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A TETRA TECH COMPANY

Operational Noise and Vibration Management Plan

SMEC

Sydney Metro Crows Nest Station – Site C
Acoustic Services

CONFIDENTIAL

Revision: 3.0 – For Review Issued: 2 August 2022



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GLOSSARY

The following terms are defined for clarity; this table will be included in the overarching Environmental Impact Statement and as such does not require inclusion in the appended statements. Consistent terms and abbreviations should be used where possible.

Term	Definition
'A' Weighted	Frequency filter applied to a noise spectrum that adjusts ('weights') each frequency differently. The 'A' weighting very roughly corresponds with subjective assessments of noise levels.
Ambient Sound	The overall noise level associated with an environment or space. It is usually a composite of sounds from many sources, both near and far. Usually taken to mean the L_{Aeq} value.
Background Noise Level	The average of the lowest measured noise levels in an affected area, in the absence of noise from occupants and/or unwanted external noise sources. Usually taken to mean the L_{A90} value.
Concept SSD Application	A concept development application as defined in section 4.22 of the EP&A Act. It is a development application that sets out the concept for the development of a site, and for which detailed proposals for the site or for separate parts of the site are to be the subject of a subsequent development application or applications.
Council	North Sydney Council, unless otherwise indicated
Crows Nest Station precinct	The Crows Nest Station precinct comprises the land between the Pacific Highway and Clarke Street (eastern side of the Pacific Highway) and Oxley Street and south of Hume Street, Crows Nest. The precinct is divided into three (3) sites: <ul style="list-style-type: none"> Site A: The block bound by the Pacific Highway, Hume Street, Oxley Street, and Clarke Lane (497-521 Pacific Highway, Crows Nest) Site B: The block on the southern corner of Hume Street and the Pacific Highway (477-495 Pacific Highway, Crows Nest) Site C: One lot on the north-western corner of Hume Street and Clarke Street (14 Clarke Street, Crows Nest)
CSSI	Critical State Significant Infrastructure
CSSI Approval	The approval under the EP&A Act for the construction of the Sydney Metro City & Southwest Chatswood to Sydenham project, as amended by subsequent modification applications. The CSSI project (application number SSI 15_7400) was approved by the (then) Minister for Planning on 9 January 2017 and has been amended on 6 previous occasions. Any reference to the CSSI Approval is a reference to the most current version of that approval as amended by any subsequent modification application
dB(A)	The overall 'A' Weighted sound pressure level.
Decibel, dB	Unit of acoustic measurement. Measurements of power, pressure and intensity may be expressed in dB relative to standard reference levels.
Detailed SSD Application	The SSD Application(s) made after the concept SSD Application that seek consent for the use, design and to physically construct stages of the development.
DPE	Department of Planning and Environment



Term	Definition
EIS	Environmental Impact Statement
ENL	Existing Noise Level, L_{Aeq} dB
EP&A Act	Environmental Planning and Assessment Act 1979 (NSW)
EP&A Regulation	Environmental Planning and Assessment Regulation 2000 (NSW)
Heritage item	An item of environmental heritage that is listed in Schedule 5 of North Sydney Local Environmental Plan 2013 or on the State Heritage Register under the Heritage Act 1977
IAP	Interchange Access Plan required under Condition E92 of the CSSI Approval. The IAP complements the SDPP and informs the final design of transport and access facilities and services, including footpaths, cycleways, passenger facilities, parking, traffic and road changes, and the integration of public domain and transport initiatives around and at each station.
NPfI	NSW Noise Policy for Industry
ISD	Integrated station development – combined station, OSD and public domain works
L_{90}, L_{10}, etc	A statistical measurement giving the sound pressure level which is exceeded for the given percentile over a measurement period, ie L_{90} is the level which is exceeded for 90% of the measurement period. Likewise, the L_{10} level is the noise level exceeded for 10% of the measurement time. The L_{A90} , L_{A10} (etc) levels are the A-weighted noise levels exceeded for the respective percentile.
$L_{Aeq, T}$	Equivalent continuous A-weighted sound pressure level. The equivalent continuous A-weighted sound that, within a measurement time interval T, has the same A-weighted sound energy as a time-varying sound.
Minister	The Minister for Planning and Public Spaces
Noise Reduction	The difference in sound pressure level between any two areas. The term 'noise reduction' does not specify any grade or performance quality unless accompanied by a specification of the units and conditions under which the units apply.
NR, Noise Rating	Single number evaluation of a background or ambient noise level. The noise spectrum is plotted against a series of NR curves and the NR is determined by the lowest NR curve not crossed by the noise spectrum. The NR is categorized by the level at 1 kHz i.e. the NR 50 curve has a value of 50 dB at 1 kHz. The NR level is normally around 5 to 6 dB below the 'A' weighted sound pressure level.
NSDCP 2013	North Sydney Development Control Plan 2013
NSLEP 2013	North Sydney Local Environmental Plan 2013
OSD	Over station development as defined in the CSSI Approval – includes non-rail related development that may occupy land or airspace above, within or in the immediate vicinity of the Sydney Metro CSSI but excluding spaces and interface works such as structural elements that may be constructed as part of the CSSI Approval to make provision for future developments
PIR	The Submissions and Preferred Infrastructure Report submitted as part of Sydney Metro City & Southwest Chatswood to Sydenham project, application no. SSI 15_7400
POEO	Protection of the Environment Operations (Noise Control) Regulation 2017. This Regulation controls noise from motor vehicles and marine vessels and



Term	Definition
	sets community standards on acceptable noise intrusion in homes from such appliances as intruder alarms, music amplifiers, air conditioners and powered garden tools.
Rating Background Level (RBL)	A single figure noise level that represents the background noise level for assessment purposes
R_w	Weighted Sound Reduction Index. A single number value of the acoustic performance of a partition or building element. Calculation procedures for R _w are defined in ISO 140-2:1991 “ <i>Measurement of Sound Insulation in Buildings and of Building Elements Part 2</i> ”. The R _w is function of the level difference between two spaces separated by the building partition or element, surface area of the building partition or element, room volume and area of absorption in the receiver room (generally measured by the reverberation time).
SDPP	Station Design and Precinct Plan required under Condition E101 of the CSSI Approval. The SDPP resolves the public domain areas for the Crows Nest Station precinct as part of the CSSI Approval and addresses (among other things): <ul style="list-style-type: none"> ■ Opportunities for public art ■ Landscaping and building design opportunities to mitigate the visual impacts of rail infrastructure and operational fixed facilities ■ Any salvaged historic and artistic elements ■ Location of existing vegetation and proposed landscaping ■ Location and design of operational lighting and measures to minimise lighting impacts ■ Timing for the implementation of access, landscaping and public realm initiatives
SEARs	The Secretary’s environmental assessment requirements, which informs the content of an EIS
Secretary	Secretary of the NSW Department of Planning, Industry and Environment, or their delegate
Sound Isolation	A reference to the degree of acoustical separation between any two areas. Sound isolation may refer to sound transmission loss of a partition or to noise reduction from any unwanted noise source. The term ‘sound isolation’ does not specify any grade or performance quality and requires the units and measurement conditions to be specified.
Sound Pressure Level L_p, dB	A measurement obtained directly using a microphone and sound level meter. Sound pressure level depends on the distance from a source and on the measuring environment. Sound pressure level equals 20 times the logarithm to the base 10 of the ratio of the rms. sound pressure to the reference sound pressure of 20 microPascals - $20\log_{10}(\text{measured rms pressure}/2 \times 10^{-6})$
SSD	State significant development as defined by Section 4.36 of the EP&A Act
Station box	The volumetric area of the Crows Nest Station development approved under the CSSI Approval – includes below and above ground elements up to the ‘transfer slab’ level, within and above which would sit each OSD
Sydney Metro	The applicant for this detailed SSD Application



Term	Definition
Sydney Metro City & Southwest – Chatswood to Sydenham project	<p>The Chatswood to Sydenham component of Sydney Metro City & Southwest involves the construction and operation of a 16.5 kilometre metro line from Chatswood, under Sydney Harbour and through Sydney's CBD out to Sydenham</p> <p>This section of the Sydney Metro City & Southwest will deliver new metro stations at:</p> <ul style="list-style-type: none">■ Crows Nest■ Victoria Cross■ Barangaroo■ Martin Place■ Pitt Street■ Central (new underground platforms)■ Waterloo■ Sydenham <p>This part of the project will operate between Chatswood and Sydenham Stations</p>
Sydney Metro City & Southwest –Sydenham to Bankstown Upgrade	<p>Upgrading of the T3 Bankstown Line to Sydney Metro standards between Sydenham and Bankstown, including the upgrade of all 10 stations.</p> <p>These works are the subject of a separate Critical State Significant Infrastructure project (reference SSI 17_8256), which was granted consent in December 2018.</p>
Sydney Metro CSSI	Sydney Metro City & Southwest – Chatswood to Sydenham project



1 INTRODUCTION

1.1 Purpose of this report

This report provides an Operational Noise and Vibration Management Plan for the use of Over Station Development (OSD) on Site C of the Crows Nest Station precinct.

On 9 January 2017, the Minister for Planning (the Minister) approved the Sydney Metro City & Southwest - Chatswood to Sydenham application lodged by Transport for NSW (TfNSW) as a Critical State Significant Infrastructure project (reference SSI 15_7400), hereafter referred to as the CSSI Approval. The CSSI Approval includes all physical work required to construct the CSSI, including the demolition of existing buildings and structures on each site. Importantly, the CSSI Approval also includes provision for the construction of below and above ground structures and other components of the future OSD (including building infrastructure and space for future lift cores, plant rooms, access, parking and building services, as relevant to each site). The rationale for this delivery approach, as identified within the CSSI application is to enable the OSD to be more efficiently built and appropriately integrated into the metro station structure.

Sydney Metro is seeking to develop an OSD commercial building located above and integrated with the Clarke Street entrance to the Crows Nest Station. It represents the next phase in the realisation of the Crows Nest Station precinct. It follows and is pursuant to the Concept SSD Application (SSD 9579), granted consent on 23 December 2020, which established the planning and assessment framework for all OSD within the Crows Nest Station precinct. This detailed SSD Application has been prepared to be consistent with the Concept SSD Application in accordance with Division 4.4 of the EP&A Act.

The Concept SSD Application established the building envelopes (i.e. volumetric parameters), maximum gross floor area (GFA), minimum non-residential GFA, land uses, future subdivision (if required) and general development strategies to inform the future detailed design of the OSD. It is consistent with the strategic planning work undertaken by DPE, including the finalisation of the St Leonards and Crows Nest 2036 Plan (2036 Plan) and the Crows Nest Sydney Metro Site Rezoning Proposal (Rezoning Proposal).

The Concept SSD Application approved the following key parameters with regard to Site C:

- **Maximum building height** – RL 127 metres or 9 storeys (includes two station levels and conceptual OSD space approved under the CSSI Approval)
- **Maximum building services zone** – RL 132 or 5 metres to accommodate lift overruns, rooftop plant and services
- **Gross floor area** – maximum of 3,100 square metres
- **Land uses** – commercial office premises (of which two floors could be provided as social infrastructure), including the use of approximate conceptual areas associated with the OSD which have been provisioned for in the Crows Nest station box (CSSI Approval) including areas above ground level (i.e. OSD lobbies and associated spaces)
- **Strategies** – for modulation and expression of built forms, loading, vehicular and pedestrian access arrangements, utilities and services provision, managing stormwater and drainage, achievement of ecological sustainable development, providing public art, signage zones, and a design excellence framework

This detailed SSD Application for the Site C OSD is classified as SSD in accordance with Clause 12 of *State Environmental Planning Policy (State and Regional Developments) 2011* (SEPP SRD). Under Clause 12 of the SEPP, any development application pursuant to a Concept SSD Application is also classified as SSD whether or not that part of the development exceeds the minimum value specified in the relevant schedule of the SEPP. Accordingly, while the estimated capital investment value of this application does not exceed \$30 million in accordance with clause 19(2) of Schedule 1 of the SEPP, it is pursuant to the approved Concept SSD

Application and has not been delegated to Council under Section 4.37 of the EP&A Act. The proposed development is, therefore, classified as SSD and is submitted to DPE for assessment and determination.

1.2 Site description

The Crows Nest Station precinct is located between the Pacific Highway and Clarke Street (eastern side of the Pacific Highway) and Oxley Street and south of Hume Street, Crows Nest. It is wholly located within the North Sydney Local Government Area, however, it is also near the boundary of both the Willoughby and Lane Cove Local Government Areas.

The approved Concept SSD Application encompasses three sites that make up the Crows Nest Station precinct. Of relevance to this application is Site C that comprises one lot on the north-western corner of Hume Street and Clarke Street (14 Clarke Street, Crows Nest). Site C has a site area of 608 square metres.

Separate and future application/s will be undertaken for OSD in relation to Sites A and B.



Figure 1: Aerial photograph of Site C within the greater Crows Nest Station precinct

1.3 Overview of the proposed development

The development comprises the following:

- The design, construction and operation of a new nine storey (plus rooftop plant) commercial OSD tower consistent with the building envelope for Site C established under the approved Concept SSD Application

- The detailed design and delivery of interface areas within the approved station box that contain OSD exclusive elements including the entry lobby, bicycle parking and end of trip facilities, and plant not associated with the rail infrastructure
- Vehicle loading associated with the OSD office space being provided
- Works related to the provision of services, management of drainage and flooding, and the mitigation of construction noise and vibration
- Provision of rooftop building identification signage zones

The development is located entirely within the approved Concept SSD Application building envelope and has a maximum height of RL 132m and a GFA of 2,977m² (attributed to the OSD, excluding CSSI areas).



Figure 2: Proposed Site C OSD contained within the approved building envelope (view from Clarke St)

1.4 Assessment requirements

DPE has issued a condition of consent requiring an operational noise and vibration management plan to be prepared. This document is intended to fulfil this requirement.



D4. Within six months of the date of this consent, an **Operational Noise and Vibration Management Plan (ONVMP)** prepared by a suitably qualified person shall be submitted to and approved by the Planning Secretary. The **ONVMP** must be prepared in consultation with Council and the EPA. The **ONVMP** shall include (but not be limited to):

- (a) be prepared in accordance with the EPA's Noise Policy for Industry
- (b) identify nearby sensitive receivers and land uses
- (c) identify the noise limits applying to the development
- (d) identify all key sources of operational noise and vibration
- (e) details of all reasonable and feasible management and mitigation measures to be implemented to minimise noise and vibration
- (f) be consistent with and incorporate all relevant recommendations and mitigation measures outlined in the Crows Nest Site C Over Station Development Noise and Vibration Impact Assessment prepared by CNDC, dated September 2021
- (g) address community consultation and complaint management; and
- (h) include a suitable proactive noise and vibration monitoring program which aims to ensure the noise and vibration criteria in this approval are not exceeded.

1.5 Compliance Matrix

Condition	Description	Where Addressed
D4 (a)	be prepared in accordance with the EPA's Noise Policy for Industry	Entire report
D4 (b)	identify nearby sensitive receivers and land uses	Section 2.1
D4 (c)	identify the noise limits applying to the development	Section 3.1
D4 (d)	identify all key sources of operational noise and vibration	Section 4.1
D4 (e)	details of all reasonable and feasible management and mitigation measures to be implemented to minimise noise and vibration	Section 4, 5.1, 6.2
D4 (f)	be consistent with and incorporate all relevant recommendations and mitigation measures outlined in the Crows Nest Site C Over Station Development Noise and Vibration Impact Assessment prepared by CNDC, dated September 2021	Entire report
D4 (g)	address community consultation and complaint management; and	Section 6
D4 (h)	include a suitable proactive noise and vibration monitoring program which aims to ensure the noise and vibration criteria in this approval are not exceeded	Section 7

1.6 Revision History

Rev	Date Issued	Comment
1.0	3 rd June 2022	Draft for review
2.0	15 th July 2022	For Review
3.0	2 nd August 2022	For Review

2 EXISTING NOISE ENVIRONMENT

2.1 Affected Receivers

We have identified the following noise sensitive receivers, to which we have assessed noise and vibration levels:

- Crows Nest Site A – commercial
- Crows Nest Site B – residential
- 20 Clarke Street – commercial, education and healthcare
- 22 Clarke Street – residential
- 10 Clarke Street – commercial, education and healthcare
- 31 Hume St – commercial
- Corner Hume & Clarke St - childcare

These are displayed in Figure 2-1. Note that Crows Nest Sites A and B are future developments however are considered in this report.



Figure 2-1 - Noise sensitive receivers

For the purpose of predicting noise levels at the nearest sensitive receivers we have considered the following receivers:

- Crows Nest Site B (residential, Pacific Hwy noise catchment)
- 22 Clarke St, Clarke St-facing (residential, Clarke St noise catchment)
- Kelly's Place Children's Centre, corner Hume and Clarke Sts (childcare)
- Crows Nest Site A (commercial)
- College of Professional Psychologists (school classroom)
- Reskin Medical (hospital ward)

2.2 Unattended Noise Monitoring

Unattended noise monitoring was carried out by NDY at 28 Hume St between 17th June 2022 and 30th June 2022 and by SLR Consulting on behalf of Metron at 420 Pacific Highway from 19th June 2015 to 1st July 2015. Two noise monitoring locations were chosen to reflect the differing noise characteristics on the west side of the development, exposed to Pacific Highway, and the east side of the development, exposed to the quieter Clarke St.

Data from SLR's noise logging has been used for the Pacific Highway catchment because it does not capture noise from construction activities which has been a constant feature of the area since 2018.

2.2.1 Meteorological Data

In order to verify the noise data obtained during suitable meteorological conditions, weather data such as rain and wind speed was obtained from the Bureau of Meteorology Sydney Observatory Hills weather station 066214 as a representative site.

Noise data is excluded (as per the NSW NPFI methodology) from the results in case of:

- Rain observed during any 15 – minute noise measurement period and/or
- Wind speeds exceeded 5m/s during 15 – minute noise measuring period.

2.2.2 Instrumentation

Noise levels were measured using the noise loggers listed in Table 2-1 and the graphical representation of noise levels can be observed at Appendix A: Unattended Noise monitoring results . Refer to Appendix B for details of SLR's noise monitoring.

Table 2-1 Noise Logger Information

Location	Noise Logger	Type	Serial Number	Date of last calibration
28 Hume St	NL– 42EX	Class 2	01173760	16.06.2022

The noise logger was configured to record all relevant noise parameters including background noise (L_{A90}) and equivalent continuous noise levels L_{Aeq} . Samples were recorded at 15-minute A-weighted continuous intervals. The noise monitor responses were set to *fast* response.



Figure 2-2 Unattended noise monitoring locations

3 NOISE AND VIBRATION EMISSION CRITERIA

3.1 Operational Noise Criteria

Under the POEO, the Environment Protection Authority, now incorporated within the NSW Office of Environment and Heritage (OEH), has the responsibility to issue policy statements to set out criteria and methods of management for noise within the state.

It should be noted that this has been adopted for the main Crows Nest Station precinct for the design of the main metro station and over station development, under planning consent conditions for the Crows Nest Metro project, of which Site C is a part. We have applied the Noise Policy for Industry (NPfI) to this project.

3.1.1 NSW Noise Policy for Industry

For the purpose of the assessment, the measured noise data was processed into the following time periods:

- Daytime: 0700 to 1800 hrs.
- Evening: 1800 to 2200 hrs.
- Night-time: 2200 to 0700 hrs.

The measured background (L_{A90}) and equivalent continuous (L_{Aeq}) noise levels during these defined time periods. The L_{A90} noise levels presented are *Rating Background Levels* (RBLs), being the median of the background L_{A90} (i.e. of the lowest 10th percentile of samples) in each daytime, evening and night-time measurement period, for each 24-hour period during the noise survey.

We have not considered shoulder periods in this assessment as the use of the subject site is Commercial, therefore it is expected the development will generally operate only during business hours.

3.1.1.1 Amenity and Intrusiveness Criteria

The NSW NPfI provides assessment methodologies, criteria and detailed information on the assessment of environmental noise emissions in NSW. The NSW NPfI criteria for noise sources consider two (2) components:

- Controlling **intrusive** noise impacts for residential receivers. Assessing intrusiveness generally requires noise measurements to quantify background (L_{A90}) noise levels at a location considered representative of the most potentially affected residential receiver(s). The intrusiveness criterion essentially means that the equivalent continuous noise level (L_{Aeq}) of the source(s) under consideration should be controlled to not exceed background noise levels by more than 5 dBA.
- Maintaining noise **amenity** for various categories of land use (including residential receivers and other sensitive receivers). The amenity criterion is based on the sensitivity of a particular land use to industrial-type noise. The recommended amenity noise levels detailed in Table 2.2 of NSW NPfI represent the objective for total industrial noise at a receiver location, whereas the project amenity noise level represents the objective for noise from a single industrial development at a receiver location. This is to ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area. The project amenity criteria for each new source of industrial noise is equal to recommended amenity noise level minus 5 dBA.

A +3 dBA to be added to project amenity noise level for conversion from a period level to a 15-minutes level. Where the resultant project amenity noise level is 10 dB or more below the existing industrial noise level, the project amenity noise levels can be set at 10 dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.

The NPfI recommends “Intrusive noise levels are only applied to residential receivers (residences).”



Table 3-1: NSW NPfl Amenity Criteria

Type of receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level, dB
Residence	Urban	Day 7:00 to 18:00	60
		Evening 18:00 to 22:00	50
		Night 22:00 to 7:00	45
School classroom – internal	All	Noisiest 1-hour period when in use	35
Hospital ward internal external	All	Noisiest 1-hour	35
	All	Noisiest 1-hour	50
Active recreation area (e.g. school playground, golf course)	All	When in use	55
Commercial premises	All	When in use	65

3.1.1.2 NSW NPfl Project Specific Criteria

The noise monitor was located in the ‘free – field’. Following the determination of the intrusiveness and amenity criteria, the following project specific criteria were determined for the project, which is summarized below in Table 3-3.

Table 3-2: Baseline noise data for the proposed development

Monitoring Location	L_{A90} Rating Background Noise Level (RBL)			L_{Aeq} Ambient Noise Levels		
	Day (7:00 to 18:00)	Evening (18:00 to 22:00)	Night (22:00 to 7:00)	Day (7:00 to 18:00)	Evening (18:00 to 22:00)	Night (22:00 to 7:00)
420 Pacific Hwy	59	55	50	68	67	62
28 Hume St	54	49	41	62	58	52

Table 3-3: NPfl Project Specific Noise Levels, dB

Period	Intrusive Criterion RBL + 5	Urban Amenity Criteria (L_{Aeq} , dBA)	Project Specific Criteria
Crows Nest Site B (based on 420 Pacific Hwy monitoring location)			
Day (7:00 to 18:00)	$(59+5) = 64$	$(60-5)+3 = 58$	58 dB $L_{Aeq,15min}$
Evening (18:00 to 22:00)	$(55+5) = 60$	$(50-5)+3 = 48$	48 dB $L_{Aeq,15min}$
Night (22:00 to 7:00)	$(50+5) = 55$	$(45-5)+3 = 43$	43 dB $L_{Aeq,15min}$
22 Clarke St, Clarke St-facing (based on 28 Hume St monitoring location)			
Day (7:00 to 18:00)	$(54+5) = 59$	$(60-5)+3 = 58$	58 dB $L_{Aeq,15min}$
Evening (18:00 to 22:00)	$(49+5) = 54$	$(50-5)+3 = 48$	48 dB $L_{Aeq,15min}$
Night (22:00 to 7:00)	$(41+5) = 46$	$(45-5)+3 = 43$	43 dB $L_{Aeq,15min}$
Kelly's Place Children's Centre			



Period	Intrusive Criterion RBL + 5	Urban Amenity Criteria (L_{Aeq} , dBA)	Project Specific Criteria
When in use	-	55 dB $L_{Aeq, period}$	55 dB $L_{Aeq, period}$
Crows Nest Site A (commercial)			
When in use	-	65 dB $L_{Aeq, period}$	65 dB $L_{Aeq, period}$
College of Professional Psychologists (education/school classroom), L1, 10 Clarke St			
When in use, internal	-	35 dB $L_{Aeq, 1hour}$	35 dB $L_{Aeq, 1hour}$
Reskin Medical, L4, 10 Clarke St			
When in use, internal	-	35 dB $L_{Aeq, 1hour}$	35 dB $L_{Aeq, 1hour}$

3.2 Sleep Disturbance

The potential for sleep disturbance from maximum noise level events during the night-time period is assessed against the following criteria:

- $L_{Aeq, 15min}$ 40 dBA or the prevailing RBL plus 5 dB, whichever is the greater, and/or
- L_{AFmax} 52 dBA or the prevailing RBL plus 15 dB, whichever is the greater

Table 3-4 Sleep disturbance criteria

Period	$L_{Aeq, 15min}$	L_{AFmax}
Crows Nest Site B (based on 28 Clarke Ln monitoring location)		
Night (22:00 to 7:00)	(50+5) = 55	(50+15) = 65
22 Clarke St, Clarke St-facing (based on 28 Hume St monitoring location)		
Night (22:00 to 7:00)	(41+5) = 46	(41+15) = 56

3.3 NSW Road Noise Policy

The requirements of the NSW Road Noise Policy are applicable to this assessment. Table 3-5 summarises the noise assessment criteria based on the type of road and the land use. The functional role for each type of road category is as follows:

- Freeways or motorways/arterial roads:
 - Support major regional and inter- regional traffic movement.
 - Freeways and motorways usually feature strict access controls via grade separated interchanges.
- Sub-arterial roads:
 - Provide connection between arterial roads and local roads.
 - May support arterial roads during peak periods.
 - May have been designed as local streets but can serve major traffic generating developments or support non-local traffic.
- Local roads:
 - Provide vehicular access to abutting property and surrounding streets.
 - Provide a network for the movement of pedestrians and cyclists and enable social interaction in a neighbourhood.



- Should connect, where practicable, only to sub-arterial roads.

Table 3-5 Road Traffic Noise Assessment Criteria for Residential Land Uses

Road Category	Type of Project/land use	Assessment Criteria, dB	
		Day (7am to 10pm)	Night (10pm to 7am)
Freeway/arterial/ sub-arterial roads	1. Existing residences affected by noise from new freeway/arterial/sub-arterial road corridors	L _{Aeq,15hour} 55 (External)	L _{Aeq,9hour} 50 (External)
	2. Existing residences affected by noise from redevelopment of existing freeway/arterial/sub-arterial roads	L _{Aeq,15hour} 60 (External)	L _{Aeq,9hour} 55 (External)
	3. Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments		
Local Roads	4. Existing residences affected by noise from new local road corridors	L _{Aeq,1hour} 55 (External)	L _{Aeq,1hour} 50 (External)
	5. Existing residences affected by noise from redevelopment of existing local roads		
	6. Existing residences affected by additional traffic on existing local roads generated by land use developments		

The noise assessment criteria for non-residential land uses are listed in Table 4 5. These criteria are applied when assessing the impact and determining mitigation measures in the following situations:

- When there is a new road or road development;
- When there is a land use development with the potential to generate additional traffic on local, sub-arterial or arterial roads.



Table 3-6 : Road Traffic Noise Assessment Criteria for Non-residential Land Uses Affected by Proposed Road Projects and Traffic Generating Development

Existing Land Uses	Assessment Criteria, dB	Additional Consideration
School classrooms	L _{Aeq,1hr} 40 (Internal) When in use	In the case of building used for education or health care, noise level criteria for spaces other than classrooms and wards may be obtained by interpolation from the 'maximum' levels shown in Australian Standard 2107:2016.
Office Buildings (General Office Areas)	L _{Aeq,1hr} 43 (Internal) When in use	-

Where internal noise criteria are specified, NDY has assumed a 10dB(A) reduction through the facade with windows partially opened to obtain an estimated external noise criteria.

3.4 Operational Vibration Criteria

While the Environment Protection Authority does not prescribe operational vibration emission limits for developments, this project has adopted the vibration criteria stated within *Assessing Vibration - A Technical Guide* (DEC, 2006).

Table 3-7 and **Table 3-8** outlines the recommended vibration levels within affected buildings.

Table 3-7 – Criteria for Continuous and Impulsive Vibration

Location	Assessment period ¹	Preferred values		Maximum values	
		z-axis	x- and y-axes	z-axis	x- and y-axes
Continuous vibration					
Critical areas ²	Day- or night-time	0.0050	0.0036	0.010	0.0072
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day- or night-time	0.020	0.014	0.040	0.028
Workshops	Day- or night-time	0.04	0.029	0.080	0.058
Impulsive vibration					
Critical areas ²	Day- or night-time	0.0050	0.0036	0.010	0.0072
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day- or night-time	0.64	0.46	1.28	0.92
Workshops	Day- or night-time	0.64	0.46	1.28	0.92

¹ Daytime is 7.00 am to 10.00 pm and night-time is 10.00 pm to 7.00 am

² Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specified above. Stipulation of such criteria is outside the scope of this policy, and other guidance documents (e.g. relevant standards) should be referred to. Source: BS 6472-1992



Table 3-8 Criteria for Intermittent Vibration

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

1 Daytime is 7.00 am to 10.00 pm and night-time is 10.00 pm to 7.00 am.

2 Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas.

Source: BS 6472–1992



4 OPERATIONAL NOISE ASSESSMENT

The main sources of operational noise emission for the development are expected to be building services equipment and, to a lesser degree, loading noise. These are addressed in the following sections.

4.1 Building Services

4.1.1 Mechanical Services

4.1.1.1 System Description

Fresh air is provided by air handling units and outside air fans, located on Level 9, via on-floor fan coil units. Stair pressure fans are located in the Level 10 plant enclosure on the western side of the rooftop. Smoke spill fans serving the lift lobbies and office floors are located at the top of the smoke spill plenums at the southern corner of the rooftop. Cooling is achieved through an air-cooled chiller on the eastern side of the rooftop.

Sound power levels of the mechanical services systems are listed in the table below.

Table 4-1 Mechanical services sound power level data

Equipment	Sound power level (dB) per octave frequency band									
	63Hz	125Hz	250Hz	500Hz	1000Hz	2000Hz	4000Hz	8000Hz	Linear	A-wtd
TEF-G.1	73	73	80	73	71	78	78	72	85	83
GEF-G.1	72	84	75	73	71	78	66	62	86	81
OAF-9.1	57	71	72	67	71	66	61	56	77	74
GEF-10.1	77	76	78	76	81	79	73	62	86	85
TEF-10.1	81	82	78	74	72	72	68	63	86	79
AHU-9.1	-	80	80	80	75	74	79	65	86	84
SSF-10.1 & - 10.2	88	83	89	86	85	82	78	72	94	90
SPF-10.1 & - 10.2	87	82	88	85	84	81	77	71	93	89
CH-10.1	-	89	88	89	87	82	82	76	95	92
CH-10.2	92	79	72	68	60	55	47	41	92	71

4.1.1.2 Acoustic Treatment

Preliminary analysis of base building plant has been undertaken for costing purposes. It should be noted that the plant is approximately 6m distance from the nearest commercial receiver on the western boundary. The following allowances have been made for in the design:

- Intake and Discharge (up to attenuators) ductwork of SPF-10.1 and SPF-10.2 shall be internally lined with 50mm thick acoustic insulation.
- Intake ductwork of AHU-9.1 shall be internally lined with 50mm thick acoustic insulation.
- All penetrations to the plant rooms should be properly dimensioned, packed and sealed;
- Main services ducts and pipes to have their own individual penetrations, with suitable spacing to allow good sealing;

- Allowance for acoustic attenuation treatments e.g., internal lining to air inlets and discharges to meet Council/INP criteria;
- Allowance for 50mm thick heavy density (35-48kg/m³) mineral wool/polyester insulation with perforated metal facing (>20% perforation) should be made to the entire plant room walls;
- For major equipment such as chillers, allow for local stiffening of the plant room floor;
- All intakes and discharges from the plant room are to be internally lined with 75mm perforated faced insulation;
- Speed controllers, if used, should be of good quality and compatible with the motor model. Poor quality controllers can result in significant increase in motor noise, typically 10 dB(A) or greater, with an offensive high frequency tone;
- Selection of low noise fans, allowance for smooth airflow conditions in ductwork, use of attenuators and lined duct work while minimising regenerated noise at bends, take-offs and transitions;
- All return air duct work should as a minimum consist of at least 1 50mm internally lined bend, 1 50mm internally lined plenum and 1 meter of 50mm internally lined ductwork past the bend;
- Select a low noise chiller, typically 10-15 dB(A) quieter than the standard Carrier unit. Make an allowance for fan discharge attenuators, as per Figure 4-1.

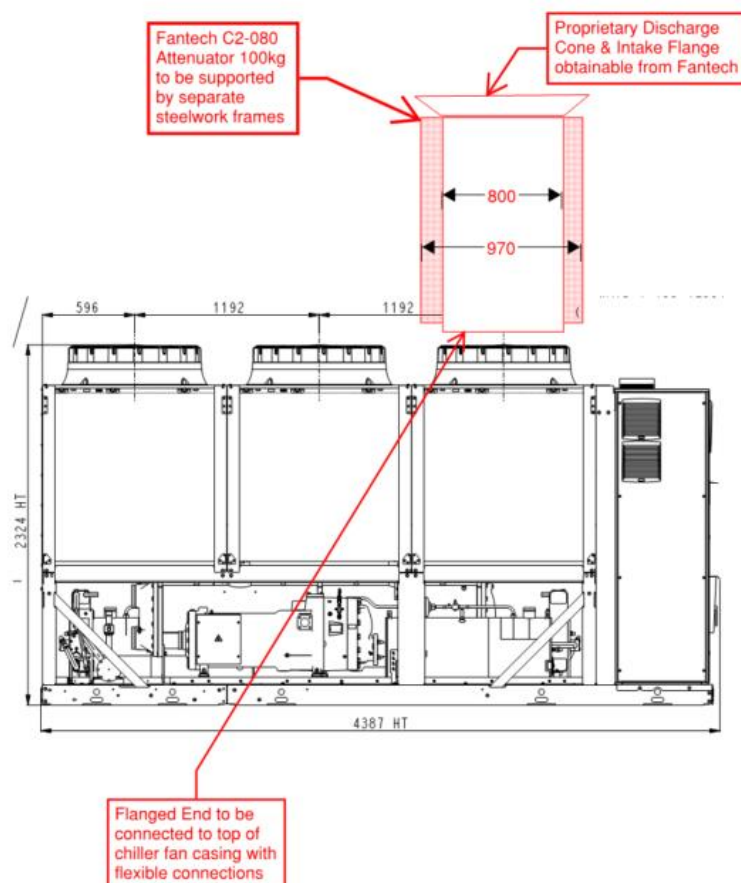


Figure 4-1 Large chiller treatment for rooftop platform

4.1.2 Fire Protection Services

Two fire pumps are located on the Level 9 plant floor. The detailed design of the fire pump room and selection of the plant is yet to be finalised, however it is expected to require the following acoustic treatment to achieve boundary noise compliance:

- Heavy construction to acoustic enclosure walls and ceiling
- Acoustic attenuators to intake, outlet and exhaust

Detailed design and selection of the fire pump and plantroom will ensure that fire pump noise emissions from the development will be designed to satisfy the boundary noise requirements.

4.1.3 Hydraulic Services

We do not anticipate any significant sources of noise emission from hydraulics services equipment.

4.1.4 Electrical Services

We do not anticipate any significant sources of noise emission from electrical services equipment.

4.1.5 Predicted Noise Levels

An assessment has been carried out of building services noise emission to the nearest affected receivers. Compliance is achieved with night period project trigger levels.

Note that in the prediction of noise levels to both the College of Professional Psychologists and Reskin Medical, a conservative approach was taken in estimating the performance of the façade by estimating a 10 dB loss across the façade.

Table 4-2 Predicted noise levels.

Equipment	Treatment	Predicted noise (dBA)					
		Site B L _{Aeq,15min}	22 Clarke St L _{Aeq,15min}	Kelly's Place L _{Aeq,period}	Site A L _{Aeq,period}	College of Professional Psychologists L _{Aeq,1hour}	Reskin Medical L _{Aeq,1hour}
TEF-G.1	50mm internal duct lining	29	16	18	38	14	14
GEF-G.1	50mm internal duct lining	32	18	19	40	16	16
OAF-9.1	50mm internal duct lining	24	16	14	16	16	16
GEF-10.1	Acoustic barrier around plant deck	31	28	31	31	27	27
TEF-10.1	Acoustic barrier around plant deck	31	28	31	31	25	27
AHU-9.1	Lined ductwork; Acoustic barrier around plant deck	22	20	35	24	22	24
SSF-10.1 & -10.2	Cylindrical attenuator; Acoustic barrier around plant deck	30	17	19	34	18	18
SPF-10.1 & -10.2	Fantech SBL1 acoustic louvre; Acoustic barrier around plant deck	28	19	27	25	18	19
Chillers	Fantech C-080 attenuator to discharge;	38	30	33	42	29	29



Equipment	Treatment	Predicted noise (dBA)					
		Site B L _{Aeq,15min}	22 Clarke St L _{Aeq,15min}	Kelly's Place L _{Aeq,period}	Site A L _{Aeq,period}	College of Professional Psychologists L _{Aeq,1hour}	Reskin Medical L _{Aeq,1hour}
	Acoustic barrier around plant deck						
Fire pump	Fantech SBL2 acoustic louvre to intake/discharge; internal lining to plantroom	39	26	27	37	28	30
Combined noise levels		43	35	40	47	34	35
Noise Criteria (night period)		43	43	55	65	35	35
Compliance		Compliant	Compliant	Compliant	Compliant	Compliant	Compliant

The table demonstrates that compliance is achieved with all equipment running, including emergency equipment such as the SSF and fire pump. These emergency equipment are the loudest items, and during normal operation the levels can be expected to be quieter.

4.2 Loading Noise

There is no formal loading dock area proposed for Site C as loading is proposed to occur on-street. We also note the following:

- Upon completion of Crows Nest Station and the OSD projects it is expected that service vehicle numbers will decrease slightly from current use (from 32 to 26)
- The pre-existing usage of Clarke Lane and associated access roads was predominantly uses, trucks in loading docks and waste removal. Most of the pre-existing developments used Clarke Lane for waste removal.
- The shift in land use to predominantly residential is likely to change the mix of vehicles to a higher proportion of private light vehicles which benefits the acoustic environment.

Based on the above we do not expect a net increase to the ambient acoustic environment from noise associated from loading activities.

4.3 Road Traffic

Road traffic has been assessed in the Noise & Vibration Impact Assessment Report SMCSWSCN-SMC-SCN-EM-REP-000024. The outcomes of the report will be maintained provided the approved traffic volumes are maintained (Table 4-3).

Table 4-3 - Estimated traffic generated from OSD Site C in the AM and PM peak hours based on land-use intensity (Sydney Metro City & Southwest Crows Nest Over Station Development Submissions Report - Transport, traffic and parking assessment report).

Building	Land Use	Scale (unit, sqm GFA)	AM				PM				Daily			
			Rate	Total	In	Out	Rate	Total	In	Out	Rate	Total	In	Out
C	Com.	2160	0.0017	5	4	0	0.0014	4	0	3	0.0123	33	17	17



5 OPERATIONAL VIBRATION ASSESSMENT

5.1 Plant Vibration Isolation

The main sources of vibration emission will be associated with building services equipment such as fans, air handling units, chillers, and the fire pump. With regards to continuous vibration, all plant and equipment are to be reviewed for determining factors rotational speeds, weights and structural requirements to select suitable vibration isolation for the project in accordance with ASHRAE Chapter 47 and relevant review of manufacturer data. Installation of mounts which are manufactured by a supplier who can demonstrate a proven record of successful installations and that will provide appropriate warranty and technical support. All rotating plant and associated pipes shall be with compatible vibration isolation mountings with the aim to achieve minimum 90% isolation efficiency. Mount types which provide the minimum deflection under operating load have been recommended as per below.

With building services plant equipment isolated as per Table 5-1, the development will readily comply with the nominated operational vibration emission criteria.

Table 5-1 Vibration isolation mounts for plant and equipment.

Equipment Type	Shaft Power (kW) and Other	RPM	Equipment Location											
			Slab on Grade			Floor Span								
			Base Type	Isola- tor Type	Min. Defl. (mm)	Up to 6m			6 to 9m			9 to 12m		
						Base Type	Isolator Type	Min. Defl. (mm)	Base Type	Isolator Type	Min. Defl. (mm)	Base Type	Isolator Type	Min. Defl. (mm)
Chillers														
Centrifugal, screw, scroll, Absorption	All	All	A	1	8	A	4	25	A	4	50	A	4	50
Air Compressors and Vacuum Pumps														
	All	All	C	3	25	C	3	25	C	3	50	C	3	50
Pumps														
Close-coupled	≤5.6	All	B	2	8	C	3	25	C	3	25	C	3	25
	≥7.5	All	C	3	25	C	3	25	C	3	50	C	3	50
Large inline	3.7 to 19	All	A	3	25	A	3	50	A	3	50	A	3	50
	≥22	All	A	3	50	A	3	50	A	3	50	A	3	75
End suction and split case	≤30	All	C	3	25	C	3	25	C	3	50	C	3	50
	37 to 93	All	C	3	25	C	3	25	C	3	50	C	3	75
	≥110	All	C	3	25	C	3	50	C	3	75	C	3	100
Cooling Towers														
	All	Up to 300	A	1	8	A	4	100	A	4	100	A	4	100
		301 to 500	A	1	8	A	4	75	A	4	75	A	4	75
		500 and up	A	1	8	A	4	25	A	4	25	A	4	50
Boilers														
	All	All	A	1	8	B	4	25	B	4	50	B	4	75
Axial Fans														
< 560mm diameter	All	All	A	2	8	A	3	25	A	3	25	C	3	25
> 610mm diameter	≤500 Pa SP	Up to 300	B	3	75	C	3	100	C	3	100	C	3	100
		300 to 500	B	3	25	B	3	50	C	3	75	C	3	75
		500 and up	B	3	25	B	3	50	B	3	50	B	3	50
	≥500 Pa SP	Up to 300	C	3	75	C	3	100	C	3	100	C	3	100



Equipment Type	Shaft Power (kW) and Other	RPM	Equipment Location											
			Slab on Grade			Floor Span								
						Up to 6m			6 to 9m			9 to 12m		
			Base Type	Isolator Type	Min. Defl. (mm)	Base Type	Isolator Type	Min. Defl. (mm)	Base Type	Isolator Type	Min. Defl. (mm)	Base Type	Isolator Type	Min. Defl. (mm)
		300 to 500	C	3	50	C	3	50	C	3	75	C	3	75
		500 and up	C	3	25	C	3	50	C	3	50	C	3	75
Centrifugal Fans														
< 560mm diameter	All	All	B	2	8	B	3	25	B	3	25	C	3	50
> 610mm diameter	≤30	Up to 300	B	3	75	B	3	100	B	3	100	B	3	100
		300 to 500	B	3	50	B	3	50	B	3	75	B	3	75
		500 and up	B	3	25	B	3	25	B	3	25	B	3	50
	≥37	Up to 300	C	3	75	C	3	100	C	3	100	C	3	100
		300 to 500	C	3	50	C	3	50	C	3	75	C	3	75
		500 and up	C	3	50	C	3	50	C	3	50	C	3	75
Heat Pumps														
	All	All	A	3	25	A	3	25	A	3	25	A/D	3	50
Condensing Units														
	All	All	A	1	8	A	4	25	A	4	50	A/D	4	50
PAC Units														
All	≤7.5	All	A	3	25	A	3	25	A	3	25	A	3	25
	≤11, ≤1kPA SP	Up to 300	A	3	25	A	3	100	A	3	100	C	3	100
		300 to 500	A	3	25	A	3	75	A	3	75	A	3	75
		500 and up	A	3	25	A	3	50	A	3	50	A	3	50
	≥11, ≥1kPA SP	Up to 300	B	3	25	C	3	100	C	3	100	C	3	100
		300 to 500	B	3	25	C	3	50	C	3	75	C	3	75
		500 and 3up	B	3	25	C	3	50	C	3	50	C	3	75
PAC Rooftop Equipment														
	All	All	A / D	1	8	D	3	25	-	-	-	-	-	-
Engine-Driven Generators														
	All	All	A	3	25	C	3	50	C	5	75	C	5	100
Base Type:						Isolator Type:								
A. No base, isolators attached directly to equipment						1. Rubber pads								
B. Structural steel rails or base						2. Rubber floor isolator or hanger								
C. Concrete inertia base						3. Spring floor isolator or hanger								
D. Curb-mounted base						4. Restrained spring isolator								
						5. Air mount								



6 METHODS OF NOISE AND VIBRATION MANAGEMENT AND MITIGATION

6.1 Management

This section sets out procedures that will, if properly implemented by the identified responsible person, ensure that operational noise and vibration emissions are controlled to appropriate levels, based on the noise emitting activities and equipment addressed in this report. If further noise generating activities or equipment are introduced in the future an acoustic assessment may need to be conducted that assesses the noise emission levels against the relevant criteria.

- Council shall be provided with the name and contact details of the Facilities Manager or other identified person who will be responsible for the implementation of the ONVMP:

Name of person responsible for implementing ONVMP:	
Cellular phone number:	
Email address:	

- The implementation of the ONVMP shall be included in the written job description of the identified responsible person. At least one responsible person shall be present on site at all times.
- The identified responsible person shall ensure that:
 - All identified noise measures are in place and effective at all times
 - Any noise complaints are responded to in a prompt and reasonable manner, following the methodology set out below.
- Measured or available reference noise levels for additional plant and equipment not covered in this report shall be used to predict the levels of noise that will be generated at identified sensitive receivers.
- Where the predicted noise levels exceed the required noise limits, practicable and cost-effective additional noise control measures shall be identified.
- In the event that any complaint is received due to the operational noise or vibration, this shall be monitored by a suitable trained person under the direction of an identified responsible person. For monitoring requirements, refer to Section 7. Measurements shall be taken to determine the noise or vibration impact.
- Suitable noise monitoring locations shall be identified that are representative of the location of the complainant(s).
- In the event that the measured noise levels are found to exceed the operational noise limits the Facilities Manager or other responsible person shall be advised. Options for further noise control measures shall be investigated. Council will be informed of the exceedances and any noise control measures implemented.
- The Facilities Manager shall require that all on-site plant and equipment be properly maintained, and that all acoustic treatment is properly fitted and in good working order.
- The Facilities Manager shall require all contractors to maintain road-going vehicles in a roadworthy condition and ensure that all relevant noise control equipment is fitted and operating effectively.
- A complaints record log shall be kept at the site office and in the event of a complaint being received relating to noise or vibration.



- If activities are identified that are considered to be generating excessive noise, the identified responsible person shall take all practicable actions to reduce noise to a reasonable level and contact the complainant and advise them of the outcome of the investigation and make a written note of the event and the outcome.

6.2 Mitigation

Table 6-1 provides a summary of noise and vibration mitigation measures presented in this report.

Table 6-1 Summary of noise and vibration mitigation measures

Operational Consideration	Mitigation Measures
Building services noise	<ul style="list-style-type: none">■ Internal duct lining■ Attenuators■ Acoustic barriers around plant deck■ Acoustic louvre■ Selection of low-noise equipment
Building services vibration	<ul style="list-style-type: none">■ Vibration isolation mounts
Loading noise	Nil required



7 OPERATIONAL NOISE AND VIBRATION MONITORING

Monitoring of noise and vibration is an important part of managing emissions from operational sites. We recommend noise and vibration monitoring is undertaken in the event any complaints are received, the results of which shall be submitted to Council's compliance team leader within one week of receiving the complaint.

7.1 Location

Noise monitoring should occur at the facade of location of the complainant. We propose assessment locations for vibration, if any complaint is received, to be carried out at the location of complaint

7.2 Extent of Monitoring

We would suggest that the best means of conducting measurements is to utilise qualified acoustic engineers with Type 1/Class 1 hand held sound level meter and accelerometer. When reporting results, the engineer should exclude traffic noise/vibration from operational noise/vibration to establish the actual level of noise/vibration being produced by the site. Furthermore, they can identify what types of equipment are creating the most noise/vibration and if needed, advise the Facilities Manager on additional mitigation measures.

In the event that complaints are received, noise measurements to monitor the noise emissions of the development should be carried out in accordance with the NSW EPA and the NPfI. The preferred method of determining compliance with the noise limits is attended noise measurements at the compliance point. Information gathered during the measurements should be at a minimum consistent with section 7.1.2 of the NPfI and reporting should be consistent with section 7.1.3 of the NPfI.



8 CONCLUSIONS

A commercial development is proposed at 14 Clarke Street, Crows Nest. This report addresses operational and operational noise and vibration emissions as received at the most affected receivers, located around the subject site:

- Crows Nest Site B (residential, Pacific Hwy noise catchment)
- 22 Clarke St, Clarke St-facing (residential, Clarke St noise catchment)
- Kelly's Place Children's Centre, corner Hume and Clarke Sts (childcare)
- Crows Nest Site A (commercial)
- College of Professional Psychologists (school classroom)
- Reskin Medical (hospital ward)

8.1 Operational Noise

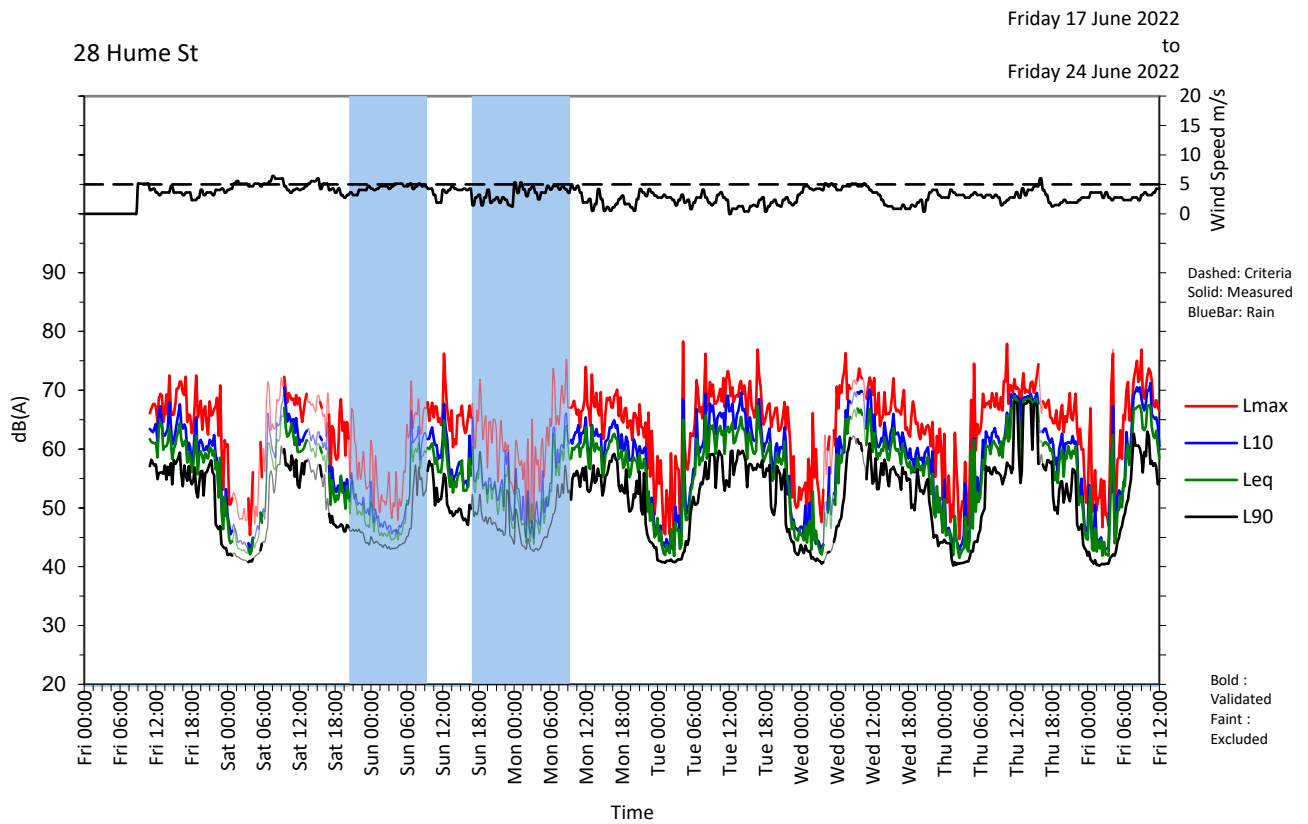
- Operational noise criteria will be set in accordance with NSW NPfI on completion of the unattended noise monitoring currently being undertaken
- The main contributors of operational noise emission are expected to be building services equipment
- Building services equipment will be attenuated through the use of typical acoustic treatment items such as internally lined ductwork, attenuators, acoustic louvres, etc., as required.

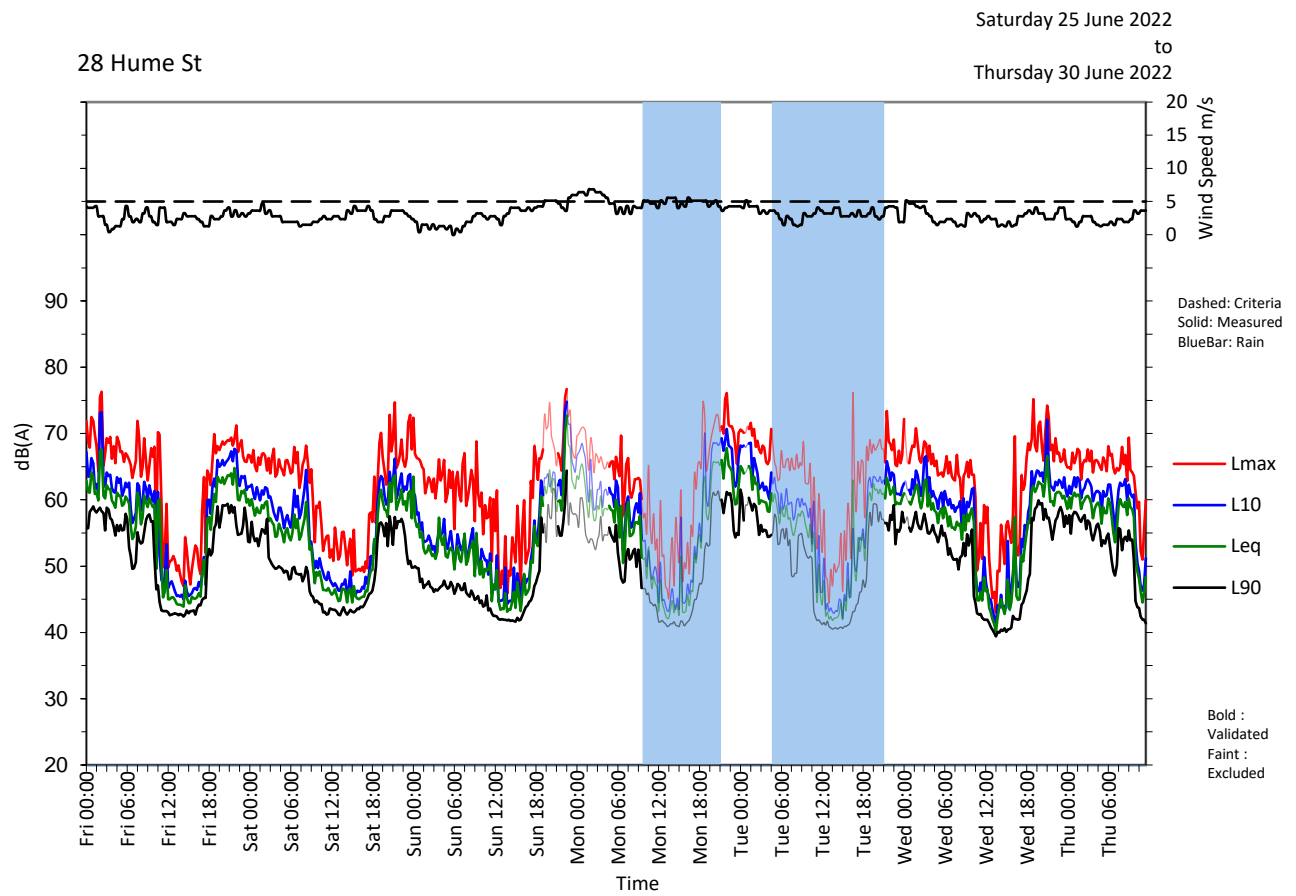
8.2 Operational Vibration

- Operational vibration criteria have been set as per AS 2670
- The main contributors of operational vibration emission are expected to be building services equipment
- Building services equipment will incorporate vibration isolators according to the equipment operating parameters and the characteristics of the supporting structure.



APPENDIX A: UNATTENDED NOISE MONITORING RESULTS







APPENDIX B – SLR CONSULTING NOISE MONITORING DATA

Appendix B.19

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Background Noise Monitoring Results – B.19

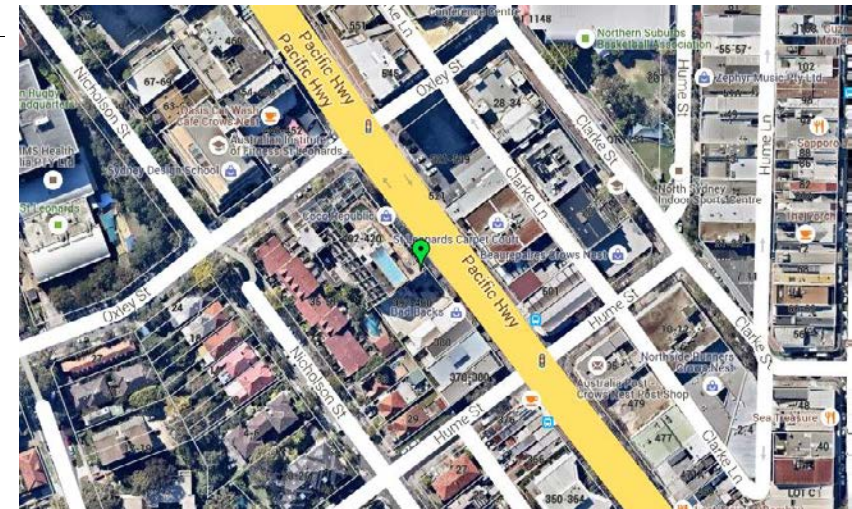
Noise Monitoring Location: B.19
Noise Monitoring Address: 420 Pacific Highway, Crows Nest 2065

Logger Device Type: Svantek 957
 Logger Serial No: 23241

Ambient noise logger deployed on the roof of 420 Pacific Highway, Crows Nest. Logger located on the north eastern facade with noise catchment over Pacific Highway below.

Attended noise measurements indicate that the ambient noise environment at this location is dominated by road traffic noise from Pacific Highway. Surrounding mechanical plant contributed to the LA90 (background) noise level throughout, as well as the constant road traffic along the main road below.

Map of Noise Monitoring Location



Ambient Noise Logging Results – INP Defined Time Periods

Monitoring Period	Noise Level (dBA)			
	RBL	LAeq	L10	L1
Daytime	59	68	70	74
Evening	55	67	68	72
Night-time	50	62	64	69

Attended Noise Measurement Results

Date	Start Time	Measured Noise Level (dBA)		
		LA90	LAeq	LAmx
19/06/2015	11:39:56	62	67	78

Photo of Noise Monitoring Location



Appendix B.19

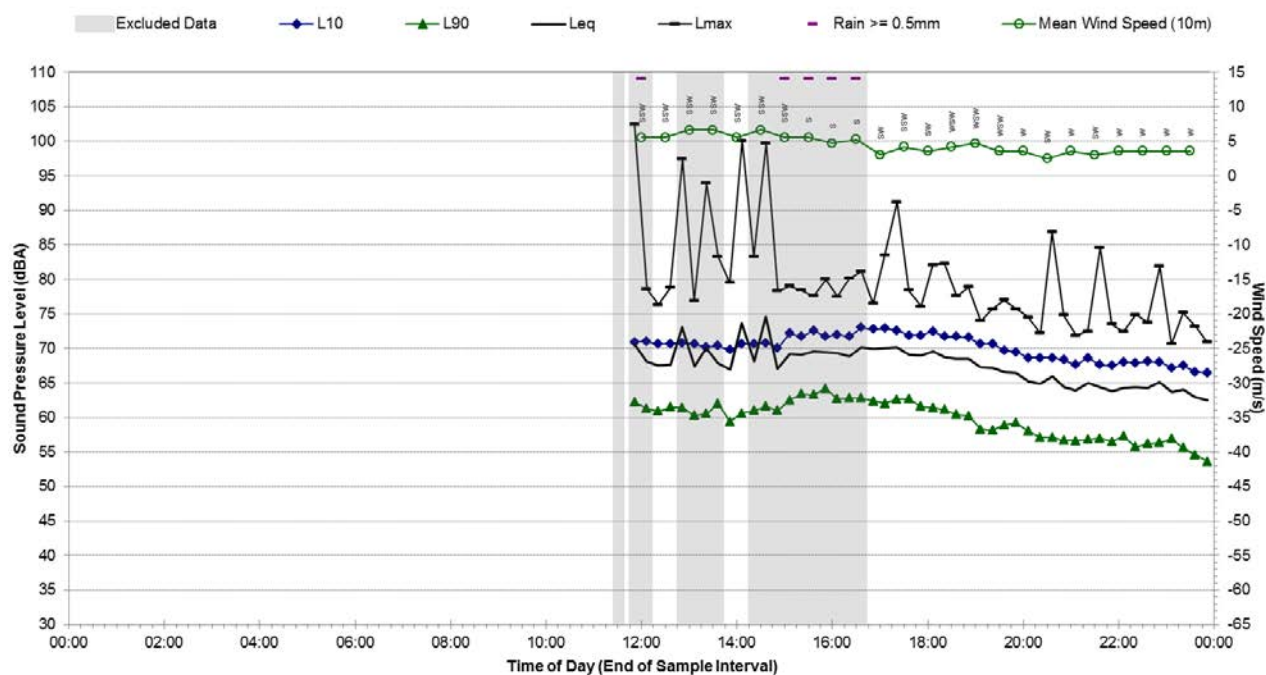
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Background Noise Monitoring Results – B.19

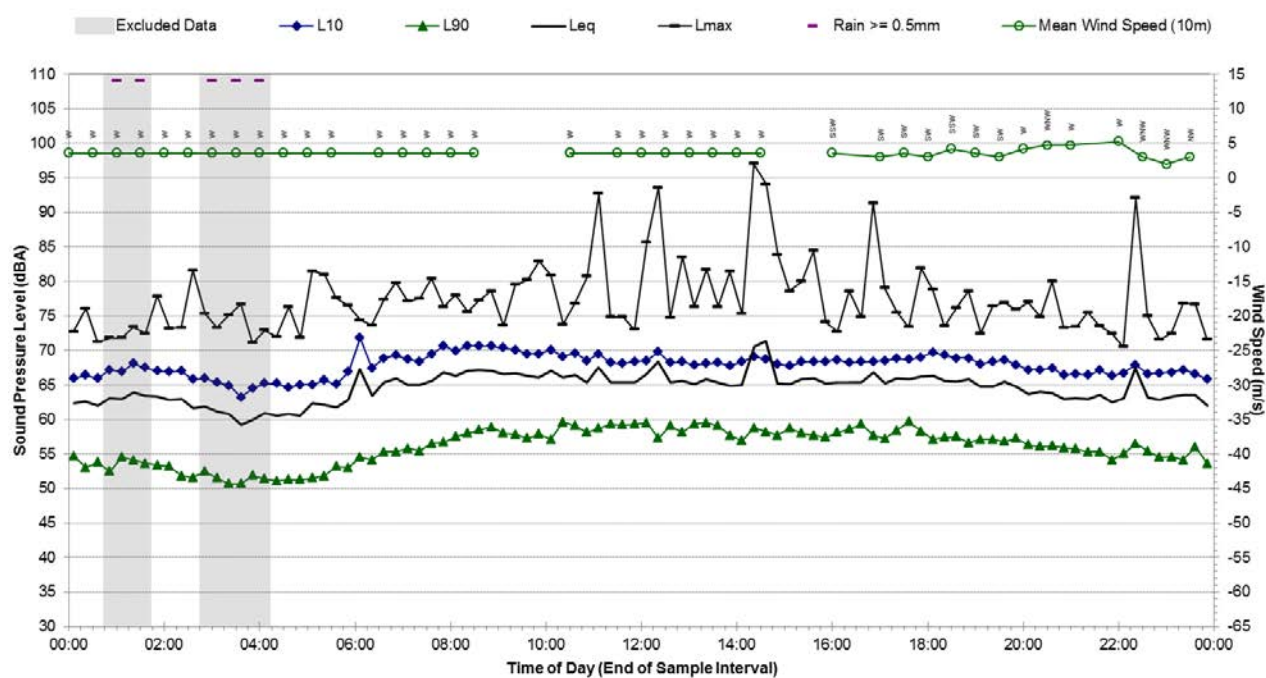
Statistical Ambient Noise Levels

B.19 - Friday, 19 June 2015



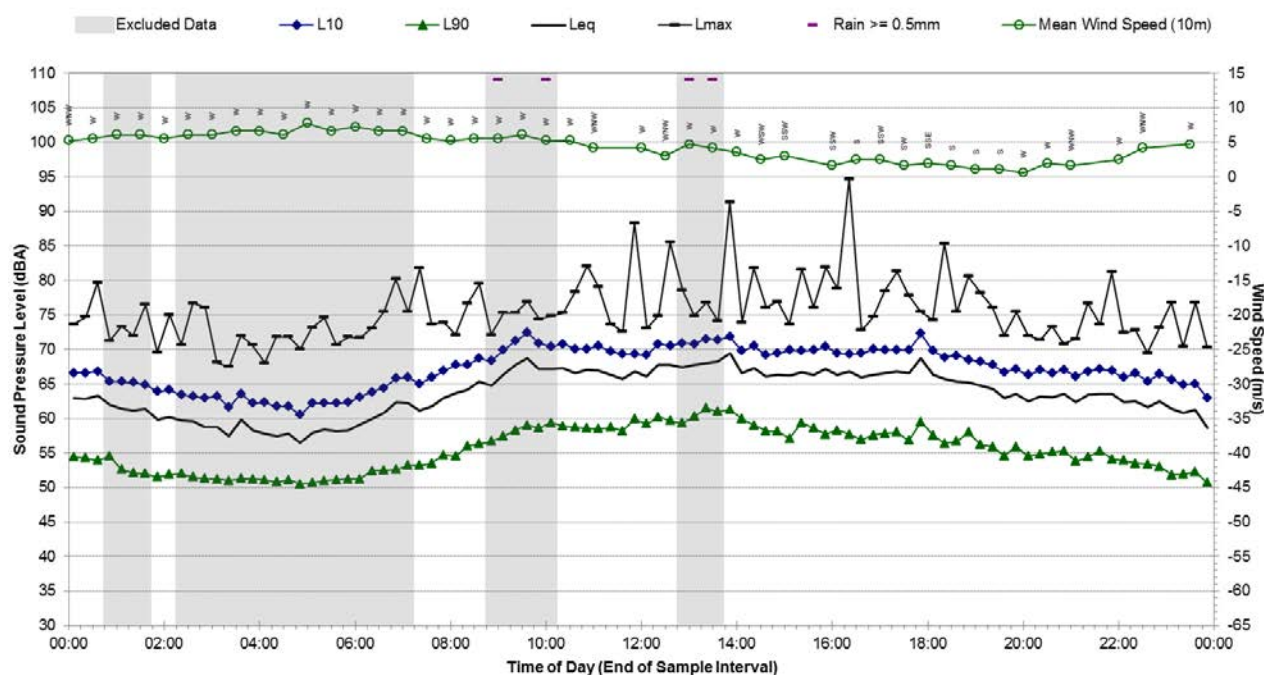
Statistical Ambient Noise Levels

B.19 - Saturday, 20 June 2015



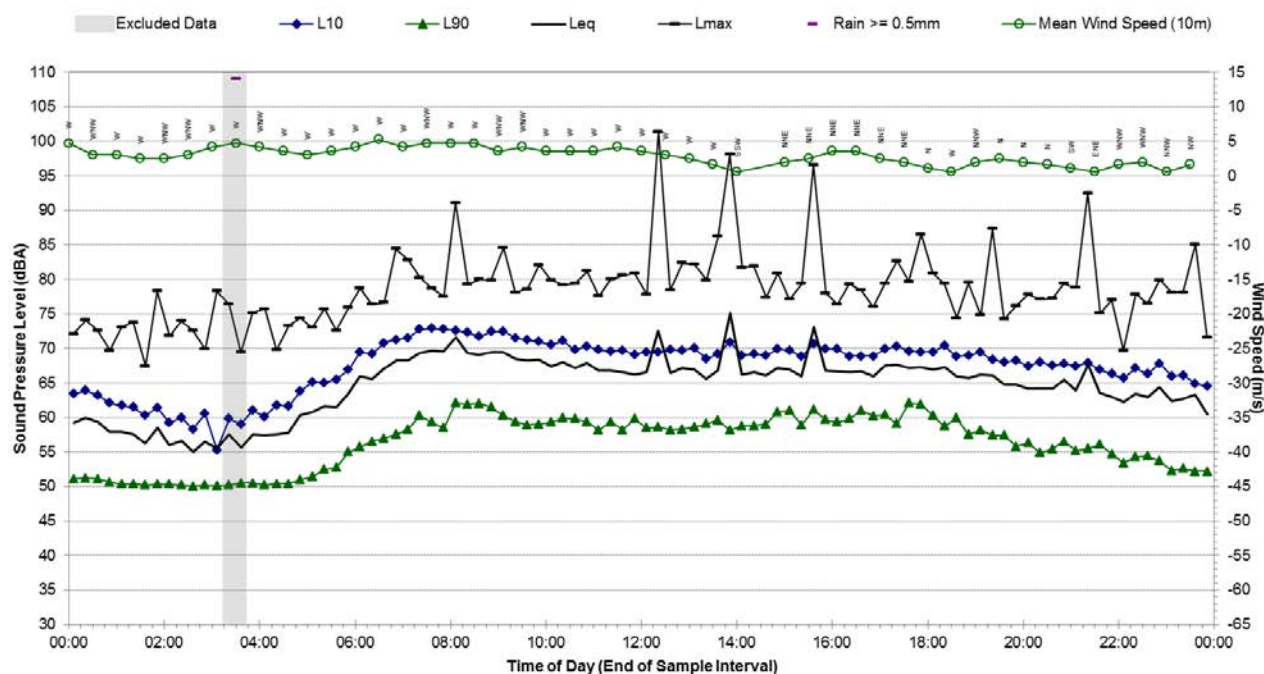
Statistical Ambient Noise Levels

B.19 - Sunday, 21 June 2015



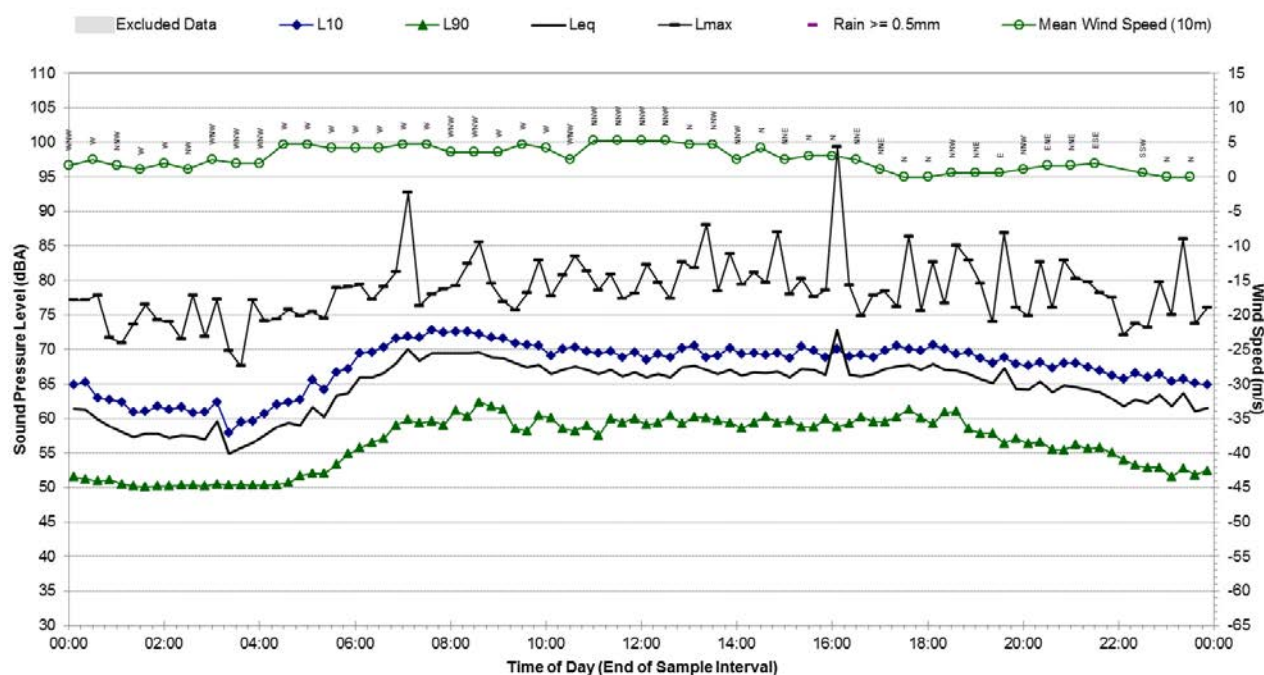
Statistical Ambient Noise Levels

B.19 - Monday, 22 June 2015



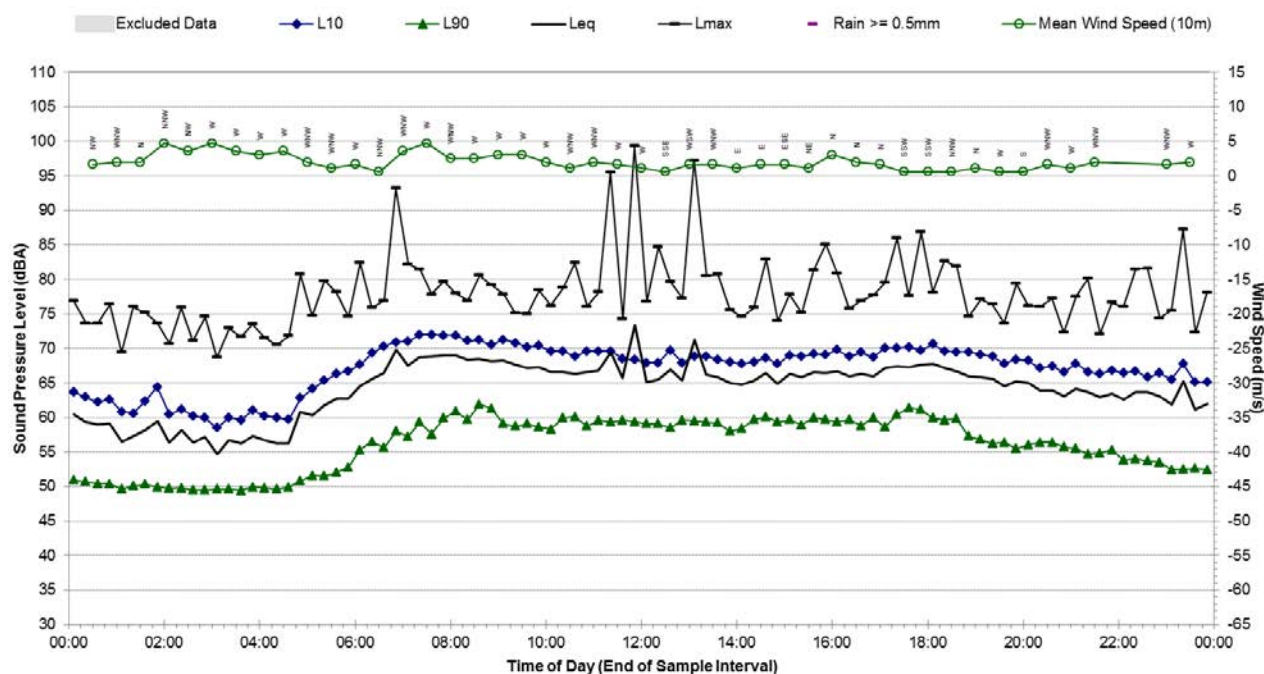
Statistical Ambient Noise Levels

B.19 - Tuesday, 23 June 2015



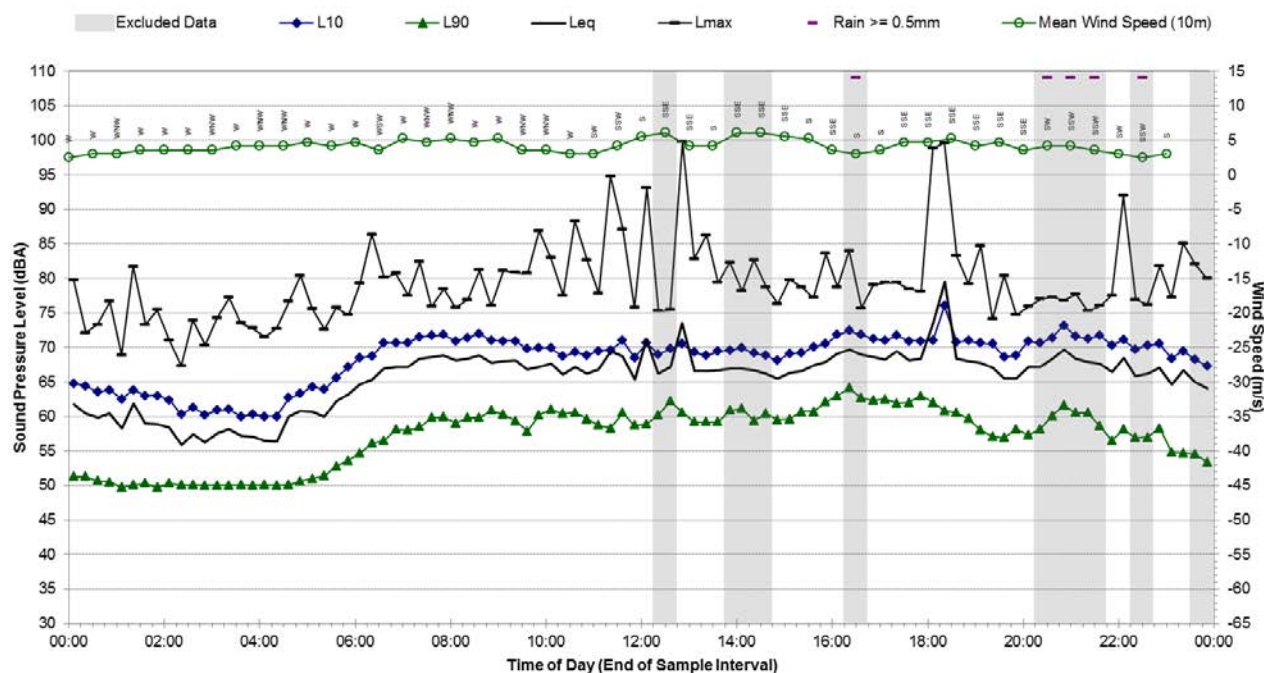
Statistical Ambient Noise Levels

B.19 - Wednesday, 24 June 2015



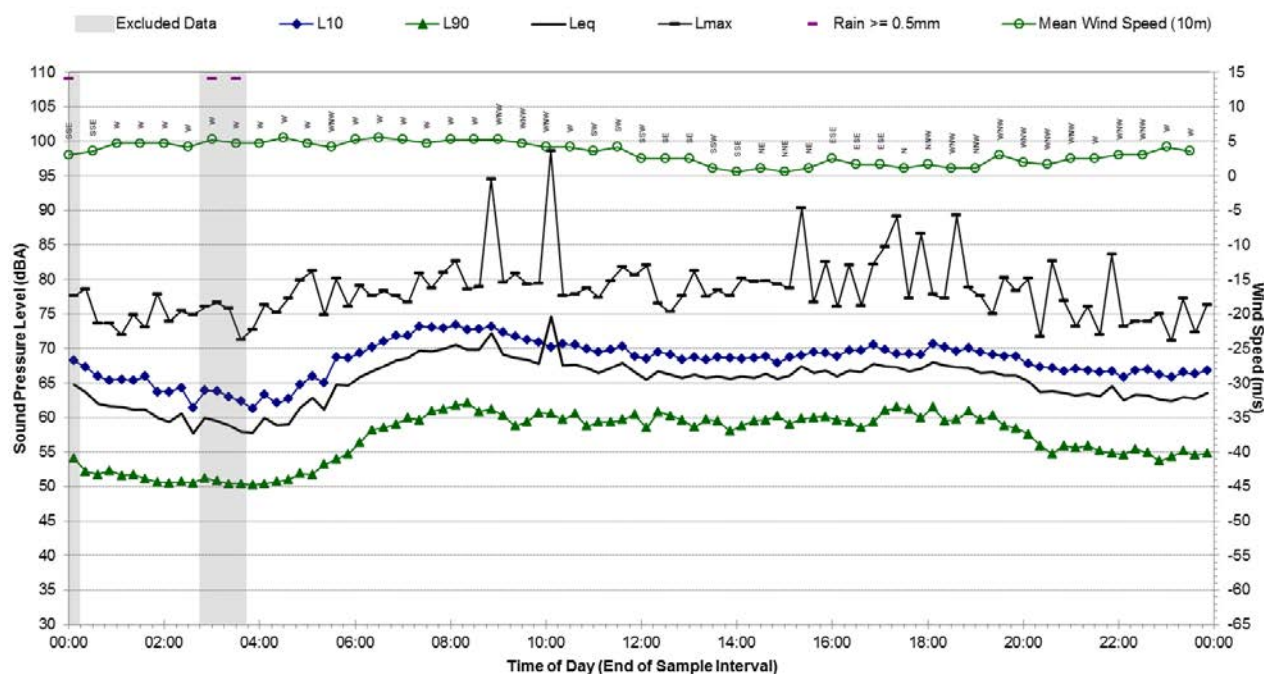
Statistical Ambient Noise Levels

B.19 - Thursday, 25 June 2015



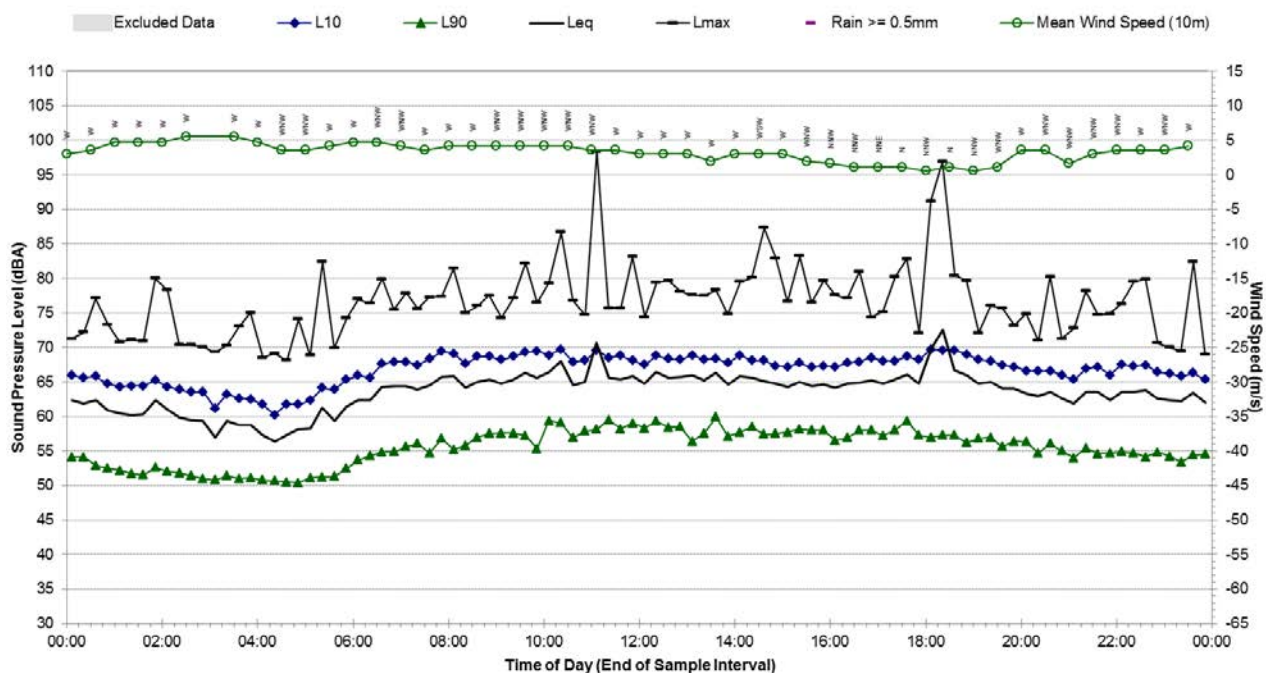
Statistical Ambient Noise Levels

B.19 - Friday, 26 June 2015



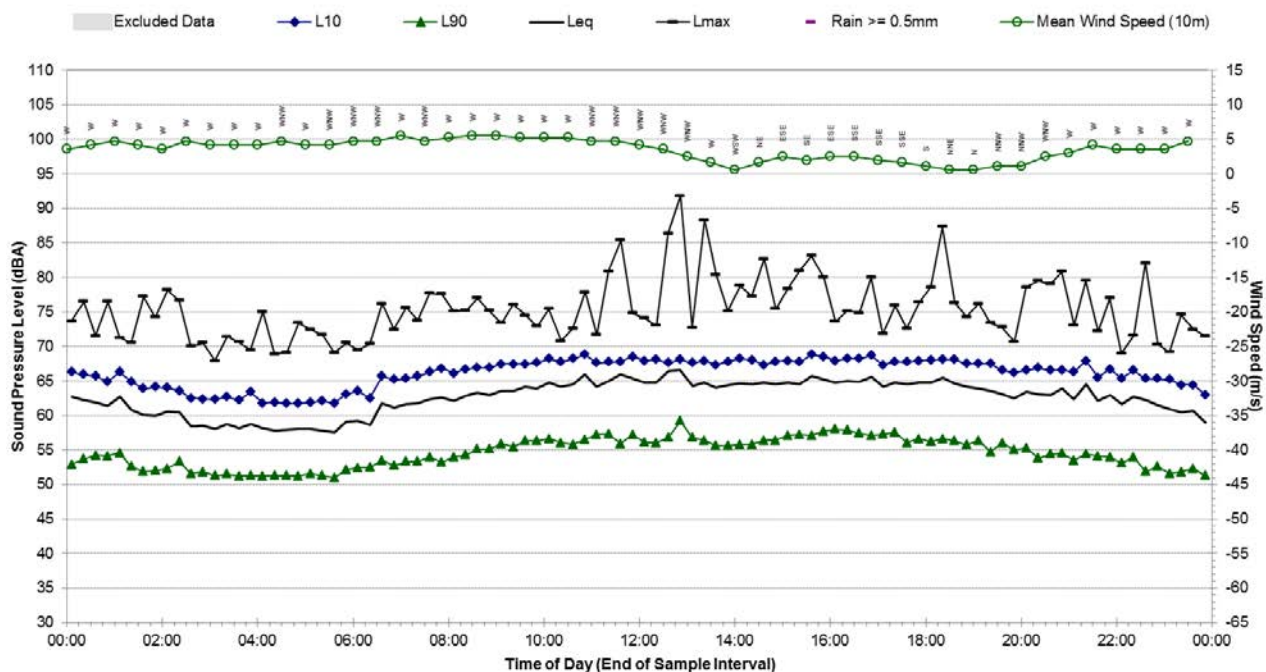
Statistical Ambient Noise Levels

B.19 - Saturday, 27 June 2015



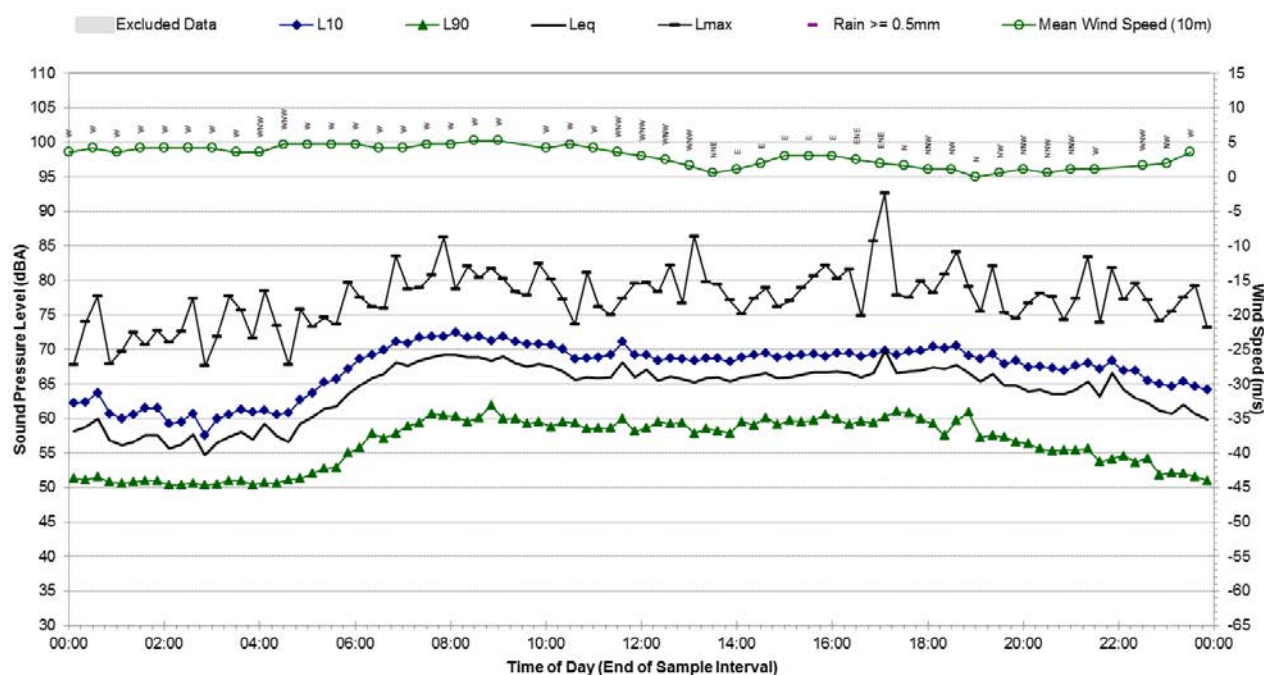
Statistical Ambient Noise Levels

B.19 - Sunday, 28 June 2015



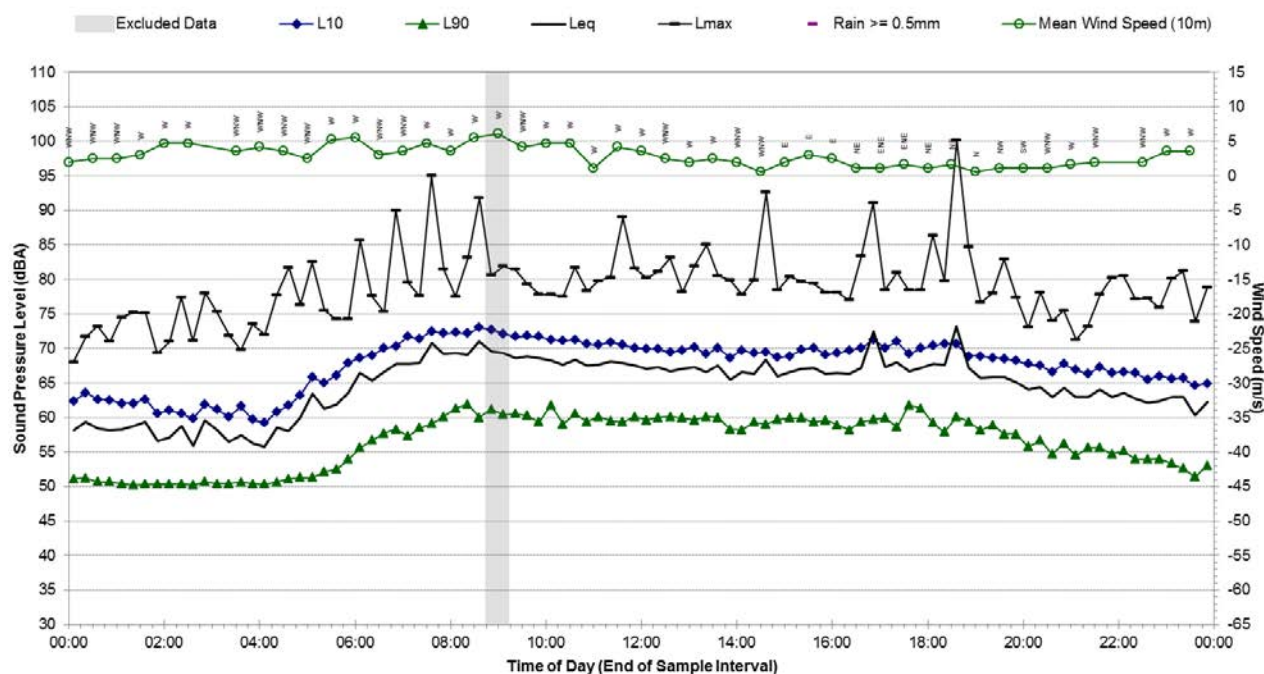
Statistical Ambient Noise Levels

B.19 - Monday, 29 June 2015



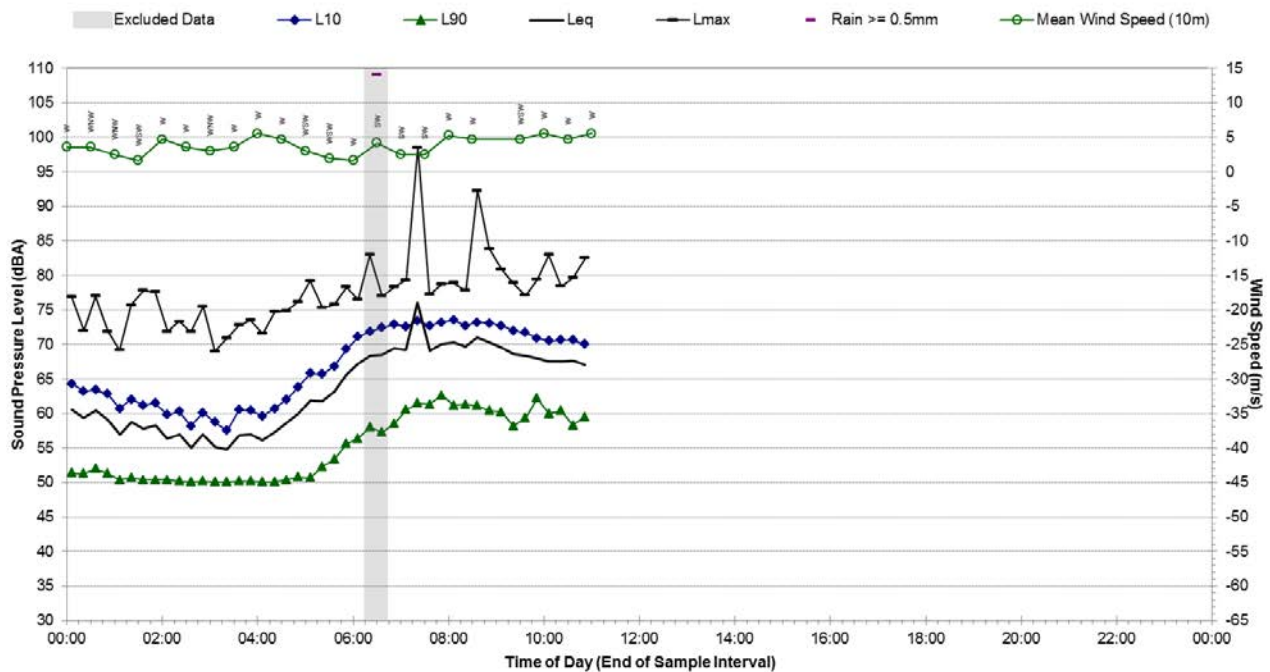
Statistical Ambient Noise Levels

B.19 - Tuesday, 30 June 2015



Statistical Ambient Noise Levels

B.19 - Wednesday, 1 July 2015





NORMAN DISNEY & YOUNG CONSULTING ENGINEERS

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NDY QA SYSTEM

Revision No: 3.0
Revision Date: 2 August 2022
Reason Description: For Review

Client Name: SMEC
Client Contact: Oliver Bauer

Project Leader: Robert Bartlett
Editor: Cameron Walbran
Filename: rp220602s0002
File Location: \\tt.local\ndy\syd\w\S322xx\S32225\002\J-124_Reports

Authorisation By: Laurent Laberibe

Verification By: Thomas Warren

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