Project No: 171542

Noise Assessment
Proposed Catherine McAuley College
Medowie Road
Medowie, NSW

Prepared for:

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CONTENTS

1.0 - INTRODUCTION

This report presents the results, findings and recommendations arising from an acoustic assessment of the proposed Catherine McAuley Catholic College (College) to be constructed at number 507 Medowie Road and 2 Kingfisher Close (Lots 412 1nd 413 D.P. 1063902), Medowie, NSW.

The plans for the site include the construction of a primary school, a secondary school, a place of worship, an early learning centre and some residential uses as shown in **Figure 1**.

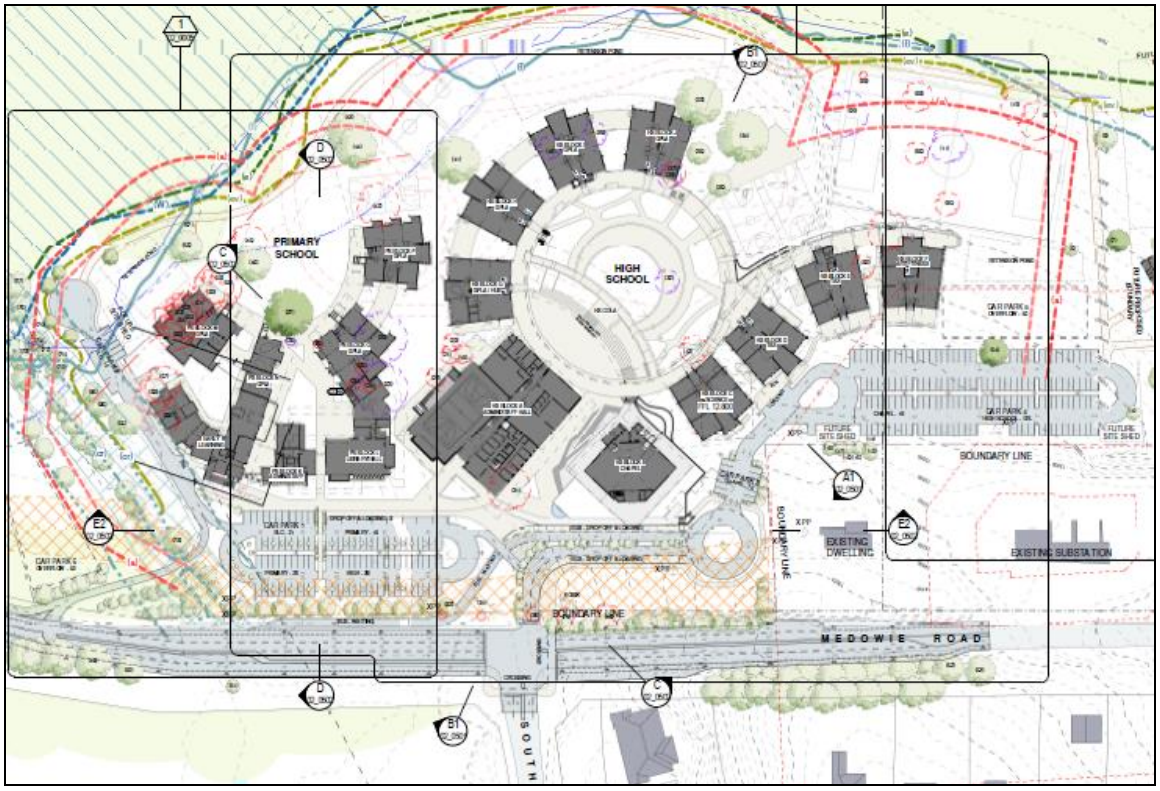


Figure 1 – Site Location Plan

It is proposed that the school may cater for up to a maximum of 1190 high school students, 630 primary school students and 124 children at the early learning centre.

As shown in Figure 1 the school will consist of adjoining areas for the High School, Primary School and Early Learning Centre. There will also be a chapel, outdoor sporting fields and an indoor basketball court on the site.

The assessment was requested by the Catholic Schools Office Diocese of Maitland-Newcastle to support a Development Application to Port Stephens Council (PSC).

The assessment will be incorporated in an EIS for the proposal and will address the conditions of the Environmental Planning and Assessment Regulation (2000).

Normal school hours are generally from 8.00 am to 5.00 pm Monday to Friday with classes usually from 8.45am to 3.15pm. The sporting fields may also be accessed by local community sporting clubs with activities typically taking place on Saturday mornings.

The Chapel would be used during school hours and also for a Mass either on a Saturday evening (5.30 to 6.00 pm) or Sunday morning (8.00 to 9.00am). The Chapel may be used occasionally for weddings, funerals and baptisms.

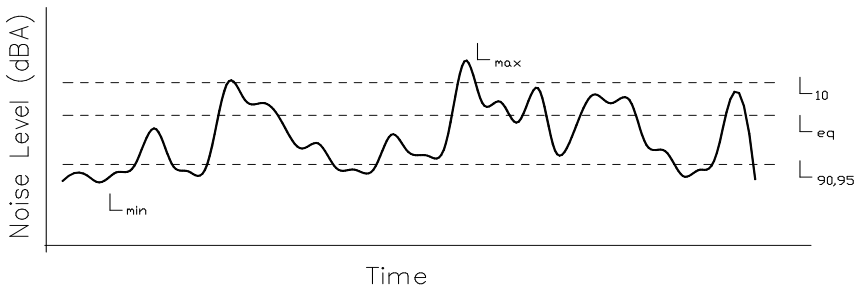
2.0 - TERMS AND DEFINITIONS

Table 1 contains the definitions of commonly used acoustical terms and is presented as an aid to understanding this report.

TABLE 1
DEFINITION OF ACOUSTICAL TERMS

Term	Definition
dB(A)	The quantitative measure of sound heard by the human ear, measured by the A-Scale Weighting Network of a sound level meter expressed in decibels (dB).
SPL	Sound Pressure Level. The incremental variation of sound pressure above and below atmospheric pressure and expressed in decibels. The human ear responds to pressure fluctuations, resulting in sound being heard.
STL	Sound Transmission Loss. The ability of a partition to attenuate sound, in dB.
Lw	Sound Power Level radiated by a noise source per unit time re 1pW.
Leq	Equivalent Continuous Noise Level - taking into account the fluctuations of noise over time. The time-varying level is computed to give an equivalent dB(A) level that is equal to the energy content and time period.
L1	Average Peak Noise Level - the level exceeded for 1% of the monitoring period.
L90	Average Minimum Noise Level - the level exceeded for 90% of the monitoring period and recognised as the Background Noise Level. In this instance, the L90 percentile level is representative of the noise level generated by the surrounds of the residential area.

TABLE 1
DEFINITION OF ACOUSTICAL TERMS (cont.)



3.0 - CRITERIA

3.1 Environmental Noise

The Office of Environment and Heritage (OEH) and PSC generally share responsibility for the approval and control of noise emissions from commercial and industrial premises within council boundaries. These approvals are usually based on procedures and criteria detailed in the Noise Policy for Industry (NPI).

The NPI doesn't contain specific procedures for the assessment of noise emissions from schools but, in keeping with similar situations in other local government areas, it is used in this assessment as a guide for determining potential noise impacts and applicable criteria.

The NPI describes intrusive and amenity criteria applicable to industrial sites. These noise criteria depend on the existing background noise level at potentially affected residential receiver areas.

Ambient noise levels representative of the residential areas near the site were measured as part of the acoustic assessment for the current project. Ambient noise levels were measured on the site at the location shown in **Figure 2** from 5 to 11 December, 2017.

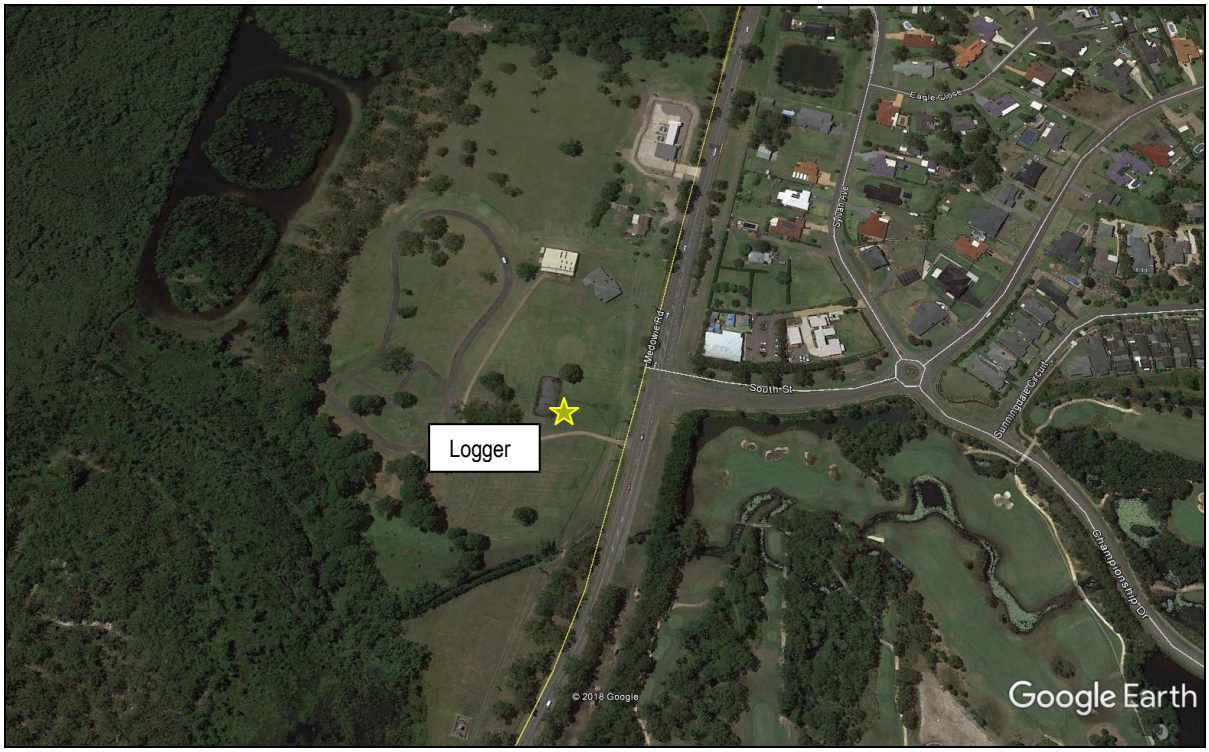


Figure 2 – Noise Logger Location

Noise levels were measured at 15 minute statistical intervals using a Rion NL42 sound level meter set up as an environmental noise logger. The measurements were done in accordance with relevant OEH guidelines and AS 1055-1997 "Acoustics – Description and Measurement of Environmental Noise". The noise logger used complies with the requirements of AS 1259.2-1990 "Acoustics – Sound Level Meters", and has current NATA calibration certification.

The logger was programmed to continuously register environmental noise levels over the 15 minute intervals, with internal software calculating and storing Ln percentile noise levels for each sampling period. Calibration of the logger was performed as part of the instrument's initialisation procedures, with calibration results being within the allowable ± 0.5 dB(A) range.

The ambient acoustic environment of the area is dominated by noise from traffic on Medowie Road and more distant traffic noise from Richardson Road. The site is relatively remote from any industrial noise sources. The site is located in the vicinity of the Newcastle Airport and the Salt Ash Weapons Range and it may, therefore, be potentially impacted by noise from aircraft using those facilities.

The logger was located at approximately the same distance from Medowie Road as the residences which may be most potentially affected by noise from the College site. The data recorded is, therefore,

considered to be representative of the residential areas near the project site.

Ambient Leq and background noise levels, obtained from the logger, are summarised in **Table 2** and shown graphically in **Appendix I**. The time trace from the logger data (shown in Appendix I) is typical of an area near a busy road with characteristically high traffic flow from early morning and in the early evening.

TABLE 2
MEASURED AMBIENT NOISE LEVELS dB(A)
Site Logger

Period	L90	Leq (15 min)
Day	49	58
Evening	44	55
Night	38	54

In setting noise goals for a particular project the NPI considers both Amenity and Intrusiveness criteria. The former is set to limit continuing increase in noise from industry, whilst the latter is set to minimise the intrusive impact of a particular noise source.

Amenity criteria are dependent upon the nature of the receiver area and the existing level of industrial noise. The most potentially affected receiver areas near the site would be considered "suburban" as per the definitions in the NPI and shown below (extract from Table 2.3 of the NPI).

- ***Suburban*** *– an area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area often has the following characteristic: evening ambient noise levels defined by the natural environment and human activity.*

The project amenity noise level for an industrial development (or school for the current assessment) is equal to the recommended amenity noise level (from Table 2.2 in the NPI) minus 2 dB(A) (derived as detailed in the notes to **Table 3**).

The intrusiveness criteria are based on the Rating Background Level (RBL) for the time period, plus 5 dB(A). The RBL (L90) is defined as the overall single figure background level representing each assessment period.

Table 3 specifies the noise criteria determined for the site derived in accordance with procedures in the NPI.

TABLE 3 NOISE CRITERIA			
Criterion	Day (7am-6pm)	Evening (6pm-10pm)	Night (10pm-7am)
Intrusiveness dB(A),Leq(15-min.)[1]	54	49	43
Amenity dB(A),Leq(period)[2]	53	43	38
Project-Specific Noise Goals	**53 (15 min)**	**43 (15 min)**	**38 (15 min)**

1 Rating Background Level (RBL) + 5dB. RBL is the median value of each ABL (Assessment Background Level) over the entire monitoring period. The ABL is a single figure representing the "L_{90} of the $L_{90's}$" for each separate day of the monitoring period.

2. Project amenity noise level (ANL) is suburban ANL (NPI Table 2.1) minus 5 dB(A) plus 3 dB(A) to convert from a period level to a 15-minute level

3.2 Aircraft Noise

The location of the proposed College is depicted on **Figure 3**. This shows that the location lies outside of the "Aircraft Noise Planning Area" as defined in the PSC DCP (2104). Figure 3 also shows that the site is outside of the ANEF 20 contours for 2012 and 2025 for the Newcastle Airport and RAAF Base, Williamtown ("RAAF Base Williamtown and Salt Ash Weapons Range ANEF", GHD, Appendix E Figure 2, 10 August 2011), as defined on RAAF endorsed plans.

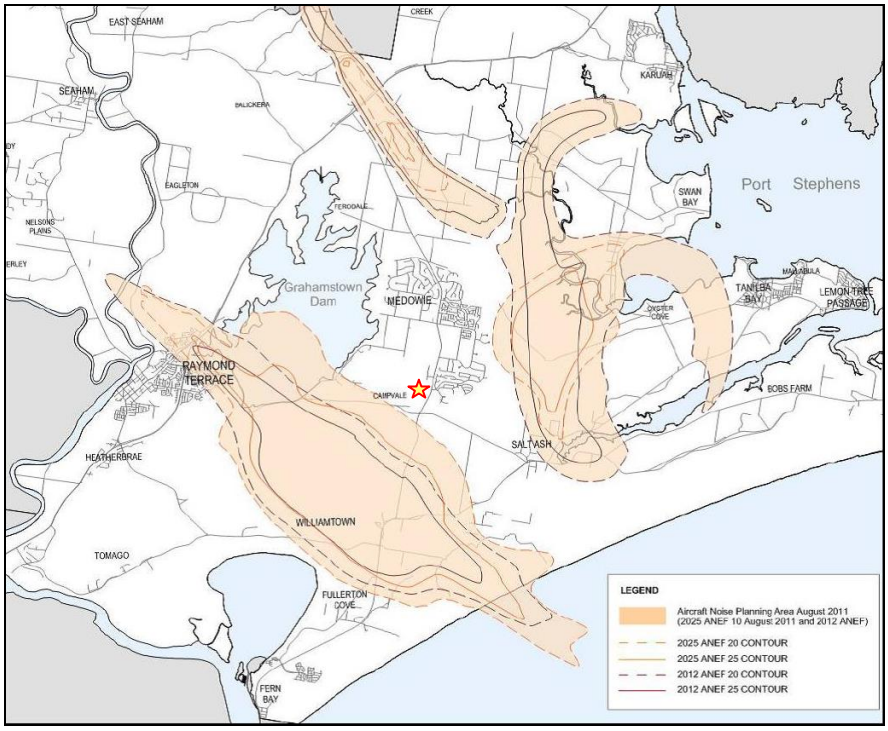


Figure 3 – PSC Aircraft Noise Planning Area (college site shown as a star)

As the site is situated outside of the ANEF 20 contour it fits the description of "acceptable" for a school or university in accordance with Table 2.1 of AS/NZS 2021-2015 "Acoustics-Aircraft Noise Intrusion-Building Siting and Construction" (the Standard).

Under Section 2.3 “Action resulting from acceptability determination” of the Standard, Section 2.3.1 states that, for the “acceptable” classification, specific protection against aircraft noise is not necessary.

By way of example the Standard determines that (for residences) standard residential construction materials and methods will achieve the applicable internal design noise levels (in Table 3.3 of the Standard and Table BJ of DCP 2014) which will, therefore, result in an adequate internal noise amenity in the residence.

It has been indicated by PSC, however, that consideration should be given to maximum noise levels from aircraft to ensure the future amenity of all school uses. To assess any potential impacts guidance has been taken from the Standard.

Table 4 shows design indoor aircraft noise levels as specified in Table 3.3 of the Standard.

TABLE 4 Extract from Table 3.3 of AS 2021-2000	
Building type and activity	**Indoor design sound level, dB(A),Lmax**
Schools, universities	
Library, study areas	50
Teaching areas, assembly areas	55
Workshops, gymnasia	75
Commercial Buildings, offices, shops	
Private Offices, conference rooms	55
Public Buildings	
Churches, religious activities	50

3.3 Road Traffic Noise

The NSW Road Noise Policy (RNP) details (in *Table 4* of the RNP) “Road traffic noise assessment criteria for non-residential land uses affected by road projects and traffic generating developments”. For a school classroom the recommended internal noise level is 40 dB(A) Leq (1hr) when the room is in use.

Similarly the recommended internal noise level for a place of worship is 40 dB(A) Leq (1hr) when in use.

For the current assessment this criterion has been used to determine the appropriate design noise level inside the new classrooms and chapel.

3.4 Construction Noise

The assessment of potential construction noise impacts is undertaken in accordance with the *Interim Construction Noise Guideline* (ICNG) and *Assessing Vibration: A Technical Guideline* (AVTG). These guidelines are non-mandatory but are usually referred to by local councils and the NSW Department of Planning and Environment (DPE) when construction/demolition works require development approval.

The criteria in the ICNG cover all activities and machinery associated with construction on the site including, but not limited to, site preparation, excavation work and erection of buildings and related infrastructure. It is designed to ensure noise emissions resulting from the construction are maintained to minimise potential impacts to nearby receivers.

Section 1.5 of the ICNG outlines the steps for management of construction noise impacts as follows;

1. **identify sensitive land uses** that may be affected.
2. **identify hours** for the proposed construction works.
3. **identify impacts** at sensitive land uses.
4. **select and apply the best work practices** to minimise noise impacts.

Each of the above four points is assessed in detail in the following sections.

Surrounding Land Uses

The project site is in a suburban/residential area which is relatively remote from any significant industrial noise sources. There is an existing child care centre across Medowie Road from the proposed site access.

Potential noise impacts in the nearby residential areas and the child care centre will be included in the current assessment of construction noise.

Operating Hours

The recommended standard hours for construction works are shown in *Table 1*, *Section 2.2* of the ICNG as reproduced below.

Table 1: Recommended standard hours for construction work

Work type	Recommended standard hours of work*
Normal construction	Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays
Blasting	Monday to Friday 9 am to 5 pm Saturday 9 am to 1 pm No blasting on Sundays or public holidays

* The relevant authority (consent, determining or regulatory) may impose more or less stringent construction hours.

Construction works outside the hours in *Table 1* (from the ICNG) is normally only permissible for delivery of oversized structures, emergency works, public infrastructure works that are supported by the affected community or where the proponent demonstrates and justifies a need to work outside the recommended standard hours (ICNG, p9).

Impacts at Sensitive Land Uses

The ICNG provides two assessment methodologies for construction noise impacts: a 'qualitative' assessment where works occur for less than three weeks and a 'quantitative' assessment for works of longer duration. As construction works on the site will take longer than three weeks, the quantitative methodology is applicable.

Noise management Levels

Table 2, *Section 2.2* of the ICNG is reproduced below and sets out noise management levels for construction works.

The day time ambient Leq and background noise level, obtained from the unattended logging on the site are shown in Table 3.

Based on the daytime background noise level (RBL) of 49 dB(A),L90, the daytime construction noise management level is, therefore, **59 dB(A),Leq (15 min)**, at residential receivers, in accordance with *Table 2* from the ICNG.

Table 2: Noise at residences using quantitative assessment

Time of day	Management level $L_{Aeq\ (15\ min)}$ *	How to apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 1 pm No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{Aeq\ (15\ min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

* Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5 m above ground level. If the property boundary is more than 30 m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

The ICNG also details the construction noise management levels at other potentially sensitive land uses. There are no specific requirements for child care centres but there is a management level detailed for “active recreation areas” which are characterised by activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion. For the current assessment this management level is considered applicable to the play areas in the child care centre as follows;

- active recreation areas - external - 65 dB(A) Leq (15 min).

4.0 - NOISE ASSESSMENT

4.1 School Classrooms

The proponent has supplied the following information in relation to the operation of the school.

The high school will, typically, cater for approximately 1190 students, with 630 in the infants/primary classes and a further 124 in the early learning centre.

The high school will be built as a series of classroom blocks around a central open space. The blocks will be isolated from each other. There will be a playing field, capable of hosting football games, at the north western corner of the high school site.

The primary school will be similarly built as a series of classrooms in a generally semi circular arrangement around an open space. Smaller play areas will be located away from residential receivers and acoustically shielded from them by the class room buildings.

Due to the separation between the class rooms and the residential receivers noise emissions from general class room activities will be at levels that will not create any adverse impacts at any receivers.

From an acoustic point of view the main potential for noise impacts from the classroom section of the high school may come from activities in the Technology and Applied Sciences (TAS) rooms and the Music Suites.

To assess these potential noise impacts data were taken from the Spectrum Acoustics technical database. All sound levels in the technical database have been measured with a Bruel & Kjaer Type 2260 Precision Sound Level Analyser with calibration performed before and after the survey.

The relevant measured Leq noise levels from the technical database are shown in **Table 5**.

TABLE 5
MEASURED NOISE LEVELS as dB(A) Leq (15 min)

		Octave Band Centre Frequency (Hz)							
Location	dB(A)	63	125	250	500	1K	2K	4K	8K
TAS	87	57	61	65	74	79	83	82	77
Roll Call	72	32	44	59	66	67	67	62	54
Music Room	80	57	67	76	75	72	68	66	60

The noise level detailed in Table 5 for a TAS workshop is the arithmetic average of a series of noise measurements made around the room during woodwork and metalwork classes at an existing school in the Hunter Valley. All measurements were made whilst typical noise producing activities were being carried out in the classroom. That is, the measurements were made to ensure capture of all significant noise sources to enable an assessment of the worst case for noise emissions.

At other times students are variously under instruction or involved in planning and design and, therefore, the noise level in the Table 5 is considered to represent a worst case for noise from the TAS workshop.

Measurements were also made before a roll call class when all children present were conversing. This is considered to represent a worst case for general classroom noise.

For the music room the measurement was made at the interior walls of the classroom whilst a band (including drums and electric guitars) was playing.

For the purpose of assessing a worst case these measured noise levels shown in Table 5 were considered to be constant for the full 15 minute assessment period.

Blocks D and E of the proposed high school will be used for TAS classes. Each block will house TAS workshops. To assess the potential impacts from activities in the TAS workshops, a noise source with the Leq (15min) sound pressure level for TAS, shown in Table 5, was considered to be located near the internal walls (closest to the receivers) of the TAS workshops in Block D.

Noise levels were then theoretically propagated to the nearest residence taking into account the effects of transmission loss through building elements and hemispherical spreading (distance loss). From consideration of the dimensions and orientation of the various building elements, the sound pressure levels immediately outside these were propagated to the nearest receiver using an equation[1] giving the sound field due to an incoherent plane radiator. The predicted received noise levels were then compared to project noise goal to determine noise impacts.

The school buildings are to have operable windows but the rooms will also be air conditioned. For this assessment it has been assumed that, under normal operating conditions, the windows will be closed. All calculations of noise emissions assumed that all windows were closed.

Table 6 shows a calculation of noise propagated through the glazing in the southern façade of the TAS workshop and impacting on the nearest residential receiver to the north east on Medowie Road (see Receiver R2 on **Figure 4**).

The results in Table 6 represent the calculation of impacts to the potentially most affected point on the western boundary of Receiver R2,

[1] Equation (5.104), DA Bies and CH Hansen, *Engineering Noise Control*, E & FN Spon, 1996.

35m from the centre of the façade of the closest TAS workshop to the boundary.

TABLE 6
CALCULATED SPL AT NEAREST RESIDENTIAL RECEIVER R2
TAS WORKSHOP

		Octave Band Centre Frequency, Hz							
Item	dB(A)	63	125	250	500	1k	2k	4k	8k
Source SPL	87	57	61	65	74	79	83	82	77
TL[1] Glazing		20	22	25	29	33	31	38	36
Exterior SPL	55	37	39	40	45	46	52	44	41
SPL @ receiver[2]	22								
TL[3] Roof		16	20	22	27	32	35	32	39
Exterior SPL	55	41	41	43	47	47	48	50	38
Directivity Loss	7								
SPL @ receiver[2]	6								
Total SPL	22								
Criterion Leq (15 min)	53								

[1] Transmission loss 6.38mm laminated glass

[2] Propagated to the nearest receiver using an equation giving the sound field due to an incoherent plane radiator

[3] Transmission loss for colorbond steel roofing with insulation underlay

The results in Table 6 show that there will be no adverse impacts, at the potentially worst affected boundary, as a result of the assessed noise emissions from the TAS workshop.

There are five TAS workshops proposed for Blocks D and E combined. Assuming all are in use at the same time and producing the maximum noise emissions assessed in Table 6, the total received noise at the boundary would be less than 30 dB(A) Leq (15 min) and there would be no adverse noise impacts.

All other receivers are more distant from the TAS workshops and will be more acoustically shielded by intervening class room buildings, which will further reduce noise levels at those receivers. There will, therefore, be no adverse impacts at any receivers as a result of emissions from the TAS workshops.

The results shown in Table 6 are based on the assumption that the windows will be fitted with 6.38mm laminated glass and that windows are closed.

Whilst the fitting of the laminated glass may not be necessary to mitigate environmental noise emissions it is recommended to reduce the potential for noise transmission between the TAS workshop and other nearby classrooms.

There will be two music suites as well as several music practise rooms located in Block A at the northern end of the main hall.

The music suites and practise rooms will be located within the class room Block A and will not have any facades which are exposed to residential receivers. The music will be adequately attenuated by the structure of the building and intervening building elements such that there will be minimal noise emission in the direction of any residential receivers. Further assessment of this noise is, therefore, not considered warranted.

Noise from the activities in the TAS workshops and music suites are expected to represent the worst case for noise emissions from the proposed class rooms. The other class rooms are to be general class rooms.

4.2 Playing Fields and Outdoor Play Areas

The high school will have a dedicated playing field which will be used for organised class activities as well as informal play during recess and lunch breaks. It is envisaged that the main playing field at the north western corner of the site may be used for organised sporting activities on Saturday mornings.

It is considered that the worst case for noise generation from the playing field will occur during organised activities or Saturday morning competitions.

Noise sources associated with sporting fields included raised voices, referee whistles, half-time sirens and public address (PA) systems. These are all intermittent sources with relatively high maximum levels but considerably lower Leq (15 min) levels.

The typical sound power level from a raised adult male voice is up to 90 dB(A),Lmax and at similar levels from a referee's whistle. Previous measurements conducted by Spectrum Acoustics have found 15-minute average levels from sporting fields to be at 5 to 10dB below the maximum level, due to the non-constant nature of the noise source. A worst case sound power level of 85 dB(A),Leq (15 min) has therefore been estimated during a sporting event as shown in **Table 7**.

Modern sporting venues do not have a single, centrally located speaker for the PA system. Rather, smaller speakers are distributed throughout spectator areas. Maximum noise levels in the order of 75 to 80 dB(A) are typical with intermittent use implying much lower Leq (15 min) levels.

TABLE 7 MEASURED NOISE LEVELS as dB(A) Leq (15 min)									
		Octave Band Centre Frequency (Hz)							
Location	dB(A)	63	125	250	500	1K	2K	4K	8K
Playing Field	85	60	65	71	78	80	79	75	69

For the current assessment the noise from a sporting event was considered to be three separate sources located generally around the playing field as shown in **Figure 4**. The nearest potentially affected residential receivers are also shown on Figure 4.

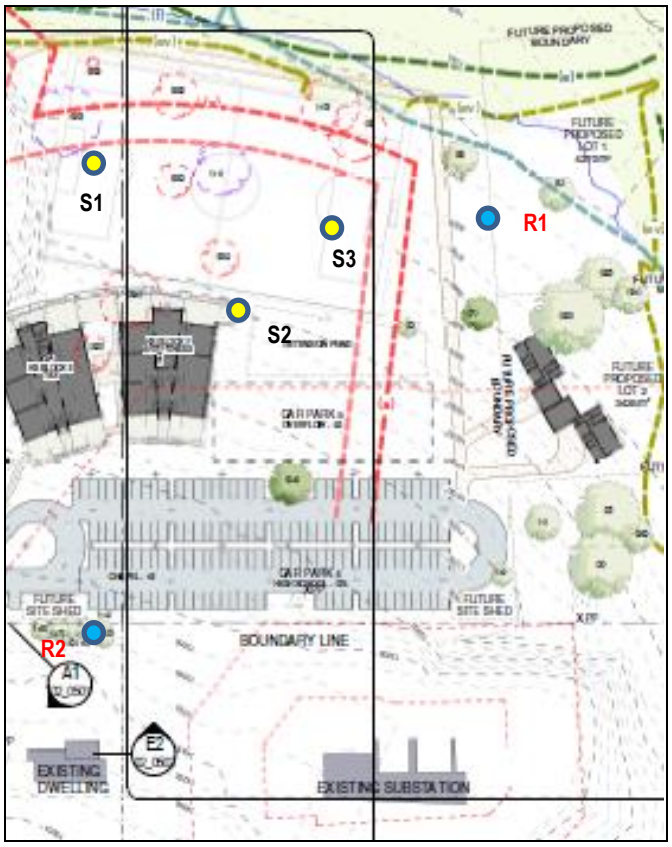


Figure 4 – Playing Field Noise Source Location

Table 8 shows the results of a calculation of potential impacts at Receiver R1 due to the assessed noise emissions from the playing fields.

TABLE 8 CALCULATED SPL AT RECEIVER R1 PLAYING FIELD			
Noise Source	1 (130m)	2 (80m)	3. (50m)
Source Lw as Leq (15 min)	80	80	80
Distance Loss dB(A)	50	46	42
SPL at boundary Leq (15min)	30	34	40
Combined SPL at boundary Leq (15min)	41		
Criterion (Day)	53		
Impact	**0**		

Table 9 shows the results of a calculation of potential impacts at Receiver R2 due to the assessed noise emissions from the playing fields.

TABLE 9 CALCULATED SPL AT RECEIVER R2 PLAYING FIELD			
Noise Source	1 (130m)	2 (100m)	3. (130m)
Source Lw as Leq (15 min)	80	80	80
Distance Loss dB(A)	50	48	50
SPL at boundary Leq (15min)	30	32	30
Combined SPL at boundary Leq (15min)	35		
Criterion (Day)	53		
Impact	**0**		

The results in Tables 8 and 9 show that, under the assessed conditions, there will be no adverse impacts due to noise emissions from the playing fields.

The calculations are simplistic as they don't take into account any acoustic barrier effects for fencing along the boundary to R1, or for classroom buildings between the playing fields and R2. This will apply a degree of conservatism to the results.

Other outdoor play areas for the primary and high school will be at various locations around the site. Each of these playground areas will be used, on average twice a day, at recess (for 15 minutes) and at lunch time (for 50 minutes).

The 15 minute Leq noise emissions from these areas will vary depending on the type of activity which may be taking place at any time.

Each play area or group would have an average Lw of between 75 and 80 dB(A) Leq (15 min) (based on noise measurements made at existing schools in general play areas). This implies compliance with the noise

criterion at distances of greater than 10m from the playing groups (that is for an Lw of 80 dB(A) minus 28 for distance loss of 10m).

As all play areas will be significantly more distant from any receivers than this, and will be acoustically shielded from any receivers by the intervening classroom buildings, the received noise at all residences will be in compliance with the day time noise criterion.

4.3 Class Bell/Siren

It is anticipated that a bell or siren would be operated to indicate the start and finish of class periods and breaks etc. In order to be heard all over the school it is anticipated that such a bells or sirens would need a sound pressure level of between 10 and 15 dB(A) above the existing Leq noise level and extend for a period of between 3 to 5 seconds.

Assuming a worst case of a sound pressure level of 73 dB(A) at the boundary (i.e. existing Leq + 15) and a duration of 5 seconds, this equates to a 15 minute Leq of 45 dB(A). That is when averaged over a full 15 minute noise assessment period the noise level would be 45 dB(A).

The NPI also contains modification factor adjustments to allow for particular qualities of a received noise which may be perceived as being capable of greater annoyance.

The noise from a bell (or siren) would typically be a tonal noise and, therefore would have a 5 dB(A) penalty imposed. As such, the noise under the assessed conditions above would be 50 dB(A) Leq (15 min), which would not exceed the project specific noise goal for the site.

It must be noted that the above assessment assumes the worst case noise level at the boundary and the noise level would, therefore, be higher than this in the play areas. In reality the bell not need be this loud to achieve the aim of alerting students to the end of periods etc. Similarly it may be considered that the bell need not extend for 5 seconds.

The assessment has shown, however, that the operation of the school bell will not cause any undue noise impacts, provided it has a sound pressure level of 78 dB(A) Leq at the school boundary and it operates for less than 5 seconds.

4.4 Car Park

There will be two large and one smaller car parking areas associated with all of the schools as shown in **Figure 5**.

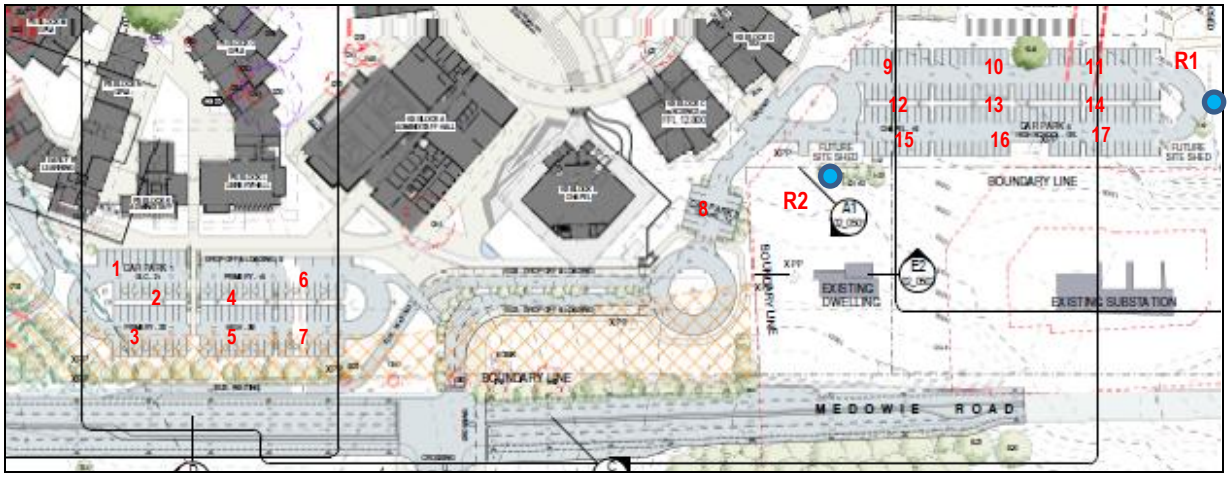


Figure 5 – Car Park Noise Source Location

For most of each day the car parking spaces will be occupied and there will be very little movement of cars in and out. The majority of use of the car park and vehicle movements will usually coincide with the period at the start and end of each school day. The worst case for noise generation from the car park would be during one of those periods.

A heavy usage of the car park would result in up to 50% of the car parks being used in a single 15 minute period. To ensure consideration of the absolute worst case for the current assessment it was assumed that 75% of the car parks would be used in a single 15 minute period, as may be the case in the afternoon when school finishes.

Noise in car parks typically comes from people walking to and from cars, doors opening and closing etc., as well as vehicles moving at slow speeds. Each noise event is characterised by a brief peak which when averaged out over a 15 minute period has a relatively low Leq. The impact of each noise event on any single receiver is also variable depending upon the location of individual cars within a car park and as they move in and out.

Typical noise levels from car parks have been sourced from the Spectrum Acoustics technical database. This contains noise measurements from a series of vehicles arriving and departing a car park with people moving to and from vehicles.

The measurements were made over a representative period to ascertain a typical noise level from these activities. The measurements were made at varying distances from each car to approximate the situation in relation to an adjacent residence over a 15 minute interval. That is, at any time throughout each 15 minute interval various car parks, at different distances from the nearest residences, will be in use.

The measurements in the database show a noise level of 53 dB(A) Leq measured over a 5 minute period where up to 6 vehicles moved in and out of a car park. The measurements were made at an average distance of 7m.

Assuming the noise from the 6 vehicles is consistent for a full 15 minutes at a distance of 7m this equates to a sound power level of 73 dB(A) Leq (15 min) for that car park noise. This value has been used to determine impacts over a 15 minute assessment period during the morning before school.

Due to the layout of the car parks, individual parking spaces will be at various distances from receivers. The proposed layout is for a series of "banks" of parking spaces.

To assess potential impacts the car park was considered to consist of 18 banks of 10 to 12 parking spaces each with a worst case average Lw of 76 dB(A) Leq (15 min). Received noise levels were determined for each "bank" and the combined result calculated for the most potentially affected receivers in Medowie Road and Blueberry Road.

The noise from the car park will be at different levels when measured at various points on any individual receiver boundary. That is, depending on the distance from individual cars/noise events etc. To assess the practical impacts the noise was calculated for a single theoretical reception point at the most affected point on the boundary of the site and Receivers R1 and R2 (as shown on Figure 5).

A summary of the results of the assessment of car park noise, as described above, is shown in **Table 10**. Car park numbers referred to in the tables are as shown diagrammatically in Figure 5.

TABLE 10 CALCULATED SPL – Leq (15 min) - CAR PARK		
Car Park Number	R1 dB(A)/Distance	R2 dB(A)/Distance
1	17 (360m)	20 (250m)
2	17 (350m)	20 (240m)
3	17 (350m)	20 (240m)
4	18 (320m)	22 (210m)
5	18 (320m)	22 (190m)
6	18 (300m)	22 (190m)
7	18 (300m)	22 (190m)
8	26 (120m)	36 (40m)
9	28 (100m)	34 (50m)
10	28 (100m)	36 (40m)
11	28 (100m)	42 (20m)
12	31 (70m)	32 (60m)
13	31 (70m)	34 (50m)
14	31 (70m)	36 (40m)
15	38 (30m)	28 (100m)
16	38 (30m)	29 (90m)
17	38 (30m)	29 (90m)
Total Leq (15 min)	**44**	**46**
Criterion Leq (15 min)	**53**	**53**

The results in Table 10 show there will be no exceedance of the day time noise criterion at any receivers as a result of the assessed car park noise.

4.4 Aircraft Noise

Maximum aircraft noise levels have been previously published (2009) for the Joint Strike Fighter (JSF) aircraft at Williamtown. Based on the published contours it is anticipated that worst case maximum noise levels of up to 80 dB(A) may be experienced from JSF aircraft at the proposed College location. Noise levels from all other aircraft types are lower than those for the JSF at this location.

This indicates that the class room buildings and offices must be capable of attenuating up to 25 dB(A) Lmax in order to achieve the adequate internal noise levels detailed in Table 4. The requirements for the Library and Chapel is for the building structure to attenuate up to 30 dB(A) Lmax.

In all standard building construction, the acoustically 'weak' elements are the glazed windows and/or doors. Published sound transmission loss data from window suppliers indicate that, in a typical construction scenario, 4mm float glass windows will attenuate up to 29 dB(A) of

aircraft noise. Similarly, fitting the same windows with 6.38mm laminated glass will attenuate up to 32 dB(A) of aircraft noise.

The above discussion indicates that, in relation to aircraft noise, standard glazing will achieve an adequate internal noise level in all class rooms in the schools. External windows to libraries and the chapel should be fitted with minimum 6.38mm laminated glass.

To confirm the above a series of sample calculations were made for various rooms throughout he schools.

Minimum glazing requirements the various rooms were calculated in accordance with AS2021-2015. The calculations were based on an average Lmax noise level of 80 dB(A).

For example the aircraft noise attenuation requirement for Room GPLA 15 on the first floor of H Block was determined based on a floor area of 73m^2, standard ceiling height and a glazing area of 18m^2. The calculation assumed the windows are fully exposed to the aircraft noise and there was no shielding from awnings, or other buildings etc. The plans show that there will be some such shielding and this will apply a degree of conservatism to the results.

The Rw requirements for Room GPLA 15 are as follows;

- Windows – Rw 23
- Walls – Rw 24
- Roof/Ceiling – Rw 26

Standard building construction will adequately achieve the Rw requirements detailed above.

The results of other, similar, sample calculations show that the Rw requirements detailed above are the maximum applicable to all class rooms and offices in the schools.

4.5 Road Traffic Noise

The noise logger was located with full line of sight to the traffic on Medowie Road and, therefore, measured the existing traffic noise in the area. The logger was located at approximately the same distance from the road (i.e. traffic noise source) as the closest façade of any of the school buildings.

It is usual for RMS and Councils to require design standards to meet projected traffic levels for the 10 years after a development is completed. There are no AADT figures for Medowie Road. Assuming an increase in traffic volumes of 10% over current levels, this would

lead to a resultant increase in traffic noise of slightly less than 0.5 dB(A) Leq or a total at the logger location of **58.5 dB(A),Leq (15 hr)** during the day.

This indicates that the class room buildings and offices must be capable of attenuating up to 19 dB(A) Leq (1 hr) in order to achieve the adequate internal noise levels detailed in **Section 3.3**. This is applicable to all areas of the schools.

As discussed for aircraft noise intrusion, in all standard building construction, the acoustically 'weak' elements are the glazed windows and/or doors.

Published sound transmission loss data from window suppliers indicate that, in a typical construction scenario, 4mm float glass windows will attenuate up to 28 dB(A) of road traffic noise. Similarly, fitting the same windows with 6.38mm laminated glass will attenuate up to 30 dB(A) of road traffic noise.

Sample calculations of the required Rw for windows in the school were undertaken. The measured Leq noise level from the logger was assumed to be impacting on the outer façade of the windows in the Administration Building. From this the required Rw was calculated in accordance with the mathematical procedure given in AS3671-1989 "Acoustics - Road traffic noise intrusion - Building siting and construction".

Sample Calculation

Detailed below is a sample calculation of the Rw for the window in Principals Office. This window will be fully exposed to the traffic noise from Medowie Road.

The internal noise criterion for the office is 40 dB(A), therefore, the required traffic noise reduction is;

$$TNR = 59\text{-}40 = 19 \text{ dB(A)}.$$

The traffic noise attenuation, *TNA*, required of the window is calculated according to the equation given in Clause 3.4.2.6 of AS 3671,

$$TNA = TNR + 10\log_{10}[(S/S_f) \times 3/h \times 2T_{60} \times C] \quad \textit{equation 1}$$

where S = Surface area of windows = $6.4m^2$

S_f = Surface area of floor = $21.5m^2$

h = Ceiling height, assumed to be 2.4m

T_{60} = Reverberation time, 0.5s

C = No. of components = 3 (wall and 2 x windows)

Assuming that the room is acoustically average (neither too 'live' nor too 'dead') equation 9.26 in *Noise and Vibration Control*, L. L. Beranek, 1971, gives a reverberation time of 0.46s. Consequently, the value of 0.5s was used in equation 1.

Using the values listed above gives;

TNA = 18 dB(A) for the windows.

Substituting this value into the equation given in Clause 3.4.3.1 of AS3671 gives

Rw = *TNA* + 6 ≈ 24 (note: the +6 is an allowance for the low frequency component of traffic noise).

The results show that the window in the Principals Office should be fitted with glass with a minimum Rw of 24. Published sound insulation performance in terms of Rw ratings relate to partitions tested in ideal laboratory conditions or opinions based on such measurements and suppliers must be able to ensure compliance with the detailed Rw ratings when windows are installed. For example, Rw 24 could, depending on the entire window system, be achieved with standard glazing.

Other sample calculations were made for rooms in various sections of the school with resultant Rw requirements being less than 24. This indicates that, for the attenuation of the traffic noise, standard glazing will be sufficient for all windows in the schools.

4.6 Mechanical Plant

The most acoustically significant mechanical plant associated with the school will be air conditioning equipment for the various areas of occupancy. It is most likely that this will be provided by split system air conditioners.

Typical condenser units on split systems for applications such as this have sound power levels in the vicinity of 67 to 70 dB(A). This means that in the free field, with no reflecting surfaces and no impediments or barriers to noise, the a/c units would produce sound pressure levels of around 50 dB(A) at between about 3 to 4m from the condenser.

In terms of noise impacts on adjoining properties, the cumulative effects of more than one condenser operating at the same time, and in relatively close proximity, needs to be considered.

Table 11 shows the calculated noise impact at the nearest residential boundary from the combined emissions from six condenser units located at ground level. This would be considered a worst case scenario where all condensers in the set of six units were operating at maximum sound power levels.

In relation to potential impacts at surrounding receivers, the distance of each condenser to the closest point on the nearest residential boundary is variable depending upon where it is mounted. As each condenser will be at varying distances from each other and the boundary a representative calculation has been carried out for a distance of 10m.

TABLE 11
AIR CONDITIONER NOISE IMPACT

Item	dB(A)
6 x condensers	78
Distance loss (10m)	28
Received Noise	50 Leq (15 min)
Criterion	53 Leq (15 min)

Given the proposed layout of the school it is considered feasible that all air conditioner condensers can be mounted either a sufficient distance from the boundary and/or behind an effective acoustic barrier (i.e. in this case shielded by building elements of the school buildings). Care must be taken when locating the units to avoid the effects of reflected noise from nearby buildings or off barriers etc.

In addition to minimising environmental noise as a result of the condensers, there may be the potential for structure borne noise to impact on classrooms within the building. To avoid the possibility of structure borne noise due to vibrations, all duct work for HVAC venting must be isolated from the main structure of the building. Duct and pipe penetrations must be kept free of the structure either by externally lagging or by use of non-setting sealants at the point of penetration.

Vibrating equipment such as a/c condenser units must be mounted such that vibrations cannot transfer to the surrounding structure.

4.7 Construction

The most significant noise emissions from construction activities will occur during the site excavation and preparation and initial foundation works for the class room buildings, playing fields and car parks etc.

Other works will involve fitout of the various buildings. For the most part these will be undertaken internally within the buildings with resultant reduced received noise.

Typical noise levels of construction plant items are shown in **Table 12** (as adapted from the Environmental Noise Management Manual and supplemented with data from the Spectrum Acoustic technical database).

TABLE 12
TYPICAL NOISE LEVELS
Leq (15 min) – CONSTRUCTION PLANT @ 7m

Plant Item	dB(A) Leq (15 min)
Compressor	71
Backhoe	79
Concrete Vibrator	83
Crane	79
Excavator	76
General construction	79

The figure shown as “general construction” in the above table is an arithmetical average of several measurements of noise emissions from typical construction activity during the foundation and excavation stage of works at a multi storey development. This is indicative of the type of construction noise emissions from the current project.

Construction noise levels will vary throughout individual days and also throughout the length of the overall works. The noise level at individual receivers will also be dependent upon the location of the various works, relative to those receivers, at any time. In this instance, in the direction of some receivers, there will also be shielding from topographical effects.

Based on the noise levels shown in Table 12, **Table 13** show the results of a calculation of potential noise impacts at the most potentially affected receivers due to general construction works taking place at the closest parts of the car parks to the various boundaries.

TABLE 13 THEORETICAL SPL dB(A) Leq (15 min) - CONSTRUCTION NOISE			
Item	dB(A)		
	R1	R2	Child Care Centre
General construction noise Leq (15 min)	104	104	104
Distance Loss to Receiver, (m)	-47 (90m)	-42 (50m)	-44 (60m)
Received Noise Leq (15 min)	**57**	**62**	**60**
Criterion Leq (15 min)	**59**	**59**	**65**
Impact Leq (15 min)	**0**	**3**	**0**

The results in Table 13 show, that under the assessed conditions, there may be an exceedance of the construction noise criterion at the closest point on the boundary to Receiver R2. This exceedance will be of a short term nature and will occur only during those parts of the construction when the works are closest to the receiver.

The received noise will result in received noise in the “noise affected” category but below the “highly affected” category of the ICNG.

The calculations shown in Table 13 are for that phase of construction involving heavy machinery ground preparation work for the closest parts of the car park to the residences, as described previously. This phase of the construction will be only relatively short term in nature.

As construction progresses the major noise generating activities will be carried out inside buildings or will be substantially shielded by building elements. As a result, at these times, received noise levels will be less than those shown in Table 13.

In keeping with the requirements of the ICNG the following general recommendations are made to minimise potential impacts, and maintain the amenity of, the surrounding areas.

All neighbouring residents should be notified of the proposed works. Particular emphasis should be placed on the time frame of the works. A contact name and phone number of a responsible person should be given out so that complaints can be dealt with effectively and efficiently. All complaints or communication should be answered.

During the liaison process note should be made of any particularly noise sensitive times of day and care be taken to avoid scheduling noisy works at these times.

All personnel working on the job including contractors and their employees should be made aware of their obligations and responsibilities with regard to minimising noise emissions.

Contractors should familiarise themselves with methods of controlling noisy machines and alternative construction procedures. These are explained in AS2436-1981 “Guide to Noise Control on Construction, Maintenance and Demolition Sites”.

Activities that are known, or have the potential, to create excessive noise should, where possible, be scheduled to occur at times to cause least annoyance to the community. Carrying out such work during early morning should be avoided. This includes start up and idling etc. of heavy machinery prior to commencement of work.

Mechanical plant should be silenced using best available control technology. Noise suppression devices should be maintained to manufacturer’s specifications. Internal combustion engines should be fitted with appropriate, well maintained, high efficiency mufflers.

Machines which are used intermittently should either be shut down in the intervening periods between work or throttled down to a minimum.

Alternatives to reverse alarms such as manually adjustable or ambient noise sensitive types (“smart” reversing alarms) should be considered. Alternative site management strategies can be developed, in accordance with a site OH&S Plan, with the concurrence of the appropriate OH&S Officer.

Any portable equipment with the potential to create high levels of noise e.g. compressors, generators etc. should only be selected for use if it incorporates effective noise control. This equipment should be located where practical so that natural ground barriers or site sheds etc. are between it and the nearest potentially affected receivers.

Where possible loading and unloading of plant and materials should be carried out away from potentially affected receivers.

5.0 – DISCUSSION OF RESULTS AND CONCLUSION

An acoustical assessment of theoretical noise emissions has been carried out for the operation of the proposed Catherine McAuley Catholic College (College) to be constructed at number 507 Medowie Road and 2 Kingfisher Close (Lots 412 1nd 413 D.P. 1063902), Medowie, NSW.

The noise impacts at the nearest residential boundaries have been assessed, due to the noise emissions from each of;

- Class rooms, including TAS workshops and music suites,
- Playgrounds,
- Bell or siren noise,
- Car park, and
- Construction activities.

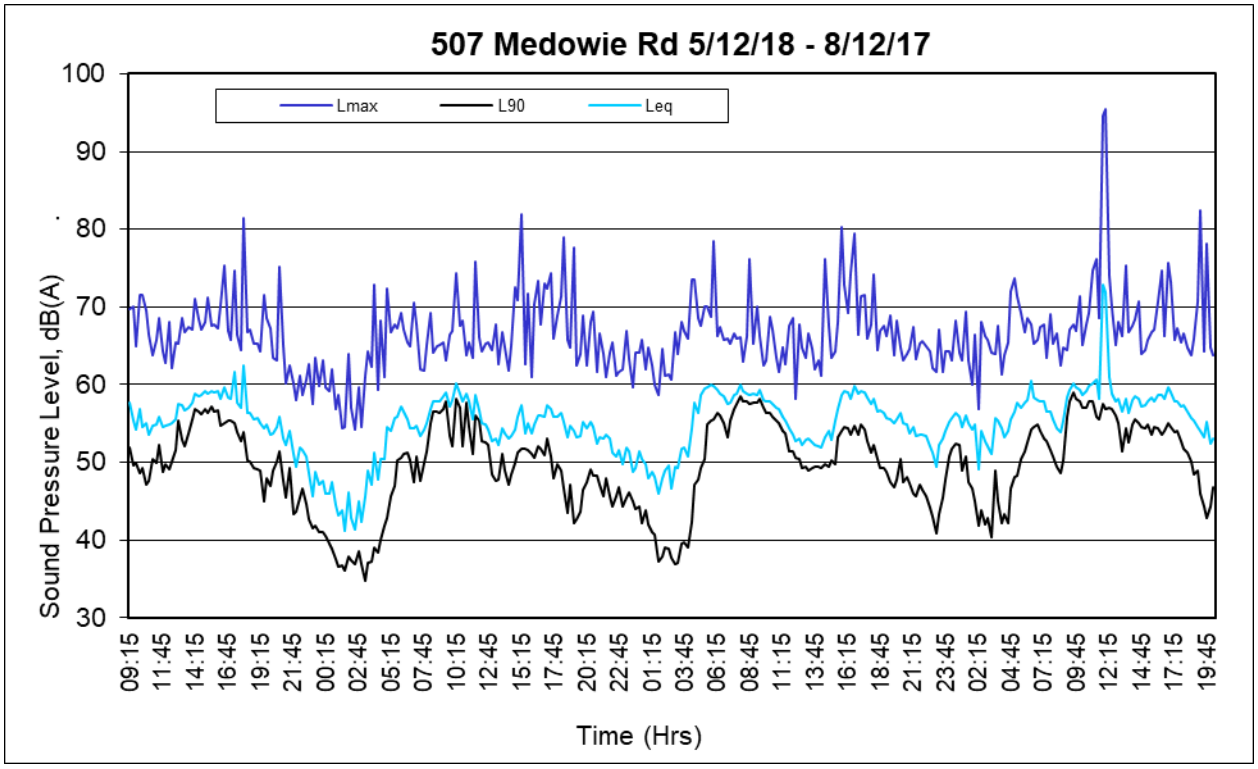
The assessment has shown that there is very little potential for adverse noise impacts under the scenarios considered.

There are no other predicted noise exceedances as a result of the operation of the school. A summary of the noise control recommendations is shown below,

- All windows in the external facades of the TAS workshops must be minimum 6.38 mm laminated glass,
- Windows to the TAS workshops should be closed whilst machinery is being operated,
- Any siren or bell must be adjusted to have a maximum sound pressure level of 45 dB(A) Leq (5 sec) when measured at the boundary of the site and have a maximum duration of 5 seconds,
- Air conditioner condensers must be mounted at ground level either a sufficient distance from the boundary and/or behind an effective acoustic barrier,
- To avoid the possibility of structure borne noise due to vibrations, all duct work for HVAC venting must be isolated from the main structure of the building.
- A series of recommendations have been made to minimise potential impacts on surrounding areas as a result of noise emissions from construction activities.

APPENDIX I

NOISE LOGGER CHARTS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Leq
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80
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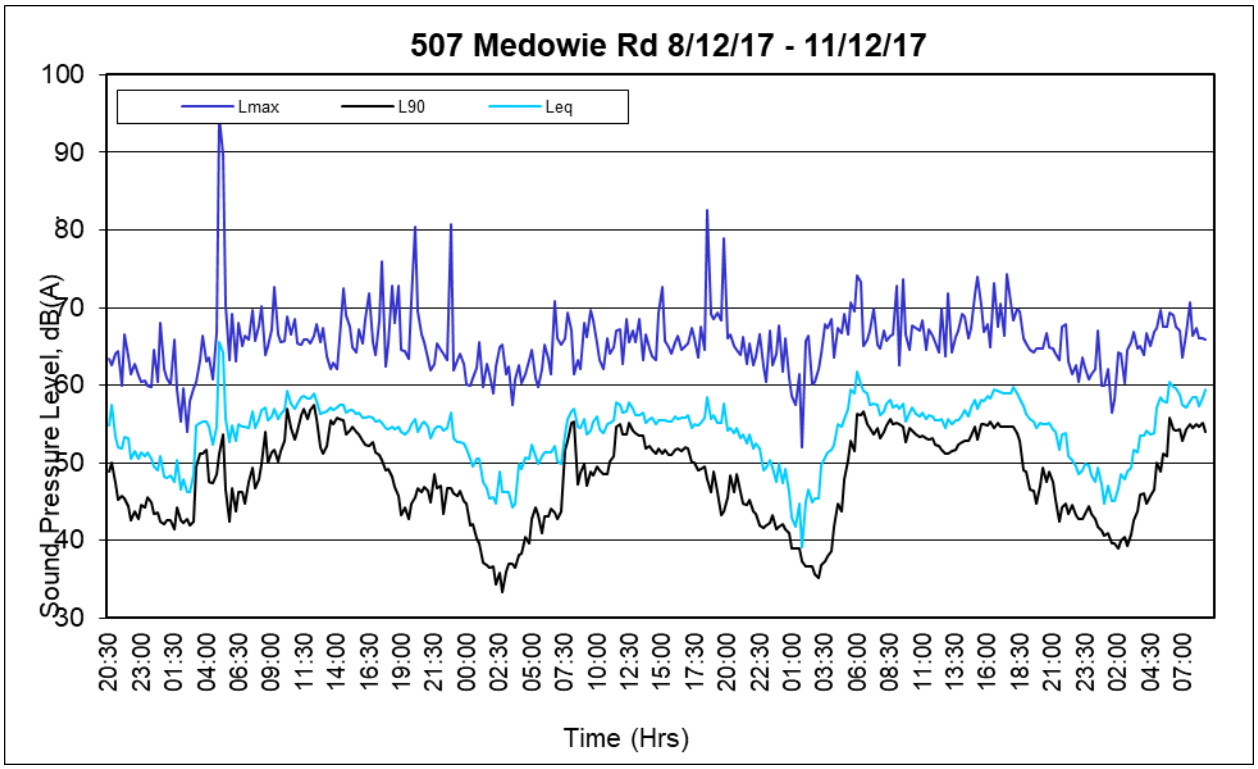
507 Medowie Rd 8/12/17 - 11/12/17
Lmax
L90
Leq
Sound Pressure Level, dB(A)
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