St Leonards – 13-19 Canberra Avenue, St Leonards

Noise Impact Assessment

Hyecorp

Report number: 210263_210707_Noise Impact Assessmnet_BW_R2
Date: 29 September 2021
Version: For Information

PULSE WHITE NOISE ACOUSTICS Level 5, 73 Walker Street, North Sydney NSW 2060
P 1800 4 PULSE (1800 478 573) **E** info@pwna.com.au **pwna.com.au** ABN 95 642 886 306

DOCUMENT CONTROL

Project Name	13-19 Canberra Avenue, St Leonards
Project Number	210263
Report Reference	210263_210707_Noise Impact Assessmnet_BW_R1.docx
Client:	Hyecorp

Revision	Description	Reference	Date	Prepared	Checked	Authorised
1	For Information	210263_210707_Noise Impact Assessment_BW_R1.docx	19 August 2021	Ben White	Matthew Furlong	Ben White
2	For Information	210263_210707_Noise Impact Assessmnet_BW_R2.docx	29 September 2021	Ben White	Matthew Furlong	Ben White

PREPARED BY:

Pulse White Noise Acoustics Pty Ltd
ABN 95 642 886 306
Level 5, 73 Walker Street, North Sydney, 2060
1800 4 PULSE

TABLE OF CONTENTS

TABLES

FIGURES

1 INTRODUCTION

Pulse White Noise Acoustics has been engaged to undertake the Noise Impact Assessment of the proposed mixed use residential and commercial development located at 13-19 Canberra Avenue, St Leonards.

The proposed project includes a multi story development site and includes the following:

1. 13-19 Canberra Avenue –
    a. Car parking on the lower 4 basement floors of the project
    b. Mixed use residential and retail use on Lower Ground floor and Ground floor.
    c. Mixed use residential and commercial (chide care centre) use on Level 1.
    d. Residential dwellings on the remaining floors including levels 2 to 13.

This assessment includes the acoustic investigation into the potential for noise impacts from the operation of the completed project, including the proposed child care centre, as well as potential noise impacts from existing noise sources within the vicinity of the site which predominantly includes traffic noise from surrounding roadways.

1.1 Development Description

The site is located at 13-19 Canberra Avenue, St Leonards within the block bound by Canberra Avenue to the east, and Holdsworth Avenue to the west. The surrounding receivers to the site include existing and future residential properties.

The site location is detailed in Figure 1 below.

Figure 1 Site Location

2 PROPOSED DEVELOPMENT

The proposed project is located at 13-19 Canberra Avenue, St Leonards and is located within the Lane Cove Municipal Council local government area.

The site is located on Canberra Avenue to the east and Holdsworth Avenue to the west which are not defined as a busy road carrying over 40,000 Annual Average Daily Traffic (AADT) number, nor carries over 20,000 AADT as defined in Map 16 of the RTA's *Traffic Volume Maps for Noise Assessment for Buildings on Land Adjacent to Busy Roads*. The site is also located more than 60m from a railway line.

See the Figure below which includes the site location included on Map 16 as detailed above.

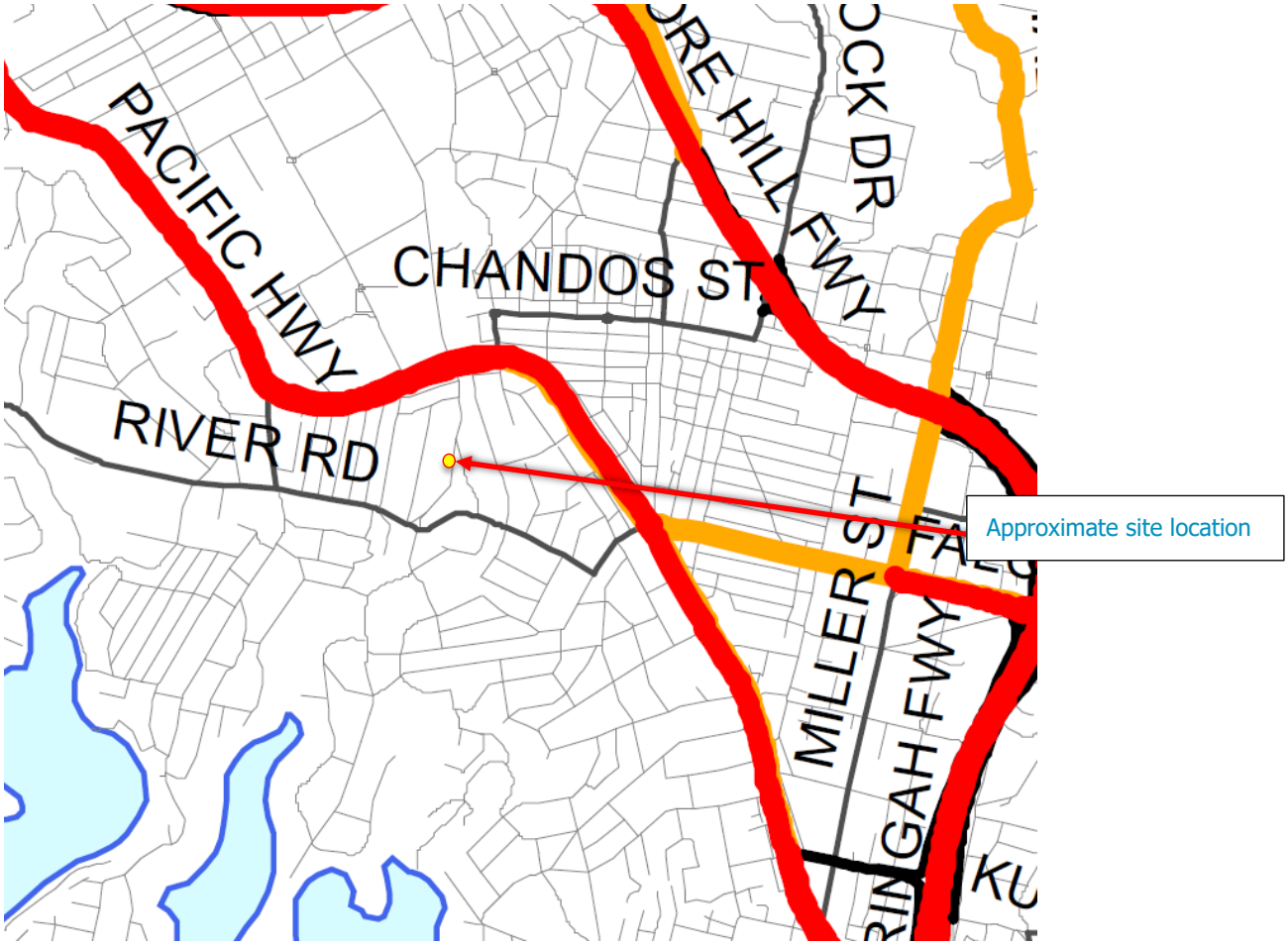


Figure 2 Sit Location of Map 16 of the RTA's *Traffic Volume Maps for Noise Assessment for Buildings on Land Adjacent to Busy Roads*

The site is also located to the west of the North Shore Train line which is located more than 60m from the site, see figure 3 Below.

Figure 3 Site proximity to railway lines to the east

Section 3.5.1 of the Department of Planning *Development Near Rail Corridors and Busy Roads – Interim Guideline* includes the guidance for the assessment of sensitive developments within proximity of railway lines. Figures 3.1 (rail noise) and figure 3.2 (Rail Vibration) if the DNRCBR include the following.

3.5.1 RAIL CORRIDORS

Noise

Figure 3.1 provides a guide as to the level of assessment required when noise sensitive developments are located in the vicinity of existing rail lines. Zones A and B are indicative acoustic assessment zones where sensitive land-uses are likely to be adversely affected. Where there are noise maps available based on actual rail movements the noise map information should be used in preference to **Figure 3.1**.

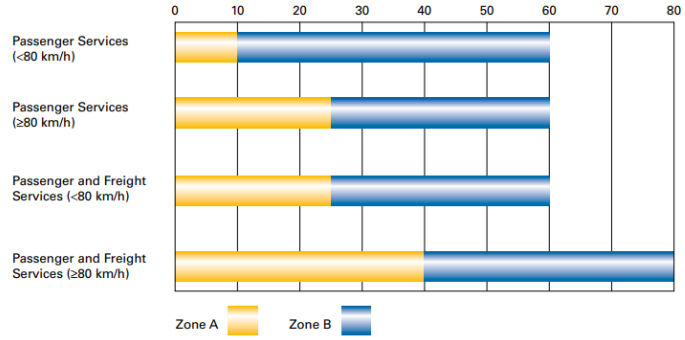


Figure 3.1: Acoustic Assessment Zones based on distance (m) of noise-sensitive development from operational track (not corridor)

Rail Vibration

The vibration assessment zone for typical development sites adjacent to rail corridors or above rail tunnels is shown in **Figure 3.2**. The assessment zone may need to be increased for specific areas where vibration issues are known to already exist. Refer to section 3.6.3 vibration criteria for additional information. Developments within this zone will need a vibration assessment.

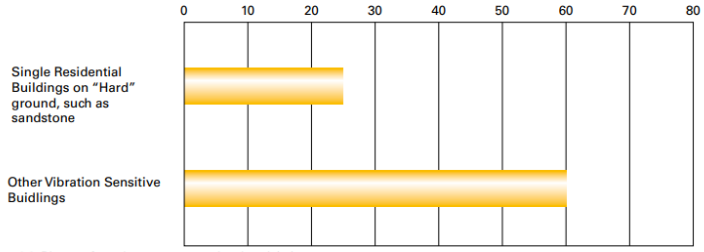


Figure 3.2: Distance from the nearest operational track (m)

Based on the location of the project site which includes an approximate distance of 87m (at a minimum) to the railway line to the east, as detailed in Figure 3 above, a detailed assessment of noise and vibration resulting from trains is not required to be undertaken.

Notwithstanding the above, the assessment noise at the site includes noise level measurements at the site and details recommended building constructions which will ensure internal noise levels (including train noise) is within the recommendations of the Australian Standard AS2107:2016. The recommended acoustic treatments in this report will ensure a suitable internal acoustic amenity for future residence resulting from train movements on the railway line to the east of the site.

3 EXISTING ACOUSTIC ENVIRONMENT

The proposed site is located within an area which would be classified as a *Suburban* area based on the definitions with the EPA's *Noise Policy for Industry*. The exiting noise levels at the site are predominantly as a result from traffic noise within the vicinity of the site including Canberra Avenue as well as other surrounding roadways.

As part of this assessment an acoustic survey of the existing acoustic environment at the site was undertaken. The survey included attended noise level measurements at the site, during various times of the day on the 21st June, 2021 as well as long term unattended noise logging which was undertaken between the 8th and 15th of June, 2021. During the testing periods there was no inclement weather periods.

Noise logging was undertaken using a Rion NL-42EX type noise monitor with serial number 00998079 and calibration with calibration number C19678. The noise logger was located to the rear of the existing property as detailed in Figure 1 above to obtain representative background noise levels. The logger was positioned such that it included façade corrects which have been applied in this assessment.

Attended noise level testing was conducted using a Bruel and Kjaer 2236C type meter. The meter was calibrated before and after testing and no significant drift was recorded.

3.1 Noise Survey Results

The attended and unattended noise locations were selected to obtain suitable noise levels for the assessment of background noise levels ($L_{90\ (t)}$) as well as the impact from traffic movements ($Leq_{(t)}$). The results of the acoustic survey are detailed in the tables below which have been used as the basis of this assessment.

Table 1 Results of the Attended Noise Survey at the Site

Measurement Location	Time of the Measurement	$L_{Aeq,\ 15min}$ dB(A)	$L_{A90,\ 15min}$ dB(A)	Comments
Attended noise measurement location on Canberra Avenue - north	4.30pm to 4.45 pm	54	43	Noise resulting from traffic noise on surrounding streets
Attended noise measurement location on Canberra Avenue - south	4.50pm to 5.05 pm	52	44	

Table 2 Results of Noise Logging at the Site

Measurement Location	Time of Measurement	Maximum Repeatable $L_{Aeq,\ 15min}$ dB(A)	Representable Background noise Level (RBL) $L_{A90,\ 15min}$ dB(A)
Noise logger location, see figure 1 above	Day	54	43
	Evening	52	41
	Night	50	37

4 INTERNAL NOISE LEVEL CRITERIA

Internal noise levels within the future residential occupancies have been based on the relevant noise levels as detailed within the Australian Standard AS2107:2000 *Acoustics - Recommended design sound levels and reverberation times for building interiors*.

The recommended levels for various areas of the project are detailed in the following table. The recommended noise levels for residential dwellings near major roadways detailed within AS2107:2016 have been used as the basis of this assessment and are detailed below.

Table 3 Internal Noise Level Criteria

Type of Occupancy/Activity	Design sound level maximum
Common areas (e.g. foyer, lift lobby)	55 $L_{Aeq\ 15\ hour}$
Residential - Living areas	40 $L_{Aeq\ 15\ hour}$
Residential - Sleeping areas (night time)	35 $L_{Aeq\ 9\ hour}$[1]
Toilets	55 $L_{Aeq\ 15\ hour}$
Note 1: The relevant time period for bedrooms include the period of 10pm to 7am	

5 ENVIRONMENTAL NOISE INTRUSION

This section of the report details the assessment of environmental noise intrusion into the proposed development and the recommended acoustic treatments to ensure the recommended internal noise levels detailed in the Sections above (including traffic noise intrusion) are achieved.

Internal noise levels within the future areas of the development will result from the noise intrusion into the building through the external façade including glass, masonry and other façade elements. Typically, the acoustic performance of building elements including the relatively light weight elements of the building façade, including glass and/or plasterboard constructions, will be the determining factors in the resulting internal noise levels.

Calculations of internal noise levels have been undertaken based on the measured traffic and calculated aircraft environmental noise levels at the site and the characteristics of the building, including window openings, buildings constructions and the like.

5.1 External Glass Elements

The recommended acoustic constructions to the buildings external façade glass elements are detailed in the table below to ensure the recommended internal noise levels detailed above are achieved, with the façade building openings closed.

Table 4 External Glass Acoustic Requirements

Façade Orientation	Room Type	Recommended Glass Construction	Minimum Façade Acoustic Perforamnce[1]
All façade orientations	Bedrooms	6.38mm Laminated	Rw 30
	Living Areas	6.38mm Laminated	Rw 30
	Wet Areas	4mm Float/Toughened	Rw 28
	Common areas and lobbies	6.38mm Laminated	Rw 30
	Retail areas	6.38mm Laminated	Rw 30
	Child Care Centre[2]	10.38mm Laminated	Rw 35

Note 1: The acoustic performance of the external façade includes the installed glazing and frame including (but not limited to) the façade systems seals and frame. All external glazing systems are required to be installed using acoustic bulb seals.

Note 2: Includes required glass for the mitigation of noise generated within the childcare centre as detailed in the following sections of this report.

The recommended glass constructions detailed in the table above include those required to ensure the acoustic requirements of the project are achieved. Thicker glazing may be required to achieve other project requirements such as structural, thermal, safety or other requirements and is to be advised by others.

5.2 External Building Elements

The proposed external building elements including masonry or concrete external walls and roof are acoustically acceptable without additional acoustic treatment.

Any light weight external pasteboard walls should be constructed from a construction with a minimum acoustic performance of Rw 50.

5.3 External Roof

The required external roof and ceiling constructions for the project are required to include the following:

- Concrete external roof construction – no additional treatments required.
- Metal deck roof construction – no additional treatments required.

5.4 External Opening and Penetrations

All openings and penetrations are required to be acoustically treated such that the performance of the building construction is not compromised. This may require lining of duck work behind mechanical service openings/grills, treatments to ventilation opening and the like.

6 EXTERNAL NOISE EMISSION ASSESSMENT

This section of the report details the relevant noise level criteria for noise emissions generated on the site once completed.

The relevant authority which provides the required noise level criteria for noise levels generated on the site includes the NSW Environmental Protection Authority's (EPA) Noise Policy for Industry (NPI).

6.1 NSW Environmental Protection Authority, Noise Policy for Industry

The NSW Environmental Protection Authority (EPA) Noise Policy for Industry (NPfI), previously Industrial Noise Policy, details noise criteria for the control of noise generated from the operation of developments and the potential for impact on surrounding receivers.

The NPfI includes both intrusive and amenity criteria which are summarised below.

1. Intrusive noise level criteria, The NPfI states the following:

   'The intrusiveness of an industrial noise source may generally be considered acceptable if the level of noise from the source (represented by the LAeq descriptor), measured over a 15minute period, does not exceed the background noise level by more than 5 dB when beyond a minimum threshold. This intrusiveness noise level seeks to limit the degree of change a new noise source introduces to an existing environment.'

2. Amenity noise level criteria, The NPfI states the following:

   'To limit continuing increases in noise levels from application of the intrusiveness level alone, the ambient noise level within an area from all industrial noise sources combined should remain below the recommended amenity noise levels specified in Table 2.2 where feasible and reasonable. The recommended amenity noise levels will protect against noise impacts such as speech interference, community annoyance and some sleep disturbance.'

   Project amenity noise level for industrial developments = recommended amenity noise level (Table 2.2) minus 5 dB(A)

   Where the resultant project amenity noise level is 10 dB or more lower than the existing industrial noise level. In this case 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 LAeq is determined over a 15-minute period for the project intrusiveness noise level and over an assessment period (day, evening and night) for the project amenity noise level. This leads to the situation where, because of the different averaging periods, the same numerical value does not necessarily represent the same amount of noise heard by a person for different time periods. To standardise the time periods for the intrusiveness and amenity noise levels, this policy assumes that the LAeq,15min will be taken to be equal to the LAeq, period + 3 decibels (dB), unless robust evidence is provided for an alternative approach for the particular project being considered.

   Project amenity noise level (ANL) is urban ANL (Table 2.1) minus 5 dB(A) plus 3 dB(A) to convert from a period level to a 15-minute level (dB = decibel; dB[A] = decibel [A-weighted]; RBL = rating background noise level).

Noise level used in the assessment of noise emission from the site have been based on the noise level survey conducted at the site and detailed in this section of the report.

Consequently, the resulting noise level criteria are summarised in the table below. The criteria are nominated for the purpose of determining the operational noise limits for the operation of the site including mechanical plant associated with the development which can potentially affect noise sensitive receivers and operational noise levels from the future tenancies. For each assessment period, the lower (i.e. the more stringent) of the amenity or intrusive criteria are adopted. The calculated *Project Amenity Noise Level* includes either the Recommended Amenity Noise Level minus 5 dB(A) plus 3 dB(A) (for a 15minum period) or the measured existing Leq noise level – 10 dB if this is greater as determined by the NPfI. The resulting noise emission criteria is summarised in the table below.

Table 5 Site Noise Emissions Criteria

Location	Time of Day	Project Amenity Noise Level, $L_{Aeq,\ period}$ [1] (dBA)	Measured $L_{A90,\ 15\ min}$ [2] (dBA) RBL	Measured $L_{Aeq,\ period}$ Noise Level (dBA)	Intrusive $L_{Aeq,\ 15\ min}$ Criterion for New Sources (dBA)
Urban residences	Day	53	43	54	**48**
	Evening	**43**	41	52	46
	Night[4]	**38**	37	50	42
Commercial	When in use	65	N/A	N/A	N/A

Note 1: Project Amenity Noise Levels corresponding to "Urban" areas, recommended noise levels.

Note 2: LA90 Background Noise or Rating Background Level including façade corrections

Note 3: Project Noise Trigger Levels are shown in bold

Note 4: Noise from the operation of residential condensers are to be inaudible within a neighbouring residential premises during night time hours

6.2 Noise Impact Assessment

An assessment of noise generated on the site has been undertaken on this section of the report. The assessment of noise levels generated on the site and are detailed in the following sections.

6.2.1 Building Services Noise Impact Assessment

An assessment of noise generated from the site from the operation of services operation on the site has been undertaken on this section of the report. The assessment of noise levels generated on the site are summaries below:

1. Mechanical Services Equipment –Detailed selections of the proposed mechanical plant and equipment to be used on the site are not available at this time. All future plant and equipment are to be acoustically treated to ensure the noise levels at all surrounding receivers comply with noise emission criteria detailed within this report. Experience with similar projects indicated that it is both possible and practical to treat all mechanical equipment such that the relevant noise levels are achieved. Examples of the possible acoustic treatments to mechanical equipment includes the following:
    a. Supply and Exhaust Fans – location of fans within the building and treated using internally lined ductwork or acoustic silencers.
    b. General supply and exhaust fans – general exhaust and supply fans such as toilet, kitchen, lobby and other small mechanical fans can be acoustically treated using acoustic flex ducting or internal lined ducting.
    c. Air conditioning equipment – Condenser equipment will be required on the site to service the required air conditioning of the future spaces. This will include the requirement for external condenser equipment which could be located externally to the building on the ground floor, within the carparking area, on the roof or on unit balconies. Once selections of the required condenser units are completed acoustic treatment including screening, or the location of the equipment can be undertaken to ensure the relevant noise level criteria is achieved.

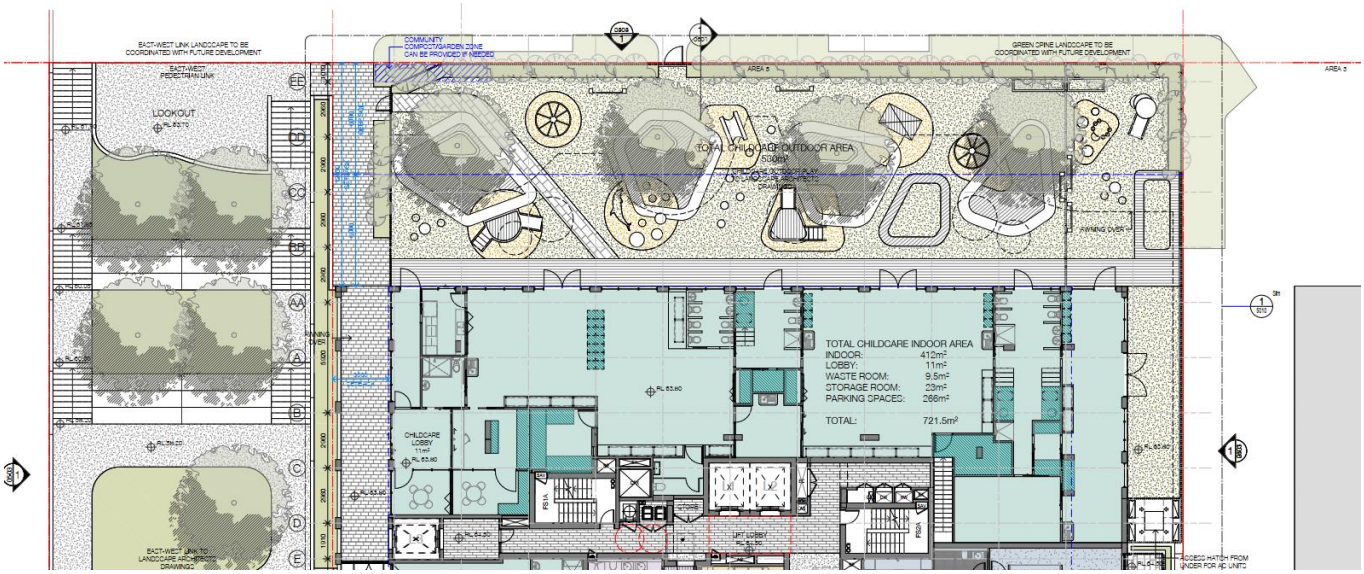
Details of the required mechanical services equipment and acoustic treatments to ensure the relevant noise level criteria is achieved will be provided as part of the CC submission of the project.

Experience with similar projects indicates that the acoustic treatment of all services items proposed for the site is both possible and practical such that the relevant noise level criteria at all surrounding receivers is achieved.

6.2.2 Childcare Centre - Activity Noise Assessment

This section of the report details the assessment of activity noise levels generated from the proposed child care centre which is to be located on Level 1 of the proposed development, including the use of the internal and external areas for play.

The proposed childcare centre is to be located on level 1 of the building, as detailed in the figure below.



The proposed childcare centre is located with the outdoor play area which will be adjacent to neighbouring areas which include outdoor common areas to the west and a pedestrian link to the south. The location of the proposed play areas includes a position which includes the maximum separation to the future receivers including an approximate separation of 12m to the neighbouring buildings.

This assessment includes the potential for noise emissions from the use of the childcare centre to the following locations:

1. Future residential receivers neighbouring the site, including the proposed set basks and common areas.
2. Future residential receivers located within the building and located on the levels above.

The AAAC *Guideline for Child Care Centre Acoustic Assessment Version 3* includes recommendations for the assessment of noise levels from the use of play areas impacting on neighbouring residential receivers. The AAAC includes the following:

> **Background Greater Than 40 dB(A)** – The contributed $L_{eq,15min}$ noise level emitted from an outdoor play and internal activity areas shall not exceed the background noise level by more than 5 or 10 dB at the assessment location, depending on the usage of the outdoor play area. AAAC members regard that a total time limit of approximately 2 hours outdoor play per morning and afternoon period should allow an emergence above the background of 10 dB (ie background +10 dB if outdoor play is limited to 2 hours in the morning and 2 hours in the afternoon).
>
> **Up to 4 hours (total) per day** – If outdoor play is limited to no more than 2 hours in the morning and 2 hours in the afternoon, the contributed $L_{eq,15\ minute}$ noise level emitted from the outdoor play shall not exceed the background noise level by more than 10 dB at the assessment location.
>
> **More than 4 hours (total) per day** – If outdoor play is not limited to no more than 2 hours in the morning and 2 hours in the afternoon, the contributed $L_{eq,15\ minute}$ noise level emitted from the outdoor play area shall not exceed the background noise level by more than 5 dB at the assessment location.

As the proposed childcare centre will use external areas of the centre for more than 2 hours per day the suitable noise level emission criteria is background noise + 5 dB(A). The relevant noise level criteria for the use of the childcare centre is detailed in the table below.

Table 6 Noise Emission Criteria for Activity Noise on the site

Location	Time of Day	Measured $L_{A90,\ 15\ min}$ (dBA) Representative Background Noise Level	Intrusive $L_{Aeq,\ 15\ min}$ Criterion for New Sources (dBA)
Residential Receivers	Day time periods	43	48

This section of the report details the activity noise assessment which has been undertaken for the proposed childcare centre. The assessment has been undertaken based on the following:

1. The centre is operational to maximum capacity including up to 60 children.
2. All areas of the centre including the internal and external areas are in use simultaneously.
3. All recommended acoustic treatments and controls detailed in this report are included in the construction and operation of the site.
4. Noise level generated are based on the source noise levels of the AAAC for external play areas and internal noise levels are based on experience of similar operational facilities operating at maximum capacity. Details of the source noise levels used in this assessment are detailed in the following table.

Table 7 Activity Source Noise Levels

Location	Play Type	Age Group	Source Noise Level
Internal play areas	Normal maximum levels	All Ages	Up to 70 dB(A) Sound Pressure Level
External Play Areas	Active Play[1] For groups of 10 children	0-2	78 dB(A) Sound Power Level
		2-3	85 dB(A) Sound Power Level
		3-6	87 dB(A) Sound Power Level
	Passive Play[2] For groups of 10 children	0-2	77 dB(A) Sound Power Level
		2-3	83 dB(A) Sound Power Level
		3-6	84 dB(A) Sound Power Level

Notes: 1 – Active play include areas where children can actively play and generate noise levels such as running, playing with movable items (scooters and the like). Active play noise levels are based on the medium noise level presented in the AAAC guideline.

2 – Passive play includes areas where play will include less active play such as a sand pit, use of tables and the like where play includes activities do not include moving around and hence a lower noise level results. Passive play noise levels are based on the lower range detailed within the AAAC guideline.

The AAAC *Guideline for Child Care Centre Acoustic Assessment Version 3* includes the effective sound power levels of children which have been used in this report (as detailed above), including the following:

Table 1 provides recommended sound power levels for lots of 10 children, within the different age groupings, along with a recommended source height.

Table 1 – Effective Sound Power Levels ($L_{Aeq,\ 15min}$) for Groups of 10 Children Playing

Number and Age of Children	Sound Power Levels [dB] at Octave Band Centre Frequencies [Hz]								
	dB(A)	63	125	250	500	1k	2k	4k	8k
10 Children - 0 to 2 years	78	54	60	66	72	74	71	67	64
10 Children - 2 to 3 years	85	61	67	73	79	81	78	74	70
10 Children - 3 to 5 years	87	64	70	75	81	83	80	76	72

Notes:
1 If applicable, an adjustment to the above sound power levels of -6 dB could be applied in each age group for children involved in passive play.
2 For simplicity, based upon a review of World Health Organization (WHO) data, a single recommended source height of 1metre is suggested as the source heights.

6.2.2.1 Recommended Acoustic Treatments and Controls

This section of the report details the required acoustic treatments and controls required for the proposed childcare centre to ensure noise emissions comply with the noise level criteria detailed in this report at the neighbouring property boundaries and the future residential receivers located on the levels above within the proposed development.

The required acoustic treatments and controls include the following:

1. All plant and equipment to be used on the site is required to be assessed as part of the CC/design stage of the project. Suitable acoustic treatments are to be specified to ensure noise emission criteria detailed in this report are achieved. Treatments may include lined ductwork, acoustic silencers, time control switches, variable speed drives, acoustic screens or the like.

2. The management of active and passive play is to be undertaken to include the following:

    a. Active play to be located to the eastern portion of the external play area and below the required acoustic cover detailed in the point below.

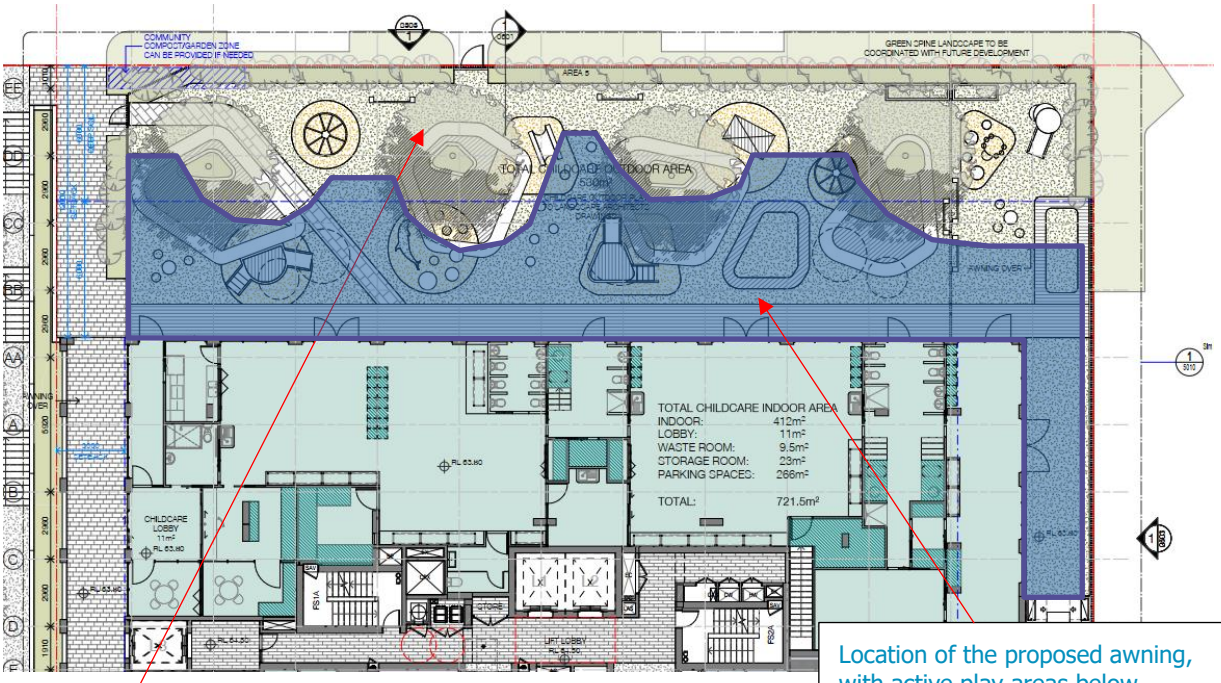
    b. Passive play to be located to the western portion of the external play area and can be undertaken beyond the external cover detailed in the point below.

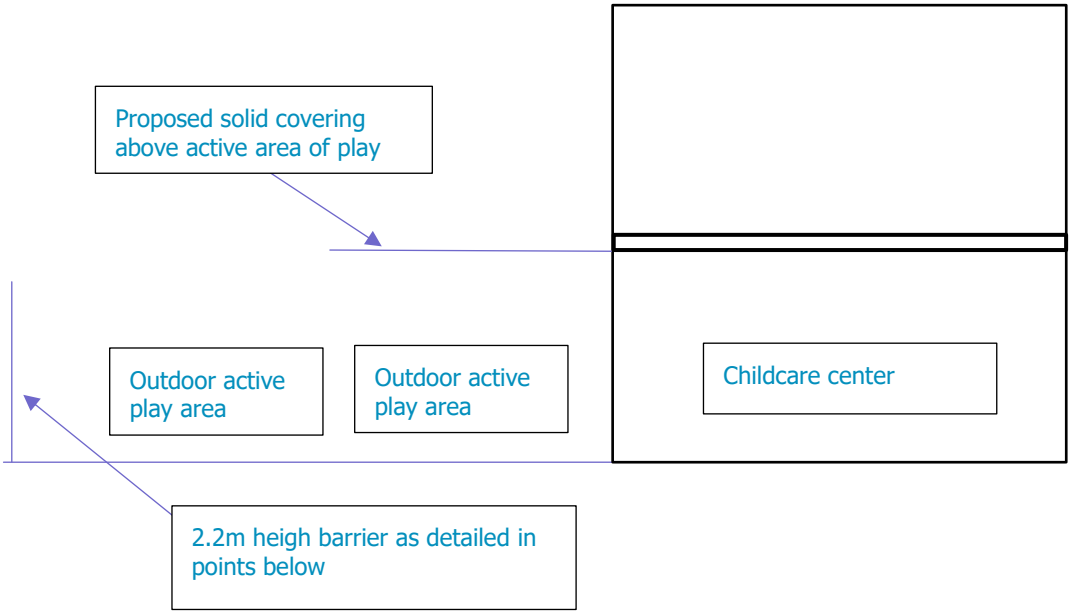
3. A solid acoustic cover is required to be installed to the areas where active play is proposed to the eastern portion of the external play area. The cover is required to be constructed from a solid material such as 9mm FC sheet, metal deck, 10.38mm laminated glass or other solid building construction with a minimum Rw of 25.

4. The external cover should include a mix of glass and solid construction including approximately 50% of each.

5. An acoustically absorptive material is to be installed to the underside of the solid external cover (detailed in the points above). The material is to include a minimum acoustic performance of NRC no less than 0.60 and can include surface finishes or spray on materials.

6. A summary of the recommended treatment above is included in the figures below.





7. All glass openings within the façade of the internal elements of the childcare centre are to include a minimum 10.38mm laminated glass with a minimum acoustic performance of Rw 35.

8. All openable glazing is to be closed during periods of play or high noise generating activities.

9. All external play areas are to include supervision when used by children by a childcare operator.

10. No outdoor play to occur on the site after 7pm.

11. Details of a suitable site contact should be included a street frontage of the centre where complaints regarding the operation of the centre can be directed.

12. Install an acoustic barrier to the perimeter of the out door play areas. The barrier should be constructed from a solid material and can include masonry, 9mm FC sheet, Hebel, sheet metal, 10.38mm glass or 10mm Perspex, lapped and capped timber fence or the like. The screen should be constructed to a minimum height of 2.2m. The location of the screen is detailed in the figure below.

Providing the recommended treatments included above are the design and operation of the proposed child care canter the resulting noise emissions will comply with the relevant noise emissions criteria and result in a suitable acoustic amenity to the future residential receivers surrounding the centre.

7 CONSTRUCTION NOISE AND VIBRATION MANAGEMENT PLAN

This section of the report details the assessment of construction noise and vibration resulting from the required construction activities to be undertaken on the site.

7.1 Construction Noise

The assessment of construction noise from the site has been undertaken in accordance with the EPA's *Interim Construction Noise Guideline* which includes the requirements detailed in this section of the report.

7.1.1 EPA Interim Construction Noise Guideline Recommended Working Hours

The EPA's Interim Construction Noise Guideline defines normal day time hours as the following:

2.2 Recommended standard hours

The recommended standard hours for construction work are shown in Table 1; however, they are not mandatory. There are some situations, as described below, where construction work may need to be undertaken outside of these hours. The likely noise impacts and the ability to undertake works during the recommended standard hours should be considered when scheduling work.

Table 1: Recommended standard hours for construction work

Work type	Recommended standard hours of work*
Normal construction	Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays
Blasting	Monday to Friday 9 am to 5 pm Saturday 9 am to 1 pm No blasting on Sundays or public holidays

* The relevant authority (consent, determining or regulatory) may impose more or less stringent construction hours.

Construction works on the site will be undertaken in accordance with the hours approved and included in the projects *Conditions of Consent*.

7.2 Construction Noise Assessment Levels

Noise criteria for construction activities are discussed in the *Interim Construction Noise Guideline* (ICNG). The ICNG also recommends procedures to address potential impacts of construction noise on residences and other sensitive land uses. The main objectives of the ICNG are summarised as follows:

- Promote a clear understanding of ways to identify and minimise noise from construction works;
- Focus on applying all "feasible" and "reasonable" work practices to minimise construction noise impacts;
- Encourage construction to be undertaken only during the recommended standard hours unless approval is given for works that cannot be undertaken during these hours;
- Streamline the assessment and approval stages and reduce time spent dealing with complaints at the project implementation stage; and
- Provide flexibility in selecting site-specific feasible and reasonable work practices in order to minimise noise impacts.

The ICNG contains a quantitative assessment method which is applicable to this project. Guidance levels are given for airborne noise at residences and other sensitive land uses.

The quantitative assessment method involves predicting noise levels at sensitive receivers and comparing them with the Noise Management Levels (NMLs). The NML affectation categories for receivers have been reproduced from the guideline and are listed in the table below.

Table 8 Noise Management Levels from Construction – Quantitative Assessment

Receiver Type	Time of Day	Noise Management Level $L_{Aeq(15minute)}$ [1,2]	How To Apply
Residential	Approved working hours of the project, including those included in the *Conditions of Consent*	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 LAeq(15minute) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
		Highly noise affected 75 dBA	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences. 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
	Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. The proponent should apply all feasible and reasonable work practices to meet the noise affected level. Where all feasible and reasonable practices have been applied and noise is more than 5 dB above the noise affected level, the proponent should negotiate with the community.
Commercia and retail outlets	When is use	Highly noise affected 70 dBA	The external noise levels should be assessed at the most-affected occupied point of the premises

Note 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.*

Note 2 *The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW Industrial Noise Policy (EPA 2000).*

7.3 Vibration Criteria

Effects of ground borne vibration on buildings may be segregated into the following three categories:

- Human comfort – vibration in which the occupants or users of the building are inconvenienced or possibly disturbed. Refer to further discussion in Section 7.3.1.
- Effects on building contents – where vibration can cause damage to fixtures, fittings and other non-building related objects. Refer to further discussion in Section 7.3.2.
- Effects on building structures – where vibration can compromise the integrity of the building or structure itself. Refer to further discussion in Section 7.3.2.

7.3.1 Vibration Criteria – Human Comfort

Vibration effects relating specifically to the human comfort aspects of the project are taken from the guideline titled *"Assessing Vibration – A Technical Guideline"*. (AVTG) This type of impact can be further categorised and assessed using the appropriate criterion as follows:

- Continuous vibration – from uninterrupted sources (refer to Table 9).
- Impulsive vibration – up to three instances of sudden impact e.g. dropping heavy items, per monitoring period (refer to Table 10).
- Intermittent vibration – such as from drilling, compacting or activities that would result in continuous vibration if operated continuously (refer to Table 11).

Table 9 Continuous vibration acceleration criteria (m/s²) 1 Hz-80 Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
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
		0.04	0.029	0.080	0.058
Workshops	Day or night-time	0.04	0.029	0.080	0.058

Table 10 Impulsive vibration acceleration criteria (m/s²) 1 Hz-80 Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
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

Table 11 Intermittent vibration impacts criteria (m/s$^{1.75}$) 1 Hz-80 Hz

Location	Daytime		Night-time	
	Preferred Values	Maximum Values	Preferred Values	Maximum Values
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

7.3.2 Vibration Criteria – Building Contents and Structure

The vibration effects on the building itself are assessed against international standards as follows:

- For transient vibration: British Standard BS 7385: Part 2-1993 *"Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration"* (BSI 1993); and
- For continuous or repetitive vibration: German DIN 4150: Part 3 – 1999 *"Effects of Vibration on Structure"* (DIN 1999).

7.3.2.1 Standard BS 7385 Part 2 - 1993

For transient vibration, as discussed in standard BS 7385 Part 2-1993, the criteria are based on peak particle velocity (mm/s) which is to be measured at the base of the building. These are summarised in Table 8 and illustrated in Figure 2.

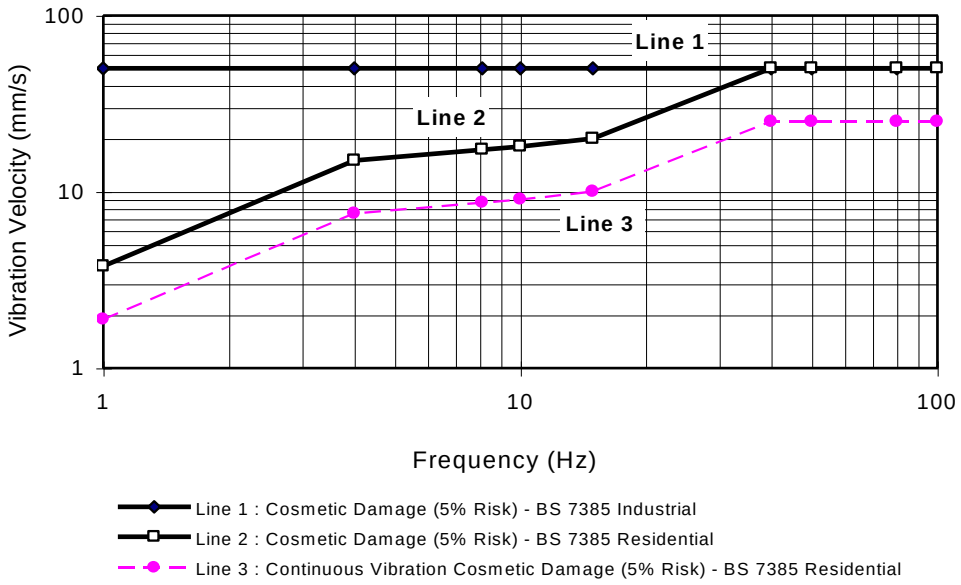
Table 12 Transient vibration criteria as per standard BS 7385 Part 2 - 1993

Reference Line	Type of Building	Peak Component Particle Velocity in Frequency Range of Predominant Pulse	
		4 Hz to 15 Hz	15 Hz and Above
1	Reinforced or framed structures Industrial and heavy commercial buildings	50 mm/s at 4 Hz and above	
2	Unreinforced or light framed structures Residential or light commercial type buildings	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above

Standard BS 7385 Part 2 – 1993 states that the values in Table 12 relate to transient vibration which does not cause resonant responses in buildings.

Where the dynamic loading caused by continuous vibration events is such as that results in dynamic magnification due to resonance (especially at the lower frequencies where lower guide values apply), then the values in Table 12 may need to be reduced by up to 50% (refer to Line 3 in Figure 2).

Figure 4 BS 7385 Part 2 – 1993, graph of transient vibration values for cosmetic damage



In the lower frequency region where strains associated with a given vibration velocity magnitude are higher, the recommended values corresponding to Line 2 are reduced. Below a frequency of 4 Hz where a high displacement is associated with the relatively low peak component particle velocity value, a maximum displacement of 0.6 mm (zero to peak) is recommended. This displacement is equivalent to a vibration velocity of 3.7 mm/s at 1 Hz.

The standard also states that minor damage is possible at vibration magnitudes which are greater than twice those given in Table 12, and major damage to a building structure may occur at values greater than four times the tabulated values.

Fatigue considerations are also addressed in the standard and it is concluded that unless calculation indicates that the magnitude and number of load reversals is significant (in respect of the fatigue life of building materials) then the values in Table 12 should not be reduced for fatigue considerations.

7.3.2.2 Standard DIN 4150 Part 3 - 1999

For continuous or repetitive vibration, standard DIN 4150 Part 3-1999 provides criteria based on values for peak particle velocity (mm/s) measured at the foundation of the building; these are summarised in Table 13. The criteria are frequency dependent and specific to particular categories of structures.

Table 13 Structural damage criteria as per standard DIN 4150 Part 3 - 1999

Type of Structure	Peak Component Particle Velocity, mm/s			
	Vibration at the foundation at a frequency of			Vibration of horizontal plane of highest floor at all frequencies
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz[1]	
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
Structures that, because of their sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8
Note 1: For frequencies above 100Hz, at least the values specified in this column shall be applied.				

7.4 Ground-Borne Noise Criteria

According to the NSW EPA *Interim Construction Noise Guideline (*ICNG) 2009, the criteria for ground-borne noise at residences is defined as follows:

- Maximum internal noise levels of 40 dB $L_{Aeq(15mins)}$ between 6:00pm and 10:00pm.

It is noted that the ground borne criteria will apply for construction works undertaken outside of standard hours. That is, work conducted during the evening period Monday to Friday between 6:00pm and 7:00pm only.

7.5 Project Vibration Impacts

Based on the discussions included in the sections above the recommended construction vibration limits for surrounding receivers includes the following:

1. Residential Receivers – 7mm/s.

8 CONSTRUCTION AND VIBRATION ASSESSMENT

This section of the report details the assessment of noise and vibration resulting from the proposed construction activities to be undertaken on the site.

The required construction required to be undertaken as part of the project include equipment and activities which are commonly used on construction projects.

8.1 Construction Noise Assessment

Sound power levels have been predicted for the construction tasks identified in the project program. The equipment anticipated for use in each task is based on previous project experience. The sound power levels for the equipment likely to be used for each of the listed tasks are provided in Table 14 below.

Table 14 Summary of predicted sound power levels

Tasks	Equipment	Sound Power Levels (dBA re 1pW)	Aggregate Sound Power Level per Task (dBA re 1pW)
Site Establishment Works	Mobile crane	110	113
	Power hand tools	109	
	Semi Rigid Vehicle [1]	105	
Ground Works and Demolition	Excavator	112	120
	Hydraulic Hammer	118	
	Piling Rig	110	
	Handheld jack hammer [1]	111	
	Dump truck [1]	104	
	Concrete saw [1]	114	
	Skid steer	110	
	Power hand tools	109	
Structure	Handheld jack hammer [1]	106	117
	Concrete saw [1]	114	
	Power hand tools	109	
	Welder	101	
	Concrete pump truck	110	
	Concrete agitator truck	108	
Internal Works	Power hand tools	109	109
Common and External Works	Concrete agitator truck	108	114
	Saw cutter [1]	104	
	Dump truck [1]	104	
	Concrete saw [1]	114	
	Power hand tools	109	

Note 1: An assumed time correction has been applied, this being 5 minutes of operation in any 15-minute interval.

8.1.1 Qualitative Construction Noise Assessment

An assessment of the expected construction noise levels resulting from the proposed works to be undertaken as part of the project on surrounding receivers has been undertaken. The assessment has been based on the expected noise levels to be generated on the site including those detailed in the Section above. Calculations of the resulting construction noise levels of the receivers within proximity to the site is detailed in the table below.

Table 15 Receiver 1 – To the North of the site - Summary of predicted construction noise levels – STANDARD HOURS

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Predicted Combined Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Noise Management Level dBA $L_{Aeq\ 15\ minutes}$	Summary of Result
Site Establishment Works	Mobile crane	113	65 to 88	68 to 91	During Approved Working Hours – 53 dB(A) $L_{eq\ 15\ min}$	Works near the receiver expected be above the BG + 10dBA and therefore management is required. Recommended mitigations are included in this report
	Power hand tools		64 to 87			
	Semi Rigid Vehicle		55 to 78			
Ground Works and Demolition	Excavator	120	67 to 90	75 to 98		
	Hydraulic Hammer		73 to 96			
	Piling Rig		63 to 86			
	Handheld jack hammer		61 to 84			
	Dump truck		54 to 77			
	Concrete saw		64 to 87			
	Skid steer		65 to 88			
	Power hand tools		64 to 87			
Structure	Handheld jack hammer	117	56 to 79	72 to 95		
	Concrete saw		64 to 87			
	Power hand tools		64 to 87			
	Welder		56 to 79			
	Concrete pump truck		65 to 88			
	Concrete agitator truck		63 to 86			
Internal Works	Power hand tools	109	44 to 67	44 to 67		
Common and External Works	Concrete agitator truck	114	63 to 86	69 to 92		
	Saw cutter		54 to 77			
	Dump truck		54 to 77			
	Concrete saw		64 to 87			
	Power hand tools		64 to 87			

Table 16 Receiver 2 – To the West of the site - Summary of predicted construction noise levels – STANDARD HOURS

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Predicted Combined Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Noise Management Level dBA $L_{Aeq\ 15\ minutes}$	Summary of Result
Site Establishment Works	Mobile crane	113	60 to 88	63 to 86	During Approved Working Hours – 53 dB(A) $L_{eq\ 15\ min}$	Works near the receiver expected be above the BG + 10dBA and therefore management is required. Recommended mitigations are included in this report
	Power hand tools		59 to 87			
	Semi Rigid Vehicle		51 to 78			
Ground Works and Demolition	Excavator	120	62 to 90	70 to 93		
	Hydraulic Hammer		68 to 96			
	Piling Rig		59 to 86			
	Handheld jack hammer		57 to 84			
	Dump truck		50 to 77			
	Concrete saw		60 to 87			
	Skid steer		60 to 88			
	Power hand tools		59 to 87			
Structure	Handheld jack hammer	117	52 to 79	68 to 90		
	Concrete saw		60 to 87			
	Power hand tools		59 to 87			
	Welder		51 to 79			
	Concrete pump truck		60 to 88			
	Concrete agitator truck		58 to 86			
Internal Works	Power hand tools	109	39 to 67	39 to 62		
Common and External Works	Concrete agitator truck	114	58 to 86	64 to 87		
	Saw cutter		50 to 77			
	Dump truck		50 to 77			
	Concrete saw		60 to 87			
	Power hand tools		59 to 87			

Table 17 Receiver 3 - To the South of the site - Summary of predicted construction noise levels – STANDARD HOURS

Phase	Activity	Aggregate Sound Power Level (dBA re 1pW)	Predicted Individual Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Predicted Combined Noise Level at Receiver dBA $L_{Aeq\ 15\ minutes}$	Noise Management Level dBA $L_{Aeq\ 15\ minutes}$	Summary of Result
Site Establishment Works	Mobile crane	113	60 to 88	63 to 86	During Approved Working Hours – 53 dB(A) $L_{eq\ 15\ min}$	Works near the receiver expected be above the BG + 10dBA and therefore management is required. Recommended mitigations are included in this report
	Power hand tools		59 to 87			
	Semi Rigid Vehicle		51 to 78			
Ground Works and Demolition	Excavator	120	62 to 90	70 to 93		
	Hydraulic Hammer		68 to 96			
	Piling Rig		59 to 86			
	Handheld jack hammer		57 to 84			
	Dump truck		50 to 77			
	Concrete saw		60 to 87			
	Skid steer		60 to 88			
	Power hand tools		59 to 87			
Structure	Handheld jack hammer	117	52 to 79	68 to 90		
	Concrete saw		60 to 87			
	Power hand tools		59 to 87			
	Welder		51 to 79			
	Concrete pump truck		60 to 88			
	Concrete agitator truck		58 to 86			
Internal Works	Power hand tools	109	39 to 67	39 to 62		
Common and External Works	Concrete agitator truck	114	58 to 86	64 to 87		
	Saw cutter		50 to 77			
	Dump truck		50 to 77			
	Concrete saw		60 to 87			
	Power hand tools		59 to 87			

8.1.2 Construction Noise Management – Qualitative Assessment

Based on the assessment conducted of the expected construction noise levels generated from the ground works and construction to be conducted on the site, levels are generally expected to require the building contractor to engage in management of activities on the site and engagement with the local community.

Notwithstanding, the following management controls are recommended to mitigate construction noise levels on the site:

1. Toolbox meetings should be undertaken with all contractors commencing works on the site detailing the requirements to limit noise impacts to neighbouring including their responsibilities detailed in this report.
2. All plant and equipment are to be maintained such that they are in good working order.
3. A register of complaints is to be recorded in the event of complaints being received, including location, time of complaint, nature of the complaint and actions resulting from the complaint.
4. If required a noise level measurement of the offending plant item generating complaints is to be conducted and noise mitigations undertaken to reduce noise levels to within Noise Management levels in the event magnitude of noise levels is found to be above suitable levels.
5. The use of percussive and concrete sawing should be undertaken behind the existing façades of buildings when possible.
6. The use of percussive equipment including hydraulic hammering should be limited such that they comply with the requirements of the projects Conditions of Consent.
7. Access for trucks entering and exiting the site are required to follow the traffic management plan, including use of Alfred Street.

In addition to the recommended mitigations above details of the proposed construction works to be conducted on the site, including type of activities to be conducted as well as the expected duration of activities should be provided to the neighbouring receivers.

In the event noise levels are found to required additional noise reduction then all possible and practical mitigations are required to be included in the construction of the project. Possible acoustic treatments and controls may include the following:

1. Use of alternative appliances to complete the required works which result in reduced noise impacts on surrounding neighbours.
2. Period when noisy appliances are undertaken, such as undertaking noisy works to be conducted outside of sensitive period if possible, in communication with affected receivers.
3. Construction of acoustic screening to permanently located high noise generating equipment such as pumps and generators.
4. Scheduling of high noise generating works outside of noise sensitive periods if possible.
5. Other site-specific treatments and controls which may become possible once works commence.
6. The consideration should be given for the short term (3-4 months) rental of office accommodation for nearby work from home residents to use for the excavation phase of the project, so to manage noise complaints and provide local residents with respite from noise and vibration during the proposed demolition and excavation period of the project.

8.2 Construction Traffic Noise Assessment

It is proposed that the construction traffic could access the site via Canberra Avenue.

Construction traffic accessing the site including the movements of heavy vehicles are required to comply with the projects *Conditions of Consent* and will be detailed in the sites *Construction Management Plan.*

8.3 Vibration Assessment

In order to maintain compliance with the human comfort vibration criteria discussed in the sections above, it is recommended that the indicative safe distances listed in Table 18 should be maintained. These indicative safe distances should be validated prior to the start of construction works by undertaking measurements of vibration levels generated by construction equipment to be used on site.

If applicable, the criteria for scientific or medical equipment (should any of these exist close to the site) can be more stringent than those required for human comfort, vibration validating measurements should be conducted at each site to determine the vibration level and potential impact onto this sensitive equipment.

Recommended safe working distances for various items of plant are included in the following table.

Table 18 Recommended indicative safe working distances for vibration intensive plant

Plant	Rating / Description	Safe Working Distances (m)	
		Cosmetic Damage (BS 7385: Part 2 DIN 4150: Part 3)	Human Comfort (AVTG)
Vibratory roller	< 50 kN (Typically 1 – 2 tonnes)	5	15 – 20
	< 100 kN (Typically 2 – 4 tonnes)	6	20
	< 200 kN (Typically 4 – 6 tonnes)	12	40
	< 300 kN (Typically 7 – 13 tonnes)	15	100
	> 300 kN (Typically more than 13 tonnes)	20	100
Small hydraulic hammer	300 kg, typically 5 – 12 tonnes excavator	2	7
Medium hydraulic hammer	900 kg, typically 12 – 18 tonnes excavator	7	23
Large hydraulic hammer	1600 kg, typically 18 – 34 tonnes excavator	22	73
Vibratory pile driver	Sheet piles	2 – 20	20
Jackhammer	Hand held	1	Avoid contact with structure and steel reinforcements

An assessment of the potential for vibration generated as part of the required construction activities on the project (including excavation) has been undertaken based on the expected vibration detailed in the table above.

To ensure the vibration impact criteria detailed in this report are complied with the following safe working mitigations and/or working distances should be implemented as detailed in the table below.

Table 19 Vibration Mitigation Requirements

Construction Phase	Activity	Vibration Mitigation
Excavation	Removal of Rock	Prior to the use of hydraulic hammering within 20m of neighbouring building a saw cut to the perimeter of the basement to be excavated is required to the undertaken. Saw cutting of the perimeter of the excavation is required to be undertaken on each level of the excavation.
Construction	General Construction activities	General construction activities are not expected to exceed project vibration limits detailed in this report.

8.4 Noise and Vibration Management

Table 20 below summarises the management procedures recommended for airborne noise and vibration impact. These procedures are also further discussed in the report. Hence, where applicable, links to further references are provided in Table 20.

Table 20 Summary of mitigation procedures

Procedure	Abbreviation	Description	Further Reference
General Management Measures	GMM	Introduce best-practice general mitigation measures in the workplace which are aimed at reducing the acoustic impact onto the nearest affected receivers.	Refer to Section 8.4.3.3 For vibration impact, also refer to section 8.3
Project Notification	PN	Issue project updates to stakeholders, discussing overviews of current and upcoming works. Advanced warning of potential disruptions can be included. Content and length to be determined on a project-by-project basis.	Refer to Section 8.5
Verification Monitoring	V	Monitoring to comprise attended or unattended acoustic surveys. The purpose of the monitoring is to confirm measured levels are consistent with the predictions in the acoustic assessment, and to verify that the mitigation procedures are appropriate for the affected receivers. If the measured levels are higher than those predicted, then the measures will need to be reviewed and the management plan will need to be amended.	For noise impact, refer to Section 8.4.4. For vibration impact, refer to Section 8.3
Complaints Management System	CMS	Implement a management system which includes procedures for receiving and addressing complaints from affected stakeholders	Refer to Section 8.5
Specific Notification	SN	Individual letters or phone calls to notify stakeholders that noise levels are likely to exceed noise objectives. Alternatively, contractor could visit stakeholders individually in order to brief them in regards to the noise impact and the mitigation measures that will be implemented.	Refer to Section 8.5
Respite Offer	RO	Offer provided to stakeholders subjected to an ongoing impact. The offer could include movie tickets, meal vouchers, gift cards or equivalent measures.	-
Alternative Construction Methodology	AC	Contractor to consider alternative construction options that achieve compliance with relevant criteria. Alternative option to be determined on a case-by-case basis. It is recommended that the selection of the alternative option should also be determined by considering the assessment of on-site measurements (refer to Verification Monitoring above).	-

The application of these procedures is in relation to the exceedances over the relevant criteria. For airborne noise, the criteria are based on NMLs. The allocation of these procedures is discussed in Section 8.4.1

For vibration, the criteria either correspond to human comfort, building damage or scientific and medical equipment. The application of these procedures is discussed in Section 8.4.2.

8.4.1 Allocation of Noise Management Procedures

For residences, the management procedures have been allocated based on noise level exceedances at the affected properties, which occur over the designated NMLs. The allocation of these procedures is summarised in Table 21 below.

Table 21 Allocation of noise management procedures

Construction Hours	Exceedance over NML (dB)	Management Procedures (see definition above)
Standard Hours Mon – Fri: 8:00 am to 7:00 pm Sat: 8:00 am – 5:00 pm	0 - 3	GMM
	4 - 10	GMM, PN, V [1], CMS, AC
	> 10	GMM, PN, V, CMS, SN, AC
Outside Standard Hours Mon – Fri: 7:00 am to 8:00 am Sat: 7:00 am to 8:00 am	0 - 10	GMM, AC
	11 - 20	GMM, PN, V [1], CMS, AC
	> 20	GMM, PN, V, CMS, SN, RO, AC

Notes

1. Verification monitoring to be undertaken upon complaints received from affected receivers

Please note the following regarding the allocation of these procedures:

- The exceedances have been estimated as part of the acoustic assessment, and these are summarised in Section 8.1.
- The allocation of procedures is based on the assumptions used for noise level predictions (refer to Section 8.1). Consequently, these allocations can be further refined once additional details of the construction program become available.

8.4.2 Allocation of Vibration Management Procedures

Table 22 below summarises the vibration management procedures to be adopted based on exceedance scenarios (i.e., whether the exceedance occurs over human comfort criteria, building damage criteria, or criteria for scientific and medical equipment). Please note these management procedures apply for any type of affected receiver.

Table 22 Allocation of vibration management procedures

Construction Hours	Exceedance Scenario	Management Procedures
Standard Hours Mon – Fri: 8:00 am to 7:00 pm Sat: 8:00 am – 5:00 pm	Over human comfort criteria (refer to Section 7.3)	GMM, PN, V, RO
	Over building damage criteria (refer to Section 7.3)	GMM, V, AC
Outside Standard Hours Mon – Fri: 7:00 am to 8:00 am Sat: 7:00 am to 8:00 am	Over human comfort criteria (refer to Section 7.3)	GMM, SN, V, RO, CMS
	Over building damage criteria (refer to Section 7.3)	GMM, V, AC

8.4.3 General Comments

The contractor will, where reasonable and feasible, apply best practice noise mitigation measures. These measures shall include the following:

- Maximising the offset distance between plant items and nearby noise sensitive receivers.
- Preventing noisy plant working simultaneously and adjacent to sensitive receivers.
- Minimising consecutive works in the same site area.
- Orienting equipment away from noise sensitive areas.
- Carrying out loading and unloading away from noise sensitive areas.

In order to minimise noise impacts during the works, the contractor will take all reasonable and feasible measures to mitigate noise effects.

The contractor will also take reasonable steps to control noise from all plant and equipment. Examples of appropriate noise control include efficient silencers and low noise mufflers.

The contractor should apply all feasible and reasonable work practices to meet the NMLs and inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels, duration of noise generating construction works, and the contact details for the proposal.

8.4.3.1 Alternate Equipment or Process

Exceedance of the site's NMLs should result in an investigation as to whether alternate equipment could be used, or a difference process could be undertaken.

In some cases, the investigation may conclude that no possible other equipment can be used, however, a different process could be undertaken.

8.4.3.2 Acoustic Enclosures/Screening

Typically, on a construction site there are three different types of plant that will be used: mobile plant (i.e., excavators, skid steers, etc.), semi mobile plant (i.e., hand tools generally) or static plant i.e. (diesel generators).

For plant items which are static it is recommended that, in the event exceedances are being measured due to operation of the plant item, an acoustic enclosure/screen is constructed to reduce impacts. These systems can be constructed from Fibre Cement (FC) sheeting or, if airflow is required, acoustic attenuators or louvres.

For semi mobile plant, relocation of plant should be investigated to either be operated in an enclosed space or at locations away from a receiver.

With mobile plant it is generally not possible to treat these sources. However, investigations into the machine itself may result in a reduction of noise (i.e., mufflers/attenuators etc).

8.4.3.3 General Mitigation Measures (Australia Standard 2436-2010)

As well as the above project specific noise mitigation controls, AS 2436-2010 "*Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites*" sets out numerous practical recommendations to assist in mitigating construction noise emissions. Examples of strategies that could be implemented on the subject project are listed below, including the typical noise reduction achieved, where applicable.

8.4.3.4 Adoption of Universal Work Practices

- Regular reinforcement (such as at toolbox talks) of the need to minimise noise and vibration.
- Regular identification of noisy activities and adoption of improvement techniques.
- Avoiding the use of portable radios, public address systems or other methods of site communication that may unnecessarily impact upon nearby sensitive receivers.
- Where possible, avoiding the use of equipment that generates impulsive noise.
- Minimising the need for vehicle reversing for example (particularly at night), by arranging for one-way site traffic routes.
- Use of broadband audible alarms on vehicles and elevating work platforms used on site.
- Minimising the movement of materials and plant and unnecessary metal-on-metal contact.
- Minimising truck movements.

8.4.3.5 Plant and Equipment

The operation of plant and equipment on the site should be undertaken, including the following:

- Choosing quieter plant and equipment based on the optimal power and size to most efficiently perform the required tasks.
- Selecting plant and equipment with low vibration generation characteristics.
- Operating plant and equipment in the quietest and most efficient manner.

8.4.3.6 Work Scheduling

- Providing respite periods which could include restricting very noisy activities to time periods that least affect the nearby noise sensitive locations, restricting the number of nights that after-hours work is conducted near residences or by determining any specific requirements.
- Scheduling work to coincide with non-sensitive periods.
- Planning deliveries and access to the site to occur quietly and efficiently and organising parking only within designated areas located away from the sensitive receivers.
- Optimising the number of deliveries to the site by amalgamating loads where possible and scheduling arrivals within designated hours.
- Including contract conditions that include penalties for non-compliance with reasonable instructions by the principal to minimise noise or arrange suitable scheduling.

8.4.3.7 Source Noise Control Strategies

Some ways of controlling noise at the source are:

- Where reasonably practical, noisy plant or processes should be replaced by less noisy alternatives.
- Modify existing equipment: Engines and exhausts are typically the dominant noise sources on mobile plant such as cranes, graders, excavators, trucks, etc. In order to minimise noise emissions, residential grade mufflers should be fitted on all mobile plant utilised on site.
- Siting of equipment: locating noisy equipment behind structures that act as barriers, or at the greatest distance from the noise-sensitive area; or orienting the equipment so that noise emissions are directed away from any sensitive areas, to achieve the maximum attenuation of noise.
- Regular and effective maintenance.

8.4.3.8 Miscellaneous Comments

Deliveries should be undertaken, where possible, during standard construction hours.

Maximise hammer penetration (and reduce blows) by using sharp hammer tips. Keep stocks of sharp profiles at site and monitor the profiles in use.

It is advised that mobile plant and trucks operating on site for a significant portion of the project are to have reversing alarm noise emissions minimised. This is to be implemented subject to recognising the need to maintain occupational safety standards.

No public address system should be used on site.

The consideration should be given for the short term (3-4 months) rental of office accommodation for nearby work from home residents to use for the excavation phase of the project, so to manage noise complaints and provide local residents with respite from noise and vibration during the highest noise periods of the proejct including demolition and excavation stages.

8.4.4 Vibration Mitigation Measures

Based on the existing distance separation to receiver's compliance with construction vibration criteria is expected to be achieved without additional mitigations.

8.4.5 Noise and Vibration Monitoring

Noise monitoring is recommended to be undertaken by attended noise measurements at the start of any new phase of works (i.e. excavation or construction works etc.). The statistical parameters to be measured should include the following noise descriptors: L_{Amin}, L_{A90}, L_{A10}, L_{A1}, L_{Amax} and L_{Aeq}. Unattended noise measurements should be conducted over consecutive 15 minute periods.

The survey methodology and any equipment should comply with the requirements discussed in Standard AS 1055.1-1997.

As part of the management of noise and vibration from the proposed construction activities to be undertaken on the site the following noise and vibration measurements are recommended to be undertaken:

1. Noise –
    a. Attended noise level measurements of typical excavation activities should be undertaken at site.

       Attended construction noise surveys of the site and surrounding impacts on neighbours should be undertaken during the following as a minimum:
        i. Commencement of any rock breaking or sawing on the site.
        ii. In response to any ongoing complaints received from neighbours.

2. Vibration –

   Vibration monitoring, if required, should be undertaken continuously at the nearest most affected structures to the north and west of the site.

   The monitoring location would be on a stiff part of the structure (at the foundation) on the side of the structure adjacent to the subject demolition and construction works.

   The vibration monitoring system will be configured to record the peak vibration levels and to trigger an alarm when predetermined vibration thresholds are exceeded. The thresholds correspond to an "Operator Warning Level" and an "Operator Halt Level", where the Warning Level is 75% of the Halt Level. The Halt Level should be determined based on the vibration criteria for building contents and structure (refer to Section 7.3).

   Exceedance of the "Operator Warning Level" would not require excavation or demolition work to cease, but rather, alerts the site manager to proceed with caution at a reduced force or load.

   An exceedance of the "Operator Halt Level" would require the contractor to implement an alternative excavation technique pending further analysis of the vibration frequency content in order to determine any potential exceedance of the criteria.

   The vibration monitoring equipment would be downloaded and analysed by the acoustical consultant.

   Reports of the measured vibration levels and their likely impacts would be prepared by the acoustical consultant and issued to the contractor.

8.5 Community Engagement and Consultation

Active community consultation and the maintenance of positive relations with local residents and businesses would assist in alleviating concerns and thereby minimising complaint. It is common for construction projects to provide community consultation if an exceedance of noise goals has been predicted. This communication is commonly conducted in the form of a letter box drop or more active engagement with more highly impacted receivers.

This form of notification should provide specific notification of the duration and timing of the construction activities so that residents are informed about the proposed works ahead of time. The letter should also provide the community with a hotline number for a community liaison officer available to adequately respond to all project related enquiries.

Ideally the hotline number should provide concerned locals an opportunity to raise any concerns with the project proponent and provide an opportunity to determine the best method to satisfy all requirements.

Prior to the works onsite being undertaken, it is recommended that community consultation with the neighbouring affected parties be undertaken. Community engagement and consultation should not be limited to the beginning of the onsite works but throughout, providing the community with constant updates on the progress and upcoming works. In our experience these could include:

- Site noticeboard;
- Email notifications; and
- Letterbox drops.

During the proposed construction of the project (including excavation and construction) the building contractor is required to engage in community interaction. The community interaction and notification is required to include the following:

1. Notification of the proposed works to be undertaken on the site and the periods when works will be conducted, including information regarding the programme of works such as excavation activities. This should include the expected period when activities such as hydraulic hammering, rock breaking, concrete or rock sawing is required to be undertaken.

2. Details of the relevant site representative where complaints can be registered.

3. Details of the methodology to respond to complaints raised from the surrounding receivers.

4. A register of complaints, to be kept on site including record of time and nature of the complaint as well as the outcomes and comments regarding investigations resulting from the complaint.

8.6 Complaints Management System

Should complaints arise they must be dealt with in a responsible and uniform manner, therefore, a management system to deal with complaints is detailed below:

Local residents and land owners should be informed by direct mail of a direct 24-hour telephone line where any noise complaints related to the construction will be recorded. The 24-hour telephone line number will be made available on the construction site signage.

All complaints should be investigated by the Contractor in accordance with the procedures outlined in Australia Standard 2436-2010. Consequently, a complaint response procedure should be implemented. Information to be gathered as part of this process should include:

- location of complainant
- time/s of occurrence of alleged noise or vibration impacts
- nature of impact particularly with respect to vibration
- Perceived source
- Prevailing weather conditions and similar details that could be utilised to assist in the investigation of the complaint.

All resident complaints will be responded to in the required timeframe and action taken recorded.

Post receiving a noise and or vibration complaint, the process outlined in the *Contingency Plans* below should be undertaken.

8.7 Contingency Plans

Contingency plans are required to address noise or vibration problems if excessive levels are measured at surrounding sensitive receivers and/or if justified complaints occur. Such plans include:

- Stop the onsite works.
- Identify the source of the main equipment within specific areas of the site which is producing the most construction noise and vibration at the sensitive receivers; and
- Review the identified equipment and determine if an alternate piece of equipment can be used or the process can be altered.
- In the event an alternate piece of equipment or process can be used, works can re-commence.
- In the event an alternate piece of equipment or process cannot be determined implement a construction assessment to be performed by a suitably qualified acoustic consultant.

The Superintendent shall have access to view the Contractor's noise measurement records on request. The Superintendent may undertake noise monitoring if and when required.

9 CONCLUSION

This report details the Noise Impact Assessment of the proposed mix use commercial and residential development located at 13-19 Canberra Avenue, St Leonards.

This report details the required acoustic constructions of the building's façade, including external windows, to ensure that the future internal noise levels comply with the relevant noise levels of the Australian Standard AS2107:2016. Providing the recommended constructions detailed in this report are included in the construction of the project the required internal noise levels will be achieved.

External noise emissions from the site have been assessed and detailed in accordance with the NSW Environmental Protection Authorities Noise Policy for Industry. The future design and treatment of all building services associated with the project can be acoustically treated to ensure all noise emissions from the site comply with the EPA NPfI criteria. Details of the equipment and associated acoustic treatments will be provided as part of the CC submission of the project.

An assessment of the proposed use of the childcare centre to be located on Level 1 of the development has been undertaken and recommended acoustic mitigations (including treatments and the controls) have been recommended to ensure the suitable noise emissions criteria will be achieved.

An assessment of the use of the proposed childcare located on the ground floor of the project has been undertaken and the recommended acoustic treatments and controls are included in this report such that noise emissions will be acceptable to receivers within the future development as well as the surrounding areas (including future residential developments).

An assessment of noise and vibration impacts from the required processes to be undertaken during the construction period of the project has been undertaken and suitable treatments, management controls, perioding measurements and community engagement has been detailed in this report. The assessment has been undertaken in conjunction with the requirements of the EPA's *Interim Construction Noise Guideline* and detail the recommended noise and vibration mitigations and management which construction should be undertaken in accordance with. This report includes the recommended noise and vibration mitigations and management controls for the operation of construction activities on the site to ensure impacts to surrounding receivers are minimised as required by the EPA's *Interim Construction Noise Guideline*.

For any additional information please do not hesitate to contact the person below.

Regards

Ben White
Director

Pulse White Noise Acoustics

10 APPENDIX A – GLOSSARY OF TERMS

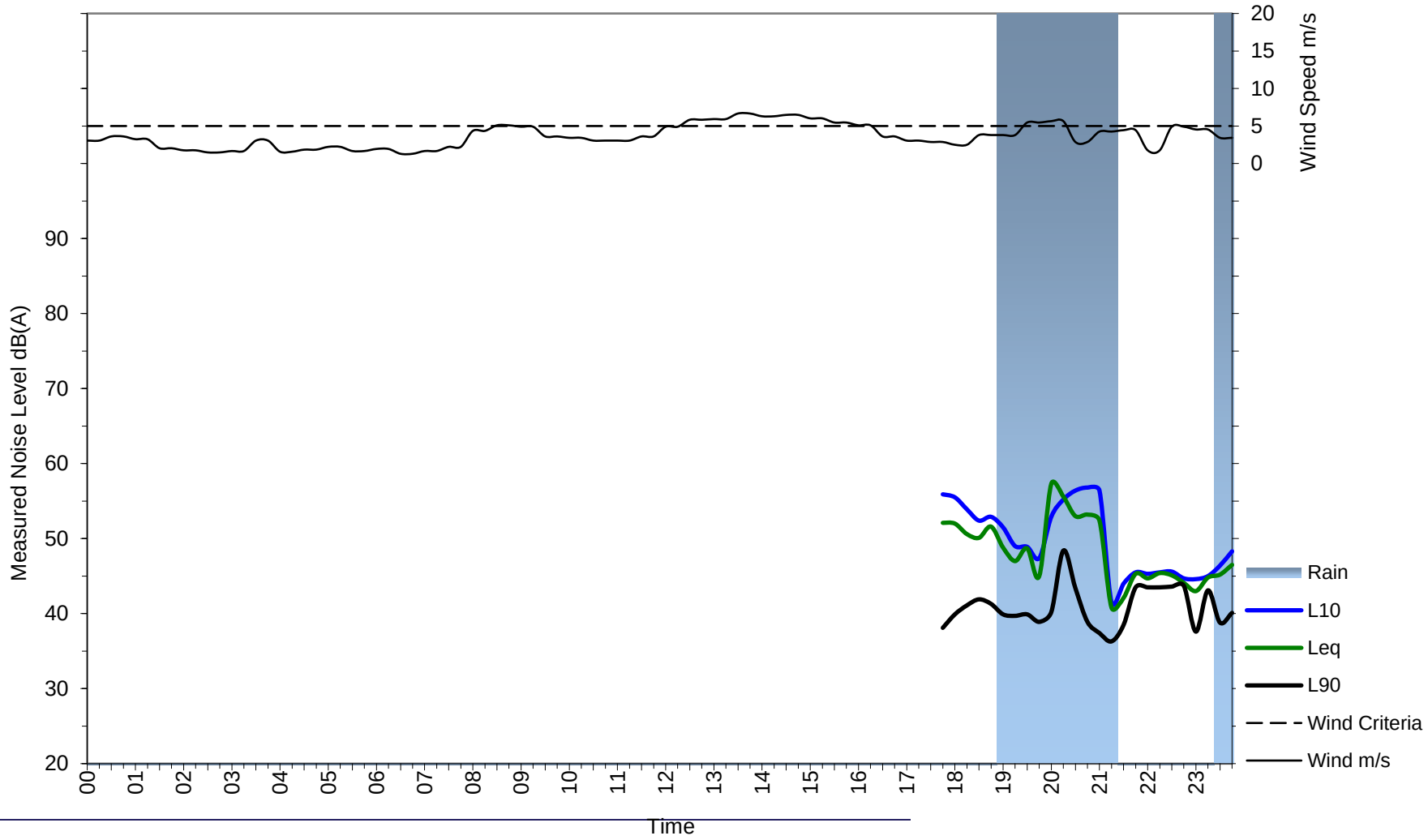
Ambient Sound	The totally encompassing sound in a given situation at a given time, usually composed of sound from all sources near and far.
Audible Range	The limits of frequency which are audible or heard as sound. The normal ear in young adults detects sound having frequencies in the region 20 Hz to 20 kHz, although it is possible for some people to detect frequencies outside these limits.
Character, acoustic	The total of the qualities making up the individuality of the noise. The pitch or shape of a sound's frequency content (spectrum) dictate a sound's character.
Decibel [dB]	The level of noise is measured objectively using a Sound Level Meter. The following are examples of the decibel readings of every day sounds; 0dB the faintest sound we can hear 30dB a quiet library or in a quiet location in the country 45dB typical office space. Ambience in the city at night 60dB Martin Place at lunch time 70dB the sound of a car passing on the street 80dB loud music played at home 90dB the sound of a truck passing on the street 100dB the sound of a rock band 115dB limit of sound permitted in industry 120dB deafening
dB(A)	*A-weighted decibels* The ear is not as effective in hearing low frequency sounds as it is hearing high frequency sounds. That is, low frequency sounds of the same dB level are not heard as loud as high frequency sounds. The sound level meter replicates the human response of the ear by using an electronic filter which is called the "A" filter. A sound level measured with this filter switched on is denoted as dB(A). Practically all noise is measured using the A filter. The sound pressure level in dB(A) gives a close indication of the subjective loudness of the noise.
Frequency	Frequency is synonymous to *pitch*. Sounds have a pitch which is peculiar to the nature of the sound generator. For example, the sound of a tiny bell has a high pitch and the sound of a bass drum has a low pitch. Frequency or pitch can be measured on a scale in units of Hertz or Hz.
Loudness	A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on
L_{Max}	The maximum sound pressure level measured over a given period.
L_{Min}	The minimum sound pressure level measured over a given period.
L_1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L_{10}	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L_{90}	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L_{90} noise level expressed in units of dB(A).
L_{eq}	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.
Background Sound Low	The average of the lowest levels of the sound levels measured in an affected area in the absence of noise from occupants and from unwanted, external ambient noise sources. Usually taken to mean the L_{A90} value

Ctr	A frequency adaptation term applied in accordance with the procedures described in ISO 717.
dB (A)	'A' Weighted overall sound pressure level
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 shall apply
NR Noise Rating	Single number evaluation of the background noise level. The NR level is normally around 5 to 6 dB below the "A" weighted noise level. The NR curve describes a spectrum of noise levels and is categorised by the level at 1000 Hz ie the NR 50 curve has a value of 50 dB at 1000 Hz. The NR rating is a tangential system where a noise spectrum is classified by the NR curve that just encompasses the entire noise spectrum consideration.
R_w	Weighted Sound Reduction Index - Laboratory test measurement procedure that provides a single number indication of the acoustic performance of a partition or single element. Calculation procedures for Rw are defined in ISO 140-2:1991 "Measurement of Sound Insulation in Buildings and of Building Elements Part 2: Determination, verification and application of precision data".
R'_w	Field obtained Weighted Sound Reduction Index - this figure is generally up to 3-5 lower than the laboratory test determined level data due to flanked sound transmission and imperfect site construction.
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 to be specified for any contractual condition
Sound Pressure Level, L_P dB	A measurement obtained directly using a microphone and sound level meter. Sound pressure level varies with distance from a source and with changes to 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 micro Pascals.
Sound Power Level, L_W dB	Sound power level is a measure of the sound energy emitted by a source, does not change with distance, and cannot be directly measured. Sound power level of a machine may vary depending on the actual operating load and is calculated from sound pressure level measurements with appropriate corrections for distance and/or environmental conditions. Sound power levels is equal to 10 times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 picoWatt
Speech Privacy	A non-technical term but one of common usage. Speech privacy and speech intelligibility are opposites and a high level of speech privacy means a low level of speech intelligibility. It should be recognised that acceptable levels of speech privacy do not require that speech from an adjacent room is inaudible.
Transmission Loss	Equivalent to Sound Transmission Loss and to Sound Reduction Index in terminology used in countries other than Australia. A formal test rating of sound transmission properties of any construction, by usually a wall, floor, roof etc. The transmission loss of all materials varies with frequency and may be determined by either laboratory or field tests. Australian Standards apply to test methods for both situations.

11 APPENDIX B – NOISE LOGGING RESULTS

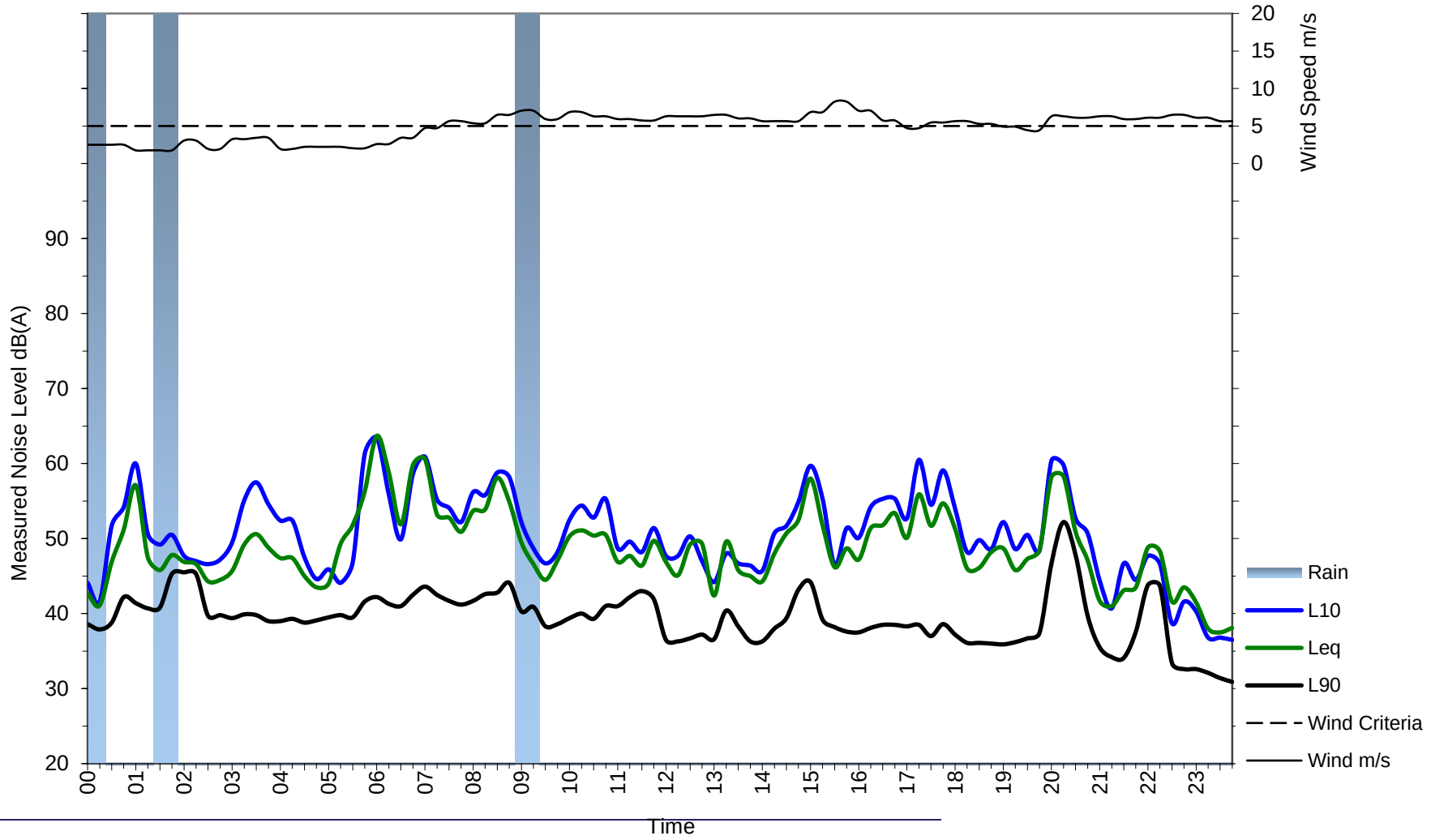
19 Canberra Avenue, St Leonards

Tuesday 08 June 2021



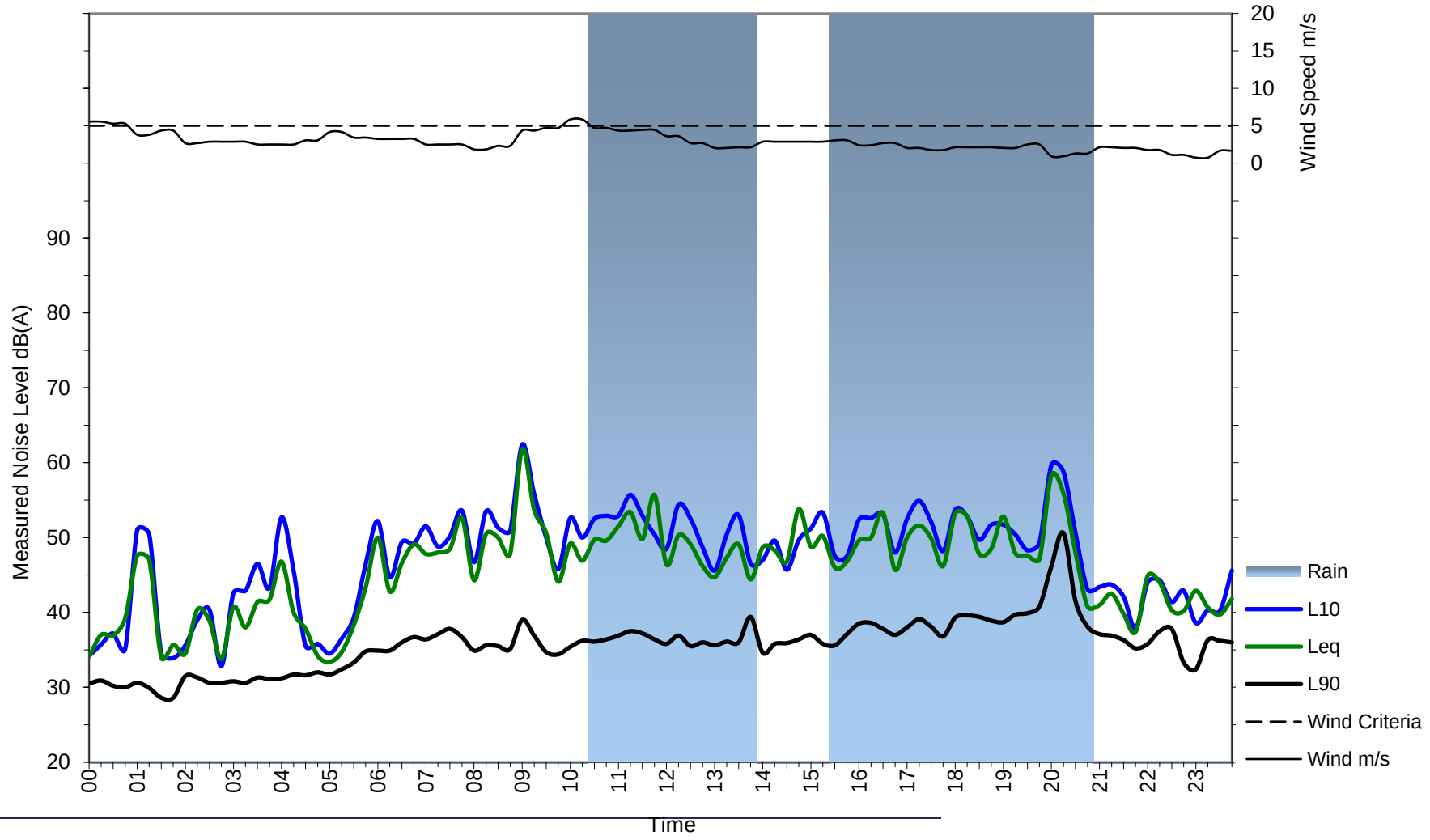
19 Canberra Avenue, St Leonards

Wednesday 09 June 2021



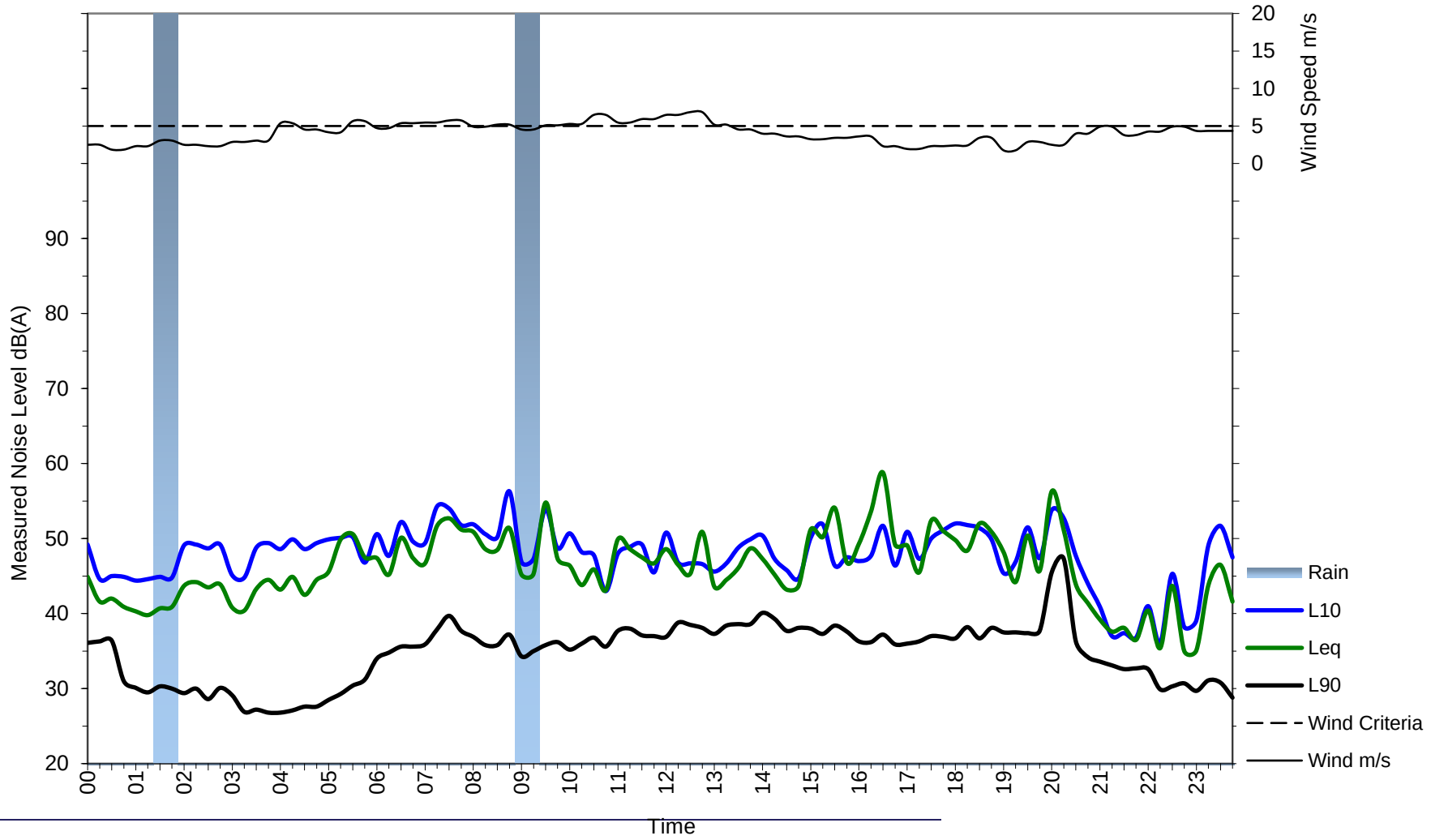
19 Canberra Avenue, St Leonards

Thursday 10 June 2021



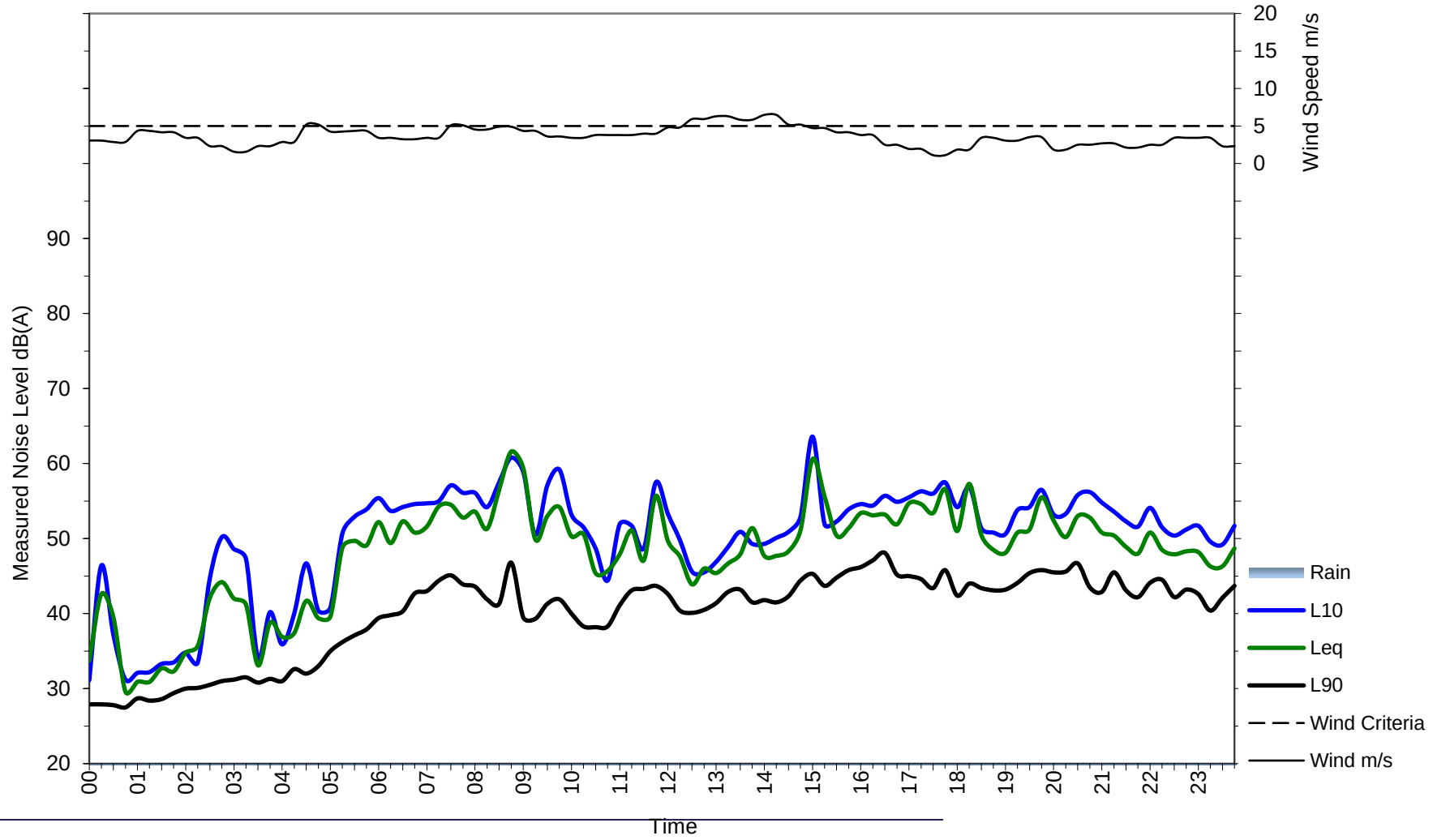
19 Canberra Avenue, St Leonards

Friday 11 June 2021



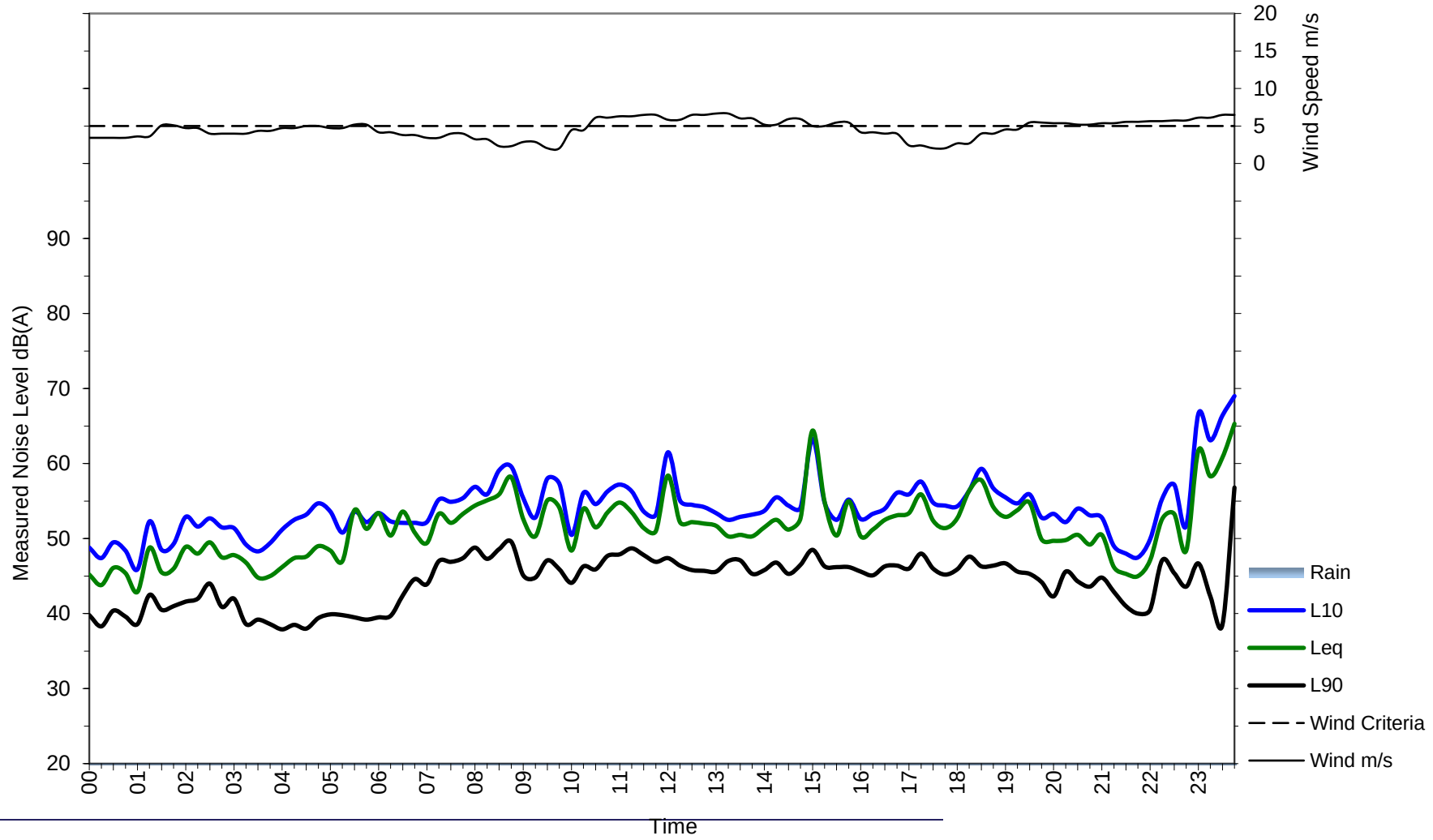
19 Canberra Avenue, St Leonards

Saturday 12 June 2021



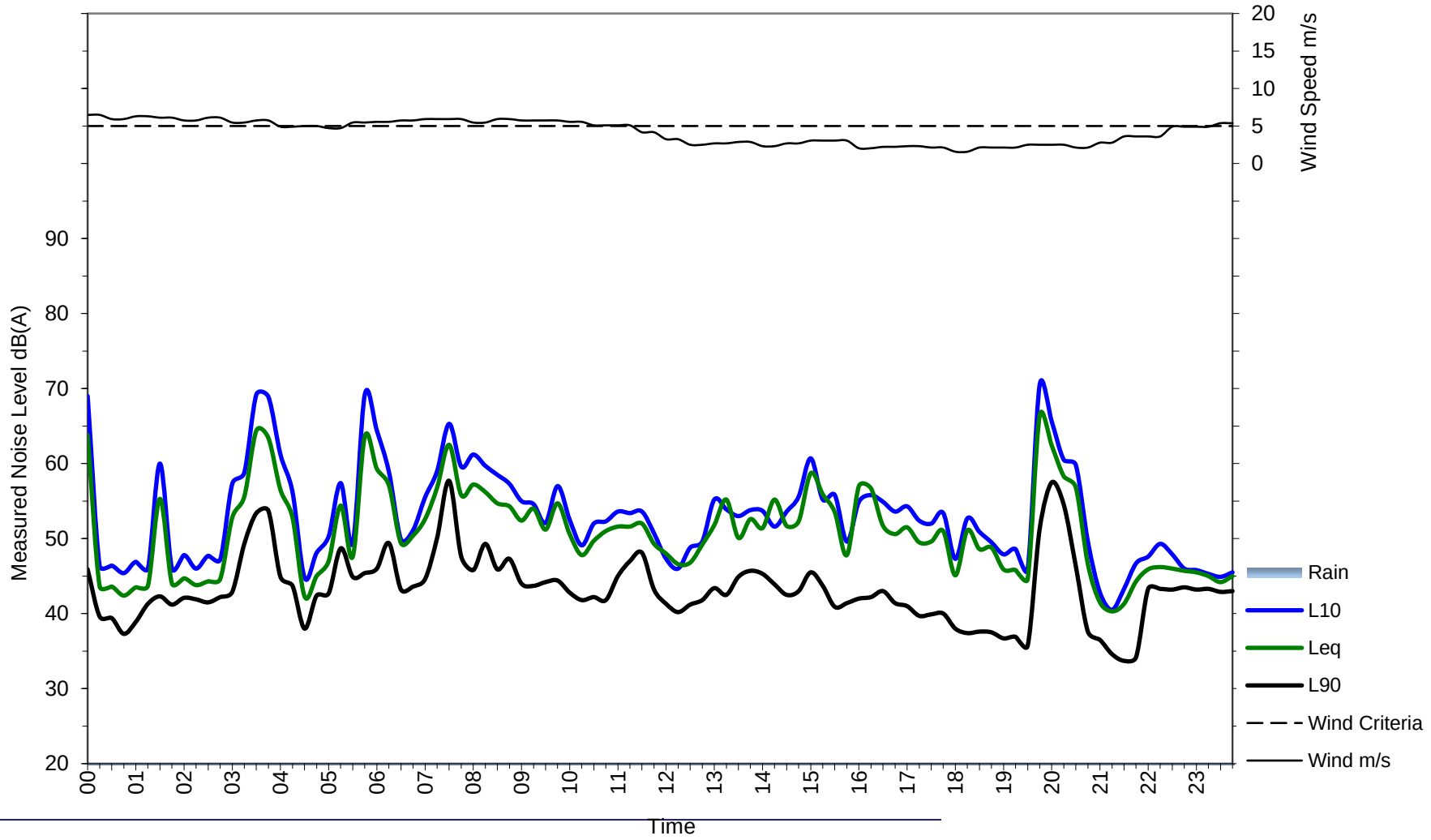
19 Canberra Avenue, St Leonards

Sunday 13 June 2021



19 Canberra Avenue, St Leonards

Monday 14 June 2021



19 Canberra Avenue, St Leonards

Tuesday 15 June 2021