Willow Tree Waste Management Facility Expansion

Noise and Vibration Assessment

Liverpool Plains Shire Council

1 December 2022

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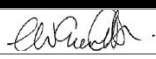
S4	0	E Potoczny	C Evenden		S Lawer		01/12/22

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Abbreviations and acronyms

Term	Definition
AGL	Above ground level
AS	Australian Standards
AWS	Automatic weather station
BS	British Standards
°C	Degrees Celsius
CEMP	Construction Environmental Management Plan
CNVG	Construction Noise and Vibration Guideline (TfNSW, 2016)
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.
DCNG	Draft Construction Noise Guideline (EPA, 2021)
DEC	Department of Environment and Conservation NSW
DECC	Department of Environment and Climate Change NSW
DECCW	Department of Environment and Climate Change and Water NSW
DIN	German Institute for Standardisation (Deutsches Institut für Normung)
DP	Deposited Plan
DPIE	Department of Planning, Industry and Environment
EIS	Environmental Impact Statement
EPA	Environment Protection Authority NSW
GHD	GHD Pty Ltd
ICNG	Interim Construction Noise Guideline (DECC, 2009)
ISO	International Organization for Standardisation (Organisation internationale de normalisation)
km	Kilometre
$L_{A1(1min)}$	The noise level exceeded for 1 per cent of the time over a 1 minute period, used to denote maximum noise levels
m	Metre
m/s	Metres per second
NCA	Noise Catchment Area
NML	Noise Management Level
NPI	Noise Policy for Industry (EPA, 2017)
NSW	New South Wales
RBL	Rating Background Noise Level
RNP	Road Noise Policy (DECCW, 2011)
SEARs	Secretary's Environmental Assessment Requirements
SPL	Sound Pressure Level
SSD	State Significant Development

Term	Definition
SWL	Sound Power Level
µPa	Micropascals
VDV	Vibration Dose Value

Glossary of 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.
Noise-enhancing weather conditions	Weather effects that enhance noise (i.e. wind and temperature inversions) that occur at a site for a significant period of time (i.e. light winds, up to and including 3 m/s, 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.
Construction footprint	Defined as the area that will be directly affected by construction of the proposal. It includes: – The location of project infrastructure and immediate surrounds – The area that will be directly disturbed by the movement of construction plant and machinery, and the location of the temporary, construction compounds and laydown areas that will be used during construction
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, considering 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)
Ground-borne vibration	Vibration transmitted from a source to a receptor via the ground.
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 and operations 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 NML as defined by the 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 land use	Land uses that are sensitive to noise, such as residential areas.

Term	Definition
Non-compliance	Development is 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.
One third-octave	Single octave bands divided into three parts.
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 proposed noise generating facility.
Proponent	Liverpool Plains Shire Council
Proposal site	Lot 213 DP 1173230, Merriwa Road, Willow Tree, NSW
Rating Background Level	The RBL is defined by the Noise Policy for Industry (NPI) as the overall, single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24-hour period used for the assessment background level). This is the level used for assessment purposes.
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.
Z-Weighting (or Linear-weighted)	Zero-weighting or Linear-weighting indicates no weighting filter has been applied and refers to a flat frequency response for sound level meters.

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1. Introduction

Liverpool Plains Shire Council (LPSC) are proposing to expand the Willow Tree Waste Management Facility (WMF) (the project) at Lot 213 DP 1173230, Merriwa Road, Willow Tree (the site) within the Liverpool Plains Local Government Area (LGA).

The project is classified as designated development and requires development consent from LPSC under Part 4 of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act).

As the project would dispose of more than 200 tonnes per year of other waste material it is classified as "Waste management facilities or works" and deemed 'designated development' in accordance with the requirements of Schedule 3 of the Environmental Planning & Assessment Regulation 2021 (EP&A Regulation).

Waste management facilities or works which are classified as designated development under the EP&A Regulation are also classified as regionally significant development under *State Environmental Planning Policy (Planning Systems) 2021* (Planning Systems SEPP).

GHD has been engaged by LPSC to prepare a Noise and Vibration Impact Assessment (NVIA) as part of the EIS for the Willow Tree WMF expansion.

1.1 Purpose of this report

A noise and vibration impact assessment has been undertaken to assess the potential impact of noise and vibration on the identified nearby sensitive receptors during both construction and operation of the Willow Tree WMF expansion project.

The purpose of this noise and vibration assessment is to:

– Respond to the SEARs
– Describe potential sources of noise and vibration emissions during construction and operation
– Provide mitigation and management measures to reduce any potential impacts

1.2 Scope and limitations

This report: has been prepared by GHD for Liverpool Plains Shire Council and may only be used and relied on by Liverpool Plains Shire Council for the purpose agreed between GHD and Liverpool Plains Shire Council as set out in Section 1.1 of this report.

GHD otherwise disclaims responsibility to any person other than Liverpool Plains Shire Council arising in connection with this report. GHD also excludes implied warranties and conditions, to the extent legally permissible.

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

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

The opinions, conclusions and any recommendations in this report are based on assumptions made by GHD described in this report (refer Section(s) 1.3 of this report). GHD disclaims liability arising from any of the assumptions being incorrect.

Accessibility of documents

If this report is required to be accessible in any other format, this can be provided by GHD upon request and at an additional cost if necessary.

1.3 Assumptions

– This assessment is based upon the available information provided, including the development layout shown in this report (or referenced elsewhere).
– It is anticipated that blasting will not be required during the construction phase.
– Modelling assumptions can be found in Sections 5, 7.1, 7.4, and 7.6.

2. Project description

2.1 Overview

This section provides a brief description of the project, including the infrastructure required, indicative construction activities, and the proposed operation arrangements for the landfill expansion.

Additional details of the project are contained within the Willow Tree Waste Management Facility Landfill Expansion Master Plan (GHD, 2021).

2.2 Project need

In 2018, LPSC developed a 10-year strategy for the ongoing management of waste within their region (MRA Consulting Group, 2018). The strategy proposes to rationalise the landfilling operations across the region by establishing the Willow Tree WMF as the primary landfill, servicing the Liverpool Plains LGA, via an expansion of this existing landfill site with the lot boundary.

2.3 Key features of the project

The project would involve the expansion of the Willow Tree WMF. The project is at concept stage and details of the types and volumes of waste are currently unknown. The proposed expansion of the landfill as detailed in the Masterplan (GHD, 2021) suggests an initial throughput of 4,000 t/yr increasing up to 9,000 t/yr of landfill, based on waste projections contained in Council's Waste Management Strategy (MRA Consulting Group, 2018). It is likely that the facility would operate for 32 years with a capacity of approximately 256,800 m^3 (or approximately 210,000 tonnes).

The expanded WMF would receive a range of wastes including:

– Landfill waste from LPSC 'red bin' garbage collection
– 'Clean fill' (such as soil, sand, gravel, bricks or other excavated or hard material)
– Solid or liquid organic materials

The project would involve:

– Site establishment, including preparation of construction compound, suitable stockpile and bunding areas, and sediment and erosion controls
– Site preparation and vegetation clearing
– Construction of the WMF expansion
– Operation of the expanded WMF to service the Liverpool Plains LGA

The construction footprint covers an area of approximately 3 hectares. Concept plans are contained in Appendix A of the Willow Tree Waste Management Facility Landfill Expansion Masterplan (GHD, 2021).

2.4 Construction of the project

Construction of the project would involve the following activities:

– Site establishment, including preparation of construction compound, suitable stockpile and bunding areas, and sediment and erosion controls
– Vegetation clearing
– Subgrade preparation, including:
    - Remove existing stockpiles
    - Regrade surface to establish suitable levels and grades
    - Decommission one existing pond

– Augment existing pond for use as sediment pond
– Augment existing pond for use as leachate pond
– Construction of landfill cell 1
– Seal site access road from Merriwa Road
– Construct supporting infrastructure consisting of weighbridge, site office, amenities, resource recovery area and small vehicles transfer station
– Decommission construction compound and rehabilitate site

The concept plans for the WMF expansion show the construction of 2 landfill cells. The construction of landfill cells would be staged, with the initial landfill cell located in the former quarry area and initially offset from the existing landfilled waste areas. This cell would provide 10 years of landfilling for the site, based on landfilled waste projections in Council's Waste Management Strategy (MRA Consulting Group, 2018). The cell would be constructed with 2 stages of lining works and would be filled in 2 stages, each providing 5 years of landfilling.

Existing waste would either be moved to a lined cell, or a piggyback liner would be installed over the cell.

Construction is proposed to commence mid-2022 and would take approximately 4 months to complete.

Construction would generally be during the following times:

– Monday to Friday 7:00 am to 6:00 pm
– Saturday 8:00 am to 1:00 pm

Where works are proposed outside of the standard construction hours, this would be documented in the EIS, along with justification for any proposed activities and proposed mitigation measures.

2.4.1 Cell excavation and stockpiling

For the western undeveloped area, based on the geotechnical conditions, excavation may be significantly hampered by the subsurface rock materials. In addition, LPSC has been in contact with the operator of the privately run gravel quarry adjacent to the site and confirmed that arrangements could be made to source cover and capping material from the quarry (using their quarry overburden or similar materials). As such, the cell excavation will be shallow and designed to primarily establish a suitable grading along the landfill base for construction and operation, limiting excavation to a minimum.

For the northern former quarry area, the previous quarrying that has already been undertaken will limit any additional excavation. As such, only very limited excavation will be undertaken where possible to establish a suitable grading along the landfill base for construction and operation.

It is anticipated that the excavated materials will be segregated during cell construction for future reuse, including topsoil for capping, soil materials for cover and capping, and rock material for processing and reuse in access road construction. Given the limited excavation quantities expected, the excavated material will be progressively stockpiled in unused landfill areas, interim covered areas and/or capped areas as the landfilling progresses. It is assumed the same stockpiling process can be used for the cover material sourced from the quarry and that it will be progressively provided to suit landfilling operations.

2.4.2 Facilities

Table 2.1 summarises the landfill facilities that have been allowed for as part of the masterplan alongside the new landfill cells and supporting infrastructure. These facilities are primarily to support the operational staff and domestic customers at the site. The area allocated for these facilities will be based on previous experience with similar sized landfill sites and will be refined as part of the subsequent phases of the project, if deemed feasible.

Table 2.1 Landfill facilities basis summary

Facility	Summary of basis
Weighbridge	Located at site entrance, dual weighbridge preferred.
Site office and amenities	Located near site entrance including parking for 3-5 staff.
Resource recovery area	General area for resource recovery, may include a community recycling centre, and drop-off locations for domestic customers for tyres, concrete, steel, green waste, bulky wastes, etc.
Small vehicles transfer station	Area for waste disposal by domestic customers, for transfer by the site operator or collections contractor to the landfill cells.

2.5 Operation of the project

2.5.1 Leachate management

The concept plan shows that an existing pond at the site would be repurposed as a leachate pond. Leachate disposal via evaporation from this pond is feasible and would be implemented. The need for emergency leachate disposal measures (such as irrigation and off-site tankering during or immediately after high rainfall events) would be assessed as part of the subsequent phases of the project, if deemed feasible.

The leachate pond was sized based on high level staging of the landfill operations with consideration to the default rainfall infiltration percentages provided in NSW EPA's Environmental Guidelines: Solid Waste Landfills (2016). The final pond size would be refined as part of the subsequent phases of the project, if deemed feasible.

2.5.2 Landfill gas management

Landfill gas management would be addressed during operation of the cell and not specifically as part of the concept design of the cell which is industry practice.

2.5.3 Resources and waste

Electricity would be required to power the site office and amenities.

Water would be required for the amenities block.

The site is not currently connected to electricity and mains water. These services would be connected to the site.

The site is not currently connected to sewer. This service would be connected to the site.

2.5.4 Access

As the project is at concept stage, no plan is available of the vehicle access, parking and circulation areas.

Access arrangements would comprise the following:

– Access from the Merriwa Road via formalisation of the existing access track running through the site for both domestic and commercial vehicles.
– Combined access to the weighbridge for domestic and commercial vehicles, followed by delineation of these vehicles to separate routes.
– Access road for domestic vehicles to the resource recovery areas (to promote resource recovery in the first instance), followed by access to the small vehicles transfer station for residual waste disposal, and then access to the site exit route.
– Access road for commercial vehicles directly to the landfill cells, and then access to the site exit route. Safety measures to be implemented where commercial vehicles re-join and share domestic vehicle routes. Additional access for commercial vehicles to the small vehicles transfer station for waste transfer to the landfill cells.

2.5.5 Personnel

Up to 5 staff would be employed at the site at any given time.

2.5.6 Hours of operation

The project would operate 7 days per week between the hours of 7 am to 5 pm.

3. Legislative and policy context

3.1 Secretary's Environmental Assessment Requirements

The SEARs relevant to noise and vibration, together with a reference to where they are addressed in this report are summarised in Table 3.1.

Table 3.1 Noise and vibration SEARs

Requirement	Where addressed in this report
Noise and vibration	
A description of all potential noise and vibration sources during construction and operation, including noise association with any blasting, machinery and plant movements, and road traffic noise	Section 7.4 (Construction – ICNG)
A noise and vibration assessment in accordance with the relevant Environment Protection Authority guidelines	Section 7.1 (Operation – NPI)
A description and appraisal of noise and vibration mitigation and monitoring measures	Section 7.6 (Traffic – RNP)

3.2 Guidelines and policies

The assessment was undertaken in accordance with the SEARs and with reference to the requirements of relevant legislation, policies and/or assessment guidelines, including:

– Interim Construction Noise Guideline (ICNG) (DECC, 2009)
  - Used for the assessment of noise associated with construction phases of the project
– NSW Road Noise Policy (RNP) (DECCW, 2011)
  - Used for the assessment of traffic generation from the project
– Noise Policy for Industry (NPI) (EPA, 2017)
  - Used for the assessment of operational noise impacts, that is, typical operations of the Willow Tree WMF when opened during year 1 operations
– Assessing Vibration: A Technical Guideline (DEC, 2006)
  - Used for the assessment of project ground vibration impacts
– DIN 4150-3 Structural Vibration – effects of vibration on structures (German Standards, 2016)
  - Used for the determination of suitable vibration intensity thresholds for structures

3.3 Other relevant legislation

3.3.1 Protection of the Environment Operations Act 1997

An objective of the *Protection of the Environment Operations Act 1997* (POEO Act) is to protect, restore and enhance the quality of the environment, in recognition of the need to maintain ecologically sustainable development. The POEO Act provides for an integrated system of licensing and contains a core list of activities in Schedule 1 which require an Environment Protection Licence (EPL). Willow Tree WMF does not currently operate under an EPL as they receive less than 5,000 tonnes per annum, the threshold for requiring an EPL in an unregulated area under the POEO Act. Based on feedback from LPSC and the waste management strategy's forecast for waste generation, recycling and disposal, it is expected that the waste accepted at the expanded site will exceed this threshold and hence an EPL will be required.

4. Existing environment

4.1 Project location

The site is Lot 213 DP 1173230, Merriwa Road, Willow Tree, NSW within the Liverpool Plains Local Government Area (LGA). The site is 2 kilometres south-west of the town of Willow Tree when measured by direct line, or 3.2 km by road. A regional map is shown in Figure 4.1.

The site is 20.8 ha in size.

Figure 4.1 Regional context

Source: Google Earth

1.1.1 Surrounding land uses

Land surrounding the site is predominantly zoned RU1 Primary Production and is used for general agricultural and rural activities:

– Willow Tree Gravels operates a quarry on the adjacent lot to the west, Lot 1 DP 502092, and to the north, Lot 121 DP 857377. The quarry operates under Environmental Protection Licence (EPL) 5154.
– Some native vegetation remains near the project site and quarries.
– All other land in the vicinity of the site is primarily used for grazing.

Based on aerial imagery, the closest residence appears to be approximately 490 metres south-east of the site.

4.2 Sensitive receptors

Noise sensitive receptors are defined in the *Noise Policy for Industry* (NPI) based on the type of occupancy and activities performed in the surrounding land uses. Sensitive noise and vibration receptors could include:

– Residences
– Educational facilities
– Hospitals and medical facilities
– 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
– Community centres
– Hotels, motels, caretaker's quarters, holiday accommodation and permanent resident caravan parks

Within the study area, five potentially most-affected receptors have been selected to represent all sensitive receptors within the wider community. The sensitive receptors are shown in Figure 4.2.

These key receptors are provided below in Table 4.1. The closest non-residential receptors identified in the vicinity of the project is Willow Tree Public School, detailed in Table 4.2.

Table 4.1 Key residential sensitive receptors

ID	MGA20 Z56 coordinates		Type	Distance from project	Direction
	x	y			
R02	281421	6494118	Residential	1.5 km	SW
R54	283885	6494470	Residential	490 m	SE
R41	284077	6494219	Residential	790 m	SE
R28	284461	6494911	Residential	1.1 km	E
R24	283617	6496196	Residential	1.2 km	NE

Table 4.2 Non-residential sensitive receptors

ID	MGA20 Z56 coordinates		Type	Distance from project	Direction	Description
	x	y				
EDU_01	284596	6495374	Educational	1.3 km	NE	Willow Tree Public School

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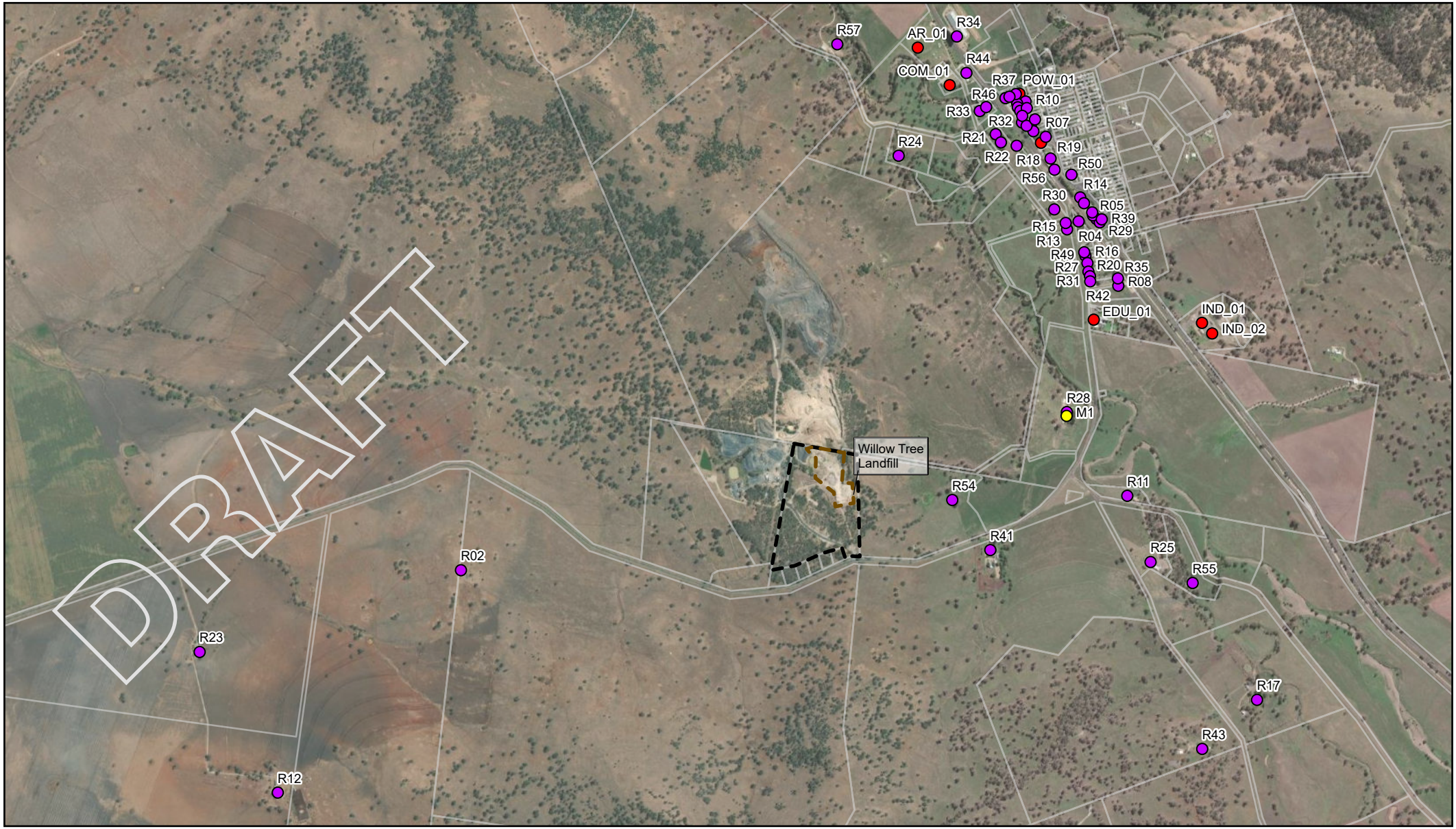
Figure 4.2 Sensitive receptors



Legend

Receptor Type

- Noise monitoring location
- Non-residential receptors
- Residential receptors
- Tipping area
- Site boundary
- Cadastre

Paper Size ISO A4

0 200 400 600 800

Metres

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

N

Liverpool Plains Shire Council
Willow Tree Regional Landfill
Noise and Vibration Assessment

Sensitive receptors

Project No. **12534581**
Revision No. **A**
Date **7/09/2022**

FIGURE 4.2

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Data source: : Elevation - 2011 Elvis DEM, Cadastre, Hydrolines and Contours - NSW Spatial Services 2022World Imagery: Maxar World Imagery: Maxar. Created by: pfernandes

5. Effects of meteorology on noise levels

5.1 Overview

The NPI provides two options for a proponent to consider meteorological effects on noise levels:

1. Adopt the noise-enhancing meteorological conditions for all assessment periods for noise impact assessment purposes without an assessment of how often these conditions occur – a conservative approach that considers source-to-receptor wind vectors for all receptors and F class temperature inversions with wind speeds up to 2 m/s at night.
2. Determine the significance of noise-enhancing conditions. This involves assessing the significance of temperature inversions (F and G class stability categories) for the night-time period and the significance of light winds up to and including 3 m/s for all assessment periods during stability categories other than E, F or G. Significance is based on a threshold of occurrence of 30 percent determined in accordance with the provisions in this policy. Where noise-enhancing meteorological conditions occur for less than 30 percent of the time, standard meteorological conditions may be adopted for the assessment.

This assessment has used the option 1 approach and assumed a source to receptor wind and temperature inversion conditions to represent a conservative assessment of noise impacts.

For the purposes of this NVIA, meteorological data from Tamworth AWS BoM station data was used to determine if prevailing winds are a feature of the area.

5.2 Wind

Wind has the potential to increase noise at a receptor when it is light and stable and blows from the direction of the source of the noise. As the strength of the wind increases, the noise produced by the wind will obscure noise from most industrial and transport sources.

Wind effects need to be considered when wind is a feature of the area under consideration. Where wind blows from the source to the receptor at speeds up to 3 m/s for more than 30 percent of the time in any season (NPI, 2017), then wind is considered to be a feature of the area.

Hourly wind speed and direction data, among other parameters, have been taken from the closest AWS station to Willow Tree, being in Tamworth, NSW, approximately 65 km northeast to the project site. A detailed approach has been utilised for the purpose of this assessment.

In order to determine the prevailing conditions, weather data from the 2021 full calendar year was obtained from the Tamworth AWS station.

In accordance with the NPI, this data was analysed to determine the frequency of occurrence of winds of speeds up to 3 m/s in each season during the day, evening and night-time period. The NPI states that for the 16-direction wind compass rose, the percentage occurrence of light winds is the arithmetic sum of the direction being reported plus two directions on either side.

The results of the wind analysis are provided in Table 5.1 and presented graphically in Figure 5.1 to Figure 5.4 for daytime only. In each figure, the wind directions and percentage occurrence are those dominant during each season.

Seasonal wind records indicate that winds up to 3 m/s exceed the 30 percent threshold in the SSE direction during spring, autumn, and winter nights. Prevailing winds are therefore considered a feature of the area during night-time only, however since proposed operations and construction will occur during daytime hours, prevailing winds have not been included in the assessment.

Table 5.1 Percentage occurrence of winds 0.5 m/s to 3 m/s

Wind direction	Percentage occurrence of winds between 0.5 m/s to 3 m/s (%)											
	Spring			Summer			Autumn			Winter		
	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night	Day	Evening	Night
N	2	4	3	2	4	1	2	4	2	3	6	4
NNE	2	4	4	2	2	0	3	3	2	1	4	2
NE	2	2	1	1	2	1	1	2	1	2	3	1
ENE	1	1	1	1	1	0	1	2	1	2	1	1
E	2	2	3	2	1	2	2	3	3	3	4	1
ESE	2	2	4	2	1	2	4	3	4	3	4	4
SE	3	2	8	4	1	6	5	4	11	5	7	9
SSE	2	2	10	3	2	8	4	3	11	3	2	12
S	1	1	8	3	1	5	2	1	4	1	2	7
SSW	1	2	3	1	1	2	2	3	3	1	1	4
SW	1	4	2	2	1	3	3	3	1	1	1	2
WSW	2	2	2	2	2	1	4	2	1	2	3	1
W	3	2	1	3	1	2	4	2	1	4	4	2
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NW	4	2	3	3	1	0	4	4	1	5	5	1
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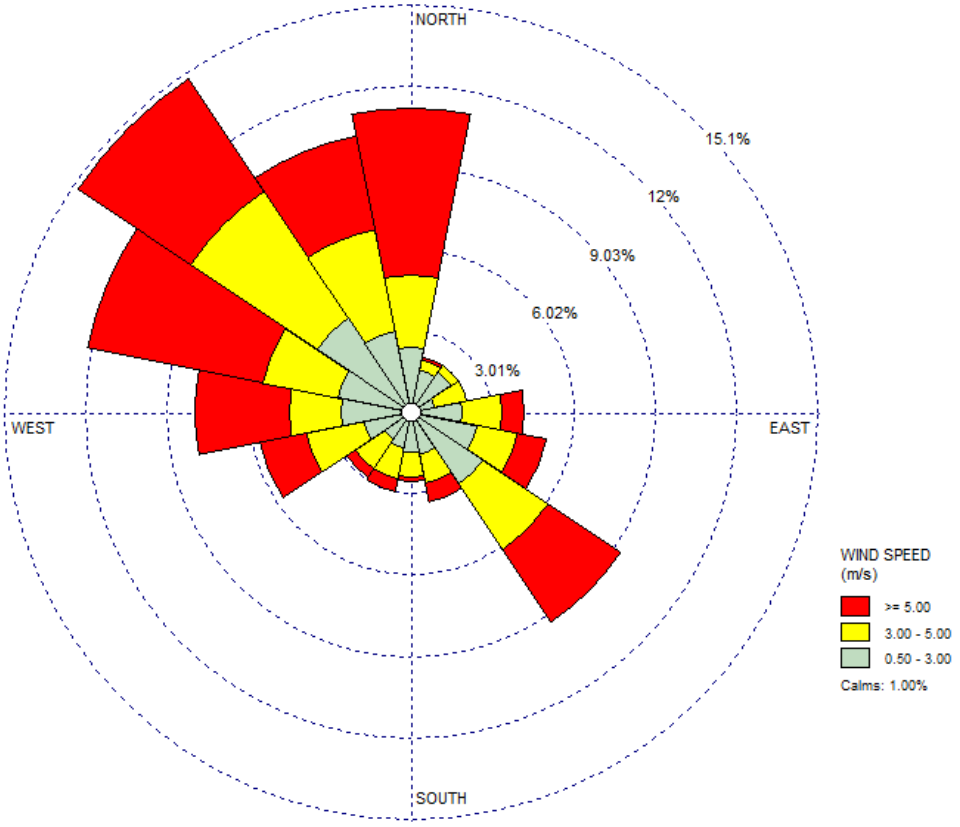

Figure 5.1 Daytime wind rose – Spring

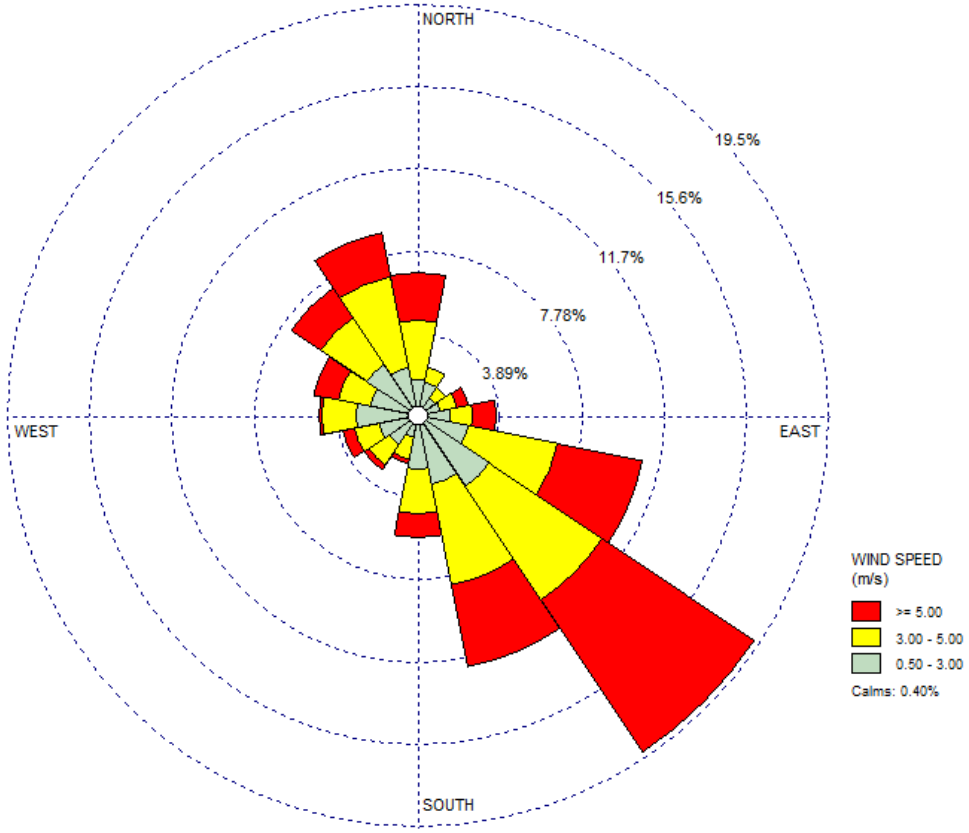

Figure 5.2 Daytime wind rose – Summer

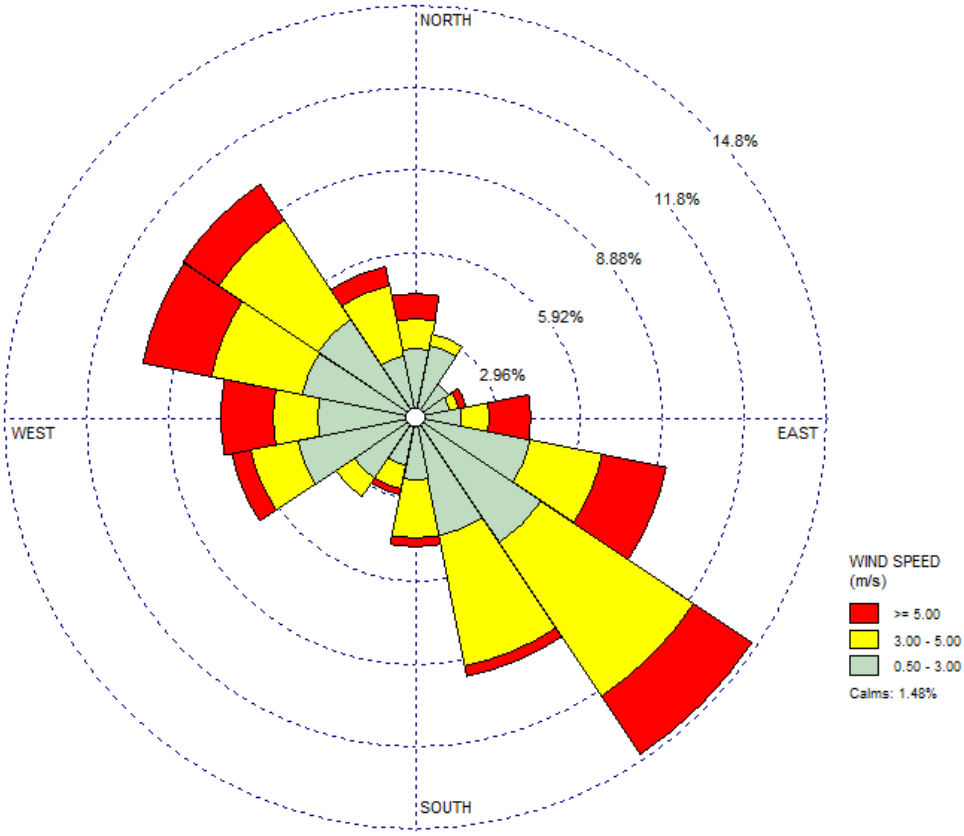

Figure 5.3 Daytime wind rose – Autumn

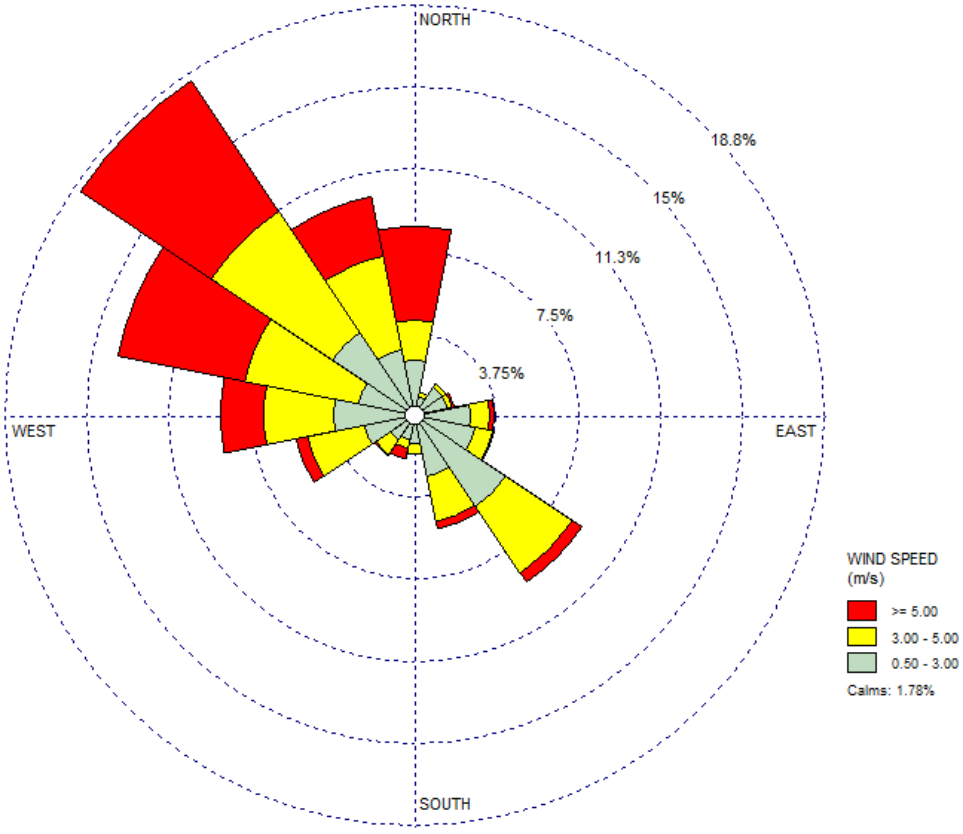

Figure 5.4 Daytime wind rose – Winter

6. Assessment criteria

6.1 Rating Background Levels (RBL)

GHD has undertaken long term unattended monitoring to determine the Rating Background Levels (RBLs) in accordance with the *Noise Policy for Industry*.

Noise logging was undertaken using one SVAN 977 noise logger (SN 36820), which was within current NATA accredited calibration. This instrument conforms to the requirements of Type 1 as set out in AS 1259.2 (1990) *Acoustics – Sound Level Meters – Integrating – Averaging* or AS IEC 61672.1 (2019) *Electro Acoustics - Sound Level Meters Specifications.*

The noise logger was deployed on 11 July 2022 and retrieved on 19 July 2022. This provided sufficient time to enable a full seven days of data to be captured, allowing for any periods of adverse weather during the survey to be excluded. The loggers were programmed to accumulate A-weighted, fast time response environmental noise data continuously over sampling periods of 15 minutes for the entire logging duration.

Pre-measurement calibration checks were 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 calibration was re-checked to ensure that the sensitivity of the noise monitoring equipment had not varied. The noise logger was found to be within the acceptable tolerance of ± 0.5 dBA.

Logged data was reviewed to exclude any anomalous data and data potentially affected by adverse weather conditions. Meteorological data for the monitoring period in 30-minute intervals was sourced from the Tamworth Airport AWS. Table 6.2 outlines the unattended noise monitoring locations and Table 6.3 outlines the Rating Background Level (RBL) results for the noise logger.

The most-affected receptors (all NCAs) can be characterised as rural residential, with dominant noise sources being wildlife, and occasional car passbys along Merriwa road. The resultant RBLs for day and evening were below the minimum assessable background noise levels as per the NPI, as such, they have been set at the minimum RBL in accordance with the NPI.

Table 6.1 Unattended noise monitoring locations

Logger ID	Equipment type and serial number	Date deployed and retrieved	Picture
M1	SVAN 977 SN 36820	11/07/2022 – 19/07/2022	

Table 6.2 Representative background and ambient noise levels in the study area

Monitoring I.D	RBL, $L_{90,day}$ - dBA	RBL, $L_{90,evening}$ - dBA	RBL, $L_{90,night}$ - dBA
M1	35	30	30

Notes:

1. The RBL during night period exceeded the evening time RBL, as such has been lowered to evening time RBL in accordance with the advice in the NPI.

6.2 Operational noise

The SEARs incorporate and consolidate the assessment requirements of the Department of Planning and Environment (DPE) for Development Consent Applications and the Environment Protection Authority (EPA) for Environment Protection License (EPL) applications for their consideration during the planning approval phase of the project. The Development Consent and/or EPL will generally contain conditions stipulating environmental noise limits for noise from the site. Willow Tree WMF does not currently operate under an EPL as they receive less than 5,000 tonnes per annum, the threshold for requiring an EPL in an unregulated area under the POEO Act. Based on feedback from LPSC and the waste management strategy's forecast for waste generation, recycling and disposal, it is expected that the waste accepted at the expanded site will exceed this threshold and hence an EPL will be required.

In addition, the *Environmental Planning and Assessment Act 1979* (EP&A Act) and the *Protection of the Environment Operations Act 1997* (POEO Act) require that authorities examine and take into account matters affecting the environment when making decisions about development and activities.

6.2.1 Noise Policy for Industry

The NPI provides noise levels for assessing the potential impact of noise from industry and includes a framework for considering feasible and reasonable mitigation measures. This enables the EPA to regulate noise emissions from scheduled premises under the POEO Act.

The objectives of project noise trigger levels (PNTL) for industry are to balance the need for industrial activity with the community's desire to minimise intrusive noise.

It should be noted that the audibility of a noise source does not necessarily equate to disturbance at an assessment location. To ensure these objectives are met, the EPA provides two separate noise trigger levels: intrusiveness and amenity. The intrusiveness noise levels apply over 15 minutes in any period (day, evening or night) and aim to control the relative audibility of operational noise compared to the background level at residential receptors.

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

6.2.2 Intrusiveness noise level

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

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

6.2.4 Summary of project noise trigger levels

Based on the NPI, a summary of the project noise trigger levels (PNTLs) for residential land uses are presented in Table 6.3. All identified residential receptors have been classified as 'rural residential'. Compliance with the residential PNTLs ensure compliance with the less-stringent non-residential PNTLs. The project noise trigger levels for non-residential receptors are presented in Table 6.4.

For a residence, the project noise trigger level and maximum noise levels are to be assessed at the reasonably most-affected point on or within the residential property boundary or, if that is more than 30 metres from the residence, at the reasonably most affected point within 30 m of the residence, but not closer than 3 m to a reflective surface and at a height of between 1.2–1.5 m above ground level.

In assessing amenity noise levels at commercial or industrial premises, the noise level is to be assessed at the reasonably most-affected point on or within the property boundary.

Table 6.3 Project noise trigger levels for rural residential receptors

	Assessment period	Rating Background Level (RBL), $L_{90,T}$-dBA	Intrusive noise level, $L_{Aeq(15min)}$	Project amenity noise level[1] $L_{Aeq(15min)}$	Project noise trigger level, $L_{Aeq(15min)}$ dBA
All receptors	Day	35	40	48	40
	Evening	30	35	43	35
	Night	30	35	38	35

Notes:

1. Project amenity noise level (ANL) is rural ANL (Table 2.1) minus 5 plus 3 dB(A) to convert from a period level to a 15-minute level.

Table 6.4 Project noise trigger levels for non-residential receptors (external)

Type	Time of day	Project noise trigger level, $L_{Aeq(15min)}$ dBA
Educational	When in use	43[1]

Notes:

1. Project amenity noise level (ANL) is educational ANL (Table 2.1) minus 5 plus 3 dB(A) to convert from a period level to a 15-minute level. 10 dB has been added to reflect an external noise level.

6.2.5 Cumulative noise impacts

Cumulative noise impacts affecting receptors from all industrial noise sources are assessed against the amenity criteria of the NPI. The combined impact of all industrial noise sources at a receptor location should be considered, where industrial facilities are either operating or have been approved for development. The cumulative noise criteria that apply for the residential receptors within the study area are the recommended amenity noise levels for 'rural residential' receptors being:

– Day period – $L_{Aeq(period)}$ 50 dBA
– Evening period - $L_{Aeq(period)}$ 45 dBA
– Night period - $L_{Aeq(period)}$ 40 dBA

The objective of the NPI 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 receptors. The NPI provides a recommended amenity noise level to represent the objective for total industrial noise at a receptor location and a project amenity noise level for noise from a single industrial development at a receptor 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 NPI states that were the project amenity noise level can be met, no additional consideration of cumulative industrial noise is required.

6.2.6 Modifying factor corrections

The NPI 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 6.5. At this point in time it is assumed that no equipment operating on site has any annoying characteristics.

Table 6.5 NPI 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]
Intermittent noise	Subjectively assessed	When the night-time noise level drops to that of the background noise level with a noticeable change in noise level of at least 5 dBA.	5 dBA

Notes:

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

6.3 Construction noise

As part of this project, there will be a number of elements which would fall under an assessment in accordance with the Interim Construction Noise Guideline (ICNG). This includes bulk earthworks, construction of main structures, and grading of access roads.

6.3.1 Interim Construction Noise Guideline

The EPA has released the Draft Construction Noise Guideline (DCNG) in 2020 for public consultation purposes only and once public consultation is complete, the feedback will be used to provide a final guideline to replace the ICNG. The ICNG will remain applicable for projects as it is referred to in the SEARs.

However, the DCNG still provides useful guidance and includes the following changes:

– Emphasis on the need to engage with the community, to ensure that the community's views are considered when planning how to manage construction noise impacts.
– Improved guidance for managing noise from construction activities taking place outside the recommended standard hours of work.

– Alignment of the level of assessment required with risk of noise impact.
– A simplified assessment path for routine activities undertaken by public authorities on public infrastructure through industry management procedures.
– Increased emphasis on the need for proponents to justify the selection of noise mitigation measures to improve transparency.

The intent of these changes has been considered in this assessment however construction noise associated with the project has been assessed against the requirements of the ICNG.

6.3.2 ICNG construction hours

The ICNG provides guidance for assessment and management of construction noise. The guideline recommends standard hours for project activities as follows:

– Monday to Friday: 7:00 am to 6:00 pm
– Saturday: 8:00 am to 1:00 pm
– No work on Sundays or Public Holidays.

Where practical, and subject to the final construction timetable, it is assumed that construction will be carried out during the standard construction hours only.

6.3.3 Noise management levels

The construction noise management levels (NMLs) represent a noise level that, if exceeded, will require management measures including:

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

The management measures are aimed at reducing noise impacts at the residential receptors. However, it may not be reasonable and feasible to reduce noise levels to below the noise affected management level at all times. The noise affected construction NMLs are not intended as a noise limit but rather a level at which noise management is required.

Table 2 in the ICNG provides recommended NML for residential receptors, which are detailed in Table 6.6.

Table 6.6 Residential construction noise management levels, dBA (ICNG, 2009)

Time of day	Noise management level, $L_{Aeq(15\ min)}$	Application notes
Recommended standard hours	Noise affected: RBL + 10 dBA	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq(15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected: 75 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 relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: – Times identified by the community when they are less sensitive to noise (such as before and after school, or mid-morning or mid-afternoon for works near residences). – If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Time of day	Noise management level, $L_{Aeq(15\ min)}$	Application notes
Outside recommended standard hours	Noise affected: RBL + 5 dBA	A strong justification will 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 negotiate with the community.

6.3.4 Sleep disturbance

No construction works are proposed during the night period (10:00 pm to 7:00 am Monday to Saturday and 10:00 pm on Saturday to 8:00 am on Sunday). If activities are required to be undertaken during these times it will be limited to activities which are not audible at the nearest sensitive receptor, or discreet events which need to be undertaken outside standard hours for safety reasons.

As such, no sleep disturbance impacts are anticipated during the construction phases of the project.

6.3.5 Noise management levels

The noise management levels (NMLs) at sensitive receptors in the study area are summarised in Table 6.7 and have been based on the RBLs presented in Table 6.2.

Table 6.7 Project specific noise management levels

Sensitive receptor type	Construction Noise Management Levels, $L_{Aeq(15min)}$	
	Standard construction hours	
	Noise affected	Highly noise affected
Residential	45	75
Educational	55 (external) (when in use)	

6.4 Traffic noise

The RNP provides traffic noise target levels for residential receptors in the vicinity of existing roads and are applied to road upgrades. For this assessment, these levels are also applied to traffic associated with construction works to identify potential construction traffic impacts and the potential for reasonable and feasible mitigation measures. The RNP road types are based on the functional roles shown in Table 6.8.

Table 6.8 Road Categories from RNP

Road category	Functional role	Public roads used by project
Local roads	Provide vehicular access to abutting property and surrounding streets. Provide a network of the movement of pedestrians and cyclists and enable social interaction in a neighbourhood. Should connect, where practicable, only to sub-arterial roads.	– Merriwa Road

The application notes for the RNP state that "*for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level as a result of the development should be limited to 2 dB above that of the noise level without the development. This limit applies wherever the noise level without the development is within 2 dB of, or exceeds, the relevant day or night noise assessment criterion*."

If the road traffic noise increase from the project is within 2 dB of current levels, then the objectives of the RNP are met and no specific mitigation measures are required. Mitigation should be applied when road traffic noise levels increase by 2 dB *and* the controlling noise criterion in Table 6.9 are exceeded at the façade of the residence.

Table 6.9 Road traffic noise criteria, dBA

Development type	Applicability to assessment	Day 7:00 am to 10:00 pm	Night 10:00 pm to 7:00 am
Existing residence affected by additional traffic on local roads generated by land use developments	– Merriwa Road	55 $L_{eq(1hr)}$	50 $L_{eq(1hr)}$

6.5 Project vibration

6.5.1 Human comfort

Vibration is assessed based on the criteria in *Assessing Vibration: A Technical Guideline* (DEC, 2006). *BS6472: Guide to Evaluation of Human Exposure to Vibration in Buildings* (1 Hz to 80 Hz) (British Standards, 2008) is recognised as the preferred standard for assessing the 'human comfort criteria'. Intermittent vibration, such as construction work, is assessed using the vibration dose value (VDV).

Whilst the assessment of response to vibration in BS 6472-1:2008 is based on vibration dose value and weighted acceleration, for construction related vibration it is considered more appropriate to provide guidance in terms of a peak particle velocity (PPV), since this parameter is likely to be more routinely measured based on the more usual concern over potential building damage. Table 6.10 provides guidance on the effect of vibration levels for human comfort in terms of peak particle velocity.

Table 6.10 Acceptable PPV Values for Human Comfort (BS 6472-2008)

Receptor	Period	Continuous and impulsive vibration guide goals	
		Preferred value	Maximum value
Residential	Day	0.28 (8.6)	0.56 (17.0)
Offices, schools, educational institutes and places of worship	When in use	0.56 (18.0)	1.1 (36.0)
Workshops	When in use	1.1 (18.0)	2.2 (36.0)

Notes:

1. Impulsive goals are shown in brackets – These are most relevant to activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading.

Humans are capable of detecting vibration at levels which are well below those causing risk of damage to a building. The degrees of perception for humans are suggested by the vibration level categories given in *BS5228.2 – 2009, Code of Practice Part 2 Vibration for noise and vibration on construction and open sites – Part 2: Vibration* (British Standards, 2009), as shown below in Table 6.11.

Table 6.11 Guidance on effect of vibration levels for human comfort (BS 5228.2 – 2009)

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.

6.5.2 Structural damage to standard and heritage structures

Vibrations as a result of construction work relating to the project are considered as a short-term vibration impact and criteria have been established accordingly.

The minimum working distances for structural (cosmetic) damage used for this assessment have been based on *DIN 4150-3 Structural Vibration – effects of vibration on structures* (German Standards, 2016) levels from ground borne vibration which enables the likelihood of building damage from ground vibration to be assessed. Experience has shown that if these values are complied with, damage that reduces the serviceability of the building will not occur. If damage nevertheless occurs, it is to be assumed that other causes are responsible. Measured values exceeding those listed in Table 6.12 do not necessarily lead to damage; should they be significantly exceeded however, further investigations may be necessary.

The vibration levels in this standard are adopted as building damage criteria and are presented Table 6.12 for industrial premises, domestic premises, and heritage structures.

No heritage structures have been identified within 250 metres of the project footprint and as such, no vibration impacts to heritage structures are anticipated.

Table 6.12 DIN 4150-3:2016 guideline values for short term vibration velocity

Line	Type of building	Guideline values for velocity, (mm/s)		
		Vibration at the foundation at a frequency of		
		1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz[3]
1	Offices and industrial premises	20	20-40	40-50
2	Domestic houses and similar construction	5	5-15	15-20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10

Notes:

1. Values referred to are at the base of the building.
2. At frequencies below 4 Hz, a maximum displacement of 0.6 mm (zero to peak) should not be exceeded.
3. At frequencies above 100 Hz the values given in this column may be used as minimum values.

7. Noise and vibration impacts

7.1 Operational noise impacts

It has been assumed that all activity associated with the project would be conducted during daytime hours. The main operational scenarios envisaged and assessed are as follows:

– Operational Scenario 1 – Typical daily operation of the expanded Willow Tree WMF, year 1 of operations.

Note that the entire landfill footprint has been included in the model ensuring that a worst-case scenario has been modelled.

7.1.1 Noise modelling methodology

The following factors have been considered in the noise modelling methodology:

– The Sound Power Level (SWL) of external industrial noise sources either modelled as a point source, a line source, or an area source
– External moving point sources (e.g. external truck movements, staff vehicles)
– External fixed point sources or area sources (e.g. fixed plant)
– Terrain topography
– Absorption from the ground coverage
– Atmospheric absorption
– The operating times of the relevant noise sources and the frequency of vehicle movements
– Noise enhancing meteorological conditions
– The ISO 9613-2:1996 prediction methodology was utilised within CadnaA noise modelling software (Version 2021), to predict noise emissions
– The noise model inputs and assumptions for this assessment are provided in Table 7.1.

Table 7.1 Noise modelling parameters

Modelling component	Assumption
Noise model	CadnaA v 2021
Prediction algorithm	*ISO 9613 – 2 Acoustics – Attenuation of sound during propagation outdoors*
Modelling period	Typical worst case 15-minute period of operation where each significant item of equipment is running at full power
Meteorology	ISO 9613 considers 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
Ground absorption coefficient	G = 0.75 representing vegetative grassland areas (75%) and non-porous ground (25%)
Atmospheric absorption	Based on a default temperature of 10°C and an average humidity of 70%
Receiver heights	1.5 m above building ground level (ground floor)

The analysis in Section 5 indicates that standard meteorological conditions are appropriate to be used in the assessment during the day period. No noise-enhancing wind effects have been included in the noise model during any assessment period as they do not occur for more than 30% of the time (see Section 5).

7.1.2 Equipment noise level estimates

The primary noise generating equipment used in the noise model are based on conservative estimates of similar equipment used for similar projects. The sound power levels, equipment type and location of each item of equipment modelled is presented in Table 7.2.

The general methodology using CadnaA modelling software to predict the noise levels at sensitive receptors involves:

– Conservative assumptions based on previous experience relating to equipment or direct input from equipment manufacturer's specifications
– Assume all equipment is operating simultaneously within a 15-minute period
– Predict the noise level at the nearest sensitive receptors using the ISO 9613 prediction algorithm for environmental noise propagation

Table 7.2 Operational equipment Sound Power Levels

Scenario	Project element	Equipment	Quantity	Duration	Equipment SWL, dB(A)	Combined SWL
OS1	Operation of Willow Tree WMF	Wheeled loader	1	100%	102	115
		Moxy dump truck	1	100%	111	
		Huka truck (truck and dog)	1	100%	107	
		Landfill compactor	1	100%	110	
		Waste trucks	2 per day (see below)	-	109	
		Light vehicles	6 (see below)	-	85	

7.1.3 Modelling assumptions – workforce and public

The following modelling traffic assumptions were made to represent the typical worst-case noise conditions from operations:

– 5 staff vehicles modelled accessing the site in peak hour during daytime period (5 movements)
– 1 self-haulage light vehicle accessing and leaving the site in peak hour during daytime period (2 movements).
– 2 waste trucks accessing the site per day, assumed to be 1 truck accessing and leaving the site in peak hour (2 movements).

7.1.4 Predicted noise levels

The predicted $L_{Aeq(15min)}$ noise levels at the most-affected sensitive receptors are presented in Table 7.3, with detailed results for all receptors presented in Appendix A. The noise modelling indicates compliance is predicted at all sensitive receptor locations for the daytime period. L_{Aeq} noise contours at 1.5 m above ground for day operations are presented in Figure 7.1.

Table 7.3 Predicted $L_{Aeq(15min)}$ noise levels at sensitive receptors, dBA

RID	Receptor Type	NPI Project noise trigger level, $L_{Aeq(15min)}$, dBA Daytime period	Predicted $L_{Aeq(15min)}$ noise level, dBA Daytime period	Complies?
R02	Residential	40	30	Yes
R54	Residential	40	36	Yes
R41	Residential	40	35	Yes
R28	Residential	40	31	Yes
R24	Residential	40	21	Yes
EDU01	Educational	43	29	Yes

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Figure 7.1 OS1 Predicted noise contours – Typical operations

7.2 Cumulative noise impacts

According to the NPI, the intrusiveness noise level aims to protect the community against significant changes in noise levels, whilst the project amenity noise level seeks to protect against uncapped incremental changes in noise level from multiple industrial noise sources (that is, cumulative noise impacts). Applying the most stringent requirement as the project noise trigger level ensures that intrusive noise is limited and long-term amenity is protected. It also ensures that no single industry can unacceptably change the noise level of an area. The results of the operational noise assessment shows that all receptors would comply with project noise trigger levels during the daytime period. This means that noise impacts are predicted to be at or below the background noise levels and as such, no further assessment or consideration of cumulative noise is required in accordance with the NPI.

7.3 Sleep disturbance impacts

The NPI states that where the subject development/premises night-time noise levels at a residential location exceed:

– $L_{Aeq,15min}$ 40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or
– $L_{AFmax\ 52}$ dB(A) or the prevailing RBL plus 15 dB, whichever is the greater,

a detailed maximum noise level event assessment should be undertaken. Since there are no activities anticipated for the night-time assessment period, sleep disturbance impacts are not expected to occur.

7.4 Construction noise impacts

Information was provided by LPSC regarding the proposed construction scenarios and equipment for the construction activities associated with the proposal were based on similar projects. The most significant impacts are expected to occur during grading and sealing of the access road. It has been assumed that all construction activity associated with the proposal would be conducted during the recommended standard construction hours. The main construction scenarios envisaged and assessed are as follows:

– Construction Scenario 1 – Ground works and excavation, which includes bulk earthworks and construction of landfill cells
– Construction Scenario 2 – Construction of main structures, which includes weighbridge, site office, amenities, resource recovery area, and small vehicles transfer station
– Construction Scenario 3 – Grading and sealing of access roads

7.4.1 Construction equipment

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

– Australian Standard AS2436 – *Guide to Noise Control on Construction, Maintenance and Demolition Site* (2010)
– NSW Roads and Maritimes Services – *Construction Noise and Vibration Guideline* (2016)
– GHD measurements of similar equipment

The anticipated plant and equipment to be used for each construction scenario is shown in Table 7.4 along with corresponding sound power levels used in the noise model.

Table 7.4 Construction equipment sound power levels

Equipment	SWL, dBA	Source	CS1	CS2	CS3
Activity SWL, dBA			**115**	**114**	**119**
Bobcat	109	DEFRA		✓	
Boom lift	108	DEFRA		✓	
Bulldozer	112	GHD database	✓		✓
Compactor	109	AS2436	✓		✓
Concrete truck	102	AS2436			✓
Excavator	110	AS2436	✓	✓	✓
Forklift	100	AS2436		✓	
Grader	106	AS2436			✓
Light vehicles	85	GHD database	✓	✓	✓
Mobile crane	101	AS2436		✓	
Smooth drum roller	106	CNVG			✓
Trucks	107	AS2436	✓	✓	✓

In addition, the indicative traffic generation associated with the proposal during construction are summarised as:

– 5 inbound and 5 outbound heavy vehicle trips per day modelled on internal access roads.
– 10 construction staff vehicles modelled per hour on internal access roads.

7.4.2 Noise modelling assumptions and parameters

Acoustic modelling was undertaken using CadnaA noise modelling software to predict the effects of construction noise generated by the proposed works. General parameters used in the model are listed in Table 7.5.

Table 7.5 Noise modelling parameters

Variable	Parameter used
Calculation method	ISO 9613- 2:1996
Meteorology	ISO 9613 considers 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
Topography	Sourced from ELVIS GIS Australia - 5 m elevation intervals
Receiver heights	1.5 m above building ground level
Ground absorption	G = 0.75 representing vegetative grassland areas (75%) and non-porous ground (25%)

7.4.3 Predicted noise levels

Construction noise levels have been predicted at the sensitive receivers within the study area with consideration to the acoustic requirements of the ICNG. The predicted $L_{Aeq(15min)}$ noise levels at the most-affected sensitive receivers are presented in Table 7.6, with detailed results for all receivers are presented in Appendix A. The noise modelling assumes that all pieces of 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 often highly conservative and actual noise levels are likely to be lower than those the levels presented below for the majority of the time.

Reasonable and feasible mitigation measures are recommended in Section 8 to reduce any potential noise impacts at sensitive receivers with consideration to the following:

– the effectiveness of the mitigation measures
– whether the measures are considered reasonable and feasible

Construction noise contours for each scenario are shown in Figure 7.2 to Figure 7.4.

Table 7.6 Summary of construction noise levels – Standard construction hours (day)

RID	Receiver Type	NML, $L_{Aeq(15min)}$ dBA Standard hours	Predicted $L_{Aeq(15min)}$ noise level, dBA			Complies?
			CS1	CS2	CS3	
R02	Residential	45	29	31	32	Yes
R54	Residential	45	35	41	35	Yes
R41	Residential	45	34	39	35	Yes
R28	Residential	45	30	34	33	Yes
R24	Residential	45	20	22	23	Yes
EDU01	Educational	55	29	31	31	Yes

Predictive modelling indicates that at all receptors in the study area, predicted noise levels for all assessed scenarios are predicted to be below noise management levels (NML) during worst case conditions with all equipment operating simultaneously. Notwithstanding this, the application of reasonable and feasible mitigation measures at the source is considered best practice and should be implemented where reasonable and feasible. Mitigation measures are discussed further in Section 8 with consideration to the following:

– The effectiveness of the mitigation measures
– Whether the measures are considered reasonable and feasible

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Figure 7.2 CS1 Predicted noise contours – Ground works and excavation

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Figure 7.3 CS2 Predicted noise contours – Construction of main structures

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Figure 7.4 CS3 Predicted noise contours – Grading and sealing of access roads

7.5 Project vibration impacts

7.5.1 Vibration modelling methodology

The method for the 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).
– Safe working distances for vibration intensive equipment are shown in Table 7.7. The vibratory equipment associated with the project include compactors (or vibratory roller) and excavators.
– Buildings within the safe working distances have been identified for consideration of management measures.

7.5.2 Vibration safe working distances

Safe working distances for vibratory intensive equipment has been sourced from the TfNSW CNVS and are shown in Table 7.7.

Table 7.7 Vibration safe working distances

Equipment	Human comfort (OH&E Assessing Vibration – A Technical 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
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)

7.5.3 Human comfort

The most vibration intensive activities associated with the works are anticipated to be excavation works with a medium to large excavator and compacting during bulk earthworks and grading of the access road.

Excavation activities have the potential to exceed the human comfort vibration criteria should these works occur within 73 m of residences, while compacting works have the potential to exceed human comfort levels within 100 m (data for large vibratory roller used). No residences have been identified within 100 m of these vibration intensive works and as such, no adverse vibration impacts are anticipated as a result of the project.

7.5.4 Structural damage

Excavation works have the potential to exceed the cosmetic damage criteria should these works occur within 22 m of a sensitive receptor building. No other sensitive buildings have been identified within 22 m of excavation works.

7.6 Traffic noise impacts along public roads

7.6.1 Existing traffic conditions

Existing traffic volumes along Merriwa Road are not currently known, as traffic surveys were not undertaken along this road. As Merriwa Road is categorised as a local road, according to the GHD Traffic Assessment for Willow Tree Waste Management Facility (GHD, 2022) indicative volumes on a local road is typically between 500 and 4,000 per day. Assuming Merriwa Road carries approximately 1500 vehicles per day, a peak hour estimate would be in the area of approximately 100 vehicles total, both ways.

The estimated peak hour volumes in each the eastbound and westbound directions are included in Table 7.8 below. Light vehicle (LV) and heavy vehicle (HV) split was not available but is assumed to be an approximate 80% light vehicle to 20% heavy vehicle ratio, which corresponds to the LV/HV split seen at the closest TfNSW traffic count station (ID 6158). Table 7.9 outlines the calculated volumes based on these ratios.

Table 7.8 Estimated peak hour volumes along Merriwa Road

	AM Peak	PM Peak
Eastbound	50 vph	50 vph
Westbound	50 vph	50 vph
Total	**100 vph**	**100 vph**

Table 7.9 Estimated peak hour volumes along Merriwa Road LV and HV split

	AM Peak	PM Peak
Eastbound LV	40	40
Eastbound HV	10	10
Westbound LV	40	40
Westbound HV	10	10
Total	**100 vph**	**100 vph**

7.6.2 Project traffic generation

The estimated traffic generation associated with the project during the peak of operation/construction are summarised as:

– Construction
  - Approximately 10 construction staff vehicles arriving or departing during peak hour
  - Approximately 1 construction heavy vehicle arriving and departing the site during peak hour (2 movements)

– Operation
  - Approximately 5 operational staff vehicles arriving or departing during peak hour
  - Approximately 1 waste truck arriving and departing the site during peak hour (2 movements)
  - Approximately 1 additional self-haul light vehicle arriving and departing the site during peak hour (2 movements)

7.6.2.1 Traffic modelling methodology

Noise predictions were undertaken using the Road Traffic Noise Estimator model within the construction and maintenance noise estimator (Construction and Maintenance Noise Estimator, 2017 version, TfNSW) utilising the CoRTN method. The model was used to assess the potential change in traffic noise level associated with both construction and operational traffic generation to determine if noise impacts are within 2 dB of current levels. The parameters used in this noise model are presented in Table 7.10.

Table 7.10 Noise calculation parameters – RMS construction noise estimator model

Variable	Parameter used
Calculation method	CoRTN
Pavement surface	Dense Graded Asphalt (DGA)
Road type	Local road
Traffic speeds	80 km/hr
Ground type	Undeveloped green fields (rural areas with isolated dwellings)

7.6.2.2 Construction traffic noise impacts

Table 7.11 outlines the results of the noise predictions for additional construction traffic during the worst case 1-hour period along Merriwa Road, the closest public road to the identified sensitive receptors.

Table 7.11 Project traffic noise impacts along Merriwa Road during peak period

Vehicle category	Existing Vehicles	Additional vehicles	Overall change in noise levels	Require consideration of additional mitigation measures?
	Both directions	Both directions		
Light vehicles	80	10	+0.4	No
Heavy vehicles	20	2		
Total	100	12		

Noise predictions show that traffic noise impacts due to the project are anticipated to remain within 2 dB of current levels, and therefore additional mitigation measures are not required.

7.6.2.3 Operational traffic noise impacts

Table 7.11 outlines the results of the noise predictions for additional operational traffic during the worst case 1-hour period along Merriwa Road, the closest public road to the identified sensitive receptors.

Table 7.12 Project traffic noise impacts along Merriwa Road during peak period

Vehicle category	Existing Vehicles	Additional vehicles	Overall change in noise levels	Require consideration of additional mitigation measures?
	Both directions	Both directions		
Light vehicles	80	7	+0.4	No
Heavy vehicles	20	2		
Total	100	9		

Noise predictions show that traffic noise impacts due to the project are anticipated to remain within 2 dB of current levels, and therefore additional mitigation measures are not required.

8. Mitigation measures

It is predicted that activities associated with the project would comply with the NMLs in accordance with the ICNG, and the PSNLs in accordance with the NPI. The measures provided in Table 8.1 are best practice and should be implemented to minimise potential noise and vibration impacts where reasonable and feasible.

Table 8.1 Mitigation measures during the construction phase

Control type	ID	Measure	Timing
Community consultation			
Notification of works	NV1	Notification should be a minimum of 7 calendar days prior to the start works and should include information such as total building time, what works are expected to be noisy, their duration, what is being done to minimise noise and when respite periods will occur. If there are works outside standard hours, inform closest residents and other sensitive land use occupants within 14 days of commencement. Provide information to neighbours before and during construction through media such as letterbox drops, meetings or individual contact. In some areas, the proponent will need to provide notification in languages other than English. A website will also be established for the project to provide information.	Pre-construction
Community relations	NV2	Ensure site managers periodically check the site and nearby residences and other sensitive land uses for noise problems so that solutions can be quickly applied. Maintain good communication between the community and project staff. Consider a regular newsletter with site news, significant project events and timing of different activities. Facilitate contact with people to ensure that everyone can see that the site manager understands potential issues, that a planned approach is in place and that there is an ongoing commitment to minimise noise.	Pre-construction During construction
Community liaison officer	NV3	Appoint a community liaison officer to: – provide a designated point of contact – attend local group or forum meetings – manage and implement any community consultation obligations – resolve complaints (to the greatest extent practicable)	Construction
Complaints handling.	NV4	Provide a readily accessible contact point, e.g. through a 24 hour toll-free information and complaints line. Document and maintain a complaints register detailing the following: – date and time – complainants' details – person receiving complaint and person referred to – description of complaint. Provide quick response to complaints, with complaint handling staff having both a good knowledge of the works and ready to access information.	Pre-construction During construction

Control type	ID	Measure	Timing
Management measures			
Site inductions	NV5	All employees, contractors and subcontractors are to receive an environmental induction. The induction must at least include: – all project specific and relevant standard noise and vibration mitigation measures – relevant licence and approval conditions – permissible hours of work – any limitations on high noise generating activities – location of nearest sensitive receptors – construction employee parking areas – designated loading/unloading areas and procedures – site opening/closing times (including deliveries) – environmental incident procedures	Construction
Schedule activities to minimise noise impacts	NV6	All activities on site should be confined between the hours: daytime hours of 7:00 am to 6:00 pm from Monday to Friday and 8:00 am to 1:00 pm on Saturday, with the exception of the following activities: – the delivery of oversized plant of structures – emergency work to avoid the loss of life or damage to property, or to prevent environmental harm	Pre-construction During construction
Behavioural practices	NV7	Avoid the use of radios or stereos outdoors where neighbours can be affected. Avoid the overuse of public address systems. Avoid shouting and minimise talking loudly and slamming vehicle doors. Reduce throttle setting and turn off equipment when not being used. Avoid use of reversing alarms by designing site layout to avoid reversing, such as by including drive- through for parking and deliveries. Install where feasible and reasonable less annoying alternatives to the typical 'beeper' alarms taking into account the requirements of the Occupational Health and Safety legislation; examples are smart alarms that adjust their volume depending on the ambient level of noise and multifrequency alarms that emit noise over a wide range of frequencies.	Construction
Update Construction Environmental Management Plans	NV8	The Construction Environmental Management Plan CEMP must be regularly updated to account for changes in noise and vibration management issues and strategies.	Pre-construction During construction
Construction Noise and Vibration Management Plan	NV9	A CNVMP should be prepared post approval, after the alliance partner has been engaged and prepared its construction methodology. The CNVMP would include a review of the construction noise predictions during the environmental impact assessment phase based on the construction contractor's methodology and revise it accordingly to include a detailed examination of feasible and reasonable work practices and noise mitigation measures to manage sensitive receptors that are predicted to be 'noise affected'. CNVMP should also include: – details of the construction methodology – feasible and reasonable mitigation measures to be implemented – updated noise predictions at sensitive receptors – a noise monitoring procedure for the duration of works – a community consultation plan to liaise with the noise affected receptors	Post approval

Control type	ID	Measure	Timing
Source mitigation measures			
Construction hours and scheduling.	NV10	Where feasible and reasonable, construction should be carried out during the standard daytime working hours. Work generating high noise and/or vibration levels should be scheduled during less sensitive time periods.	Construction
Non-tonal and ambient sensitive reversing alarms	NV11	Non-tonal reversing beepers (or an equivalent mechanism) must be fitted and used on all construction vehicles and mobile plant regularly used on site and for any out of hours work. Consider the use of ambient sensitive alarms that adjust output relative to the ambient noise level.	Construction
Equipment selection	NV12	Use quieter and less vibration emitting construction methods where feasible and reasonable.	Pre-construction During construction
Reduced equipment power	NV13	Use only the necessary size and power.	Construction
Minimise disturbance arising from delivery of goods to construction sites.	NV14	Loading and unloading of materials/deliveries is to occur as far as possible from sensitive receptors. Select site access points and roads as far as possible away from sensitive receptors. Dedicated loading/unloading areas to be shielded if close to sensitive receptors. Delivery vehicles to be fitted with straps rather than chains for unloading, wherever possible. Avoid or minimise these out of hours movements where possible.	Construction
Engine compression brakes	NV15	Limit the use of engine compression brakes in proximity to residences.	Construction
Maintain equipment	NV16	Regularly inspect and maintain equipment to ensure it is in good working order. Also check the condition of mufflers. Equipment must not be operated until it is maintained or repaired, where maintenance or repair would address the annoying character of noise identified.	Construction
Transmission path mitigation measures			
Maximise shielding	NV17	Use temporary site buildings and materials stockpiles as noise barriers. Use natural landform as noise barrier – place fixed equipment in cuttings, or behind earth berms.	Construction
Compliance monitoring			
Complaints	NV18	Compliance monitoring should be undertaken to investigate complaints.	Construction

9. Evaluation and conclusion

The noise and vibration impact assessment has established the ambient and background noise and assessed the potential noise impacts associated with the construction and operational phases of the project with respect to the following guidelines:

– Operational phase - *Noise Policy for Industry* (NPI)
– Construction phase - *Interim Construction Noise Guideline* (ICNG)
– Road network - *Road Noise Policy* (RNP)
– Vibration – *Assessing Vibration: A Technical Guideline* (AVTG)
– Vibration - *DIN 4150-3 (2016) Structural Vibration – effects of vibration on structures*

The assessment has led to the following conclusions, which are subject to the limitations and modelling assumptions provided in 1.3.

An assessment of potential noise impacts during the construction phase has been undertaken against the ICNG during standards hours. Predicted noise levels during all stages are predicted to result in noise levels below the Noise Management Level (NML) at all receptors. In addition:

– No sensitive receptors have been identified within the safe working distances for vibratory intensive work. As such, no adverse (structural damage or human comfort) vibration impacts are anticipated.
– Mitigation measures to reduce the risk of the noise impacts during these works have been recommended in Section 8 and should be incorporated into the Contractor's CEMP.

Noise modelling was undertaken using CadnaA (v 2022) to predict operational noise levels at sensitive receptors and assessed against the NPI project noise trigger levels during the day period based on typical worst-case operating conditions. All assessed receptors are predicted to receive noise levels below the project noise trigger levels established.

Noise predictions were undertaken using the CoRTN method to predict changes in traffic noise levels at the most-affected residential receptors along haulage routes during the project. The results indicate that traffic noise impacts due to the project are anticipated to remain within 2 dB of current levels, and therefore additional mitigation measures are not required.

Appendices

Appendix A

Noise model results

Receiver ID	Easting	Northing	Predicted $L_{Aeq(15min)}$ noise level, dBA			
			OS1	CS1	CS2	CS3
AR_01	283712.6	6496738	<20	<20	<20	<20
COM_01	283872.8	6496550	21	20	<20	<20
EDU_01	284595.5	6495374	29	29	31	31
HA_01	284330.9	6496261	26	25	<20	<20
IND_01	285138.6	6495358	26	26	<20	<20
IND_02	285189.8	6495305	26	26	<20	<20
POW_01	284223	6496507	<20	<20	<20	<20
R001	284254.2	6496468	24	23	<20	<20
R002	281421.1	6494118	30	29	31	32
R003	284211.9	6496457	24	23	<20	<20
R004	284519.9	6495867	28	27	28	30
R005	284609	6495879	28	27	26	29
R006	284215.2	6496439	24	23	<20	<20
R007	284355.1	6496291	25	24	<20	<20
R008	284719.1	6495544	28	28	30	30
R009	284227.1	6496421	24	23	<20	<20
R010	284259.7	6496435	24	23	<20	<20
R011	284764.4	6494491	30	29	33	33
R012	280501.7	6493003	<20	<20	<20	<20
R013	284462.5	6495827	28	27	30	29
R014	284527.9	6495987	27	26	26	29
R015	284454.7	6495859	28	27	29	29
R016	284553.8	6495694	28	28	30	30
R017	285415.3	6493468	<20	<20	<20	<20
R018	284208.7	6496246	26	25	25	27
R019	284378.5	6496182	26	25	25	28
R020	284564.1	6495658	28	28	30	30
R021	284104.4	6496304	25	24	24	26
R022	284129.5	6496263	25	25	24	27
R023	280109.5	6493708	<20	<20	<20	<20
R024	283617.2	6496196	21	20	22	23
R025	284880.8	6494159	29	29	32	31
R026	284547	6495958	27	27	26	29
R027	284568.9	6495615	28	28	30	30
R028	284460.7	6494911	31	30	34	33
R029	284625.8	6495862	28	27	26	29
R030	284397.6	6495927	27	27	29	29
R031	284576.9	6495592	29	28	30	31
R032	284236.5	6496363	24	23	<20	<20
R033	284023.6	6496420	24	23	<20	<20

Receiver ID	Easting	Northing	Predicted $L_{Aeq(15min)}$ noise level, dBA			
			OS1	CS1	CS2	CS3
R034	283908.6	6496794	<20	<20	<20	<20
R035	284717.3	6495581	28	28	30	30
R036	284592	6495897	28	27	26	29
R037	284205.5	6496505	24	23	<20	<20
R038	284280.9	6496339	24	24	<20	<20
R039	284635.9	6495877	28	27	26	29
R040	284236.6	6496396	24	23	<20	<20
R041	284077.3	6494219	35	34	39	35
R042	284577.6	6495566	29	28	31	31
R043	285140.1	6493222	<20	<20	<20	<20
R044	283957.1	6496611	22	21	<20	<20
R045	284587.7	6495912	27	27	26	29
R046	284153.1	6496485	23	23	<20	<20
R047	284055.5	6496440	23	22	<20	<20
R048	284293.1	6496319	24	24	<20	<20
R050	284548.1	6495712	28	28	30	30
R051	284484.3	6496101	27	26	25	24
R052	284258.7	6496346	24	24	<20	<20
R053	284300.9	6496378	24	23	<20	<20
R054	284172.8	6496492	24	23	<20	<20
R055	283885.8	6494470	36	35	41	35
R056	285091.9	6494054	24	22	27	23
R057	284398.7	6496126	26	26	25	28

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