived from the intrusiveness and project amenity noise levels. Project noise trigger levels should be achieved during all periods of the day, as the facility will operate 24 hours a day (loudest operations between 7 am and 6 pm). An assessment of potential operational noise impacts has been undertaken in Section 6.4.

Table 5-7 Project noise trigger levels – residential receivers, dBA

Criteria $L_{Aeq(15min)}$	NCA	Residential receivers			
		EMS[1]	Day[1]	Evening[1]	Night[1]
Intrusiveness noise level	NCA1	43	41	35[2]	35[2]
	NCA2	44	42	35[2]	35[2]
Project amenity noise level (rural)	All	38	48	43	38
Project noise trigger levels	NCA1	38	41	35	35
	NCA2	38	42	35	35

Note 1: The NPfI defines Day as 7 am to 6 pm Monday to Friday and 8 am to 6 pm Saturday, Sunday and Public Holidays, Evening 6 pm to 10 pm, Early Morning Shoulder Period 6 am to 7 am and Night as the remaining periods.

Note 2: The minimum rating background level used for the intrusiveness criteria for the evening/night period is 30 dBA in accordance with the NPfI

For educational insitutes and commercial receivers, the project noise trigger levels are provided in Table 5-8.

Table 5-8 Project noise trigger levels – non-residential receivers, dBA

Receiver	Time of day	$L_{Aeq(15m)}$, dBA
Classrooms	When in use	45 (external)
Commercial premises	When in use	65 (external)
Notes: Based on an internal noise level of 35 dBA + 10 dBA to account for noise through and open window		

5.3.5 Modifying factor corrections

The NPfI requires that corrections for annoying characteristics are applied if the noise sources contain tonal, intermittent or low frequency characteristics, which have the potential to increase annoyance. The modifying factor adjustments are detailed in Table 5-9.

Table 5-9 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 above 400 Hz • 8 dB or more if the centre frequency of the band containing the tone is 160 to 400 Hz inclusive • 15 dB or more if the centre frequency of the band containing the tone is below 160 Hz.	5 dBA[2]
Low frequency noise	Measurement of C-weighted and A-weighted level	Measure/assess C and A weighted $L_{eq,T}$ 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]
Intermitte nt 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
Impulsive noise	A-weighted fast response and impulse response	If the difference in A-weighted maximum noise levels between fast response and impulse response is greater than 2 dB.	Apply the difference in measured noise levels as the correction up to a maximum of 5 dBA

Note 1: Where two or more modifying factors are present the maximum correction is limited to 10 dBA.

Note 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.

5.3.6 Sleep disturbance

The NPfI provides guidelines for assessing sleep disturbance from short-term noise events. A detailed maximum noise level event assessment should be undertaken where noise levels from the project site during night time hours (10:00 pm to 7:00 am) at residential receivers exceeds:

- $L_{Aeq,15min}$ 40 dBA 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 the greater,

No significant maximum noise events are anticipated between the hours of 10 pm and 6 am as there are no truck movements between these hours and there will be no sorting into the external despatch bins. As such, assessment of the potential sleep disturbance impacts between 6 am and 7 am is considered the worst-case. Table 5-10 below summarises the background noise level at the nearby residential receivers and sleep disturbance criterion.

Table 5-10 Sleep disturbance screening criteria

Receiver type	Early morning shoulder L_{A90} background noise level, dBAA	Screening criteria, dBA
Nearby residential receivers (NCA1)	38	40 $L_{Aeq,15min}$ 53 L_{AFmax}

5.1 Traffic noise – construction and operation

5.1.1 Noise policy

The *Road Noise Policy* (RNP) (DECCW, 2011) provides road traffic noise criteria for residential land uses affected by construction traffic on the public road network.

Section 3.4.1 of the RNP states that any increase in the total noise level at existing residences and other sensitive land uses affected by traffic generation on existing roads should be limited to 2 dBA above current levels. This limit only applies when the noise level without the development is within 2 dBA or exceeds the road traffic noise criterion provided in the RNP.

This has been used to identify potential impacts as a result of noise produced by construction traffic. If road traffic noise increases as a result of construction works within 2 dBA of current levels then the objectives of the RNP are considered to be met and no specific mitigation measures would be required.

Where construction traffic increases the existing road traffic noise levels by more than 2 dBA then further assessment against the road traffic noise criteria in Table 5-11 is required.

Table 5-11 Road traffic noise criteria, dBA

Type of development	Day 7 am to 10 pm	Night 10 pm to 7 am
Existing residence affected by additional traffic on arterial and sub-arterial roads generated by land use developments	60 $L_{Aeq(15\ hour)}$	55 $L_{Aeq(9\ hour)}$
Existing residence affected by additional traffic on local roads generated by land use developments	55 $L_{Aeq(1\ hour)}$	50 $L_{Aeq(1\ hour)}$

The construction traffic generated by the project is not significant enough to increase noise levels along Princess Highway.An assessment of potential road traffic noise increases along Kalander Street (sub-arterial road), Albatross Road (sub-arterial road), Yalwal Road (sub-arterial road) and Flatrock Road (local road).

6. Impact assessment

6.1 Construction noise impacts

6.1.1 Construction equipment

The noise levels for the construction equipment have been sourced from the following documents:

- Australian Standard 2436 – Guide to Noise Control on Construction, Maintenance and Demolition Site (2010)
- NSW Roads and Maritimes Services – Construction Noise and Vibration Guideline (2016)

The anticipated plant and equipment used for the project is shown in Table 6-1 with the corresponding sound power levels used in the noise model and the source of the noise level.

Table 6-1 Construction equipment sound power levels

Equipment	Noise Level (dBA)	Source
6t excavator	104	AS2436
20t Excavator	107	AS2436
25t crane	104	AS2436
Backhoe loader	106	AS2436
Bulldozer	108	AS2436
Hand tools	102	AS2436
Truck	110	CNVG
Concrete truck	113	CNVG
Welder	105	AS2436
Mobile crane	104	AS2436

Table 6-2 Construction noise scenarios – standard hours

Scenario ID	Scenario name/activity	Equipment	Activity nosie level (dBA)
CS1	Site establishment	• Trucks • Hand tools	111
CS2	Ground works and excavation	• Bulldozer (CAT D10) • 20t excavator • 6t excavator • Backhoe loader	113
CS3	Structure	• 25t crane • Welder • Trucks • Concrete truck	116
CS4	Landscaping	• 25t crane • Backhoe loader	108
CS5	Testing and commissioning	• Truck • welder	111

6.1.2 Noise modelling assumptions and parameters

Acoustic modelling was undertaken using CadnaA 2020 noise modelling software to predict the effects of construction noise generated by the proposed works.

CadnaA is a computer program for the calculation, assessment and prognosis of noise propagation. CadnaA calculates environmental noise propagation according to ISO 9613-

2:1996. Terrain topography, ground absorption, atmospheric absorption and relevant shielding objects are taken into account in the calculations.

The ISO 9613-2:1996 algorithm also takes into account the presence of a well-developed moderate ground based temperature inversion, such as commonly occurs on clear, calm nights or 'downwind' conditions which are favourable to sound propagation. The proposed construction hours are 7.00 am to 6 pm weekdays and until 1 pm on Saturdays meaning that temperature inversions are not likely. As such, modelling moderate temperature inversions and downwind during the daytime considered conservative. General parameters used in the model are listed in Table 6-3.

Table 6-3 Noise modelling parameters

Variable	Parameter used
Calculation method	ISO 9613- 2:1996
Meteorology	Well-developed moderate ground based temperature inversion, such as commonly occurs on clear, calm nights or 'downwind' conditions which are favourable to sound propagation.
Topography	1 metre resolution
Receiver heights	1.5 metres above building ground level
Ground absorption	0.75 for all areas (0 is non-porous ground and 1 is porous ground such as that found in a rural setting comprising of mainly grass and vegetation)

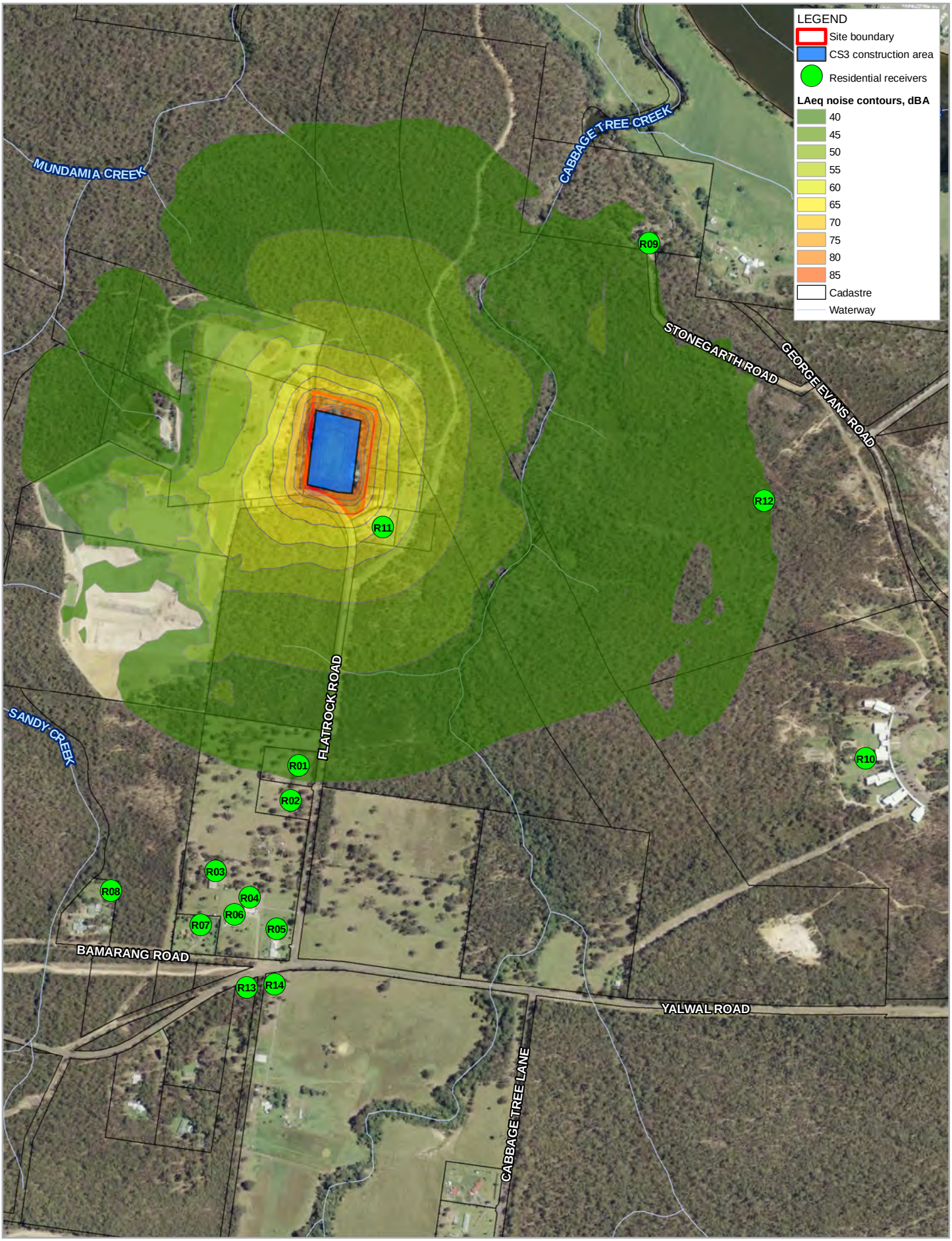
6.1.3 Predicted noise levels

Construction noise levels have been predicted to the sensitive receivers within the study area with consideration to the acoustic requirements of the ICNG. The predicted maximum noise level along with the noise management levels (NML) for each receiver are presented in Table 6-4. The noise modelling assumes that all equipment in the scenario are operating at maximum capacity simultaneously at the closest distance between the construction works and the receiver. As such, the predicted noise levels are highly conservative and actual noise levels are likely to be lower than those presented below.

The results of the modelling indication that construction noise management levels are not predicted to be exceeded at any sensitive receiver during standard hours. The construction scenario that is predicted to result in the highest noise levels is Phase 3 construction of the structure (CS3). The highest noise levels at the nearest residential receivers are predicted to be more than 5 dBA below the NML at all sensitive receivers. Standard mitigation measures are recommended tin Section 7.1 to reduce any potential noise impacts at sensitive receivers.

Construction noise contours for the worst-case scenario (CS3) are shown in Figure 6-2.

Note should be made that predictions have not been made to the potential future sensitive receivers (R12, R13 and R14). However, should these subdivisions be built before the commencement of construction works, noise levels at these receivers are anticipated to be below the NMLs.



Paper Size ISO A4
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Metres

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

N

GHD

Bioelektra Australia Pty Ltd
West Nowra Resource Recovery Park - Stage 2

Project No. 12536311
Revision No. -
Date 06 May 2021

Construction noise contours

FIGURE 6-1

\\ghdnet\ghd\AU\Sydney\Projects\21\12536311\GIS\Maps\Deliverables\12536311_Z008_CS3.mxd Data source: Aerial imagery - Google Earth 2021 (image date - 24/02/2016, image extracted - 25/08/2020) & Sixmaps 2021 (© Department of Customer Service 2020); General Topo: NSW LPI DTDB 2020 & 2015; Cadastre: NSW LPI DCDB 2020; Borehole locations - ENRS. Created by: afoddy

Table 6-4 Predicted noise levels, dBA

ID	Name / location	NML	CS1	CS2	CS3	CS4	CS5
R01	43 Flatrock road	46	35	37	40	32	35
R02	41 Flatrock Road	46	34	36	39	31	34
R03	3 Flatrock Rd	47	30	32	35	27	30
R04	3 Flatrock Rd	47	30	32	35	27	30
R05	3 Flatrock Rd	47	29	31	34	26	29
R06	3 Flatrock Rd	47	29	31	34	26	29
R07	18 Bamarang Road	47	29	31	34	26	29
R08	38A Old Bamarang Road	47	28	30	33	25	28
R09	Stonegarth Road	46	32	34	37	29	32
R10	University of Wollongong - Shoalhaven Campus	55	25	27	30	22	25
R11	NPWS Office	70	57	59	62	54	57

6.2 Construction vibration impacts

6.2.1 Vibration modelling methodology

The method for the construction vibration assessment included:

- Identifying safe working distances to comply with the human comfort and the cosmetic damage criteria. These buffer distances have been adopted from *Construction Noise and Vibration Strategy* (CNVS) (TfNSW 2019) which has been provided as a reference document in the SEARs.
- Safe working distances for vibration intensive equipment are shown in Table 6-5. The vibratory equipment associated with the project include vibratory rollers, rock breakers and jackhammers.
- Buildings within the safe working distances have been identified for consideration of management measures.

6.2.2 Vibration safe working distances

Safe working distances for vibratory intensive equipment has been sourced from the TfNSW CNVS and are shown in Table 6-5.

Table 6-5 Vibration safe working distances

Equipment	Human comfort (OH&E Vibration guideline)	Cosmetic damage (BS 7385)
Piling rig – Bored <800 mm	N/A	2 m (nominal)
Piling rig–Hammer (12 t down force)	50 m	15 m
Piling rig – Vibratory (sheet piles)	20 m	2 m to 20 m
Vibratory roller (>18 tonnes)	100 m	25 m
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

Equipment	Human comfort (OH&E Vibration guideline)	Cosmetic damage (BS 7385)
Small hydraulic hammer 300 kg (5-12t excavator)	7 m	2 m
Medium hydraulic hammer 900 kg (12-18t excavator)	23 m	7 m
Large hydraulic hammer 1600 kg (18-34t excavator)	73 m	22 m
Jackhammer (handheld)	Avoid contact with structure	1 m (nominal)

6.2.3 Human comfort

The most vibration intensive activity associated with the construction works are anticipated to be excavation works with a 26 tonne excavator. Excavation activities have the potential to exceed the human comfort vibration criteria should these works occur within 73 metres of residences. No residences have been identified within 73 metres of excavation works and as such, no adverse vibration impacts are anticipated as a result of the project.

6.2.4 Structural damage

Excavation works have the potential to exceed the cosmetic damage criteria should these works occur within 22 metres of a sensitive receiver building. No buildings have been identified within 22 metres of excavation works and as such, no adverse cosmetic damage vibration impacts are anticipated as a result of the project.

6.3 Road traffic noise impacts

6.3.1 Vehicles along arterial/sub-arterial/collector roads

Forecasts of the traffic volumes along Yalwah Road (east of Flatrock Road), Albatross Road, Kalander Street and Princess Highway have been undertaken by the GHD traffic team (Table 2-2 of the West Nowra Traffic Impact Assessment). These daily volumes are presented in Table 6-6 below.

A significant increase in traffic volumes would be needed in order to increase road traffic noise by 2 dBA (increasing the existing traffic volumes by a minimum factor of 1.6 times). It is estimated that during peak construction periods up to 40 heavy vehicles and 50 light vehicles will utilise the roads identified in Table 6-6 below. An additional 90 vehicle movements (40 heavy vehicles and 50 light vehicle movements) is not significant enough to increase noise levels by 2 dBA along these roads. As such, the noise requirements of the RNP are predicted met along these roads.

During operation, it is estimated that up to 42 heavy vehicles and 170 light vehicles will utilise the roads identified in Table 6-6 below. An additional 212 vehicle movements (42 heavy vehicles and 170 light vehicle movements) is not significant enough to increase noise levels by 2 dBA along these roads. As such, the noise requirements of the RNP are predicted to be met along these roads.

Table 6-6 Predicted 2020 traffic volumes

Location	Predicted 2020 volumes (bi-directional)
Yalwah Road (east of Flatrock)	1,652
Albatross Road	11,700
Kalandar Street	8,641
Princes Highway	39,062

Location	Predicted 2020 volumes (bi-directional)
Princes Highway	77,252

6.3.1 Vehicles along local roads

To evaluate the impacts on receivers near the proposed access road to the site, calculations were undertaken using the RMS construction noise estimator utilising the United Kingdom Department of Transport, Calculation of Road Traffic Noise, 1988 (CoRTN) prediction method.

To assess noise impacts from traffic along Flatrock Road during construction and operation of the project, an initial screening test has been undertaken to evaluate whether noise levels are predicted to increase by more than 2 dBA. Where increases are 2 dBA or less, then no further assessment is required

Where noise levels levels increase by more than 2 dBA (i.e., 2.1 dBA) and noise levels exceed the controlling criterion, then the receiver qualifies for consideration of noise mitigation under the RMS Noise Mitigation Guideline. The estimated peak hour traffic volumes along Flatrock Road are shown in Table 6-7 and the change in traffic noise levels along Flatrock Road are shown in Table 6-8.

Table 6-7 Peak traffic volumes along Flatrock road

Road	Scenario	Day Peak (1 hour) – 7 am to 10 pm		Night Peak (1 hour) – 6 am to 7 am[2]	
		HV	LV	HV	LV
Flatrock Road	Existing traffic volumes[1]	5	61	1	6
	Additional traffic during construction[3]	4	5	0	0
	Additional traffic during operation[4]	8	54	4	27
	Total traffic volumes during construction	9	66	1	6
	Total traffic volumes during operation	13	115	2	33

Notes:

1 Based on GHD traffic forecasts for Flatrock Road for the PM peak hour period with an assumed 8% HV.
2 Existing hourly volumes between 6 am and 7 am were not available. Hourly volumes during the EMS period (6 am to 7am) is estimated to be 10% of the peak hourly volumes during the day period (11 am to 12 pm). This is based on a difference of 10 dBA for the $L_{Aeq(1hour)}$ day and $L_{Aeq(1hour)}$ night periods at 41 Flatrock Road (see Table 4-5).
3 Assumptions based on Table 3-2
4 Assumptions based on Table 3-3

Table 6-8 Change in traffic noise levels, Flatrock Road

Road	Change in noise level, $L_{Aeq(1hr)}$ dBA		Distance where the controlling criterion is exceed		Any residential dwellings along Flatrock Road within the mitigation distance?
	Day	Night	Day, $L_{Aeq(1hr)}$ 55 dBA	Night, $L_{Aeq(1hr)}$ 50 dBA	
During construction	+ 1.3	+0.0	35 metres	14 metres	No
During operation	+0.9	+5.6	37 metres	34 metres	No

Notes:

Speed of construction related vehicles assumed to be 80 km/hr as a worst-case
Speed of operation related heavy vehicles assumed to be 50 km/hr to reduce potential traffic noise impacts

6.3.2 Assessment of impacts during construction

During standard hours an increase in road traffic noise levels of +1.3 dBA is predicted for residences along Flatrock Road. As such, the noise requirements of the RNP are met and no further mitigation is required.

6.3.3 Assessment of impacts during operation

To reduce potential traffic noise impacts during operation, heavy vehicle movements along Flatrock Road should be limited to 50 km/hr. Based on this assumption, an increase of +0.9 dBA is predicted during the day period and increase of +5.6 dBA is predicted during the night period (between 6 am and 7 am). Noise levels are predicted to exceed the $L_{Aeq(1hour)}$ night criterion of 50 dBA at 34 metres from the edge of the road and the $L_{Aeq(1hour)}$ day criterion of 55 dBA at 37 metres from the road. No residential dwellings have been identified as falling within this mitigation distance and as such, the noise requirements of the RNP are met.

Operational traffic related mitigation measures are provided in Section 7.3.

6.4 Operational noise impacts

6.4.1 Noise modelling inputs

Acoustic modelling was undertaken using CadnaA 2020 noise modelling software to predict the effects of noise generated during the operation of the facility.

CadnaA is a computer program for the calculation, assessment and prognosis of noise propagation. CadnaA calculates environmental noise propagation according to the ISO 9613-2 prediction method. Terrain topography, ground absorption, atmospheric absorption and relevant shielding objects are taken into account in the calculations.

NPfI noise enhancing meterological conditions have been adopted for the assessment. The calculation method used in the noise modelling (ISO 1996-2) predicts the noise level under meteorological conditions favourable to propagation of noise. These conditions are for downwind propagation from source to receiver, as specified in Section 5.4.3.3 of ISO 1996-2:1987 and factors in a well-developed moderate ground based temperature inversion, such as commonly occurring at night. As such, modelling moderate temperature inversions and downwind source to receiver conditions during all periods of the day is considered conservative.

General parameters used in the model are listed in Table 6-9.

Table 6-9 Noise modelling parameters

Variable	Parameter used
Calculation method	ISO 9613-2 - assumes the presence of a well-developed moderate ground based temperature inversion, such as commonly occurs on clear, calm nights and factors in 'downwind' conditions which are favourable to sound propagation
Topography - existing	1 metre resolution
Receiver heights	1.5 metres above building ground level
Ground absorption	0.75 for all areas (0 is non-porous ground and 1 is porous ground such as that found in a rural setting comprising of mainly grass and vegetation)
Volume attenuation area (foliage)	10 m high foliage (based on Sixmaps aerial imagery)

6.4.2 Noise generating equipment and activities

Operational noise source data has been estimated based on AS 2436 – 2010 'Guide to Noise Control on Construction, Maintenance and Demolition Sites', previous GHD measurements and from manufacturer source noise data. For noise sources with limited source noise data, GHD has conservatively assumed the following:

- Conveyors and drive units have a cumulative sound power level of 100 dBA during operation. The number of conveyors per hall has been estimated based.

- The dosing bunker has a sound power level of 110 dBA during operation
- External pumps and motor units have a cumulative sound power level of 89 dBA
- External aerators have a sound power level of 80 dBA
- The external transformer has a sound power level of 84 dBA
- Each autoclave has a sound power level of 95 dBA
- The boiler burner and pumps have cumulative sound power level of 105 dBA (radiated)
- Each separator in the sorting hall has a sound power level of 105 dBA during operation
- The dust collector has a sound power level of 105 dBA (radiated)
- Material being sorted from the sorting facility into each material bin has a sound power level of 110 dBA. As a worst-case it is assumed that four of these chutes are operational along the northern façade and four along the eastern façade simultaneously.
- All ventilation fans and exhausts are designed to have a maximum sound power level of 90 dBA at the exhaust, including (but not limited to):
  - Reception Hall exhaust fan x 1
  - Sorting Hall ventilation fan x 8
  - Boiler flue exhaust x 1
  - Dust collector exhaust x 1
  - Sorting Hall ventilation fan x 1
- Rooftop ventilation fans are sufficiently isolated from the structure of the building (mechanically decoupled) to not result in structure-borne noise

The octave-band noise levels used in the noise model are shown in Appendix D.

Table 6-10 Operational noise source data

Location	Internal / external	Quantity	Noise source/activity	SWL (each), dBA	Source	Worst-case operation
Stationary equipment						
Reception Hall	Internal	2	Eggersman Teuton Shredder	117	Eggersman	All
	Internal	1	Loader	104	AS 2436	All
	Internal	2	Conveyor and drive unit	100	GHD estimate	All
	Internal	1	Dosing bunker	110	GHD estimate	All
	Roof	1	Ventilation exhaust fan	90	To be designed	All
Sterilisation Hall	Internal	16	RotoSteril BEG 7000 autoclave	90	GHD estimate	All
	Internal	5	Conveyor and drive unit	100	GHD estimate	All
	Roof	8	Exhaust fan	90	To be designed	All
Sorting Hall	Internal	6	Fe separator	105	GHD estimate	All
	Internal	2	Sieve / screens	105	GHD estimate	All
	Internal	1	Tomra Finder	105	GHD estimate	All
	Internal	2	Air separator	105	GHD estimate	All
	Internal	2	Rotoshifter	105	GHD estimate	All
	Internal	5	Optical separator	105	GHD estimate	All
	Internal	1	Eggersman 2D/3D separator	105	GHD estimate	All
	Internal	2	Eddy Current separator	105	GHD estimate	All
	Internal	1	Atlas copco air compressor	105	GHD estimate	All
	Internal	1	Dust collector (radiated)	105	GHD estimate	All
	Roof	1	Dust collector (exhaust)	90	GHD estimate	All
	Roof	4	Ventilation exhaust fan	90	To be designed	All
Boiler room	Internal	1	Burner and pumps	105	GHD estimate	All
	Roof	1	Flue gas exhaust	90	To be designed	All
Despatch area	External	4	North façade sorting areas	110	GHD estimate	All
	External	4	East façade sorting areas	110	GHD estimate	All
Transformer area	External	1	Transformer	84	GHD estimate	All
Wastewater Treatment Plant	External	3	Tank aerators	80	GHD estimate	All
	External	2	Pump and motor	89	GHD estimate	All
Mobile plant						
Internal roads	External	Max 4/hour	Trucks arriving and departing	109	AS 2436	6 am to 6 pm
Northern despatch area	External	1	Loader operating	104	AS 2436	6 am to 6 pm
Eastern despatch area	External	1	Loader operating	104	AS 2436	6 am to 6 pm

Table 6-11 Sound transmission performance of building components

Area	Component	Type	Façade	Sound reduction performance, octave-band									Rw	Modelled area
				31.5	63	125	250	500	1k	2k	4k	8k		
Reception Hall	Walls	Concrete panel	South	15	22	30	34	40	50	50	52	53	45	600 m^2
		Concrete panel	East	15	22	30	34	40	50	50	52	53	45	270 m^2
		Concrete panel	West	15	22	30	34	40	50	50	52	53	45	350 m^2
	Roof	Sandwich panel	Roof	2	12	16	16	27	33	42	49	52	30	2075 m^2
	Roller door	0.6 mm steel	East	0	3	8	14	20	23	26	27	35	23	80 m^2
	Louvres	Acran 100	South	0	5	14	14	16	21	27	27	25	21	26 m^2
Sterilisation Hall	Walls	Concrete panel	North	15	22	30	34	40	50	50	52	53	45	300 m^2
		Concrete panel	South	15	22	30	34	40	50	50	52	53	45	600 m^2
		Concrete panel	East	15	22	30	34	40	50	50	52	53	45	650 m^2
		Concrete panel	West	15	22	30	34	40	50	50	52	53	45	450 m^2
	Roof	Sandwich panel	Roof	2	12	16	16	27	33	42	49	52	30	2180 m^2
	Louvres	Weather louvre	East	3	3	3	3	3	3	3	3	3	3	40 m^2
		Weather louvre	West	3	3	3	3	3	3	3	3	3	3	40 m^2
Sorting Hall	Walls	Concrete panel	North	15	22	30	34	40	50	50	52	53	45	730 m^2
		Concrete panel	East	15	22	30	34	40	50	50	52	53	45	540 m^2
		Concrete panel	West	15	22	30	34	40	50	50	52	53	45	310 m^2
	Roof	Sandwich panel	Roof	2	12	16	16	27	33	42	49	52	30	2000 m^2
	Louvres	Weather louvre	East	3	3	3	3	3	3	3	3	3	3	40 m^2
		Weather louvre	West	3	3	3	3	3	3	3	3	3	3	40 m^2
	Openings	Opening	North	0	0	0	0	0	0	0	0	0	0	40 m^2
		Opening	East	0	0	0	0	0	0	0	0	0	0	40 m^2
Boiler room	Walls	Concrete panel	West	15	22	30	34	40	50	50	52	53	45	200 m^2
	Roof	Sandwich panel	Roof	2	12	16	16	27	33	42	49	52	30	560 m^2
	Louvres	Weather louvre	West	3	3	3	3	3	3	3	3	3	3	32 m^2

6.4.1 Predicted noise levels

The predicted noise results are presented in Table 6-12 below.

Table 6-12 Predicted noise levels

Receiver ID	Residential NCA	Type	$L_{Aeq(15min)}$ Project noise trigger level (NPfI), dBA		Predicted LAeq(15min) Level – Day / EMS	Predicted LAeq(15min) Level – Evening / Night	Compliance?
			Day (EMS)	Evening / Night			
R01	NCA1	Residential	41 (38)	35	38	35	Yes
R02	NCA1	Residential	41 (38)	35	36	34	Yes
R03	NCA1	Residential	41 (38)	35	33	32	Yes
R04	NCA2	Residential	42 (38)	35	32	31	Yes
R05	NCA2	Residential	42 (38)	35	32	30	Yes
R06	NCA2	Residential	42 (38)	35	32	31	Yes
R07	NCA2	Residential	42 (38)	35	31	30	Yes
R08	NCA2	Residential	42 (38)	35	31	30	Yes
R09	NCA2	Residential	42 (38)	35	33	30	Yes
R10	-	Classrooms	45	45	31	28	Yes
R11	-	Commercial	65	65	50	46	Yes
R12	NCA2	Future residential	42 (38)	35	34	31	Yes
R13	NCA2	Future residential	42 (38)	35	31	30	Yes
R14	NCA2	Future residential	42 (38)	35	33	29	Yes

6.4.2 Assessment of impacts

The results of the noise modelling indicate that compliance is predicted at all existing and future sensitive receivers during worst-case operations during the early morning shoulder period. Compliance during this period ensure compliance with the less-stringent day period.

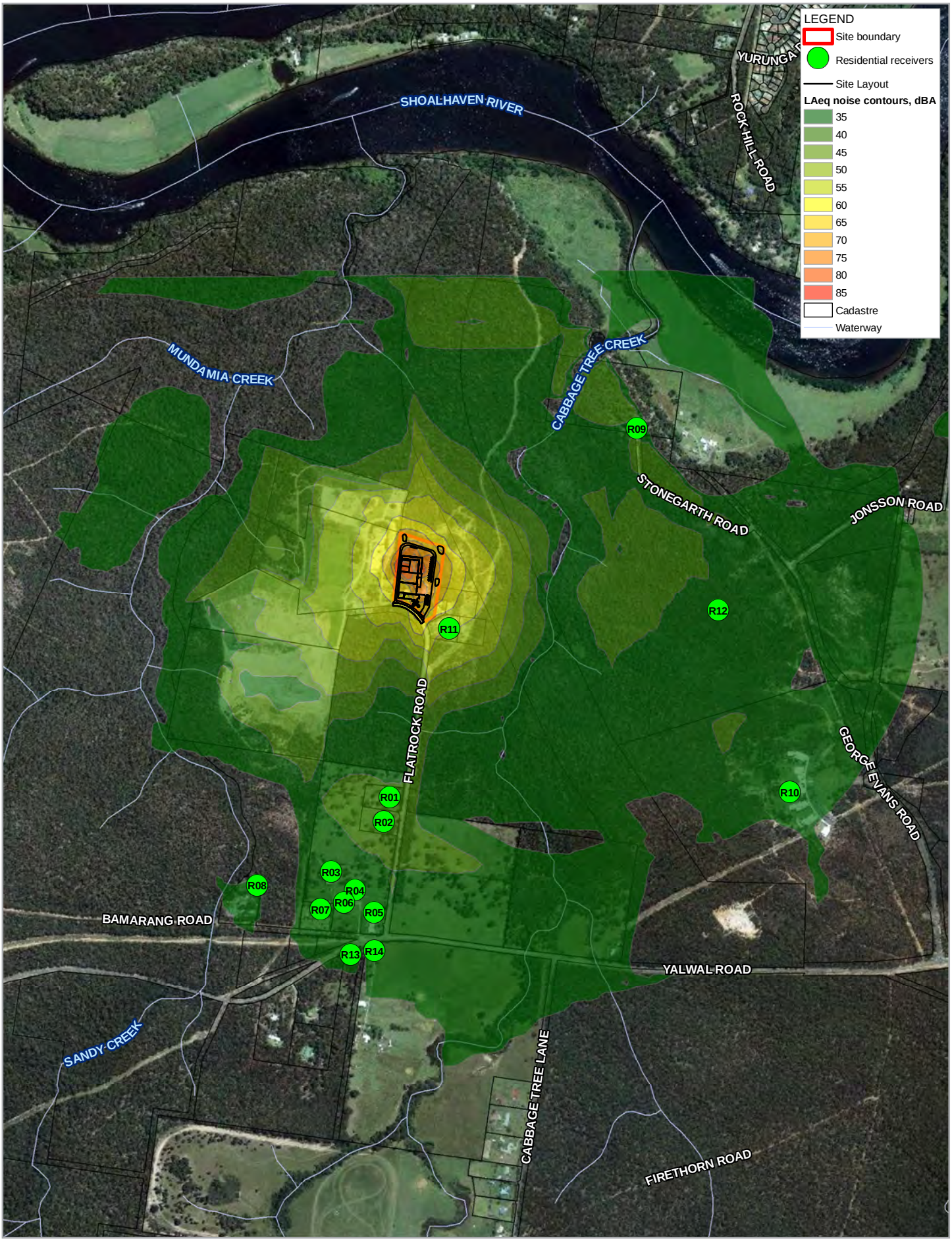
Note should be made that the noise levels during the early morning shoulder period are likely to be lower than those presented as there will be less truck movements during this period and the roller door will be open for a shorter period of time.

Compliance with the evening and night period is also predicted based on the assumption that there are no truck movements or sorting into the external despatch areas between 6 pm and 6 am.

Noise mitigation measures are provided in Section 7.2 to ensure compliance with the noise requirements of the Noise Policy for Industry (EPA 2017). Noise monitoring is also recommended at the commencement of operation in accordance with license conditions for the site. Operational noise contours during the EMS/day and the evening/night period are shown in Figure 6-2 and Figure 6-3, respectively.

6.4.3 Sleep disturbance impacts

Compliance with the noise criteria of $L_{Aeq(15minute)}$ 35 dBA during the night period and $L_{Aeq(15minute)}$ 38 dBA during the early morning shoulder period should ensure there are no sleep disturbance impacts at the nearest sensitive receivers. Should a maximum noise level event occur within the site (external of the building) at a sound power level of 115 dBA (dropped metal at a height as a worst case), the received noise level at the nearest residences is predicted to be less than L_{AFmax} 40 dBA and complies with the sleep disturbance criterion of L_{AFmax} 53 dBA.



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

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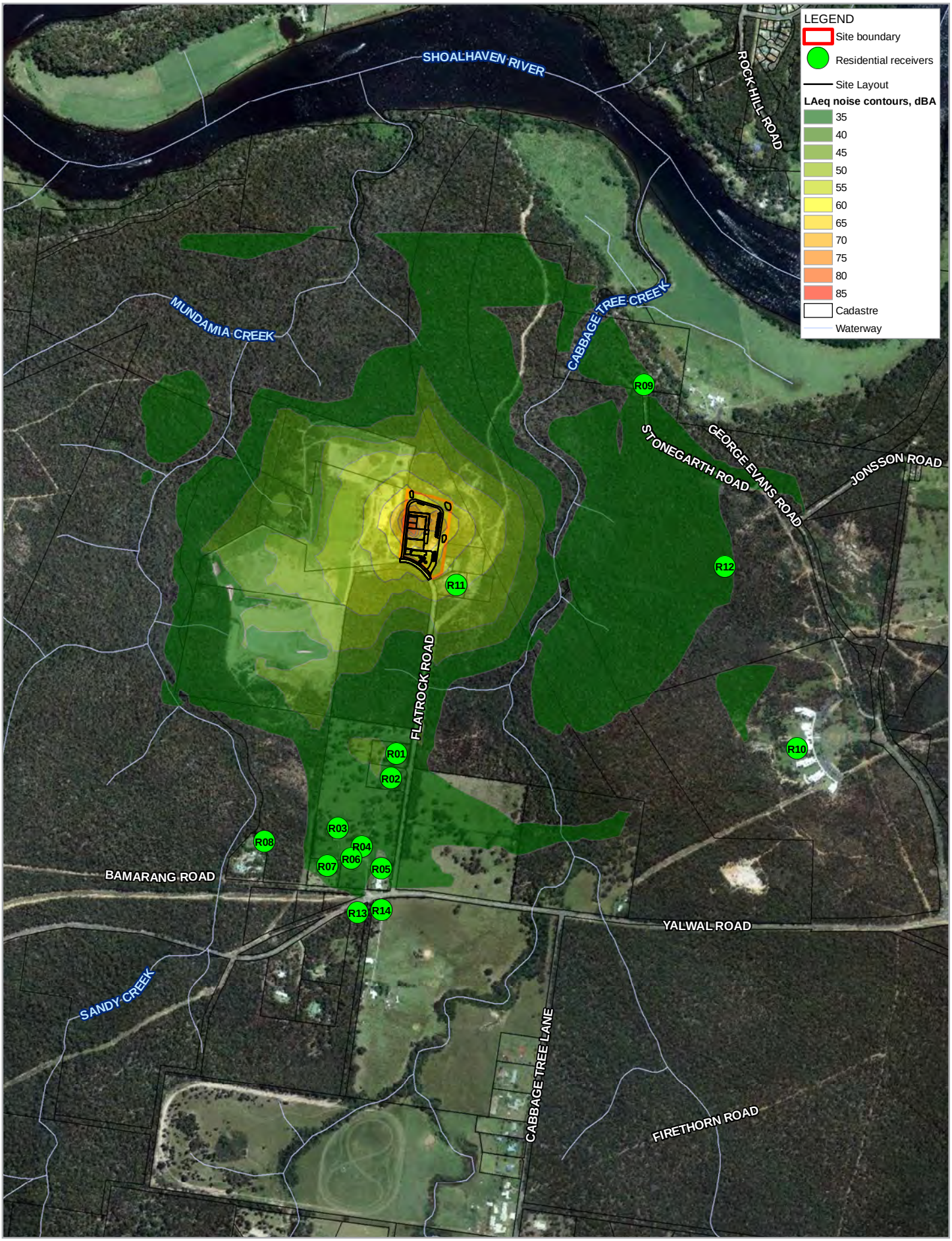
Bioelektra Australia Pty Ltd
West Nowra Resource Recovery Park - Stage 2

Operational noise contours, early morning shoulder period

Project No. 12536311
Revision No. -
Date 06 May 2021

FIGURE 6-2



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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Bioelektra Australia Pty Ltd
West Nowra Resource Recovery Park - Stage 2

Operational noise contours, night period

Project No. 12536311
Revision No. -
Date 06 May 2021

FIGURE 6-3

\\ghdnet\ghd\AU\Sydney\Projects\21\12536311\GIS\Maps\Deliverables\12536311_Z010_Night.mxd Data source: Aerial imagery - Google Earth 2021 (image date - 24/02/2016, image extracted - 25/08/2020) & Sixmaps 2021 (© Department of Customer Service 2020); General Topo: NSW LPI DTDB 2020 & 2015; Cadastre: NSW LPI DCDB 2020; Borehole locations - ENRS. Created by: afoddy

6.5 Cumulative noise impacts

6.5.1 Noise Policy for Industry amenity noise levels

The objective of the NPfI amenity noise level is to limit continuing increases in noise levels from the application of the intrusiveness level so the total industrial noise level remains below the recommended amenity noise level for residential receivers. The NPfI provides a recommended amenity noise level to represent the objective for total industrial noise at a receiver location and a project amenity noise level for noise from a single industrial development at a receiver location.

To ensure that industrial noise levels (existing plus new) remain with the recommended amenity noise level for an area, the project amenity noise levels is set at the recommended amenity noise level minus 5 dBA.

The NPfI states that were the project amenity noise level can be met, no additional consideration of cumulative industrial noise is required. As the predicted noise levels from the proposal are below the project amenity noise levels at all receiver locations, no further assessment of cumulative industrial noise is required.

Nevertheless, the Department of Planning, Industry and Environment (DPIE) has requested a cumulative assessment be undertaken to consider noise emissions from the project and the existing and future landfill operations of the West Nowra Recycling and Waste Facility.

To determine the cumulative noise impact of the project and the existing and future operations of the landfill, the total industrial noise level has been assessed against the recommended amenity noise level at each receiver location. The recommended amenity noise levels during the day period are presented in as this is the only assessment period where both sites will be operating concurrently.

Table 6-13 Project amenity noise levels – cumulative noise impacts

Receiver	Receiver type	Project amenity noise level, dBA
Existing residential receiver (R01 to R09)	Rural residential	$L_{Aeq(15min)}$ 53[1]
University of Wollongong – Shoalhaven Campus - R10	Educational institute (classrooms) – when in use	$L_{Aeq(1hour)}$ 45[2]
National Parks and Wildlife Services – R11	Commercial – when in use	$L_{Aeq(1hour)}$ 65

Notes:

1) To standardise the approach between $L_{Aeq(period)}$ and $L_{Aeq(15min)}$ noise level indicators, the NPfI recommends that the $L_{Aeq(15min)} = L_{Aeq(period)} + 3$ dBA

2) Based on an internal noise level of 35 dBA + 10 dBA to account for noise through and open window

6.5.2 West Nowra Recycling and Waste Facility

Shoalhaven City Council is developing an extension to the existing landfill operation at the West Nowra Recycling and Waste Facility at Flatrock Road located adjacent (to the west, southwest and south) of the proposal site. The existing landfill operations were approved in 1988 under the Environment Protection License (EPL) 5877 and the extension the the landfill has been approved under State Significant Development (SSD) 7187. The development of the landfill has been divided into stages, which are:

- Stage 1 – “old” landfill area, stockpile and irrigation areas, and landfill gas extraction;

- Stage 2 – recently completed landfill area, currently utilised for stockpiling and landfill gas extraction;
- Stage 3 – the active landfill disposal area(s) and wet weather tipping area; and
- Stage 4 – proposed landfill extension area.

The operating hours of the landfill (existing and future) is limited to 8 am to 5 pm, Monday to Sunday.

6.5.3 Predicted noise levels of existing and future landfill operations

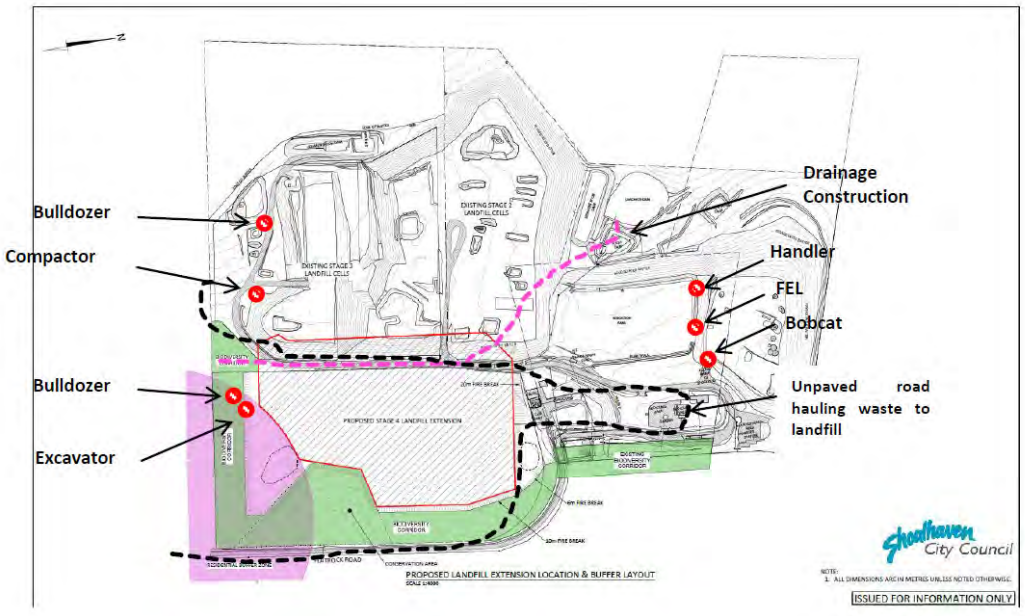
Three possible scenarios have been assessed to determine worst-case cumulative noise levels at each receiver location, being:

- Existing landfill operations and the Bioelektra facility operating at maximum capacity (Existing scenario) during the day period
- Operation of Stage 3 and Clearing of Landfill Sub-cell 1 of Stage 4 landfill operations and the Bioelektra facility operating at maximum capacity (Scenario 1) during the day period
- Operation of Landfill Sub-cell 1 and and Clearing of Landfill sub-cell 2 of Stage 4 and the Bioelektra facility operating at maximum capacity (Scenario 2) during the day period

The $L_{Aeq(15min)}$ operational noise predictions from the following reports have been taken to calculate the cumulative noise impacts for the relevant scenarios:

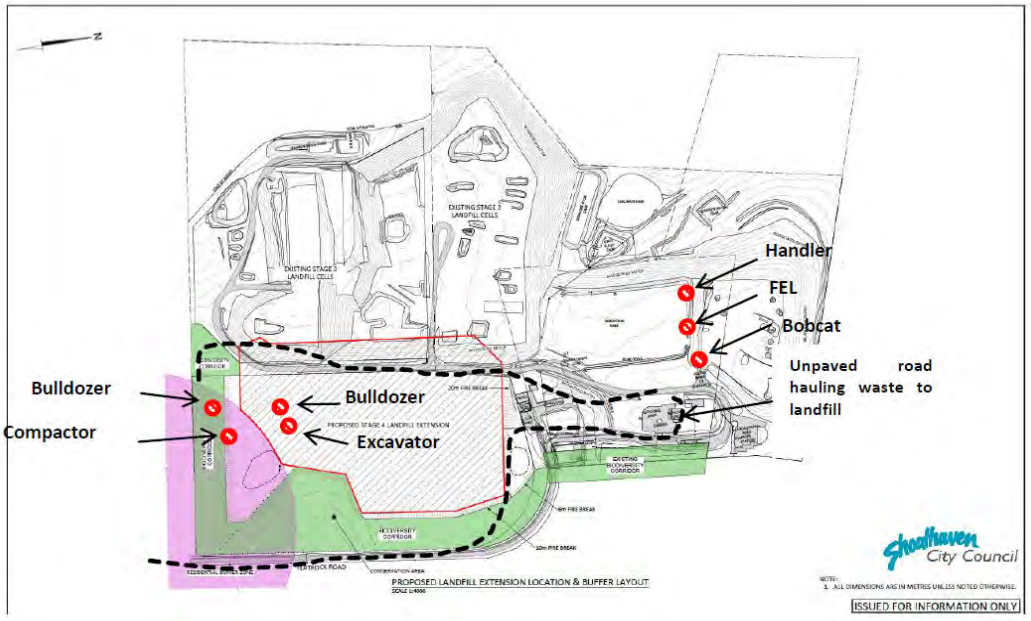
- Existing scenario - West Nowra Resource Recovery Park EIS Noise Assessment (GHD, Nov 2015)
- Scenario 1 and Scenario 2 – West Nowra Recycling and Waste Facility Noise Impact Assessment– Proposed Stage 4 Landfill Extension (SLR, June 2018)

The location of equipment for Scenario 1 and Scenario 2 are shown in Figure 6-4 and , respectively.



Source: West Nowra Recycling and Waste Facility NIA– Proposed Stage 4 Landfill Extension (SLR, June 2018)

Figure 6-4 Stage 4 Scenario 1 assumptions



Source: West Nowra Recycling and Waste Facility NIA – Proposed Stage 4 Landfill Extension (SLR, June 2018)

Figure 6-5 Stage 4 Scenario 2 assumptions

6.6 Cumulative noise impacts

The calculated cumulative noise levels at each receiver for all three scenarios indicate that the total industrial noise level is below the recommended amenity noise level.

The individual predicted noise levels and the calculated cumulative noise levels at each receiver is presented in Table 6-14 along with the relevant NPfI recommended amenity noise level.

Table 6-14 Calculated $L_{Aeq(15min)}$ cumulative noise levels, landfill (existing and future) and Bioelektra site

Receiver ID	Receiver Type	Predicted $L_{Aeq(15min)}$ noise levels, dBA				Calculated cumulative $L_{Aeq(15min)}$ noise levels, dBA			Recommended amenity $L_{Aeq(15min)}$ noise level, dBA	Total industrial noise level below recommended amenity noise level?
		Bioelektra	Existing landfill	Scenario 1	Scenario 2	Existing landfill + Bioelektra	Scenario 1 + Bioelektra	Scenario 2+ Bioelektra		
R01	Residential	38	43	44	42	44	45	43	53	Yes
R02	Residential	36	42	42	39	43	43	41	53	Yes
R03	Residential	33	41	39	35	41	40	37	53	Yes
R04	Residential	32	39	38	33	40	39	36	53	Yes
R05	Residential	32	38	35	31	39	37	34	53	Yes
R06	Residential	32	39	37	36	40	38	37	53	Yes
R07	Residential	31	39	37	32	40	38	35	53	Yes
R08	Residential	31	40	38	33	41	39	35	53	Yes
R09	Residential	33	35	29	28	37	35	35	53	Yes
R10	Classrooms	31	31	26	27	34	32	32	45	Yes
R11	Commercial	50	48	46	49	52	51	53	65	Yes
R12	Future residential	34	34[1]	29[2]	29[2]	37	35	35	53	Yes
R13	Future residential	31	38[1]	37[2]	37[2]	39	38	38	53	Yes
R14	Future residential	33	37[1]	35[2]	35[2]	38	37	35	53	Yes

Notes:

1) Noise predictions of the existing landfill at the future residential receivers has been modelled using the original CadnaA model for the West Nowra Resource Recovery Park EIS Noise Assessment (GHD, Nov 2015)

2) Noise predictions of future landfill operations (Scenario 1 and Scenario 2) at the future receivers have been estimated based on the highest-predicted noise level in the vicinity of the future receiver, being R09 for R12, R07 for R13 and R05 for R14 as a worst-case

7. Mitigation measures

7.1 Construction phase

Construction noise impacts will be undertaken during the standard construction hours. The following general noise mitigation measures are suggested to mitigate construction noise impacts:

- All engine covers should be kept closed while equipment is operating.
- As far as possible, materials dropping heights into or out of trucks should be minimised.
- Vehicles should be kept properly serviced and fitted with appropriate mufflers. The use of exhaust brakes should be eliminated, where practicable.
- Machines found to produce excessive noise compared to industry best practice should be removed from the site or stood down until repairs or modifications can be made.
- To reduce the annoyance associated with reversing alarms, broadband reversing alarms (audible movement alarms) would be used for all site equipment. Satisfactory compliance with occupational health and safety requirements would need to be achieved and a safety risk assessment may need to be undertaken to determine that safety is not compromised. Refer to Appendix C of the ICNG (2009) for more information.
- All equipment would be selected to minimise noise emissions. Equipment would be fitted with appropriate silencers and be in good working order. Machines found to produce excessive noise compared to normal industry expectations would be removed from the site or stood down until repairs or modifications can be made.

7.1.1 Work ethics

All site workers would be sensitised to the potential for noise impacts on local residents and encouraged to take practical and reasonable measures to minimise the impact during the course of their activities. This would include:

- Avoid the use of loud radios.
- Avoid shouting and slamming doors.
- Where practical, machines would be operated at low speed or power and switched off when not being used rather than left idling for prolonged periods.
- Keep truck drivers informed of designated vehicle routes, parking locations and delivery hours.
- Minimise reversing.
- Avoid dropping materials from height and avoid metal to metal contact on material.
- All engine covers would be kept closed while equipment is operating.

7.1.2 Community relations

Consultation and cooperation with the neighbours to the site will assist in minimising uncertainty, misconceptions and adverse reactions to noise. The following community relation measures would be implemented:

- The contractor would provide a community liaison phone number and permanent site contact so that noise complaints can be received and addressed in a timely manner.

- Upon receipt of a noise complaint, monitoring would be undertaken and reported as soon as possible. If exceedances are detected, the situation would be reviewed in order to identify means to attempt to reduce the impact to acceptable levels.

7.2 Operational phase

- Should any of the equipment listed within Section 6.4.2 have an operating sound power level higher than what has been assumed, further noise modelling is recommended during the detailed design stage to ensure the requirements of the Noise Policy for Industry (EPA 2017) are met.
- The roller doors to the reception hall should be closed, except during the ingress or egress of trucks
- Where possible, operation of the shredder should be limited to when the roller doors to the reception hall are closed
- Sorting of material into the external despatch bins on the northern and eastern facades of the facility should be limited to between 7 am and 6 pm Monday to Friday and 8 am to 6 pm on Saturdays
- The roof of the facility should be constructed of a material with a minimum Rw 30 (a suitable sandwich panel material can be specified in the detailed design phase)
- The walls of the facility should be constructed of a material with a minimum Rw 45 (such as 150 mm thick precast concrete panel)
- Louvres on the southern façade of the reception hall are to be constructed using acoustic louvres with a minimum width of 100 mm (for e.g. Acran 100 louvres or better)
- Rooftop ventilation fans are sufficiently isolated from the structure of the building (mechanically decoupled) to not result in structure-borne noise
- All ventilation fans and exhausts are designed to have a maximum sound power level of 90 dBA at the exhaust, including (but not limited to):
  - Reception Hall exhaust fan x 1
  - Sorting Hall ventilation fan x 8
  - Boiler flue exhaust x 1
  - Dust collector exhaust x 1
  - Sorting Hall ventilation fan x 1
- Noise monitoring at the nearest residential receivers is recommended at the commencement of operation in accordance with any license conditions

7.3 Traffic related mitigation measures

The following mitigation measures should be incorporated into the management plan for the site:

- To reduce potential traffic noise impacts during operation, heavy vehicle movements along Flatrock Road are to be limited to 50 km/hr.
- Drivers should undergo training to understand the potential noise impacts associated with the truck movements and to ensure only the prescribed haulage route is used to access the site
- Limit the use of exhaust brakes
- The use of mufflers on trucks, where possible

8. Conclusion

This report was prepared to assess potential noise impacts associated with construction and operation of the West Nowra Resource Recovery Park. Baseline noise levels were measured at two sensitive receiver locations within the study area. The results of baseline noise measurements, combined with construction and operational information were used to predict potential impacts on key sensitive receivers.

Construction activities during recommended standard hours are not predicted to exceed the construction noise management levels at any sensitive receivers. Recommended noise mitigation measures would be implemented where feasible and reasonable and all potentially impacted residents would be informed of the nature of the works, expected noise levels, duration of works and a method of contact to raise noise complaints.

Construction traffic noise is not expected to increase noise levels by more than 2 dBA at any residential receivers along the haulage routes. To ensure traffic noise levels do not exceed the RMS controlling noise criterion during operation, heavy vehicle movements are to be limited to 50 km/hr along Flatrock Road.

Operational noise from the resource recovery park is predicted to comply with the NPfI at the surrounding sensitive receivers (existing and future potential) during day, evening and night operations subsequent to the incorporation of the mitigation measures provided in Section 7.2.

As noise emissions from the project are below the project amenity noise levels during all relevant assessment periods, no further consideration of cumulative noise impacts are required. Nevertheless, DPIE has requested a cumulative noise impact assessment considering noise emissions from the project and the existing and future operations of the adjacent landfill.

A cumulative noise assessment has been undertaken to determine the total industrial noise level from the resource recovery park and the adjacent landfill for an existing scenario and two worst-case future scenarios (Stage 4). The total industrial noise level at each receiver was calculated to be below the NPfI recommened amenity noise level.

The project would be acceptable from an acoustic perspective assuming the recommended mitigation measures are implemented.

9. References

12536311 – West Nowra Traffic Impact Assessment Report, GHD 2020

AS 1055 Description and Measurement of Environmental Noise, Australian Standards 1997

AS 2436 Guide to noise and vibration control on construction, demolition and maintenance sites, Australian Standards 2010

BS 5228.2 Code of Practice for noise and vibration control on construction and open sites: Part 2 Vibration, British Standards, 2009

BS 7385-2 Evaluation and measurement for vibration in buildings – Guide to damage levels from ground borne vibration, British Standards 1993

Construction Noise and Vibration Guideline. RMS 2016

Construction Noise and Vibration Strategy, TfNSW 2020

Interim Construction Noise Guideline, DEC 2009

ISO 9316-2 Acoustics – Attenuation of sound during propagation outdoors – Part 2: General method of calculation, ISO 1996

Noise Policy for Industry, EPA 2017

Road Noise Policy, DECCW 2011

Secretary's Environmental Assessment Requirements (SSD 9887), 18 March 2019.

Appendices

Appendix A – Glossary and terminology

Acoustic concepts and terminology

Definition of 'noise'

Sound may be defined as any pressure variation that the human ear can detect. The terms "sound" and "noise" are more or less interchangeable however, "noise" is generally often referred to as unwanted sound.

Factors that contribute the environmental noise

Noise from an activity such as construction noise or noise during the operation of a facility at a given receiver location can be affected by a number of different factors, including:

- How loud the source activity is and the type of source:
  - Point (for e.g. a pump or motor)
  - Line (for e.g. a road or railway line)
  - Area (for e.g. the external façades of an industrial building)
- The distance from the source to receiver
- The type of ground between the sound and receiver locations (e.g. hard surfaces or porous ground)
- The ground topography between the source and the receiver. For e.g. is it flat or hilly? Blocking the line of sight will generally reduce the noise level for the receiver
- Obstacles that may block the line of sight between the source and the receiver. For e.g. buildings or noise walls
- Atmospheric absorption (dependent on humidity and temperature)
- Meteorological conditions that may increase or reduce environmental sound propagation (for e.g. wind direction or temperature inversions)

Noise measurements

Noise is generally measured using a specially designed 'sound level meter' (SLM) and must meet internationally recognized performance standards. To avoid expressing sound or noise in terms of Pa, which could involve some unmanageable numbers, the logarithmic decibel or dB scale is used. The scale uses the hearing threshold of 20 µPa or 20 x 10^{-6} Pa as the reference level and is defined as 0 dB.

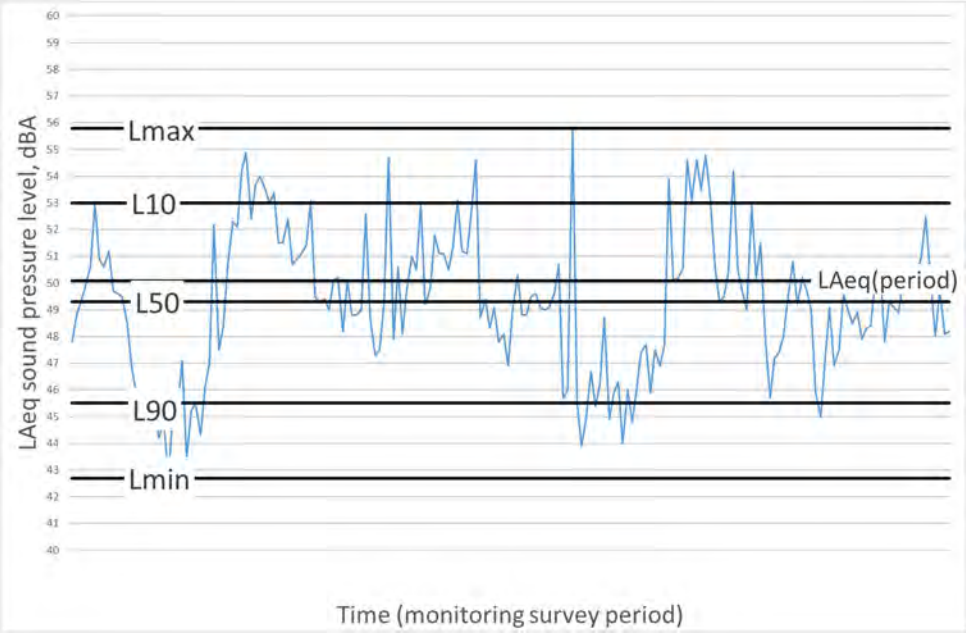
Typical noise levels

The table below presents typical noise sources for each various sound pressure levels and a corresponding subjective noise level description.

Subjective level	**Sound pressure level (dBA)**	**Typical sources**
Silent	0	Threshold of hearing
Almost silent	20	Recording studio
Quiet	30	Bedroom
	40	Private office
Moderate	50	General office
	60	Department store
Loud	70	Loud television
	80	Kerb side of busy street
Very loud	90	Construction site
	100	Loud car horn (3 m away)
Extremely loud	110	Grinding on steel
	120	Heavy rock concert
Intolerable	130	Threshold for pain

Typical noise descriptors

Noise is represented by the descriptor L_{AN}, representing a statistical sound measurement recorded on the 'A' weighted scale. A typical noise monitoring chart is shown in the graph below along with the noise descriptors.



Where:

- L_{Amax}: The maximum sound level recorded during the measurement period.
- L_{Amin}: The minimum sound level recorded during the measurement period.
- $L_{A10(period)}$: The A-weighted sound pressure level that is exceeded for 10% of the measurement period.
- $L_{Aeq(period)}$: Equivalent sound pressure leve, the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
- $L_{A90(period)}$: The A-weighted sound pressure level that is exceeded for 90% of the time over which a given sound is measured. This is considered to represent the background noise e.g. $L_{A90(15min)}$.

Changes in noise levels

The table below presents a qualitative description of average human responses to changes in noise levels.

Difference	**Human response**
Difference of 2 dBA	Generally imperceptible by the human ear
Difference of 5 dBA	Considered significant
Difference of 10 dBA	Perceived as a doubling (or halving) of the noise source
Addition of two identical noise levels	Increase levels by 3 dBA
Addition of second noise level of similar character	If the secondary noise level is a minimum 8 dBA below the primary noise level, the noise level will not significantly increase
Doubling of distance between source and receiver	Results in a 3 dBA decrease for a line source and 6 dBA for a point source
A doubling of traffic volume	Results in a 3 dBA increase in noise

Audibility of noise

The table below presents quantitative guidance and qualitative descriptions regarding the audibility of noise.

Audibility	**Description**
Inaudible	Noise source cannot be heard. The noise level is generally less than the background noise level, potentially by more than 10 dBA or greater
Barely audible	Characteristics of the noise is difficult to define or masked by extraneous noise. The noise level is generally 5-7 dBA below the background noise or ambient noise level, depending on the nature of the noise e.g. constant or intermittent
Just audible	Characteristics of the noise can be defined but extraneous noise sources are also contributing to the received noise. The noise level is typically below the background and ambient noise level.
Audible	Characteristics of the noise can be easily defined. The noise level may be at the level of the background noise and above.
Dominant	The noise source is significantly ‘louder’ than all other noise sources. The noise level will likely be significantly greater than the background noise level.

Types of noise sources

The table below offers a qualitative description of various noise types and provides the noise descriptor that is typically used to measure the type of noise.

Duration of the noise	**Description**
Continuous noise	Continuous noise is produced by equipment or activities that operates without interruption in the same mode, for e.g. blowers, pumps and processing equipment. Measuring for just a few minutes with hand-held equipment is sufficient to determine the noise level. If tones or low frequencies are heard, the frequency spectrum can be measured for documentation and further analysis. Continuous noise sources are generally captured by the L_{90} noise descriptor.
Intermittent noise	Intermittent noise is a noise level that increases and decreases rapidly. This might be caused by a train passing by, factory equipment that operates in cycles, or aircraft flying above. Intermittent noise is measured in a similar way to continuous noise, with a sound level meter. The duration of each occurrence and the time between each event is important to note. To gain a more reliable estimate of the noise level, multiple occurrences of the noise source is measured to gain a reliable estimate. Intermittent noise sources are generally captured by the L_{eq} noise descriptor.
Impulsive noise	The noise from impacts or explosions, for e.g. from a pile driver, punch press or gunshot, is called impulsive noise. It is brief and abrupt, and its startling effect causes greater annoyance than would be expected from a simple measurement of sound pressure level. To quantify the impulsiveness of noise, the difference between a quickly responding and a slowly responding parameter can be used. Impulsive noise sources are generally captured by the L_{max} or L_{peak} noise descriptor.
Frequency content	**Description**
Low frequency	Noise containing major components in the low-frequency range (10 hertz [Hz] to 160 Hz) of the frequency spectrum
Tonal noise	Tonal noise contains one or more prominent tones (i.e. distinct frequency components), and is normally regarded as more offensive than ‘broad band’ noise
Defining characteristic	**Description**
Extraneous noise	Noise resulting from activities that are not typical of the area. Atypical activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous.
Subject noise	The noise in question removed from any extraneous noise in the area
Offensive noise	The definition of offensive noise in the POEO Act is noise: (a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances: (i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or (ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or (b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances, prescribed by the regulations.

Frequency analysis

Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers. The units for frequency are Hertz (Hz), which represent the number of cycles per second. Frequency analysis can be in:

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

Definition of ‘vibration’

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

Vibration descriptors

These may be expressed in terms of ‘peak’ velocity or ‘rms’ velocity. The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as ‘peak particle velocity’, or PPV. The latter incorporates ‘root mean squared’ averaging over some defined time period. Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) and transverse. The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/Vo), where Vo is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used by some organisations.

How humans perceive vibration

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

Types of vibration

Vibration in buildings can be caused by many different external sources, including industrial, construction and transportation activities. The vibration may be continuous (with magnitudes varying or remaining constant with time), impulsive (such as in shocks) or intermittent (with the magnitude of each event being either constant or varying with time). A description of each vibration type including examples are presented in the table below.

Vibration type	**Description**	**Examples**
Continuous vibration	Vibration continues uninterrupted for a defined period (usually throughout daytime and/or night-time). This type of vibration is assessed on the basis of weighted rms acceleration values	Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery)
Impulsive vibration	A vibration source (continuous or intermittent) which has a rapid build up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). This type of vibration is assessed on the basis of weighted rms acceleration values	Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading.
Intermittent vibration	Interrupted periods of continuous (for e.g. a drill) or repeated periods of impulsive vibration (for e.g. a pile driver), or continuous vibration that varies significantly in magnitude. This type of vibration is assessed on the basis of vibration dose values	Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers. Where the number of vibration events in an assessment period is three or fewer this would be assessed against impulsive vibration criteria

Typical vibration levels

Typical ground vibration from civil construction activities occurs in the frequency range of approximately 8 Hz to 100 Hz. Within this frequency range, building contents such as blinds and pictures would commence visible movement at 0.5 mm/s. At vibration levels higher than 0.9 mm/s, rattling of windows, crockery or loose objects would be audible and annoying.

Velocity level (mm/s)	Typical source	Response
0.01	Typical background vibration level	Scanning electron microscopes to 50000 x amplification
0.03		500x amplification bench microscopes
0.1	Average passenger train vibration	Approximate threshold for human perception of vibration
0.3	Average freight train vibration Max passenger train vibration	Approx. residential annoyance for train passbys
1	Large rock breaker	Vibration level that will generally result in complaints
3	Blasting/ Impact pile driving	Threshold for minor cosmetic damage

Acronyms and Abbreviations

Term	Definition
AWS	Automatic Weather Station
BOM	Bureau of Meteorology
dB	Decibel is the unit used for expressing the sound pressure level (SPL) or power level (SWL) in acoustics.
dBA	Decibel expressed with the frequency weighting filter used to measure 'A-weighted' sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at low and high frequencies.
dBZ or dBL	The unit used to measure 'Z-weighted' sound pressure levels with no weighting applied, linear.
DECC	Department of Environment and Climate Change
DECCW	Department of Environment, Climate Change and Water
EPA	Environmental Protection Authority
ICNG	*Interim Construction Noise Guideline* (DECC, 2009).
NPfI	*Noise Policy for Industry* (EPA, 2017).
$L_{Aeq(period)}$	Equivalent 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.
$L_{A10(period)}$	The noise level exceeded for 10 per cent of the time and is approximately the average of the maximum noise levels.
$L_{A90(period)}$	The sound pressure level that is exceeded for 90% of the measurement period.
L_{Amax}	The absolute maximum noise level in a noise sample
NSW	New South Wales
PPV	Peak particle velocity is the maximum vector sum of three orthogonal time-synchronized velocity components regardless of whether these component maxima occurred simultaneously.
RBL	Rating Background Level . The overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period.
RNP	Road Noise Policy (DECCW, 2011).
RRF	Resource Recovery Facility
SEARs	Secretary's Environmental Assessment Requirements
SPL	Sound Pressure Level
SWL	Sound Power Level
Rw	Weighted Sound Reduction Index which provides a single-number quantity which characterises the airborne sound insulation of a material or building element over a range of frequencies
VDV	Vibration dose value - As defined in BS6472 – 2008, VDV is given by the fourth root of the integral of the fourth power of the frequency weighted acceleration.

Common Terms

Term	Definition
A weighting	The human ear responds more to frequencies between 500 Hz and 8 kHz and is less sensitive to very low-pitch or high-pitch noises. The frequency weightings used in sound level measurements are often related to the response of the human ear to ensure that the meter better responds to what you actually hear
Adverse weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions 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. This is described using the Leq descriptor
Background noise	The underlying level of noise present in the ambient noise, excluding the noise source under investigation, when extraneous noise is removed. This is described using the L90 descriptor
Compliance	The process of checking that source noise levels meet with the noise limits in a statutory context.
Extraneous noise	Noise resulting from activities that are not typical of the area. Atypical activities may include construction, and traffic generated by holiday periods and by special events such as concerts or sporting events. Normal daily traffic is not considered to be extraneous
EIS	Environmental Impact Assessment
Feasible and reasonable measures	Feasibility relates to engineering considerations and what is practical to build. reasonableness relates to the application of judgement in arriving at a decision, taking into account the following factors: - • Noise mitigation benefits (amount of noise reduction provided, number of people protected); • Cost of mitigation (cost of mitigation versus benefit provided); • Community views (aesthetic impacts and community wishes); • Noise levels for affected land uses (existing and future levels, and changes in noise levels)
Hertz	The measure of frequency of sound wave oscillations per second. 1 oscillation per second equals 1 hertz.
Maximum noise event	The loudest event or events within a given period of time. This is generally described using the L_{max} descriptor
Meteorological conditions	Wind and temperature inversion conditions
Most-affected location	Location(s) that experience (or will likely experience) the greatest noise impact from the construction works under consideration. In determining these locations, existing background noise levels, noise source location(s), distance and any shielding between the construction works (or proposed works) and the residences and other sensitive land uses need to be considered.
Noise management level	The Noise Management Level (NML) as defined as the EPA's ICNG. To be measured and assessed at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the residential property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most affected point within 30 m of the residence.
Noise sensitive receiver	An area or place potentially affected by noise which includes: • a residential dwelling • an educational institution, library, childcare centre or kindergarten • a hospital, surgery or other medical institution • an active (e.g. sports field, golf course) or passive (e.g. national park) recreational area • commercial or industrial premises

Term	Definition
	• a place of worship.
Non-compliance	Development is deemed to be in non-compliance with its noise consent/ licence conditions if the monitored noise levels exceed its statutory noise limit (exceptions may be given if the noise level exceeds by less than 2 dB)
Octave	A division of the frequency range into bands, the upper frequency limit
Project noise trigger level	Target noise levels for a particular noise generating facility. They are based on the most stringent of the intrusive criteria or amenity criteria. Which of the two criteria is the most stringent is determined by measuring the level and nature of existing noise in the area surrounding the actual or propose noise generating facility.
Proposal	The construction and operation of the SWRO site, the modifications to the Illawarra WFP site and associated infrastructure including the power route, the delivery pipeline, the se and the intake and outlet tunnels.
proposal site	The immediate location of the proposal, which is the area that has the potential to be directly disturbed by construction and operation.
Resonance	Resonance describes the phenomenon of increased amplitude that occurs when the frequency of a periodically applied force is equal or close to a natural frequency of the system on which it acts.
Study area	Land in the vicinity of, and including, the proposal site. The ‘study area’ is the wider area surrounding the proposal site.
Temperature inversion	An atmospheric condition in which temperature increases with height above the ground.
Third-octave	Single octave bands divided into three parts.

Appendix B – Agency requirements (EPA)

Agency requirements – Environmental Protection Authority
The proposal
• Identify all noise sources or potential sources from the development (including both construction and operation phases). Detail all potentially noisy activities including ancillary activities such as transport of goods and raw materials. • Specify the times of operation for all phases of the development and for all noise producing activities. • For projects with a significant potential traffic noise impact provide details of road alignment (include gradients, road surface, topography, bridges, culverts etc), and land use along the proposed road and measurement locations – diagrams should be to a scale sufficient to delineate individual residential blocks.
The location
• Identify any noise sensitive locations likely to be affected by activities at the site, such as residential properties, schools, churches, and hospitals. Typically the location of any noise sensitive locations in relation to the site should be included on a map of the locality. • Identify the land use zoning of the site and the immediate vicinity and the potentially affected areas.
The environmental issues

Describe baseline conditions
• Determine the existing background (L_{A90}) and ambient (L_{Aeq}) noise levels, as relevant, in accordance with the NSW Noise Policy for Industry.
  • Determine the existing road traffic noise levels in accordance with the NSW Road Noise Policy, where road traffic noise impacts may occur.
  • The noise impact assessment report should provide details of all monitoring of existing ambient noise levels including:
  o details of equipment used for the measurements;
  o brief description of where the equipment was positioned;
  o a statement justifying the choice of monitoring site(s), including the procedure used to choose the site(s), having regards to Fact Sheets A and B of the NSW Noise Policy for Industry;
  o details of the exact location of the monitoring site and a description of land uses in surrounding areas;
  o a description of the dominant and background noise sources at the site;
  o day, evening and night assessment background levels for each day of the monitoring period;
  o the final Rating Background Level (RBL) value;
  o graphs of the measured noise levels for each day should be provided; and

- a record of periods of affected data (due to adverse weather and extraneous noise), methods used to exclude invalid data and a statement indicating the need for any re-monitoring.

Assess impacts

- Determine the project noise trigger levels for the site. For each identified potentially affected receiver, this should include:
  - determination of the project intrusive noise level for each identified potentially affected receiver;
  - selection and justification of the appropriate amenity category for each identified potentially affected receiver;
  - determination of the project amenity noise level for each receiver; and
  - determination of the appropriate maximum noise level event assessment (sleep disturbance) trigger level.
- Maximum noise levels during night-time period (10pm-7am) should be assessed to analyse possible affects on sleep. Determine expected noise level and noise character likely to be generated from noise sources during:
  - site establishment;
  - construction;
  - operational phases;
  - transport including traffic noise generated by the proposal; and
  - other services.

    Note: The noise impact assessment report should include noise source data for each source in 1/1 or 1/3 octave band frequencies including methods for references used to determine noise source levels. Noise source levels and characteristics can be sourced from direct measurement of similar activities or from literature (if full references are provided).
- Determine the noise levels likely to be received at the reasonably most affected location(s) (these may vary for different activities at each phase of the development).
- The noise impact assessment report should include:
  a. a plan showing the assumed location of each noise source for each prediction scenario;
  b. a list of the number and type of noise sources used in each prediction scenario to simulate all potential significant operating conditions on the site;
  c. any assumptions made in the predictions in terms of source heights, directivity effects, shielding from topography, buildings or barriers, etc;
  d. methods used to predict noise impacts including identification of any noise models used;
  e. the weather conditions considered for the noise predictions;
  f. the predicted noise impacts from each noise source as well as the combined noise level for each prediction scenario;

Agency requirements – Environmental Protection Authority

g. for developments where a significant level of noise impact is likely to occur, noise contours for the key prediction scenarios should be derived; and

h. an assessment of the need to include modification factors as detailed in Fact Sheet C of the NSW Noise Policy for Industry.

- Discuss the findings from the predictive modelling and, where relevant noise criteria have not been met, recommend additional feasible and reasonable mitigation measures.
- The noise impact assessment report should include details of any mitigation proposed including the attenuation that will be achieved and the revised noise impact predictions following mitigation.
- Where relevant noise/vibration levels cannot be met after application of all feasible and reasonable mitigation measures the residual level of noise impact needs to be quantified.
- For the assessment of existing and future traffic noise, details of data for the road should be included such as assumed traffic volume; percentage heavy vehicles by time of day; and details of the calculation process. These details should be consistent with any traffic study carried out in the EIS.

Describe management and mitigation measures

- Determine the most appropriate noise mitigation measures and expected noise reduction including both noise controls and management of impacts for both construction and operational noise. This will include selecting quiet equipment and construction methods, noise barriers or acoustic screens, location of stockpiles, temporary offices, compounds and vehicle routes, scheduling of activities, etc.
- For traffic noise impacts, provide a description of the ameliorative measures considered (if required), reasons for inclusion or exclusion, and procedures for calculation of noise levels including ameliorative measures. Also include, where necessary, a discussion of any potential problems associated with the proposed ameliorative measures, such as overshadowing effects from barriers. Appropriate ameliorative measures may include:

    a. use of alternative transportation modes, alternative routes, or other methods of avoiding the new road usage;

    b. control of traffic (eg: limiting times of access or speed limitations);

    c. resurfacing of the road using a quiet surface;

    d. use of (additional) noise barriers or bunds;

    e. treatment of the façade to reduce internal noise levels buildings where the night-time criteria is a major concern;

    f. more stringent limits for noise emission from vehicles (i.e. using specially designed ‘quite’ trucks and/or trucks to use air bag suspension;

    g. driver education;

    h. appropriate truck routes;

    i. limit usage of exhaust brakes;

    j. use of premium muffles on trucks;

Agency requirements – Environmental Protection Authority
k. reducing speed limits for trucks; l. ongoing community liaison and monitoring of complaints; and m. phasing in the increased road use.
Guidance material – noise and vibration
• NSW Noise Policy for Industry (EPA 2017) • Interim Construction Noise Guideline (DEC 2006) • NSW Road Noise Policy (DECCW 2011) • NSW Rail Infrastructure Noise Guideline (EPA 2013)

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Agency requirements – Environmental Protection Authority
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The location
• Identify any noise sensitive locations likely to be affected by activities at the site, such as residential properties, schools, churches, and hospitals. Typically the location of any noise sensitive locations in relation to the site should be included on a map of the locality. • Identify the land use zoning of the site and the immediate vicinity and the potentially affected areas.
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  o details of equipment used for the measurements;
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Agency requirements – Environmental Protection Authority

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    f. more stringent limits for noise emission from vehicles (i.e. using specially designed ‘quite’ trucks and/or trucks to use air bag suspension;

    g. driver education;

    h. appropriate truck routes;

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Agency requirements – Environmental Protection Authority
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  o brief description of where the equipment was positioned;
  o a statement justifying the choice of monitoring site(s), including the procedure used to choose the site(s), having regards to Fact Sheets A and B of the NSW Noise Policy for Industry;
  o details of the exact location of the monitoring site and a description of land uses in surrounding areas;
  o a description of the dominant and background noise sources at the site;
  o day, evening and night assessment background levels for each day of the monitoring period;
  o the final Rating Background Level (RBL) value;
  o graphs of the measured noise levels for each day should be provided; and

- a record of periods of affected data (due to adverse weather and extraneous noise), methods used to exclude invalid data and a statement indicating the need for any re-monitoring.

Assess impacts

- Determine the project noise trigger levels for the site. For each identified potentially affected receiver, this should include:
  - determination of the project intrusive noise level for each identified potentially affected receiver;
  - selection and justification of the appropriate amenity category for each identified potentially affected receiver;
  - determination of the project amenity noise level for each receiver; and
  - determination of the appropriate maximum noise level event assessment (sleep disturbance) trigger level.
- Maximum noise levels during night-time period (10pm-7am) should be assessed to analyse possible affects on sleep. Determine expected noise level and noise character likely to be generated from noise sources during:
  - site establishment;
  - construction;
  - operational phases;
  - transport including traffic noise generated by the proposal; and
  - other services.

    Note: The noise impact assessment report should include noise source data for each source in 1/1 or 1/3 octave band frequencies including methods for references used to determine noise source levels. Noise source levels and characteristics can be sourced from direct measurement of similar activities or from literature (if full references are provided).
- Determine the noise levels likely to be received at the reasonably most affected location(s) (these may vary for different activities at each phase of the development).
- The noise impact assessment report should include:
  a. a plan showing the assumed location of each noise source for each prediction scenario;
  b. a list of the number and type of noise sources used in each prediction scenario to simulate all potential significant operating conditions on the site;
  c. any assumptions made in the predictions in terms of source heights, directivity effects, shielding from topography, buildings or barriers, etc;
  d. methods used to predict noise impacts including identification of any noise models used;
  e. the weather conditions considered for the noise predictions;
  f. the predicted noise impacts from each noise source as well as the combined noise level for each prediction scenario;

Agency requirements – Environmental Protection Authority

g. for developments where a significant level of noise impact is likely to occur, noise contours for the key prediction scenarios should be derived; and

h. an assessment of the need to include modification factors as detailed in Fact Sheet C of the NSW Noise Policy for Industry.

- Discuss the findings from the predictive modelling and, where relevant noise criteria have not been met, recommend additional feasible and reasonable mitigation measures.
- The noise impact assessment report should include details of any mitigation proposed including the attenuation that will be achieved and the revised noise impact predictions following mitigation.
- Where relevant noise/vibration levels cannot be met after application of all feasible and reasonable mitigation measures the residual level of noise impact needs to be quantified.
- For the assessment of existing and future traffic noise, details of data for the road should be included such as assumed traffic volume; percentage heavy vehicles by time of day; and details of the calculation process. These details should be consistent with any traffic study carried out in the EIS.

Describe management and mitigation measures

- Determine the most appropriate noise mitigation measures and expected noise reduction including both noise controls and management of impacts for both construction and operational noise. This will include selecting quiet equipment and construction methods, noise barriers or acoustic screens, location of stockpiles, temporary offices, compounds and vehicle routes, scheduling of activities, etc.
- For traffic noise impacts, provide a description of the ameliorative measures considered (if required), reasons for inclusion or exclusion, and procedures for calculation of noise levels including ameliorative measures. Also include, where necessary, a discussion of any potential problems associated with the proposed ameliorative measures, such as overshadowing effects from barriers. Appropriate ameliorative measures may include:

    a. use of alternative transportation modes, alternative routes, or other methods of avoiding the new road usage;

    b. control of traffic (eg: limiting times of access or speed limitations);

    c. resurfacing of the road using a quiet surface;

    d. use of (additional) noise barriers or bunds;

    e. treatment of the façade to reduce internal noise levels buildings where the night-time criteria is a major concern;

    f. more stringent limits for noise emission from vehicles (i.e. using specially designed ‘quite’ trucks and/or trucks to use air bag suspension;

    g. driver education;

    h. appropriate truck routes;

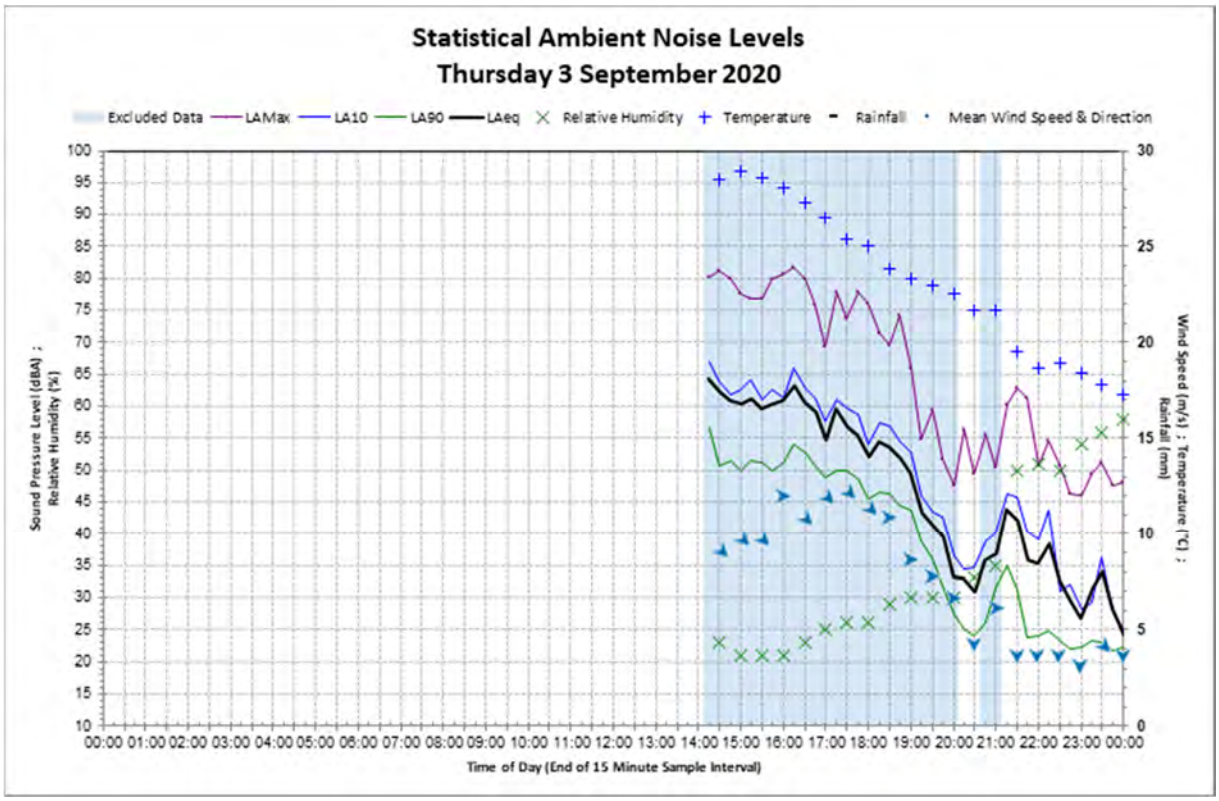
    i. limit usage of exhaust brakes;

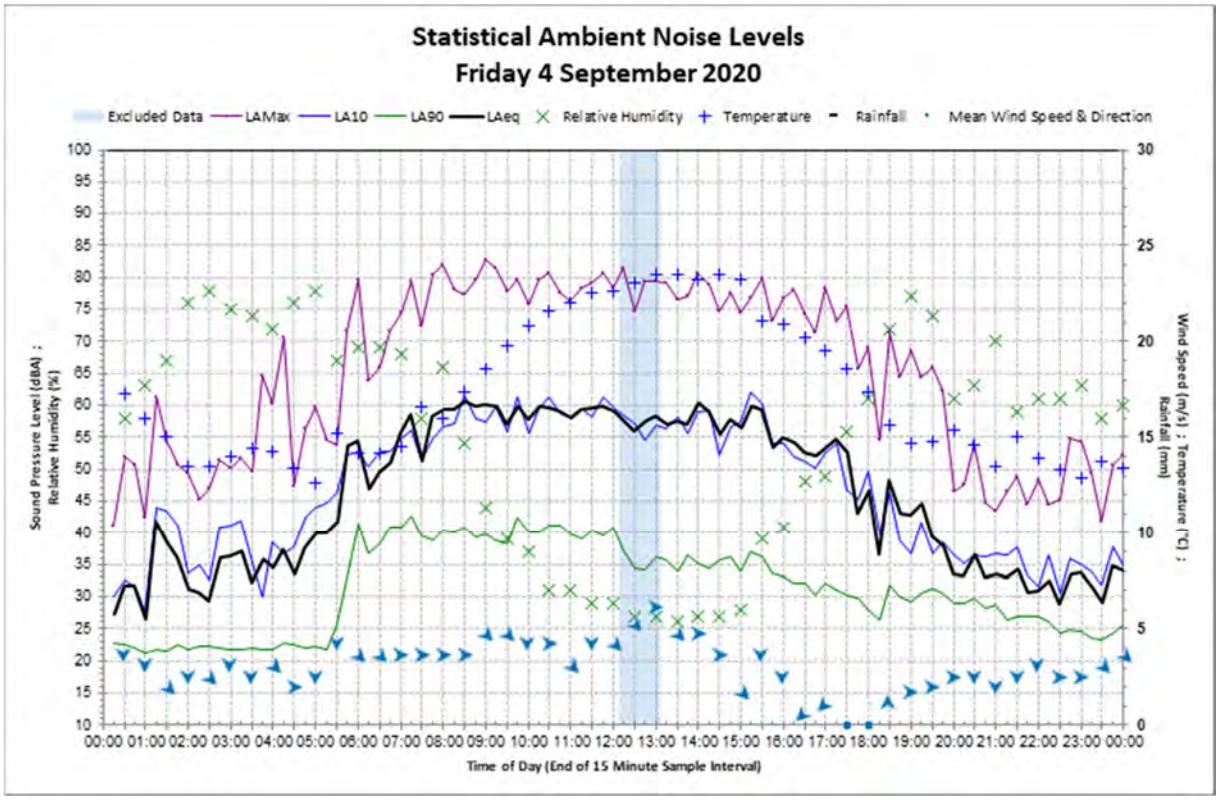
    j. use of premium muffles on trucks;

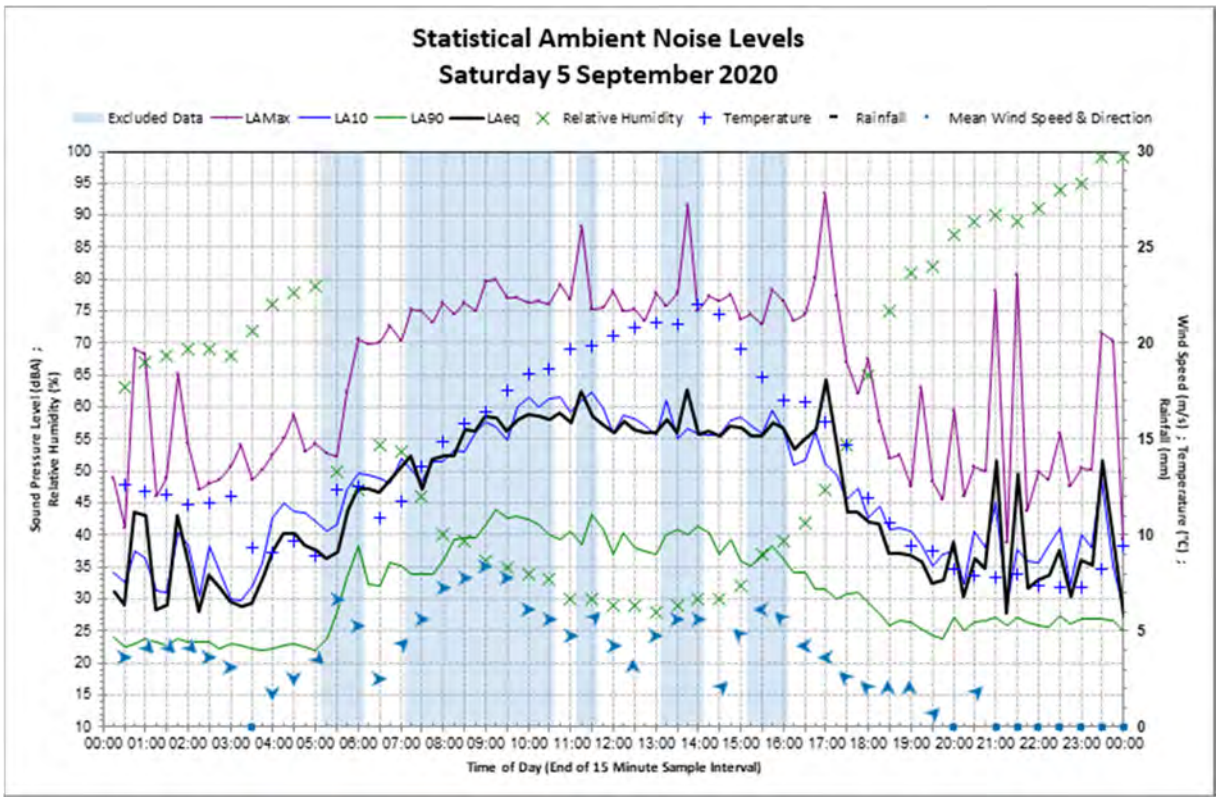
Agency requirements – Environmental Protection Authority
k. reducing speed limits for trucks; l. ongoing community liaison and monitoring of complaints; and m. phasing in the increased road use.
Guidance material – noise and vibration
• NSW Noise Policy for Industry (EPA 2017) • Interim Construction Noise Guideline (DEC 2006) • NSW Road Noise Policy (DECCW 2011) • NSW Rail Infrastructure Noise Guideline (EPA 2013)

Appendix C – Noise monitoring charts

M1 41 Flatrock Road



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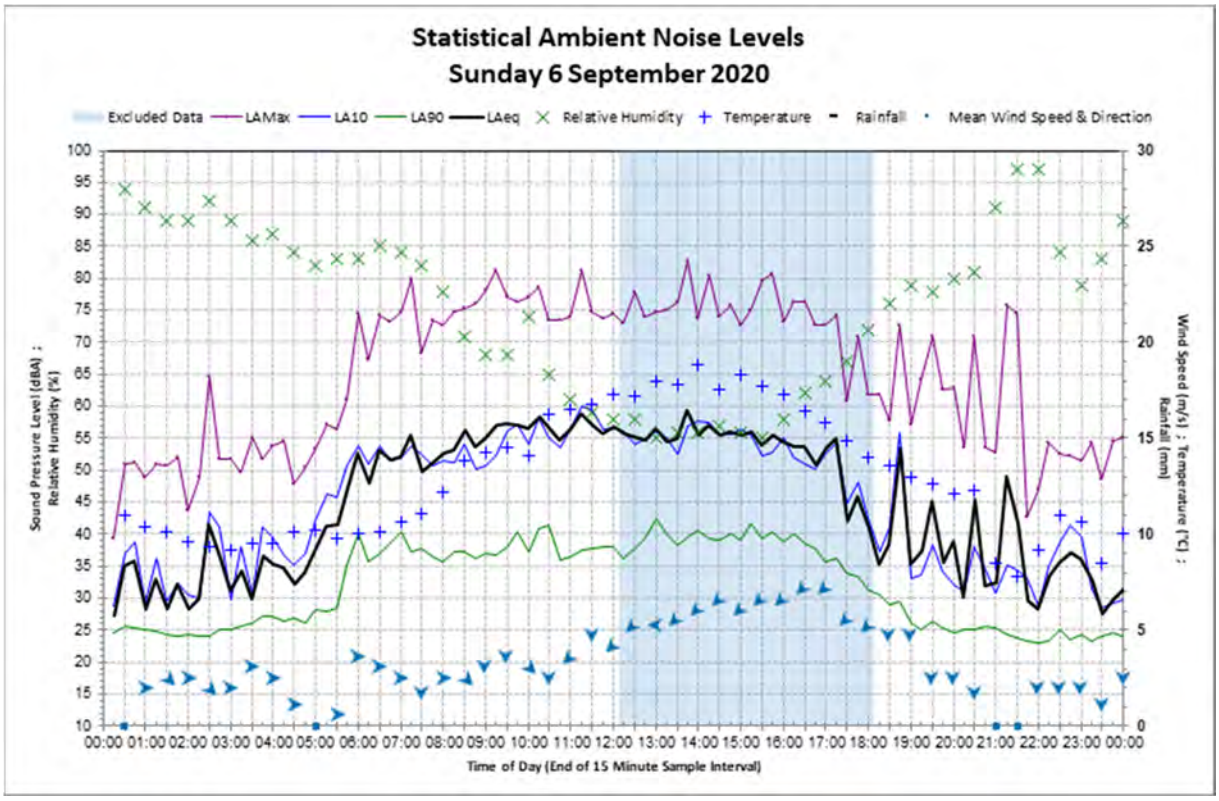
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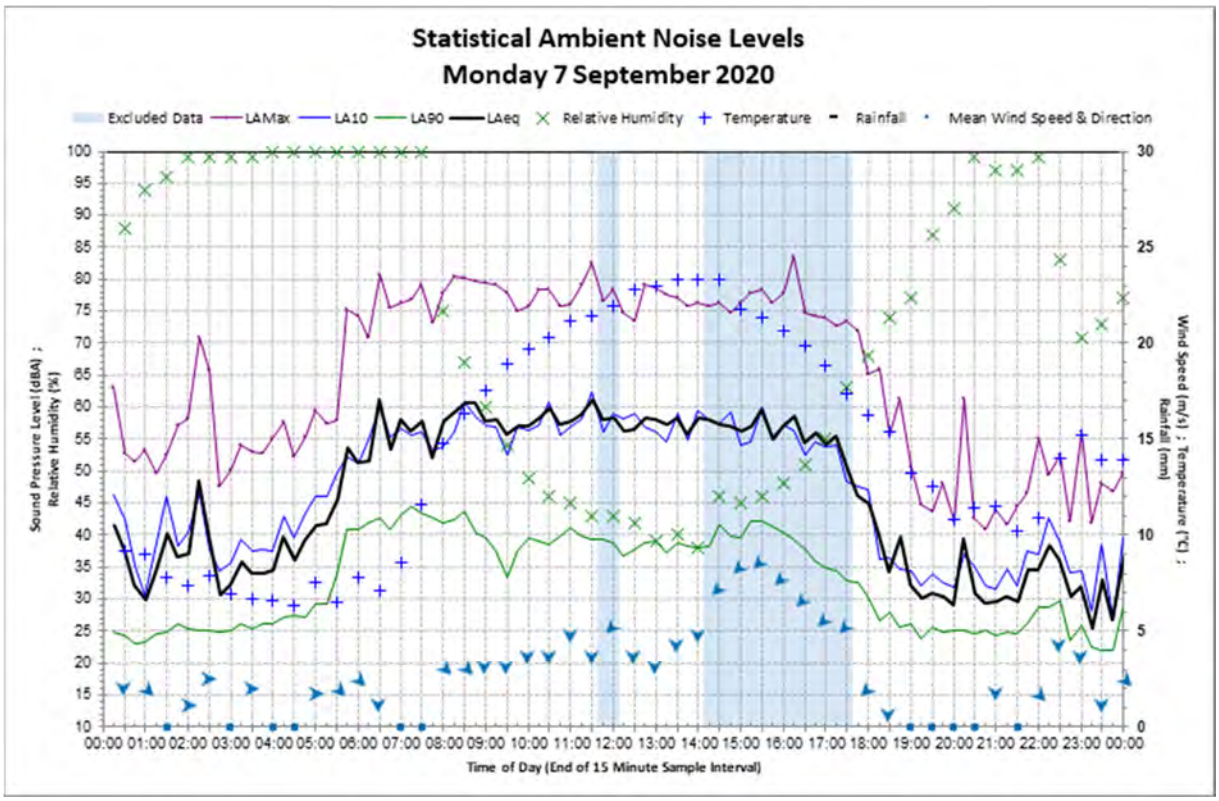
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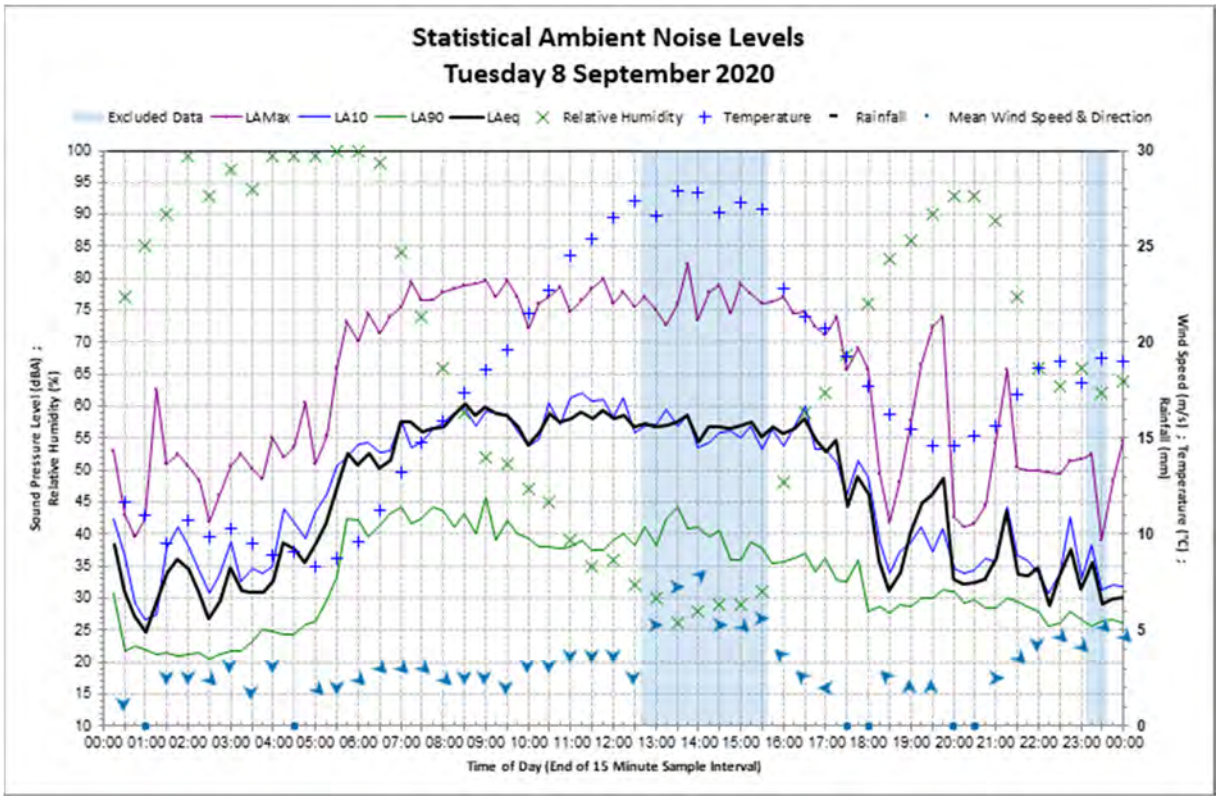
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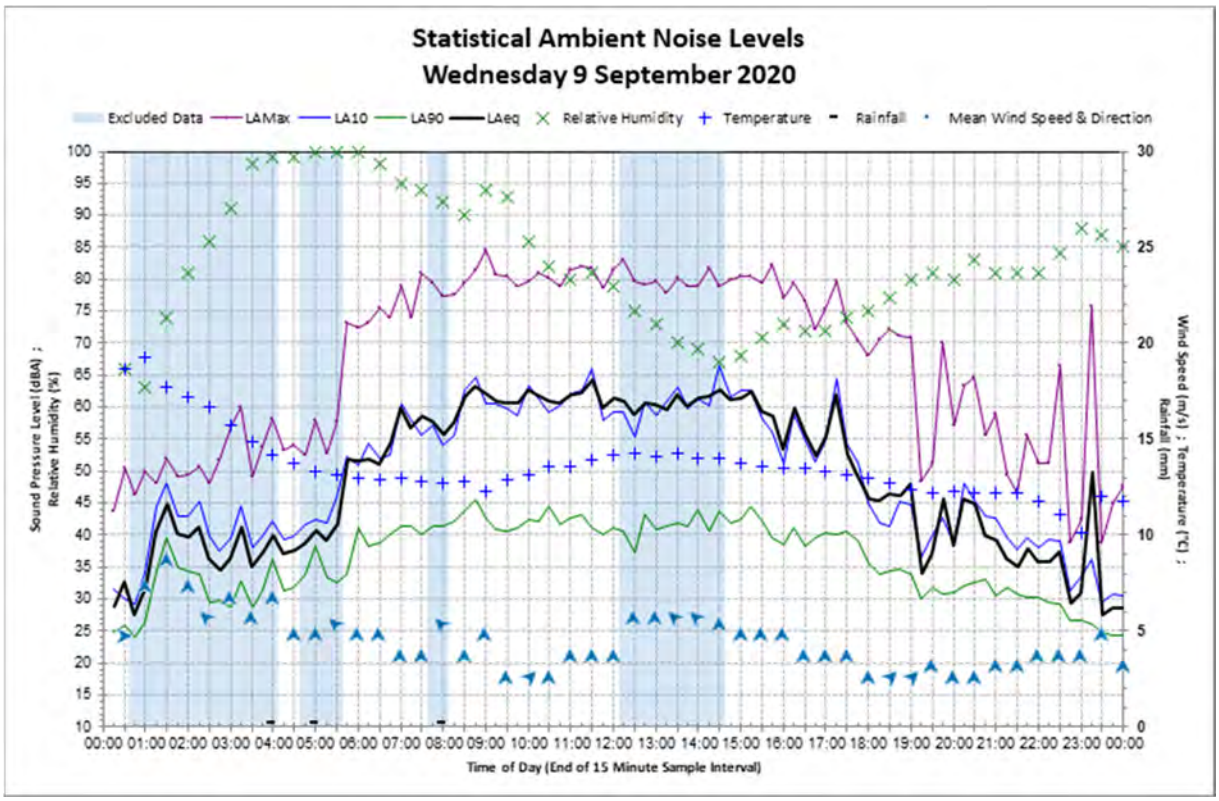
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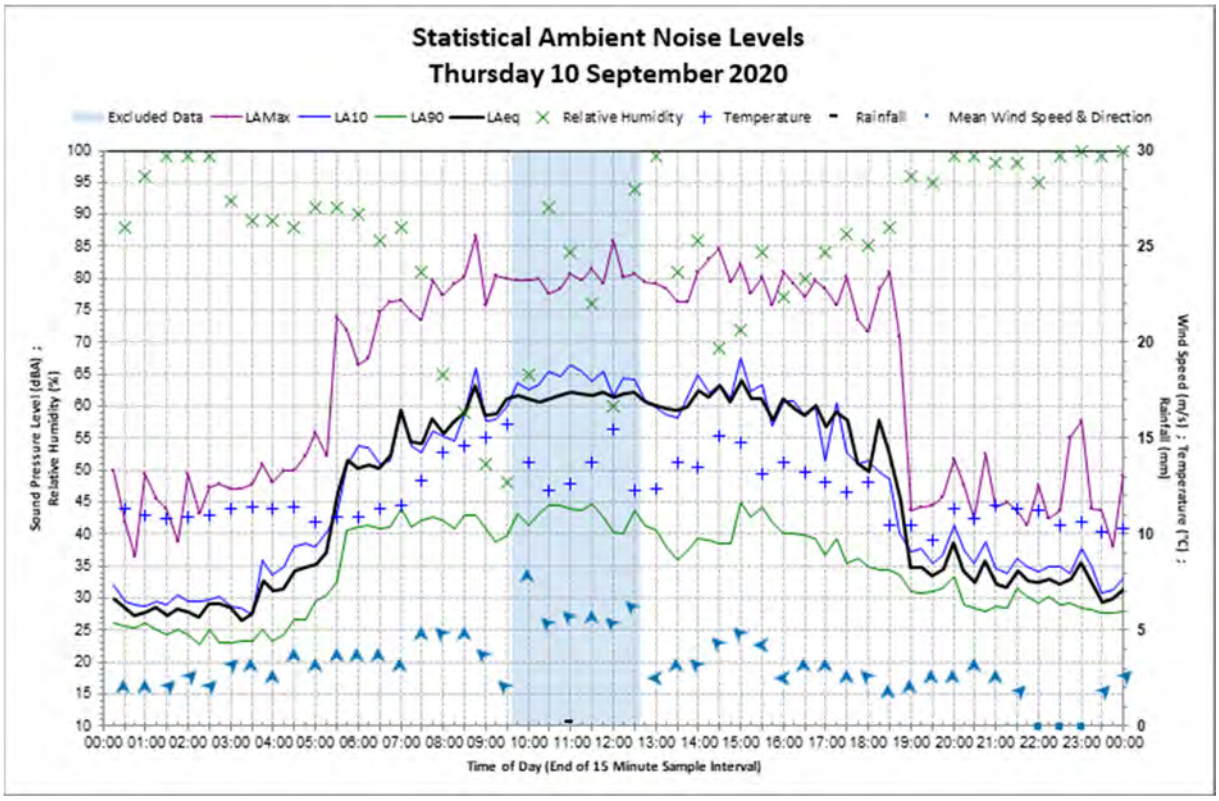
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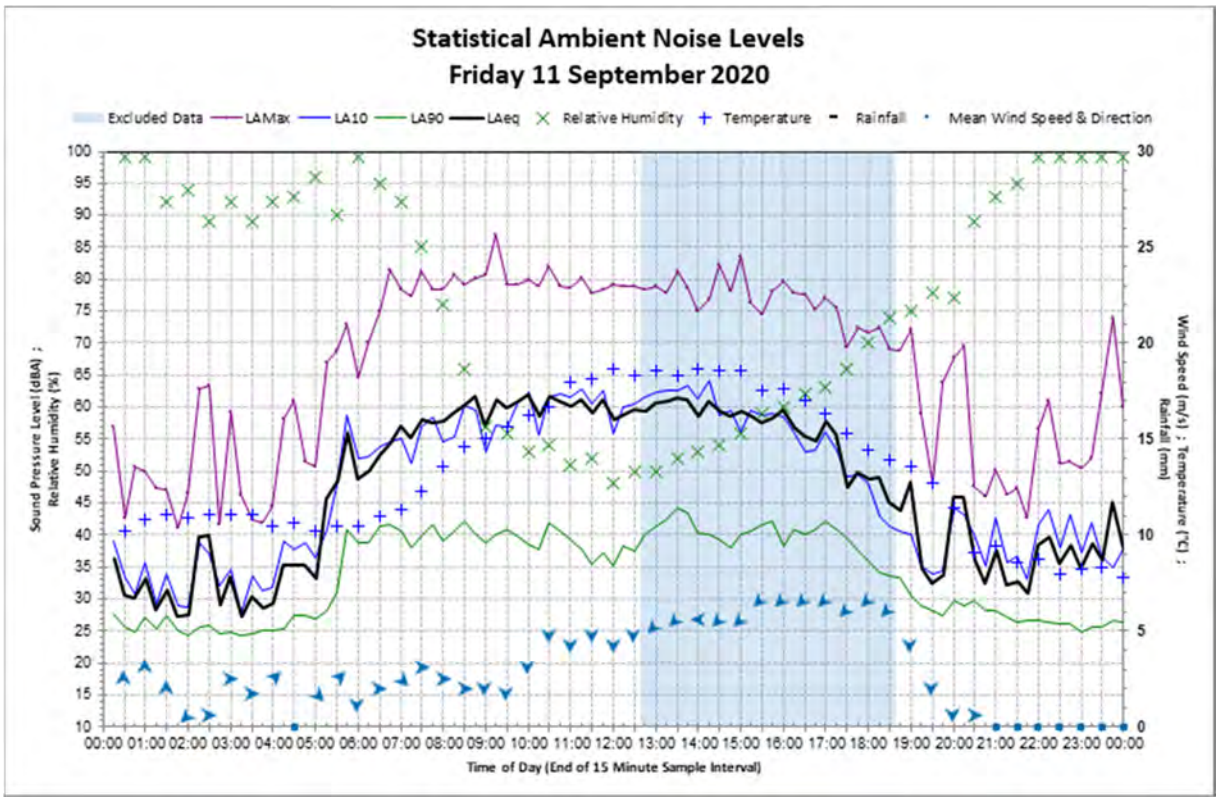
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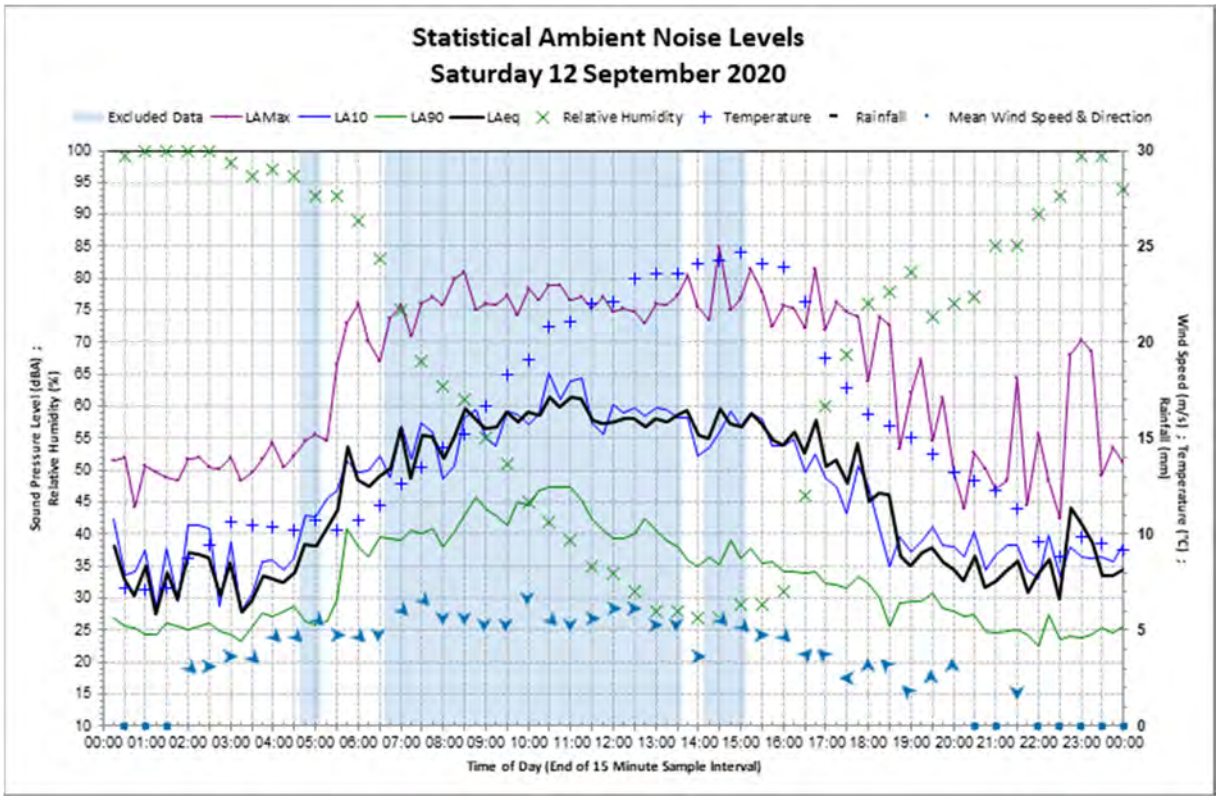
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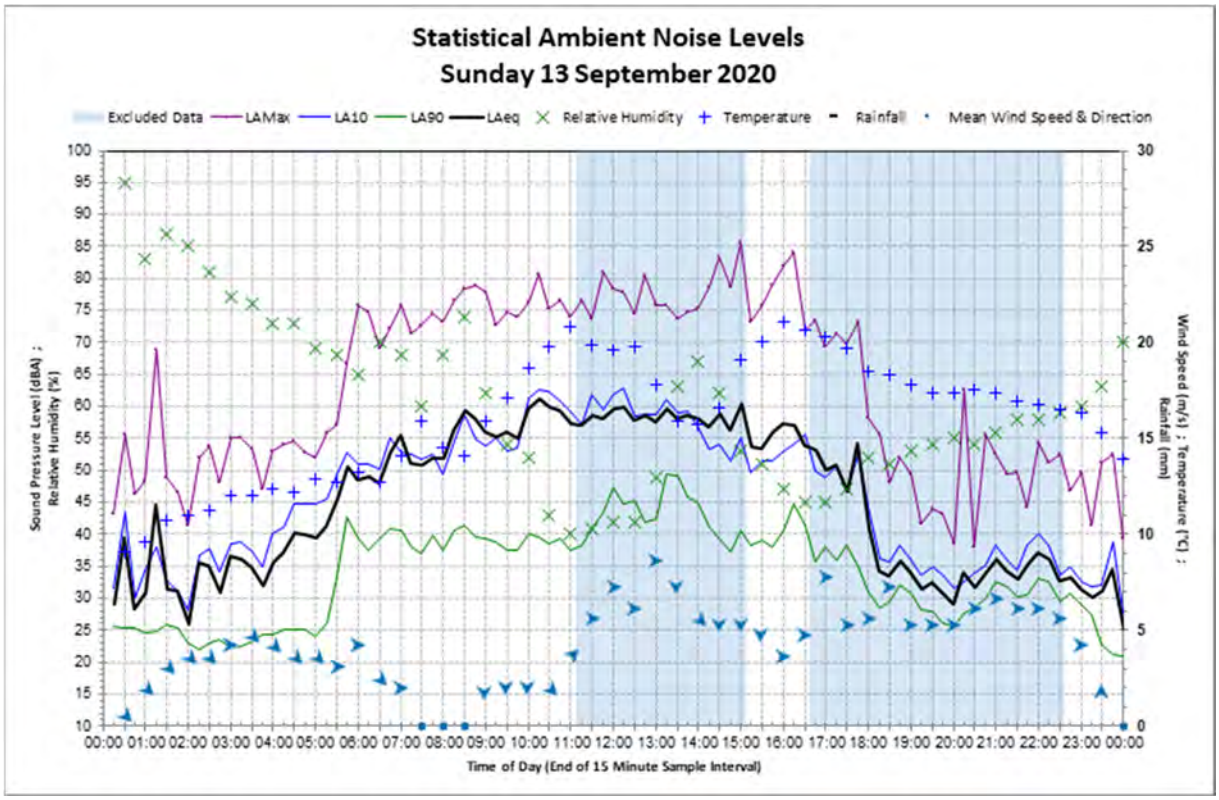
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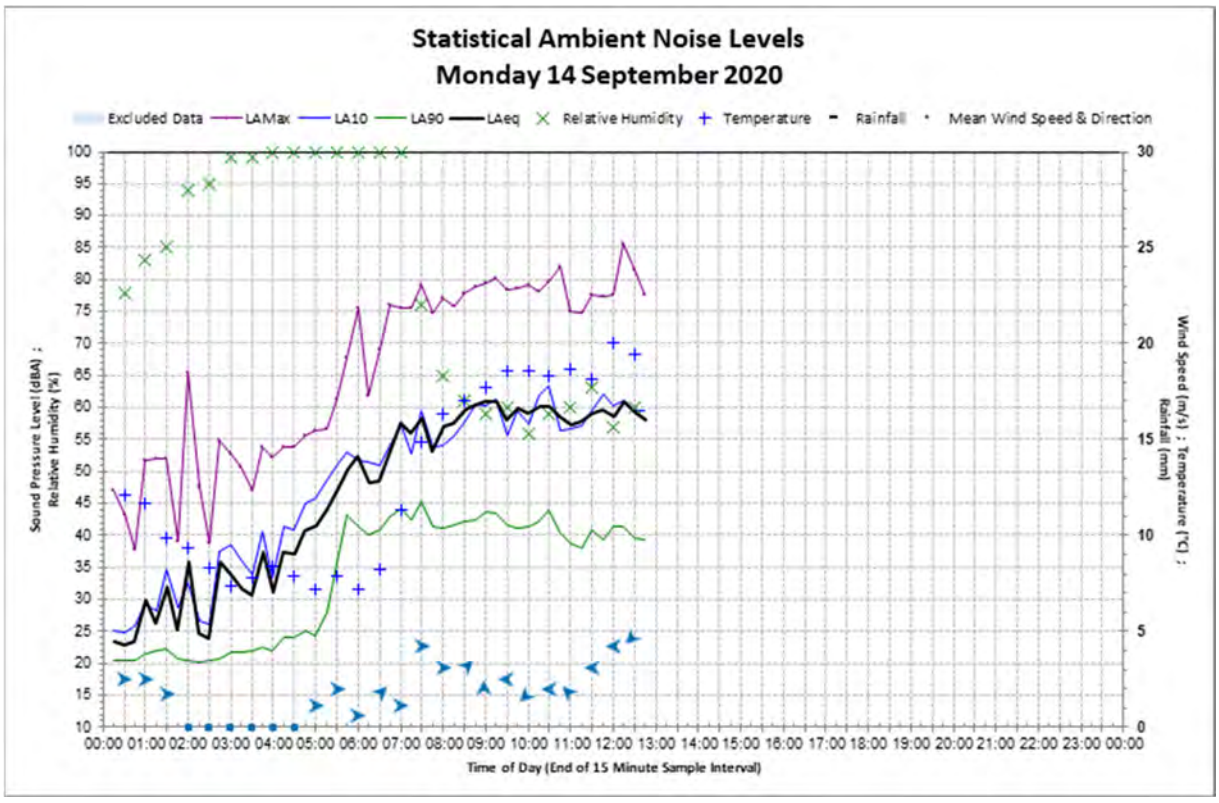
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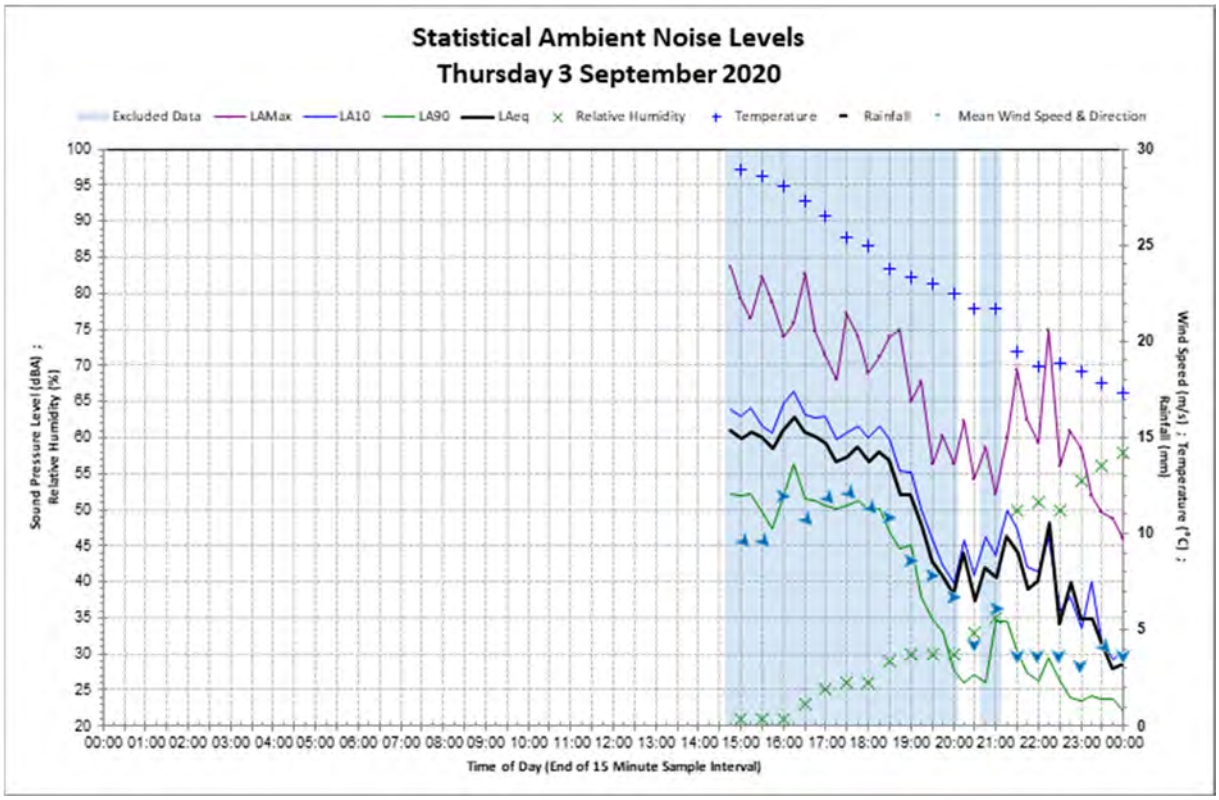
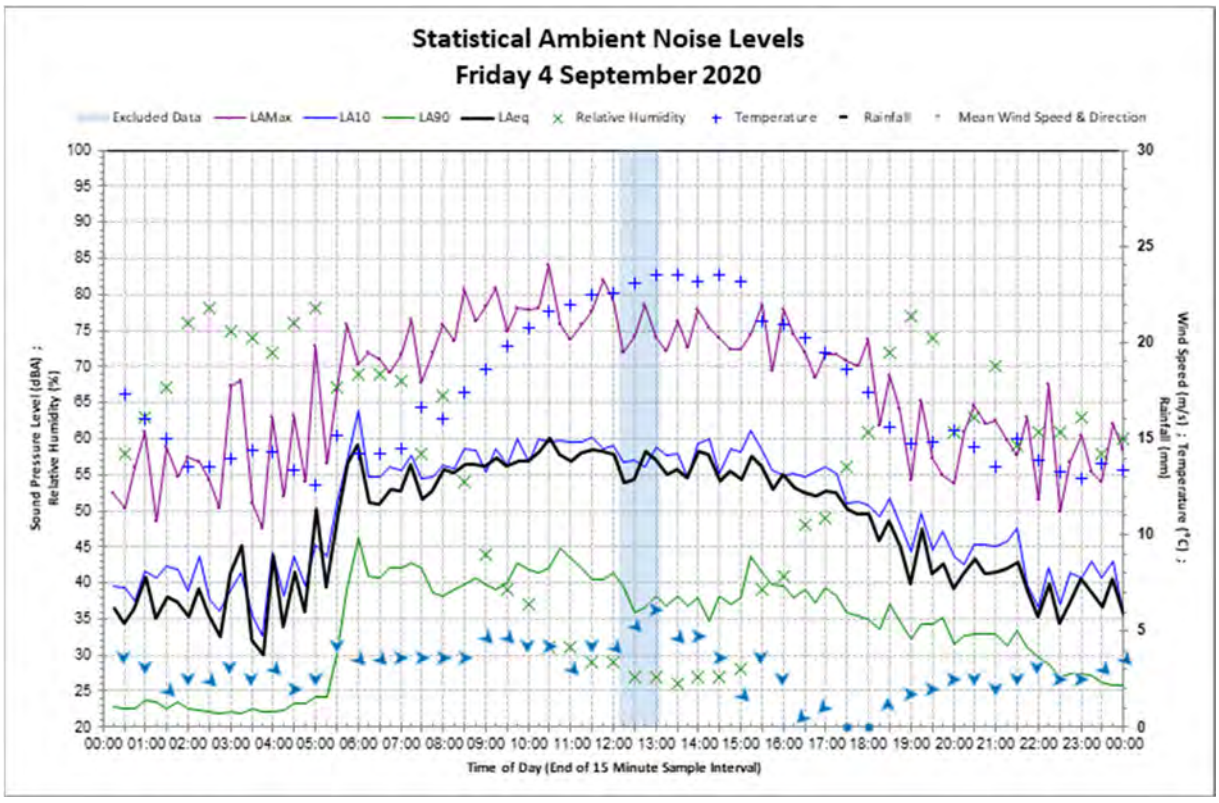
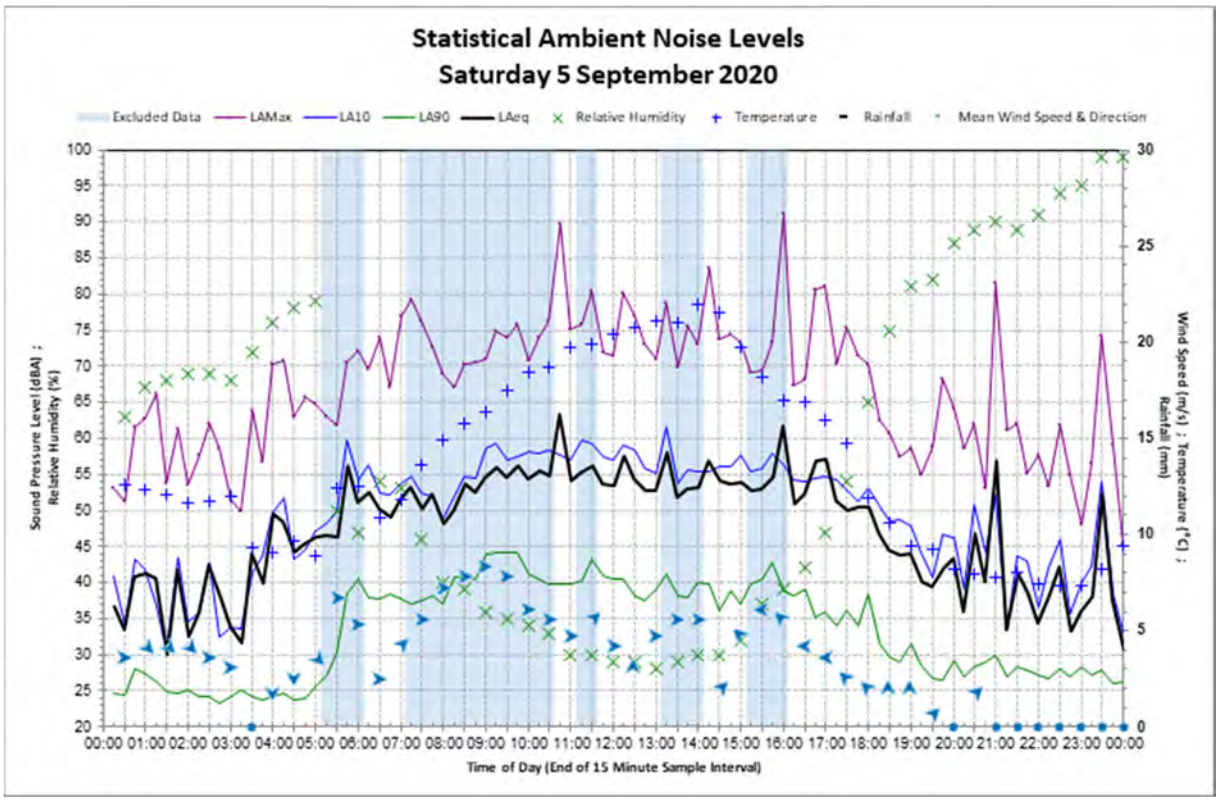
M2 3 Flatrock Road



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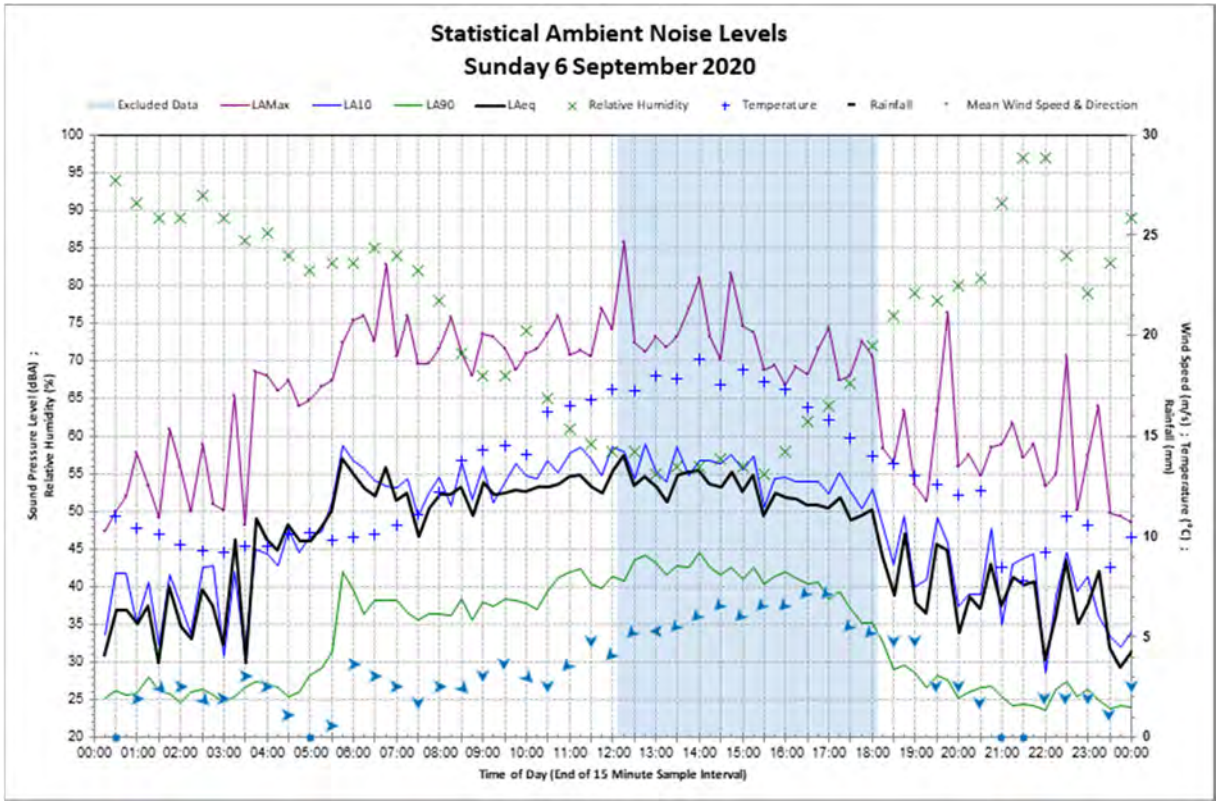
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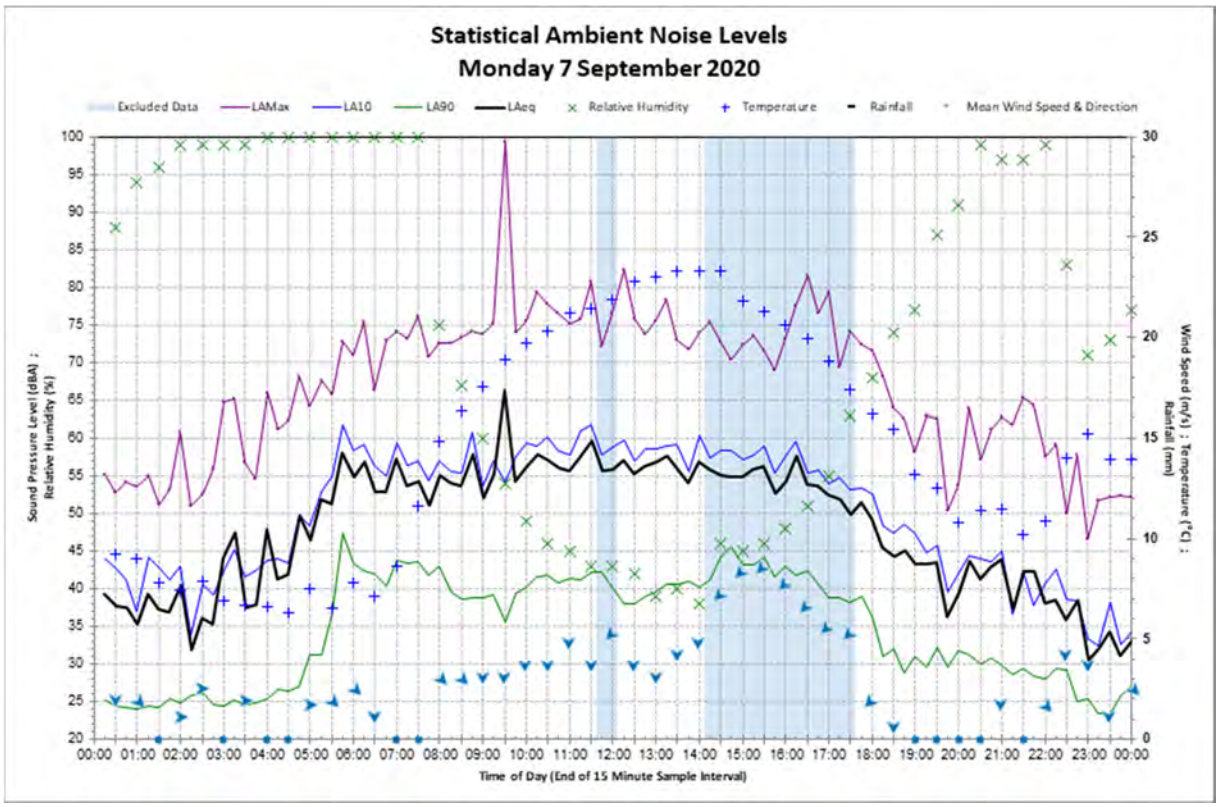
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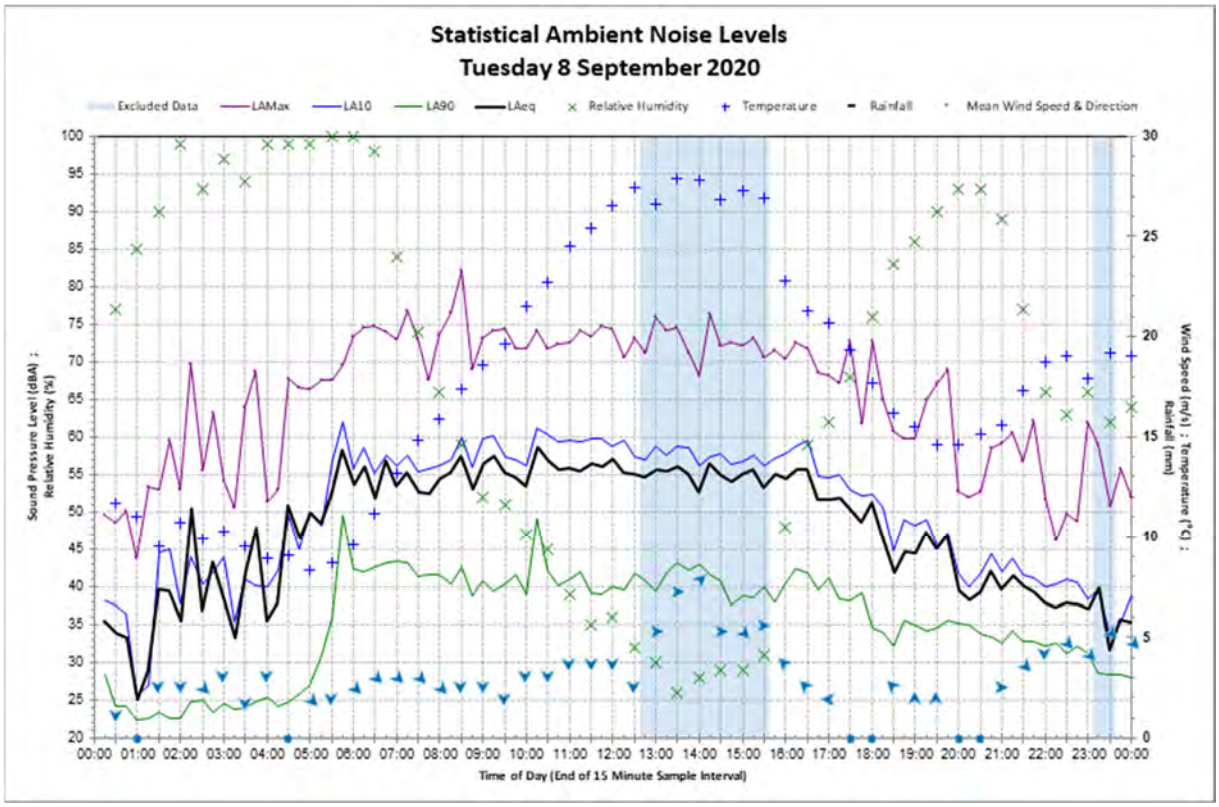
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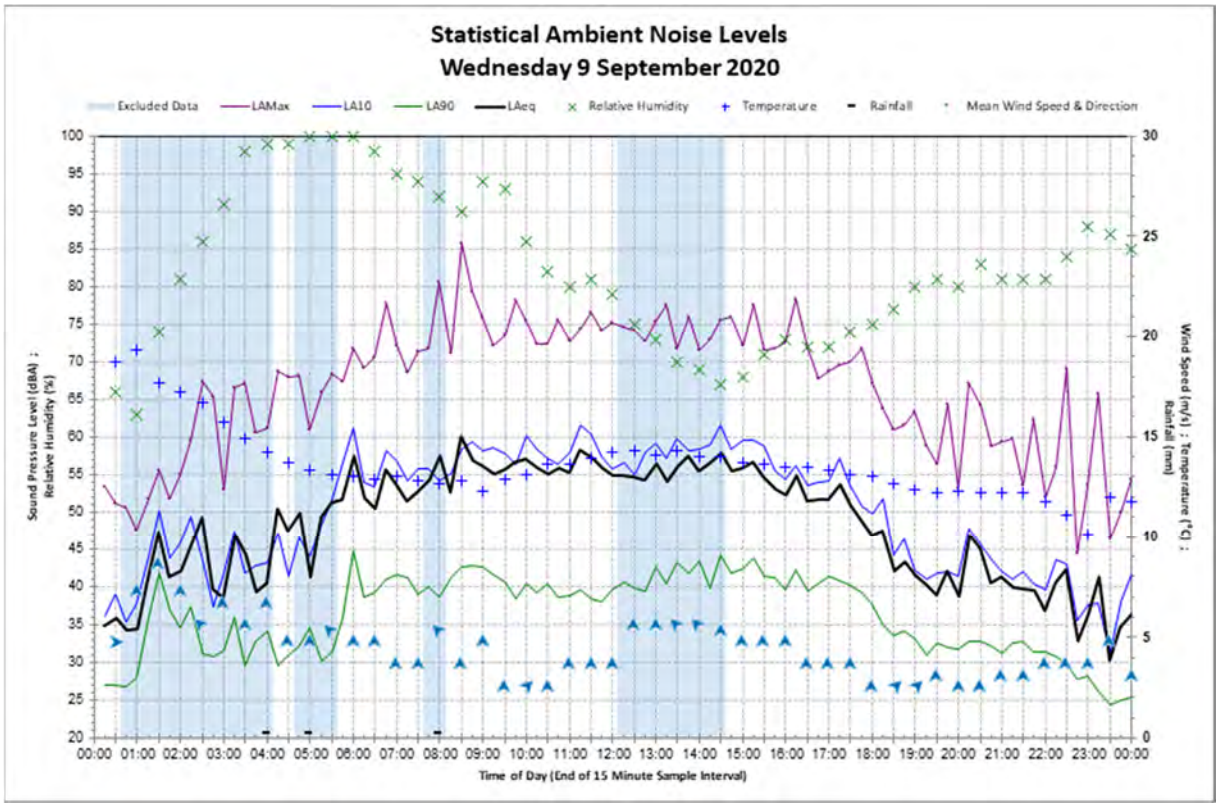
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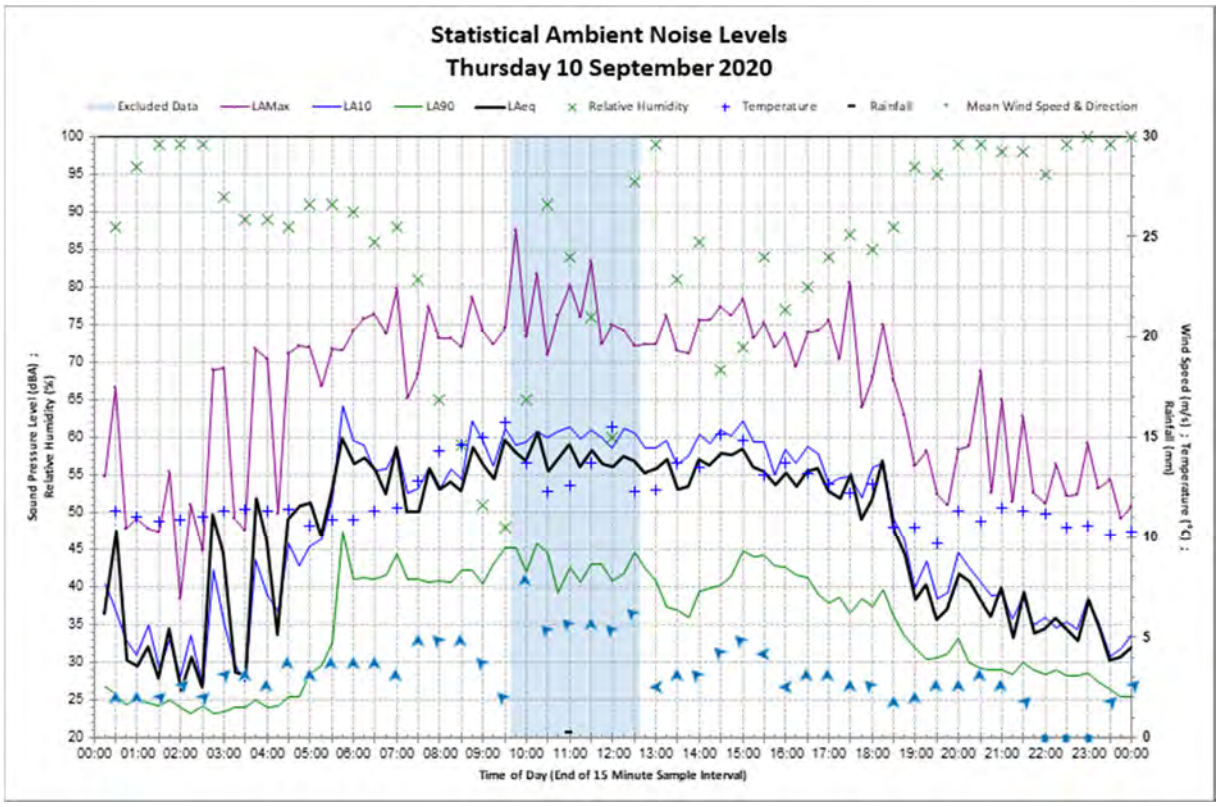
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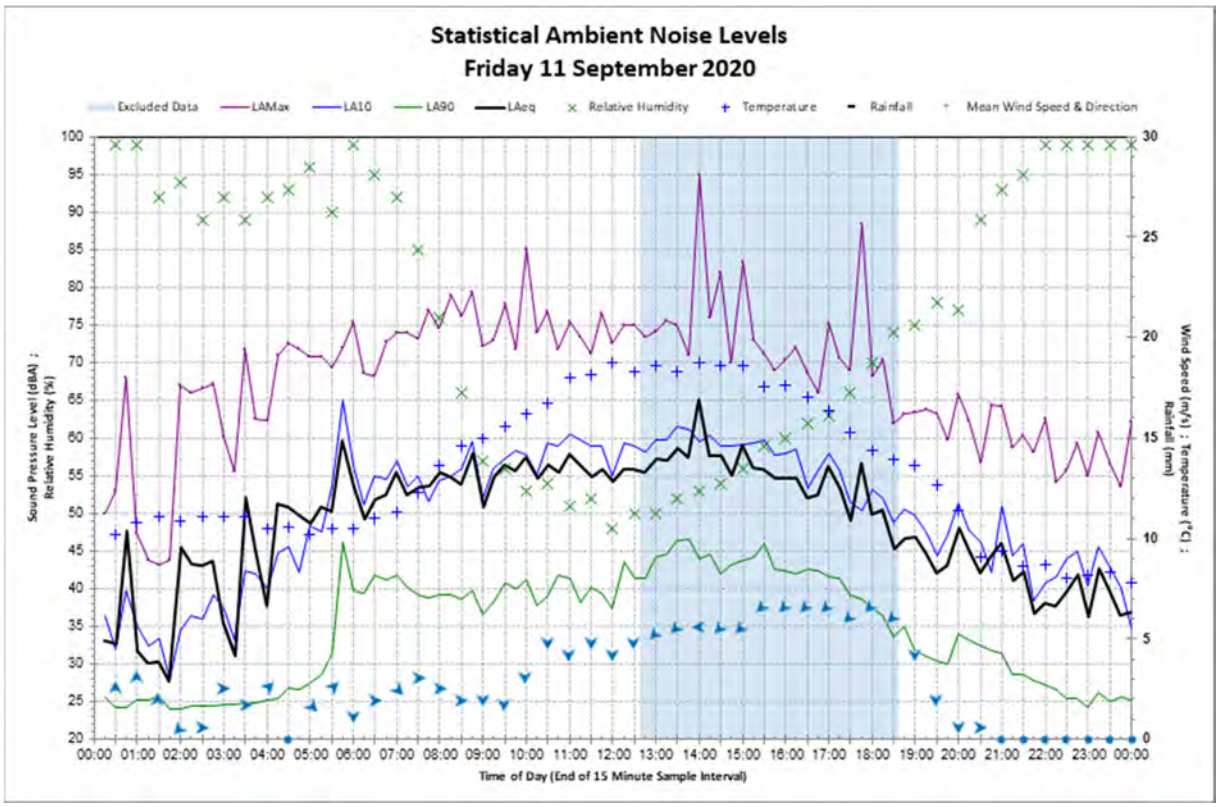
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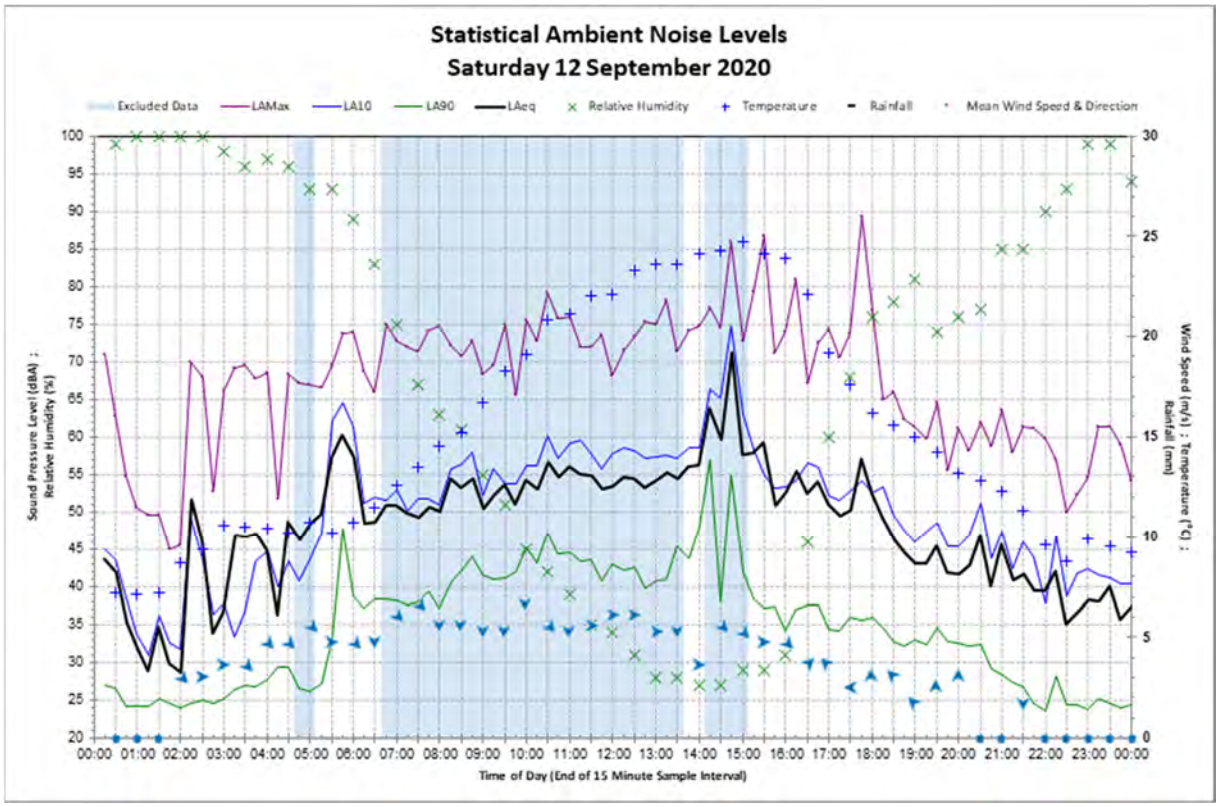
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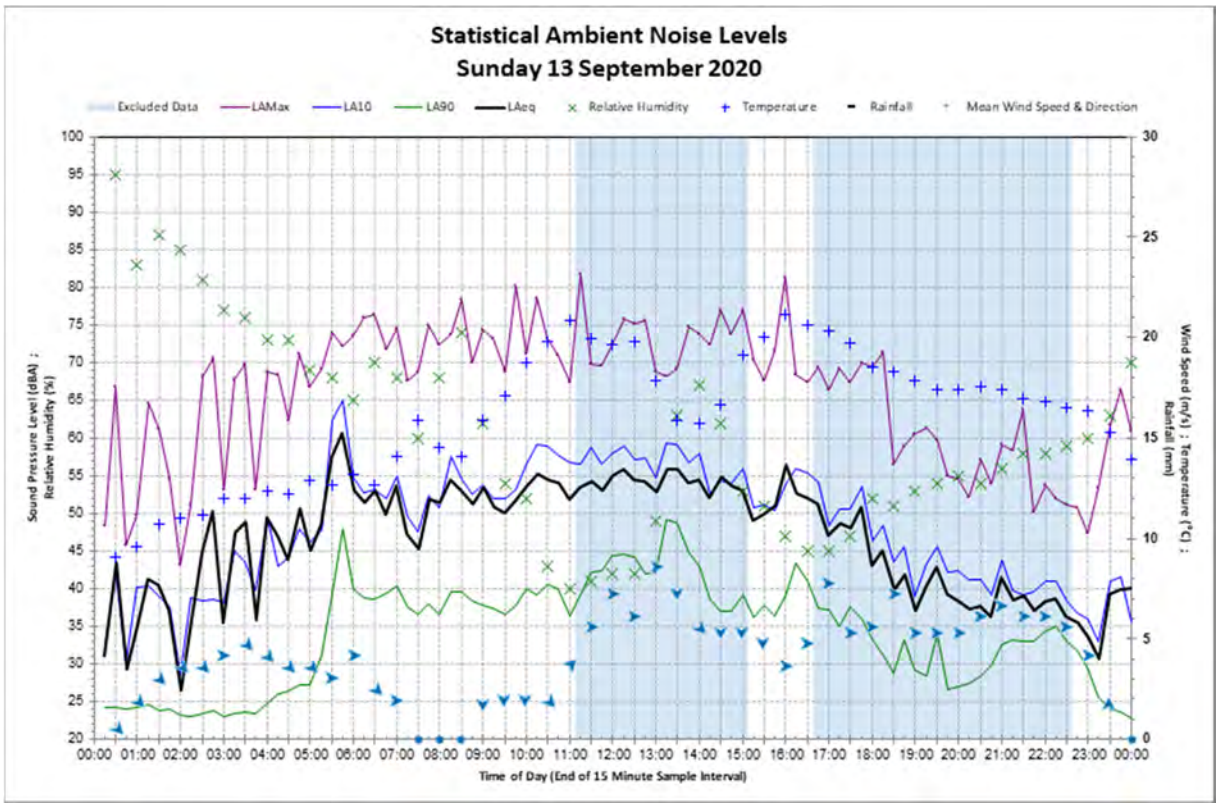
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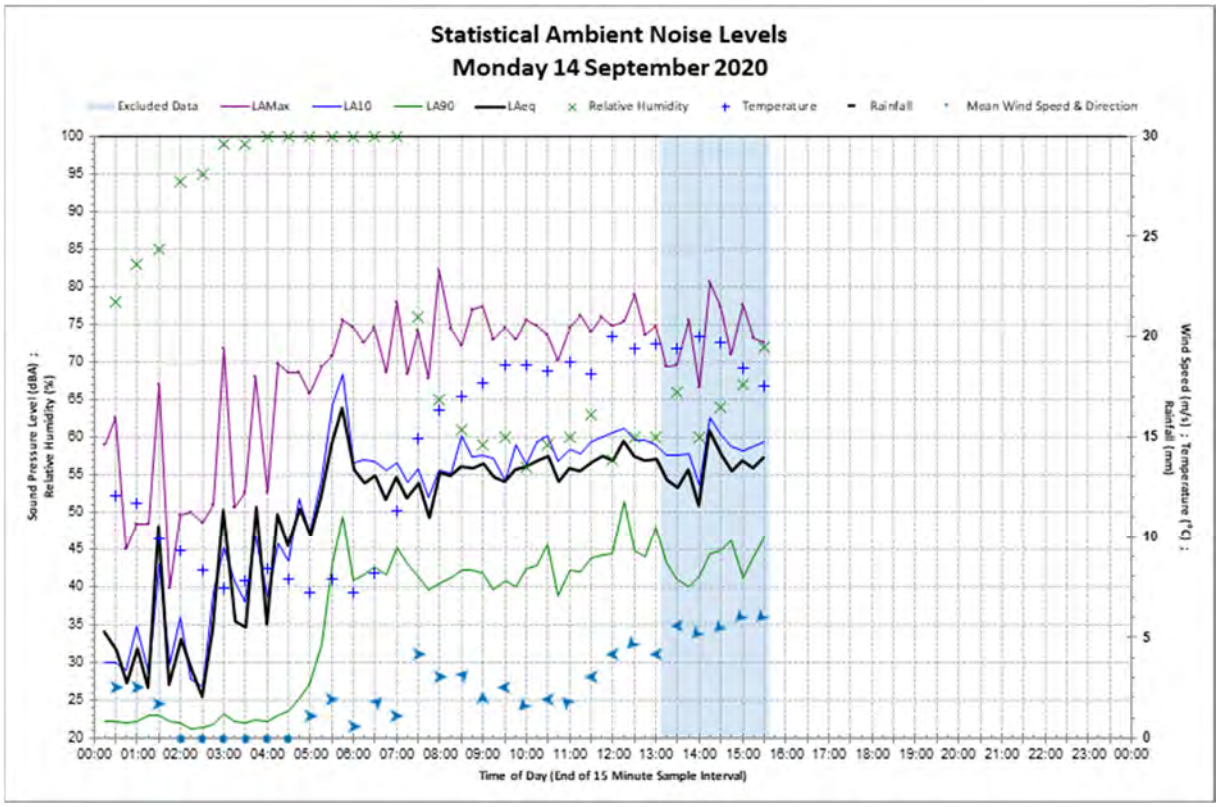
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Appendix D – Octave-band noise data used in the operational noise model

Noise source	Area	External / Internal	Level type	octave-band noise level, dBA									Overall	
				31.5	63	125	250	500	1000	2000	4000	8000	dBA	dBZ
Internal reverberant noise level														
A_ReceptionHall	Reception Hall	internal	Lp internal	55	72	82	89	91	93	93	89	80	98	105
B_Sterilisation_Hall	Sterilisation Hall	internal	Lp internal	64	76	76	80	75	81	81	80	71	87	106
C_SortingHall	Sorting Hall	internal	Lp internal	56	69	81	88	88	91	91	87	81	97	103
D_BoilerRoom	Boiler room	internal	Lp internal	62	77	88	86	83	77	69	60	52	91	108
Sound power level of noise sources (each)														
A_Loader	Reception Hall	internal	Lw (source)	75	86	90	91	96	99	99	94	84	104	117
A_ReceptionHall_Fan	Reception Hall	external	Lw (source)	34	60	61	78	84	85	83	81	77	90	93
A_Shredder	Reception Hall	internal	Lw (source)	68	90	101	108	110	112	112	108	99	117	123
A_Dosing_Bunker	Reception Hall	internal	Lw (source)	-4	81	95	103	102	104	104	99	92	110	116
B_Autoclaves	Sterilisation Hall	internal	Lw (source)	75	87	86	85	85	87	86	89	80	95	117
B_SterilisationHall_Fans	Sterilisation Hall	external	Lw (source)	33	60	66	77	85	86	83	79	68	90	93
C_DustCollector_Fan	Sorting Hall	external	Lw (source)	34	60	61	78	84	85	83	81	77	90	93
C_DustCollector	Sorting Hall	internal	Lw (source)	49	75	76	93	99	100	98	96	92	105	108
C_Compressor	Sorting Hall	internal	Lw (source)	49	75	76	93	99	100	98	96	92	105	108
C_Separator	Sorting Hall	internal	Lw (source)	55	77	88	95	97	99	99	95	89	105	110
C_SortingHall_Fans	Sorting Hall	external	Lw (source)	34	60	61	78	84	85	83	81	77	90	93
Conveyor	All	internal	Lw (source)	66	72	86	94	83	95	95	90	83	100	109
D_Boiler_Burnerandpump	Boiler room	internal	Lw (source)	76	91	102	100	97	91	83	74	66	105	122
D_BoilerExhaustFan	Boiler room	external	Lw (source)	61	75	87	85	82	76	68	59	51	90	107
Material sorting	External sorting area	external	Lw (source)	16	51	72	87	94	99	101	96	88	105	105
Truck	Internal roads	external	Lw (source)	-	90	102	99	104	104	100	94	88	109	121
Loader	Internal roads	external	Lw (source)	-	84	94	90	98	97	96	95	85	104	114

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Document Status

Revision	Author	Reviewer		Approved for Issue		
		Name	Signature	Name	Signature	Date
0	M.Velasco	E.Milton		D. Gamble		28/01/2021
1	M.Velasco	E.Milton		D. Gamble		07/05/2021

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