Glenwood High School

Post Completion Noise Compliance Testing

Richard Crookes Constructions

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1 INTRODUCTION

Pulse White Noise Acoustics PTY LTD has been engaged to undertake post completion acoustic compliance testing of the operational noise resulting from the mechanical system serving the completed Glenwood High School project.

Noise level measurements were conducted in conjunction with the projects Condition of Consent including Items E4 and E5 of the projects SSD 23512960 Conditions of Consent which includes reference to the SSDA Noise and Vibration Impact Assessment dated 12 November 2021 and prepared by AECOM document number: 60659173-RPNV-01 Acoustic testing of the operational school has been undertaken for the completed project.

A glossary of terminology used in this report is provided in Appendix A.

2 PROJECT DESCRIPTION

The following site description is from the previously approved SSDA Noise and Vibration Impact Assessment dated 12 November 2021 and prepared by AECOM document number: 60659173-RPNV-01.

Figure 1 - Site Description (AECOM Document 60659173-RPNV-01)

1.3 Site description

Glenwood High School is located at 85 Forman Avenue, Glenwood. An existing childcare centre is also located within the site. The site is located in the Blacktown Local Government Area (LGA) in the suburb of Glenwood. It is situated within a well-established residential area approximately 4.7 km north-east of Blacktown Train Station.

The site is bound by residential development and Forman Avenue to the south; Glenwood Reserve to the north and west with residential development beyond; and Glenwood Park Drive to the east, with a drainage channel and residential development beyond. Refer to Figure 1 below.

Residential receivers which are located within proximity to the site include a combination of single and two storey dwellings with windows overlooking the school property. The nearest sensitive receivers to the site have been identified below.

Receiver 1: Single and duel residential dwellings located to the east of the school located along Kidman Street.

Receiver 2: Single and duel residential dwellings located to the south of the school located along Forman Street.

A site map has been provided below which identifies surrounding receivers and monitoring locations, see figure below.

Project Site

Residential Receivers

Commercial Receivers

Attended Measurement Locations

3 PROJECT NOISE LEVEL CRITERIA

Noise level testing conducted as part if the assessment includes the required levels detailed in Items E4 and E5 of the projects SSD 23512960 Conditions of Consent which includes reference to the SSDA Noise and Vibration Impact Assessment dated 12 November 2021 and prepared by AECOM document number: 60659173-RPNV-01

Operational Noise Limits

E4. The Applicant must ensure that noise generated by operation of the development does not exceed the noise limits in Glenwood High School Noise and Vibration Impact Assessment dated 12 November 2021 and prepared by AECOM Australia Pty Ltd.

E5. The Applicant must undertake short term noise monitoring in accordance with the *Noise Policy for Industry* (2017) where valid data is collected following the commencement of use of each stage of the development. The monitoring program must be carried out by an appropriately qualified person and a monitoring report must be submitted to the Planning Secretary within two months of commencement use of each stage of the development or other timeframe agreed to by the Planning Secretary to verify that operational noise levels do not exceed the recommended noise levels for mechanical plant identified in Glenwood High School Noise and Vibration Impact Assessment dated 12 November 2021 and prepared by AECOM Australia Pty Ltd. Should the noise monitoring program identify any exceedance of the recommended noise levels referred to above, the Applicant is required to implement appropriate noise attenuation measures so that operational noise levels do not exceed the recommended noise levels or provide attenuation measures at the affected noise sensitive receivers.

Section 4.1.3 (Project noise trigger levels) of the SSDA Noise and Vibration Impact Assessment dated 24 February 2022 and prepared by AECOM document number: 60654726-RPNV-01_E, includes the project required noise level emissions criteria as project noise trigger levels for the operation of building services, including the following:

4.1.3 Project noise trigger levels

Table 15 presents the applicable project noise trigger levels.

Table 15 NPfI project noise trigger levels

Type of receiver	Time of day	Intrusiveness noise level (RBL+5) ($L_{Aeq,\ 15\ minutes}$), dB(A)	Project amenity level ($L_{Aeq,\ 15\ minutes}$), dB(A)	Project noise trigger level ($L_{Aeq\ 15\ minutes}$), dB(A)
Residential Receivers	Day	43	53	43
	Evening	35	43	35
	Night	35	38	35
School Classroom – Internal	Noisiest 1-hour period when in use	-	38[1]	38[1]
Passive recreation area	When in use	-	48	48
Active recreation area	When in Use	-	53	53

4 OPERATIONAL NOISE LEVEL MEASURMENTS

Attended noise level measurements of the operation of the mechanical system serving the Glenwood High School was conducted at the boundary of the nearest residential receivers within proximity to the school, further detail of the measurement locations can be identified in AECOM document number: 60659173-RPNV-01

Testing was conducted on the 14th of February 2024 during a period when all the building services were operational including the external condenser equipment.

Testing was undertaken as part of the completed school in total.

The noise level survey was performed using a Brüel & Kjær Hand-held Analyser Type 2270 type meter. Calibration of the sound level meter was checked with a Brüel & Kjær Type 4231 acoustical calibrator prior to and following the measurements. Drift in calibration did not exceed ±0.5 dBA. All equipment carried current NATA calibration certificates.

Attended measurements took place between 11.00am and 12:15pm on the 14th of February 2024.

Prior to all the noise measurements being undertaken all ventilation and air conditioning systems were checked to be operational and were confirmed by the mechanical contractor as to being in operation.

The noise level testing undertaken as part of the compliance testing was undertaken in accordance with the requirements of the EPA's Noise Policy for Industry and the relevant Australian Standards including AS1055:2018 'Acoustics – Description and Measurement of Environmental Noise.

The attended and unattended noise locations were selected to obtain suitable noise levels for the normal operation of the mechanical services equipment and the projects noise level criteria as detailed in the SSD and the projects Noise Impact Assessment which are detailed in the section above.

Noise levels at the school was undertaken in accordance with the requirements of the EPA and the testing methodologies of AS1055. Details of the testing are included in this Section of the report.

The project noise level criteria is based on the projects Condition of Consent including Items E4 and E5 of the projects SSD 23512960 Conditions of Consent which includes reference to the SSDA Noise and Vibration Impact Assessment dated 12 November 2021 and prepared by AECOM document number: 60659173-RPNV-01.

The period of the testing undertaken at as part of the Operational Noise Compliance Testing included 15 min period.

The period of testing was undertaken as this was identified as a representative period when the school was operational at a normal maximum capacity, including the building services equipment and the like.

The noise level test location includes that which are representable of the potentially worst affected receivers, including those located to the east and south of the project site as identified above.

The testing was undertaken during the period when the equipment was operational at maximum capacity. Details of the operation of the plant provided to this office has indicated that the major plant is not operational at maximum capacities during night-time hours.

The results of measured external noise levels during a period when the building services operating under normal conditions are detailed in the table below.

Table 1 - Measured External Noise Levels

Measurement Location	Time of Measurement	Measured Noise $L_{Aeq(15min)}$ dB(A)	Project Noise Level Trigger $L_{Aeq(15min)}$ dB(A)	Comments
Location 1 – Measurement Location to the east of the project site	14th of February 2024 11:00am – 12:15pm Period when the building services were operational including condenser equipment	Measured noise level - 41 dB(A)	43 dB(A) $L_{Aeq(15min)}$	Noise from the operation of the mechanical equipment was inaudible at this location. Noise level generated from the operation of the building services compliant with relevant day and evening criteria. The building services will not be required to run at maximum capacities during night time periods including the external condenser equipment
Location 2 – Measurement Location to the east of the project site		Measured noise level - 41 dB(A)	43 dB(A) $L_{Aeq(15min)}$	Noise from the operation of the mechanical equipment was inaudible at this location Noise level generated from the operation of the building services compliant with relevant day and evening criteria. The building services will not be required to run at maximum capacities during night time periods including the external condenser equipment
Location 3 – Measurment Location to the south of the project site		Measured noise level - 40 dB(A)	43 dB(A) $L_{Aeq(15min)}$	Noise from the operation of the mechanical equipment was inaudible at this location Noise level generated from the operation of the building services compliant with relevant day and evening criteria.

				The building services will not be required to run at maximum capacities during night time periods including the external condenser equipment
Location 4 – Measurement Location to the south of the project site		Measured noise level - 41 dB(A)	43 dB(A) $L_{Aeq(15min)}$	Noise from the operation of the mechanical equipment was inaudible at this location Noise level generated from the operation of the building services compliant with relevant day and evening criteria. The building services will not be required to run at maximum capacities during night time periods including the external condenser equipment

4.1 Discussion

During testing the recorded noise levels at the locations as set out above included environmental noise sources which were not associated with the operation of the school and included noise from traffic – from surrounding roadways and other environmental noise contributions.

Based on the results of testing, the contribution of the environmental noise sources has been corrected from the obtained site measurement such that the noise contributions from the operation of the school can be assessed as detailed in the above table.

Based on the Rating background noise levels outlined in the AECOM document number: 60659173-RPNV-01, the existing ambient L_{eq} noise levels at the site, prior to the development of the school are as follows:

4.1.3 Project noise trigger levels

Table 15 presents the applicable project noise trigger levels.

Table 15 NPfI project noise trigger levels

Type of receiver	Time of day	Intrusiveness noise level (RBL+5) ($L_{Aeq, 15\ minutes}$), dB(A)	Project amenity level ($L_{Aeq, 15\ minutes}$), dB(A)	Project noise trigger level ($L_{Aeq\ 15\ minutes}$), dB(A)
Residential Receivers	Day	43	53	43
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School Classroom – Internal	Noisiest 1-hour period when in use	-	38[1]	38[1]
Passive recreation area	When in use	-	48	48
Active recreation area	When in Use	-	53	53

Based on the results of the operational noise testing the $L_{Aeq(15min)}$ noise levels have not increased as a result of the operation of the mechanical services of the school based on the above provided noise data.

Post completion mechanical operational compliance testing was conducted in the positions outlined in figure 1 of the report. These locations were selected as they are the nearest affected residential receivers to the project site.

Based on the results of acoustic testing noise levels resulting from the operation of the mechanical equipment on the site are compliant with the projects items E4 and E5 of the projects SSD 23512960 Conditions of Consent.

As exceedances have not been identified no additional noise mitigations are required.

5 CONCLUSION

This report details the results of the post completion noise level testing conducted of the operational noise levels resulting from the mechanical system serving the completed Glenwood High School project.

Based on the results of the acoustic testing, noise levels resulting from the operation of the mechanical equipment on the site are compliant with conditions E4 and E5 of the projects SSD 23512960 Conditions of Consent which includes reference to the SSDA Noise and Vibration Impact Assessment dated 24 February 2022 and prepared by AECOM document number: 60654726-RPNV-01_E.

In the event you require any further information or clarification regarding this document, please contact the undersigned.

Kind Regards,

George Kinezos
Acoustic Engineer
PULSE WHITE NOISE ACOUSTICS PTY LTD

APPENDIX A. APPENDIX TERMINOLOGY

Sound power level	The total sound emitted by a source
Sound pressure level	The amount of sound at a specified point
Decibel [dB]	The measurement unit of sound
A Weighted decibels [dB(A])	The A weighting is a frequency filter applied to measured noise levels to represent how humans hear sounds. The A-weighting filter emphasises frequencies in the speech range (between 1kHz and 4 kHz) which the human ear is most sensitive to, and places less emphasis on low frequencies at which the human ear is not so sensitive. When an overall sound level is A-weighted it is expressed in units of dB(A).
Decibel scale	The decibel scale is logarithmic in order to produce a better representation of the response of the human ear. A 3 dB increase in the sound pressure level corresponds to a doubling in the sound energy. A 10 dB increase in the sound pressure level corresponds to a perceived doubling in volume. Examples of decibel levels of common sounds are as follows:
	0dB(A) Threshold of human hearing 30dB(A) A quiet country park 40dB(A) Whisper in a library 50dB(A) Open office space 70dB(A) Inside a car on a freeway 80dB(A) Outboard motor 90dB(A) Heavy truck pass-by 100dB(A) Jackhammer/Subway train 110 dB(A) Rock Concert 115dB(A) Limit of sound permitted in industry 120dB(A) 747 take off at 250 metres
Frequency [f]	The repetition rate of the cycle measured in Hertz (Hz). The frequency corresponds to the pitch of the sound. A high frequency corresponds to a high pitched sound and a low frequency to a low pitched sound.
Ambient sound	The all-encompassing sound at a point composed of sound from all sources near and far.
Equivalent continuous sound level [L_{eq}]	The constant sound level which, when occurring over the same period of time, would result in the receiver experiencing the same amount of sound energy.
Reverberation	The persistence of sound in a space after the source of that sound has been stopped (the reverberation time is the time taken for a reverberant sound field to decrease by 60 dB)
Air-borne sound	The sound emitted directly from a source into the surrounding air, such as speech, television or music
Impact sound	The sound emitted from force of one object hitting another such as footfalls and slamming cupboards.
Air-borne sound isolation	The reduction of airborne sound between two rooms.
Sound Reduction Index [R] *(Sound Transmission Loss)*	The ratio the sound incident on a partition to the sound transmitted by the partition.
Weighted sound reduction index [R_w]	A single figure representation of the air-borne sound insulation of a partition based upon the R values for each frequency measured in a laboratory environment.
Level difference [D]	The difference in sound pressure level between two rooms.
Normalised level difference [D_n]	The difference in sound pressure level between two rooms normalised for the absorption area of the receiving room.
Standardised level difference [D_{nT}]	The difference in sound pressure level between two rooms normalised for the reverberation time of the receiving room.
Weighted standardised level difference [$D_{nT,w}$]	A single figure representation of the air-borne sound insulation of a partition based upon the level difference. Generally used to present the performance of a partition when measured in situ on site.
C_{tr}	A value added to an R_w or $D_{nT,w}$ value to account for variations in the spectrum.

Impact sound isolation	The resistance of a floor or wall to transmit impact sound.
Impact sound pressure level [L_i]	The sound pressure level in the receiving room produced by impacts subjected to the adjacent floor or wall by a tapping machine.
Normalised impact sound pressure level [L_n]	The impact sound pressure level normalised for the absorption area of the receiving room.
Weighted normalised impact sound pressure level [$L_{n,w}$]	A single figure representation of the impact sound insulation of a floor or wall based upon the impact sound pressure level measured in a laboratory.
Weighted standardised impact sound pressure level [$L'_{nT,w}$]	A single figure representation of the impact sound insulation of a floor or wall based upon the impact sound pressure level measured in situ on site.
C_I	A value added to an L_{nW} or $L'_{nT,w}$ value to account for variations in the spectrum.
Energy Equivalent Sound Pressure Level [$L_{A,eq,T}$]	'A' weighted, energy averaged sound pressure level over the measurement period T.
Percentile Sound Pressure Level [$L_{Ax,T}$]	'A' weighted, sound pressure that is exceeded for percentile x of the measurement period T.
Speech Privacy	A non-technical term but one of common usage. Speech privacy and speech intelligibility are opposites and a high level of speech privacy means a low level of speech intelligibility. It should be recognised that acceptable levels of speech privacy do not require that speech from an adjacent room is inaudible.
Sound Pressure Level, LP dB	A measurement obtained directly using a microphone and sound level meter. Sound pressure level varies with distance from a source and with changes to the measuring environment. Sound pressure level equals 20 times the logarithm to the base 10 of the ratio of the rms sound pressure to the reference sound pressure of 20 micro Pascals.
Sound Power Level, Lw dB	Sound power level is a measure of the sound energy emitted by a source, does not change with distance, and cannot be directly measured. Sound power level of a machine may vary depending on the actual operating load and is calculated from sound pressure level measurements with appropriate corrections for distance and/or environmental conditions. Sound power levels is equal to 10 times the logarithm to the base 10 of the ratio of the sound power of the source to the reference sound power of 1 picoWatt
Noise Reduction	The difference in sound pressure level between any two areas. The term "noise reduction" does not specify any grade or performance quality unless accompanied by a specification of the units and conditions under which the units shall apply
Audible Range	The limits of frequency which are audible or heard as sound. The normal ear in young adults detects sound having frequencies in the region 20 Hz to 20 kHz, although it is possible for some people to detect frequencies outside these limits.
Background Sound Low	The average of the lowest levels of the sound levels measured in an affected area in the absence of noise from occupants and from unwanted, external ambient noise sources. Usually taken to mean the LA90 value
Character, acoustic	The total of the qualities making up the individuality of the noise. The pitch or shape of a sound's frequency content (spectrum) dictate a sound's character.
Loudness	A rise of 10 dB in sound level corresponds approximately to a doubling of subjective loudness. That is, a sound of 85 dB is twice as loud as a sound of 75 dB which is twice as loud as a sound of 65 dB and so on
LMax	The maximum sound pressure level measured over a given period.
LMin	The minimum sound pressure level measured over a given period.
L1	The sound pressure level that is exceeded for 1% of the time for which the given sound is measured.
L10	The sound pressure level that is exceeded for 10% of the time for which the given sound is measured.
L90	The level of noise exceeded for 90% of the time. The bottom 10% of the sample is the L90 noise level expressed in units of dB(A).
Leq	The "equivalent noise level" is the summation of noise events and integrated over a selected period of time.