**Schools Infrastructure New South Wales**

# Melrose Park High School

## Noise and Vibration Assessment Report

Reference: AC04

2.0 | 30 January 2025





Job number 303392

Arup Pty Limited | ABN 18 000 966 165

**Arup Pty Limited**
Level 5
151 Clarence Street
Sydney
NSW, 2000
Australia
arup.com

ARUP

# Document Verification

| | |
|---|---|
| **Project title** | Melrose Park High School |
| **Document title** | Noise and Vibration Assessment Report |
| **Job number** | 303392 |
| **Document ref** | AC04 |
| **File reference** | AC04_v3.0_MPHS_Noise and Vibration Assessment Report |

| **Revision** | **Date** | **Filename** | AC04_v1.0_MPHS_Noise and Vibration Assessment Report | | |
|---|---|---|---|---|---|
| Draft 1 | 29 November 2024 | **Description** | First draft | | |
| | | | **Prepared by** | **Checked by** | **Approved by** |
| | | **Name** | Amy Tibbels | Mitchell Allen | Mitchell Allen |
| | | **Signature** | | | |
| Issue | 17 January 2025 | **Filename** | AC04_v2.0_MPHS_Noise and Vibration Assessment Report | | |
| | | **Description** | | | |
| | | | **Prepared by** | **Checked by** | **Approved by** |
| | | **Name** | Amy Tibbels | Mitchell Allen | Mitchell Allen |
| | | **Signature** | | | |
| Issue | 30 January 2025 | **Filename** | AC04_v3.0_MPHS_Noise and Vibration Assessment Report | | |
| | | **Description** | | | |
| | | | **Prepared by** | **Checked by** | **Approved by** |
| | | **Name** | Amy Tibbels | Mitchell Allen | Mitchell Allen |
| | | **Signature** | | | |

Issue Document Verification with Document ✓

# Contents



## Tables

## Figures



## Drawings

**No table of figures entries found.**

## Pictures

**No table of figures entries found.**

## Photographs

**No table of figures entries found.**

## Attachments

**No table of figures entries found.**

## Appendices

# 1. Introduction and declaration

This Noise and Vibration Assessment Report has been prepared by Arup on behalf of the Department of Education (DoE) to assess the potential environmental impacts that could arise from the construction and use of the new Melrose Park High School project (the Activity) at 37 Hope Street, Melrose Park. This report supports the assessment of the proposed Activity under Part 5 of the Environmental Planning and Assessment Act 1979. The Activity is proposed by the DoE to meet the growth in educational demand in the Melrose Park precinct.

This report has been prepared to assess noise emission associated with operation and construction of the Activity. Noise intrusion into the future Melrose Park High School is also assessed to demonstrate suitability of the site for the proposed Activity.

## 1.1 Summary of the Activity

The proposed activity involves the construction and use of a new high school in two stages for approximately 1,000 students.

Stage 1 of the proposed activity includes the following:

- Site preparation works.
- Construction of Block A – a six-storey (with additional roof/plant level) school building in the south-western portion of the site containing staff rooms and General Learning Spaces (GLS).
- Construction of Block B – a one storey (double height) hall, gymnasium, canteen and covered outdoor learning area (COLA) building in the south-eastern portion of the site.
- Construction of Block C – a single storey plant and storage building at the north-eastern portion of the site.
- Associated landscaping.
- Construction of on-site car parking.
- Provision and augmentation of services infrastructure.
- Associated public domain infrastructure works to support the school, including (but not limited to):
  - Provision of kiss and drop facilities along Wharf Road, and widening of the Wharf Road footpath.
  - Raised pedestrian crossings on Wharf Road and Hope Street.

Stage 2 of the proposed activity includes the following:

- Construction of Block D – a five-storey (with additional roof/plant level) school building in the north-western portion of the site containing staff rooms and GLS:
- Additional open play spaces within the terrace areas of Building D.
- Minor layout amendments to Block A.

The Review of Environmental Factors prepared by Ethos Urban provides a full description of the proposed works.

## 1.2 Site description

The site is located at 37 Hope Street, Melrose Park within the Parramatta LGA. The school covers an approximate area of 9,500m2 and is generally rectangular in shape. The site is currently cleared and vacant. The site is located approximately 8km east of the Parramatta CBD.

The nearest existing noise sensitive receivers are residences across Wharf Road to the east. Future proposed multi-storey residential buildings are to be located to the west.

The dominant source of noise intrusion to the site is from road traffic along Hope Street and Wharf Road. There is some limited light industry to the south west of the site across Hope Street.

Figure 1 shows the site location and its immediate surroundings.


**Figure 1: Melrose Park High School development site and surrounds**

Figure 2 shows the school site in the context of future proposed developments in the Melrose Park Urban Renewal Precinct Masterplan.


**Figure 2: Melrose Park Urban Renewal Masterplan**

Figure 3 shows noise sensitive receivers and acoustic monitoring locations.


**Figure 3: Sensitive receiver locations**

Figure 4 summarises NSW Planning Portal zone classifications for surrounding land uses.

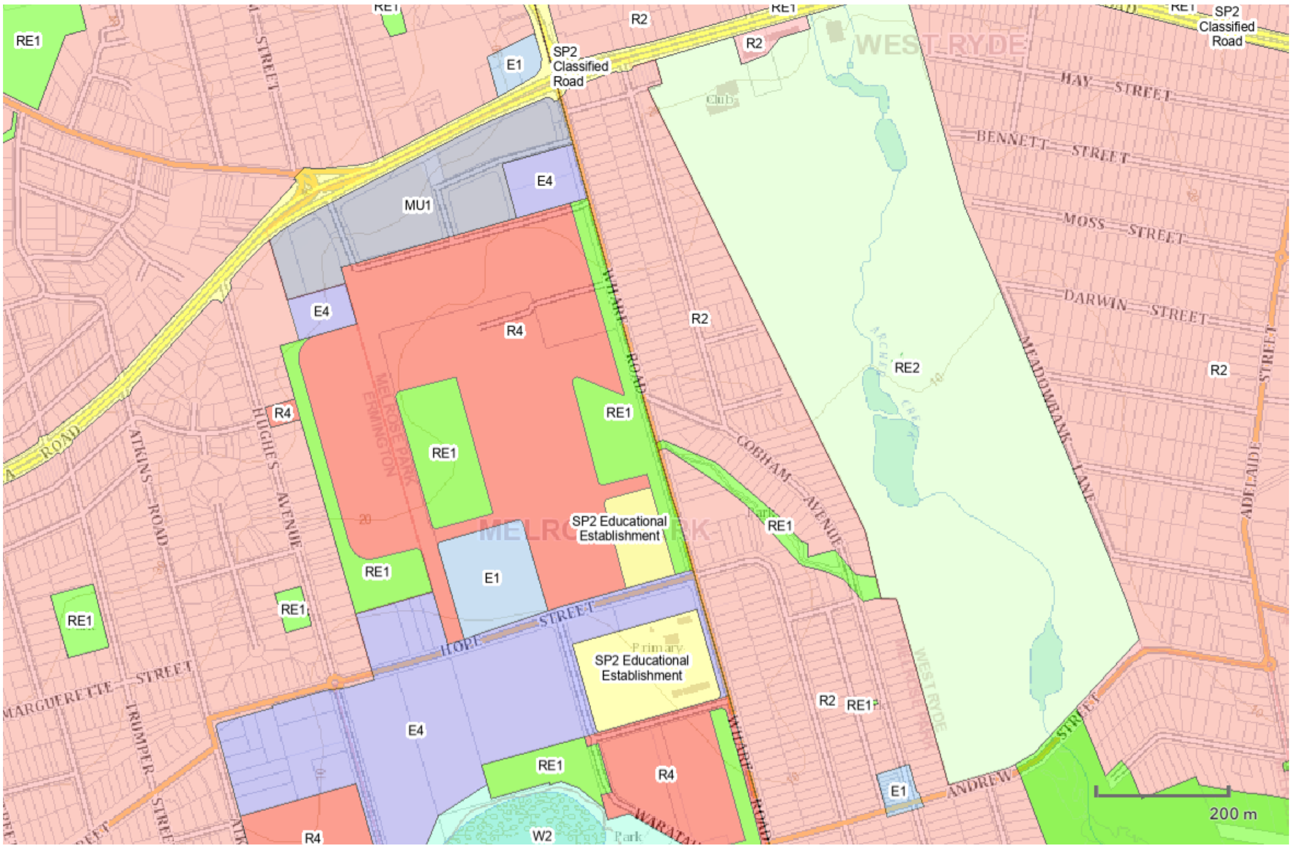



**Figure 4: NSW Planning Portal zone classifications**

The nearest potentially affected noise sensitive receivers to the site are summarised in Table 1.

**Table 1: Nearest noise sensitive receivers**

| Receiver ID | Address | Classification |
|---|---|---|
| R1 | Building O3, Melrose Park Urban Renewal Precinct | Residential |
| R2, R3 | Building O6, Melrose Park Urban Renewal Precinct | Residential |
| R4 | Building O1, Melrose Park Urban Renewal Precinct | Residential |
| R5 | Building H3, Melrose Park Urban Renewal Precinct | Residential |
| R6 | 1B Lancaster Avenue, Melrose Park | Residential |
| R7 | 81 Wharf Road, Melrose Park | Residential |
| R8 | 79 Wharf Road, Melrose Park | Residential |
| R9 | 77 Wharf Road, Melrose Park | Residential |
| R10 | 73 Wharf Road, Melrose Park | Residential |
| R11 | 71 Wharf Road, Melrose Park | Residential |
| R12 | 69 Wharf Road, Melrose Park | Residential |
| R13 | 67 Wharf Road, Melrose Park | Residential |

| Receiver ID | Address | Classification |
|---|---|---|
| R14 | 87 Wharf Road, Melrose Park | Residential |
| R15, R16 | Building O3, Melrose Park Urban Renewal Precinct | Residential |
| SS1 | Melrose Park Public School, 110 Wharf Road, Melrose Park | School |
| I1 | 10 Hope Street, Melrose Park | Industrial |
| I2 | 12 Hope Street, Melrose Park | Industrial |
| I3 | 100 Wharf Road, Melrose Park | Industrial |

Figure 5 shows a site plan of the proposed Activity.

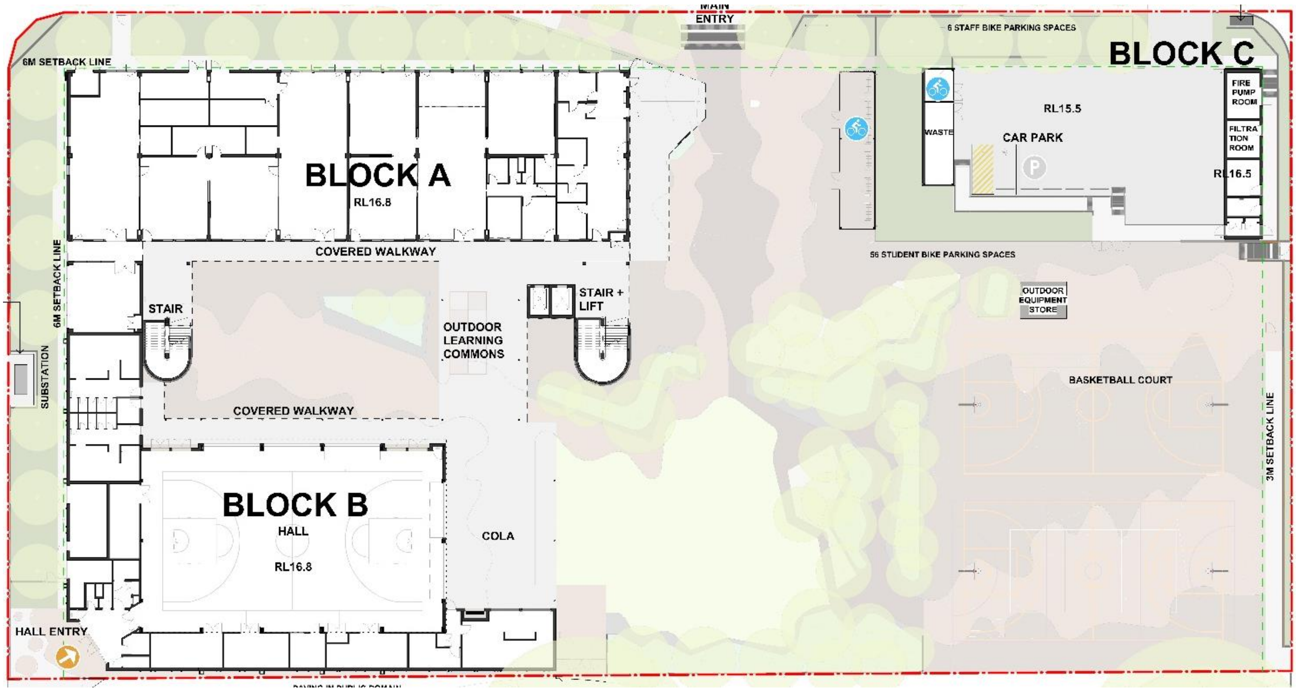



Figure 5: Site Plan

## 1.3 Existing acoustic environment

The existing acoustic environment at the site is currently impacted by construction works both on and adjacent to the proposed site. Further, the existing acoustic environment in the absence of construction noise is unlikely to be representative of the future developed locale.

An acoustic assessment was undertaken as part of the Melrose Park Town Centre Development Application (DA/764/2022). Attended and unattended noise measurements were undertaken as part of the assessment in August 2022 at locations depicted in Figure 1.

Measured data is reproduced in Table 2 for reference.

**Table 2: Unattended noise monitoring data – Melrose Park Town Centre DA Acoustic Report**

| Measurement Location | Rating Background Level, (dB(A) $L_{90}$) | | | Traffic noise level (dB(A), $L_{eq(period)}$) | |
|---|---|---|---|---|---|
| | Day (7am to 6pm) | Evening (6pm to 10pm) | Night (10pm to 7am) | Day (7am to 10pm) | Night (10pm to 7am) |
| M1 – Hope Street | 49 | 46 | 45 | 63 | 57 |
| M2 – Hughes Avenue | 45 | 44 | 39 | 56 | 51 |

The Melrose Park Town Centre DA Acoustic Report notes the following with respect to monitoring information:

- Existing development surrounding the project site is primarily industrial use. Planning proposals for the precinct indicate that these uses will be removed and generally replaced with high density residential development.
- Background noise levels at Location M1 were impacted by commercial/industrial activity carried out along Hope Street.
- Background noise levels at monitor location M2 have been measured- at the nearest existing residential dwellings, and are more representative of future background noise levels within the precinct following redevelopment of the industrial uses.
- On this basis the lower background noise levels at monitor location M2 will be used to determine noise emission goals to residential receivers within, and adjacent to the project site.

Supplementary attended measurements undertaken as part of the DA Acoustic Assessment for the Melrose Park Town Centre Masterplan are also provided for reference.

**Table 3: Attended noise monitoring data – Melrose Park Town Centre DA Acoustic Report**

| Measurement location | Measured level (dB(A) $L_{eq,15min}$) |
|---|---|
| A1 – Hope Street, Melrose Park – 4m from nearest trafficable lane directly in front of project site. | 66 |
| A2 – Hughes Avenue, Ermington – 4m to nearest trafficable lane in front of 75 Hughes Avenue. | 58 |
| A3 – Wharf Road, Melrose Park – 4m to nearest trafficable lane in front of 81 Wharf Road, Melrose Park | 65 |

## 1.4 Significance of Environmental Impacts

Based on the identification of potential issues, and an assessment of the nature and extent of the impacts of the proposed development, it is determined that:

- The extent and nature of potential impacts are low and are unlikely to have significant impact on the locality, community and/or the environment.
- Potential impacts can be appropriately mitigated or managed to ensure that there is no significant impact on the environment.

# 2. Acoustic assessment criteria

## 2.1 Relevant standards, guidelines and regulations

The following have been used to develop the noise and vibration criteria for the project:

**Local Council Guidelines and Policies**

- Parramatta Council – Development Control Plan (2024)

**NSW Government Guidelines and Policies**

- NSW Department of Education – Educational Facilities Standards and Guidelines v2.0, 0001c Design Checklist – Acoustics
- NSW Department of Planning, Development Near Rail Corridors and Busy Roads – Interim Guideline (2008)
- NSW Department of Environment and Conservation, Assessing Vibration: A technical guideline (February 2006)
- NSW Environmental Protection Authority – Noise Policy for Industry (October 2017)
- NSW State Environmental Planning Policy (Infrastructure) 2007
- NSW Road Noise Policy (March 2011)
- NSW EPA, Environmental Criteria for Road Traffic Noise (1999) Australian and International Standards
- NSW Department of Environment and Climate Change (DECC) "Interim Construction Noise Guideline" (ICNG) 2009.
- NSW Department of Environment and Conservation (DEC) "Assessing Vibration: A Technical Guideline" (AVTG) 2006.
- NSW Protection of the Environmental Operations (POEO) Act 1997.

**National Standards**

- AS 2107:2016 Acoustics—Recommended design sound levels and reverberation times for building interiors
- AS 2021:2021 – Acoustics – Aircraft noise intrusion – building siting and construction.
- AS 2436:2010 – Guide to Noise and Vibration Control on Construction, Demolition & Maintenance Sites.
- AS 1055:1997 – Acoustics – Description and Measurement of Environment Noise.

**Industry guidelines**

- Association of Australasian Acoustical Consultants (AAAC) — Guideline for Educational Facilities, Version 2.0
- Association of Australian Acoustical Consultants (AAAC) Guidelines for Child Care Centre Acoustic Assessment, V 3.0

**Sustainability Standards**

- Green Building Council of Australia – Buildings v1

## 2.2 Parramatta Council DCP

Parramatta Council Development Control Plan (2023) summarises assessment requirements for developments within its jurisdiction. Table 4 summarises relevant acoustic assessment requirements.

**Table 4: Parramatta Council Development Controls – Noise and vibration**

| Development control | Assessment requirements |
|---|---|
| Part 4.5 – Acoustic Privacy Control C.04 | The design of the proposed educational establishment should minimise the projection of noise from the various activities anticipated to occur within the site. Adjoining and nearby residents should not be exposed to unreasonable levels of noise arising from the proposed use. |
| Part 4.5 – Acoustic Privacy Control C.05 | A noise impact assessment statement, prepared by a suitably qualified acoustic engineer, is to be submitted with all applications for development within residential zones or which adjoin residential zones. This should describe hours of operation and predicted noise levels for regular lunch and tea breaks and for special events such as festivals and religious celebrations. Where possible, reference should be made to similar operating uses whether or not within the City.<br>Note: Consideration will be given to exempt C.05 where applications are received for minor modifications or alterations to existing premises. |

## 2.3 Operational noise emissions

Consideration is given to the following:

- Noise emission from building services
- Noise emission from school activities and operations; and
- Noise emission from additional traffic generated by the development.

The following sections summarise corresponding assessment criteria.

### 2.3.1 Building services

#### *2.3.1.1 Normal operations*

Building services noise emissions will be assessed in accordance with the NSW Noise Policy for Industry (NPI) which is primarily concerned with controlling intrusive noise impacts in the short-term for residences and maintaining long-term noise level amenity for residences and other land uses.

The NPI sets out the procedure to determine the project noise trigger levels relevant to an industrial development. The project noise trigger level is a level that, if exceeded would indicate a potential noise impact on the community and so ‘trigger’ a management response.

Table 5 summarises the derived project specific noise levels based on the NPI as presented in the Melrose Park Town Centre Acoustic DA Report.

**Table 5: NPI Project specific noise levels**

| Receiver | Time Period | Project Specific Noise Levels | |
|---|---|---|---|
| | | Intrusive Noise Trigger Levels<br>$L_{Aeq,15min}$ | Project Amenity Noise Level (PANL)<br>$L_{Aeq,period}$ |
| Nearest residential receivers | Day | **54** | 58 |
| | Evening | **50** | 58 |
| | Night | 49 | **43** |
| School outdoor areas | When in use | - | 55 |

| Receiver | Time Period | Project Specific Noise Levels | |
|---|---|---|---|
| | | Intrusive Noise Trigger Levels<br>$L_{Aeq,15min}$ | Project Amenity Noise Level (PANL)<br>$L_{Aeq,period}$ |
| School classroom - internal | Noisiest 1 – hour period | - | 40 $L_{Aeq(1hr)}$[1] |
| Industrial premises | When in use | - | 70 |
| Notes:<br>1 – As stated in table 2.2 note in the NPI, in the case where existing schools are affected by noise from existing industrial noise sources, the acceptable $L_{Aeq}$ noise level may be increased to 40 dB $L_{Aeq(1hr)}$. | | | |

The school is not expected to operate during the night-time period, therefore daytime criterion is taken as the most onerous target on which assessment of noise emission is based.

#### 2.3.1.2 Modifying factors

Table C1 of the NPI sets modifying factor corrections for annoying noise characteristics such as tonality, dominant low frequency, intermittency or irregularity.

When assessing low frequency impacts, an initial screening test is first undertaken by evaluating whether the difference in noise levels in C-weighted and in A-weighted are 15 dB or more at the receivers, which identifies the potential for an unbalanced spectrum in which case further assessment is required.

#### 2.3.1.3 Sleep disturbance

The NSW NPI also recommends criteria for the assessment of potential sleep disturbance, for the period between 10 pm and 7 am. The school is not expected to operate during this time period, therefore potential sleep disturbance is not being considered.

#### 2.3.1.4 Emergency equipment

There are no provisions in NSW legislation for noise impacts associated emergency plant.

In lieu of relevant criteria, the VIC EPA State Environment Protection Policy (SEPP) No. N-1 states:

> *Where the noise source under consideration is a standby generator, standby boiler or fire pump, the noise limit shall be increased by 10 dB for a day period and by 5 dB for all other periods.*

This is considered an appropriate provision for short and intermittent operation of equipment during testing such as stair pressurisation fans.

### 2.3.2 School activity

There are no specific regulatory policies or guidelines for noise associated with general school activity. Furthermore, the following is noted from NSW Land and Environment Court (LEC) proceeding (Meriden School v Pedavoli, 22 Oct 2009, case NSW LEC 183)

> *"All noise that emanates from the normal activities at a school is not offensive".*

Notwithstanding, assessment of noise impacts from this type of activity is typically made with reference to the Association of Australasian Acoustical Consultants (AAAC) Guideline for Child Care Centre Acoustic Assessment. The Guideline states the following with respect to outdoor activity:

> *Up to 4 hours (total) per day – If outdoor play is limited to no more than 2 hours in the morning and 2 hours in the afternoon, the contributed Leq,15 minute noise level emitted from the outdoor play shall not exceed the background noise level by more than 10 dB at the assessment location.*

The guidance relating to up to 4 hours outdoor play is deemed appropriate in the context of typical high school programme and activity.

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 Guideline states the following with respect to indoor play:

> *The cumulative Leq,15 minute noise emission level resulting from the use and operation of the childcare centre, with the exception of noise emission from outdoor play discussed above, shall not exceed the background noise level by more than 5 dB at the assessment location as defined above. This includes the noise emission resulting from:*
>
> - *Indoor play;*
> - *Mechanical plant;*
> - *Drop off and pick up;*
> - *Other activities/operations (not including outdoor play).*

Assessment of school activities will be guided by these noise management levels to assist in operational management of the school, noting they are aspirational criteria and not mandatory requirements.

### 2.3.3 Road traffic noise

The NSW Road Noise Policy (RNP) includes assessment criteria for existing noise sensitive receivers affected by additional traffic on existing roads generated by land use developments. These criteria are reproduced in Table 6 for reference.

**Table 6: Road traffic noise assessment criteria for residential land uses.**

| Road category | Type of project / land use | Assessment criteria | |
|---|---|---|---|
| | | Day (7am–10pm) | Night (10pm–7am) |
| Freeway / arterial / sub-arterial roads | Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments | 60 dB $L_{Aeq, (15\ hour)}$ (external) | 55 $L_{Aeq, (9\ hour)}$ (external) |
| Local roads | Existing residences affected by additional traffic on existing local roads generated by land use developments | 55 $L_{Aeq, (1\ hour)}$ (external) | 50 $L_{Aeq, (1\ hour)}$ (external) |

Where existing traffic noise levels are above the noise assessment criteria, the primary objective is to reduce these through feasible and reasonable measures to meet the assessment criteria. A secondary objective is to protect against excessive decreases in amenity as the result of a project by applying the relative increase criteria.

In assessing feasible and reasonable mitigation measures, an increase of up to 2 dB represents a minor impact that is considered barely perceptible to the average person.

## 2.4 Noise intrusion

### 2.4.1 Internal background noise levels

Section 0.03 of the EFSG Acoustic Checklist states the following:

*An internal noise level assessment must be carried out for all new buildings to ensure comfortable acoustic conditions for the spaces occupied.*

*The internal noise levels within the space must meet the limits stipulated in Table 11.06.1 of Section 11.6 Acoustic Performance Guidelines or be within the range stipulated in Table 1 of the AS/NZS 2107:2016 standard. The more stringent of the two should be met.*

For normal operations, internal noise levels are to be met cumulatively taking into account the sources discussed in the following sections.

#### 2.4.1.1 Building services noise

Building services are typically the predominant source of background noise within a space. Internal building services noise targets are set at 3 dB below overall internal noise criteria to allow for cumulative compliance once noise intrusion through façade elements is added.

#### 2.4.1.2 Road traffic noise intrusion

In addition, the EFSGs stipulate that road noise shall be assessed in accordance with the requirements of the State Environmental Planning Policy (Infrastructure) 2007 (ISEPP). The ISEPP is supported by the Development Near Rail Corridors and Busy Roads – Interim Guideline, which sets the following internal noise criteria for educational facilities:

**Table 7: ISEPP internal airborne noise criteria.**

| Receiver type | Time | Airborne noise daytime $L_{Aeq,15h}$ | Airborne noise night time $L_{Aeq,9h}$ |
|---|---|---|---|
| Educational Institutions including childcare centres | When in use | 40 | 40 |

Based on the use of the different spaces, lower internal noise levels may be required in line with the EFSG, therefore, the ISEPP criteria should be considered as a minimum legislative requirement.

#### 2.4.1.3 Natural ventilation implications

The internal noise criteria are generally achieved through a sealed building. Ideally where natural ventilation is to be provided, the same criteria would also be achieved, particularly for critical spaces, where higher ambient noise levels may otherwise impact on speech intelligibility or unduly impact concentration.

For less critical uses, research has indicated that occupants are willing to accept trade-offs in the ambient noise levels where natural ventilation is provided. The ISEPP guideline generally allows for a + 10 dB concession for the ‘open windows’ condition. It is noted that for teaching and learning spaces this recommendation is based on the ability to close the windows to achieve internal noise targets.

### 2.4.2 Outdoor areas

The criteria from the NSW State Environmental Planning Policy (Infrastructure) (ISEPP) considers the impact of road traffic noise on internal comfort, but does not address external amenity.

The NSW Environmental Criteria for Road Traffic Noise (ECRTN) and the NSW Road Noise Policy (RNP) provide criteria for school playgrounds and childcare outdoor play areas respectively.

Criteria for outdoor learning areas are not provided by any of the relevant policies and guidelines referenced.

The proposed aspirational noise criteria for outdoor areas are presented in Table 8.

**Table 8: Aspirational noise criteria for outdoor areas.**

| Type of space | Assessment Criteria, $L_{Aeq, 1hr}$ |
|---|---|
| Outdoor school playgrounds | 55 |

| Type of space | Assessment Criteria, $L_{Aeq, 1hr}$ |
|---|---|
| Outdoor learning areas | 50 |

The above criteria should be aimed for where possible and practical. But they may not be feasible nor necessary to achieve based on the site constraints and the specific uses proposed for the different areas.

## 2.5 Construction noise and vibration

### 2.5.1 Hours of work

Construction works will be undertaken within the hours outlined in Table 9, in accordance with ICNG standard hours of construction

**Table 9: Proposed Hours of Construction**

| Day | Standard construction hours |
|---|---|
| Monday to Friday | 7.00 am to 6:00 pm |
| Saturdays | 8.00 am to 1:00 pm |
| Sundays or Public Holidays | No construction |

In some additional cases, after-hours permits may be sought from the relevant authorities where special requirements exist, for example oversized deliveries.

### 2.5.2 Construction noise criteria

The Interim Construction Noise Guideline (ICNG) provides recommended noise levels for airborne construction noise at sensitive land uses. The ICNG provides construction management noise levels above which all ‘feasible and reasonable’ work practices should be applied to minimise the construction noise impact. The ICNG works on the principle of a ‘screening’ criterion – if predicted or measured construction noise exceeds the ICNG levels then the construction activity must implement all ‘feasible and reasonable’ work practices to reduce noise levels.

The ICNG sets out management levels for noise at noise sensitive receivers, and how they are to be applied. These noise management levels (NMLs) for residential receivers and other sensitive receivers are reproduced in Table 10 and in Table 11 respectively.

**Table 10: Construction noise management levels (NMLs) at residential receivers**

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

| Time of day | Management level[1] $L_{Aeq\ (15\ min)}$ | How to apply |
|---|---|---|
| | Highly noise affected<br>75dB(A) | The highly noise affected level represents the point above which there may be strong community reaction to noise.<br>Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account:<br>• 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<br>• 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<br>RBL + 5dB | A strong justification would typically be required for works outside the recommended standard hours.<br>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.<br>Where all feasible and reasonable practices have been applied and noise is more than 5dBA above the noise affected level, the proponent should negotiate with the community.<br>For guidance on negotiating agreements see section 7.2.2 of the ICNG. |
| Note:<br>1. Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence. | | |

**Table 11: Construction noise management levels (NMLs) at other noise sensitive land uses**

| Land use | Where objective applies | Management level $L_{Aeq(15\ min)}$[1] |
|---|---|---|
| Classrooms at schools and other educational institutions | Internal noise level | 45 dB(A) |
| Hospital wards and operating theatres | Internal noise level | 45 dB(A) |
| Places of worship | Internal noise level | 45 dB(A) |
| Active recreation areas | External noise level | 65 dB(A) |
| Passive recreation areas | External noise level | 60 dB(A) |
| Community centres | Depends on the intended use of the centre. | Refer to the ‘maximum’ internal levels in AS2107 for specific uses. |
| Commercial premises | External noise level | 70 dB(A) |

| Land use | Where objective applies | Management level $L_{Aeq(15\ min)}$[1] |
|---|---|---|
| Industrial premises | External noise level | 75 dB(A) |
| 1 - Noise management levels apply when receiver areas are in use only. | | |

For work within standard construction hours, if after implementing all 'feasible and reasonable' noise levels the site still exceeds the noise affected level, the ICNG does not require any further action – since there is no further scope for noise mitigation.

For out-of-hours work, the ICNG uses a noise level 5 dB below the noise-affected level as a threshold where the proponent should negotiate with the community.

Measured noise data obtained at the logger location most representative of each noise catchment area has been used to derive appropriate noise management levels for the project. These are summarised in Table 4.

**Table 12: Construction Noise Management Criteria for Residential Premises**

| Time Period | Description | NML Criteria $L_{Aeq\ (15\ min)}$[1] |
|---|---|---|
| During recommended standard hours | Noise affected | 51 |
| | Highly noise affected | 75 |
| Outside recommended standard hours | Noise affected | 46 |
| 1 - Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. | | |

### 2.5.3 Construction vibration criteria

#### *2.5.3.1 Disturbance to buildings occupants*

Potential vibration disturbance to human occupants of buildings is made in accordance with the NSW Assessing Vibration; a technical guideline. The criteria outlined in the guideline is based on the British Standard BS 6472-1992. Sources of vibration are defined as either 'Continuous', 'Impulsive' or 'Intermittent', as described in Table 13.

**Table 13: Types of vibration – Definition**

| Type of vibration | Definition | Examples |
|---|---|---|
| Continuous vibration | Continues uninterrupted for a defined period (usually throughout the day-time and/or night-time) | Machinery, steady road traffic, continuous construction activity (such as tunnel boring machinery). |
| Impulsive vibration | A rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at approximately the same amplitude, providing that the duration is short, typically less than 2 seconds | Infrequent: Activities that create up to 3 distinct vibration events in an assessment period, e.g. occasional dropping of heavy equipment, occasional loading and unloading. |

| Type of vibration | Definition | Examples |
|---|---|---|
| Intermittent vibration | Can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude | Trains, nearby intermittent construction activity, passing heavy vehicles, forging machines, impact pile driving, jack hammers.<br>Where the number of vibration events in an assessment period is three or fewer, this would be assessed against impulsive vibration criteria. |

For continuous and intermittent vibration, the preferred and maximum values (in are weighted acceleration values (Wg for z axis and Wd for x and y axes). For intermittent vibration, the preferred and maximum values are Vibration Dose Values (VDVs), based on the weighted acceleration values.

Table 14 reproduces the 'Preferred' and 'Maximum' acceleration values for continuous and impulsive vibration (Wg for z axis and Wd for x and y axes). Table 15 reproduces the 'Preferred' and 'Maximum' Vibration Dose Values (VDVs) for intermittent vibration, based on the weighted acceleration values (Table 2.2 and 2.4 of the Guideline respectively).

**Table 14: Preferred and maximum vibration acceleration levels for human comfort, $m/s^2$**

| Location | Assessment period[1] | Preferred values | | Maximum values | |
|---|---|---|---|---|---|
| | | z-axis[3] | x- and y-axes[3] | z-axis[3] | x- and y-axes[3] |
| Continuous vibration (weighted root-mean-square (RMS) acceleration, $m/s^2$, 1-80Hz) | | | | | |
| Critical areas[4] | Day- or night-time | 0.0050 | 0.0036 | 0.010 | 0.0072 |
| Residences | Daytime | 0.010 | 0.0071 | 0.020 | 0.014 |
| | Night-time | 0.007 | 0.005 | 0.014 | 0.010 |
| Offices, schools, educational institutions and places of worship | Day- or night-time | 0.020 | 0.014 | 0.040 | 0.028 |
| Workshop | Day- or night-time | 0.040 | 0.029 | 0.080 | 0.058 |
| Impulsive vibration (weighted2 RMS acceleration, $m/s^2$, 1-80Hz) | | | | | |
| Critical areas4 | Day- or night-time | 0.0050 | 0.0036 | 0.010 | 0.0072 |
| Residences | Daytime | 0.30 | 0.21 | 0.60 | 0.42 |
| | Night-time | 0.10 | 0.071 | 0.20 | 0.14 |
| Offices, schools, educational institutions and places of worship | Day- or night-time | 0.64 | 0.46 | 1.28 | 0.92 |
| Workshop | Day- or night-time | 0.64 | 0.46 | 1.28 | 0.92 |
| Notes:<br>1_Daytime is 7 am to 10 pm and night-time is 10 pm to 7 am<br>2_None (to avoid confusion with the acceleration unit)<br>3_Two frequency weightings (Wg and Wd) are required for the general measurement of whole body vibration with respect to its effect on activities. The weightings should be applied to measurements made in the three vibration axes: Wg for z axis and Wd for x and y axes. | | | | | |

| Location | Assessment period[1] | Preferred values | | Maximum values | |
|---|---|---|---|---|---|
| | | z-axis[3] | x- and y-axes[3] | z-axis[3] | x- and y-axes[3] |
| 4_Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. | | | | | |

**Table 15: Acceptable vibration dose values (VDV) for intermittent vibration ($m/s^{1.75}$)**

| Location | Daytime1 | | Night-time | |
|---|---|---|---|---|
| | Preferred value | Maximum value | Preferred value | Maximum value |
| Critical areas3 | 0.10 | 0.20 | 0.10 | 0.20 |
| Residences | 0.20 | 0.40 | 0.13 | 0.26 |
| Offices, schools, educational institutions and places of worship | 0.40 | 0.80 | 0.40 | 0.80 |
| Workshops | 0.80 | 1.60 | 0.80 | 1.60 |

Notes:

1_Daytime is 7 am to 10 pm and night-time is 10 pm to 7 am

2_Note that the VDV is dependent upon the level and duration of the vibration event and the number of vibration events occurring during the assessment period; a higher vibration level is permitted if the total duration of the vibration event(s) is small.

3_Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. There may be cases where sensitive equipment or delicate tasks require more stringent criteria than the human comfort criteria specified above such as assessing intermittent values against the continuous or impulsive criteria for critical areas and/or referring to criteria in Section 1.2)

#### *2.5.3.2 Impact on structures and services*

Potential structural or cosmetic damage to buildings as a result of vibration is typically assessed in accordance with British Standard 7385 Part 2 and/or German Standard DIN4150-3.

**Standard structures**

British Standard 7385 Part 1:1990, defines different levels of structural damage as:

> *Cosmetic – The formation of hairline cracks on drywall surfaces, or the growth of existing cracks in plaster or drywall surfaces; in addition, the formation of hairline cracks in mortar joints of brick/concrete block construction.*
>
> *Minor – The formation of large cracks or loosening of plaster or drywall surfaces, or cracks through bricks/concrete blocks.*
>
> *Major – Damage to structural elements of the building, cracks in supporting columns, loosening of joints, splaying of masonry cracks, etc.*

BS7385-2 (Table 1 and Section 7.4.2) sets limits for the protection against the different levels of structural damage and those levels (for frequencies within the range 4-250 Hz) are reproduced in Table 16. The criteria relate predominantly to transient vibration that does not give rise to resonant responses in structures, and to low rise buildings.

Where the dynamic loading caused by continuous vibration is such as to give rise to dynamic magnification due to resonance, especially at the lower frequencies where lower guide values apply, the BS7385-2 values may need to be reduced by up to 50%. Activities considered to have the potential to cause dynamic loading in some structures (e.g. residences) include rock breaking/hammering and sheet piling activities. On the basis that the predominant vibration energy occurs at frequencies greater than 4 Hz (and usually in the 10 Hz to 100 Hz range) a conservative vibration damage screening level per receiver type is given below:

Reinforced or framed structures: 25.0 mm/s PCPV

Unreinforced or light framed structures: 7.5 mm/s PCPV

At locations where the predicted and/or measured vibration levels are greater than above, a more detailed analysis of the building structure, vibration source, dominant frequencies and dynamic characteristics of the structure would be required to determine the applicable safe vibration level.

**Table 16: BS 7385-2 Structural damage criteria – low rise building**

| Line | Type of structure | Damage level | Peak component particle velocity1 (PCPV), mm/s | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Where vibration that does not give rise to resonant responses in structures[3] | | | Where vibration might give rise to resonant responses in structures[4] | | |
| | | | 4 Hz to 15 Hz | 15 Hz to 40 Hz | 40 Hz and above | 4 Hz to 15 Hz | 15 Hz to 40 Hz | 40 Hz and above |
| 1 | Reinforced or framed structures Industrial and heavy commercial buildings | Cosmetic | 50 | | | 25 | | |
| | | Minor2 | 100 | | | 50 | | |
| | | Major2 | 200 | | | 100 | | |
| 2 | Un-reinforced or light framed structures Residential or light commercial type buildings | Cosmetic | 15 to 20 | 20 to 50 | 50 | 7.5 to 10 | 10 to 25 | 25 |
| | | Minor2 | 30 to 40 | 40 to 100 | 100 | 15 to 20 | 20 to 50 | 50 |
| | | Major2 | 60 to 80 | 80 to 200 | 200 | 30 to 40 | 40 to 100 | 100 |

Notes:

1_Peak Component Particle Velocity is the maximum Peak particle velocity in any one direction (x, y, z) as measured by a tri-axial vibration transducer.

2_Minor and major damage criteria established based on British Standard 7385 Part 2 (1993) Section 7.4.2

3_Levels relates to transient vibrations in low-rise buildings.

4_A 50% reduction might apply to the guide levels for "vibration that does not give rise to resonant responses in structures" if there is potential for continuous vibration to give rise to dynamic magnifications. Activities considered to have the potential to cause dynamic loading in some structures (e.g. residences) include rock breaking/hammering and sheet piling activities.

### Sensitive structures

German Standard DIN 4150 – Part 3 'Structural vibration in buildings – Effects on Structure' is generally recognised to be conservative and is often referred to for the purpose of assessing structurally sensitive buildings.

Heritage buildings and structures should not be assumed to be more sensitive to vibration unless they are found to be structurally unsound and should otherwise be assessed in accordance with BS7385-2. If a heritage building or structure is found to be structurally unsound (following inspection) DIN 4150-3, line 3 as outlined in Table 17, provides a conservative cosmetic damage objective that should be adopted unless alternative limits are justified by a dilapidation or structural survey. The sensitivity of heritage buildings and other potentially at-risk structures are subject to confirmation by the contractor prior to start of any works.

Table 17: DIN 4150-3 structural damage guideline values

| Line | Type of structure | Peak component particle velocity (PCPV), mm/s | | | | |
|---|---|---|---|---|---|---|
| | | Vibration at the foundation at a frequency of | | | At horizontal plane of highest floor | In the vertical direction, at floor slabs |
| | | 1 Hz to 10 Hz | 10 Hz to 50 Hz | 50 Hz to 100 Hz1 | All frequencies | All frequencies |
| 1 | Buildings used for commercial purposes, industrial buildings, and buildings of similar design | 20 | 20 to 40 | 40 to 50 | 40 | 20 |
| 2 | Residential buildings and buildings of similar design and/or occupancy | 5 | 5 to 15 | 15 to 20 | 15 | 20 |
| 3 | Structures that because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under a preservation order)3 | 3 | 3 to 8 | 8 to 10 | 8 | 202 |
| Notes<br>1_At frequencies above 100 Hz, the values given in this column may be used as minimum values.<br>2_Guideline value might have to be lowered to prevent minor damage | | | | | | |

## Buried services

DIN 4150-2:2016 part 3 sets out guideline values for vibration effects on buried pipework (see Table 18).

Other services that maybe encountered include electrical cables and telecommunication services such as fibre optic cables. While these may sustain vibration velocity levels from between 50 mm/s and 100 mm/s, the connected services such as transformers and switchgear, may not. Where encountered, site specific vibration assessment in consultation with the utility provider should be carried out.

Table 18: Guideline values for vibration impacts on buried pipework

| Line | Pipe material | Peak component particle velocity (PCPV) measured on pipe, mm/s | |
|---|---|---|---|
| | | Where vibration that does not give rise to resonant responses in structures[3] | Where vibration might give rise to resonant responses in structures[4] |
| 1 | Steel, welded | 100 | 50 |

| Line | Pipe material | Peak component particle velocity (PCPV) measured on pipe, mm/s | |
|---|---|---|---|
| | | Where vibration that does not give rise to resonant responses in structures[3] | Where vibration might give rise to resonant responses in structures[4] |
| 2 | Vitrified clay, concrete, reinforced concrete, pre-stressed concrete, metal (with or without flange) | 80 | 40 |
| 3 | Masonry, plastic | 50 | 25 |
| - | High pressure gas pipelines2 | 75<br>Monitoring required if predicted above 50.<br>No piling within 15 m of pipeline without detailed assessment. | |
| - | Electrical cables/Telecommunication services (such as fibre optic cables) | 50 to 100<br>Detailed assessment should be carried out. | |
| Notes:<br>1_For gas and water supply pipes within 2 m of buildings, the levels given in DIN4150-3 should be applied. Consideration must also be given to pipe junctions with the building structure as potential significant changes in mechanical loads on the pipe must be considered.<br>2_Based on UK National Grid's specification<br>3_Levels relates to transient vibrations.<br>4_A 50% reduction to the guide levels for "vibration that does not give rise to resonant responses in structures" might be appropriate if there is potential for continuous vibration to give rise to dynamic magnifications. Activities considered to have the potential to cause dynamic loading in some structures include rock breaking/hammering and sheet piling activities. | | | |

# 3. Operational noise and vibration assessment

## 3.1 Operating Hours

Typical hours of school operations used as the basis of assessment are summarised in Table 19.

**Table 19: School hours of operation**

| Operation | Times |
|---|---|
| School hours | 8am to 4pm, Monday to Friday |
| Recess and lunch | 8am to 4pm, Monday to Friday<br>Various times throughout the day<br>Expected total less than 4 hours |
| Administration / Office | 8am to 4pm, Monday to Friday |
| Gymnasium | 6pm to 10pm, Monday to Friday<br>9am to 10pm, Saturday<br>9am to 6pm, Sunday |
| Waste collection | Outside of school hours Monday to Friday |

## 3.2 Building services

The preliminary mechanical strategy for the school is expected to be to provide mechanical ventilation and conditioning via the following main items of mechanical plant:

- Condenser units
- Fan coil units; and
- Exhaust fans

Key considerations for mechanical equipment noise mitigation include:

- In the first instance, mitigating noise at the source by opting for low-noise plant selections and operating fans at low-medium speeds should be considered.
- Equipment locations should be nominated to allow reasonable lengths of lined ductwork and duct attenuators where necessary. Locations of externally-located equipment and plantrooms should be reviewed and coordinated with the acoustic consultant.
- The building services design needs to be coordinated to integrate with the architectural design. Room-to-room sound insulation requirements need to be understood in developing air flow strategies, locations and detailing of services penetrations through internal partitions and transfer ducts to avoid design conflicts.
- Equipment serving rooms with lower noise level criteria such as teaching and learning spaces should be located above a sealed/solid ceiling. If an open or semi-open ceiling is used, fans will likely either need to be located outside the room and ducted in, or 'boxed-out' in a solid plasterboard enclosure.

During ongoing design of the development, equipment will need to be selected and provided with noise and vibration attenuation measures as required to meet the criteria in Section 2.3.1.

A preliminary assessment has been undertaken of key mechanical plant items and has been based on information available at this stage of design and is discussed in the following sections.

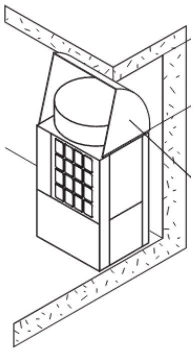
### 3.2.1 Condenser Units

High rise apartment buildings to the west of the site overlook Building A. This limits mitigation measures available to effectively screen rooftop mechanical plant if required.

A preliminary layout of rooftop Condenser Unit plant and early equipment selections has been developed by the Mechanical Engineers. This information was used to undertake a preliminary acoustic assessment to inform positioning of rooftop plant. Analysis was undertaken using the ISO 9613 algorithm within the SoundPLAN model developed for the site.

Table 22 summarises the sound power spectrum used as the basis of the mechanical plant noise emission assessment.

**Table 20: Mechanical plant sound power spectrum – Condenser unit**

| Equipment | Octave band centre frequency (Hz), Sound power level re: 1pW | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
| Condenser unit (50 kW)<br>+ 50 mm lined radiused bend<br> | 86 | 81 | 75 | 70 | 63 | 60 | 57 | 49 |

Appendix B shows grid noise maps of predicted mechanical plant noise emissions to neighbouring receivers.

The predictions demonstrate compliance with target criteria based on the preliminary condenser selections at all nearby noise sensitive receiver locations.

Mechanical plant noise levels in outdoor areas across the school are predicted to be below target criteria for both teaching and learning.

Predicted mechanical noise levels at the nearest affected school facades are more than 10 dB below the prevailing road traffic noise and hence not a driving consideration in façade sound insulation requirements.

Further analysis and refinement of equipment selection and layouts will be necessary during subsequent design stages of design to ensure continued compliance.

### 3.2.2 Fans

The following preliminary acoustic treatments are recommended for all fans and are based on typical required acoustic treatments. These recommendations will need be reviewed and assessed in detail as the development progresses.

**Table 21: Preliminary acoustic mitigation measures – Fans**

| Equipment | Typical minimum recommended acoustic treatment |
|---|---|
| Outside air fans | • Minimum 2 m internally lined duct on each side of fan.<br>• External lagging of fan plus flexible connections and 2m of duct on each side of fan.<br>• For the Gymnasium, allowance for acoustic louvres on intake and attenuators on supply. |
| Toilet exhaust fans | • Minimum 2 m internally lined duct on each side of fan.<br>• External lagging of fan plus flexible connections and 2m of duct on each side of fan. |
| Kitchen exhaust fans[1] | • Internally lined ductwork on exhaust side of each fan. |
| Smoke exhaust fans | • Allowances for attenuators on exhaust. |
| Dust extraction fan[1] | • Allowances for muffler and minimum 2 m lined ductwork on exhaust. |
| [1] It is understood that Kitchen exhaust and Dust extraction fans are not required to meet EFSG specified internal noise levels. | |

#### *3.2.2.1 Dust extraction system*

A review has been undertaken based on preliminary selections for dust extraction systems associated with the Wood Workshop. Final equipment selection and associated acoustic attenuation will need to be confirm during detailed design.

In the context of the school development and surrounding environment, the dust extraction system must adhere to a maximum sound pressure level of 53 dB(A) at 1 m from the exhaust opening to comply with environmental noise emission criteria.

### 3.2.3 Fan Coil Units

An acoustic review has been undertaken of preliminary FCU selections and typical arrangements provided by the Mechanical Engineer. A summary of minimum recommended acoustic treatments is provided in Table 22.

**Table 22: Typical FCU acoustic treatments**

| Design criteria | Minimum recommended acoustic treatment | | |
|---|---|---|---|
| | Supply/outlet | Return/inlet | Casing |
| 30 dB(A) Support Learning | 1 m of 50 mm internally lined duct + 1.8 m 33% open area attenuator + three 2 m of acoustic flex duct | 1.8 m 33% open area attenuator + one 50 mm lined elbow bend into 27 $m^3$ plenum | Plasterboard boxing<br>OR<br>External lagging + mass loaded vinyl in ceiling to 1m beyond FCU in all directions |
| 35 dB(A) General Learning | 1 m of 50 mm internally lined duct + 1.2 m 33% open area attenuator + three 2 m of acoustic flex duct | 1.2 m 33% open area attenuator + one 50 mm lined elbow bend into 27 $m^3$ plenum<br>OR<br>1.8 m 27% open area attenuator + one 50 mm lined elbow bend | Plasterboard boxing<br>OR<br>External lagging + mass loaded vinyl in ceiling to 1m beyond FCU in all directions |

| Design criteria | Minimum recommended acoustic treatment | | |
|---|---|---|---|
| | Supply/outlet | Return/inlet | Casing |
| 35 dB(A) Interview, Private offices, Study[1] | 1.2 m 33% open area attenuator + three 1 m of acoustic flex duct | 1.5 m 38% open area attenuator + one 50 mm lined elbow bend | Plasterboard boxing<br>OR<br>External lagging + mass loaded vinyl in ceiling to 1m beyond FCU in all directions |
| 40 dB(A) Library | 1 m of 50 mm internally lined duct + 0.9 m 43% open area attenuator + three 1 m of acoustic flex duct | 0.9 m 43% open area attenuator + one 50 mm lined elbow bend into room | External lagging |
| 40 dB(A) Open Offices, Reception, Staff Areas | 1 m of 50 mm internally lined duct + 0.9 m 38% open area attenuator + three 1 m of acoustic flex duct | 0.9 m 33% open area attenuator + one 50 mm lined elbow bend into room | External lagging |

It is noted that spatial constraints may restrict the extent of acoustic treatment practicable to install. Where this is the case, a departure from EFSG requirements may be required.

### 3.2.4 Electrical equipment

The 1000kVA substation proposed to the northwest of the site is expected to be readily controlled via standard enclosure. Adverse impacts to either the school or nearby noise sensitive receivers is not anticipated provided sufficient attenuation is specified for this item of electrical equipment, the details of which are to be worked through in subsequent phases of design.

## 3.3 Operational activities

### 3.3.1 Outdoor play areas

Assessment of noise emission from outdoor play areas is based on the following assumptions:

- Both passive (e.g. courtyard) and active (e.g. sports) outdoor play areas defined in the architectural site plan (refer Figure 5).
- Noise source levels of students playing outdoors determined in accordance with the method outlined in the AAAC Guidelines (refer Table 23).
- Number of students occupying an outdoor play area derived based on expected class sizes and scaled to incorporate a combination of active and passive play.
- Courts are assessed to have 60 students engaged in active play, and other open play spaces are assessed to have 300 students engaged in active play, and 300 students engaged in passive play. This is considered a conservative approach to assessment.

**Table 23: Sound power spectra for outdoor play areas - AAAC**

| Source | Overall dB(A) | Octave band centre frequency, Hz | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | 31.5 | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
| Active Play<br>(per 10 children) | 87 | 64 | 70 | 75 | 81 | 83 | 80 | 76 | 72 | 87 |
| Passive Play<br>(per 10 children) | 81 | 58 | 64 | 69 | 75 | 77 | 74 | 70 | 66 | 81 |

Resultant predicted noise levels from outdoor play activity are summarised in Table 24.

**Table 24: Predicted noise levels from outdoor play areas**

| Receiver | Target criterion ($dBL_{Aeq,15min}$) | Predicted noise level ($dBL_{Aeq,15min}$) | Compliance? |
|---|---|---|---|
| R1 | 59 | 53 | Yes |
| R2 | 59 | 54 | Yes |
| R3 | 59 | 48 | Yes |
| R4 | 59 | 48 | Yes |
| R5 | 59 | 50 | Yes |
| R6 | 59 | 47 | Yes |
| R7 | 59 | 49 | Yes |
| R8 | 59 | 51 | Yes |
| R9 | 59 | 52 | Yes |
| R10 | 59 | 53 | Yes |
| R11 | 59 | 52 | Yes |
| R12 | 59 | 51 | Yes |
| R13 | 59 | 49 | Yes |
| R14 | 59 | 43 | Yes |
| R15 | 59 | 56 | Yes |
| R16 | 59 | 55 | Yes |

Noise levels during times when the entire student body is using the outdoor play areas (i.e. recess and lunch) are expected to comply with the operational noise criteria at all residential receivers. This is considered a worst case scenario. During periods when the outdoor areas are used for structured learning activities, noise levels are expected to be significantly lower.

Assessment has been based on Stage 1 student population and building configuration (i.e. no Block D) in lieu of detailed information being available for Stage 2. The increase in population in Stage 2 to 1000 students would correspond to approximately a 2 dB increase in source noise levels. From the predictions in Table 24, this is expected to still comply with target criteria.

To help mitigate this impact, strategic site planning has been implemented, incorporating buffer zones that increase the distance between major activity areas and nearby receivers. The current design places active play areas away from residential areas and utilizes perimeter buildings to shield much of the noise generated.

### 3.3.2 Gymnasium noise breakout

Assessment of noise breakout from the Gymnasium has been undertaken based on the following scenarios:

- Noise source: internal reverberant level of up to 75 dBA which considers a typical worst case noisy learning activity / setting from sports and music.
- Windows / doors open – this includes bifold glazing doors and high-level louvres for natural ventilation

Table 25 summarises predicted noise levels at the nearest noise sensitive receiver locations due to noise breakout from the Gymnasium.

**Table 25: Predicted Gymnasium noise breakout**

| Receiver | Target criterion ($dBL_{Aeq,15min}$) | | | Predicted noise level ($dBL_{Aeq,15min}$) | | Compliance? |
|---|---|---|---|---|---|---|
| | Day | Evening | Night | Doors open | Doors closed | |
| R1 | 54 | 51 | 50 | 28 | 8 | Yes |
| R2 | 54 | 51 | 50 | 28 | 11 | Yes |
| R3 | 54 | 51 | 50 | 37 | 19 | Yes |
| R4 | 54 | 51 | 50 | 32 | 9 | Yes |
| R5 | 54 | 51 | 50 | 39 | 15 | Yes |
| R6 | 54 | 51 | 50 | 26 | 9 | Yes |
| R7 | 54 | 51 | 50 | 31 | 9 | Yes |
| R8 | 54 | 51 | 50 | 29 | 8 | Yes |
| R9 | 54 | 51 | 50 | 32 | 10 | Yes |
| R10 | 54 | 51 | 50 | 39 | 15 | Yes |
| R11 | 54 | 51 | 50 | 38 | 15 | Yes |
| R12 | 54 | 51 | 50 | 38 | 14 | Yes |
| R13 | 54 | 51 | 50 | 37 | 13 | Yes |
| R14 | 54 | 51 | 50 | 30 | 13 | Yes |
| R15 | 54 | 51 | 50 | 35 | 9 | Yes |
| R16 | 54 | 51 | 50 | 39 | 12 | Yes |

Predicted noise breakout from typical Gymnasium use are expected to comply with target criteria during all time periods with doors open and doors closed.

### 3.3.3 Covered outdoor workshop area

Feedback obtained during Technical Stakeholder Group meetings with SINSW representatives identified that the COWA is an area where handheld tools (i.e. circular saws and angle grinders) are occasionally used to process larger deliveries. There is no requirement for this space to meet internal noise level criteria for teaching and learning as it is not a regular function of the space.

Analysis of noise breakout from the Covered Outdoor Workshop Area was investigated using a circular saw as a worst case high noise generating piece of equipment. Analysis was based on the architectural configuration in Figure 6.

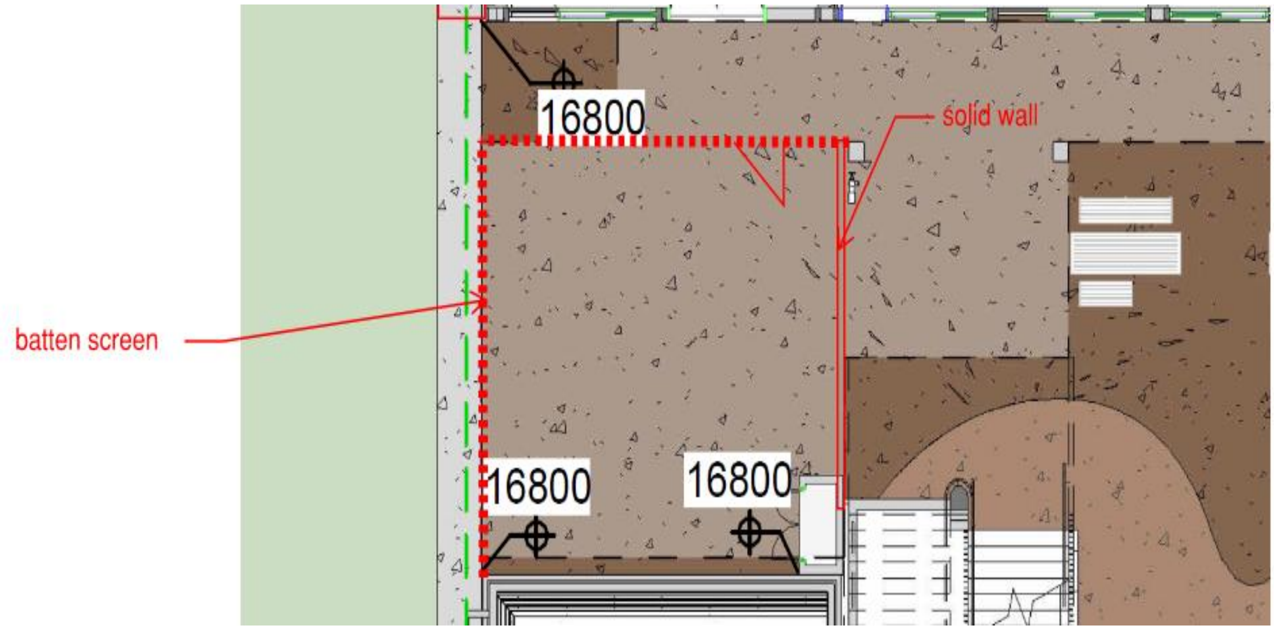


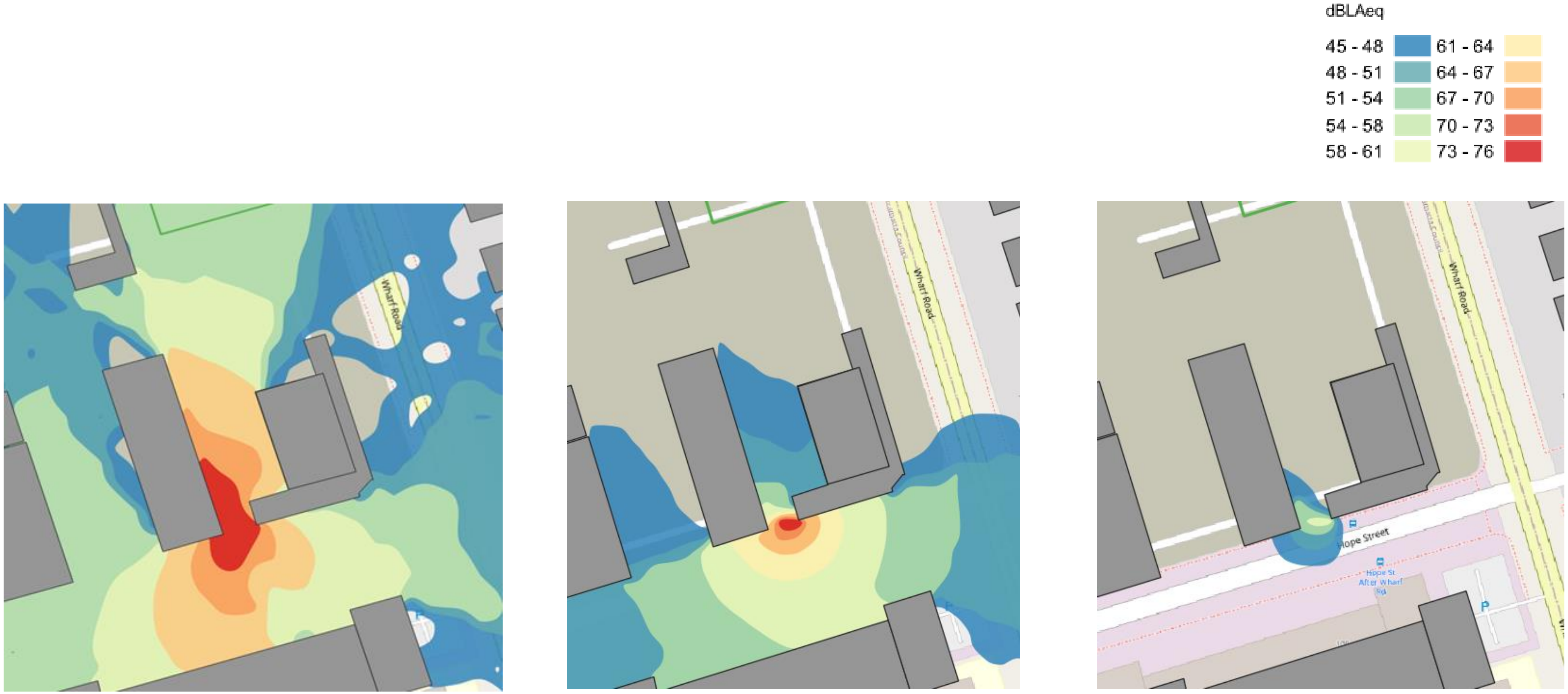

Figure 6: Indicative COWA layout

Three scenarios were explored as follows:

- Weather louvres (full height)
- Acoustic louvres (minimum required for natural ventilation)
- Fully enclosed (mechanical ventilation)

For all scenarios soffit mounted acoustic treatment is incorporated to control reverberant noise build up.

Figure 7 shows predicted noise impact from operation of a circular saw within the COWA with these three scenarios.




Full height regular louvres

Minimum acoustic louvres for natural ventilation

Fully enclosed facade

**Figure 7: Predicted noise breakout from COWA – Circular saw**

Predicted noise levels are significant with no acoustic treatment in place, being more than 20 dB above the existing ambient background noise at the nearest residential receivers and 60 dBA through the school courtyard.

Inclusion of acoustic louvres brings noise levels at the nearest residential receivers to within industrial noise emission criteria. The majority of outdoor noise criteria for the school itself also comply with the target criteria. Noise levels on Hope Street are expected to remain high, being in the order of up to 70 dBA.

It is necessary to fully enclose the COWA to achieve any further mitigation of noise breakout. This approach would result in the space no longer being 'outdoor'.

It is reiterated that this assessment has been conducted on the basis of very noisy equipment being used. Should operational constraints be placed on the space to not incorporate the use of powered machinery, it would be acceptable to retain a weather louvre façade.

#### 3.3.4 Carpark

Assessment of carpark noise impacts to nearby noise sensitive receivers has been made with reference to the AAAC Guidelines. Typical sound power levels for vehicles within the car park area used as the basis of assessment are summarised in Table 26.

**Table 26: Typical sound power levels for vehicles within the car park**

| Vehicle | Level ($dBL_{Aeq}$) |
|---|---|
| Car | 81 |
| Delivery van | 86 |

The latest architectural plans show provision for a 5 space car par with entrance via new NSR-4 road off Hope Street. As a conservative worst-case scenario the car park noise assessment has considered the following:

- Noise source locations closest to the affected residences within the car park area.
- Up to 2 delivery van vehicle and 3 car movements over a 15-minute period.

The predicted operational noise levels associated with the car park are summarised in Table 27.

**Table 27: Predicted car park operational noise levels**

| Receiver | Target criterion ($dBL_{Aeq,15min}$) | Predicted noise level ($dBL_{Aeq,15min}$) | Compliance? |
|---|---|---|---|
| R1 | 54 | 36 | Yes |
| R2 | 54 | 46 | Yes |
| R3 | 54 | 44 | Yes |
| R4 | 54 | 41 | Yes |
| R5 | 54 | 44 | Yes |
| R6 | 54 | 38 | Yes |
| R7 | 54 | 40 | Yes |
| R8 | 54 | 40 | Yes |
| R9 | 54 | 41 | Yes |

| Receiver | Target criterion ($dBL_{Aeq,15min}$) | Predicted noise level ($dBL_{Aeq,15min}$) | Compliance? |
|---|---|---|---|
| R10 | 54 | 41 | Yes |
| R11 | 54 | 38 | Yes |
| R12 | 54 | 38 | Yes |
| R13 | 54 | 38 | Yes |
| R14 | 54 | 31 | Yes |
| R15 | 54 | 48 | Yes |
| R16 | 54 | 50 | Yes |

The operational noise levels of the car park are expected to meet target criteria at all locations. The car park will primarily be used during daytime hours and will feature controls, such as gate access, to restrict public and after-hours usage. Speed limits will help reduce noise emissions from vehicles accessing and navigating the car park.

### 3.3.5 School traffic

The predicted worst-case traffic volumes (i.e busiest 1-hour periods) on the surrounding road network due to the operation of the school is presented in Table 28. Proposed school generated traffic volumes were provided by TTW on 8 January 2025. This information has been used to determine the predicted relative increase in road traffic noise level as a result of the project by analysing against future predicted road traffic numbers summarised in Section 3.4.1.

**Table 28: Forecast peak hourly traffic – relative increase**

| Road | School traffic – AM Peak |
|---|---|
| Hope Street | 214 |
| Wharf Road | 151 |
| NSR4 | 94 |

Based on the predicted increase in road traffic during peak periods, the road traffic noise levels are expected to increase by less than the 2 dB screening criterion summarised in Section 2.3.3.

All other times outside of peak times are expected to result in similar noise level to existing conditions due to relatively little road traffic activity from the school during these times.

The NSW Road Noise Policy provides examples of strategies to mitigate noise from traffic-generating developments on existing roads, including the following, where considered reasonable and feasible:

1. Location of private access roads
2. Regulating times of use
3. Noise barriers

4. Property treatment

The design and development phase will be used to inform and implement feasible and reasonable noise mitigation measures for the project.

### 3.3.6 Public Address

Noise from public address systems has the potential to affect nearby noise sensitive receivers. To reduce the likelihood of noise disturbance to surrounding properties, the following measures are recommended for all public address systems:

- Restrict usage to daytime hours only (7am to 6pm).
- Use best practice design, including directional speakers that focus inward toward the school and cover only the necessary areas.
- Set volume levels to the minimum required to ensure clarity and audibility within the designated coverage zones, as specified in EFSG.

### 3.3.7 Waste Removal, Deliveries and Cleaning

There will be a limited number of deliveries or waste removals on any given day. To minimize disturbance to nearby residents, it is recommended that all loading dock activities and waste removal take place between 7:00 AM and 10:00 PM.

To prevent disturbing the sleep of nearby residents, it is recommended that all noisy cleaning activities be conducted between 7:00 AM and 10:00 PM. If activities must occur between 10:00 PM and 7:00 AM, the following measures should be taken:

- Ensure windows and doors are closed to minimize noise emissions.
- Do not operate air conditioning.
- Refrain from performing outdoor cleaning activities (e.g., leaf-blowing).

## 3.4 Noise intrusion

### 3.4.1 Road Traffic

The primary source of noise intrusion for the site is existing and future projected road traffic on the immediately adjacent road network.

A road traffic noise model has been built using the Calculation of Road Traffic (CoRTN) algorithm in SoundPLAN 9.0 to predict road traffic noise levels throughout the site. This noise model is constructed from the following inputs:

- Terrain mesh extracted from Elvis - Elevation and Depth - Foundation Spatial Data.
- Existing building structures, digitized from geolocated satellite imagery.
- Proposed Town Centre Masterplan buildings, based on information within in the Melrose Park Urban Renewal Precinct Masterplan
- Proposed school building structures, digitized from supplied drawings by NBRS.
- Surrounding road network strings, digitized from geolocated satellite imagery.
- Traffic volumes were provided by TTW on 8 January 2025

As informed by the traffic engineers on the project, due to there being no existing traffic surveys for the subject site, traffic data is based on predicted 2036 traffic volumes extracted from a Transport Management and Accessibility Plan (TMAP) report (Jacobs, 2019) for Hope Street and Wharf Road, and for the new road NSR4 road traffic data is based on 2036 background traffic modelled by the developer (DA 1100/2021). It is noted the existing traffic volume data from the TMAP is incomplete, it provides either AM or PM peak data for each street. Given the lack of data the traffic engineers have advised to adopt the same traffic volumes for AM & PM.

Road traffic noise Model outputs are summarised in Appendix C and have been used as the basis of assessments discussed in Section 3.4.2 to 3.4.5. It is noted that these predicted levels are based on existing peak hourly flows and are therefore considered to represent the worst case period of the day. Predicted levels have also been validated against on site measurements summarised in Section 1.3.

### 3.4.2 Building envelope

#### *3.4.2.1 Glazing*

Table 29 summarises recommended façade glazing to control road traffic noise intrusion to internal spaces based on the predicted noise levels summarised in Appendix C and latest architectural drawings.

It is noted that the quoted performance is not only subject to the glazing selection but also to the construction of the window frame and the frame seal selection.

**Table 29: Minimum sound insulation requirements and indicative constructions – Façade glazing**

| Building | Façade | External Noise Level $L_{Aeq, 1hr}$ | Internal Noise Level Criteria | Façade Glazing | |
|---|---|---|---|---|---|
| | | | | Recommended Minimum Sound Insulation Performance $R_{w} + C_{tr}$ | Indicative Construction |
| A | West – near Hope Street | 45-64 | 40 (Workshops) | 35 | 10 mm float glass / 12 mm cavity / 6.38 mm laminated glass |
| | | | 35 (GLS, Interview, Seminar)<br>40 (Offices) | 30 | 10 mm float glass / 12 mm cavity / 4 mm laminated glass |
| | | | 40 (Library) | 28 | 6 mm float glass / 12 mm cavity / 6.8 mm laminated glass |
| | | | 50 (Storeroom) | 20 | Standard 4mm float |
| | West – further from Hope Street | 51-64 | 30 (SLU) | 35 | 10 mm float glass / 12 mm cavity / 6.38 mm laminated glass |
| | | | 40 (Library) | 28 | 6 mm float glass / 12 mm cavity / 6.8 mm laminated glass |
| | | | 35 (GLS)<br>40 (Offices) | 27 | 6.38 mm laminated glass openable |
| | | | 50 (Storeroom, Kitchen, Amenities) | 20 | Standard 4mm float |
| | East | 51-64 | 30 (SLU, Performing Arts, Laboratories) | 35 | 10 mm float glass / 12 mm cavity / 6.38 mm laminated glass |
| | | | 35 (GLS, Study, Visual Arts and Textile) | 30 | 10 mm float glass / 12 mm cavity / 4 mm laminated glass |
| | | | 35 (Interview, Seminar and Private Offices)<br>40 (Library and Open Office) | 28 | 6 mm float glass / 12 mm cavity / 6.8 mm laminated glass |
| | | | 50 (Storeroom, Amenities) | 20 | Standard 4mm float |
| B | West | 48-54 | 35 (Assembly) | 35 | 10 mm float glass / 12 mm cavity / 6.38 mm laminated glass |
| | East | 61-64 | 35 (Assembly) | 37 | 6 mm float glass / 12 mm cavity / 10.76 mm laminated glass |

### 3.4.2.2 Natural ventilation

The design currently allows for openable windows within General Learning Spaces. Internal noise criteria will not be met with the windows open. Further it is noted that operable windows typically do not perform as well acoustically as fixed glazing. The inclusion of mechanical ventilation should allow for windows to remain closed and the option for sealed glazing to be installed for General Learning Spaces.

A review has been undertaken of natural ventilation openings proposed in the Gymnasium. Figure 8 show the proposed configuration of natural ventilation openings in the Gymnasium.

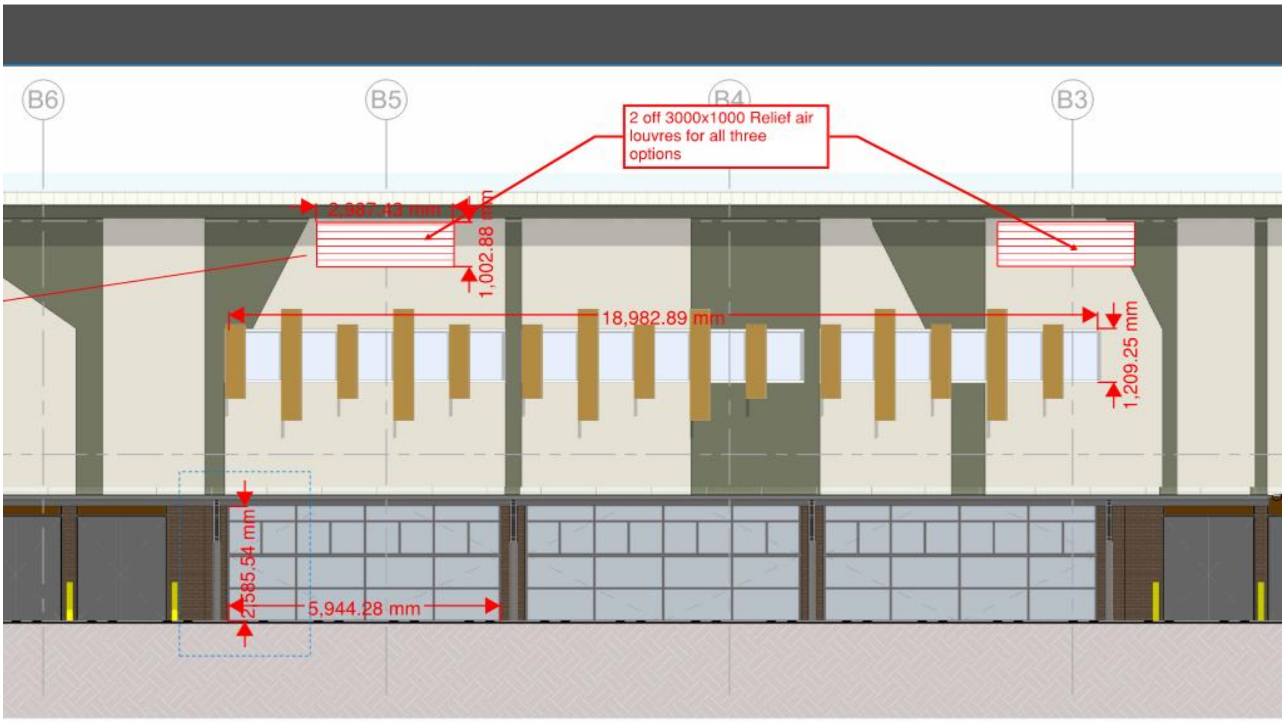



Figure 8: Gymnasium natural ventilation openings – West facade

Analysis of the proposed natural ventilation openings has been made based on road traffic noise levels summarised in Appendix C. Results show that an acoustic louvre will be required to meet internal noise criteria for Assembly Halls.

Table 30 summarises transmission loss spectra for natural ventilation elements used in road traffic noise predictions to meet internal noise levels.

Table 30: Acoustic louvre minimum sound transmission loss

| Item | Transmission Loss, dB<br>Octave Band Centre Frequency, Hz | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 63 | 125 | 250 | 500 | 1k | 2k | 4k | 8k |
| Acoustic louvre | -4.0 | -7.0 | -9.0 | -13.0 | -14.0 | -12.0 | -12.0 | -8.0 |

### 3.4.3 External doors

Schools Infrastructure Pattern Book: Standardised Designs for Schools, Volume 2 Building Components provides the following indicative guidance for external entry doors:

> *Entry doors to occupied teaching, music, drama and sports spaces: Solid core, minimum 35 mm thick with acoustic weather (where external) seals on all rebated closing faces. Gap at floor to be minimized.*

In addition to the above requirement, a preliminary review has been undertaken of noise breakin via external doors based on road traffic noise levels summarised in Appendix C. The following guidance is provided:

- All single external facing doors should be minimum $R_w$ 32 to meet internal noise levels
- The Performing Arts and SLU have a more sensitive internal noise level criteria and require a minimum $R_w$ 35 rating
- Doors to the wood and metal workshop should be minimum $R_w$ 35 to control noise breakout to courtyard and teaching spaces
- Gymnasium glazed doors (including vertically folding) should be $R_w$ 32 to control noise breakin

### 3.4.4 Façade wall

Masonry and concrete façade wall elements are sufficient to mitigate road traffic noise intrusion. There is a potential for noise intrusion to be more significant where lightweight wall systems are proposed. Minimum sound insulation requirements and indicative constructions have been developed and are summarised in Table 31.

**Table 31: Minimum sound insulation requirements and indicative constructions – Lightweight façade walls**

| Building | Façade | Minimum sound insulation requirement, $R_{w+Ctr}$ | Indicative construction |
|---|---|---|---|
| A | All | 40 | 3 mm aluminium cladding<br>+ 6 mm fibre cement<br>+ 200 mm timber stud cavity<br>+ 100 mm fibreglass insulation<br>+ 13 mm plasterboard |
| | Western façade of Performing Arts space | 45 | 3 mm aluminium cladding<br>+ 6 mm fibre cement<br>+ 200 mm timber stud cavity<br>+ 100 mm fibreglass insulation<br>+ 2 x 13 mm plasterboard |

### 3.4.5 Outdoor areas

Predicted road traffic noise levels across the site are shown in Appendix C and summarised for outdoor areas in Table 32 against target criteria for outdoor areas presented in Section 3.5.

**Table 32: Predicted road traffic noise levels – Outdoor Areas**

| Area | Predicted road traffic noise level $dBL_{Aeq,1hr}$ | Complies? | Comments |
|---|---|---|---|
| Courtyard | 48-58 | Partial | Within target criteria for outdoor areas for the majority of the courtyard.<br>Under cover areas shielded by Building B suitable for outdoor learning. |

| Area | Predicted road traffic noise level dB$L_{Aeq,1hr}$ | Complies? | Comments |
|---|---|---|---|
| Outdoor sport areas | 50-60 | Partial | Western half within target criteria for outdoor areas.<br>Eastern half up to 5dB above.<br>Inclusion of barrier/berm not considered feasible in the context of proposed school layout. |
| Covered outdoor workshop area (COWA) | 61 | No | Not considered suitable for teaching and learning.<br>Discussed further in Section 3.3.3 |
| Covered outdoor learning area (COLA)<br>Outdoor learning centre for Support learning unit (OLC for SLU) | 45-54 | Partial | Eastern half including COLA within target criteria for outdoor learning criteria.<br>Western half including OLC for SLU up to 4dB above outdoor learning criteria. |

# 4. Construction noise and vibration assessment

## 4.1 Construction noise

### 4.1.1 Construction activities

The construction phases used as the basis of this assessment are summarised below and has been based on reference schools. The overall programme for these works is anticipated to be 12 months.

- Site establishment
- Excavation / Earthworks
- Substructure
- Structural / Concreting
- Building envelope
- Fitout / Finishes
- External works / Landscaping
- Demobilisation

Assumed construction equipment to be used for redevelopment works are provided in Table 33.

Equipment sound power levels have been determined by reference to AS2436, BS5228, and Arup's measurement database. The equipment below has been assumed to operate concurrently however equipment sound power levels have been adjusted according to its usage in a worst case 15-minute period, and penalty corrections for impulsive noise characteristics.

The locations of equipment have been based on the locations of the construction works around the precinct.

**Table 33: Construction equipment usage and associated sound power levels (Lw)**

| Plant item | Plant item sound power level, $dBL_{Aeq}$ | Penalty, dB | % of use in worst case 15 mins | Site Establishment | Excavation / Earthworks | Substructure | Structural / concreting | Building Envelope | Fitout & finishes | External works / landscaping | Demobilisation |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Truck (>20 Tonne) | 107 | 0 | 50 | 1 | 1 | 1 | 1 | 1 | 1 | | 1 |
| Crane (Mobile) | 113 | 0 | 50 | | | | 1 | | 1 | | 1 |
| Loader (Front-end) (23t) | 112 | 0 | 50 | 1 | 1 | | | | | | 1 |
| Generator (Diesel) | 113 | 0 | 100 | 1 | | | 1 | | 1 | | |
| Excavator (10t) | 100 | 0 | 50 | | 1 | | | | | | |
| Excavator (10t) + hydraulic hammer | 118 | 5 | 50 | | 1 | | | | | | |
| Loader - Skidsteer (Bob-cat) (1/2t) | 107 | 0 | 50 | | 1 | | | | | 1 | |
| Truck (Dump) | 117 | 0 | 50 | | 1 | | | | | | |
| Piling (Bored) | 111 | 0 | 10 | | | 1 | | | | | |
| Concrete Pencil Vibrator | 105 | 0 | 10 | | | 1 | 1 | | | | |
| Concrete Pump | 109 | 0 | 25 | | | 1 | 1 | | | | |
| Hand Tools (Electric) | 110 | 0 | 50 | | | | 1 | 1 | 1 | 1 | 1 |
| Road Lorry (Full) | 108 | 0 | 50 | | 1 | | | 1 | | | |
| Concrete Agitator Truck | 111 | 0 | 50 | | | 1 | 1 | | | | |
| Scissor lift | 98 | 0 | 50 | | | | 1 | 1 | 1 | | |
| Angle Grinder | 108 | 0 | 25 | | | | | 1 | | | |
| Welder | 110 | 0 | 25 | | | | | | 1 | | |
| Forklift | 106 | 0 | 50 | | | | | | | 1 | |
| Crane (Truck Mounted) | 108 | 0 | 50 | 1 | | | 1 | 1 | | | |

### 4.1.2 Assessment methodology

Noise emissions from construction activities have been assessed to criteria outlined in Section 2.5.2.

Noise emissions have been modelled using SoundPLAN 9 in accordance with ISO9613-2 algorithms. The model included:

- Construction noise sources listed in Section 4.1.1;
- Surrounding buildings, ground terrain and absorption; and
- Receivers listed in Section 1.2.

Noise emissions have been modelled on the following assumptions:

- Equipment, staging and durations are based on typical scenarios for NSW school projects.
- Construction areas have been derived based on the latest architectural site plans.
- The location of equipment will be spread evenly across the site.

### 4.1.3 Noise prediction results

Predicted construction noise levels at surrounding noise sensitive receivers along with the relevant NML for the intended working hours are presented in Table 34.

**Table 34: Predicted construction noise levels**

| Receiver | Classification | NML | Construction phase | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Site Establishment | Excavation / Earthworks | Substructure | Structural / Concreting | Building Envelope | Fit out & finishes | External work / landscaping | Demobilisation |
| R6 - 1B Lancaster Avenue, Melrose Park | Residential | 59 | 64 | 71 | 62 | 68 | 63 | 67 | 59 | 63 |
| R7 - 81 Wharf Road, Melrose Park | Residential | 59 | 65 | 72 | 62 | 68 | 63 | 67 | 60 | 64 |
| R8 - 79 Wharf Road, Melrose Park | Residential | 59 | 65 | 72 | 62 | 68 | 63 | 67 | 60 | 64 |
| R9 - 77 Wharf Road, Melrose Park | Residential | 59 | 65 | 72 | 61 | 67 | 62 | 66 | 60 | 64 |
| R10 - 73 Wharf Road, Melrose Park | Residential | 59 | 65 | 72 | 60 | 66 | 61 | 65 | 60 | 64 |
| R11 -71 Wharf Road, Melrose Park | Residential | 59 | 64 | 71 | 59 | 65 | 60 | 64 | 59 | 63 |
| R12 - 69 Wharf Road, Melrose Park | Residential | 59 | 63 | 70 | 57 | 63 | 58 | 62 | 58 | 62 |
| R13 - 67 Wharf Road, Melrose Park | Residential | 59 | 61 | 68 | 56 | 62 | 57 | 61 | 56 | 60 |
| R14 - 87 Wharf Road, Melrose Park | Residential | 59 | 62 | 69 | 59 | 65 | 60 | 64 | 57 | 61 |

| Receiver | Classification | NML | Construction phase | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Site Establishment | Excavation / Earthworks | Substructure | Structural / Concreting | Building Envelope | Fit out & finishes | External work / landscaping | Demobilisation |
| SS1 - Melrose Park Public School, 110 Wharf Road, Melrose Park | School | 55[1] | 46 | 53 | 44 | 50 | 45 | 49 | 41 | 45 |
| I1 - 10 Hope Street, Melrose Park | Industrial | 75 | 63 | 70 | 60 | 66 | 61 | 65 | 58 | 62 |
| I2 - 12 Hope Street, Melrose Park | Industrial | 75 | 66 | 73 | 63 | 69 | 64 | 68 | 61 | 65 |
| I3 - 100 Wharf Road, Melrose Park | Industrial | 75 | 66 | 73 | 64 | 70 | 65 | 69 | 61 | 65 |
| Notes:<br>Levels shaded in grey indicate a notional exceedance of NMLs based on the worst-case assumptions noted above.<br>Levels in **BOLD RED** represent 'highly affected' noise levels of 75dBA or above. | | | | | | | | | | |

Results indicate that all nearby residential receivers are predicted to exceed the noise management levels for the majority of construction phases. These exceedances vary depending on distance and shielding from the activity. Compliance is predicted at the nearest non-residential receivers being the existing public school and industrial receivers across Hope Street.

Assessment has been undertaken for Stage 1 and has been based on various assumptions. Due to uncertainty associated with planned construction of Stage 2, these impacts have not been assessed. Notwithstanding, it is envisaged that the impacts will be comparable or lower and that the management measures will remain the same. This includes for impacts to the existing Stage 1 school.

During construction, plant and equipment will move through the Project area as the Project progresses, changing noise impacts in relation to the nearby individual sensitive receivers. The noise levels experienced at a particular location will rise and fall in accordance with the varying offset distance of the works, the intensity and location of construction activities, the intervening terrain and structure and the type of equipment used. It is unlikely that all construction equipment will be operating at their maximum sound levels simultaneously. In any given period, typically construction equipment would be used with maximum sound levels for only a brief amount of time and at other times the equipment may emit lower sound levels carrying out activities.

In general, construction works are temporary in nature therefore potential noise impact on the community and the surrounding environment will not be permanent or continuous. Where the predicted LAeq(15min) noise level is greater than the noise management levels all feasible and reasonable work practices should be applied, as recommended below.

#### 4.1.4 Construction noise mitigation and management measures

Indicative noise reduction for different noise mitigation measures relevant to construction activities for the project have been obtained from the guidance of AS2436 - Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites and BS5228.1 - Code of Practice for Noise and Vibration Control on Construction and Open Sites - Noise, and are summarised below in Table 22 for reference.

**Table 35: Indicative noise reduction provided by noise mitigation measures**

| Construction equipment | Noise mitigation measure | Indicative noise reduction | Source |
|---|---|---|---|
| Jackhammer | Muffler and screen | 20 dBA | Table C2, AS2436:2010 |
| Compressor, Cement mixers, Hand-held tools | Screening | 5 dBA | Table C3, AS2436:2010 |
| Excavators/loaders, Trucks, Mobile cranes, Asphalt paver, Bulldozers, Road graders, Rollers/compactors | Residential-grade silencer | 10 dBA | Table C2, AS2436:2010<br>Table B1, BS5228.1:2009 |
| Excavator with hammer attachment | Residential-grade silencer, Screening of hammer attachment | 15 dBA | Table C2, AS2436:2010 |
| Piling impact | Resilient pad (dolly) between pile and hammerhead | 10 dBA | Table C2, AS2436:2010<br>Table B1, BS5228.1:2009 |

Table 36 provides a summary of the potential project specific community consultation measures depending on the extent of NML exceedances. This table has been informed by the Construction Noise and Vibration Strategy (CNVS) and should be reviewed and refined for the development of the Construction Noise and Vibration Management Plan (CNVMP) for the project to be developed by the contractor.

**Table 36: Indicative community consultation measures**

| Construction hours | Receiver perception | Above NML | Management Measures[1,2,3,4] |
|---|---|---|---|
| Airborne noise | | | |
| Standard hours (day) | Noticeable | ≤ NML (compliant | - |
| | Clearly audible | ≤ NML + 10 | - |
| | Moderately intrusive | ≤ NML + 20 | N |
| | Highly intrusive | > NML + 20 | N |
| | Highly noise affected | ≥ 75 dBA | N, SN, RP |
| Outside standard hours (night)[5] | Noticeable | ≤ NML (compliant | - |
| | Clearly audible | ≤ NML + 10 | N |
| | Moderately intrusive | ≤ NML + 20 | N, SN |
| | Highly intrusive | > NML + 20 | N, SN, AA, RP |
| | Highly noise affected | ≥ 75 dBA | N, SN, AA, RP |

Notes:

1. N: Notifications (such as letter box drops)
2. SN: Specific notifications such as individual briefings or phone call
3. AA: Alternative accommodation
4. RP: Respite Period
5. No works outside of standard hours is proposed. Management measures are for information only.

## 4.2 Construction traffic

Construction-related road traffic is a temporary source of noise that must be assessed and managed, particularly concerning heavy vehicles accessing the site. To minimise disturbance to the neighbouring community, truck arrivals and departures should be scheduled outside peak traffic hours and, wherever possible, during times that are less sensitive to noise.

Details of predicted construction traffic volumes have been provided by TTW on 18 December 2024. Traffic caused by construction is expected to increase by a maximum of 60 vehicles per day as a worst case scenario for the construction of a 1000 student school. This increase will result in a noise level rise of under 1 dB, which is below the threshold for traffic noise increase screening criteria as discussed in Section 2.3.3.

It is important to acknowledge, however, that heavy vehicles can produce noise levels higher than regular car traffic, leading to more significant disturbances. To mitigate this, access routes should be limited to major roads and avoid local residential streets as far as practicable. Measures such as avoiding engine braking, adhering strictly to speed limits, and minimising sudden braking or acceleration should also be enforced.

All contractors and subcontractors should be informed about the importance of noise-conscious driving when traveling to and from the construction site. To manage noise from construction traffic, the following measures should be implemented:

- Staging truck arrivals to prevent queuing and idling on public streets.
- Directing vehicles to arrive and depart via designated routes that minimize the use of local roads.
- Reducing the need for reversing to limit the use of reversing alarms (“beepers”) and/or using quieter alarms (e.g., quacker alarms).
- Minimising engine braking and avoiding unnecessary noise from slamming doors, loud radios, shouting, or the use of truck horns for signalling.

The contractor will also need to evaluate cumulative noise impacts as part of the Construction Noise and Vibration Management Plan (CNVMP). Coordination with other contractors and projects in the area will be necessary if construction activities occur simultaneously.

## 4.3 Vibration

As a guide, the recommended minimum working distances for vibration intensive plant in Table 37 (which has been derived from the TfNSW CNVS) provide an indication of the possibility of impact due to vibration generating plant and equipment onto nearby receivers. While the minimum working distances are indicative only and will vary depending on the item of plant and local geotechnical conditions, if a receiver is located within the minimum working distance, vibration monitoring might be required, and equipment selection and/or method of construction might have to be reviewed.

**Table 37: Recommended minimum working distances (m) for vibration generating plant**

<table>
<tr><th rowspan="3">Plant item</th><th rowspan="3">Rating / description</th><th colspan="4">Minimum working distance (m)</th></tr>
<tr><th colspan="3">Cosmetic damage – screening criteria</th><th rowspan="2">Human response</th></tr>
<tr><th>Industrial and heavy commercial buildings<br>BS 7385<br>Line 1 -25 mm/s<br>(See note 2)</th><th>Residential and light commercial buildings<br>BS 7385<br>Line 2 - 7.5 mm/s<br>(See note 2)</th><th>Structures unsound<br>DIN 4150<br>Line 3 – 3 mm/s</th></tr>
<tr><td rowspan="2">Vibratory roller</td><td>< 50 kN (~ 1 to 2t)</td><td>2 m</td><td>5 m</td><td>11 m</td><td>15 m to 20 m</td></tr>
<tr><td>< 100 kN (~ 2 to 4t)</td><td>2 m</td><td>6 m</td><td>13 m</td><td>20 m</td></tr>
</table>

| Plant item | Rating / description | Minimum working distance (m) | | | |
|---|---|---|---|---|---|
| | | Cosmetic damage – screening criteria | | | Human response |
| | | Industrial and heavy commercial buildings<br>BS 7385<br>Line 1 -25 mm/s<br>(See note 2) | Residential and light commercial buildings<br>BS 7385<br>Line 2 - 7.5 mm/s<br>(See note 2) | Structures unsound<br>DIN 4150<br>Line 3 – 3 mm/s | |
| | < 200 kN (~ 4 to 6t) | 5 m | 12 m | 26 m | 40 m |
| | < 300 kN (~ 7 to 13t) | 6 m | 15 m | 31 m | 100 m |
| | > 300 kN (~ 13 to 18t) | 8 m | 20 m | 40 m | 100 m |
| | > 300 kN (> 18t) | 10 m | 25 m | 50 m | 100 m |
| Hydraulic hammer – Small | 300 kg / 5 to 12t excavator | 1 m | 2 m | 5 m | 7 m |
| Hydraulic hammer – Medium | 900 kg / 12 to 18t excavator | 3 m | 7 m | 15 m | 23 m |
| Hydraulic hammer – Large | 1600 kg / 18 to 34t excavator | 9 m | 22 m | 44 m | 73 m |
| Piling – Vibratory | Sheet piles | 9 m | 22 m | 44 m | 73 m |
| Piling – Bored | ⩽ 800 mm | 1 m (nominal) | 2 m | 5 m | 10 m |
| Piling – Hammer | 12t down force | 6 m | 15 m | 30 m | 50 m |
| Jackhammer | Hand-held | 1 m (nominal) | 1 m (nominal) | 3 m | 5 m |
| Mechanised bored tunnelling works (Tunnel Boring Machine, Horizontal Directional Drilling, Micro-tunnelling)1 | - | 1 m to 5 m | 2 m to 12 m | 4 m to 24 m | 6 m to 35 m |
| Note:<br>1_Based on TRL document using Godio et al formula, equation 24<br>2_Where vibration might give rise to resonant responses in structures | | | | | |

The safe working distances presented are indicative and will vary depending on the particular item of plant and local geotechnical conditions. They apply to cosmetic damage of typical buildings under typical geotechnical conditions.

The contractor will be required to manage vibration as well as noise and make use of best practice in the management of vibration using simple and practicable techniques such as avoiding dropping heavy items.

Where vibration intensive works are required within the minimum working distances outlined in Table 37, vibration monitoring at the nearest potential affected building should be considered, where real-time alerts can be generated when measured vibration levels exceed criteria.

# 5. Conclusion

An acoustic assessment has been undertaken of construction and operation of the proposed Melrose Park School. This assessment has been based on information available at this stage of design and has been developed to a level of detail suitable for submission as appendix to the Review of Environmental Factors.

The operational assessment has considered noise emissions from school operations including building services, outdoor play areas, gymnasium use, outdoor workshop areas and car parks. Road traffic noise increase associated with operation of the school has also been assessed along with noise intrusion into the development site. Various recommendations have been made to mitigate noise sources and enhance the building envelope where feasible and reasonable to demonstrate compliance with target criteria.

In lieu of detailed information being available at this stage of design, the construction noise and vibration assessment has made various assumptions based on typical approaches to building school developments. Various exceedances of target noise management levels have been identified and indicative mitigation and management measures put forward. A detailed Construction Noise and Vibration Management Plan will be required to be developed by the Contractor once more specific details are known.

Assessment of acoustic impact has been compared against relevant environmental criteria. Accompanying mitigation and management measures are proposed to effectively address any identified exceedances of screening criteria.

Subject to implementing the recommendations/mitigation measures set out in this report, the conclusion of this assessment is that the proposed Activity is not likely to significantly affect the environment in relation to acoustic matters.

# 6. Mitigation Measures

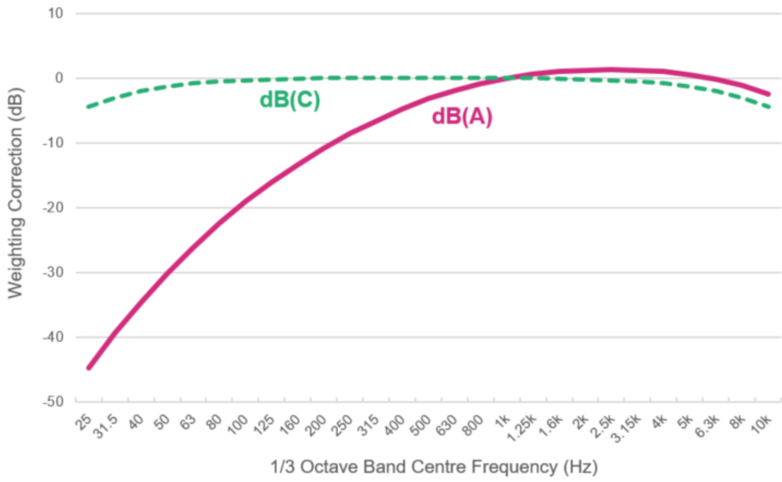
**Table 38: Mitigation measures**

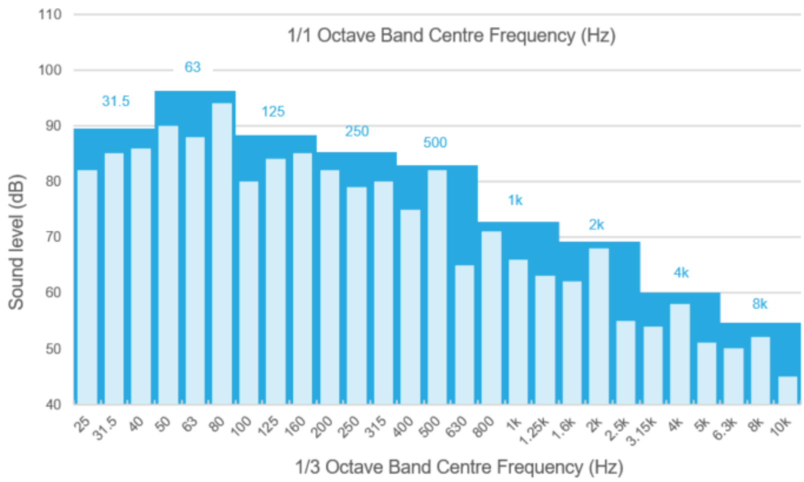
| Mitigation Name | Section | Mitigation Measure | Reason for Mitigation Measure |
|---|---|---|---|
| Building services | Section 3.2 | Appropriate equipment selection and noise mitigation design. | Achieve internal and external building services noise and vibration criteria. |
| Operational activities | Section 3.3 | Acoustic louvres to be installed within Gymnasium and Covered Outdoor workshop areas where required to achieve environmental noise emission criteria.<br>Implement feasible and reasonable mitigation measures for traffic generation in alignment with the NSW Road Noise Policy.<br>Restrict usage of Public Address to daytime hours only (7am to 6pm). Use directional speakers and set volume levels to the minimum required to ensure clarity and audibility.<br>Where practicable, all loading dock activities, waste removal and noisy cleaning activities should take place between 7:00 AM and 10:00 PM. | To minimise disruption to nearby residential receivers. |
| Noise intrusion | Section 3.4 | Façade glazing and lightweight elements and doors to be designed to control noise break-in to sensitive areas.<br>Natural ventilation to incorporate acoustic louvres where noise break-in is required to be controlled.<br>Install acoustically absorptive finishes to underside of outdoor learning areas to control reverberation build up and mitigate noise intrusion. | To control noise intrusion into sensitive spaces throughout the school. |
| Construction noise and vibration | Section 4 | Contractor to develop a detailed construction noise and vibration management plan once specific details of proposed construction activities and staging are known. | To effectively manage construction noise and vibration impacts to the surrounding community. |

# Appendix A

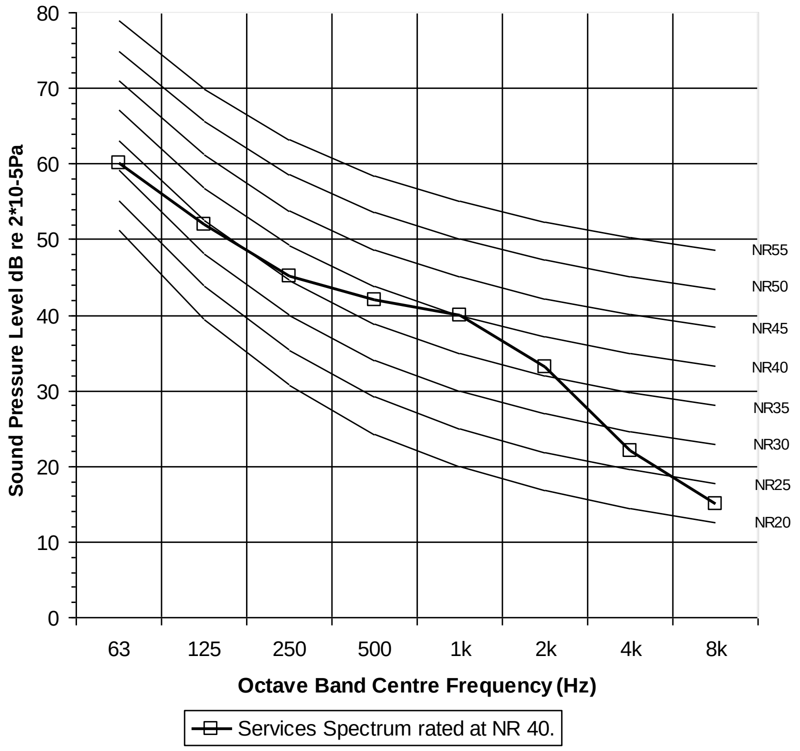
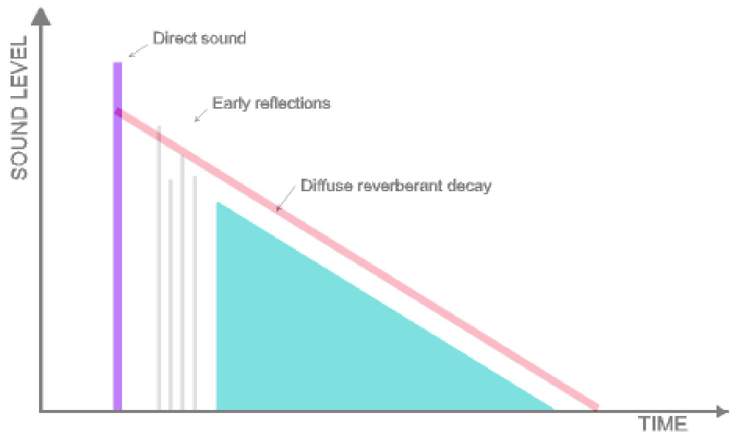
## Glossary

| Term | Definition |
|---|---|
| **Absorption Coefficient, α** | The amount of sound absorbed by a material, defined as the ratio of the amount of acoustic absorption of the material (in units of sabins) to the material's surface area. Absorption coefficient is broadly equivalent to the proportion of sound energy absorbed by the material.<br><br>Noise-reduction Coefficient (NRC): The arithmetic average of the sound-absorption coefficients of a material at 250 Hz, 500 Hz, 1 kHz and 2 kHz. It is a simplified single-number index that provides an indication of the sound absorbing efficiency of a material, typically ranging from 0 to 1. The rating is affected by type, thickness, density and mounting of the material.<br><br>Weighted absorption coefficient ($\alpha_w$): The weighted absorption coefficient, defined in ISO 11654 is a frequency-weighted single number absorption coefficient used to categorise the overall absorption effectiveness of a material.<br><br>Descriptors are used to indicate if the material absorbs strongly at high (H), mid (M) and/or low (L) frequencies – e.g. a material may be rated as $\alpha_w$ 0.85(LH), which indicates that it strongly absorbs at both low and high frequencies.<br><br>Materials can also be assigned into five absorption classes, with Class A having the highest absorption and Class E having the lowest absorption. |
| **Ambient noise level** | The ambient noise level is the overall noise level measured at a location from multiple noise sources. When assessing noise from a particular development, the ambient noise level is defined as the remaining noise level in the absence of the specific noise source being investigated. For example, if a fan located on a building is being investigated, the ambient noise level is the noise level from all other sources without the fan operating, such as traffic, birds, people talking and other noise from other buildings. |
| **Background noise level** | The background noise level is the noise level that is generally present at a location at all or most times. Although the background noise may change over the course of a day, over shorter time periods (e.g. 15 minutes) the background noise is almost-constant. Examples of background noise sources include steady traffic (e.g. motorways or arterial roads), constant mechanical or electrical plant and some natural noise sources such as wind, foliage, water and insects.<br><br>Assessment Background Level (ABL): A single-number figure used to characterise the background noise levels from a single day of a noise survey. ABL is derived from the measured noise levels for the day, evening or night time period of a single day of background measurements. The ABL is calculated to be the tenth percentile of the background $L_{A90}$ noise levels – i.e. the measured background noise is above the ABL 90% of the time.<br><br>Rating Background Level (RBL / $minL_{A90,1hour}$): A single-number figure used to characterise the background noise levels from a complete noise survey. The RBL for a day, evening or night time period for the overall survey is calculated from the individual Assessment Background Levels (ABL) for each day of the measurement period, and is numerically equal to the median (middle value) of the ABL values for the days in the noise survey. |
| **Decibel (dB)** | The logarithmic scale used to measure sound and vibration.<br><br>Human hearing is not linear and involves hearing over a large range of sound pressures, which would be challenging to present on a linear scale. A logarithmic scale allows all sound levels to be expressed based on how loud they are relative to a reference sound (typically 20 µPa, which is the approximate human threshold of hearing). For sound in other media (e.g. underwater noise) a different reference level (1 µPa) is used instead.<br><br>An increase of approximately 10 dB corresponds to a subjective doubling of the loudness of a noise. The minimum increase or decrease in noise level that can be noticed is typically 2 to 3 dB. |

| Term | Definition |
|---|---|
| **dB weighting curves** | The frequency of a sound affects its perceived loudness and human hearing is less sensitive at low and very high frequencies. When seeking to represent the summation of sound pressure levels across the frequency range of human hearing into a single number, weighting is typically applied. Most commonly, A-weighting, denoted as dB(A), is used for environmental noise assessment. This is often supplemented by the linear or C-weighting curves, where there is the potential for excess low-frequency sound at higher sound pressure levels.<br><br> |
| **dB(A)** | dB(A) denotes a single-number sound pressure level that includes a frequency weighting ('A-weighting') to reflect the subjective loudness of the sound level.<br>The frequency of a sound affects its perceived loudness. Human hearing is less sensitive at low and very high frequencies, and so the A-weighting is used to account for this effect. An A-weighted decibel level is written as dB(A). |
| **Flutter Echo** | Flutter echo refers to an acoustic defect where sound reflects backwards-and-forwards between a set of parallel surfaces with very little energy loss. The resulting flutter echo decays very slowly and can 'linger' in the room long after sound travelling in other directions has been attenuated.<br>Flutter echo can cause distortion to the sound quality, making it sound 'metallic', or if the flutter is strong enough or delayed enough, it can cause a sound to be 'blurred' and even be heard as a separate sound (a true 'echo').<br>Flutter is treated by angling surfaces so they are not parallel (typically a minimum of 7° off-parallel), adding absorption to one or both surfaces, or by adding diffusion to one or both surfaces. |

<table>
<tr><th>Term</th><th>Definition</th></tr>
<tr><td>Frequency</td><td>
Frequency is the number of cycles per second of a sound or vibration wave. In musical terms, frequency is described as ‘pitch’. Sounds towards the lower end of the human hearing frequency range are perceived as “bass” or ‘low-pitched’ and sounds with a higher frequency are perceived as ‘treble’ or ‘high pitched’.
The unit of frequency is the hertz (Hz), which is identical to cycles per second. A thousand Hz is generally denoted as kHz. Human hearing ranges approximately from 20 Hz to 20 kHz.
While single weighted sound pressure levels simplify the assessment and evaluation of sound levels, frequency analysis is often undertaken. ‘Octave bands’, either 1/1 or 1/3 octave bands are most commonly utilised and are referred to by the nominal centre frequency of the band (e.g. 31.5 Hz), while being the summation of all frequencies between a defined lower and upper frequency.


</td></tr>
<tr><td>Impact Sound Pressure Level</td><td>
The technical parameter used to determine impact sound isolation of floors is the impact sound pressure level, $L_i$.
In the laboratory, the weighted normalised impact sound pressure level, $L_{n,w}$, is used to represent the impact sound isolation as a single figure.
On site, the weighted normalised apparent impact sound pressure level, $L'_{n,w}$, and the weighted standardised apparent impact sound pressure level, $L'_{n,Tw}$, are used to represent the impact sound isolation of a floor as a single figure.
These single weighted values are determined by comparing the spectral impact sound pressure levels (as defined in ISO 140-6 and ISO 140-7) with reference values outlined in AS/NZS ISO 717.2.
</td></tr>
<tr><td>$L_{10(period)}$</td><td>
The sound level exceeded for 10% of the measurement period, or alternatively, the sound levels would be lower for 90% of the time.
The $L_{10}$ is often defined as the ‘average maximum’ sound levels, as in AS1055-2018 with the advent of statistical sound level meters.
</td></tr>
<tr><td>$L_{90(period)}$</td><td>
The sound level exceeded for 90% of the measurement period.
The $L_{90}$ is often defined as the ‘average minimum’ or ‘background’ noise level for a period of measurement. For example, 45 $dBL_{A90,15min}$ indicates that the sound level is higher than 45 dB(A) for 90% of the 15-minute measurement period.
</td></tr>
<tr><td>$L_{eq(period)}$</td><td>
The equivalent (‘eq’) continuous sound level, used to describe the level of a time-varying sound or vibration measurement.
The $L_{eq}$ is often defined as the ‘average’ level, and mathematically, is the energy-average level over a measurement period – i.e. the level of a constant sound that contains the same sound energy as the measured sound.
</td></tr>
<tr><td>$L_{peak}$ / $L_{max}$</td><td>
The $L_{peak}$ is the ‘absolute maximum’ level of a sound or vibration recorded within the measurement period. As the $L_{peak}$ is often caused by an instantaneous event, it can vary significantly between measurements.
$L_{max}$ is the maximum rms sound pressure level within a measuring period. $L_{max}$ gives a better picture of what the general maximum level was in a measurement, making it easier to calculate and measure for a noise source waveform that is changing constantly in its magnitude.
</td></tr>
</table>

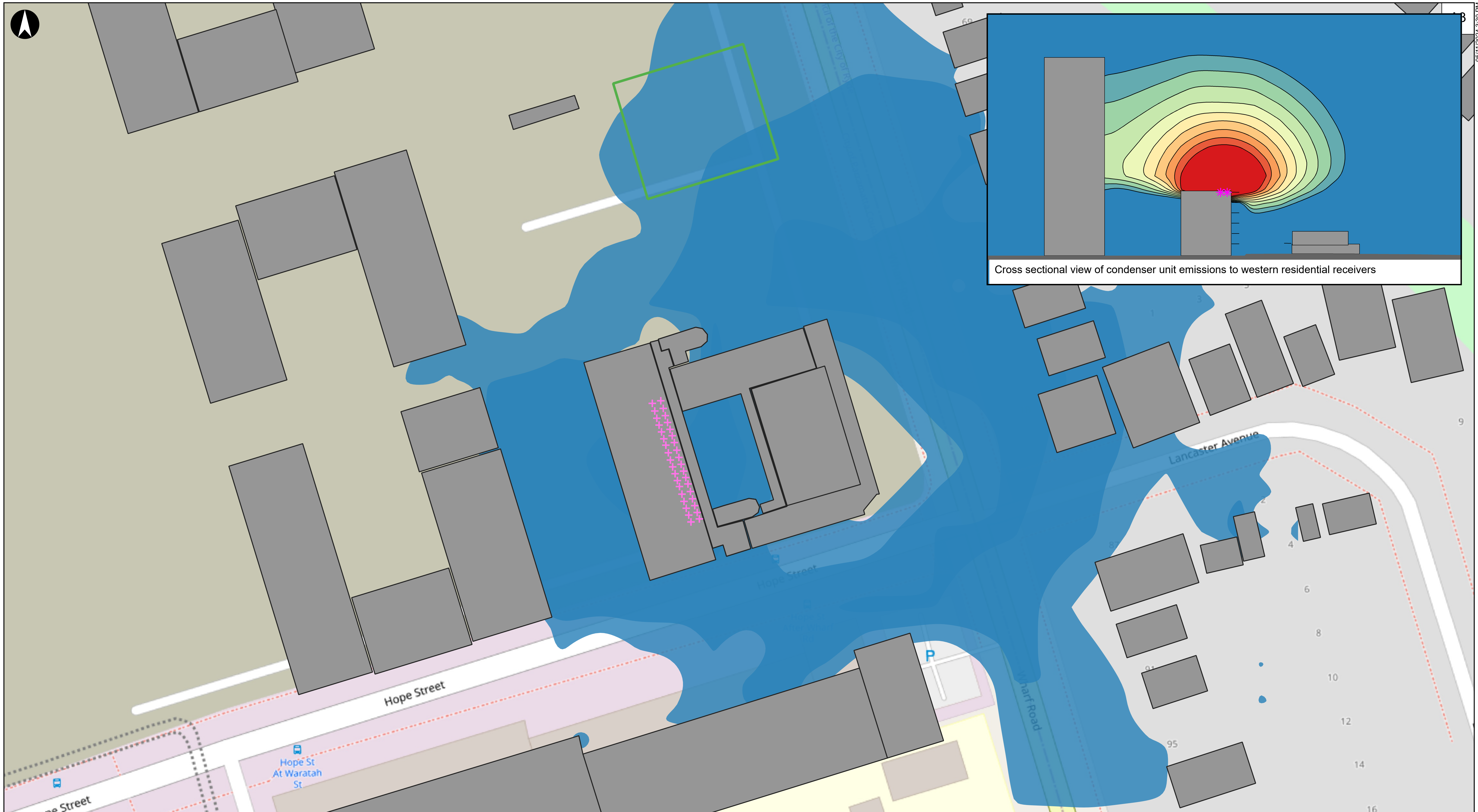
| Term | Definition |
|---|---|
| **Noise Rating (NR) Curves** | A set of internationally-agreed octave band sound pressure level curves, based on the concept of equal loudness. The curves are commonly used to define building services noise limits. The 'NR' value is obtained by plotting the octave band spectrum on the set of standard curves. The highest value curve which is reached by the spectrum is the NR value. Shown below is a mechanical plant noise spectrum at NR 40.<br><br> |
| **Reverberation Time ($T_{60}$)** | The time, in seconds, taken for a sound within a space to decay by 60 dB after the sound source has stopped is denoted at the reverberation time (RT).<br>The RT is an important indicator of the subjective acoustic within a space. A long RT subjectively corresponds to an acoustically 'live' space, while a short RT subjectively corresponds to an acoustically 'dead' space.<br><br> |

| Term | Definition |
|---|---|
| **Sound Level Difference (D)** | Used to quantify the sound insulation between two spaces and is equal to the difference in sound level between the rooms within a particular frequency band. For example, if the sound level in the source room is 100 dB and the sound level in the adjacent room is 75 dB, the sound level difference is 25 dB for that frequency band.<br><br>The weighted sound level difference, $D_w$, as defined in AS/NZS ISO 717.1, is used to provide a single-number descriptor to describe the overall performance of a partition across multiple frequency bands. Note however that $D_w$ is only calculated over a frequency range from 100 Hz to 3.15 kHz and hence sound outside of this range is excluded from calculation of $D_w$ – particularly low frequency (bass) sound below 100 Hz.<br><br>Also used are the weighted normalised level difference ($D_{n,w}$), which corrects the measured sound level difference to a reference sound absorption area in the receiving room, or the weighted standardised level difference ($D_{nT,w}$), which corrects the measurements to a reference reverberation time in the receiving room.<br><br>These single numbers are determined by comparing the spectral sound insulation test results (as defined in ISO 140-4) with reference values, as outlined in AS/NZS ISO 717.1. |
| **Sound Power and Sound Pressure** | The sound power level ($L_w$) of a source is a measure of the total acoustic power radiated by a source. The sound pressure level ($L_p$) varies as a function of the environment and distance from a source.<br><br>The sound power level is an intrinsic characteristic of a source (analogous to its mass), which is not affected by the environment within which the source is located. |
| **Sound Reduction Index (R)** | A measure of the sound level loss through a material for a particular frequency band. Sound reduction index is sometimes also referred to as transmission loss. It is a property of the component, unlike the sound level difference, which is affected by the common area between the rooms and the acoustics of the receiving room. R is the ratio (expressed in decibels) of the sound energy transmitted through the building element to the sound energy incident on the building element for a particular frequency band.<br><br>The weighted sound reduction index, $R_w$, is a single figure description of sound reduction index across multiple frequency bands and is defined in BS EN ISO 717-1: 2000. $R_w$ values are calculated from measurements in an acoustic laboratory. Note however that $R_w$ is only calculated over a frequency range from 100 Hz to 3.15 kHz and hence sound outside of this range is excluded from calculation of $R_w$ – particularly low frequency (bass) sound below 100 Hz.<br><br>Sound insulation ratings derived from site measurements are referred to as apparent sound reduction index ($R'_w$) ratings. |
| **Spectrum Adaptation Terms (C and $C_{tr}$)** | C and $C_{tr}$ denote a spectrum adaptation (in dB) that are added to the $R_w$ or $D_w$ value of a partition to adjust for different sound characteristics.<br><br>C is used to measure the performance of a partition for medium to high-frequency sound sources, such as speech.<br><br>$C_{tr}$ is used to measure the performance of a partition for low-frequency sound sources such as road traffic.<br><br>The values of C and $C_{tr}$ are dependent on the construction of the partition and are usually negative quantities, they typically increase the $R_w$ requirement of a partition. For example, for a partition with an $R_w$ of 56 dB and $C_{tr}$ -6 dB, the $R_w$+$C_{tr}$ is only 50 dB.<br><br>The overall performance of the partition is quoted as the sum of the $R_w$ value and the spectrum adaptation terms, e.g. $D_w$+C 55 dB; $R_w$+$C_{tr}$ 60 dB. |

<table>
<tr><th>Term</th><th>Definition</th></tr>
<tr><td>Speech Transmission Index (STI)</td><td>STI is a technical index, predictable and measurable using specialised equipment, for assessing speech and vocal intelligibility. STI takes into account the signal/noise ratio of the speech signal and the reverberation of the receiving environment. The higher the value of STI, the higher the expected speech intelligibility.<br><br>STI ratings are assigned subjective categories, as follows:<br><table>
<tr><th>STI range</th><th>Subjective category</th></tr>
<tr><td>< 0.3</td><td>Bad</td></tr>
<tr><td>0.3 – 0.45</td><td>Poor</td></tr>
<tr><td>0.45 – 0.6</td><td>Fair</td></tr>
<tr><td>0.6 – 0.75</td><td>Good</td></tr>
<tr><td>0.8 – 1.0</td><td>Excellent</td></tr>
</table></td></tr>
<tr><td>Structureborne noise</td><td>The transmission of noise energy as vibration of building elements. The energy may then be re-radiated as airborne noise. Structureborne noise is controlled by structural discontinuities, i.e. expansion joints and floating floors.</td></tr>
<tr><td>Vibration</td><td>Waves in a solid material are called ‘vibration’, as opposed to similar waves in air, which are called ‘sound’ or ‘noise’. If vibration levels are high enough, they can be felt; usually vibration levels must be much higher to cause structural damage.<br><br>A vibrating structure (e.g. a wall) can cause airborne noise to be radiated, even if the vibration itself is too low to be felt. Structureborne vibration limits are sometimes set to control the noise level in a space.<br><br>Vibration levels can be described using measurements of displacement, velocity and acceleration. Velocity and acceleration are commonly used for structureborne noise and human comfort. Vibration is described using either metric units (such as mm, mm/s and $mm/s^2$) or else using a decibel scale.</td></tr>
</table>

# Appendix B

## Mechanical plant noise



Cross sectional view of condenser unit emissions to western residential receivers

05/11/2024 3:30 PM

## Legend

- + Condensor Unit
- Courts
- Building

dBLAeq(1 hour)

| | |
|---|---|
| 30 - 43 | 47 - 48 |
| 43 - 44 | 48 - 49 |
| 44 - 45 | 49 - 50 |
| 45 - 46 | 50 - 51 |
| 46 - 47 | 51 - 52 |

Coordinate System: EPSG:7856

0 12.5 25 37.5 50 m

| Rev | Date | By | Chkd | Appd | Authd |
|---|---|---|---|---|---|
| A | 05/11/2024 | AT | MA | -- | -- |

**ARUP**

Level 5 Barrack Place,
151 Clarence St, Sydney
NSW 2000
www.arup.com

Client

**Schools Infrastructure NSW**

Project Name

**Melrose Park High School**
**Stage 1**
**1.5 m above ground**

Drawing Title

**Condensor Unit Emissions**

Scale at A3

**1:1000**

Role

--

Suitability

--

Project Number

-

Rev

A

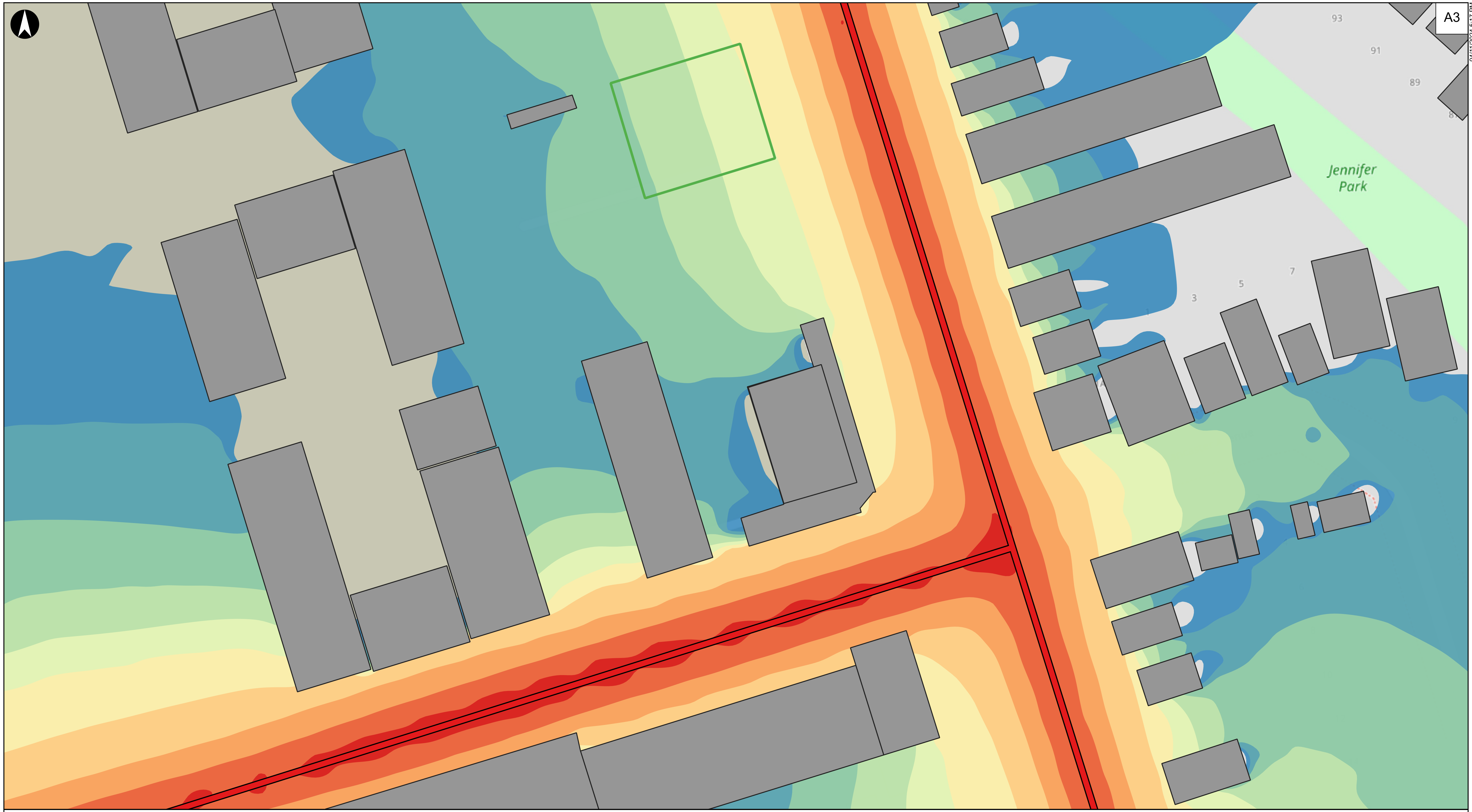
Drawing Name

--

\\global.arup.com\australasia\SYD\Projects\303000\303392-00 SINSW Projects Group\Work\Internal\Melrose\Acoustics\3_Calcs and models\QGIS\QGIS Model\Melrose_GNM_CU Scale.qgz

# Appendix C

## Road traffic noise




Legend

- Courts
- Building
- Road

dBLAeq(1 hour)

| | |
|---|---|
| 45 - 48 | 61 - 64 |
| 48 - 51 | 64 - 67 |
| 51 - 54 | 67 - 70 |
| 54 - 58 | 70 - 73 |
| 58 - 61 | 73 - 76 |

Coordinate System: EPSG:7856

0 12.5 25 37.5 50 m

| Rev | Date | By | Chkd | Appd | Authd |
|---|---|---|---|---|---|
| A | 04/11/2024 | AT | MA | -- | -- |

ARUP

Level 5 Barrack Place,
151 Clarence St, Sydney
NSW 2000
www.arup.com

Client

**Schools Infrastructure NSW**

Project Name

**Melrose Park High School**
**Stage 1**
**1.5 m above ground**

Drawing Title

**Traffic Emissions**

Scale at A3
**1:1000**

Role
**--**

Suitability
**--**

Project Number
**-**

Rev
**A**

Drawing Name
**--**

\\global.arup.com\australasia\SYD\Projects\303000\303392-00 SINSW Projects Group\Work\Internal\Melrose\Acoustics\3_Calcs and models\QGIS\QGIS Model\Melrose_GNM_Traffic.qgz

# Appendix D

## REF Checklist

| Requirement | Y | N | N/A | Comments |
| --- | --- | --- | --- | --- |
| **Noise and vibration** | | | | |
| **Noise monitoring**<br>Does the REF include an Noise and Vibration Impact Assessment (NVIA)? | ☒ | ☐ | ☐ | This report |
| Does the assessment include background noise monitoring at locations that appropriately represent the existing noise levels at nearby sensitive receivers (i.e. residences, churches, health facilities, etc.)? | ☒ | ☐ | ☐ | Section 1.3 |
| Does the background noise monitoring undertaken meet the requirements of Noise Policy for Industry (2017) i.e. at least a week with acceptable weather conditions:<br>• average wind speed <5 m/s?<br>• no rain or other extraneous noise? | ☒ | ☐ | ☐ | Section 1.3 |
| **Construction noise**<br>Does the assessment consider impacts from construction noise and vibration in accordance with the Interim Construction Noise Guideline? | ☒ | ☐ | ☐ | Section 4.1 |
| Does it:<br>• determine noise management levels for the development? | ☒ | ☐ | ☐ | Section 2.5.2 |
| • predict noise levels of the proposed construction activities (usually of expected standard activities and equipment and associated noise levels given that full construction methodology will not yet be known)? | ☒ | ☐ | ☐ | Section 4.1.3 |
| • conclude whether the predicted levels would exceed the noise management levels? | ☒ | ☐ | ☐ | Section 4.1.3 |
| • set out measures to minimise impacts to sensitive receivers, including existing school users, and ensure best practice on site? | ☒ | ☐ | ☐ | Section 4.1.4 |
| • conclude whether construction noise would be likely to result in significant impacts? | ☒ | ☐ | ☐ | Section 4.1.3 |
| • adopt standard construction hours set out in the ICNG or include justification where non-standard hours are proposed? | ☒ | ☐ | ☐ | Section 2.5.1 |
| **Vibration**<br>Does the assessment include an assessment of potential impacts as a result of vibration during constriction which:<br>• relevant standards and assessment criteria for human comfort, sensitive equipment and structural damage? | ☒ | ☐ | ☐ | Section 2.5.3 |
| • details potential sources of vibration during construction having regard to typical activities and equipment expected to undertake proposed construction works? | ☒ | ☐ | ☐ | Section 4.3 |
| • consider potential impacts having regard to separation distances to nearby sensitive receivers? | ☒ | ☐ | ☐ | Section 4.3 |
| • sets out measures to mitigate potential impacts, including existing school users? | ☒ | ☐ | ☐ | Section 6 |
| • concludes that the proposed activity would not be likely to have significant environmental affects following mitigation? | ☒ | ☐ | ☐ | Section 4.3 |
| **Operational noise** | ☒ | ☐ | ☐ | Section 2.3 |

| Requirement | Y | N | N/A | Comments |
| --- | --- | --- | --- | --- |
| Does the assessment:<br>• consider noise impacts from all aspects of proposed operations in accordance with the Noise Policy for Industry (2017) or Association of Australasian Acoustical Consultants Guideline for Child Care Centre Acoustic Assessment in the case of outdoor play? | | | | |
| • determine noise criteria that would be applicable? | ☒ | ☐ | ☐ | Section 2 |
| • consider all proposed activities, including:<br>○ indoor learning activities? | ☒ | ☐ | ☐ | Section 3.3 |
| ○ outdoor play? | ☒ | ☐ | ☐ | Section 3.3.1 |
| ○ use of public address system? | ☒ | ☐ | ☐ | Section 3.3.7 |
| ○ plant and equipment (i.e. air conditioning) | ☒ | ☐ | ☐ | Section 3.2 |
| ○ use of the hall | ☒ | ☐ | ☐ | Section 3.3.3 |
| ○ use of outdoor sports courts | ☒ | ☐ | ☐ | Section 3.3.1 |
| • conclude that the proposal would meet the project noise trigger levels? | ☒ | ☐ | ☐ | Section 3 |
| • set out mitigation measures if the proposal does not meet the trigger levels, does the assessment | ☒ | ☐ | ☐ | Section 6 |
| **Internal noise tenability**<br>Does the assessment:<br>• consider external sources of noise in proximity to the site (i.e. main roads or rail corridors)? | ☒ | ☐ | ☐ | Section 3.4 |
| • detail applicable internal noise comfort criteria having regard to the EFSG? | ☒ | ☐ | ☐ | Section 2.4.1 |
| • predict internal noise levels? | ☒ | ☐ | ☐ | Section 3.4 |
| • conclude that internal noise levels would meet criteria? | ☒ | ☐ | ☐ | Section 3.4 |
| • set out any proposed mitigation measures required to meet the criteria? | ☒ | ☐ | ☐ | Section 6 |
| **Overall assessment**<br>Does the assessment:<br>• include a list of measures to mitigate the impacts of the activity? | ☒ | ☐ | ☐ | Section 6 |
| • conclude overall, that the activity would not be likely to result in significant environmental affects? | ☒ | ☐ | ☐ | Section 5 |
| Does the REF list any mitigation measures identified in the assessment and incorporate them into the design where applicable (i.e. does the design include mechanical ventilation where this is required to achieve internal comfort levels)? | ☒ | ☐ | ☐ | Section 6 |