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Resource Recovery Facility- Minto

13 Pembury Road, Minto

Noise and Vibration Impact Assessment

State Significant Application

Report Number 610.14692.00120

23 March 2017

Skylife Properties Pty Ltd
c/- APP Corporation
13 Pembury Road
MINTO NSW 2566

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1 INTRODUCTION

SLR consulting Australia Pty Ltd (SLR) has been engaged by APP Corporation Pty Ltd (APP) on behalf of its client Skylife Properties Pty Ltd to prepare a Noise and Vibration Impact Assessment (NVIA) to accompany an Environmental Impact Statement (EIS) to be submitted to the Department of Planning and Environment (DP&E) for the proposed upgrades to the existing Resource Recovery Facility at 13 Pembury Road, Minto, NSW (the Project Site).

The nature and scale of the development is such that it will be captured as State Significant Development under Clause 8 of SEPP (State and Regional Development) 2011 and correspondingly the application will need to be supported by a comprehensive EIS prepared in response to SEARs issued by the DPE (SSD 7462).

The waste storage and processing facility currently accepts waste materials for the purpose of resource recovery and the proposed upgrades include an increase in the processing capacity and new office, amenities building and weighbridge.

It is understood that the current approval for the site permits 30,000 tonnes/annum of non-putrescible waste to be processed at the Project site, and the objective of the study is to seek approval to increase the throughput of the Project site to up to 220,000 tonnes/annum of non-putrescible waste to be processed. No additional plant would be required at the facility to achieve the increase in throughput.

This report presents the study methodology, assessment criteria, assessment of noise and vibration emissions and noise control recommendations in relation to the following specific areas of acoustic significance:

- Noise and vibration emission from vehicle movements on the premises
- Noise emission from vehicle movements on the surrounding roads
- Noise and vibration emission from operational processes on the premises
- Noise and vibration emission from the construction phases on surrounding receivers

A glossary of acoustic terminology used throughout this report is included as **Appendix A**.

1.1 Background

In 2016, SLR has prepared an NVIA for the Project based on a proposed throughput of 300,000 tonnes/annum with operating hours of 24 hours/day for processing and 6 am to 10 pm for transporting waste and product materials. Following the EIS submission to Department of Planning & Environment (DP&E), the following information request on the NVIA was received by the Proponent on 17 February 2017:

- *The report should detail the size of the substation and whether it will generate noise.*
- *The location of the unattended and attended noise log should be shown on a plan. It appears the noise logs were placed at the same location, justification for this should be provided. It is unclear whether Section 3.1.1 is referring to the attended or unattended noise log.*
- *The assessment included a 'worst case scenario' for construction. However, there is no detail on the assumptions that were made for the 'worst case scenario'.*
- *The NVIA should predict the noise impacts based off a maximum daily processing capacity i.e. worst case scenario. The processing capacity that was assumed in the modelling has not been detailed.*
- *The conclusion requires greater detail i.e. the mitigation measures proposed and any criteria exceedances should be clearly detailed in the conclusion.*

Following the feedback from DP&E, the Proponent has revised the project design to reduce the annual throughput and operating hours of processing materials.

This report outlines the impact associated with the revised design and also addresses the information request issued by DP&E on 17 February 2017. A brief summary of the responses are presented in **Table 1**.

Table 1 Response to NSW DPE's Information Request

Issue	Response
The report should detail the size of the substation and whether it will generate noise.	The substation is of capacity 600kw and has an estimated sound power level of less than 90 dBA, consequently it will not contribute to the noise emissions from the Project.
The location of the unattended and attended noise log should be shown on a plan. It appears the noise logs were placed at the same location, justification for this should be provided. It is unclear whether Section 3.1.1 is referring to the attended or unattended noise log.	Both the unattended and attended noise monitoring was conducted at the same location ie Receiver R7.
The assessment included a 'worst case scenario' for construction. However, there is no detail on the assumptions that were made for the 'worst case scenario'.	The potential worst case scenario is based on all plant and equipment per each scenario operating concurrently. A table note has been added to **Table 14** for clarity.
The NVIA should predict the noise impacts based off a maximum daily processing capacity i.e. worst case scenario. The processing capacity that was assumed in the modelling has not been detailed.	The potential worst case scenario is based on the maximum daily processing capacity and maximum daily onsite traffic movements. Further details of the worst case scenario are provided in **Table 12**.
The conclusion requires greater detail i.e. the mitigation measures proposed and any criteria exceedances should be clearly detailed in the conclusion.	The conclusion has been revised.

2 PROJECT DESCRIPTION AND SURROUNDING ENVIRONMENT

2.1 Overview

Approval is sought to increase the processing capacity of the existing waste storage and processing facility from 30,000 tonnes per annum to permit up to 220,000 tonnes per annum. The facility will continue to process general solid waste (non-putrescible), as described in the Waste Classification Guidelines, 2014, prepared by the NSW Environment Protection Authority (EPA).

The existing operations include:

- Three sheds with push walls and machinery used for tipping, processing and storage of waste materials.
- Site office.
- Two weighbridges for small trucks.

Approval is also sought for the following works on site:

- Construction of new substation, site office and amenities block.
- Proposed in-ground wheelwash at existing outbound weighbridge.
- Installation of a new in-ground weighbridge (20 m x 3.5 m) for large trucks.
- Relocate existing 30,000 litre fuel tank with roof over.
- Proposed concrete slab for carparking (118sqm) for 10 carparking spaces.

2.2 Site Location and Local Topography

The site comprises an area of 8,957 m², is legally described as Lot 1 in DP 1013852 and known generally as 13 Pembury Road, Minto. The site is situated in the IN1 General Industrial zone under the Campbelltown Local Environmental Plan 2015.

The regional locality of the Project site is shown in **Figure 1**. The proposed layout of the Project site is shown in **Figure 2**.

The ground elevation ranges from approximately 5 m to 10 m within 500 m of the site. The most significant topographical feature in the vicinity of the site is the Georges River, located approximately 3 km to the southeast.

The topographical data used in the noise impact assessment was sourced from the United States Geological Service's Shuttle Radar Topography Mission (STRTM) database that has recorded topography across Australia with a 3 arc second (~90 m) spacing. **Figure 3** illustrates the topography of the region surrounding the Project Site based on the SRTM data.

Figure 1 Regional Location of the Project Site

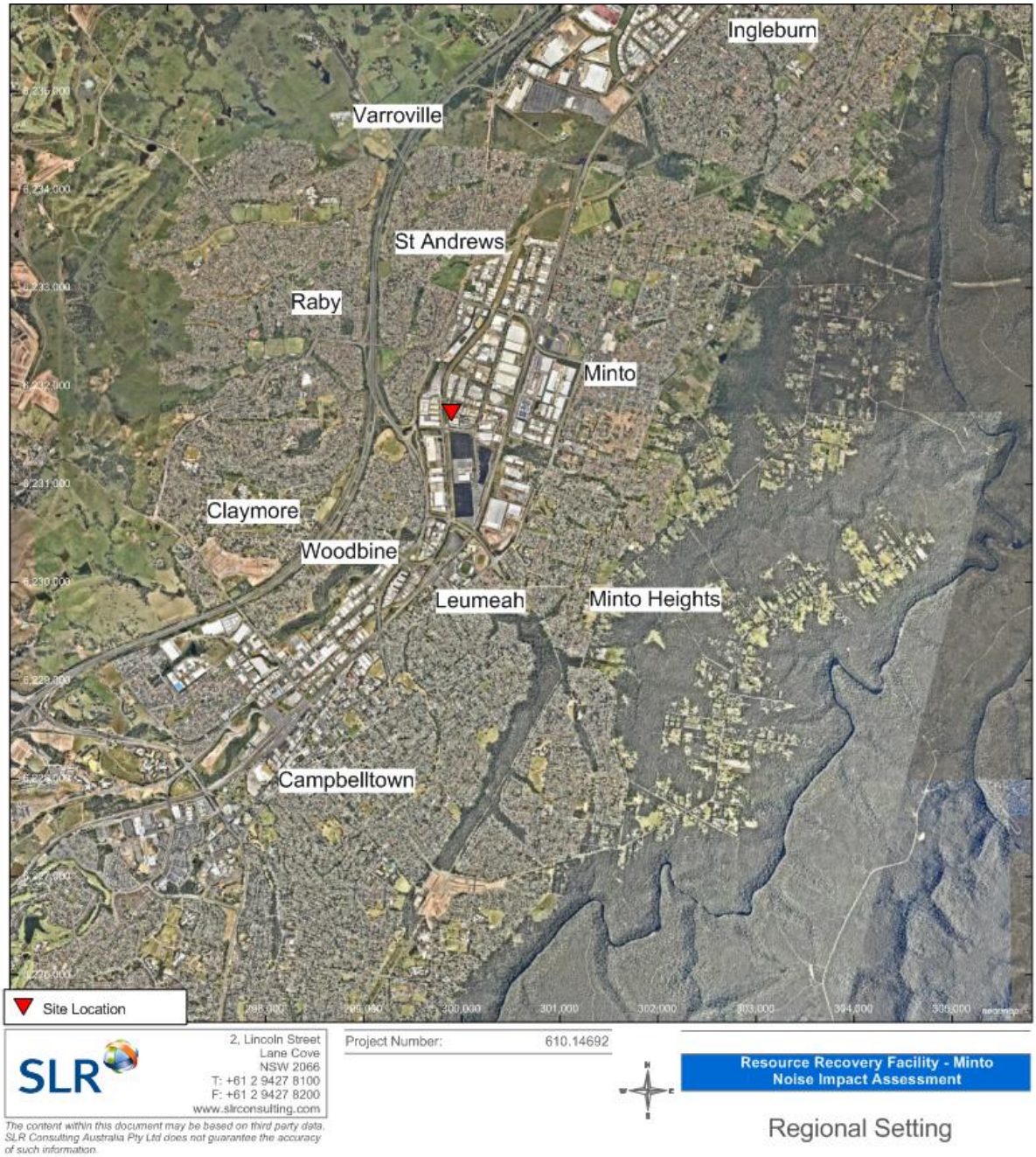


Figure 2 Project Site Layout

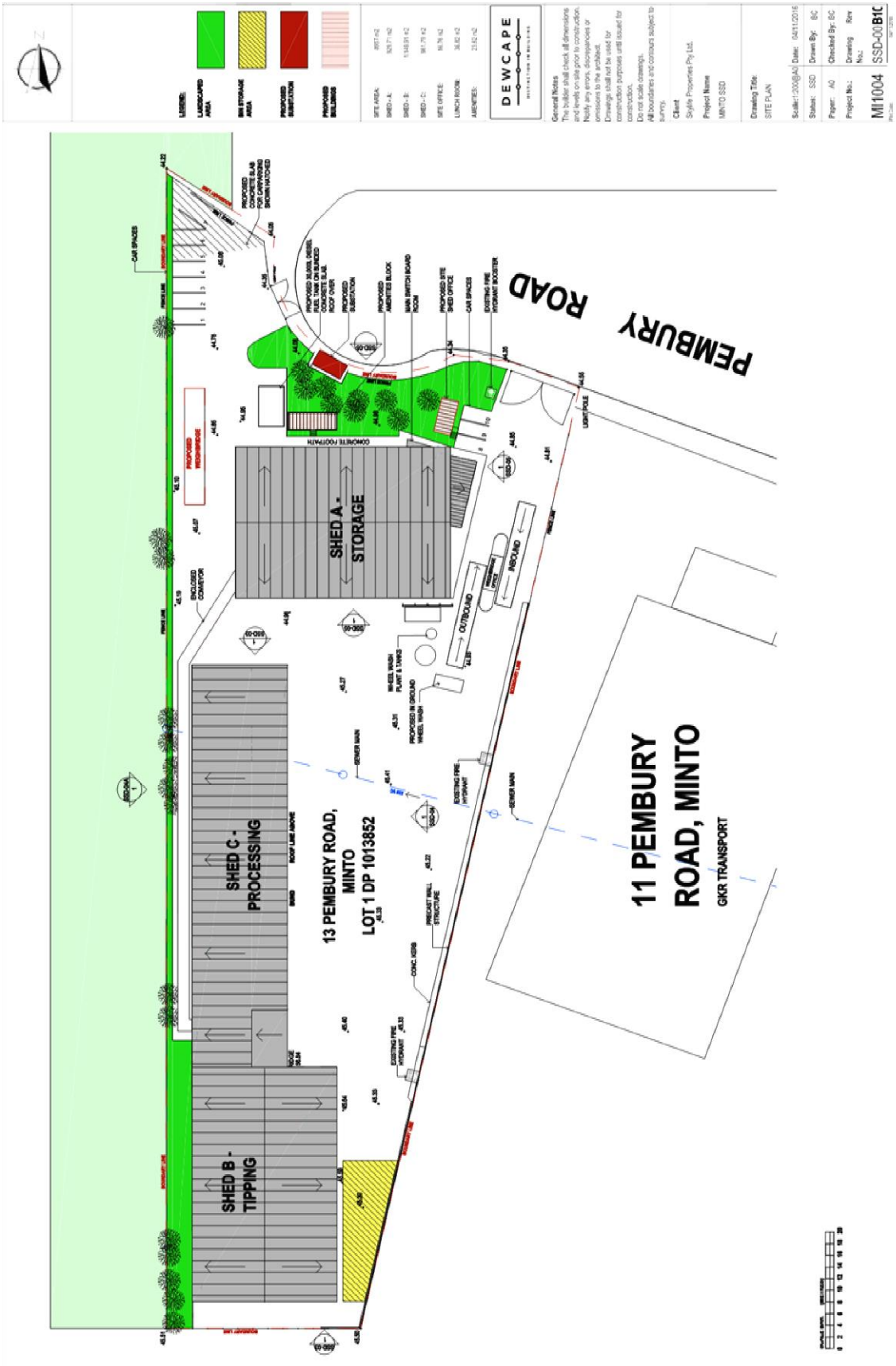
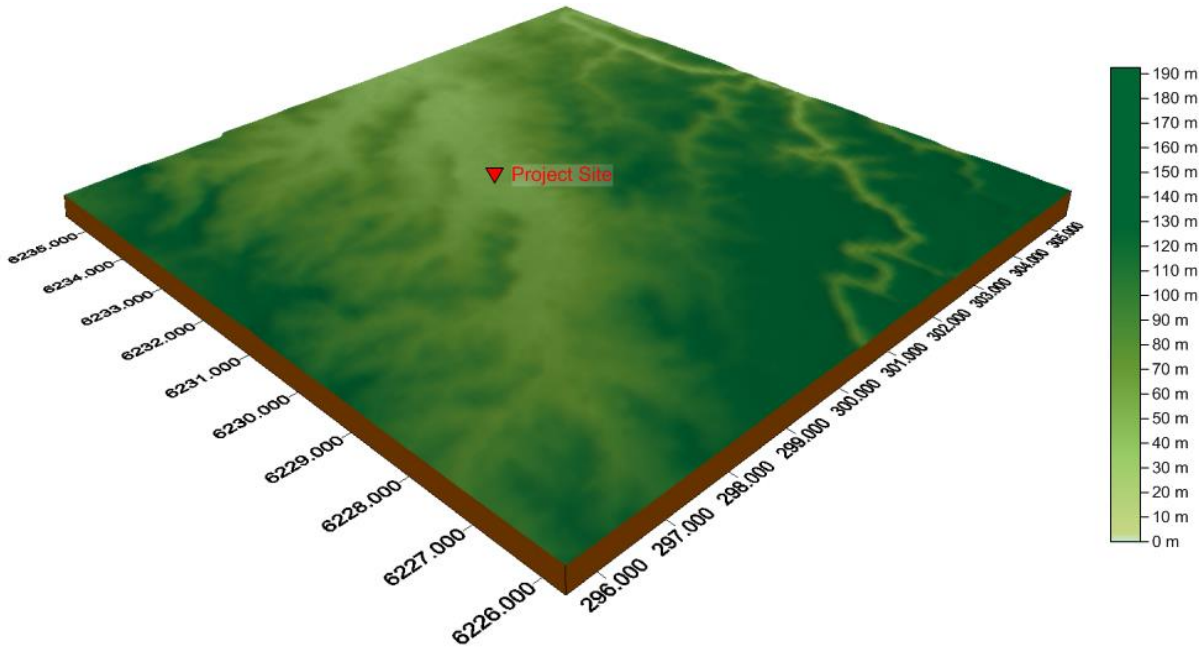


Figure 3 Topography Surrounding the Site



2.3 Proposed Operations

All waste streams will enter the site via the driveway crossing with Pembury Road, where they will be weighed on arrival on the 'eastern' weigh bridge. The contents of trucks are also visually inspected at this point by the weigh bridge operator. Trucks will then enter into the covered shed / awning and unload. Trucks are then offloaded by either tipping or through bins being tipped to remove contents wholly within the covered shed / awning area. The load is to again be inspected on the tipping floor during and after unloading to determine waste acceptability.

Covered bins containing wastes may also be stored in the designated bin storage area and moved to the processing area when operations permit processing. An example of this would involve construction waste being received outside of permitted processing hours. Under such circumstances, the bin would be covered and held in the designated bin storage area until such time as it can be accepted for processing. **Figure 4** demonstrates the proposed flow of waste and vehicle movements through the facility.

All loading, unloading and sorting activities are to be carried out within the processing shed and awning. Any non-complying waste identified will be managed in accordance with SEQ procedures and the adopted Operations Environmental Management Plan and *Asbestos and Non Complying Waste Management Procedure.*

Once trucks have exited the unloading area operations staff commence to separate waste into streams of recyclable and recoverable products and stockpiled in the designated material bins in the storage shed. Sorting and processing operations will result in wastes being separated into the following products within the designated material bins:

- Metals
- Concrete, brick tile

- Wood Products
- Plastics
- Paper and Cardboard
- Soils
- Glass
- Green waste
- Aggregate
- Non recoverable / recyclable materials

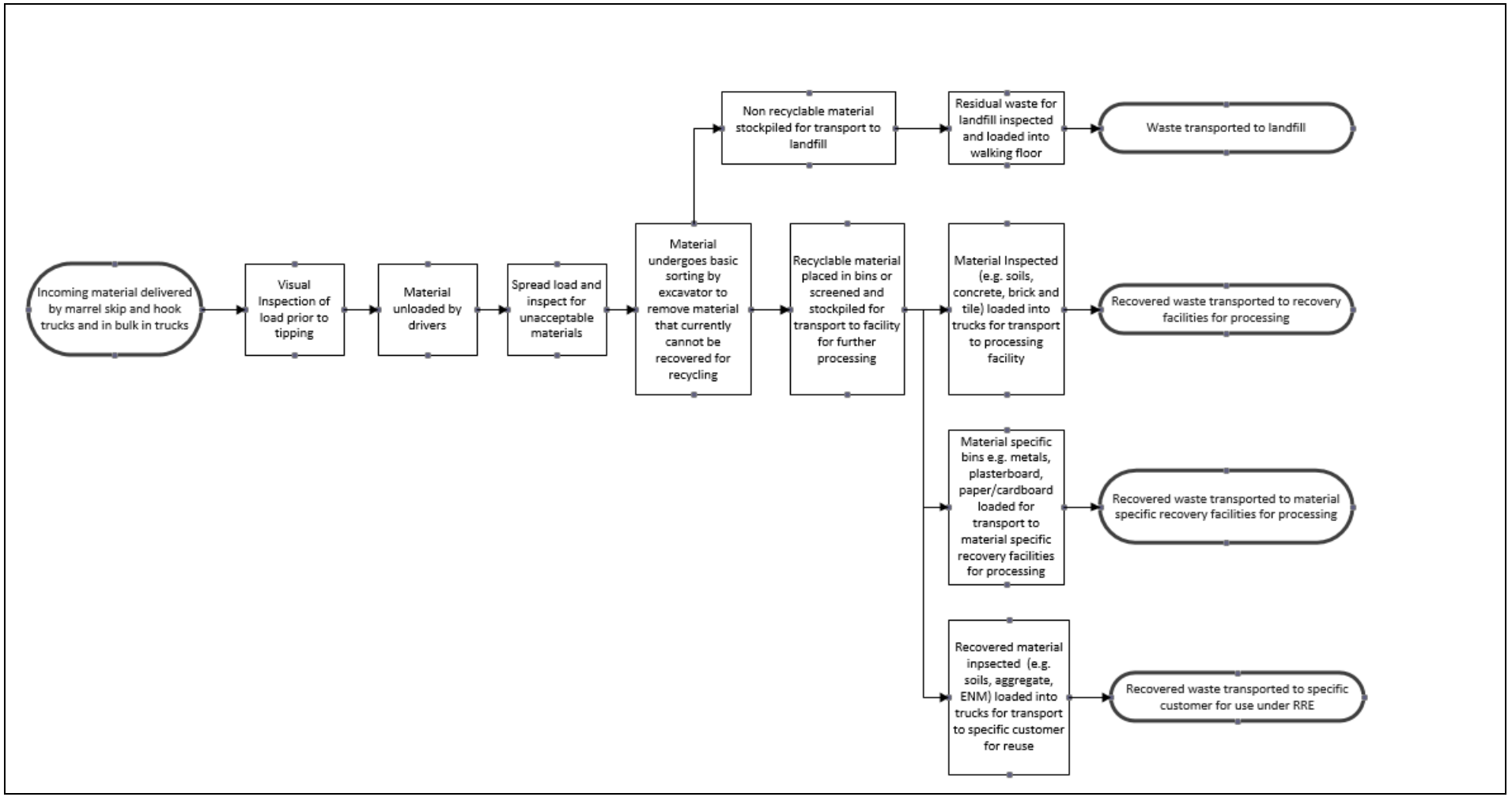
After sorting and processing, the product materials are reloaded and transported off site via the western weighbridge for reuse elsewhere. Based on existing operations and other facilities, approximately 10 - 15 percent of waste will be transported to landfill.

2.3.1 Proposed Storage Arrangements

Unprocessed waste will be contained within the building in stockpiles prior to processing or held within covered bins in the designated bin storage area. Processed waste (separated and sorted) will be stockpiled in the designated material bins.

Any waste streams not permitted to be kept on site will either be rejected at the eastern weighbridge or within the processing area and subsequently reloaded before leaving the site.

Figure 4 Proposed Flow Diagram – Waste and Vehicle Movements


Incoming material delivered by marrel skip and hook trucks and in bulk in trucks
Visual Inspection of load prior to tipping
Material unloaded by drivers
Spread load and inspect for unacceptable materials
Material undergoes basic sorting by excavator to remove material that currently cannot be recovered for recycling
Non recyclable material stockpiled for transport to landfill
Residual waste for landfill inspected and loaded into walking floor
Waste transported to landfill
Recyclable material placed in bins or screened and stockpiled for transport to facility for further processing
Material Inspected (e.g. soils, concrete, brick and tile) loaded into trucks for transport to processing facility
Recovered waste transported to recovery facilities for processing
Material specific bins e.g. metals, plasterboard, paper/cardboard loaded for transport to material specific recovery facilities for processing
Recovered waste transported to material specific recovery facilities for processing
Recovered material inpsected (e.g. soils, aggregate, ENM) loaded into trucks for transport to specific customer for reuse
Recovered waste transported to specific customer for use under RRE

2.3.2 Hours of Operation

The proposed hours of operations are:

- Monday to Saturday: 6:00am to 10:00pm
- Sunday and Public Holidays: No activity

2.4 Surrounding Environment

The surroundings are characterised by a mix of industrial developments including factories, automotive servicing, parts, panel beaters and painters, printing facilities, hardware and general supplies, manufacturing and warehousing. The industrial nature of the surrounding developments means they would not be considered as sensitive in the way that an office, school or hospital would be, hence this report focusses on potential impacts at the nearest residential receivers.

The nearest residential receivers are located approximately 350 m to the west across Campbelltown Road. Seventeen (17) discrete receptor locations were used in this study to assess the potential noise impacts of the site operations at sensitive receptor locations identified in the area surrounding the Project Site and were selected based on their close proximity to the Project Site. These locations are presented in **Figure 5**.

In addition, six community receptors have also been identified and included in this assessment. These locations are presented in **Table 2** and **Figure 5**.

As outlined in **Section 2.2**, the site is located in general industrial zone and surrounded by a number of industrial units. Five industrial receptors have also been identified and included in this assessment. The locations of these industrial receptors are also presented in **Table 2** and **Figure 5.**

The noise environment is dominated by traffic on Campbelltown Road, neighbourhood noise (dogs, birds, etc), distant road traffic noise on Raby Road and Hume Highway, and infrequent industrial noise (eg container impact noise, reverse alarms etc).

Figure 5 Sensitive Receptor Locations

Table 2 Sensitive Receptor Locations Used in this Assessment

	UTM Zone 56H		Receptor Type
Receptor ID	**Easting (m)**	**Northing (m)**	
Residential Receptors			
R1	301,332	6,232,327	Residential
R2	300,956	6,232,650	Residential
R3	301,012	6,233,168	Residential
R4	300,365	6,233,376	Residential
R5	299,933	6,232,914	Residential
R6	299,679	6,232,370	Residential
R7	299,567	6,232,073	Residential
R8	299,491	6,231,799	Residential
R9	299,491	6,231,277	Residential
R10	299,600	6,230,993	Residential
R11	299,540	6,230,488	Residential
R12	299,649	6,229,921	Residential
R13	300,474	6,230,271	Residential
R14	300,685	6,230,670	Residential
R15	300,854	6,231,036	Residential
R16	301,035	6,231,508	Residential
R17	301,190	6,231,927	Residential
Industrial Receptors			
I1	299,751	6,231,935	Industrial
I2	299,903	6,231,943	Industrial
I3	300,045	6,231,899	Industrial
I4	300,070	6,231,698	Industrial
I5	299,903	6,231,491	Industrial
Community Receptors			
C1	299,460	6,232,477	Community
C2	300,558	6,232,509	Community
C3	301,261	6,232,456	Community
C4	301,280	6,231,579	Community
C5	300,675	6,230,249	Community
C6	300,052	6,230,176	Community

3 EXISTING ACOUSTICAL ENVIRONMENT

3.1 Unattended Noise Monitoring

In order to characterise the existing acoustical environment at the nearest sensitive receivers, unattended noise monitoring was conducted in close proximity to Receiver R7 between Friday 27 November 2015 and Tuesday 8 December 2015 at the location shown in **Figure 5**.

Instrumentation for the survey comprised of one ARL EL-316 environmental noise logger (serial number 16-203-525) fitted with a microphone windshield. Calibration of the logger was checked prior to and following measurements. Drift in calibration did not exceed ±0.5 dBA. All equipment carried appropriate and current NATA (or manufacturer) calibration certificates.

Charts presenting summaries of the measured daily noise data are attached in **Appendix B**. The charts present each 24 hour period by incorporating the L_{Amax}, L_{Aeq} and L_{A90} noise levels for the corresponding 15 minute periods.

The measured data has been filtered to remove periods affected during adverse weather conditions following consultation of weather reports recorded at the Bureau of Meteorology (BOM) Campbelltown weather station. The filtered data is shown in **Appendix B**.

3.1.1 Data Processing

The data obtained from the noise logging was processed in accordance with the procedures contained in the NSW *"Industrial Noise Policy"* (INP, January 2000) to establish Rating Background Level (RBL, background noise level) at the nearest sensitive receivers. The results of this analysis are presented in **Table 3**.

Table 3 Measured Ambient Noise Levels Corresponding to INP Assessment Time Periods

Daytime [1]		Evening [1]		Night-time [1]	
RBL [2]	**LAeq [3]**	**RBL**	**LAeq**	**RBL**	**LAeq**
53	67	51	66	44	61

Note 1: For Monday to Saturday, Daytime 7:00 am - 6:00 pm; Evening 6:00 pm - 10:00 pm; Night-time 10:00 pm - 7:00 am.
On Sundays and Public Holidays, Daytime 8:00 am - 6:00 pm; Evening 6:00 pm - 10:00 pm; Night-time 10:00 pm - 8:00 am.

Note 2: The RBL noise level is representative of the "average minimum background sound level" (in the absence of the source under consideration), or simply the background level.

Note 3: The L_{Aeq} is essentially the "average sound level". It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound.

3.2 Attended Noise Monitoring

In order to identify noise sources contributing to the ambient noise environment at the nearest sensitive receivers, operator attended noise measurements were conducted at the same location as the unattended noise logging ie Receiver R7 (as shown in **Figure 5**) and the results are presented in **Table 4**.

Instrumentation for the survey comprised a Larson Davis 831 sound level meter (serial number 0001028) fitted with a microphone windshield. Calibration of the sound level meter was checked prior to and following measurements. Drift in calibration did not exceed ±0.5 dBA. All equipment carried appropriate and current NATA (or manufacturer) calibration certificates.

Measurements were conducted in accordance with AS 1055.1-1997: *"Acoustics - Description and measurement of environmental noise – General procedures".*

The result of the operator attended noise survey is presented in **Table 4**, together with a description of the contributed noise levels at the time of the measurement.

Table 4 Attended Noise Survey Results

Receiver Location	Date / Start Time	Primary Noise Descriptor			Typical Maximum Levels dBA and Vehicle Counts
		LAeq	LA1	LA90	
R7 37 Stromeferry Crescent	27/11/2015 14:00 pm 15 Minute Measurement	68	74	57	Campbelltown Road traffic: 63-84 Urban traffic/Industrial hum: 53-55 Birds: 55-72

4 NOISE ASSESSMENT PROCEDURES

4.1 Onsite Operational Noise - NSW Industrial Noise Policy

Responsibility for the control of noise emissions in New South Wales is vested in Local Government and the New South Wales Environment protection Authority (NSW EPA).

The NSW EPA oversees the Industrial Noise Policy (INP) which provides a framework and process for deriving noise criteria. The INP criteria for industrial noise sources have two components:

- Controlling the intrusive noise impacts for residents and other sensitive receivers in the short term; and
- Maintaining noise level amenity for particular land uses for residents and sensitive receivers in other land uses.

4.1.1 Intrusiveness Criterion

For assessing intrusiveness, the background noise generally needs to be measured. The intrusiveness criterion essentially means that the equivalent continuous noise level (L_{Aeq}) of the source should not be more than 5 dBA above the measured Rated Background Level (RBL), over any 15 minute period.

4.1.2 Amenity Criterion

The amenity criterion is based on land use and associated activities (and their sensitivity to noise emission). The cumulative effect of noise from industrial sources needs to be considered in assessing the impact. The criteria relate only to other industrial-type noise sources and do not include road, rail or community noise. The existing noise level from industry is measured. If it approaches the criterion value, then noise levels from new industrial-type noise sources, (including air-conditioning mechanical plant) need to be designed so that the cumulative effect does not produce total noise levels that would significantly exceed the criterion.

4.1.3 Amenity Area Classification

The INP, for the purposes of determining the appropriate noise amenity criteria, characterises an “Urban” noise environment as an acoustical environment that:

- Is dominated by “urban hum” or industrial source noise.
- Has through traffic with characteristically heavy and continuous traffic flows during peak periods.
- Is near commercial districts or industrial districts.

- Has any combination of the above.

Where "urban hum" means the aggregate sound of many unidentifiable, mostly traffic-related sound sources.

For the purposes of this assessment, the area surrounding the nearest sensitive receivers falls under the "Urban" area classification.

4.1.4 Sleep Disturbance

Intermittent noise, in particular those occurring over short durations, due to activities such as impacts or hydraulic brake releases are not directly addressed by the INP. A definitive noise level above which sleep disturbance is likely to occur has not been determined and research in the area is ongoing.

As a screening assessment, in order to minimise the risk of sleep disturbance resulting from these sources, the *INP Application Notes* recommend that the $L_{A1(60second)}$ noise level outside a bedroom window should not exceed the prevailing background L_{A90} noise level by more than 15 dBA during the 10:00 pm to 7:00 am night-time period.

Additionally, summary of research included in the NSW EPA *"Road Noise Policy"* (RNP, March 2011) concludes that:

- Maximum internal noise levels below 50-55 dBA are unlikely to awaken people.
- One or two noise events per night, with maximum internal noise levels of 65-70 dBA, are not likely to affect health and wellbeing significantly.

Corresponding external criteria of L_{Amax} 60-65 dBA and 75-80 dBA respectively result, if a 10 dBA loss through open windows is adopted (as suggested in the policy).

The wide discrepancy in sleep disturbance screening criteria (refer **Table 9**) reflects the uncertainty regarding definitive noise levels whereby sleep disturbance may occur. Nonetheless, this assessment considers the INP and RNP sleep disturbance screening criteria, as well as the frequency of exposure to the intermittent noise.

4.2 Assessing Construction Noise

4.2.1 Noise Management Levels

The NSW EPA "*Interim Construction Noise Guideline* "(ICNG) (DECC, 2009) contains procedures for the management of noise in relation to construction activities for residential and other sensitive receivers by defining Noise Management Levels (NMLs) and how they are applied. A summary of the derivation of NMLs from the ICNG is contained in **Table 5**, **Table 5** and **Table 7**.

Table 5 Interim Construction Noise Guideline (Residents)

Time of day	Management level $L_{Aeq(15minute)}$	How to apply
Recommended standard hours Monday to Friday 7am to 6pm Saturday 8am to 1pm No work Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. Where the predicted or measured $L_{Aeq(15minute)}$ 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.

Time of day	Management level $L_{Aeq(15minute)}$	How to apply
	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: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dBA above the noise affected level, the proponent should negotiate with the community.

Table 6 Interim Construction Noise Guideline (Other than Residents)

Land Use	Management Level, $L_{Aeq(15minute)}$ (applies when properties are being used)
Classrooms at schools and other educational institutions	Internal noise level 45 dBA
Hospital wards and operating theatres	Internal noise level 45 dBA
Places of worship	Internal noise level 45 dBA
Active recreation areas[1]	External noise level 65 dBA
Passive recreation areas[2]	External noise level 60 dBA
Community Centres	Depends on the intended use of the centre Refer to the recommended 'maximum' internal levels in AS2107 for specific uses.

Note1: Characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion.

Note 2: Characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation.

Table 7 Interim Construction Noise Guideline (Commercial and Industrial Premises)

Land Use	Management Level, $L_{Aeq(15minute)}$
Industrial Premises	External noise level 75 dBA
Office, retail outlets	External noise level 70 dBA

4.3 Offsite Vehicle Noise - NSW Road Noise Policy

The NSW RNP was released by the (now) EPA to replace the *"Environmental Criteria for Road Traffic Noise"* (ECRTN) from 1 July 2011. The key provisions of the new policy are an emphasis on the use of land use planning, better road design and vehicle noise emission control to avoid or minimise road traffic noise impacts. The assessment criteria for residences potentially affected by additional traffic generated by land use developments on local roads are summarised in **Table 8**.

Table 8 NSW RNP Road Traffic Noise Assessment Criteria for Residences

Road category	Type of project/land use	Assessment criteria[1]	
		Day (7:00 am to 10:00 pm)	**Night (10:00 pm to 7:00 am)**
Freeway/arterial/sub-arterial roads	Existing residences affected by **additional traffic** on existing freeways/arterial/sub-arterial roads generated by land use developments	LAeq(15hour) 60 dBA	LAeq(9hour) 55 dBA
Local Roads	Existing residences affected by **additional traffic** on existing local roads generated by land use developments	LAeq(1hour) 55 dBA	LAeq(1hour) 50 dBA

Note 1: The criteria are for assessment against façade-corrected noise levels when measured at 1 m in front of a building facade.

In relation to the noise criteria in **Table 8**, the RNP notes that an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person. Where existing residences and other sensitive land uses are potentially affected by additional traffic on existing roads due to land use developments, any increase in the total traffic noise level should be limited to 2 dB above the corresponding 'no build option'.

4.4 Vibration - Human Comfort

The NSW EPA's *Assessing Vibration: a technical guideline* provides guideline values for continuous, transient and intermittent events that are based on a Vibration Dose Value (VDV) rather than a continuous vibration level. The VDV is dependent upon the level and duration of the short-term vibration event, as well as the number of events occurring during the daytime or night-time period.

The recommended VDVs for vibration of an intermittent nature (eg construction works where more than three distinct vibration events occur) are presented in **Figure 6**.

Figure 6 Acceptable Vibration Dose Values for Intermittent Vibration (m/s$^{1.75}$) (EPA *Assessing Vibration: a technical guideline)*

Location	Daytime[1]		Night-time[1]	
	Preferred value	Maximum value	Preferred value	Maximum value
Critical areas[2]	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

1 Daytime is 7.00 am to 10.00 pm and night-time is 10.00 pm to 7.00 am.
2 Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas.
Source: BS 6472–1992

5 PROJECT SPECIFIC NOISE CRITERIA

5.1 Operational Noise Criteria

Having defined the area type, the processed results of the unattended noise monitoring have been used to determine project specific noise criteria. The intrusive and amenity criteria for nearby residential premises and industrial boundaries are presented in **Table 9**. These criteria are nominated for the purpose of assessing potential noise impacts from the proposed development.

Despite being near an industrial area, the ambient noise environment measured at the logger location is not controlled by industrial noise sources (but rather the adjoining arterial road traffic and distant traffic noise) and therefore the amenity criteria are the recommended amenity criteria for residences in an urban area (ie the "ANL" or Acceptable Noise Level). For each assessment period, the lower (ie the more stringent) of the amenity or intrusive criteria are adopted. These are shown in bold text in **Table 9**.

It is understood that the project site will commence processing operations at 6 am Monday to Saturday, therefore it would be overly stringent to expect such operation to be assessed against the night-time criteria. In accordance with Section 3.3 of the INP, a morning shoulder period has been included as part of the assessment, the hours of which are detailed in **Table 9**.

Table 9 Operational Noise Criteria for at Nearest Residential Receivers

Receiver	Time of Day	ANL [1] LAeq(period)	Measured RBL [2] LA90(15minute)	Measured LAeq(period) Noise Level)	Criteria for New Sources		
					Intrusive LAeq(15minute)	Amenity [3] LAeq(period)	Sleep Disturbance LAmax Screening Criteria
Residential	Morning Shoulder[5] Period (6am-7am)	-	52	65	**57**	55	INP 67 RNP 60-65[4] and 75-80[5]
	Day	60	53	67	**58**	60	-
	Evening	50	51	66	**56**	56	-
	Night	45	44	61	**49**	51	INP 59 RNP 60-65[4] and 75-80[5]
Commercial	When in use	Acceptable 65 Maximum 70	-	-	-	**65-70**	-
Industrial	When in use	Acceptable 70 Maximum 75	-	-	-	**70-75**	-

Note 1: ANL = "Acceptable Noise Level" for residences in Suburban areas, and acceptable and maximum noise level for industrial receivers in accordance with INP.

Note 2: RBL = "Rating Background Level".

Note 3: Assuming existing noise levels are unlikely to decrease in the future.

Note 4: Unlikely to awaken people.

Note 5: One or two noise events per night are not likely to affect health and wellbeing significantly.

Note 6: Shoulder period defined as per Section 3.3 of the INP ie 6.00 am to 7.00 am.

5.2 Construction Noise Management Levels

The Noise Management Levels (NML's) have been established based on the ambient noise levels presented in **Table 3**. The resulting construction Noise Management Levels are presented in **Table 10**.

Table 10 Construction Noise Goals

Receiver	Measured Ambient Noise Levels			Noise Management Levels - NMLs (dBA)					
	Daytime[1]	Evening[1]	Night-time[1]	Standard Hours Daytime	Highly Noise Affected	Out of Hours Daytime	Out of Hours Evening	Out of Hours Night-time	Sleep Disturbance Screening Criterion
Residential Receivers	53	51	44	63	75	58	56	49	59

Note 1: Standard hours are 7.00 am to 6.00 pm Monday to Friday, 8.00 am to 1.00 pm on Saturdays with no work on Sundays or Public Holidays. Evening is 6.00 pm to 10.00 pm. Night-time is 10.00 pm to 7.00 am Sundays to Saturday and 10.00 pm to 8.00 am on Sunday.

6 NOISE ASSESSMENT

6.1 Noise Model

In order to predict noise levels associated with the Project at noise sensitive receivers, a SoundPLAN computer model was developed for the facility. SoundPLAN is a software package which enables compilation of a sophisticated computer model comprising a digitised ground map (containing ground contours and significant structures, where appropriate), the location and acoustic power levels of significant noise sources, and the location of sensitive receptors.

6.1.1 Operational Noise Standard

The Conservation of Clean Air and Water Europe (CONCAWE) prediction methodology was utilised within SoundPLAN. This prediction method was specially designed for large industrial facilities and incorporates the influence of wind and the stability of the atmosphere on the propagation of noise.

6.1.2 Modelling Inputs

The computer model generates noise emission levels taking into account such factors as the source sound power levels, distance attenuation, ground absorption, air absorption and shielding attenuation, as well as meteorological conditions.

The proposed project site land and surrounds is essentially flat and has been modelled as such. All ground was modelled as “hard ground” that mostly reflects noise. Significant man-made structures such as the industrial sheds on site were incorporated into the noise model.

6.1.3 Plant and Equipment Sound Power Levels

From previous studies of noise emissions from similar facilities as well as site specific measurements of plant and equipment currently operating at the facility, the major noise sources associated with the facility are shown in **Table 11** together with their relevant maximum L_{Aeq} sound power levels (calculated from measured sound pressure levels).

Table 11 Plant and Equipment Noise Levels

Noise Source or Activity	Sound Power level (dBA)		Equipment per 15 minute period			
	L_{Aeq}	L_{Amax}	Morning Shoulder 6am-7am	Daytime 7am-6pm	Evening 6pm-10pm	Night-time 10pm-6am
Loaded Finger and Finlay Screen	112	123	1	1	1	Nil
External Enclosed Conveyor (30 tph)	90	92	1	1	1	Nil
Forklifts	99	104	2	2	2	Nil
Wheeled Loader	108	115	1	1	1	Nil
Volvo L110F Excavator	103	110	1	1	1	Nil
Volvo EC140C Excavator	103	110	1	1	1	Nil
Liebherr LH22M Excavator	103	110	1	1	1	Nil
Industrial Sweeper	100	102	1	1	1	Nil
Trucks idling	100	103	4	4	4	Nil
Round trip truck - entry, dump and exit	108	111	5	5	5	Nil

Note 1: The Finger and Finlay Screen will be wholly located within the shed.

Modifying Factors

The Finger and Finlay Screen has the potential to emit both tonal and low frequency noise. Accordingly, it is appropriate to determine if the INP modifying factors for tonal or low frequency noise apply to the Project.

SLR undertook a broad spectrum (1Hz to 20kHz) noise and vibration survey of Finger and Finlay Screen currently in operation at Bingo's Auburn facility, which is the same design as the one installed at the Minto facility. The survey found the screen to be operating in the dominant third octave band of 6.3Hz. The difference in the A and C weighted noise levels was found to be 4.4 dB, which is significantly lower than INP 15 dB threshold for low frequency noise annoyance. Accordingly the INP low frequency noise modifying factor does not apply.

Further, a comparison of the third octave bands adjoining 6.3Hz found the level difference to be 7dB and 12dB, respectively, which are both below INP 15dB threshold for tonal noise annoyance. Accordingly, the INP tonal noise modifying factor does not apply.

Accordingly, no INP modifying factors are applicable to the nose assessment for the Project.

6.1.4 Operational Scenarios

The proposed hours of operations are:

- Monday to Saturday: 6:00am to 10:00pm
- Sunday and Public Holidays: No operation

The operational scenarios incorporated into the noise model to reflect the above operations are discussed in **Table 12**.

Table 12 Operational Scenarios

INP Assessment Time Period	Operational Characteristics
Morning Shoulder (6:00 am to 7:00 am)	- Waste processing vehicles fully operational (equivalent to 2000 tonnes/day) sorting waste and loading trucks - Trucks dropping off / picking up waste (9 Trucks idling, up to 8 trucks arriving and leaving during any 15 minute period at a speed of 10km/h)
Daytime (7:00 am to 6:00 pm)	- Waste processing vehicles fully operational (equivalent to 2000 tonnes/day) sorting waste and loading trucks - Trucks dropping off / picking up waste (9 Trucks idling, up to 8 trucks arriving and leaving during any 15 minute period at a speed of 10km/h)
Evening (6:00 pm to 10:00 pm)	- Waste processing vehicles fully operational (equivalent to 2000 tonnes/day) sorting waste and loading trucks - Trucks dropping off / picking up waste (9 Trucks idling, up to 8 trucks arriving and leaving during any 15 minute period at a speed of 10km/h)

6.1.5 Predicted Operational Noise Levels

A summary of the predicted operational noise levels is shown in **Table 13**. The predicted noise levels are based on relevant noise sources discussed in **Table 12**.

Table 13 Predicted Operational Noise Levels

Receiver	Period				Project Specific Noise Criteria	
	Morning Shoulder	Day	Evening	Morning Shoulder (Sleep Disturbance)	Morning shoulder/ Day/Evening	Morning Shoulder (Sleep Disturbance)
	LAeq (15minute)	LAeq (15minute)	LAeq (15minute)	LAmax	LAeq (15minute)	LAmax
Residential Receptor						
R1	30	30	30	39	57/58/56	67
R2	33	33	33	40	57/58/56	67
R3	29	29	29	37	57/58/56	67
R4	22	22	22	30	57/58/56	67
R5	28	28	28	37	57/58/56	67
R6	39	39	39	45	57/58/56	67
R7	46	46	46	52	57/58/56	67
R8	45	45	45	49	57/58/56	67
R9	39	39	39	43	57/58/56	67
R10	34	34	34	39	57/58/56	67
R11	29	29	29	35	57/58/56	67
R12	34	34	34	38	57/58/56	67
R13	33	33	33	41	57/58/56	67
R14	33	33	33	41	57/58/56	67
R15	35	35	35	43	57/58/56	67
R16	34	34	34	42	57/58/56	67
R17	29	29	29	41	57/58/56	67

Receiver	Period				Project Specific Noise Criteria	
	Morning Shoulder	Day	Evening	Morning Shoulder (Sleep Disturbance)	Morning shoulder/ Day/Evening	Morning Shoulder (Sleep Disturbance)
	LAeq (15minute)	LAeq (15minute)	LAeq (15minute)	LAmax	LAeq (15minute)	LAmax
Industrial Receptor						
I1	59	59[1]	59[1]	n/a	75[2]	n/a
I2	63[1]	63[1]	63[1]	n/a	75[2]	n/a
I3	64[1]	64[1]	64[1]	n/a	75[2]	n/a
I4	60[1]	60[1]	60[1]	n/a	75[2]	n/a
I5	58[1]	58[1]	58[1]	n/a	75[2]	n/a
Community Receptor						
C1	28[1]	28[1]	28[1]	n/a	70[2]	n/a
C2	37[1]	37[1]	37[1]	n/a	70[2]	n/a
C3	27[1]	27[1]	27[1]	n/a	70[2]	n/a
C4	29[1]	29[1]	29[1]	n/a	70[2]	n/a
C5	33[1]	33[1]	33[1]	n/a	70[2]	n/a
C6	30[1]	30[1]	30[1]	n/a	70[2]	n/a

Note 1: Predicted amenity noise levels for Industrial and Community Receptors.

Note 2: Amenity noise criteria - LAeq(period).

From the predicted noise levels shown in **Table 13**, the facility operations will comply with project specific noise criteria presented in **Table 9**.

6.2 Operational Vibration

The existing mechanical plant operating at the site are not anticipated to change, however, the plant will be audited and reviewed on an ongoing basis.

The external vibration emissions and location of vibration generating plant and activities would be controlled so that the operation does not adversely impact upon neighbouring receivers and occupants within the proposed development. The criteria for vibration emissions from mechanical plant and equipment are nominated in **Section 4.4**. At this stage, no potentially vibration sensitive receivers have been identified in close proximity to the Project site.

6.2.1 Truck unloading

All loading and unloading of truck activities are to be carried out within the processing shed or under the awning. Heavy products, i.e. concrete waste are accepted within the facility and may pose a concern to adjacent tenants regarding vibratory impacts if dropped from a height onto paved areas. It is recommended that the loading and unloading of heavy materials are addressed within the Operational Environmental Management Plan (OEMP) with protocols to ensure that such products are handled through the use of appropriate plant to minimise vibration.

6.2.2 Finger and Finlay Screen

The Finger and Finlay Screen is located within the enclosed shed has been identified as the primary potential source of vibratory concern. SLR undertook a broad spectrum (1Hz to 20kHz) noise and vibration survey of Finger and Finlay Screen currently in operation at Bingo's Auburn facility, which is the same design as the one installed at the Minto facility. The survey found the screen to be operating in the dominant third octave band of 6.3Hz with overall rms (root mean square) vibration levels of 0.09 mm/s and 0.01 m/s^2 measured at 5 m. The corresponding vibration dose being 0.17 $m/s^{1.75}$, which is significantly lower than the preferred vibration dose value of 0.8 $m/s^{1.75}$ for workshops associated with the neighbouring properties.

Consequently, there will be no vibration impact to the surrounding industrial developments from the Project operation, particularly from the trucks and finger screen.

6.3 Construction Noise

6.3.1 Construction Plant and Equipment

The proposed works consist of the construction plant detailed in **Table 14**. The table also contains sound power levels for individual items of plant together with the combined sound power level.

Table 14 Construction Scenarios and Equipment Sound Power Levels

Scenario	Plant/Equipment Item	Number of items per 15 minute period	Maximum Sound Power Level (L_{Aeq})	
			Individual Item	Maximum for Scenario[1]
S1 General Construction	Elevated Working Platform	1	97	118
	Hand Tools	1	96	
	Grinder	1	98	
	Circular Saw	1	104	
	Truck (10 tonne)	1	98	
	Dozer	1	110	
	Bobcat	1	104	
	Excavator (20 tonne)	1	99	
	Front End Loader (FEL) 962	2	112	
	Tipper Truck	4	97	
	Franna Crane	2	99	
	Concrete Truck / Agitator	1	106	
	Water Tanker (8000 litre)	2	98	
S2 Noise Intensive Works	Excavator (Breaker)[2]	1	121	121

Note 1: Maximum activity assumes all plant and equipment per scenario operating concurrently.

Note 2: Denotes "annoying" items of equipment as defined in the ICNG, and as such includes a +5dB penalty to the predictions.

6.3.2 Predicted Construction Noise Levels

Noise levels were predicted to the neighbouring residential properties for the demolition and site establishment, excavation and construction phases for assessment against the approved daytime hours. Predictions have been based on the equipment sound power levels presented in **Table 14**.

Construction noise from the worst case from each of the construction scenarios at each of the surrounding residential areas is presented in **Table 15**.

Table 15 Predicted Construction Noise Levels

Scenario	Receiver ID	Receiver Type	Worst Case Predicted	Daytime RBL	Daytime NML	Daytime Exceedance
S1 General Construction	R1	Residential	32	53	63	-
	R2	Residential	36	53	63	-
	R3	Residential	32	53	63	-
	R4	Residential	25	53	63	-
	R5	Residential	27	53	63	-
	R6	Residential	43	53	63	-
	R7	Residential	49	53	63	-
	R8	Residential	49	53	63	-
S1 General Construction	R9	Residential	44	53	63	-
	R10	Residential	38	53	63	-
	R11	Residential	36	53	63	-
	R12	Residential	37	53	63	-
	R13	Residential	35	53	63	-
	R14	Residential	36	53	63	-
	R15	Residential	35	53	63	-
	R16	Residential	37	53	63	-
	R17	Residential	33	53	63	-
	I1	Industrial	59	n/a	75[2]	-
	I2	Industrial	67	n/a	75[2]	-
	I3	Industrial	66	n/a	75[2]	-
	I4	Industrial	51	n/a	75[2]	-
	I5	Industrial	59	n/a	75[2]	-
	C1	Community	27	n/a	70[2]	-
	C2	Community	39	n/a	70[2]	-
	C3	Community	31	n/a	70[2]	-
	C4	Community	32	n/a	70[2]	-
	C5	Community	30	n/a	70[2]	-
	C6	Community	28	n/a	70[2]	-
S2 Noise Intensive Works	R1	Residential	35	53	63	-
	R2	Residential	39	53	63	-
	R3	Residential	35	53	63	-
	R4	Residential	28	53	63	-
	R5	Residential	30	53	63	-
	R6	Residential	46	53	63	-
	R7	Residential	52	53	63	-
	R8	Residential	52	53	63	-
	R9	Residential	47	53	63	-
	R10	Residential	41	53	63	-
	R11	Residential	39	53	63	-
	R12	Residential	40	53	63	-

Scenario	Receiver ID	Receiver Type	Worst Case Predicted	Daytime RBL	Daytime NML	Daytime Exceedance
	R13	Residential	38	53	63	-
	R14	Residential	39	53	63	-
	R15	Residential	38	53	63	-
	R16	Residential	40	53	63	-
	R17	Residential	36	53	63	-
	I1	Industrial	62	n/a	75[2]	-
	I2	Industrial	70	n/a	75[2]	-
	I3	Industrial	69	n/a	75[2]	-
	I4	Industrial	54	n/a	75[2]	-
	I5	Industrial	62	n/a	75[2]	-
S2 Noise Intensive Works	C1	Community	30	n/a	70[2]	-
	C2	Community	42	n/a	70[2]	-
	C3	Community	34	n/a	70[2]	-
	C4	Community	35	n/a	70[2]	-
	C5	Community	33	n/a	70[2]	-
	C6	Community	31	n/a	70[2]	-

Note 1: Predicted amenity noise levels for Industrial and Community Receptors.

Note 2: Amenity noise criteria - LAeq(period).

Predicted noise levels presented in **Table 15** do not trigger the NML for residential premises at the nearest residential receivers and other land uses. Notwithstanding, any noise mitigation measures implemented to control noise at adjacent residences will have a reciprocal benefit to reducing noise levels at commercial premises and will be discussed as part of the Construction Noise Management Plan.

6.4 Off-site Road Traffic Noise Emission

Vehicles will access the site via two routes depending upon their direction. **Figure 7** and **Figure 8** depicts the routes that vehicles will take to access the Project Site.

Figure 7 Routes towards the Site

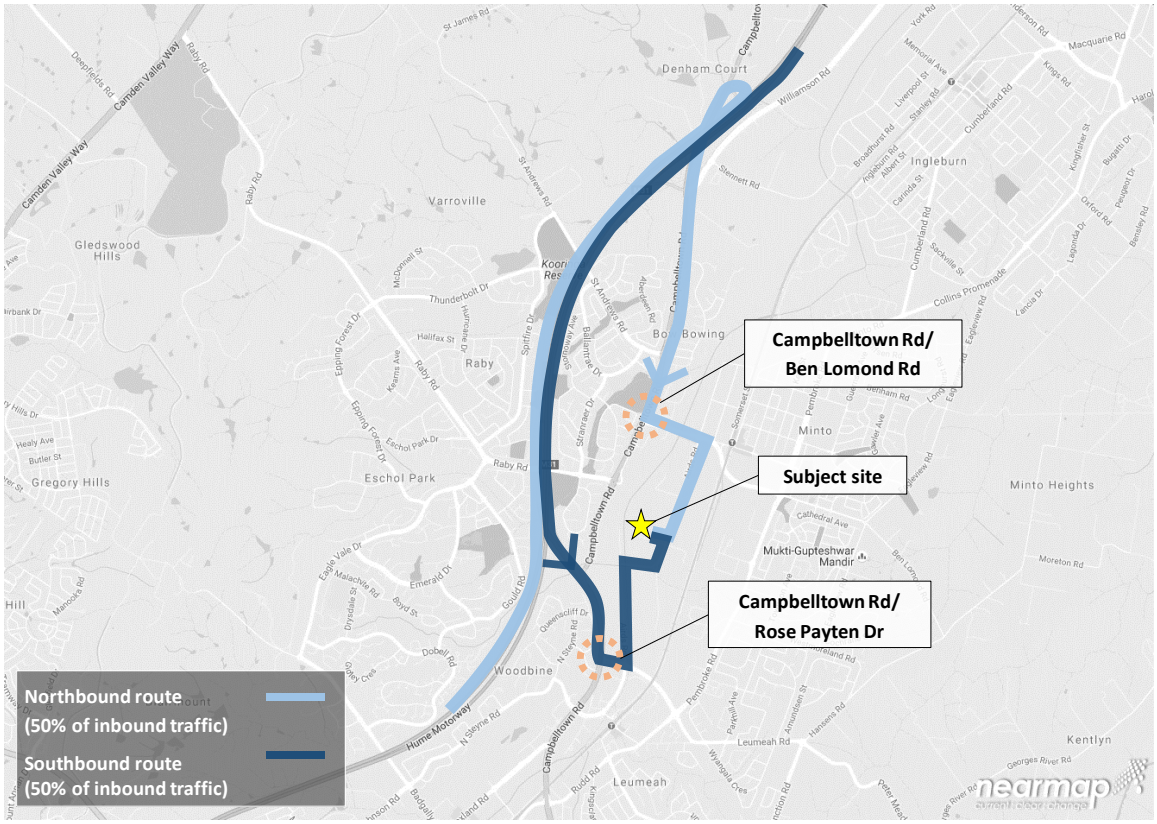
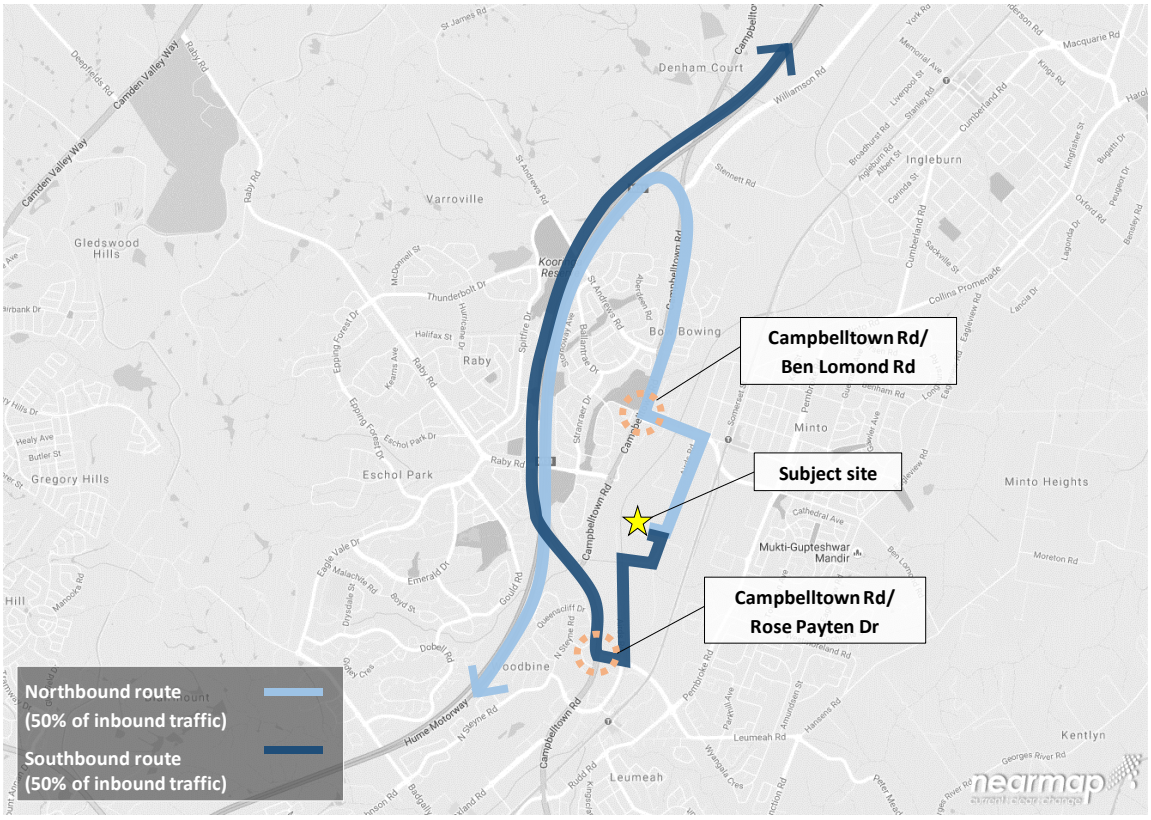


Figure 8 Routes from the Site



The existing traffic flows on Campbelltown Road are presented in **Table 16**, along with the Project-generated traffic flows. For the purposes of this noise impact assessment, the annual Monday to Saturday average daytime (7am to 10pm) and night-time (10pm to 7am) traffic flows are shown, together with the relative percentage increase associated with the Project traffic.

Table 16 Average Daily Monday to Saturday Traffic Flow on Campbelltown Road[1,6]

Road	Period	Existing[2]			Project-generated (Proposed)[3]			Cumulative			Increase due to Project		
		LV	HV	Total	LV	HV	Total	LV	HV	Total	LV	HV	Total
Campbelltown Road	Daytime[4]	36,135	3,002	39,137	12	728	740	36,147	3,730	39,877	0.0%	24.3%	1.9%
	Night-time[5]	6,601	703	7,304	12	48	60	6,613	751	7,364	0.2%	6.8%	0.8%

Note 1: Traffic flows are for two way traffic movements. To determine the number of vehicles accessing the Project Site divide Project-generated (Proposed) flow by 2.

Note 2: Existing traffic flow is based hourly annual average traffic flows from RMS's published AADT Traffic Volume Viewer database for Station 83011 on Campbelltown Road for the period 24 October 2015 to 24 October 2016 (RMS AADT).

Note 3: Proposed traffic flows based on information presented in The Transport Planning Partnership Pty Ltd report *13 Pembury Road, Minto Transport Impact Assessment* dated 17 March 2017 (TTPP Report).

Note 4: Average daily Monday to Saturday traffic flow for daytime period (7am to 10pm) from RMS AADT and TTPP Report. Divide by 15 to get average hourly daytime period traffic flow.

Note 5: Average daily Monday to Saturday traffic flow for night-time period (10pm to 7am) from RMS AADT and TTPP Report. Divide by 9 to get average hourly night-time period traffic flow.

Note 6: LV – number of light vehicles. HV – Number of heavy vehicles.

The relevant criteria for residents backing onto Campbelltown Road are the $L_{Aeq(15hour)}$ and $L_{Aeq(9hour)}$ criteria in **Table 8**.

The maximum 24.3% and 1.9% increase in heavy vehicle and total traffic flows, respectively, due to the Project related vehicles on Campbelltown Road would result in less than a 2 dBA increase in the existing traffic noise levels. Specifically, the traffic noise levels would increase by 0.6 dBA and 0.2 dBA during the daytime and night-time periods, respectively. With respect to the morning shoulder period alone (ie 6am to 7am), there would be a 22% increase in heavy vehicle traffic flow, with a corresponding 0.6 dBA increase in the road traffic noise level. As discussed in **Section 4.3**, the noise increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person. Where existing residences and other sensitive land uses are potentially affected by additional traffic on existing roads due to land use developments, any increase in the total traffic noise level should be limited to 2 dB above the corresponding 'no build option'.

Accordingly, no Project related traffic noise impacts are anticipated at residential receivers adjacent to the surrounding road network, including Campbelltown Road.

6.5 On-site Vehicle Heavy Vehicle Noise Emission

Night-time noise emissions from truck activities within the Project Site have been included in the onsite operational noise assessment presented in **Section 6.1.5**.

7 RECOMMENDATIONS

As discussed in **Section 6**, the facility will be able to operate in compliance with the project specific noise criteria based on the following recommendations:

- Maximum of 17 trucks parked in the stacking spaces adjacent to the eastern boundary at any one time.
- Consistent with the current practice at the site, all staff are to complete training at induction on commencement of employment in relation to noise management and minimisation at the site.

- Preparation of a Noise Management Plan (NMP) as part of the OEMP. The NMP would address matters such as:
  - Limiting site hours of operation to align with the NIA.
  - Implementation of a general vehicle speed limit of 5 km/hr.
  - Vibration management – handling of heavy materials;
  - Requirements for ongoing maintenance of fixed and mobile plant in accordance with manufactures specifications;
  - Development of protocols to ensure processing operations are undertaken wholly within the processing building; and
  - Procedures to handle complaints which would, if required, include monitoring to verify emissions in relation to thresholds relevant to the project.

8 CONCLUSION

SLR Consulting Australia Pty Ltd has conducted an assessment of the noise and vibration impacts associated with the proposed upgrade to the existing Waste Storage and Processing Facility located at 13 Pembury Road, Minto. This assessment has been carried out in accordance with NSW regulatory requirements and will accompany an Environmental Impact Statement (EIS) to be submitted to the Department of Planning and Environment for the proposed upgrades.

The scope of the assessment involved a survey of the existing noise environment, derivation and establishment of project specific noise and vibration criteria; a noise and vibration impact assessment relative to the appropriate criteria; and, where required, recommendations for noise and vibration control measures.

The assessment has demonstrated that the site will be able to operate at a rate of 220,000 tonnes per annum in an acoustically compliant manner with the management control of not operating more than one truck on the western weighbridge at any one time. No additional noise management or mitigation measures are required to achieve compliance with the project specific noise limits at all surrounding receivers.

Vibration emissions are predicted to comply with the relevant criteria at all surrounding receivers, provide that heavy objects are not dropped from height and that they are handled through the use of appropriate plant to minimise vibration.

Traffic noise assessment has found that the increase in the existing traffic noise levels at surrounding residential receivers will be negligible and the Project will be in compliance with the traffic noise criteria.

The assessment has also found that the potential noise emissions during construction will comply with the construction noise criteria at all surrounding receivers.

ACOUSTIC TERMINOLOGY

1 Sound Level or Noise Level

The terms "sound" and "noise" are almost interchangeable, except that in common usage "noise" is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or LP are commonly used to represent Sound Pressure Level. The symbol LA represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2E-5 Pa.

2 "A" Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an "A-weighting" filter. This is an electronic filter having a frequency response corresponding approximately to that of human hearing.

People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the loudness of that sound. Different sources having the same dBA level generally sound about equally loud.

A change of 1 dBA or 2 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness. The table below lists examples of typical noise levels

Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130	Threshold of pain	Intolerable
120 110	Heavy rock concert Grinding on steel	Extremely noisy
100 90	Loud car horn at 3 m Construction site with pneumatic hammering	Very noisy
80 70	Kerbside of busy street Loud radio or television	Loud
60 50	Department store General Office	Moderate to quiet
40 30	Inside private office Inside bedroom	Quiet to very quiet
20	Unoccupied recording studio	Almost silent

Other weightings (eg B, C and D) are less commonly used than A weighting. Sound Levels measured without any weighting are referred to as "linear", and the units are expressed as dB(lin) or dB.

3 Sound Power Level

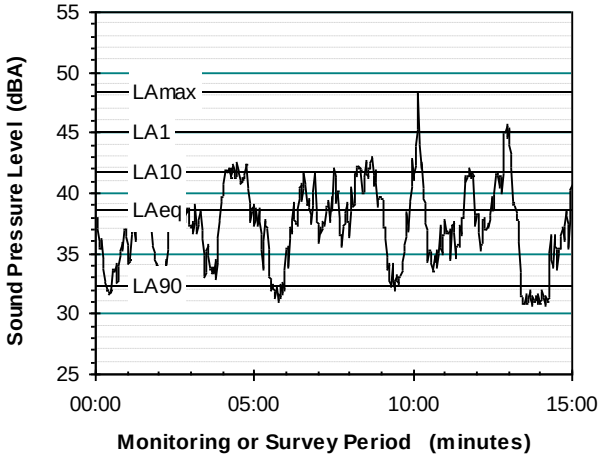
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or LW, or by the reference unit 1E-12 W.

The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels LAN, where LAN is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the LA1 is the noise level exceeded for 1% of the time, LA10 the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating the statistical indices.



Of particular relevance, are:

LA1 The noise level exceeded for 1% of the 15 minute interval.

LA10 The noise level exceed for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

LA90 The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

LAeq Is the A-weighted equivalent continuous noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the "repeatable minimum" LA90 noise level over the daytime and night-time measurement periods, as required by the DECCW. In addition the method produces mean or "average" levels representative of the other descriptors (LAeq, LA10 etc).

5 Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than “broad band" noise.

6 Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

7 Frequency Analysis

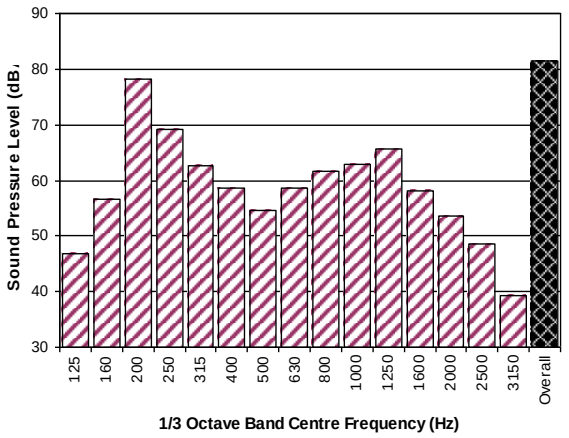
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

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)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



8 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. 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 incorporate “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 (1E-6 mm/s). Care is required in this regard, as other reference levels are used by some organisations.

9 Human Perception of 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.

10 Overpressure

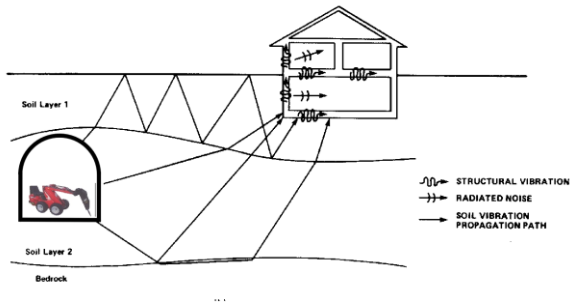
The term “over-pressure” is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

11 Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed “regenerated noise”, “structure borne noise”, or sometimes “ground-borne noise”. Regenerated noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of regenerated noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents the various paths by which vibration and regenerated noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.

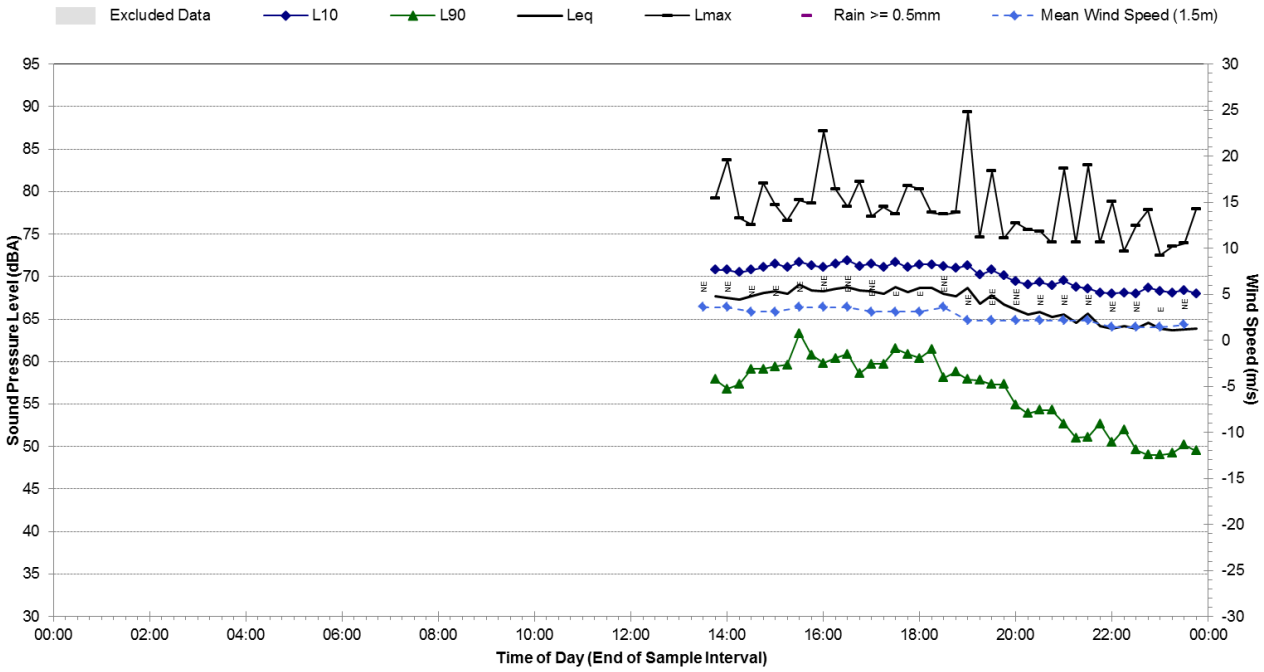


The term “regenerated noise” is also used to describe other types of noise that are emitted from the primary source as a different form of energy. One example would be a fan with a silencer, where the fan is the energy source and primary noise source. The silencer may effectively reduce the fan noise, but some additional noise may be created by the aerodynamic effect of the silencer in the airstream. This “secondary” noise may be referred to as regenerated noise.

DAILY BACKGROUND NOISE MONITORING GRAPHS

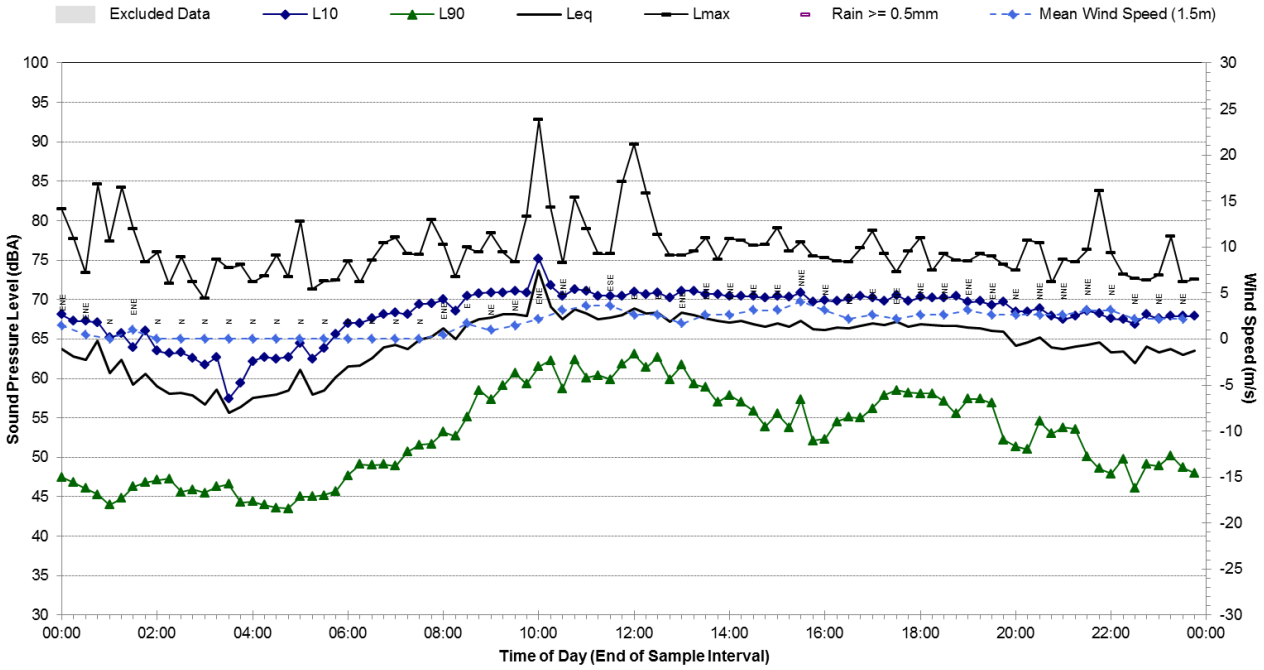
Statistical Ambient Noise Levels

37 Stromeferry Crescent - Friday, 27 November 2015



Statistical Ambient Noise Levels

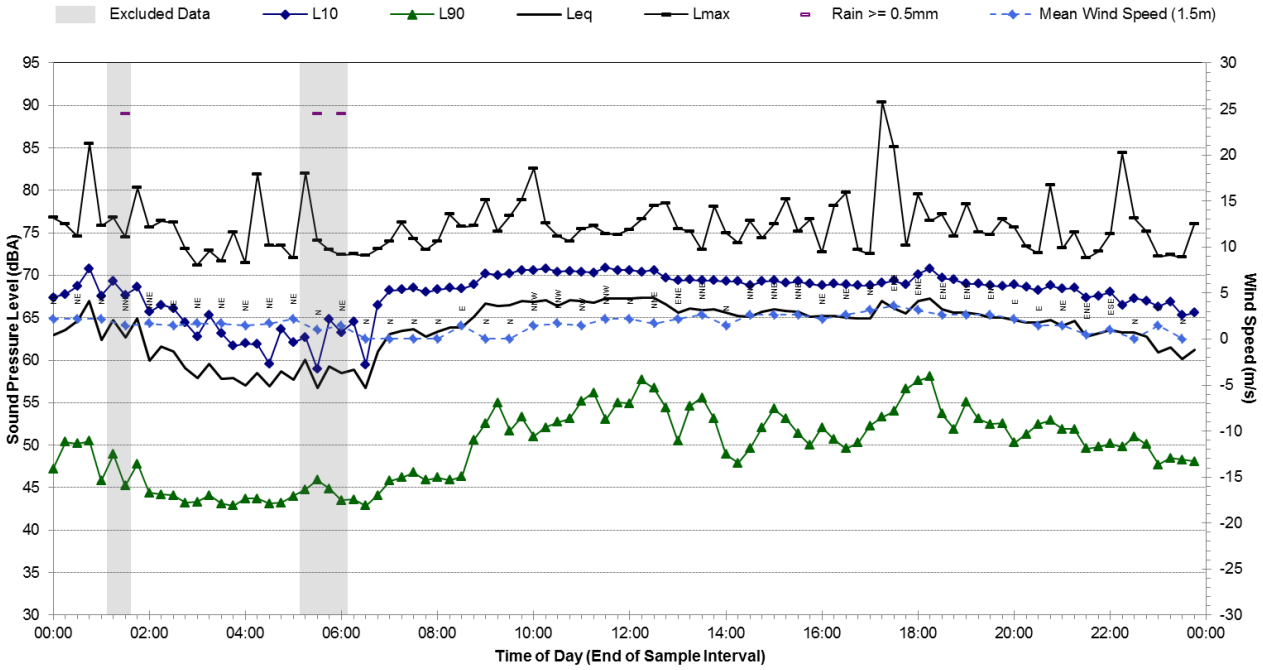
37 Stromeferry Crescent - Saturday, 28 November 2015



DAILY BACKGROUND NOISE MONITORING GRAPHS

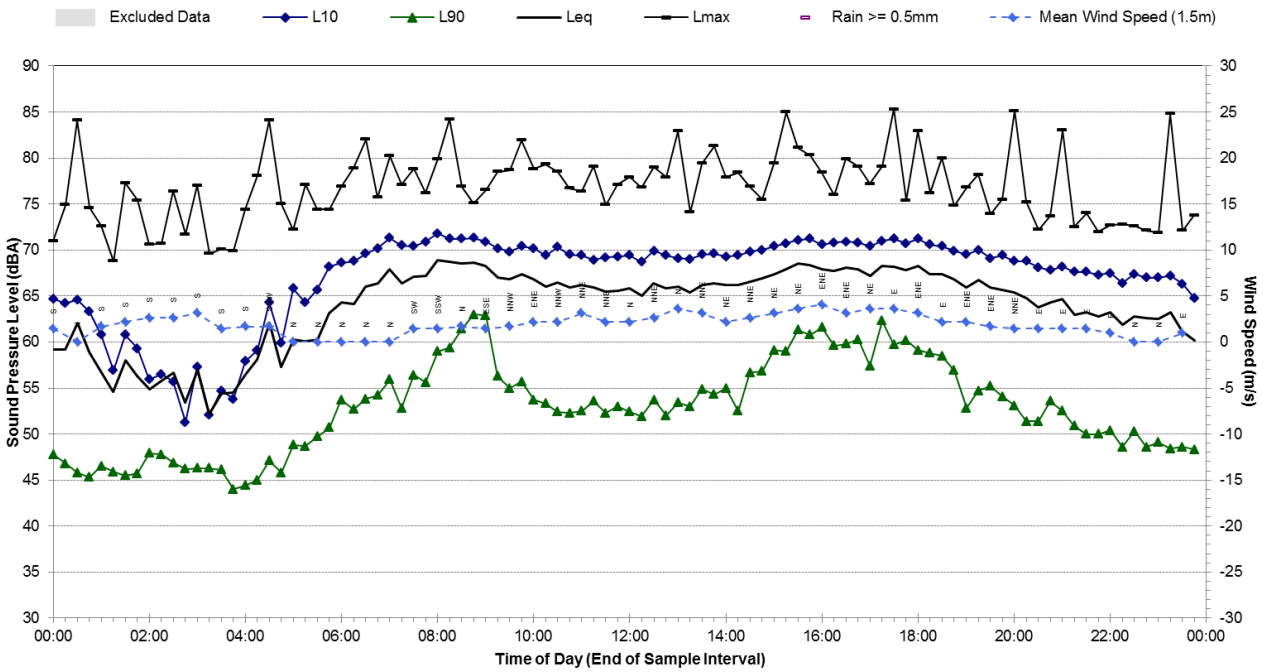
Statistical Ambient Noise Levels

37 Stromeferry Crescent - Sunday, 29 November 2015



Statistical Ambient Noise Levels

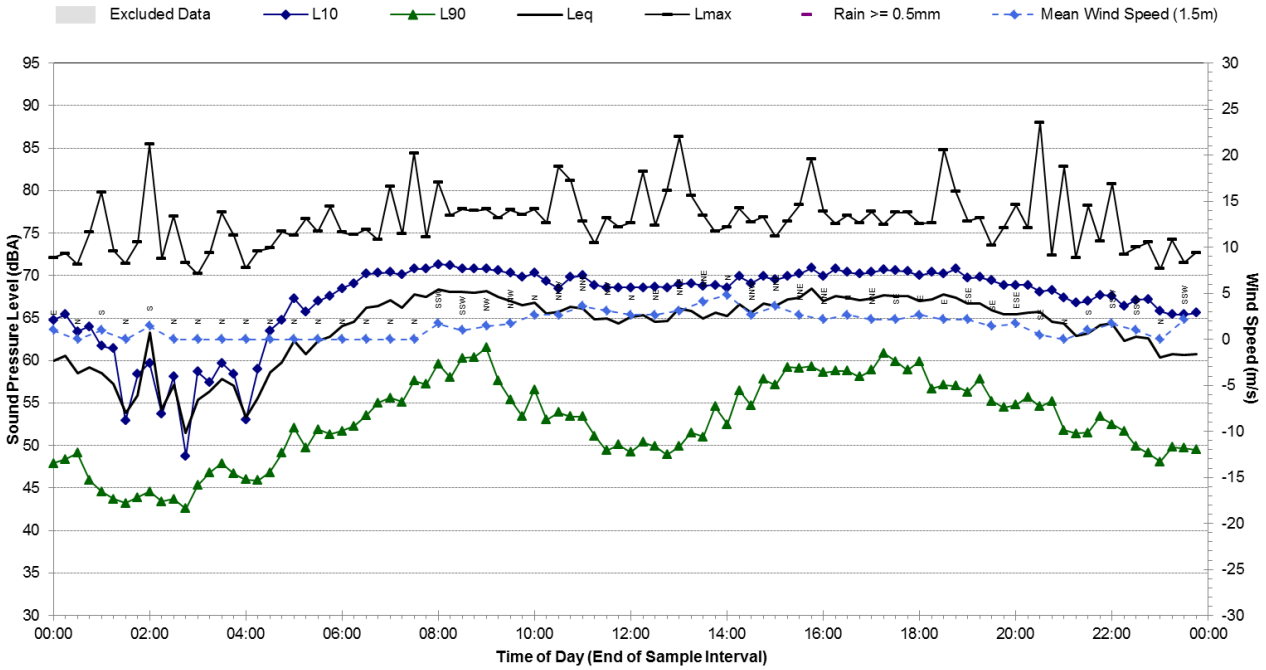
37 Stromeferry Crescent - Monday, 30 November 2015



DAILY BACKGROUND NOISE MONITORING GRAPHS

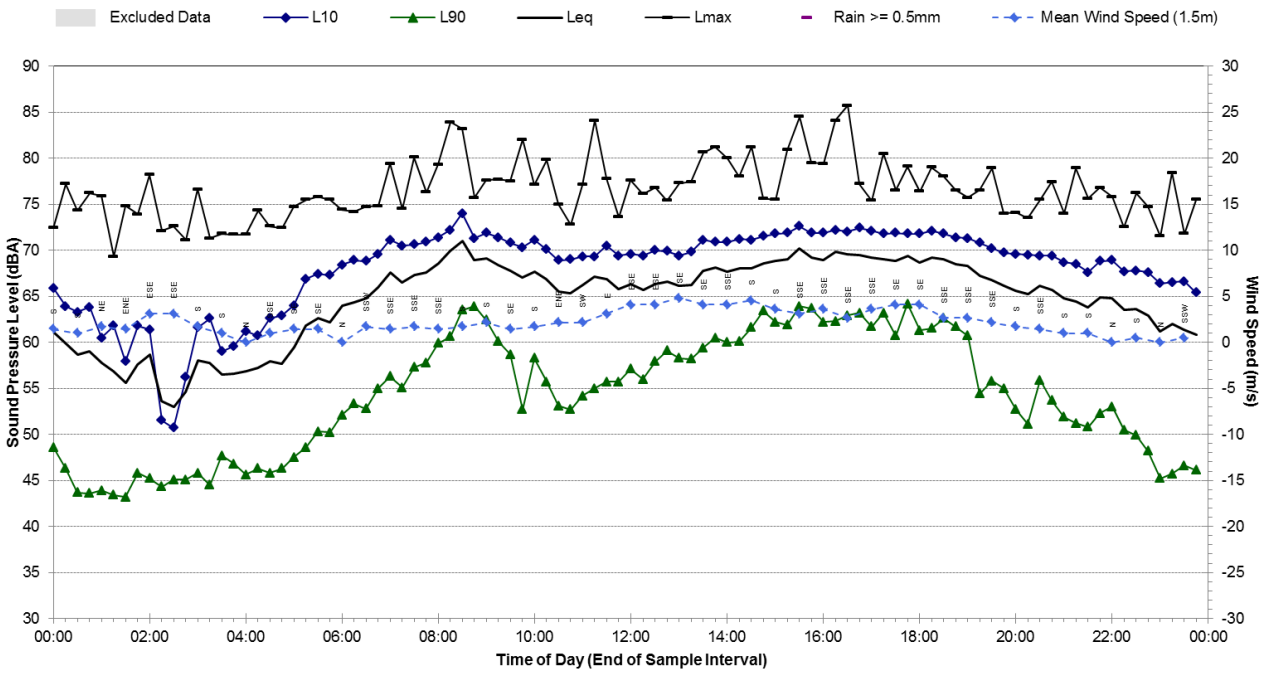
Statistical Ambient Noise Levels

37 Stromeferry Crescent - Tuesday, 1 December 2015



Statistical Ambient Noise Levels

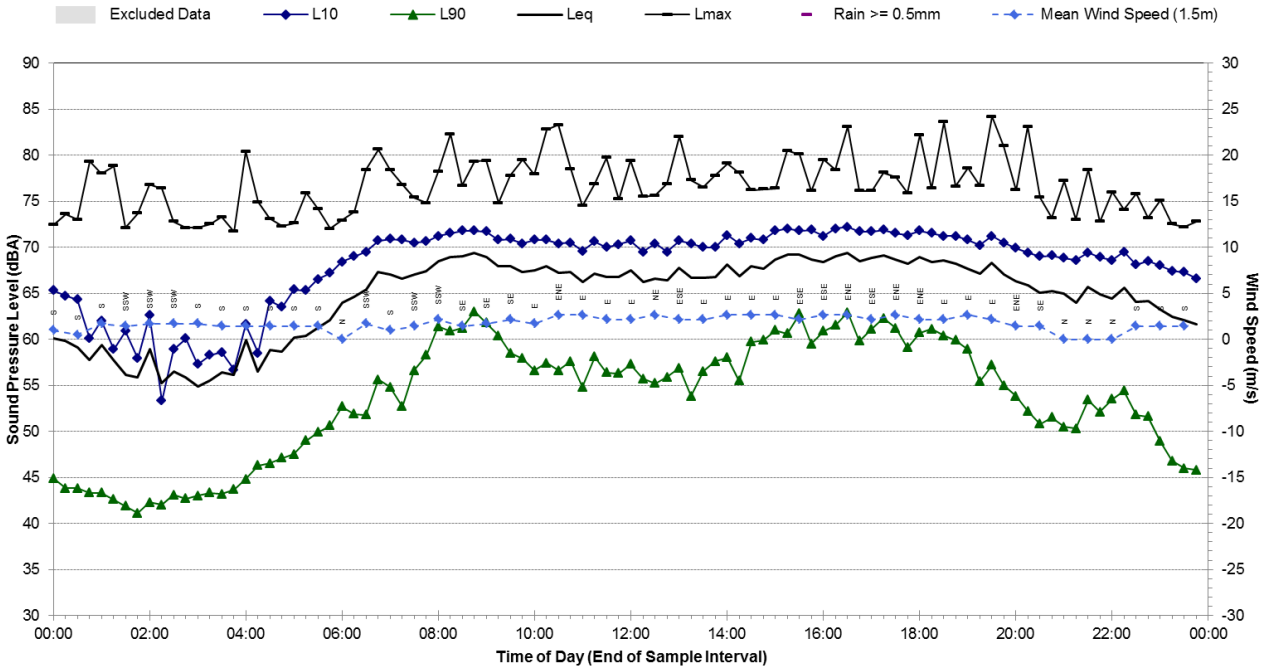
37 Stromeferry Crescent - Wednesday, 2 December 2015



DAILY BACKGROUND NOISE MONITORING GRAPHS

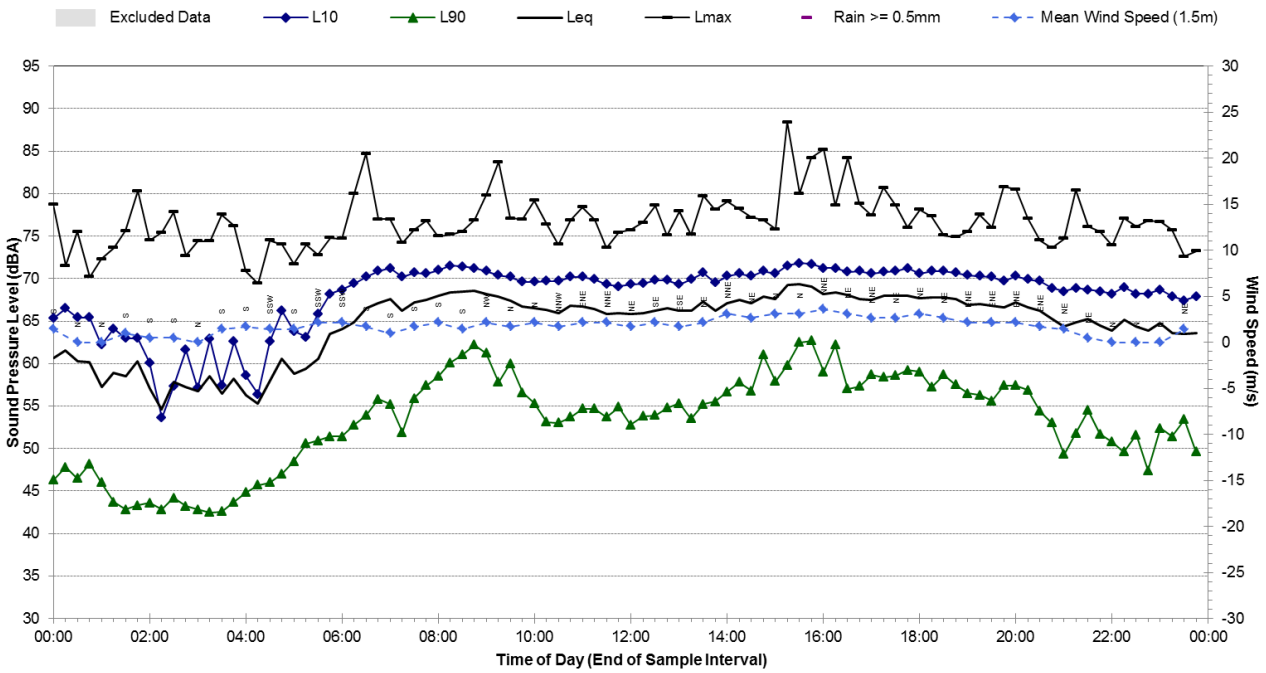
Statistical Ambient Noise Levels

37 Stromeferry Crescent - Thursday, 3 December 2015



Statistical Ambient Noise Levels

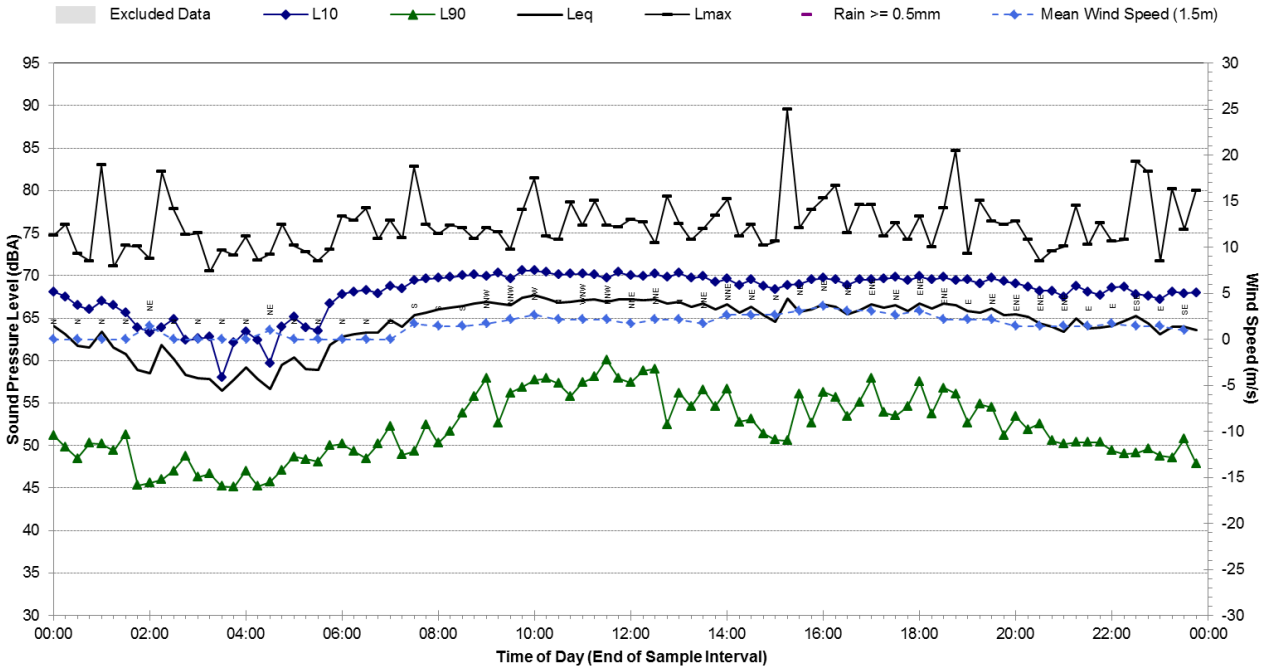
37 Stromeferry Crescent - Friday, 4 December 2015



DAILY BACKGROUND NOISE MONITORING GRAPHS

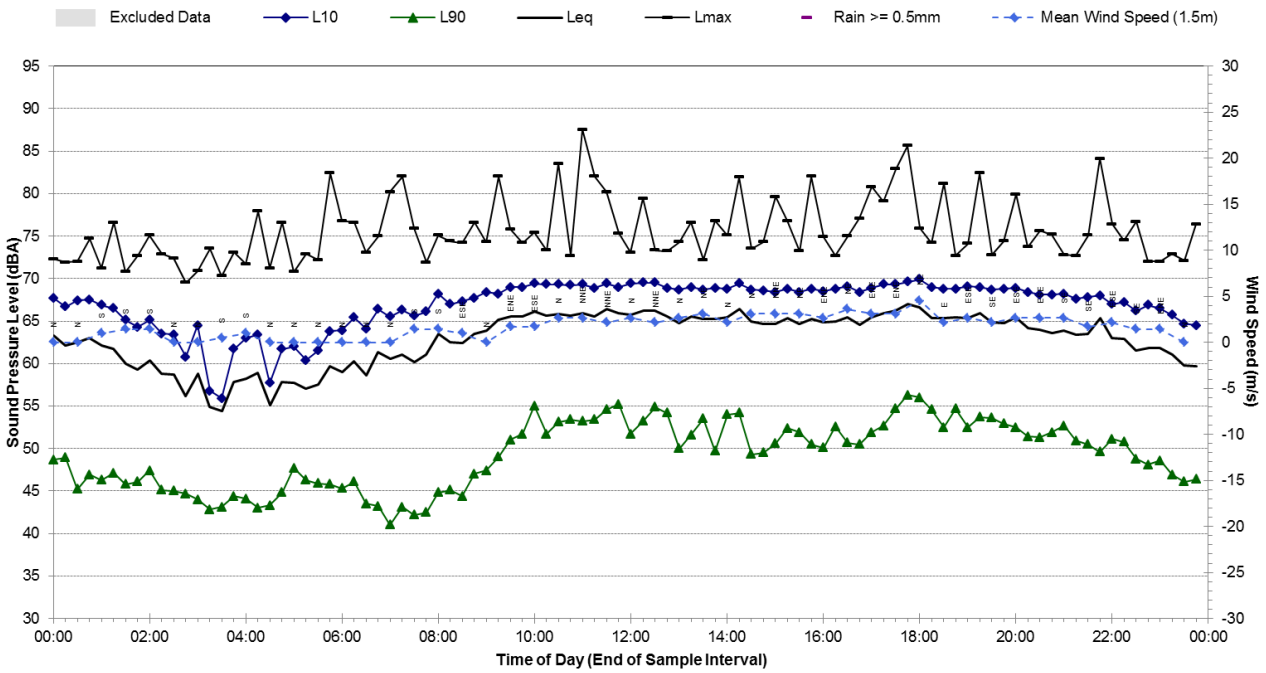
Statistical Ambient Noise Levels

37 Stromeferry Crescent - Saturday, 5 December 2015



Statistical Ambient Noise Levels

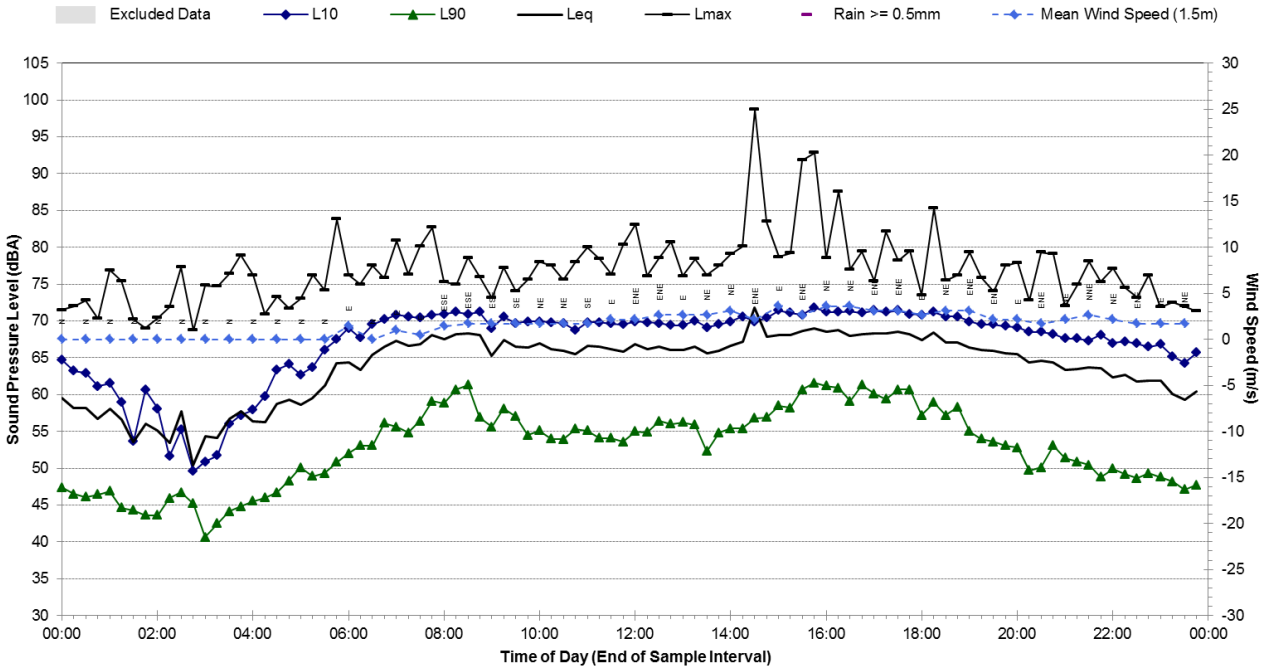
37 Stromeferry Crescent - Sunday, 6 December 2015



DAILY BACKGROUND NOISE MONITORING GRAPHS

Statistical Ambient Noise Levels

37 Stromeferry Crescent - Monday, 7 December 2015



Statistical Ambient Noise Levels

37 Stromeferry Crescent - Tuesday, 8 December 2015