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St Marys Freight Hub
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St Marys Freight Hub

Noise and Vibration Impact Assessment - Post Exhibition Version

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Client: Pacific National

ABN: 39 098 060 550

Prepared by

AECOM Australia Pty Ltd
Level 21, 420 George Street, Sydney NSW 2000, PO Box Q410, QVB Post Office NSW 1230, Australia
T +61 2 8934 0000 F +61 2 8934 0001 www.aecom.com
ABN 20 093 846 925

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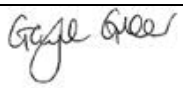
B	03-Oct-2019	Updated truck noise barrier	Gayle Greer Acoustics Team Leader – NSW	

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St Marys Freight Hub

1.0 Introduction

1.1 Background information

AECOM Australia Pty Ltd (AECOM) has been commissioned by Urbanco and SITE Planning+Design on behalf of Pacific National to undertake a Noise and Vibration Impact Assessment of the construction and operation of the proposed St Marys Intermodal Freight Hub (the Proposal).

The Proposal site has a total area of 9.6 ha and forms part of a broader 43 ha site. The site comprises predominantly flat cleared land and an existing rail siding and is zoned IN1 General Industrial. The broader site is surrounded by industrial properties to the north and east, parkland to the west and the main western railway line to the south. The closest noise sensitive receivers are located 200 m to the south.

The Proposal site will facilitate the introduction of a new container rail shuttle between Port Botany and Greater Western Sydney. It will allow an increase of the volume of import and export freight moved via rail and relieve the regional and state road network of heavy vehicle and container traffic, including primary freight roads servicing Port Botany.

Containers will be loaded onto/unloaded from trains and heavy vehicles; and transferred to designated container storage areas by mobile container handling equipment (reach stackers and forklifts).

The development would comprise the following:

- Construction of hardstand areas for container storage and laydown and loading/unloading areas
- Construction of new internal roads for light and heavy vehicles
- Construction of buildings such as offices, wash bays and parking areas
- Installation of services and ancillary works.

It is proposed for the site to operate 24 hours per day, 7 days per week with 80% of heavy vehicle movements expected to occur between 6 am and 6 pm. The site has three road frontages, Forrester Road, Lee Holm Road and Christie Street. Heavy vehicle access is proposed to be via Forrester Road and light vehicle access is proposed to be via Lee Holm Road.

Construction works would generally be limited to standard hours, however some pavement works would be undertaken outside standard hours.

1.2 Scope

The scope of this Noise and Vibration Impact Assessment is to:

- Establish the existing background noise levels in the vicinity of the Proposal
- Establish operational noise criteria, construction noise management levels and vibration limits that would apply to the Proposal
- Predict operational noise levels at nearby noise sensitive receivers due to operation of the Proposal
- Predict construction noise and vibration levels at nearby residential and other sensitive receivers due to the Proposal
- Predict noise levels from additional off-site traffic generated by both the operation and construction of the Proposal
- Assess the operational noise in accordance with the established environmental noise emission criteria and provide indicative noise control measures where necessary
- Review the potential impacts of construction noise and vibration in relation to identified sensitive sites. Determine in principle mitigation measures if required including silencing treatment of

mechanical and mobile plant, management of mechanical and mobile plant, community consultation and/or other noise mitigation and management measures

- Assess road traffic noise arising from additional traffic generation as a result of operation and construction of the Proposal and if necessary recommend management and mitigation measures.

The scope of the assessment is to assess noise generated within the boundary of the freight hub and traffic noise emissions on connection local transport routes. This assessment also considers rail noise on the rail spur which services the site but does not consider rail noise on the Main Western Rail Line. Given the existing high volumes of rail traffic on the Main Western Rail Line any movements related to the Proposal would have an negligible impact.

1.3 Report history

An earlier version of this report (60593074-RPNV-01_B dated 6 March 2019) was submitted to the Department of Planning, Industry and Environment as part of *St Marys Freight Hub - Environmental Impact Statement* and dated May 2018. During the exhibition period a number of submissions were received by the Department of Planning, Industry and Environment relating to noise and vibration. The submissions were received from Penrith City Council, the Environmental Protection Authority and Transport for NSW.

The noise and vibration impact assessment has subsequently been updated to address these submissions. The items addressed relate to the following areas of the assessment:

- Additional information regarding ambient noise monitoring and project trigger levels
- Additional information regarding extended hours construction noise impact assessment
- Performance testing of soft-landing technology on reach stackers
- Additional assessment of operational noise and feasible and reasonable noise mitigation measures including the use of soft-landing technology on reach stackers
- Additional assessment of operational rail noise including discontinuities, brake squeal, wagon bunching and curve squeal
- Changed heavy vehicle and light vehicle site access, remodelling and introduction of noise barrier
- Additional information regarding detailed operational road traffic noise assessment.

1.4 Policies and Guidelines

The following policies and guidelines are relevant for this assessment:

- *Interim Construction Noise Guideline* (ICNG), Department of Environment and Climate Change, 2009
- *Assessing Vibration: A Technical Guideline* (AVATG), Department of Environment and Conservation, 2006
- *NSW Road Noise Policy* (RNP), Department of Environment, Climate Change and Water, 2011
- *Noise Policy for Industry* (NPfI), Environment Protection Authority, 2017
- *Industrial Noise Policy (INP),* Environment Protection Authority, 2000
- *Construction Noise and Vibration Strategy* (CNVS), Transport for NSW, 2018
- *Rail Infrastructure Noise Guideline* (RING), Environment Protection Authority, 2013
- DIN Standard 4150: Part 3 1999 *Structural Vibration in Buildings - Effects on Structures*, 1999
- British Standard 7385: Part 2 1993 *Evaluation and Measurement of Vibration in Buildings*, 1993
- British Standard 6472: Part 1 2008 *Evaluation of Human Exposure to Vibration in Buildings*, 2008

- Australian Standard AS 2436-2010, *Guide to noise and vibration control on construction, demolition and maintenance sites*, 2010
- Australian Standard AS 1055:2018 – Acoustics – *Description and measurement of environmental noise*, 2018
- British Standard 5228: Part 1 2009 *Code of practice for noise and vibration control on construction and open sites*, 2009.

Definitions for acoustic terminology used within this report can be found in Appendix A

1.5 Secretary's Environmental Assessment Requirements

The Secretary's Environmental Assessment Requirements were issued on 23 October 2018. The SEARs relevant to noise and vibration are presented below in Table 1.

Table 1 Secretary's Environmental Assessment Requirements

Assessment requirements	Section of report where addressed
Provide a quantitative assessment of potential construction, operational and transport noise and vibration impacts, including potential impacts on nearby noise sensitive receivers	5.0 and 6.0
Provide details and justification of the proposed noise mitigation and noise monitoring measures	5.8 and 6.5.2
Provide an assessment of the impact on human health of 24-hour operational and predicted increase in traffic volumes	6.4 and 6.5.2

2.0 Existing Acoustic Environment

2.1 Site description

The Proposal is located within a mainly industrial environment. The closest residential receivers are located to:

- the east on Forrester Road, St Marys
- the south on Kalang Avenue and Camira Street, St Marys
- the north west in Werrington County
- the west in Werrington.

St Mary's Senior High School is located to the south of the site and there are other sensitive receivers in the local vicinity. The Proposal and its surrounding environment are shown in Figure 1.

Christie Street and Forrester Road to the north and east of the Proposal respectively, are considered to be sub-arterial roads as per categories within the Environment Protection Authority's (EPA) NSW *Road Noise Policy*. Also the Main Western Railway line is located to the south of the site.

Figure 1 Site Map

2.1.1 Noise catchment areas

To assist in determining noise criteria for the receivers surrounding the Proposal, four noise catchment areas (NCA) were identified. The NCAs are shown in Figure 1.

2.1.2 Heritage items

St Marys Railway Station Group is listed under the Penrith LEP 2010 as an item of heritage significance. The Station Group includes the station building, goods shed, signal box, crane and footbridge substructure.

2.2 Noise measurement methodology

Long term unattended and short term attended measurements were undertaken to establish the existing ambient and background noise environment at potentially affected receivers.

2.2.1 Unattended noise measurement methodology

Long term unattended noise monitoring was conducted at two locations between 5 and 18 December 2018. One noise logger was placed within each NCA at a representative location at the properties indicated in Table 2 and shown in Table 2. The noise loggers were calibrated prior to and after the monitoring period with a drift in calibration not exceeding ± 0.5 dB.

All the acoustic instrumentation employed during the noise measurements comply with the requirements of "*AS IEC 61672.1-2004 Electroacoustics - Sound level meters - Specifications*" and were within their current National Association of Testing Authorities, Australia (NATA) certified in-calibration period (i.e. calibration in the last two years).

Table 2 Noise monitoring details

NCA	Logger	Location	Model	Serial number
NCA 1	1	13 Elm Street, North St Marys	Rion NL52	876010
NCA 2	2	49 Kalang Avenue, St Marys	Rion NL52	386741
NCA 3	3	27-29 Albert Street, Werrington	Rion NL21	765701
NCA 4	4	4 Lockyer Avenue, Werrington County	ARL 315	15-299-444

The noise environment at each of the residential receivers within an NCA is considered to have a similar noise environment to the unattended monitoring location within that NCA. As such each of these residential receivers is assigned the same background noise level.

In accordance with the EPA's NSW *Noise Policy for Industry* (NPfI), noise monitoring affected by adverse weather conditions or extraneous noise events was excluded from the monitoring data. The *Noise Policy for Industry* advises that data may be affected where adverse weather, such as wind speeds higher than 5 m/s or rain, occurs. Weather data was acquired from the Bureau of Meteorology's Penrith Lakes AWS weather station (station number 067113) located around nine kilometres northwest of the Proposal.

The loggers measured the noise levels over the sample period and then determined L_{A1}, L_{A10}, L_{A90}, and L_{Aeq} levels of the noise environment. The L_{A1}, L_{A10} and L_{A90} noise levels are the levels exceeded for 1%, 10% and 90% of the measurement period respectively. The L_{A90} is taken as the background level. The L_{A1} is indicative of the maximum noise levels due to individual noise events such as the pass-by of a heavy vehicle. The L_{Aeq} level is the equivalent continuous sound level and has the same sound energy over the sample period as the actual noise environment with fluctuating sound levels.

The L_{A90} noise levels were analysed to determine a single assessment background level (ABL) for each day, evening and night period in accordance with the *Noise Policy for Industry* for each monitoring location. The ABL is established by determining the lowest ten-percentile level of the L_{A90} noise data acquired over each period of interest. Table 3 presents individual ABLs for each day's assessment periods. The background noise level or rating background level (RBL) representing the day, evening and night-time assessment periods is based on the median of individual ABLs determined over the entire monitoring period.

2.2.2 Attended noise measurement methodology

Attended noise measurements were conducted at two unattended monitoring locations on 5 and 6 December 2018 during the daytime and at all four unattended monitoring locations on 18 February during the night-time. Each measurement was conducted over a 15 minute period. Weather conditions were overcast on the days of monitoring, with no wind.

Attended noise measurements were conducted using Brüel & Kjær Type 2250 sound level meter. The sound level meter used is designated as a Type 1 instruments and has accuracy suitable for laboratory and field use. The sound level meter was calibrated before and after the measurements with a no drift in calibration exceeding ±0.5 dB.

All the acoustic instrumentation employed during the noise measurements comply with the requirements of "*AS IEC 61672.1-2004 Electroacoustics - Sound level meters - Specifications*" and were within their current National Association of Testing Authorities, Australia (NATA) certified in-calibration period (i.e. calibration in the last two years).

2.3 Noise measurement results

2.3.1 Unattended noise measurement results

Table 3 presents the existing overall representative L_{Aeq} ambient noise level and the background L_{A90} noise levels for the day, evening and night-time periods, in accordance with the *Noise Policy for Industry.* The overall representative L_{Aeq} noise levels were determined by logarithmically averaging each assessment period for the entire monitoring period.

In total 13 days of logging were completed, however some periods of noise logging were excluded due to adverse weather (particularly during the daytime). The data were processed in accordance with Fact Sheet B of the *Noise Policy for Industry*. The data for each evening and daytime period were reviewed during days which were not affected by adverse weather. It was noted that typically the quietest time during the non-affected daytime period was around noon and around 9 pm during the evening period. As the weather-affected data was in the late afternoon in the daytime period and typically 6-8 pm in the evening periods it was concluded that the weather-affected data would not affect the lowest 10th percentile background noise level for the daytime and evening periods. The attended measurements corroborated the logging results. In addition it is noted that the critical period is the night-time and each location has around 11 days of data for this period.

The results for each day and the graphical noise logging results are presented in Appendix B.

Table 3 Existing background (L_{A90}) and ambient (L_{Aeq}) noise levels – NCA 1 to 4

Location	L_{A90} background rating noise level, dB(A)			Log average noise (ambient) L_{Aeq} levels dB(A)		
	Day[1]	Evening[1]	Night[1]	Day[1]	Evening[1]	Night[1]
NCA 1	43	38	34	53	52	48
NCA 2	39	39[2](40)	37	59	60	58
NCA 3[3]	47	45	36	55	52	51
NCA 4[3]	48	45	33	58	56	52

Notes:

1. *Day is defined as 7:00 am to 6:00 pm, Monday to Saturday and 8:00 am to 6:00 pm Sundays & Public Holidays. Evening is defined as 6:00 pm to 10:00 pm, Monday to Sunday & Public Holidays. Night is defined as 10:00 pm to 7:00 am, Monday to Saturday and 10:00 pm to 8:00 am Sundays & Public Holidays.*
2. *Evening RBL adjusted to the same as the daytime RBL in accordance with the Noise Policy for Industry. This is because the community generally expects greater control of noise during the more sensitive evening periods than during the daytime period.*
3. *The logger at Lockyer Avenue was around 1.5 m from the façade, and the logger at Albert Street was <1 m from the façade. The background noise levels (i.e. L_{A90}) have not been corrected to account for façade reflections as the background noise levels at these locations are not entirely attributable to road traffic noise. The background noise includes many noise sources both distant and in close proximity to the measurement location and arriving at the microphone location from different directions.*

2.3.2 Attended noise measurements

The results of the attended noise monitoring are presented in Table 4. The daytime measurements indicated that NCA 1 and NCA 2 are affected by existing industrial noise and road traffic noise, whilst NCA 3 and NCA 4 are not affected by existing industrial noise. Night-time measurements were also undertaken for NCA 1 and NCA 2 to determine the level of existing industrial noise during the night-time. These NCAs are the controlling NCAs.

Table 4 Attended noise measurements

Logger	Date	Time	L_{Aeq} dB(A)	L_{A90} dB(A)	Comments
1	6/12/2018	12:17 PM	53	43	Noise environment dominated by constant road traffic noise from west and south. Cicadas and birds audible. Truck engine brakes and acceleration also audible.
	18/02/2019	10:05 PM	51	44	Noise environment dominated by crickets 45 dB(A) and traffic along Glossop Road, car pass-by 60-72 dB(A). Faint hum in north west direction can be heard, unable to determine if it is industrial or distant traffic. Single banging event in north-west heard, only slightly audible, does not contribute to ambient. Gate or reversing beeper audible in direction of Glossop Street, in absence of traffic.
2	5/12/2018	1:43 PM	57	44	Background noise dominated by constant road traffic noise hum. Truck acceleration and engine braking audible. Some industrial noise from the north audible at times such as reverse siren, some banging. Train passby 63 to 82 dB(A). School Bell heard.
	18/02/2019	10:30 PM	55	45	Industrial hum to the north audible and controls background with crickets. Train pass-bys 67-72 dB(A) max. Dog barking to the south audible. Reverse/gate siren audible from north (significantly more audible) and from the north west (to a lesser extent). Air brake event to the north clearly audible. Banging to the north varies between slightly audible to very audible. Engine revving to the north audible. Hydraulic whine to the north audible. Horn to the north very audible.
3	5/12/2018	1:01 PM	57	49	Noise environment dominated by constant road traffic noise from Werrington Road. Bird noise. No audible industrial noise.
4	5/12/2018	12:10 PM	59	50	Noise environment dominated by constant road traffic noise from Dunheved Road. Calm weather. Occasional dog barking. Truck and dog pass by 73 dB(A). No audible industrial noise.

2.4 Existing noise environment summary

The acoustic environment of NCA 1 is dominated by traffic on Forrester Road and Glossop Street. Natural sounds such as wind and bird noise are also audible along with some industrial noise.

The acoustic environment of NCA 2 is dominated by traffic. Intermittent rail noise and industrial noise is also audible at this location.

The acoustic environment of NCA 3 is dominated by traffic on Werrington Road. Natural sounds such as bird noise are also audible.

The acoustic environment of NCA 4 is dominated by traffic on Dunheved Road. Natural sounds such as bird noise are also audible.

All four NCAs also have local traffic with intermittent traffic flows and some limited commerce or industry. These characteristics are typical of a suburban environment.

2.5 Soft-landing technology noise measurements

Noise measurements were made of typical operations of a reach stacker with soft-landing technology at the Newcrest DeWatering Plant in Blayney, NSW on Friday 6 September 2019. The soft-landing system comprises an ultrasonic sensor which automatically slows the speed of the reach stacker boom as it engages with the container. Details are presented below.

2.5.1 Measurement methodology

The attended measurements of the reach stacker were conducted using a Bruel and Kjaer 2250 sound level meter, designated as a Type 1 instrument having an accuracy suitable for field measurements. The instrument was calibrated before and after the measurements with no drift in calibration exceeding ±0.5 dB. All equipment used for this assessment has current calibration certificates.

The data were then reviewed to identify all the maximum levels relating to latching, pick up and set down of a container. An arithmetic mean was then calculated from all the measurement data.

During the container stacking 7 containers were measured (3 with soft-landing enabled, 4 without soft-landing enabled).

2.5.2 Attended noise measurements

The results of the container stacking measurements are summarised in Table 5. These L_{A1} levels include the latching, pickup and set down of a container. With soft-landing disabled the highest L_{A1} levels were measured during latching. With soft-landing enabled the highest L_{A1} levels were measured during the set down of the container. It can be seen from the results below that the L_{A1} levels reduce on average by 8 dB(A). It should also be noted that the reach stacker measured did not have twistlock rubber dampers installed. If these dampers were installed a further reduction in L_{A1} levels associated with latching could also be achieved.

Table 5 Measured L_{Zmax} levels of reach stacker typical operations

Soft-landing technology	Distance (m)	Average L_{A1} levels[1]	Maximum L_{A1} levels[1]
Enabled	7	93 dB(A)	96 dB(A)
Disabled	7	101 dB(A)	104 dB(A)

Notes:

1. *These measurements were made close to a reflecting wall which has been estimated to increase the noise levels by around 2 dB(A)*

3.0 Construction Noise and Vibration Criteria

3.1 Construction activity noise criteria

3.1.1 Interim Construction Noise Guideline

The potential risk of adverse impact of construction noise on a receiver is determined by the extent of its emergence above the existing background noise level, the duration of the event and the characteristics of the noise.

The *Interim Construction Noise Guideline* is a NSW Government document that sets out ways to deal with the impacts of construction noise on residences and other sensitive land uses. It presents assessment approaches tailored to the scale of the construction project and identifies practices to minimise noise impacts. As the proposed works are expected to continue for a period of more than three weeks and are within relatively close proximity to noise sensitive receivers, a quantitative assessment, based on 'reasonable' worst case construction scenarios, has been carried out for these works.

Noise levels resulting from construction activities are predicted at nearby noise sensitive receivers (e.g. residences, schools, hospitals, places of worship, passive and active recreation areas) are compared to the levels provided in the ICNG. Where an exceedance of the management levels is predicted the ICNG advises that receivers can be considered 'noise affected' and the proponent should apply all feasible and reasonable work practices to minimise the noise impact. The proponent should also inform all potentially affected residents of the nature of the works to be carried out, the expected noise level and duration, as well as contact details should they wish to make a complaint.

Where construction noise levels at the receiver reach 75 dB(A) residential receivers are considered to be 'highly noise affected' and the proponent should, in consultation with the community, consider restrictions to the hours of construction to provide respite periods.

The construction noise management levels (NML) for the residential and other sensitive land uses are detailed in Table 6, Table 7 and Table 8.

Table 6 ICNG Residential noise management levels

Time of day	NML, $L_{Aeq,15min}$, dB(A)[1]	How to apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on 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 $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 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 dB(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see section 7.2.2 of the ICNG.

Notes:

1. *Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.*

The ICNG defines what is considered to be feasible and reasonable as follows:

- *"Feasible*

  A work practice or abatement measure is feasible if it is capable of being put into practice or of being engineered and is practical to build given project constraints such as safety and maintenance requirements.

- *Reasonable*

  Selecting reasonable measures from those that are feasible involves making a judgment to determine whether the overall noise benefits outweigh the overall adverse social, economic and environmental effects, including the cost of the measure."

Table 7 presents the NMLs applicable to residential receivers nearby to this development.

Table 7 Construction noise management levels – Residential receivers

Noise catchment area	Period	RBL, L_{A90} dB(A)	Standard hours noise management levels, $L_{Aeq,15min}$, dB(A)	Out-of-hours noise management levels, $L_{Aeq,15min}$, dB(A)
1	Day	43	53	48
	Evening	39	-	44
	Night	34	-	39
2	Day	39	49	44
	Evening	38	-	43
	Night	37	-	42
3	Day	47	57	52
	Evening	45	-	50
	Night	36	-	41
4	Day	48	58	53
	Evening	45	-	50
	Night	33	-	38

Table 8 presents the NMLs applicable to other noise sensitive receivers such as educational facilities and places of worship and to commercial receivers.

Table 8 Construction noise management levels – Other receivers

Land use	Noise management levels, $L_{Aeq,15min}$ (applies when properties are in use)
Classrooms at schools and other educational institutions	55 dB(A)[1]
Places of worship	55 dB(A)[1]
Childcare centres	55 dB(A)[1]
Community Hall	55 dB(A)[1]
Active Recreation	65 dB(A)
Commercial premises (including offices, retail outlets)	70 dB(A)
Industrial Premises	75 dB(A)

Notes:

1. *These external management levels are based upon a 45 dB(A) internal noise management level and a 10 dB reduction from outside to inside through an open window.*

3.1.2 Sleep disturbance criteria

The ICNG requires a sleep disturbance analysis where construction works are planned to extend over more than two consecutive nights. The L_{A1} noise levels and number of expected L_{A1} noise events should be predicted in order to determine the likelihood of potential sleep disturbance.

The EPA recommends that to minimise the risk of sleep disturbance during the night-time period (10.00 pm to 7.00 am), the $L_{A1(1\ min),}$ noise level outside a bedroom window should not exceed the $L_{A90\ (15\ minute)}$ background noise level by more than 15 dB. If this screening criterion is found to be exceeded then a more detailed analysis must be undertaken and include the extent that the maximum noise level exceeds the background noise level and the number of times this is likely to happen during the night-time period.

Sleep disturbance research presented in the *Road Noise Policy* concludes that *'Maximum internal noise levels below 50-55 dB(A) are unlikely to cause awakening reactions'*. Therefore, given that an open window provides approximately 10 dB in noise attenuation from outside to inside, external noise levels of 60-65 dB(A) are unlikely to result in awakening reactions.

Based on the measured background noise levels during the night, the sleep disturbance criteria for the nearest noise sensitive residential receivers are presented in Table 9.

Table 9 Sleep disturbance criteria

Noise catchment area	Background noise level (L_{A90}), dB(A)	Sleep disturbance criteria,	$L_{A1(1\ minute)}$, dB(A)
		Screening level	Awakening reaction
NCA 1	34	49	60 – 65
NCA 2	37	52	60 – 65
NCA 3	36	51	60 – 65
NCA 4	33	48	60 – 65

3.2 Construction traffic noise criteria

To assess noise impacts from construction traffic an initial screening test should be undertaken by evaluating whether existing road traffic noise levels would increase by more than 2 dB(A), in line with the *Road Noise Policy*. Where the predicted noise increase is 2 dB(A) or less, then no further assessment is required. However, where the predicted noise level increase is greater than 2 dB(A), and the predicted road traffic noise level exceeds the road category specific criterion then noise mitigation should be considered for those receivers affected. The *Road Noise Policy* does not require assessment of noise impact to commercial or industrial receivers.

Christie Street, Forrester Road, Glossop Street, Great Western Highway and Mamre Road provide the main access roads to the site. These roads are classified as arterial and sub-arterial and are listed in Table 10. The external noise criteria are applied one metre from the external facade of an affected building.

Table 10 Roads used by construction traffic

Road	Type	Residential receivers	Estimated AADT
Christie Street	Sub-arterial Road	No	>15,000
Forrester Road	Sub-arterial Road	Yes	>15,000
Glossop Street	Sub-arterial Road	Yes	>24,000
Great Western Highway	Arterial Road	Yes	>30,000
Mamre Road	Arterial Road	Yes	>30,000

3.3 Construction vibration criteria

The relevant standards/guidelines for the assessment of construction vibration are summarised in Table 11.

Table 11 Standards/guidelines used for assessing construction vibration

Item	Standard/guideline
Structural damage	German Standard DIN 4150 – Part 3 – Structural Vibration in Buildings – Effects on Structures (DIN 4150)
Human comfort (tactile vibration) [1]	*Assessing Vibration: A Technical Guideline* (AVATG)

Note 1: This document is based upon the guidelines contained in British Standard 6472:1992, "Evaluation of human exposure to vibration in buildings (1-80 Hz)". This British Standard was superseded in 2008 with BS 6472-1:2008 "Guide to evaluation of human exposure to vibration in buildings – Part 1: Vibration sources other than blasting" and the 1992 version of the Standard was withdrawn. Although a new version of BS 6472 has been published, the Environment Protection Authority still requires vibration to be assessed in accordance with the 1992 version of the Standard at this point in time.

Vibration, at levels high enough, has the potential to cause damage to structures and disrupt human comfort. Vibration and its associated effects are usually classified as continuous, impulsive or intermittent as follows:

- continuous vibration continues uninterrupted for a defined period and includes sources such as machinery and continuous construction activities
- impulsive vibration is a rapid build up to a peak followed by a damped decay. It may consist of several cycles at around the same amplitude, with durations of typically less than two seconds and no more than three occurrences in an assessment period. This may include occasional dropping of heavy equipment or loading activities
- intermittent vibration occurs where there are interrupted periods of continuous vibration, repeated periods of impulsive vibration or continuous vibration that varies significantly in magnitude. This may include intermittent construction activity, impact pile driving, jack hammers.

3.3.1 Structural damage

At present, no Australian Standards exist for the assessment of building damage caused by vibration.

The German standard (DIN 4150) provides recommended maximum levels of vibration that reduce the likelihood of building damage caused by vibration and are presented in Table 12. DIN 4150 states that buildings exposed to higher levels of vibration than recommended limits would not necessarily result in damage.

Table 12 DIN 4150: Structural damage safe limits for building vibration

Group	Type of structure	At foundation - Less than 10 Hz	At foundation - 10 Hz to 50 Hz	At foundation - 50 Hz to 100 Hz[1]	Vibration at the horizontal plane of the highest floor for all frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20 mm/s	20 to 40 mm/s	40 to 50 mm/s	40 mm/s
2	Dwellings and buildings of similar design and/or use	5 mm/s	5 to 15 mm/s	15 to 20 mm/s	15 mm/s
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (eg buildings that are under a preservation order/heritage listed)	3 mm/s	3 to 8 mm/s	8 to 10 mm/s	8 mm/s

Notes:

1. At frequencies above 100 Hz, the values given in this column may be used as minimum values

3.3.2 Human comfort

The assessment of intermittent vibration outlined in the NSW EPA guideline A*ssessing Vibration: A Technical Guideline* (AVTG) is based on Vibration Dose Values (VDVs). The VDV accumulates the vibration energy received over the daytime and night-time periods.

Maximum and preferred VDVs for intermittent vibration arising from construction activities are listed in Table 13. The VDV criteria are based on the likelihood that a person would be annoyed by the level of vibration over the entire assessment period.

Table 13 Preferred and maximum vibration dose values for intermittent vibration (m/s$^{1.75}$)

Location	Daytime[1]		Night-time[1]	
	Preferred	Maximum	Preferred	Maximum
Critical areas	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

Notes:
1. Day is defined as 7:00 am to 10:00 pm. Night is defined as 10:00 pm to 7:00 am

4.0 Operational Noise Criteria

4.1 Noise Policy for Industry

The NSW *Noise Policy for Industry* (NPfI) provides guidance in relation to acceptable noise limits for industrial noise emissions, which includes, but is not limited to, noise emissions from mechanical plant.

The assessment procedure in the *Noise Policy for Industry* has two components:

- controlling **intrusive** noise impacts in the short term for residences
- maintaining noise level **amenity** for residences and other land uses.

Both components are assessed at the boundary of the noise sensitive receiver site, or if the site boundary is more than 30 metres from the noise sensitive building, a distance of 30 metres from the noise sensitive building.

4.1.1 Intrusive noise impacts

The *Noise Policy for Industry* states that the noise from any single noise source should not be greatly above the prevailing background noise level. Industrial noise sources are generally considered acceptable if the A-weighted equivalent continuous sound pressure level of noise from the source, measured over a 15 minute period ($L_{Aeq,15\ min}$) does not exceed the Rating Background Level (RBL) by more than 5 dB(A) for the period under consideration. This is termed the Intrusiveness Criterion.

The RBL is the background noise level to be used for assessment purposes and is determined by the methods given in the *Noise Policy for Industry*.

The RBL and the respective intrusive criteria for the day, evening and night periods are provided in Table 14.

Table 14 Intrusive criteria

Location	Period	RBL (L_{A90}), dB(A)	Intrusive criteria (RBL+5), dB(A)
NCA 1 Residential receivers	Day	43	48
	Evening	39	44
	Night	34	39
NCA 2 Residential receivers	Day	39	44
	Evening	39	44
	Night	37	42
NCA 3 Residential receivers	Day	47	52
	Evening	45	50
	Night	36	41
NCA 4 Residential receivers	Day	48	53
	Evening	45	50
	Night	33	38

4.1.2 Protecting amenity

To limit continuing increase in noise levels, the maximum ambient noise level within an area from all industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.1 of the *Noise Policy for Industry*. That is the noise level should not exceed the level appropriate for the particular locality and land use. This is often termed the “background creep” or “amenity criterion”.

The project amenity level for a project is equal to the recommended amenity level – 5 dB(A). Therefore, relevant noise amenity level from Table 15 is assigned as the project amenity noise level. The project amenity level is then converted to a 15 minute period by adding 3 dB(A).

The project amenity noise levels applicable the Proposal are provided in Table 15. NCA 2 is subject to high traffic levels during the evening and night-time periods therefore it has been adjusted in accordance with the *Noise Policy for Industry*.

Table 15 Project amenity noise levels

Type of receiver	Indicative noise amenity area	Time of day	Project amenity noise level, dB(A)	
			$L_{Aeq\ (period)}$	$L_{Aeq\ (15\ minute)}$
NCA 1, NCA 3 and NCA 4 Residential receivers	Suburban	Day	50[1]	53
		Evening	40[1]	43
		Night	35[1]	38
NCA 2 Residential receivers	Suburban	Day	50[1]	53
		Evening	45[2]	48
		Night	43[2]	46
School classroom	All	Noisiest 1-hour period when in use	45[3]	48
Place of worship	All	When in use	50[3]	53
Commercial premises	All	When in use	65	68
Active recreation area	All	When in use	55	58

Notes:

1 Recommended amenity level minus 5 dB

2 Area dominated by high levels of rail traffic noise, existing $L_{Aeq(period,\ traffic)}$ minus 15 dB

3 External noise levels are based upon a 10 dB reduction from outside to inside through an open window.

4.1.3 Summary

A summary of the environmental noise criteria is presented in Table 16 below. These criteria apply to environmental noise emissions from any activity undertaken or plant installed as part of the Proposal.

Table 16 Summary of environmental noise emission criteria

Location	Time of day	Project noise trigger levels[1] L_{Aeq}, dB(A)
NCA 1	Day	48
	Evening	43
	Night	38
NCA 2	Day	44
	Evening	44
	Night	42
NCA 3	Day	52
	Evening	43
	Night	38
NCA 4	Day	53
	Evening	43
	Night	38
School classroom	Noisiest 1-hour period when in use	48
Place of Worship	When in use	53
Commercial premises	When in use	68
Active recreation area	When in use	58

Notes:

1. Project Noise Trigger Levels represent the lower of the intrusive and amenity criteria.

4.1.4 Maximum noise level assessment

The *Noise Policy for Industry* requires the potential for sleep disturbance to be assessed by considering maximum noise levels events during the night-time period.

Where the subject development/premises night-time noise levels at a residential location exceed the following screening levels a detailed maximum noise level event assessment should be undertaken:

- $L_{Aeq,15min}$ 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,

The detailed assessment should cover the maximum noise level, the extent to which the maximum noise level exceeds the rating background noise level, and the number of times this happens during the night-time period.

Based on the measured background noise levels during the night, the sleep disturbance criteria for the nearest noise sensitive residential receivers are presented in Table 17.

Table 17 Night-time sleep disturbance screening levels

Location	Measured night-time RBL, $L_{A90,\ 15\ mins}$ dB(A)	Sleep disturbance screening levels	
		$L_{Aeq,15min}$	L_{AFmax}
NCA 1 Residential receivers	34	40	52
NCA 2 Residential receivers	37	42	52
NCA 3 Residential receivers	36	41	52
NCA 4 Residential receivers	33	40	52

4.2 Rail Infrastructure Noise Guideline

The *Rail Infrastructure Noise Guideline* (RING) provides guidance in relation to acceptable noise limits for rail development projects. Non-network rail lines exclusively servicing industrial sites are considered within Appendix 3 of the *Rail Infrastructure Noise Guideline*. Recommended L_{Aeq} noise levels for these non-network rail lines are reproduced from the NSW *Industrial Noise Policy* (EPA, 2000) and are provided below.

Table 18 Project amenity noise levels

Type of receiver	Indicative noise amenity area	Time of day	Project amenity noise level, $L_{Aeq\ (period)}$ dB(A)	
			Recommended	Maximum
Residential receivers	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
School classroom	All	Noisiest 1-hour period when in use	45[1]	50
Place of worship	All	When in use	50[1]	55
Commercial premises	All	When in use	65	70
Active recreation area	All	When in use	55	75

Note:

1 *External noise levels are based upon a 10 dB reduction from outside to inside through an open window.*

5.0 Construction Noise Assessment

5.1 Construction stages and scheduling

In consultation with Pacific National, six distinct work packages, each consisting of a number of construction activities, have been assumed to occur for the Proposal. These would be confirmed by the construction contractor prior to construction commencing and further assessment would be undertaken if required. These work packages are described in Table 19. All work packages have been assessed.

Construction works are generally expected to be undertaken during standard construction hours over a period of up to 7 months. Some works are also proposed outside standard hours and these are shown in works package 6 in Table 19 below. The proposed area for the extended work hours construction works is shown in Figure 2.

Table 19 Construction assessment work packages

Work package	Activities	Description
1	Site establishment and delivery of materials	Site set-up including environmental control
2	Bulk earthworks	Including spoil removal
3	Trenches/utilities	-
4	Pavement/hardstand construction	-
5	Building delivery and installation	Building delivery and installation, pavement and landscaping works
6	Extended work hours construction works	Pavement construction

The scheduling of the of the construction works are provided below:

- Pre-site works commencing in Month 1
- Month 2 to Month 6 – Construction of heavy vehicle access road, bulk earth works and hard stand areas. The Stage 1 works enable the St Marys Freight Hub to commence operation at a reduced capacity whilst other parts of the project are still under construction
- Month 3 to Month 8 – Construction of administration building site, fuel storage, wash bay, transport workshop and container repair workshop sites. These works are estimated to take 4 months with completion in Month 8 and approvals for the office/administration buildings and workshop buildings will be progressed separately
- Month 2 to Month 3 – Light vehicle access road and associated parking
- Month 5 to Month 7 – Finishing works including landscaping, lighting, fencing, signage.

Figure 2 Extended work hours construction area

5.2 Construction sources

Noise sources and their respective L_{Aeq} sound power levels for each work package are shown in Table 20. These sound power levels are typical values taken from data provided in Australian Standard AS2436-2010, *Guide to noise and vibration control on construction, demolition and maintenance sites* and British Standard 5228: Part 1 2009 *Code of practice for noise and vibration control on construction and open sites*, 2009 and assume equipment is modern and in good working order.

Table 20 Equipment sound power levels per construction work package

Equipment	Sound power level, dB(A)	Work package
Trucks	108	1, 5
Tipper trucks	108	1, 2, 6
Mobile crane	106	1
Front end loader	104	1, 6
Scraper	106	2
Grader	106	2, 6
Excavator	98	2, 6
Backhoe	96	3
Crane truck	106	3, 5
Vibrating roller	105	4
Steel drum roller	106	4
Concrete trucks	106	4
Power tools	104	5
Hand tools	94	5
Light towers	95	5
Padfoot roller	106	6
Watercart	109	6

Notes:

1. Sound powers are time weighted (i.e. expected equipment levels per 15 minute period)

5.3 Modelling and meteorological conditions

In order to assess noise impacts from the site during construction, a noise model was created to represent ‘reasonable’ worst periods of upgrade works.

The construction of the Proposal has been modelled in SoundPLAN Version 8.0. The following features were included in the noise model:

- ground topography
- ground absorption and reflection
- buildings (residential and commercial)
- construction noise sources (listed in Table 20).

Noise emissions from the construction sites have been modelled using an implementation of the CONCAWE propagation algorithm with neutral metrological conditions.

It can be expected that there may be differences between predicted and measured noise levels due to variations in instantaneous operating conditions, plant in operation during the measurement and also the location of the plant equipment. The acoustic shielding calculated in the model due to fixed building structures would also vary as the construction equipment moves around the site.

5.4 Construction noise assessment

The identified residential and non-residential receivers have been assessed against the standard hours and outside of standard work hours noise management levels. The level of impact may change depending on the final construction methodology and further assessment would be undertaken if required.

During construction it is likely that all equipment would not be operating simultaneously at all times and in the one location, which would result in a reduced noise levels compared with those predicted. As each construction work package would be occurring discretely a cumulative noise impact is unlikely. Mitigation measures have been specified in Section 5.8 which may reduce the impact of these exceedances on receivers.

Noise results are presented graphically in Appendix C.

5.4.1 Summary of impacts during standard hours

Results show construction noise levels may exceed the noise management levels during standard hours at up to 125 residential receivers, one school (St Marys Senior High School) and eight industrial receivers. These results represent the worst case scenario when the works are occurring during the southern portion of the site. Construction noise levels are not expected to exceed the noise management levels outside of standard hours at any receiver.

Table 21 Number of residential properties where construction noise levels exceed the NMLs

Activities	Exceedance above NML, dB			
	1-10 dB(A) Clearly audible	11-20 dB(A) Moderately intrusive	> 20 dB(A) Highly intrusive	Highly affected >75 dB(A)
Site establishment and delivery of materials	78	30	13	0
Bulk earthworks	61	21	1	0
Trenches/utilities	40	23	0	0
Pavement/ hardstand construction	81	31	13	0
Building delivery and installation	6	0	0	0

The largest numbers of exceedances occur during the site establishment and pavement/hardstand construction activities which are located in the southern portion of the site. The largest impacts would be experienced by residences along Camira Street and Kalang Avenue. No residential receivers are predicted to be ‘highly affected’.

5.4.2 Summary of impacts outside of standard hours

Results show construction noise levels outside of standard hours are unlikely to exceed the noise management levels at any noise sensitive receivers.

Table 22 Residential properties where noise levels exceed the NMLs

Activities	Exceedance above NML, dB			
	1-10 dB(A) Clearly audible	11-20 dB(A) Moderately intrusive	> 20 dB(A) Highly intrusive	Highly affected >75 dB(A)
Extended work hours construction works	0	0	0	0

5.5 Sleep disturbance assessment

Construction noise levels outside of standard hours are not expected to exceed the sleep disturbance screening criteria at any nearby residential receivers. L_{A1} sleep disturbance contours for construction noise are presented in Appendix C.

5.6 Construction traffic assessment

The numbers of construction vehicle movements have been estimated to be up to 80 light and 140 heavy vehicles per day (up to 12 per hour) during peak construction periods. Vehicles would access the site by Christie Street, Forrester Road, Glossop Street, Great Western Highway and Mamre Road.

The existing traffic flow on all the roads listed above is substantially greater than the proposed construction traffic numbers. Therefore, the additional traffic would have a minor impact on existing road traffic noise in the area (traffic noise levels during construction are expected to increase by less than 2 dB).

To minimise the construction noise levels and reduce the risk of impacts occurring, construction traffic should be considered as part of the Noise and Vibration Management Plan.

5.7 Construction vibration assessment

Vibration intensive works may include the use of the following items of equipment:

- Vibrating rollers

The minimum working distances of these items of equipment from off-site receivers are shown in Table 23 which is based on recommendations of the TfNSW *Construction Noise and Vibration Strategy* (CNVS). If these minimum working distances are complied with no adverse impacts from vibration intensive works are likely in terms of human response or cosmetic damage.

St Marys Railway Station Group is listed under the Penrith LEP 2010 as an item of heritage significance. The Station Group includes the station building, goods shed, signal box, crane and footbridge substructure. Given the Main Western railway's current usage is as an operational railway line the Railway Station Group is assumed to not be particularly sensitive to vibration. The minimum working distances for residential/commercial receivers shown in Table 23 are recommended for this structure.

Based on the indicative construction activities assessed for the Proposal, it is not considered likely that works would occur within the minimum working distances. If, however, vibration intensive works are required within these minimum working distances, mitigation measures to control excessive vibration would be implemented as outlined in Section 5.8.

Table 23 Minimum working distances of vibration intensive equipment to be used during the Proposal

Plant	Rating/ description	Cosmetic damage		Human response
		Heritage	Residential/ commercial	
Vibratory roller	< 50 kN (typically 1-2t)	8 m	5 m	15 m
	< 100 kN (typically 2-4t)	10 m	6 m	20 m
	< 200 kN (typically 4-6t)	20 m	12 m	40 m
	< 300 kN (typically 7-13t)	25 m	15 m	100 m
	> 300 kN (typically 13-18t)	30 m	20 m	100
	> 300 kN (> 18 t)	38 m	25 m	100 m

5.8 Construction mitigation measures

5.8.1 Construction Noise and Vibration Management Plan

An Environmental Management Plan (EMP) should be developed for the Proposal and implemented prior to commencement of construction activities. The EMP would include a Construction Noise and Vibration Management Plan (CNVMP) which should include all reasonable and feasible safeguards to manage the noise emissions from the site and any complaints which may occur due to construction noise. The CNVMP should include, the following:

- identification of nearby residences and other sensitive land uses
- description of approved hours of work
- description and identification of all construction activities, including work areas, equipment and duration
- description of what work practices (generic and specific) would be applied to minimise noise and vibration
- a complaints handling process
- noise and vibration monitoring procedures, including for heritage structures
- overview of community consultation required for identified high impact works.

Construction works should be planned and carried out during standard construction hours wherever possible. Table 24 presents the standard mitigation measures contained within the *Construction Noise and Vibration Strategy* which should be considered as mitigation measures as part of the CNVMP.

Table 24 Transport for *NSW Construction Noise and Vibration Strategy* standard mitigation measures

Action required	Safeguard details
Management measures	
Implement any project specific mitigation measures required	In addition to the measures set out in this table, any project specific mitigation measures identified in this report.
Implement stakeholder consultation measures	Periodic notification (monthly letterbox drop and website notification) detailing all upcoming construction activities will be delivered to sensitive receivers at least 7 days prior to commencement of relevant works.
Site inductions	All employees, contractors and subcontractors will receive an environmental induction.
Behavioural practices	No swearing or unnecessary shouting or loud stereos/radios on site. No dropping of materials from height, throwing of metal items and slamming of doors.
Noise Monitoring	A noise monitoring program will be implemented to assist in confirming and controlling the site specific potential for disturbance at particularly sensitive localities at the commencement of activities and periodically during the construction program as the works progress. The program will be developed in accordance with the CNVMP and any approval/licence conditions. The results will be reviewed to determine if additional mitigation measures are required. All measurements will be undertaken in accordance with Australian Standard *1055.1-1997 – Acoustics – Description and measurement of environmental noise, Part 1: General procedures.*

Action required	Safeguard details
Source controls	
Construction hours and scheduling	Where feasible and reasonable, construction will be carried out during the standard daytime working hours. Any out-of-hours works would comply with the noise management levels. Work generating high noise and/or vibration levels will be scheduled during less sensitive time periods as far as practicable. This will include the use of concrete saws, grinders, rock breakers, jackhammers and piling rigs. The St Marys Senior High School will be consulted in relation to noise mitigation measures to identify any noise sensitive periods, e.g. exam periods. As much as reasonably possible noise intensive construction works in the vicinity of affected school buildings will be minimised.
Construction respite period	Noise with special audible characteristics and vibration generating activities (including jack and rock hammering, sheet and pile driving, rock breaking and vibratory rolling) will only be carried out in continuous blocks, not exceeding 3 hours each, with a minimum respite period of one hour between each block. 'Continuous' includes any period during which there is less than a 1 hour respite between ceasing and recommencing any of the work. No more than two consecutive nights of noise with special audible characteristics and/or vibration generating work will be undertaken in the same NCA over any 7-day period, unless otherwise approved by the relevant authority.
Equipment selection	Quieter and less vibration emitting construction methods will be used where feasible and reasonable (e.g. rubber wheeled instead of steel tracked plant). Equipment will be regularly inspected and maintained to ensure it is in good working order.
Maximum noise levels	The noise levels of plant and equipment will have operating sound power or sound pressure levels that would meet the predicted noise levels.
Rental plant and equipment	Noise emissions will be considered as part of the selection process.
Use and siting of plant	Avoid simultaneous operation of noisy plant within discernible range of a sensitive receiver. The offset distance between noisy plant and adjacent sensitive receivers will be maximised. Plant used intermittently to be throttled down or shut down. Plant and vehicles will be turned off when not in use. Noise-emitting plant will be directed away from sensitive receivers where reasonable and feasible.
Plan works site and activities to minimise noise and vibration	Plan traffic flow, parking and loading/unloading areas to minimise reversing movements within the site. Truck drivers will be advised of designated vehicle routes, parking locations, acceptable delivery hours or other relevant practices (i.e. minimising the use of engine brakes, and no extended periods of engine idling).
Non-tonal reversing alarms	Non-tonal reversing beepers (or an equivalent mechanism) will be fitted and used on all construction vehicles and mobile plant regularly used on site and for extended work hours construction work.

Action required	Safeguard details
Minimise disturbance arising from delivery of goods to construction sites	Loading and unloading of materials/deliveries will occur as far as possible from sensitive receivers. Site access points and roads will be selected as far as possible away from sensitive receivers. Dedicated loading/unloading areas will be shielded if close to sensitive receivers. Delivery vehicles will be fitted with straps rather than chains for unloading, wherever possible.
Silencers on Mobile Plant	Where possible noise from mobile plant will be reduced through additional fittings including: • Residential grade mufflers • Air Parking brake engagement is silenced.
Construction Related Traffic	Schedule and route vehicle movements away from sensitive receivers and during less sensitive times. Limit the speed of vehicles and avoid the use of engine compression brakes. Maximise on-site storage capacity to reduce the need for truck movements during sensitive times.
Vibration safe working distances	If vibration intensive equipment is to be used within the safe working distances for cosmetic damage, as presented in Table 23, then it is recommended that attended vibration measurements are undertaken when work commences, to determine “site specific safe working distances”. The safe working distances for cosmetic damage from Table 23 are generally considered to be conservative and working within them would not necessarily result in damage however as factors such as work practices and intervening structures can affect vibration levels. In addition, vibration intensive work should not proceed within the site specific safe working distances unless a permanent vibration monitoring system is installed approximately one metre from the building footprint, to warn operators (e.g. via flashing light, audible alarm, SMS) when vibration levels are approaching the peak particle velocity objective. It is also advisable to carry out building condition surveys of sensitive historical structures before construction works begins.
Path controls	
Shield stationary noise sources such as pumps, compressors, fans etc.	Stationary noise sources will be enclosed or shielded to the greatest extent possible whilst ensuring that the occupational health and safety of workers is maintained.
Shield sensitive receivers from noisy activities	Structures to shield residential receivers from noise such as site shed placement; earth bunds; fencing; erection of operational stage noise barriers (where practicable) will be used.

5.8.2 Community consultation and complaints handling

All residents and sensitive receivers impacted by noise from the Proposal which are expected to exceed the NML should be consulted prior to the commencement of the particular activity, with the highest consideration given to those that are predicted to be most affected as a result of the works.

The information provided to the residents would include:

- programmed times and locations of construction work
- the hours of proposed works
- construction noise and vibration impact predictions
- construction noise and vibration mitigation measures being implemented on site.

Community consultation regarding construction noise and vibration would be detailed in a Community Liaison Plan for the construction of the Proposal and would include a 24 hour hotline and complaints management process.

St Marys Senior High School should be consulted prior to construction starting. High noise construction activities in the south of the site should be avoided during sensitive times such as exam periods.

6.0 Operational noise

6.1 Noise modelling

6.1.1 Topography

The operational noise model has been based upon the following topographical information:

- Civil design within the site boundaries (contours provided at 0.2 m intervals)
- Topographical information beyond the boundaries of the site (contours provided at 1.0 m intervals).

The surface of the hardstand areas has been modelled using the 'ground absorption' function in SoundPLAN to replicate an acoustically 'hard' surface (i.e. reflective), with an absorption coefficient of 0.1. Areas other than the hardstand area have been modelled with a ground absorption of 0.75.

6.1.2 Buildings

Buildings have been incorporated into the model as follows:

- Existing buildings beyond the site boundaries including industrial, commercial and residential buildings (obtained from digital survey information and/or digitisation of aerial photography)
- Proposed buildings within the site boundary (wash bay, repair bay, transport workshop and administrative offices).

6.1.3 Barriers

- A noise barrier along the southern edge of the heavy vehicle entrance (Forrester Road) has been included in the model. The top of this barrier is 2.4 m above the height of the entrance road. The location of the noise barrier is shown in Figure 3.

Figure 3 Noise Barrier (blue)

6.1.4 Meteorological conditions

AECOM has undertaken modelling of industrial noise emission from the site under the following meteorological conditions:

- Neutral weather conditions – 0.5 m/s winds and D class stability
- Southerly winds – 3 m/s winds and D class stability (evening only)
- Westerly and south-westerly winds – 3 m/s winds and D class stability (night and evening only)

- Temperature inversion – 2 m/s winds and F class stability (night only).

Wind roses for 2017 for the Horsley Park weather station are provided in Appendix D.

6.2 Noise sources

At the St Marys Freight Hub containers will be loaded onto and unloaded from trains and heavy vehicles. These containers will be transferred to designated container storage areas by mobile container handling equipment (reach stackers and forklifts). Typically, full containers will arrive by train where they will be stored and distributed from the freight hub by heavy vehicles. Empty containers will be transported back to the freight hub where they will be stored and then reloaded onto a train to be transported back to Port Botany.

6.2.1 Industrial noise sources

It is understood that the most likely type of container moving equipment that would be used at the site is a reach stacker. Octave band sound power levels for this equipment are presented in Table 25. The location of the noise sources are presented in Appendix E.

The following industrial noise sources were included in the model:

- Three reach stackers with soft landing technology enabled.
- One empty container handler (forklift)
- Metal 'clangs' (20 per hour) around the site (ten empty container bangs and ten full container bangs)
- Container repair workshop activities
- Commercial power washer in the wash bay (one off)
- Idling trucks (eight off)
- Truck air brake release around the site (eight off)
- One idling train (three locomotives)
- One moving train (three moving locomotives) in each. (This is on the basis that there could be a pair of idling locomotives and a pair of moving trains on site during a busy 15 minute daytime period and also during a busy night-time 15 minute period)

Idling trucks have been modelled as a point source with the octave band and overall sound power levels as presented in Table 25.

Moving light vehicles and trucks have been modelled as line sources, with the sound power expressed as power per metre. This has been derived from the sound power of a moving vehicle and adjusted to account for:

- The number of trucks traversing the line source path in the assessment period (15 truck trips per hour during the daytime, 7 truck trips per hour during the evening, 8 truck trips per hour during the night-time)
- The number of light vehicles traversing the line source path in the assessment period (4 light vehicle trips per hour during the daytime, evening and night-time)
- The length of the line source
- Trucks are transporting 1-2 containers at low speed (up to 20 km/h).

A 5 dB(A) correction has been added to L_{Aeq} assessment in the noise model to account for the impulsive characteristics of these events.

6.2.2 Metal 'clang' L_{A1} sound power levels

The potential for high-level, short-duration noise events to cause sleep disturbance was assessed. The predominant source of such events was the 'clangs' which can occur when containers are picked up and put down by lifting equipment (reach stackers with soft-landing technology enabled). Other

high-level, short-duration noise events include truck air brake releases and closing of car doors. The L_{A1} sound power of such events are shown in Table 25.

6.2.3 Rail noise sources

The following rail traffic noise sources have been incorporated into the model (non-network rail line):

- Moving train (three locomotives), with the power based upon attended noise measurements previously undertaken (according to Australian Standard AS 2377:2002 – *Acoustics – Methods for the measurement or rail bound vehicle noise*) by AECOM of a heavily laden (gross weight 1040 tonnes) Class 81 locomotive accelerating on Notch 3
- Moving wagons, with the power based upon the Transport for NSW Rail Noise Database
- Idling trains (three locomotives); with the power based upon attended noise measurements previously undertaken (according to Australian Standard AS 2377:2002 – *Acoustics – Methods for the measurement or rail bound vehicle noise*) by AECOM of a heavily laden (gross weight 1040 tonnes).

The sound power levels for these sources are presented in Table 25. The sound power level presented in Table 25 for the moving train is the base power of one locomotive. The moving train has been modelled as a line source with three locos pulling away to the south, taking 468 seconds of a 900 second (15 minute) period to travel 1.3 kilometres within the site (i.e. travelling at 10 km/h). A correction of 6 dB has been added to the model to account for rail discontinuities, where the rail line becomes the non-network rail line.

Pacific National currently hold five train paths per day for the site. Three of the five trains are expected to be programmed at night.

6.2.4 Noise model sound power levels

Table 25 presents the sound power levels which were used in the operational noise model.

Table 25 Summary of sound power levels

Source	Sound power level (SWL, dB) at octave band centre frequency, Hz								Overall SWL dB(A)
	63	125	250	500	1000	2000	4000	8000	
Reach stacker	118	110	104	101	102	97	91	82	106
Empty container handlers	120	112	106	103	105	99	93	84	108
Metal 'clang'[1,2]	83	83	74	74	72	65	59	52	76
Metal 'bang' L_{A1}[2]	115	115	106	106	104	97	91	84	108
Commercial power washer	86	87	87	88	87	87	86	85	94
Idling truck	94	98	92	91	92	91	86	82	97
Moving truck	95	100	103	98	96	93	87	81	101
Truck Air Release L_{A1}	108	105	107	105	101	101	102	96	107
Moving light vehicle	83	68	72	80	88	81	79	76	90
Car door bang L_{A1}	72	81	88	87	93	97	94	85	100
Moving loco	96	96	96	97	96	98	97	97	104
Moving wagons	104	96	89	87	87	87	83	75	93
Idling loco	101	101	101	94	90	89	93	96	100
Wagon bunching L_{A1}[3]	-	-	-	-	-	-	-	-	112
Curve/brake squeal L_{A1}[3]	-	-	-	-	-	-	-	-	113

Notes:

1. *The power of the metal 'clang' is assumed to be normalised to 15 minutes.*
2. *Assumes reach stackers have "soft touch" technology enabled'*
3. *Reference: RHA Report 10-1142-R1 RAC Line-based Noise PRP Study – Noise Source Working Paper, Sep 2000*

6.3 Site operational noise

6.3.1 Results

Based on the assumptions and modelling parameters as set out in the previous sections, the typical operational noise levels were predicted at the receivers most likely to be affected. The operational noise levels were predicted under neutral and adverse meteorological conditions. The results of the modelling are presented in Table 26 to Table 29. The results are presented for four representative receivers, one in each NCA. These are expected to be the worst affected receivers in each NCA:

- 121 Forrester Road, North St Marys (NCA 1)
- 49 Kalang Avenue, St Marys (NCA 2)
- 42-44 Princess Street, Werrington (NCA 3)
- 1 Lockyer Avenue, Werrington County (NCA 4).

Noise contour plots for normal operational scenarios are presented in Appendix F for night-time neutral and adverse weather conditions (wind 3 m/s source to receiver and an F class inversion).

Table 26 Predicted operational noise levels – 121 Forrester Road, North St Marys (NCA 1)

Weather conditions	Distance from Proposal (m)	Sound pressure level, L_{Aeq} dB(A)		
		Result	Criterion	Exceedance
Day neutral conditions	450	36	48	-
Evening neutral conditions		34	43	-
Evening south-westerly wind		37	43	-
Night neutral conditions		34	39	-
Night south-westerly wind		37	39	-
Night westerly wind		37	39	-
Night temperature inversion – SW wind		37	39	-
Night temperature inversion – W wind		37	39	-

Table 27 Predicted operational noise levels – 49 Kalang Avenue, St Marys (NCA 2)

Weather conditions	Distance from Proposal (m)	Sound pressure level, L_{Aeq} dB(A)		
		Result	Criterion	Exceedance
Day neutral conditions	50	48	44	4
Evening neutral conditions		45	44	1
Evening south-westerly wind		43	44	-
Night neutral conditions		45	42	3
Night south-westerly wind		44	42	2
Night westerly wind		45	42	3
Night temperature inversion – SW wind		45	42	3
Night temperature inversion – W wind		46	42	4

Table 28 Predicted operational noise levels – 42-44 Princess Street, Werrington (NCA 3)

Weather conditions	Distance from Proposal (m)	Sound pressure level, L_{Aeq} dB(A)		
		Result	Criterion	Exceedance
Day neutral conditions	600	38	52	-
Evening neutral conditions		36	43	-
Evening south-westerly wind		28	43	-
Night neutral conditions		35	38	-
Night south-westerly wind		28	38	-
Night westerly wind		26	38	-
Night temperature inversion – SW wind		34	38	
Night temperature inversion – W wind		32	38	-

Table 29 Predicted operational noise levels – 1 Lockyer Avenue, Werrington County (NCA 4)

Weather conditions	Distance from Proposal (m)	Sound pressure level, L_{Aeq} dB(A)		
		Result	Criterion	Exceedance
Day neutral conditions	1,300	29	53	-
Evening neutral conditions		29	43	-
Evening south-westerly wind		23	43	-
Night neutral conditions		23	38	-
Night south-westerly wind		20	38	-
Night westerly wind		20	38	-
Night temperature inversion – SW wind		24	38	-
Night temperature inversion – W wind		20	38	-

6.3.2 Sleep disturbance results

The sleep disturbance noise levels associated with the typical operation of the Proposal were predicted at nearby receivers under calm meteorological conditions and worst case weather conditions. The results are presented in Table 30 to Table 33.

Table 30 Predicted night-time L_{Amax} operational noise levels and sleep disturbance criteria – 121 Forrester Road, North St Marys (NCA 1)

Weather conditions	Distance from Proposal (m)	Sound pressure level, L_{Amax} dB(A)		
		Result	Criterion	Exceedance
Night neutral conditions	450	42	52	-
Night south-westerly wind		43	52	-
Night westerly wind		43	52	-
Night temperature inversion – SW wind		43	52	-
Night temperature inversion – W wind		43	52	-

Table 31 Predicted night-time L_{Amax} operational noise levels and sleep disturbance criteria – 49 Kalang Avenue, St Marys (NCA 2)

Weather conditions	Distance from Proposal (m)	Sound pressure level, L_{Amax} dB(A)		
		Result	Criterion	Exceedance
Night neutral conditions	50	53	52	1
Night south-westerly wind		53	52	1
Night westerly wind		54	52	2
Night temperature inversion – SW wind		54	52	2
Night temperature inversion – W wind		54	52	2

Table 32 Predicted night-time L_{Amax} operational noise levels and sleep disturbance criteria – 42-44 Princess Street, Werrington (NCA 3)

Weather conditions	Distance from Proposal (m)	Sound pressure level, L_{Ama} dB(A)		
		Result	Criterion	Exceedance
Night neutral conditions	600	38	52	-
Night south-westerly wind		34	52	-
Night westerly wind		33	52	-
Night temperature inversion – SW wind		37	52	-
Night temperature inversion – W wind		36	52	-

Table 33 Predicted night-time L_{Amax} operational noise levels and sleep disturbance criteria – 1 Lockyer Avenue, Werrington County (NCA 4)

Weather conditions	Distance from Proposal (m)	Sound pressure level, v dB(A)		
		Result	Criterion	Exceedance
Night neutral conditions	1,300	22	52	-
Night south-westerly wind		22	52	-
Night westerly wind		20	52	-
Night temperature inversion – SW wind		27	52	-
Night temperature inversion – W wind		23	52	-

6.3.3 L_{Aeq} noise level discussion

Operational noise from the Proposal is not expected to exceed the project noise trigger levels at nearby sensitive receivers, with the exception of the residential receivers within NCA 2. The worst affected residential receivers within NCA 2 are expected to experience exceedances of up to 4 dB(A) during the daytime and up to 3 dB(A) during the night-time under neutral weather conditions. The worst affected residential receivers within NCA 2 are expected to experience exceedances of up to 4 dB(A) during the night-time under temperature inversion conditions.

A noise barrier is recommended to the south of the heavy vehicle entrance on Forrester Road (see Figure 3). The top of the barrier should be 2.4 m above the height of the road surface and may be constructed out of materials such as concrete, aerated concrete panels or sheet steel. This barrier will have the benefit of reducing industrial noise from the neighbouring industrial site (Australian Reinforcing Company).

It should also be noted that the fleet of heavy vehicles to be used will consist of modem Mack Granite Jan 2019 (Euro 5) and QUONOS 2019 (Euro 6) trucks only.

Due to the need to unload trains at night as a result of the limited paths available to Pacific National during the daytime, significant modification to the night- time operations of the Proposal are not feasible. Treatment of the worst affected properties is therefore recommended in line with the *Noise Policy for Industry*. Seventeen properties on Kalang Avenue, Camira Street and Carinya Avenue are predicted to experience a marginal impact (≥ 3 but ≤ 5 dB above the project trigger levels) during the daytime and night-time periods and would therefore qualify for treatment. These properties are:

- 37 Kalang Avenue, St Marys
- 39 Kalang Avenue, St Marys
- 41 Kalang Avenue, St Marys
- 43 Kalang Avenue, St Marys
- 47 Kalang Avenue, St Marys
- 49 Kalang Avenue, St Marys
- 1 Camira Street, St Marys
- 3 Camira Street, St Marys
- 5 Camira Street, St Marys
- 7 Camira Street, St Marys
- 9 Camira Street, St Marys
- 11 Camira Street, St Marys
- 13 Camira Street, St Marys
- 15 Camira Street, St Marys
- 73 Carinya Avenue, St Marys
- 75 Carinya Avenue, St Marys
- 78 Carinya Avenue, St Marys

Treatment would comprise the provision of mechanical ventilation and/or air conditioning. This would allow windows to be closed without compromising internal air quality/amenity. As the exceedance of the trigger levels is both at night and during the daytime, the treatment would apply to bedrooms and living rooms.

In addition, operational noise monitoring should be completed within 12 months of opening to verify the noise impacts at nearby sensitive receivers.

6.3.4 Sleep disturbance discussion

As discussed in section 2.5, the enabling of soft-landing technology on the reach stackers reduces L_{A1} noise levels by around 8 dB(A). Therefore, no or negligible exceedances of the sleep disturbance criteria are predicted at receivers within NCA 1, NCA 3 and NCA 4. A marginal exceedance of 2 dB is predicted for the worst affected residential receivers within NCA 2.

The exceedance of the sleep disturbance criteria is primarily due to bangs as containers are stacked. It is expected that there may be 10-20 bangs per hour due to the Proposal during the night, however only the container stacks closest to NCA 2 are expected to cause exceedances the criteria. As the

containers will be distributed across the site it is expected that 90% of all container bangs would comply with the criteria.

Given that L_{max} events are to some extent controlled by reach stacker and container handler operators the following control measures should be considered:

- Include in employment contracts and subcontractor agreements clauses that require minimisation of noise and compliance with directions from management to minimise noise
- Regularly inform reach stacker and container handler drivers of the importance of noise minimisation on site and train them to use equipment in ways to minimise noise

6.4 Operational traffic

Once operational the Proposal would generate up to 218 heavy vehicles and 60 light vehicles in and out per day (up to 30 truck movements per hour during daytime hours and 4 truck movements per hour during the night). Vehicles would access the site by Christie Street, Forrester Road, Glossop Street, Great Western Highway and Mamre Road.

The existing traffic volumes are shown below in Table 34. The peak hour volumes have been taken from the "St Marys Freight Hub, Traffic and Transport Assessment Post Exhibition Version" (6th September 2019). The Annual average daily traffic count, minimum hour traffic count and heavy vehicle percentage have been estimated.

Table 35 shows the additional truck movements proposed to be generated by the freight hub and the predicted traffic noise levels due to these additional movements. It can be seen that existing traffic volumes are substantially greater than the proposed operational traffic numbers. Therefore, the vehicles would have a minor impact on existing road traffic noise in the area (traffic noise levels during construction are expected to increase by up to 1 dB(A)). Generally an increase of 50-60% in traffic volumes is required to increase traffic noise levels by 2 dB(A). The traffic generated by the Proposal is therefore considered to comply with the *Road Noise Policy* criteria.

Table 34 Existing traffic volumes on residential roads

Road	Type	Residential receivers	Traffic Volumes	Estimated Traffic Volumes		
			Peak Hour	AADT	Minimum Hour	Heavy Vehicle %
Forrester Road	Sub-arterial Road	Yes	2,100	>15,000	> 80	10%
Glossop Street	Sub-arterial Road	Yes	2,100	>15,000	> 80	10%
Great Western Highway	Arterial Road	Yes	4,000	>30,000	> 150	10%
Mamre Road	Arterial Road	Yes	3,900	>30,000	> 150	10%

Table 35 Predicted traffic noise increase due to additional truck movements

Road	Type	Residential receivers	Peak Hour		Minimum Hour	
			Truck Trips Freight Hub	Increase in traffic noise level, LAeq 15hr dB	Truck Trips Freight Hub	Increase in traffic noise level, LAeq 1hr dB
Forrester Road	Sub-arterial Road	Yes	30	< 1	4	1
Glossop Street	Sub-arterial Road	Yes	30	< 1	4	1
Great Western Highway	Arterial Road	Yes	4	< 1	1	< 1
Mamre Road	Arterial Road	Yes	22	< 1	3	< 1

6.5 Operational rail

6.5.1 Results

Pacific National currently hold five train paths per day for the site (three are scheduled for the night time period). As the night-time is the most affected period and NCA 2 is the most affected catchment, they have been assessed below. An $L_{Aeq\ 9hr}$ assessment has been undertaken for rail movements into and out of the site and an L_{Amax} assessment has been undertaken for curve squeal and bunching (it has been assumed that brake squeal noise levels will be no louder than bunching or curve squeal).

Table 36 Predicted operational noise levels – 49 Kalang Avenue, St Marys (NCA 2)

Weather conditions	Distance from Proposal (m)	Sound pressure level, $L_{Aeq\ 9hr}$ dB(A)		
		Result	Criterion	Exceedance
Night neutral conditions	50	39	40	-
Night south-westerly wind		39	40	-
Night westerly wind		40	40	-
Night temperature inversion – SW wind		39	40	-
Night temperature inversion – W wind		40	40	-

Table 37 Predicted night-time L_{Amax} operational noise levels and sleep disturbance criteria for curve squeal – 49 Kalang Avenue, St Marys (NCA 2)

Weather conditions	Distance from Proposal (m)	Sound pressure level, L_{Amax} dB(A)		
		Result	Criterion	Exceedance
Night neutral conditions	50	59	52	7
Night south-westerly wind		59	52	7
Night westerly wind		60	52	8
Night temperature inversion – SW wind		59	52	7
Night temperature inversion – W wind		60	52	8

Table 38 Predicted night-time L_{Amax} operational noise levels and sleep disturbance criteria for bunching – 49 Kalang Avenue, St Marys (NCA 2)

Weather conditions	Distance from Proposal (m)	Sound pressure level, L_{Amax} dB(A)		
		Result	Criterion	Exceedance
Night neutral conditions	50	55	52	3
Night south-westerly wind		55	52	3
Night westerly wind		56	52	4
Night temperature inversion – SW wind		55	52	3
Night temperature inversion – W wind		56	52	4

6.5.2 Discussion

Table 36 indicates that the train movements into and out of the site are expected to comply with the *Rail Infrastructure Noise Guideline* criteria.

Sleep disturbance exceedances due to rail movements are predicted at NCA 2. Curve squeal is predicted to cause exceedances of up to 8 dB(A) and bunching is expected to cause marginal exceedances of up to 4 dB(A). However it is noted that this type of noise is already a feature of this area due to rail movements on the main western railway line.

The following measures should be considered to mitigate the maximum noise levels generated by the rail movements:

- Use of track lubrication and wagon steering to minimise curve squeal
- Use of electronically controlled pneumatic braking systems to minimise brake squeal
- Permanent noise monitoring systems with associated reporting and provision of digital data records to the Secretary
- Policies and procedures that demonstrate acceptance, monitoring and reporting on locomotive and rolling stock's performance communicated to operators using the St Marys Freight Hub

It should also be noted that:

- NCA 2 already experiences L_{Amax} noise levels in excess of 70 dB(A) during the night due to existing industrial noise and train pass-bys. The type of noise likely to be generated by operation of the Proposal will be of the same nature and generally a lower level
- The predicted exceedances due to the Proposal are worst case, noise levels would generally be lower for most of the night.

In addition, the *Road Noise Policy* contains a review of research into sleep disturbance which represents NSW EPA advice on the subject of sleep disturbance due to noise events. It concludes that having considered the results of research to date that, *'Maximum internal noise levels below 50 to 55 dB(A) are unlikely to cause awakening reactions'*. Therefore, given that an open window provides around 10 dB in noise attenuation from outside to inside, external noise levels of 60 to 65 dB(A) are unlikely to result in awakening reactions. Noise levels above 65 dB(A) may cause awakening. L_{Amax} noise levels due to the Proposal are not predicted to exceed the awakening reaction level of 65 dB(A) at any noise sensitive receiver.

6.6 Human health considerations

With regard to the impact of noise from the Proposal on human health, the document "The health effects of environmental noise" (Publication 12214 (2018) Commonwealth of Australia as represented by the Department of Health) provides guidance on the relationship between environmental noise and both sleep disturbance and cardiovascular disease. It recommends an L_{Aeq} limit of 60 dB(A) at the facade during the day time and 55 dB(A) during the night-time. The predicted noise levels shown in Section 6.3.1Table 26 and 6.5.1 are well below these levels.

7.0 Conclusions

7.1 Construction noise impacts

A construction and operational Noise and Vibration Impact Assessment has been completed for the proposed St Marys Freight Hub. Nearby noise and vibration sensitive receivers were identified. Attended and unattended noise measurements were completed to characterise the existing noise environment. The measured noise levels were used to establish operational and construction noise management levels.

The construction works are expected to commence in July 2019, take up to 7 months to complete and would be undertaken during standard construction hours generally, with some pavement works proposed to be undertaken outside standard hours. These pavement works would be limited to locations where construction noise levels would comply with the noise management level at nearby noise sensitive receivers. If additional works are required to be completed outside of standard working hours, additional approval would be sought.

Construction work packages have been developed in consultation with Pacific National and the proposed equipment has been detailed within this report. Six distinct work packages were used in a computer-based noise model to determine the potential construction noise levels. Construction noise impacts were assessed at all nearby residential and other noise sensitive receivers.

The predicted construction noise levels exceed the construction noise management levels for all scenarios at the closest noise sensitive receivers during standard hours. Noise exceedances are generally unavoidable given the proposed works and proximity to receivers, notwithstanding the implementation of feasible and reasonable noise mitigation measures. The largest impacts would be experienced by residents along Kalang Avenue and Camira Street. No residents would be 'highly affected'. Construction noise levels from extended work hours construction works would comply with the noise management levels.

An Environmental Management Plan (EMP) should be developed for the Proposal and implemented prior to commencement of construction activities. The EMP would include a Construction Noise and Vibration Management Plan (CNVMP) which would include all reasonable and feasible safeguards to manage the noise emissions from the site and any complaints which may occur due to construction noise. Implementation of mitigation measures described would aim to minimise and manage noise impacts where possible. Mitigation measures have been recommended in line with the *Interim Construction Noise Guideline* and the *Construction Noise and Vibration Strategy* in order to minimise and manage the impact of construction noise on nearby noise sensitive receivers.

7.2 Operational noise impacts

7.2.1 Site operational noise

During the operation of the Proposal, there may be changes to the existing noise levels due to the operation of the new Freight Hub. Noise levels have been assessed in accordance with the *Noise Policy for Industry* and are predicted to comply with the operational noise criteria at most noise sensitive receivers. The use of soft-landing technology to minimise container handling noise has been assumed in the assessment.

Operational noise exceedances of up to 4 dB are predicted at the worst affected receivers (Kalang Avenue) during worst weather conditions. Sleep disturbance noise exceedances of up to 2 dB are predicted at the worst affected receivers (Kalang Avenue). Noise control measures have been recommended to control these noise exceedances. These measures include:

- Offering treatment (comprising mechanical ventilation and/or air conditioning) to 17 receivers that are marginally affected (≥ 3 but ≤ 5 dB above the project trigger levels)
- Including clauses in reach stacker and container handler operator employment contracts that require minimisation of noise and compliance with directions from management to minimise noise
- Regularly informing reach stacker and container handler operators of the importance of noise minimisation on site and training them to use equipment in ways to minimise noise

- Operational noise monitoring should be completed within 12 months of opening.

7.2.2 Operational road traffic noise

Once operational the Proposal would generate up to 218 heavy vehicles and 60 light vehicles in and out per day (up to 30 truck movements per hour during daytime hours and 4 truck movements per hour during the night). Vehicles would access the site by Christie Street, Forrester Road, Glossop Street, Great Western Highway and Mamre Road.

The assessment has shown that the existing traffic volumes are substantially greater than the proposed operational traffic numbers. Therefore, the vehicles would have a minor impact on existing road traffic noise in the area (up to 1 dB(A)). Generally an increase of 50-60% in traffic volumes is required to increase traffic noise levels by 2 dB(A). The traffic generated by the operation of the site would therefore comply with the *Road Noise Policy* criteria.

7.2.3 Operational rail noise

Train movements into and out of the site are expected to comply with the *Rail Infrastructure Noise Guideline* criteria. Sleep disturbance exceedances due to rail movements are predicted at NCA 2. Curve squeal is predicted to cause exceedances of up to 8 dB(A) and bunching is expected to cause marginal exceedances of up to 4 dB(A). L_{Amax} noise levels due to the Proposal are not predicted to exceed the awakening reaction level of 65 dB(A) at any noise sensitive receiver. It is noted that this type of noise is already a feature of this area due to rail movements on the main western railway line.

The following measures should be considered to mitigate the maximum noise levels generated by the rail movements:

- Use of track lubrication and wagon steering to minimise curve squeal
- Use of electronically controlled pneumatic braking systems to minimise brake squeal
- Permanent noise monitoring systems with associated reporting and provision of digital data records to the Secretary
- Policies and procedures that demonstrate acceptance, monitoring and reporting on locomotive and rolling stock's performance communicated to operators using the St Marys Freight Hub

It is also be noted that NCA 2 already experiences L_{Amax} noise levels in excess of 70 dB(A) during the night due to existing industrial noise and train pass-bys. The type of noise likely to be generated by operation of the Proposal will be of the same nature and generally a lower level. The predicted exceedances due to the Proposal are worst case, noise levels would generally be lower for most of the night.

7.2.4 Human health implications

The predicted L_{Aeq} noise levels due to the Proposal are well below the levels recommended in *The health effects of environmental noise* (Publication 12214 (2018) Commonwealth of Australia as represented by the Department of Health) to minimise effects on sleep disturbance and cardiovascular disease.

Appendix A

Acoustic Terminology

Appendix A Acoustic Terminology

The following is a brief description of acoustic terminology used in this report.

Sound power level	The total sound emitted by a source.
Sound pressure level	The amount of sound at a specified point.
Decibel [dB]	The measurement unit of sound.
A Weighted decibels [dB(A)]	The A weighting is a frequency filter applied to measured noise levels to represent how humans hear sounds. The A-weighting filter emphasises frequencies in the speech range (between 1kHz and 4 kHz) which the human ear is most sensitive to, and places less emphasis on low frequencies at which the human ear is not so sensitive. When an overall sound level is A-weighted it is expressed in units of dB(A).
Decibel scale	The decibel scale is logarithmic in order to produce a better representation of the response of the human ear. A 3 dB increase in the sound pressure level corresponds to a doubling in the sound energy. A 10 dB increase in the sound pressure level corresponds to a perceived doubling in volume. Examples of decibel levels of common sounds are as follows:

0dB(A)	Threshold of human hearing
30dB(A)	A quiet country park
40dB(A)	Whisper in a library
50dB(A)	Open office space
70dB(A)	Inside a car on a freeway
80dB(A)	Outboard motor
90dB(A)	Heavy truck pass-by
100dB(A)	Jackhammer/Subway train
110 dB(A)	Rock Concert
115dB(A)	Limit of sound permitted in industry
120dB(A)	747 take off at 250 metres

Frequency [f]	The repetition rate of the cycle measured in Hertz (Hz). The frequency corresponds to the pitch of the sound. A high frequency corresponds to a high pitched sound and a low frequency to a low pitched sound.
Equivalent continuous sound level [L_{eq}]	The constant sound level which, when occurring over the same period of time, would result in the receiver experiencing the same amount of sound energy.
L_{max}	The maximum sound pressure level measured over the measurement period.
L_{min}	The minimum sound pressure level measured over the measurement period.
L_{10}	The sound pressure level exceeded for 10% of the measurement period. For 10% of the measurement period it was louder than the L_{10}.

L_{90}	The sound pressure level exceeded for 90% of the measurement period. For 90% of the measurement period it was louder than the L_{90}.
Ambient noise	The all-encompassing noise at a point composed of sound from all sources near and far.
Background noise	The underlying level of noise present in the ambient noise when extraneous noise (such as transient traffic and dogs barking) is removed. The L_{90} sound pressure level is used to quantify background noise.
Traffic noise	The total noise resulting from road traffic. The L_{eq} sound pressure level is used to quantify traffic noise.
Day	The period from 0700 to 1800 h Monday to Saturday and 0800 to 1800 h Sundays and Public Holidays.
Evening	The period from 1800 to 2200 h Monday to Sunday and Public Holidays.
Night	The period from 2200 to 0700 h Monday to Saturday and 2200 to 0800 h Sundays and Public Holidays.
Noise catchment area [NCA]	The noise environment at each of the sensitive receivers within a noise catchment area is considered to be similar to the unattended monitoring location within that NCA.
Assessment background level [ABL]	The overall background level for each day, evening and night period for **each day** of the noise monitoring.
Rating background level [RBL]	The overall background level for each day, evening and night period for the **entire length** of noise monitoring.

*Definitions of a number of terms have been adapted from Australian Standard AS1633:1985 *"Acoustics – Glossary of terms and related symbols"*, the EPA's *Noise Policy for Industry* and the EPA's *Road Noise Policy*.

Appendix B

Noise Logging

Noise Logger Report

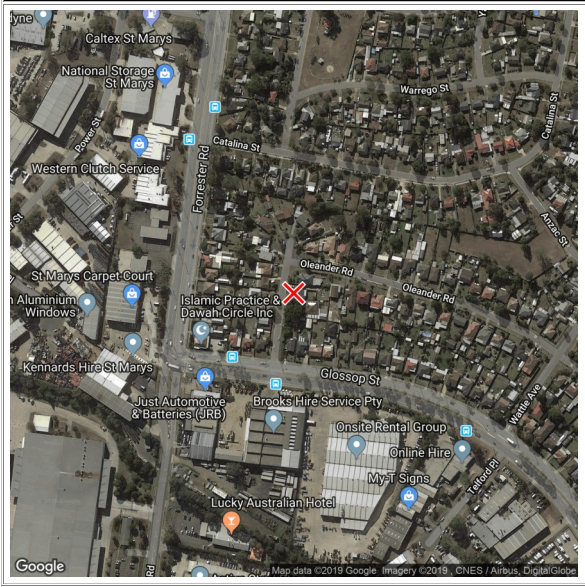
13 Elm Street, North Saint Marys

Item	Information
Logger Type	Rion NL52
Serial number	876010
Address	13 Elm Street, North Saint Marys
Location	Front Yard
Facade / Free Field	Free Field
Environment	Noise environment dominated by constant road traffic noise from west and south. Cicadas and birds audible. Truck engine brakes and accelerating also audible.

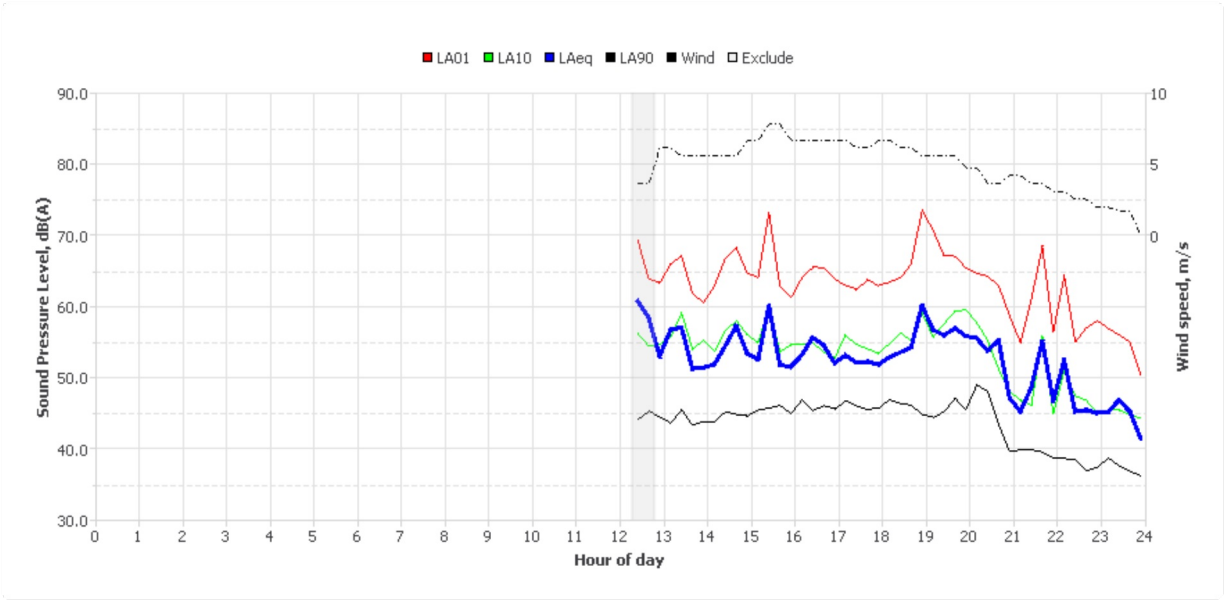
Measured noise levels

Logging Date	L_{Aeq} Day	Eve	Night	ABL Day	Eve	Night	$L_{Aeq,15hr}$	$L_{Aeq,9hr}$
Thu Dec 6 2018	55	55	47	-	40	-	55	47
Fri Dec 7 2018	54	51	51	44	-	35	54	51
Sat Dec 8 2018	51	52	48	-	39	33	52	48
Sun Dec 9 2018	52	51	46	38	38	34	51	46
Mon Dec 10 2018	54	50	50	43	-	35	54	50
Tue Dec 11 2018	53	50	48	43	36	35	53	48
Wed Dec 12 2018	54	50	48	44	38	32	53	48
Thu Dec 13 2018	53	53	46	44	-	-	53	46
Fri Dec 14 2018	55	53	49	-	-	33	54	49
Sat Dec 15 2018	53	52	47	-	-	32	53	47
Sun Dec 16 2018	53	52	47	-	-	35	52	47
Mon Dec 17 2018	53	53	49	42	40	36	53	49
Tue Dec 18 2018	53	-	48	-	-	-	53	48
Summary	**53**	**52**	**48**	**43**	**38**	**34**	**53**	**48**

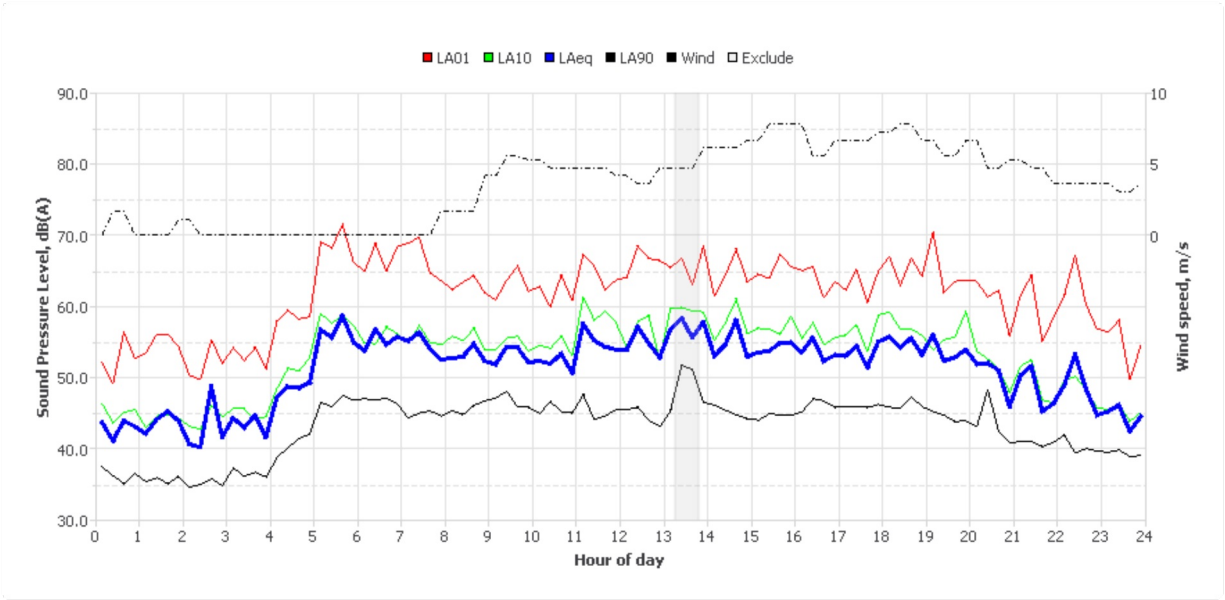
Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

Logger Location	Logger Deployment Photo
	

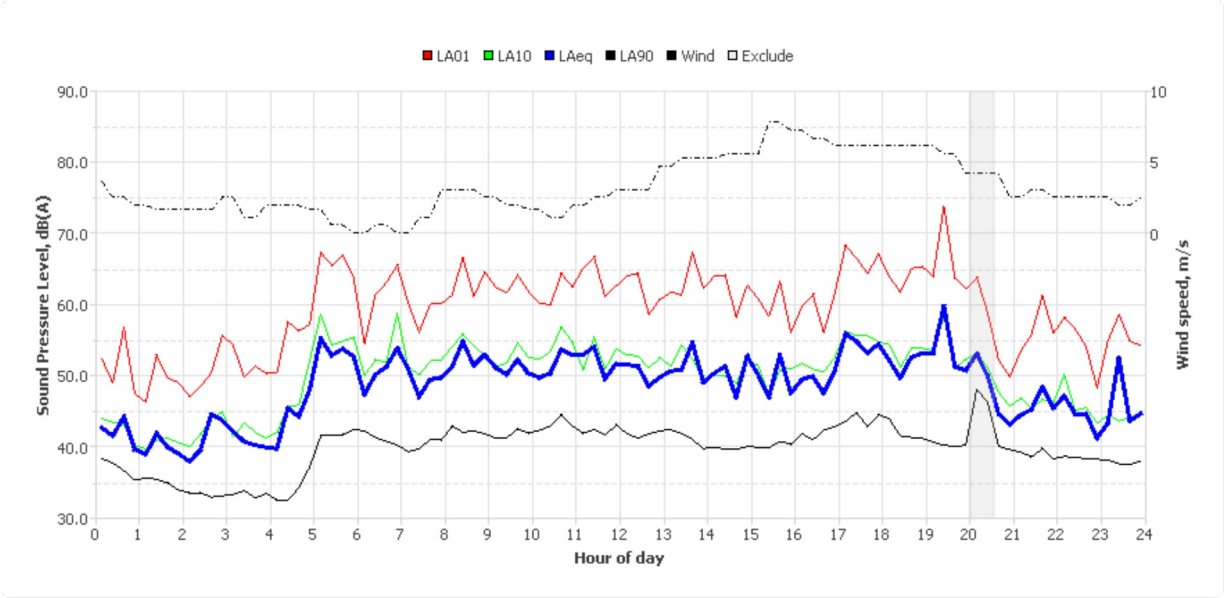
Thursday, 06 Dec 2018



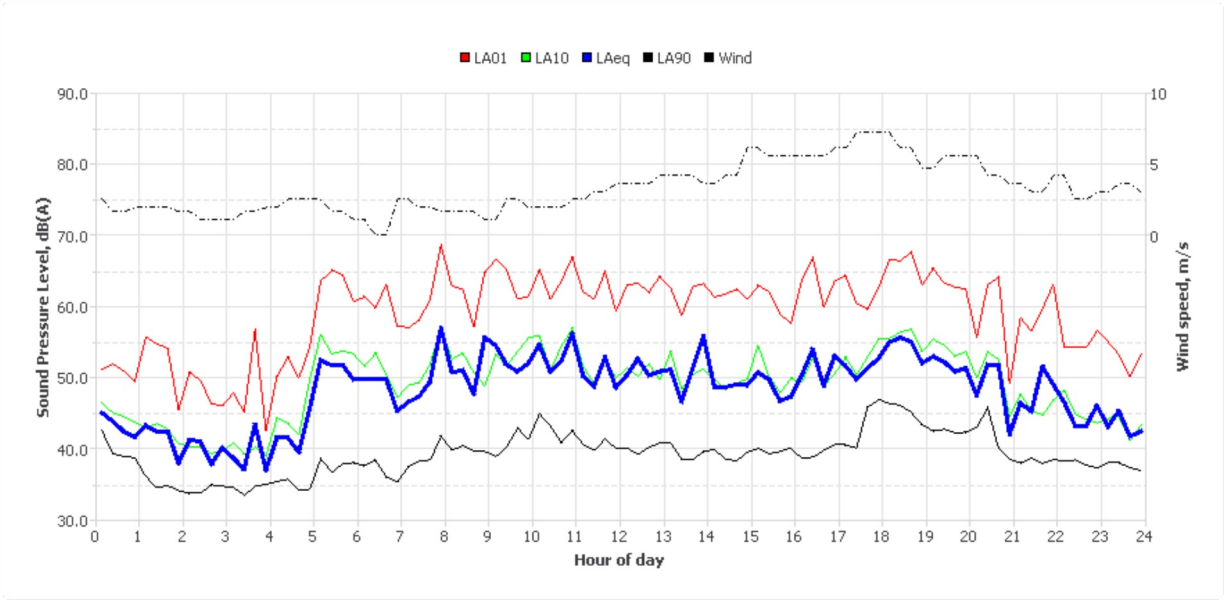
Friday, 07 Dec 2018



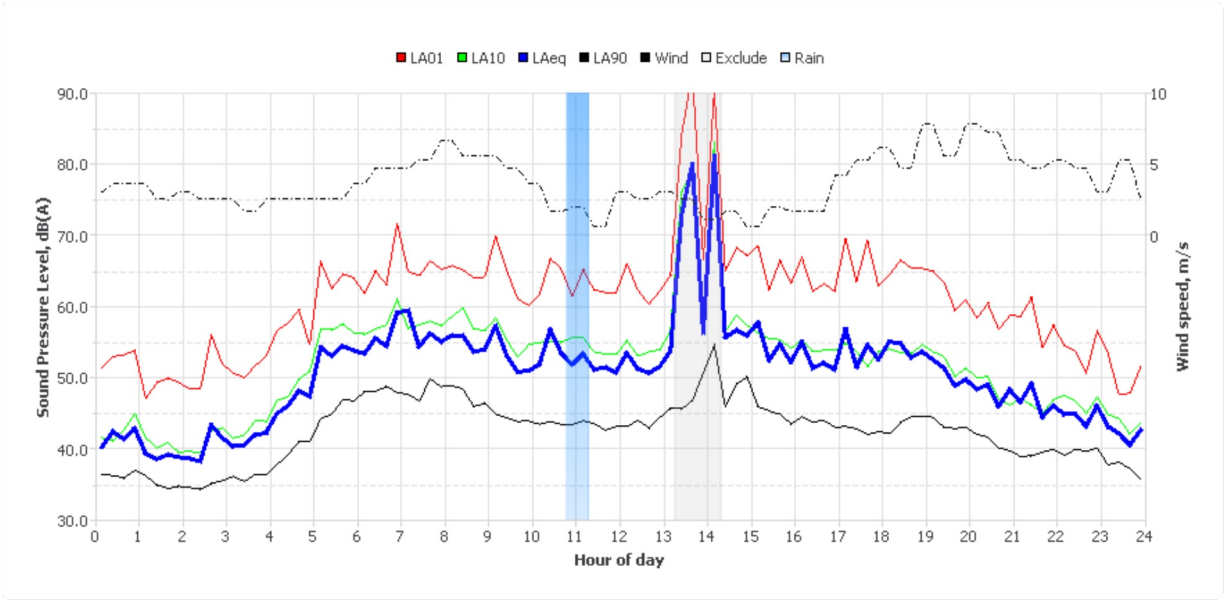
Saturday, 08 Dec 2018



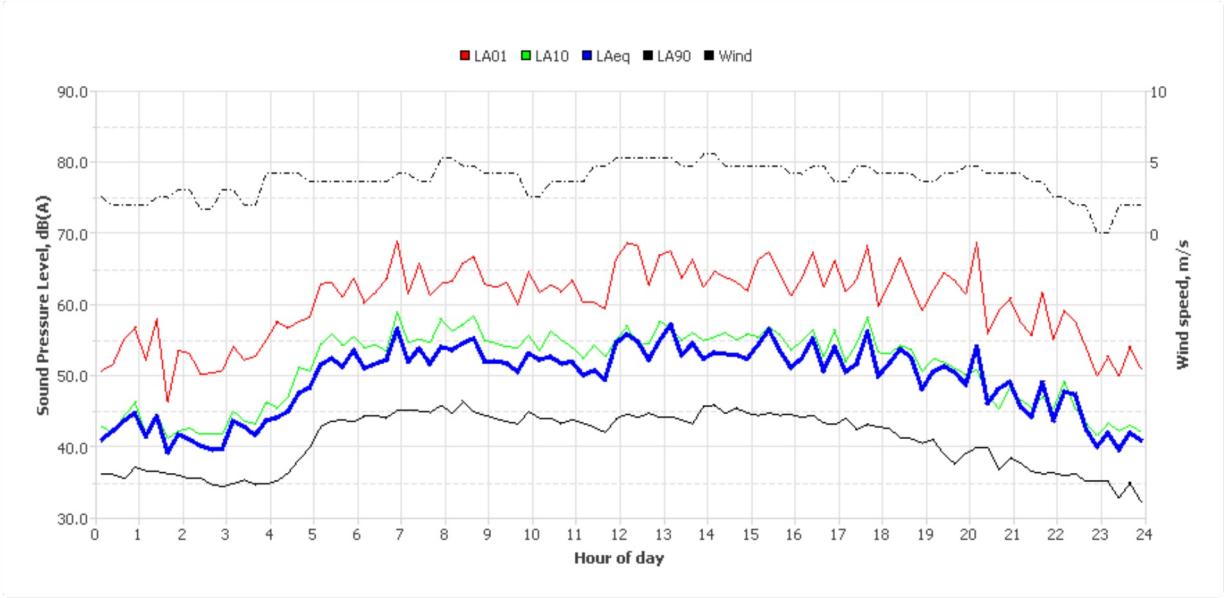
Sunday, 09 Dec 2018



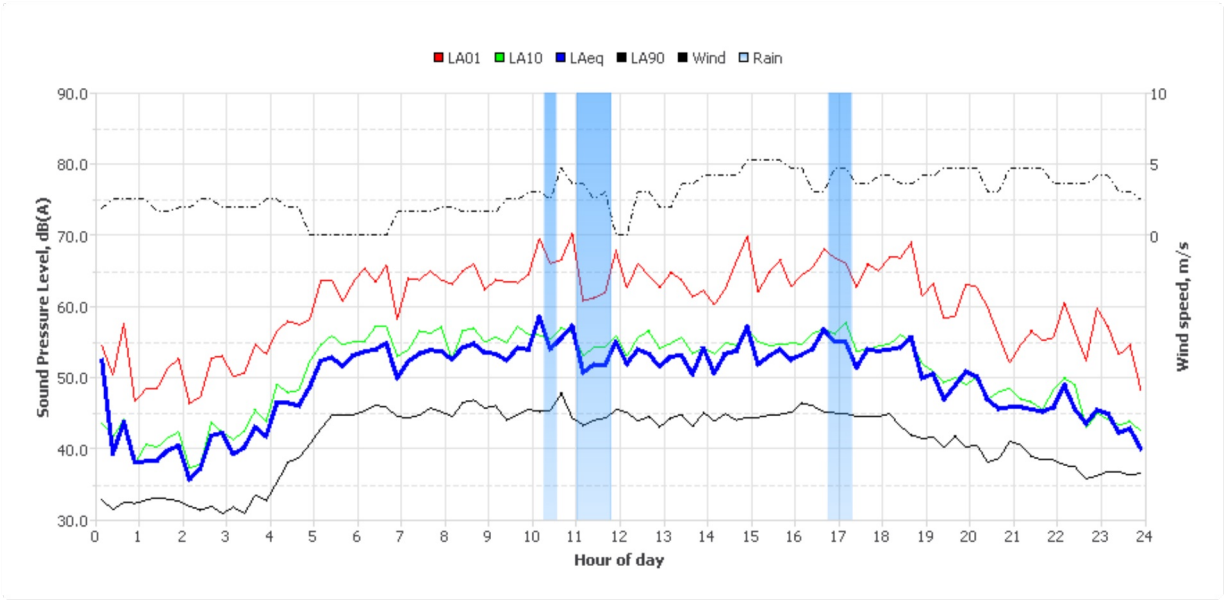
Monday, 10 Dec 2018



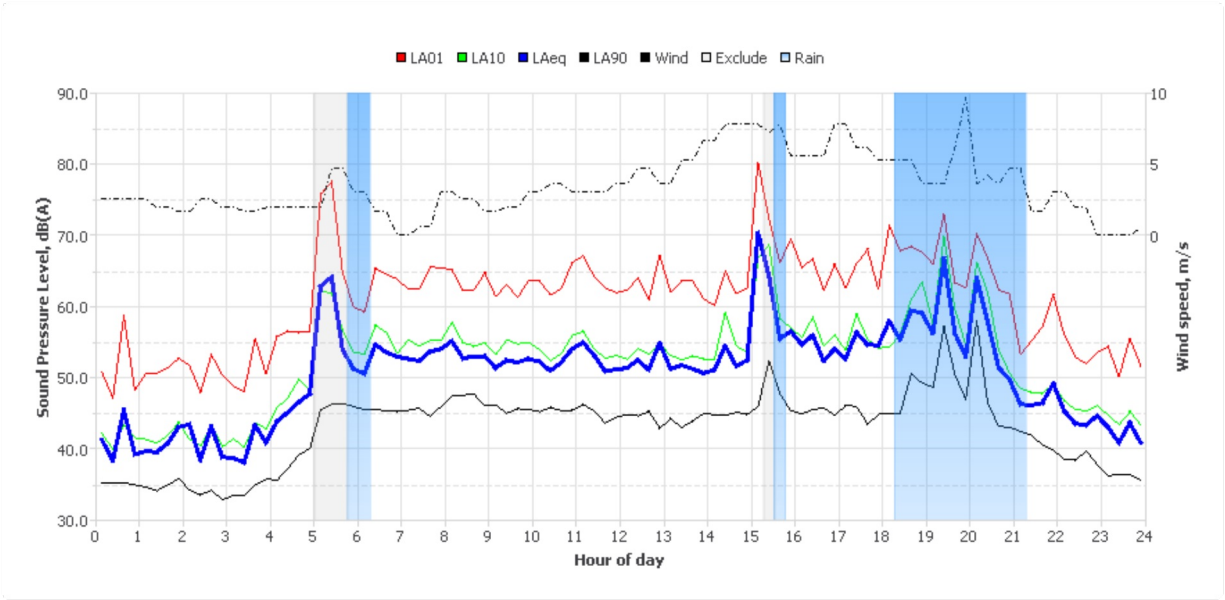
Tuesday, 11 Dec 2018



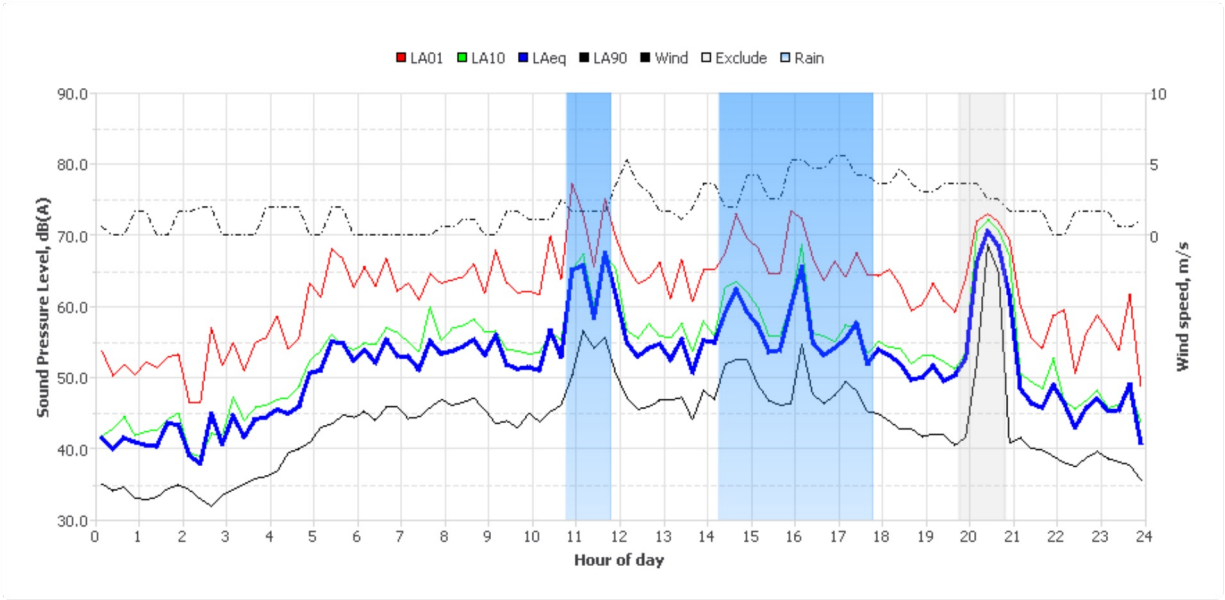
Wednesday, 12 Dec 2018



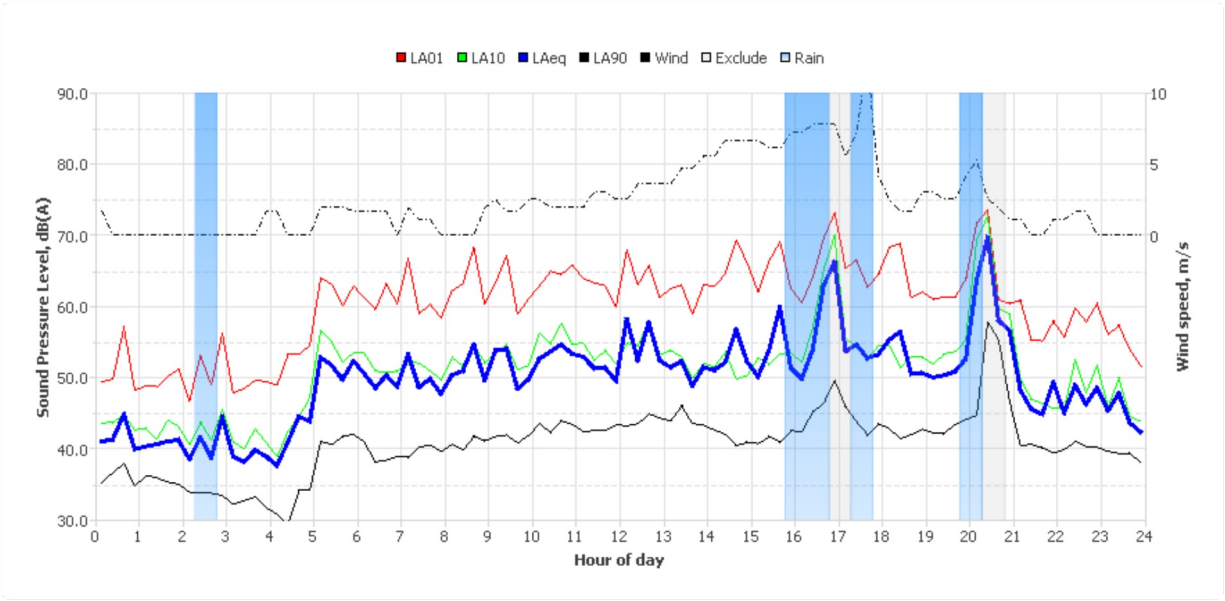
Thursday, 13 Dec 2018



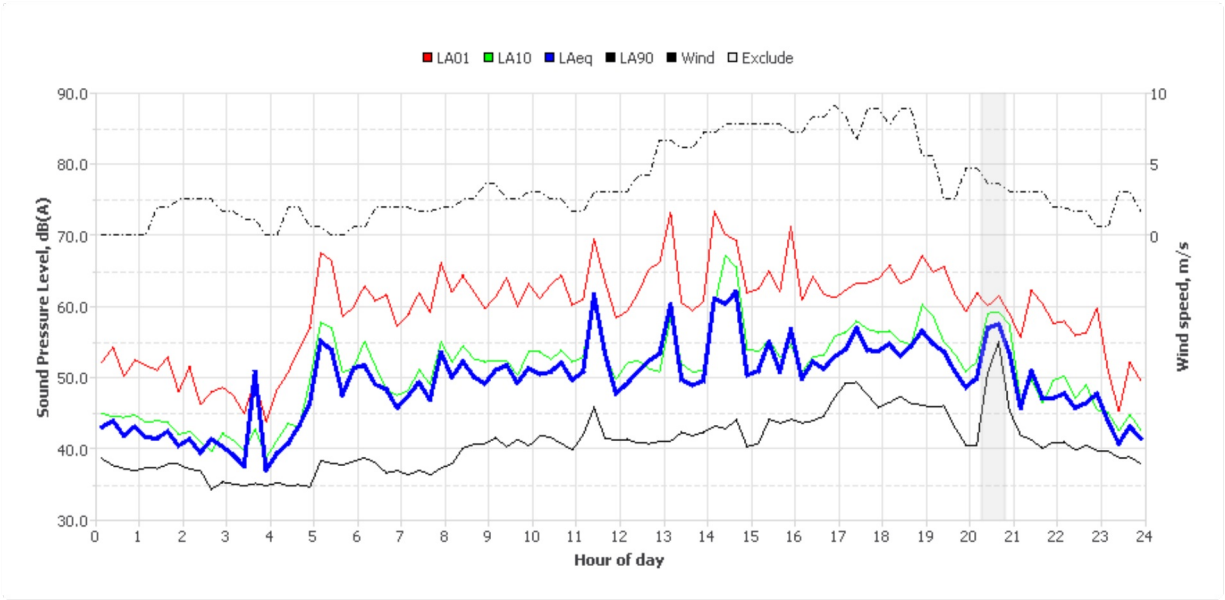
Friday, 14 Dec 2018



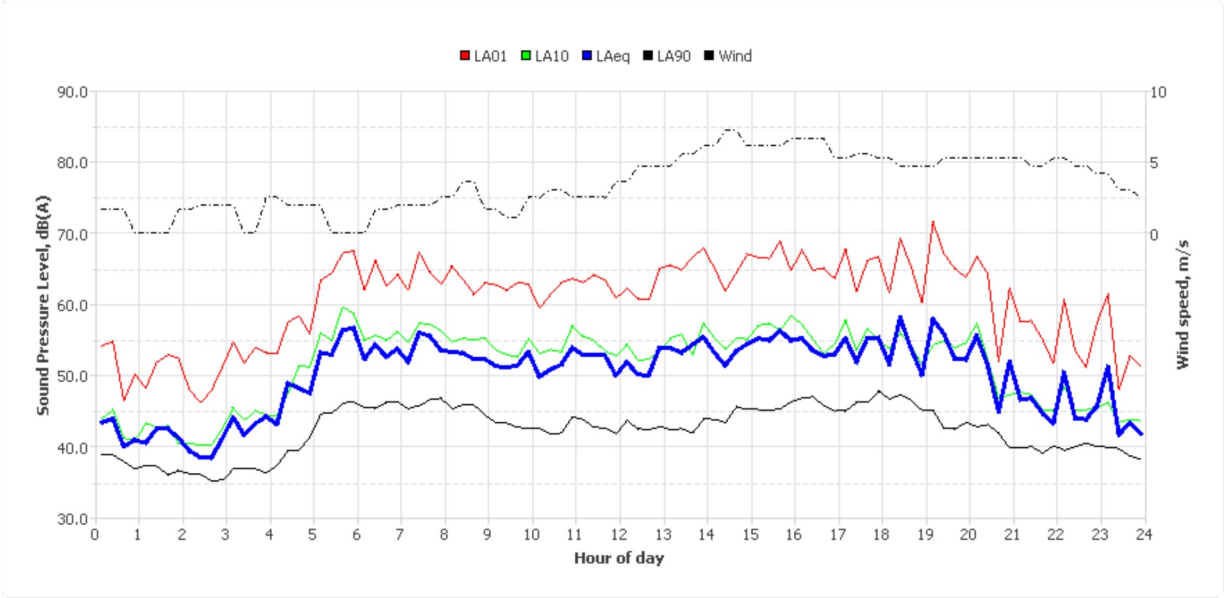
Saturday, 15 Dec 2018



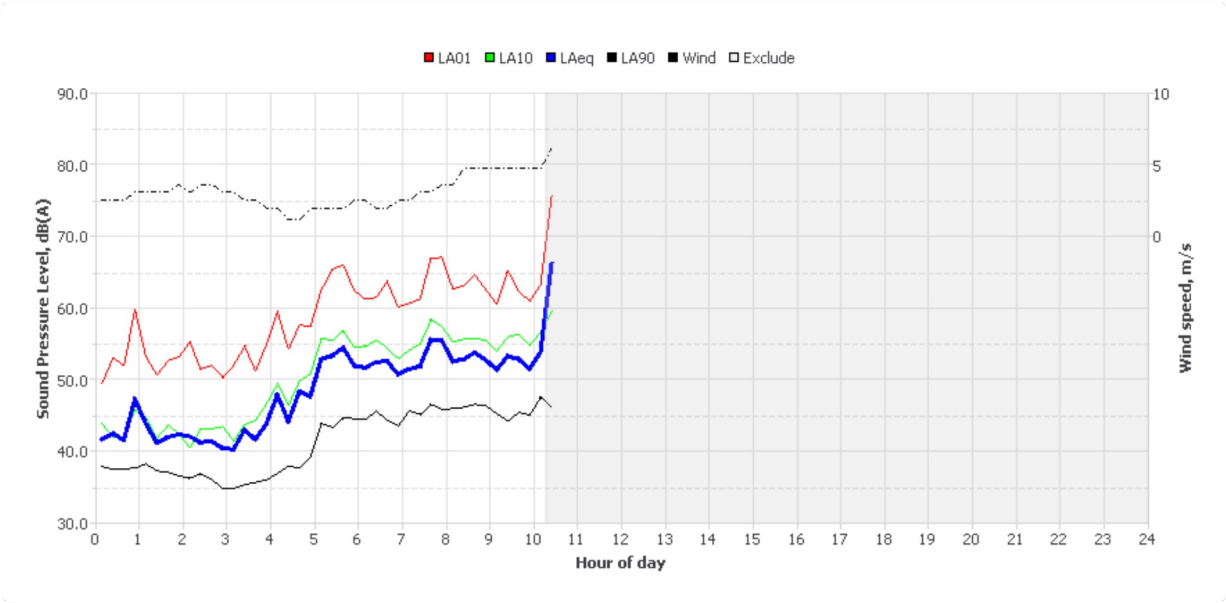
Sunday, 16 Dec 2018



Monday, 17 Dec 2018



Tuesday, 18 Dec 2018



Noise Logger Report

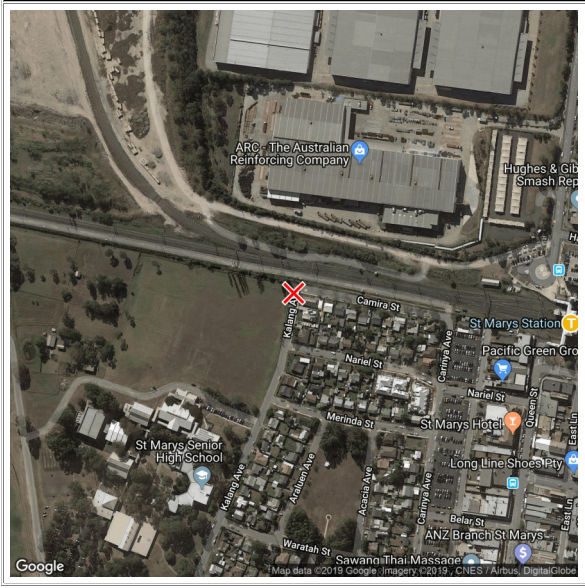
49 Kalang Avenue, Saint Marys

Item	Information
Logger Type	Rion NL52
Serial number	386741
Address	49 Kalang Avenue, Saint Marys
Location	Front Yard
Facade / Free Field	Free Field
Environment	Background noise dominated by constant road traffic noise hum from the west. Trucks accelerating and engine braking audible. Some industrial noise audible from the north audible at times such as reverse sirens, some banging. Train passby 63 to 82 dBA. School Bell heard.

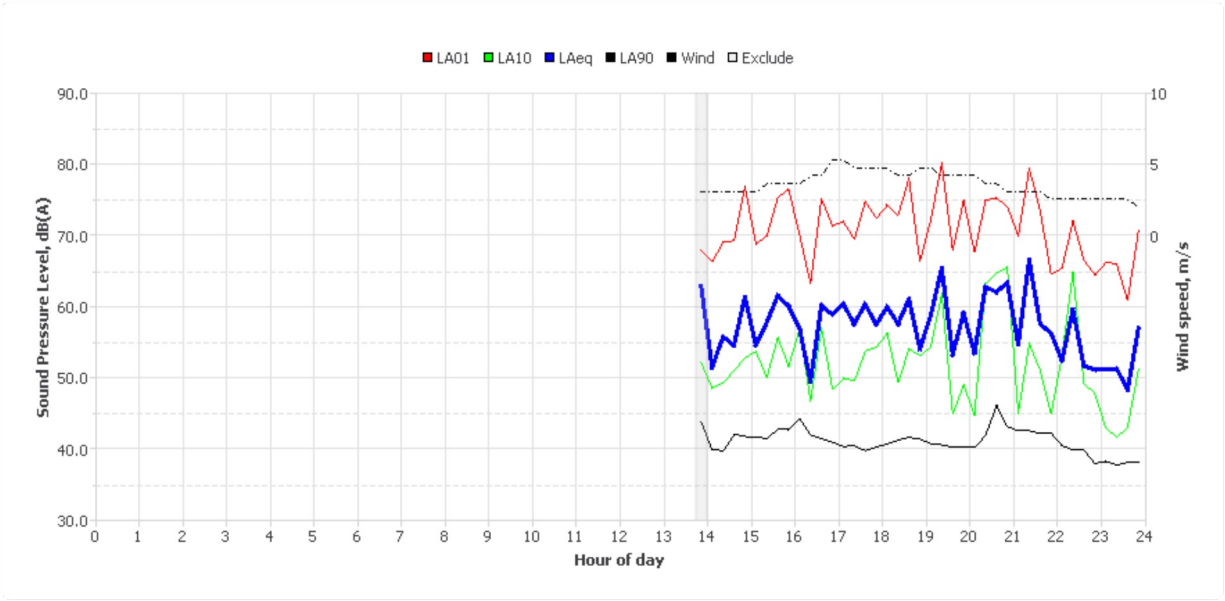
Measured noise levels

Logging Date	L_{Aeq} Day	Eve	Night	ABL Day	Eve	Night	$L_{Aeq,15hr}$	$L_{Aeq,9hr}$
Wed Dec 5 2018	58	61	54	-	40	-	60	54
Thu Dec 6 2018	60	61	58	-	-	-	61	58
Fri Dec 7 2018	59	62	58	40	42	39	60	58
Sat Dec 8 2018	58	58	57	-	-	36	58	57
Sun Dec 9 2018	58	58	57	36	-	37	58	57
Mon Dec 10 2018	59	61	58	38	-	36	59	58
Tue Dec 11 2018	58	61	59	39	39	37	59	59
Wed Dec 12 2018	58	60	60	40	41	36	59	60
Thu Dec 13 2018	59	58	57	41	-	37	59	57
Fri Dec 14 2018	61	60	59	-	-	40	61	59
Sat Dec 15 2018	57	56	52	-	39	40	57	52
Sun Dec 16 2018	56	59	58	-	-	39	57	58
Mon Dec 17 2018	59	59	56	39	40	38	59	56
Tue Dec 18 2018	58	-	59	-	-	-	58	59
Summary	**59**	**60**	**58**	**39**	**40**	**37**	**59**	**58**

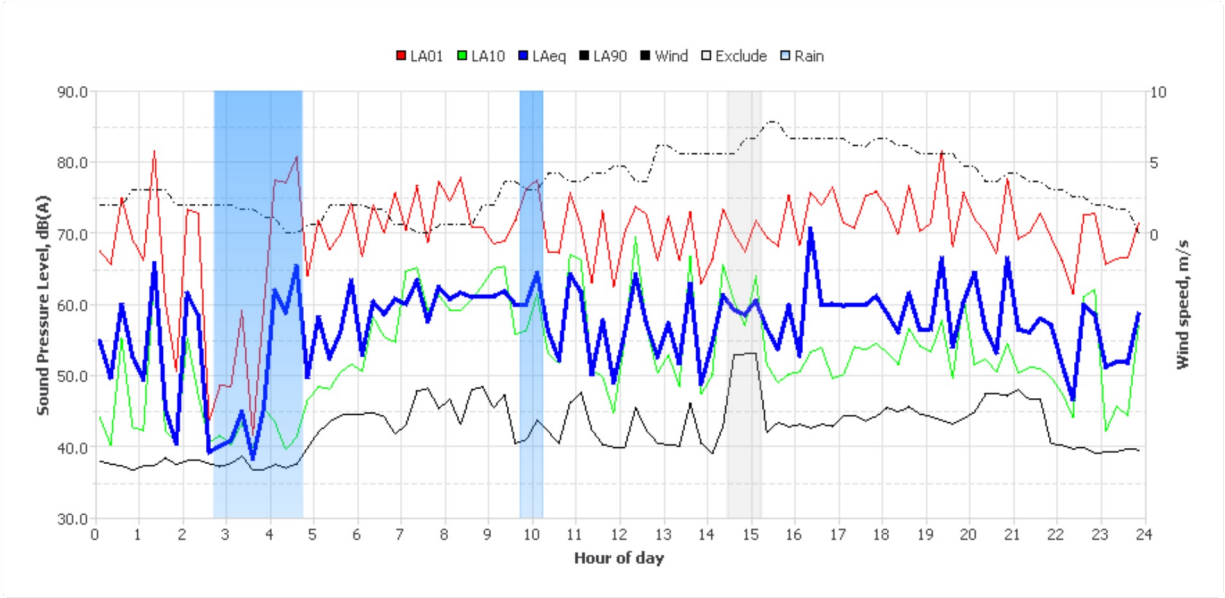
Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

Logger Location	Logger Deployment Photo
	

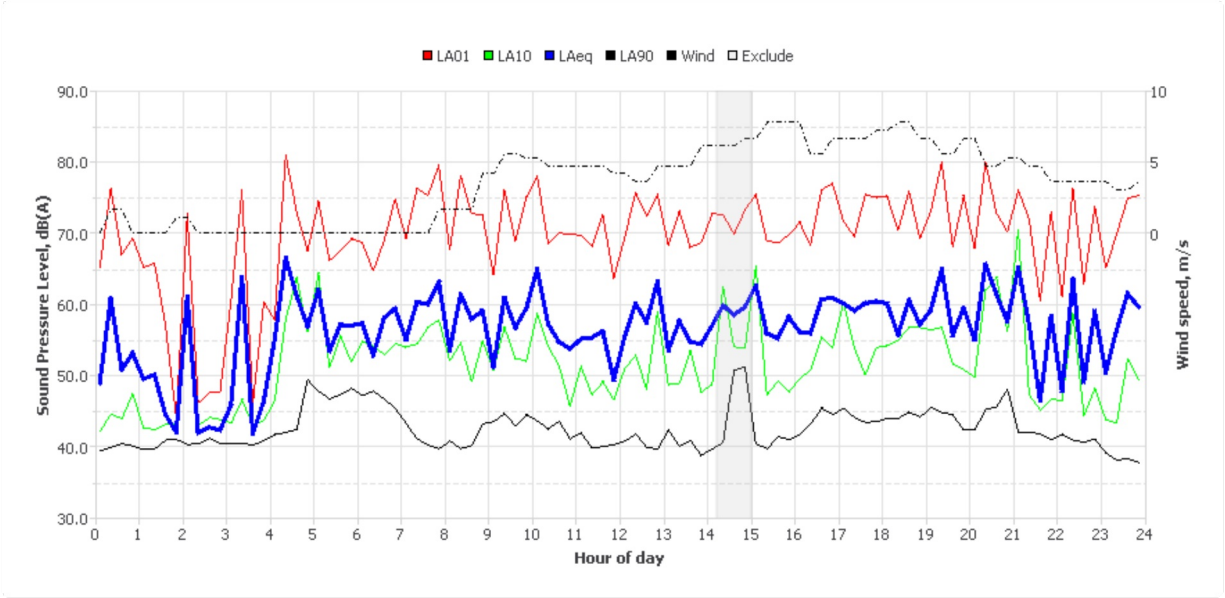
Wednesday, 05 Dec 2018



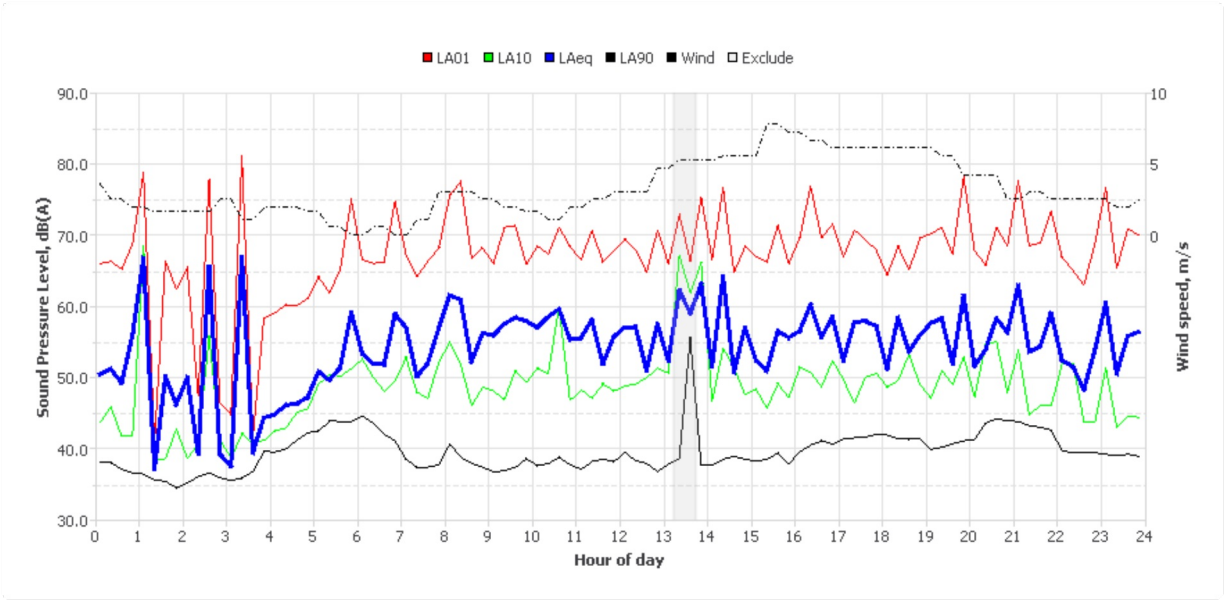
Thursday, 06 Dec 2018



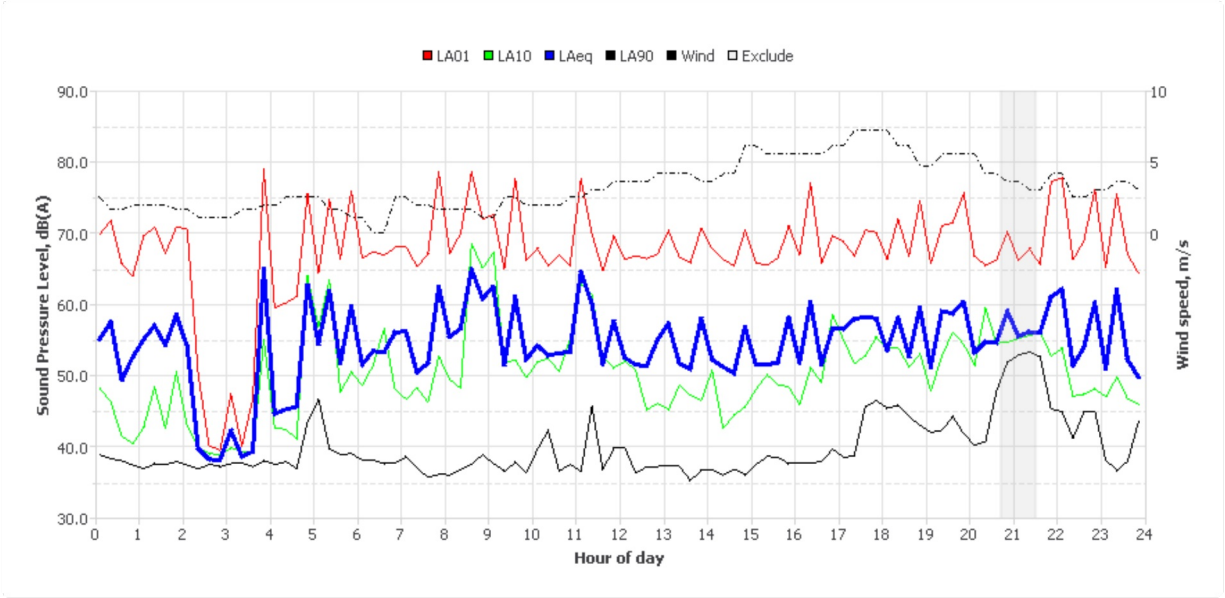
Friday, 07 Dec 2018



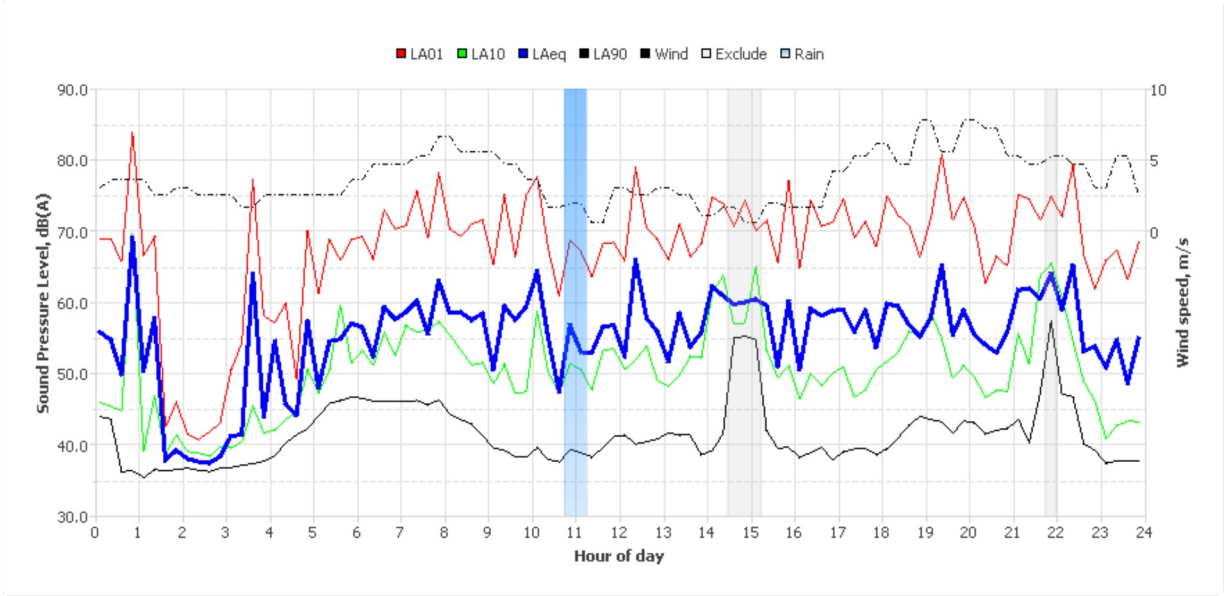
Saturday, 08 Dec 2018



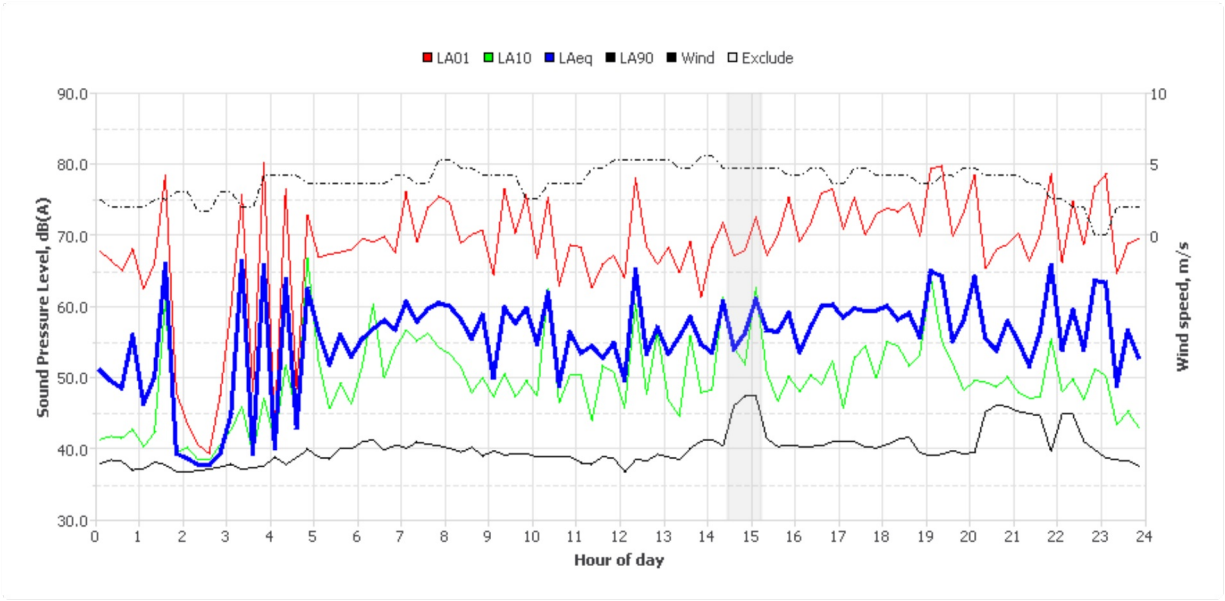
Sunday, 09 Dec 2018



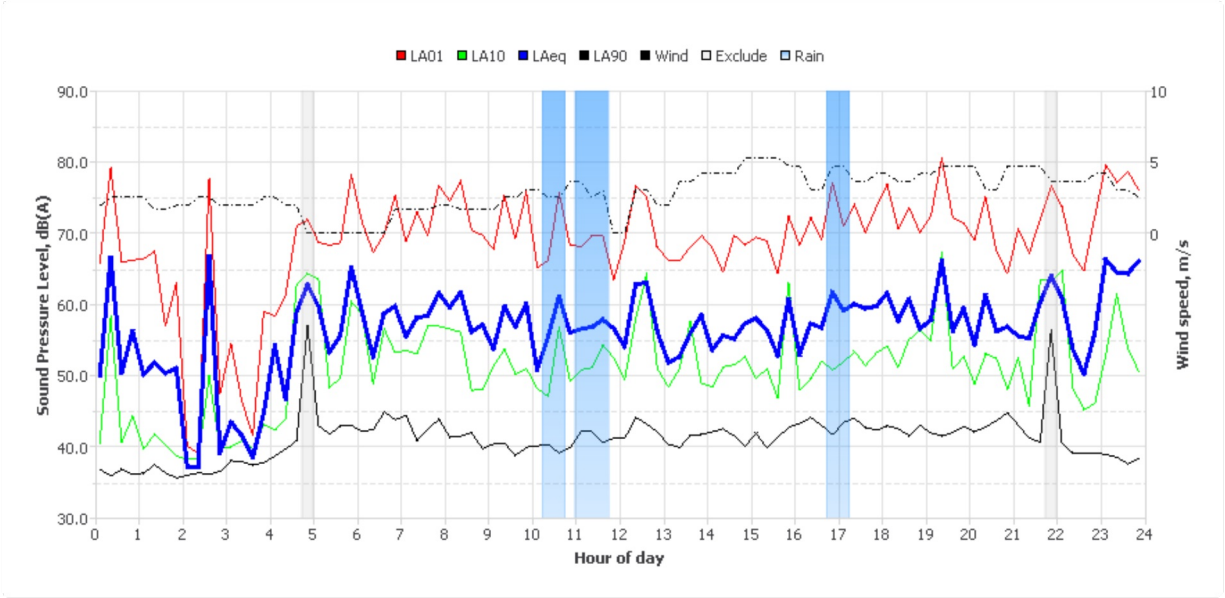
Monday, 10 Dec 2018



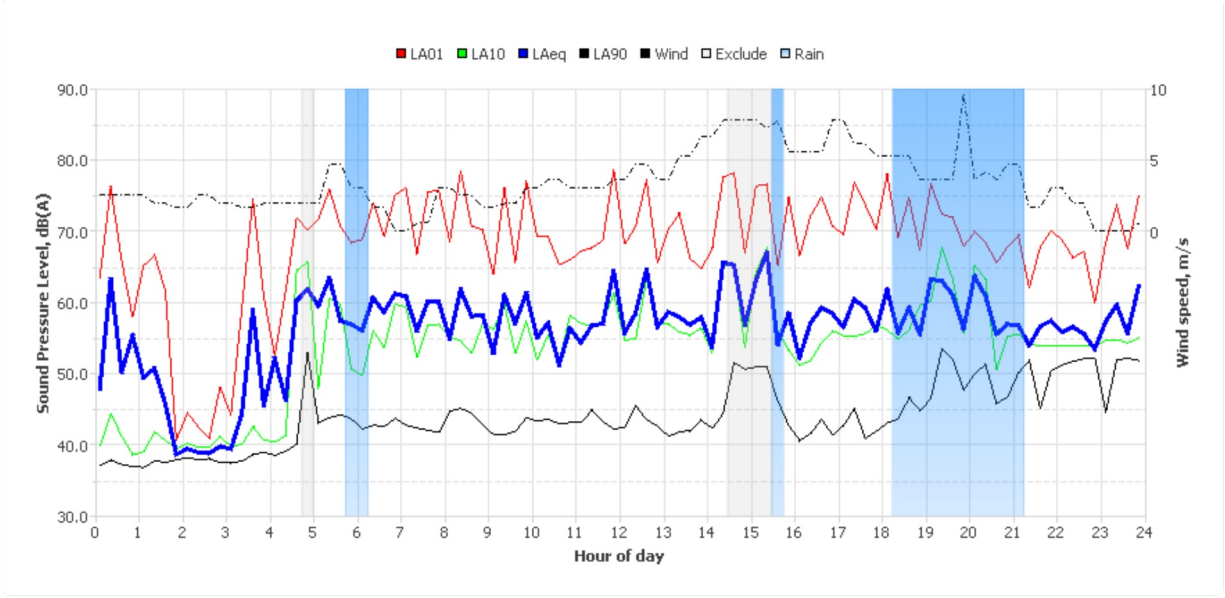
Tuesday, 11 Dec 2018



Wednesday, 12 Dec 2018



Thursday, 13 Dec 2018



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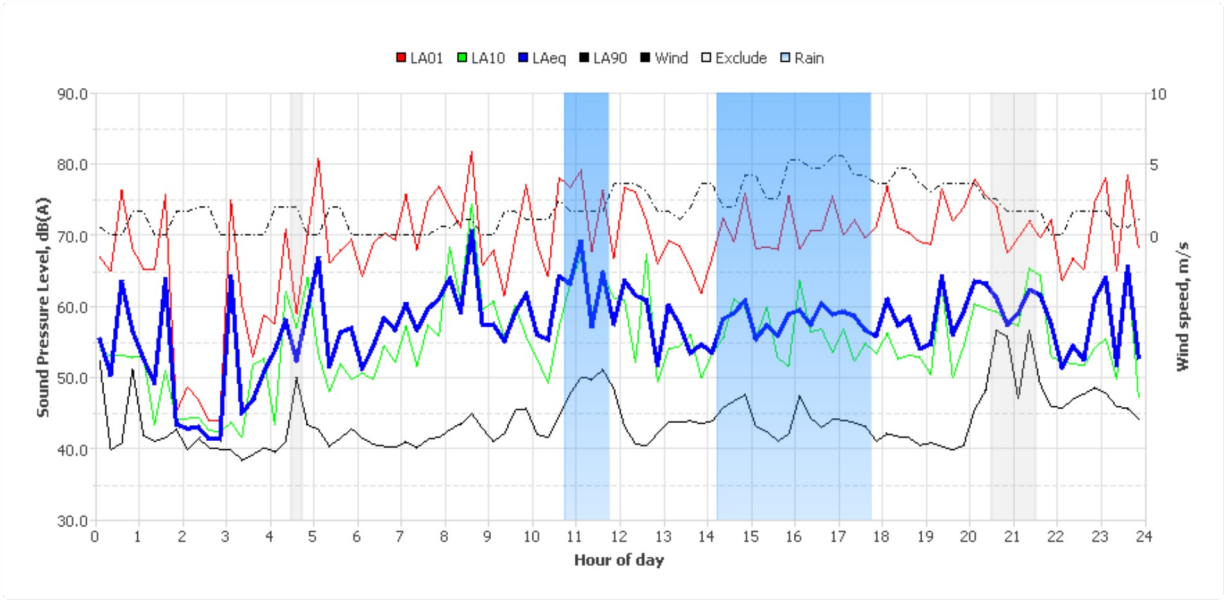
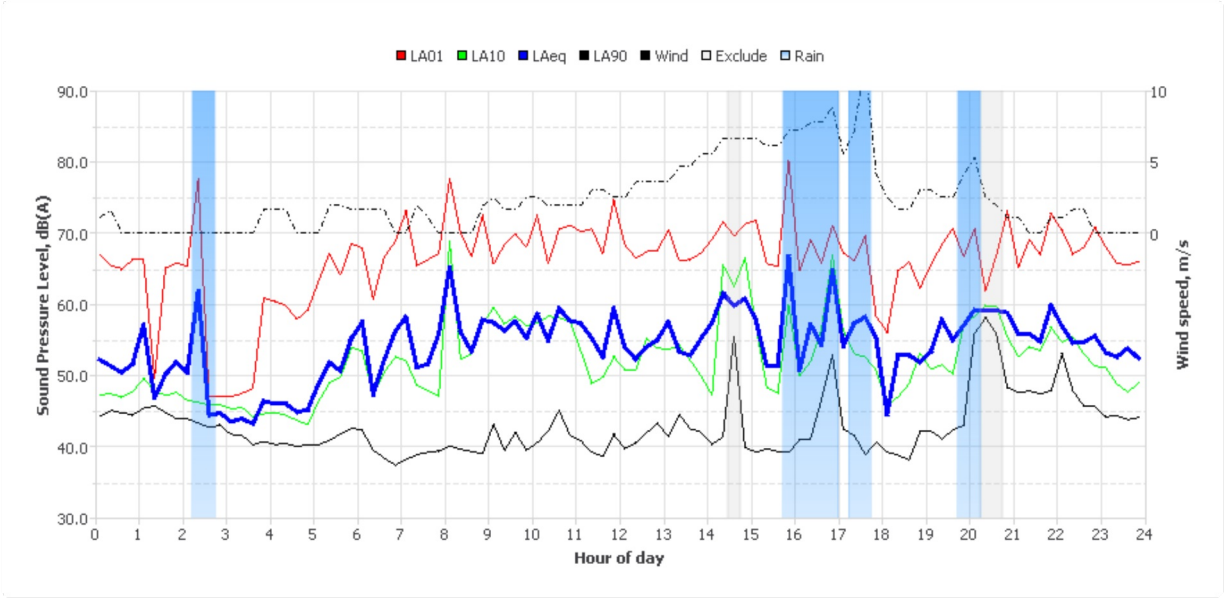
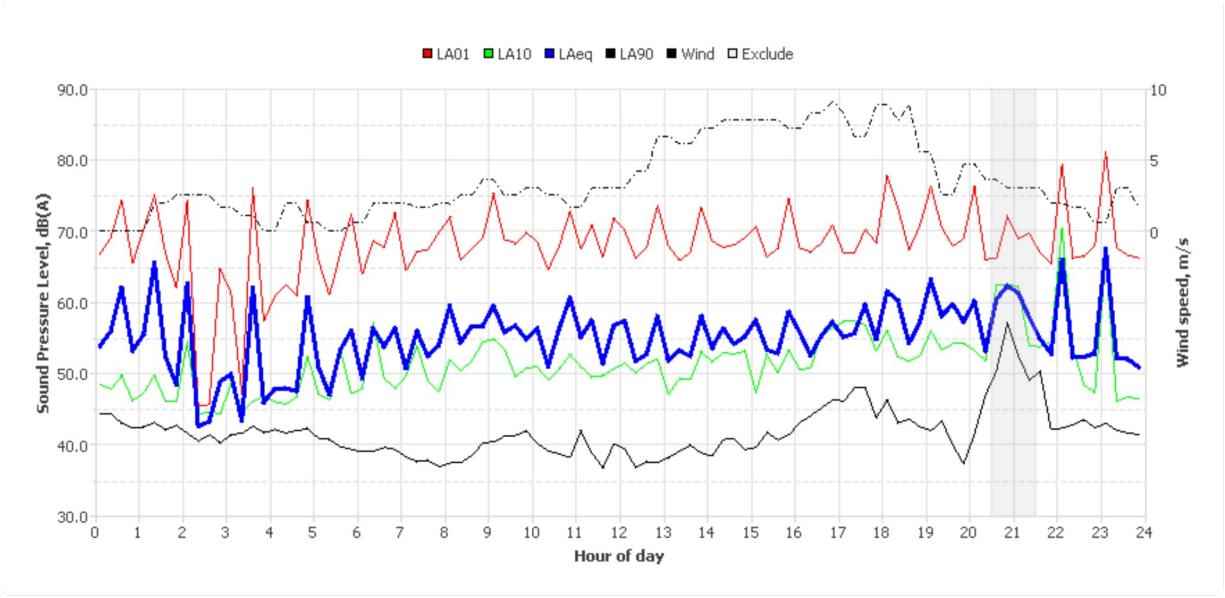


Saturday, 15 Dec 2018



Sunday, 16 Dec 2018



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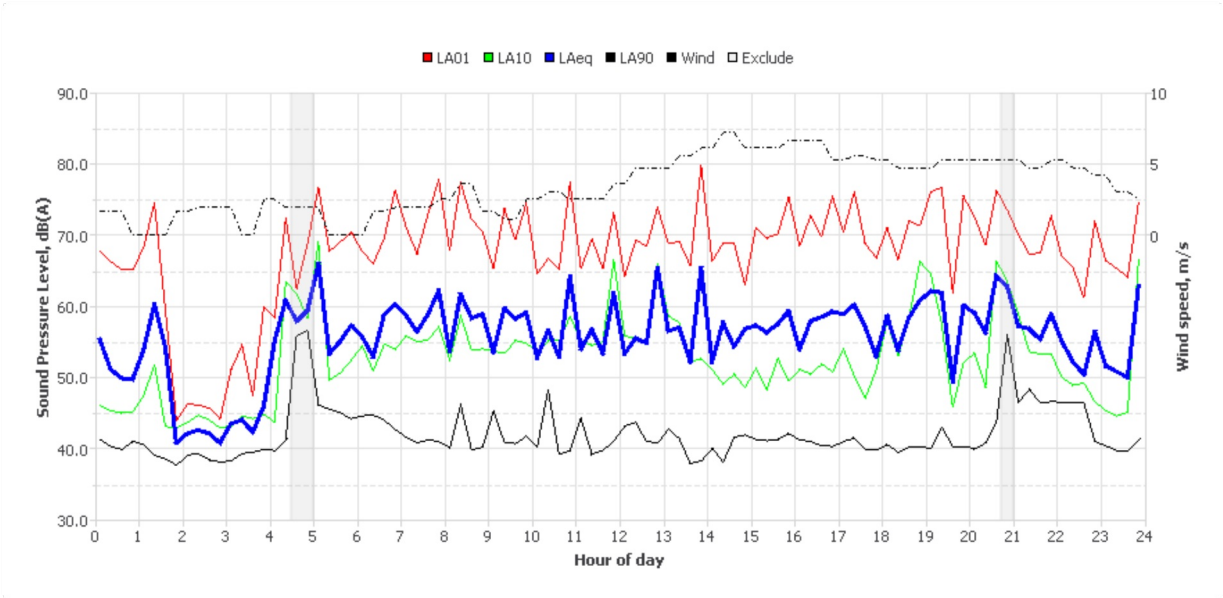
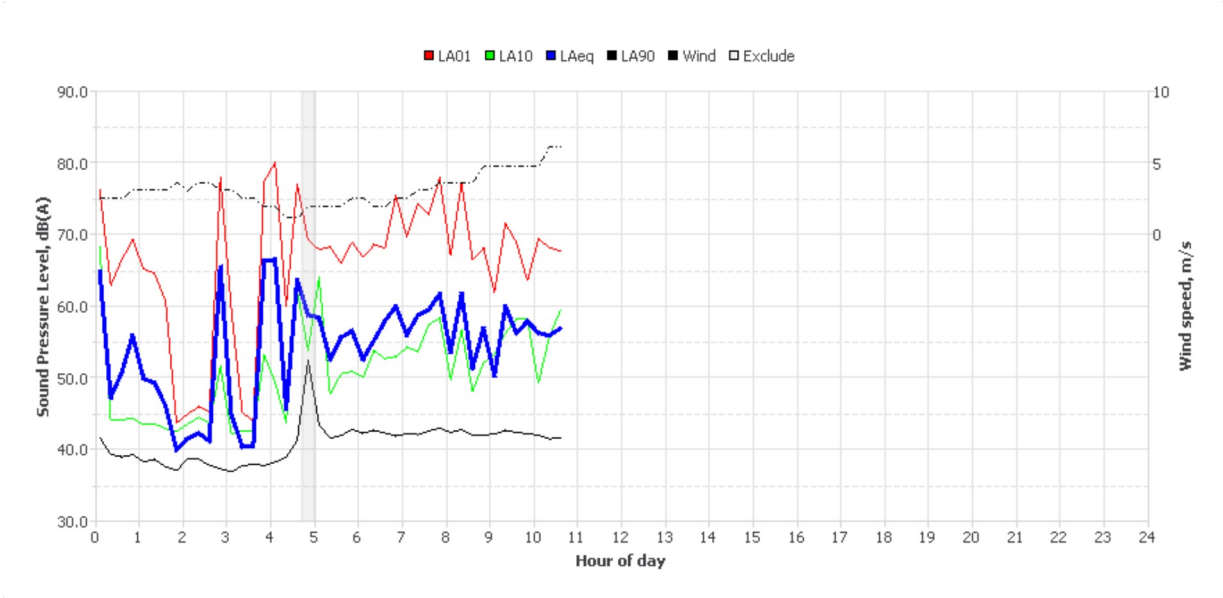


Tuesday, 18 Dec 2018



Noise Logger Report

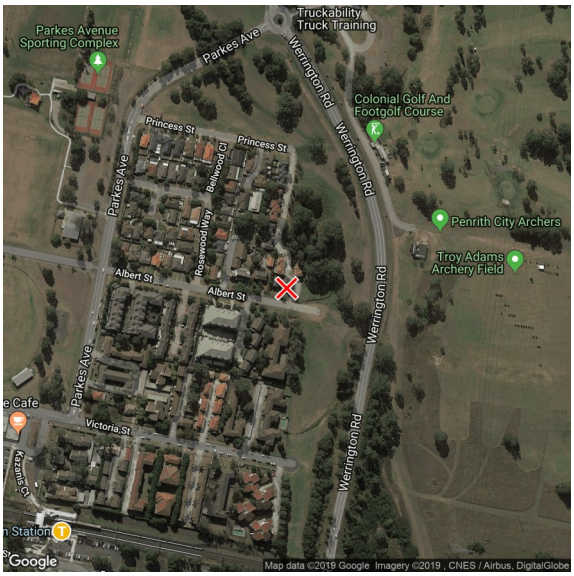
31 Albert Street, Werrington

Item	Information
Logger Type	Rion NL21
Serial number	765701
Address	31 Albert Street, Werrington
Location	Front Yard
Facade / Free Field	Free Field
Environment	Noise environment dominated by constant road traffic noise from Werrington Road. Bird noise.

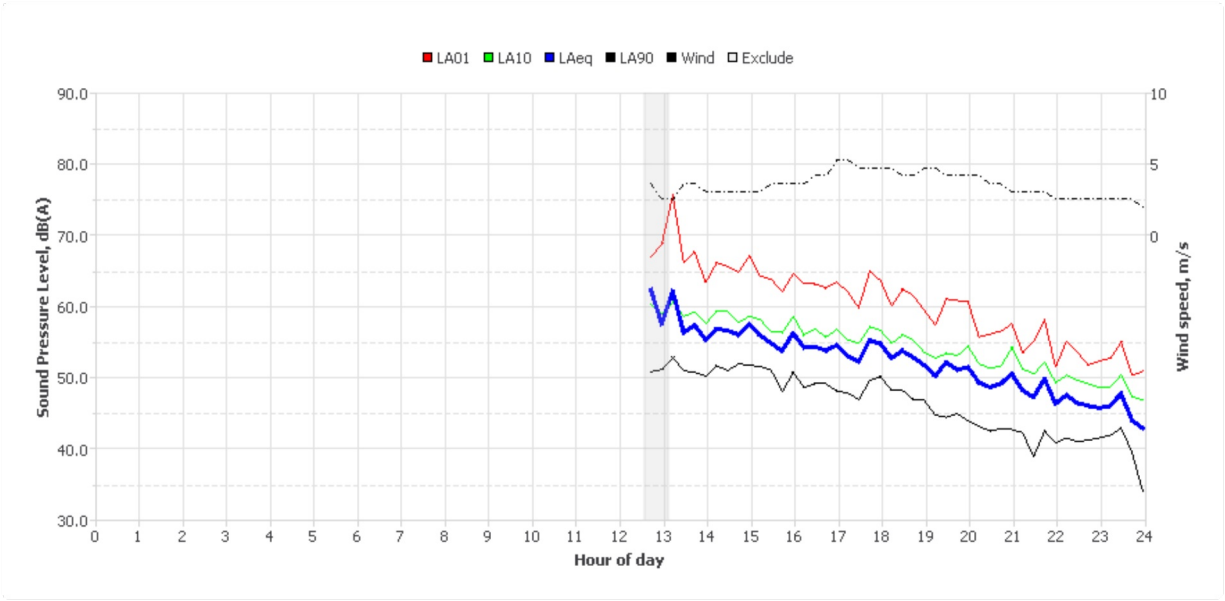
Measured noise levels

Logging Date	L_{Aeq} Day	Eve	Night	ABL Day	Eve	Night	$L_{Aeq,15hr}$	$L_{Aeq,9hr}$
Wed Dec 5 2018	56	51	46	-	41	-	54	46
Thu Dec 6 2018	56	53	51	-	-	-	55	51
Fri Dec 7 2018	55	53	51	45	-	36	54	51
Sat Dec 8 2018	54	52	51	-	-	35	53	51
Sun Dec 9 2018	52	50	50	44	-	36	52	50
Mon Dec 10 2018	56	52	53	48	-	38	56	53
Tue Dec 11 2018	56	52	52	47	40	33	56	52
Wed Dec 12 2018	55	51	52	48	44	33	54	52
Thu Dec 13 2018	54	53	51	47	-	35	54	51
Fri Dec 14 2018	57	54	50	-	48	38	56	50
Sat Dec 15 2018	52	53	53	-	45	39	53	53
Sun Dec 16 2018	51	51	51	-	-	37	51	51
Mon Dec 17 2018	55	53	53	46	46	44	54	53
Tue Dec 18 2018	55	-	52	-	-	-	55	52
Summary	**55**	**52**	**51**	**47**	**45**	**36**	**54**	**51**

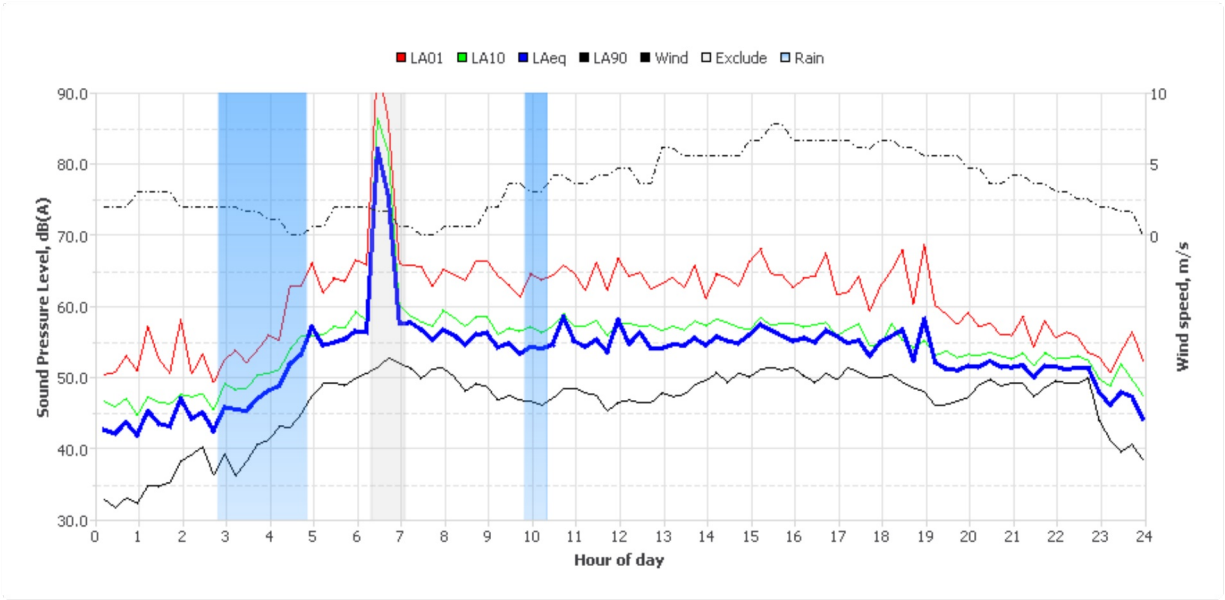
Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

Logger Location	Logger Deployment Photo
	

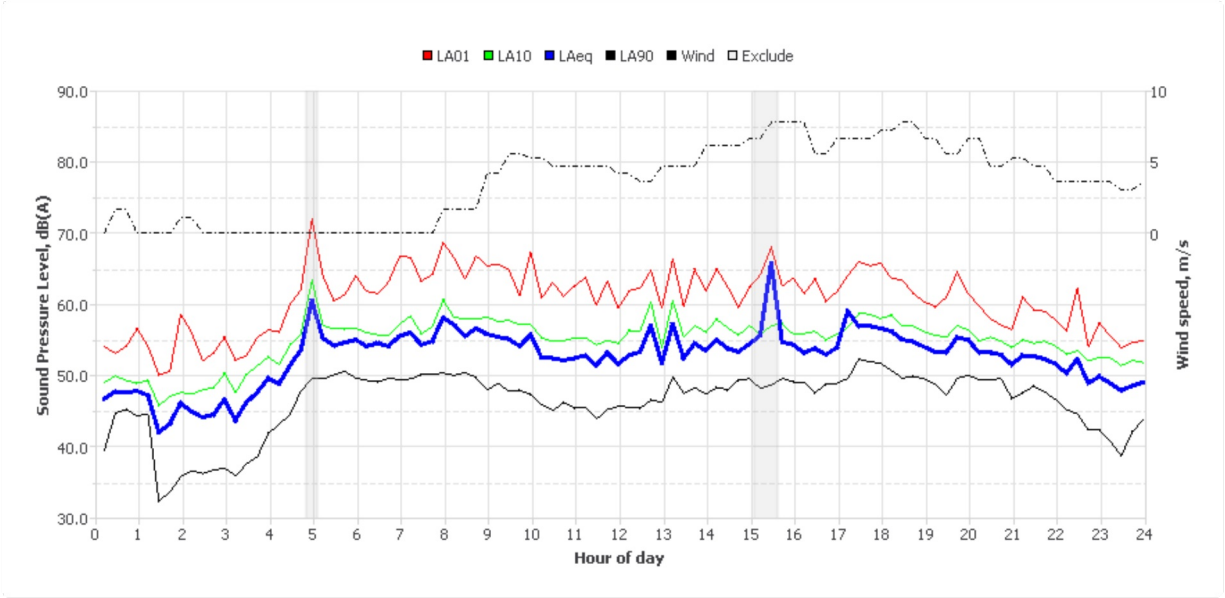
Wednesday, 05 Dec 2018



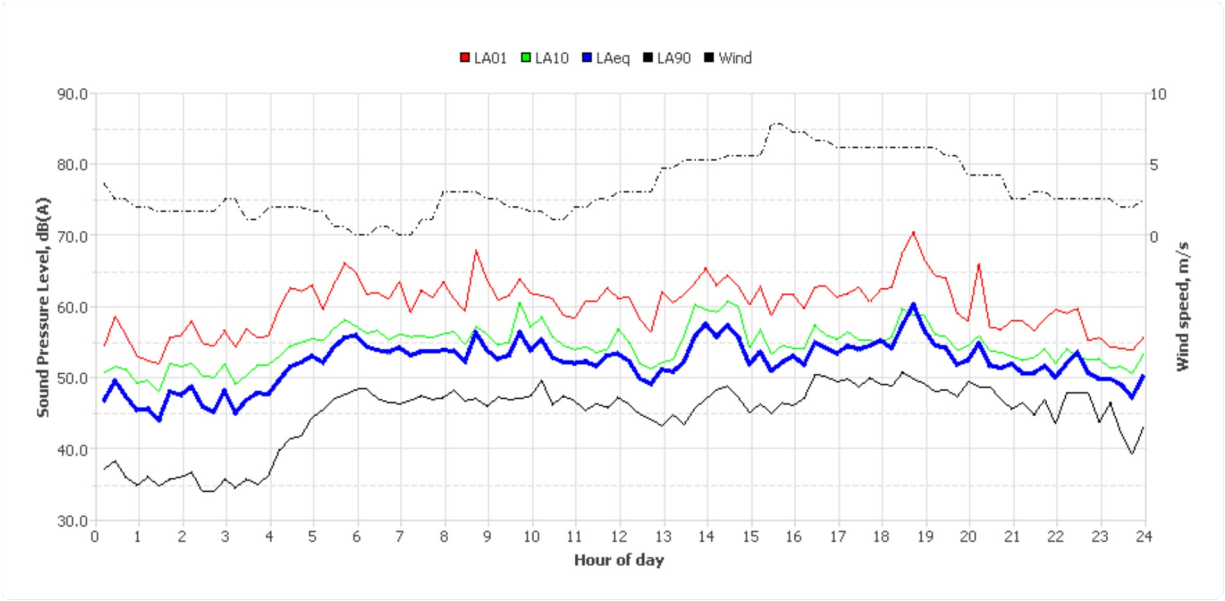
Thursday, 06 Dec 2018



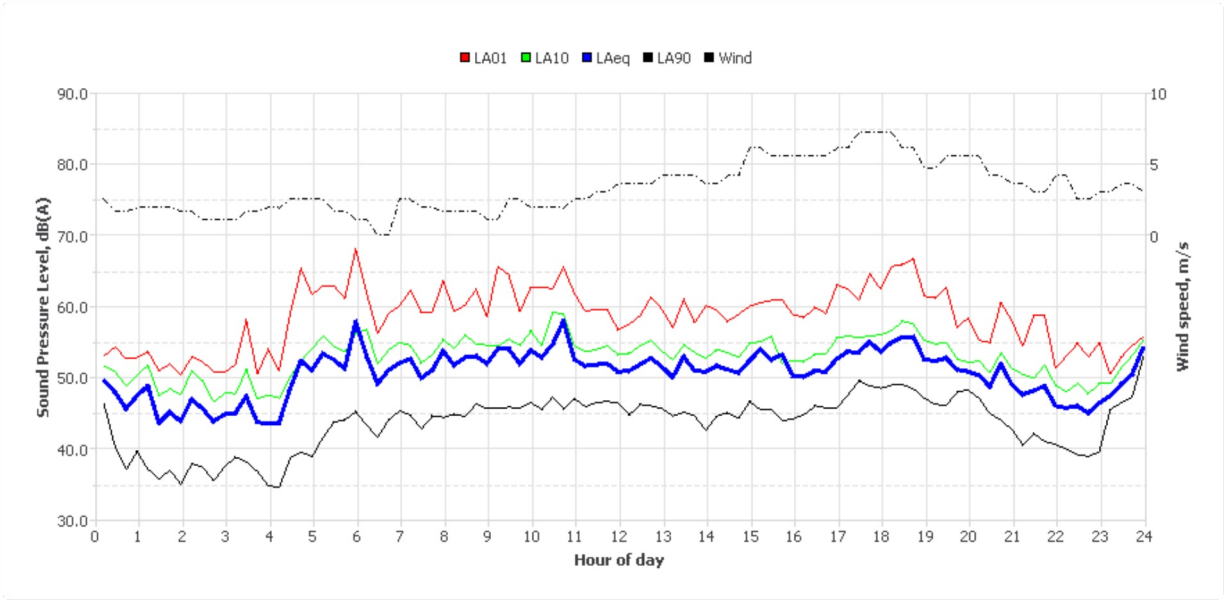
Friday, 07 Dec 2018



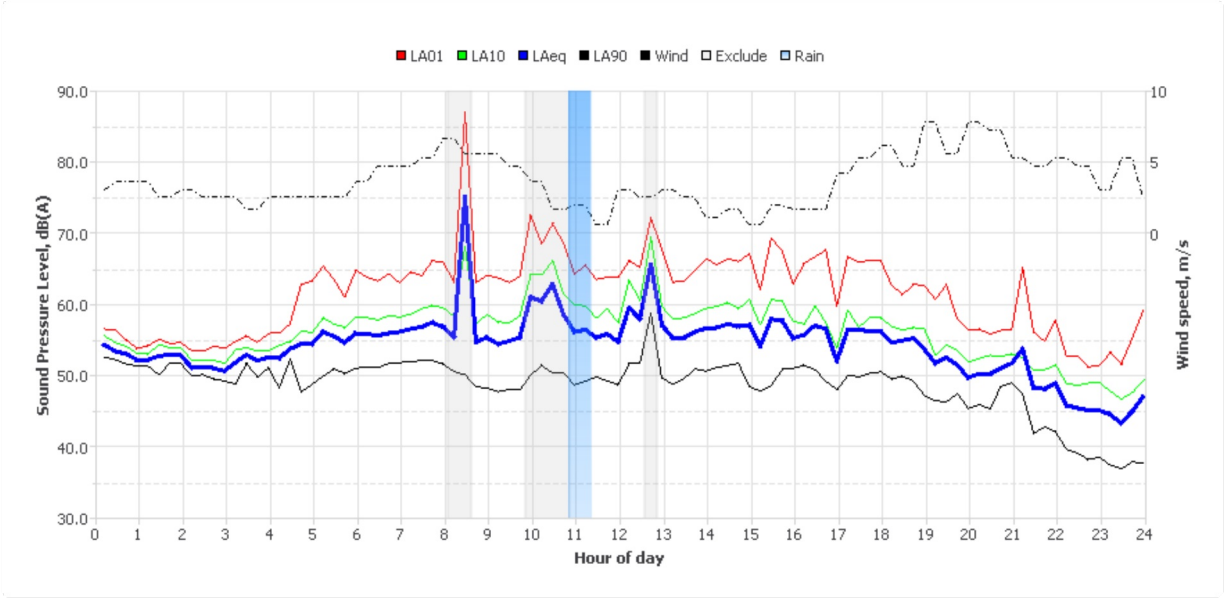
Saturday, 08 Dec 2018



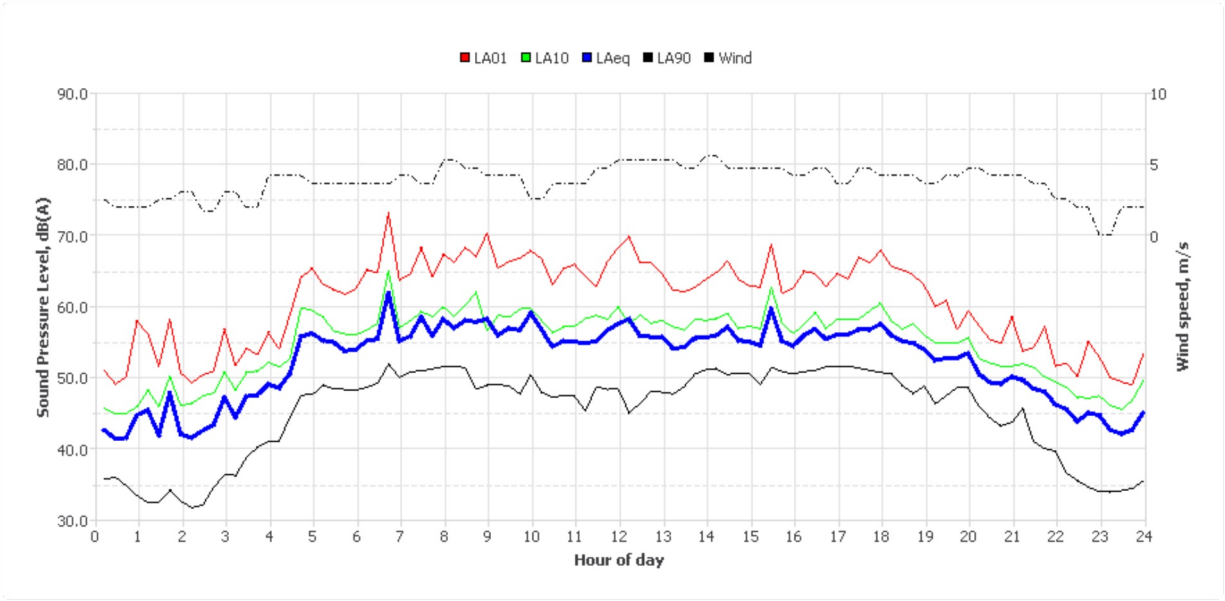
Sunday, 09 Dec 2018



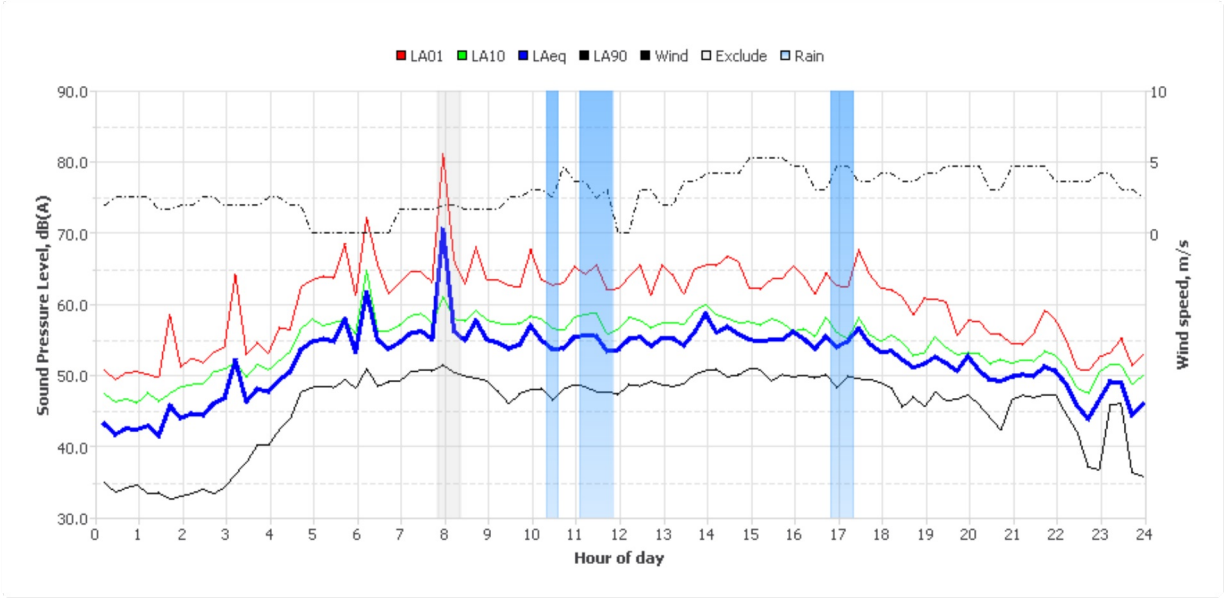
Monday, 10 Dec 2018



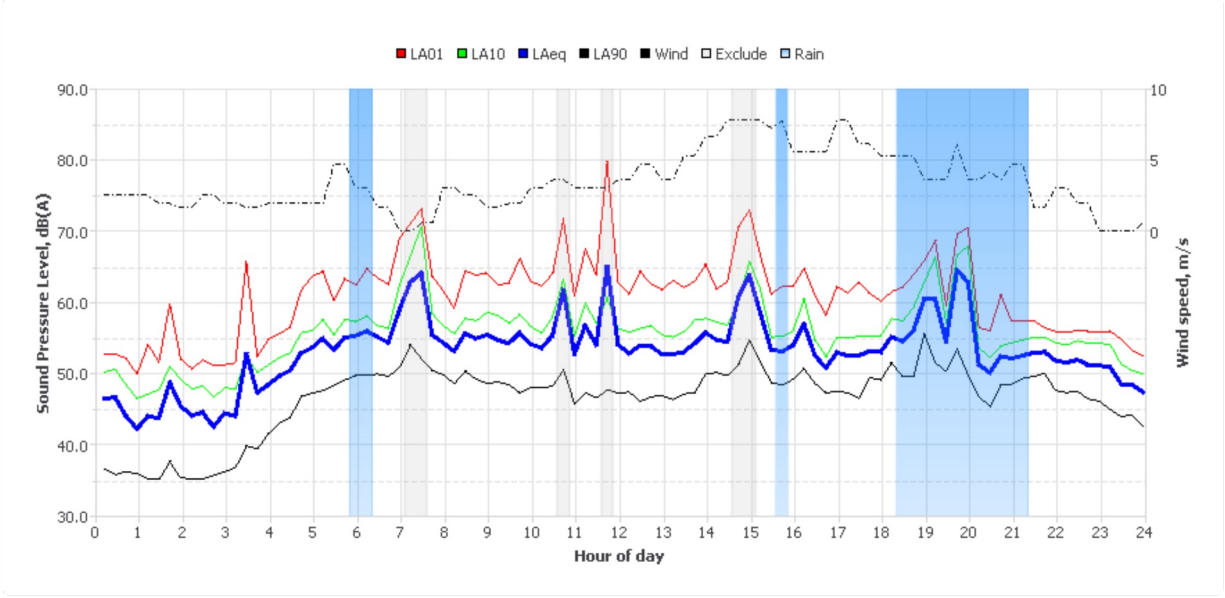
Tuesday, 11 Dec 2018



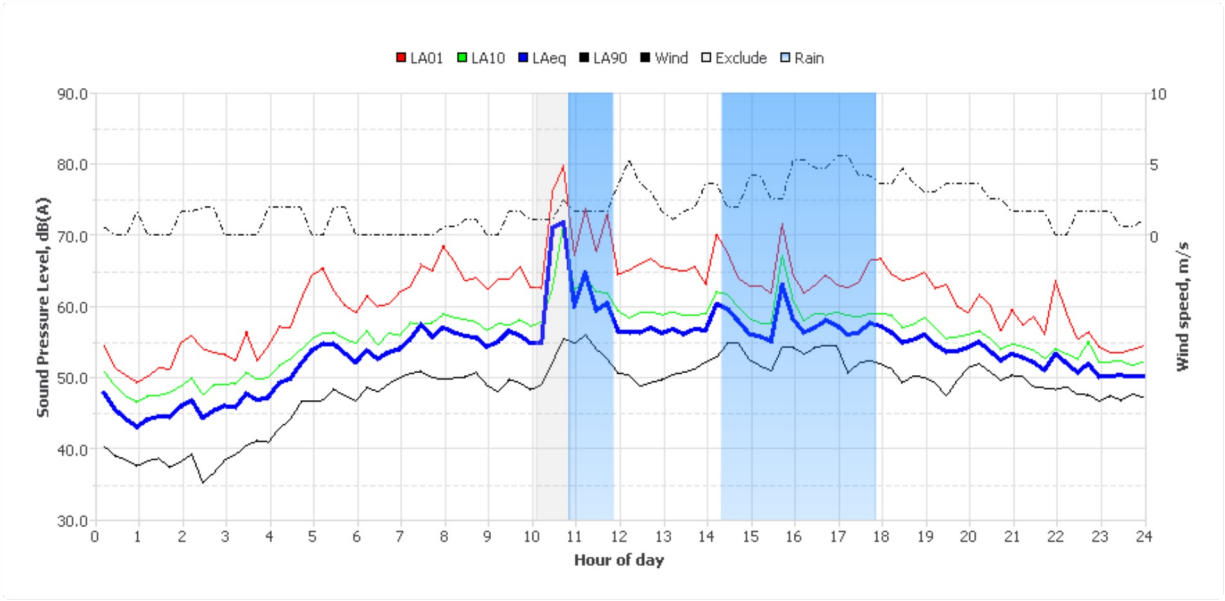
Wednesday, 12 Dec 2018



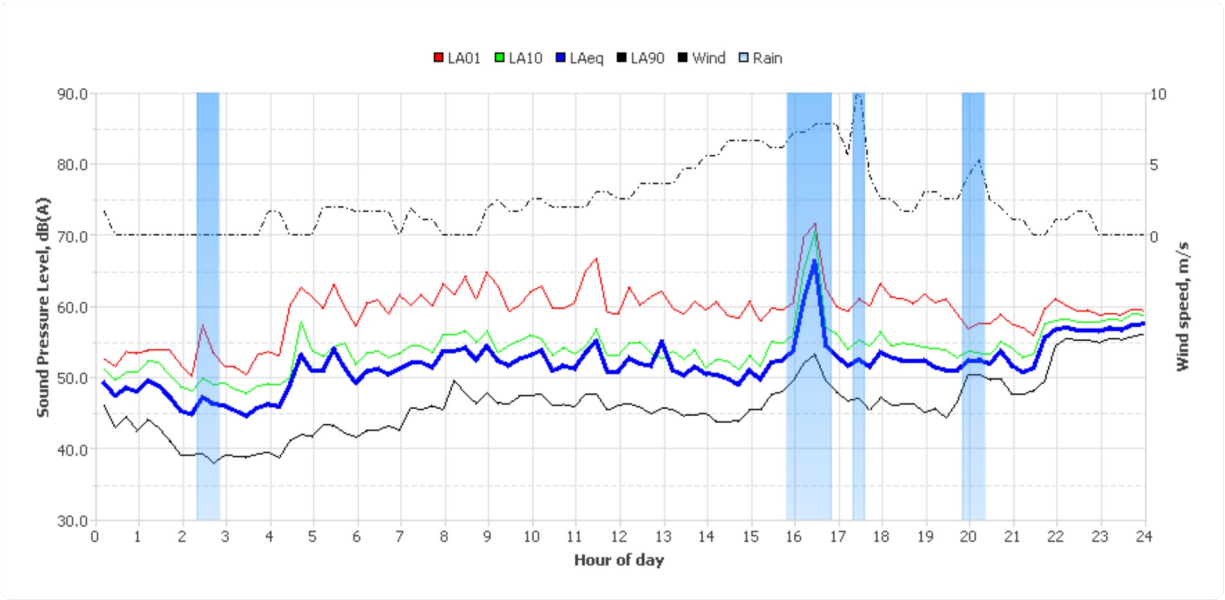
Thursday, 13 Dec 2018



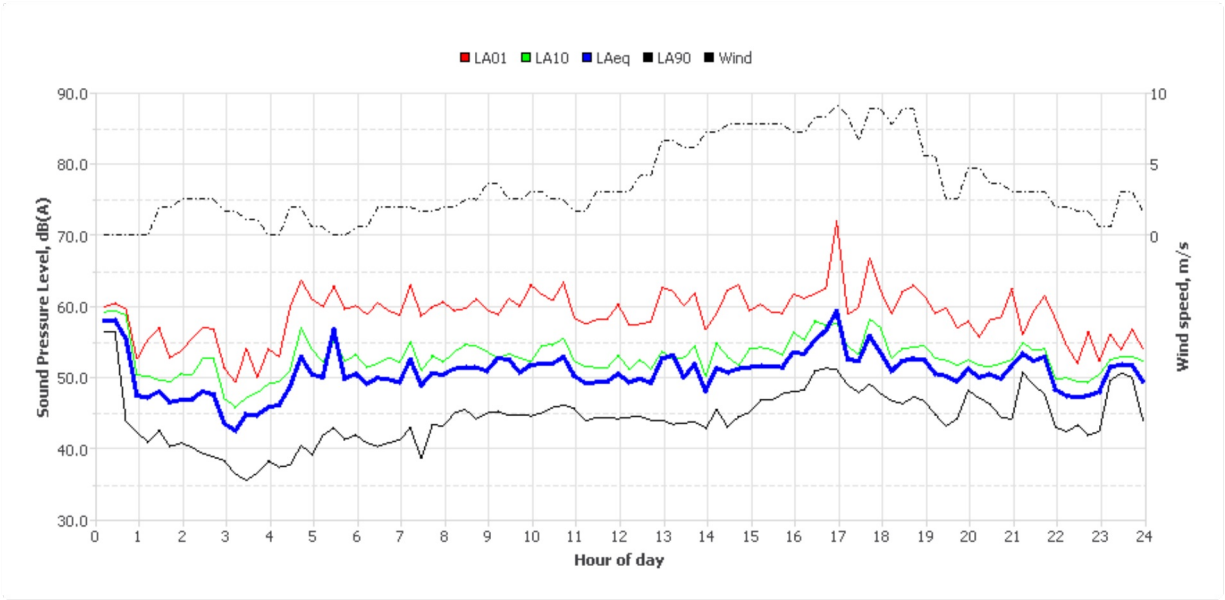
Friday, 14 Dec 2018



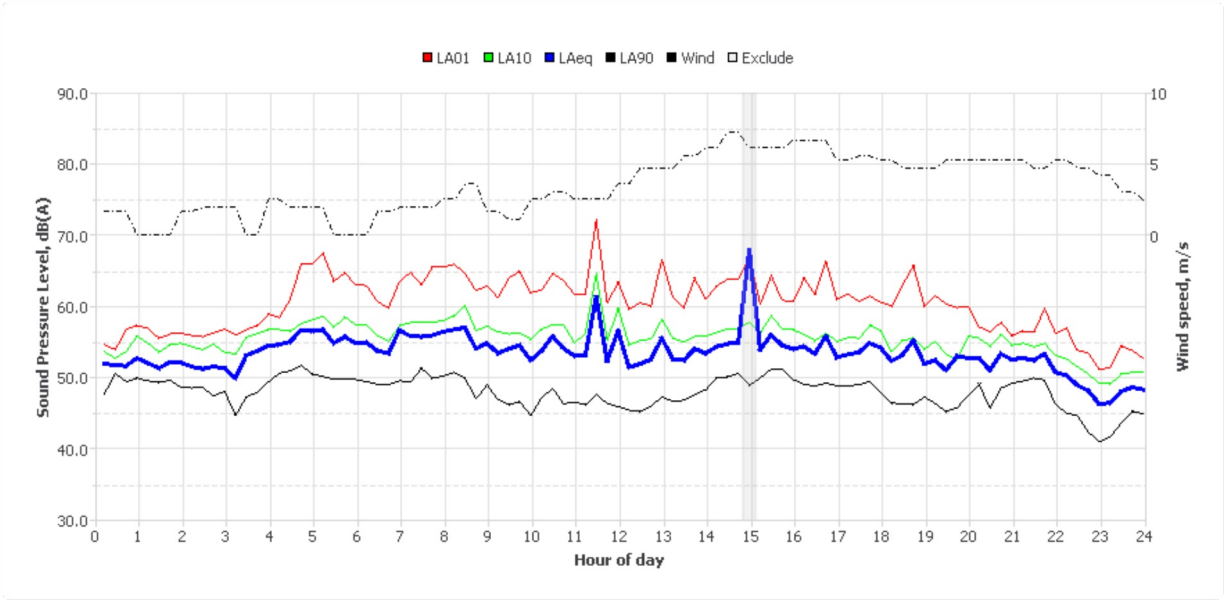
Saturday, 15 Dec 2018



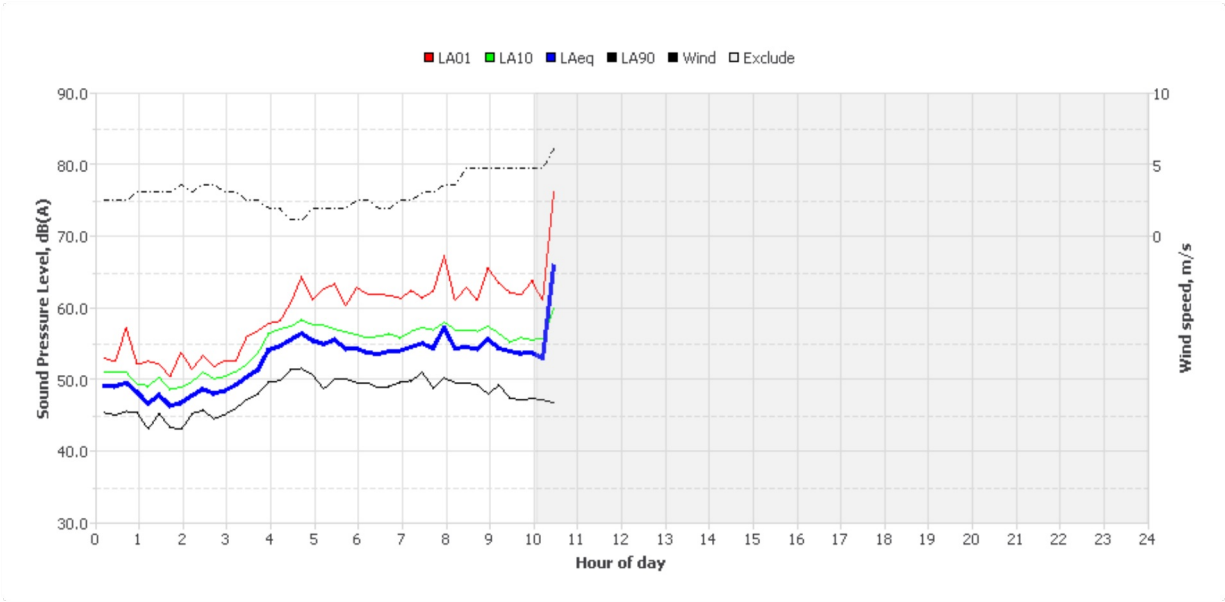
Sunday, 16 Dec 2018



Monday, 17 Dec 2018



Tuesday, 18 Dec 2018



Noise Logger Report

4 Lockyer Avenue, Werrington County

Item	Information
Logger Type	ARL315
Serial number	15-299-444
Address	4 Lockyer Avenue, Werrington County
Location	Front Yard
Facade / Free Field	Facade
Environment	Noise environment dominated by constant road traffic noise from Dunheved Road. Calm weather. Occasional dog barking. Truck and dog pass by 73 dB(A)

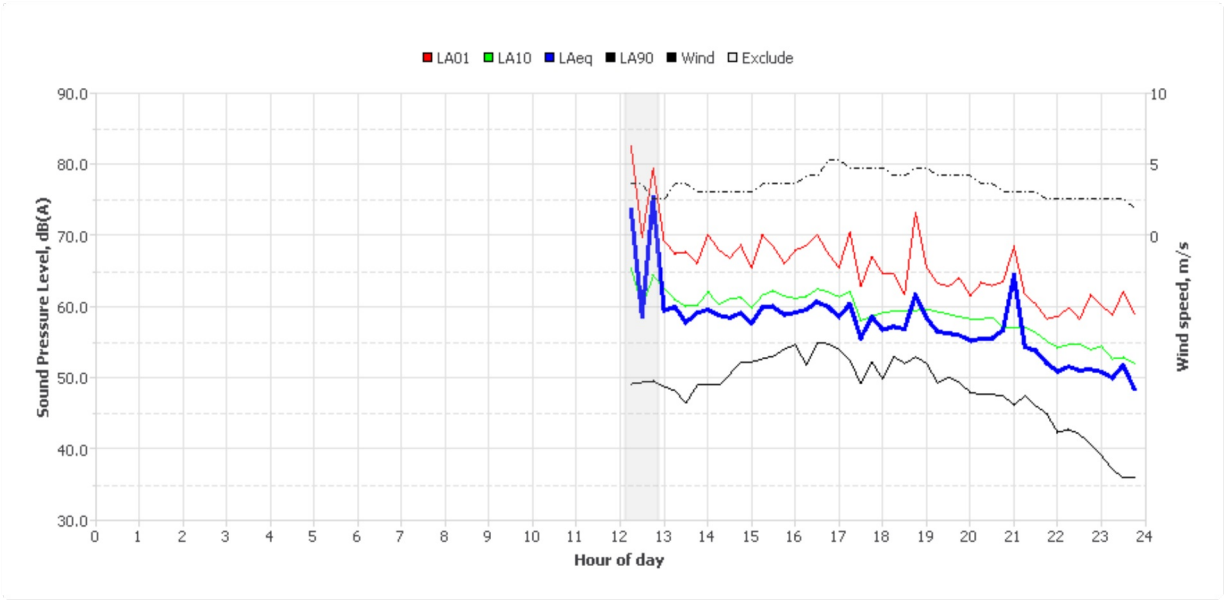
Measured noise levels

Logging Date	L_{Aeq} Day	Eve	Night	ABL Day	Eve	Night	$L_{Aeq,15hr}$	$L_{Aeq,9hr}$
Wed Dec 5 2018	59	58	51	-	46	-	59	51
Thu Dec 6 2018	58	55	53	-	-	-	57	53
Fri Dec 7 2018	58	54	53	46	-	30	57	53
Sat Dec 8 2018	57	53	51	-	-	31	56	51
Sun Dec 9 2018	56	56	49	40	-	33	56	49
Mon Dec 10 2018	59	56	52	48	-	34	58	52
Tue Dec 11 2018	58	56	51	48	44	32	58	51
Wed Dec 12 2018	59	56	53	48	42	32	58	53
Thu Dec 13 2018	59	56	51	49	-	33	58	51
Fri Dec 14 2018	59	55	52	-	45	34	58	52
Sat Dec 15 2018	59	55	51	-	44	36	58	51
Sun Dec 16 2018	57	55	49	-	-	33	56	49
Mon Dec 17 2018	60	57	52	51	45	35	59	52
Tue Dec 18 2018	57	-	52	-	-	-	57	52
Summary	**58**	**56**	**52**	**48**	**45**	**33**	**58**	**52**

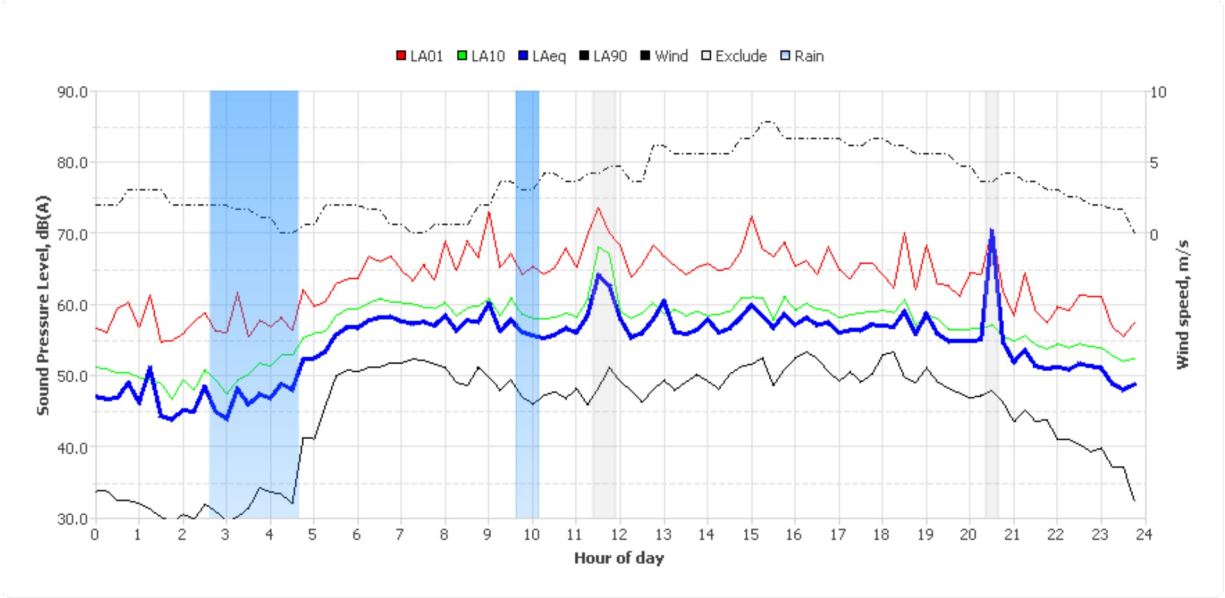
Note: Results denoted with '-' do not contain enough valid data for a value to be calculated. The data has been excluded either manually or automatically as a result of adverse weather conditions.

Logger Location	Logger Deployment Photo
	

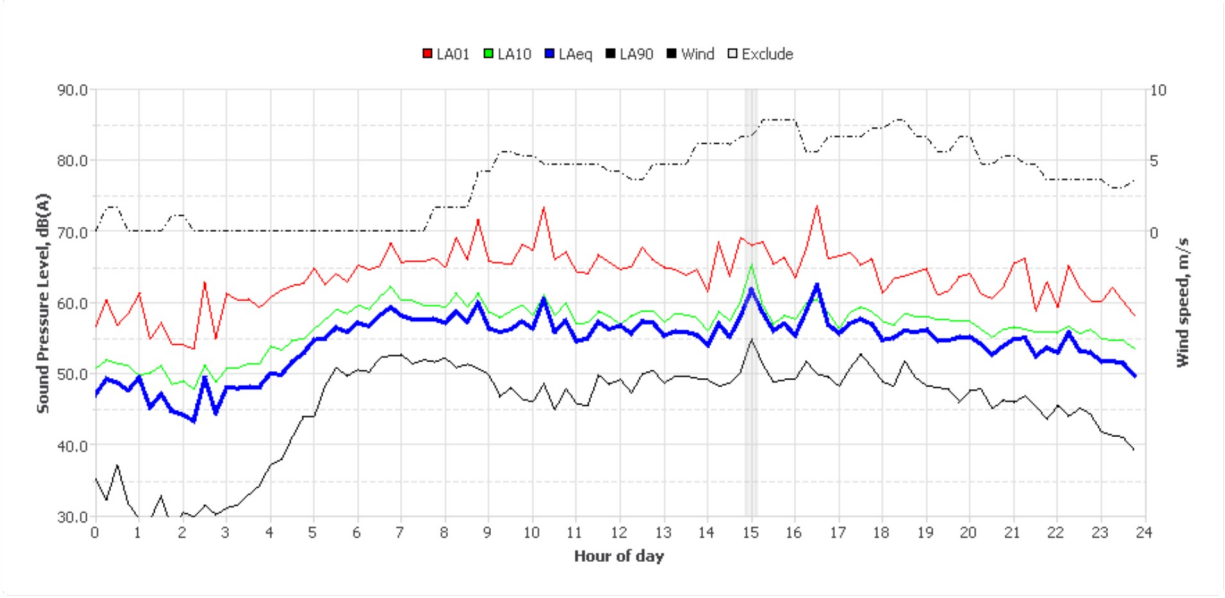
Wednesday, 05 Dec 2018



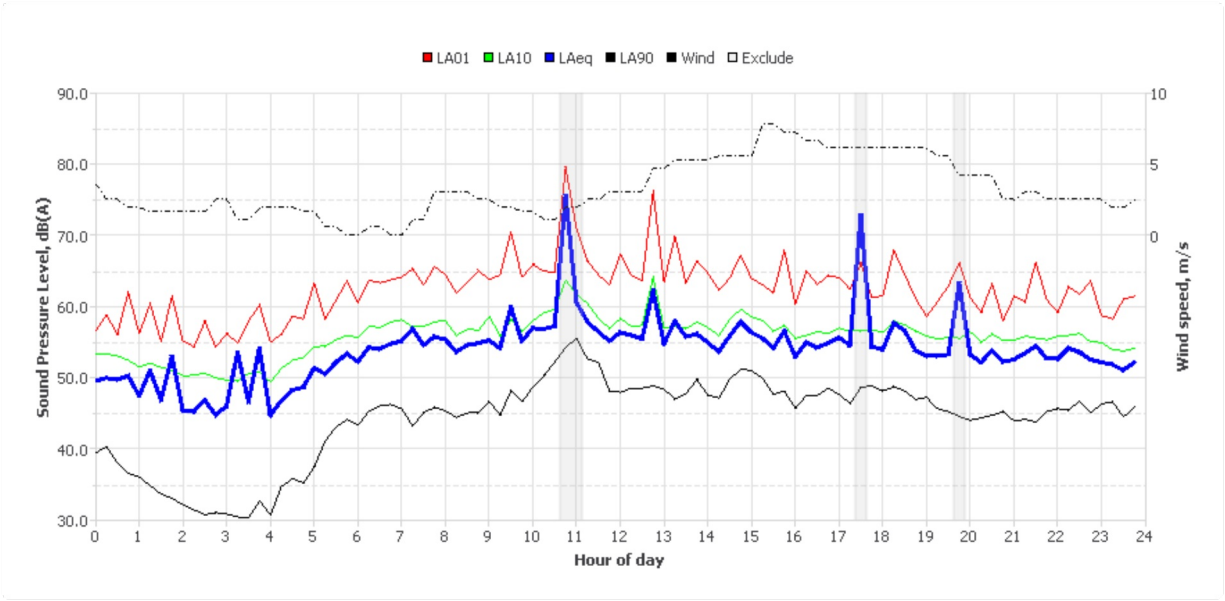
Thursday, 06 Dec 2018



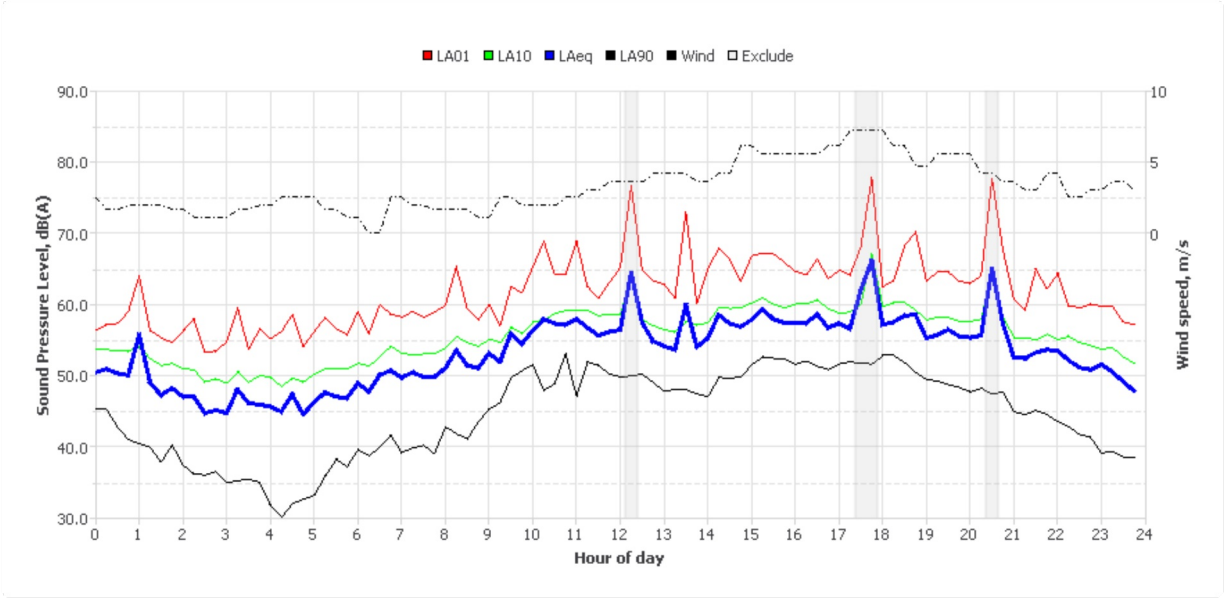
Friday, 07 Dec 2018



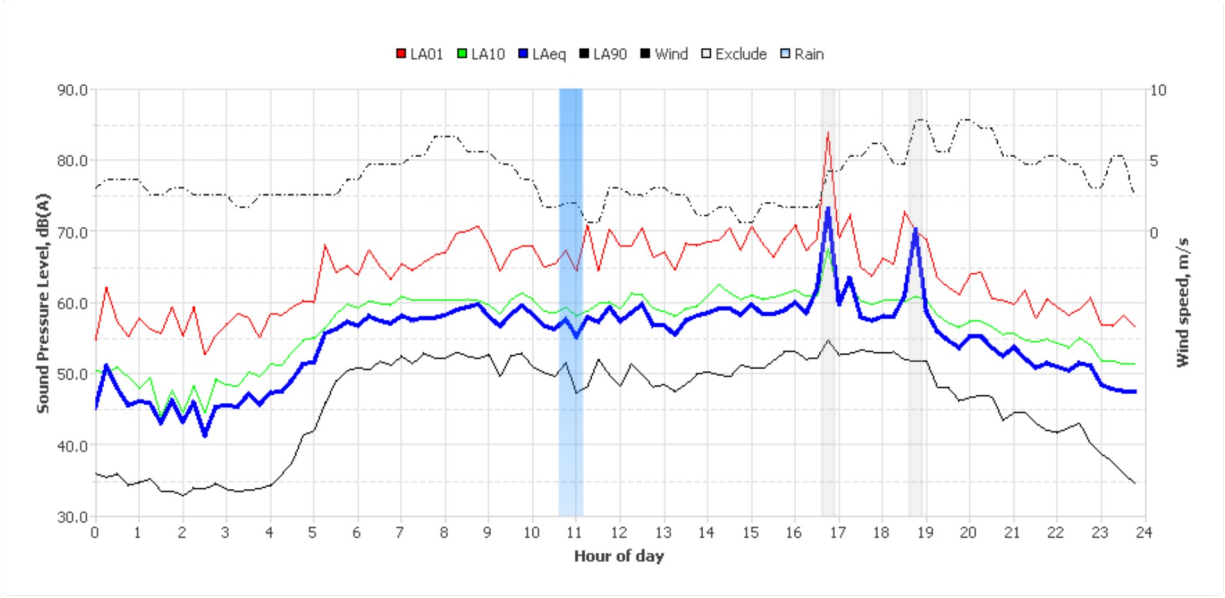
Saturday, 08 Dec 2018



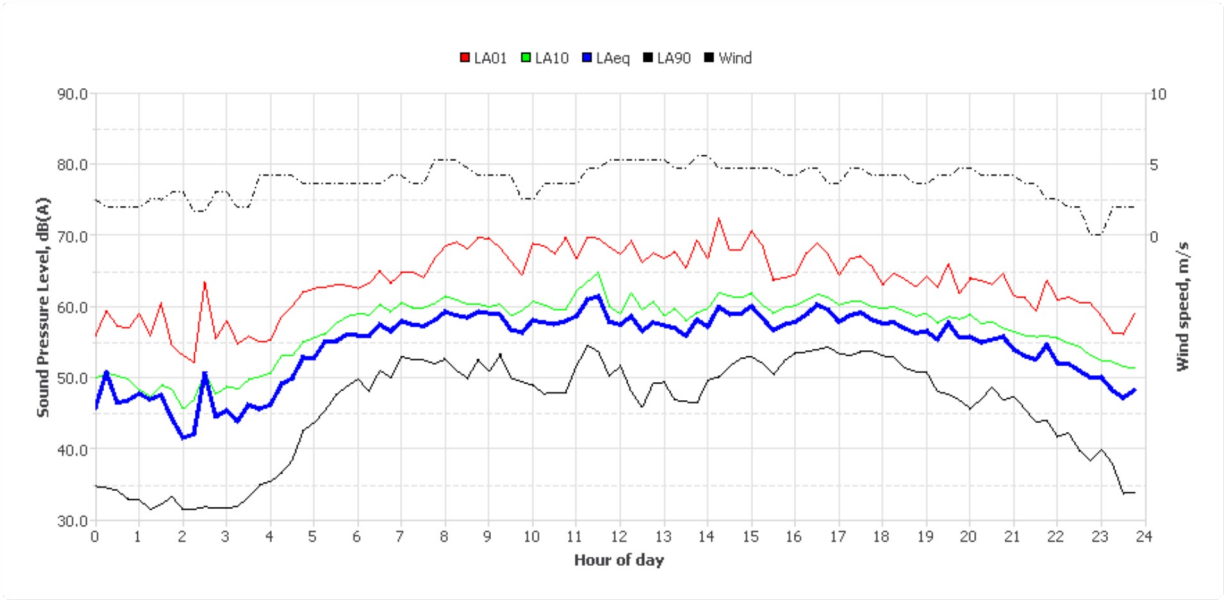
Sunday, 09 Dec 2018



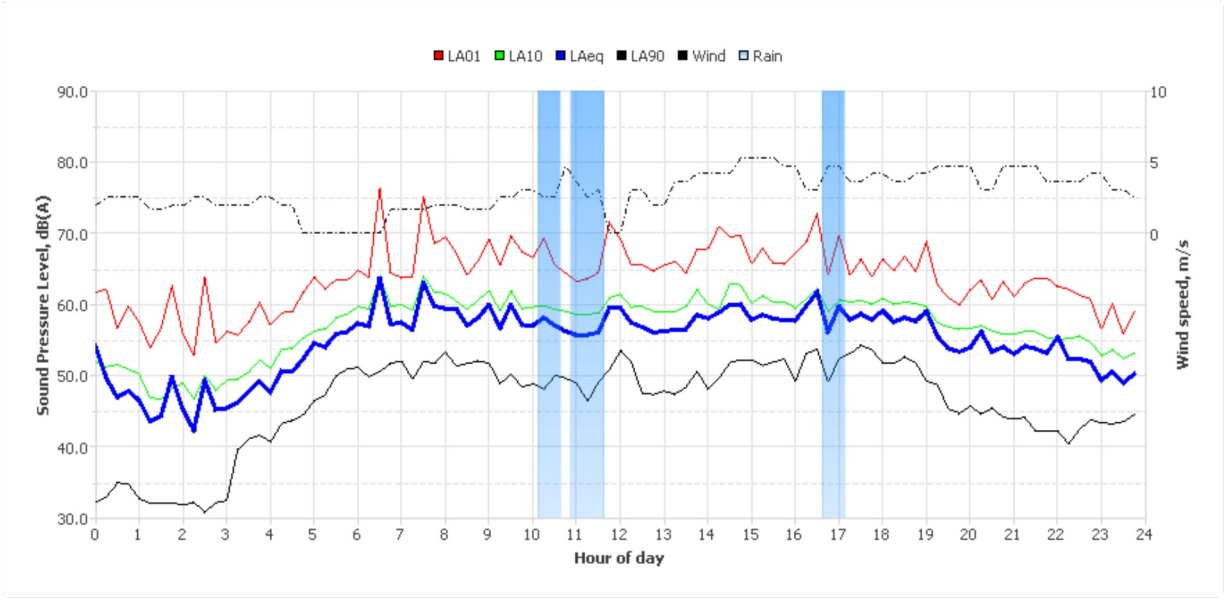
Monday, 10 Dec 2018



Tuesday, 11 Dec 2018



Wednesday, 12 Dec 2018



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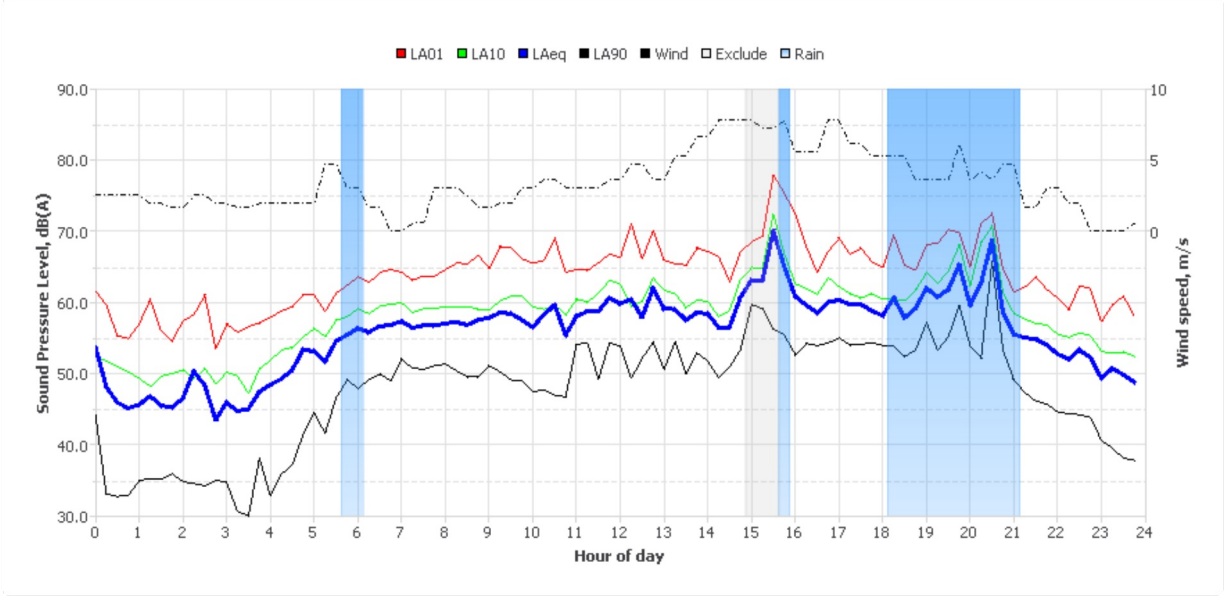
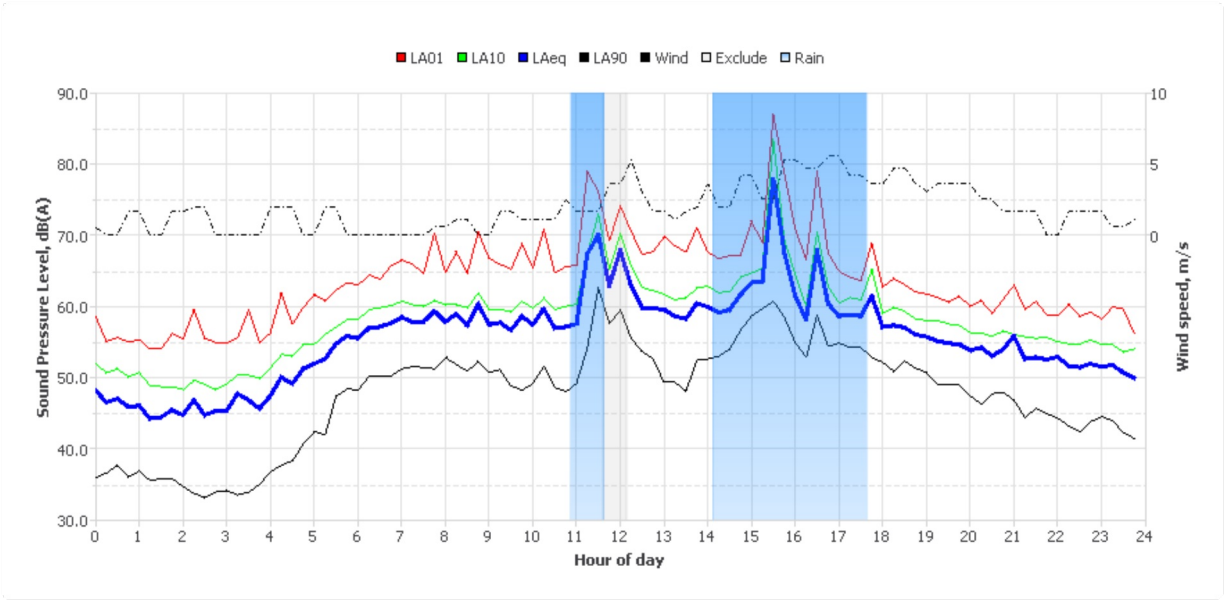
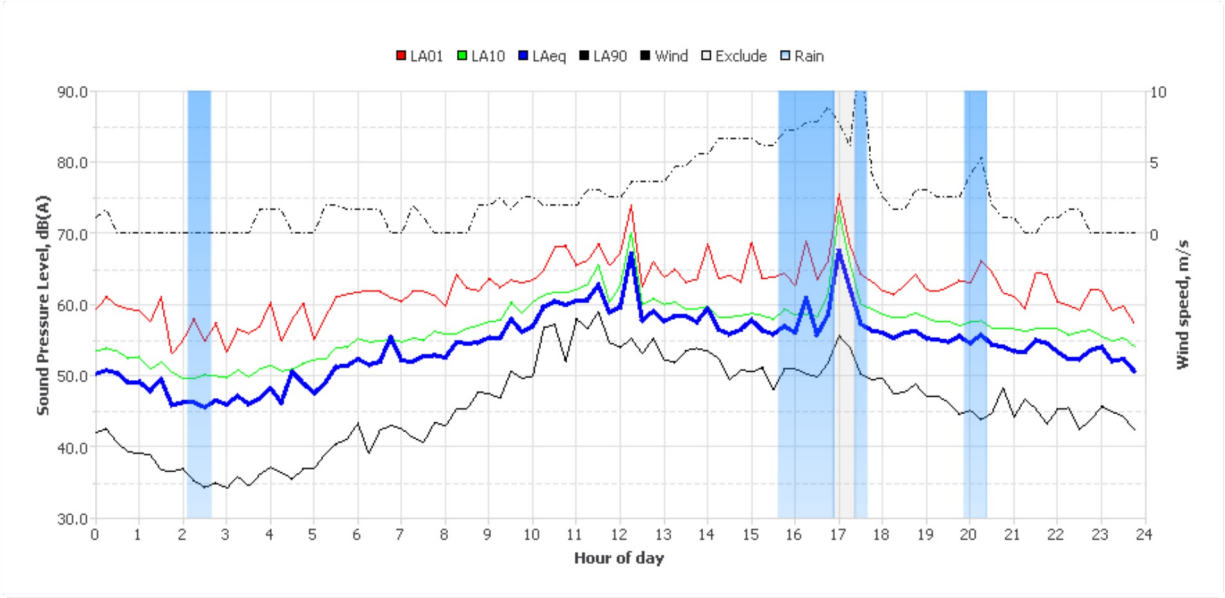


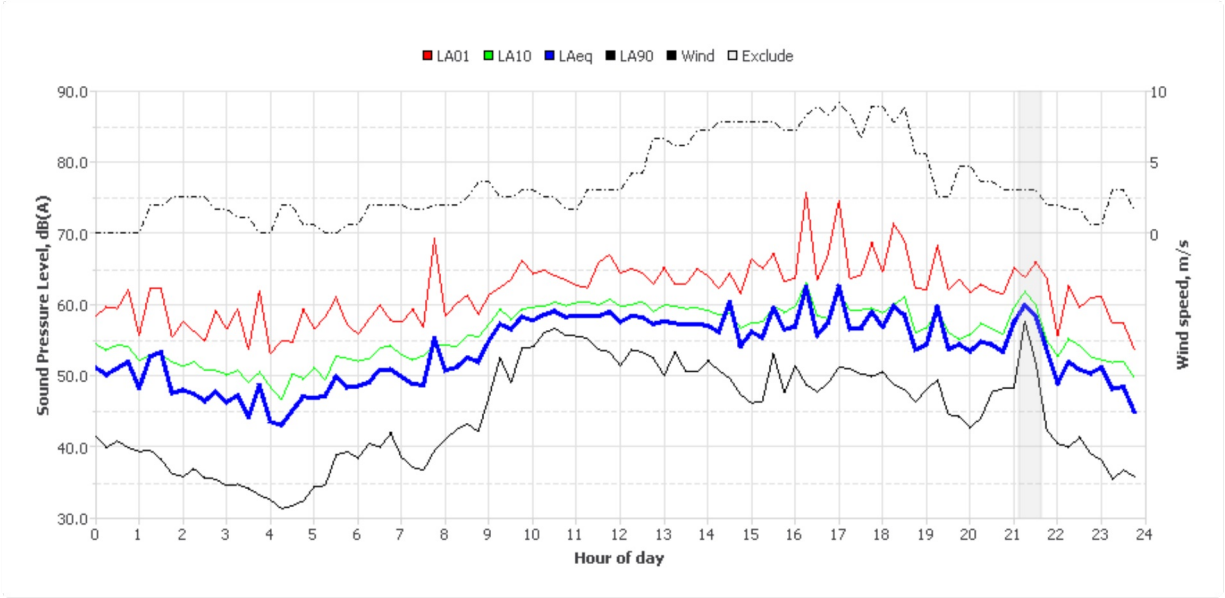
Friday, 14 Dec 2018



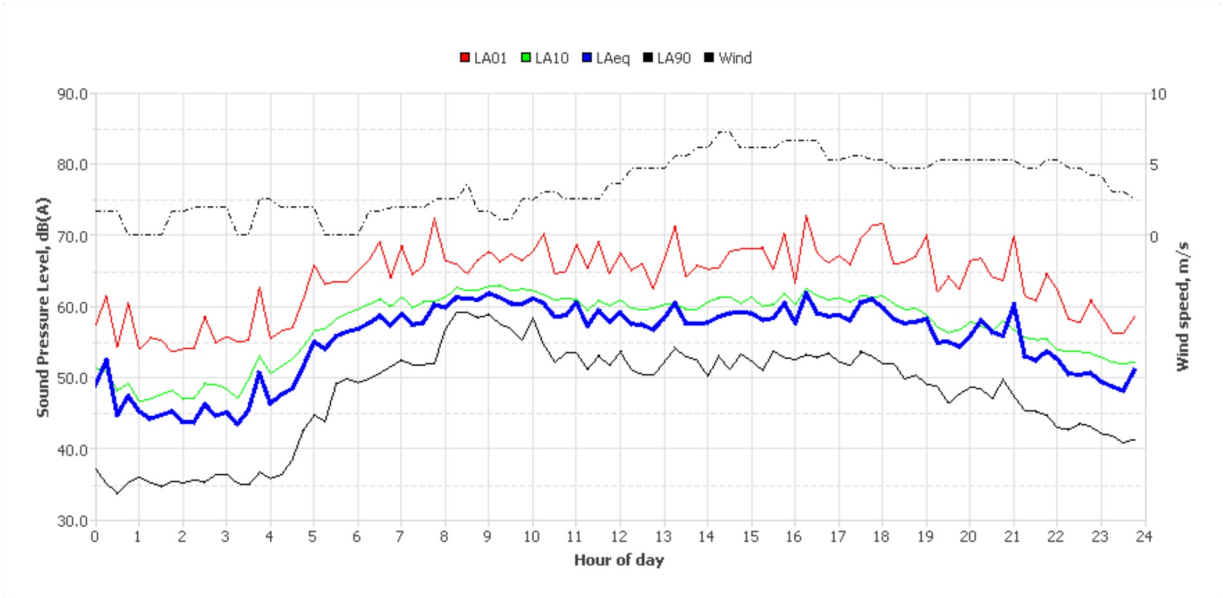
Saturday, 15 Dec 2018



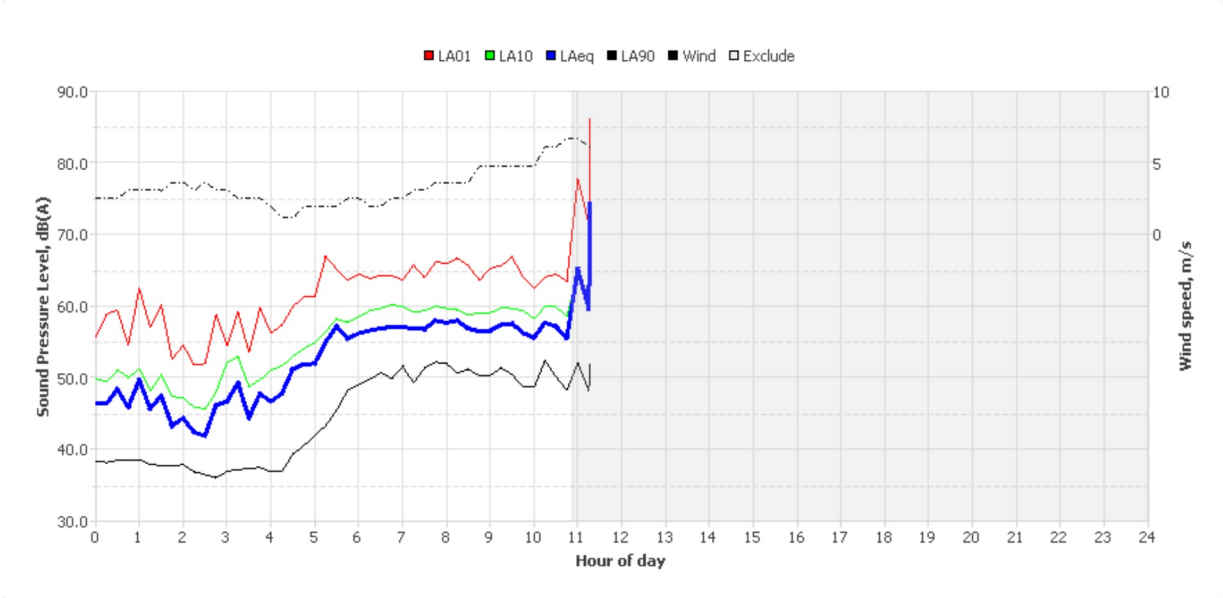
Sunday, 16 Dec 2018



Monday, 17 Dec 2018

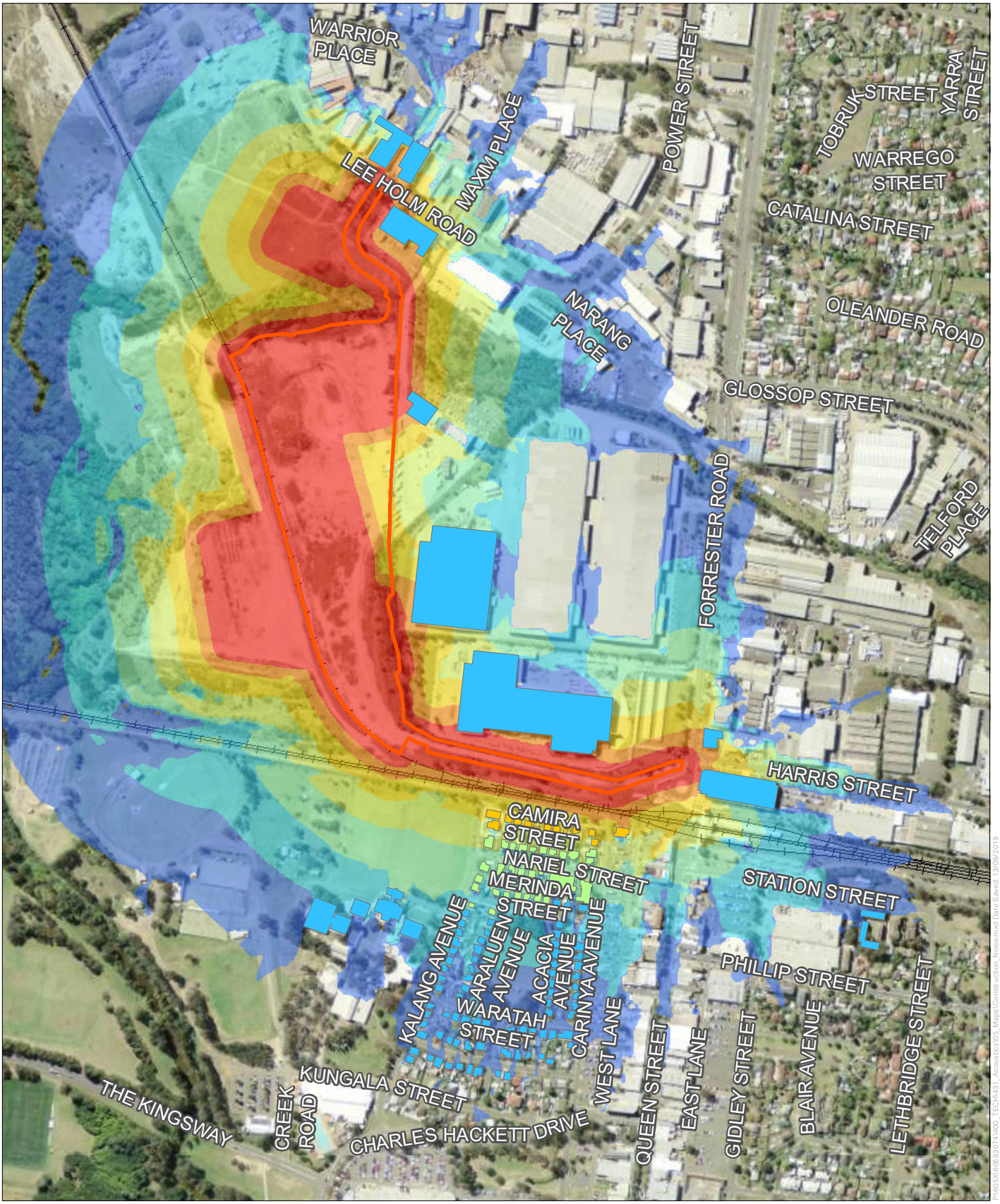


Tuesday, 18 Dec 2018



Appendix C

Construction Noise Contour Plots



Construction Noise Levels

Site establishment and delivery of materials

ST MARYS freight hub

pacificnational AECOM

N

0 100 200 Meters

P:\605X\60593074\400_TECH\431_Acoustics\05_Maps\Construction_Noise.mxd Date Saved: 13/09/2019

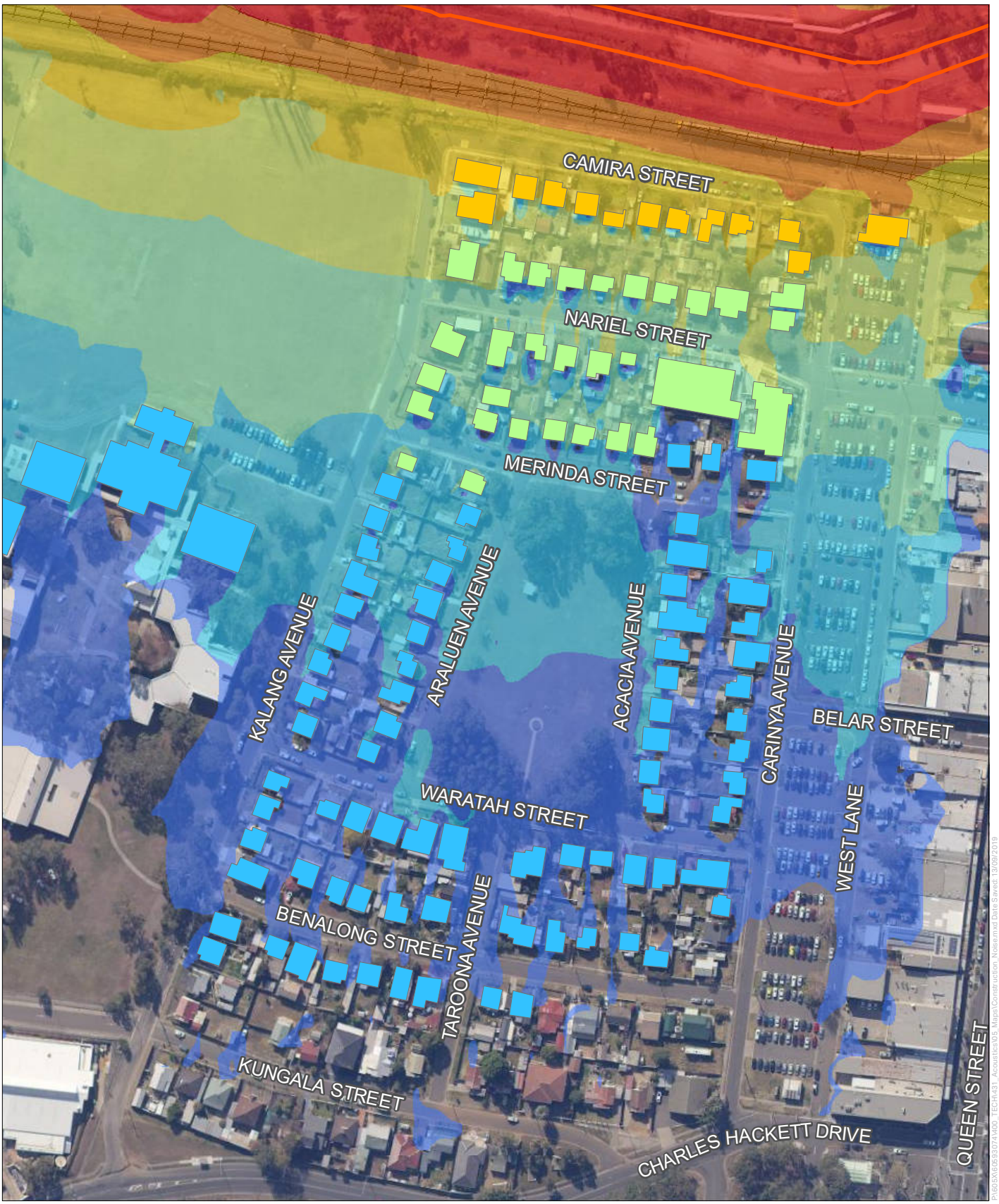
Sound Pressure Level, L_{Aeq} dB(A)

< 48 | 48 - 52 | 53 - 57 | 58 - 62 | 63 - 67 | 68 - 72 | 73 - 77 | > 77

Exceedance, dB

- < 0
- 1 - 10
- 11 - 20
- 21 - 30

Source:



Construction Noise Levels

Site establishment and delivery of materials

ST MARYS freight hub

pacificnational AECOM

N

0 30 60 Meters

Sound Pressure Level, L_{Aeq} dB(A)

< 48 | 48 - 52 | 53 - 57 | 58 - 62 | 63 - 67 | 68 - 72 | 73 - 77 | > 77

Exceedance, dB

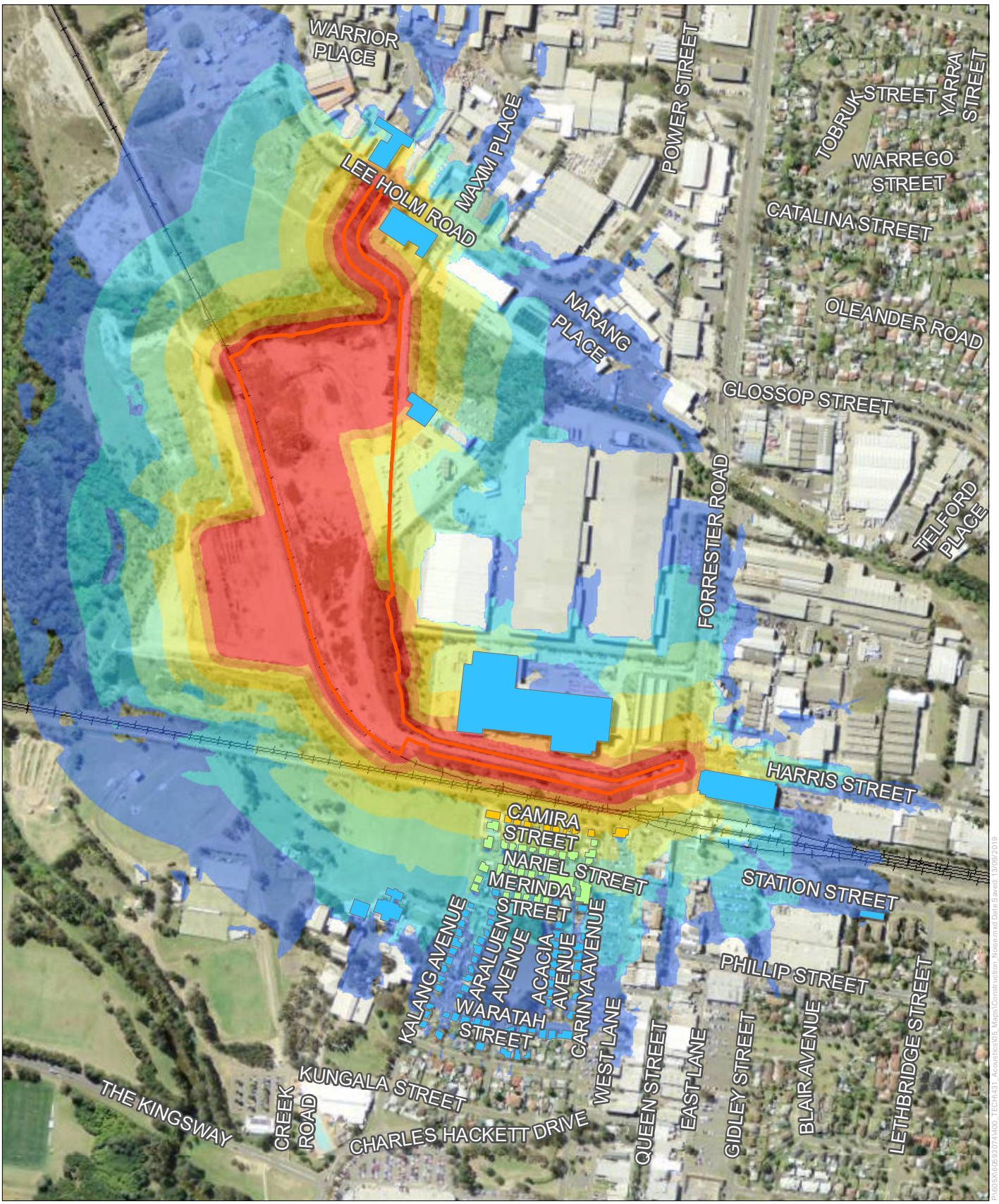
< 0

1 - 10

11 - 20

21 - 30

Source:



Construction Noise Levels

Bulk earthworks

ST MARYS freight hub

pacificnational AECOM

N

0 100 200 Meters

P:\605X\60593074\400_TECH\431_Acoustics\05_Maps\Construction_Noise.mxd Date Saved: 13/09/2019

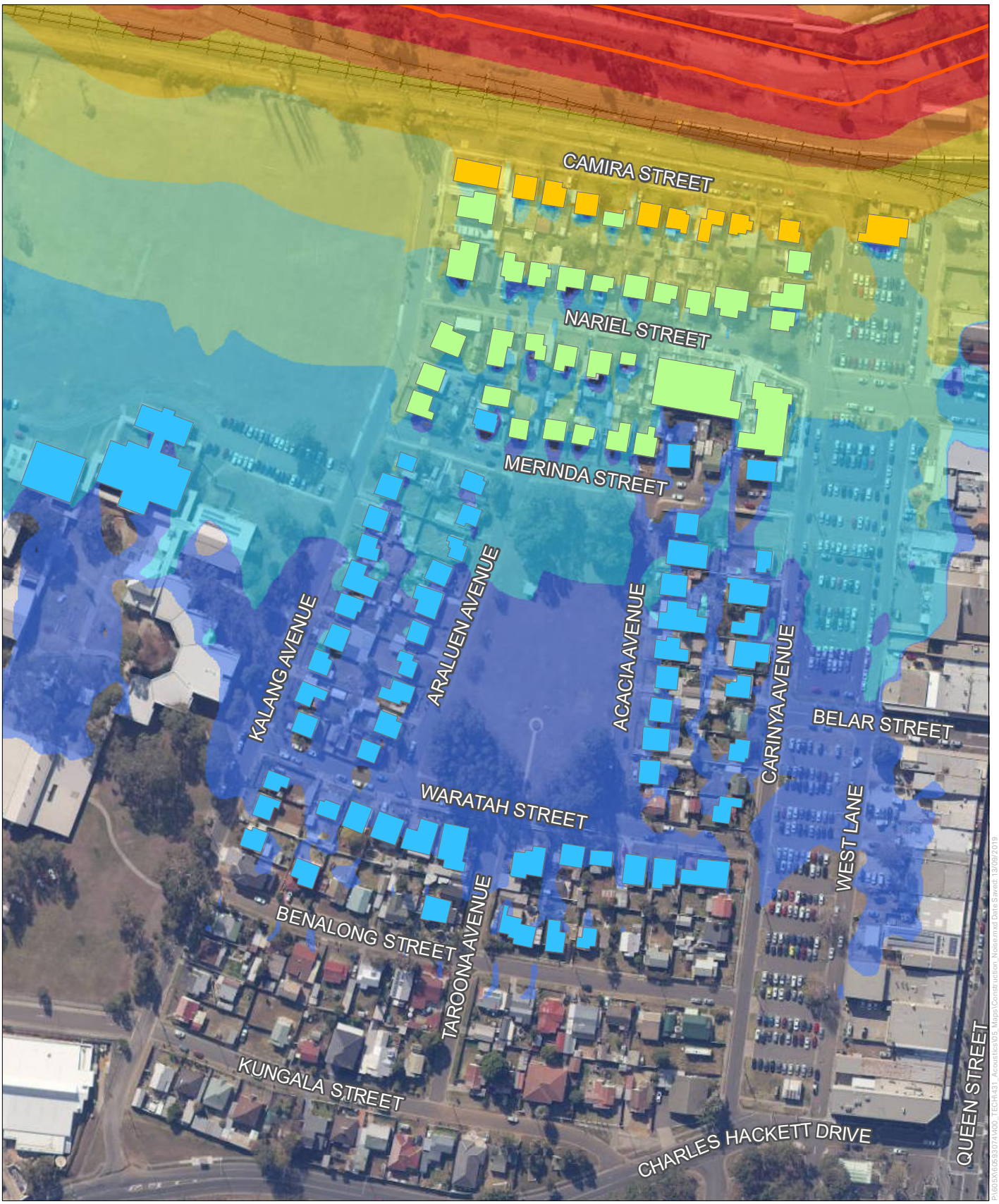
Sound Pressure Level, L_{Aeq} dB(A)

< 48 | 48 - 52 | 53 - 57 | 58 - 62 | 63 - 67 | 68 - 72 | 73 - 77 | > 77

Exceedance, dB

- < 0
- 1 - 10
- 11 - 20
- 21 - 30

Source:



Construction Noise Levels

Bulk earthworks

ST MARYS freight hub

pacificnational AECOM

N

0 30 60 Meters

Sound Pressure Level, L_{Aeq} dB(A)

< 48 | 48 - 52 | 53 - 57 | 58 - 62 | 63 - 67 | 68 - 72 | 73 - 77 | > 77

Exceedance, dB

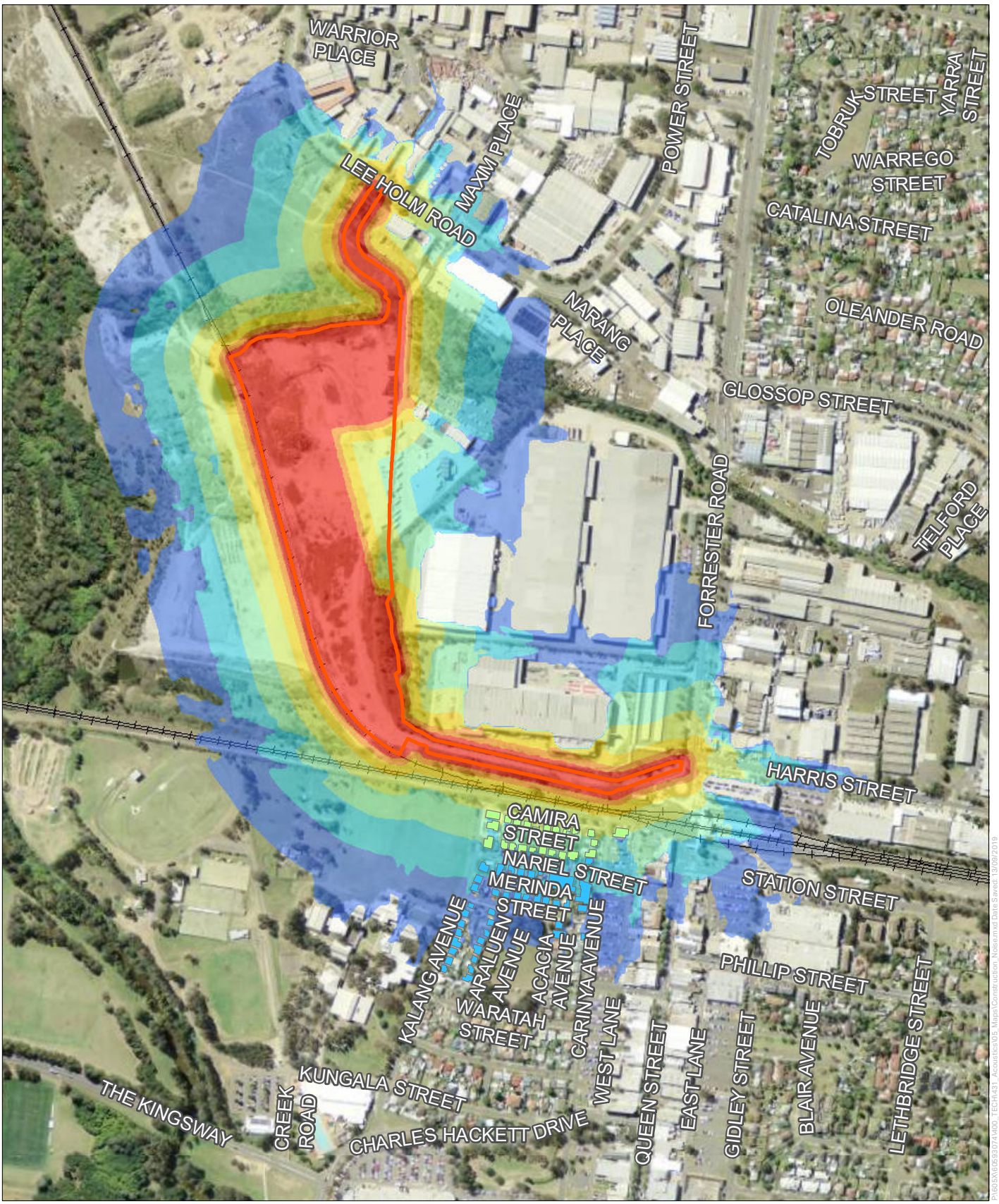
< 0

1 - 10

11 - 20

21 - 30

Source:



Construction Noise Levels

Trenches / utilities

ST MARYS freight hub

pacificnational AECOM

N

0 100 200 Meters

P:\605X\60593074\400_TECH\431_Acoustics\05_Maps\Construction_Noise.mxd Date Saved: 13/09/2019

Sound Pressure Level, L_{Aeq} dB(A)

< 48 | 48 - 52 | 53 - 57 | 58 - 62 | 63 - 67 | 68 - 72 | 73 - 77 | > 77

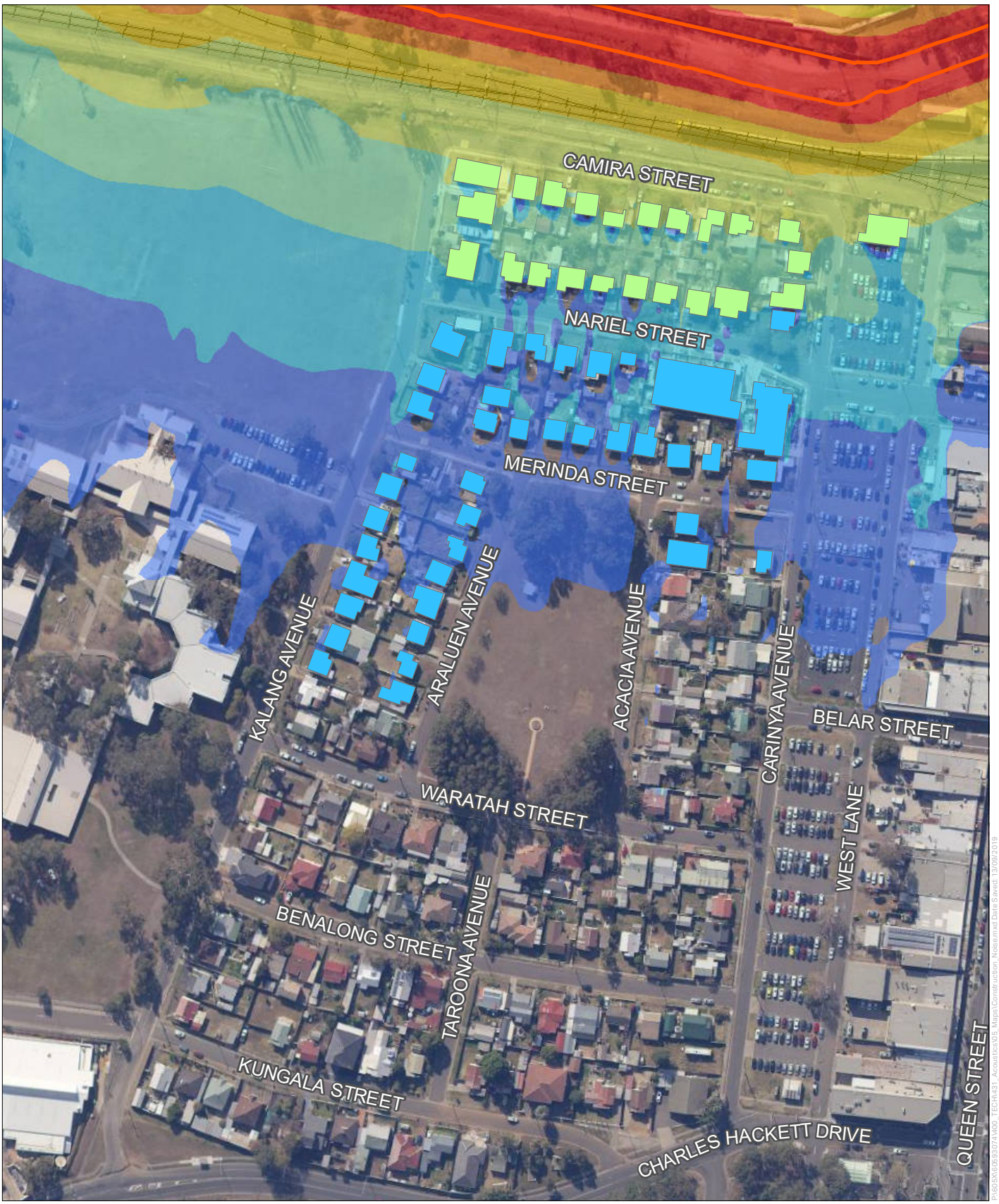
Exceedance, dB

< 0

1 - 10

11 - 20

Source:



Construction Noise Levels

Trenches / utilities

ST MARYS freight hub

pacificnational AECOM

N

0 30 60 Meters

P:\605X\60593074\400_TECH\431_Acoustics\05_Maps\Construction_Noise.mxd Date Saved: 13/09/2019

Sound Pressure Level, L_{Aeq} dB(A)

< 48 | 48 - 52 | 53 - 57 | 58 - 62 | 63 - 67 | 68 - 72 | 73 - 77 | > 77

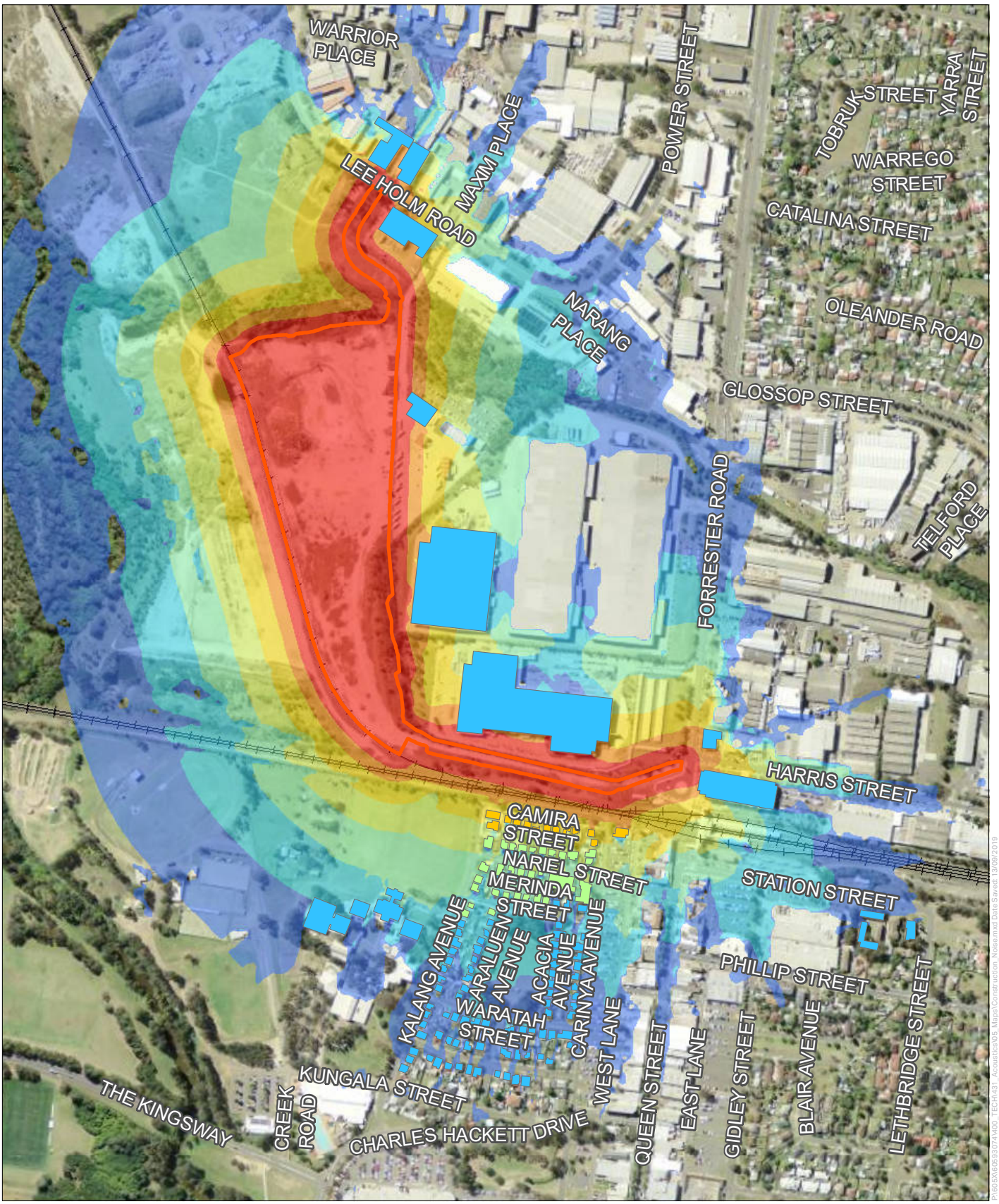
Exceedance, dB

< 0

1 - 10

11 - 20

Source:



Construction Noise Levels

Pavement / hardstand construction

ST MARYS freight hub

pacificnational AECOM

N

0 100 200 Meters

P:\605X\60593074\400_TECH\431_Acoustics\05_Maps\Construction_Noise.mxd Date Saved: 13/09/2019

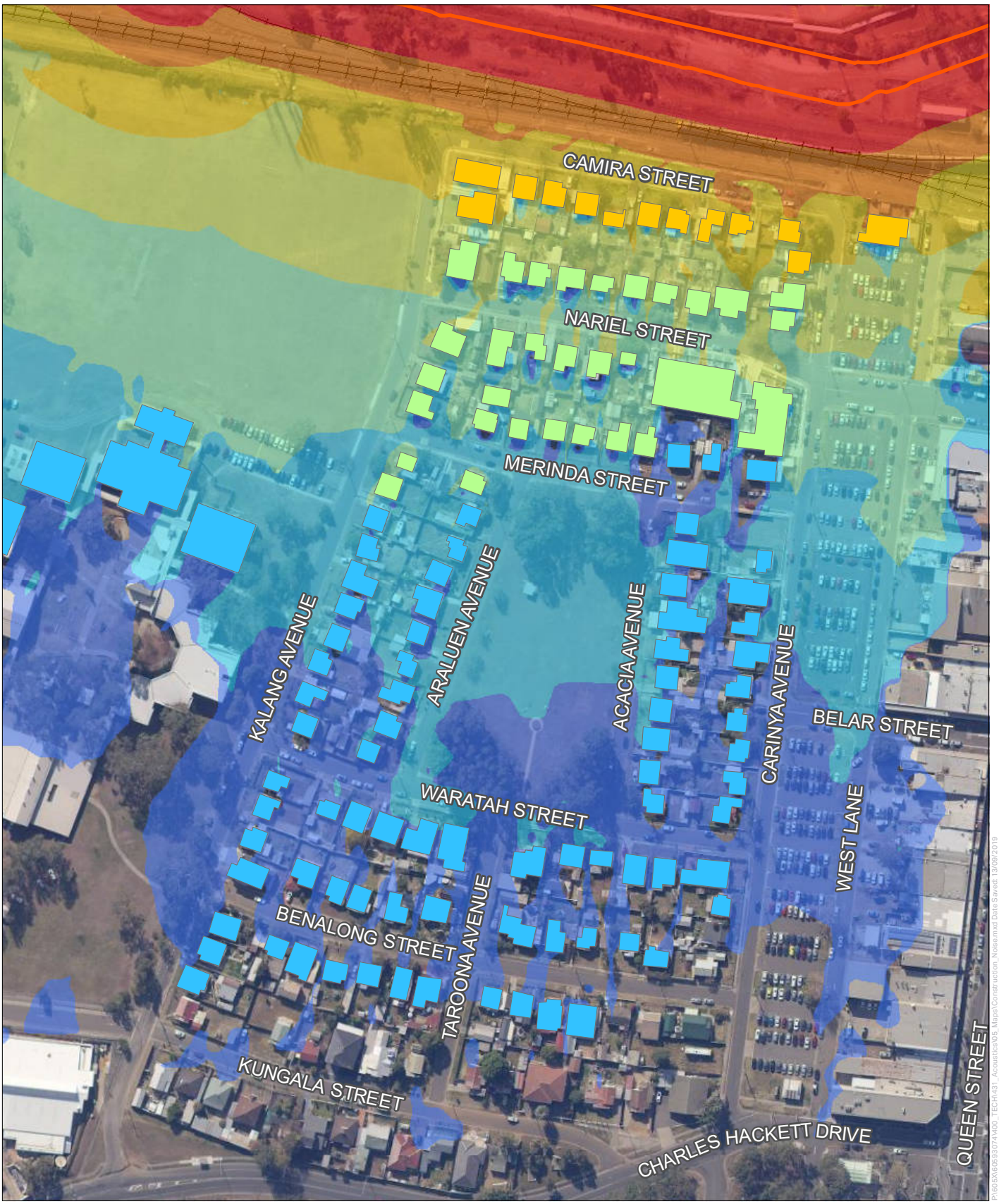
Sound Pressure Level, L_{Aeq} dB(A)

< 48 | 48 - 52 | 53 - 57 | 58 - 62 | 63 - 67 | 68 - 72 | 73 - 77 | > 77

Exceedance, dB

- < 0
- 1 - 10
- 11 - 20
- 21 - 30

Source:



Construction Noise Levels

Pavement / hardstand construction

ST MARYS freight hub

pacificnational AECOM

N

0 30 60 Meters

Sound Pressure Level, L_{Aeq} dB(A)

< 48 | 48 - 52 | 53 - 57 | 58 - 62 | 63 - 67 | 68 - 72 | 73 - 77 | > 77

Exceedance, dB

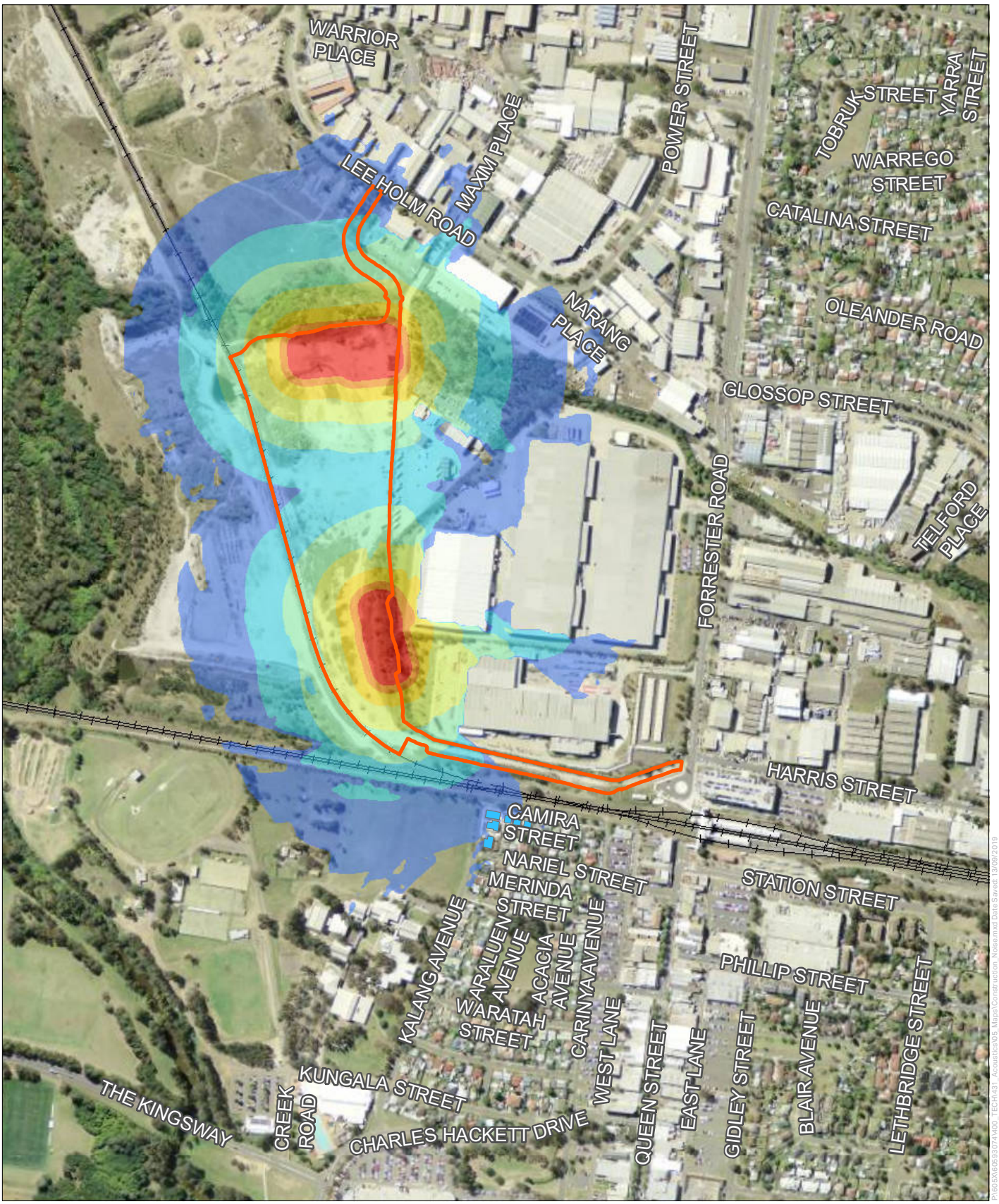
< 0

1 - 10

11 - 20

21 - 30

Source:



Construction Noise Levels

Building delivery and installation

ST MARYS freight hub | pacificnational | AECOM

N

0 100 200 Meters

Sound Pressure Level, L_{Aeq} dB(A)

< 48 | 48 - 52 | 53 - 57 | 58 - 62 | 63 - 67 | 68 - 72 | 73 - 77 | > 77

Exceedance, dB

< 0

1 - 10

Source:

Construction Noise Levels

Building delivery and installation

ST MARYS freight hub | pacificnational | AECOM

N

0 30 60 Meters

Sound Pressure Level, L_{Aeq} dB(A) Exceedance, dB

< 48

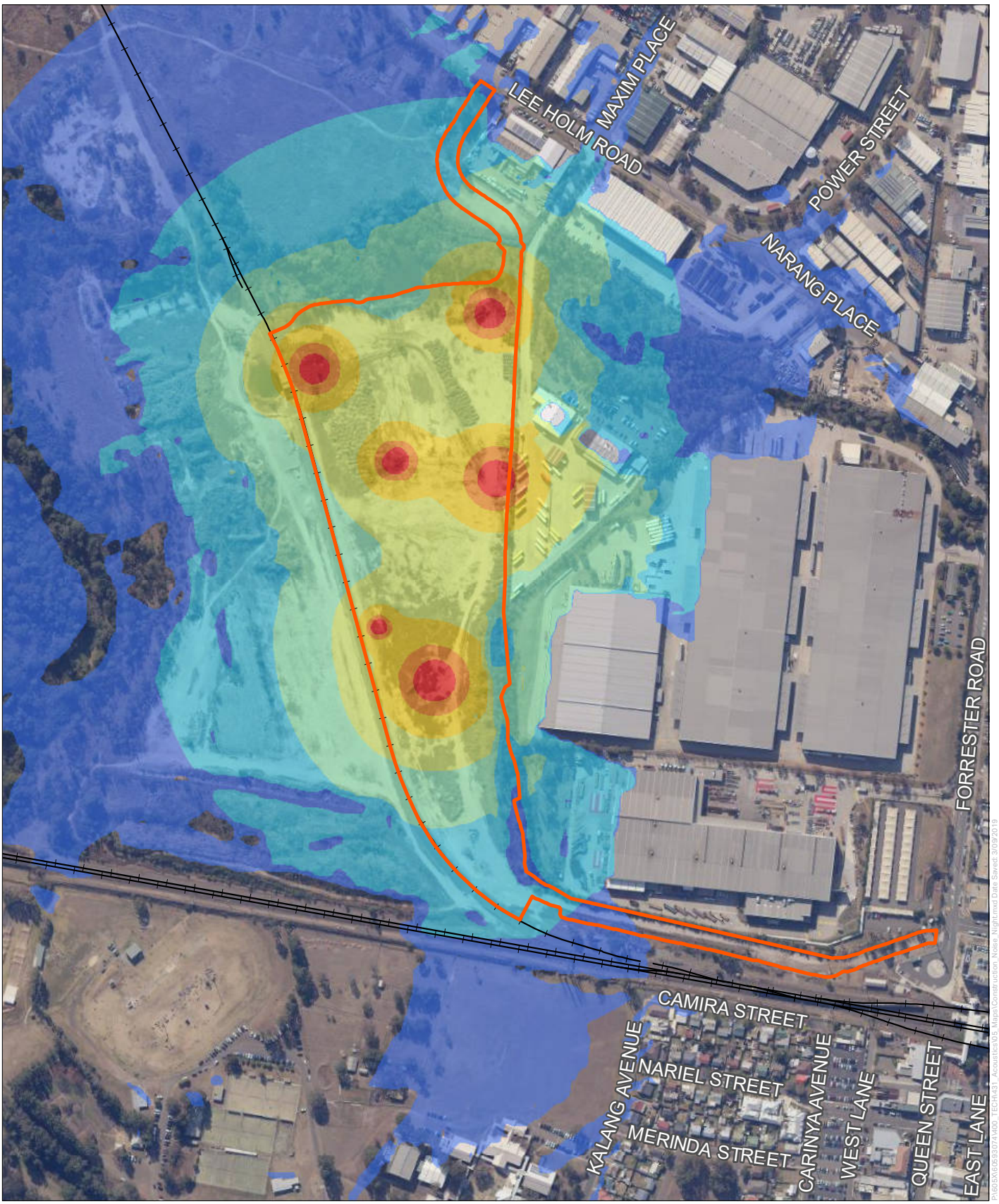
48 - 52

53 - 57

< 0

1 - 10

Source:



Construction Noise Levels

Extended hours Works

ST MARYS freight hub

pacificnational AECOM

N

0 70 140 Meters

Sound Pressure Level, L_{Aeq} dB(A)

< 42 | 42 - 46 | 47 - 51 | 52 - 56 | 57 - 61 | 62 - 66 | 67 - 71 | > 71

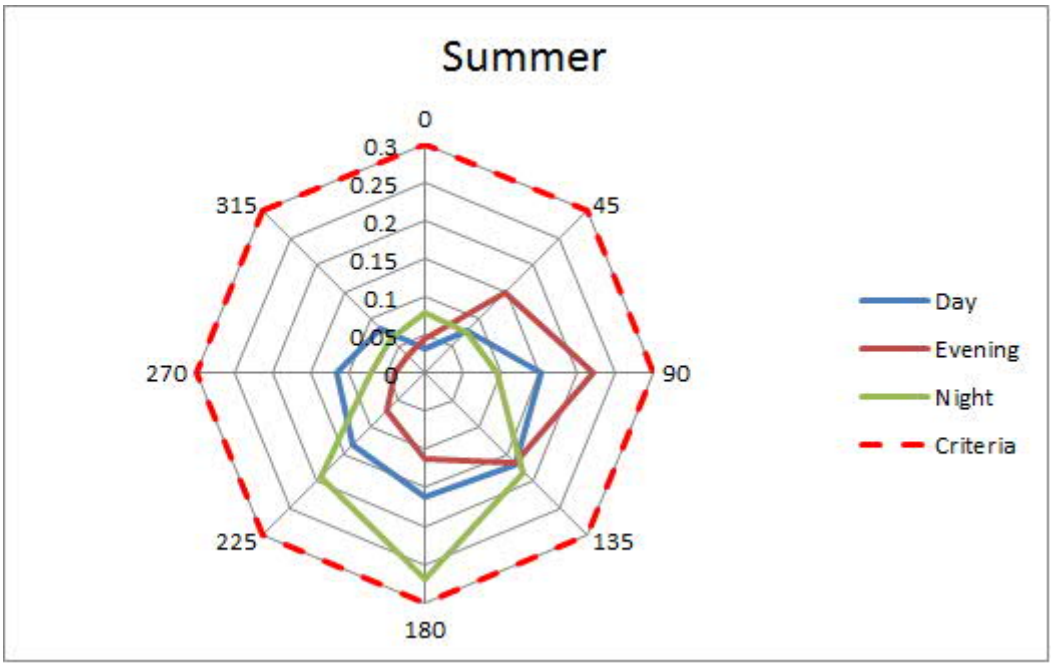
Subject Site

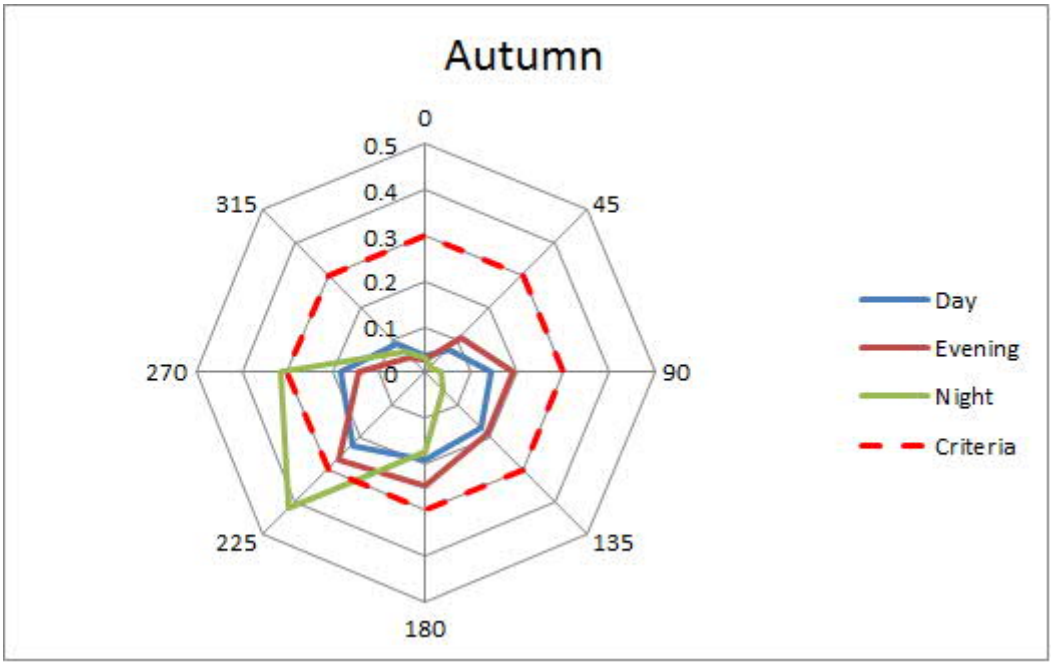
Source:

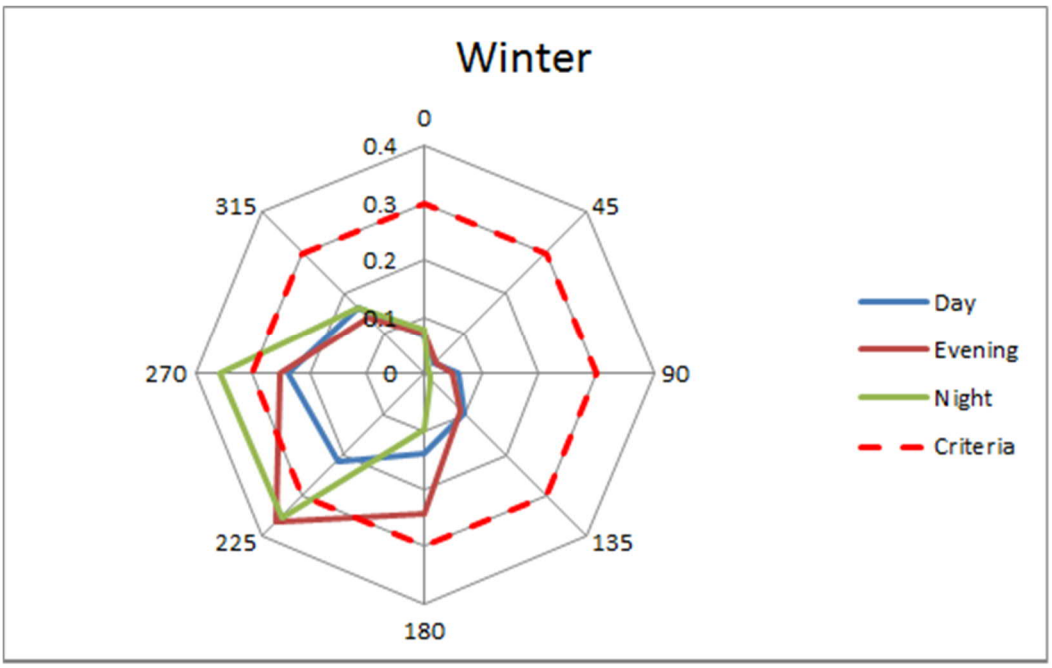
Appendix D

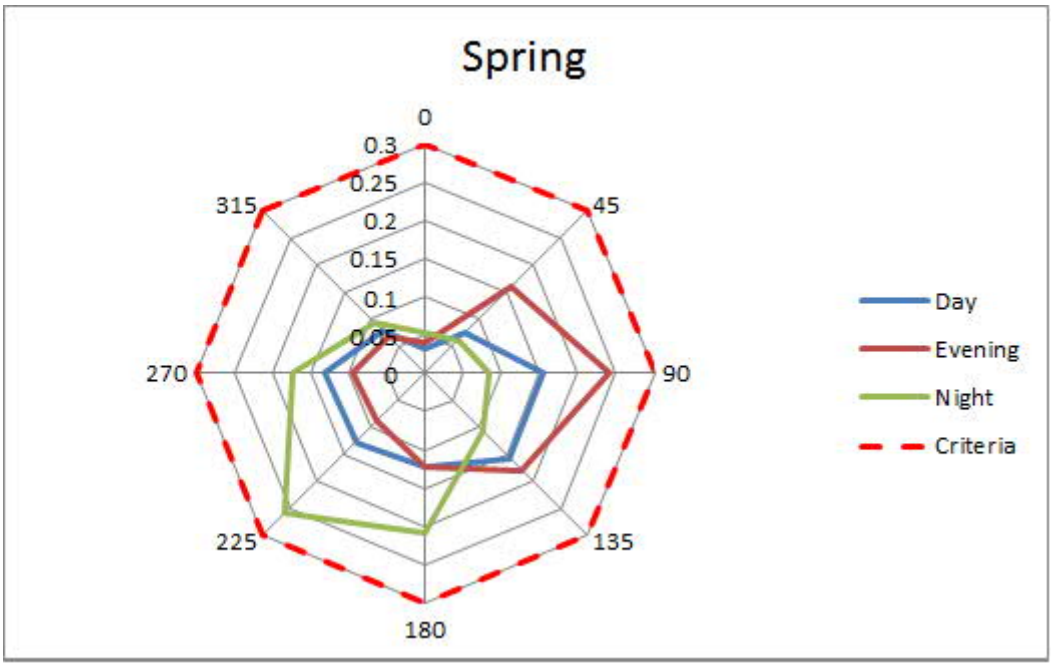
Wind Roses

Appendix D Wind Roses






Winter
0
0.4
0.3
0.2
0.1
0
45
90
135
180
225
270
315
Day
Evening
Night
Criteria

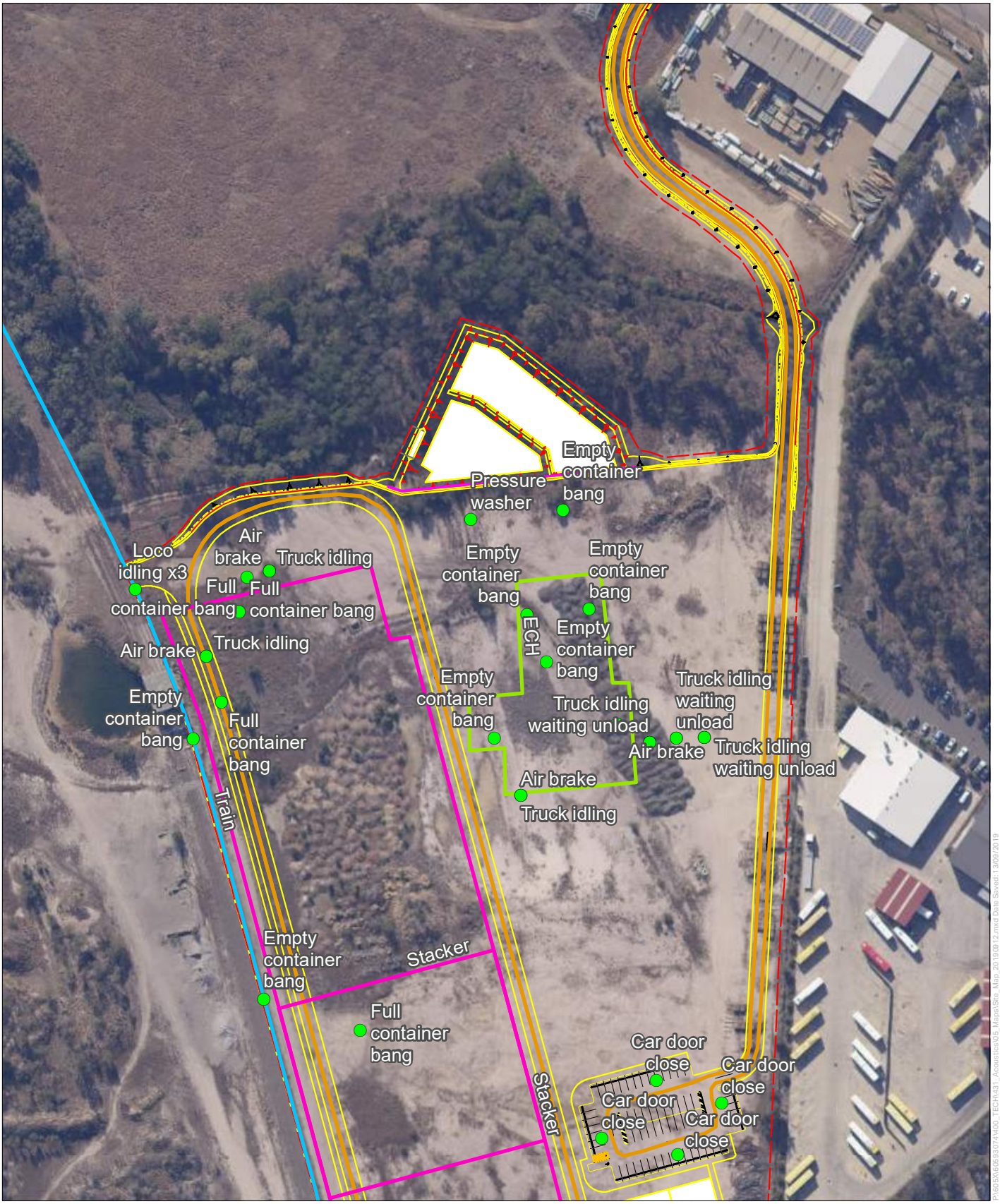

Spring
0
0.3
0.25
0.2
0.15
0.1
0.05
0
45
90
135
180
225
270
315
Day
Evening
Night
Criteria

St Marys Freight Hub

Appendix E

Site Layout and Noise Sources

Appendix E Site Layout and Noise Sources



Noise Source - Site Layout

- Point source
- Vehicle movements
- Noise wall
- Empty container handler
- Stacker
- Train

ST MARYS freight hub | pacific national | AECOM

N

0 25 50 Meters

Source:

Noise Source - Site Layout

- Point source
- Vehicle movements
- Noise wall
- Empty container handler
- Stacker
- Train

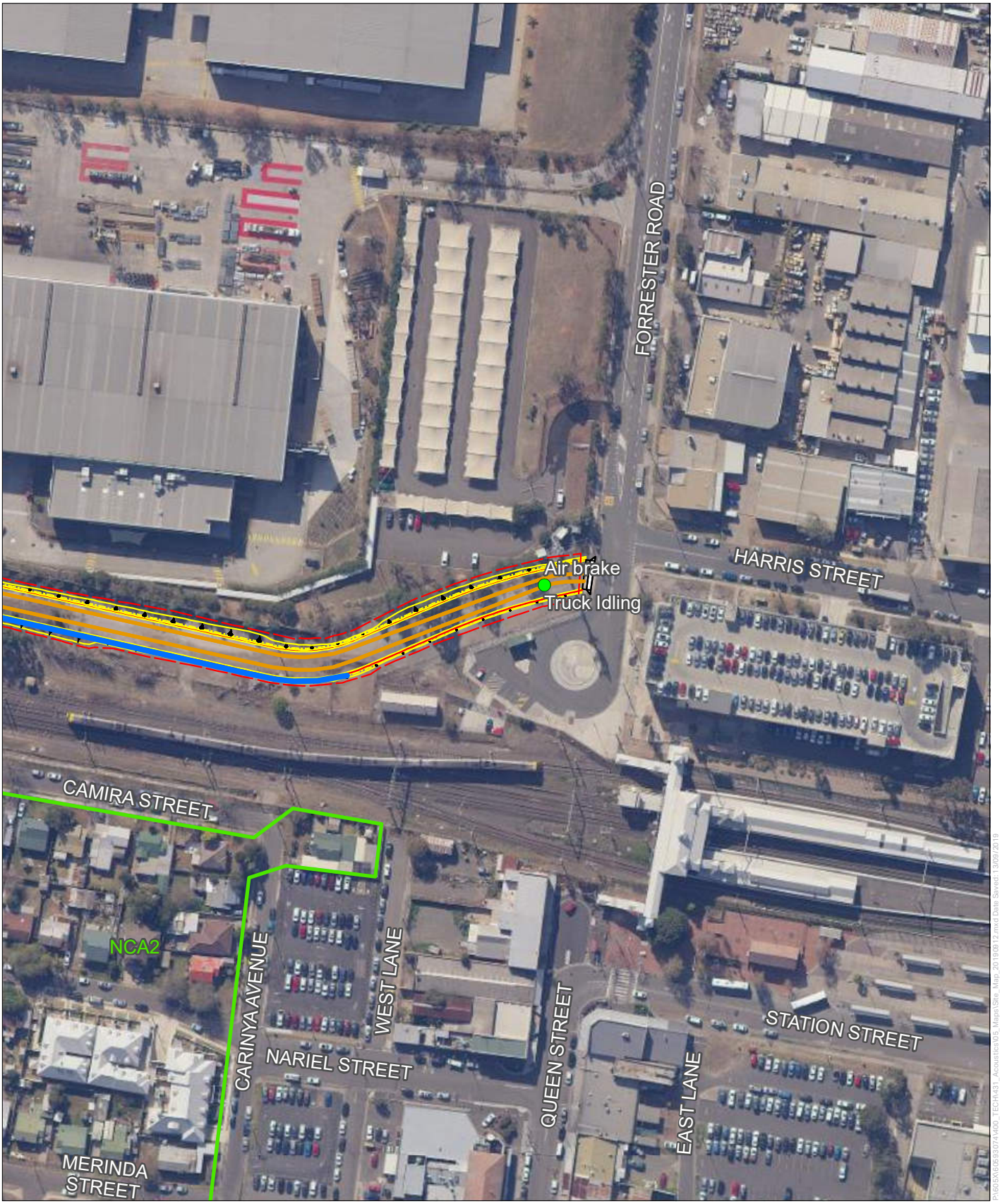
ST MARYS freight hub

pacificnational AECOM

N

0 25 50 Meters

Source:



Noise Source - Site Layout

- Point source
- Vehicle movements
- Noise wall
- Empty container handler
- Stacker
- Train

ST MARYS freight hub | pacificnational | AECOM

N

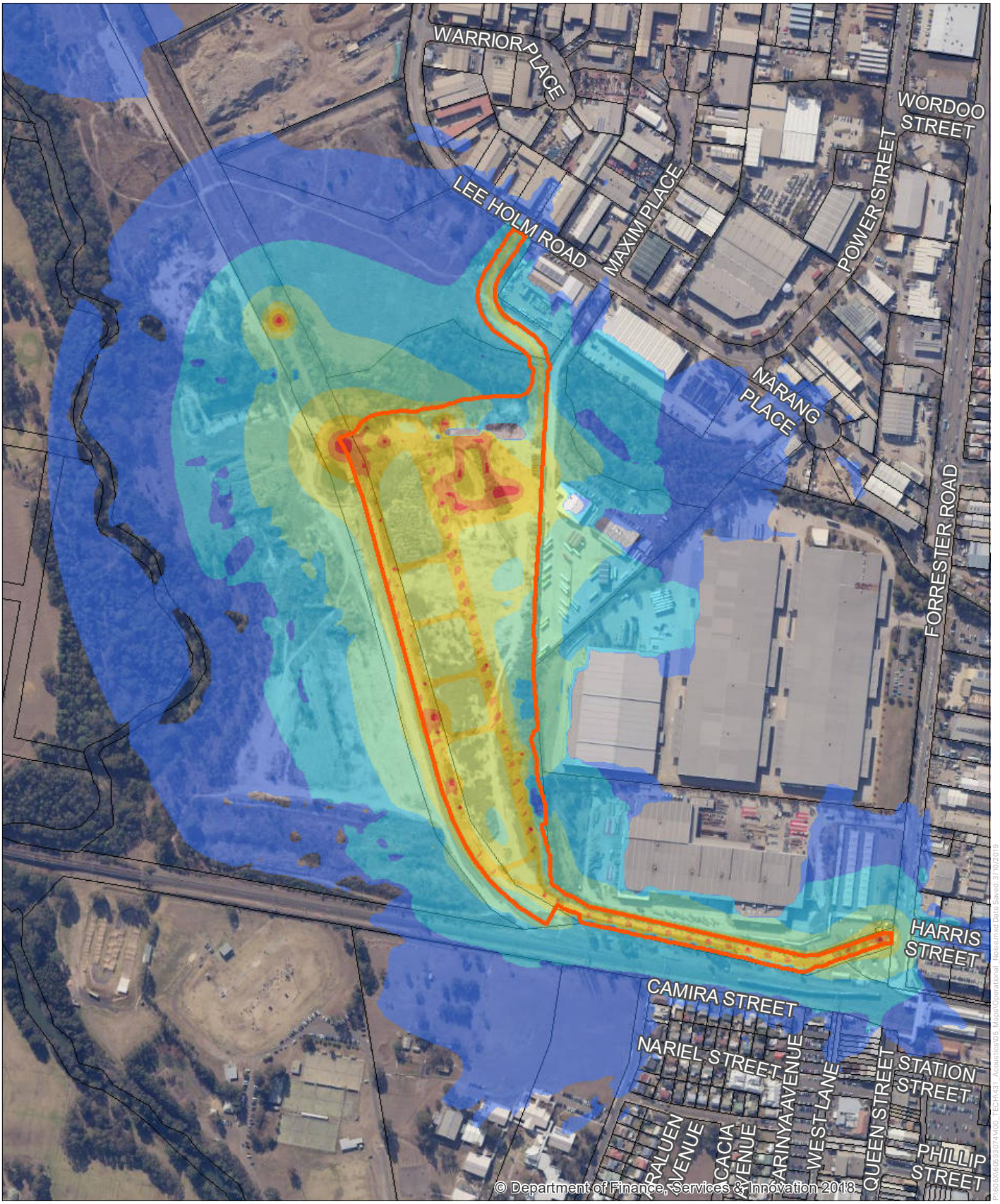
0 25 50 Meters

P:\605X\605930744\400_TECH\431_Acoustics\05_Maps\Site_Map_20190912.mxd Date Saved: 13/09/2019

Source:

Appendix F

Operational Noise Contour Plots



Operational Noise Levels

Daytime - Neutral Weather

ST MARYS freight hub

pacificnational

AECOM

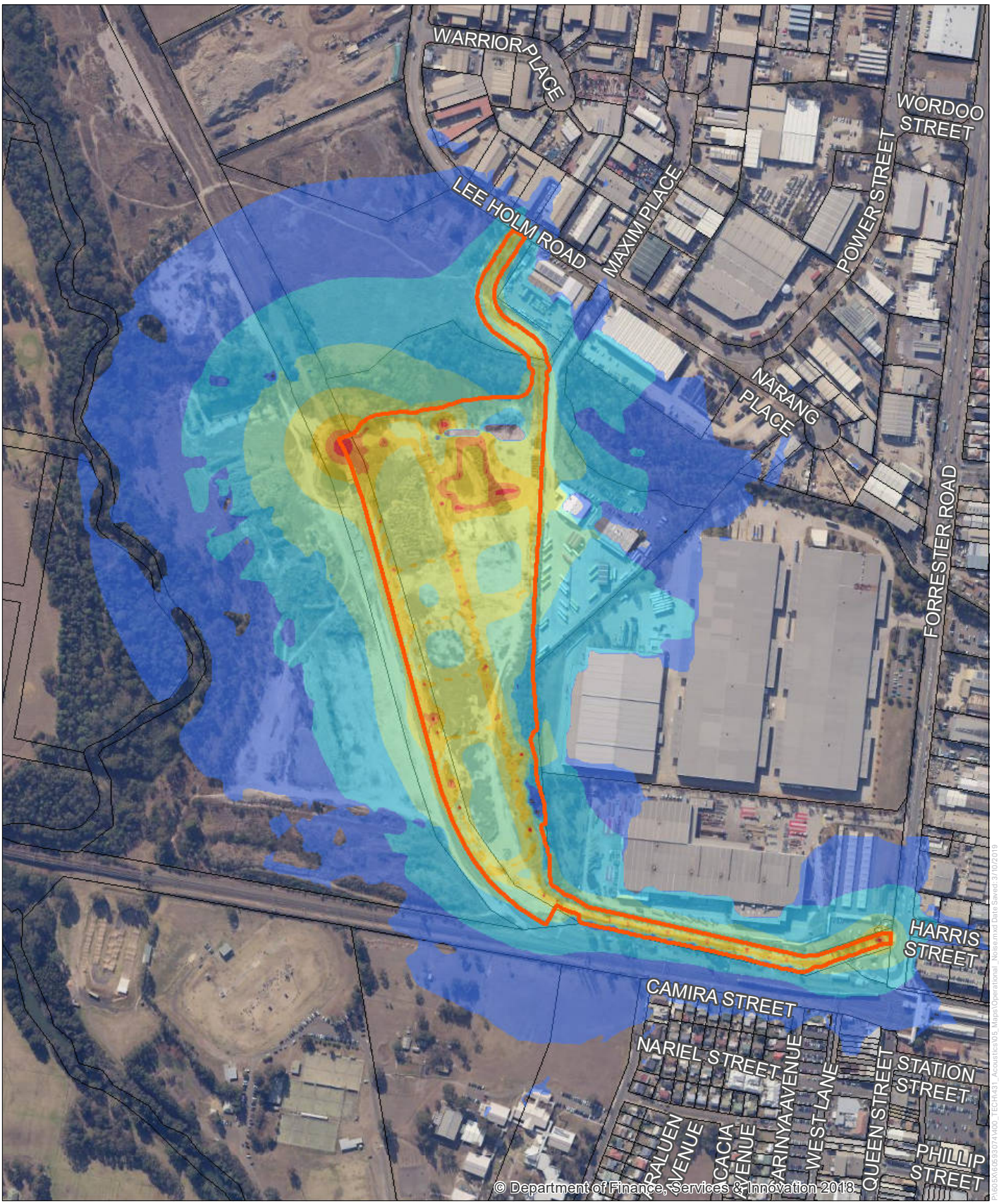
N

0 80 160 Meters

Sound Pressure Level, L_{Aeq} dB(A)

< 44 | 44 - 48 | 49 - 53 | 54 - 58 | 59 - 63 | 64 - 68 | 69 - 73 | > 73

Source:



Operational Noise Levels

Evening - Neutral Weather

ST MARYS freight hub

pacificnational

AECOM

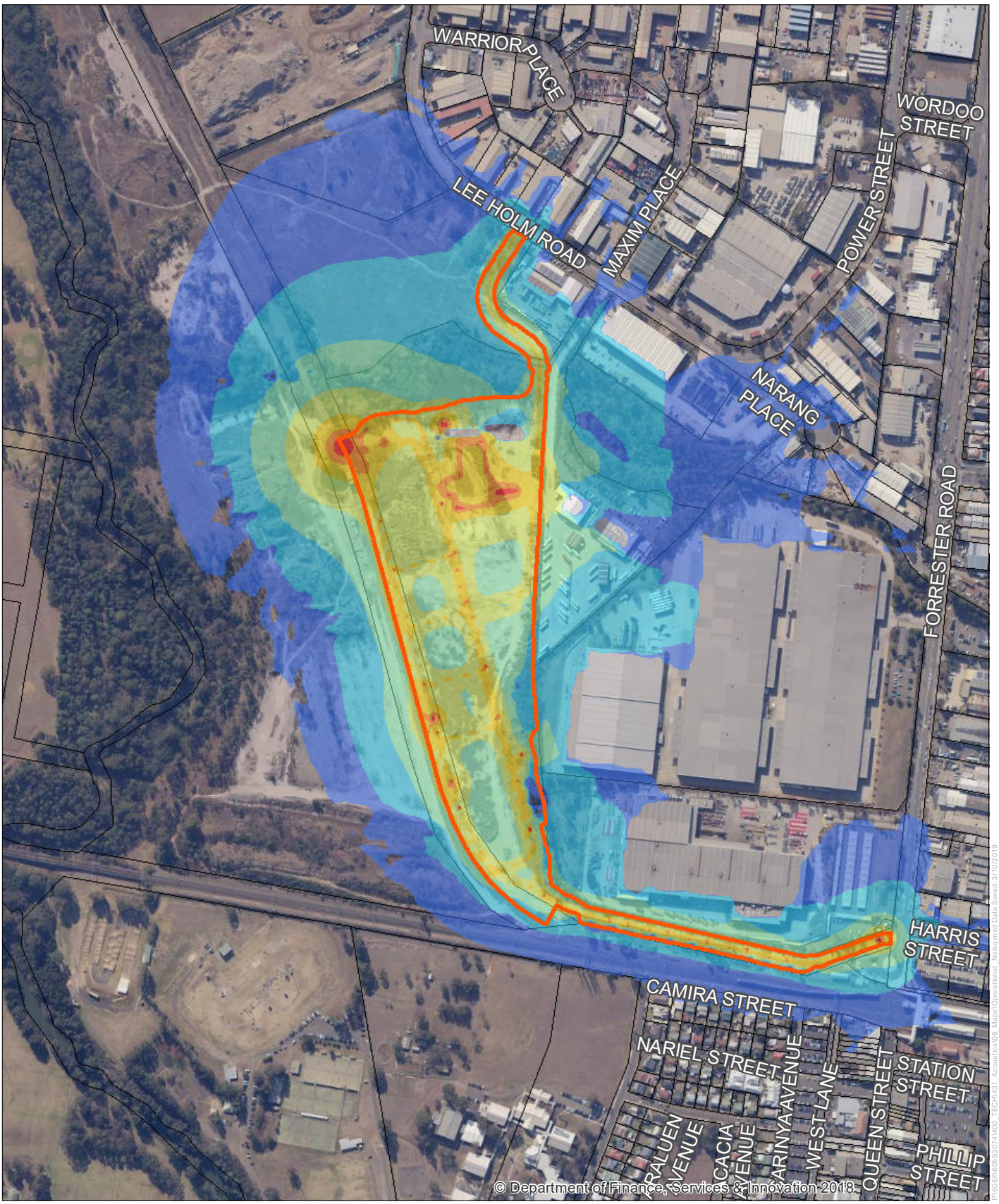
N

0 80 160 Meters

Sound Pressure Level, L_{Aeq} dB(A)

< 43 | 43 - 47 | 48 - 52 | 53 - 57 | 58 - 62 | 63 - 67 | 68 - 72 | > 73

Source:



Operational Noise Levels

Evening - South-Westerly Wind

ST MARYS freight hub

pacificnational AECOM

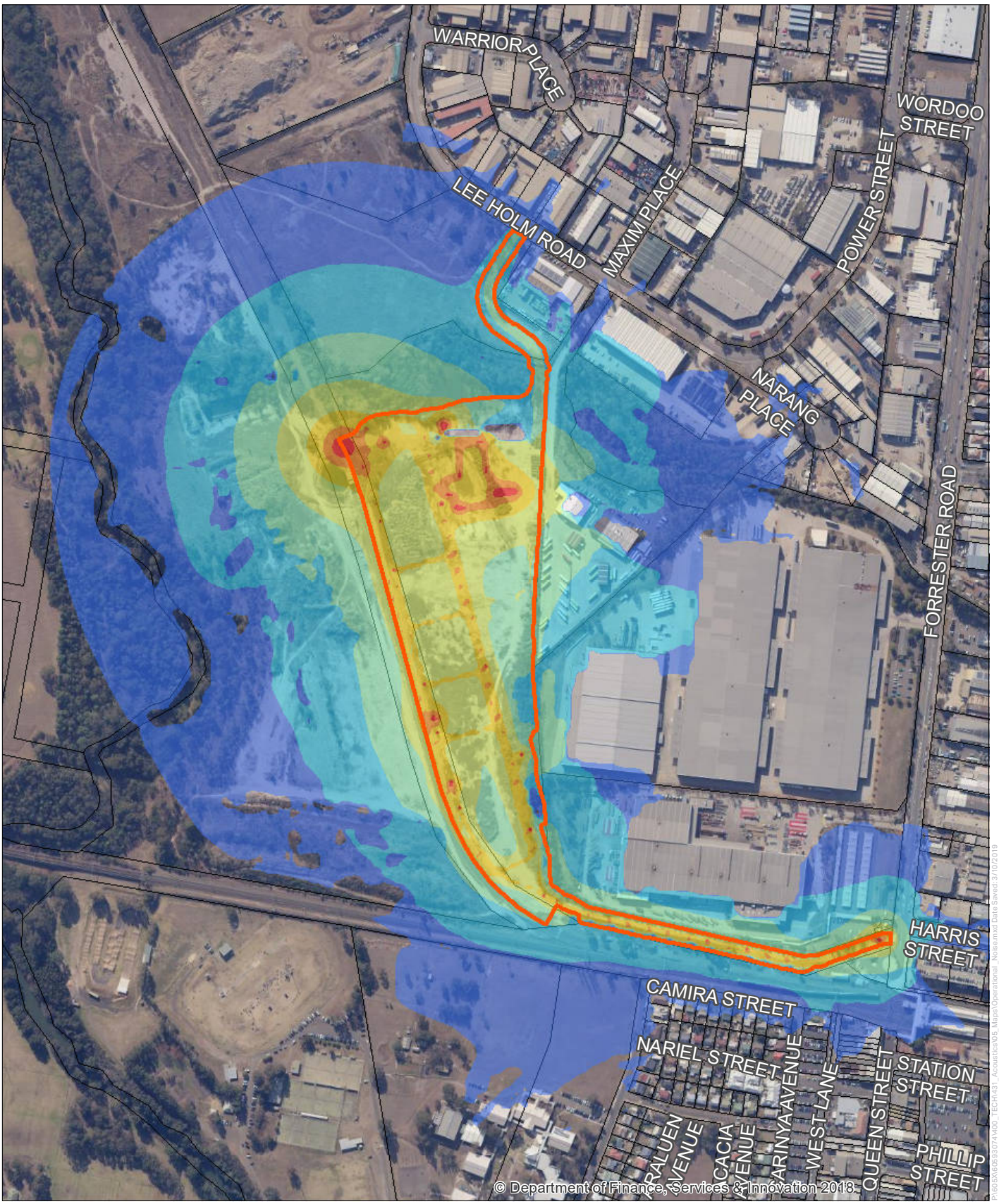
N

0 80 160 Meters

Sound Pressure Level, L_{Aeq} dB(A)

< 43 | 43 - 47 | 48 - 52 | 53 - 57 | 58 - 62 | 63 - 67 | 68 - 72 | > 73

Source:



Operational Noise Levels

Night-time - Neutral Weather

ST MARYS freight hub

pacificnational

AECOM

N

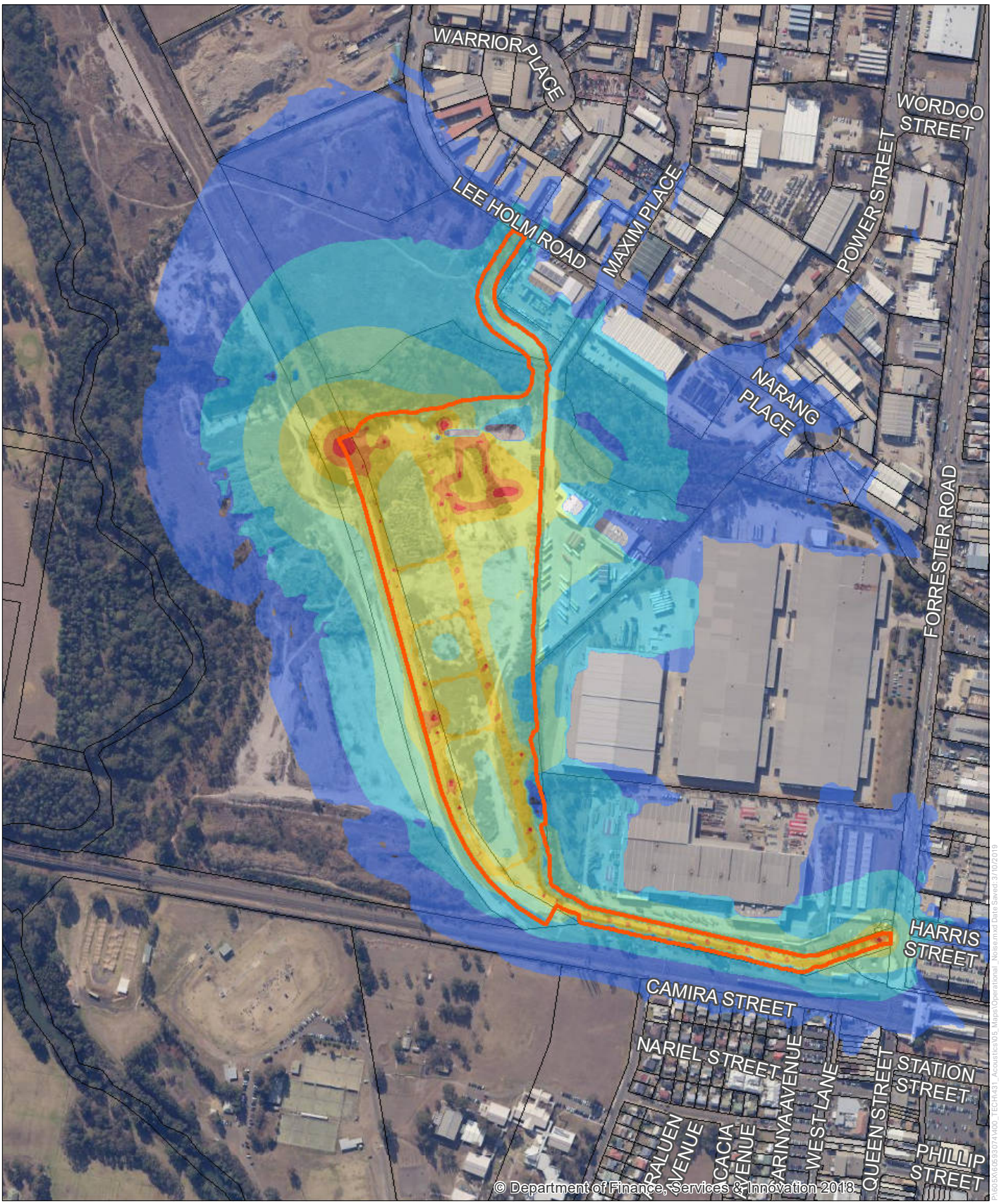
0 80 160 Meters

P:\605X\605X93074\400_TECH\431_Acoustics\05_Maps\Operational_Noise.mxd Date Saved: 3/10/2019

Sound Pressure Level, L_{Aeq} dB(A)

< 42	42 - 46	47 - 51	52 - 56	56 - 61	62 - 66	67 - 71	> 71

Source:



Operational Noise Levels

Night-time - South-Westerly Wind

ST MARYS freight hub

pacificnational AECOM

N

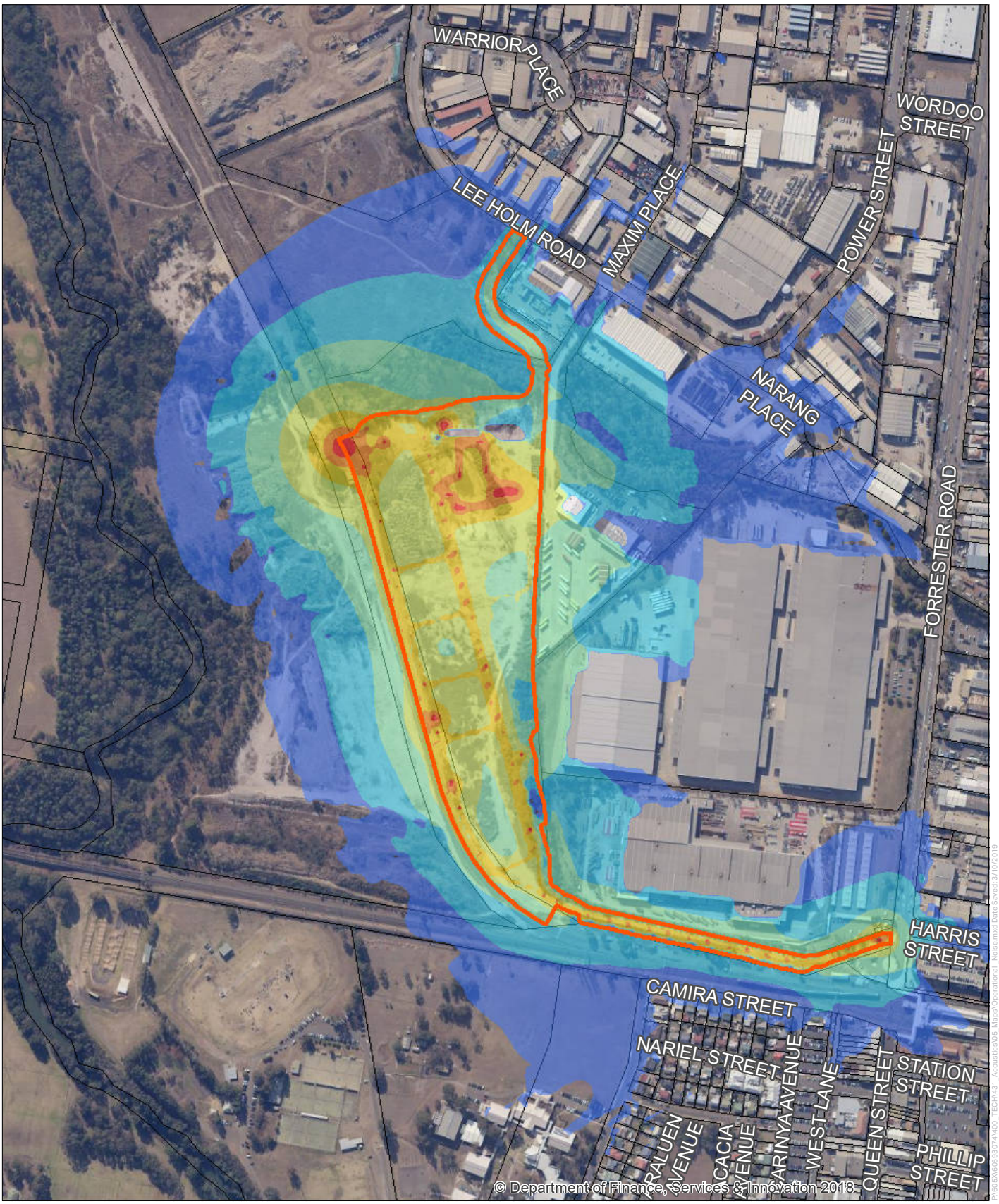
0 80 160 Meters

P:\605X\605X93074\400_TECH\431_Acoustics\05_Maps\Operational_Noise.mxd Date Saved: 3/10/2019

Sound Pressure Level, L_{Aeq} dB(A)

< 42	42 - 46	47 - 51	52 - 56	56 - 61	62 - 66	67 - 71	> 71

Source:



Operational Noise Levels

Night-time - Westerly Wind

ST MARYS freight hub

pacificnational

AECOM

N

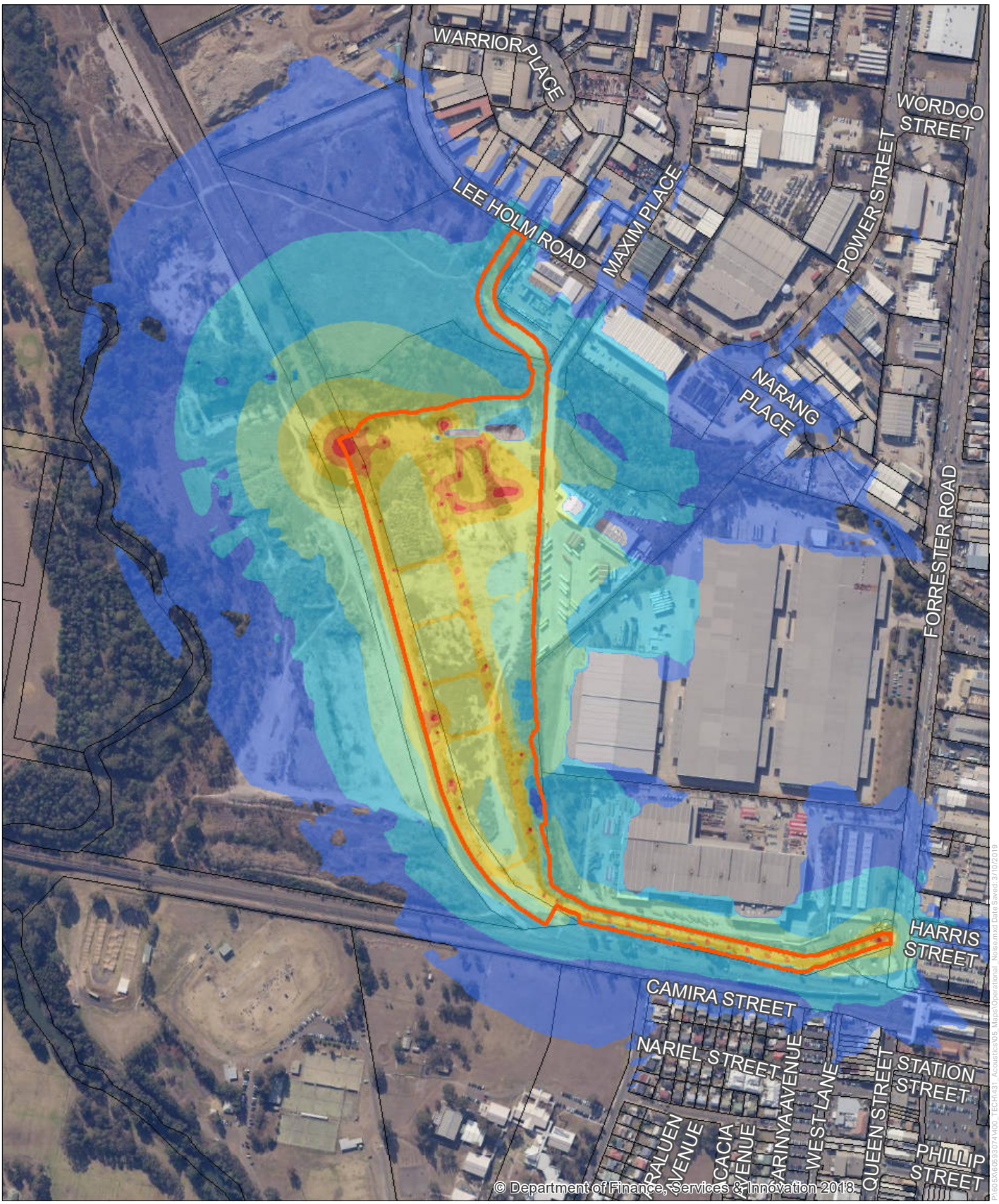
0 80 160 Meters

P:\605X\605X93074\400_TECH\431_Acoustics\05_Maps\Operational_Noise.mxd Date Saved: 3/10/2019

Sound Pressure Level, L_{Aeq} dB(A)

< 42	42 - 46	47 - 51	52 - 56	56 - 61	62 - 66	67 - 71	> 71

Source:



Operational Noise Levels

Night-time - Temperature Inversion SW Wind

ST MARYS freight hub

pacificnational

AECOM

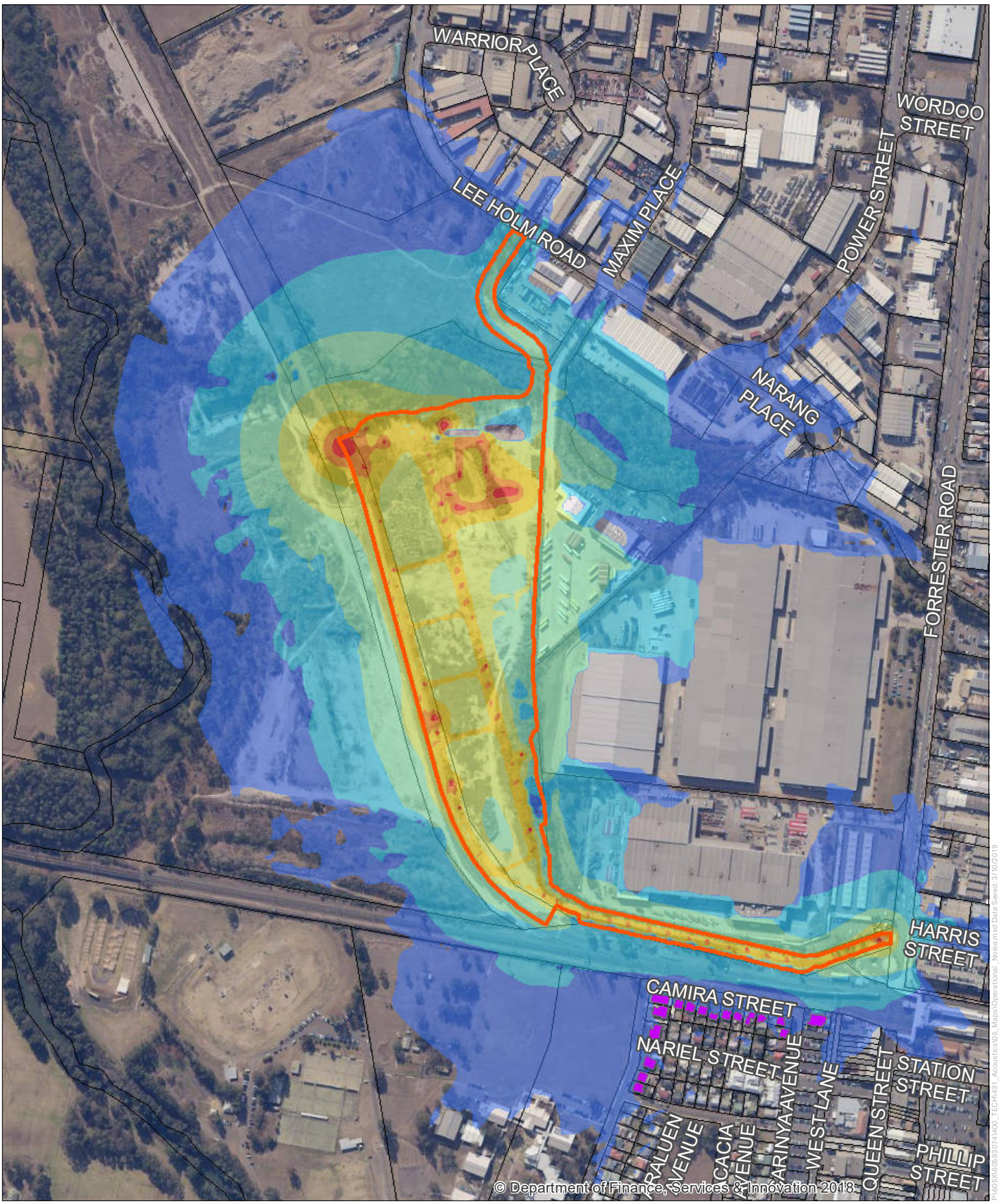
N

0 80 160 Meters

Sound Pressure Level, L_{Aeq} dB(A)

< 42 | 42 - 46 | 47 - 51 | 52 - 56 | 56 - 61 | 62 - 66 | 67 - 71 | > 71

Source:



Operational Noise Levels

Night-time - Temperature Inversion W Wind

ST MARYS freight hub

pacificnational AECOM

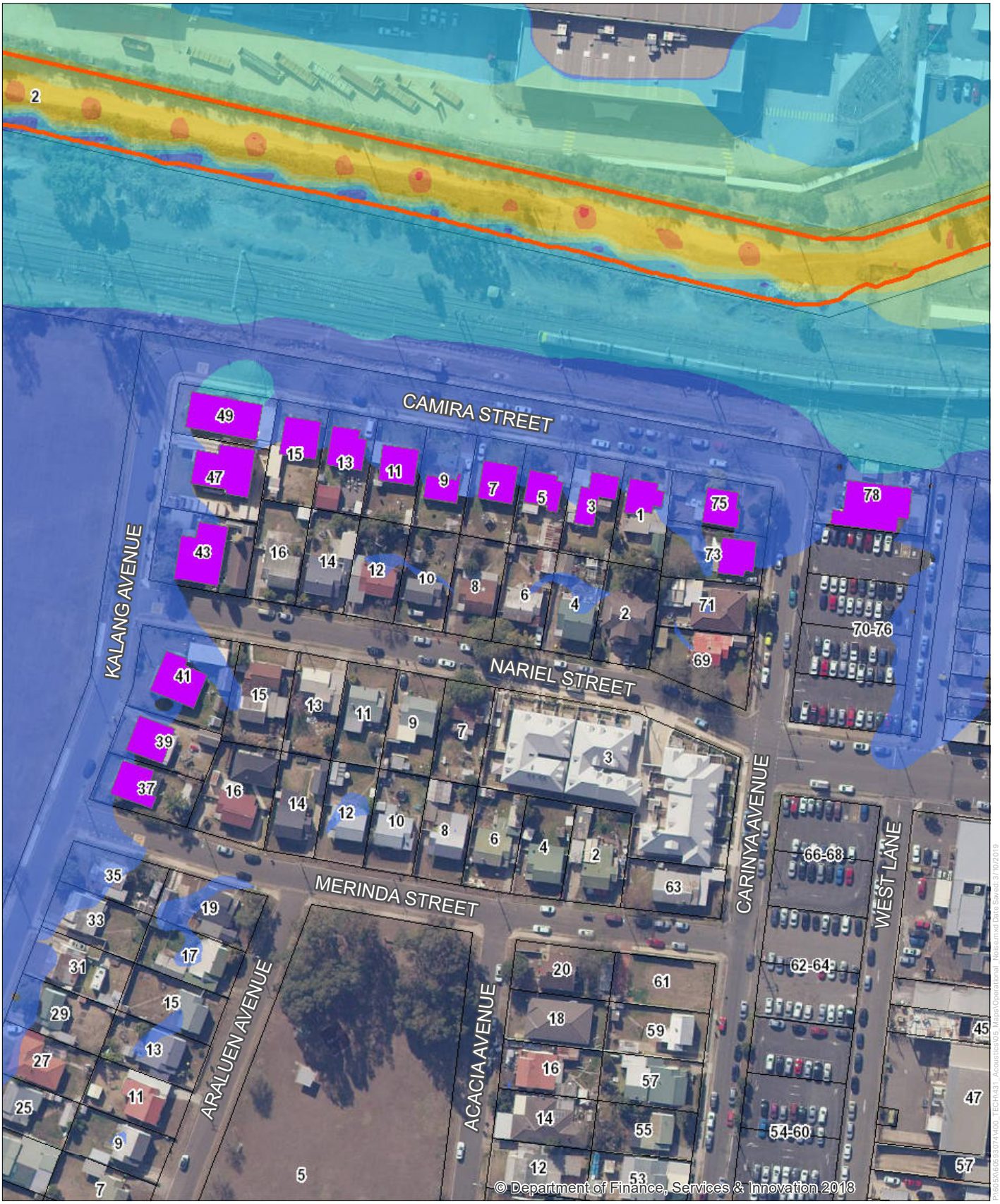
N

0 80 160 Meters

Sound Pressure Level, L_{Aeq} dB(A)

< 42 | 42 - 46 | 47 - 51 | 52 - 56 | 56 - 61 | 62 - 66 | 67 - 71 | > 71

Source:



Operational Noise Levels

Night-time - Temperature Inversion W Wind

ST MARYS freight hub

pacificnational AECOM

N

0 20 40 Meters

P:\605X\605930741400_TECH\431_Acoustics\05_Maps\Operational_Noise.mxd Date Saved: 3/10/2019

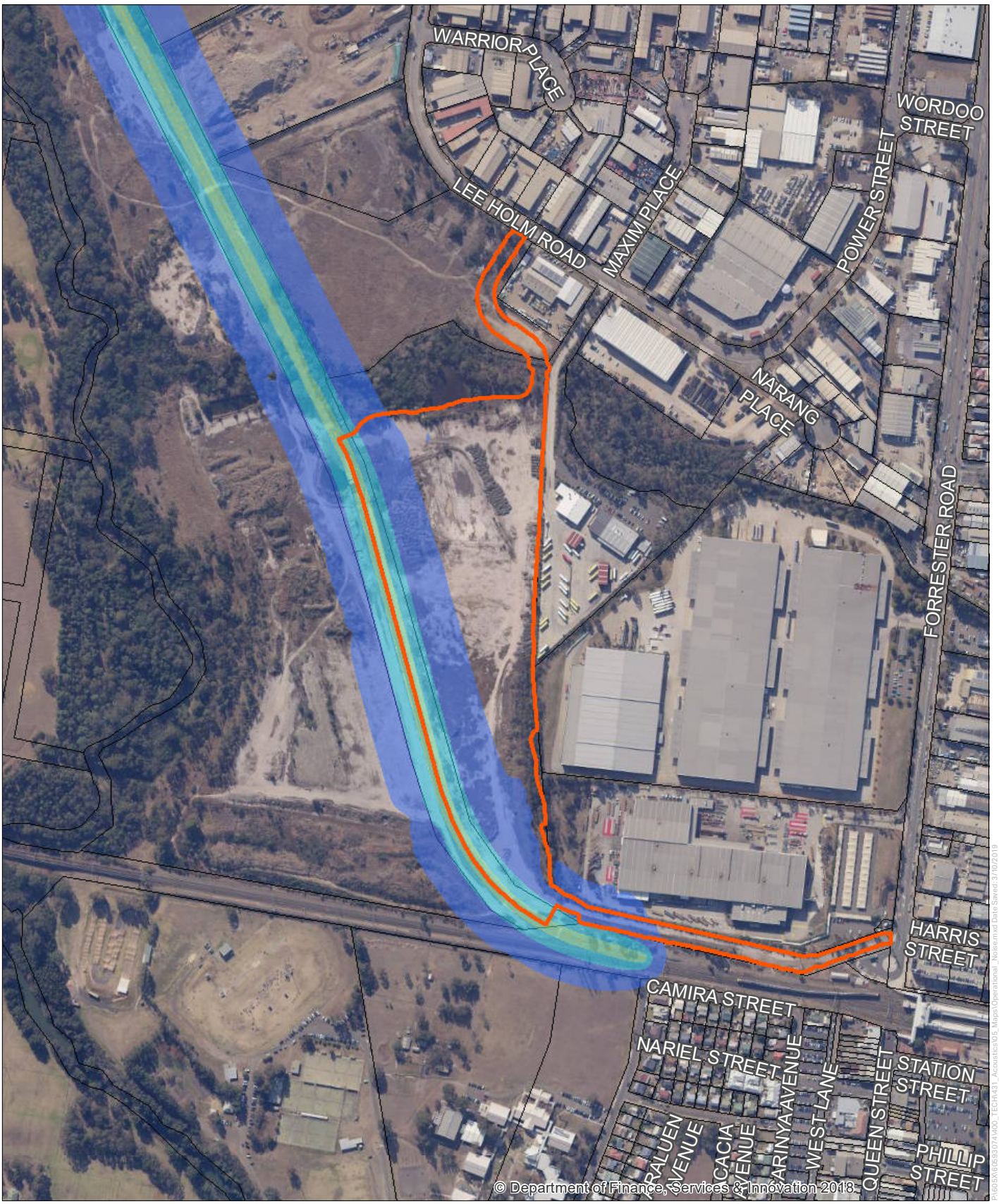
Sound Pressure Level, L_{Aeq} dB(A)

< 42

42 - 46

47 - 51

Source:



Operational Noise Levels

Night-time - Neutral Weather - Rail

ST MARYS freight hub

pacificnational AECOM

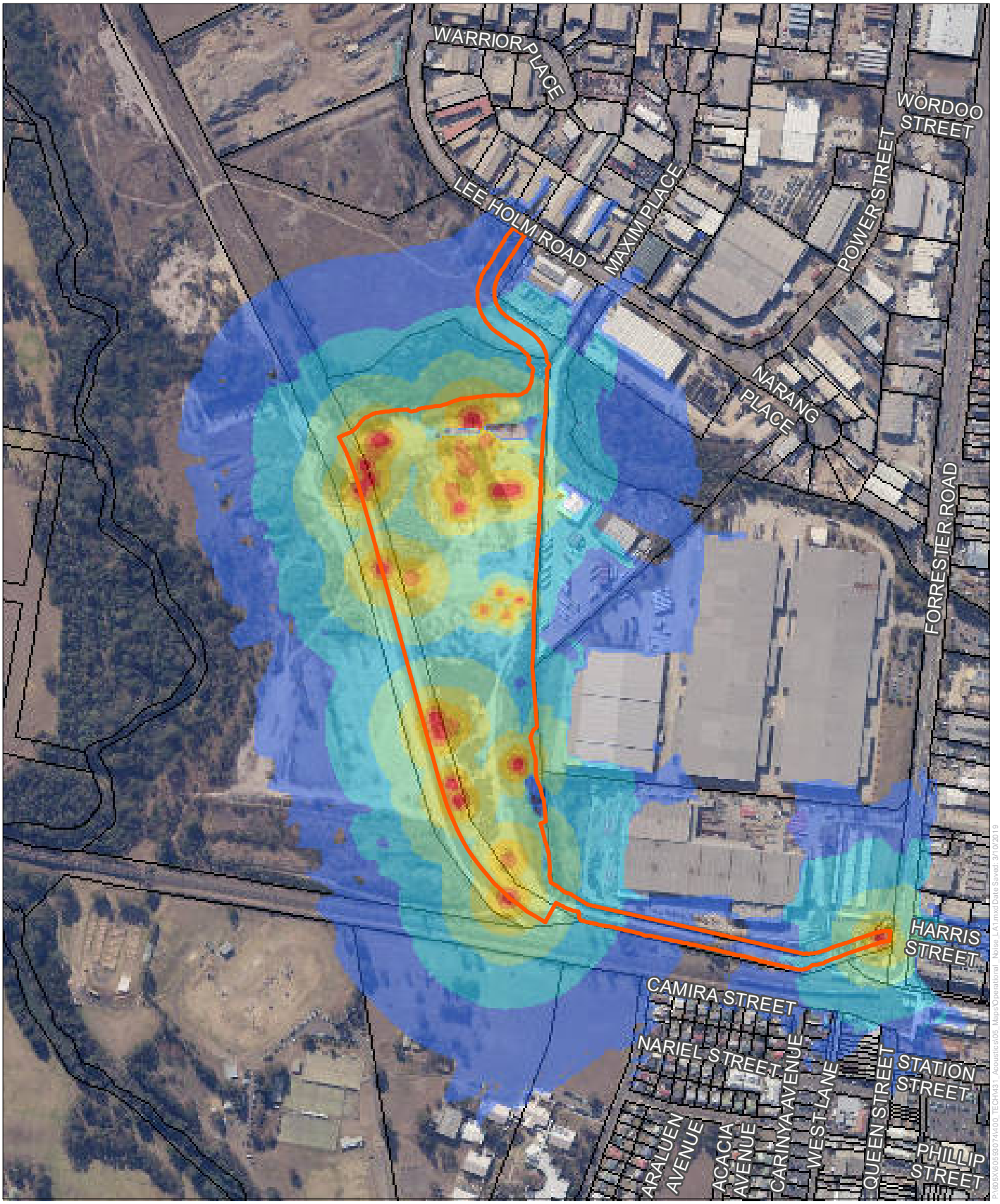
N

0 80 160 Meters

Sound Pressure Level, $L_{Aeq\ 9hr}$ dB(A)

40 - 44 45 - 49 50 - 54 55 - 59

Source:



Operational Noise Levels

Night-time - Neutral Weather

ST MARYS freight hub

pacificnational AECOM

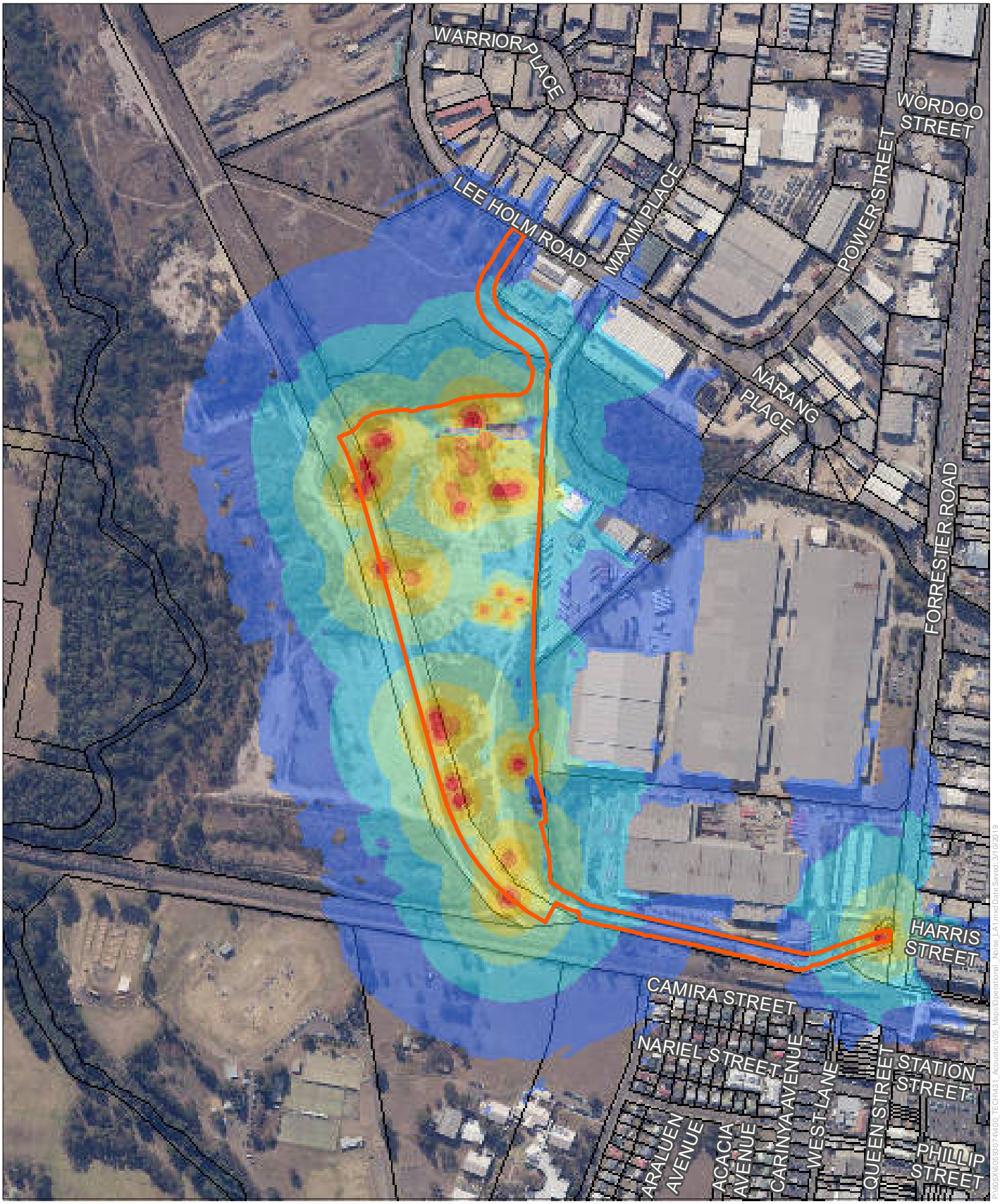
N

0 80 160 Meters

Sound Pressure Level, L_{Amax} dB(A)

< 52 | 52 - 56 | 57 - 61 | 62 - 66 | 67 - 71 | 72 - 76 | 77 - 81 | > 81

Source:



Operational Noise Levels

Night-time - South-Westerly Wind

ST MARYS freight hub

pacificnational

AECOM

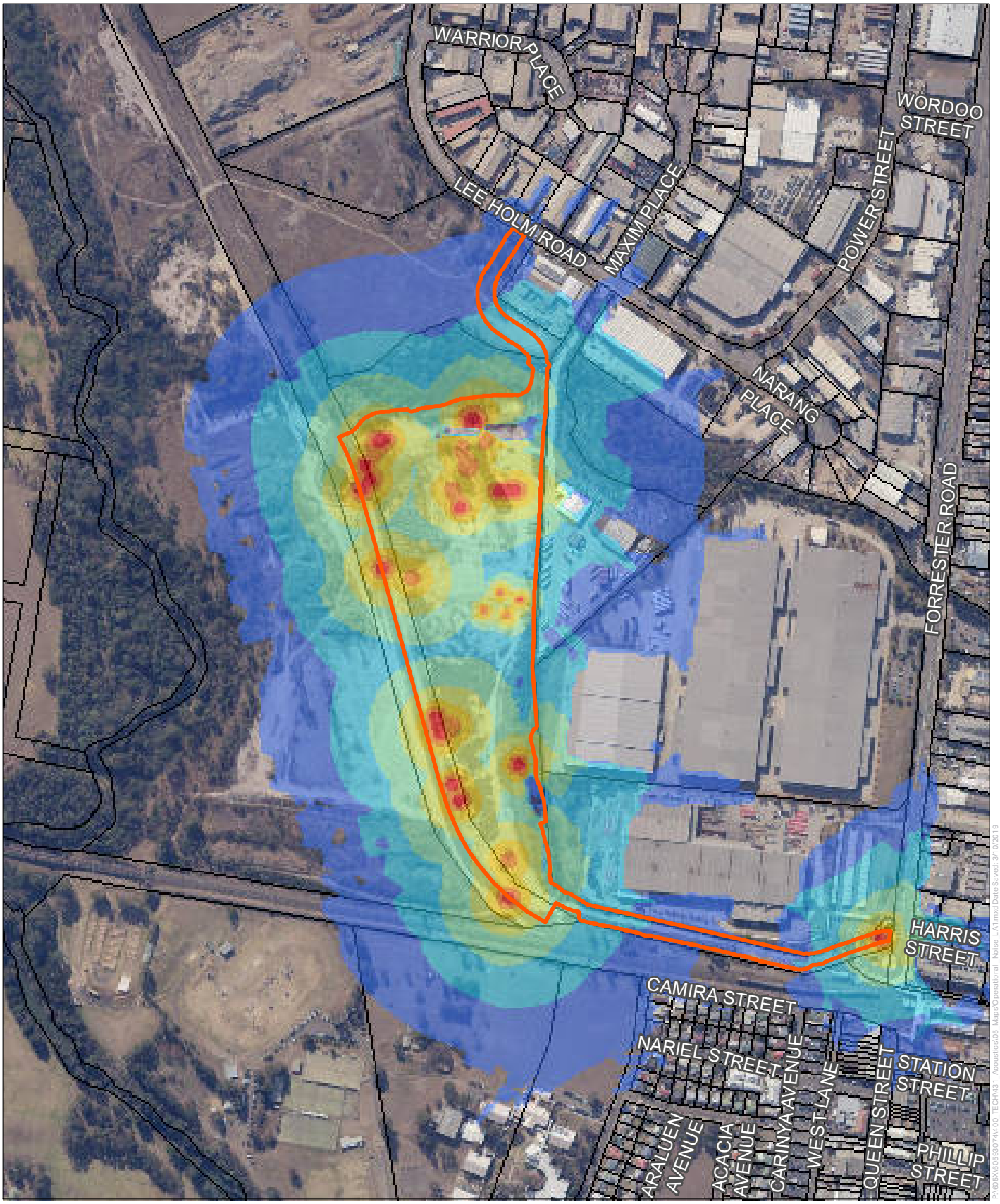
N

0 80 160 Meters

Sound Pressure Level, L_{Amax} dB(A)

< 52 | 52 - 56 | 57 - 61 | 62 - 66 | 67 - 71 | 72 - 76 | 77 - 81 | > 81

Source:



Operational Noise Levels

Night-time - Westerly Wind

ST MARYS freight hub

pacificnational

AECOM

N

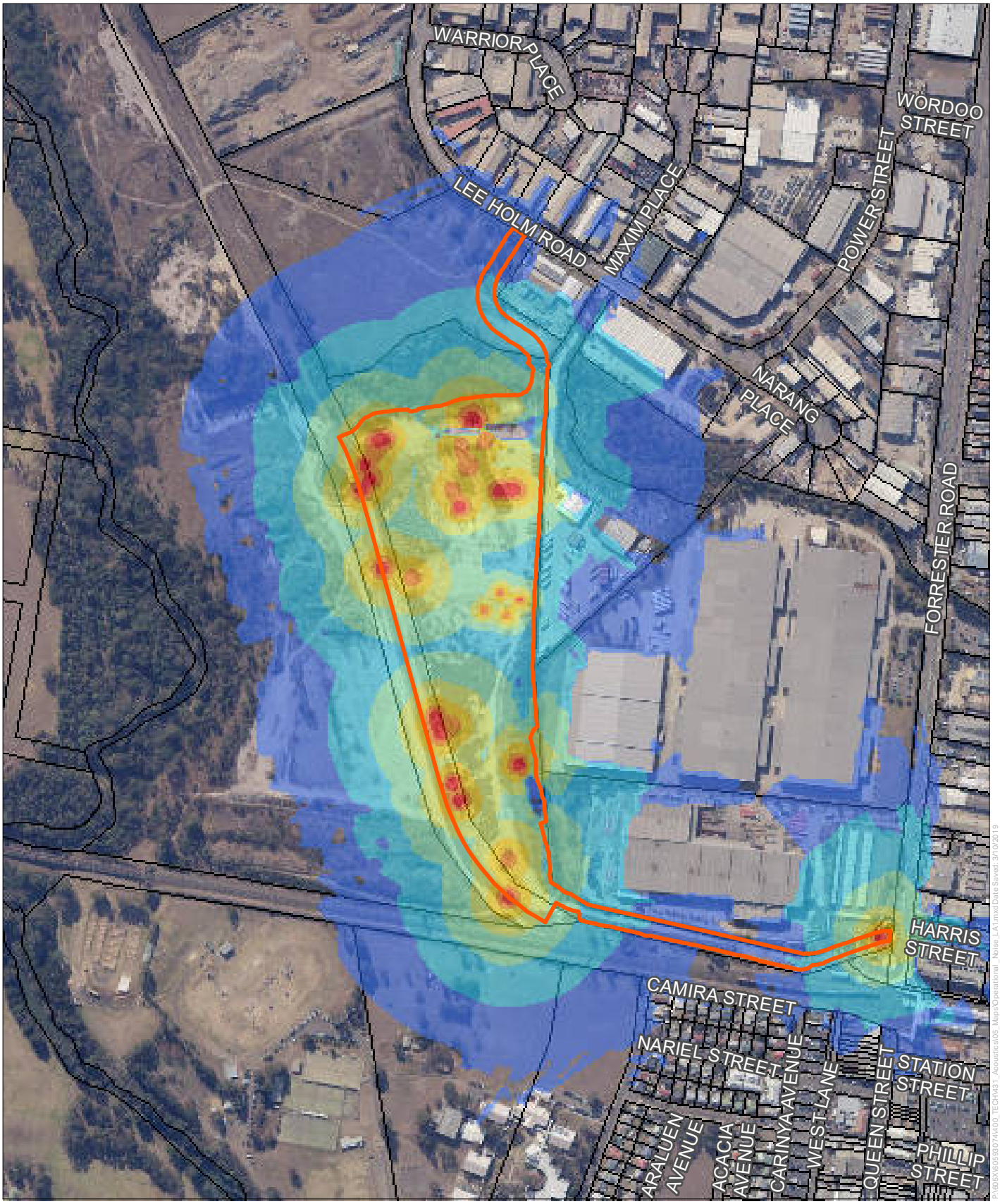
0 80 160 Meters

P:\605X\605307074\400_TECH\431_Acoustics\05_Maps\Operational_Noise_LA1.mxd Date Saved: 3/10/2019

Sound Pressure Level, L_{Amax} dB(A)

< 52	52 - 56	57 - 61	62 - 66	67 - 71	72 - 76	77 - 81	> 81

Source:



Operational Noise Levels

Night-time - Temperature Inversion SW Wind

ST MARYS freight hub

pacificnational AECOM

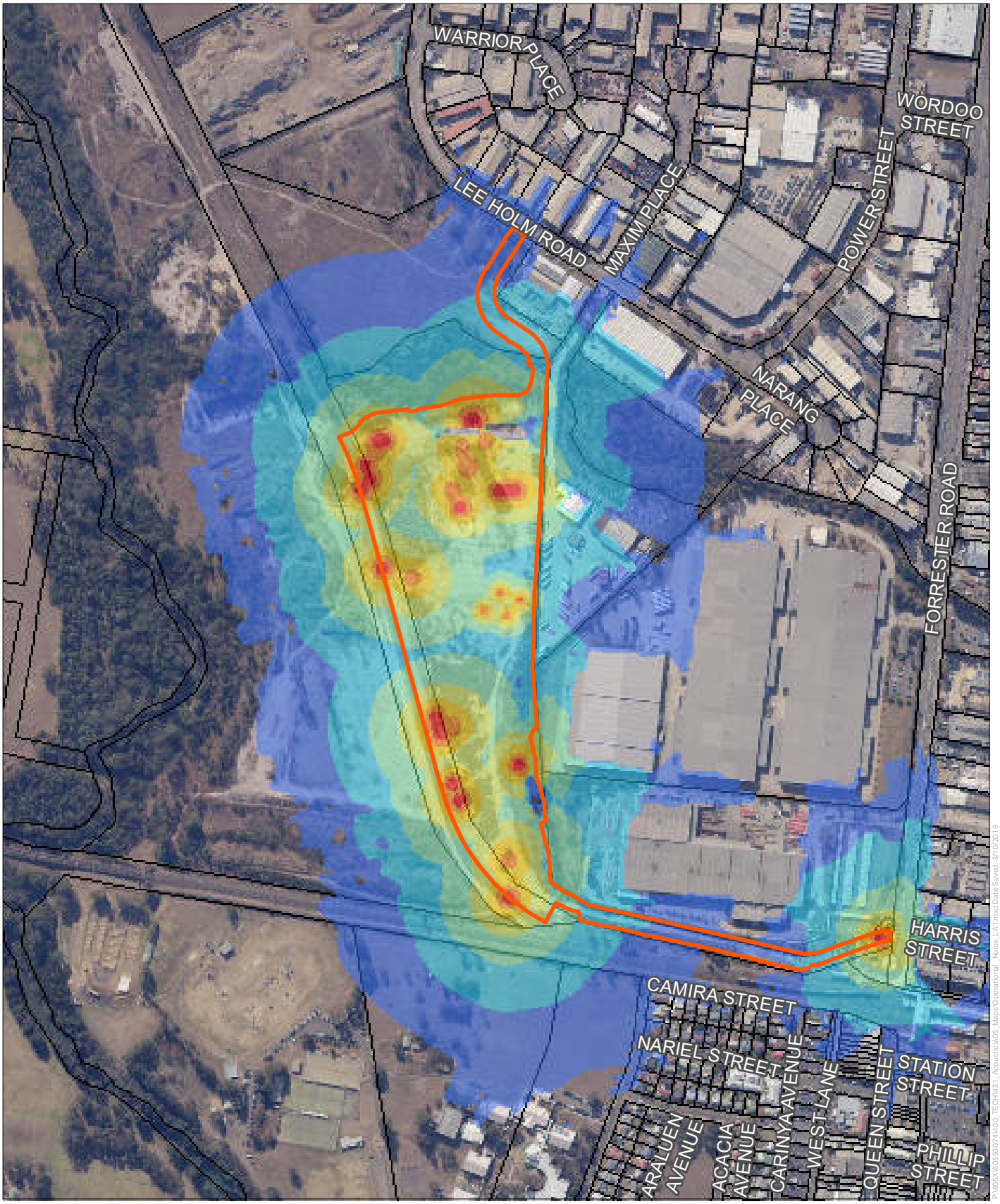
N

0 80 160 Meters

Sound Pressure Level, L_{Amax} dB(A)

< 52 | 52 - 56 | 57 - 61 | 62 - 66 | 67 - 71 | 72 - 76 | 77 - 81 | > 81

Source:



Operational Noise Levels

Night-time - Temperature Inversion W Wind

ST MARYS freight hub

pacificnational AECOM

N

0 80 160 Meters

Sound Pressure Level, L_{Amax} dB(A)

< 52 | 52 - 56 | 57 - 61 | 62 - 66 | 67 - 71 | 72 - 76 | 77 - 81 | > 81

Source: