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SUSTAINABLE BUILDING CONSULTANTS
SYDNEY BRISBANE PERTH MELBOURNE JAKARTA

MIXED USE DEVELOPMENT
2b-6 Hassall Street, Parramatta

Noise Impact Assessment for Development Application

Prepared for:

Charter Hall

WESTERN SYDNEY UNIVERSITY

Project Manager:

SOLUTIONS CONSULTING AUSTRALIA

Architect:

BlightRayner

Tzannes

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MIXED USE DEVELOPMENT **18255**
2B-6 HASSALL STREET, PARRAMATTA

NOISE IMPACT ASSESSMENT REPORT

This register identifies each issue of and each amendment to this document by Revision No, Page No, the details of each amendment and date of issue.

AMENDMENT REGISTER

Rev. No	Section & Page No.	Issue/ Amendment	Author	Project Engineer	Checked	Date
A	-	Original Issue	JC	TB	TB	26/03/2019
B		SSDA Issue	JC	TB	TB	11/04/2019

EXECUTIVE SUMMARY

This noise impact assessment report has been prepared by Floth Pty Ltd and is submitted to the Department of Planning and Environment to accompany a Development Application (DA) for a State Significant Development (SSD) at 2b-6 Hassall Street, Parramatta.

The proposal relates to the broader site redevelopment plan which includes a mixed-use development comprising a tertiary institution, commercial and retail uses. The proposed development has undergone an Architectural Design Competition, which has since been awarded.

Two separate Development Applications have been submitted to the Local Authority, City of Parramatta Council, to enable the necessary Demolition and Early Works to proceed while the design competition was underway. The benefits of this approach included the expedited local assessment and determination of an application for these early works, which are key to ensuring the development can proceed according to the timeline for the project completion in Q1 2021.

The noise intrusion assessment showed that the dominant noise sources affecting the proposed development are road traffic noise. Glazing recommendations to achieve satisfactory internal noise levels specified in AS/NZS 2107 have been provided in Section 6.2 of this report.

The environmental noise emission sources from the proposed development will consist of:

- Mechanical plant and equipment in the Level 18 Plant Room and rooftop;
- Entertainment noise associated with any patronage noise from retail tenancies on ground level (e.g. potential alfresco dining), and
- Potential noise impact on surrounding noise sensitive receivers from additional road traffic associated with the proposed development.

The noise predictions contained within this report show that the mechanical plant noise emissions can be controlled to acceptable levels at the nearest noise sensitive receivers with attenuation to the Level 18 Plant Room intake and discharge paths. Detailed noise predictions shall be conducted during the design phases of the project to ensure that the mechanical plant noise emissions satisfy the noise limits at the NSRs.

Noise emission from any potential Alfresco Dining areas associated with the ground level retail tenancies was found to comply with the daytime limits (i.e. 0700 to midnight) defined by the NSW Office of Liquor, Gaming and Racing, even for a 'worst-case' noise scenario. However, it was found that the noise criteria during the night period (i.e. midnight to 0700) was predicted to be exceeded for this 'worst-case' noise scenario, and as such, it is recommended that any Outdoor Alfresco Dining be limited to 7am to midnight unless an acoustic assessment is conducted during the fit-out stage that considers additional noise control measures.

Noise from additional traffic on local roads associated with the proposed development was found to be acceptable in accordance with the *Road Noise Policy*.

A construction noise assessment found that the nearest occupied NSRs are predicted to comply with the Noise Management Levels, however the nearby commercial premises adjoining the site are predicted to experience some periods of high noise. As such, all feasible and reasonable noise mitigation measures should be adopted by the Building Contractor. The noise mitigation measures should be identified in the Construction Management Plan (CMP) prepared by the Building Contractor and may include (but not limited to):

- Community notification
- Operate plant in quiet and efficient manner
- Train workers in minimising noise and quiet work practices
- Implement a complaint handling procedure

The construction vibration assessment showed that the vibration limits for Cosmetic Damage and Human Response / Perceptibility are expected to be satisfied at all surrounding sensitive receivers.

In conclusion, the noise impact assessment has shown that compliance with the relevant long-term noise criteria can be achieved, and that adverse noise impacts on surrounding NSRs and commercial premises during the construction period can be managed and mitigated through noise control measures and strategies.

CONTENTS

1. RESPONSE TO SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

This report has been prepared to accompany the EIS for the proposed development. It responds to the infrastructure and water management issues addressed in the SEARs as outlined in the table below.

Relevant SEARs	Item discussed at
4. Environmental Amenity Assess amenity impacts on the surrounding locality including acoustic impacts	Section 4.2 & 7
9. Noise and Vibration Identify and provide a quantitative assessment of the main noise and vibration generating sources during demolition, site preparation, bulk excavation, construction and operation. Outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.	Section 4.2-4.4 & 7-9

2. INTRODUCTION

This noise impact assessment report has been prepared by Floth Pty Ltd and is submitted to the Department of Planning and Environment to accompany a Development Application (DA) for a State Significant Development (SSD) at 2b-6 Hassall Street, Parramatta.

The proposal relates to the broader site redevelopment plan which includes a mixed-use development comprising a tertiary institution, commercial and retail uses. The proposed development has undergone an Architectural Design Competition, which has since been awarded.

Two separate Development Applications have been submitted to the Local Authority, City of Parramatta Council, to enable the necessary Demolition and Early Works to proceed while the design competition was underway. The benefits of this approach included the expedited local assessment and determination of an application for these early works, which are key to ensuring the development can proceed according to the timeline for the project completion in Q1 2021.

The two early works applications include:

- DA/714/2018
    - Demolition of existing structures
    - Removal of trees on site
    - Archaeological testing and salvage work.
- DA/66/2019
    - Site preparation works, including piling
    - Bulk excavation
    - Construction of below ground shoring walls.

This noise impact assessment for the SSD includes the following works:

- Construction and use of one basement level comprising:
    - Car parking,
    - Refuse and recycling facilities,
    - Loading Bay,
    - Bicycle parking, and
    - WSU Net Lettable Area (NLA).
- Construction and use of a 19-storey mixed-use building comprising:
    - Retail tenancies, End of Trip (EOT) and educational use on Ground Level.
    - WSU educational use on Level 1 to Level 9;
    - Commercial office use on Level 10 to 17;

  - Plant room on Level 18;
  - Terrace on Level 12.
- Landscaping and public domain works; and
- Extension and augmentation of services and infrastructure as required.

2.1 PROPOSED DEVELOPMENT AND SURROUNDING AREA

The proposed mixed-use development will consist of a 19-storey building with one basement level and composition as shown in Table 1.

Table 1: Proposed Development Schedule

Building	Designation	Use
Basement	Basement	Car Parking, Refuse & Recycling, Loading Bay, Bicycle Parking and Educational NLA
Ground	Ground	Educational, Retail, EOT
Tower	Level 1 – 9	Educational
	Level 10 – 11	Commercial
	Level 12	Commercial, Terrace
	Level 13 – 17	Commercial
	Level 18	Plant Room, Cooling Towers

The property details of the proposed site are presented in Table 2. The zoning as defined in the Parramatta Local Environmental Plan 2011, and an aerial photograph of the subject site and surrounding area are presented in Figure 1 and Figure 3 respectively.

Table 2: Property Details of the Subject Site

Property Address	2b – 6 Hassall Street, Parramatta
Property Holding Details	Lot 22 DP 608861; Lot 62 DP 1006215; LOT 7 DP 128820
Planning Scheme	Parramatta Development Control Plan 2011
Zone Name	B3 Commercial Core
Local Area Plan	Parramatta Local Environmental Plan (PLEP) 2011

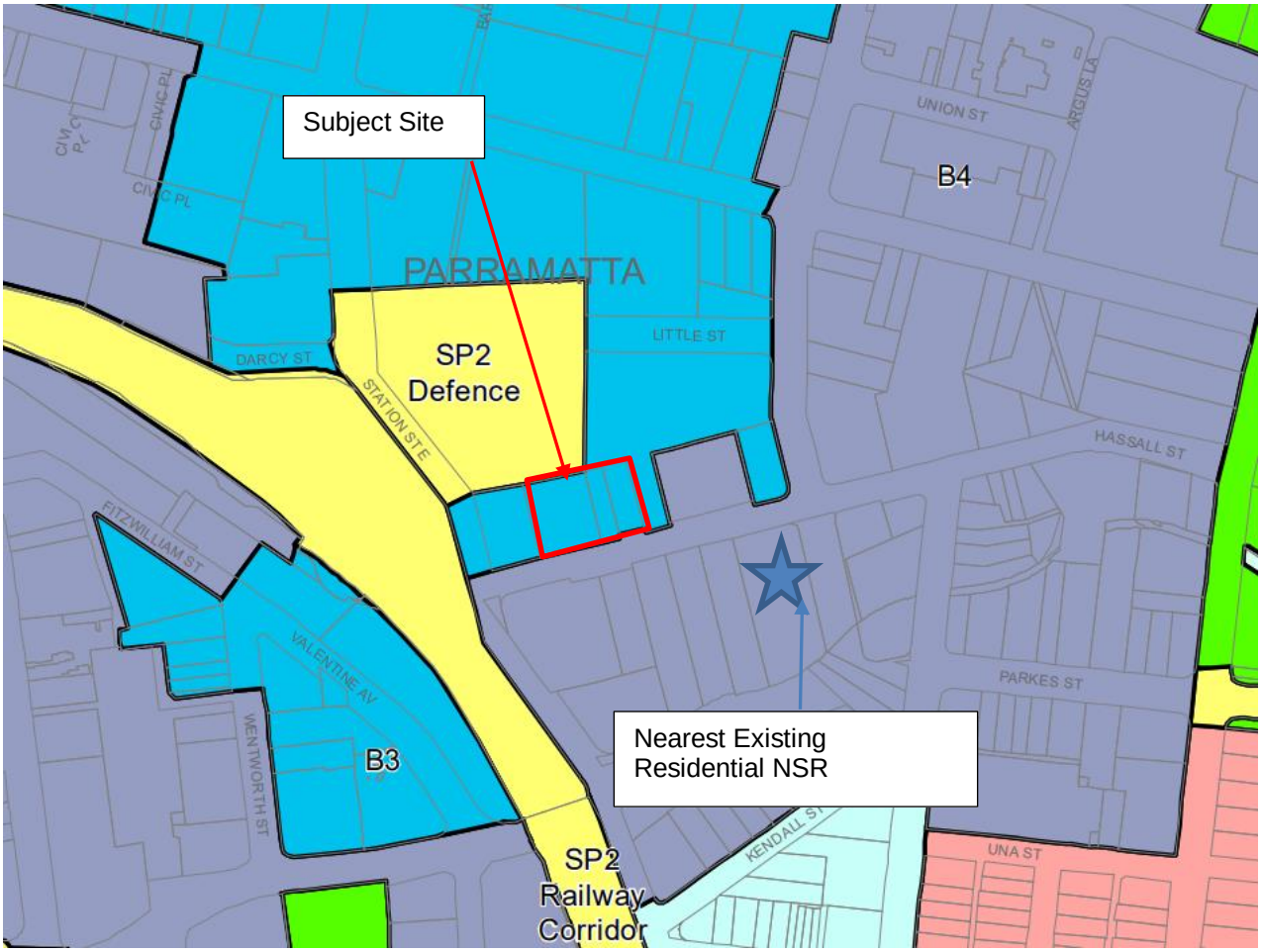


Figure 1: Land Use Zoning [Ref. PLEP – Land Zoning Map – Sheet LZN_010]

2.2 NEAREST NOISE SENSITIVE RECEIVERS

The nearest potentially affected noise sensitive receivers (NSRs) are shaded in 'green' in Figure 2 and are as follows:

- Fiori Apartments (nearest existing residential receiver) – situated approximately 45 metres southeast of the proposed site at 13-15 Hassall Street, Parramatta. This site is zoned as B4-Mixed Use and consists of two, 21-storey residential apartment buildings.
- Skyrise Apartments (under construction) – situated approximately 56 metres southeast of the proposed site at 11 Hassall Street, Parramatta. This development site is zoned as B4-Mixed Use and will consist of one, 43-storey residential apartment building.
- Imperial Apartments (proposed) – situated approximately 40 metres southeast of the proposed site at 9 Hassall Street, Parramatta. This development site is zoned as B4-Mixed Use and is proposed to consist of two, 21-storey residential apartment buildings.

Nearby commercial premises potentially affected by the proposed development are shaded in 'blue' in Figure 2 and include:

- Curtis Cheng Centre (NSW Police Headquarters) is a 13-storey commercial building located immediately north of the proposed site,
- The Commercial Hotel is a 2-storey building located at 2A Hassall Street immediately west of the proposed site.
- Eclipse Tower is a 22-storey commercial tower located approximately 23 metres south of the proposed site at 60 Station Street, Parramatta.

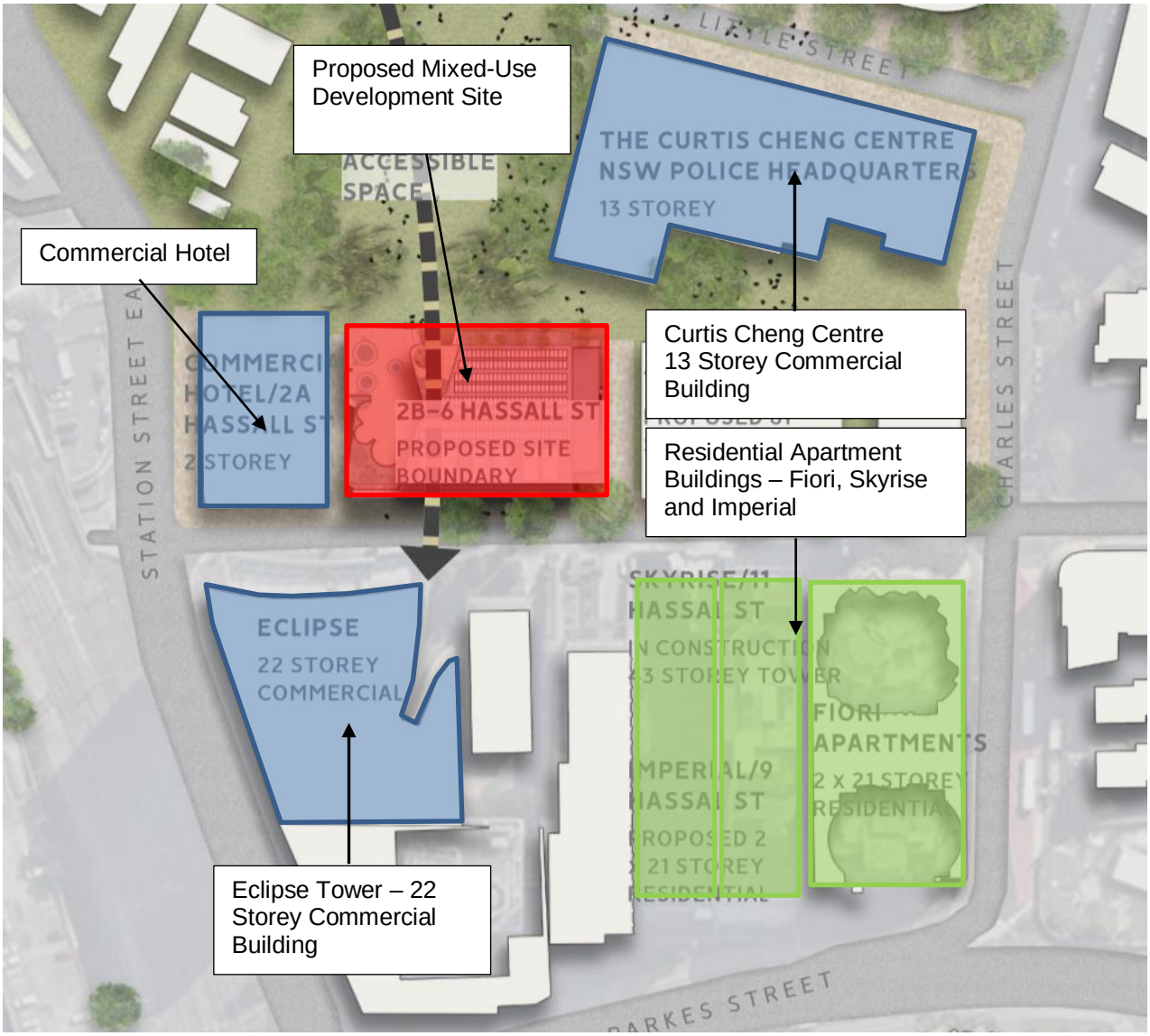


Figure 2: Subject Site and Surrounding Noise Sensitive and Commercial Receivers

2.3 SURROUNDING NOISE INTRUSION SOURCES

The site is potentially impacted by the following noise sources as shown in Figure 3:

- Hassall Street to the South, and
- Station Street and the heavy rail network to the west.

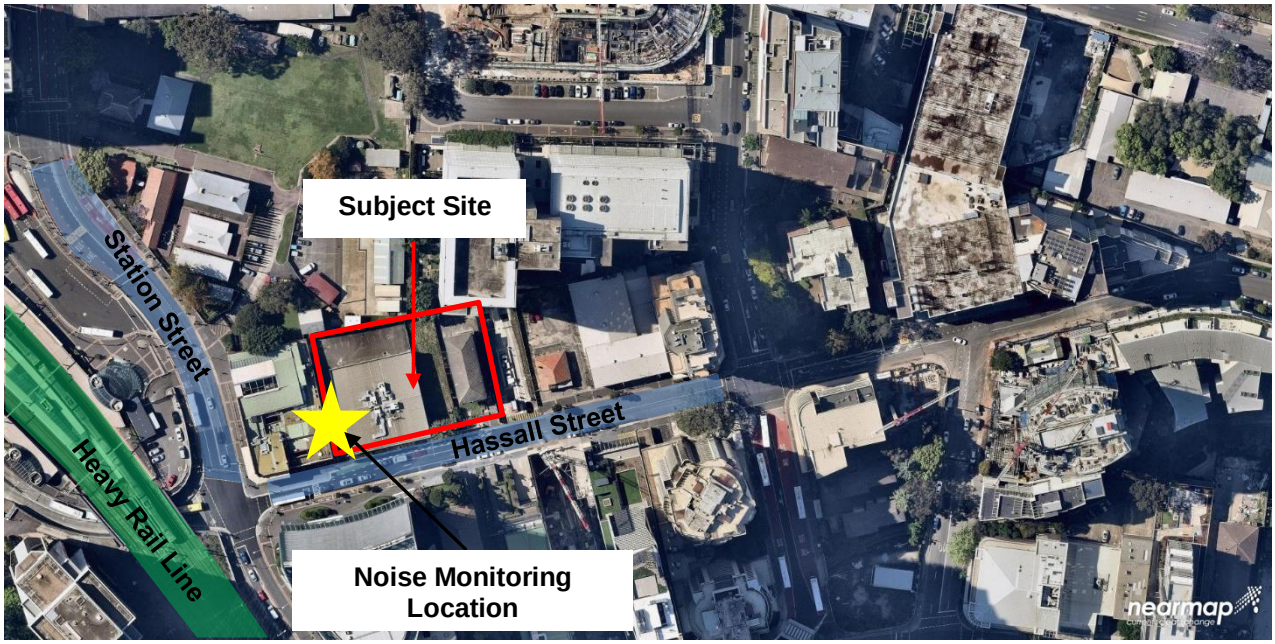


Figure 3: Subject Site and Surrounding Noise Sources

Station Street and the existing heavy rail system are located approximately 35 and 70 metres west of the proposed site respectively. The proposed development at 2b-6 Hassall Street receives significant noise shielding from these noise sources at Ground Level due to the Commercial Hotel as presented in Figure 3.

2.4 POTENTIAL NOISE EMISSION SOURCES

The following noise sources associated with the proposed development have the potential to impact the surrounding NSRs identified in Section 2.2:

- Environmental noise emissions from mechanical plant and equipment to nearby noise sensitive uses;
- Entertainment noise associated with any potential patronage noise from retail tenancies (e.g. potential alfresco dining);
- Potential noise impact on surrounding noise sensitive receivers from additional road traffic associated with the proposed development;
- Potential noise impact on surrounding noise sensitive receivers due to loading bay and refuse collection, and
- Potential noise impact on surrounding noise sensitive receivers due to car parking activities (e.g. car door slams, engine starts etc.)
- Temporary noise and vibration impact during the construction phase of the development.

It is noted that the loading bay, refuse facilities and car parking are contained within the building envelope on the Basement Level, and are not expected to result in a noise impact at surrounding noise sensitive receivers. As such, they have not been assessed further in this report.

3. EXISTING NOISE LEVELS

3.1 AMBIENT NOISE

The existing ambient noise levels at the site were measured between the 23rd and 30th November 2018. The location of the noise monitoring equipment was in 'free-field' conditions as shown in Figure 3.

The noise logger was positioned with line of sight to Hassall Street and the top of the microphone was 1.5 metres above the ground level. This location was selected due to equipment security and pedestrian safety (i.e. trip hazard) concerns.

3.2 INSTRUMENTATION

Noise monitoring was conducted with reference to the NSW Noise Policy for Industry, NSW Road Noise Policy and Australian Standard 1055.1 *"Acoustics – Description and measurement of environmental noise. Part 1: General Procedures"*.

The test instrumentation consisted of:

- Logger: Norsonic Nor139 Class 1 sound level meter, serial number: 1392796
- Calibrator: Pulsar Model 105 sound level calibrator, serial number: 77509

The instrumentation had current NATA laboratory calibrations during the monitoring period. Field calibration conducted prior-to and at the completion of logging did not find any drift in the calibration of the logger. The noise logging results are summarised in Table 3. The results include values for the L_{A01}[1], L_{A10}[2], L_{Aeq}[3], L_{Amax}[4], L_{A90}[5] and Rating Background Level (RBL[6]) averages for each of the day, evening and night periods for the weekdays.

During the logging period weather data was obtained from the Bureau of Meteorology (BOM) website for Parramatta (Station ID 066124). These weather observations were reviewed to ensure that the weather conditions did not adversely impact upon the noise logging results. Significant rainfall was recorded on the 28th November 2018 and subsequently this data was excluded from the results.

Additionally, extraneous noise from minor works conducted at the Commercial Hotel occurred between 07:00 and 11:00 on Monday, 26th November 2018. This extraneous noise was excluded from the noise logging results.

The noise logging data is presented in graphical form in Appendix A.

Table 3: Existing (Free-Field) Ambient Noise Levels

Period	Weekday Noise Level in dB(A)					
	L_{Amax}	L_{A01}	L_{A10}	L_{Aeq}	L_{A90}	RBL
Day	73	65	60	58	54	53
Evening	73	65	59	57	53	52
Night	69	61	55	53	48	45

The relationship between the $L_{A10,18h}$ noise descriptor, which is predicted using the Calculation of Road Traffic Noise (CORTN) algorithm, and various other noise descriptors used to describe the acoustic environment have been derived from the noise monitoring data as presented in Table 4.

[1] L_{A01} is the A-weighted sound pressure level exceeded for 1% of the time
[2] L_{A10} is the A-weighted sound pressure level exceeded for 10% of the time
[3] L_{Aeq} is the equivalent or energetic-averaged A-weighted sound pressure level
[4] L_{Amax} is the average of the maximum A-weighted sound pressure levels occurring within the consecutive 15-minute samples
[5] L_{A90} is the A-weighted sound pressure level exceeded for 90% of the time
[6] RBL is determined from the median of the daily assessment background levels (ABLs). The ABLs are determined from the 10th percentile of the hourly L_{A90} noise level measured during the day, evening and night-time periods.

Table 4: Relationship between Noise Descriptors based on Noise Monitoring Data

Noise Descriptor	Measured Level in dB(A)	Offset from Average $L_{A10,18h}$ in dB(A)
$L_{A10,18h}$ (0600 – 0000)	60.4	-
Average $L_{Aeq,15h(day)}$	59.2	-1.2
Average $L_{Aeq,9h(night)}$	54.1	-6.3
$L_{A10,12h}$ (0600 – 1800)	61.6	+1.2
Max $L_{Aeq,1h}$	62.2	+1.8

3.3 OCTAVE BAND SOUND PRESSURE LEVELS

Ambient average octave band sound pressure levels (L_{A90}) over the noise monitoring period are presented in Table 5.

Table 5: Ambient L_{A90} Octave Band Noise Levels

Time Period	L_{A90} Octave Band Frequency, Hz								
	31.5	63	125	250	500	1000	2000	4000	8000
Day 07:00 – 00:00	58	56	52	49	47	45	41	37	29
Night 00:00 – 07:00	49	50	47	45	41	39	34	28	21

4. NOISE CRITERIA

The noise criteria for the proposed mixed-use development are defined by Local Council requirements, NSW state polices / legislation and guidelines and applicable Australian Standards. The relevant noise criteria for the proposed development are presented in Table 6.

Table 6: Applicable Noise Policies and Guidelines

Assessment	Applicable Reference	Noise Sources
Noise Impact on the Proposed Development	NSW DECCW[7] Road Noise Policy NSW DoP[8] Development Near Rail Corridors and Busy Main Roads – Interim Guideline Australian / New Zealand Standard 2107:2016	Road traffic noise along Hassall Street and Station Street affecting the proposed development; Rail noise from the existing heavy rail network located approximately 70 metres west of the proposed development.
Noise Emissions from the Proposed Development	NSW DECCW Road Noise Policy	Noise generated on local roads from traffic associated with the proposed development
	NSW EPA[9] Noise Policy for Industry	Mechanical plant noise
	NSW – Office of Liquor, Gaming and Racing – Reducing the risk of noise disturbance: October 2009	Amplified music from retail tenancies; Noise from patrons
Construction Noise and Vibration	NSW EPA Interim Construction Noise Guideline NSW EPA Assessing Vibration: A Technical Guideline	Noise and vibration associated with construction activities

[7] Department of Environment Climate Change and Water
[8] Department of Planning
[9] Environmental Protection Agency

4.1 NOISE IMPACT ON THE PROPOSED DEVELOPMENT

The development is potentially affected by the following dominant noise sources:

- Road traffic noise from Hassall Street and Station Street;
- Noise from the existing heavy rail network located approximately 70 metres west of the proposed site.

Of the proposed development uses presented in Table 1, only the educational uses are considered to be 'noise-sensitive' as outlined in the NSW DoP *Development Near Rail Corridors and Busy Main Roads – Interim Guideline*. The remaining uses are commercial / retail and shall be designed to achieve internal noise levels that satisfy AS/NZS 2107:2016, as specified in Section 2.5.6 of the NSW DECCW *Road Noise Policy*.

4.1.1 Educational Uses

The proposed development includes a variety of educational uses associated with the Western Sydney University (WSU). The recommended internal noise level for the educational uses specified in the *Development Near Rail Corridors and Busy Main Roads – Interim Guideline* is presented in Table 7.

Table 7: Recommended Maximum Noise Level for Education Facilities

Non-Residential Buildings	Recommended Max Level, dBA
Educational Institutions including child care centres	40

The proposed development is located approximately 70 metres east of the nearest rail line. *Figure 3.1* and *Figure 3.2* of the *Development Near Rail Corridors and Busy Main Roads – Interim Guideline* provides minimum setback distances for residential premises near operational rail lines for airborne and ground borne noise respectively:

- From *Figure 3.1*, a setback distance of more than 60 metres from trains travelling less than 80 km/hr (which is the case for the trains departing from and arriving at the Parramatta Station) is acceptable for residential premises without consideration of additional noise mitigation measures.
- From *Figure 3.2*, a setback distance of more than 60 metres from an operational rail track for vibration sensitive structures is considered acceptable without the need for additional vibration mitigation measures.

The separation distance between the proposed development and the nearest operational rail track is approximately 70 metres, which is greater than the setback distance required for residential premises or vibration sensitive structures. In addition, the ground level receives significant noise shielding from the Commercial Hotel, which is a two-storey building. As such, rail noise is expected to be acceptable within the proposed development with standard construction practices and hasn't been considered further in this report.

Guidance is also sought from the NSW DECCW *Road Noise Policy* that defines noise assessment criteria for non-residential land uses affected by proposed road projects and traffic generating developments. For educational uses other than school classrooms, the Policy references AS/NZS 2107 as presented in Table 8.

Table 8: Recommended Internal Design Sound Levels and Reverberation Times from AS/NZS 2107:2016

Type of Occupancy/Activity	Recommended Sound Level Range (dBA)	Reverberation Time (s)
Educational Buildings		
Art/craft studios	40 to 45	< 0.8
Assembly halls up to 250 seats	30 to 40	0.6 to 0.8
Assembly halls over 250 seats	30 to 35	Curve 1*
Audio-visual areas	35 to 45	0.6 to 0.8
Computer rooms – Teaching Laboratories	 40 to 45 45 to 50	 0.4 to 0.6 0.4 to 0.6
Conference rooms	35 to 40	0.6 to 0.7
Corridors and lobbies	< 50	< 0.8
Drama Studios	35 to 40	Curve 1*
Engineering Workshops – Teaching Non-teaching	 < 45 < 60	 See Note 1 See Note 1
Weight training / Fitness room	< 50	< 1.0
Interview / counselling rooms	40 to 45	0.3 to 0.6
Laboratories – Teaching Working	 35 to 45 40 to 50	 0.5 to 0.8 0.5 to 0.8
Lecture rooms up to 50 seats	30 to 35	Curve 3*
Lecture theatres – Without speech reinforcement With speech reinforcement	 30 to 35 30 to 40	 Curve 3* Curve 3*
Libraries – General areas Reading areas	 40 to 50 40 to 45	 < 0.6 < 0.6
Manual arts workshops	< 45	< 0.8
Medical rooms (First Aid)	40 to 45	0.6 to 0.8
Music practice rooms	40 to 45	0.7 to 0.9
Music studios	30 to 35	Curve 2* (see Note 3)
Office areas	40 to 45	0.4 to 0.7
Professional and administrative offices	35 to 40	0.6 to 0.8
Teaching spaces / single classroom – Open plan teaching spaces Primary schools	 35 to 45 35 to 45	 Curve 3* (See Note 1) Curve 3* (see Note 2)

Type of Occupancy/Activity	Recommended Sound Level Range (dBA)	Reverberation Time (s)
Secondary schools	35 to 45	Curve 3*
Staff common rooms	40 to 45	< 0.6
Staff studies / collegiate	40 to 45	0.4 to 0.6
Sports hall	< 50	Curve 4*
Toilet / change / showers	< 55	-

*Refer to Appendix A of AS/NZS 2017:2016

Note 1: Reverberation time should be minimised for noise control

Note 2: Certain teaching spaces, including those intended for students with learning difficulties and English as a second language, should have reverberation times at the lower end of the range.

Note 3: Specialist advice should be sought for these spaces

4.1.2 Commercial / Retail – Continuous (Non-Time Varying) Noise

Intruding noise from external sources such as road traffic must achieve compliance with the recommended levels specified in Table 1 of AS/NZS 2107:2016 *Acoustics – Recommended Design Sound Levels and Reverberation Times for Building Interiors*. The appropriate design sound limits and reverberation times from the Standard for office and retail buildings are presented in Table 9.

Table 9: Recommended Internal Design Sound Levels and Reverberation Times from AS/NZS 2107:2016

Type of Occupancy/Activity	Recommended Sound Level Range (dBA)	Reverberation Time (s)
Office Buildings		
Board and conference rooms	30 to 40	0.6 – 0.8
Cafeterias	45 to 50	< 1.0
Call centres	40 to 45	0.1 to 0.4
Corridors and lobbies	45 to 50	< 1.0
Executive office	35 to 40	0.4 to 0.6
General office areas	40 to 45	0.4 to 0.6
Meeting room (small)	40 to 45	< 0.6
Open plan office	40 to 45	0.4 (see Note 1)
Public spaces	40 to 50	0.5 to 1.0
Quiet rooms	40 to 45	< 0.6
Reception areas	40 to 45	0.6 to 0.8
Rest rooms & break-out spaces	40 to 45	0.4 to 0.6
Toilets	45 to 55	N/A
Undercover carparks	< 65	N/A
Video/audio conference rooms	30 to 40	0.2 to 0.4
Shop Buildings		
Department Stores – Main floor Upper floor	 < 55 < 50	 See Note 1 See Note 1

Type of Occupancy/Activity	Recommended Sound Level Range (dBA)	Reverberation Time (s)
Enclosed carparks	< 65	-
Small retail stores (general)	< 50	See Note 1
Shopping malls	< 55	See Note 1
Show rooms	< 50	See Note 1
Speciality shops	< 45	See Note 1

Note 1: Reverberation Time should be minimised for noise control

4.2 NOISE EMISSION FROM THE PROPOSED DEVELOPMENT

4.2.1 Traffic Noise Generated by the Development

The NSW DECCW *Road Noise Policy* provides guidance on the assessment of noise due to additional road traffic on public roads directly attributed to the proposed development. For traffic generating developments, the policy states:

*For existing residences and other sensitive land uses affected by **additional traffic on existing roads generated by land use developments**, any increase in total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option.'*

The Road Noise Policy also provides assessment criteria for residential land uses affected by traffic generating developments as presented in Table 10.

Table 10: Road Traffic Noise Assessment Criteria for Residential Land Uses

Road Category	Type of Project / Land Use	Assessment Criteria, façade corrected	
		Day (7.00AM – 10.00PM)	Night (10.00PM – 7.00AM)
Freeway / arterial / sub-arterial	Existing residences affected by **additional traffic** on existing freeways / arterial / sub-arterial roads generated by land use developments	$L_{eq,15hour}$ 60 dB(A), external	$L_{eq,9hour}$ 55 dB(A), external
Local roads	Existing residences affected by **additional traffic** on existing local roads generated by land use developments	$L_{eq,1hour}$ 55 dB(A), external	$L_{eq,1hour}$ 50 dB(A), external

The potential noise impact on surrounding residential NSRs will be conservatively assessed against a '+2 dB increase' criteria as outlined in Section 3.4.1 of the *Road Noise Policy*.

4.2.2 Mechanical Plant Noise

The proposed development has the potential to impact on the nearby residential NSRs and commercial premises through the introduction of mechanical plant and equipment. In order to define the assessment criteria for mechanical plant, reference is made to the *NSW Noise Policy for Industry*. The noise policy is used to derive the following three noise parameters:

1. Project Intrusiveness Noise Levels
2. Project Amenity Noise Levels
3. Project Noise Trigger Level

4.2.2.1 Project Intrusiveness Noise Levels

The Project Intrusiveness Noise Level aims to protect against significant changes in noise levels as industry is introduced into areas containing noise sensitive uses such as residences. The Project Intrusiveness Noise Levels applicable to the residences surrounding the proposed development are presented in Table 11.

Table 11: Project Intrusiveness Noise Levels

Receiver	Time of day	$L_{Aeq,15min}$ dB(A)
Residential	Day	RBL + 5 dB = 58 dB(A)
	Evening	RBL + 5 dB = 57 dB(A)
	Night	RBL + 5 dB = 49 dB(A)

4.2.2.2 Project Amenity Noise Levels

The Project Amenity Noise Levels seek to protect against the cumulative noise impacts from industry and maintain amenity of sensitive land uses (e.g. residences). The Project Amenity Noise Levels applicable to

the residences surrounding the proposed development, as well as nearby commercial premises are presented in Table 12.

Table 12: Project Amenity Noise Levels

Receiver	Noise amenity area	Time of day	Recommended Amenity Levels	Project Amenity Levels
			L_{Aeq}, dB(A)	L_{Aeq}, dB(A)
Residential	Urban (B4-Mixed Use Zone)	Day	60	55
		Evening	50	45
		Night	45	40
Commercial premises	N/A	When in use	65	60

4.2.2.3 Project Noise Trigger Level

The Project Noise Trigger Levels are the lower of the Project Intrusiveness Noise Level and the Amenity Noise Level for each assessment period and are presented in Table 13 for this project.

Table 13: Project Noise Trigger Levels

Receiver	Time of day	Project Intrusiveness Noise Levels	Project Amenity Noise Levels*	Project Noise Trigger Level
		$L_{Aeq,15min}$ dB(A)	$L_{Aeq,15min}$ dB(A)	$L_{Aeq,15min}$ dB(A)
Residential	Day	58	58	58
	Evening	57	48	48
	Night	49	43	43
Commercial premises	When in use	N/A	63	63

*Project amenity noise level (ANL) is Urban ANL (Table 2.1 of NSW Noise Policy for Industry) minus 5 dB(A) plus 3 dB(A) to convert from a period level to a 15-minute level.

4.2.2.4 Maximum Noise Level Event Assessment

Where a subject development / premises has night time noise emissions at a residential location that exceed the following noise limits, an additional assessment is required to assess the potential for sleep disturbance:

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

The proposed development is not expected to operate during the night period. However, the mechanical plant is expected to operate in 'purge' mode for at least part of the night period, and as such the maximum noise level event assessment is required in accordance with the *NSW Noise Policy for Industry.*

4.2.3 Outdoor Alfresco Dining and Patron Noise

The types of retail tenancies that may occupy the ground floor leases are not yet known. It is possible that cafés or restaurants with the potential for patronage noise emissions from Outdoor Alfresco Dining areas could tenant the spaces. As such, a preliminary noise impact assessment of the potential noise emissions has been conducted. A standard condition imposed by the NSW *Office of Liquor, Gaming and Racing (OLGR)* in order to control noise emissions from a licensed premise is as follows*:*

1. *The L_{A10} noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) by more than 5dB between 07:00am and 12:00 midnight at the boundary of any affected residence.*
2. *The L_{A10} noise level emitted from the licensed premises shall not exceed the background noise level in any Octave Band Centre Frequency (31.5 Hz to 8 kHz inclusive) between 12:00 midnight and 07:00am at the boundary of any affected residence.*

Based on the standard noise criteria imposed by the OLGR, the noise limits at nearby noise sensitive receivers for a licensed premise based on the existing ambient noise levels at site presented in Table 5, are shown in Table 14.

Table 14: L_{A10} Octave Band Noise Criteria for a Licensed Premise, measured at the nearest residential NSR

Time Period	L_{A10} Octave Band Frequency, Hz								
	31.5	63	125	250	500	1000	2000	4000	8000
Day 07:00 – 00:00	63	61	57	54	52	50	46	42	34
Night 00:00 – 07:00	49	50	47	45	41	39	34	28	21

4.3 CONSTRUCTION NOISE

The potential for construction noise to impact upon the surrounding noise sensitive receivers will be assessed in accordance with the NSW EPA *Interim Construction Noise Guideline (ICNG).* The key steps to managing construction noise outlined in the ICNG are as follows:

1. Identify sensitive land uses that may be affected,
2. Identify hours for the proposed construction works,
3. Identify noise impacts at sensitive land uses,
4. Select and apply the best work practices to minimise noise impacts.

The sensitive land uses that may potentially be affected by construction noise associated with the proposed development are nominated in Section 2.2.

The necessary Demolition and Early Works including the excavation of basement levels and construction of below ground shoring walls is the subject of alternative Development Applications. The construction phases associated with this Development Application include the construction of the tower only. The proposed construction phases are expected to occur over a period of approximately 12 months. Floth understands that all construction works will be undertaken between the standard hours nominated in the ICNG as presented in Table 15.

Table 15: Recommended Standard Hours for Construction Work

Work Type	Recommended Standard Hours of Work
Normal construction	Monday to Friday: 7am to 6pm Saturday: 8am to 1pm No work on Sundays or public holidays
Blasting	Monday to Friday: 9am to 5pm Saturday 9am to 1pm No blasting on Sundays or public holidays

4.3.1 Quantitative Assessment Method

Given that the proposed construction timeline for the project is expected to extend for approximately 12 months, the quantitative assessment method as described in the ICNG is warranted.

4.3.1.1 Airborne Noise

The ICNG provides an approach for determining Noise Management Levels (NMLs) at potentially affected residential receivers based on the Rating Background Level (refer to Table 3). The NMLs at surrounding residential receivers are presented in Table 16.

Table 16: NMLs for Residential Receivers

Time of Day	Noise Management Level, $L_{Aeq(15min)}$ dB(A)	How to Apply
Recommended standard hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or public holidays	Noise affected RBL + 10dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq(15min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as

		contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended hours	Noise affected RBL + 5 dB	• A strong justification would typically be required for work outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

The ICNG nominates the following air-borne construction noise levels for commercial receivers surrounding the proposed development:

- Office, retail outlets: external $L_{Aeq(15min)}$ 70 dB(A)

The screening levels used to assess the potential for airborne construction noise impacts at surrounding receivers are presented in Table 17.

Table 17: Airborne Construction Noise Screening Levels

Time of Day	Rating Background Level, dB(A)	Type of Receiver, $L_{Aeq(15min)}$ dB(A)	
		Residential	Commercial
Monday to Friday 7am to 6pm	53	63 (external)	70 (external)
Saturday 8am to 1pm	53	63 (external)	70 (external)

4.3.1.2 Ground borne Noise at Residences

The ICNG provides guidance on acceptable levels of ground borne noise at residential premises due to construction activities. The noise limits apply during the evening and night periods, which are outside the recommended standard construction hours. Construction activities are not expected to occur outside of the recommended hours for the proposed development, and as such, the potential for ground borne noise has not been assessed further.

4.3.1.3 Sleep disturbance at Residences

The ICNG provides an assessment methodology for sleep disturbance during the night period at residential premises due to construction activities. As construction activities are not expected to occur during the night period, a sleep disturbance assessment has not been conducted.

4.4 CONSTRUCTION VIBRATION

Vibration generated from construction activities has the potential to affect surrounding sensitive receivers and buildings in the following ways:

- Perceptible vibration exceeding human comfort criteria affecting occupants of the building; and
- Structural vibration that may lead to the deterioration or cosmetic damage to the building structure.

It is noted that the level of vibration that may cause cosmetic damage to a building structure is typically orders of magnitude higher than that which would cause an adverse comment by building occupants. As such, perceptible vibration is not necessarily damaging to the building structure.

4.4.1 Human Comfort Vibration Criteria

The NSW EPA's *Assessing Vibration: a technical guideline* nominates vibration limits aimed at minimising the potential for adverse reaction by building occupants based on the type of vibration (e.g. continuous, transient and intermittent events) in terms of the Vibration Dose Value (VDV). The VDV is a weighted vibration velocity dose referenced to an eight-hour day that penalises vibration impulses (i.e. rapid changes in vibration level), due to their perceived annoyance to occupants. The vibration associated with the types of construction activities that will be undertaken as part of the development is best described as 'intermittent'. The VDV limits for intermittent vibration nominated in the guideline are presented in Table 18.

Table 18: Acceptable Vibration Dose Values for Intermittent Vibration ($ms^{-1.75}$)

Location	Daytime[10] VDV Limits ($ms^{-1.75}$)	
	Preferred Value	Maximum Value
Residences	0.20	0.40
Offices, schools, educational institutions and places of worship	0.40	0.80

4.4.2 Structural Vibration Criteria

There are no currently available Australian Standards for the assessment of potential building damage due to vibration. Instead, reference is made to British Standard BS 7385-2:1993 *'Evaluation and measurement for vibration in buildings.'* It is noted that this Standard is also referenced in NSW Roads & Maritime Services' *Construction Noise and Vibration Guideline.*

The recommended maximum limits from BS 7385-2 to prevent cosmetic damage to building structures are presented in Table 19.

Table 19: Maximum Vibration Limits to Minimise the Potential for Cosmetic Damage to Structures

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

[10] Daytime is defined as 7:00 am to 10:00 pm

5. NOISE MODEL

5.1 ROAD TRAFFIC NOISE

A three-dimensional computer noise model of the site and surrounds was created in SoundPLAN v7.4 as presented in Figure 4. The road elevations, road alignments and local topography was obtained from Google Earth topography and available survey data. Aerial photography and site observations were used to determine the existing building heights and other shielding effects.

Point receivers have been assigned to the building facades at a distance of 1 metre (i.e. the predictions include façade reflection). The receivers were placed 1.5 metres above the proposed FFLs, which has been assumed based on preliminary plans and floor to floor heights.

The traffic noise prediction algorithm selected was the Calculation of Road Traffic Noise (CoRTN) methodology, which is a method endorsed by regulatory bodies in New South Wales. No road surface correction has been applied to the base noise level calculated by SoundPLAN because the base noise level prediction assumes a dense graded asphalt (DGA) road surface, as is the case with the roads surrounding the site. The corrections applied to the predicted $L_{A10,18hr}$ noise descriptor to calculate the $L_{Aeq,15hr}$ and $L_{Aeq,9hr}$ noise descriptors are presented in Table 4.

5.1.1 Traffic Volume Data

Existing traffic volumes for the surrounding road networks were provided by Ason Group, the Project's Traffic Consultant, as presented in Table 20 and Table 21.

Table 20: Road Traffic Volumes for Station Street East – Peak Periods

Road	AM Peak Period (06:00 to 10:00)		PM Peak Period (15:00 to 19:00)		Speed (km/h)
	Northbound	Southbound	Northbound	Southbound	
Station Street East	1,070	1,061	748	1,251	50

Table 21: Road Traffic Volumes for Hassall Street – Peak Periods

Road	AM Peak Period (06:00 to 10:00)	PM Peak Period (15:00 to 19:00)	Speed (km/h)
	Westbound	Westbound	
Hassall Street	457	602	50

5.1.2 Traffic Generated by the Development

Ason Group has also provided peak traffic forecasts generated by the development. This data will be used to assess any potential noise increase caused by additional traffic on local roads in accordance with the *Road Noise Policy*. The traffic forecasts are as follows:

- 39 vehicles per hour during the morning peak period
- 35 vehicles per hour during the evening peak period.

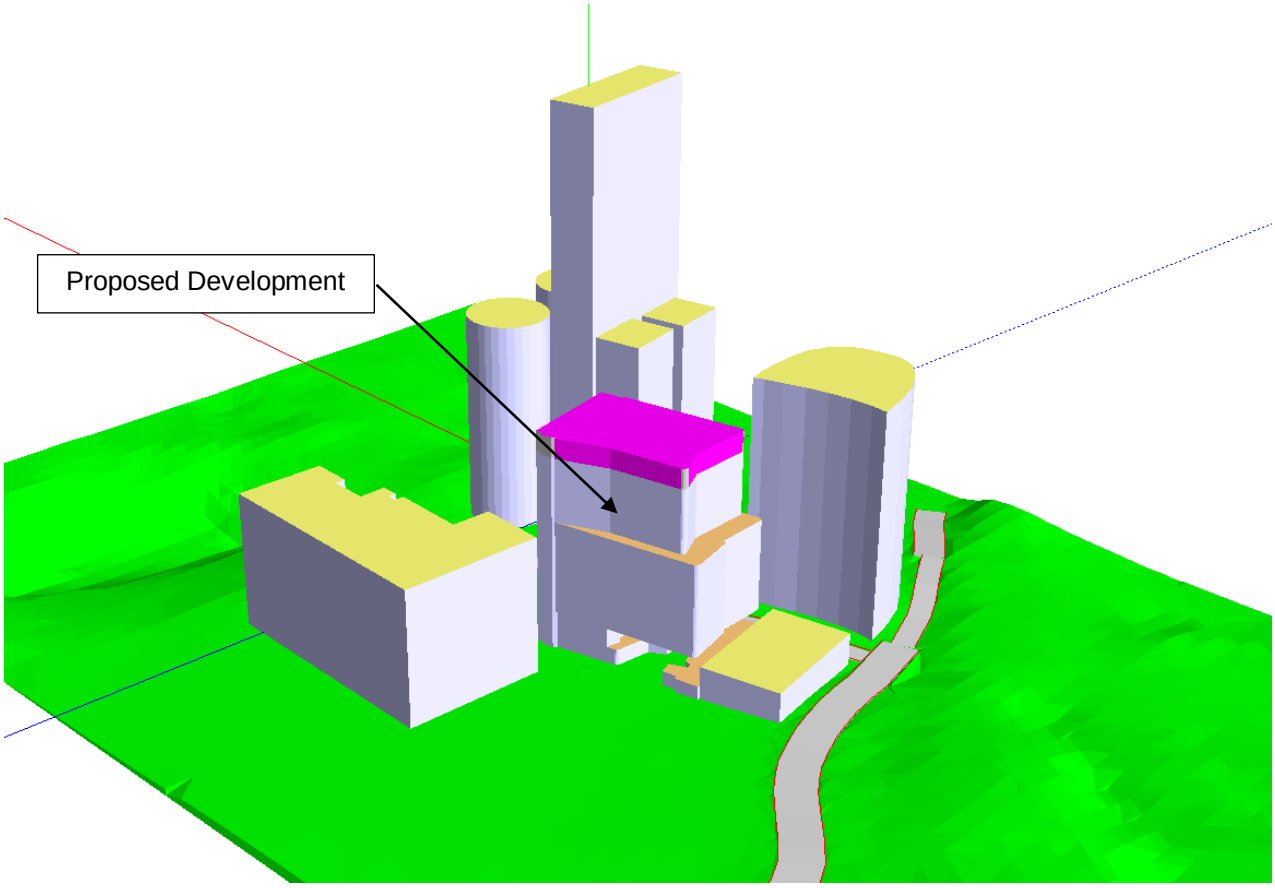


Figure 4: SoundPLAN Noise Model for Road Traffic Noise for Proposed Development

5.1.3 Traffic Noise Model Validation

In order to validate the noise model, the existing road traffic volumes in Section 5.1.1 were used to predict road traffic noise at the noise monitoring location (shown in Figure 3), with the results compared in Table 22.

Table 22: Road Traffic Noise Model Verification

Location	Predicted Noise Level ($L_{A10,18h}$, dB(A))	Measured Noise Level ($L_{A10,18h}$, dB(A)) – (Refer to Table 4)	Difference (dB) (Predicted – Measured)
Logger 1	59.6	60.4	-0.8 dB

The difference between the predicted and measured noise level at the noise monitoring location is within a ± 2 dB tolerance, and as such, the noise model is considered to be valid for noise predictions. The difference has been added to the predicted road traffic noise levels for each point receiver.

5.2 MECHANICAL PLANT NOISE

A separate scenario has been modelled to determine the noise emission from mechanical plant. The size, capacity and number of mechanical plant items for the proposed development had not been finalised at the time of writing this report. The following preliminary details have been used to determine the likely impact, and possible acoustic treatments (if required) for the mechanical plant associated with the proposed development (refer to Figure 5 for locations). The selection is based on preliminary mechanical plant capacities and experience with similarly sized projects:

- 5-off cooling towers on the rooftop each with sound power level (L_W) of 81 dB(A). The cooling towers would incorporate Variable Speed Drives (VSD) which would reduce the fan speed and subsequent noise levels as the cooling requirements reduced over the day;
- 6-off Air Handling Units contained in the Level 18 Plant Room with capacities ranging from 10 to 29 m^3/s and sound power levels (L_W) of approximately 86 dB(A). The corresponding return-air fans (RAF) were modelled with sound power levels ranging from 84 to 89 dB(A);
- 4-off Chiller Plant in the Level 18 Chiller Plant Room with sound power levels (L_W) of 85 to 94 dB(A) per unit, fully contained within the building envelope. It is noted that one chiller may not be installed unless a future tenant requires it;
- 2-off Toilet Exhaust Fans (TEF), 1-off Kitchen Exhaust Fan (KEF), 1-off General Exhaust Fan (GEF) and 1-off Tenant Outside Air Fan (TOAF), each with fan located inside the Level 18 Plant Room and discharging vertically at the rooftop. The maximum noise level at the point of discharge for each fan was modelled as 80 dB(A);
- 8-off pumps (chilled water and condenser water) modelled with maximum sound power level of 95 dB(A) contained within the Level 18 Plant Room;
- The mechanical plant system will operate in 'Purge' mode during the evening and night periods, but most plant items would not operate. The Air Handling Unit Fans (i.e. without Chillers) and 1 Cooling Tower (low-load) would operate in this mode.

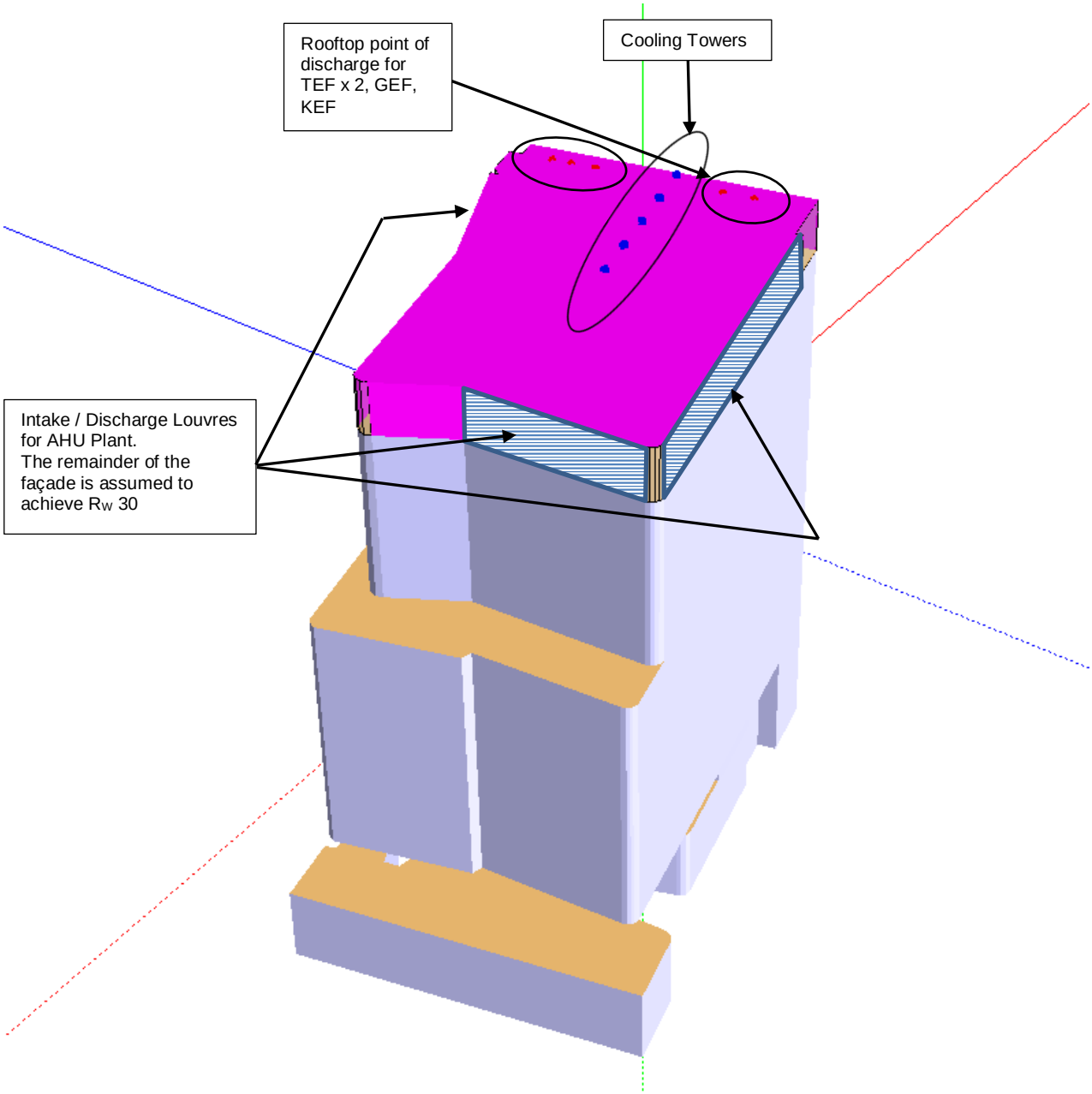


Figure 5: Locations of Mechanical Plant Noise Emission Sources in Noise Model

5.3 ENTERTAINMENT NOISE

There is the potential for the ground floor retail spaces to be leased by a café or restaurant that has the potential for outdoor alfresco dining noise emissions or noise emissions through the operable façade. The proposed ground floor layout is presented in Figure 6. In order to assess the potential noise impacts at surrounding NSRs, a separate noise modelling scenario was created.

We expect that noise emission from any future Alfresco Dining Areas on the ground level may consist of the following:

- Background music;
- Noise from patrons conversing in an outdoor/external setting.

In order to assess the potential noise emissions from the potential Alfresco Dining Areas at nearby NSRs, the following worst-case scenario was modelled:

- The total retail tenancy area is approximately 190 m^2. We have conservatively assumed a maximum of 190 people could patron the space (1 person / m^2 on average).
- Of the total 190 people, a maximum of 95 could be talking at any given time (i.e. it is assumed that for every speaker there is at least one listener).
- Given the outdoor environment, we have assumed that the 95 people could be speaking with a raised voice.
- We have assumed that background music (approximately 70 dB(A) at 1m from the speaker) could be distributed across the area.

Based on this scenario, the noise source definition is presented in Table 23.

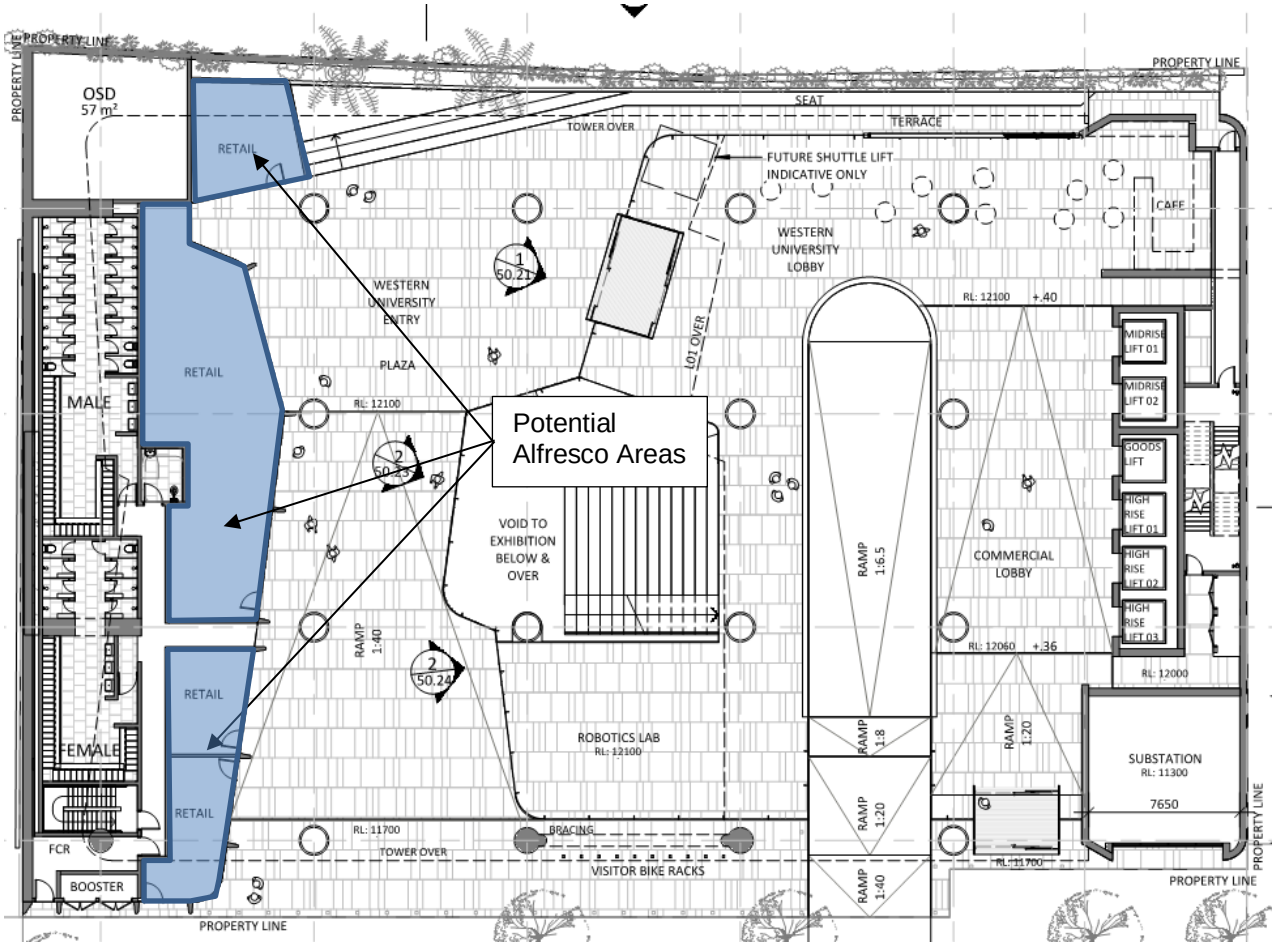


Figure 6: Potential Outdoor Alfresco Dining Areas on Ground Level

Table 23: Noise Source Definition for the Potential Outdoor Alfresco Dining Areas

f (Hz)	Octave Band Noise Levels, dB, at 1 metre from Source								Total, dB(A)
	63	125	250	500	1k	2k	4k	8k	
Raised Voice per person – Average of Male and Female	-	46	60	64	63	59	54	49	67
Background Music	74	76	69	66	65	63	54	46	70

6. NOISE INTRUSION ASSESSMENT

The external façade shall be designed to attenuate noise from surrounding noise sources. Based upon a review of the surrounding area the significant noise intrusion sources are:

- Hassall Street to the South, and
- Station Street to the West.

6.1 ROAD TRAFFIC NOISE

The predicted $L_{Aeq,15h}$ road traffic noise levels at the facades of the buildings are presented in Table 24.

Table 24: Predicted Façade Road Traffic Noise Intrusion Levels

Level	Maximum Predicted $L_{Aeq,15h}$ Level at façade (dBA)			
	North	South	East	West
Ground	57	68	57	62
Podium 1	60	69	59	65
Podium 2	61	68	60	66
1	62	69	60	70
2	62	68	59	70
3	63	68	59	70
4	63	67	59	70
5	63	67	58	70
6	63	67	58	69
7	63	66	58	69
8	63	66	57	69
9	63	66	57	69
10	63	66	57	69
11	62	63	55	58
12	62	63	55	63
13	62	64	55	65
14	62	64	55	66
15	62	64	54	66
16	62	63	54	66
17	62	63	54	66

6.2 FAÇADE NOISE REDUCTION REQUIREMENTS

Based upon the predicted noise levels presented in Table 24, the minimum glazing performances to satisfy the requirements of the AS/NZS 2107 are presented in Table 25. Given that road traffic noise has the highest overall contribution to the incident noise levels, the methodology presented in AS 3671 '*Acoustics – Road traffic noise intrusion – Building siting and construction*' has been used for the calculations.

Table 25: Minimum Acoustic Requirements for Façade Glazing

Level	Occupancy / Use	Minimum R_W Rating
Ground	Retail Robotics Lab	26 30
1	Lounge / Breakout Office Areas Computer Labs Tiered Lecture Room	30 30 30 34
2	Informal Learning / Computer Labs Tiered Lecture Room Meeting / Conference Room	30 34 34
3	Open Plan Teaching Spaces	30
4	Open Plan Teaching Spaces	30
5	Open Plan Teaching Spaces	30
6	Open Plan Teaching Spaces	30
7	Open Plan Teaching Spaces	30
8	Open Plan Teaching Spaces	30
9	Open Office	30
10	Open Office	30
11	Open Office	30
12	Open Office	30
13	Open Office	30
14	Open Office	30
15	Open Office	30
16	Open Office	30
17	Open Office	30

The glazing performances have been determined based upon the assumption that the reverberation times achieved within the space will comply with the recommended times presented in Table 8 and Table 9. If the reverberation times are higher than the recommended times, the acoustic performance of the glazing would need to be reviewed to achieve the satisfactory internal noise levels contained in AS/NZS 2107. Acoustic Test Reports or Opinions from the supplier should be reviewed prior to the final selection of glazing to ensure the acoustic performance (i.e. R_W) is achieved.

7. ENVIRONMENTAL NOISE EMISSIONS

Environmental noise emissions from the proposed development will consist of:

- Environmental noise emissions from mechanical plant and equipment to nearby noise sensitive uses;
- Entertainment noise associated with any patronage noise from retail tenancies (e.g. potential outdoor alfresco dining);
- Potential noise impact on surrounding noise sensitive receivers from additional road traffic associated with the proposed development;
- Potential noise impact on surrounding noise sensitive receivers due to loading bay and refuse collection, and
- Potential noise impact on surrounding noise sensitive receivers due to car parking activities (e.g. car door slams, engine starts etc.)

The loading / unloading, refuse facilities and car parking are contained within the existing basement levels, and as such are not expected to cause any negative noise impacts at the surrounding NSRs. These noise emission sources have not been assessed further.

7.1 MECHANICAL PLANT – TYPICAL OPERATIONS

The mechanical plant design had not been finalised at the time of writing this report. As such, the assumptions in Section 5.2 have been used to determine the potential noise emissions and noise attenuation measures (if necessary). Notwithstanding these preliminary noise calculations, the mechanical services design must ensure that the noise limits presented in Table 13 are satisfied at the nearest noise sensitive receivers identified in Figure 2.

7.1.1 Predicted Noise Levels during the Daytime Period

Table 26 shows the highest predicted A-weighted noise levels under normal operating conditions during the daytime period at the nearest NSRs and an assessment against the noise criteria. It can be seen from Table 26 that the noise levels are predicted to comply with the noise criteria during the daytime period without additional noise controls.

Table 26: Highest Predicted Mechanical Plant Noise Emission Levels during Daytime Period at Nearest NSRs

NSR	Predicted Daytime Noise Level without Intake / Discharge Attenuation		Predicted Daytime Noise Level with Intake / Discharge Attenuation	
	$L_{Aeq(day)}$, dB(A)	Noise Criteria – dB(A)	$L_{Aeq(day)}$, dB(A)	Noise Criteria – dB(A)
Imperial Apartments (9 Hassall Street)	55 - Complies	58	45 - Complies	58
Skyrise Apartments (11 Hassall Street)	53 - Complies	58	49 - Complies	58
Fiori Apartments (13-15 Hassall Street)	53 - Complies	58	44 - Complies	58

7.1.2 Predicted Noise Levels during the Evening Period

Table 27 shows the highest predicted A-weighted noise levels under normal operating conditions during the evening period at the nearest NSRs and an assessment against the noise criteria. It can be seen from Table 27 that additional noise control measures to attenuate noise through the Level 18 intake and discharge paths are required to achieve compliance with the noise criteria.

Table 27: Highest Predicted Mechanical Plant Noise Emission Levels during Evening Period at Nearest NSRs

NSR	Predicted Evening Noise Level without Intake / Discharge Attenuation		Predicted Evening Noise Level with Intake / Discharge Attenuation	
	$L_{Aeq(evening)}$, dB(A)	Noise Criteria – dB(A)	$L_{Aeq(evening)}$, dB(A)	Noise Criteria – dB(A)
Imperial Apartments (9 Hassall Street)	54 – Exceeds by 6dB	48	44 - Complies	48
Skyrise Apartments (11 Hassall Street)	52 – Exceeds by 4dB	48	47 - Complies	48
Fiori Apartments (13-15 Hassall Street)	51 – Exceeds by 3dB	48	42 - Complies	48

7.1.3 Predicted Noise Levels during the Night Period

It is noted that the mechanical plant is expected to operate in Purge mode during the night time period. The noise levels are predicted to comply with the night time (most stringent) noise criteria as presented in Table 28 with the addition of noise control measures to the intake and discharge paths in the Level 18 Plant Room. In addition, the mechanical plant is also predicted to satisfy the Maximum Noise Level Event criteria (i.e. $L_{Aeq,15min}$ 49 dB(A)) during the night period.

Table 28: Highest Predicted Mechanical Plant Noise Emission Levels during Night Period at Nearest NSRs

NSR	Predicted Night Noise Level without Intake / Discharge Attenuation		Predicted Night Noise Level with Intake / Discharge Attenuation	
	$L_{Aeq(evening)}$, dB(A)	Noise Criteria – dB(A)	$L_{Aeq(evening)}$, dB(A)	Noise Criteria – dB(A)
Imperial Apartments (9 Hassall Street)	43 - Complies	43	39 - Complies	48
Skyrise Apartments (11 Hassall Street)	45 – Exceeds by 2dB	43	43 - Complies	48
Fiori Apartments (13-15 Hassall Street)	41 - Complies	43	37 - Complies	48

7.2 NOISE CONTROL MEASURES

It can be seen from Section 7.1 that the mechanical plant noise emissions are predicted to exceed the noise criteria during the evening and night periods without further noise attenuation. However, it can be seen from Table 27 and Table 28 that the noise criteria are predicted to be satisfied at surrounding NSRs with attenuation to the intake and discharge paths to the Level 18 Plant Room. The required insertion loss to achieve compliance with the noise criteria is presented in Table 29. This is required for the southern and western intake / discharges only. The insertion loss targets can be achieved using:

- Acoustically lined AHU plenums; and / or
- Acoustically rated (600mm deep) louvres to relief / spill air.

Table 29: Required Level 18 Plant Room Insertion Loss Targets

Element	Required Insertion Loss, dB							
	63	125	250	500	1k	2k	4k	8k
Required Insertion Loss of intake / discharge paths on Southern and Western façade of Level 18 Plant Room	5	10	14	22	27	25	21	17

The noise emissions shall be reassessed during the design phases of the project when the mechanical design is further refined.

7.3 MECHANICAL PLANT – EMERGENCY POWER OUTAGE

During an emergency or unscheduled power outage, the standby diesel generators would operate to maintain the critical infrastructure such as emergency lighting, stair pressurisation fans and ventilation. Noise control measures have been introduced to minimise the noise impact on surrounding noise sensitive receivers including containing the generators within the building envelope and orientation of the intake / discharge for the generators away from the nearby NSRs. It is expected that these generators would be tested on a monthly basis during daytime hours and for a duration of up to one-hour. Besides the monthly testing regime, it is expected that these generators would rarely operate. As such, the applied noise controls are considered to be as low as reasonably practicable (ALARP).

7.4 ENTERTAINMENT NOISE

The types of tenancies that will occupy the retail spaces on ground level are not yet known. It is possible that cafés or restaurants with the potential for patronage noise emissions could tenant the spaces. The noise emissions would have to comply with conditions specified by the OLGR (refer to Section 4.2.3). In order to determine the potential noise impact, a 'worst-case' noise modelling scenario was developed as presented in Section 5.3. Based on the scenario modelled and the noise source definition presented in Table 23, the predicted noise levels at the NSRs is shown in Table 30.

Table 30: Predicted Noise Levels from 'Worst-Case' Outdoor Alfresco Dining Area Scenario

NSR	Predicted Noise Level, L_{A10} in dB(A)								
	31.5	63	125	250	500	1000	2000	4000	8000
Imperial Apartments (9 Hassall Street)	n/a	3	15	32	42	45	41	34	19
Skyrise Apartments (11 Hassall Street)	n/a	0	13	29	40	43	40	32	15
Fiori Apartments (13-15 Hassall Street)	n/a	1	14	31	41	43	40	32	14

Note: Shaded cells exceed the noise criteria during the night period only

The predicted noise levels from the Alfresco Dining Area scenario presented in Table 30 complies with the noise criteria (refer to Table 14) during the daytime period (i.e. 0700 to 0000) at all nearby NSRs. However, the noise criteria would be exceeded by up to 7 dB during the night period (i.e. 0000 to 0700), and as such, it is recommended that the use of the outdoor areas or open facades is restricted to 7am to midnight unless a more detailed acoustic assessment is conducted during the fit-out stage that considers additional noise control measures.

7.5 NOISE FROM ADDITIONAL ROAD TRAFFIC ASSOCIATED WITH THE DEVELOPMENT

The potential noise impact due to the additional road traffic generated by the development has been assessed against the 2dB noise increase limit presented in Section 4.2.1. The proposed development is expected to generate up to 39 vehicles per hour during the morning peak period. In order to limit any noise increase to 2dB, the road traffic volumes associated with development must be limited to 58% of the road traffic volumes on existing roads. Table 21 shows that Hassall Street carries 457 vehicles during the morning peak period from 06:00 to 10:00. A 58% increase in the existing traffic flow would be an additional 265 vehicles. An additional 39 vehicles per hour during the peak periods would add an additional 156 vehicles in total between 6am and 10am. As such, the predicted noise increase from additional road traffic associated with the development is 1.3 dB, which is acceptable in accordance with the *Road Noise Policy*.

8. CONSTRUCTION NOISE

Noise from the construction of the proposed development has the potential to impact nearby NSRs as shown in Figure 7. It is noted that the proposed residential towers to be located at 9 Hassall Street (refer to Figure 2 and Figure 7) have not commenced construction. As such, they are not likely to be completed and occupied by the time that the significant noise generating construction activities for the proposed development are completed.

The NSW Roads & Maritime Services' *Construction Noise and Vibration Guideline* was used to estimate the source noise levels from construction activities (where applicable), or experience with other projects otherwise. The description and type of equipment that may be used for each phase of construction, as well as the activity sound power levels and estimated durations are presented in Table 31.

Table 31: Proposed Construction Equipment for the Construction Stages

Construction Component	Description of Activity	Equipment Used	Activity Total Sound Power Level, L_W (dBA)	Estimated Duration
Building Works	Construction of the Podium and Tower Levels	Concrete mixers Concrete pumps Trades noise (carpenters, façade installation) Cranage Trucks	108	12 months

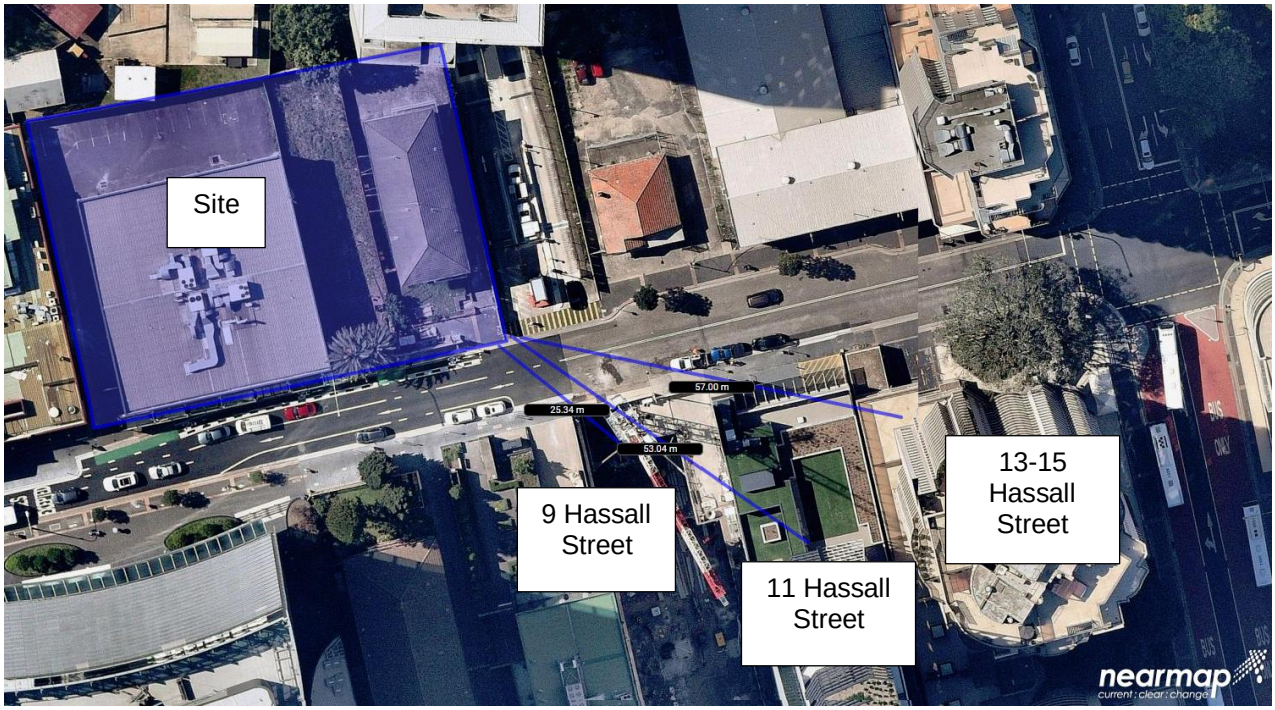


Figure 7: Proposed Site and Nearby NSRs during Construction Phase

The predicted construction noise levels at the surrounding NSRs are presented in Table 32. The assessment has included a 3-metre high barrier along the site boundary which has been installed as part of the Early Works phase. The screening criteria is presented in Table 17.

Table 32: Predicted Construction Noise Levels at Noise Sensitive Receivers

Construction Component	Nearest NSRs	Minimum Distance	Predicted Noise Level (L_{Aeq}), dB(A)	Assessment NML[1,2]
Building Works	9 Hassall Street	25 m	67 (external)	Noise Affected
	11 Hassall Street	53 m	61 (external)	Complies
	13 – 15 Hassall Street	57 m	60 (external)	Complies

1. Noise Affected: $L_{Aeq,15min}$ is greater than RBL + 10 dB = 63 dB(A)
2. Highly Noise Affected: $L_{Aeq,15min}$ is greater than 75 dB(A)

It can be seen from Table 32 that the surrounding NSRs are predicted to comply with the construction noise criteria for the Building Works, with the exception of 9 Hassall Street, which we expect will not be occupied by the time a majority of the construction at the proposed site is complete. As such, the construction activities are expected to be acceptable at nearby NSRs.

The predicted construction noise levels at the surrounding Commercial receivers identified in Section 2.2 are presented in Table 33.

Table 33: Predicted Construction Noise Levels at Commercial Receivers

Construction Component	Nearest Commercial Receivers	Minimum Distance	Predicted Noise Level (L_{Aeq}), dB(A)	Assessment Criteria, 70 dB(A)
Building Works	Commercial Hotel	6 m	79 (external)	Noise Affected
	Curtis Cheng Centre	6 m	79 (external)	Noise Affected
	Eclipse Tower	23 m	68 (external)	Complies

It can be seen that the noise criteria is expected to be exceeded at the Commercial Hotel and Curtis Cheng Centre for periods during the Building Works. These premises are commercial in nature and are not considered to be noise sensitive. Nevertheless, we recommend that all feasible and reasonable noise mitigation measures should be adopted by the Building Contractor. The noise mitigation measures should be identified in the Construction Management Plan (CMP) prepared by the Building Contractor and may include (but not limited to):

- Community notification
- Operate plant in quiet and efficient manner
- Train workers in minimising noise and quiet work practices
- Implement a complaint handling procedure

9. CONSTRUCTION VIBRATION

Based on the construction equipment in Table 31, construction vibration is not expected to result in excessive vibration at the surrounding noise sensitive receivers. Standard vibration mitigation techniques incorporated as part of the Building Contractor's CMP are expected to be acceptable.

10. SUMMARY

Floth has completed a noise impact assessment for the proposed mixed-use development located at 2b-6 Hassall Street, Parramatta.

The noise intrusion assessment showed that the dominant noise sources affecting the proposed development are road traffic noise. Glazing recommendations to achieve satisfactory internal noise levels specified in AS/NZS 2107 have been provided in Section 6.2 of this report.

The environmental noise emission sources from the proposed development will consist of:

- Mechanical plant and equipment in the Level 18 Plant Room and rooftop;
- Entertainment noise associated with any patronage noise from retail tenancies (e.g. potential alfresco dining), and
- Potential noise impact on surrounding noise sensitive receivers from additional road traffic associated with the proposed development.

The noise predictions contained within this report show that the mechanical plant noise emissions can be controlled to acceptable levels at the nearest noise sensitive receivers with attenuation to the intake and discharge paths to the Level 18 Plant Room. Detailed noise predictions shall be conducted during the design phases of the project to ensure that the mechanical plant noise emissions satisfy the noise limits at the NSRs.

Noise emission from any potential Alfresco Dining areas associated with the ground level retail tenancies was found to comply with the daytime limits (i.e. 0700 to midnight) defined by the NSW Office of Liquor, Gaming and Racing, even for a 'worst-case' noise scenario. However, it was found that the noise criteria during the night period (i.e. midnight to 0700) was predicted to be exceeded for this 'worst-case' noise scenario, and as such, it is recommended that any Outdoor Alfresco Dining be limited to 7am to midnight unless an acoustic assessment is conducted during the fit-out stage that considers additional noise control measures.

Noise from additional traffic on local roads associated with the proposed development was found to be acceptable in accordance with the *Road Noise Policy*.

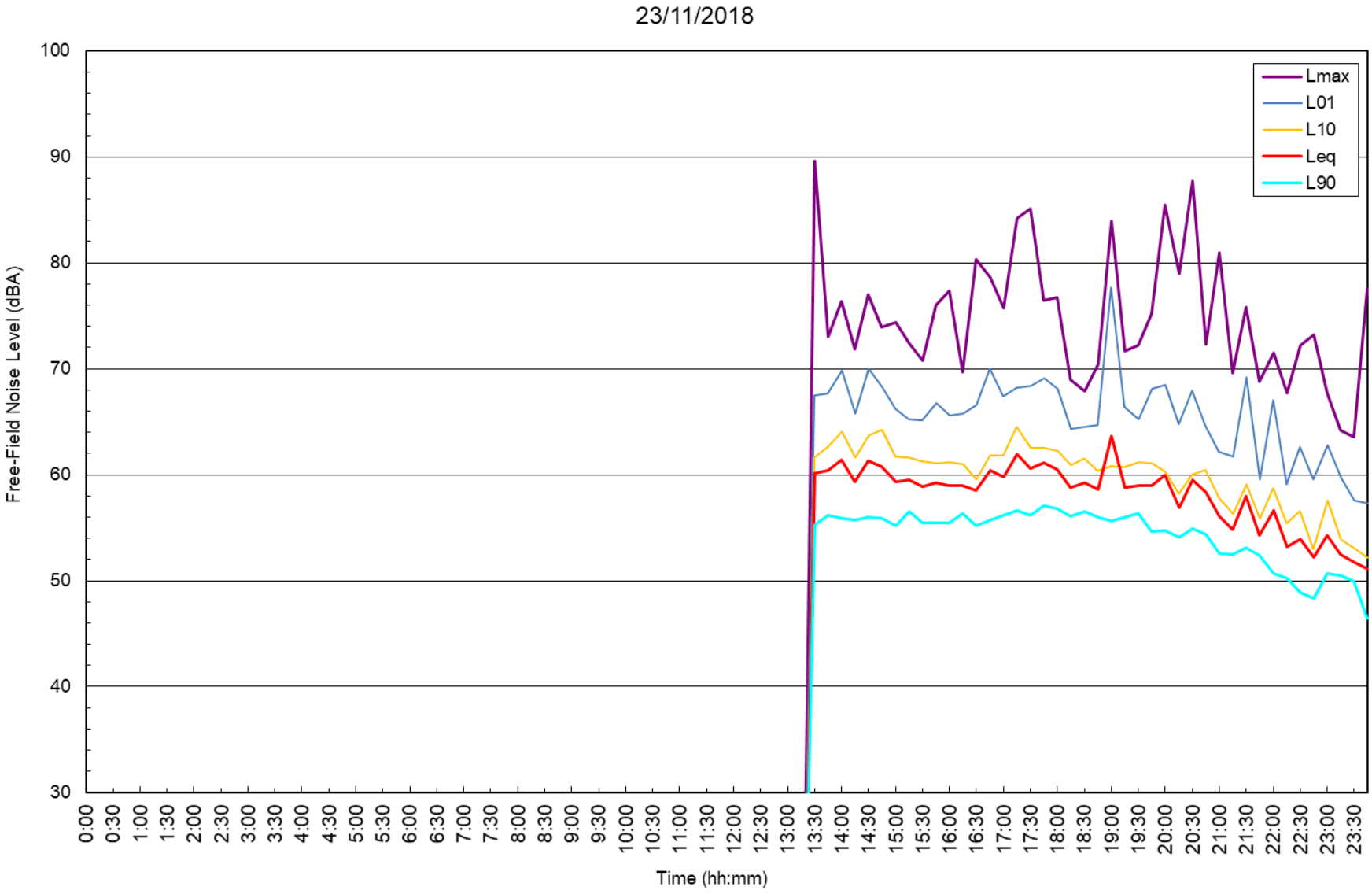
A construction noise assessment found that the nearest occupied NSRs are predicted to comply with the Noise Management Levels, however the nearby commercial premises adjoining the site are predicted to experience some periods of high noise. As such, all feasible and reasonable noise mitigation measures should be adopted by the Building Contractor. The noise mitigation measures should be identified in the Construction Management Plan (CMP) prepared by the Building Contractor and may include (but not limited to):

- Community notification
- Operate plant in quiet and efficient manner
- Train workers in minimising noise and quiet work practices
- Implement a complaint handling procedure

The construction vibration assessment showed that the vibration limits for Cosmetic Damage and Human Response / Perceptibility are expected to be satisfied at all surrounding sensitive receivers.

In conclusion, the noise impact assessment has shown that compliance with the relevant long-term noise criteria can be achieved, and that adverse noise impacts on surrounding NSRs and commercial premises during the construction period can be managed and mitigated through noise control measures and strategies.

APPENDIX A –
NOISE LOGGING DATA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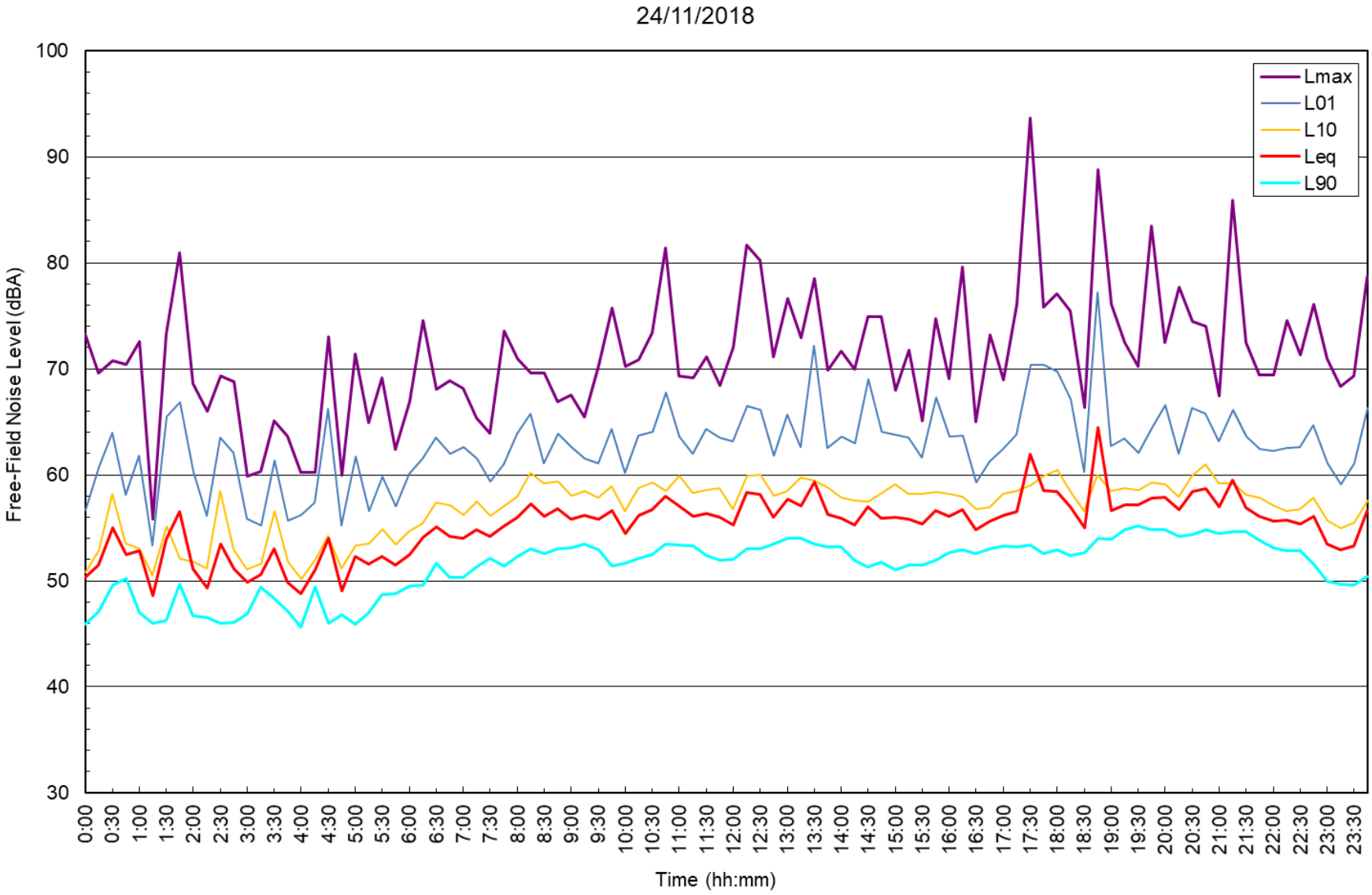
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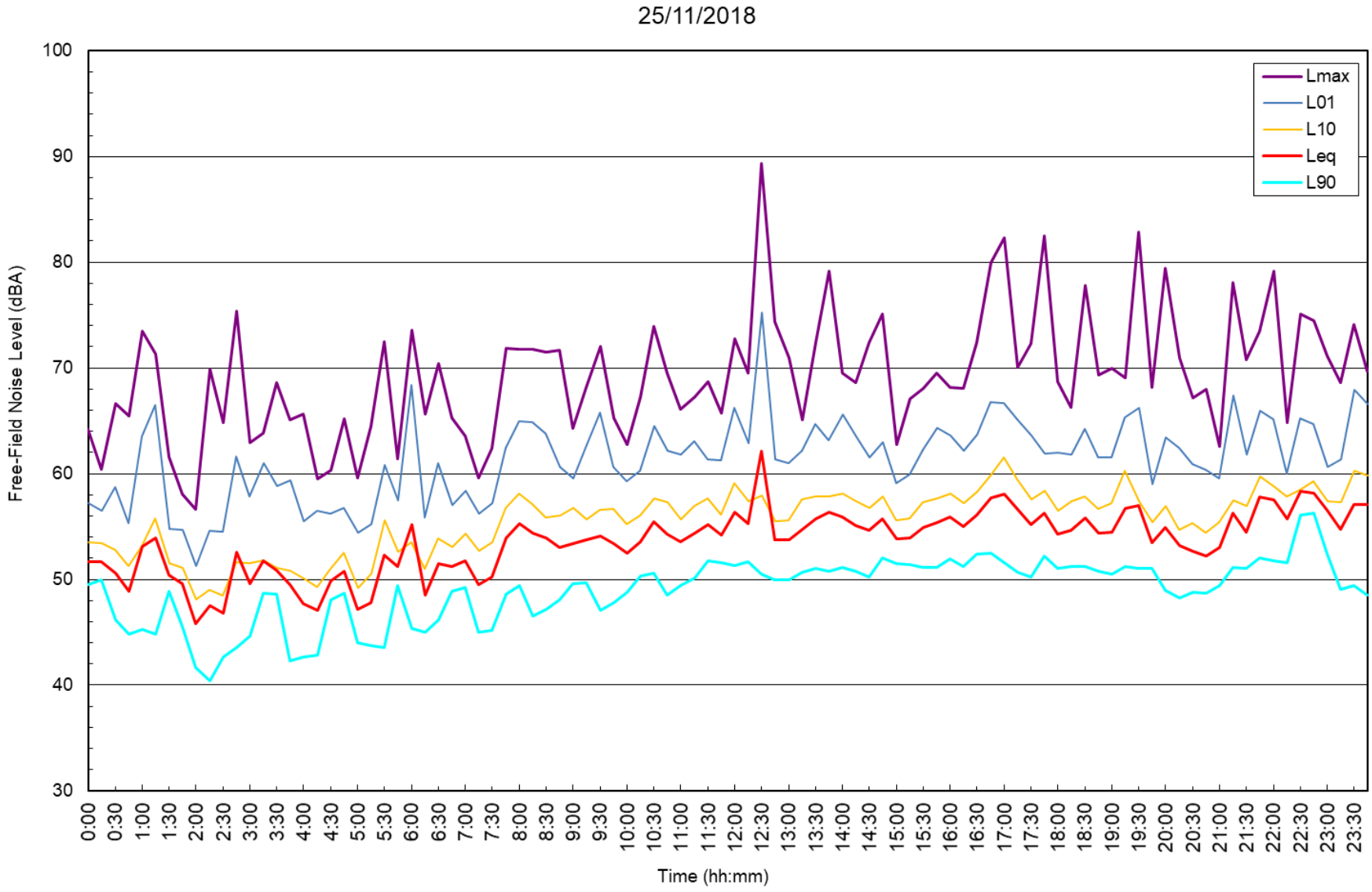
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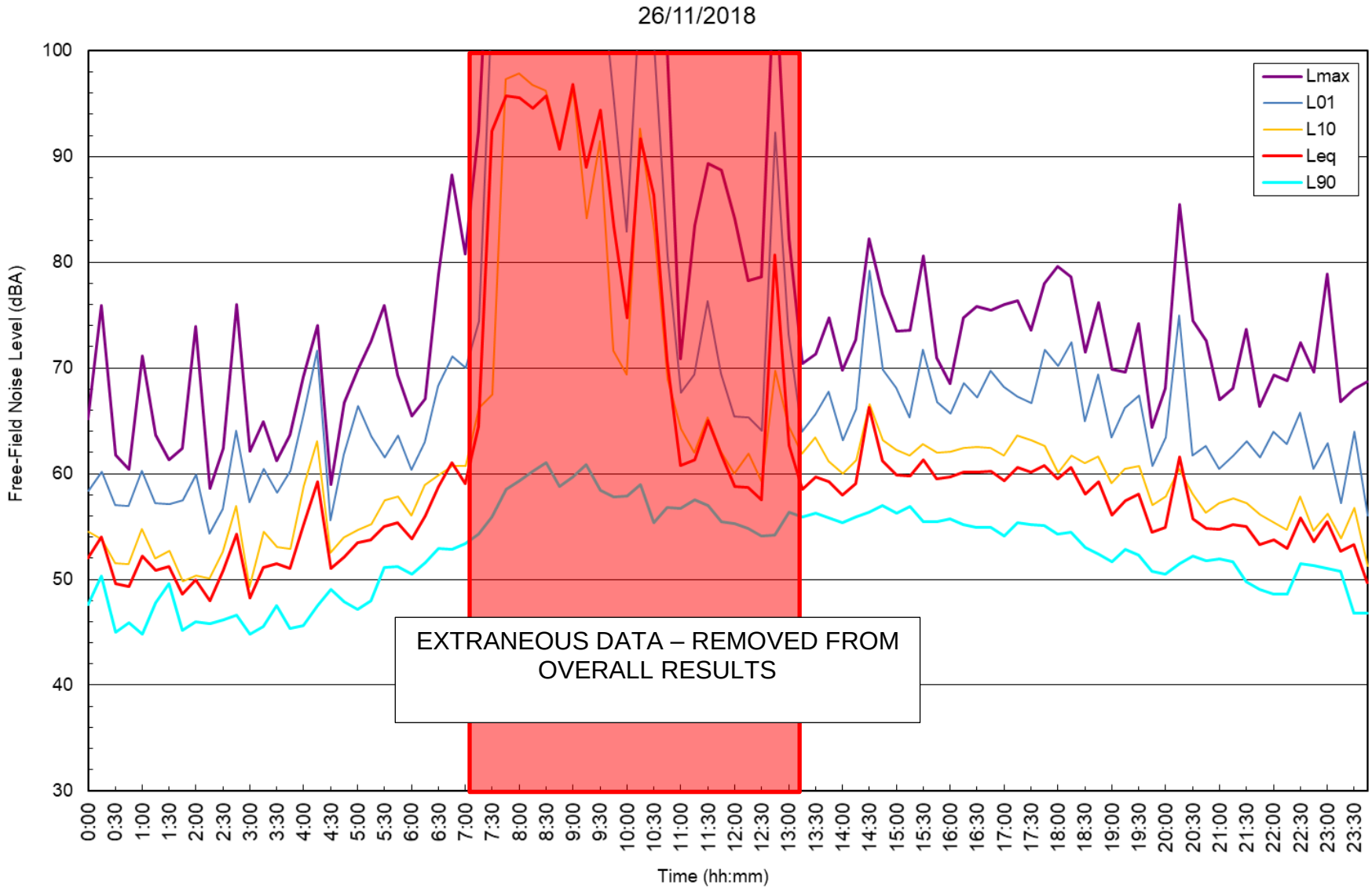
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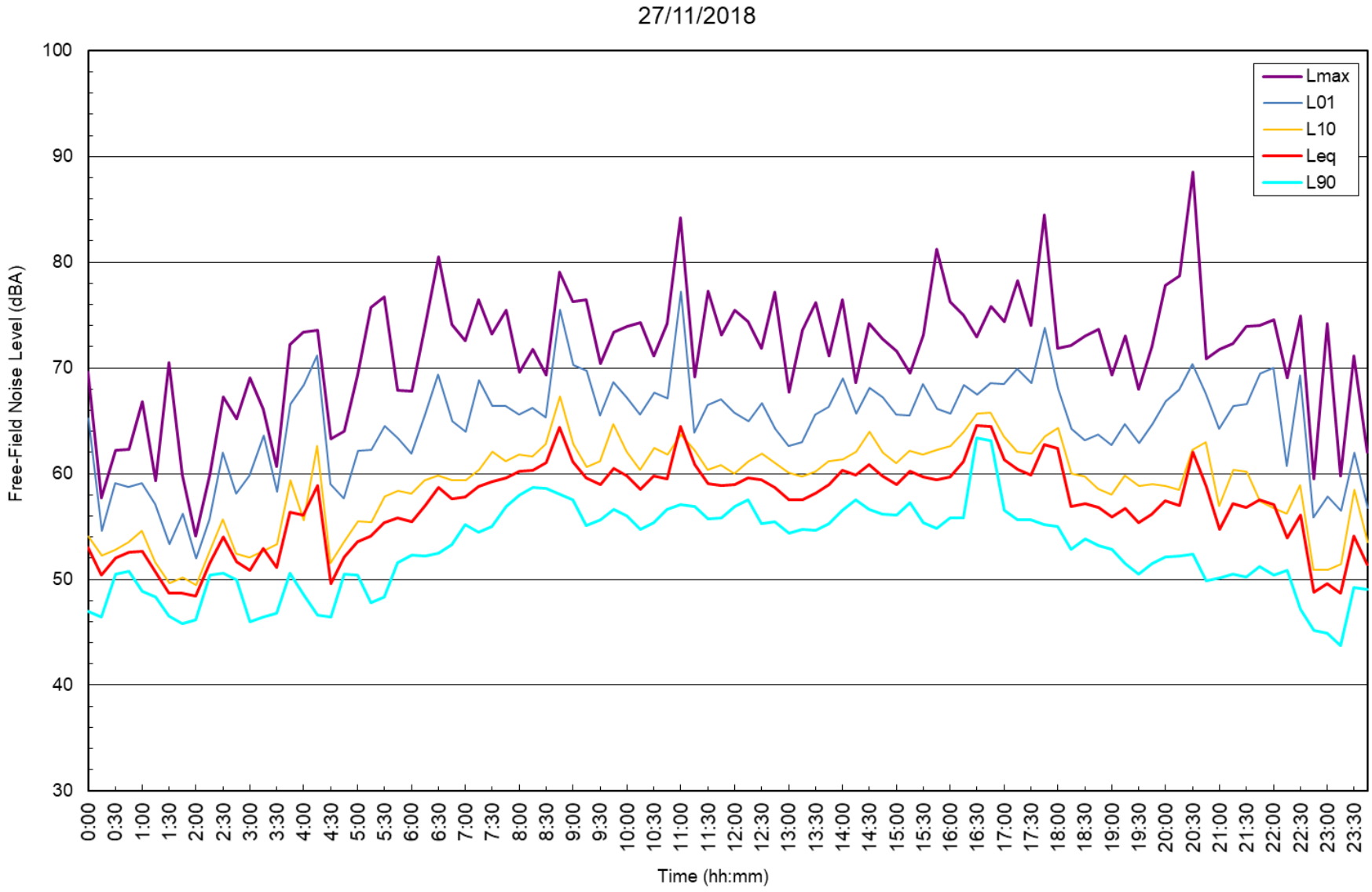
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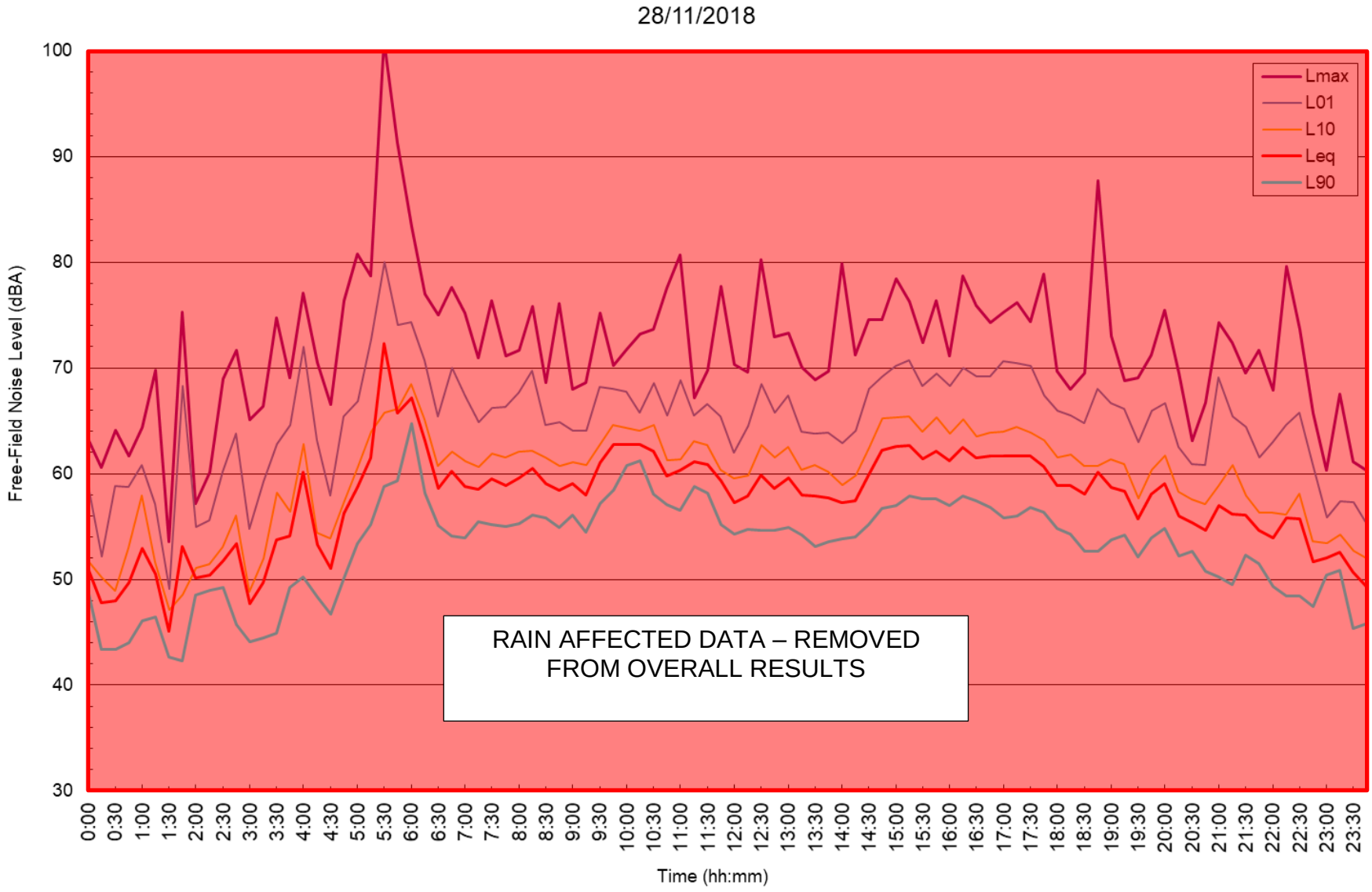
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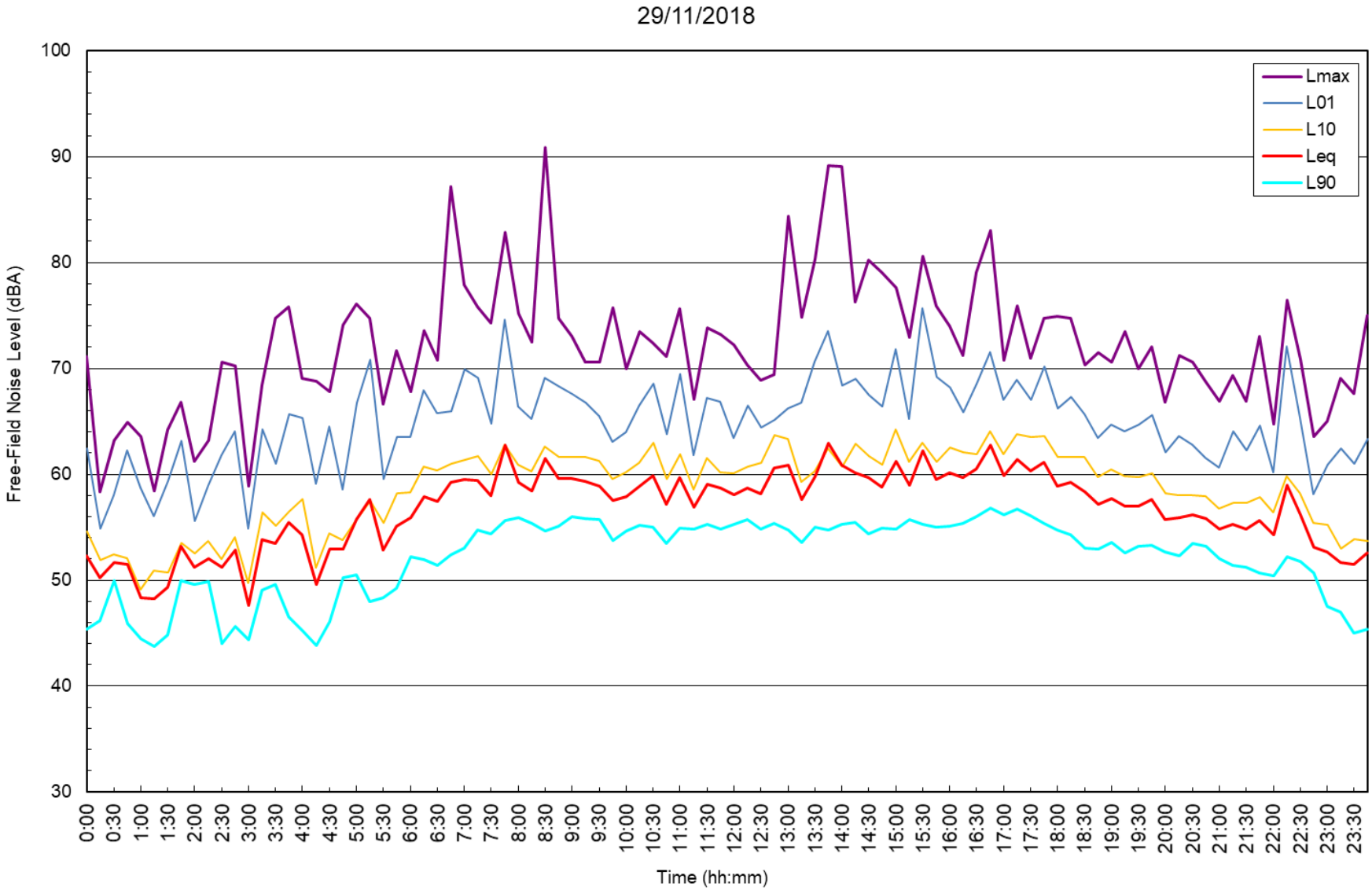
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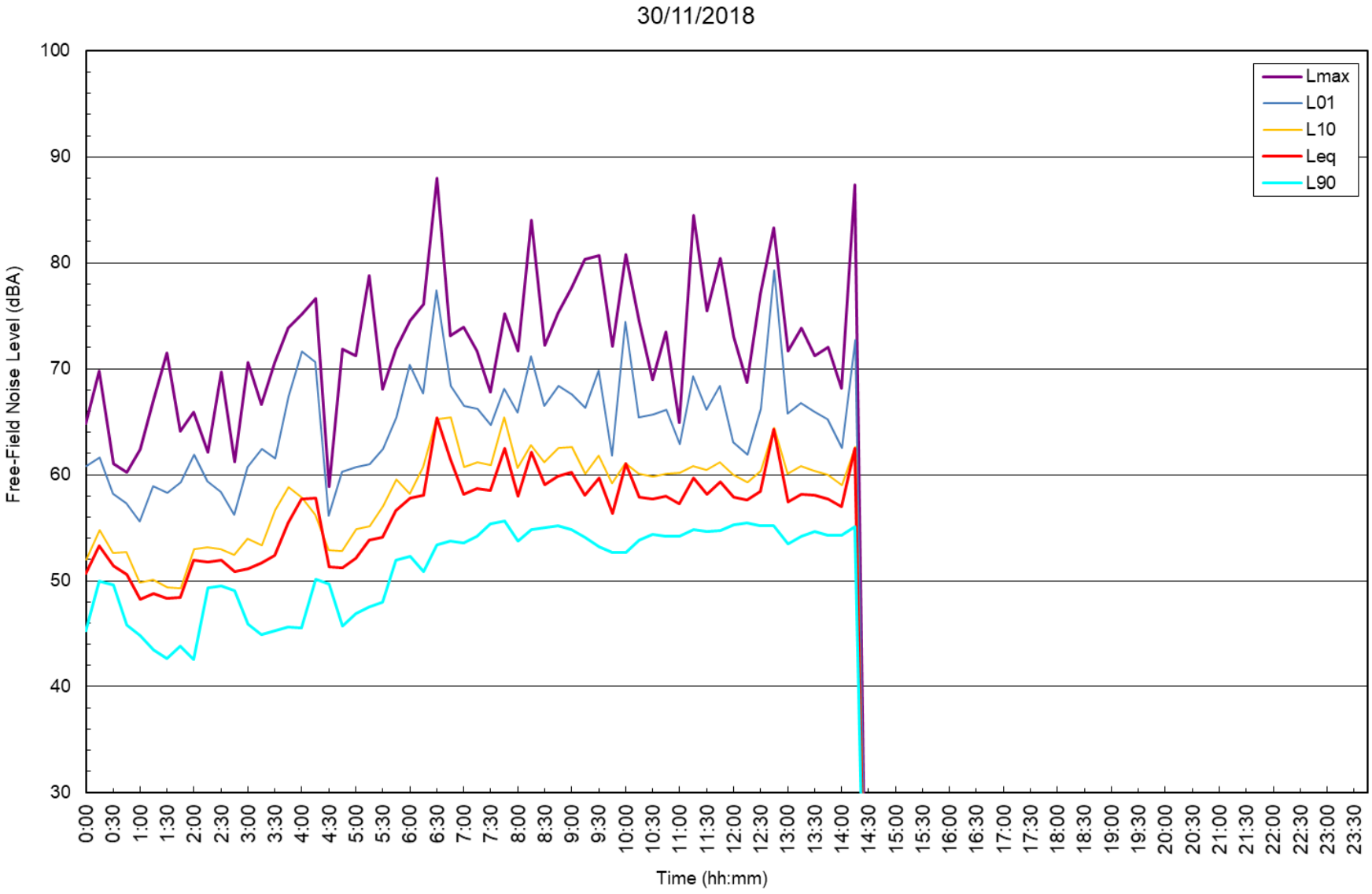
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