SCS - North Sydney Marist

Noise & Vibration Impact Assessment

State Significant Development Application

Prepared for: CTPG

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Date: 26 April 2021

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Revision

Revision	Date	Comment	Prepared By	Approved By
001	15/10/2020	Draft Issue	Brandon Notaras	Brandon Notaras
002	30/10/2020	For Review	Mia Strembickyj	Brandon Notaras
003	21/12/2020	SSDA Issue	Mia Strembickyj	Brandon Notaras
004	29/01/2021	SSDA Issue (Revised)	Mia Strembickyj	Brandon Notaras
005	26/04/2021	Updated addressing DPIE comments	Mia Strembickyj	Elle Hewett

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Contents

Contents

Contents

List of Figures

List of Tables

Contents

1. Executive Summary

Based on the findings and recommendations of this noise and vibration impact assessment, the following measures are suggested to mitigate the identified impacts of the development:

Table 1: Summary of suggested mitigation measures

Mitigation Measures
Construction Noise – Section 13.1.1 A solid acoustic barrier (made from plywood or similar) 2.4 meters above Ground Level is recommended to be erected around the perimeter of the site. The acoustic barrier should be Class A type hoarding.
Construction Vibration – Section 13.1.2 Prior to the commencement of jackhammering, attended vibration measurements should be conducted to ensure the levels are acceptable on the heritage structure.
Road Noise Intrusion – Section 12.1 - Open Windows Noise-affected spaces that require alternative means of ventilation are identified in Appendix E - Closed Windows Required glazing types wit acoustic demand ratings are outlined in Appendix D
Childcare Noise Emissions No additional mitigation measures are required
Rooftop Outdoor Terrace Noise Emissions No additional mitigation measures are required with current assumptions made during assessment (Section 10.5)
PA System and School Bell(s) Noise Emissions No additional mitigation measures are required other than the assumed locations of the PA and School Bell(s)
Loading Dock Noise Emissions – Section 12.3 All activities conducted within the loading dock are performed with the loading dock shutter door closed.
Mechanical Noise Emissions – Section 12.2 Acoustic louvres to be installed as outlined in Section 12.2 with the required insertion losses.
Auditorium Noise Emissions No additional mitigation measures are required with current assumptions made during assessment (Section 10.9)

2. Introduction

This noise and vibration impact assessment supports a Stage Significant Development (SSD) Development Application (DA) for the expansion and redevelopment of Marist Catholic College North Shore, which is submitted to the Department of Planning, Industry and Environment (DPIE) pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (the Act). Sydney Catholic Schools is the proponent of the SSD DA.

3. Background

A 24-month study undertaken by Sydney Catholic Schools has identified a major deficiency in the provision of affordable, non-government education within the North Sydney Local Government Area (LGA).

The study also identified that the choice for families is extremely limited, as almost all of the schools in North Sydney provide single-sex education, with co-educational schools significantly underrepresented.

Sydney Catholic Schools, as operators of St Mary's Catholic Primary School and Marist College North Shore, is responding to this challenge and has identified a strategic response that can positively support the future of North Sydney.

4. Site Description

The site is located at 270 Miller Street, North Sydney within North Sydney LGA. It is bound by Carlow Street to the north, Ridge Street to the south, Miller Street to the east, and Ridge Lane to the west. It is surrounded by a mix of civic, residential and commercial uses.

It is approximately 700m north of the North Sydney CBD and located opposite St Leonards Park and North Sydney Oval. The site is strategically located between the Crows Nest and North Sydney, which will soon be connected by the Sydney Metro. The site is approximately 250m to the north of the future Sydney Metro Station at the corner of Miller and McLaren Streets.

Existing development on the site includes St Mary's Primary School, Marist College North Shore, St Mary's Church and Parish Centre, the former Presbytery and Monastery, as well as the two acquired terraces along Miller Street and a childcare centre known as the Jacaranda Centre.

The site comprises 26 lots and has a total area of 22,420m2. The locational context of the site is shown at Figure 1 and an aerial photograph of the site is shown at Figure 2.

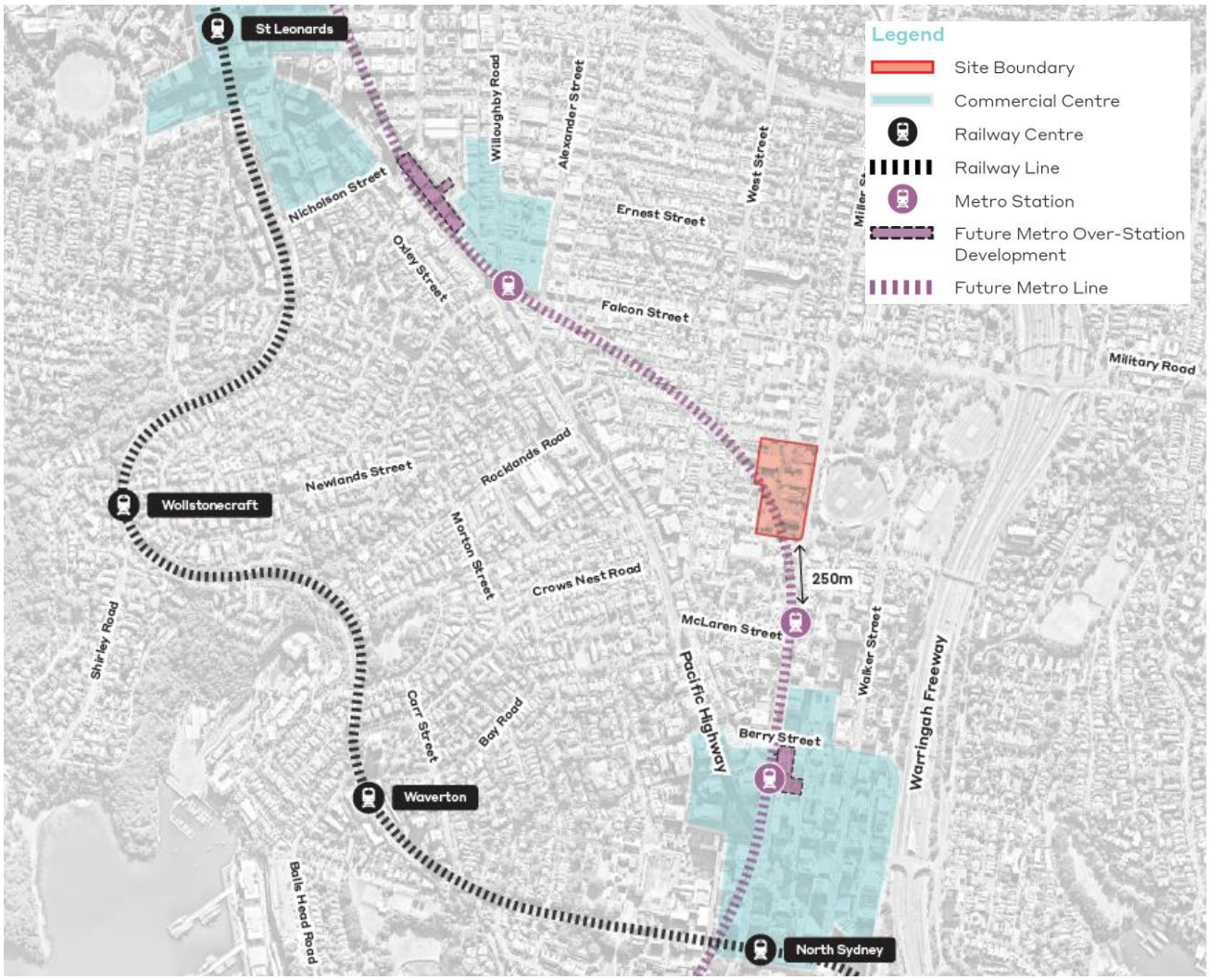


Figure 1 Site Context

Source: Ethos Urban

Figure 2 Site Aerial

Source: Ethos Urban

5. Secretary's Environmental Assessment Requirements (SEARs)

DPIE has issued Secretary's Environmental Assessment Requirements (SEARs) for the proposed development. This report has been prepared having regard to the relevant SEARs as follows:

Table 2 Summary of Secretary's Environmental Assessment Requirements

SEAR	Comment / Reference
3. Operation – Provide details of how the school will continue to operate during construction activities of the new primary and secondary school, including proposed mitigation measures	Refer to Section 13
4. Operation – Demonstrate good environmental amenity including access to natural daylight and ventilation, acoustic separation, access to landscape and outdoor spaces and future flexibility.	Refer to Section 12.1
5. Environmental Amenity – Assess amenity impacts on the surrounding locality, including solar access, visual privacy, visual amenity, overshadowing, wind impacts and acoustic impacts. A high level of environmental amenity for any surrounding residential land uses must be demonstrated.	Section 10
12. Noise and Vibration – Identify and provide a quantitative assessment of the main noise and vibration generating sources during demolition, site preparation, bulk excavation, construction. Outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.	Refer to Section 11
12. Noise and Vibration – Identify and assess operational noise, including consideration of any public-address system, school bell, mechanical services (e.g. air conditioning plant), use of any school hall for concerts etc. (both during and outside school hours) and any out of hours community use of school facilities, and outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.	Refer to Section 10
12. Noise and Vibration – Identify and assess any additional noise impacts due to the proposed operation of the tertiary education component within the site.	No longer applicable to the proposed state significant development.

6. Overview of the Proposed Development

The SSD DA seeks approval for:

- Retention of key buildings including St Mary's Church and Parish Centre, the former Presbytery and Monastery, St Mary's Primary School and some existing buildings on the western boundary.
- Demolition of existing buildings along Miller Street and Carlow Street, including the childcare centre and terrace houses.
- Construction of a mixed-use education precinct comprising a high school and early learning centre, including:
    - adaptive reuse of the existing Presbytery, and alterations and additions to retained educational buildings;
    - construction of a multistorey educational building on the corner of Miller Street and Carlow Street;
    - construction of a multistorey mixed-use building along Miller Street, accommodating teaching facilities, an early learning centre and an auditorium.
    - construction of a new basement car park; and
    - provision of ancillary canteen/café uses.
- Landscaping and public domain works, including the creation of a new plaza along Miller Street, adjoining St Mary's Church

7. Methodology

To assess the noise and vibration impacts of the proposed development, the following process was carried out:

- Identify and classify the surrounding noise and vibration sensitive receivers surrounding the proposed development;
- Identify and classify the noise and vibration sources generated by the proposed development, together with external noise and vibration sources impacting on the proposed development;
- Review historical site noise investigations and carry out additional site noise investigations to quantify the background noise levels local to the proposed development;
- Determine the project noise and vibration criteria applicable to the proposed development in accordance with the requirements listed in the Secretary's Environmental Assessment Requirements (SEARs).
- Assess the operational and construction noise and vibration impacts of the noise and vibration sources generated by the proposed development to the surrounding noise-sensitive receivers together with any impacts on the occupants of the proposed development; and
- Provide details of mitigation measures required to alleviate noise and vibration impacts to achieve the project noise and vibration criteria.

The following operational noise and vibration assessments will be conducted as part of this noise and vibration impact assessment:

- Noise impact from Miller St on surrounding noise and vibration sensitive receivers;
- Noise and vibration impact of mechanical plant and equipment serving the proposed development on surrounding noise and vibration sensitive receivers;
- Noise impacts of additional traffic on surrounding local roads generated by the proposed development;
- Noise impacts of additional traffic on surrounding local roads generated by the proposed development.

The following construction noise and vibration assessments will be conducted as part of this noise and vibration impact assessment:

- Noise generated during the construction of the proposed development and associated impacts on the surrounding noise sensitive receivers; and
- Vibration generated during the construction of the proposed development and associated impacts on the surrounding vibration sensitive receivers.

8. Site Noise Investigations

Site noise investigations were conducted to obtain background noise levels at the surrounding noise sensitive receivers together with characteristic noise emissions statistics associated with vehicle movements along relevant streets.

The results of the site noise investigations were acquired from a combination of noise monitoring conducted by Stantec Australia between the 14th and 23rd of September 2020.

8.1 Site Noise Investigations

Site surveys have been conducted by Stantec Australia to obtain current background noise levels. It should be noted that the site surveys were conducted during the COVID-19 pandemic. Please refer to Section 8.1.1 for further discussion surrounding consideration given to noise monitoring results affected by COVID-19.

Short-term and long-term noise surveys were carried out on and around the proposed development site to characterise the noise generated by nearby traffic noise sources (Miller St) and background and ambient noise at surrounding noise-sensitive receivers.

8.1.1 COVID-19 Pandemic and Effects on Noise Surveys

These noise surveys were carried out under noise-subdued circumstances as a result of the COVID-19 pandemic. For background and ambient noise, the noise statistics obtained will be lower than that of a typical day to day operation and hence can be considered the worst-case scenario.

For the traffic noise measurements, the noise statistics obtained will not be representative of typical traffic noise. As a result, the traffic noise measured on-site has been adjusted using comparisons between COVID-19 and standard peak hour traffic volumes on these roads.

8.1.2 Instrumentation

The following equipment was used for the noise surveys:

- Rion NL42-EX long-term noise monitor S/N 1173624
- Rion NL42-EX long-term noise monitor S/N 184110
- Rion NL42-EX long-term noise monitor S/N 184111
- Rion NL42-EX long-term noise monitor S/N 885459
- Hand-held sound spectrum analyzer NTi XL2 S/N A2A-11555-E0
- Hand-held sound spectrum analyzer B&K 2250, S/N 2709742;
- Sound Calibrator B&K Type 4231, S/N 2709826;

All equipment was calibrated before and after the measurements and no significant drift was found. All equipment carries current traceable calibration certificates that can be provided upon request.

8.1.3 Survey Locations

The site location, measurement positions and surrounding noise and vibration sensitive receivers are shown in Figure 3.

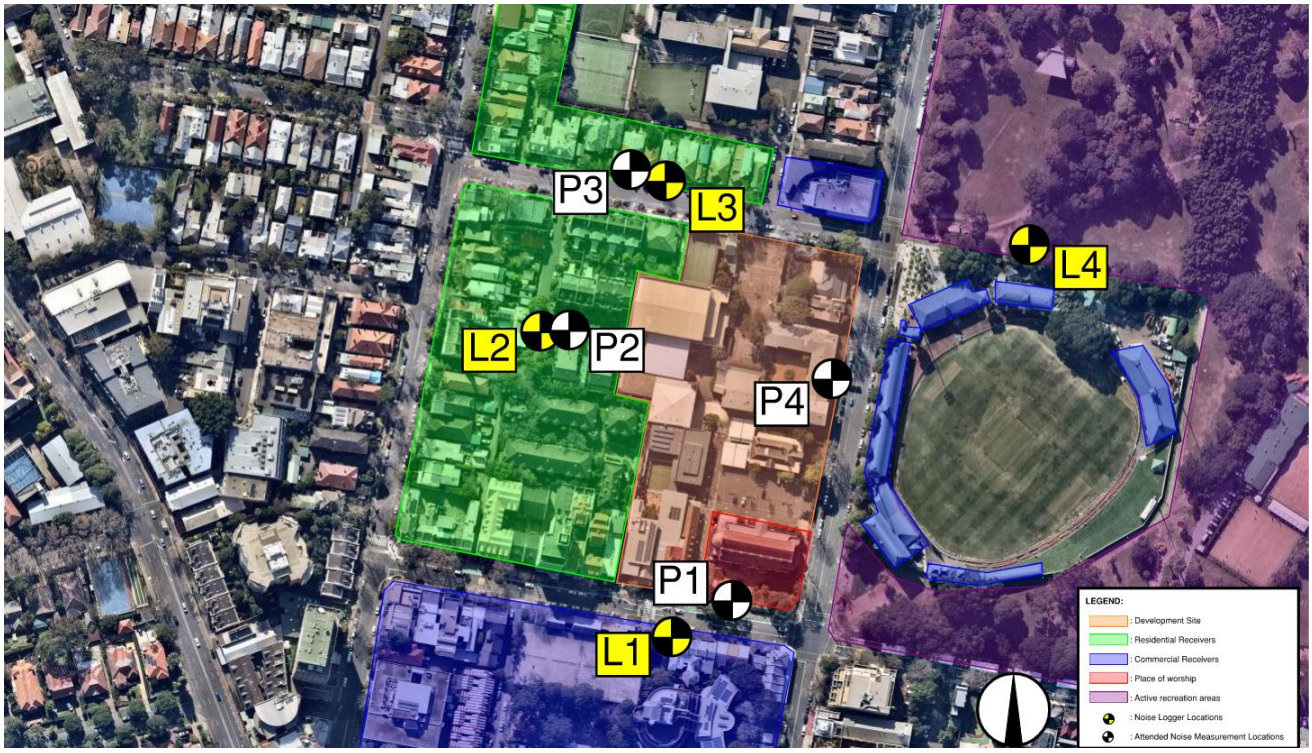


Figure 3: Overview of the site, surrounding noise-sensitive receivers and measurement locations conducted by Stantec Australia

8.1.4 Long-Term (Unattended) Noise Surveys

Background Noise

Noise monitors were placed at positions L1, L2 and L3 as shown in Figure 3 to measure the background and ambient noise that is representative of the surrounding noise-sensitive receivers. Noise monitors L1, L2, and L3 were installed from the 14th and 23rd of September 2020. The results of the unattended background and ambient noise survey is shown in Table 3 below (for the day, evening and night periods).

Table 3: Long-term noise survey summary – Background noise

Location	Equivalent Continuous Noise Level $L_{Aeq,period}$ - dB(A)			Background Noise Level RBL - dB(A)		
	Day	Evening	Night	Day	Evening	Night
L1	59	54	59	49	46	41
L2	61	48	49	43	39	34
L3	65	60	55	46	39	33

The local ambient noise environment is dominated by residual noise from existing industrial noise sources from surrounding buildings (loading docks, plant and equipment) nearby busy roads, together with pedestrian traffic throughout the majority of the day, evening and night periods. Note that any rain affected data or non-repeatable extraneous events during the period of logging have been excluded from the calculations. Refer to Figure 5 for the noise data for the total period of measurement. Refer to Figure 4 (L1), Figure 5 (L2) and Figure 6 (L3) for the noise data for the total period of measurement.

Figure 4: Long-term background noise monitoring data – L1

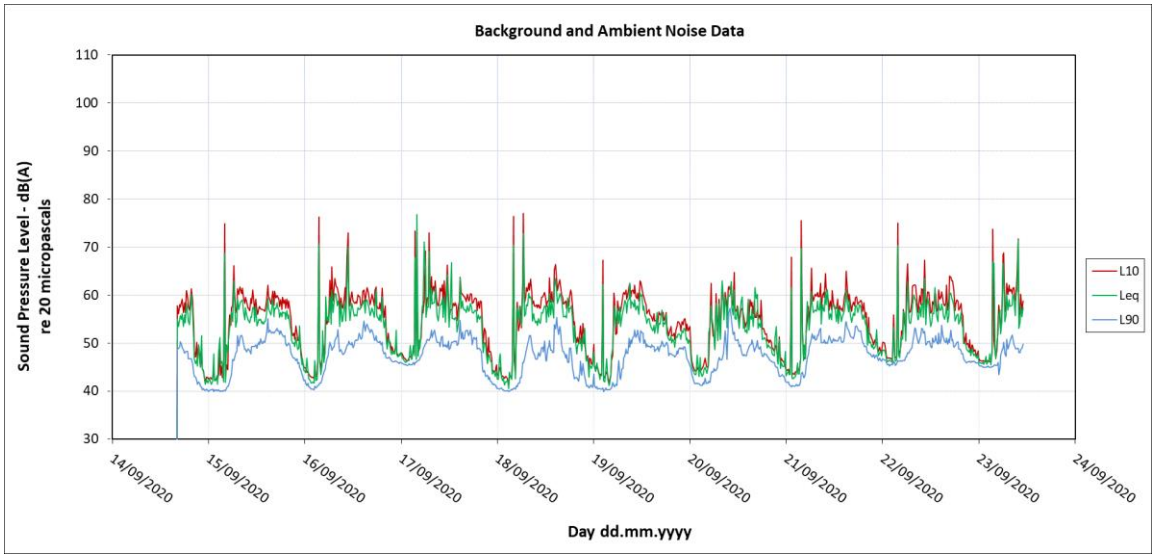


Figure 5: Long-term background noise monitoring data – L2

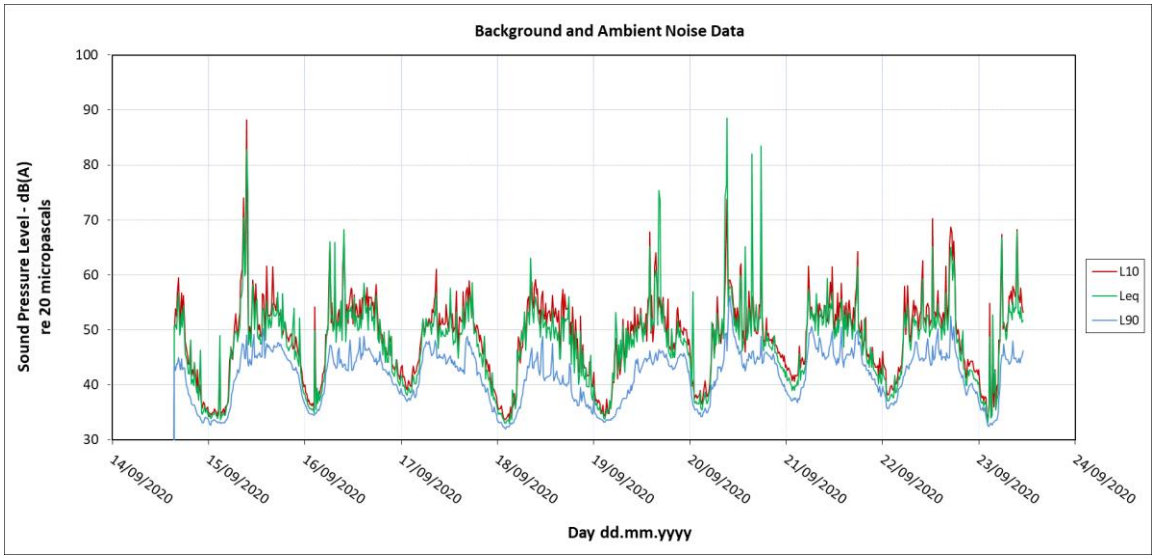
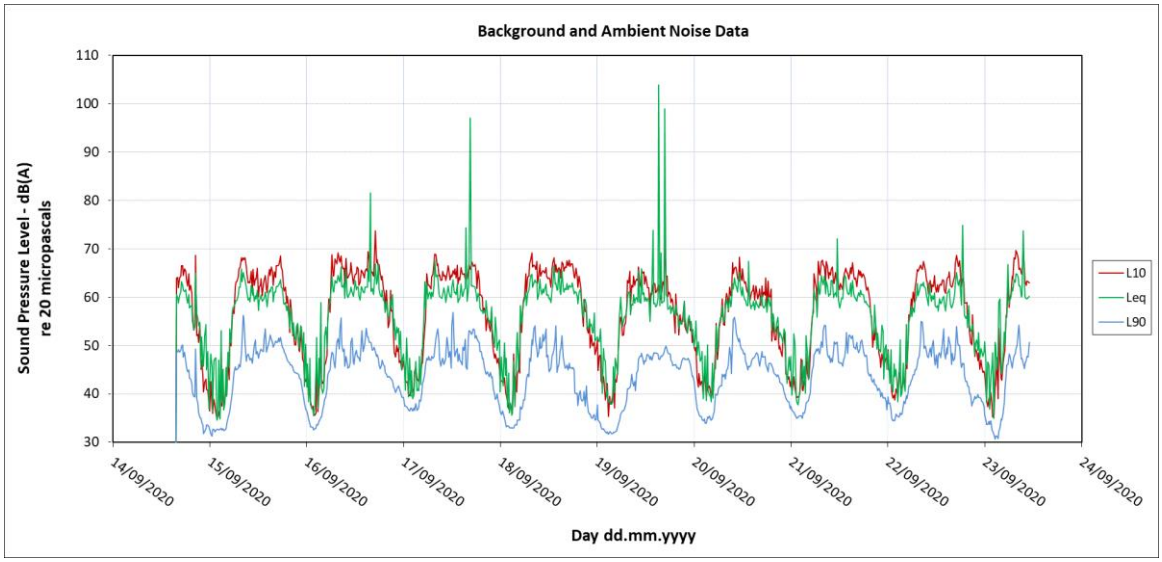


Figure 6: Long-term background noise monitoring data – L3



Traffic Noise

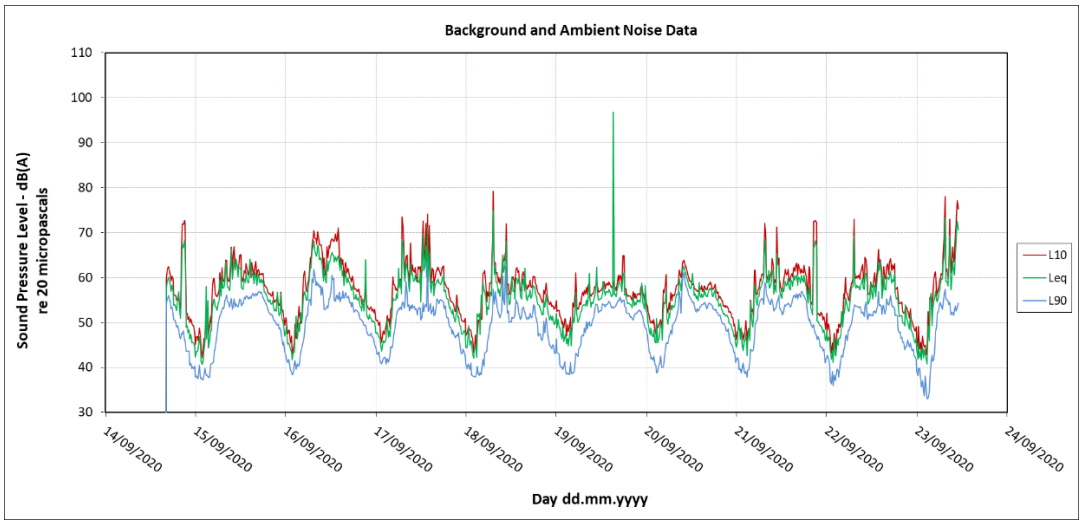
A noise monitor was placed at position L4 as shown in Figure 3 to measure the noise generated by vehicle movements along Miller Street during the 15-hour day and 9-hour periods established in the DPIE's Development near Rail Corridors and Busy Roads – Interim Guideline. Noise monitor L4 was installed from the 14th and 23rd of September 2020. The results for the long-term traffic noise surveys are shown in Table 4 below (for the day and night periods).

Table 4: Long-term noise survey summary – Traffic noise

Location	Equivalent Continuous Noise Level $L_{Aeq,period}$ - dB(A)	
	Day (15hr)	Night (9hr)
L4	62	53

Note that any rain affected data or non-repeatable extraneous events during the period of logging have been excluded from the calculations.

Figure 7: Long-term traffic noise monitoring data – L4



8.1.5 Short-Term (Attended) Noise Surveys

Background Noise

Short-term noise measurements were conducted in the vicinity of surrounding noise-sensitive receivers to characterize the background and ambient noise associated with these receivers. The results of the background noise measurements conducted at locations P1 – P3 (see Figure 3 for location) is provided in Table 5.

Table 5: Short-term noise measurement summary – Background noise

Measurement Location	Measurement Time	L_{Aeq} dB(A)	L_{A90} dB(A)	L_{A10} dB(A)	Comments
P1	10:09am – 10:24am	58.2	50.5	61.0	Dominated by pedestrian traffic and traffic movements in and out of the adjacent car park
P2	9:11am – 9:26am	51.9	47	55.0	General noise associated with the environment, birds chirping in the distance
P3	8:45am – 9:00am	63.1	48	65.5	Existing noise from the school, vehicle movements on Carlow St

Traffic Noise

A short-term noise measurement of vehicle movements was carried out on Miller Street. A summary of the results from the short-term noise measurement of vehicle movements on this road conducted at location P4 is provided in Table 6.

Table 6: Short-term noise measurement summary – Traffic noise

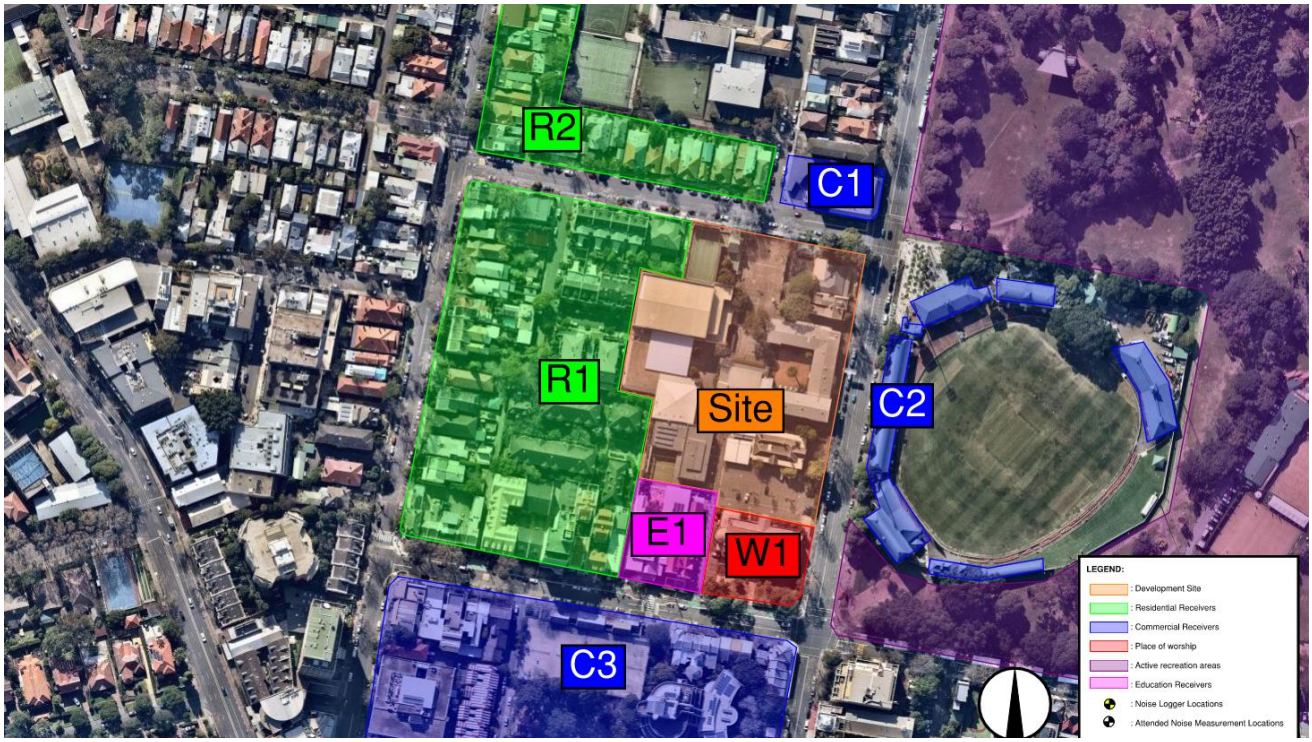
Measurement Location	Measurement Time	L_{Aeq} dB(A)	L_{A90} dB(A)	L_{A10} dB(A)	Comments
P4	9:43am – 9:58am	67.1	54	71	Dominated by vehicle movements on Miller Street

8.2 Summary of Noise Investigation

The site noise investigations are a key piece of information when understanding the existing ambient noise environment characteristic of the surrounding receivers to the proposed development. The various receivers are outlined in Figure 8. The receivers include:

- Residential receivers (R1 & R2)
- Commercial receivers (C1, C2 & C3)
- Places of worship receivers (W1)

Figure 8: Overview of the development site and surrounding noise-sensitive receivers



9. Project Noise and Vibration Criteria

9.1 Relevant Noise and Vibration Assessment Documents

This assessment has been prepared considering the following documents:

- Secretary's Environmental Assessment Requirements (SEARs)
- State Environmental Planning Policy (SEPP) (Infrastructure) 2007
- DPIE – Development near Rail Corridors and Busy Roads – Interim Guideline
- AS 2363:1999 Acoustics – Measurement of noise from helicopter operations
- NSW EPA Noise Policy for Industry (NPI) 2017
- NSW Road Noise Policy, 2011 (RNP 2011)
- NSW EPA Interim Construction Noise Guideline 2009
- The NSW OEH "Assessing Vibration: A Technical Guideline (2006)
- British Standard BS5228: Part 1:1997 "Noise and Vibration Control on Construction and Open Sites."
- British Standard BS7358:1993 "Evaluation and Measurement for Vibration in Buildings" – Part 2: "Guide to Damage Levels from Groundborne Vibration"
- German Standard DIN4150-Part 3 "Structural vibration in buildings – Effects on structures"
- Association of Australasian Acoustical consultants (AAAC) – License Premises Noise Assessment Technical Guideline Version 2.0

9.2 Operational Noise Criteria

9.2.1 Internal Noise Levels

SEPP (Infrastructure) 2007 & Development Near Rail Corridors and Busy Roads – Interim Guideline

Table 7 provides a summary of the internal noise limits for both windows closed and open established in Clause 3.6 "What Noise and Vibration Criteria Should Be Applied" of the DoP Interim Guideline.

Table 7: Summary of DoP's Interim Guideline criteria spaces adjacent to busy roads

Type of habitable space	Applicable Time Period	Assessment Noise Metric	Windows/Doors Closed Criteria dB(A)	Windows/Doors Open Criteria – dB(A)
Educational Spaces & Facilities	When in use	LAeq,T	40	50
Child care centre spaces	When in use	LAeq,T	40	50

Project Internal Noise Limits

Table 8 below outlines the project internal noise level targets for the development site-wide for the various metrics, summarising the internal noise level requirements from the previous sections for closed windows. For closed windows, the ISEPP 2007 criteria have been adopted.

Table 8: Project internal noise limits – closed windows

Type of occupancy / activity	Metric	Standard	Noise Level Range dB(A)
Educational Spaces & Facilities	LAeq,T (when in use)	ISEPP 2007, DPIE Interim Guideline	< 40
Child care centre spaces	LAeq,T (when in use)	ISEPP 2007, DPIE Interim Guideline	< 40

Table 9 below outlines the project internal noise level targets for the development site-wide for the various metrics, summarising the internal noise level requirements from the previous sections for open windows.

Table 9: Project internal noise limits – open windows and doors

Type of occupancy / activity	Metric	Standard	Noise Level Range dB(A)
Educational Spaces & Facilities	LAeq,T (when in use)	ISEPP 2007, DPIE Interim Guideline	< 50
Child care centre spaces	LAeq,T (when in use)	ISEPP 2007, DPIE Interim Guideline	< 50

9.2.2 External Noise Emissions

NSW EPA Noise Policy for Industry (2017)

The *NSW Noise Policy for Industry* has been applied to address the noise emissions from the development to the surrounding noise-sensitive receivers. The NSW NPI sets out noise criteria to control the noise emission from industrial noise sources generated by the proposed development. Operational noise emissions from the development shall be addressed following the guideline in the NSW NPI.

The calculation is based on the results of the unattended ambient and background noise monitoring, addressing two components:

- Controlling intrusive noise into nearby residences (Intrusiveness Criteria)
- Maintaining noise level amenity for particular land uses (Amenity Criteria)

Once both criteria are established, the most stringent for each considered assessment period (day, evening, night) is adopted as the project-specific noise level (PSNL).

Intrusiveness Criteria

The NSW NPI 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."*

The intrusiveness criterion can be summarised as L_{Aeq}, 15 minute ≤ RBL background noise level plus 5 dB(A).

Table 5: NSW NPI Rating background noise levels (RBLs)

Period	Noise Descriptor – dB(A)	Noise Criteria – dB(A)
Residential – R1		
Daytime 7am – 6pm	$L_{Aeq,15min}$ ≤ RBL + 5	48
Evening 6pm – 10pm	$L_{Aeq,15min}$ ≤ RBL + 5	44
Night 10pm – 7am	$L_{Aeq,15min}$ ≤ RBL + 5	39
Residential – R2		
Daytime 7am – 6pm	$L_{Aeq,15min}$ ≤ RBL + 5	51
Evening 6pm – 10pm	$L_{Aeq,15min}$ ≤ RBL + 5	44
Night 10pm – 7am	$L_{Aeq,15min}$ ≤ RBL + 5	38

Amenity Criteria

The NSW NPI 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. The recommended amenity noise levels have been selected on the basis of studies that relate industrial noise to annoyance in communities (Miedema and Voss, 2004).*

The applicable parts of Table 2.2: Amenity noise levels from Industrial Noise Sources – L_{Aeq}, dB(A) which are relevant to the project are reproduced below:

Table 10: NSW NPI Table 2.2 amenity criteria for external noise levels

Reciever	Type of Receiver	Noise Amenity Area	Time of Day	L_{Aeq}, dB(A) Recommended amenity noise level	Project amenity noise level $L_{Aeq, 15min}$
R1	Residential	Suburban *	Day	55	54
		Suburban *	Evening	45	43
		Suburban *	Night	40	42
R2	Residential	Suburban *	Day	55	58
		Suburban *	Evening	45	53
		Suburban *	Night	40	48
C1, C2 & C3	Commercial Premises	All	When in use	65	63
E1	School Classroom (Internal)	All	Noisiest 1-hour period when in use	35	33
W1	Place of Worship (Internal)	All	When in use	40	38

Note 1: Suburban area as defined in EPA NPI 2. 2.1.6.

Note that where the resultant project amenity noise level is 10dB or more lower than the existing industrial noise level the project amenity noise levels can be set at 10dB below existing industrial noise levels if it can be demonstrated that existing industrial noise levels are unlikely to reduce over time.

'Modifying Factor' Adjustments

The NSW NPI also states:

> *"Where a noise source contains certain characteristics, such as tonality, intermittency, irregularity or dominant low-frequency content, there is evidence to suggest that it can cause greater annoyance than other noise at the same noise level."*

In order to take into account, the potential annoying character of the noise an adjustment of 5 dB(A) for each annoying character aspect and cumulative of up to a total of 10 dB(A), is to be added to the measured value to penalise the noise for its potentially greater annoyance aspect.

Table C1 of Fact Sheet C of the NSW NPI (see Table 11 below) provides procedures for determining whether an adjustment should be applied for greater annoyance aspect.

Table 11: Table C1 from the NSW NPI – Modifying factor corrections

Factor	Assessment / Measurement	When to Apply	Correction[1]	Comments
Tonal Noise	One-third octave band analysis using the objective method for assessing the audibility of tones in noise – simplified method *(ISO1996.2-2007 – Annex D)*.	Level of one-third octave band exceeds the level of the adjacent bands on both sides by: • 5 dB or more if the centre frequency of the band containing the tone is in the range 500–10,000 Hz • 8 dB or more if the centre frequency of the band containing the tone is in the range 160–400 Hz • 15 dB or more if the centre frequency of the band containing the tone is in the range 25–125 Hz.	5 dB[2,3]	Third octave measurements should be undertaken using unweighted or Z-weighted measurements. **Note**: Narrow-band analysis using the reference method in *ISO1996-2:2007, Annex C* may be required by the consent/regulatory authority where it appears that a tone is not being adequately identified, e.g. where it appears that the tonal energy is at or close to the third octave band limits of contiguous bands.
Low Frequency Noise	Measurement of source contribution C-weighted and A-weighted level and one-third octave measurements in the range 10–160 Hz	Measure/assess source contribution C- and A-weighted $L_{eq,T}$ levels over same time period. Correction to be applied where the C minus A level is 15dB or more and: • where any of the one-third octave noise levels in Table C2 are exceeded by up to and including 5 dB and cannot be mitigated, a 2dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period • where any of the one-third octave noise levels in Table C2 are exceeded by more than 5 dB and cannot be mitigated, a 5-dB(A) positive adjustment to measured/predicted A-weighted levels applies for the evening/night period and a 2dB(A) positive adjustment applies for the daytime period.	2 or 5 dB[2]	A difference of 15 dB or more between C- and A-weighted measurements identifies the potential for an unbalance spectrum and potential increased annoyance. The values in Table C2 are derived from Moorhouse (2011) for DEFRA fluctuating low-frequency noise criteria with corrections to reflect external assessment locations.

Factor	Assessment / Measurement	When to Apply	Correction[1]	Comments
Intermittent Noise	Subjectively assessed but should be assisted with measurement to gauge the extent of change in noise level.	The source noise heard at the receiver varies by more than 5 dB(A) and the intermittent nature of the noise is clearly audible.	5 dB	Adjustment to be applied for **night-time only.**
Duration	Single-event noise duration may range from 1.5 min to 2.5h	One event in any assessment period.	0 to 20 dB(A)	The project noise trigger level may be increased by an adjustment depending on duration of noise (see Table C3).
Maximum Adjustment	Refer to individual modifying factors	Where two or more modifying factors are indicated	Maximum correction of 10dB(A)[2] (excluding duration correction)	

Note 1: Corrections to be added to the measured or predicted levels, except in the case of duration where the adjustment is to be made to the criterion.

Note 2: Where a source emits tonal and low-frequency noise, only one 5-dB correction should be applied if the tone is in the low-frequency range, that is, at or below 160 Hz.

Note 3: Where narrow-band analysis using the reference method is required, as outlined in column 5, the correction will be determined by the ISO1996-2:2007 standard.

Project Noise Trigger Levels

The project noise trigger levels for industrial noise sources such as mechanical plant etc. are provided in Table 12. These noise levels have been derived from the Noise Policy for Industry 2017.

Table 12: Project noise trigger levels for industrial noise emissions

Receiver	Period	Descriptor	Project Noise Trigger Levels dB(A)
Residential Receivers – R1	Day (7:00am to 6:00pm)	$L_{Aeq,15min}$	48
	Evening (6:00pm to 10:00pm)	$L_{Aeq,15min}$	43
	Night (10:00pm to 7:00am)	$L_{Aeq,15min}$	39
Residential Receivers – R2	Day (7:00am to 6:00pm)	$L_{Aeq,15min}$	51
	Evening (6:00pm to 10:00pm)	$L_{Aeq,15min}$	44
	Night (10:00pm to 7:00am)	$L_{Aeq,15min}$	38
Commercial Receivers (C1, C2 & C3)	When in use	$L_{Aeq,15min}$	63
School classroom – internal	Noisiest 1-hour period when in use	$L_{Aeq,1hr}$	35
Place of worship – internal	When in use	$L_{Aeq,15min}$	38

Child Care Centre Noise Emissions

The Association of Australian Acoustical Consultants (AAAC) sets out criteria for noise emissions from Childcare Centres. The following criteria have been deemed applicable to this development.

The AAAC's Guideline for Child Care Centre Acoustic Assessment sets out a recommended assessment method for the submission of a Noise Impact Assessment to accompany a Development Application for Child Care Centres and provides widely accepted and typical recommendations for the control of noise from such Centres. Where requirements of a local council are non-specific, this guideline will assist in determining a suitable assessment procedure. In this case, we would consider the requirements non-specific as there are not noise controls provided in planning documents applicable to this site. Furthermore, 2i (b) of this condition is stringent and will result in very strict controls/measures associated with the childcare centre.

The beforementioned mitigation measures were considered in the modelling of noise emissions from the childcare centre. If we revert to the controls as proposed by NSW EPA which is applicable to industrial noise sources considered offensive within the POEO, the predominant noise controls that can be applied will be to reduce the hours of operation, reduce the amount of outdoor play time and make reductions with regards to the amount of children playing at any one time. The AAAC does not endorse such measures to avoid issues with centre operation and behavioural issues because of outdoor play time amongst other appropriate measures

The AAAC states the following in regards to outdoor play area noise to residential receivers:

> *For most centres as the duration of time that children are allowed to play outside is reduced then the overall noise impact reduces. Therefore, it is reasonable to allow a higher level of noise impact for a shorter duration of outdoor play. AAAC members regard that a total time limit of approximately 2 hours outdoor play per day (e.g. 1 hour in the morning and 1 hour in the afternoon) should allow an additional emergence above the background of 5 dB.*
>
> *Up to 2 hours (total) per day - The $L_{eq,15}$ min noise level emitted from the outdoor play area shall not exceed the background noise level by more than 10 dB at the assessment location.*
>
> *More than 2 hours per day - The $L_{eq,15}$ min noise level emitted from the outdoor play area shall not exceed the background noise level by more than 5 dB at the assessment location.*
>
> *The assessment location is defined as the most affected point on or within any residential receiver property boundary. Examples of this location may be:*
>
> - *1.5 m above ground level;*
> - *On a balcony at 1.5 m above floor level;*
> - *Outside a window on the ground or higher floors.*

The AAAC states the following in regards to indoor play area, mechanical plant, pickup and drop off noise to residential receivers:

> *The Leq,15min noise level emitted from the cumulative noise impact of children playing indoors, mechanical plant and traffic on the site shall not exceed the background noise level by more than 5dB at the assessment location.*

The AAAC states the following in regards to noise emissions to commercial receivers:

- The $L_{eq,15min}$ noise level emitted from the Child Care Centre shall not exceed 65dB(A) when assessed at the most affected point at or within any commercial property boundary.

A summary of the criteria for noise emissions from the childcare centre is provided Table 13.

Table 13: Summary of maximum LAeq,15min for noise emissions from the childcare centre

Receiver	Period	Noise Descriptor	Maximum $L_{Aeq,15min}$ – dB(A)
Residential – R1	7am – 6pm (up to 2 hours)	RBL + 10dB(A)	53
	7am – 6pm (more than 2 hours)	RBL + 5dB(A)	48
	6pm – 10pm	RBL + 5dB(A)	44
	10pm – 7am	RBL + 5dB(A)	39
Residential – R2	7am – 6pm (up to 2 hours)	RBL + 10dB(A)	56
	7am – 6pm (more than 2 hours)	RBL + 5dB(A)	51
	6pm – 10pm	RBL + 5dB(A)	44
	10pm – 7am	RBL + 5dB(A)	38
Commercial	7am – 6pm	65dB(A)	65

The outdoor play area of the childcare centre should be considered a sensitive receiver within the development. To provide a suitable noise environment during outdoor play, the noise levels $L_{Aeq,1h}$ within the area should be limited as stated in the AAAC Guideline for Child Care Centre Acoustic Assessment:

> *"The noise level $L_{Aeq,1hr}$ from road, rail traffic or industry at any location within the outdoor play or activity area during the hours when the centre is operating shall not exceed 55dB(A)."*

PA System and School Noise Emissions

The PA System and School Bell should not exceed the noise criteria established in Table 12 when the school is operating under standard conditions to ensure the external noise levels nominated to the nearby sensitive receivers by criteria outlined by the NSW EPA Noise Policy for Industry are met.

9.2.3 Traffic Noise Generation Criteria

The L_{Aeq} noise level or the "equivalent continuous noise level" correlates best with the human perception of annoyance associated with traffic noise.

Road traffic noise impact is assessed in accordance with the introduced NSW Road Noise Policy which supersedes the *NSW Environmental Criteria for Road Traffic Noise* (ECRTN, Department of Environment Climate Change and Water 1999). The criterion (Table 3 – Road Traffic Noise Assessment Criteria for Residential Land Uses) divides land use developments into different categories and lists the respective criteria for each case. The category that is relevant to the proposed use of the site is shown below in Table 14.

Table 14: NSW Road Noise Policy – Traffic noise assessment criteria

Road Category	Type of project/land use	Assessment Criteria – dB(A)	
		Day (7am – 10pm)	Night (10pm – 7am)
Local roads	Existing residences affected by additional traffic on existing local roads generated by land use developments	$L_{Aeq,1\ hour}$ 55 (external)	$L_{Aeq,1\ hour}$ 50 (external)

If the traffic noise at the site is already in excess of the criteria noted above, the NSW RNP states that the primary objective is to reduce the existing level through feasible and reasonable measures to meet the criteria above.

If this is not achievable, Section 3.4.1 Process for applying the criteria – Step 4 states that for existing residences affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise should be limited to 2 dB above that of the corresponding 'no build option'.

9.3 Operational Vibration Criteria

9.3.1 Human Comfort

The NSW Environment Protection Authority (EPA) developed a document, "Assessing vibration: A technical Guideline" in February 2006 to assist in preventing people from exposure to excessive vibration levels within buildings. The guideline does not however address vibration induced damage to structures or structure-borne noise effects. Vibration and its associated effects are usually classified as continuous, impulsive or intermittent.

Continuous & Impulsive Vibration

Structural vibration in buildings can be detected by occupants and can affect them in many ways including reducing their quality of life and also their working efficiency. Complaint levels from occupants of buildings subject to vibration depend upon their use of the building and the time of the day.

Maximum allowable magnitudes of building vibration with respect to human response are shown in Table 22. It should be noted that the human comfort for vibration are more stringent than the building damage criteria.

Table 15: Preferred and maximum weighted RMS values for continuous and impulsive vibration (m/s^2)

Location	Assessment period1	Preferred values		Maximum values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration					
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 place of worship	Day or night-time	0.020	0.014	0.040	0.028
Impulsive vibration					
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 place of worship	Day or night-time	0.64	0.46	1.28	0.92

Intermittent Vibration

Disturbance caused by vibration will depend on its duration and its magnitude. This methodology of assessing intermittent vibration levels involves the calculation of a parameter called the Vibration Dose Value (VDV) which is used to evaluate the cumulative effects of intermittent vibration. Various studies support the fact that VDV assessment methods are far more accurate in assessing the level of disturbance than methods which is only based on the vibration magnitude.

Table 16: Acceptable Vibration Dose Values for Intermittent Vibration (m/s$^{1.75}$)

Location	Daytime (7:00am to 10:00pm)		Night-time (10:00pm to 7:00am)	
	Preferred value	Maximum value	Preferred value	Maximum value
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and place of worship	0.40	0.80	0.40	0.80

9.3.2 Cosmetic Damage

Table 24 presents guide values for building vibration, based on the lowest vibration levels above which cosmetic damage has been demonstrated as per BS7385-Part 2:1993.

Table 17: Transient vibration guide values for cosmetic damage

Type of Building	Peak Particle Velocity in frequency range of predominant pulse (PPV)	
	4 Hz to 15 Hz	15 Hz and above
Residential or light commercial type buildings	15mm/s at 4Hz increasing to 20mm/s at 15Hz	20mm/s at 15Hz increasing to 50mm/s at 40Hz and above

9.3.3 Steady-state Structural Damage

Ground vibration criteria is defined in terms of the levels of vibration emission from the construction activities which will avoid the risk of damaging surrounding buildings or structures. It should be noted that human comfort criteria are normally expressed in terms of acceleration whereas structural damage criteria are normally expressed in terms of velocity.

Most specified structural vibration levels are defined to minimize the risk of cosmetic surface cracks and are set below the levels that have the potential to cause damage to the main structure. Structural damage criteria are presented in German Standard DIN4150-Part 3 “Structural vibration in buildings – Effects on structures” and British Standard BS7385-Part 2: 1993 “Evaluation and Measurement for Vibration in Buildings”. Table 18 indicates the vibration limits presented in DIN4150-Part 3 to ensure structural damage doesn’t occur.

Table 18 - Guideline value of vibration velocity, vi, for evaluating the effects of short-term vibration

Line	Type of Structure	Vibration velocity, vi, in mm/s			
		Foundation			Plane of floor of uppermost full storey
		At a frequency of			
		Less than 10Hz	10 to 50Hz	50 to 100*Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that, because of their particular 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

*For frequencies above 100Hz, at least the values specified in this column shall be applied

9.4 Construction Noise Criteria

Noise criteria for construction sites are established in accordance with the Interim Construction Noise Guideline (ICNG July 2009) under the NSW Environment Protection Authority (EPA). It is important to note that the recommended criteria are for planning purposes only. Numerous other factors need to be considered when assessing potential noise impacts from construction works.

9.4.1 Interim Construction Noise Guideline (ICNG)

In undertaking the assessment of potential noise intrusion associated with the proposed construction activities, Chapter 4 of the NSW EPA ICNG (July 2009) were specifically referenced.

The limits presented in Table 19 apply.

Table 19: NSW EPA ICNG Construction Noise Criteria

Time of Day	Management Level $L_{Aeq,15min}$ *	How to Apply
Recommended Standard Hours: Mon – Fri (7am – 6pm) Sat (8am – 1pm) No work on Sunday & Public Holidays	Noise Affected RBL + 10dB(A)	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 residences 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 in, taking into account: • 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) • 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 + 5dB(A)	• A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see section 7.2.2.

Note: 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 30m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Source: Chapter 4 (Table 2 Sec 4.1.1) of NSW DECCW ICNG

Table 20 below (Section 4.1.3 of the ICNG) sets out the noise management levels for other land uses, including commercial premises. The external noise levels should be assessed at the most affected occupied point for commercial and industrial uses, and at the most affected point within 50 metres of the area boundary for parks.

Table 20: Construction Noise Criteria for Land Uses

Land Use	Management Level, $L_{Aeq,15min}$ – applies when land use is being utilized
Classrooms at schools and other education institutions	Internal noise level 45 dB(A)
Passive recreation, parks	External noise level 60 dB(A)
Industrial premises	External noise level 75 dB(A)
Offices, retail outlets	External noise level 70 dB(A)
Places of Worship	Internal noise level 45 dB(A)

Based on the criteria in the tables above, the following noise management levels in Table 21 should be applied to the receivers outlined in Section 8.1.3.

Table 21 - Project Specific Construction Noise Management Levels

Land Use	Receiver	Period	Management Level, $L_{Aeq,15min}$
Residential	R1	Standard Hours	53 dB(A) External
		Outside Standard Hours	44 dB(A) External
Residential	R2	Standard Hours	56 dB(A) External
		Outside Standard Hours	44 dB(A) External
Commercial	C1, C2 & C3	When in use	70 dB(A) External
Places of Worship	W1	When in use	45 dB(A) Internal

9.5 Construction Vibration Criteria

It is important for vibration emissions from vibration-intensive equipment utilized during the construction works be managed to maintain appropriate levels of human comfort, and to avoid both cosmetic and structural damage. The vibration limits proposed in the ensuing sub-sections aid in achieving this outcome.

9.5.1 Human Comfort

The office of Environment and Heritage (OEH) developed a document, "Assessing vibration: A technical guideline" in February 2006 to assist in preventing people from exposure to excessive vibration levels from construction and operation of a development within buildings. The guideline does not however address vibration induced damage to structures or structure-borne noise effects. Vibration and its associated effects are usually classified as continuous, impulsive or intermittent.

Continuous & Impulsive Vibration

Structural vibration in buildings can be detected by occupants and can affect them in many ways including reducing their quality of life and also their working efficiency. Complaint levels from occupants of buildings subject to vibration depend upon their use of the building and the time of the day.

Maximum allowable magnitudes of building vibration with respect to human response are shown in Table 22. It should be noted that the human comfort for vibration are more stringent than the building damage criteria.

Table 22: Preferred and maximum weighted RMS values for continuous and impulsive vibration (m/s^2)

Location	Assessment period1	Preferred values		Maximum values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Continuous vibration					
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 place of worship	Day or night-time	0.020	0.014	0.040	0.028
Impulsive vibration					
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 place of worship	Day or night-time	0.64	0.46	1.28	0.92

Intermittent Vibration

Disturbance caused by vibration will depend on its duration and its magnitude. This methodology of assessing intermittent vibration levels involves the calculation of a parameter called the Vibration Dose Value (VDV) which is used to evaluate the cumulative effects of intermittent vibration. Various studies support the fact that VDV assessment methods are far more accurate in assessing the level of disturbance than methods which is only based on the vibration magnitude.

Table 23: Acceptable vibration dose values for intermittent vibration ($m/s^{1.75}$)

Location	Daytime (7:00am to 10:00pm)		Night-time (10:00pm to 7:00am)	
	Preferred value	Maximum value	Preferred value	Maximum value
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and place of worship	0.40	0.80	0.40	0.80

9.5.2 Cosmetic Damage

Table 24 presents guide values for building vibration, based on the lowest vibration levels above which cosmetic damage has been demonstrated as per BS7385-Part 2:1993.

Table 24: Transient vibration guide values for cosmetic damage

Type of Building	Peak Particle Velocity in frequency range of predominant pulse (PPV)	
	4 Hz to 15 Hz	15 Hz and above
Residential or light commercial type buildings	15mm/s at 4Hz increasing to 20mm/s at 15Hz	20mm/s at 15Hz increasing to 50mm/s at 40Hz and above

9.5.3 Structural Damage

Ground vibration criteria are defined in terms of levels of vibration emission from the construction activities which will avoid the risk of damaging surrounding buildings or structures. It should be noted that human comfort criteria are normally expressed in terms of acceleration whereas structural damage criteria are normally expressed in terms of velocity.

Most commonly specified structural vibration levels are defined to minimize the risk of cosmetic surface cracks and are set below the levels that have the potential to cause damage to the main structure. Structural damage criteria are presented in German Standard DIN4150-Part 3 “Structural vibration in buildings – Effects on structures” and British Standard BS7385-Part 2: 1993 “Evaluation and Measurement for Vibration in Buildings”. Table 25 indicates the vibration limits presented in DIN4150-Part 3 to ensure structural damage doesn’t occur.

Table 25: Guideline value of vibration velocity, vi, for evaluating the effects of short-term vibration

Line	Type of Structure	Vibration velocity, vi, in mm/s			
		Foundation			Plane of floor of uppermost full storey
		At a frequency of			
		Less than 10Hz	10 to 50Hz	50 to 100*Hz	All Frequencies
1	Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that, because of their particular 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

*For frequencies above 100Hz, at least the values specified in this column shall be applied

9.5.4 Project Construction Vibration Limits

Table 26 indicates the vibration criteria for the nearest residential properties to the development.

Table 26: Construction human comfort vibration criteria summary

Receiver	Period	Human Comfort Vibration Objectives			Structural Damage Criteria
		Continuous mm/s2 (RMS)		Intermittent $m/s^{1.75}$ (VDV)	Peak Velocity (mm/s)
		z-axis	x- and y-axis		
C1, C2 & C3	At any time	64 - 128	46 - 92	0.40 - 0.80	20
R1, R2 & R3	At any time	64 - 128	46 - 92	0.40 - 0.80	3
W1	At any time	64 - 128	46 - 92	0.40 - 0.80	3
E1	At any time	64 - 128	46 - 92	0.40 - 0.80	3

10. Operational Noise and Vibration Assessment

10.1 Road Noise Impact Assessment

10.1.1 Noise Modelling and Assumptions

In order to provide acoustic amenity to occupants of the proposed development and comply with the project specific internal noise limits, the noise impacts of surrounding roads were assessed at the façade of the educational spaces within the proposed development in accordance with the SEPP (Infrastructure) 2007.

3D acoustic modelling for noise emissions from the surrounding roads was conducted using the software SoundPlan (Version 8.1). Noise emissions and impacts from vehicle movements on the surrounding busy roads (including Miller St), were modelled in accordance with the CoRTN prediction techniques and calibrated to measurements and logger data from around the site.

This model is recognised by regulatory authorities around Australia and is endorsed by the NSW DPIE for use in projects of this scale. The acoustic modelling was undertaken considering specific meteorological characteristics such as wind speeds, prevailing wind directions and temperature in accordance with the hourly weather data for a full calendar year described in the Test Reference Year for Mascot 1987 (94767 Mascot (Syd AMO) 1978-87 1987).

3D modelling was implemented in this specific situation because of the complexity of integrating all noise sources and types of noise sources to develop an overall incident façade noise level. Attenuation due to distances, building shielding and environmental absorption, together with additional noise incident on the façade due to façade reflections are taken into account within the 3D model. The results of the 3D modelling are provided in Appendix C (in the form of façade noise contours), showing the incident noise levels on the façade as a result of noise emissions from the external noise sources mentioned above. The incident noise levels are presented in both the $L_{Aeq,1h}$ and $L_{Aeq,15h/9h}$ statistical forms for the purpose of demonstrating compliance with the DPIE Interim Guideline limits.

10.1.2 Closed Windows Assessment

The general limiting factor of the performance of a building façade in term of noise attenuation is the glazing. In the case of the proposed development, the traffic noise on Miller Street, places the largest acoustic demand on the facades of the sensitive spaces within the development.

In order to achieve the project internal noise limits established in Section 9.2.1, noise mitigation measures have been provided in Section 12.1.1.

10.1.3 Open Windows Assessment

An open windows assessment has been conducted to assess whether the habitable spaces can meet the project internal noise limits established in Section 9.2.1 with windows open for natural ventilation (open in accordance with the natural ventilation requirements of the National Construction Code 2019).

If there is an exceedance of the project internal noise limits with the windows open, educational space is considered noise-affected and an alternative means of ventilation is required in accordance with the requirements of the National Construction Code 2019 (i.e. an alternative ventilation system complying with AS 1668.2 and AS/NZS 3666.1). These performance recommendations shall assist the proposed development in achieving sustainable natural ventilation outcomes.

The assessment has been conducted under the assumption the occupant has opened their windows to achieve natural ventilation (and as recommended in the DP&E Interim Guideline). That is, when the windows are open to 5% of the floor area of the room being ventilated, with a reduction of incident noise level to internal noise level of 10dB(A). Room loss has also been considered.

In order to achieve the project internal noise limits established in Section 9.2.1 whilst simultaneously achieving the ventilation requirements, mitigation measures have been proposed in Section 12.1.2 for the education facility.

10.2 Mechanical Plant & Equipment Noise Emissions

This assessment has considered the noise emissions from the mechanical plant serving the internal spaces of the development. These noise sources have been used to predict the worst-case scenario noise impact of the proposed use of the site to the nearby sensitive receivers. The assessment has been conducted to achieve noise levels as per the NSW NPI. Both have been assessed at the most affected external point at the surrounding residential, educational and commercial receivers.

In order to assess the worst-case scenario, it was assumed that the mechanical services associated with the development are running at any time throughout the daytime and evening periods (7:00am – 10:00pm). While exact equipment has not been selected for the project, the sound power levels provided in Table 27 have been assigned to each significant plant and equipment item, based on typical noise emissions data for plant and equipment of the sizes indicated.

For our assessment we have assumed the following mechanical plant and equipment is located within development will include:

- Auditorium AHU and Roof Exhaust Area Plant (Level 4, Zone 2)
- Condenser Room (Level 4, Zone 2)

Table 27: Maximum Sound power levels of mechanical equipment and plant for typical size

Plant and Equipment	Maximum Sound Power Level re 10^{-12} W, dB – Octave Band Centre Frequency								
	63 Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz	8 kHz	Overall dB(A)
Auditorium AHU and Roof Exhaust Area Plant (Level 4, Zone 2)	89	90	90	89	87	83	79	73	92
Condenser Room (Level 4, Zone 2)	77	77	74	71	67	64	61	53	73

The noise generated by the mechanical plant and equipment within the rooftop plantroom has been assessed to the noise-sensitive receivers surrounding the proposed development with consideration given to the following assumptions:

- The mechanical plant and equipment will be operating during the daytime and evening periods (7:00am – 10:00pm)

Table 28 provides a summary of the results of the noise impact assessment of the mechanical plant and equipment. The noise generated by the plant and equipment has been assessed with and without the noise mitigation measures outlined in Section 12.2.

Table 28: Summary of results of mechanical noise impact assessment (with and without mitigation)

Receiver	Period	Predicted Noise Level LAeq,15min - dB(A) Without Mitigation	Predicted Noise Level LAeq,15min - dB(A) With Mitigation	PNTL LAeq,15min - dB(A)	Compliance (Yes/No)
R1	Day	57	43	48	Yes, with mitigation
	Evening			43	Yes, with mitigation
	Night	N/A	N/A	39	N/A
R2	Day	55	44	51	Yes, with mitigation
	Evening			44	Yes, with mitigation
	Night	N/A	N/A	38	N/A
C1	When in use	74	61	63	Yes, with mitigation
C2	When in use	75	62	63	Yes, with mitigation

Based on the results of the assessment of the noise generated by the mechanical plant and equipment, the predicted noise levels at the surrounding noise-sensitive receivers are expected to comply with the project noise trigger levels established in Section 9.2.2 upon implementation of the mitigation measures outlined in Section 12.2.

It is assumed that the condenser units will not be operating during the night-time period, and therefore no further mitigation measure are to be implemented. The main source of mechanical noise affecting receivers ‘R1’ and ‘R2’ are the condensers located on the Level 4 Rooftop Plant and have not been assessed during the night-time period.

10.3 Existing & Future Operational School Noise Impacts

The existing noise environment within the surrounding community is outlined in Section 8.1 of this report. Using the data from noise monitor L2, due to its proximity to the school an analysis of the ambient noise during school hours (Monday to Friday, 9am to 3:00pm) was compared to noise monitor L4 school hours timeframe and L2 during Saturday and Sunday and day time between the hours of 3:30pm – 6:00pm, to try and determine how much the operation of the school was contributing to the ambient background levels.

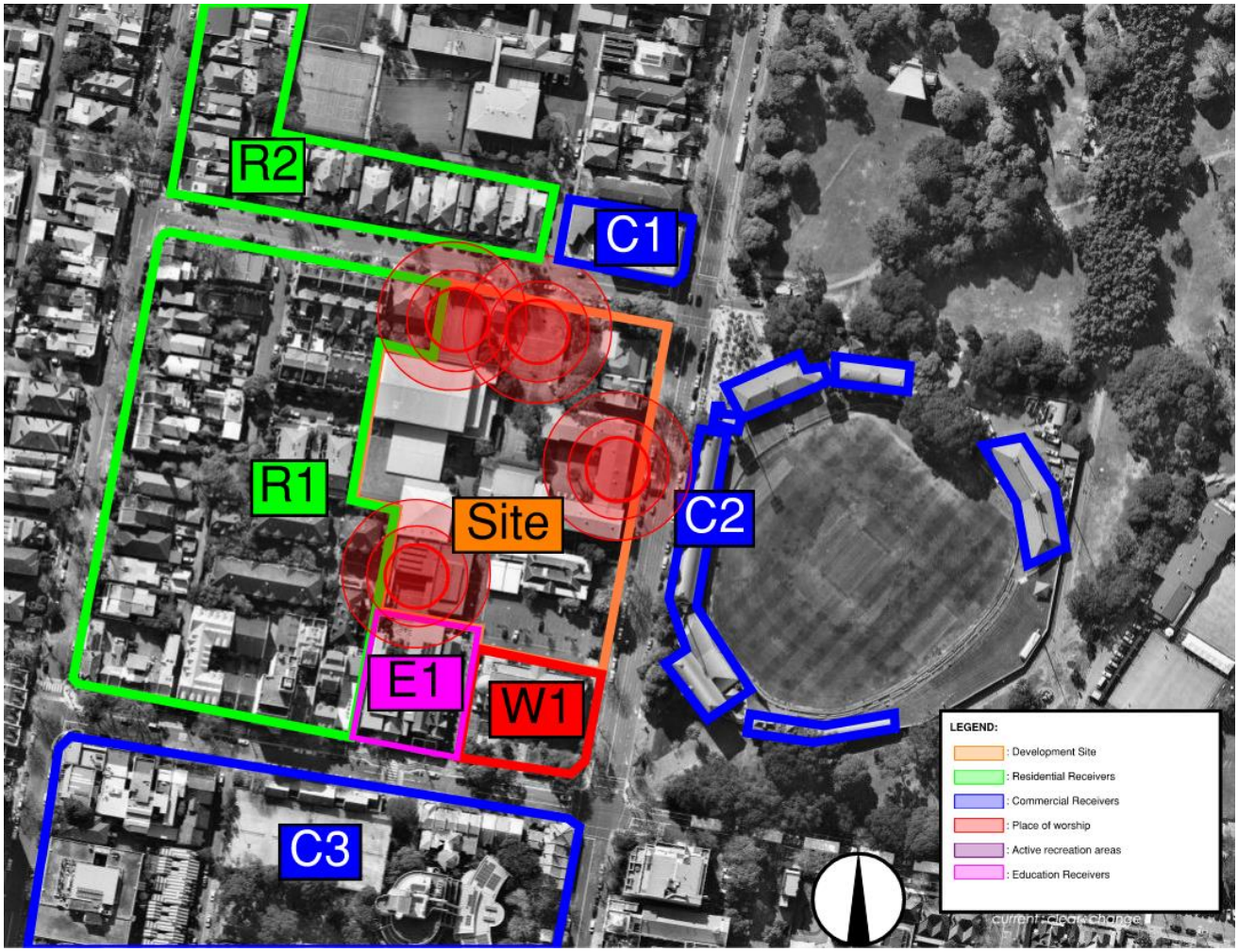
It is difficult to accurately determine how much noise is produced from the operation of the school, traffic noise and other noise sources. After analysing the day by day measurement data, any clear increase in noise within the recess and lunch hours (above the general noise level) could not be identified.

When attended measurements were conducted during school hours it was clear the noise from Miller Street dominated the noise measurements on Carlow Street. Other noise sources such as local carparks also contributed to the ambient noise levels, though the noise emissions from the operation of the school were audible during typical recess and lunch times.

We estimate the contribution of the noise of the operation of the school to be approximately 30% of the measured noise levels (this assumes that the noise contribution of the operation of the school is slightly less of that of the surrounding roads combined with other noise sources).

The current school building form provides little to no screening for the sensitive receivers along Cassins Ave (R1). Figure 9 shows the existing high noise emissions zones within the school of main concern impacting the nearby sensitive receivers.

Figure 9: Expected noise source impact contributions on nearby receivers



Given the proposed development will consist of tall buildings in place of the high noise emissions zones (existing cricket nets and basketball court), the operational school noise emissions will likely be reduced by these shielding structures. The reduction of noise could be in the order of 5 – 15 dB(A), depending on the location of the noise sources and location of the noise-sensitive receivers.

As a result of the shielding structures, while taking into account the increase in population of both the primary and secondary spaces, it is likely the noise emissions from the operation of the school will decrease at receivers along Carlow St and Ridge St.

The noise emissions from the operation of the school at noise-sensitive receivers along Cassins Ave is predicted to increase approximately 0.5 dB(A) (given an increase in primary school population of 11%). Increases in noise levels between 0 and 2 dB(A) are typically imperceptible and hence, the increase in noise level is not expected to have a significant impact on residents along Cassins Ave.

10.4 Childcare Centre Noise Emissions

The proposed childcare centre is expected to have 90 children in the centre, aging from 6 weeks to 6 years old. The centre opening hours are subject to Council and the childcare operators' requirements; however, it is currently assumed that the childcare will operate during the hours of 7:00am to 6:00pm. The sound power levels as recommended in the AAAC guideline are summarised below. The sound power levels obtained from the guideline were adjusted to take into consideration the number of children in each age group in order to conduct the assessment.

The sound power levels from the AAAC guideline are as follows:

- 10 Children aged 0 to 2 years – 77 to 80 dB(A)
- 10 Children aged 2 to 3 years – 83 to 87 dB(A)
- 10 Children aged 3 to 6 years – 84 to 90 dB(A)

The age split of the childcare centre for the 90 children in total, together with predicted sound power levels (SWL) for a group of five (5) children have been provided in Table 36. The assessment has been conducted considering 90 children playing outdoors continuously, split into groups of five, throughout a 15-minute period, distributed around the outdoor area.

Table 29: Child-care centre age split and SWLs for each group of 5

Age Split	Number of Children	Average SWL for Group of 10 - dB(A)	SWL for Group of 5 - dB(A)
0 – 2	30	80	77
2 – 3	30	85	84
3 – 5	30	87	87

The predicted noise level from the operation of the outdoor play area is shown below in Table 30, assessed at the future residential receivers within the proposed development (Building 2, Central Precinct) as well as the nearest external noise-sensitive receiver.

Table 30: Predicted noise levels at surrounding receivers

Receiver	Period	Predicted Noise Level $L_{Aeq,15minutes}$ dB(A)	Noise Criteria $L_{Aeq,15minutes}$ dB(A	Compliance (Yes/No)
Residential – R1	7am – 6pm (up to 2 hours)	19	53	Yes
	7am – 6pm (more than 2 hours)		48	Yes
Residential – R2	7am – 6pm (up to 2 hours)	20	56	Yes
	7am – 6pm (more than 2 hours)		51	Yes
Commercial (C1)	7am – 6pm	31	65	Yes
Commercial (C2)	7am – 6pm	49	65	Yes
Commercial (C3)	7am – 6pm	15	65	Yes

Based on the results of the assessment of the noise generated by children playing within the outdoor area of the child care centre, the predicted noise levels at the surrounding noise-sensitive receivers are expected to comply with the project noise trigger levels established in Section 9.2.2 without further mitigation.

10.5 Rooftop Terrace Noise Emissions

The proposed outdoor rooftop terrace is expected to have 300 students playing at once and only operating during school hours. The sound power levels (SWLs) obtained from the AAAC guideline using the maximum levels provided and were adjusted to take into consideration the number of students in order to conduct the assessment.

The following assumptions were made:

- Rooftop terrace outdoor playground is to be only used by students during school hours
- The rooftop terrace outdoor playground will not be used for the purposes of active recreation
- Minimum 1m solid barrier/balustrade/parapet above FFL (refer to Figure 10)
- All 300 students are outdoors playing at once split into groups of ten, throughout a 15-minute period, distributed around the outdoor area.

Figure 10: Location of solid barrier

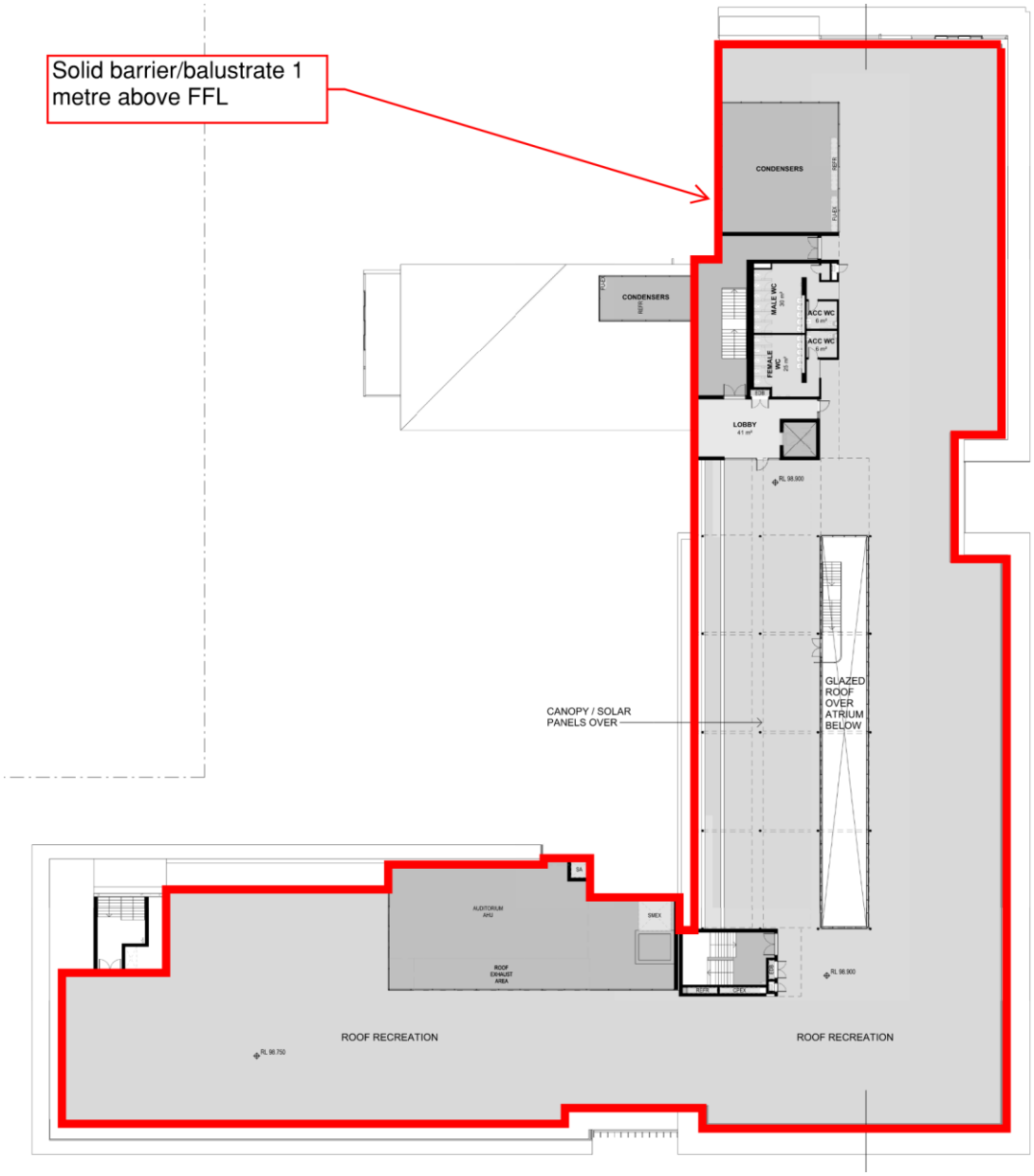


Table 31: SWLs for each group of 10 students

Number of Children	SWL for Group of 10 - dB(A)
300	90

The predicted noise level from the operation of the outdoor play area is shown below in Table 34, assessed at the nearby receivers.

Table 32: Predicted noise levels at surrounding receivers for the childcare centre

Most Affected Receiver	Predicted Noise Level LAeq,15min - dB(A)	Project Noise Trigger Level (Day) LAeq,15min - dB(A)	Compliance (Yes/No)
R1	44	48	Yes
R2	51	51	Yes
C1	49	63	Yes
C2	45	63	Yes
C3	39	63	Yes

Based on the results of the assessment of the noise generated by students playing on the outdoor, rooftop terrace area. the predicted noise levels at the surrounding noise-sensitive receivers are expected to comply with the project noise trigger levels established in Section 9.2.2 without further mitigation.

10.6 Loading Dock & Waste Collection Noise Emissions

An assessment of the noise generated by activities within the loading dock (such as garbage collections and deliveries) has been conducted to determine the impacts on the surrounding noise-sensitive receivers. Table 40 outlines the sound power level (SWL) and typical duration (minutes) associated with each of the standard loading dock activities.

Table 33: Typical sound power levels and duration of loading dock activities

Loading Dock Activity	Typical Duration of Activity	Sound Power Level (LAeq, 15min)
Garbage truck unloading bins	2 minutes	88
Medium rigid truck accelerating	1 minute	72
Loading and unloading activities	10 minutes	88
Medium rigid truck idling on turntable	5 minutes	69

The noise generated by the activities during a 15-minute period have been predicted to the facades of the nearest surrounding noise-sensitive receivers. Using the assessment methods outlined above, the predicted noise levels at the nearest noise-affected premises are summarised below in Table 34. The following assumptions have been made for the assessment:

- Service vehicles are assumed to be either medium rigid trucks or garbage trucks;
- Two (2) service vehicle entering and exiting within a 15-minute period; and
- Loading and unloading activities will take place indoors

Table 34: Predicted noise levels at surrounding receivers

Most Affected Receiver	Predicted Noise Level, without Mitigation LAeq,15min - dB(A)	Predicted Noise Level, with Mitigation LAeq,15min - dB(A)	Project Noise Trigger Level (Evening) LAeq,15min - dB(A)	Compliance (Yes/No)
R1	50	41	43	Yes, with mitigation
R2	53	44	44	Yes, with mitigation
C2	46	37	63	Yes, with and without mitigation

The predicted noise levels of the loading dock activities at the surrounding noise-sensitive receivers are expected to comply with the project noise trigger levels established in Section 9.2.2 with the mitigation measures outlined in Section 12.3.

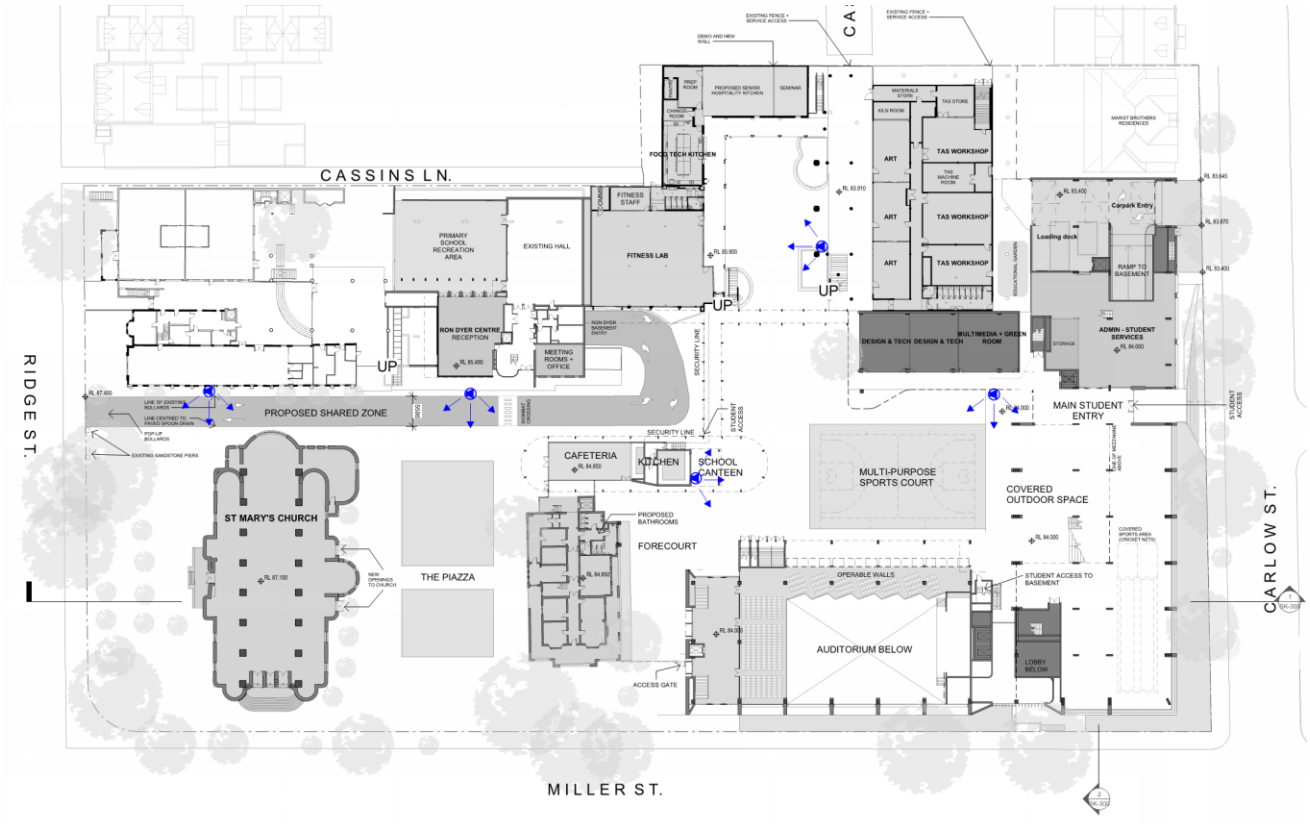
10.7 PA System and School Bell Noise Emissions

An assessment of the noise generated by the PA system and the school bell noise emissions throughout the school grounds has been conducted to assess the potential impact and disturbance to nearby receivers. It should be noted this assessment has only been conducted for the external PA systems and school bells and not any that may be located within internal hallways and classrooms.

The following assumptions have been made for this assessment.

- PA system and bell to be facing towards the internal school yard and not facing any nearby receivers (refer to Figure 11 for assumed locations used for the assessment)
- The worst-case scenario of each school bell and/or PA system operating at a maximum of 90dB(A) running simultaneously
- PA System and Bell are only used during school hours (NPI Daytime criteria)

Figure 11: Location of PA System and Bells used for assessment

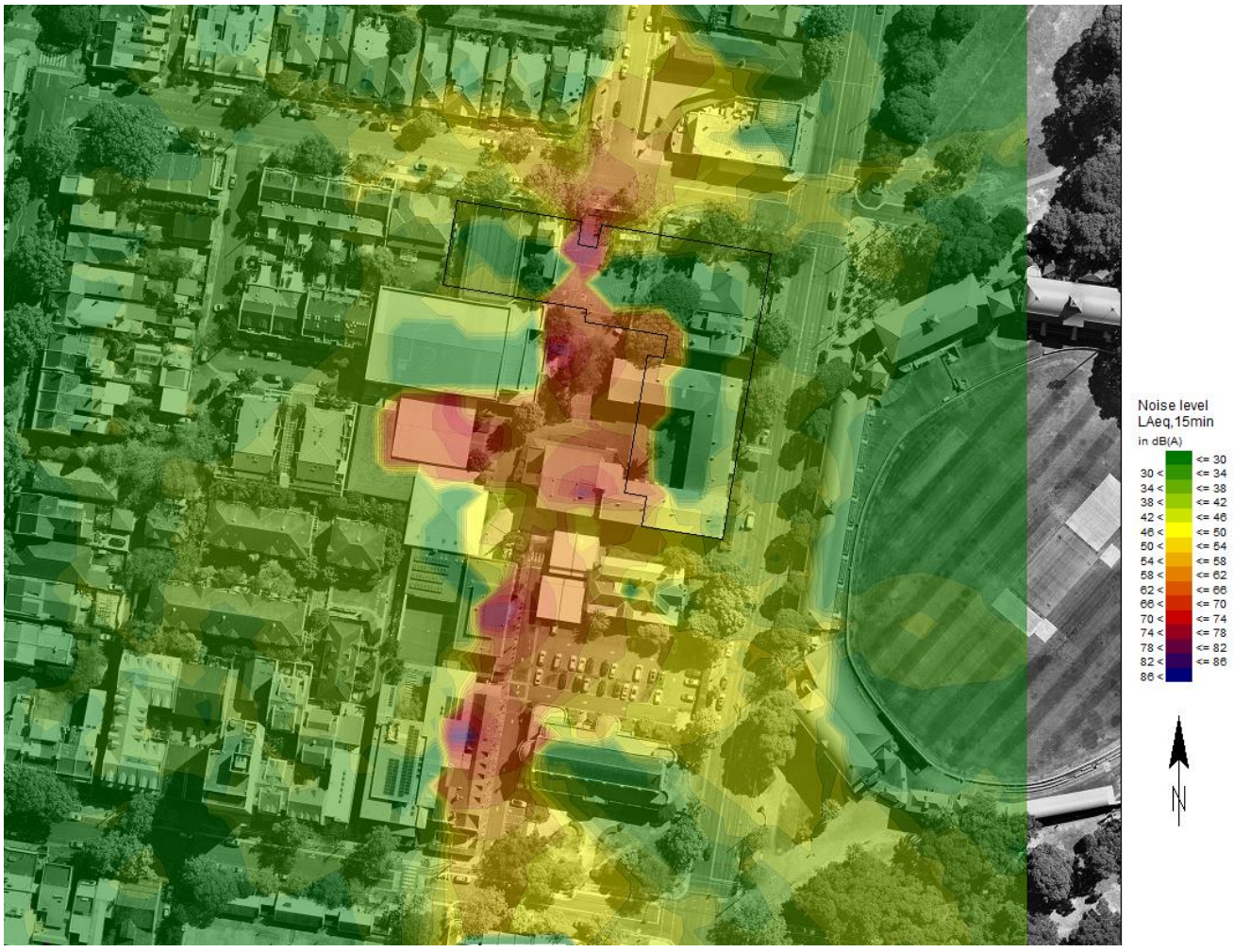


The noise generated by the PA Systems and School Bells during a 15-minute period have been predicted to the facades of the nearest surrounding noise-sensitive receivers. Using the assessment methods outlined above, the predicted noise levels at the nearest noise-affected premises are summarised below in Table 34 and results presented in Figure 12.

Table 35: Predicted noise levels at surrounding receivers

Most Affected Receiver	Predicted Noise Level LAeq,15min - dB(A)	Project Noise Trigger Level (Day) LAeq,15min - dB(A)	Compliance (Yes/No)
R1	41	48	Yes
R2	46	51	Yes
C1	45	63	Yes
C2	46	63	Yes
C3	45	63	Yes

Figure 12: Coverage of PA System and Bells used for assessment



The predicted noise levels of the PA systems and school bell at the surrounding noise-sensitive receivers are expected to comply with the project noise trigger levels established in Section 9.2.2.

10.8 Traffic Generation Noise Impact Assessment

For the road traffic noise assessment, existing peak hour traffic count and traffic generation for the site was based on the Traffic Impact Assessment prepared by “The Transport Planning Partnership”. This data has been used to calculate the expected noise increase due to traffic associated with the development onto Miller Street, Ridge Street and Carlow Street. The results are summarised in Table 36.

Table 36: Existing and predicted traffic noise generation (peak hour)

Location	Existing vehicles AM	Existing vehicles PM	Predicted Increase AM	Predicted Increase PM	Noise Level Increase dB AM	Noise Level Increase dB PM
Miller Street	2,934	2,068	-14	188	-	0.4
Ridge Street	490	1,913	-62	78	-	0.2
Carlow Street	397	312	153	124	1.4	1.5

Based on the results of the assessment, there is predicted to be less than a 1.5dB increase in traffic noise levels. Therefore, the proposed development is expected comply with the requirements of the NSW Road Noise Policy because the predicted increase is less than 2dB.

10.9 Auditorium Noise Impact Assessment

An assessment of the ground floor auditorium has been conducted to assess the potential impact of concerts and performance effecting the nearby receivers. This assessment has been conducted assuming that performances could take place during the evening period (up to 10pm) as in accordance with the NPI. The Association for the Australasian Acoustical consultants recommends in the guideline “Licensed Premises Noise Assessment Technical Guideline V2.0” that Live Music in Internal spaces, such as the auditorium in the proposed development, that these types of venues are dominated by amplified music rather than patron noise. With the absence of another criteria, this guideline has been adopted for this project. It is understood that the auditorium is not a licensed venue however the main source of activity in this space is amplified music.

In Table 1 of this guideline, a typical internal reverberant noise for this type of venue is 92dBA-96dBA.

The following assumptions have been made for this assessment.

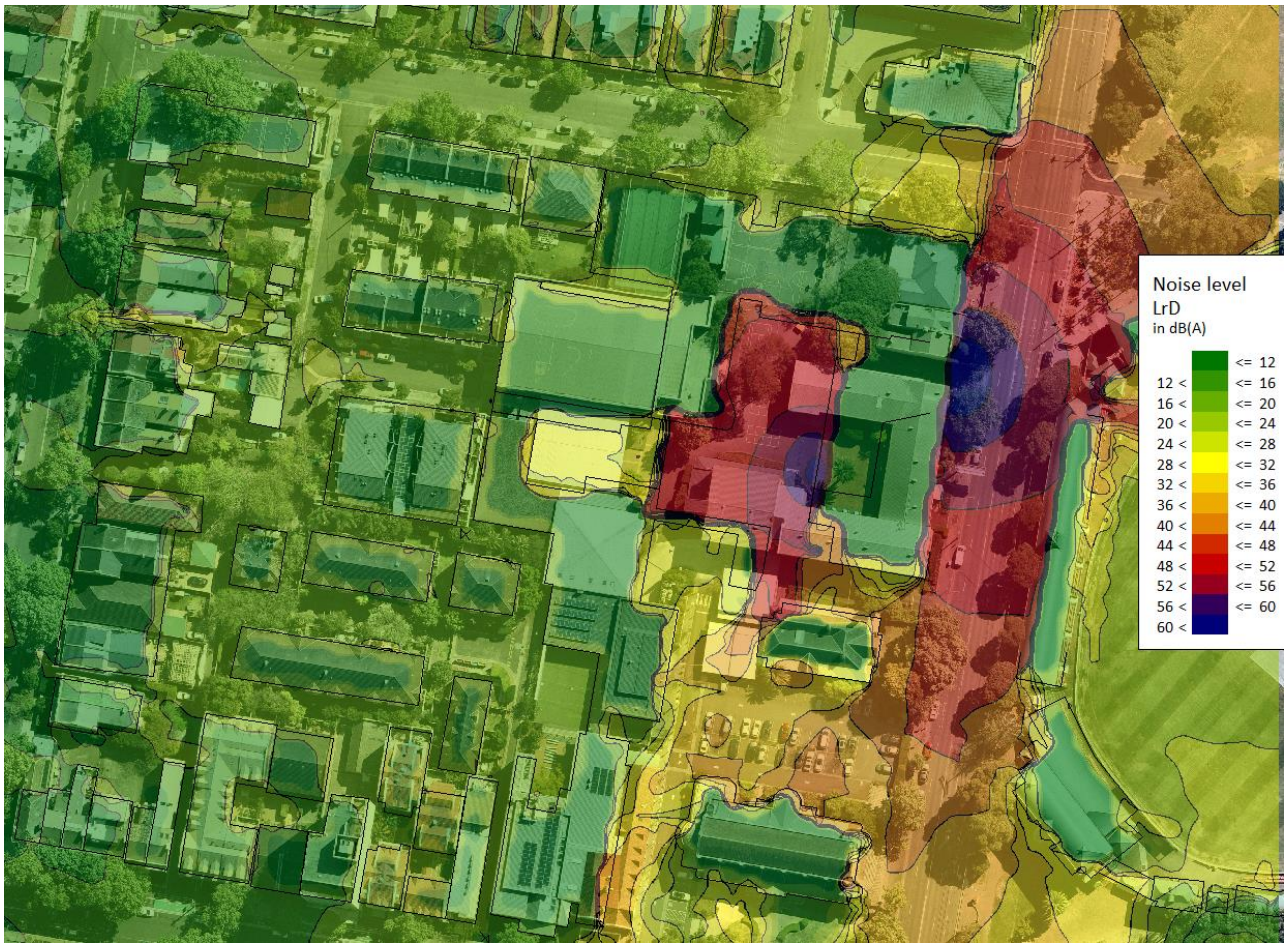
- Music through amplified speakers to have a noise limiter to 96dBA
- Noise break-out will be from entry doors on the ground floor to the auditorium.
- Glazing is minimum 6.38mm on the façade facing the east.
- All other facades are to be solid walls (min Rw50).
- Auditorium to run as late as 10pm on any given day (NPI evening time criteria).

The noise generated by the auditorium during a 15-minute period have been predicted to the facades of the nearest surrounding noise-sensitive receivers. Using the assessment method outlined above, the predicted noise levels at the nearest noise-affected premises are summarised below in Table 37 and results presented in Figure 12.

Table 37: Predicted noise levels at surrounding receivers – School Auditorium

Most Affected Receiver	Predicted Noise Level LAeq,15min - dB(A)	Project Noise Trigger Level (Evening) LAeq,15min - dB(A)	Compliance (Yes/No)
R1	19	44	Yes
R2	20	44	Yes
C1	31	63	Yes
C2	49	63	Yes
C3	15	63	Yes

Figure 13: Predicted noise emissions impact from Auditorium



11. Construction Noise & Vibration Assessment

11.1 Construction Noise Assessment

11.1.1 Proposed Construction Activities

In this assessment, the noise impact from the construction works are considered. The construction works are expected to occur during the following hours:

- Monday to Friday: 7:00am to 6:00pm
- Saturday: 7:00am to 3:30pm
- Sunday and public holidays: no work
- Safety inspections are permitted from 7:00am

11.1.2 Precinct Segments and Construction Description

It is to our understanding that the construction stages are to be conducted as outlined below. Noting that the assessment was conducted assuming all stages listed below are running concurrently as the worst-case scenario.

- Stage 2 – Carlow Street (detailed design to run concurrent with SDD)
  - Enabling works
  - Demolition of hall, lobby and ante space
  - Specialist classrooms – early handover
  - Carlow St Main Build
  - Infrastructure works
- Stage 3 – Precinct works
  - Demolition of Miller Street
  - Precinct works inc. Presbytery to Parish Refurbishment
  - Refit/Repurpose Ron Dyer building
  - Precinct Pavilion and Café/Canteen.
- Stage 4 – Miller Street Development
  - New auditorium, function space, childcare centre and commercial lettable spaces
- Stage 5 – Finalisation works
  - External areas inc. landscaping
- Stage 6 – Sport hall & Tech rooms
  - Sports Hall re-purpose
  - Tech and Applied Science refurb
  - Admin Refurb
- Stage 7 – Childcare fit out

11.1.3 Expected Construction Equipment

The noise sources likely to be associated with the works listed in the previous section of this report are presented in Table 38. The equipment noise levels have been extracted from AS 2436:2010 Guide to *Noise and Vibration Control on Construction, Demolition and Maintenance Sites.*

Table 38: Cumulative impact - Construction equipment noise levels

Phases	Equipment	Quantity	Sound Power Level – dB(A)	Acoustical Usage Factor (%)	Usage in 15-minute period (minutes)	Time Corrected Sound Power Level ($L_{Aeq,15min}$)
Early Works – Demolition & Dismantle	Jackhammer	1	113	20	3	106
	Electric hand tools	4	102	50	7.5	99
	Excavator 30 tonne	1	110	40	6	106
	Excavator breaker	1	115	40	6	111
	Dump truck	2	108	40	6	104
Excavation, Retention and Foundation	Excavator 30 tonne	1	110	40	6	106
	Jackhammer	1	113	20	3	106
	Powered hand tool	4	102	50	7.5	99
	Concrete pump	1	109	50	7.5	106
	Mobile crane	2	110	16	2.4	102
	Bored piling	1	110	16	2.4	102
	Generator	1	104	20	3	97
	Truck	2	108	40	6	104
Structural Works	Powered hand tool	4	102	50	7.5	99
	Concrete pump	1	109	50	7.5	106
	Mobile crane	2	110	16	2.4	102
	Bored piling	1	110	16	2.4	102
	Generator	1	104	20	3	97
	Truck	2	108	40	6	104
Structural Works & Façade and Finishes	Powered hand tool	11	102	50	7.5	99
	Concrete pump	1	109	50	7.5	106
	Mobile crane	2	110	16	2.4	102

11.1.4 Noise Modelling and Assumptions

In order to assess the noise impact from the site during the various construction stages, a noise model was prepared using commercial software SoundPLAN v8.1, which is a comprehensive software package for conducting three-dimensional complex noise propagation modelling. Using the software, a 3D model of the site and its surroundings was constructed including the nearby buildings, and the construction plant and equipment were positioned as noise sources. Within the model, the effects of the environment (built and natural) on propagation of sound were considered to reliably estimate the resulting noise effects on the surrounding noise sensitive receivers.

The assumptions that were made within the assessment include the following:

- The mitigation measures outlined in Section 13 are implemented; and
- Neutral weather conditions;

11.1.5 Predicted Noise Levels

The maximum predicted noise levels have been presented in Table 39, Table 40, Table 41, and Table 42 and have been assessed to the construction noise criteria established in Section 9.4. The noise contour maps produced by the three-dimensional noise propagation modelling are provided in Appendix G.

Table 39: Predicted noise levels – Scenario 1: Early Works – Demolition & Dismantle

Receiver	Predicted Worst-Case Noise Level - Without Mitigation $L_{Aeq,15min}$	Predicted Worst-Case Noise Level - With Mitigation $L_{Aeq,15min}$	Noise Management Level $L_{Aeq,15min}$	Noise Management Level Exceedance (dB)	Exceeds Highly Noise Affected Level? (> 75dBA)
R1	65-73	60-71	53	7-18	No
R2	67-70	61-66	56	5-10	No
C1	65-74	64-69	70	-	No
C2	67-71	61-66	70	-	No
C3	52-55	48-50	70	-	No
W1	66-72 (Internal)[1]	65-71 (Internal)[1]	45 (Internal)	20-26	No
Existing Primary School	56-62 (Internal)[1]	52-62 (Internal)[1]	45 (Internal)	7-17	No

Note 1: For the internal predicted noise levels presented in the table, it has been assumed that there is a 10dB loss through the receiver's façade (open window)

Table 40: Predicted noise levels – Scenario 2: Excavation, Retention & Foundations

Receiver	Predicted Noise Level - Without Mitigation $L_{Aeq,15min}$	Predicted Noise Level - With Mitigation $L_{Aeq,15min}$	Noise Management Level $L_{Aeq,15min}$	Noise Management Level Exceedance (dB)	Exceeds Highly Noise Affected Level? (> 75dBA)
R1	58-72	57-69	53	5-16	No
R2	62-68	61-65	56	5-9	No
C1	62-71)	60-68	70	-	No
C2	61-70	58-65	70	-	No
C3	47-55	45-48	70	-	No
W1	54-62 (Internal)[1]	53-62 (Internal)[1]	45 (Internal)	8-17	No
Existing Primary School	53-65 (Internal)[1]	41-64 (Internal)[1]	45 (Internal)	0-19	No

Note 1: For the internal predicted noise levels presented in the table, it has been assumed that there is a 10dB loss through the receiver's façade (open window).

Table 41: Predicted noise levels – Scenario 3: Structural Works

Receiver	Predicted Noise Level - Without Mitigation $L_{Aeq,15min}$	Predicted Noise Level - With Mitigation $L_{Aeq,15min}$	Noise Management Level $L_{Aeq,15min}$	Noise Management Level Exceedance (dB)	Exceeds Highly Noise Affected Level? (> 75dBA)
R1	55-71	54-65	53	12	No
R2	59-68	58-60	56	4	No
C1	58-75	57-65	70	-	No
C2	58-64	55-62	70	-	No
C3	43-56	41-50	70	-	No
W1	50-62 (Internal)[1]	48-61 (Internal)[1]	45 (Internal)	16	No
Existing Primary School	48-62 (Internal)[1]	37-63 (Internal)[1]	45 (Internal)	18	No

Note 1: For the internal predicted noise levels presented in the table, it has been assumed that there is a 10dB loss through the receiver's façade (open window)

Table 42: Predicted noise levels – Scenario 5: Façade and Finishes

Receiver	Predicted Noise Level - Without Mitigation $L_{Aeq,15min}$	Predicted Noise Level - With Mitigation $L_{Aeq,15min}$	Noise Management Level $L_{Aeq,15min}$	Noise Management Level Exceedance (dB)	Exceeds Highly Noise Affected Level? (> 75dBA)
R1	55-68	54-64	53	11	No
R2	59-71	58	56	2	No
C1	58-70	56-64	70	-	No
C2	58-66	54-61	70	-	No
C3	41-53	39-47	70	-	No
W1	50-60 (Internal)[1]	49-60 (Internal)[1]	45 (Internal)	15	No
Existing Primary School	48-62 (Internal)[1]	36-62 (Internal)[1]	45 (Internal)	17	No

Note 1: For the internal predicted noise levels presented in the table, it has been assumed that there is a 10dB loss through the receiver's façade.

Given there is no exceedance in the highly noise noise-affected level (75 dB(A) at any receivers surrounding the proposed construction works (upon implementation of the mitigation measures outlined in Section 13) it is not expected there will be significant construction noise impacts on the surrounding noise-sensitive receivers.

11.2 Construction Vibration Assessment

The vibration associated with construction is dependent on a number of variables including the types of machinery, the proximity to the nearby receivers as well as the ground type.

Generic safe working distances for vibration impacts associated with various types of machinery at given distances are presented within the transport for NSW 'Construction Noise Strategy' document. This document presents the safe construction working limits for Cosmetic Damage to adjacent structures (in accordance with BS 7385) and Human Comfort (OH&E).

Table 43: Working Distances for Vibration Intensive Plant

Plant Item	Rating/Description	Safe Working Distance	
		Cosmetic Damage (BS 7385)	Human Response (OH&E Vibration Guideline)
Concrete Vibrator	<50 kN (Typically 1-2 tonnes)	5m	15m to 20m
CFA Piling Rig	≤ 800mm	2m (nominal)	N/A
Excavator with hydraulic hammer (15t)	(900kg – 12 to 18t excavator)	7m	23m

Concrete vibrators & excavators are expected be used in close proximity to the onsite church and near the school. Mitigation measures to ensure vibration generated on the structure of the Church (W1) and School (E1) does not exceed the project vibration requirements are provided in Section 13.

12. Operational Mitigation Measures

12.1 Road Noise Mitigation

12.1.1 Closed Windows Assessment

In order to achieve the project internal noise limits established in Section 9.2.1 the glazing components of the façade of the proposed development must meet the acoustic demand ratings presented in Table 44 below. The designations of acoustic demand ratings on the façade are indicated on the drawings provided in Appendix D.

The double-glazed acoustic rating (R_w) is higher than the single-glazed acoustic rating is because of the reduction in acoustic performance double-glazed units (with 12-20mm cavities) experience at lower frequencies (63 Hz to 125 Hz), which are the peak frequencies typically characteristic of traffic noise emissions.

Table 44: Acoustic demand ratings for façade of proposed development

Acoustic Demand Rating	Single-Glazed Acoustic Performance (Weighted Sound Reduction Index, Rw)	Double-Glazed Acoustic Performance (Weighted Sound Reduction Index, Rw)
1	32	34
2	34	36
3	36	38
4	40	42

In addition to the required glazing systems outlined in Table 44 and indicated in in Appendix D, the solid/non-glazed elements of the façade shall have an acoustic performance of no less than Rw 55 to ensure the resulting internal noise levels within each space in the proposed development do not exceed the project internal noise limits outlined in Section 9.2.1.

The acoustic demand ratings proposed above has been provided as a high-level analysis only. The acoustic performance of the glazing facade may be reduced at certain locations within the development during the detailed design phase of the project.

12.1.2 Open Windows Assessment

An open windows assessment has been conducted in order to assess whether the educational spaces can meet the internal noise level requirements of the DPIE Interim Guideline with windows open for natural ventilation (open in accordance with the natural ventilation requirements of the NCC). If there is an exceedance of the internal noise level criteria with the windows open, alternative means of ventilation is required in accordance with the requirements of the NCC (i.e. alternative ventilation system complying with AS 1668.2 and AS/NZS 3666.1) to the noise-affected spaces (noise-affected defined in Section 10.1.3).

The results of the acoustic façade modelling indicate that the apartments shown in Appendix D will require an alternative means of ventilation to meet the aforementioned requirements.

12.2 Mechanical and Generator Plant and Equipment

To meet the external noise emissions requirements for noise generated by the mechanical plant and equipment the following noise mitigation measures are required:

- Install acoustic barriers to the Level 4 AHU plantroom where indicated in Figure 14 to the height shown in the architectural documentation. Acoustic barriers can be solid or can be an acoustic louvre, though the barrier must have a noise reduction of no less than the values shown in Table 45.
- Install acoustic barriers to the Level 4 condenser plantroom where indicated in Figure 15 to the height shown in the architectural documentation. Acoustic barriers can be solid or can be an acoustic louvre, though the barrier must have a noise reduction of no less than the values shown in Table 45.

Table 45: Insertion loss required for types of acoustic barriers

Louvre	Insertion Loss (dB) – Octave Band Centre Frequency				
	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz
Type 1	7	10	15	22	22
Type 2	11	11	21	33	32

Figure 14: Acoustic barrier type designations - Level 24 AHU plantroom

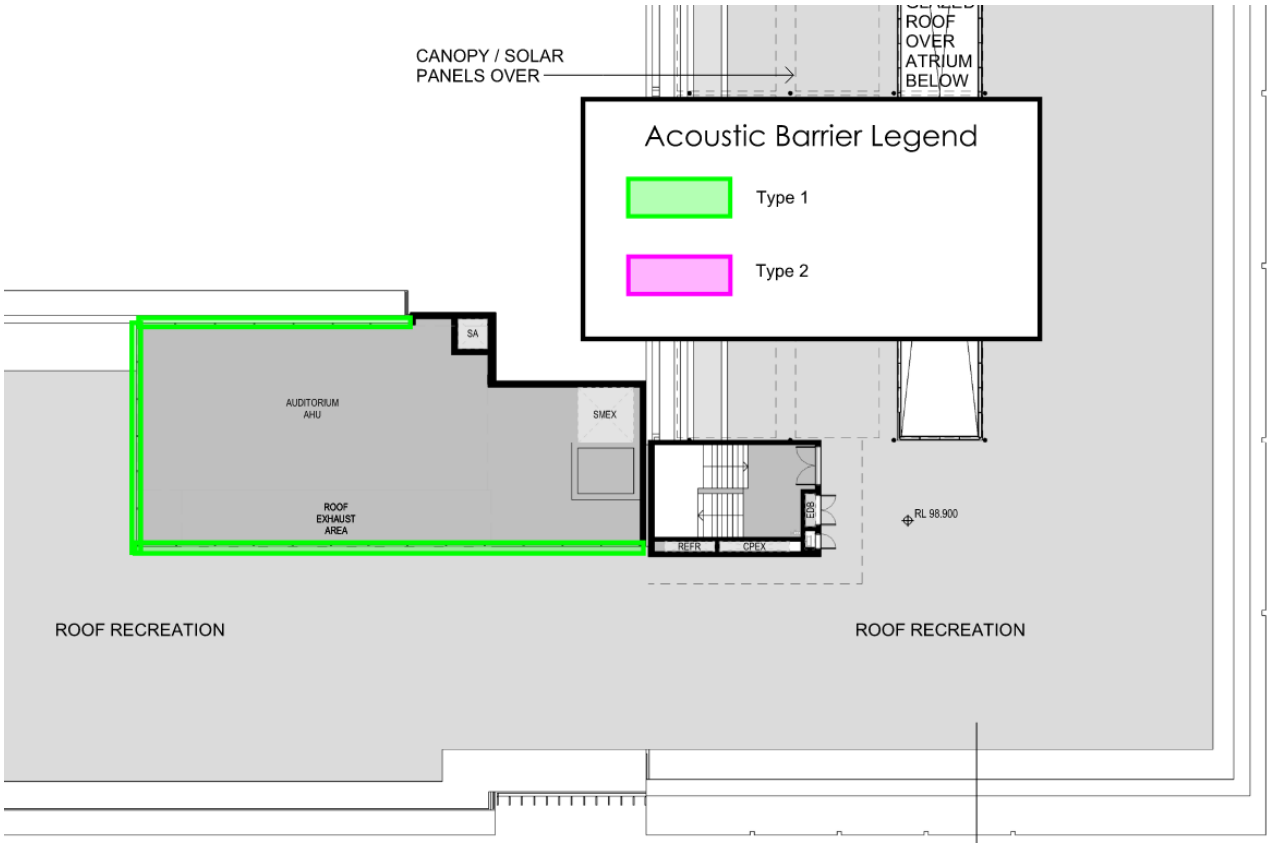
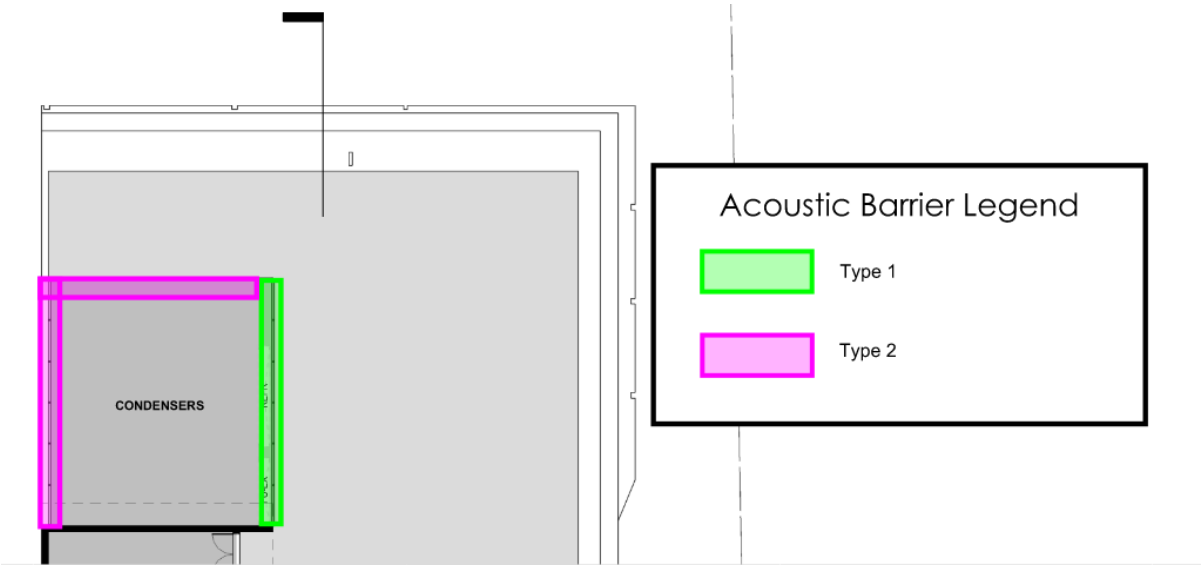


Figure 15: Acoustic barrier type designations - Level 4 condenser plantroom



Additional mitigation measures for the mechanical plant should be considered during the design development stage to ensure compliance with the outlined criteria at the nearest sensitive receivers. These amelioration measures could include but not limited to the following:

- Positioning mechanical plant away from nearby receivers
- Acoustic attenuators fitted to duct work
- Screening around mechanical plant
- Acoustic insulation within duct work

It should be noted that the noise reduction requirements will likely be refined and reduced once the mechanical plant and equipment selections and designs have been progressed further during the detailed design of the proposed development. The mitigation measures proposed at this stage of the development are conservative in nature.

12.3 Loading Dock and Waste Collection

To ensure that compliance with the EPA's Noise Policy for Industry it is recommended that activities conducted within the loading dock are performed with the loading dock shutter door is closed. The insertion loss used for the assessment conducted in Section 10.6 is outlined in below:

Table 46: Minimum transmission loss requirements for loading dock and waste collection

Required Transmission Loss– Octave Band Centre Frequency						
63Hz	125 Hz	250 Hz	500 Hz	1 kHz	2 kHz	4 kHz
7	8	9	9	9	10	10

It is also recommended that the activities shall be conducted with the implementation of the following management practices:

- Not operating before 7am or after 10pm (7 days per week)
- Maintaining rubbish trucks and braking materials to minimize or eliminate noise such as squeaky brakes
- Educating drivers and collectors to be careful and to implement quiet work practices

13. Construction Mitigation Measures

13.1 Project Specific Noise & Vibration Recommendations

13.1.1 Noise

The excavators with the rock breaker attachment are predicted to produce the highest noise levels during the demolition and excavation phases at the surrounding most affected sensitive receivers.

The use of a standard 2.4 metre tall A-class hoarding of the following materials and construction will suffice to mitigate the impact of the highest predicted noise levels, erected around the construction site.

- The A-class hoarding should be impervious of gaps and cracks which would compromise its performance
- it should be comprised of acoustically suitable materials such as 17 mm plywood

In addition to the sound attenuating barrier, at least a one hour respite period, for example between 12:00pm – 1:00pm (or other period to coincide with construction workers lunch time(s)), should be offered per day during the most intensive periods of hammering and rock breaking. Frequent and proactive communication with the surrounding residents is also encouraged. More details regarding communication with the community can be found in Section 13.2.

In addition, noise monitoring is recommended to be conducted at the most-affected noise-sensitive receivers in accordance with the monitoring program proposed in Section 13.3.

13.1.2 Vibration

Due to the proximity of demolition works to the surrounding vibration-sensitive, there may be exceedances of the cosmetic damage and human comfort criteria. Prior to the use of the excavators with rock breakers on the western boundary during demolition, attended vibration measurements should be conducted to determine if there is an exceedance of the vibration limits set out in Section 9.5.

Upon any exceedances in vibration levels, reasonable and feasible measures should be considered to lessen the impact, such as an alternative means of demolition or reducing the capacity of the rock breaker to achieve the vibration levels required.

To further diminish the vibration impact, the one hour respite period, for example between 12:00pm – 1:00pm (or other period to coincide with construction workers lunch time(s)), recommended for noise mitigation shall also apply to vibration.

13.2 General Acoustic Recommendations for Construction

According to AS 2436 – 2010 *"Guide to noise and vibration control on construction, demolition and maintenance sites"* the following techniques could be applied to minimize the spread of noise and vibrations to the potential receivers.

13.2.1 Noise

If a process that generates significant noise levels cannot be avoided, the amount of noise reaching the receiver should be minimized. Two ways of achieving this are to either increase the distance between the noise source and the receiver or to introduce noise reduction measures such as screens.

Physical methods to reduce the transmission of noise between the site works and residences, or other sensitive land uses, are generally suited to works where there is longer-term exposure to the noise. Practices that will reduce noise from the site include:

- Increasing the distance between noise sources and sensitive receivers.
- Reducing the line-of-sight noise transmission to residences or other sensitive land uses using temporary barriers (stockpiles, shipping containers and site office transportables can be effective barriers).
- Constructing barriers that are part of the project design early in the project to introduce the mitigation of site noise.
- Installing purpose-built noise barriers, acoustic sheds and enclosures.

13.2.2 Screening

On sites where distance is limited, the screening of noise may be beneficial, and this should be taken into account during the planning stages.

If structures such as stores, site offices and other temporary buildings are situated between the noisiest part of the site and the nearest dwellings, some of the noise emission from the site can be reduced. If these buildings are occupied, sound insulation measures may be necessary to protect workers inside the buildings.

A hoarding that includes a site office on an elevated structure offers superior noise reduction when compared with a standard (simple) hoarding. The acoustic performance is further enhanced when the hoarding is a continuous barrier.

Storage of building materials or the placement of shipping containers between the noise source and any noise-sensitive area may also provide useful screening and the same is true of partially completed or demolished buildings. A noisy, stationary plant can be placed in a basement, the shell of which has been completed, provided reverberant noise can be controlled. Where compressors or generators are used in closed areas, it is necessary to ensure that the exhaust gases are discharged directly to the outside air and that there is good cross-ventilation to prevent the build-up of poisonous carbon monoxide fumes and to allow an adequate air supply to maintain efficiency when operating the equipment.

Where such noise barriers are not practical, a worthwhile reduction in noise can be obtained by siting the plant behind and as close as possible to mounds of earth, which may effectively screen any noise-sensitive areas from the plant. These can often be designed into the construction schedule or site arrangement for future landscaping.

Water pumps, fans and other plant equipment that operate on a 24-hour basis may not be an irritating source of noise during the day but may be problematic at night. They should therefore be effectively screened by either situating them behind a noise barrier or by being positioned in a trench or a hollow in the ground provided this does not generate reverberant noise. In such cases, however, adequate ventilation should also be ensured. Long, temporary earth embankments can provide quite an effective noise screen for mobile equipment moving, for example, on a haulage road. When the earthworks are complete, the earth mounds should be removed if possible, with smaller, quieter excavators. A noise barrier may be a more reliable method of noise control than the imposition of restrictions on throttle settings.

In many cases it may not be practical to screen earthmoving operations effectively, but it may be possible to partially shield a construction plant or to build-in at the early stages protective features required to screen traffic noise. Where earth noise barriers are not practical due to lack of space, consideration should be given to the possibility of constructing temporary screens from wood or any equivalent material in surface density.

The usefulness of a noise barrier will depend upon its length, its height, its position relative to the source and to the receiver, and the material from which it is made. A barrier designed to reduce noise from a moving source should extend beyond the last property to be protected to not less than ten times the shortest measurement from the property to the barrier. A barrier designed to reduce noise from a stationary source should, where possible, extend to a distance beyond the direct line between the noise source and the receiver to a distance equal to ten times the effective barrier height, which is the height above the direct line between source and receiver.

If the works are predominately within nominally closed structures, careful consideration should be given to reducing noise breakout at any openings.

13.2.3 Crane (diesel operated)

An appropriate silencer on the muffler and acoustic screen around the engine bay are recommended to attenuate the noise emission.

13.2.4 Reversing and warning alarms

Community complaints often involve the intrusive noise of alarms commonly used to provide a safe system of work for vehicles operating on a site. Beeper reversing alarm noise is generally tonal and may cause annoyance at significant distances from the work site.

There are alternative warning alarms capable of providing a safe system of work that are equal to or better than the traditional 'beeper', while also reducing environmental noise impacts. The following alternatives should be considered for use on construction sites as appropriate:

(a) Broadband audible alarms incorporating a wide range of sound frequencies (as opposed to the tonal frequency 'beep') are less intrusive when heard in the neighbourhood.

(b) Variable-level alarms reduce the emitted noise levels by detecting the background noise level and adjusting the alarm level accordingly.

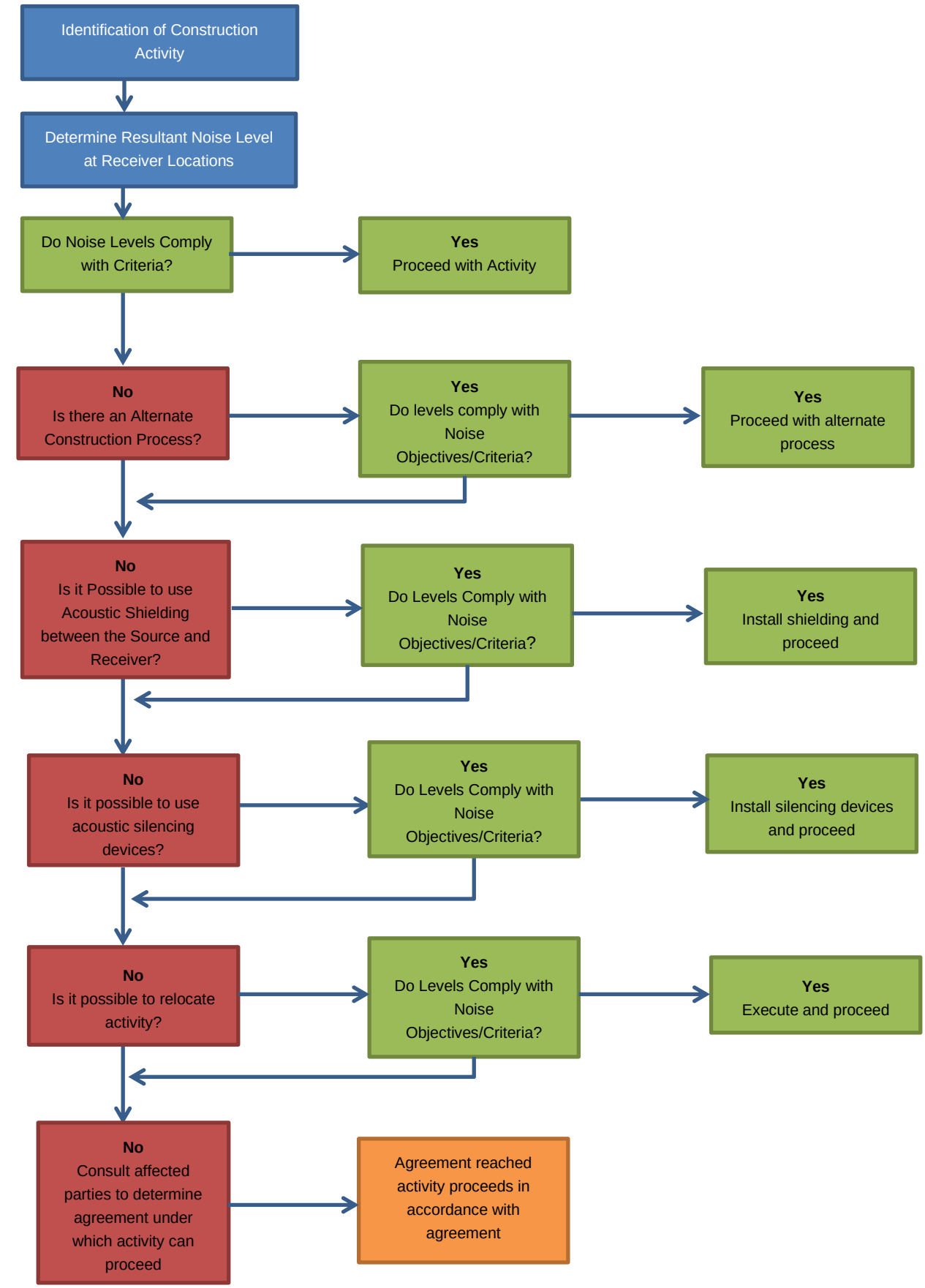
(c) Non-audible warning systems (e.g. flashing lights, reversing cameras) may also be employed, providing safety considerations, are not compromised.

(d) Proximity alarms that use sensors to determine the distance from objects, such as people or structures, and generate an audible alarm in cabin for the driver.

(e) Spotters or observers.

The above methods should be combined, where appropriate.

Figure 16: Noise mitigation management flow chart



13.3 Noise & Vibration Monitoring Strategy

13.3.1 General Methodology

Noise and vibration levels should be monitored from time to time to ensure that noise generated as a result of remediation and construction activities does not disturb local businesses.

Monitoring may be in the form of regular checks by the builder or indirectly by an acoustic consultant engaged by the builder and in response to any noise or vibration complaints. Where noise and vibration criteria are being exceeded or in response to valid complaints, noise and / or vibration monitoring should be undertaken. This would be performed inside the premises of the affected property and on site adjacent to the affected receivers.

Monitoring is to be undertaken by an experienced noise and vibration monitoring professional or an acoustic consultant. The results of any noise or vibration monitoring are to be provided to the relevant party or person in a timely manner allowing the builder to address the issue and respond to the complaints.

Noise and vibration monitoring can take two forms:

- Short term monitoring
- Long-term monitoring

Short-term monitoring

Short-term monitoring consists of attended monitoring when critical stages of the construction are occurring. This normally provides real-time assistance and guidance to the subcontractor on site letting them know when the noise and vibration criteria are exceeded allowing the selection of alternative method on construction or equipment selection in order to minimise noise and vibration impacts.

Long-term monitoring

Similarly, long-term monitoring uses noise and vibration loggers providing real-time alerts to the builder / site manager when the noise and vibration criteria are exceeded.

Typically, the noise and vibration loggers stay on site for a period of several months for the critical construction stages of the project. Sometimes the period of construction noise and vibration monitoring is dictated by the local authorities through the DA conditions.

Both methods are complementary and normally used simultaneously providing a significant of amount of data via the long-term monitoring but also providing information on the sources of noise and vibration generating exceedances via the short-term or attended monitoring.

13.3.2 Noise & Vibration Monitoring Program

The proposed noise and vibration monitoring program during the construction works is outlined in Table 47.

Table 47: Proposed noise and vibration monitoring locations details

Sensitive Receiver Details	Proposed Monitoring Type and Phase
W1 (Onsite Church)	Noise – Demolition and Excavation
	Vibration – Demolition and Excavation
E1 (Existing School)	Noise – All stages
	Vibration – Demolition and Excavation

The monitoring programme as shown above is to be carried out during the likely noisiest stages as agreed with the Acoustic Engineer and Contractor.

14. Conclusion

A noise and vibration impact assessment for the expansion and redevelopment of Marist Catholic College North Shore located at 270 Miller Street, North Sydney has been conducted. This document forms part of the documentation package to be submitted to relevant authorities as part of the Stage Significant Development Application process.

This report has provided criteria, in-principle treatment and design requirements which aim to achieve the statutory criteria discussed in Section 9. In terms of noise and vibration criteria, we have provided the following:

- Noise criteria for internal noise levels according to the DPIE's Development near Rail Corridors and Busy Roads – Interim Guideline, provided in Section 9.2.1;
- Noise criteria for noise emissions from the proposed expansion and redevelopment to noise-sensitive receivers in accordance with the NSW NPI Section 9.2.2;
- Traffic noise criteria for additional vehicle movements on public roads generated by the proposed expansion and redevelopment presented in Section 9.2.3;
- Operational vibration criteria for human comfort and structural damage, provided in Section 9.3;
- Construction noise criteria provided in Section 9.4; and
- Construction vibration criteria for human comfort and structural damage, provided in Section 9.5.

Having given regard to the analysis conducted within this report, it is the finding of this noise and vibration impact assessment that the proposed development is compliant with the relevant noise and vibration criteria controls for this type of development (and as outlined in the SEARs), and it is expected to comply with the applicable regulations with regards to noise and vibration, particularly those listed above.

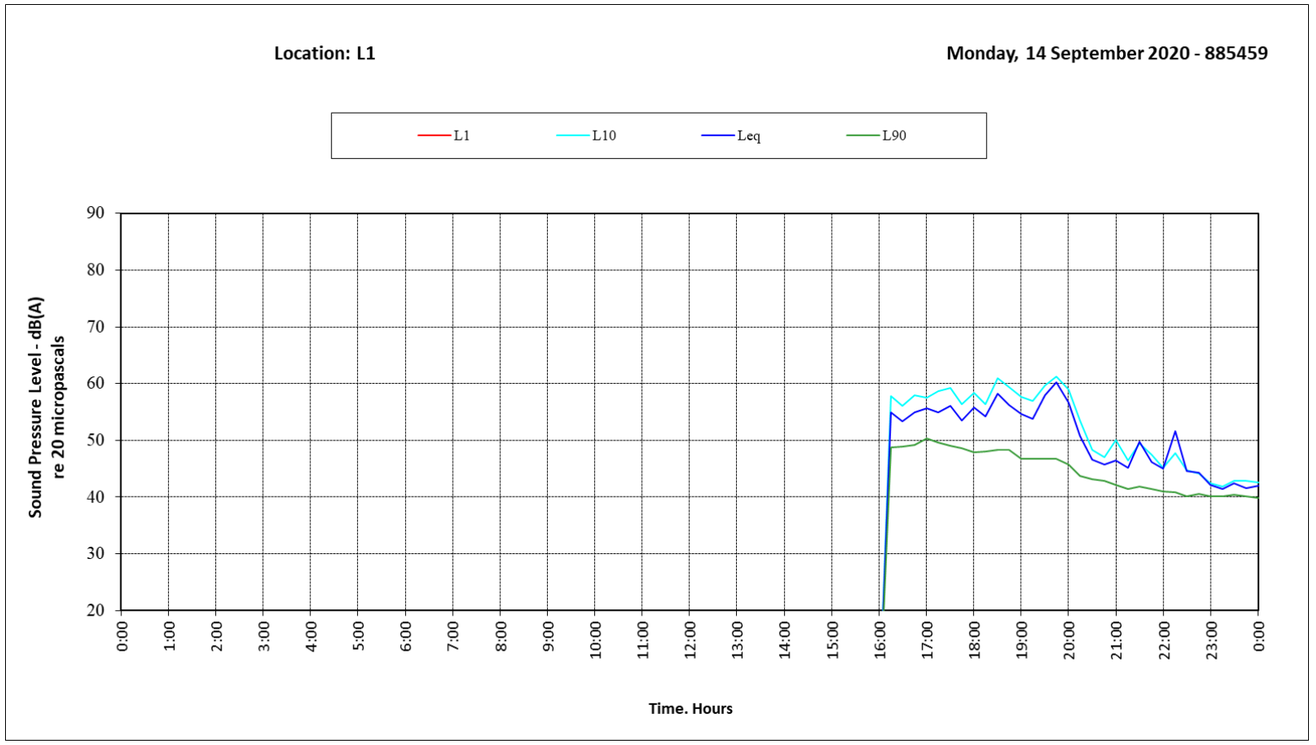
It is recommended the state significant development application for the proposed development is not rejected on the basis of noise and vibration, given the implementation of the mitigation measures outlined within this report.

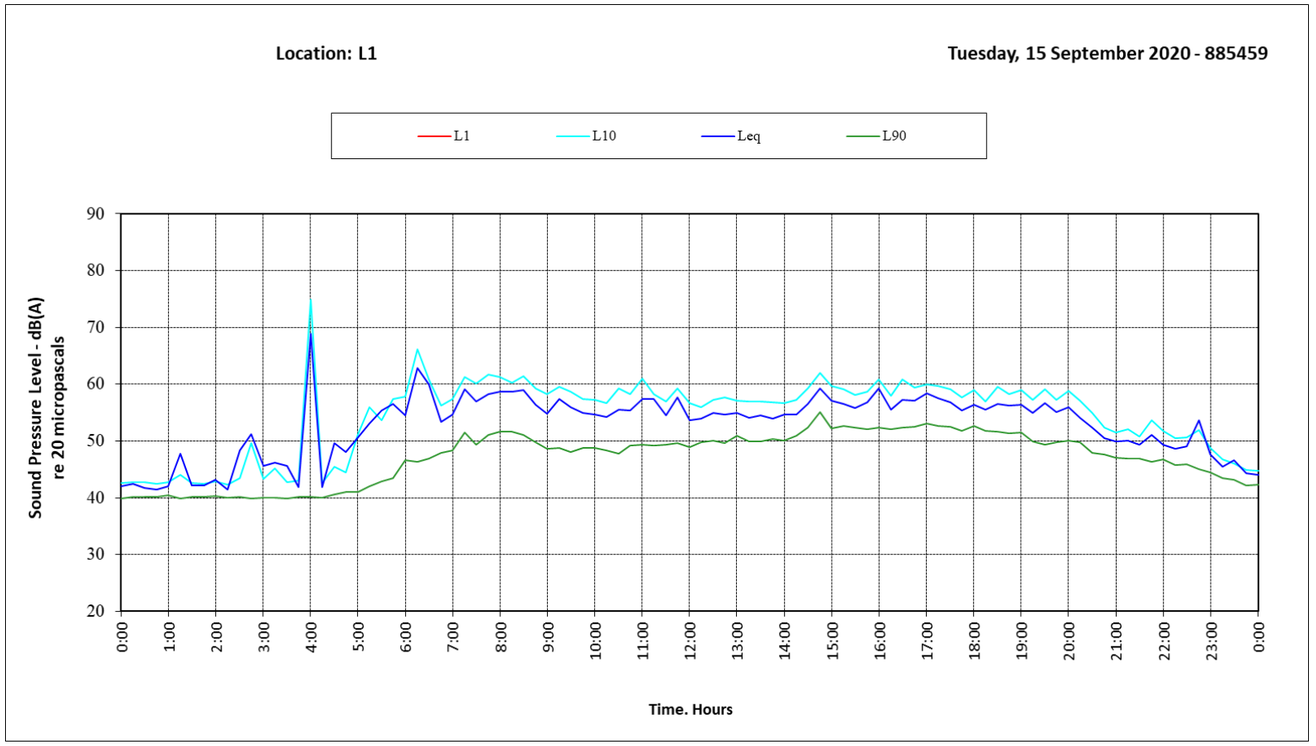
Appendix A - Glossary of Acoustic Terms

Term	Definition
Acceptable Noise Level:	The acceptable L_{Aeq} noise level from industrial sources, recommended by the EPA (Table 2.1, INP). Note that this noise level refers to all industrial sources at the receiver location, and not only noise due to a specific project under consideration.
Adverse Weather:	Weather conditions that affect noise (wind and temperature inversions) that occur at a particular site for a significant period of time. The previous conditions are for wind occurring more than 30% of the time in any assessment period in any season and/or for temperature inversions occurring more than 30% of the nights in winter).
Acoustic Barrier:	Solid walls or partitions, solid fences, earth mounds, earth berms, buildings, etc. used to reduce noise.
Ambient Noise:	The all-encompassing noise associated within a given environment at a given time, usually composed of sound from all sources near and far.
Assessment Period:	The period in a day over which assessments are made.
Assessment Location	The position at which noise measurements are undertaken or estimated.
Background Noise:	Background noise is the term used to describe the underlying level of noise present in the ambient noise, measured in the absence of the noise under investigation, when extraneous noise is removed. It is described as the average of the minimum noise levels measured on a sound level meter and is measured statistically as the A-weighted noise level exceeded for ninety percent of a sample period. This is represented as the L_{A90} noise level.
Decibel [dB]:	The units of sound pressure level.
dB(A):	A-weighted decibels. Noise measured using the A-filter.
Extraneous Noise:	Noise resulting from activities that are not typical of the area. Atypical activities include construction, and traffic generated by holidays period and by special events such as concert or sporting events. Normal daily traffic is not considered to be extraneous.
Free Field:	An environment in which there are no acoustic reflective surfaces. Free field noise measurements are carried out outdoors at least 3.5m from any acoustic reflecting structures other than the ground
Frequency:	Frequency is synonymous to pitch. Frequency or pitch can be measured on a scale in units of Hertz (Hz).
Impulsive Noise:	Noise having a high peak of short duration or a sequence of such peaks. A sequence of impulses in rapid succession is termed repetitive impulsive noise.
Intermittent Noise:	Level that drops to the background noise level several times during the period of observation.
L_{Amax}	The maximum A-weighted sound pressure level measured over a period.
L_{Amin}	The minimum A-weighted sound pressure level measured over a period.
L_{A1}	The A-weighted sound pressure level that is exceeded for 1% of the time for which the sound is measured.
L_{A10}	The A-weighted sound pressure level that is exceeded for 10% of the time for which the sound is measured.
L_{A90}	The A-weighted level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L_{A90} noise level expressed in units of dB(A).
L_{Aeq}	The A-weighted “equivalent noise level” is the summation of noise events and integrated over a selected period of time.

$L_{Aeq,T}$	The constant A-weighted sound which has the same energy as the fluctuating sound of the measurement, averaged over time T.
Reflection:	Sound wave changed in direction of propagation due to a solid object met on its path.
R_w:	The Sound Insulation Rating R_w is a measure of the noise reduction performance of the partition.
SEL:	Sound Exposure Level is the constant sound level which, if maintained for a period of 1 second would have the same acoustic energy as the measured noise event. SEL noise measurements are useful as they can be converted to obtain L_{eq} sound levels over any period of time and can be used for predicting noise at various locations.
Sound Absorption:	The ability of a material to absorb sound energy through its conversion into thermal energy.
Sound Level Meter:	An instrument consisting of a microphone, amplifier and indicating device, having a declared performance and designed to measure sound pressure levels.
Sound Pressure Level:	The level of noise, usually expressed in decibels, as measured by a standard sound level meter with a microphone.
Sound Power Level:	Ten times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power.
Tonal noise:	Containing a prominent frequency and characterised by a definite pitch.

Appendix B – Noise Monitoring Results – Daily Noise Data





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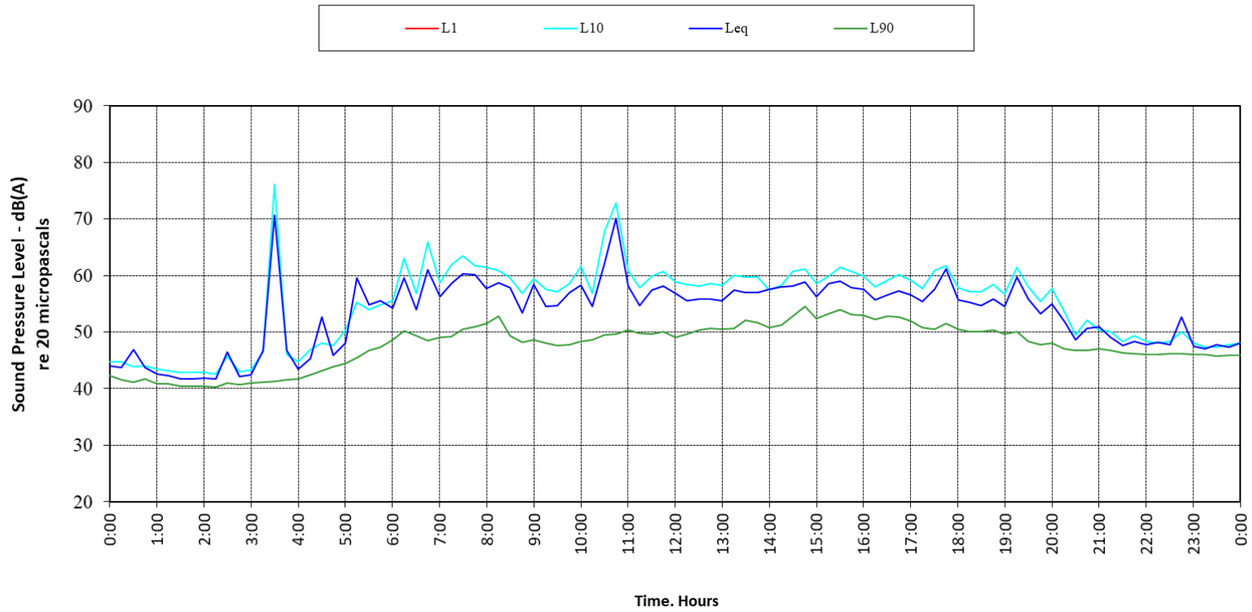

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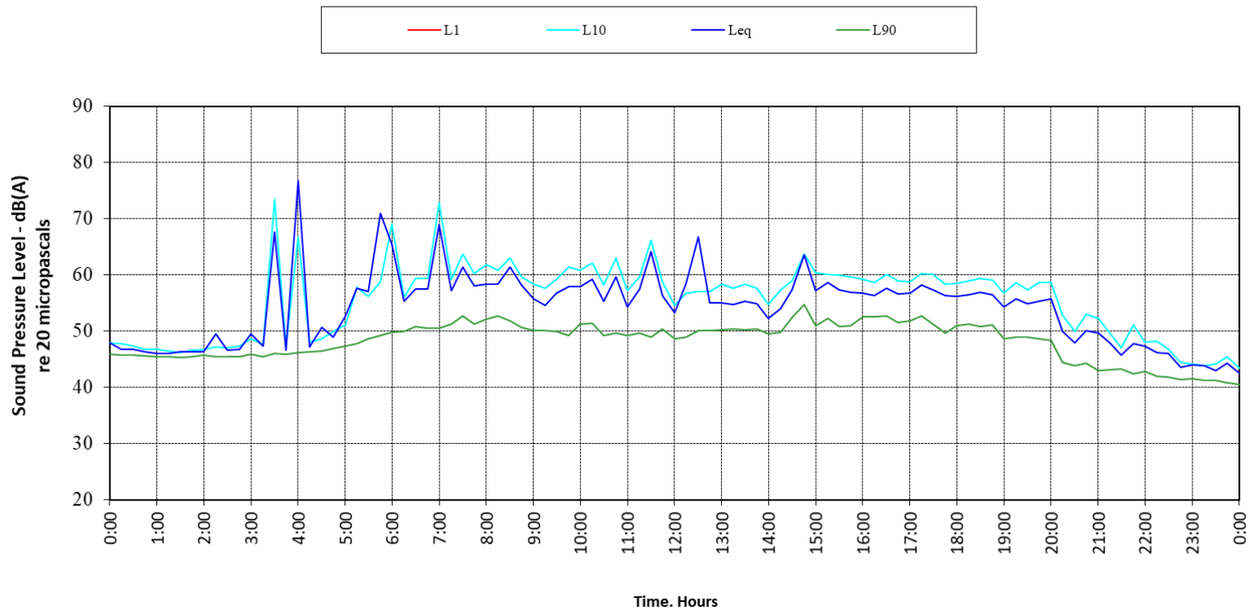

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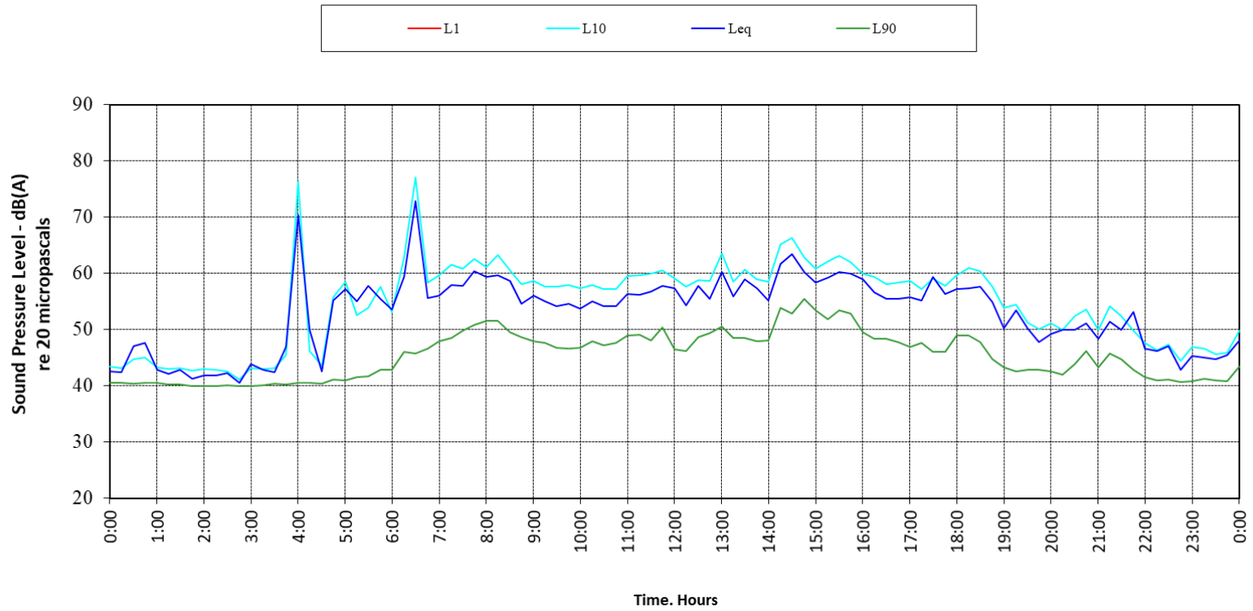

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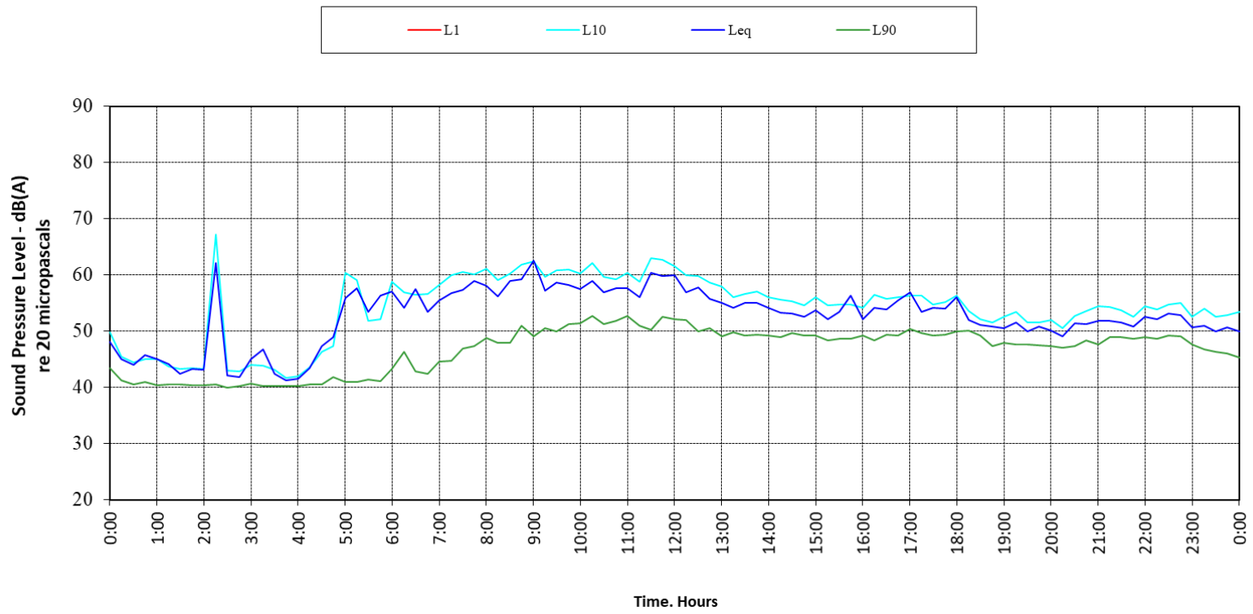

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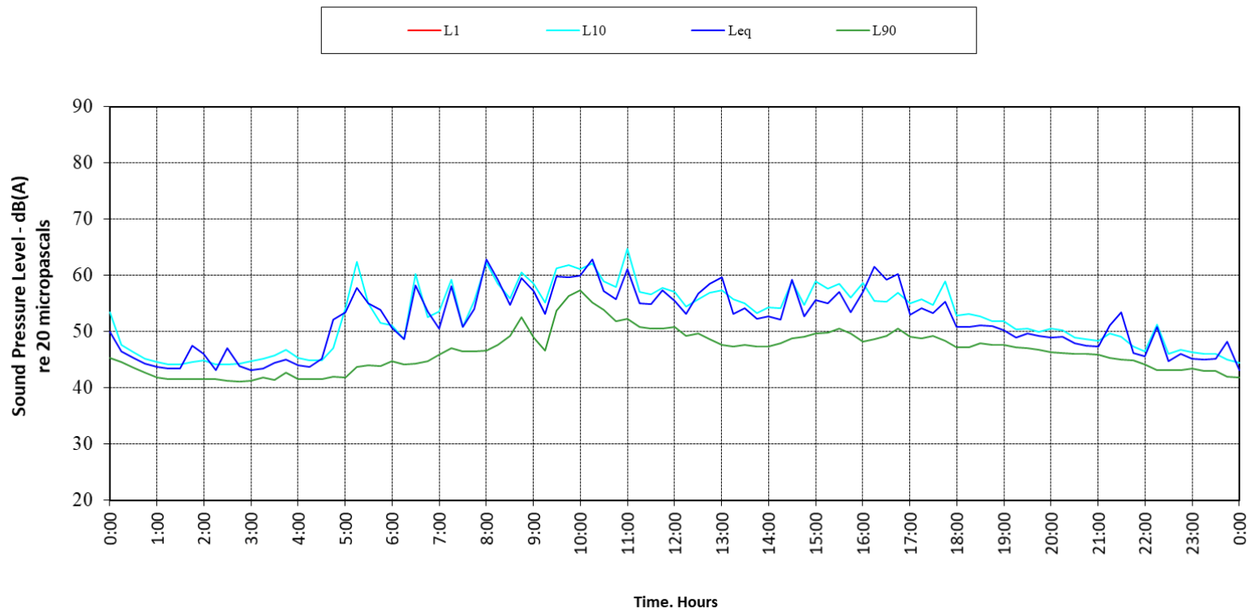

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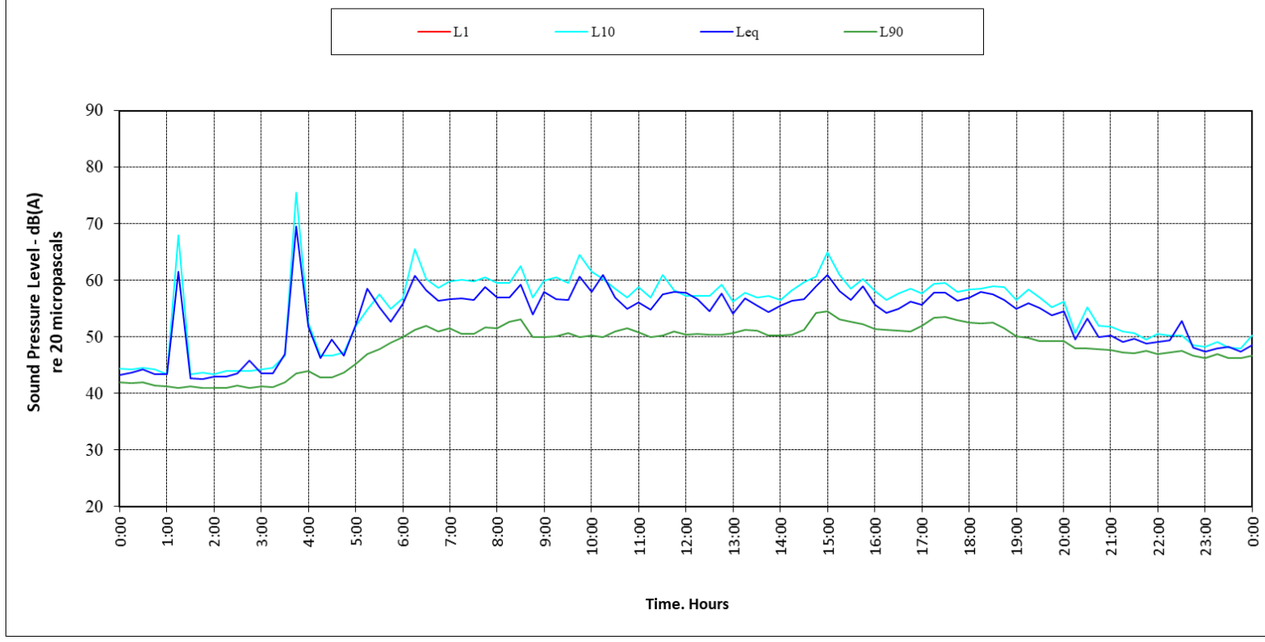

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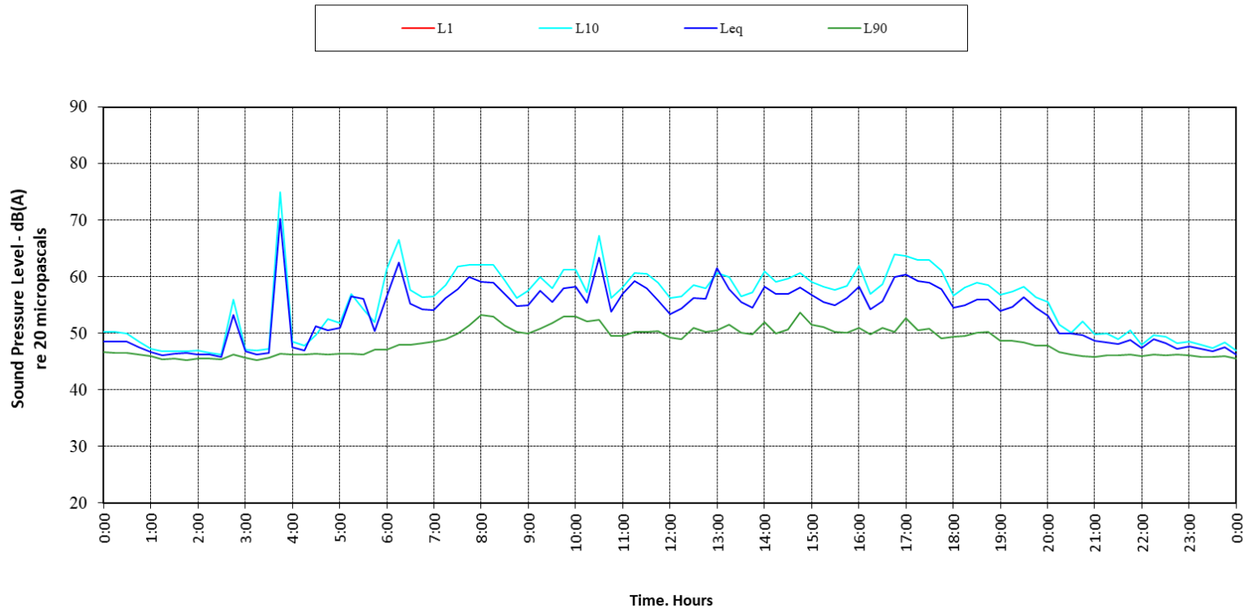

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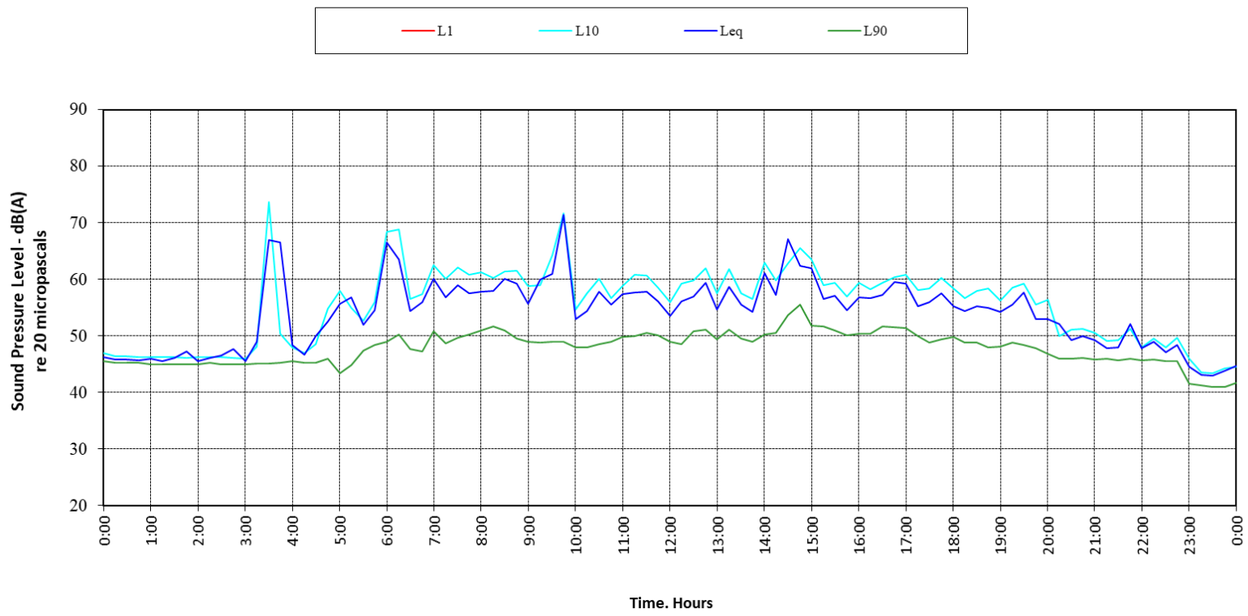

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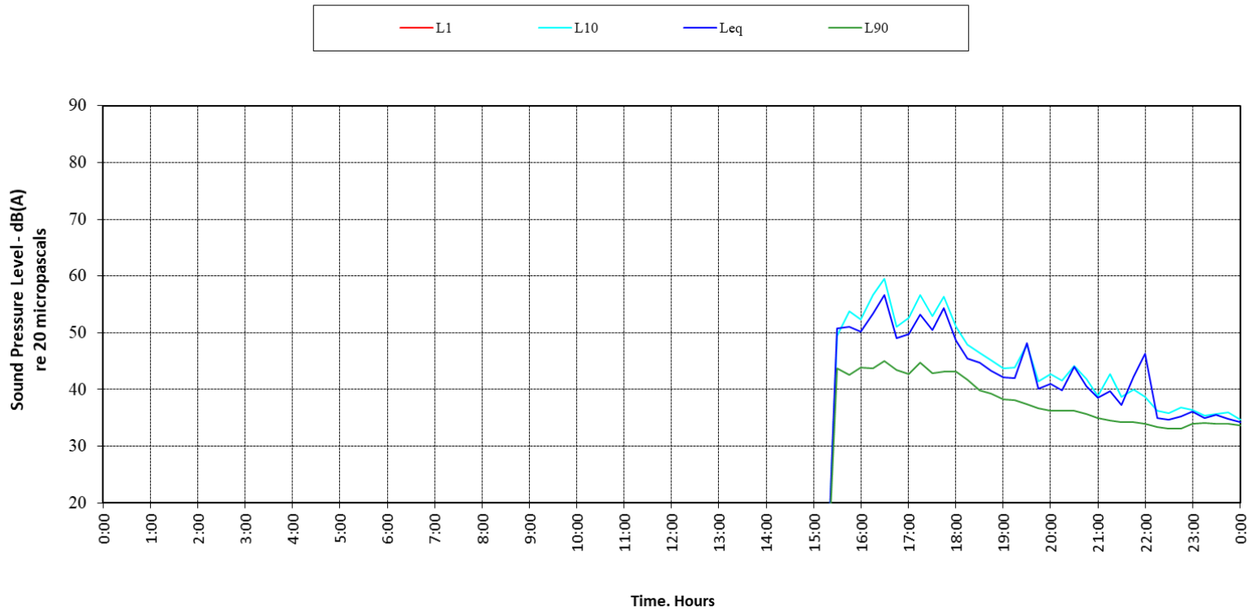

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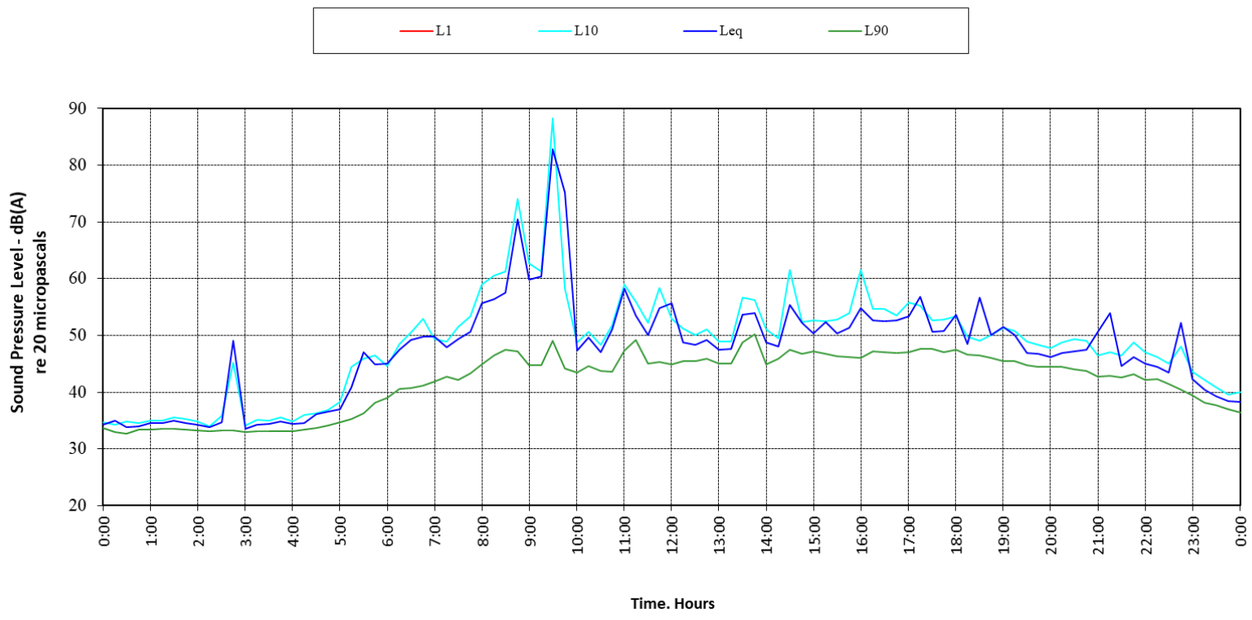

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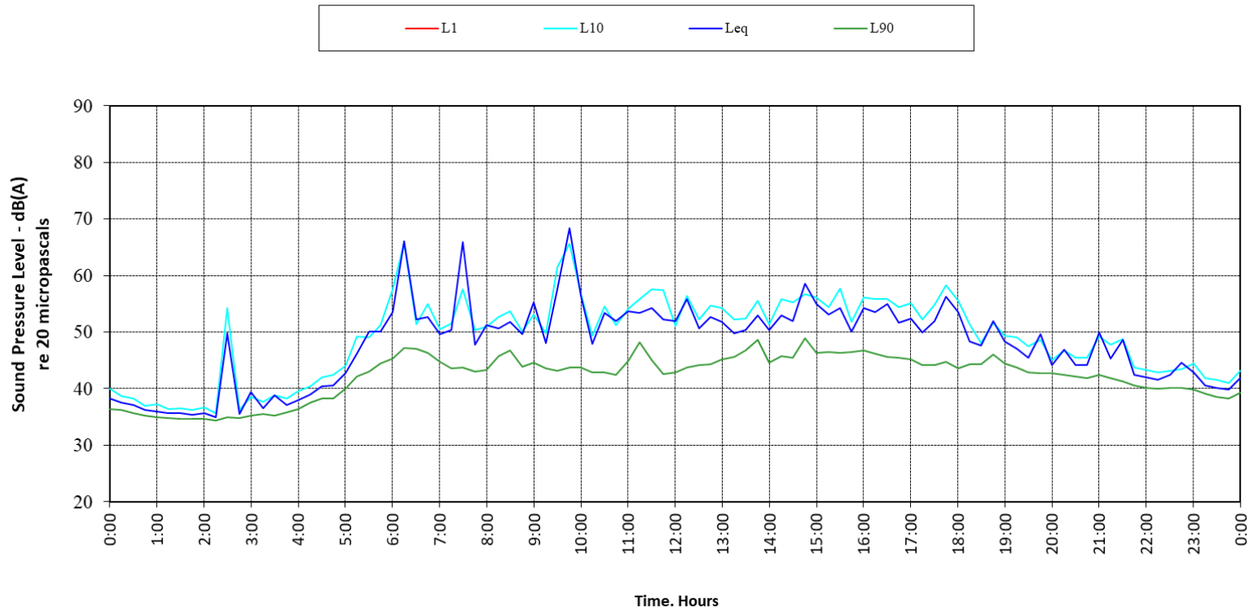

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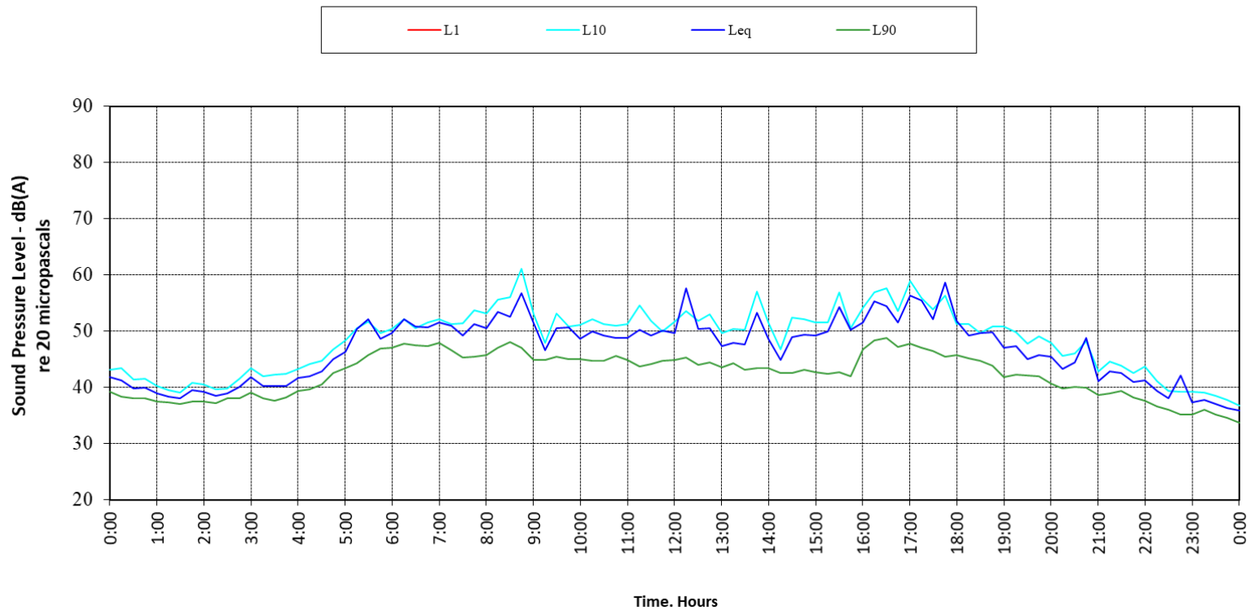

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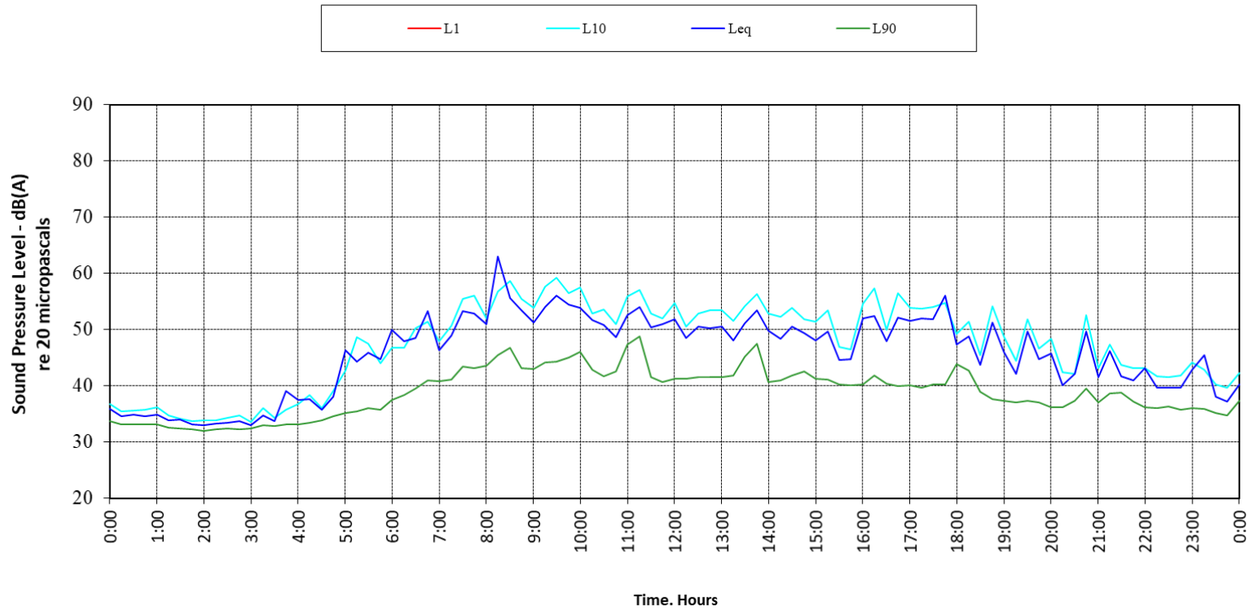

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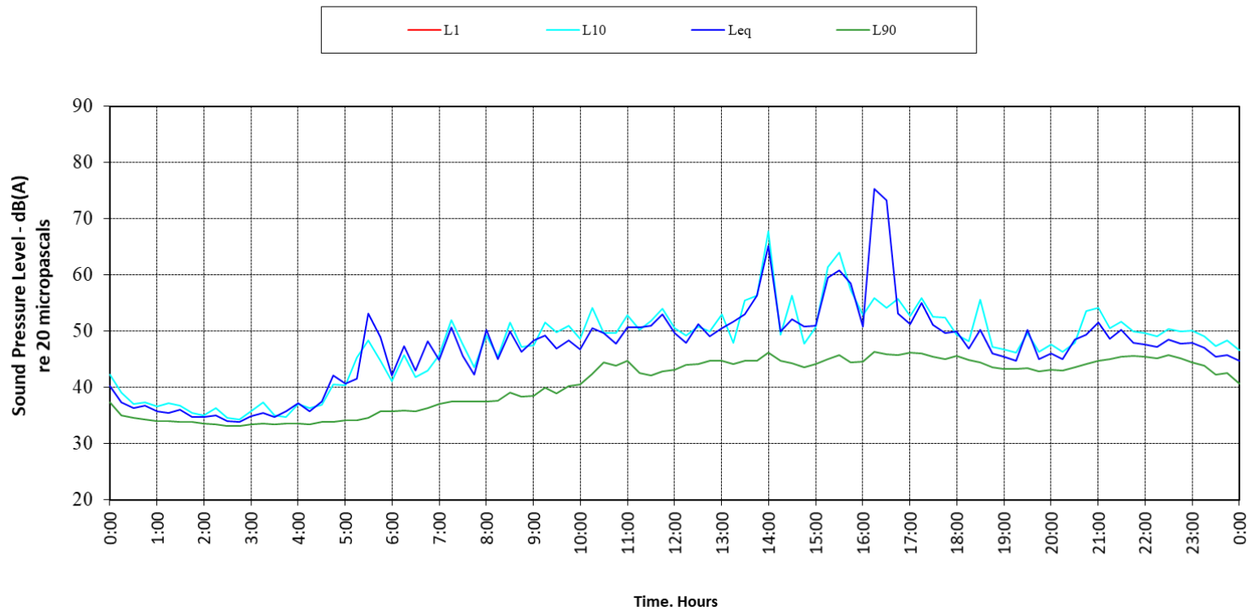

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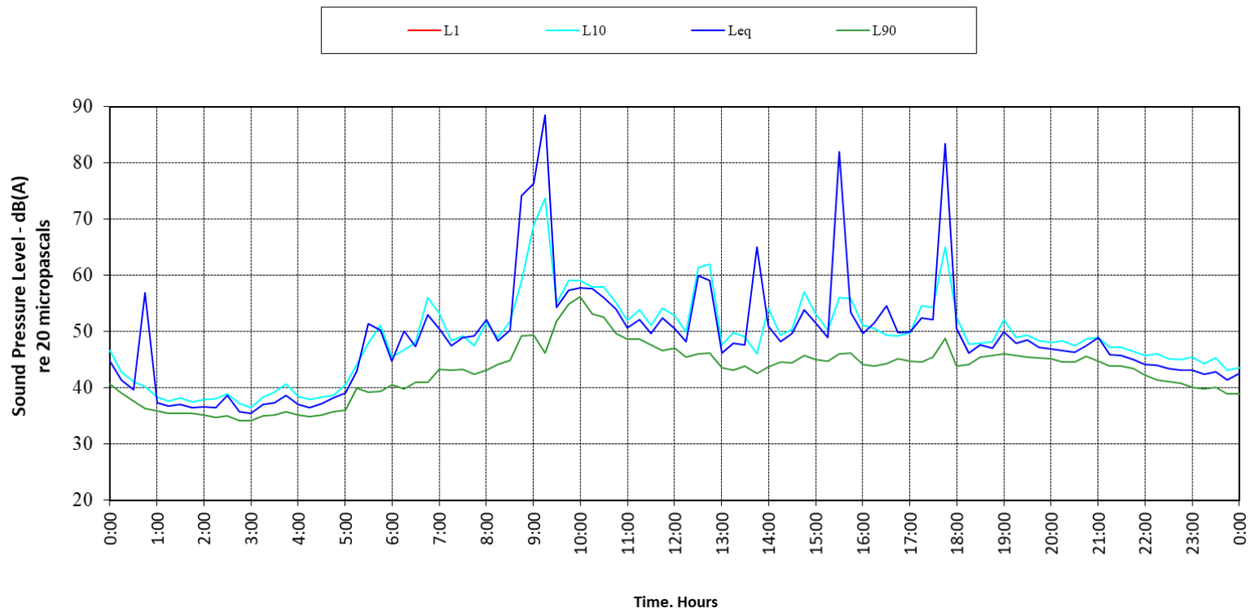

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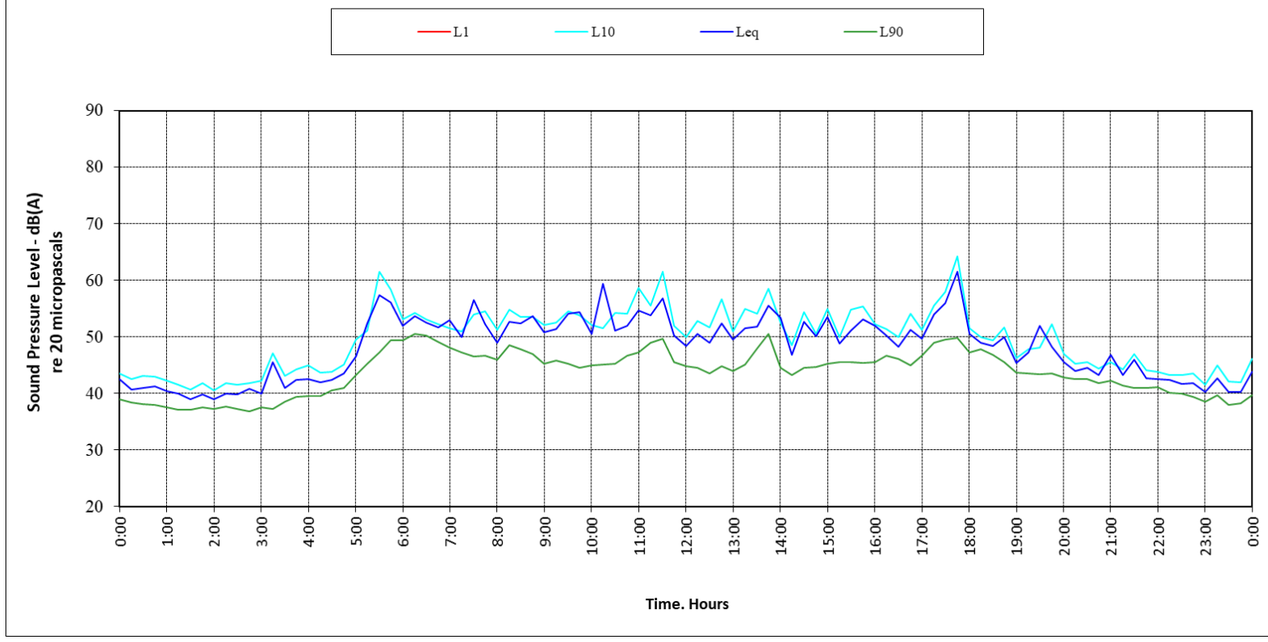

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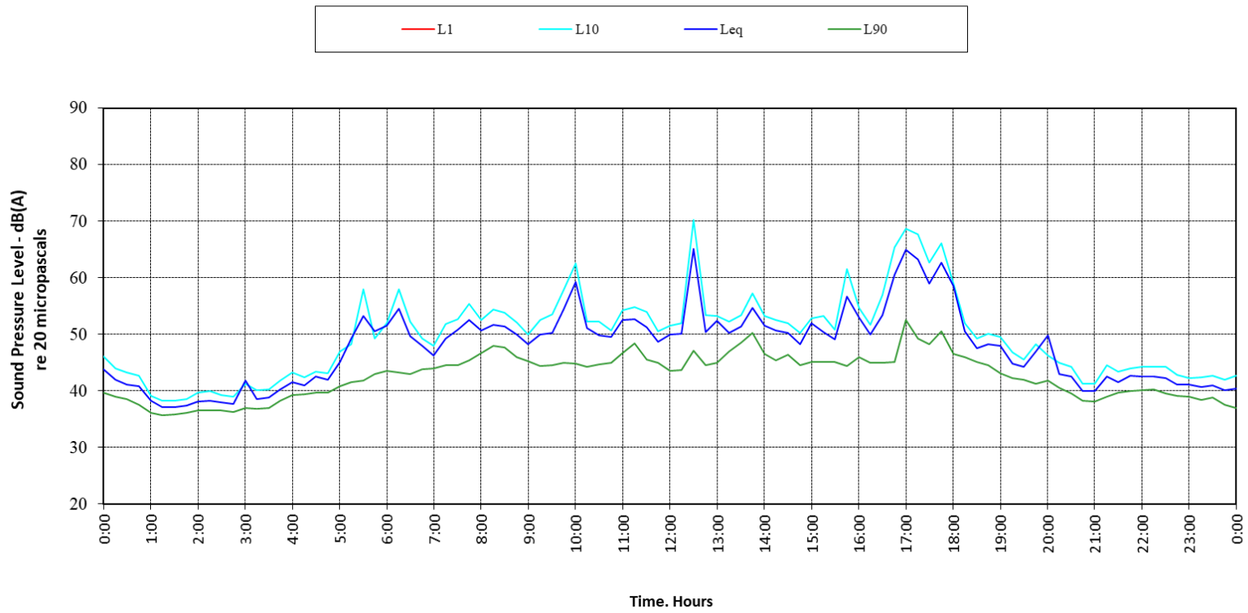

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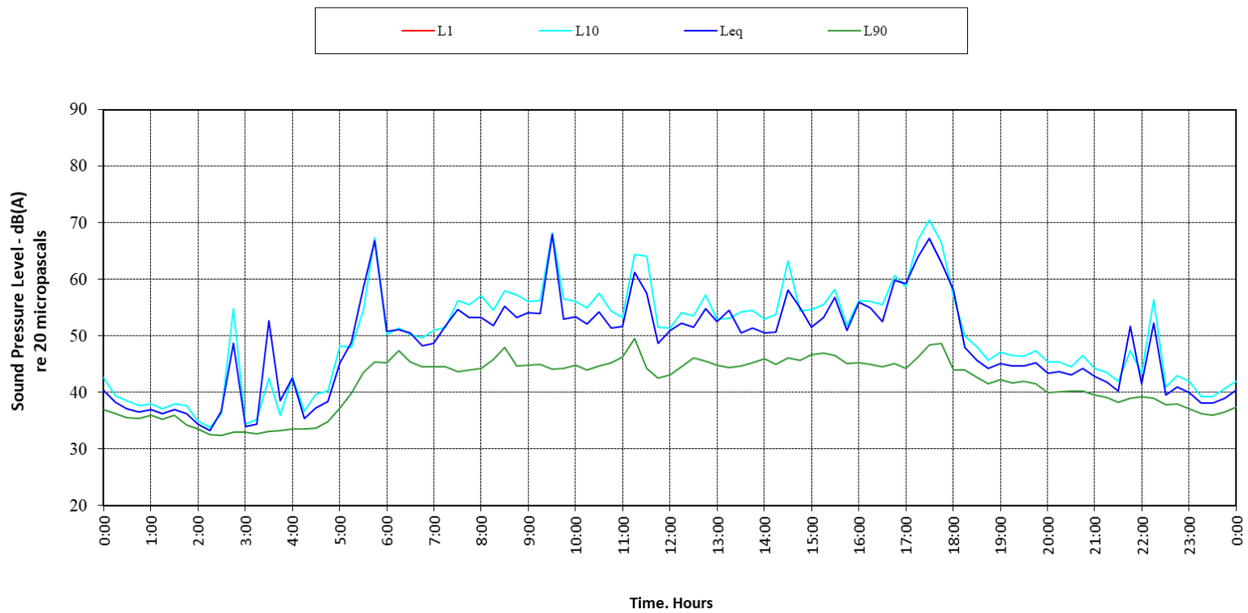

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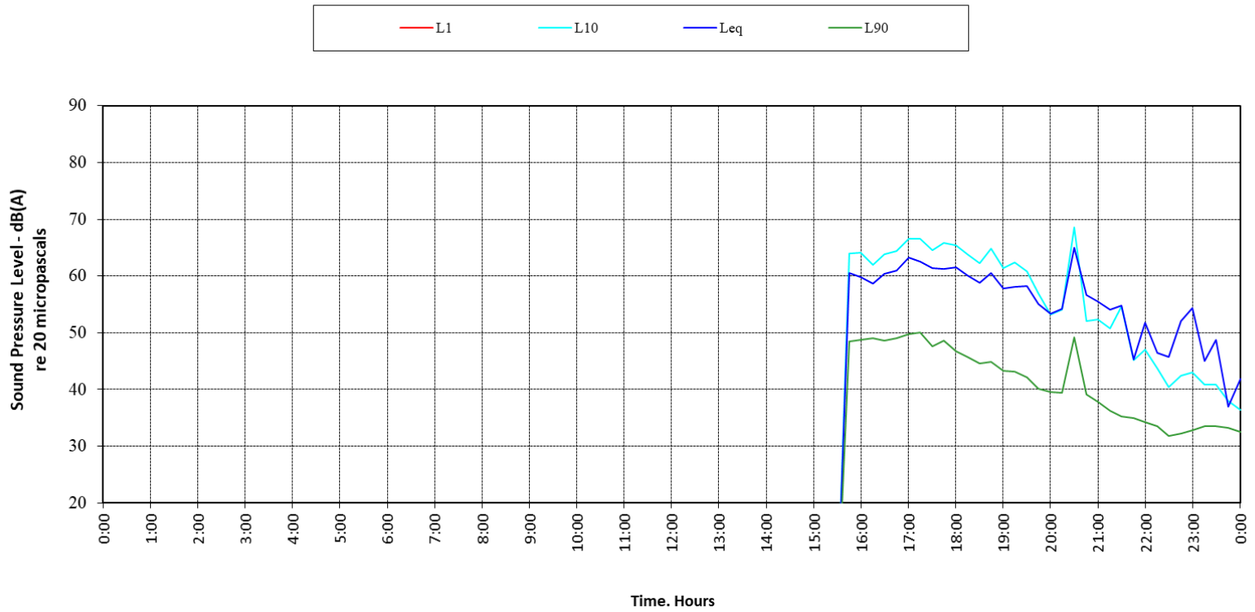

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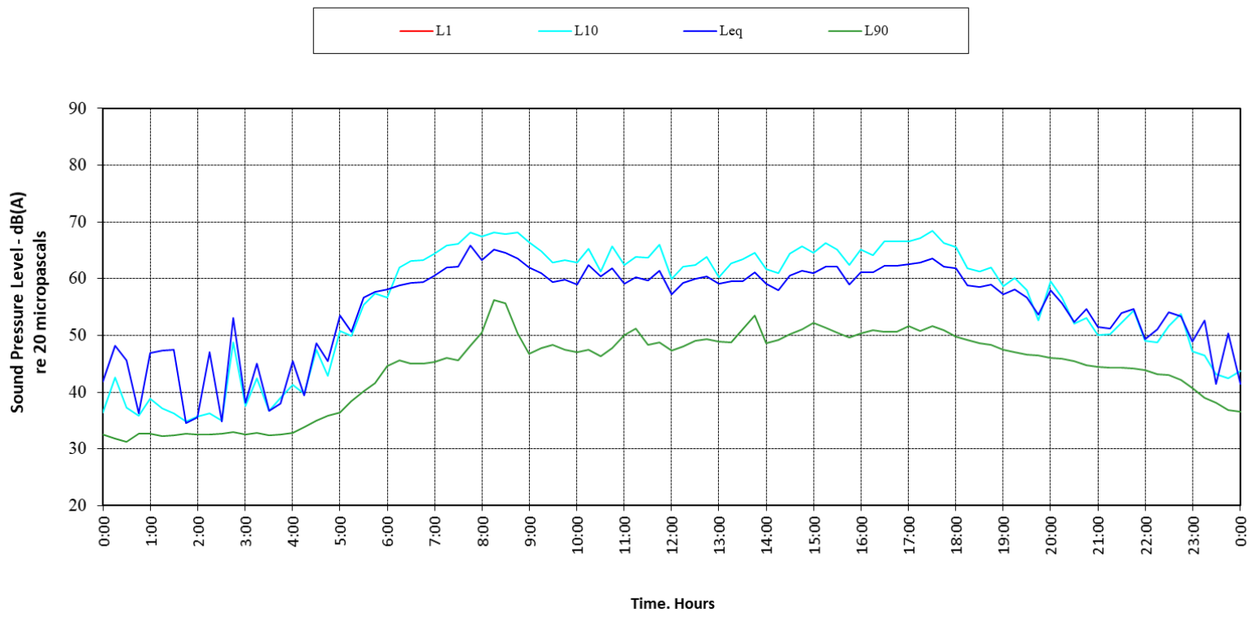

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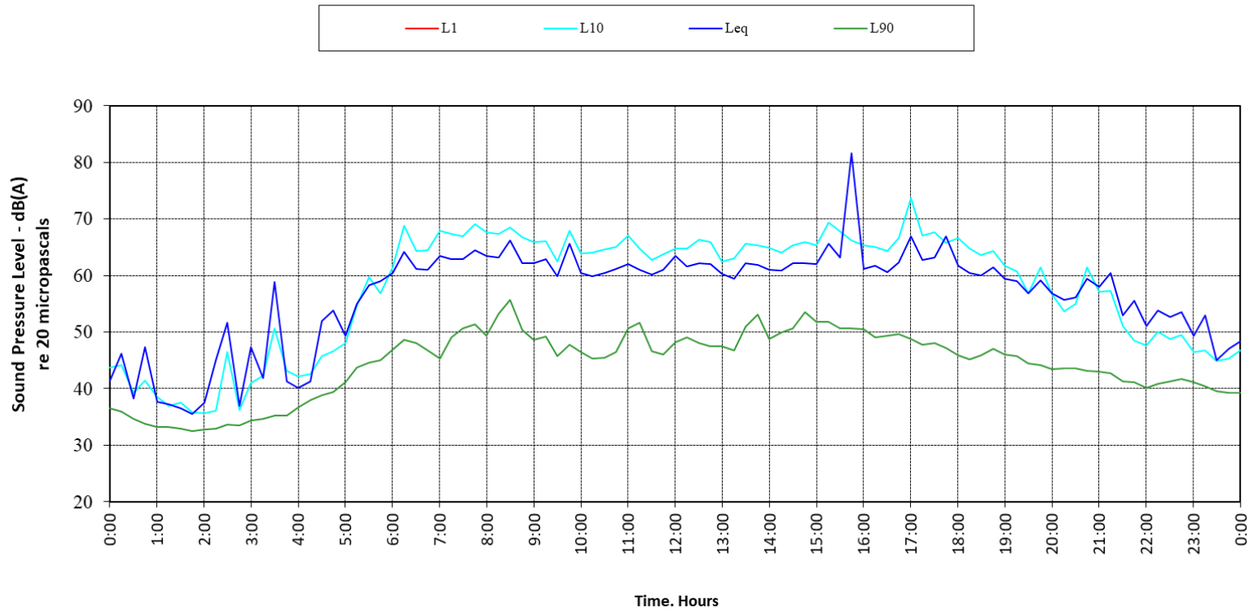

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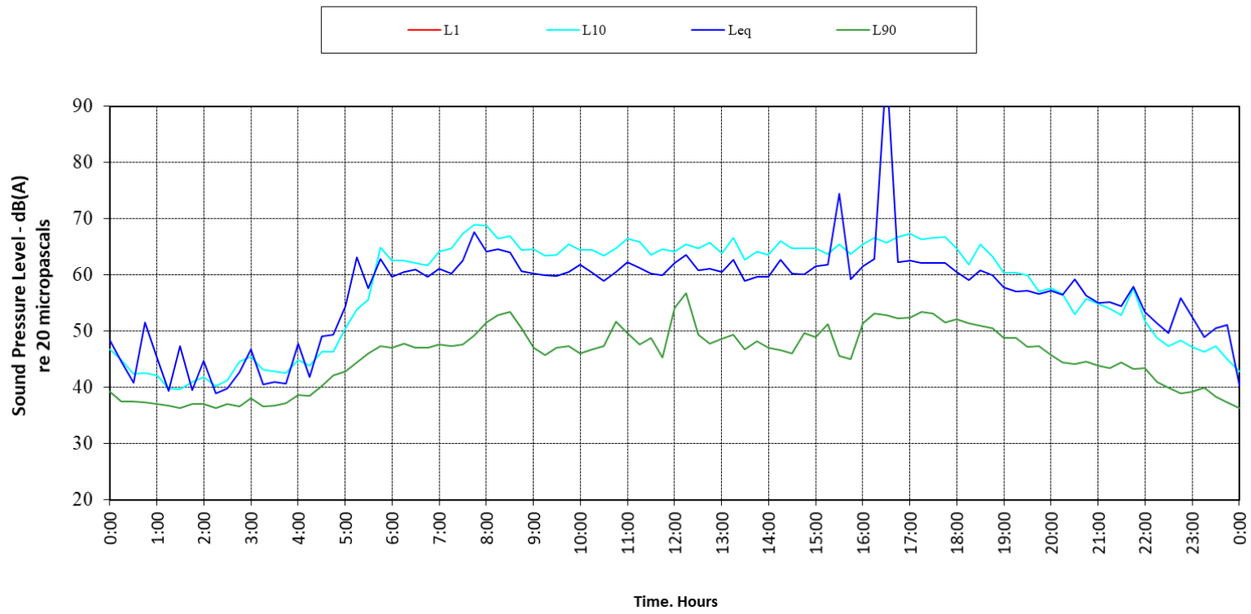

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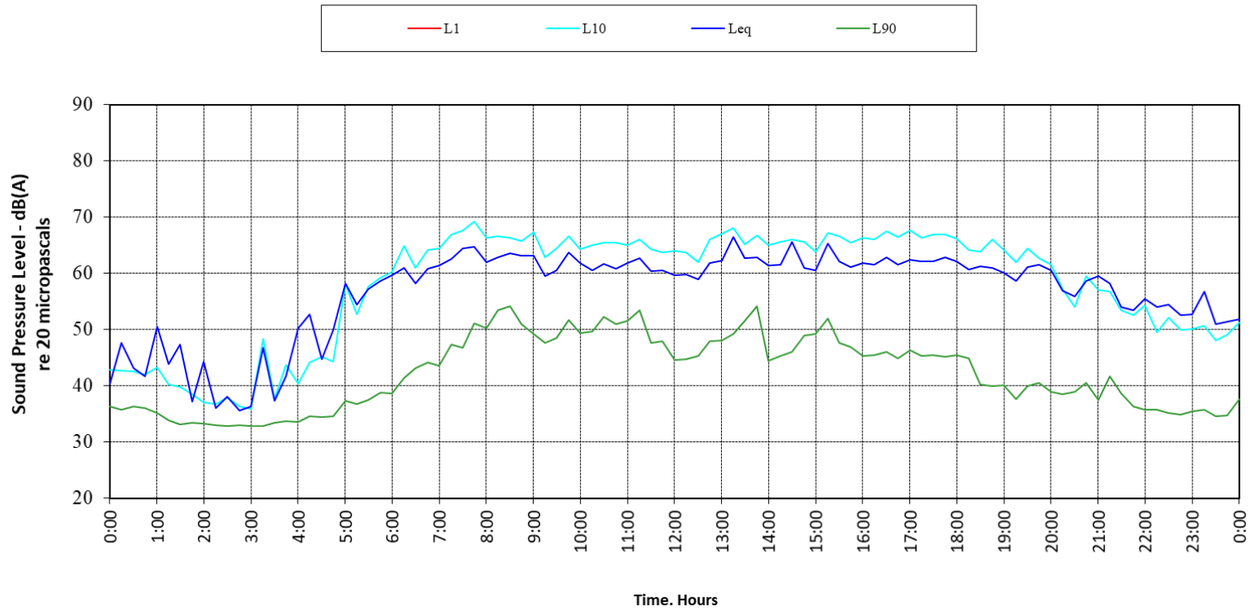

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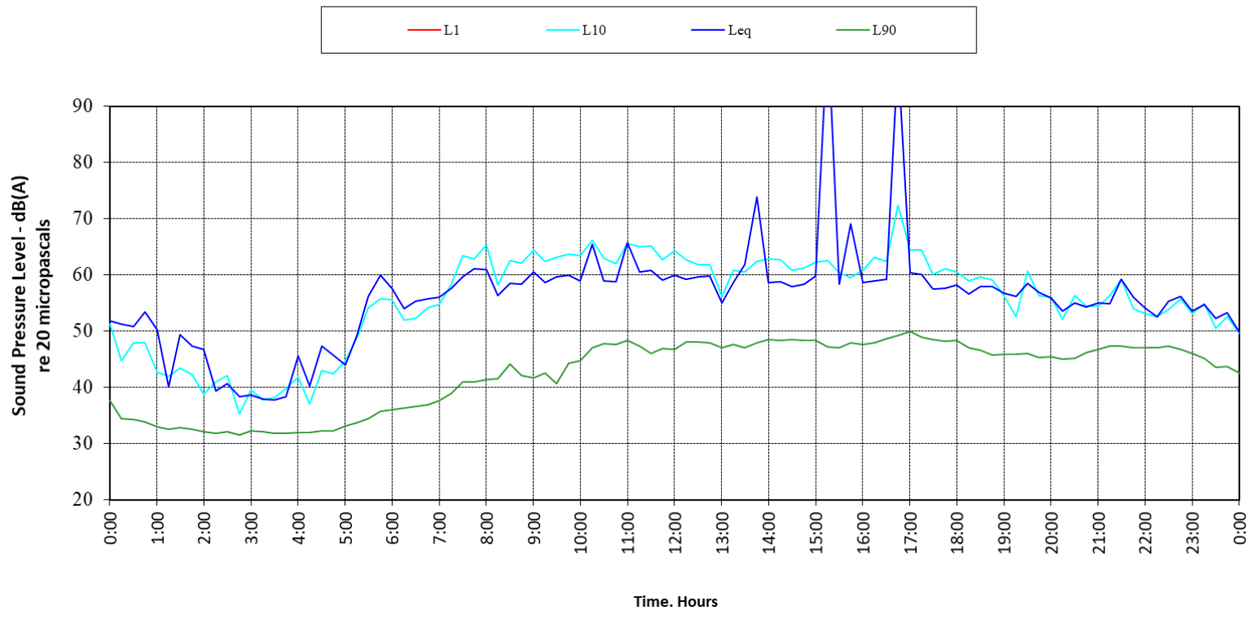

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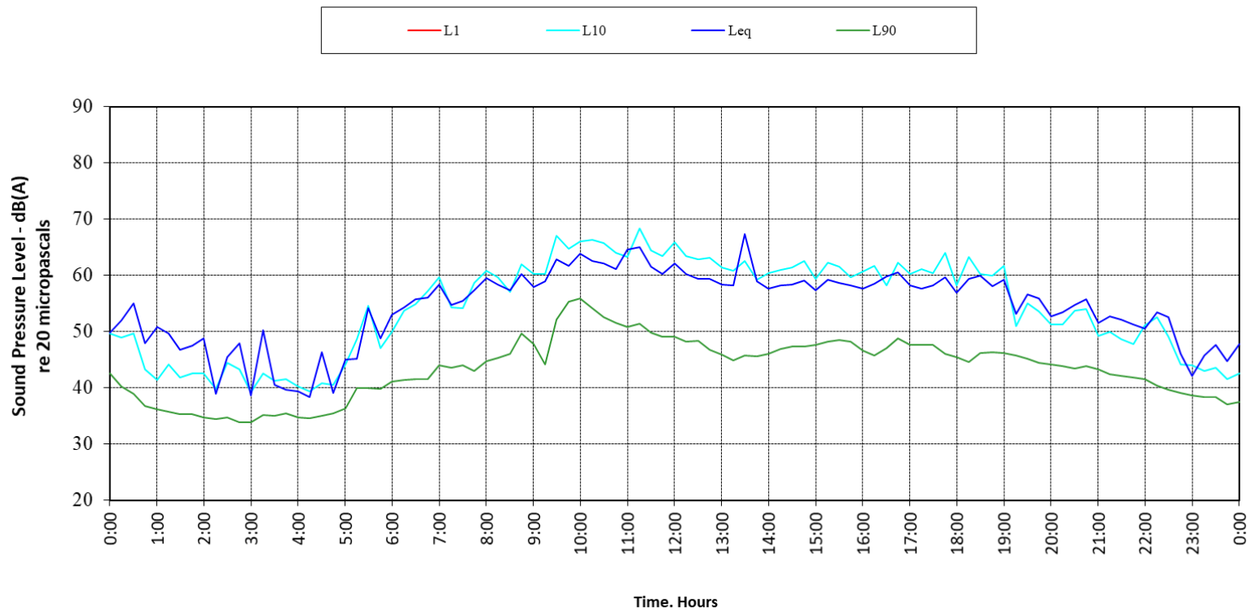

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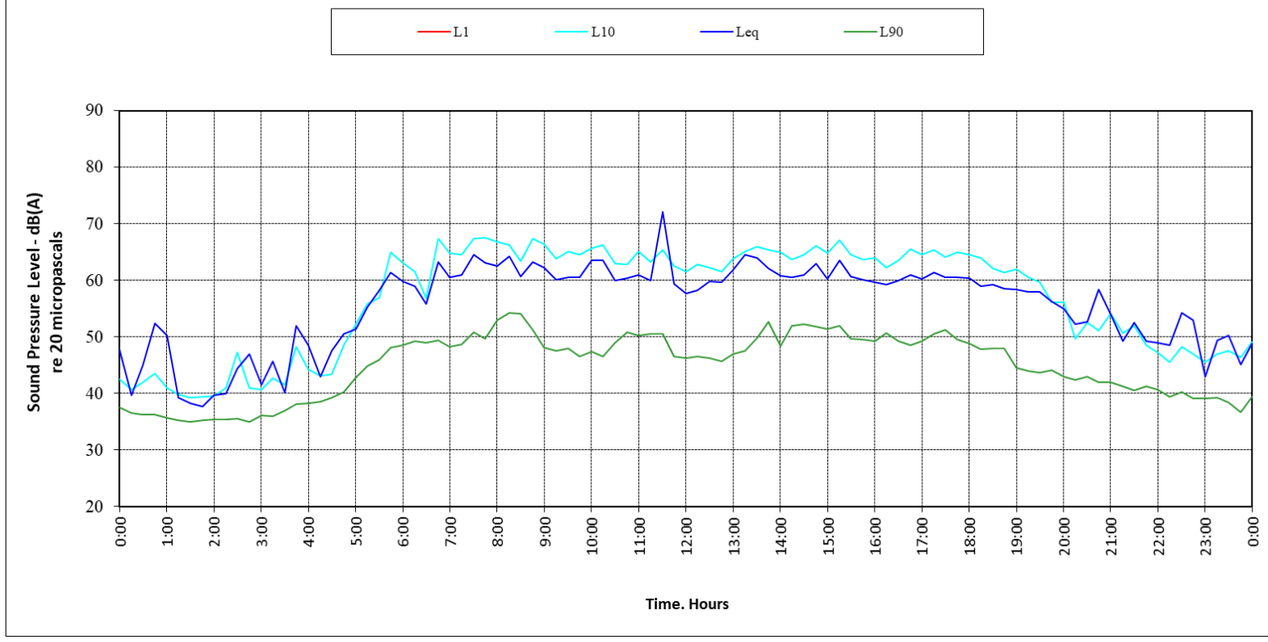

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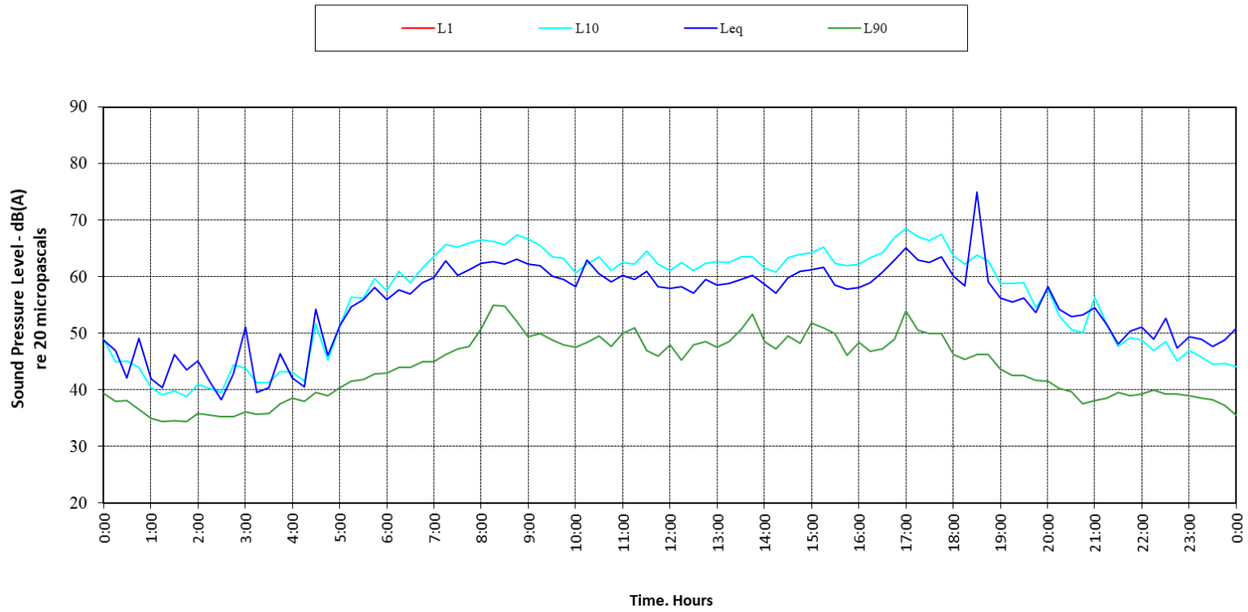

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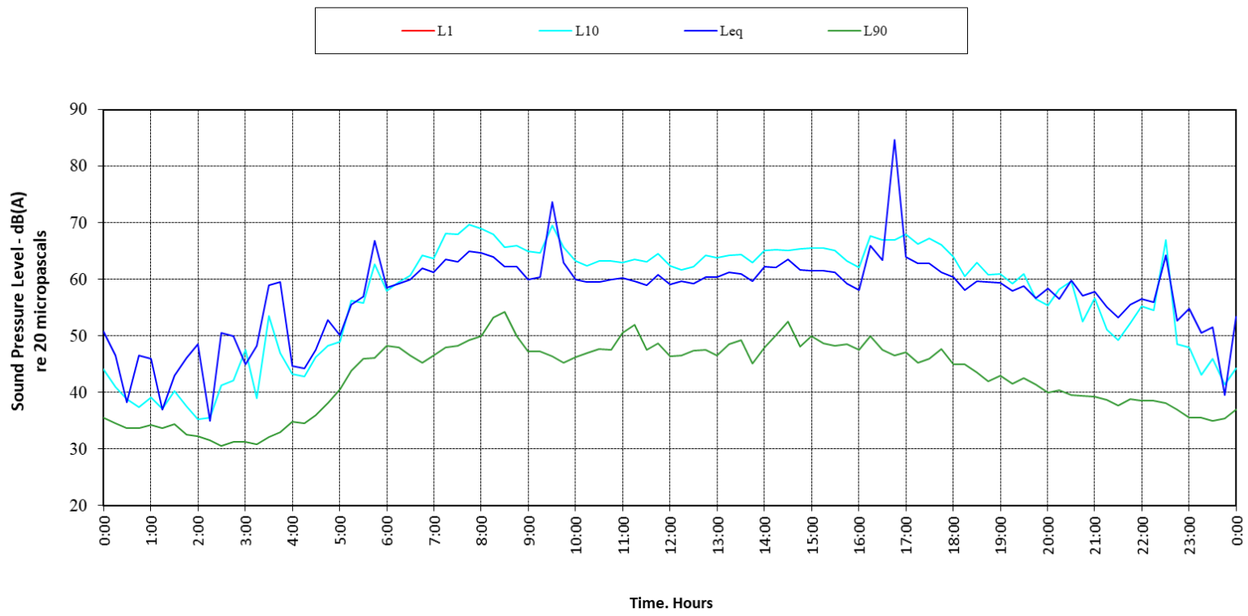

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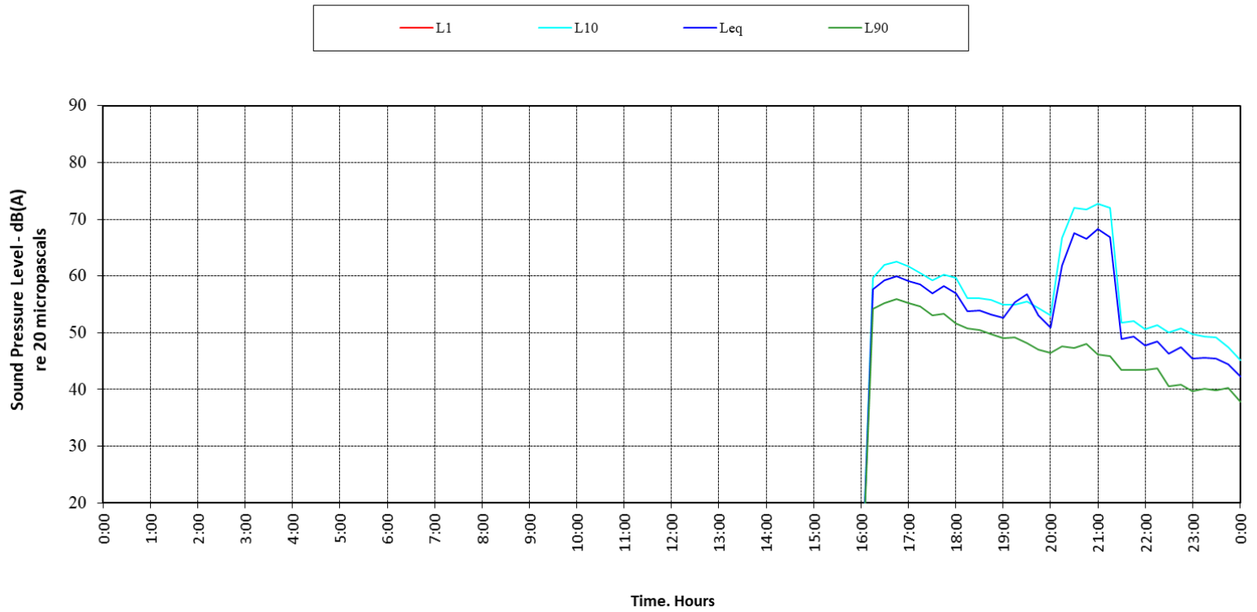

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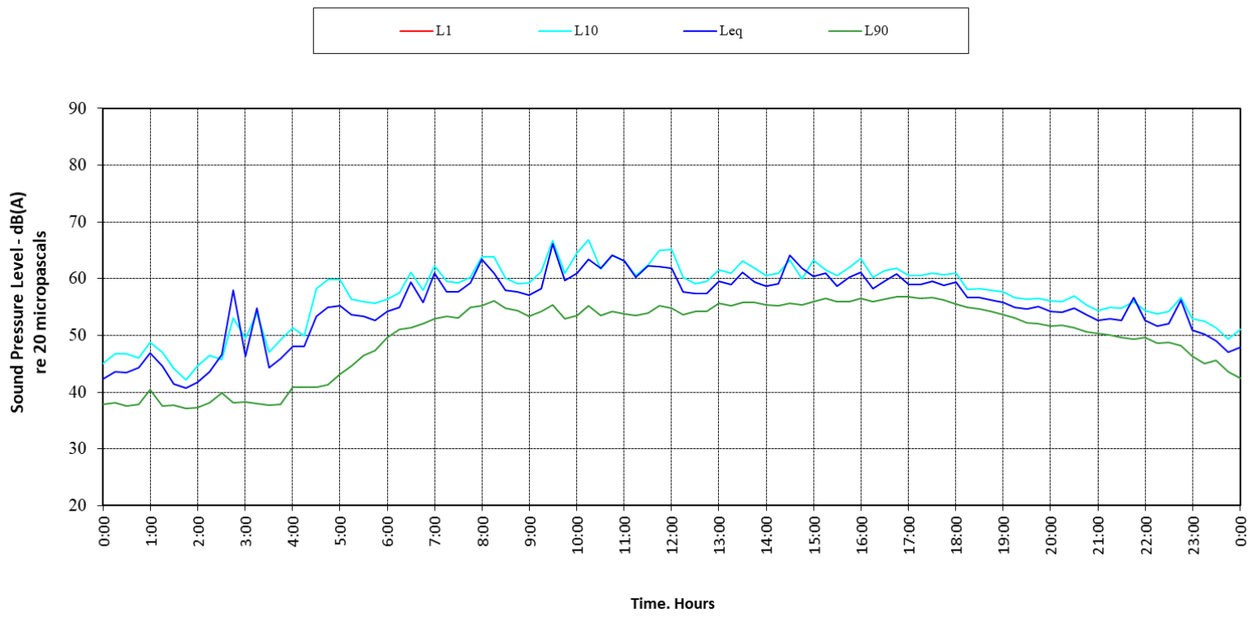

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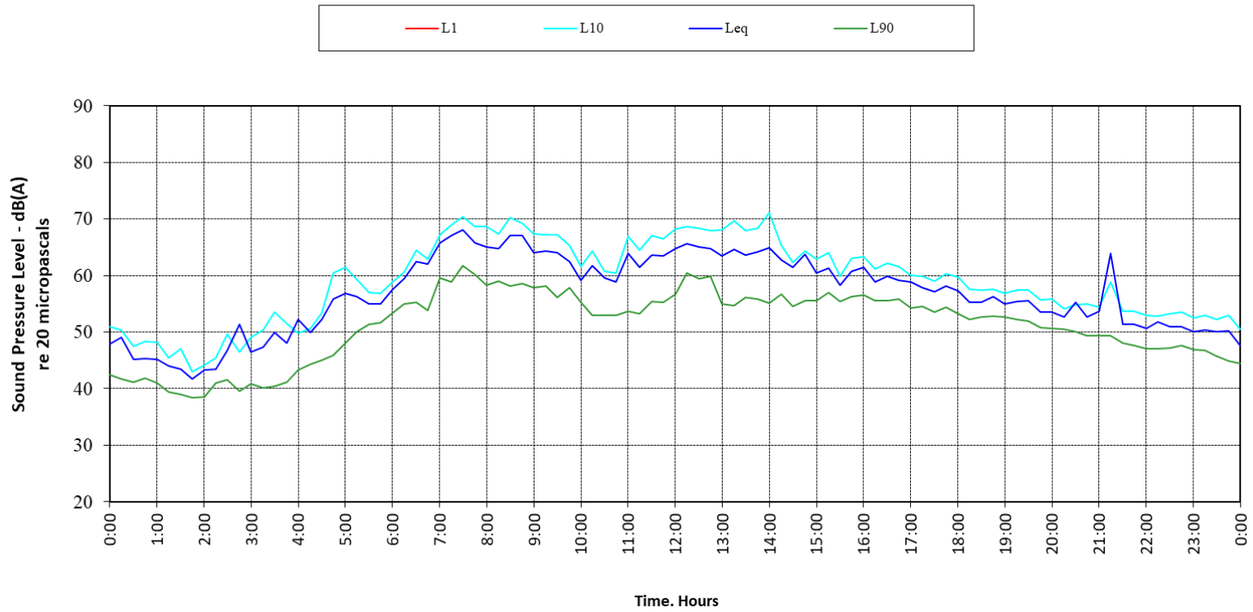

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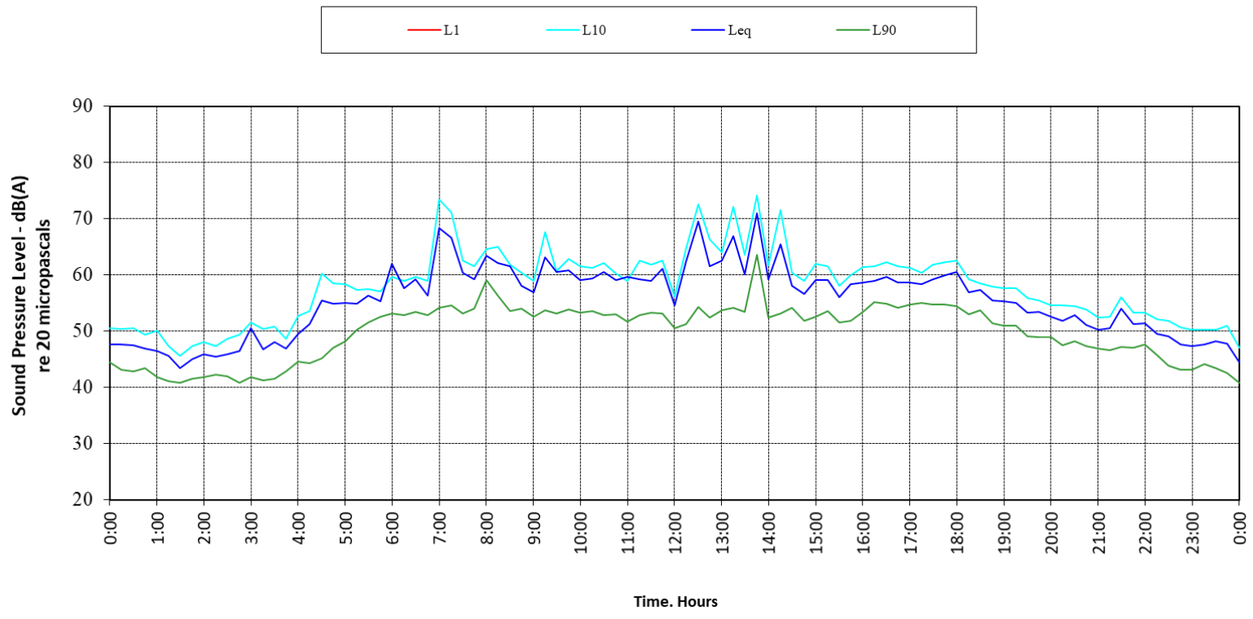

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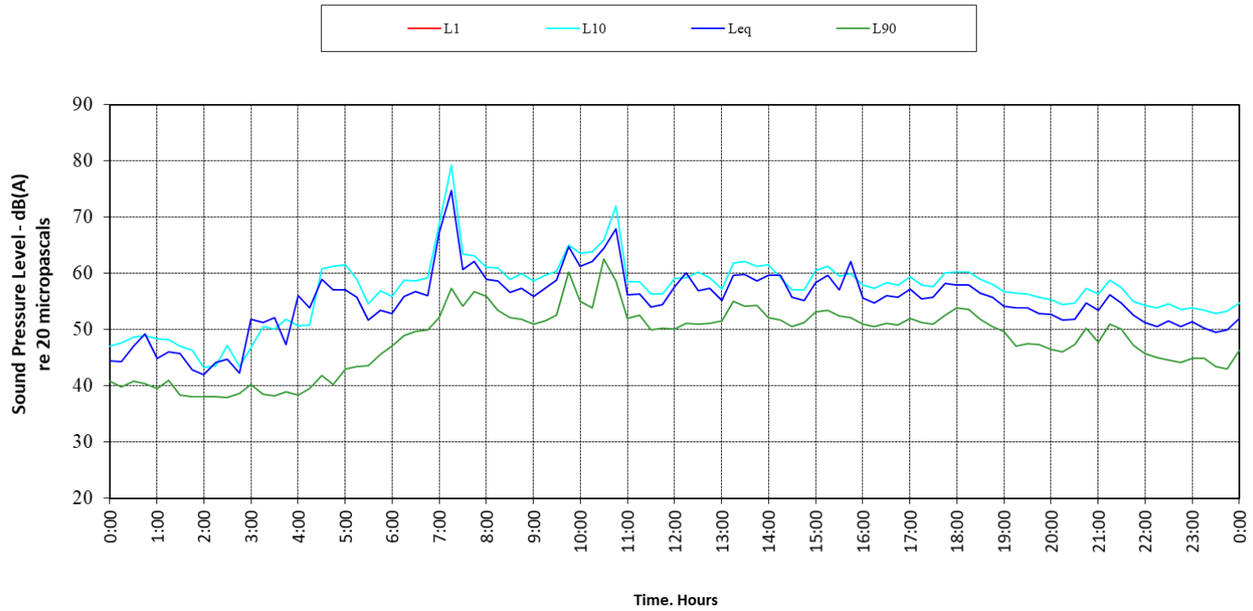

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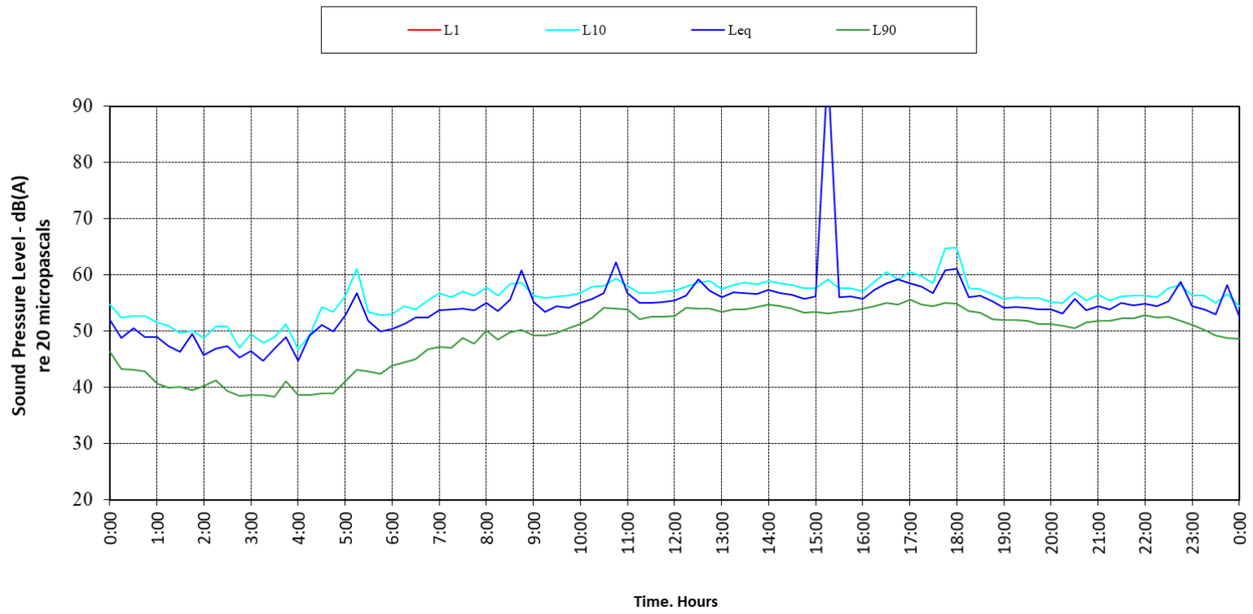
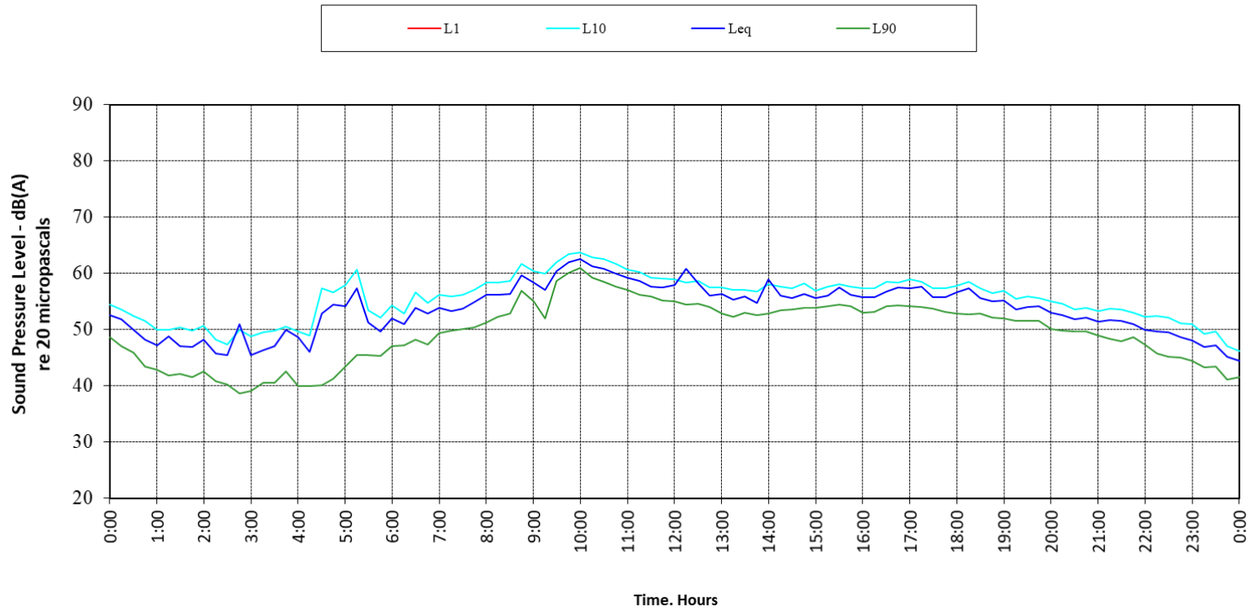


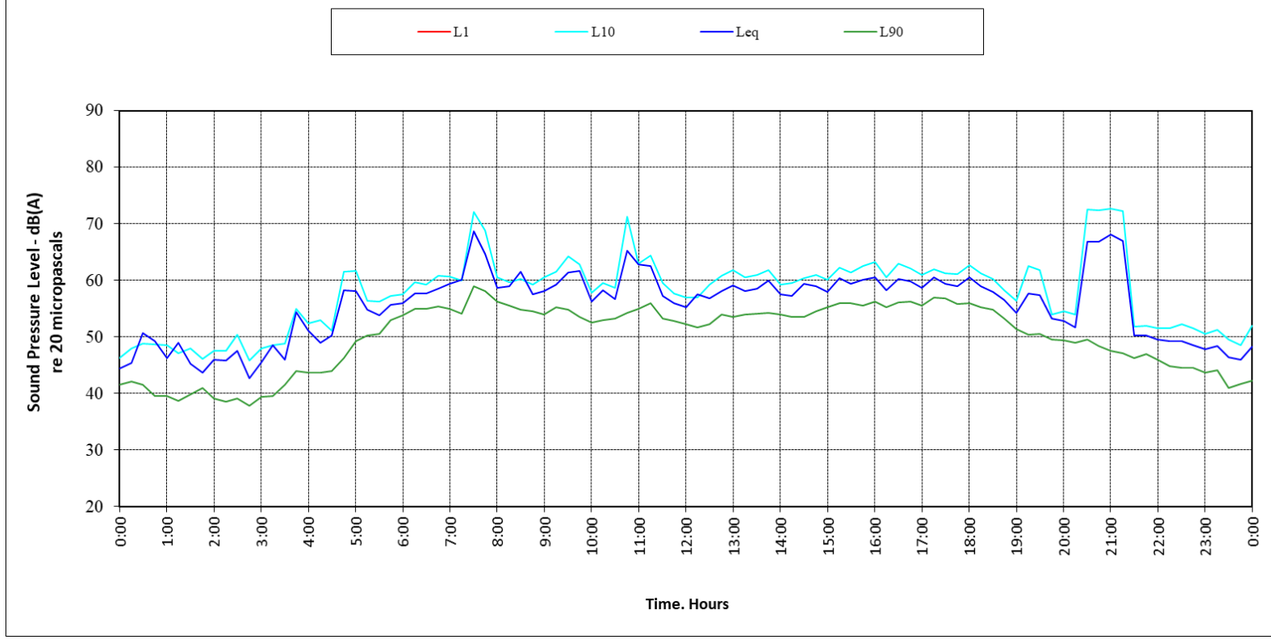
Location: L4

Sunday, 20 September 2020 - 1173624

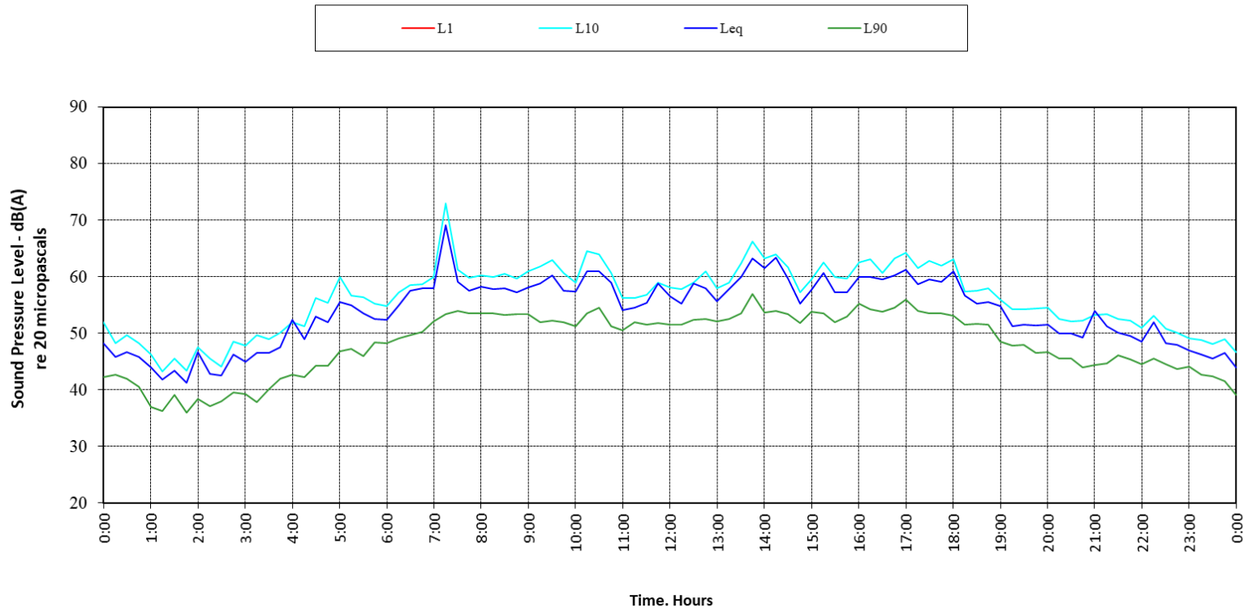


Location: L4

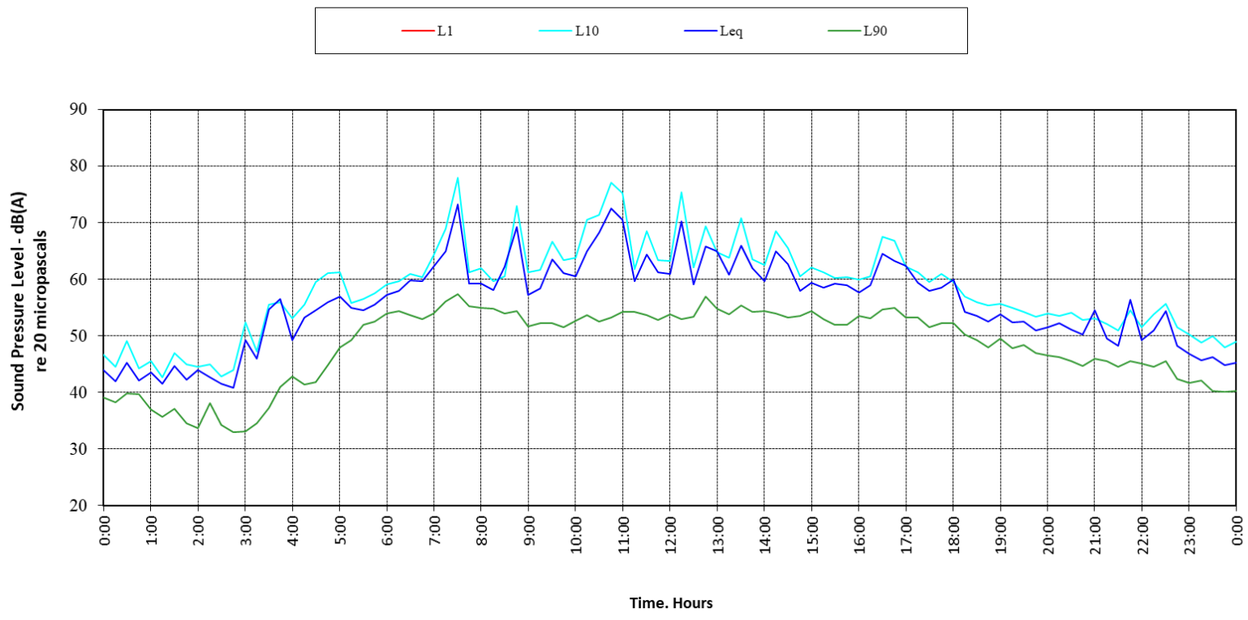
Monday, 21 September 2020 - 1173624



Location: L4 **Tuesday, 22 September 2020 - 1173624**

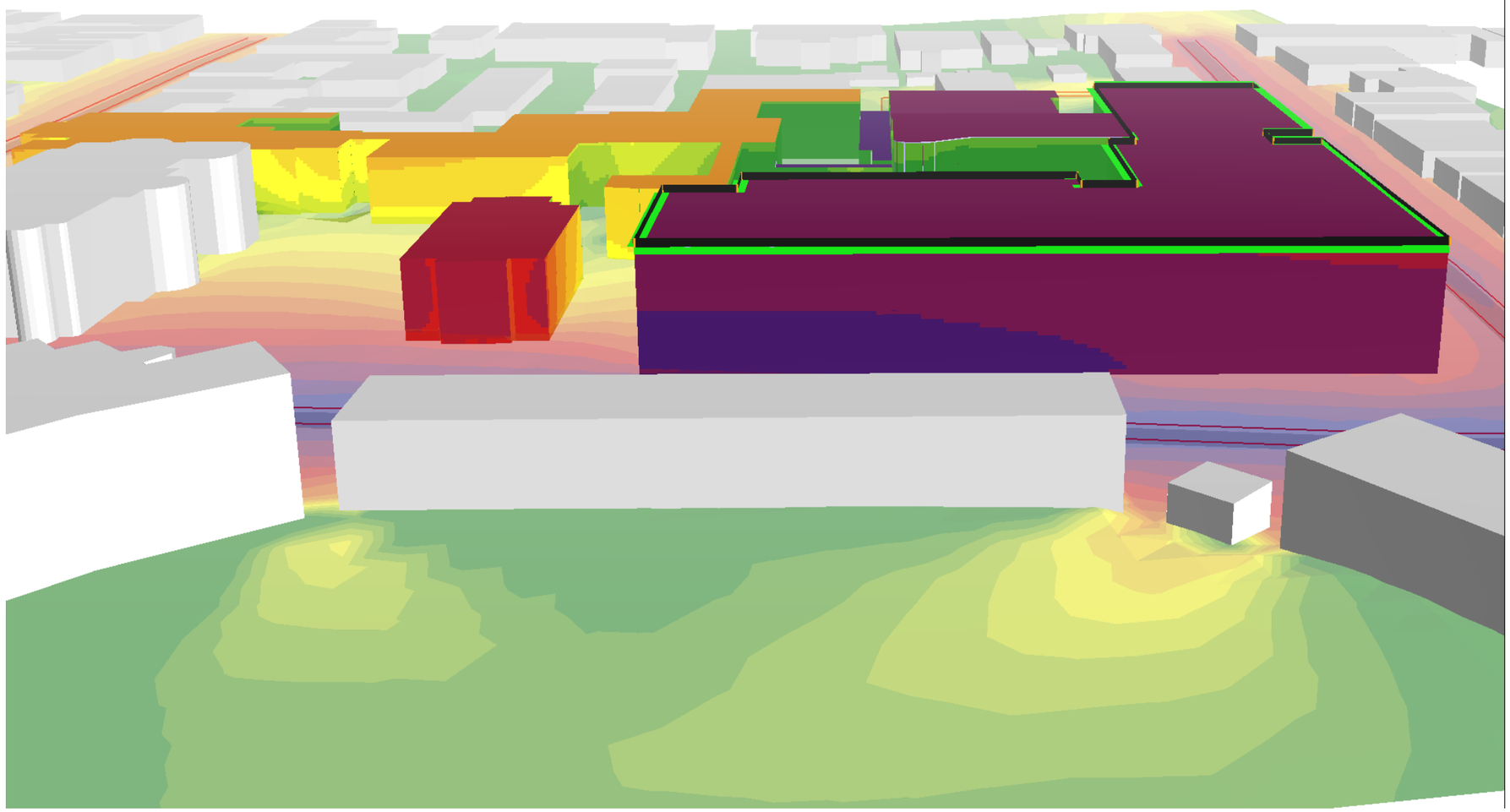


Location: L4 **Wednesday, 23 September 2020 - 1173624**



SCS - North Sydney Marist

Facade Noise Map



Noise level
LAeq(15h)
in dB(A)

	<= 45
45 <	<= 47
47 <	<= 49
49 <	<= 51
51 <	<= 53
53 <	<= 55
55 <	<= 57
57 <	<= 59
59 <	<= 61
61 <	<= 63
63 <	<= 65
65 <	<= 67
67 <	<= 69
69 <	<= 71
71 <	<= 73
73 <	

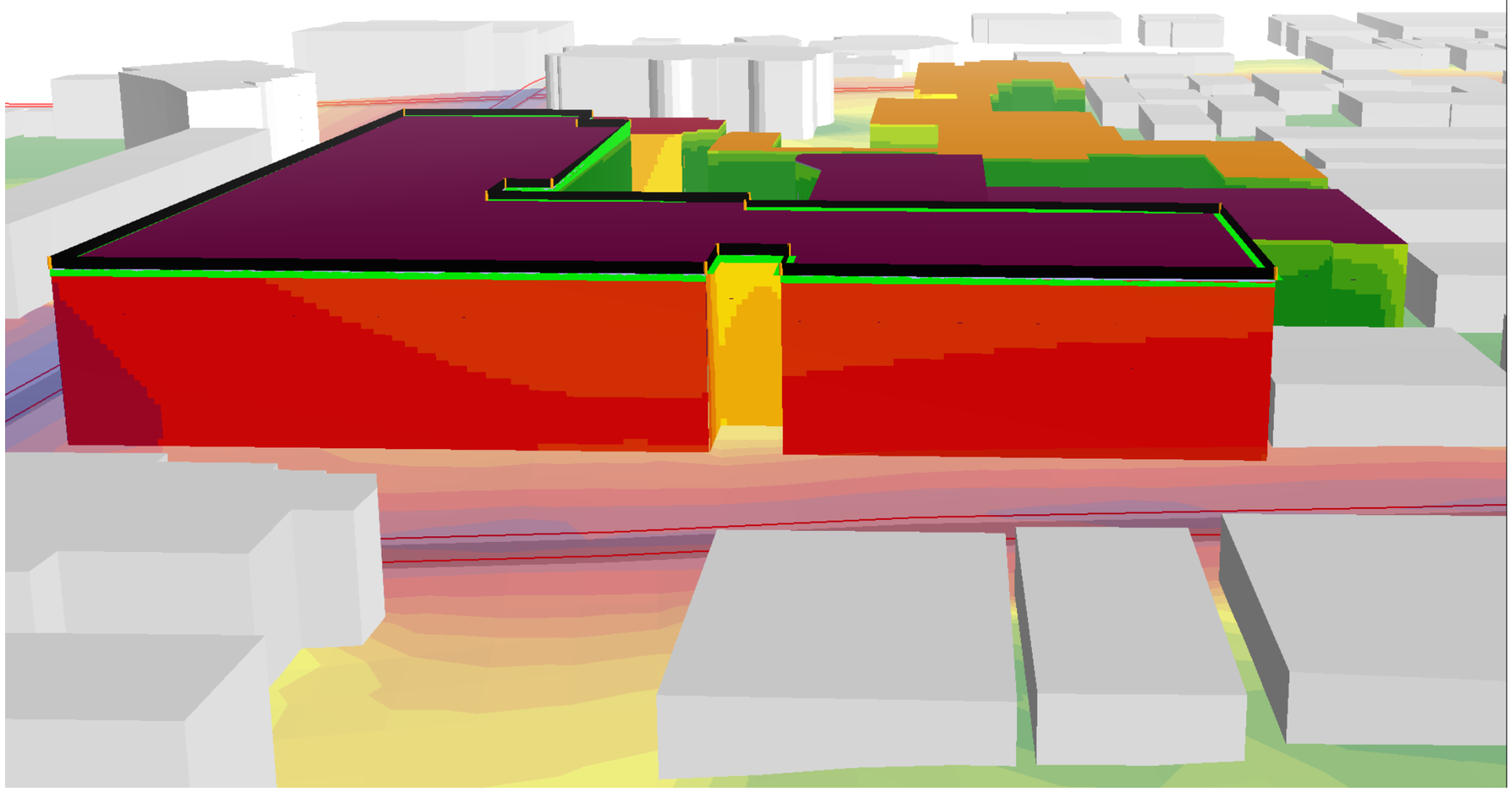
Scale 1:2027

0 10 20 40 60 80 m

Stantec

SCS - North Sydney Marist

Facade Noise Map



Noise level
LAeq(15h)
in dB(A)

	<= 45
45 <	<= 47
47 <	<= 49
49 <	<= 51
51 <	<= 53
53 <	<= 55
55 <	<= 57
57 <	<= 59
59 <	<= 61
61 <	<= 63
63 <	<= 65
65 <	<= 67
67 <	<= 69
69 <	<= 71
71 <	<= 73
73 <	

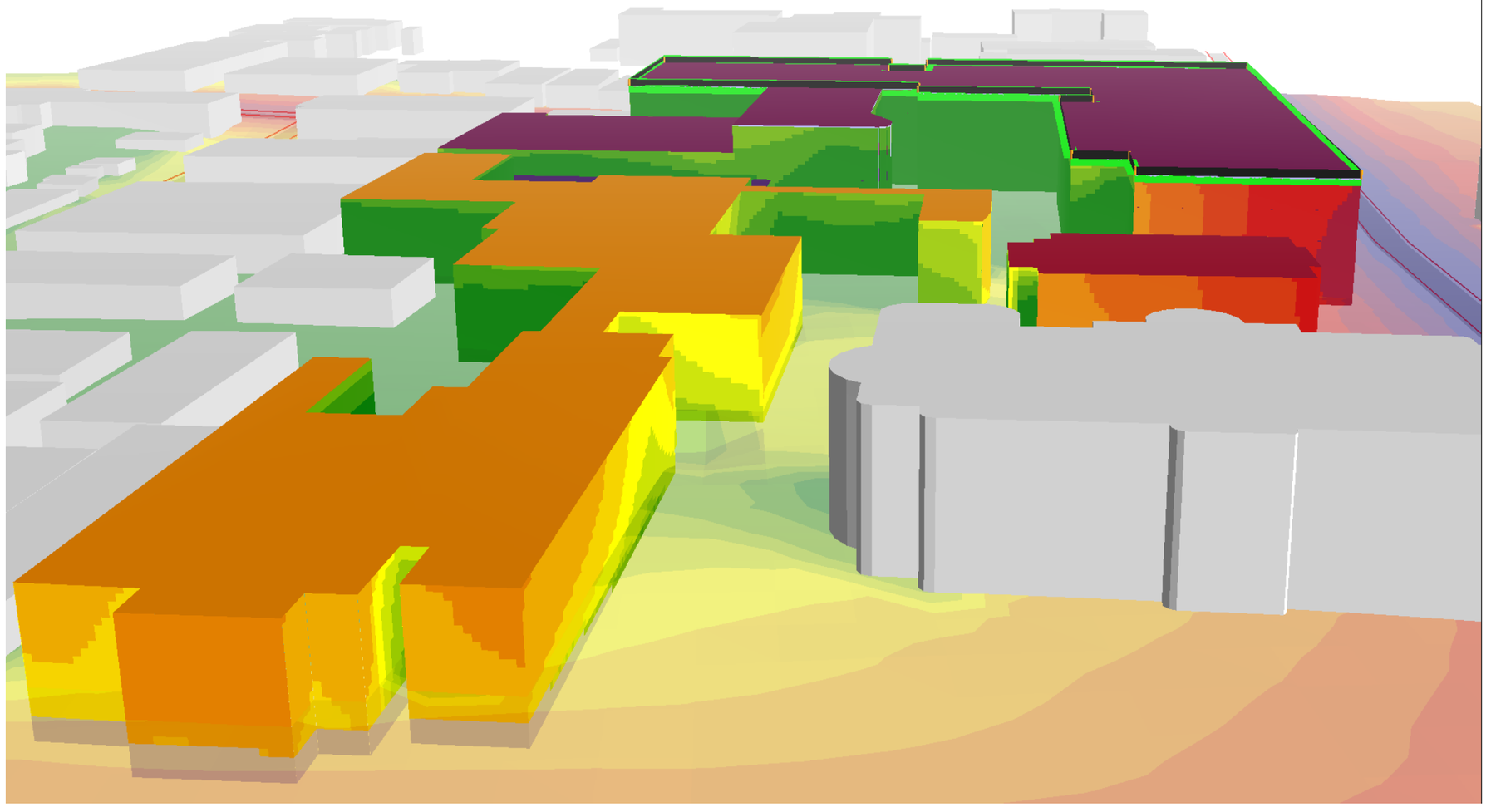
Scale 1:2027

0 10 20 40 60 80 m

Stantec

SCS - North Sydney Marist

Facade Noise Map



Noise level
LAeq(15h)
in dB(A)

	<= 45
45 <	<= 47
47 <	<= 49
49 <	<= 51
51 <	<= 53
53 <	<= 55
55 <	<= 57
57 <	<= 59
59 <	<= 61
61 <	<= 63
63 <	<= 65
65 <	<= 67
67 <	<= 69
69 <	<= 71
71 <	<= 73
73 <	

N

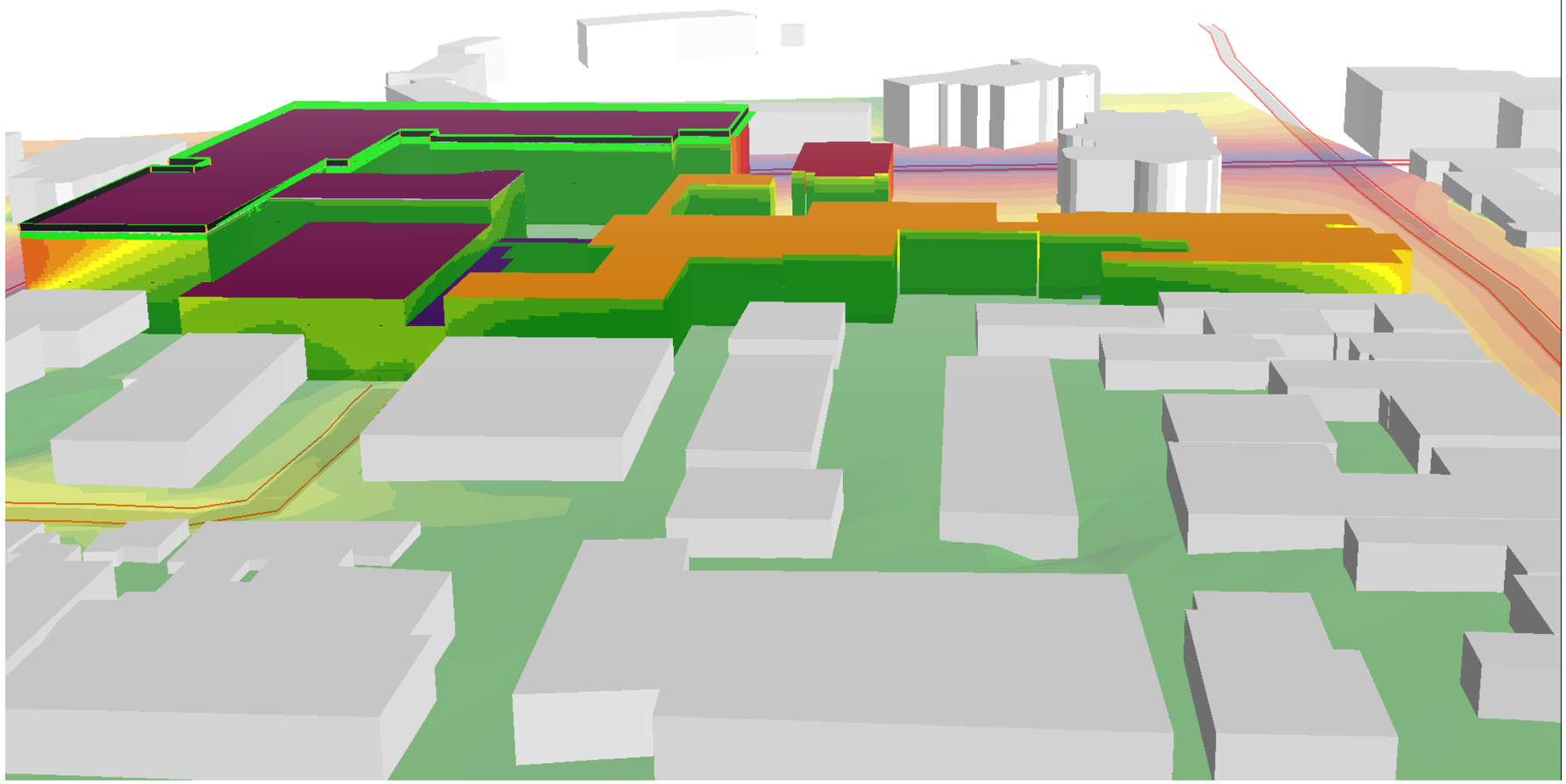
Scale 1:2027

0 10 20 40 60 80 m

Stantec

SCS - North Sydney Marist

Facade Noise Map



Noise level
LAeq(15h)
in dB(A)

	<= 45
45 <	<= 47
47 <	<= 49
49 <	<= 51
51 <	<= 53
53 <	<= 55
55 <	<= 57
57 <	<= 59
59 <	<= 61
61 <	<= 63
63 <	<= 65
65 <	<= 67
67 <	<= 69
69 <	<= 71
71 <	<= 73
73 <	

N

Scale 1:2027

0 10 20 40 60 80 m

Stantec

Appendix D – Acoustic Demand Ratings of Façade

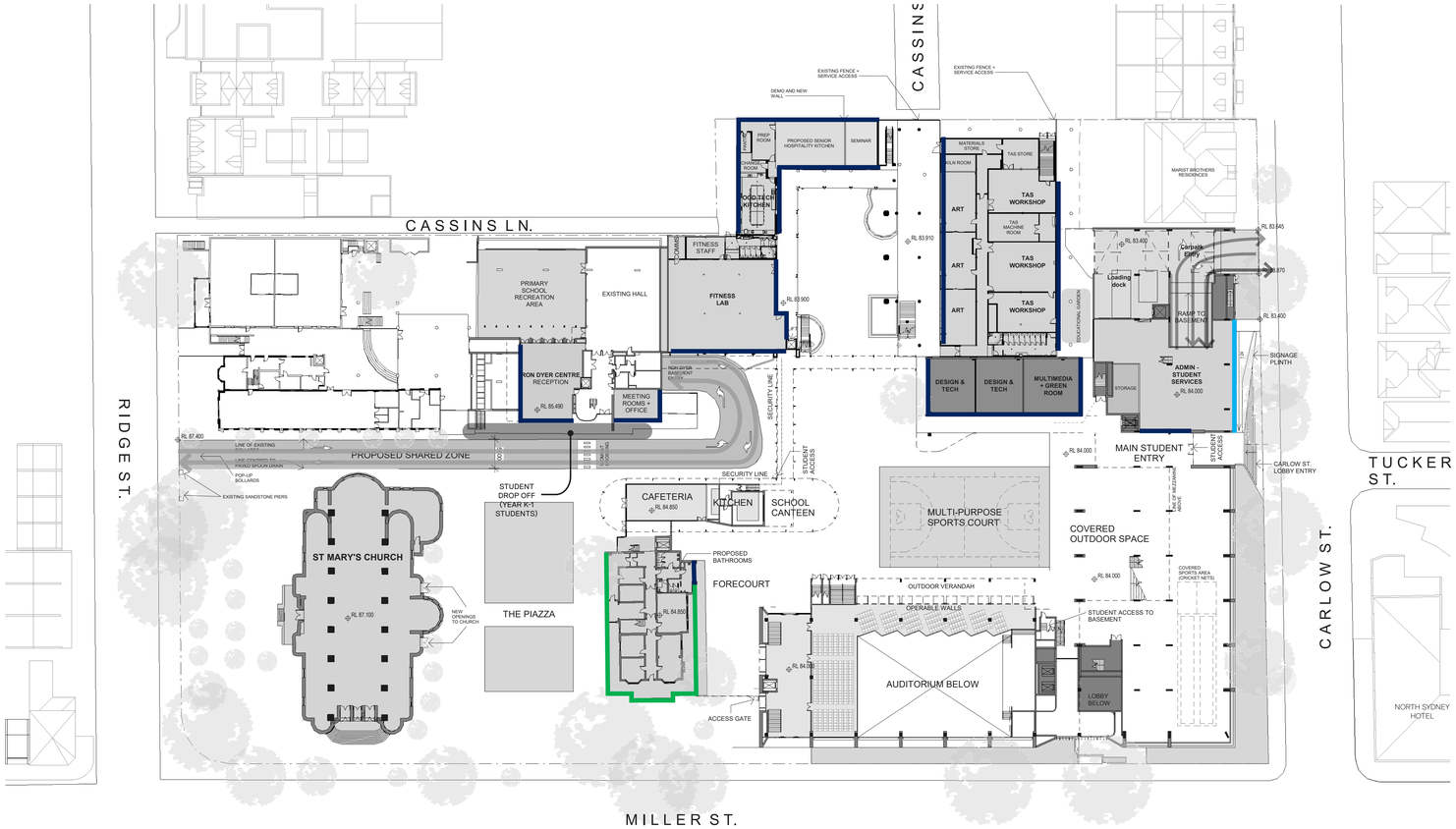
Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

2. This is a preliminary drawing demonstrating general acoustic performance requirements for the facade. Acoustic performance of individual facade elements on each floor will be refined in future drawings.

3. Refer to the glazing schedule (drawing no. BLDA-AC-GL-SCH) for indicative glazing arrangements corresponding to the acoustic performances nominated for each acoustic demand rating.



THIS DRAWING HAS BEEN DOCUMENTED IN COLOUR
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BLACK & WHITE PRINTING MAY BE USED IF SPECIFIC BLACK & WHITE DOCUMENTS HAVE BEEN OBTAINED FROM WSE

REV	DESCRIPTION	DRAWN	APP'D	DATE
001	For Review	MIS	BN	30/10/20

ARCHITECT/CLIENT

PROJECT: SCS - NORTH SYDNEY MARIST

TITLE: GLAZING PERFORMANCE REQUIREMENTS

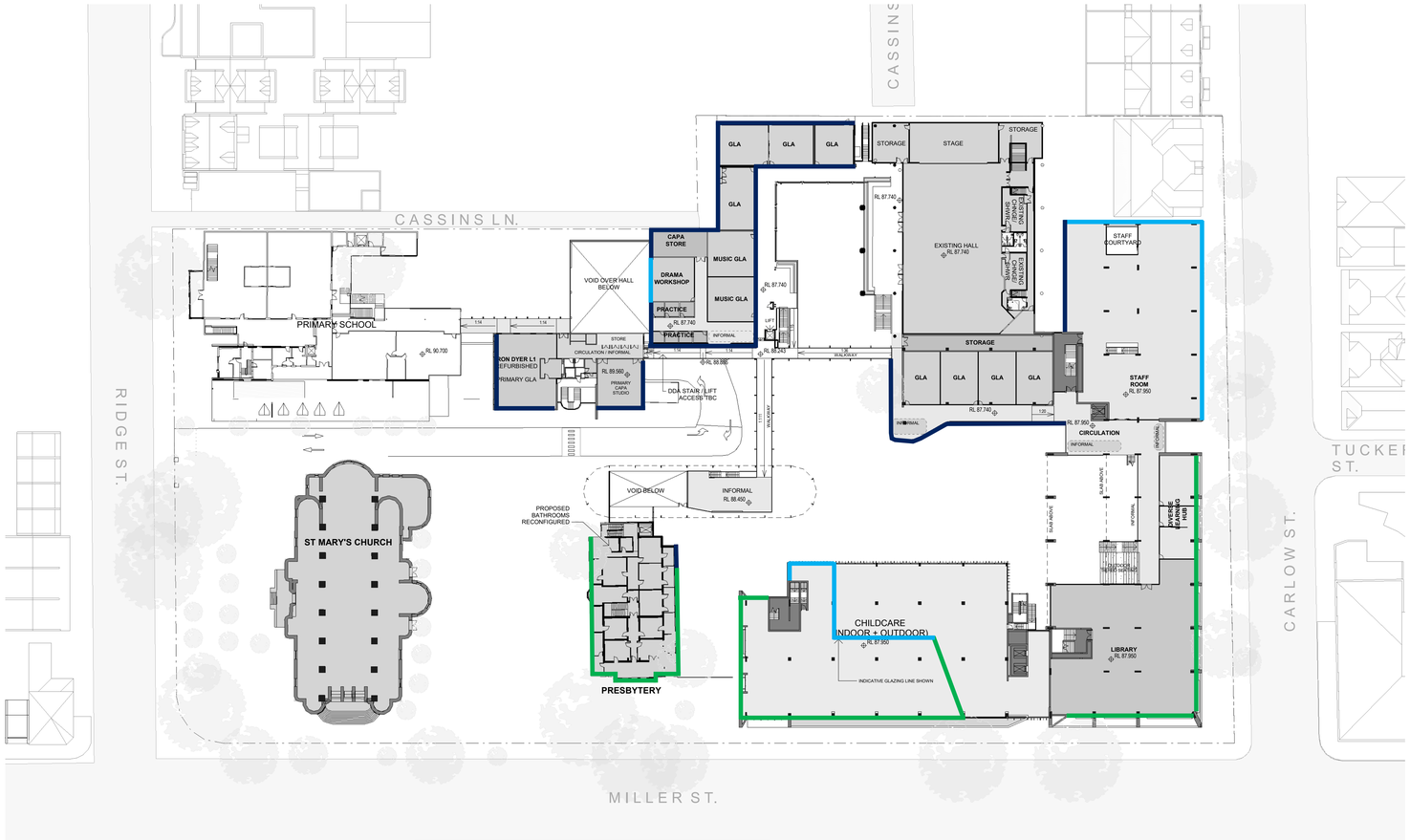
GROUND FLOOR

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
NTS	301348236	AC-SK-GL	1

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42



DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

2. This is a preliminary drawing demonstrating general acoustic performance requirements for the facade. Acoustic performance of individual facade elements on each floor will be refined in future drawings.

3. Refer to the glazing schedule (drawing no. BLDA-AC-GL-SCH) for indicative glazing arrangements corresponding to the acoustic performances nominated for each acoustic demand rating.

REV	DESCRIPTION	DRAWN	APP'D	DATE
001	For Review	MIS	BN	30/10/20

ARCHITECT/CLIENT

PROJECT	TITLE
SCS - NORTH SYDNEY MARIST	GLAZING PERFORMANCE REQUIREMENTS LEVEL 01

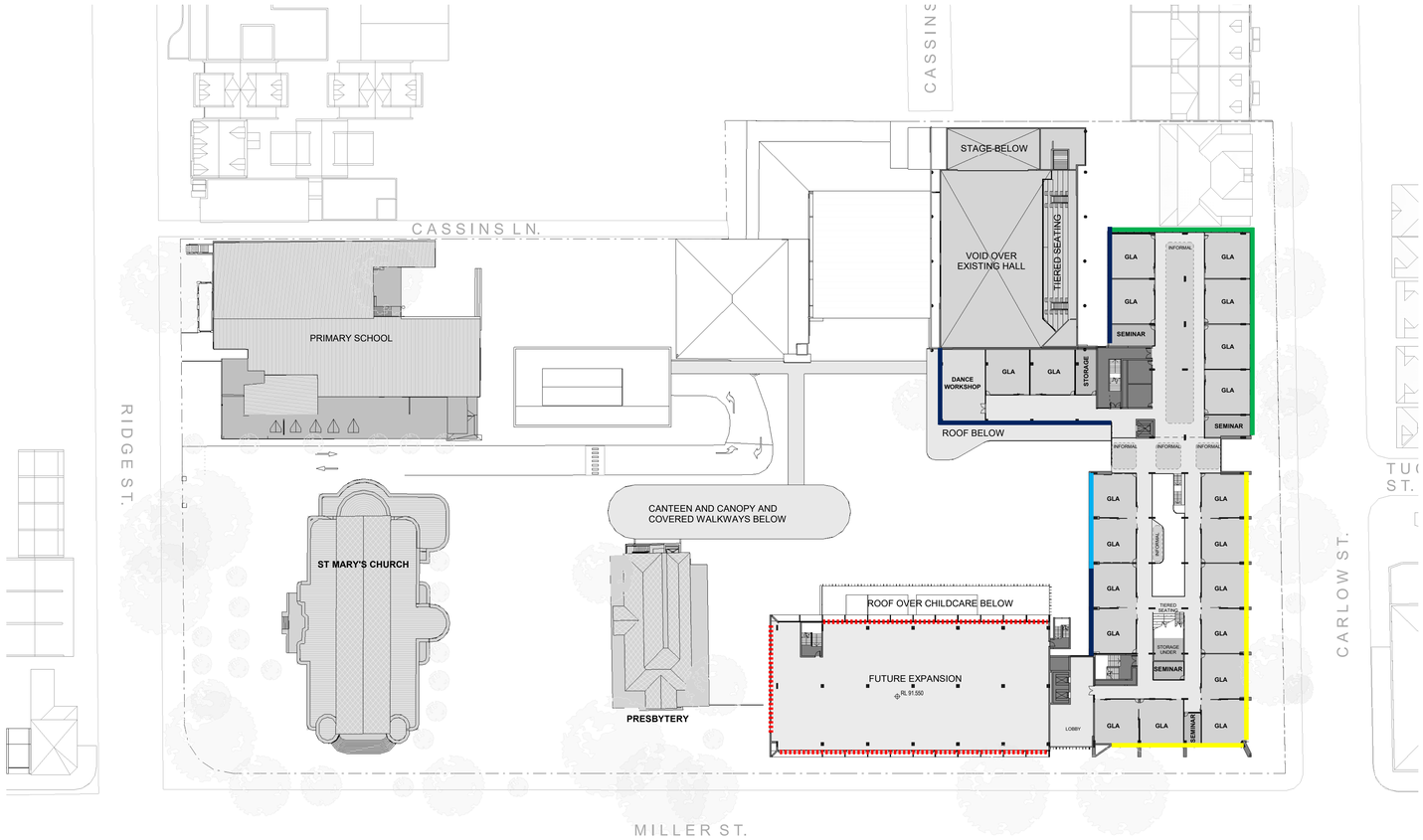
Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
NTS	301348236	AC-SK-GL	1

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

TBC



DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

2. This is a preliminary drawing demonstrating general acoustic performance requirements for the facade. Acoustic performance of individual facade elements on each floor will be refined in future drawings.

3. Refer to the glazing schedule (drawing no. BLDA-AC-GL-SCH) for indicative glazing arrangements corresponding to the acoustic performances nominated for each acoustic demand rating.

REV	DESCRIPTION	DRAWN	APP'D	DATE
001	For Review	MIS	BN	30/10/20

ARCHITECT/CLIENT

PROJECT: SCS - NORTH SYDNEY MARIST

TITLE: GLAZING PERFORMANCE REQUIREMENTS

LEVEL 02

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
NTS	301348236	AC-SK-GL	1

Acoustics Demand Rating	SGU Acoustic Performance	DGU Acoustic Performance
1	R_w 32	R_w 34
2	R_w 34	R_w 36
3	R_w 36	R_w 38
4	R_w 40	R_w 42

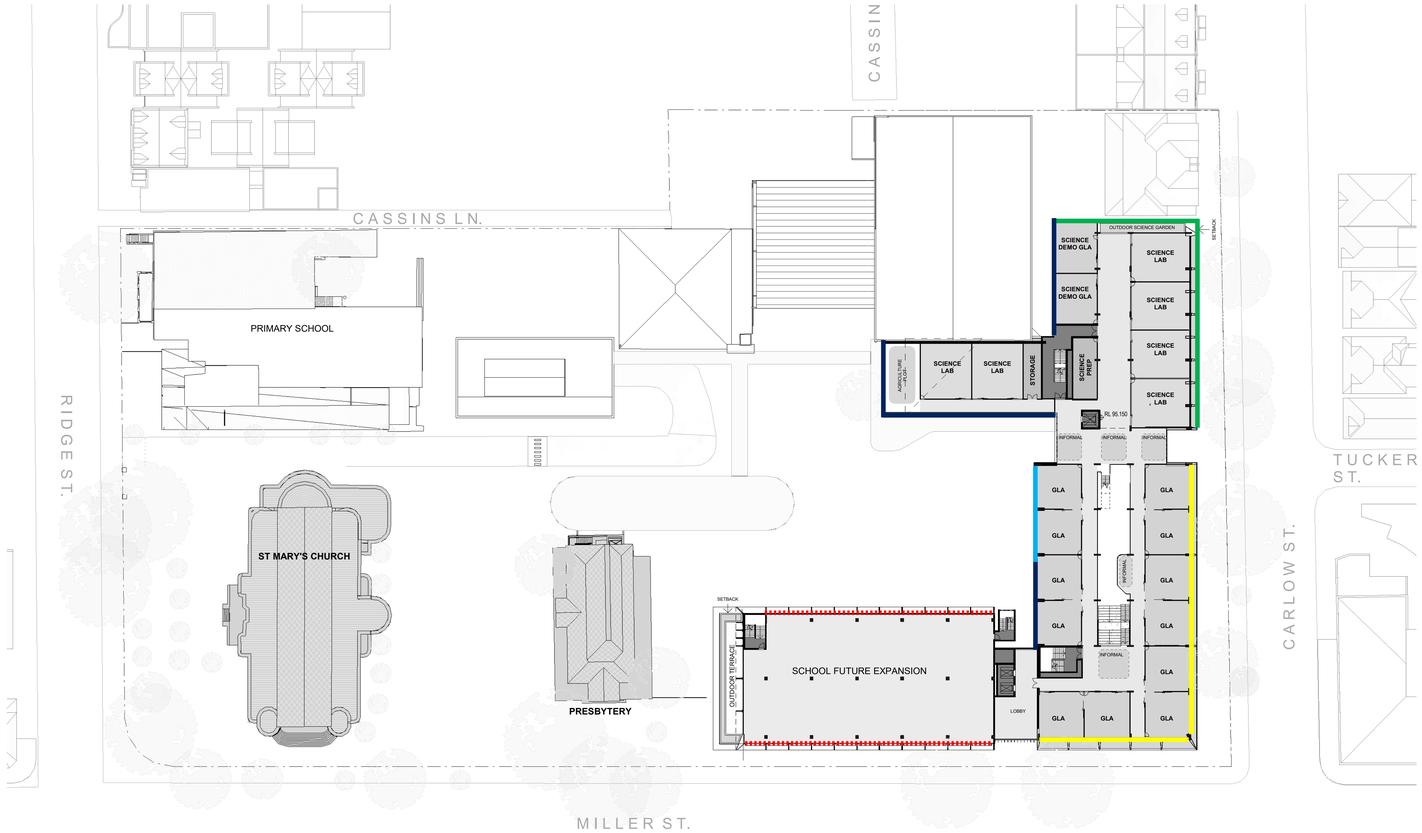
TBC

DRAWING NOTES

1. SGU acoustic performance for a nominal acoustic demand rating differs to a DGU acoustic performance due to resonant effects in the DGU systems. This is generally overcome using large air cavities.

2. This is a preliminary drawing demonstrating general acoustic performance requirements for the facade. Acoustic performance of individual facade elements on each floor will be refined in future drawings.

3. Refer to the glazing schedule (drawing no. BLDA-AC-GL-SCH) for indicative glazing arrangements corresponding to the acoustic performances nominated for each acoustic demand rating.



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REV	DESCRIPTION	DRAWN	APP'D	DATE
001	For Review	MIS	BN	30/10/20

WMK | ctpg | Sydney Catholic Schools — ARCHITECT/CLIENT

SCS - NORTH SYDNEY MARIST — PROJECT

GLAZING PERFORMANCE REQUIREMENTS

LEVEL 03 — TITLE

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

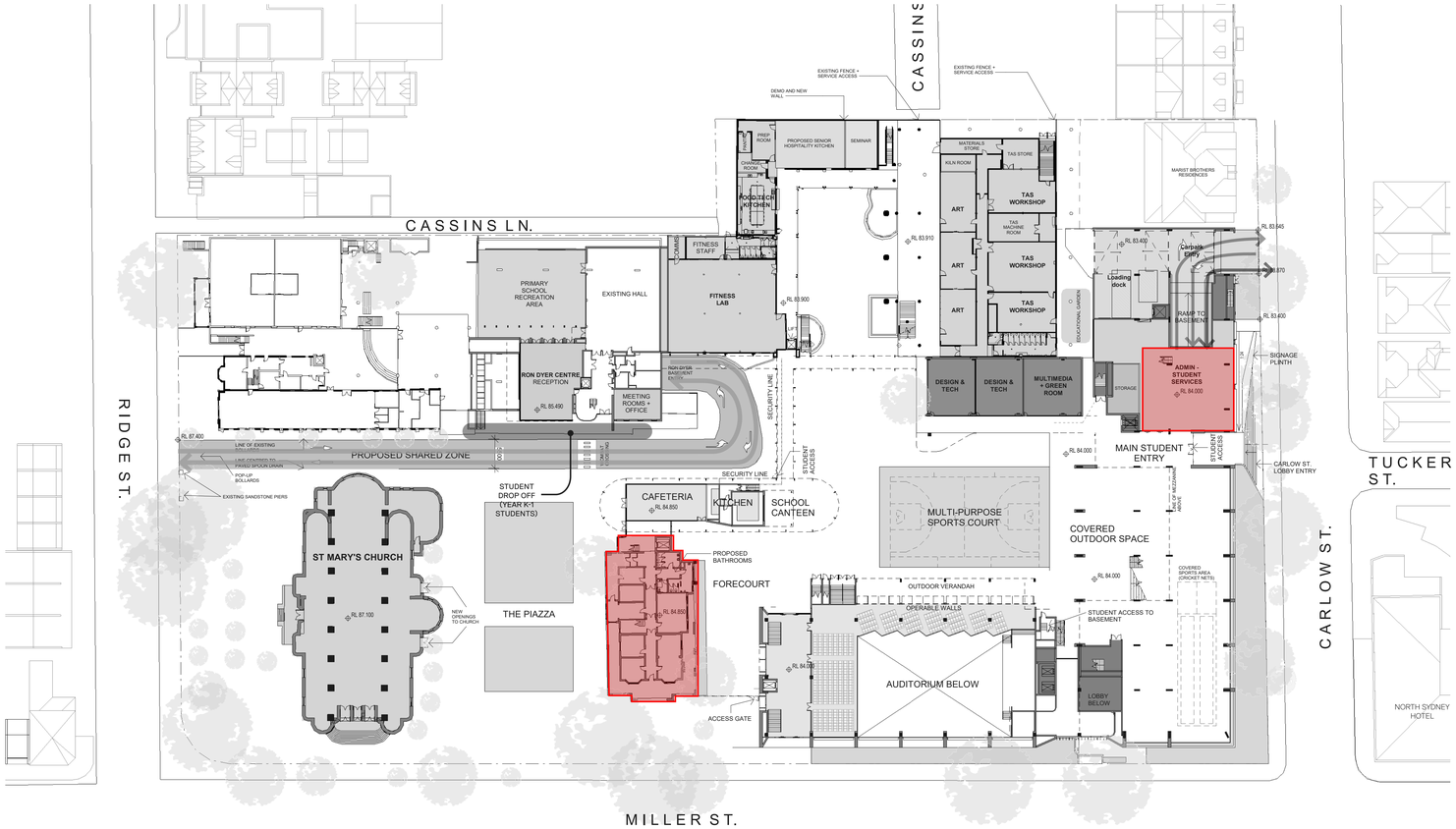
SCALE @ A3	PROJECT No	DRAWING No	REV
NTS	301348236	AC-SK-GL	1

Appendix E – Noise-Affected Habitable Spaces

Noise Affected Space	

DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.



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BLACK & WHITE PRINTING MAY BE USED IF SPECIFIC BLACK & WHITE DOCUMENTS HAVE BEEN OBTAINED FROM WGE

REV	DESCRIPTION	DRAWN	APP'D	DATE
001	For Review	MIS	BN	30/10/20

ARCHITECT/CLIENT

PROJECT: SCS - NORTH SYDNEY MARIST

TITLE: NOISE AFFECTED SPACES
GROUND FLOOR

Stantec

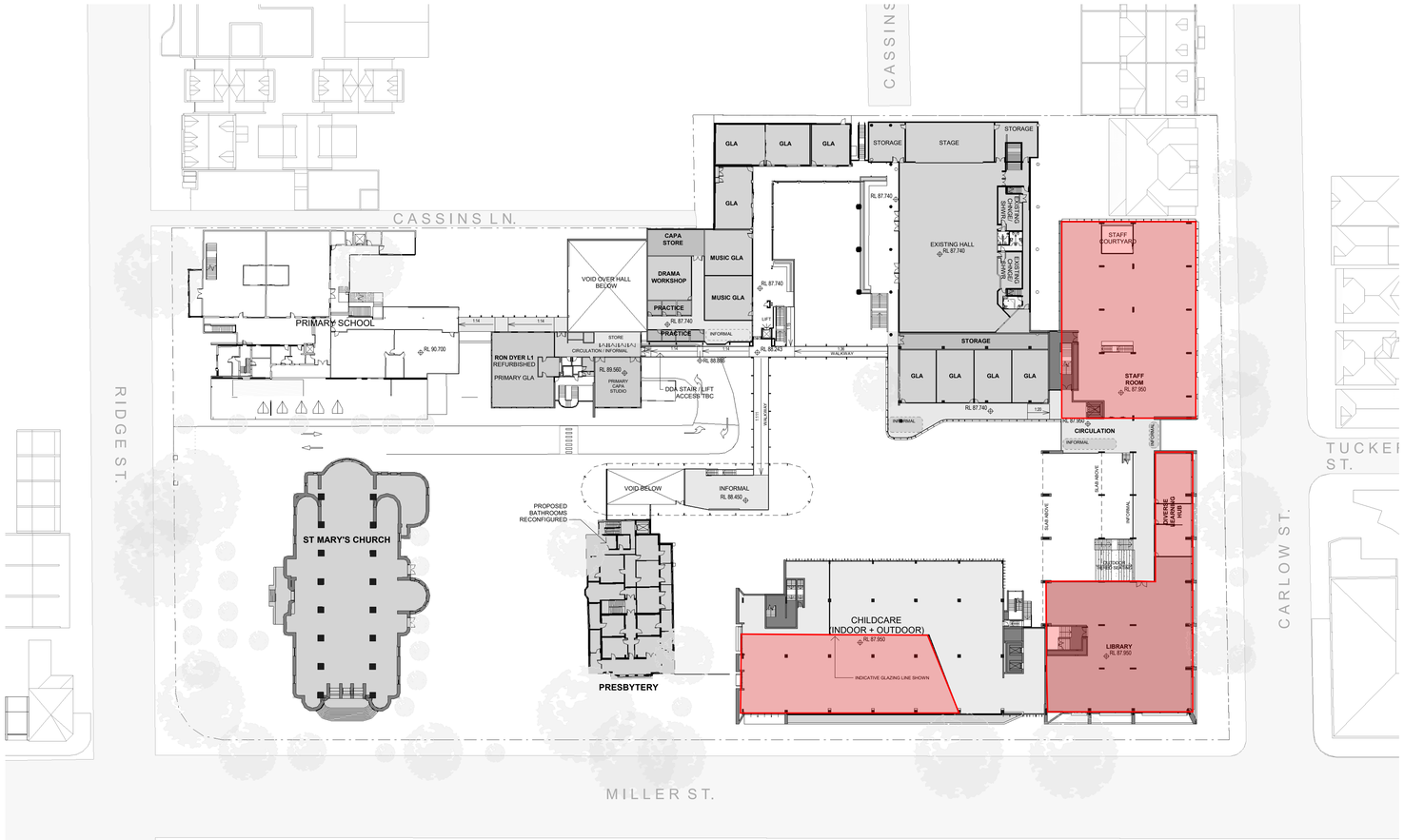
PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
NTS	301348236	AC-SK-NA	1

Noise Affected Space	

DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.



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THIS DRAWING IS REQUIRED TO BE PRINTED IN COLOUR
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BLACK & WHITE PRINTING MAY BE USED IF SPECIFIC BLACK & WHITE DOCUMENTS HAVE BEEN OBTAINED FROM WGE

REV	DESCRIPTION	DRAWN	APP'D	DATE
001	For Review	MIS	BN	30/10/20

ARCHITECT/CLIENT

PROJECT: SCS - NORTH SYDNEY MARIST

TITLE: NOISE AFFECTED SPACES
LEVEL 01

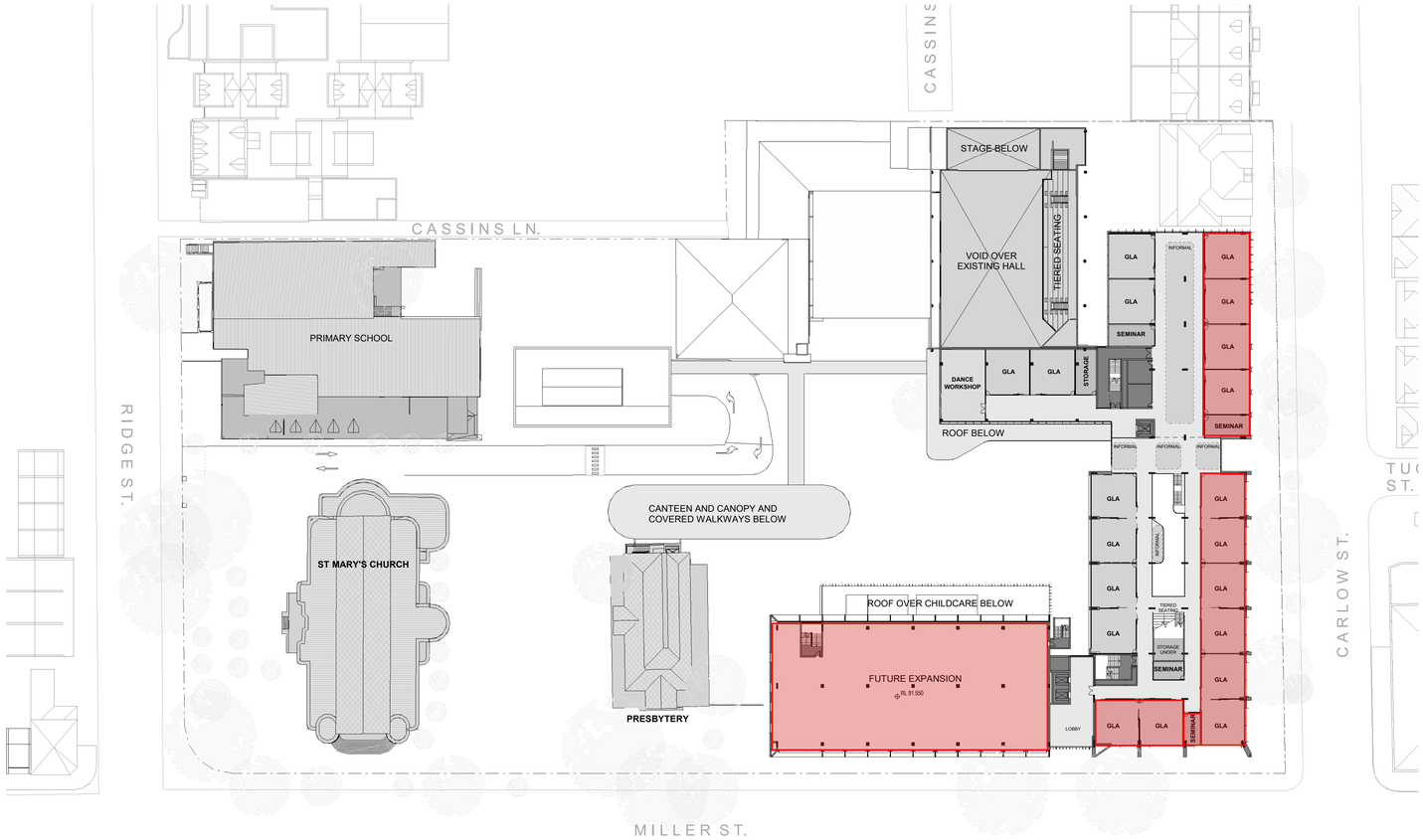
PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
NTS	301348236	AC-SK-NA	1

Noise Affected Space	

DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.



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BLACK & WHITE PRINTING MAY BE USED IF SPECIFIC BLACK & WHITE DOCUMENTS HAVE BEEN OBTAINED FROM WSE

REV	DESCRIPTION	DRAWN	APP'D	DATE
001	For Review	MIS	BN	30/10/20

WMK ctpg Sydney Catholic Schools

ARCHITECT/CLIENT

SCS - NORTH SYDNEY MARIST — PROJECT

NOISE AFFECTED SPACES
LEVEL 02 — TITLE

Stantec

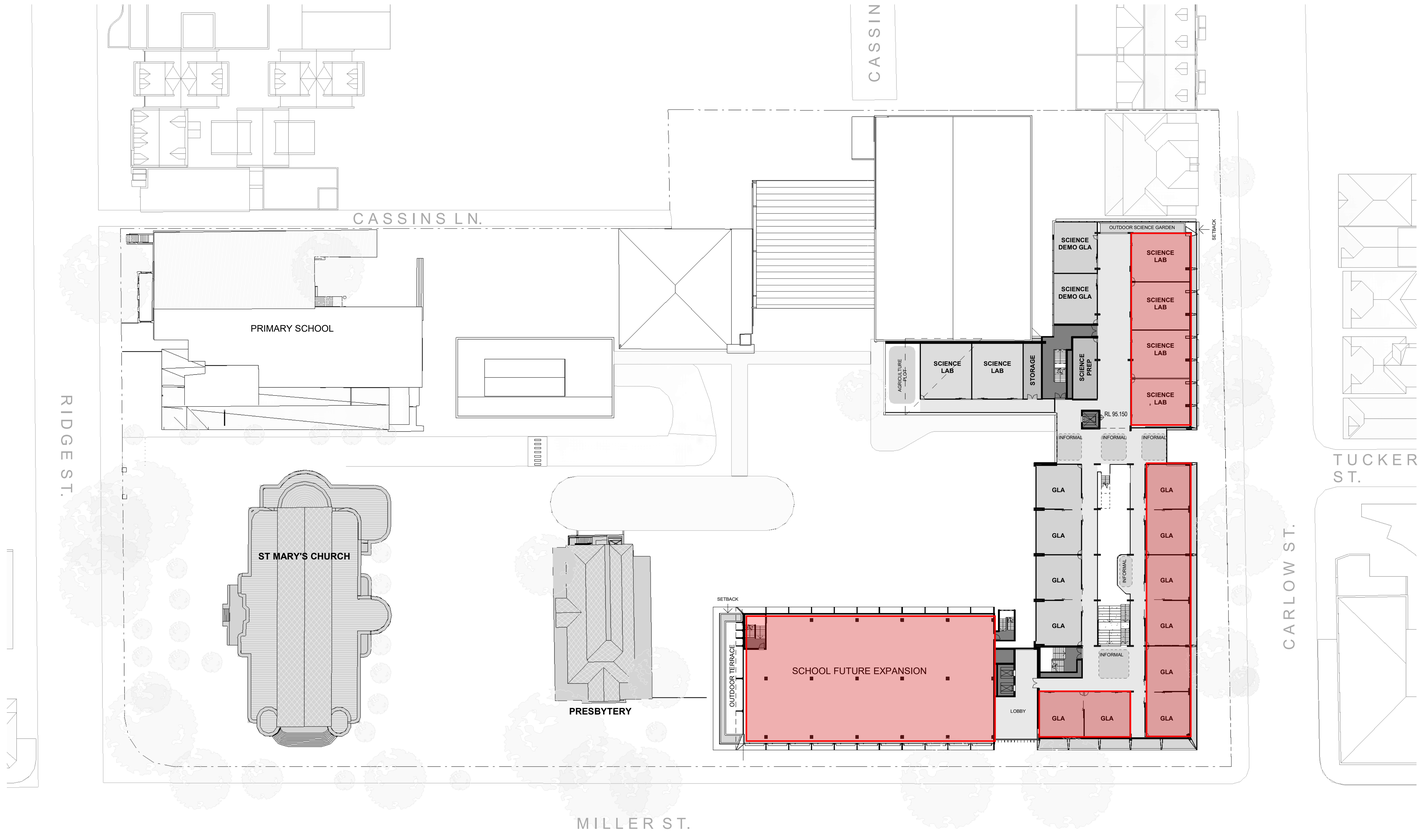
PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A0	PROJECT No	DRAWING No	REV
NTS	301348236	AC-SK-NA	1

Noise Affected Space	

DRAWING NOTES

1. A noise affected space is classified as a space in which occupants cannot rely on opening the windows in the space to achieve the natural ventilation requirements of the NCC and simultaneously meet the acoustic requirements internal to the space.



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BLACK & WHITE PRINTING MAY BE USED IF SPECIFIC BLACK & WHITE DOCUMENTS HAVE BEEN OBTAINED FROM WGE

REV	DESCRIPTION	DRAWN	APP'D	DATE
001	For Review	MIS	BN	30/10/20

ARCHITECT/CLIENT

PROJECT: SCS - NORTH SYDNEY MARIST

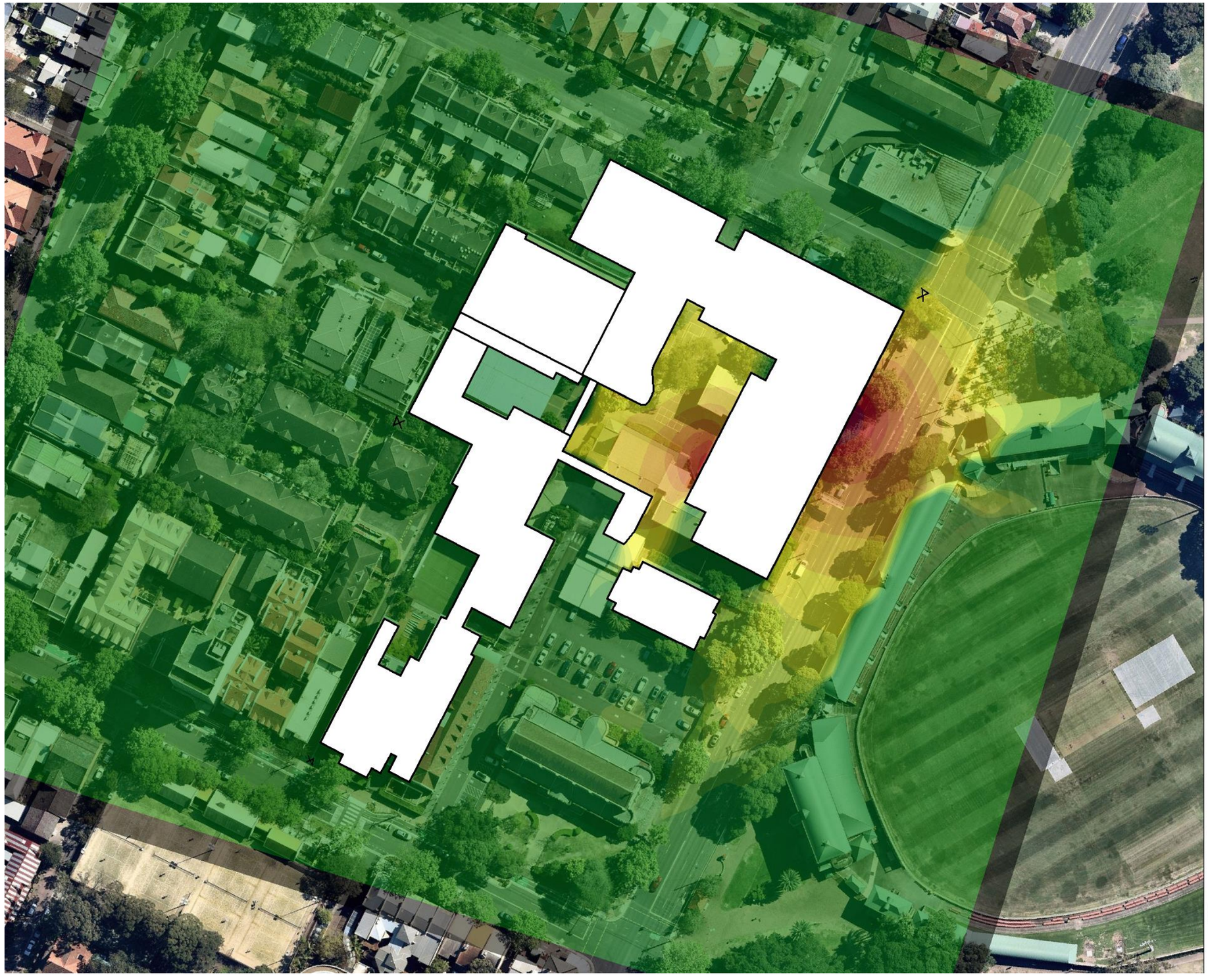
TITLE: NOISE AFFECTED SPACES
LEVEL 03

Stantec

PRELIMINARY
NOT FOR CONSTRUCTION
Acoustics, Noise & Vibration

SCALE @ A3	PROJECT No	DRAWING No	REV
NTS	301348236	AC-SK-NA	1

Appendix F – Child Care Noise Emissions Modelling



SCS - North Sydney Marist

Childcare Cetre

Noise Emissions

Noise level
LAeq(15min)
in dB(A)

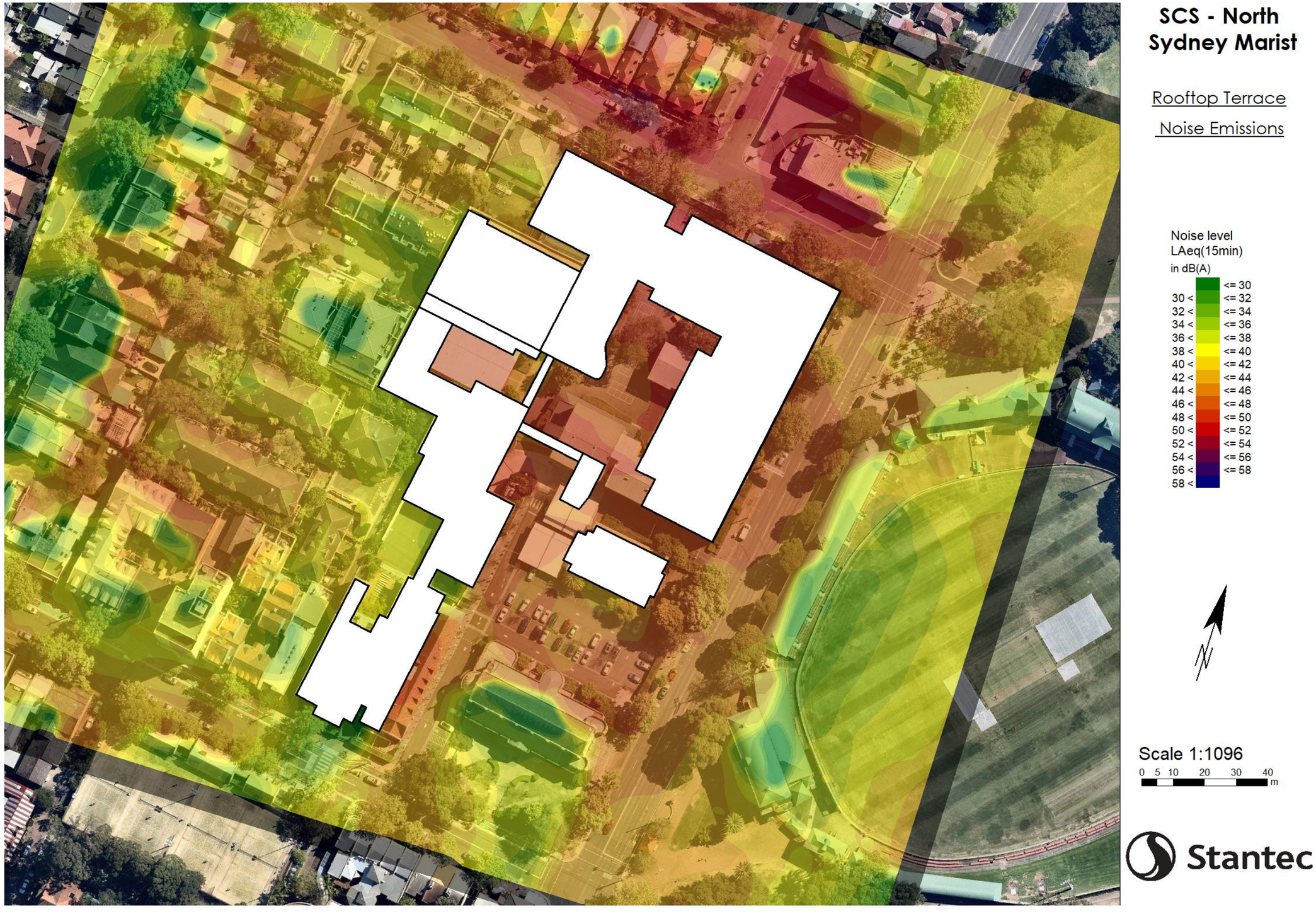
	<= 40
40 <	<= 42
42 <	<= 44
44 <	<= 46
46 <	<= 48
48 <	<= 50
50 <	<= 52
52 <	<= 54
54 <	<= 56
56 <	<= 58
58 <	<= 60
60 <	<= 62
62 <	<= 64
64 <	<= 66
66 <	<= 68
68 <	

Scale 1:1096

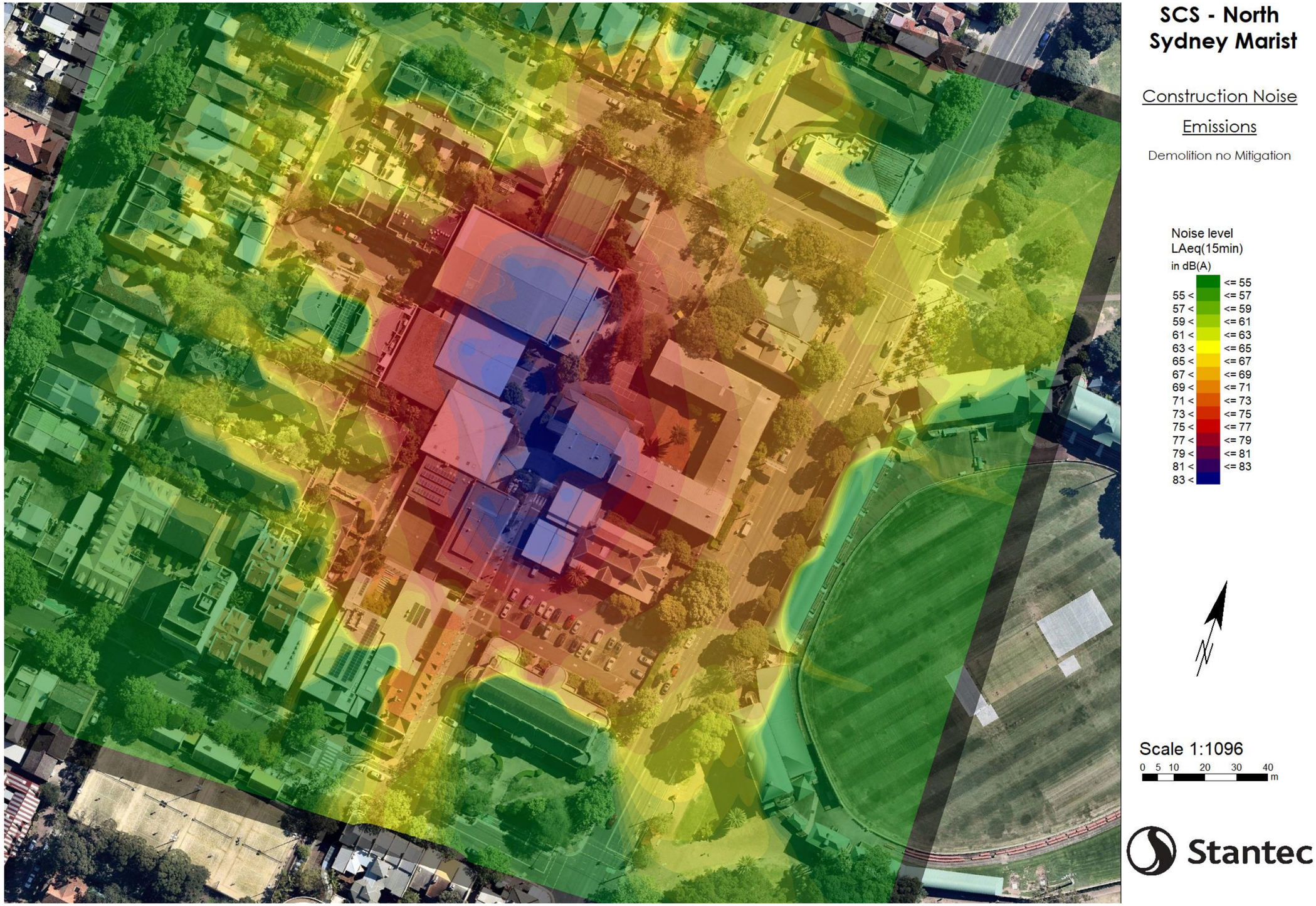
0 5 10 20 30 40 m

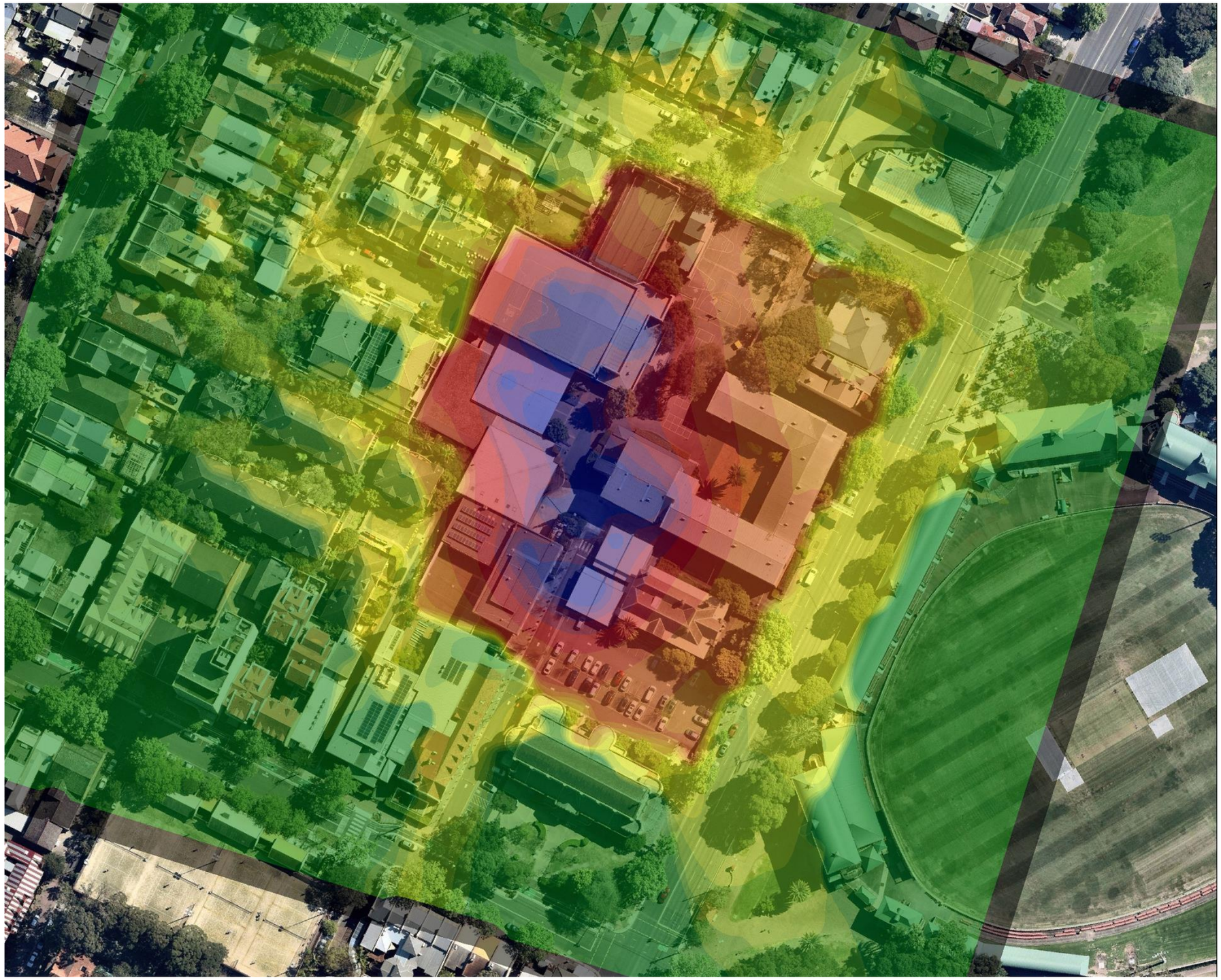
Stantec

Appendix G – Rooftop Terrace Noise Emissions Modelling



Appendix H – Construction Noise Emissions Modelling & Mapping





SCS - North Sydney Marist

Construction Noise Emissions

Demolition with Mitigation

Noise level
LAeq(15min)
in dB(A)

	<= 55
55 <	<= 57
57 <	<= 59
59 <	<= 61
61 <	<= 63
63 <	<= 65
65 <	<= 67
67 <	<= 69
69 <	<= 71
71 <	<= 73
73 <	<= 75
75 <	<= 77
77 <	<= 79
79 <	<= 81
81 <	<= 83
83 <	

Scale 1:1096

0 5 10 20 30 40 m

Stantec

SCS - North Sydney Marist

Construction Noise Emissions

Excavation no Mitigation

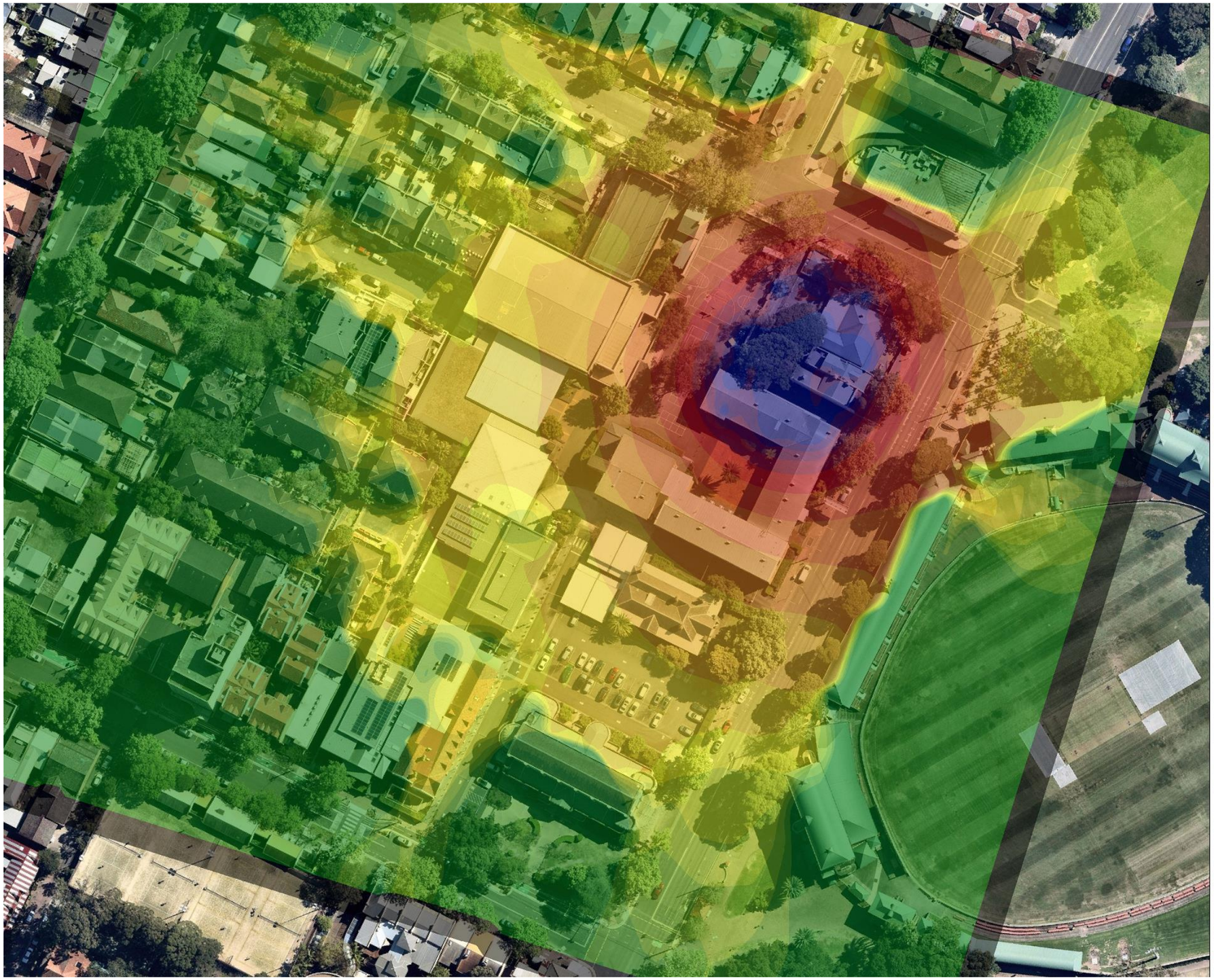
Noise level
LAeq(15min)
in dB(A)

	<= 55
55 <	<= 57
57 <	<= 59
59 <	<= 61
61 <	<= 63
63 <	<= 65
65 <	<= 67
67 <	<= 69
69 <	<= 71
71 <	<= 73
73 <	<= 75
75 <	<= 77
77 <	<= 79
79 <	<= 81
81 <	<= 83
83 <	

Scale 1:1096

0 5 10 20 30 40 m

Stantec



SCS - North Sydney Marist

Construction Noise Emissions

Excavation no Mitigation

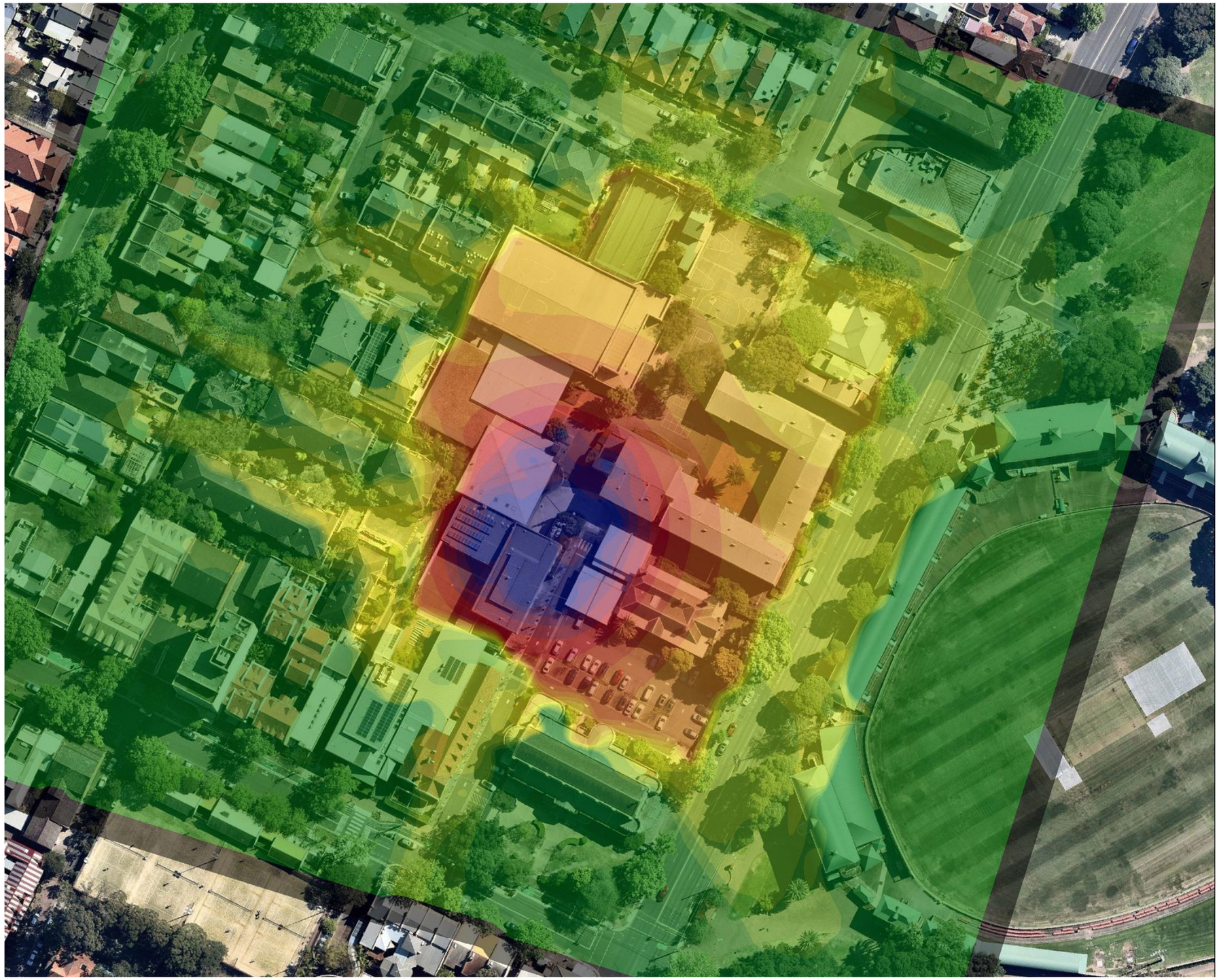
Noise level
LAeq(15min)
in dB(A)

	<= 55
55 <	<= 57
57 <	<= 59
59 <	<= 61
61 <	<= 63
63 <	<= 65
65 <	<= 67
67 <	<= 69
69 <	<= 71
71 <	<= 73
73 <	<= 75
75 <	<= 77
77 <	<= 79
79 <	<= 81
81 <	<= 83
83 <	

Scale 1:1096

0 5 10 20 30 40 m

Stantec



SCS - North Sydney Marist

Construction Noise Emissions

Excavation with Mitigation

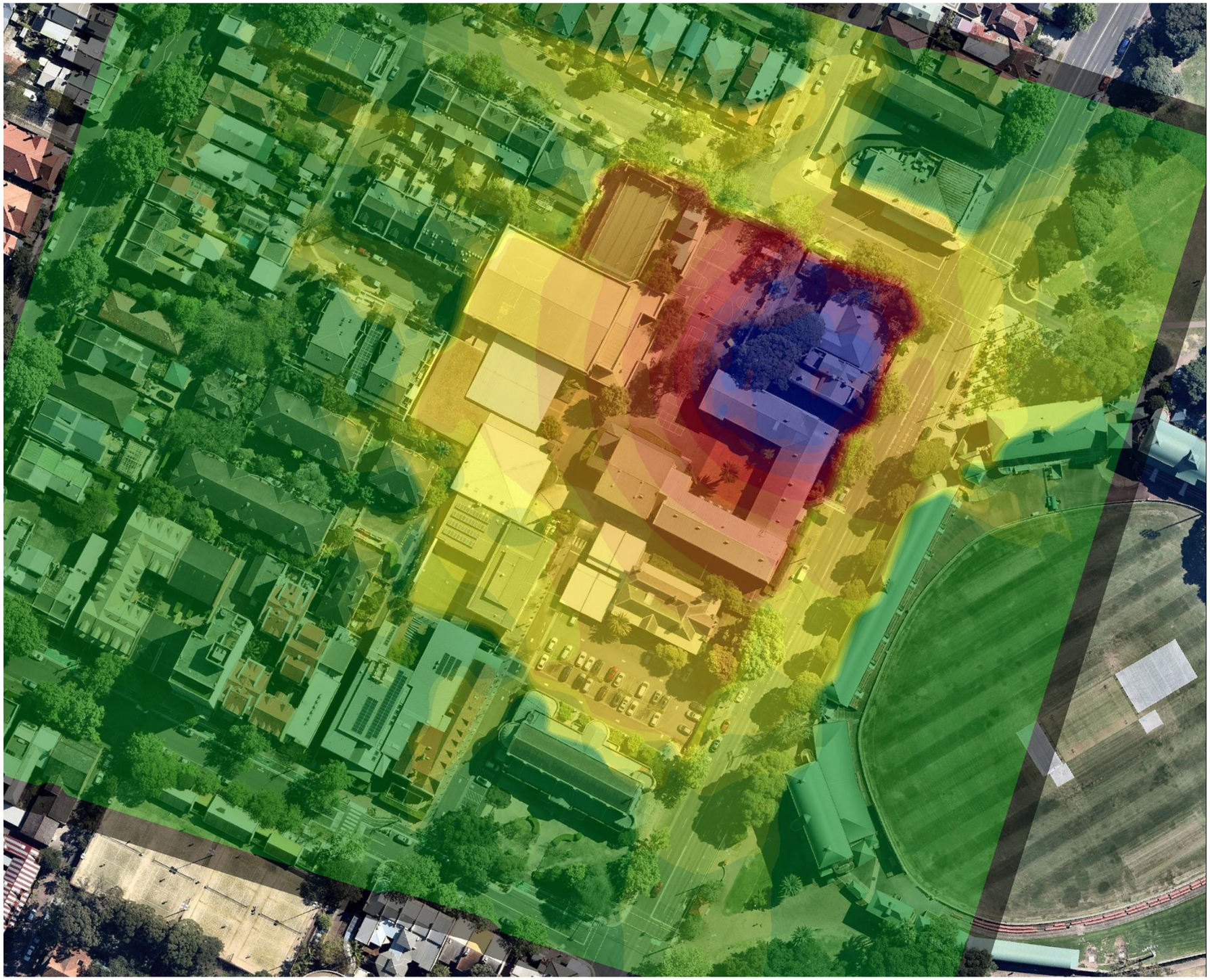
Noise level
LAeq(15min)
in dB(A)

	<= 55
55 <	<= 57
57 <	<= 59
59 <	<= 61
61 <	<= 63
63 <	<= 65
65 <	<= 67
67 <	<= 69
69 <	<= 71
71 <	<= 73
73 <	<= 75
75 <	<= 77
77 <	<= 79
79 <	<= 81
81 <	<= 83
83 <	

Scale 1:1096

0 5 10 20 30 40 m

Stantec



SCS - North Sydney Marist

Construction Noise Emissions

Excavation with Mitigation

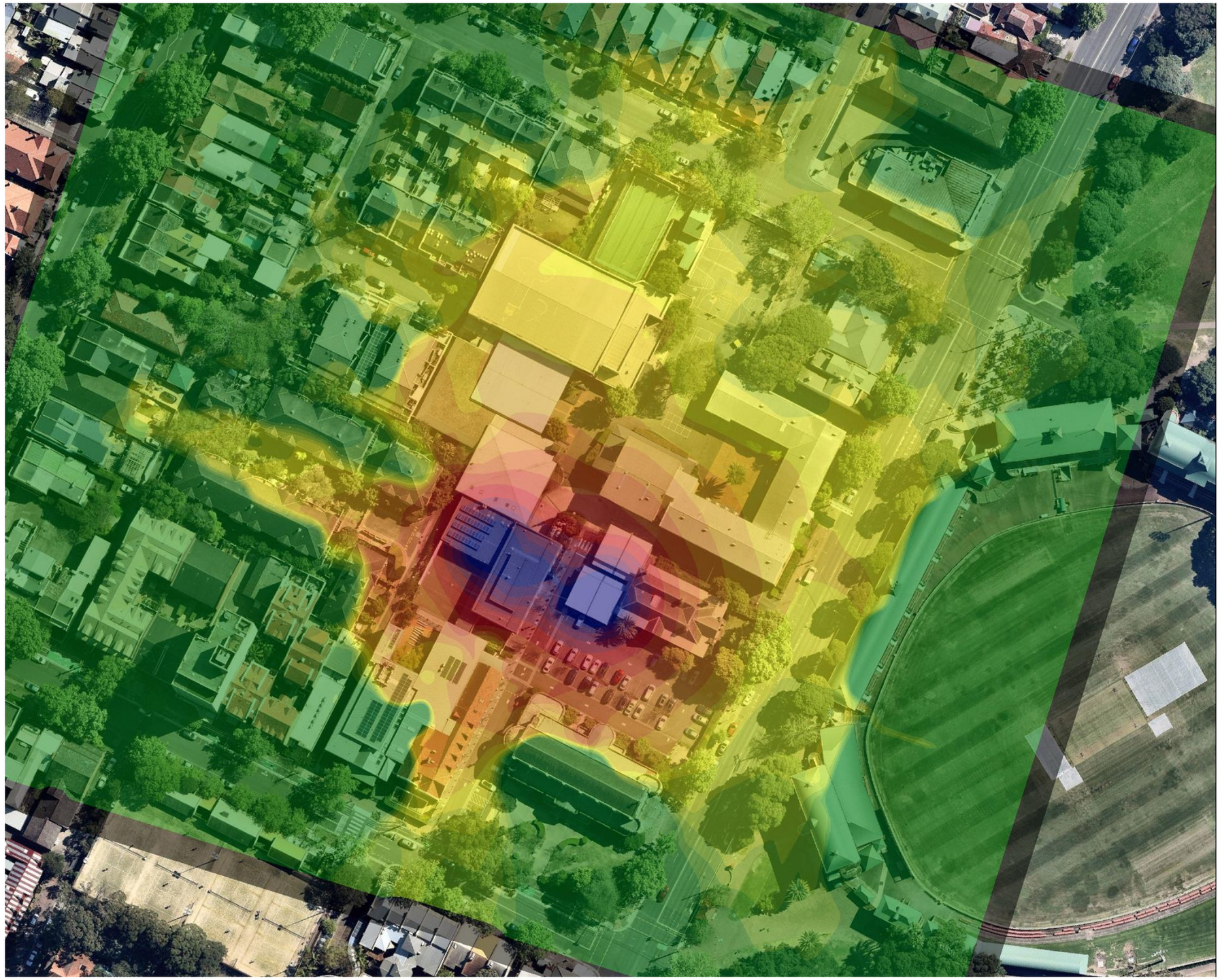
Noise level
LAeq(15min)
in dB(A)

	<= 55
55 <	<= 57
57 <	<= 59
59 <	<= 61
61 <	<= 63
63 <	<= 65
65 <	<= 67
67 <	<= 69
69 <	<= 71
71 <	<= 73
73 <	<= 75
75 <	<= 77
77 <	<= 79
79 <	<= 81
81 <	<= 83
83 <	

Scale 1:1096

0 5 10 20 30 40 m

Stantec



SCS - North Sydney Marist

Construction Noise Emissions

Structure no Mitigation

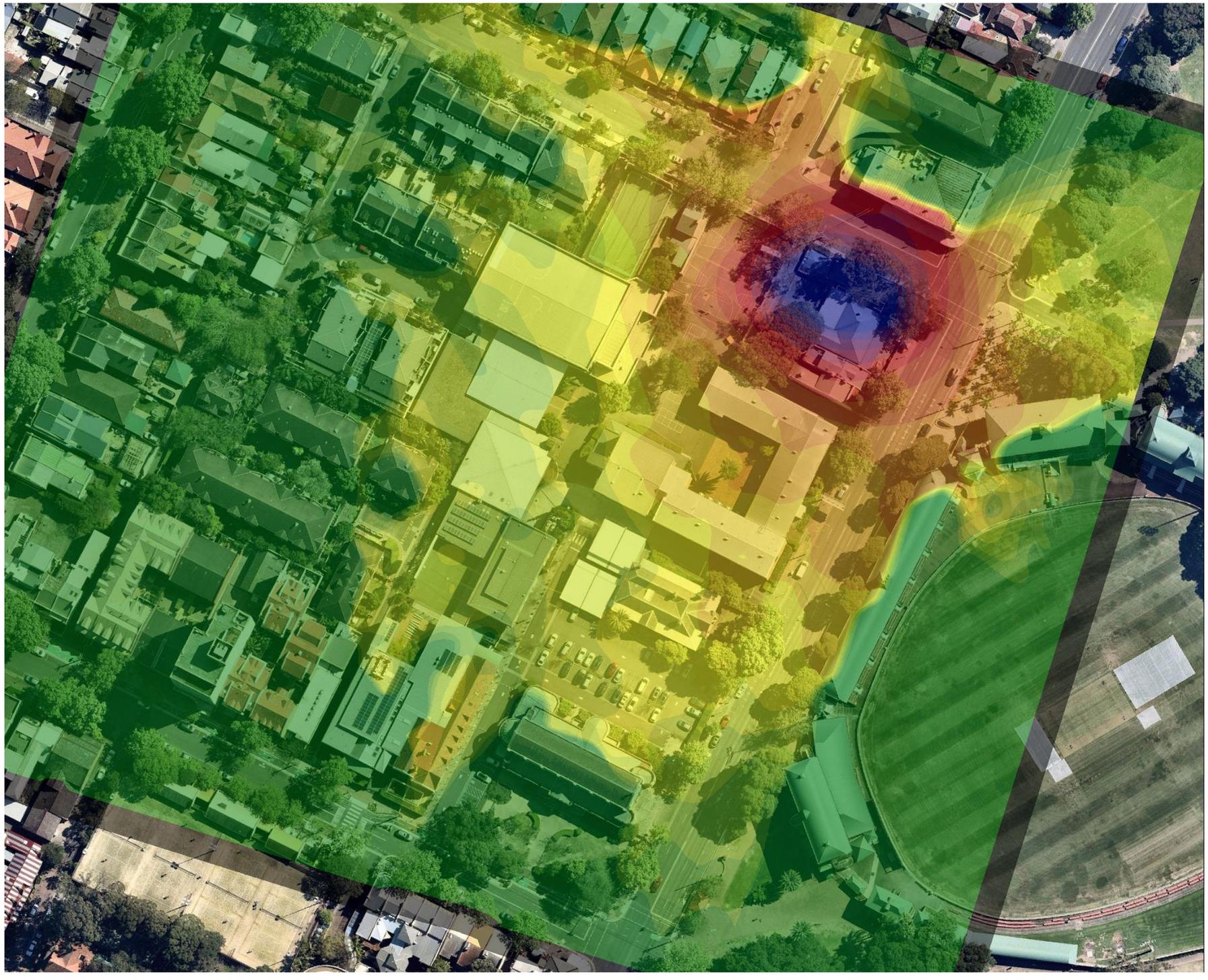
Noise level
LAeq(15min)
in dB(A)

	<= 55
55 <	<= 57
57 <	<= 59
59 <	<= 61
61 <	<= 63
63 <	<= 65
65 <	<= 67
67 <	<= 69
69 <	<= 71
71 <	<= 73
73 <	<= 75
75 <	<= 77
77 <	<= 79
79 <	<= 81
81 <	<= 83
83 <	

Scale 1:1096

0 5 10 20 30 40 m

Stantec



SCS - North Sydney Marist

Construction Noise Emissions

Structure no Mitigation

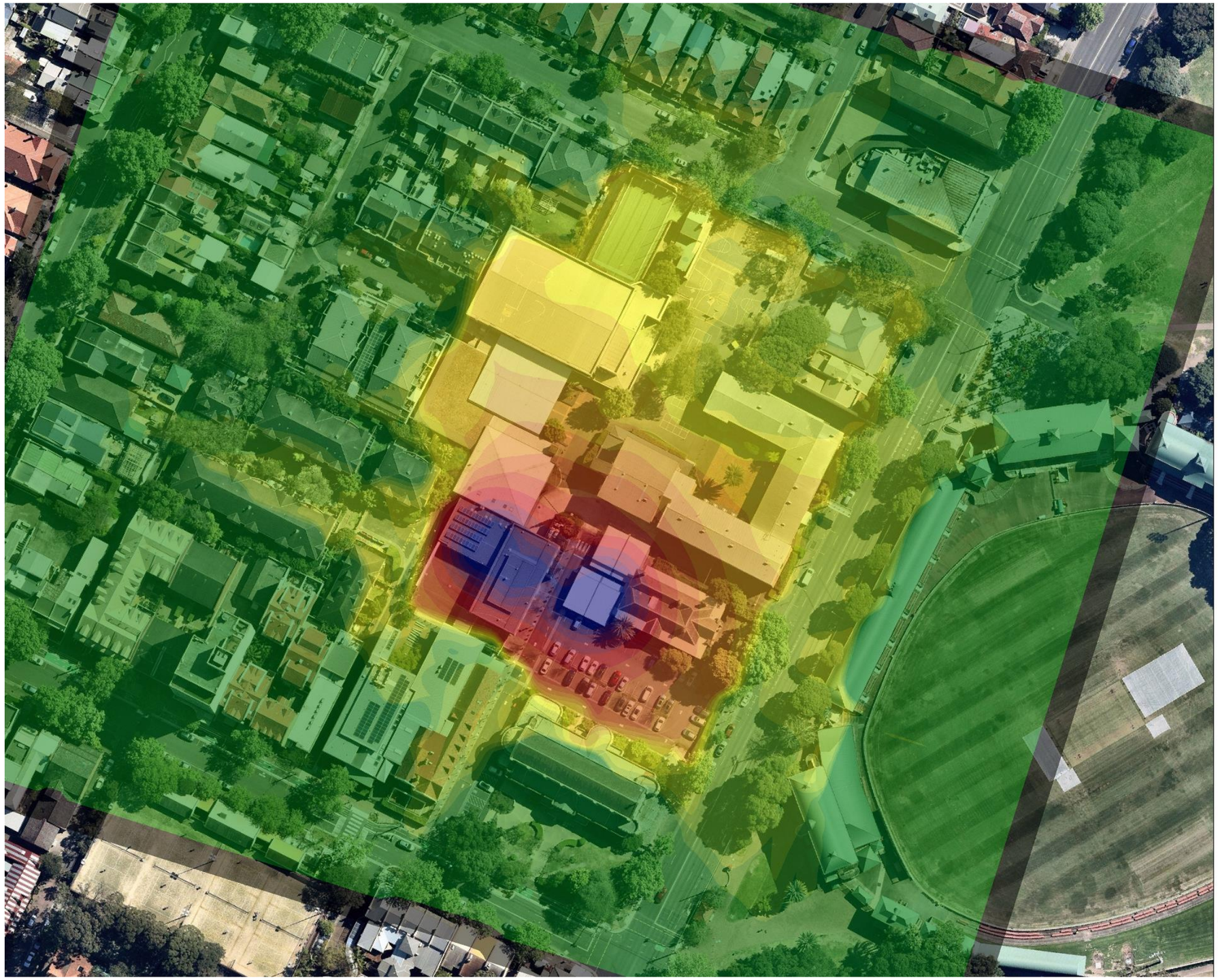
Noise level
LAeq(15min)
in dB(A)

	<= 55
55 <	<= 57
57 <	<= 59
59 <	<= 61
61 <	<= 63
63 <	<= 65
65 <	<= 67
67 <	<= 69
69 <	<= 71
71 <	<= 73
73 <	<= 75
75 <	<= 77
77 <	<= 79
79 <	<= 81
81 <	<= 83
83 <	

Scale 1:1096

0 5 10 20 30 40 m

Stantec



SCS - North Sydney Marist

Construction Noise Emissions

Structure with Mitigation

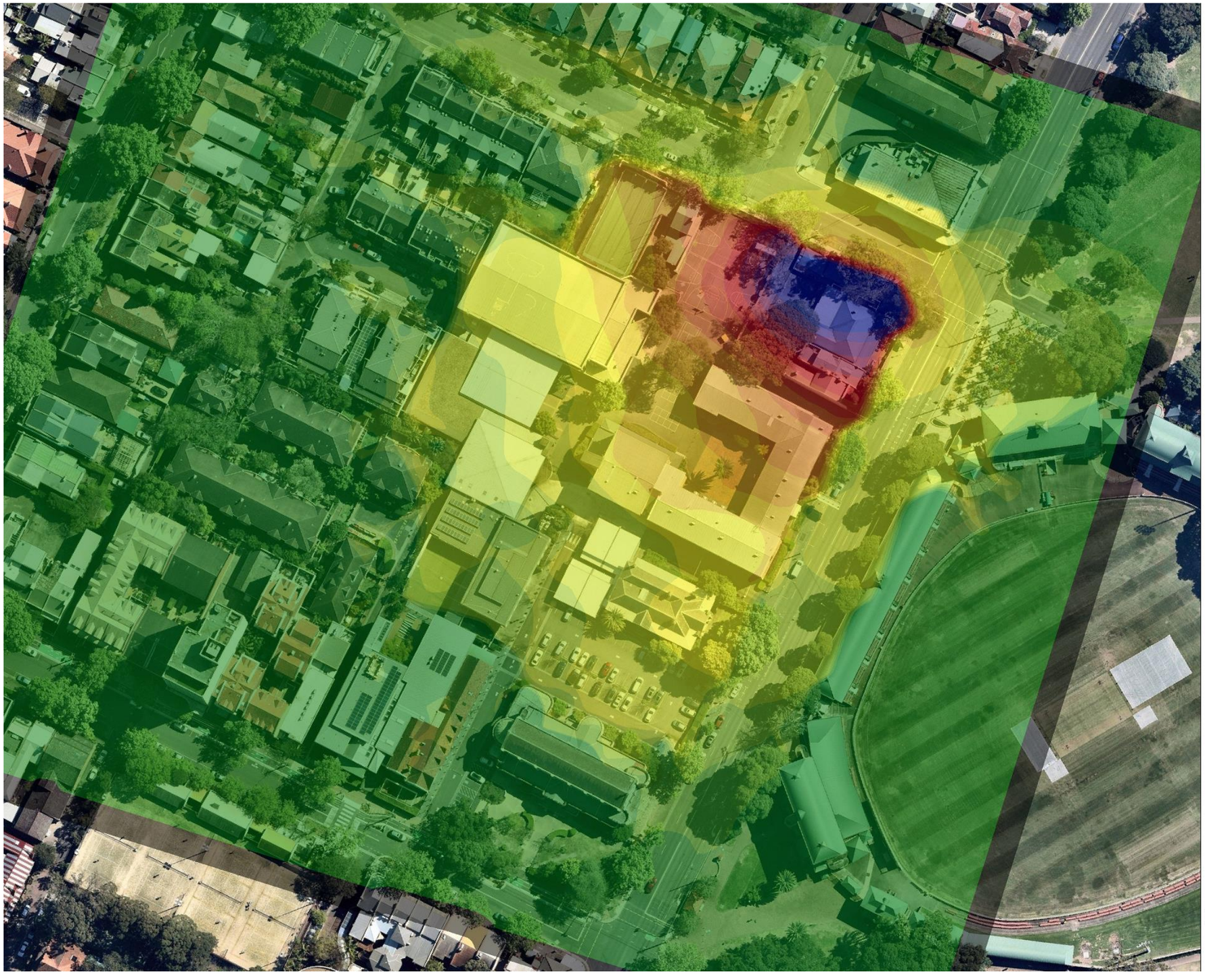
Noise level
LAeq(15min)
in dB(A)

	<= 55
55 <	<= 57
57 <	<= 59
59 <	<= 61
61 <	<= 63
63 <	<= 65
65 <	<= 67
67 <	<= 69
69 <	<= 71
71 <	<= 73
73 <	<= 75
75 <	<= 77
77 <	<= 79
79 <	<= 81
81 <	<= 83
83 <	

Scale 1:1096

0 5 10 20 30 40 m

Stantec



SCS - North Sydney Marist

Construction Noise Emissions

Structure with Mitigation

Noise level
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71 <	<= 73
73 <	<= 75
75 <	<= 77
77 <	<= 79
79 <	<= 81
81 <	<= 83
83 <	

Scale 1:1096

0 5 10 20 30 40 m

Stantec

SCS - North Sydney Marist

Construction Noise Emissions

Facade no Mitigation

Noise level
LAeq(15min)
in dB(A)

	<= 55
55 <	<= 57
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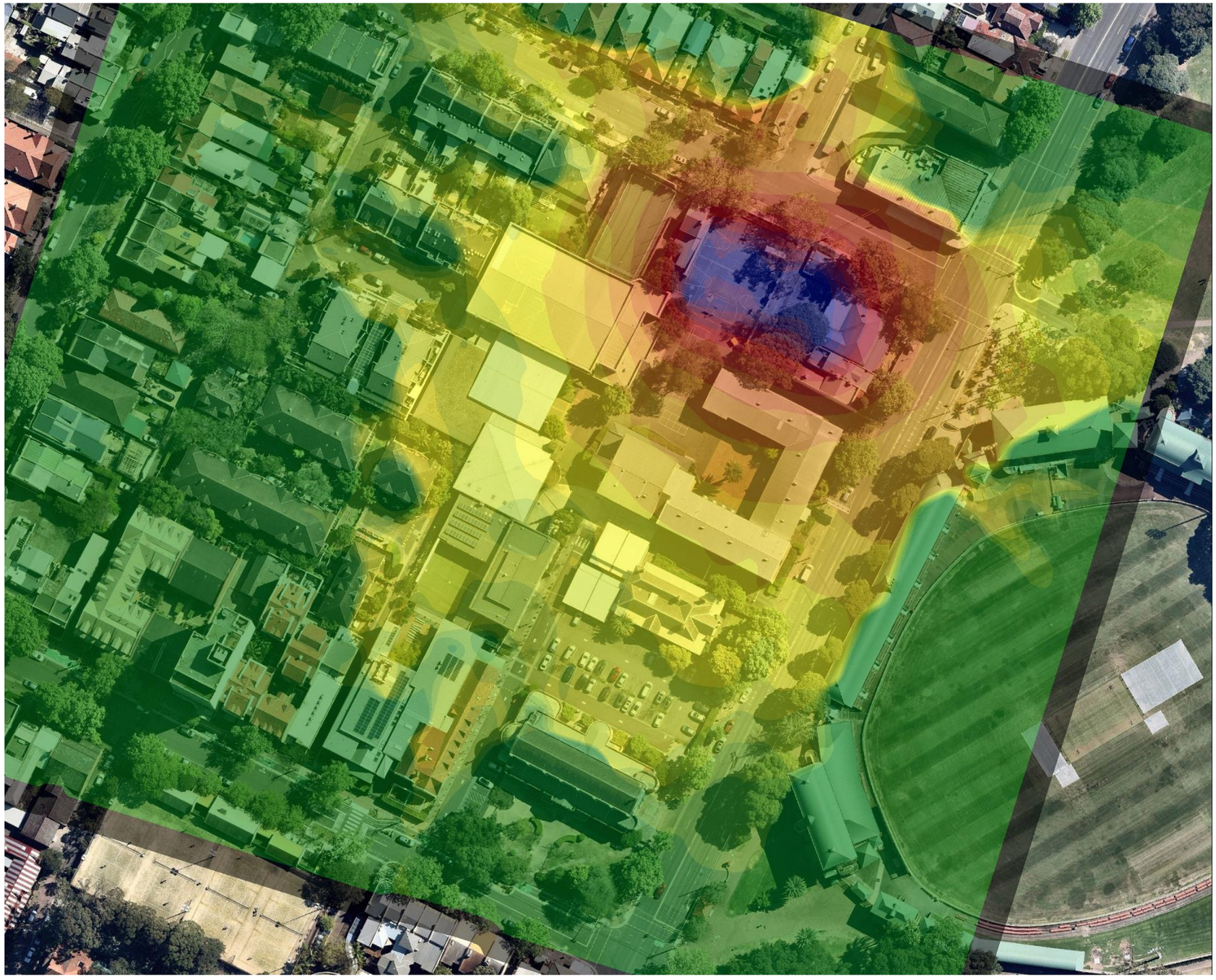
67 <	<= 69
69 <	<= 71
71 <	<= 73
73 <	<= 75
75 <	<= 77
77 <	<= 79
79 <	<= 81
81 <	<= 83
83 <	

Scale 1:1096

0 5 10 20 30 40 m

Stantec



SCS - North Sydney Marist

Construction Noise Emissions

Facade no Mitigation

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81 <	<= 83
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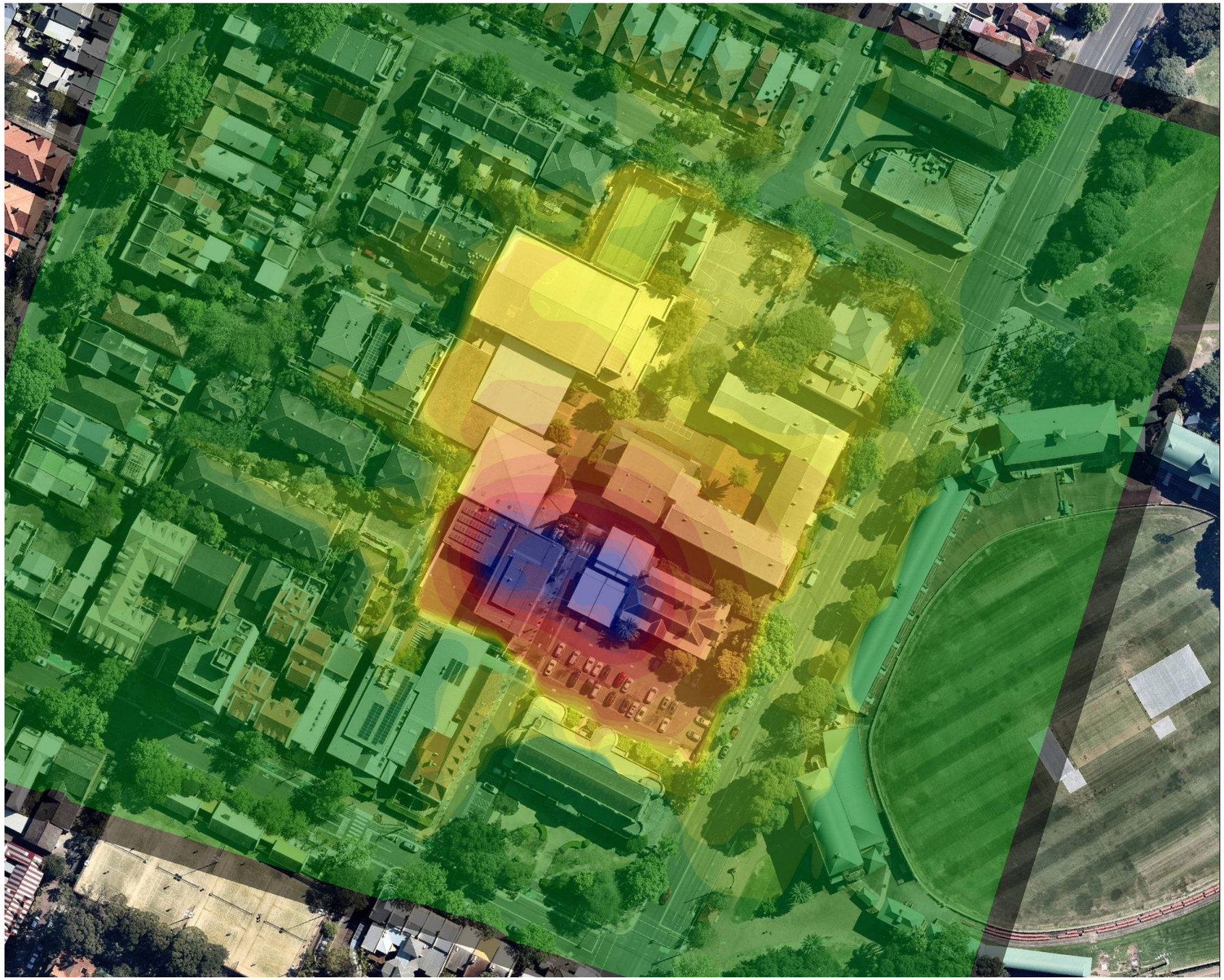
Scale 1:1096

0 5 10 20 30 40 m

Stantec



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Construction Noise Emissions

Facade with Mitigation

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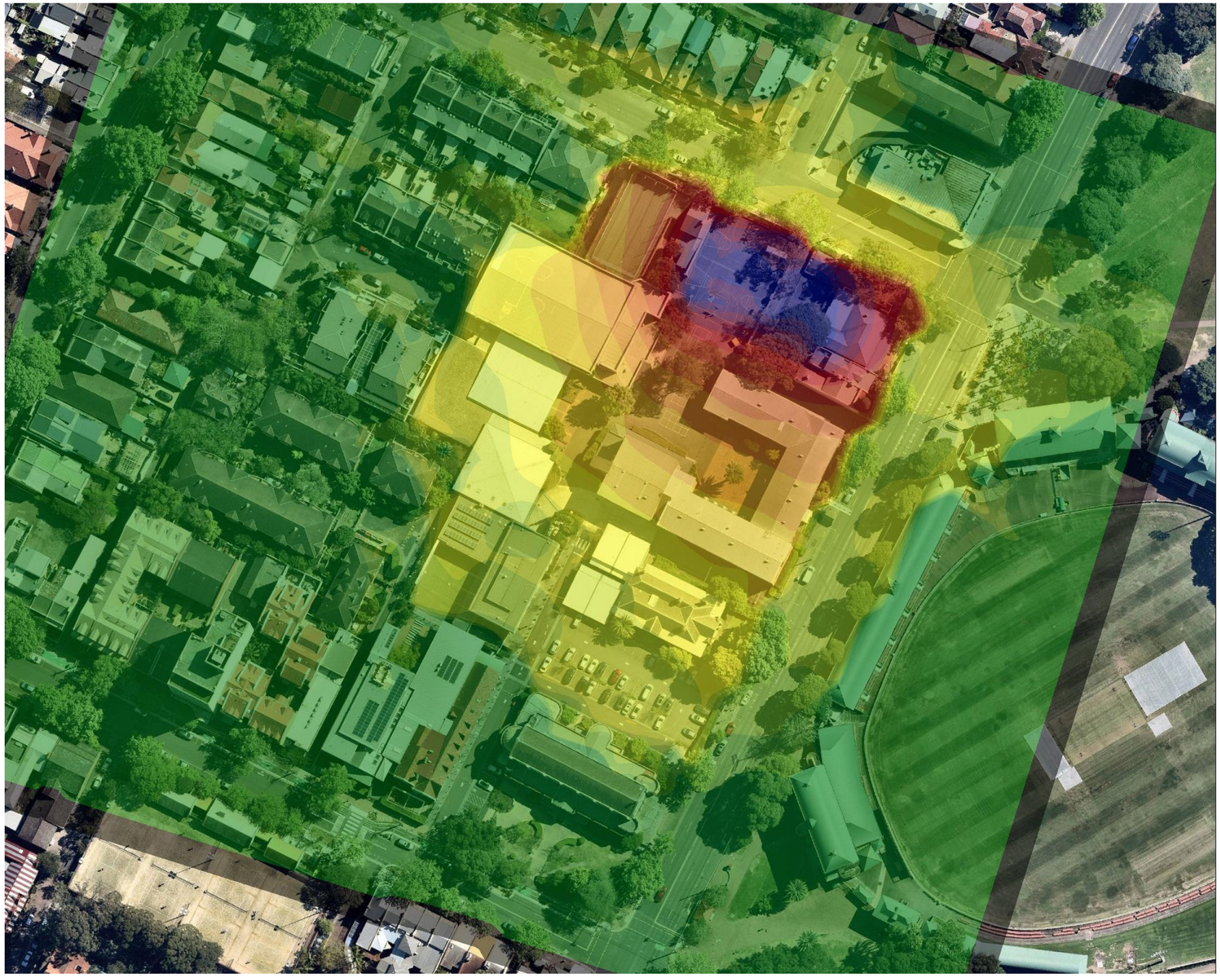
Scale 1:1096

0 5 10 20 30 40 m

Stantec



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Construction Noise Emissions

Facade with Mitigation

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83 <	

Scale 1:1096

0 5 10 20 30 40 m

Stantec

Design with
community in mind

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Tel +61 2 8484 7000

For more information please visit
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