DIRECTORS
MATTHEW PALAVIDIS
VICTOR FATTORETTO
MATTHEW SHIELDS

Western Sydney Schools

Jordan Springs Public School Environmental Noise and Vibration Assessment

SYDNEY
A: 9 Sarah St
MASCOT 2020
T: (02) 8339 8000

SYDNEY MELBOURNE BRISBANE CANBERRA
LONDON DUBAI SINGAPORE GREECE

ABN: 11 068 954 343

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1 INTRODUCTION

This environmental noise and vibration assessment has been prepared by Acoustic Logic Consultancy on behalf of the Schools Infrastructure NSW (the Applicant). It accompanies an Environmental Impact Statement (EIS) in support of State Significant Development Application (SSD 18_9354) for the new Jordan Springs Public School at 14-28 Cullen Avenue, Jordan Springs (the site).

The new school will cater for approximately 1,000 primary school students and 70 full-time staff upon completion. The proposal seeks consent for:

- Construction of a 2-storey library, administration and staff building (Block A) comprising:
  - School administrative spaces including reception;
  - Library with reading nooks, makers space and research pods;
  - Staff rooms and offices;
  - Special programs rooms;
  - Amenities;
  - Canteen;
  - Interview rooms; and
  - Presentation spaces.
- Construction of three 2-storey learning hubs containing 42 homebases comprising:
  - Collaborative learning spaces;
  - Learning studios;
  - Covered outdoor learning spaces;
  - Practical activity areas; and
  - Amenities.
- Construction of a single storey assembly hall (Block C) with a performance stage and integrated covered outdoor learning area (COLA). The assembly hall will have OOSH facilities and store room areas;
- Associated site landscaping and open space including associated fences throughout and sporting facilities;
- Pick-up and drop-off zone from Cullen Avenue;
- Pedestrian access points along both Cullen Avenue and Lakeside Parade;
- Construction of an at-grade carpark containing 62 spaces accessible from Lakeside Parade and 2 spaces accessible from Cullen Avenue;
- School signage to the front entrance; and
- New substation fronting Cullen Avenue.

All proposed school buildings will be connected by a double storey covered walkway providing integrated covered outdoor learning areas (COLAs).

The purpose of this assessment is to address the SEARs related to noise and vibration impacts, including an assessment of noise emissions during the construction and operational phases of the project and potential impacts from surrounding environmental noise sources.

2 RESPONSE TO SEARS

The environmental noise and vibration is required by the Secretary's Environmental Assessment Requirements (SEARs) for SSD 18_9368. This table identifies the SEARs and relevant reference within this report.

Table 1- SEARs and Relevant Reference

SEARs Item	Report Reference
Item 5. Assess amenity impacts on the surrounding locality, including … and acoustic impacts.	Sections 5 to 11
Item 11 • Identify and provide a quantitative assessment of the main noise and vibration generating sources during site preparation, bulk excavation, construction. Outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land . • Identify and assess operational noise, including consideration of any public address system, school bell, mechanical services (e.g. air conditioning plant), use of any school hall for concerts etc. (both during and outside school hours) and any out of hours community use of school facilities, and outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land . 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 9.1 Section 6 to 9

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.

3 SITE DESCRIPTION AND SITE OPERATION

The proposed school site is located on Cullen Avenue between Lakeside Parade and Alina Promenade, Jordan Springs.

The surrounding area includes future residential receivers to the south of the site on Cullen Avenue, and to the north, existing commercial receiver (including child care centre to the south-west), residential receivers further to the west on Lakeside Parade and playing fields to the east.

Western Sydney Schools, Jordan Springs Public School site location

Figure 1 – Site Location and Noise Measurement Locations

● Unattended noise logging location

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

Table 2- School Uses and Operating Times

Item	Use	Times
GENERAL	The proposed Jordon Springs Public School will cater for students K- Year 6. The school will have the following capacity following completion of the development: • 70 full time staff • 1,000 students	General operating hours for the school will be Monday – Friday 8am - 5pm.
HALL	Intended use by school during school hours. Occasional evening use for music performance, presentations, parent/teacher nights. Hall to be made available to the community through a booking system arranged by the school.	Maximum Operating time till 10pm
OOSH	Out of school hours (OOSH) use of the school facilities.	Weekdays at Mornings 6.30am – 9am and Afternoons 3pm – 6.30pm.
LIBRARY	Intended use by school only. School hours only.	Occasional weeknight evening use for presentations, parent/teacher nights.
SHARED USE / COMMUNITY USE	At this point in time, there is no intended shared use of any of the school facilities by the community. Notwithstanding, we note that the DoE is currently exploring shared-use opportunities of the proposed school facilities for community use.	

The assessment is based on Group GSA drawings ref: AL0000-1, A1000-1, A1100-1, A1120-22, A3020-21, A3120,A500,A6001, A7500-02 dated 23/1/2019 Revision B.

● Unattended noise logging location

Figure 2 – Proposed School Project

4 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-principle 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.

5 SURVEY OF AMBIENT NOISE

Unattended noise logging was conducted to quantify the existing acoustic environmental at the site. All monitoring and measurement locations are shown in Figure 1. Given the intermittent nature of traffic flows on Cullen Avenue during the middle of the day and later in the evening (the two times that effectively determine the RBL for the day and evening periods), the monitoring would be representative of the surrounding receivers. In some cases, for those dwellings closer to Cullen Avenue and Lakeside Drive, is may marginally underestimate the background noise level, which means the use of the RBL's derived from the monitoring will provide a conservative assessment.

5.1 UNATTENDED, LONG TERM NOISE LOGGING

Unattended noise monitoring was conducted between 10 and 17 May 2017 using an Acoustic Research Laboratories monitor set on A-weighted fast response mode. The monitor was 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.

Periods of logging that are impacted by adverse weather (rain, windspeed over 6m/s) have been excluded when determining the Rating Background Noise Level, as is required in the EPA Noise Policy for Industry.

Weather data is shown in the logging data, presented in Appendix 1.

5.2 RESULTS

Measurement results are presented below.

Table 3 - Long Term Noise Logging

Time of Day	Background Noise Level – dB(A)L_{90}
Day (7am-6pm)	40
Evening (6pm-10pm)	34

6 OPERATIONAL NOISE EMISSION CRITERIA

The SEARS requires 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. The NSW Educational SEPP requirement relating to noise emissions is:

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 L_{Aeq} of 5 dB(A) above background noise when measured at any lot boundary.

Guidelines referenced in the SEARS, as well as other guidelines are provided below:

- EPA Noise Policy for Industry 2017 (applicable for plant/equipment noise)
- EPA Road Noise Policy (for the assessment of noise from traffic generation by the site).
- Assessing Vibration: A Technical Guideline (EPA, 2006)
- Development Near Rail Corridors and Busy Roads –Interim Guideline (Department of Planning 2008) (to assess noise from traffic on the subject development)

We note that the EPA Noise Policy for Industry noise trigger levels are not strictly applicable to school developments. They are primarily intended to assess noise emissions from industrial/commercial developments. However, it is the most useful guideline policy for the assessment of plant and equipment noise impact to surrounding receivers.

In our experience it is extremely common in the assessment of noise generation by schools that compliance with acoustic guidelines (in particular noise from playgrounds and during pick up/drop off) is not required (and for schools located in residential areas, it is in fact generally not achievable). The NSW Educational SEPP requires noise emissions from school buildings to be limited, and there is no requirement related to external uses.

An outline of relevant acoustic criteria is presented below.

6.1 EDUCATIONAL SEPP

The following table outlines the criteria to assess noise emissions from school buildings:

Table 4- NSW Educational SEPP Criteria

Location	Time of Day	Rating Background Noise Level - dB(A)L_{90}	Intrusiveness Noise Objective dB(A) $L_{eq(15min)}$ (Background + 5dB)
Adjacent Residential Development	Day Time (7am – 6pm)	41	46
	Evening (6pm-10pm)	34	39

6.2 EPA NOISE POLICY FOR INDUSTRY

Noise sources 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.

6.2.1 Intrusiveness Assessment

Intrusiveness criteria permit noise generation to be 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. The criteria are as follow:

Table 5- EPA Intrusiveness Criteria

Location	Time of Day	Rating Background Noise Level - dB(A)L_{90}	Intrusiveness Noise Objective dB(A)$L_{eq(15min)}$ (Background + 5dB)
Adjacent Residential Development	Day Time (7am – 6pm)	41	46
	Evening (6pm-10pm)	34	39

6.2.2 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. In this case the intrusiveness criteria for residential receivers are more stringent than the amenity criteria.

6.3 ROAD NOISE POLICY (RNP)

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

Cullen Ave and Lakeside Drive would be defined as a sub-arterial roads.

The applicable assessment criteria for residential receivers are (measured at the façade of dwellings):

- Sub-arterial – 60 dB(A) Leq,15hr (7am to 10pm) and 55 dB(A) Leq,9hr (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.

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

The guideline recommends a maximum noise level within classrooms of 40 dB(A) $L_{eq,1hr}$.

7 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

7.1 NOISE FROM INTERNAL SPACES

The administration and teaching spaces generate low to medium levels of noise. The teaching spaces are typically at least 35m from any residential receiver and emissions from these buildings, or the Block A Administration and Library Building, would clearly not exceed the Educational SEPP criteria.

Block B.02c is located approximately 12m from the northern (residential boundary) but would typically still not exceed the criterion provided the openable area is limited to 5% of the floor area on the north facing façade.

7.1.1 Hall

Block C contains the school hall that may be used for presentations and performances. The hall opens out to the south of the building to the presentation lawn. The most potentially impacted receivers would be the child care centre and residential receivers to the south. Where activities are

held in the evening there would be no impact to the adjacent child care centre as it will not be operating at that time.

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.
- East facing doors closed.
- South facing door open and closed. Door to have minimum sound transmission loss of R_w 20 when closed.

The calculated noise levels are (south door open):

- Residences to the south – 46 dB(A) $L_{eq,15min}$
- Child Care Centre Pay Area – 48 dB(A) $L_{eq,15min}$
- Child Care Centre Internally (5% open window area) - 35 dB(A) $L_{eq,15min}$

The calculated noise levels are (south door and ventilation openings closed):

- Residences to the south – 28 dB(A) $L_{eq,15min}$
- Child Care Centre Pay Area – 29 dB(A) $L_{eq,15min}$
- Child Care Centre Internally (5% open window area) - 26 dB(A) $L_{eq,15min}$

The background + 5 dB(A) noise emissions criteria are not exceeded except at the residences to the south when operating during the evening. Closing the south facing door during the evening would achieve compliance at all times.

Noise producing activities on the outdoor presentation lawn should be restricted to normal school hours.

7.2 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.

7.3 TRAFFIC GENERATION

A staff carpark (64 vehicle capacity approx.) is proposed to be accessed from Lakeside Parade, and "kiss and drop" and bus stop would be located on Cullen Avenue. These roads act as local collector roads and would be classed as "sub-arterial" under the RNP. The noise levels generated by traffic movements associated with the school would not cause a significant increase in traffic noise on these roads and would therefore not adversely impact receivers along nearby traffic routes.

Further, on review of the predicted traffic generation in section identified in section 6.1 of the *Traffic Impact Assessment* by Bitzios Consulting, the projected peak hour traffic generation by the site will be 670 vehicle movements in a peak one hour period.

At 670 movements per hour, the noise level at the building line of the nearest residences on Lakeside Drive/Cullen Ave will be less than 60dB(A)L_{eq1hr}. This is therefore compliant with the Road Noise Policy allowable noise level as detailed in section 6.3 (which permits 60dB(A) as an average noise level over a 15 hour period).

7.4 WASTE REMOVAL

Waste would be stored near the child care centre boundary adjacent to Block C. Waste removal times should be co-ordinated with the child care centre to avoid child rest periods.

7.5 NORMAL SCHOOL EXTERNAL ACTIVITIES

There are no criteria to be met regarding normal activities conducted by the school. The external spaces are separated from any existing and future by significant distance buffers. The child care centre is buffered to an extent by its carpark and the proposed hall building.

7.6 NON-SCHOOL USES, AND AFTER HOURS SCHOOL ACTIVITIES

After hour school activities would largely relate to use of the school hall as assessed above. There could also be other "quiet" activities that may occur externally or within the buildings that would not result in significant emissions. This would include parent/teacher nights, election activities, etc. Where music practice occurs within a school classroom outside of normal hours the windows of the rooms should be kept closed.

External activities by non-school uses are not proposed at this stage. If uses are proposed in the future they should be assessed for noise impact and appropriate mitigation and management implemented to prevent adverse impacts on surrounding properties. As part of the assessment appropriate assessment criteria should be developed depending on the frequency of use, time of day, type of activity, etc.

8 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.

9 NOISE INTRUSION ASSESSMENT

The school is not impacted by any local environmental noise source except local traffic on the surrounding streets. The most impacted buildings would be those facing Cullen Avenue as all other buildings are screened from traffic noise sources and/or have significant distance separation.

9.1 TRAFFIC NOISE MEASUREMENT

Attended noise levels of traffic noise impacting the site were conducted at the site during a typical afternoon rush hour period of 2pm to 3pm of the 17th May, 2017.

The traffic noise levels were determined based on the attended noise levels are presented below. Monitoring results are attached at the end of this report. In determination of acoustic treatments, the measured level is adjusted for distance, barrier attenuation and orientation.

Table 6 – Measured Traffic Noise Levels, dB(A) Leq

LOCATION	TRAFFIC NOISE LEVEL, dB(A) $L_{eq(worst\ 1hr)}$
	Day time 3pm to 4pm
Cullen Avenue	60
Lakeside Avenue	59

Additional traffic generate by the school would primarily occur prior to and after school hours, and so need not be added to the existing noise levels.

9.2 RECOMMENDED TREATMENT

The following is recommended to meet the recommended internal noise levels:

- The south, east and west facing windows of Block A should have minimum 6.38mm glass fitted into openable frames to give a minimum R_w of 30.
- Any glazing in the south, and east façades of the hall should have minimum 6.38mm glass fitted into openable frames to give a minimum R_w of 30. Any doors in the east and south facades should have a minimum rating of R_w 20.

10 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.

10.1 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 is 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: 7:30am – 3:30pm
- Sundays or Public Holidays: No work.

10.2 RECEIVER LOCATIONS

Sensitive receiver locations are presented in Section site description and site operation3. It is noted that existing sensitive receivers to the east (dwellings on Antonia Parade) and south-east are separated at least 200m from the site. There are no existing sensitive in the immediate vicinity of the site to the west and south.

10.3 NOISE AND VIBRATION GUIDELINES

10.3.1 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;
- Recommendation of noise controls strategies when 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.

For the child care centre the NML will be based on the maximum recommended noise level in AS2107 for classrooms, which is 45 dB(A). Assuming windows are open to 5% of the floor area, this corresponds to an external noise level of 45 dB(A). There are also commercial receivers around the site. However, these will be less impacted than the other receivers and any noise mitigation needed to manage noise to the other receivers will also adequately address noise to commercial receivers.

A summary of the above noise management levels from the ICNG is presented below in **Error! Reference source not found.**.

Table 7 – Noise Management Levels - Residential

Location	"Noise Affected" Level - dB(A)$L_{eq(15min)}$	"Highly Noise Affected" Level - dB(A)$L_{eq(15min)}$
Residential Receivers	52	75
Child Care Centre	55	n/a

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

10.3.2 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.

10.3.2.1 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 4.

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 8 – 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.

10.3.2.2 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 9 – 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

10.4 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 10 - 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).

10.5 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 tables. Predictions take into account the expected noise reduction as a result of distance only.

Table 11 – Predicted Noise Generation to Residential Receivers North of Site

Activity	Predicted Level dB(A) $L_{eq(15min)}$ (External)	Comment
Dozer/Excavator	57 to 90	Will exceed NML, and the HNML when operating within 30m of the boundary
Concrete Pump	55 to 69	Will exceed NML
Trucks	45 to 62	Will generally exceed NML
Bobcat	50 to 83	Will generally exceed NML
Crane/hoist (electric)	31 to 50	Within NML
Powered Hand Tools (Externally)	46 to 68	Will generally exceed NML

Table 12 – Predicted Noise Generation to Residential Receivers East of Site

Activity	Predicted Level dB(A) $L_{eq(15min)}$ (External)	Comment
Dozer/Excavator	53 to 62	Will exceed NML
Concrete Pump	54 to 58	Will exceed NML
Trucks	41 to 50	Within NML
Bobcat	46 to 55	Generally within NML or marginal exceedance
Crane/hoist (electric)	29 to 33	Within NML
Powered Hand Tools (Externally)	44 to 48	Within NML

Table 13 – Predicted Noise Generation to Residential Receivers South of Site

Activity	Predicted Level dB(A) $L_{eq(15min)}$ (External)	Comment
Dozer/Excavator	56 to 73	Will exceed NML
Concrete Pump	54 to 66	Will exceed NML
Trucks	44 to 61	Will exceed NML when operating at southern end of site
Bobcat	49 to 66	Will generally exceed NML
Crane/hoist (electric)	29 to 41	Within NML
Powered Hand Tools (Externally)	44 to 58	Will exceed NML when operating at southern end of site

Table 14 – Predicted Noise Generation to Residential Receivers West of Site

Activity	Predicted Level dB(A) $L_{eq(15min)}$ (External)	Comment
Dozer/Excavator	56 to 77	Will exceed NML and HNML when close to western edge of site
Concrete Pump	54 to 60	Will exceed NML
Trucks	44 to 65	Will exceed NML when operating at western end of site
Bobcat	49 to 70	Will generally exceed NML
Crane/hoist (electric)	29 to 35	Within NML
Powered Hand Tools (Externally)	44 to 50	Within NML

Table 15 – Predicted Noise Generation to Child Care Centre

Activity	Predicted Level dB(A) $L_{eq(15min)}$ (External)	Comment
Dozer/Excavator	57 to 83	Will exceed NML
Concrete Pump	55 to 69	Will exceed NML
Trucks	45 to 62	Will exceed NML when operating close to boundary
Bobcat	50 to 76	Will exceed NML when operating close to boundary
Crane/hoist (electric)	30 to 43	Within NML
Powered Hand Tools (Externally)	45 to 70	Will exceed NML when operating close to boundary

10.6 DISCUSSION – NOISE

Without mitigation noise at the sensitive receivers around the site will exceed the NML, and in some cases the HNML.

The greatest noise impact will be at the residences immediately to the north of the site and the child care centre. The residences to the east will be relatively lightly impacted.

Therefore, "reasonable and feasible" mitigation should be applied in accordance with the "Control of Construction Noise and Vibration – Procedural Steps" outlined below. Additional time management also be required to manage noise impacts to the residences to the north and the child care centre.

10.7 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 **Error! Reference source not found.**.

10.8 RECOMMENDATIONS

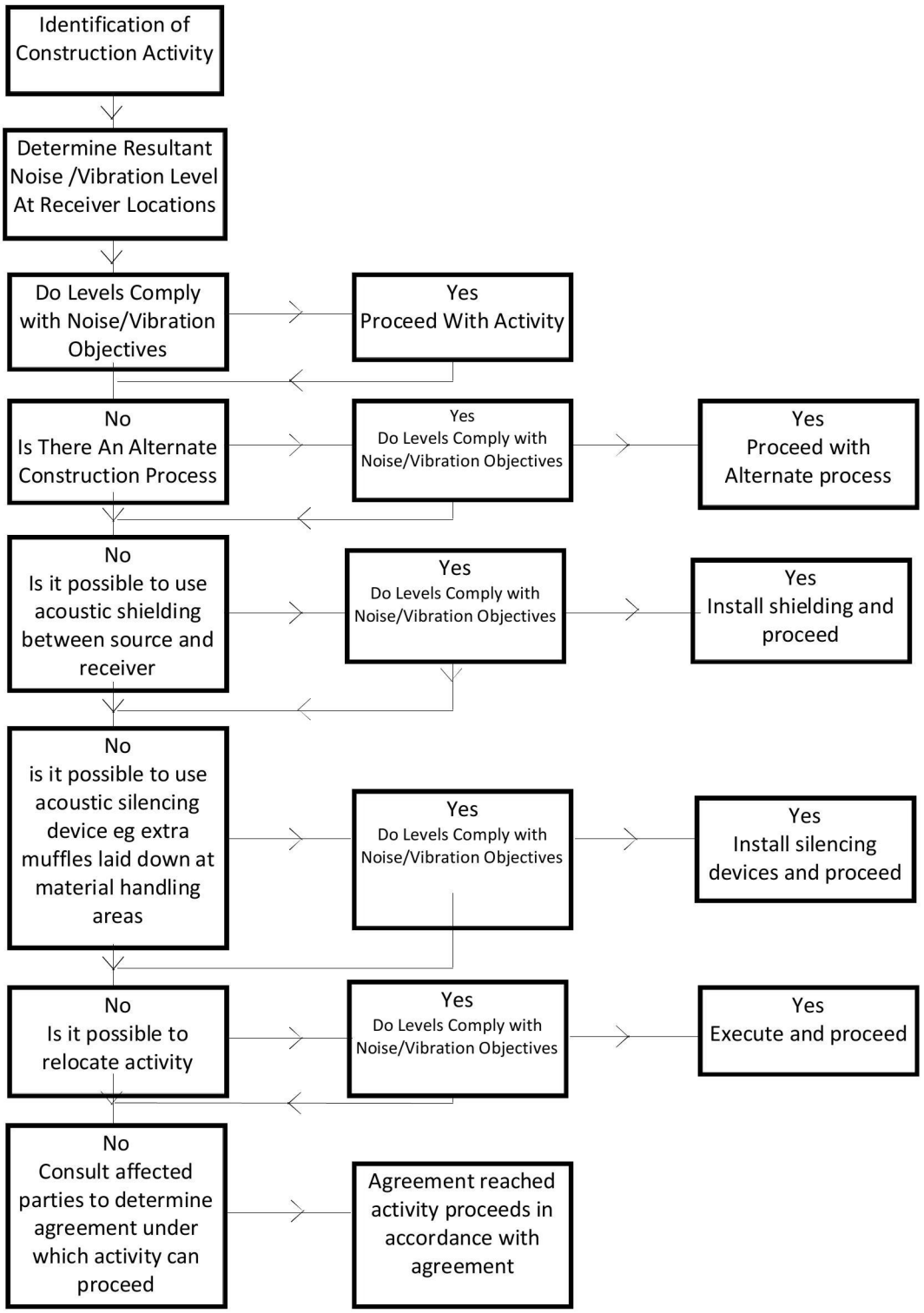
In light of the above, the following recommendations are made:

- Operation of large earthmoving equipment (bulldozers and excavators) between 7am and 8am within 30m of the northern site boundary should be avoided.
- Liaise with the child care centre to schedule very noisy activities such as excavator operation close to the boundary during noise sensitive periods such as sleep periods.
- Erect a temporary barrier along the child care centre boundary with the school site. Barrier to be min 1.8m high and constructed from a solid material such as plywood or sheet metal having a surface density exceeding 3 kg/m^2 with no gaps.
- 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:
    - 9am – 12pm, Monday to Friday
    - 3pm – 5pm Monday to Friday; and
    - 9am to 12pm, Saturday
- Noisy activities (exceeding the NML) should not be carried out after 1pm Saturdays.
- 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 should 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.

10.9 CONTROL OF CONSTRUCTION NOISE AND VIBRATION – PROCEDURAL STEPS

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



10.10 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.

10.10.1 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.

10.10.2 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) would be acceptable for the barriers.

10.10.3 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).

10.10.4 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.

10.10.5 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.

10.10.6 Combination of Methods

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

10.11 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.

11 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.

- External activities by non-school uses are not proposed at this stage. If uses are proposed in the future they should be assessed for noise impact and appropriate mitigation and management implemented to prevent adverse impacts on surrounding properties. As part of the assessment appropriate assessment criteria should be developed depending on the frequency of use, time of day, type of activity, etc.

- 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), 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 6.2.1 and 7.2).

- Waste removal times should be scheduled between 7am and 6pm and co-ordinated with the child care centre to avoid child rest periods.

- The school hall doors and other large ventilation openings should be closed after 6pm where the activity involves amplified or loud music or speech. Use of the presentation lawn for noise producing activities should be limited to normal school hours.

- The south, east and west facing windows of Block A should have minimum 6.38mm glass fitted into openable frames to give a minimum R_w of 30.

- Any glazing in the south, and east façades of the Hall should have minimum 6.38mm glass fitted into openable frames to give a minimum R_w of 30. Any doors should have a minimum R_w of 20.

- The proposal would not produce adverse vibration impacts on nearby structures or impact the amenity of the surrounding properties.

- Construction noise impacts should be managed as outlined in Section 10.8.

12 CONCLUSION

Noise emissions associated with the proposed Jordon Springs Primary School Schofields 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. Refer Section 9. Provided the recommendations are adopted the proposed school will not adversely impact the acoustic amenity of surrounding receivers.

Yours faithfully,

Victor Fattoretto

APPENDIX A – NOISE LOGGING DATA