MATTHEW PALAVIDIS
VICTOR FATTORETTO
MATTHEW SHIELDS

Monaro Cluster High Schools

New High School in Jerrabomberra Environmental Noise and Vibration Assessment

SYDNEY
9 Sarah St
MASCOT NSW 2020
(02) 8339 8000

ABN 98 145 324 714
www.acousticlogic.com.au

Project ID	20210459.2
Document Title	New High School in Jerrabomberra Environmental
Attention To	Hindmarsh Construction Australia Pty Ltd

Revision	Date	Document Reference	Prepared By	Checked By	Approved By
0	21/05/2021	20210459.2/2105A/R0/GC	GC		
1	8/09/2021	20210459.2/0809A/R1/GC	GC		GC
2	17/09/2021	20210459.2/1709A/R2/GC	GC		GC
3	20/09/2021	20210459.2/2009A/R3/GC	GC		GC
4	3/11/2021	20210459.2/0311A/R4/GC	GC		GC

TABLE OF CONTENTS

1 INTRODUCTION

This Environmental Noise and Vibration Assessment accompanies an Environmental Impact Statement (EIS) pursuant to Part 4 of the Environmental Planning and Assessment Act 1979 (EP&A Act) in support of an application for a State Significant Development (SSD No 24461956). The SSDA is for a new high school located at Jerrabomberra.

This report addresses the Secretary's Environmental Assessment Requirements (SEARs), notably:

Table 1- SEARs and Relevant Reference

SEARs Item	Report Reference
Item 4. Assess amenity impacts on the surrounding locality, including … and acoustic impacts.	Sections 7 to 11
Item 10 • Provide a noise and vibration impact assessment that: ○ includes a quantitative assessment of the main noise and vibration generating sources during demolition, site preparation, bulk excavation and construction. ○ details the proposed construction hours and provide details of, and justification for, instances where it is expected that works would be carried out outside standard construction hours. Includes a quantitative assessment of the main sources of operational noise, including consideration of any public-address system, school bell, mechanical services (e.g. air conditioning plant), use of any school hall for concerts etc. (both during and outside school hours) and any out of hours community use of school facilities. ○ Outlines measures to minimise and mitigate the potential noise impacts on nearby sensitive receivers. ○ Considers sources of external noise intrusion in proximity to the site (including, road rail and aviation operations) and identifies building performance requirements for the proposed development to achieve appropriate internal amenity standards. ○ Demonstrates that the assessment has been prepared in accordance with polices and guidelines relevant to the context of the site and the nature of the proposed development. . Relevant Policies and Guidelines: •NSW Noise Policy for Industry 2017 (EPA) •Interim Construction Noise Guideline (DECC) •Assessing Vibration: A Technical Guideline 2006 •Development Near Rail Corridors and Busy Roads –Interim Guideline (Department of Planning 2008)	Section 12 Section 7 to 11

In this assessment we will:

- Identify nearby noise sensitive receivers and operational noise sources with the potential to adversely impact nearby development.
- Identify relevant Council and EPA noise emission criteria applicable to the development.
- Predict operational noise emissions and assess them against acoustic criteria.
- If necessary, determine building and/or management controls necessary to mitigate potential noise impacts.

2 PROPOSAL

The proposed development is for the construction of a new high school in Jerrabomberra. The proposal will meet community demand and to ensure new learning facilities are co-located near existing open space infrastructure. The proposal generally includes the following works:

- Site preparation;
- Construction of a series of buildings up to three storeys including administration/staff areas, library, hall and general learning spaces;
- Construction of new walkways, central plaza and outdoor games courts;
- Construction of a new at-grade car park;
- Associated site landscaping and open space.

The proposal has been designed to accommodate approximately 500 students with Stream 3 teaching spaces, however the core facilities will be future proofed to a Stream 5 to enable possible future expansion to meet projected demand.

The proposal will include site preparation works, such as clearing and levelling to accommodate the proposed buildings and play areas. The proposal will involve the construction of a series of buildings housing general learning spaces, administration and staff wings, outdoor learning areas, a library and assembly hall.

The proposal will include construction of a new driveway and hardstand with access proposed off the northern stub road east of Environa Drive. Pedestrian access is proposed off Environa Drive and the northern stub road.

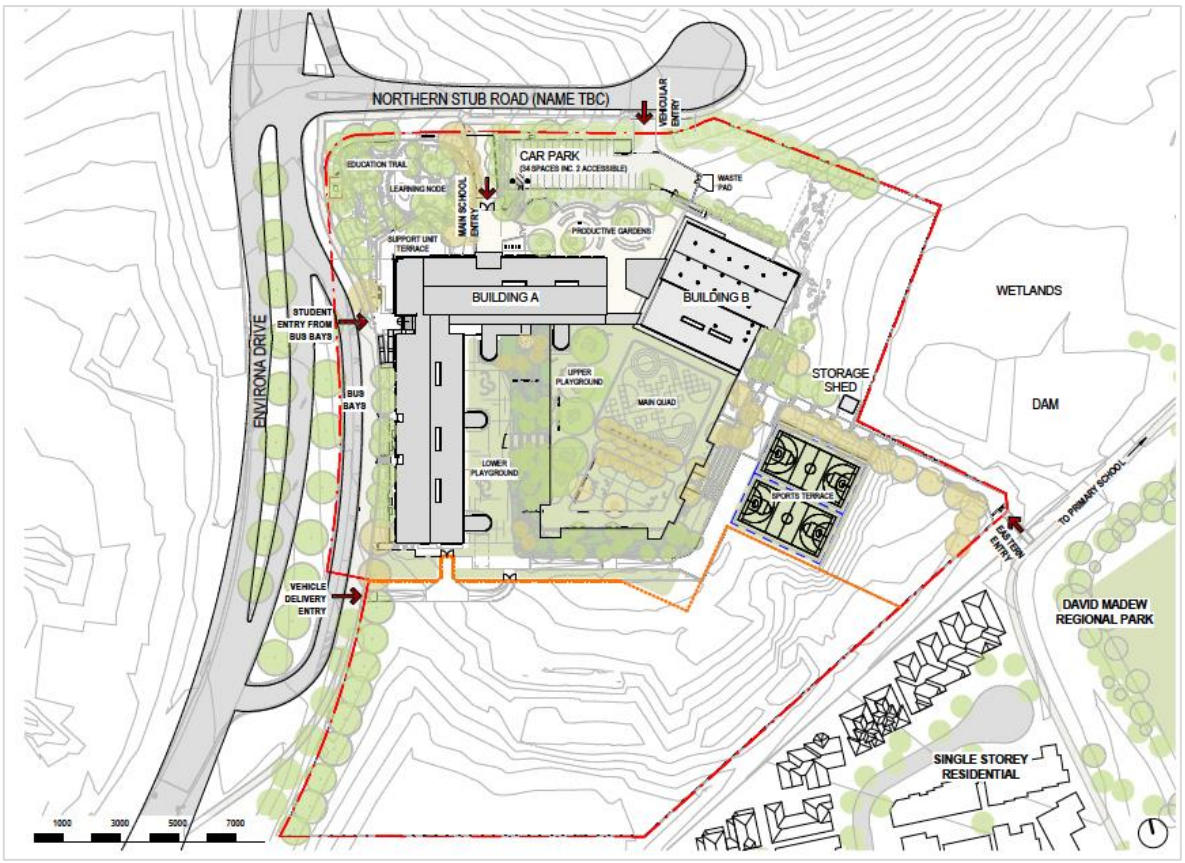


Figure 1: Proposed site plan
Source: TKD Architects

3 SITE DESCRIPTION

The proposed development is located within the South Jerrabomberra Innovation Precinct, also referred as the Poplars Innovation Hub, in the local government area of Queanbeyan-Palerang Regional Council.

The school site- is part of an existing lot (Lot 1 in DP 1263364), which is approximately 65.49ha in area and will be characterised by a mix of business park and open space uses and a new north-south connector road named Environa Drive.

Delivery of the Precinct is underway with Environa Drive currently under construction. Most of the-lot, however, remains undeveloped.

The school site is subject to a proposed lot (Lot 2 in DP 1263364), which was approved by Council under DA332-2015 on 10 March 2021 but is not yet registered. The approved lot is irregular in shape, is largely cleared and is approximately 4.5ha in area. A small dam is located adjacent to the south eastern boundary of the site, which forms part of a broader wetland.

The site is located in excellent proximity to existing open space facilities. It adjoins David Madew Regional Park to the south east and is located 100m east of an existing recreational field associated with Jerrabomberra Public School.

A description of the site is provided in the table below.

Table 2 -New High School in Jerrabomberra Site Description

Item	Description
Site address	School address yet to be determined however, it is located within the Jerrabomberra Innovation Precinct at 300 Lanyon Drive, Jerrabomberra.
Legal description	Lot 1 in DP 1263364 (existing) Lot 2 in DP 1263364 (proposed, but not registered)
Total area	Lot 1 – 65.49ha Lot 2 – 4.5ha
Frontages	The site provides frontage to Environa Drive and the northern stub road, both currently under construction.
Existing use	The site is undeveloped and contains a series of small vegetation clusters scattered across the site.
Existing access	Existing access is via an informal unsealed driveway off Tompsitt Drive along the northern boundary of the existing lot. The site will be accessed via Environa Drive and a secondary access road (North Road), which is currently under construction.

Table 2 cont. -New High School in Jerrabomberra Site Description

Item	Description
Context	Land to the south is primarily residential in nature. Jerrabomberra Public School and David Madew Regional Park are located to the east/south-east, while land to the west is undeveloped and features Jerrabomberra Creek. The site is located within the South Jerrabomberra Innovation Precinct, which is currently under construction. The areas north and west of the site are currently undeveloped but the site is currently undergoing a transition from rural to business park uses. Development further north on the opposite side of Tompsitt Drive and along Edwin Land Parkway includes retail and commercial uses. Development immediately to the south includes existing low density residential development. Land in the south west has been identified for future low density residential, light industrial and business park uses.

Figure 2: Site aerial depicting the land subject to the proposed High School.
Source: TKD Architects

4 SITE OPERATION

The following table describes how the school is proposed to be used.

Table 3- School Uses and Operating Times

Item	Use	Times
GENERAL	The new high school in Bungendore will cater for students Year 7 - Year 12. The school will have the following capacity following completion of the development: - 45 full time staff - 500 students	Monday to Friday between 8am and 5pm
HALL/GYM	Generally used during standard school hours. The application contemplates the use of the hall for community use, whether for one-off or periodic events. This will be subject to reaching a shared use agreement in the future.	Monday to Friday between 8am and 5pm. If a shared use agreement is reached, from time to time use of the school hall may be used for out of hours community use. Sat, Sun and Public Holidays between 8am and 10pm
OUTDOOR SPORTS COURTS/GYM NASIUM	Intended to only be used by School during standard school operating hours.	Monday to Friday between 8am and 5pm
LIBRARY	Intended use for school only during standard school hours.	Monday to Friday between 8am and 5pm

The assessment is based on TKD Architect drawings reference AR DA HS 0000, AR DA HS 0100, AR DA HS 0500, AR DA HS 0501, AR DA HS 1010, AR DA HS 2000, AR DA HS 2001, AR DA HS 2002, AR DA HS 2003, AR DA HS 3000, AR DA HS 3001, AR DA HS 3400, AR DA HS 3410, AR DA HS 8000, AR DA HS 8200, AR DA HS 9000, AR DA HS 9100, dated 06/09/2021 Revision A. Figure 3 shows the proposed site plan.

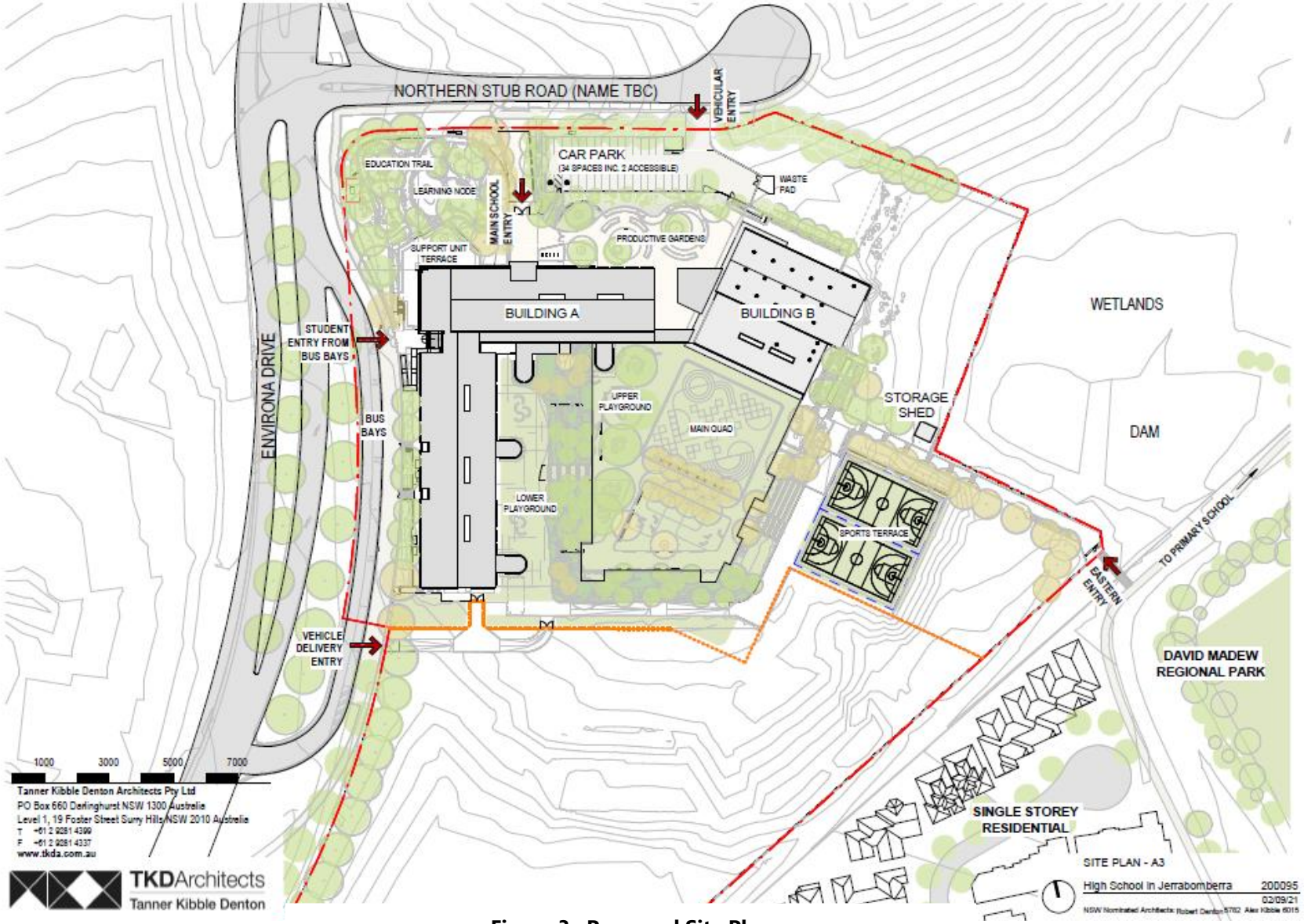


Figure 3 –Proposed Site Plan

● Logger Location

Figure 4 – Site Location and Noise Measurement Location

5 NOISE DESCRIPTORS

Environmental noise constantly varies. Accordingly, it is not possible to accurately determine prevailing environmental noise conditions by measuring a single, instantaneous noise level.

To accurately determine the environmental noise a 15-20 minute measurement interval is utilised. Over this period, noise levels are monitored on a continuous basis and statistical and integrating techniques are used to determine noise description parameters.

In analysing environmental noise, three principal measurement parameters are used, namely L_{10}, L_{90} and L_{eq}.

The L_{10} and L_{90} measurement parameters are statistical levels that represent the average maximum and average minimum noise levels respectively, over the measurement intervals.

The L_{10} parameter is commonly used to measure noise produced by a particular intrusive noise source since it represents the average of the loudest noise levels produced by the source.

Conversely, the L_{90} level (which is commonly referred to as the background noise level) represents the noise level heard in the quieter periods during a measurement interval. The L_{90} parameter is used to set the allowable noise level for new, potentially intrusive noise sources since the disturbance caused by the new source will depend on how audible it is above the pre-existing noise environment, particularly during quiet periods, as represented by the L_{90} level.

The L_{eq} parameter represents the average noise energy during a measurement period. This parameter is derived by integrating the noise levels measured over the 15 minute period. L_{eq} is important in the assessment of traffic noise impact as it closely corresponds with human perception of a changing noise environment; such is the character of environmental noise.

L_1 levels represent is the loudest 1% noise events during a measurement period.

6 SURVEY OF AMBIENT NOISE

Long term unattended noise logging was conducted to quantify the existing acoustic environmental at the site. All monitoring and measurement locations are shown in Figure 2.

6.1 UNATTENDED, LONG TERM NOISE LOGGING

Unattended noise monitoring was conducted between 27th April and 10th May 2021 using Acoustic Research Laboratories monitors set on A-weighted fast response mode. The monitors were field calibrated before and after the measurements using a Rion Type NC-73 calibrator. No significant drift was recorded.

The monitoring location was selected to represent the background noise level at the potentially most impacted receivers. The source of ambient noise was noted as being distant traffic noise.

The monitoring location was selected to be indicative of the "true" ambient noise level of residential receivers to the east and south of the site in the absence of noise from existing surrounding commercial premises and existing public school noise.

6.2 RESULTS

Measurement results are presented below. The Rating Background Noise Level has been determined using NPfI guidelines with periods affected by excessive wind or rain (as noted on the attached graphs) excluded from the calculation. The day by day and median background noise levels are presented in the following tables. Where no level is indicated these periods were either incomplete or the period was weather affected and invalid. It is noted that the Canberra Airport weather station was used to obtain weather information.

The wind data obtained during the daytime period of the 4th to the 6th May exceeded 5 m//s however the noise data obtained does not show any increase due to weather (the background noise levels were close to the minimum recorded) and therefore has been retained.

Table 4 – Noise Monitoring Results Southern Side of Site(Location 1)

Date	Day L_{90}	Evening L_{90}	Night L_{90}
Tuesday - 27 April 2021	-	30.2	21.4
Wednesday - 28 April 2021	34.2	32.7	24.5
Thursday - 29 April 2021	33.7	31.6	23.5
Friday – 30 May 2021	32	31.5	22.2
Saturday - 1 May 2021	27.3	33.3	24.9
Sunday - 2 May 2021	34.1	30.5	24.9
Monday - 3 May 2021	33.3	34.4	25.8
Tuesday - 4 May 2021	37.3	28.7	29
Wednesday - 5 May 2021	39.3	35.2	29.8
Thursday - 6 May 2021	36.7	69.9	34.4
Friday - 7 May 2021	31.2	61.1	25.1
Saturday - 8 May 2021	28.3	35.1	26.4
Sunday - 9 May 2021	28	36	27.2
Monday - 10 May 2021	30	-	

Table 5 - Summary Long Term Noise Logging

Location	Time of Day	Rating Background Noise Level – dB(A)L_{90}
Southern Side of Site - Logger Location in Figure 2	Day (7am-6pm)	35*
	Evening (6pm-10pm)	33
	Night (10pm to 7am)	30*

*Note: As per the EPA Noise Policy for Industry *"Where the rating background noise level is found to be less than 35 dB(A) for the day periods, then it is set to 35 dB(A). Where the rating background noise level is found to be less than 30 dB(A) for the night periods, then it is set to 30 dB(A)"*

7 OPERATIONAL NOISE EMISSION CRITERIA

The SEARS require a consideration of noise emissions including any public address system, school bell, mechanical services (e.g. air conditioning plant), use of any school hall for concerts etc. (both during and outside school hours) and any out of hours community use of school facilities, and outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land.

There are no specific EPA criteria applicable to the acoustic assessment of schools. Noise assessment goals for the various noise sources can be inferred from other guidelines.

7.1 STATE ENVIRONMENTAL PLANNING POLICY (EDUCATIONAL ESTABLISHMENTS AND CHILD CARE FACILITIES) 2017

Schedule 2 " Schools-complying development" of the Educational SEPP provides the following complying development requirements relating to setbacks and noise emissions:

3 Side and rear setback

A building (whether a new building, or an existing building as a result of an addition or alteration) or any part of a building (including a basement or any other part of a building that is constructed below ground):

(a) that is 12m or less in height—must be located more than 5m from any side or rear property boundary with land in a residential zone or more than 1m from any side or rear property boundary with land in an industrial or a business zone, or

(b) that is more than 12m but less than 15m in height—must be located more than 8m from any side or rear property boundary with land in a residential zone or more than 2.5m from any side or rear property boundary with land in an industrial or a business zone, or (c) that is more than 15m but no more than 22m in height—must be located more than 10m from any side or rear property boundary with land in a residential zone or more than 4m from any side or rear property boundary with land in an industrial or a business zone.

6 Noise

A new building or (if the development is an alteration or addition to an existing building for the purpose of changing its use) an existing building that is to be used for the purpose of a school or school-based child care must be designed so as not to emit noise exceeding an LAeq of 5 dB(A) above background noise when measured at any lot boundary.

It is noted that the "noise" complying development requirement for Universities and TAFE establishments includes an additional requirement for minimum setback between educational buildings and residential development. This implies such a setback (other than to comply with Clause 3) is not required to control noise emissions from school classroom buildings.

7.2 EPA NOISE POLICY FOR INDUSTRY (2017)

Noise sources generally covered by this code are mechanical services and plant noise. Both the intrusiveness and the amenity criteria (as set out below) must be complied with. Emissions from activities carried out prior to 7am and after 10pm should also be assessed for potential impacts on sleep for residential receivers.

7.2.1 Intrusiveness Assessment

Intrusiveness criteria aim to limit noise generation to no more than 5dB(A) above existing background noise levels. The intent is to limit the audibility of noise emissions above the prevailing background noise level.

7.2.2 Amenity Assessment

The amenity criteria set additional criteria based on the land use of the noise sensitive receivers and time of day. The intent is to limit the absolute noise level to that is consistent with the prevailing land use.

The applicable recommended amenity levels for residential receivers are Day 55 dB(A), Evening 45 dB(A) and Night 40 dB(A). Given the residential receivers are not currently impacted by other "industrial" noise sources, nor are likely to in the future, the recommended levels can be adopted as trigger levels.

7.2.3 Sleep Arousal Assessment

In addition to the above, the NSW EPA *NPfI* provides an assessment procedure for assessing any potential sleep arousal impacts for when any noise is generated between 10:00pm and 7:00am (i.e. night period). Sleep arousal is a function of both the noise level and the duration of the noise.

As recommended in the *NPfI*, to assess potential sleep arousal impacts a two-stage test is carried out:

- Step 1 – Section 2.5 *Maximum noise level event assessment* from the NPfI states the following:

  Where the subject development/premises night-time noise levels at a residential location exceed:

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

  a detailed maximum noise level event assessment should be undertaken.

- Step 2 - If there are noise events that could exceed the average/maximum criteria detailed in the tables above, then an assessment of sleep arousal impact is required to be carried out taking into account the level and frequency of noise events during the night, existing noise sources, etc. This test takes into account the noise level and number of occurrences of each event with the potential to create a noise disturbance. As is recommended in the explanatory notes of the EPA *NPfI*, this more detailed sleep arousal test is conducted using the guidelines in the EPA Road Noise Policy. Most relevantly, the Road Noise Policy states:

  For the research on sleep disturbance to date it can be concluded that:

  - *Maximum internal noise levels below 50-55dB(A) are unlikely to awaken people from sleep.*
  - *One to two noise events per night with maximum internal noise levels of 65-70dB(A) are not likely to affect health and wellbeing significantly.*

7.2.4 Summary of NPfI Trigger Levels

Table 6 summarises the trigger levels determined using NPfI guidelines and the measured rating background noise levels. It is noted that where the evening or early morning RBLs were higher than the day RBL, the intrusiveness trigger level adopted was based on the day RBL. A general night time criterion is not required as there are no noise emissions during this period. It is noted that the early morning background noise level is higher than the "day" background noise level, as the background noise level is set by distant traffic noise, which is highest during the morning and afternoon peak periods and lowest (during the EPA "day" period) around lunch time.

Table 6 – Summary of NPfI Trigger Levels

Receiver	Time	Intrusiveness $L_{Aeq,15min}$	Amenity $L_{Aeq,period}$	Sleep $L_{Aeq,15min}$ / L_{AFmax}
Northern Boundary of Bayside Ct receivers	Day (7am-6pm)	40	55	-
	Evening (6pm-10pm)	38	45	-
	Night (10pm-7am)	35	40	40/52

7.3 NSW ROAD NOISE POLICY (2011) (RNP)

The RNP provides guidelines for assessing noise emissions from public roads, including the impact of traffic generated by developments.

According to the policy the future Environa Drive would be defined as a Collector Road and North Road has some characteristics of a Collector Road and some of a local road. The applicable assessment criteria for residential receivers are (measured at the façade of dwellings):

- Sub-arterial – 60 dB(A) $L_{eq,15hr}$ (7am to 10pm) and 55 dB(A) $L_{eq,9hr}$ (10pm to 7am)
- Local – 60 dB(A) $L_{eq,1hr}$ (7am to 10pm) and 55 dB(A) $L_{eq,1hr}$ (10pm to 7am)

The policy also states that:

- Consideration of the noise increase should be made for sub-arterial and arterial roads.
- Noise impacts from increases in noise levels of 2 dB(A) or less are minor, and by implication do not require mitigation.

7.4 "DEVELOPMENT NEAR RAIL CORRIDORS AND BUSY ROADS –INTERIM GUIDELINE" - (DEPARTMENT OF PLANNING 2008)

The guideline is used to assess the impact of adjacent road on noise sensitive development. The guideline recommends a maximum noise level within classrooms of 40 dB(A) $L_{eq,1hr}$.

8 SCHOOL USES - OPERATIONAL NOISE EMISSION ASSESSMENT

An assessment of operational noise emissions is presented below. The following noise sources are assessed:

- Noise from internal areas
- Noise from mechanical plant, PA system and school bells.
- Traffic generation
- Waste Removal
- External activities

8.1 NOISE FROM INTERNAL SPACES

8.1.1 Learning and Admin Spaces

The administration and teaching spaces generate low to medium levels of noise. The building A administration and teaching spaces are typically at least 100m from any residential receiver and emissions from this building would not exceed the Educational SEPP criteria.

8.1.2 Gym

Block B contains the school gym that may be used for presentations and performances. The hall opens out to the west of the building to a covered outdoor area. The potentially most impacted receivers would be the residential receivers to the south.

Noise emissions to the surrounding properties was calculated based on the following:

- Hall internal noise level of 80 dB(A) $L_{eq,15min}$ representing the sound level during a music performance.
- West facing door open and closed. Door to have minimum sound transmission loss of R_w 20 when closed.

The calculated noise levels are (west door open):

- Residences to the south <25 dB(A) $L_{eq,15min}$

The calculated noise levels are (west door closed):

- Residences to the south <10 dB(A) $L_{eq,15min}$

The background + 5 dB(A) noise emissions criteria are not exceeded.

8.2 NOISE FROM MECHANICAL PLANT, SCHOOL BUILDINGS PUBLIC ADDRESS SYSTEM AND SCHOOL BELL

Detailed acoustic design of mechanical plant cannot be undertaken at approval stage, as plant selections and locations are not finalised. However, detailed acoustic assessment of all ventilation or other plant items should be undertaken at CC stage, once equipment items are selected and location is finalised.

Given the proposed buildings are remote from existing and future residential buildings, it is both possible and practical to treat noise from the operation of the proposed mechanical equipment to comply with the EPA NPfI criteria using standard acoustic treatments such as lined ductwork, silencers, screens and the like.

In regard to the school bell/PA system, the system should minimise noise spill to adjacent properties

- Speaker positioning/selection:
    - Speaker location and direction can be used to reduce noise spill to neighbouring properties while still maintaining suitable noise levels within the school grounds (typically 70-75dB(A)).
    - Broadly speaking, more speakers, closer to the noise receiver is a more effective way to provide coverage of the external areas while reducing noise spill to neighbouring properties.
    - Similarly, highly directional speakers (angled downwards) will also reduce noise spill. Speakers with a drop of at least 5dB(A) for mid-frequencies noise for each 10 degrees in the horizontal plane outside of the coverage area should be considered.

8.3 TRAFFIC GENERATION

The school will use a carpark located on the northern side of the site. The projected car spaces required by the school is a maximum of 34 additional car park spaces (ref: TKD Drawing number AR DA HS – 1010 Rev A). The school carpark will typically fill and empty once per day.

A school parent/pupil drop off bay is proposed along the future North Road with approximately 85vehicles in peak periods of activity. Given the distance to the nearest residential receiver is approximately 200m, no significant impact from the pupil drop off bay is anticipated.

8.4 WASTE REMOVAL

Waste would be stored near the northern boundary of the school adjacent to Building B. The waste removal truck would park approximately 200m from the nearest residential building. This distance separation should adequately address noise impact from waste removal operations.

8.5 EXTERNAL ACTIVITIES

The expected external school activities include:

- Use of all external spaces immediately before school commencing and recess/lunch periods.
- Use of courts for sports lessons during the normal school day, plus occasional afternoon and Saturday use for sports tournaments/competitions.

There are no criteria to be met regarding normal activities conducted by the school, nor is its assessment a specific requirement of the SEARS. The external spaces are separated from any existing and future by significant distance buffers, as well as, for the receivers to the west and north, screening from structures.

Noise emissions from the use of the outdoor play areas is predicted based on the following assumptions/information:

- Number of students:
    - High School – 500 Students
- General Playground noise measurements:
    - High School - noise level per student of 83dB(A) (sound power level one in two students), based on measurements conducted at Anzac Park Public School.
- All play areas in operation at once.
- Sports courts noise measurements – Use of sports courts for competitive sports is a potentially more intensive use of these spaces compared to typical playground use. As a part of studies of play ground noise emission, ALC have undertaken measurements noise created on sports courts. In our experience, noise from an intensive use of *one* sports court (competitive basketball, a louder than typical sporting activity) is approximately 61dB(A) $L_{eq,15min}$ when standing 10m from the edge of the court. This data is then used to predict noise levels at nearby properties (the relative position between the court and the receivers).

The most impacted residential receivers from general playground activity would be those to the north of the site having direct line of sight to parts of the oval and the courts. The remainder of the residential receivers would have much lower levels of noise exposure.

The predicted noise levels at the most impacted residential receivers to the south are:

- General recess/lunch 53dB(A) $L_{eq,15min}$
- Sports courts in use 40dB(A) $L_{eq,15min}$

The predicted noise levels exceed the rating background level by up to 13 dB(A). The level of impact at all other residences will be significantly lower due to the screening effects provide by the school buildings, and because of additional distance loss.

With respect to the above for playground use it is typical to apply a less stringent indicator of noise impact than "background + 5 dB(A)" given that it is present for short periods through the day and it is regarded as "community" noise.

However, in our opinion, the higher exceedances for the most exposed residences are not unreasonable for the following reasons:

- Noise from school playgrounds is a noise source intended to be governed by documents such as the EPA Noise Policy for Industry (NPfI) 2017. It is common (and almost unavoidable) in school development that a playground is located in close proximity to residential development. In this regard we note that in *Meriden v Pedavoli [2009 NSWLEC 183]* the NSW Land and Environment Court noted "*All noise that emanates from the normal activities at a school is not offensive*". The Court had regard to the fact that there was other school development in the local government area in which playgrounds adjoin residential development and the fact the proposed use was permissible in the zone. This is consistent with the proposed development.

- As noted above, a playground located near a residential boundary is a common scenario in school developments. At the subject site, the main play areas are located well away from residential receivers.

- Given that there is already significant distance and barrier separation between the play areas and residences, the only way of minimising noise impact is to erect noise barriers around the school, However, these barriers have other negative impacts which, while technically feasible, may not be a reasonable response to a level of impact that typically occurs with schools placed within residential zonings and appears to be a generally accepted level of impact.

- The school is adjacent to council operated sporting fields (i.e David Madew Regional Park) and therefore "play" noise is already part of the normal noise environment.

9 COMMUNITY USES

9.1 SCHOOL BUILDINGS

Community use of the school buildings and hall are not proposed

9.2 COURTS

Community use of the courts and hall are not proposed

10 OPERATIONAL VIBRATION EMISSION ASSESSMENT

There would be no vibration impact from the proposal as there would be no vibration sources that would produce perceptible vibration on any surrounding property.

11 NOISE INTRUSION ASSESSMENT

11.1 AIRCRAFT NOISE ASSESSMENT

This aircraft assessment has been made in conjunction with the GHD ANEF Assessment (ref 12542771-58717-1 dated 29 March 2021)

11.1.1 Aircraft Noise Criteria

The criteria for internal aircraft noise levels are outlined in AS2021 – 2015 Acoustics – Aircraft noise intrusion – Building siting and construction.

11.1.2 Australian Standard AS2021:2015

AS2021 provides for a 2 stage assessment of aircraft noise impact.

The suitability of the land use proposed for the site is assessed by comparing the ANEF noise exposure with the site acceptability table in the standard. The site will be either "acceptable", "conditionally acceptable" or "unacceptable".

Where a site is considered to be "conditionally acceptable" a full evaluation of internal noise levels must be carried out, as recommended in the standard. This full evaluation requires an examination of likely levels of internal noise from aircraft flyovers, with envelope constructions selected so that noise levels are within the maximum fly-over levels recommended in the standard.

AS2021 stipulates the internal noise levels listed in the table below for school buildings. These levels will be used to assess aircraft noise intrusion into the school areas of the development.

Table 7 - Aircraft Noise Levels inside School Buildings

ACTIVITY	INDOOR DESIGN SOUND LEVEL FROM AIRCRAFT FLYOVER
Libraries, Study Areas	50 dB(A)
Teaching Areas, Assembly Areas	55 dB(A)
Private Offices, Meeting Rooms	55 dB(A)
Workshops, Gymnasium	75 dB(A)

11.1.3 Site Evaluation

Assessing the acceptability of aircraft noise exposure is done so using Australian Standard AS 2021-2015 "Aircraft Noise Intrusion – Building Siting and Construction". The standard sets the criteria for the allowable levels of aircraft noise exposure dependant on the situation and use of the development.

The acceptability of a site in terms of aircraft noise exposure is assessed using the Australian Noise Exposure Forecast System (ANEF). ANEF was produced to provide a rating system that reflects actual human response to different aspects of aircraft noise, allowing the noise exposure of a particular location to be readily assessed. The three fundamental factors that influence the perception of aircraft noise are as follows; the frequency of aircraft movements overhead, the noise level and duration of individual aircraft movements and the time of the day in which they occur.

The proposed site is located between the ANEF 20-25 contour, based on the Canberra Airport 2019 ANEF plan. The site is “conditionally acceptable” for school uses, and it is recommended that the proposed buildings on the site be assessed to ensure that internal noise levels are limited to those recommended in AS2021.

11.1.4 External Aircraft Noise Levels

Aircraft noise levels at the site were determined using AS 2021. The Standard gives aircraft noise levels for aircraft landing and taking off for locations near airports. The location of the runways was obtained from the Canberra Airport ANEF 2019.

Based on the distance from the site to the runways and an assessment of all the aircraft types listed in AS 2021 typically using the airport, the standard predicts that the average loudest typical aircraft movement will be from a Boeing 737-800 landing on the main runway (based on typical flight paths and schedules provided by Canberra Airport). The noise level at the site as indicated by the standard is 74dB(A). This noise level will be used to predict the resultant internal noise levels.

Table 8 – Predicted External Aircraft Noise Level

Airbus A737-800 Aircraft	Canberra Airport Main Runway
Sideline Distance (DS), m	0m for take offs - 0m for landings
Distance for Take Offs (DT), m	11000m
Distance for Landings (DL), m	7500m
A737-800 Take Off – (dB (A))	<73
A737-800 Landing – (dB (A))	<74
Aircraft Noise Reduction (ANR) - Take Off - (dB (A))	23 Libraries, Study Areas 18 Teaching Areas, Assembly Areas 18 Private Office, Meeting Rooms -2 Workshops, Gymnasium
Aircraft Noise Reduction (ANR) - Landing – (dB (A))	24 Libraries, Study Areas 19 Teaching Areas, Assembly Areas 19 Private Office, Meeting Rooms -1 Workshops, Gymnasium

11.1.5 Evaluation of Noise Intrusion

Internal noise levels will primarily be as a result of noise transfer through the windows, external doors and metal deck roof, as these are relatively light building elements that offer less resistance to the transmission of sound. Any external walls that are proposed to be of heavy masonry elements will not require upgrading.

The complying constructions to attenuate external noise impacts through windows and doors for the proposed school development are discussed below. The constructions have been based on the predicted aircraft noise level and spectral characteristics of the aircraft noise, the area of building elements exposed to aircraft noise, the absorption characteristics of the rooms and the noise reduction performance of the building elements to ensure compliance with the internal noise level criteria.

Calculations were performed taking into account the orientation of windows, barrier effects (where applicable), the total area of glazing, facade transmission loss and the likely room sound absorption characteristics. In this way the likely interior noise levels can be predicted.

Table 9 - Recommended Glazing Construction

Building	Room	Element	Glazing Thickness	Acoustic seals
A	Classrooms and Study Areas	Glazing	6mm toughened with 6mm acoustic glazed louvres	Yes
	Offices	Glazing	6mm toughened with 6mm acoustic glazed louvres	Yes
	Meeting Rooms	Glazing	6mm toughened with 6mm acoustic glazed louvres	Yes
	Library	Glazing (Windows and Doors)	6mm toughened with 6mm acoustic glazed louvres	Yes
	Workshops	Glazing	Standard Glazing	Yes
B	Gym and Canteen	Glazing (Windows and doors)	6mm float	No
	General Learning Spaces	Glazing (Windows and Doors)	6mm float	Yes
		Sunroof	6mm float	Yes

In addition to meeting the minimum glazing thickness requirements given, the design of the window mullions, perimeter seals and the installation of the windows/doors in the building openings shall not reduce the R_w rating of the glazing assembly and the values nominated in the table below. Where nominated, this will require the use of acoustic seals equal to Schlegel Q-lon series *(acoustic bulb seal)* around the full perimeter of operable frames. The frame will need to be sealed into the building opening using a flexible sealant equal to Selleys Proseries Fireblock.

Note that mohair seals and/or mohair/plastic fin combination seals in windows and doors are not acceptable where acoustic seals are required.

The window/door suppliers should provide evidence that the systems proposed have been tested in a registered laboratory with the recommended glass thicknesses and comply with the minimum listed R_w requirements. Also, the glazing installer should certify that the window/doors have been constructed and installed in a manner equivalent to the tested samples.

Table 10 - Minimum R_w of Glazing (with Acoustic Seals)

Glazing Assembly	Minimum R_w of Installed Window
6mm float or toughened	29
6mm acoustic glazed louvres	R_w 28

11.1.6 External Doors

Building B (Hall) - Any timber external doors shall be constructed from minimum 40mm solid core timber.

Building A and B - Any external glass doors should be constructed using glazing thickness as specified in Table 8. Where seals are specified in Table 8, full perimeter acoustic seals around the doors are required.

11.1.7 Mechanical Ventilation

AS2021-2015 requires the installation of ventilation or air conditioning system where aircraft noise exposure exceeds ANEF 20. As internal noise levels cannot be achieved with windows open it is required that all internal spaces have alternative outside air supply system or air conditioning be installed in accordance with AS 1668.2 requirements. Any mechanical ventilation system that is installed should be acoustically designed such that the acoustic performance of the recommended constructions are not reduced by any duct or pipe penetrating the wall/ceiling/roof. Noise emitted to the property boundaries by any ventilation system shall comply with Council requirements.

11.1.8 External Walls

Concrete/ masonry elements on external wall construction will be acoustically acceptable and will not require any acoustic treatment. There should not be vents on the internal skin of external walls. All penetrations in the internal skin of external walls should be acoustically sealed.

If external wall construction should be constructed from lightweight elements, the following complying construction for walls are recommended.

The recommended wall construction is shown in Figure 5 and Table 11 below.

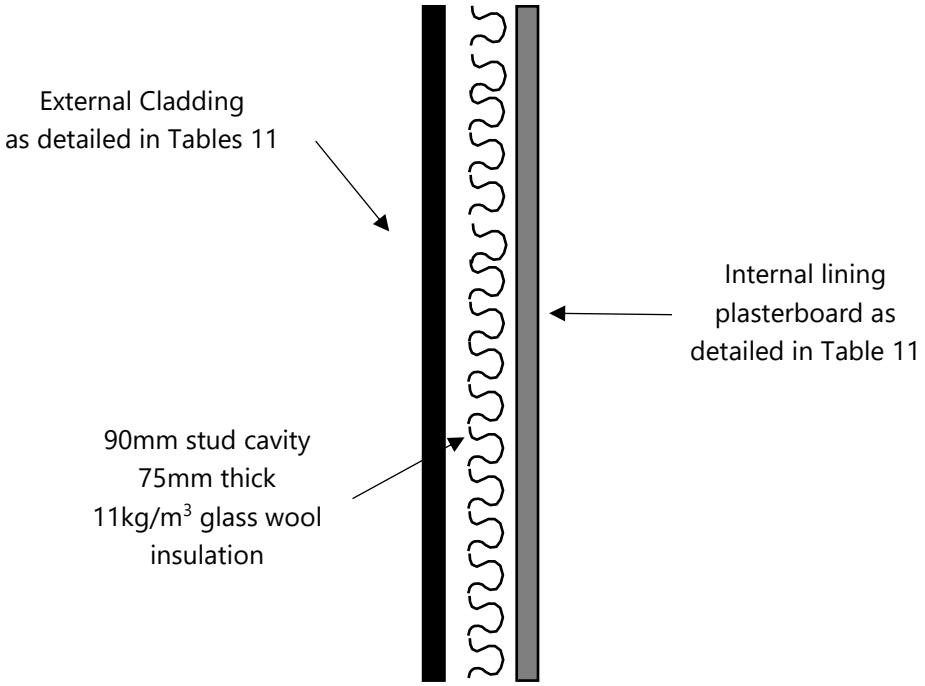


Figure 5 – Minimum Recommended Wall Construction

Table 11 – External Wall Requirements

Building	Facade	Space	Internal Lining	Stud System	External Lining
A	All	Classrooms and Study Areas	1x13mm plasterboard	90mm stud cavity 75mm thick 11kg/m^3 glass wool insulation	1x 9mm FC sheet or equal
		Offices			
		Meeting Rooms			
		Library			
		Workshops			
B	All	General Learning Spaces			
		Gym and Canteen			

11.1.9 Roof / Ceiling Construction

Any external roof construction to be constructed from concrete will not require any further acoustic upgrading. In the event that any penetrations are required through the external skin, an acoustic sealant should be used to minimise all gaps.

Any roof/ceiling proposed to be constructed of lightweight materials. Penetrations in all ceilings must be acoustically treated and sealed gap free with a flexible sealant.

The recommended roof/ceiling construction to control aircraft noise is shown in Figure 6.

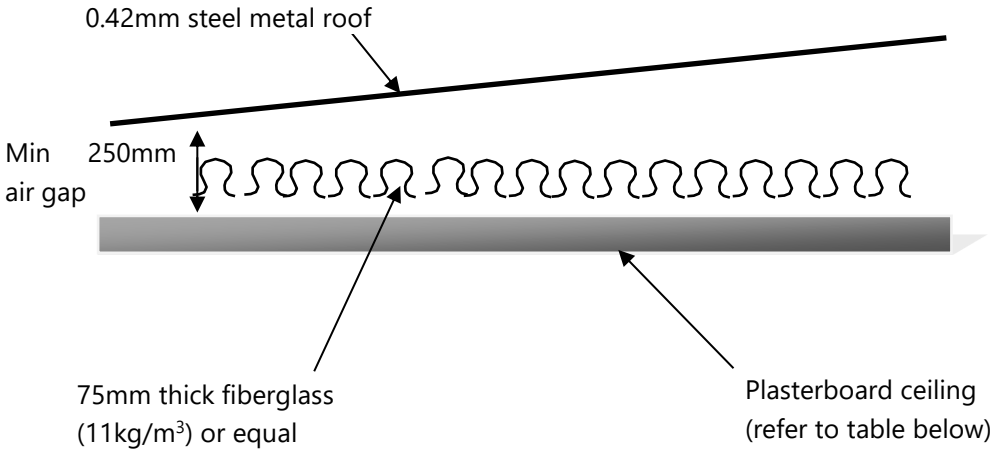


Figure 6 – Roof / Ceiling Construction

Table 12 – Roof/ Ceiling Construction

Building	Room	Roof Construction	Cavity	Ceiling Construction
A	All	0.42mm steel metal sheet	Min 250mm, with 75mm thick fiberglass (11kg/m^3) insulation	1x13mm plasterboard
B	Gym	0.42mm steel metal sheet	Nil	Nil
	Remaining	0.42mm steel metal sheet	Min 250mm, with 75mm thick fiberglass (11kg/m^3) insulation	1x13mm plasterboard

12 CONSTRUCTION NOISE ASSESSMENT

An assessment of likely construction noise impacts has been undertaken. The assessment includes:

- Identification of the noise and vibration guidelines which will be applicable to this project.
- Identification of potentially impacted nearby sensitive receivers.
- Identify likely sources of noise and vibration generation and predicted noise levels at nearby development.
- Formulation of a strategy to address the guidelines identified and including mitigation treatments.

12.1 SITE DESCRIPTION

Construction works for the proposed school will consist primarily of three construction phases, namely site works, general construction activities and completion landscaping/external works. The proposal consists of a number of buildings including a hall, general teaching areas and administrative offices.

There are no below ground / basement levels proposed, meaning that significant excavation and piling will not be required. Construction works (and typical loudest plant/equipment) expected for the project are as follows:

- Clearing of the site and earthworks to level the site as required and excavate for footings and services (excavators, pneumatic hammers)
- Erection of building structure (powered hand tools for formwork, concrete pump, vibrators);
- Internal fit out.
- Landscaping (front end loaders etc);

Work hours for the site are proposed as follows:

- Monday to Friday: 7am – 6pm
- Saturday: 8:00am – 5:00pm
- Sundays or Public Holidays: No work.

12.2 RECEIVER LOCATIONS

The closest sensitive receiver locations are identified as the existing low density residential premises along Bayside Ct to the south of the proposed development.

12.3 NOISE AND VIBRATION GUIDELINES

12.3.1 EPA Interim Construction Noise Guideline

The EPA Interim Construction Noise Guideline (ICNG) assessment requires:

- Determination of noise management levels (based on ambient noise monitoring);
- Review of generated noise levels at nearby development;
- If necessary, recommendation of noise controls strategies in the event that noise management levels are exceeded.

EPA guidelines adopt differing strategies for noise control depending on the predicted noise level at the nearest residences:

- *"Noise affected" level*. Where construction noise is predicted to exceed the "noise affected" level at a nearby residence, the proponent should take reasonable/feasible work practices to ensure compliance with the "noise affected level". For residential properties, the "noise effected" level occurs when construction noise exceeds ambient levels by more than 10dB(A)$L_{eq(15min)}$.
- "*Highly noise affected level"*. Where noise emissions are such that nearby properties are "highly noise affected", noise controls such as respite periods should be considered. For residential properties, the "highly noise affected" level occurs when construction noise exceeds 75dB(A)$L_{eq(15min)}$ at nearby residences.

A summary of the above noise management levels from the ICNG is presented below in Table 13.

Table 13 – Noise Management Levels - Residential

Location	"Noise Affected" Level - dB(A)$L_{eq(15min)}$	"Highly Noise Affected" Level - dB(A)$L_{eq(15min)}$
Residential Receivers (to south – Bayside Ct)	45	75

If noise levels exceed the management levels identified above, reasonable and feasible noise management techniques will be reviewed.

12.3.2 Vibration

Vibration caused by construction at any residence or structure outside the subject site must be limited to:

- For structural damage vibration, German Standard DIN 4150-3 *Structural Vibration: Effects of Vibration on Structures; and*
- For human exposure to vibration, the evaluation levels presented in the British Standard BS 6472:1992 *Guide to Evaluate Human Exposure to Vibration in Buildings (1Hz to 80Hz)* for low probability of adverse comment.

12.3.2.1 Structure Borne Vibrations (Building Damage Levels)

German Standard DIN 4150-3 (1999-02) provides vibration velocity guideline levels for use in evaluating the effects of vibration on structures. The vibration levels presented in DIN 4150-3 (1999-02) are detailed in Table 14.

It is noted that the peak velocity is the value of the maximum of any of the three orthogonal component particle velocities as measured at the foundation, and the maximum levels measured in the x- and y-horizontal directions in the plane of the floor of the uppermost storey.

Table 14 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration

TYPE OF STRUCTURE		PEAK PARTICLE VELOCITY (mms^{-1})			
		At Foundation at a Frequency of			**Plane of Floor of Uppermost Storey**
		< 10Hz	**10Hz to 50Hz**	**50Hz to 100Hz**	**All Frequencies**
1	Buildings used in commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

The surrounding commercial/industrial buildings would be considered a Type 1 structure, whilst nearby residences would be classified as a type 2 structure.

12.3.2.2 Assessing Amenity

The NSW EPA document "*Assessing Vibration: A Technical Guideline*" provides procedures for assessing tactile vibration and regenerated noise within potentially affected buildings and is used in the assessment of vibration impact on amenity.

Relevant vibration levels are presented below.

Table 15 – EPA Recommended Vibration Levels

		RMS acceleration (m/s^2)		RMS velocity (mm/s)		Peak velocity (mm/s)	
Place	Time	Preferred	Maximum	Preferred	Maximum	Preferred	Maximum
Continuous Vibration							
Residences	Daytime	0.01	0.02	0.2	0.4	0.28	0.56
Offices		0.02	0.04	0.4	0.8	0.56	1.1
Workshops		0.04	0.08	0.8	1.6	1.1	2.2
Impulsive Vibration							
Residences	Daytime	0.3	0.6	6.0	12.0	8.6	17.0
Offices		0.64	1.28	13.0	26.0	18.0	36.0
Workshops		0.64	1.28	13.0	26.0	18.0	36.0

12.4 ACTIVITIES TO BE CONDUCTED AND THE ASSOCIATED NOISE SOURCES

Typically, the most significant sources of noise or vibration generated during a construction project will be demolition, ground works and building structure works. The following table presents assessment noise levels for typical construction equipment expected to be used during the construction of the proposal.

Table 16- Sound Power Levels of the Typical Equipment

Equipment / Process	Sound Power Level dB(A)*
Dozer/Excavator	112
Concrete Pump	110
Trucks	100
Bobcat	105
Crane (electric)	85
Powered Hand Tools	95-100

The noise levels presented in the above table are derived from the following sources, namely:

- Table A1 of Australian Standard 2436-2010.
- Data held by this office from other similar studies.

Noise levels take into account correction factors (for tonality, intermittency where necessary).

12.5 NOISE PREDICTIONS

The predicted noise levels during excavation and construction will depend on:

- The activity undertaken.
- The distance between the work site and the receiver. The distance between the noise source and the receiver will vary depending on which end of the site the work is undertaken. For this reason, the predicted noise levels will be presented as a range.

Predicted noise levels are presented in the following table. Predictions take into account the expected noise reduction as a result of distance only.

Table 17 – Predicted Noise Generation to Residential Receivers to the South of Site (Bayside Ct)

Activity	Predicted Level dB(A) $L_{eq(15min)}$ (External)	Comment
Dozer/Excavator	49-61	Will generally exceed NML
Concrete Pump	47-59	Will generally exceed NML
Trucks	37-49	Will generally exceed NML when at southern boundary of site
Bobcat	42-54	Will generally exceed NML when at southern boundary of site
Crane/hoist (electric)	22-34	Generally Within NML
Powered Hand Tools (Externally)	37-49	Will generally exceed NML when at southern boundary of site

12.6 DISCUSSION – NOISE

The greatest noise impact will be at the residences immediately to the south of the site. Noise levels will generally exceed the NML but will be less than the HNAL. Therefore, "reasonable and feasible" mitigation should be applied in accordance with the "Control of Construction Noise and Vibration – Procedural Steps" outlined below.

12.7 DISCUSSION - VIBRATION

There are no significant sources of vibration envisaged. Given the distance from nearby receivers, vibration impacts on all receivers is expected to be within the recommended levels detailed in Section 11.3.1.

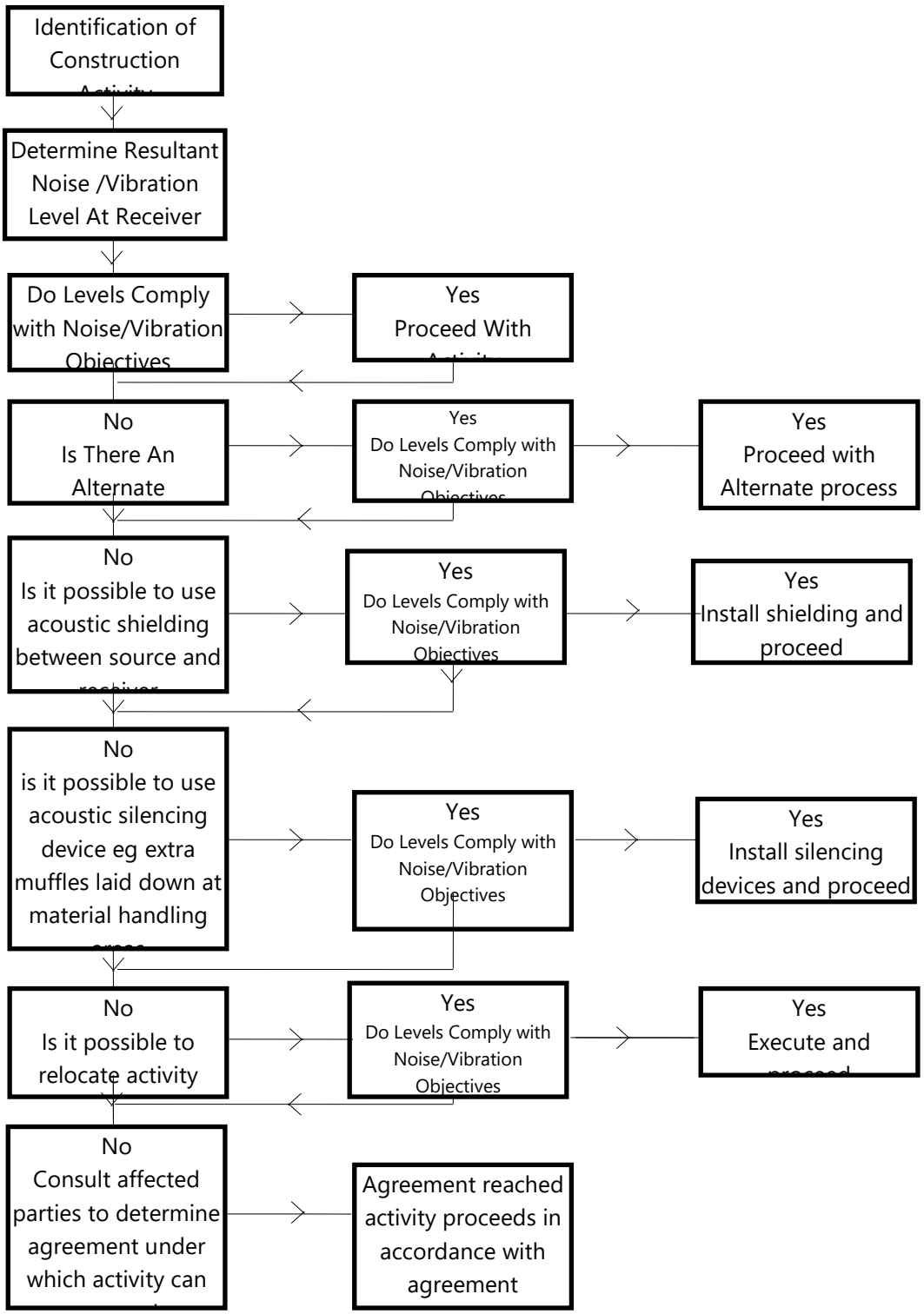
12.8 RECOMMENDATIONS

In light of the above, the following recommendations are made:

- Operation of large earthmoving equipment (bulldozers and excavators) between 7am and 8am within 30m of the southern, eastern and western site boundary should be avoided.
- Quiet work methods/technologies:
    - The primary noise generating activity at the site will be the ground work period. As much as practicable, use of quieter methods is adopted.
    - Concrete pump trucks should be located within the bounds of the site (rather than on nearby roads at the perimeter of the site) where possible.
    - Materials handling/vehicles:
        - Trucks and bobcats to use a non-tonal reversing beacon (subject to OH&S requirements) to minimise potential disturbance of neighbours.
        - Avoid careless dropping of construction materials into empty trucks.
        - Trucks, trailers and concrete trucks (if feasible) should turn off their engines during idling to reduce noise impacts (unless truck ignition needs to remain on during concrete pumping).
- In respect of pneumatic/hydraulic hammering (if required) noise impacts should be addressed via the imposition of respite periods, typically limiting operation to:
    - 8am – 6pm, Monday to Friday
    - 8am to 5pm, Saturday
    - In any case maximum 3 hours operation with 1 hour uninterrupted respite.
- Noisy activities (exceeding the RBL by more than 5 dB(A)) should not be carried out after 1pm Saturdays. This would generally limit the activities to "quiet" trades such as internal fitout and maintenance activities.
- Complaints handling - In the event of complaint, the procedures outlined in Sections 8.9, 8.10 and 8.11 should be adopted.
- A detailed noise management plan will be be developed by the main contractor that describes in detail the construction phases, programme, processes and equipment used, noise impact assessment and proposed mitigation and management.
- Site Induction:
    - A copy of the Noise Management Plan is to be available to contractors. The location of the Noise Management Plan should be advised in any site induction.
    - Site induction should also detail the site contact is to be notified in the event of noise complaint.

12.9 CONTROL OF CONSTRUCTION NOISE AND VIBRATION – PROCEDURAL STEPS

The flow chart presented below illustrates the process that will be followed in assessing construction activities.



12.10 ADDITIONAL NOISE AND VIBRATION CONTROL METHODS

In the event of complaints, there are a number of noise mitigation strategies available which can be considered.

The determination of appropriate noise control measures will be dependent on the particular activities and construction appliances. This section provides an outline of available methods.

12.10.1 Selection of Alternate Appliance or Process

Where a particular activity or construction appliance is found to generate excessive noise levels, it may be possible to select an alternative approach or appliance. For example; the use of a hydraulic hammer on certain areas of the site may potentially generate high levels of noise. Undertaking this activity using bulldozers, ripping and/or milling machines will result in lower noise levels. This measure has the potential to reduce noise emissions by 10 dB(A) or more.

12.10.2 Acoustic Barriers

Given the position of adjacent development, it is unlikely that noise screens will provide significant acoustic benefit for commercial or residential receivers, but will provide noticeable improvement for those on ground level.

The placement of barriers at the source is generally only effective for static plant. Equipment which is on the move or working in rough or undulating terrain cannot be effectively attenuated by placing barriers at the source.

Barriers can also be placed between the source and the receiver.

The degree of noise reduction provided by barriers is dependent on the amount by which line of sight can be blocked by the barrier. If the receiver is totally shielded from the noise source reductions of up to 15dB(A) can be effected. Where only partial obstruction of line of sight occurs, noise reductions of 5 to 8dB(A) may be achieved. Where no line of sight is obstructed by the barrier, generally no noise reduction will occur.

As barriers are used to provide shielding and do not act as an enclosure, the material they are constructed from should have a noise reduction performance that is approximately 10dB(A) greater than the maximum reduction provided by the barrier. In this case the use of a material such as 10mm or 15mm thick plywood (radiata plywood) with minimum 2 metre height would be acceptable for the barriers.

12.10.3 Material Handling

The installation of rubber matting over material handling areas can reduce the sound of impacts due to material being dropped by up to 20dB(A).

12.10.4 Treatment of Specific Equipment

In certain cases it may be possible to specially treat a piece of equipment to dramatically reduce the sound levels emitted.

12.10.5 Establishment of Site Practices

This involves the formulation of work practices to reduce noise generation. A more detailed management plan will be developed for this project in accordance to the construction methodology outlining work procedures and methods for minimising noise.

12.10.6 Combination of Methods

In some cases, it may be necessary that two or more control measures be implemented to minimise noise.

12.11 ADDRESSING COMPLAINTS

Should ongoing complaints of excessive noise or vibration levels occur immediate measures shall be undertaken to investigate the complaint, the cause of the exceedances and identify the required changes to work practices.

If a noise complaint is received the complaint should be recorded. Any complaint form should list:

- The name and address of the complainant (if provided);
- The time and date the complaint was received;
- The nature of the complaint and the time and date the noise was heard;
- The name of the employee who received the complaint;
- Actions taken to investigate the complaint, and a summary of the results of the investigation;
- Required remedial action, if required;
- Validation of the remedial action; and
- Summary of feedback to the complainant.

A permanent register of complaints should be held by Hindmarsh.

13 SUMMARY OF RECOMMENDATIONS

We recommend the following acoustic treatments/management controls are implemented to mitigate acoustic impact as much as practicable:

- Operation of the school should be limited to the activities and times of operation indicated in Table 2 of this report, subject to additional mitigation of noise for certain activities and operating times as indicated below.
- Detailed acoustic review of all external plant items should be undertaken following equipment selection and duct layout design. All plant items will be capable of meeting noise emission requirements of Council and the EPA Noise Policy for Industry (2017) Trigger Levels, with detailed design to be done at CC stage.
- External speakers for PA and bells should designed to minimise noise spill, be directional facing away from residential receivers to comply with EPA Noise Policy for Industry (2017) guidelines (refer Sections Summary of NPfI Trigger Levels 6.2.4)
- Ground maintenance should only occur between 7am and 6pm, Monday to Friday.
- Where music practice occurs within a school classroom outside of normal hours the windows of the rooms should be kept closed.
- The proposal would not produce adverse vibration impacts on nearby structures or impact the amenity of the surrounding property
- Complying construction of teaching building for aircraft noise intrusion requirements in AS2021-2015 as per Section 10 of this report.
- Construction noise impacts should be managed as outlined in Section 11.

14 CONCLUSION

Noise emissions associated with the proposed Jerrabomberra High School have been assessed with reference to relevant EPA and relevant acoustic guidelines.

The following noise emission sources have been addressed:

- Noise from internal areas
- Noise from mechanical plant, PA system and school bells.
- Traffic generation
- Waste Removal
- External activities
- Construction activities

Recommendations have been made to ensure that noise emissions from the school do not adversely impact the surrounding properties. Provided the recommendations are adopted the proposed school will not adversely impact the acoustic amenity of surrounding receivers.

We trust this information is satisfactory. Please contact us should you have any further queries.

Yours faithfully,

Acoustic Logic Pty Ltd
Glen Campbell

Appendix A – Noise Logging Data