Roseville College SWELL Centre
Development Application Acoustic Assessment
29-37 Bancroft Avenue, Roseville, NSW

Client:
Anglican Schools Corporation
C/o- epm Projects Pty Ltd

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GLOSSARY

NOISE

Noise is produced through rapid variations in air pressure at audible frequencies (20 Hz – 20 kHz). Most noise sources vary with time. The measurement of a variable noise source requires the ability to describe the sound over a particular duration of time. A series of industry standard statistical descriptors have been developed to describe variable noise, as outlined in Section 2 below.

NOISE DESCRIPTORS

L_{eq} – The sound pressure level averaged over the measurement period. It can be considered as the equivalent continuous steady-state sound pressure level, which would have the same total acoustic energy as the real fluctuating noise over the same time period.

dB – Decibels. The fundamental unit of sound, a Bell is defined as the logarithm of the ratio of the sound pressure squared over the reference pressure squared. A Decibel is one-tenth of a Bell. Probably the most common usage of the Decibel in reference to sound loudness is dB sound pressure level (SPL), referenced to the nominal threshold of human hearing. For sound in air and other gases, dB(SPL) is relative to 20 micropascals (μPa) = 2×10^{-5} Pa, the quietest sound a human can hear.

$D_{nT,w}$ – Weighted Standardised Level Difference. A measure of on-site sound insulation performance of a building element. The higher the number, the better the insulation performance.

D_w – Weighted Sound Level Difference. A single number rating of on-site sound level difference insulation performance of a building element. The higher the number, the better the insulation performance.

R_w – Weighted Sound Reduction Index. A measure of sound insulation performance of a building element. This is a laboratory measurement that is commonly used to describe the sound insulation performance, with the higher the number, the better the insulation performance.

RT or T_{60} – Reverberation Time. The time, in seconds, that it takes for the sound pressure level generated to decay by 60 dB after the noise source has ceased.

A-WEIGHTING

"A-weighting" refers to a prescribed amplitude versus frequency curve used to "weight" noise measurements in order to represent the frequency response of the human ear. Simply, the human ear is less sensitive to noise at some frequencies and more sensitive to noise at other frequencies. The A-weighting is a method to present a measurement or calculation result with a number representing how humans subjectively hear different frequencies at different levels.

1 INTRODUCTION

1.1 SUMMARY

Acoustic Dynamics has been engaged by **epm Projects Pty Ltd** on behalf of **Anglican Schools Corporations** to assess external & internal noise intrusion, external noise emission and provide advice on internal acoustic privacy and design advice for the proposed Student Wellness (SWELL) Centre development within the Roseville college site, located at 29-37 Bancroft Avenue, Roseville NSW.

This document provides a technical assessment, as well as recommendations for construction materials and methods to achieve compliance with the relevant acoustic design criteria and requirements. It has been prepared in accordance with the requirements of Ku-ring-gai Council, the NSW Department of Planning and Infrastructure (DP&I), the NSW Department of Education and relevant Australian Standards.

1.2 LOCATION OF PROPOSED DEVELOPMENT

The site is located at 29-37 Bancroft Avenue, Roseville in the Ku-ring-gai Council area of NSW. The site currently contains a residential building at 37 Bancroft Avenue (owned by Roseville College) and two outdoor multi-purpose sports fields (tennis court / football pitch etc.).

The proposal is for the development of a new Student Wellness (SWELL) Centre, including a swimming pool, gym, general learning area (GLA) classrooms, a food technologies workshop/kitchen, a rooftop outdoor multipurpose sports field(s) and multi-level car parking facilities.

Acoustic Dynamics understands that the proposal is not seeking to increase the hours of operation from the existing site usage. Seasonal swim programmes (currently offered on site) are proposed to operate year round however they will be conducted at the same time and to the existing school community groups.

The proposal intends to retain the current hours of use:

- Monday to Friday 7:00am to 6:00pm;
- Saturday 7:00am to 2:00pm;
- After hours: 5:00pm to 10:00pm, Monday to Friday. This will include infrequent access to the gym, swimming pool and rooftop multi-purpose sports area; and
- Staff arriving from 7:00am and staff and student/parents departing within half an hour of the cessation of activities.

The subject site has two main road frontages with the southern boundary direct to Victoria Street, with additional access via Spearman Street and the northern boundary direct to Bancroft Avenue. The eastern and western boundaries are shared with residential premises. The subject site is zoned *SP2 – Infrastructure: Educational Establishment*, however is surrounded primarily by *R2 – Low Density Residential* zoned areas.

In regards to the noise emission assessment, the nearest sensitive receivers are as follows:

- Residential receiver located at 23 Bancroft Avenue (located 48m to the west);
- Residential receiver located at 26 Bancroft Avenue (located 46m to the north-west);
- Residential receiver located at 28 Bancroft Avenue (located 29m to the north);
- Residential receiver located at 30 Bancroft Avenue (located 29m to the north);
- Residential receiver located at 32 Bancroft Avenue (located 35m to the north-east);
- Residential receiver located at 39 Bancroft Avenue (located 4m to the east); and
- Residential receiver(s) located at 33 to 41 Victoria Street (located 143m to the south).

The proposed development is shown in the Location Map, Aerial Photo and Drawings presented within **Appendix A**.

1.3 SCOPE

Acoustic Dynamics has been engaged to provide an external noise (road traffic) intrusion, external noise emission and internal acoustic privacy assessment suitable for submission to Ku-ring-gai Council.

The scope of the assessment is to include the following:

- Review of legislation, Council criteria and Australian Standards relevant to the noise intrusion, noise emission and internal acoustic privacy at the proposed development;
- Travel to site to conduct inspections and testing;
- Conduct noise monitoring to establish background and traffic noise levels at the development site;
- Examination of architectural drawings and review of the proposed construction/materials;
- Calculation of the sound transmission reduction required to meet the criteria;
- Prediction of likely noise emission from proposed mechanical plant and various other sources at the development site;
- Assessment and provision of advice on internal acoustic privacy; and
- Recommendation of materials and construction techniques to achieve compliance with the relevant acoustic requirements and criteria.

2 ASSESSMENT CRITERIA AND STANDARDS

Acoustic Dynamics has conducted a review of the local council, state government and federal legislation that is applicable to noise assessment for the proposed development. The relevant sections of the legislation are presented below. The most stringent criteria which have been used in the assessment of the proposed development are summarised below.

2.1 KU-RING-GAI COUNCIL CRITERIA

2.1.1 LOCAL ENVIRONMENT PLAN & DEVELOPMENT CONTROL PLAN

A review of Ku-ring-gai Council's *Local Environment Plan (LEP)* 2012 and *Development Control Plan (DCP)* 2016 did not yield specific acoustic criteria.

2.2 NSW DEPARTMENT OF PLANNING AND INFRASTRUCTURE (DP&I)

2.4.1 STATE ENVIRONMENTAL PLANNING POLICY (SEPP) (EDUCATIONAL ESTABLISHMENTS & CHILD CARE FACILITIES) 2017

The NSW Department of Planning and Infrastructure's (DP&I) State Environmental Planning Policy (SEPP) (Educational Establishments & Child Care Facilities) 2017 provides guidance and criteria for the assessment of educational establishment developments within NSW.

Reference to acoustics and noise, for this development, within the policy, have been reproduced below:

"State Environmental Planning Policy (SEPP) (Educational Establishments & Child Care Facilities) 2017

Division 5 Complying development

19 General requirements for complying development

Note. A service approval is required to operate an early education and care facility that is an education and care service to which the Children (Education and Care Services) National Law (NSW) applies or a State regulated education and care service to which the Children (Education and Care Services) Supplementary Provisions Act 2011 applies. Approved services are subject to various operational requirements under that legislation, including requirements for the physical environment of the approved service.

Part 4 Schools – specific development controls

Principle 5 – amenity

Schools should include appropriate, efficient, stage and age appropriate indoor and outdoor learning and play spaces, access to sunlight, natural ventilation, outlook, visual and acoustic privacy, storage and service areas.

39 Existing schools – complying development

(4) Nothing in this clause authorises the carrying out of development in contravention of any existing condition of the most recent development consent (other than a complying development certificate) that applies to any part of the school, relating to hours of operation, noise, car parking, vehicular movement, traffic generation, loading, waste management, landscaping or student or staff numbers."

2.3 NSW EPA'S ENVIRONMENTAL NOISE CRITERIA

2.3.1 NOISE POLICY FOR INDUSTRY (NPFI)

Acoustic Dynamics advises that noise emission assessment at noise sensitive receivers within close proximity to the subject site, has been conducted with reference to relevant acoustic criteria and standards and has yielded the following information.

The newly implemented NSW Noise Policy for Industry (NPfI, 2017) has replaced the NSW Industrial Noise Policy (INP, 2000), with certain specific exceptions. Acoustic Dynamics advise that the following criteria have been applied for the assessment of the mechanical plant associated with the proposed residential development.

Project Intrusiveness Noise Level

The intrusiveness noise level is determined as follows:

$L_{Aeq,\ 15min}$ = rating background noise level + 5 dB	
where:	
$L_{Aeq,\ 15min}$	represents the equivalent continuous (energy average) A-weighted sound pressure level of the source over 15 minutes.
and	
Rating background noise level	represents the background level to be used for assessment purposes, as determined by the method outlined in Fact Sheets A and B.

Project Amenity Noise Level

The recommended amenity noise levels represent the objective for **total** industrial noise at a receiver location, whereas the **project amenity noise level** represents the objective for noise from a **single** industrial development at a receiver location.

To ensure that industrial noise levels (existing plus new) remain within the recommended amenity noise levels for an area, a project amenity noise level applies for each new source of industrial noise as follows:

Project amenity noise level for industrial developments = recommended amenity noise level (Table 2.2) minus 5 dB(A)

The following exceptions to the above method to derive the project amenity noise level apply:

"*4. Where cumulative industrial noise is not a necessary consideration because no other industries are present in the area, or likely to be introduced into the area in the future. In such cases the relevant amenity noise level is assigned as the project amenity noise level for the development."*

To establish the acoustic environment at the subject site in accordance with the guidelines of the NSW EPA's NPfI, two (2) unattended noise loggers were deployed between Tuesday 23 July 2019 and Tuesday 30 July 2019. The loggers were deployed within the front yard of 26 Bancroft Avenue and the eastern boundary of 37 Bancroft Ave (directly adjacent to 39 Bancroft Avenue).

Acoustic Dynamics advises the selected locations are representative of the existing noise environment of the nearest receivers to the subject development site. In addition, short-term operator-attended background noise measurements were undertaken at various locations surrounding the site to supplement unattended background noise monitoring data collected. Measurement locations are presented within **Appendix A**.

Following the general procedures outlined in the EPA's NPfI, a summary of the established noise environment, and relevant environmental noise criteria is presented in **Table 2.1**.

Acoustic Dynamics advises that the assessment has been based on the **lowest** background noise levels in the area during typical **maximum** operations of the proposed development. Acoustic Dynamics advises that such an assessment is conservative and will ensure no loss of amenity to the nearby residential receivers.

Table 2.1 Summary of Measured Noise Levels and Noise Emission Criteria – At Residences

Location	Time of Day	L_{A90} Rating Background Noise Level (RBL) [dB]	Measured L_{Aeq} [dB]	Project Intrusive Noise Level [dB]	Project Amenity Noise Level[2] L_{Aeq} [dB]	Project Noise Trigger Level L_{Aeq} [dB]
Location 1 Southern Boundary of 26 Bancroft Ave	Daytime[1] (7am to 6pm)	38	53	43	58	**43**
	Evening (6pm to 10pm)	36	52	41	48	**41**
	Night time (10pm to 7am)	31	47	36	43	**36**
Location 2 Eastern Boundary of 37 Bancroft Ave	Daytime[1] (7am to 6pm)	36	50	41	58	**41**
	Evening (6pm to 10pm)	37	47	42	48	**42**
	Night time (10pm to 7am)	31	43	36	43	**36**
School Classroom (Internal)	Daytime	-	-	35	-	**35**[3]

Note: 1) 8am to 6pm on Sundays and public holidays

2) Amenity adjustment based on "Suburban" receiver type (Table 2.3 of the NPfI). The noise emission objective has been modified in accordance with the recommendations detailed within the NPfI Section 2.2, for time period standardising of the intrusiveness and amenity noise levels ($L_{Aeq,15min}$ will be taken to be equal to the **$L_{Aeq,\ period}$ + 3 decibels (dB).**

3) Denotes internal noise level criteria for a school.

The EPA's NPfI specifies additional noise emission level corrections that should be applied when a noise source is determined to include "modifying factors" that can vary the perceived intrusiveness of a noise source. Such modifying factors include tonal, low frequency, impulsive, or intermittent noise.

2.4 PROTECTION OF THE ENVIRONMENT OPERATIONS (POEO) ACT 1997

In addition to the noise emission requirements of Ku-ring-gai Council, we advise that noise emission from the proposed development must also comply with the requirements of the relevant legislation, being the Protection of the Environment Operations (POEO) Act 1997. The POEO Act 1997 requires that the noise emission associated with the proposed development must not generate "offensive noise". Offensive noise is defined as follows:

> *"**Offensive noise**" means noise:*
>
> *(a) that, by reason of its level, nature, character or quality, or the time at which it is made, or any other circumstances:*
>
> *(i) is harmful to (or is likely to be harmful to) a person who is outside the premises from which it is emitted, or*
> *(ii) interferes unreasonably with (or is likely to interfere unreasonably with) the comfort or repose of a person who is outside the premises from which it is emitted, or*
>
> *(b) that is of a level, nature, character or quality prescribed by the regulations or that is made at a time, or in other circumstances, prescribed by the regulations."*

2.5 SLEEP DISTURBANCE

Acoustic Dynamics advises that sleep disturbance is a complex issue, and the potential for sleep disturbance to occur depends on both the level of noise at a sensitive receiver, and the number of events that occur.

The NSW EPA has in the past investigated overseas and Australian research on sleep disturbance. The method of assessing noise for sleep disturbance relies on the application of a screening that indicates the potential for this to occur. The EPA's *Noise Guide for Local Government*, provides the following guidance for such a screening test:

> *"Currently, there is no definitive guideline to indicate a noise level that causes sleep disturbance and more research is needed to better define this relationship. Where likely disturbance to sleep is being assessed, a screening test can be applied that indicates the potential for this to occur. For example, this could be where the subject noise exceeds the background noise level by more than 15 dB(A). The most appropriate descriptors for a source relating to sleep disturbance would be $L_{A1(1\ minute)}$ (the level exceeded for 1% of the specified time period of 1 minute) or L_{Amax} (the maximum level during the specified time period) with measurement outside the bedroom window."*

Additionally, the guidelines of the NSW EPA's NPfI provide the following additional information:

> *"Where the subject development/premises night-time noise levels at a residential location exceed:*
>
> - $L_{Aeq,15min}$ *40 dB(A) or the prevailing RBL plus 5 dB, whichever is the greater, and/or*
> - L_{AFmax} *52 dB(A) or the prevailing RBL plus 15 dB, whichever is greater".*

Further to the above information, the following summarizes the sleep disturbance criterion:

L_{Amax} or $L_{A1(1\ minute)} < L_{A90}$ + 15 dB(A)

In addition to the above, the NSW EPA has previously published the following additional information relating to findings of significant research carried out for sleep disturbance:

> *"Maximum internal noise levels below 50-55 dBA are unlikely to cause awakening reactions… One or more noise events per night, with maximum internal noise levels of 65-70 dBA, are not likely to affect health and wellbeing significantly."*

Sleep Disturbance Criterion = 52 dB(A)

2.6 AAAC'S GUIDELINE FOR EDUCATIONAL FACILITIES

The Association of Australasian Acoustical Consultants provides within *"AAAC Guideline for Educational Facilities"* (Version 2.0 January 2018), the following provisions relating to the acoustical quality of educational facilities:

> ***"Objectives***
>
> ***Acoustical Design Conditions***
>
> *The AAAC recommends that the following qualities should be achieved in teaching spaces and associated areas in educational facilities:*
>
> - *Appropriate background noise levels;*
> - *Reverberation times appropriate to the room use and function;*
> - *Good signal-to-noise rations (S/N);*
> - *Minimum disturbance or distraction from nearby or adjacent activities, or external noise sources.*
>
> *For good acoustical design, it is important to achieve a balance of performance across all these design attributes.*
>
> ***Acoustical Design of Educational Facilities***
>
> ***Internal Ambient Noise Levels***
>
> *Internal ambient noise levels are generally determined by two different noise sources:*

- *Building services noise involves noise from ventilation and air-conditioning services and any other equipment associated with the operation of the facility such as plumbing services;*
- *External noise intrusion is most commonly caused by transportation systems such as road, rail or air traffic. It may also include noise from nearby industry, commerce and residential buildings. Other school activities such as sport may generate noise intrusion.*

Achieving suitable Internal noise levels in educational facilities will require the following actions:

- *Assessment of noise levels from building services equipment, with control of noise from this equipment being considered at the design stage;*
- *An assessment of noise levels from external noise sources should be conducted with:*
  - *the building envelope being designed to provide a defined limit for the ingress of external noise;*
  - *internal walls/ceilings constructed to allow separate school room functions and activities.*

Suitable noise levels are measured using the descriptors in AS/NZS 2107-2016.

Acoustic Design Criteria

It is important that all acoustical factors be considered holistically in the design and construction of educational facilities. Accordingly, the acoustical performance criteria for background noise (which includes both external noise intrusion and sound insulation) and reverberation time, must both be satisfied to achieve a suitable learning environment in the classroom.

Recommended acoustic design criteria for main learning and auxiliary spaces in educational facilities are provided in tables below. Table 1 identifies the particular table holding each type of criterion.

Table 2 – Recommended internal noise levels and reverberation times

Room	***Design level range for internal ambient noise level, L_{Aeq} (dB)***	***Reverberation time Maximum time, (s) T_{60}***
Atria (for circulation, not teaching)	*40-50*	*≤1.5*
Art / craft studios	*40-45*	*≤0.8*
Assembly halls up to 250 seats	*30-40*	*0.6-0.8*
Assembly halls over 250 seats	*30-35*	*
Audio-visual areas	*35-45*	*0.6-0.8*
Cafeterias	*45-50*	*≤1.0*
Computer rooms – Teaching	*40-45*	*0.4-0.6*
Computer rooms – Laboratories	*45-50*	*0.4-0.6*
Conference room	*35-40*	*0.6-0.7*
Corridors and lobbies	*≤50*	*≤0.8*
Dance Studios	*35-40*	*

Room	Design level range for internal ambient noise level, L_{Aeq} (dB)	Reverberation time Maximum time, (s) T_{60}
Drama Studios	35-40	*
Engineering workshops – Teaching	≤45	**
Engineering workshops – Non-Teaching	≤60	**
Gymnasia / indoor sports	≤45	*
Weight training / fitness room	≤50	≤1.0
Interview / counselling rooms	40-45	0.3-0.6
Laboratories – Teaching	35-45	0.5-0.8
Laboratories – Working	40-50	0.5-0.8
Lecture rooms – up to 50 seats	30-35	*
Lecture theatres – without speech reinforcement and more than 50 seats	30-35	*
Lecture theatres – with speech reinforcement	30-40	*
Libraries – General areas	40-50	<0.6
Libraries – Reading areas	40-45	<0.6
Manual arts workshops	≤45	*
Medical rooms (First aid)	40-45	0.5-0.7
Music practice rooms	35-45	*
Music studios	30-35	*
Nursery / pre-school – Play rooms	35-40	≤0.6
Nursery / pre-school – Quiet rooms	≤35	≤0.6
Office areas	40-45	0.4-0.7
Professional and administrative offices	35-40	0.6-0.8
Teaching spaces – Open plan	≤40	≤0.6
Teaching spaces – Primary schools	35-40	≤0.6
Teaching spaces – Secondary schools	35-40	≤0.6
Teaching spaces – Hearing impaired	≤30	≤0.4
Staff common rooms	40-45	≤0.6
Staff studies / collegiate	40-45	0.4-0.6
Toilet/ change / showers	≤55	-
Swimming pools	50-60	≤2.0

Notes: * The appropriate reverberation time shall be influenced by the use, volume and geometry of the space. Guidance from an acoustical engineer should be sought.

** Reverberation should be minimised for noise control.

Note that rain noise is excluded. For rain noise, the noise level at a rainfall of 25mm/hr should not exceed the upper extent of the noise level range in Table 2 by more than 5 dBA.

Room Temporal Response

Classrooms, in particular, should have the sound absorption distributed over the walls and part of the ceilings and as much acoustic diffusion introduced as possible using furniture, bookcases etc.

Table 3 – Airborne and impact sound insulation requirements

Room	***Sound insulation***		
	Source room impact generation	***Source room activity airborne noise generation***	***Receiving space noise tolerance***
Atria (for circulation, not teaching)	*Medium*	*Average*	*High*
Art / craft studios	*Medium*	*Average*	*Medium*
Assembly halls up to 250 seats	*High*	*Very High*	*Low*
Assembly halls over 250 seats	*High*	*Very High*	*Low*
Audio-visual areas	*Low*	*High*	*Low*
Cafeterias	*High*	*Very High*	*High*
Computer rooms – Teaching	*Low*	*Average*	*Medium*
Computer rooms – Laboratories	*Low*	*Average*	*Medium*
Conference room	*Low*	*High*	*Very Low*
Corridors and lobbies	*Medium*	*Average*	*High*
Dance Studios	*High*	*Very High*	*Medium*
Drama Studios	*Medium*	*High*	*Low*
Engineering workshops – Teaching	*High*	*High*	*High*
Engineering workshops – Non-Teaching	*High*	*High*	*High*
Gymnasia / indoor sports	*High*	*Very High*	*Medium*
Weight training / fitness room	*High*	*High*	*Medium*
Interview / counselling rooms	*Low*	*Low*	*Medium*
Laboratories – Teaching	*Low*	*Average*	*Medium*
Laboratories – Working	*Low*	*Average*	*Medium*
Lecture rooms – up to 50 seats	*Low*	*Average*	*Medium*
Lecture theatres – without speech reinforcement and more than 50 seats	*Low*	*Average*	*Low*
Lecture theatres – with speech reinforcement	*Low*	*High*	*Medium*
Libraries – General areas	*Medium*	*Average*	*Medium*
Libraries – Reading areas	*Low*	*Low*	*Low*
Manual arts workshops	*Medium*	*Average*	*Medium*
Medical rooms (First aid)	*Low*	*Low*	*Medium*

Room	Sound insulation		
	Source room impact generation	Source room activity airborne noise generation	Receiving space noise tolerance
Music practice rooms	Low	Very High	Low
Music studios	Low	Very High	Very Low
Nursery / pre-school – Play rooms	Medium	Average	Medium
Nursery / pre-school – Quiet rooms	Low	Low	Low
Office areas	Low	Average	Medium
Professional and administrative offices	Low	Average	Medium
Teaching spaces – Open plan	Low	Average	Low
Teaching spaces – Primary schools	Low	Average	Low
Teaching spaces – Secondary schools	Low	Average	Low
Teaching spaces – Hearing impaired	Low	Average	Low
Staff common rooms	Low	Low	Medium
Staff studies / collegiate	Low	Low	Low
Toilet/ change / showers	Medium	Average	High
Swimming pools	Medium	High	High
Plant rooms	Low	High	High

Table 4 – Impact isolation ratings for floor/ceiling between vertically separated spaces , L'_{nTw} dB

Min L'_{nTw}		Sound insulation		
		Low	Medium	High
Noise tolerance in receiving room	High	70	65	60
	Medium	65	60	55
	Low	60	55	50*
	Very Low	55	50*	45*

*Notes: * Where high impact generating activities are to be located above spaces with low noise tolerance, consideration should be given to the relocating of one of the spaces. Specialist advice should be sought where very high impact activities, such as gymnasia, are to occur above a sensitive space.*

Table 5 – Sound insulation ratings for interfaces without pass doors*, D_w dB

Min D_w		Sound insulation			
		Low	Medium	High	Very High
Noise tolerance in receiving room	High	30	35	40	45
	Medium	35	40	45	50
	Low	40	45	50	55
	Very Low	45	50	55	60

*Notes: * Where doors are proposed between spaces consideration must be given to the placement and performance requirements of the door since ratings for doors with no acoustic treatment are not likely to exceed D_w 20 dB while standard solid core doors with full perimeter acoustic seals could achieve a rating up to D_w 30 dB.*

Table 6 – Speech Transmission Index ratings

Space	Lower limit STI*
Open plan teaching spaces	0.7
Auditoria	0.65
Gymnasia (sole use)	0.5
Multipurpose Hall	0.6

*Notes: * Measurements of STI must include the effects of reverberation and echo and the equivalent total noise level due to activity and noise ingress measured as L_{eq} in octave frequency bands."*

2.7 AUSTRALIAN STANDARDS

Acoustic Dynamics has conducted a review of relevant Australian Standards in relation to the subject development. The following details this review.

2.7.1 AS2107 "ACOUSTICS – RECOMMENDED DESIGN SOUND LEVELS"

Australian Standard 2107:2016 recommends satisfactory and maximum design sound levels for various types of occupancies within buildings. AS 2107 recommends the following design sound level ranges for the various types of occupancies and areas within and adjacent to the proposed development.

Table 2.2 Recommended Design Sound Levels for Different Areas of Occupancy in Buildings (Extract from Australian Standard 2107 Table 1)

Type of Occupancy / Activity	*Design Sound Level ($L_{Aeq,t}$) Range*	*Design Reverberation Time (T) Range, s*
1 EDUCATIONAL BUILDINGS		
Computer rooms -		
Teaching	*40 to 45*	*0.4 to 0.6*
Laboratories	*45 to 50*	*0.4 to 0.6*
Corridors and lobbies	*< 50*	*< 0.8*
Medical rooms (First Aid)	*40 to 45*	*0.6 to 0.8*
Weight training/Fitness room	*< 50*	*< 1.0*
Office areas	*40 to 45*	*0.4 to 0.7*
Professional and administrative offices	*35 to 40*	*0.6 to 0.8*
Teaching spaces/single classroom-		
Open plan teaching spaces	*35 to 45*	*Curve 3* (see Note 1)*
Primary schools	*35 to 45*	*Curve 3* (see Note 1)*
Secondary schools	*35 to 45*	*Curve 3**
Staff common rooms	*40 to 45*	*< 0.6*
Sports hall	*< 50*	*Curve 4**
Toilets/change/showers	*< 55*	*–*
7 RESIDENTIAL BUILDINGS		
Houses and apartments in inner city areas or entertainment districts or near major roads –		
Apartment common areas (e.g. foyer, lift lobby)	*45 to 50*	*–*
Living areas	*35 to 45*	*–*
Sleeping areas (night time)	*35 to 40*	*–*
Work areas	*35 to 45*	*–*

Note 1) Reverberation time should be minimized as far as practical for noise control.

2.7.2 AUSTRALIAN STANDARD 3671:1989

Australian Standard 3671 "*Acoustics - Road Traffic Noise Intrusion - Building Siting and Construction*" concerns the reduction of road traffic noise intrusion in buildings in areas near new or upgraded freeways, tollways, major roads and national routes or other roads carrying more than 2000 vehicles per day. The standard may also be used to assess the acoustical adequacy of existing buildings in similar areas. The standard provides methodology for the assessment of noise intrusion from road traffic and guidance for determining the type of building construction necessary to achieve acceptable noise levels indoors, for different types of occupancy.

2.8 NSW DEPARTMENT OF EDUCATIONS' "EDUCATIONAL FACILITIES STANDARDS AND GUIDELINES" (EFSG)

The NSW Department of Education provides within *"Educational Facilities Standards and Guidelines"* (EFSG), a design guide for the acoustical quality of educational facilities, being DG11. This document follows closely the recommended design levels and parameters previously detailed within **Section 2.5** and **Section 2.6**, with the following a list of the differences:

> *"Rain noise is to be assessed for general learning areas, music, drama, movement studios and halls or as otherwise directed. Rain is to be assessed using the one-year annual recurrence, one-hour event for the region as reported by the Bureau of Meteorology. A recognised rain noise calculation procedure (such as Dubout, 1969 or Griffin, Ballagh, 2012) shall be used.*
>
> *Prescriptive Constructions*
>
> *The following elements have prescriptive acoustic performance or construction requirements:*
>
> - *Operable walls (between general learning areas, all schools): R_w 45*
> - *Entry doors to occupied teaching, music, drama and sporting spaces: Solid core, minimum 35 mm thick with acoustic weather (where external) seals on all rebated closing faces. Gap at floor to be minimised.*
> - *Internal glazed sections in walls and vision panels in or adjacent to internal doors: minimum 10.38 mm laminated glass. In some situations acoustic windows may be needed for satisfactory noise separation.*
> - *Construction separating wastewater pipework from occupied spaces: R_w 40*
> - *Where adjacent to an occupied space (and not serving that space), hydraulic supply pipework and wastewater pipework shall be separated from the adjacent occupied space. Construction between the adjacent spaces in this instance shall be a 'staggered stud' arrangement or otherwise discontinuous.*

Table 11.06.1 – Guidelines on internal noise levels and reverberation times

Room	***Internal noise level (dB L_{Aeq})***	***Reverberation time, s $RT_{60(Av\ 500Hz\ and\ 1000Hz)}$***
Art/craft studios	*40*	*<0.8*
Assembly halls up to 250 seats	*35*	*see Note 1*
Assembly halls over 250 seats	*35*	*see Note 1*
Audio-visual areas	*35*	*<0.8*
Computer rooms - Teaching	*40*	*<0.6*
Computer rooms - Laboratories	*45*	*<0.6*
Conference room	*35*	*<0.7*
Corridors and lobbies	*45*	*Minimise*
Dance Studios	*40*	*<1.2*
Dining rooms	*45*	*<1*
Drama Studios	*30*	*<1*
Duplicating rooms/stores	*50*	*-*

Room	Internal noise level (dB L_{Aeq})	Reverberation time, s $RT_{60(Av\ 500Hz\ and\ 1000Hz)}$
Engineering workshops	*50*	*Minimise*
Gymnasiums	*40*	*<1.5*
Interview/counselling rooms	*35*	*<0.6*
Kitchens	*50*	*-*
Laboratories - Teaching	*40*	*<0.7*
Laboratories - Working	*45*	*<0.8*
Lecture rooms - up to 50 seats	*35*	*see Note 1*
Lecture theatres - without speech reinforcement and >50 seats	*30*	*see Note 1*
Lecture theatres - with speech reinforcement	*35*	*see Note 1*
Libraries - General areas	*40*	*<0.6*
Libraries - Reading areas	*35*	*<0.6*
Libraries - Stack areas	*45*	*<0.6*
Manual arts workshops	*40*	*Minimise*
Medical rooms (First aid)	*40*	*<0.8*
Music practice rooms	*35*	*see Note 1*
Music studios	*30*	*see Note 1*
Office areas	*40*	*<0.8*
Open plan teaching areas	*40*	*<0.8*
Professional and Administrative offices	*35*	*<0.8*
Staff common rooms	*40*	*<0.6*
Study Rooms	*35*	*<0.8*
Teaching spaces – Hearing impaired	*30*	*<0.4*
Teaching spaces – Primary schools	*35*	*<0.5*
Teaching spaces – Secondary schools	*35*	*<0.6*
Toilet/change/showers	*50*	*-*

Table 11.06.2 – Guideline airborne and impact sound insulation requirements

Room	Source room activity noise	Receiving room noise tolerance	Impact sound insulation rating (L'_{nTw})
Art/craft studios	*Average*	*Medium*	*60*
Assembly halls up to 250 seats	*High*	*Low*	*60*
Assembly halls over 250 seats	*High*	*Low*	*60*
Audio-visual areas	*High*	*Low*	*60*
Computer rooms - Teaching	*Average*	*Low*	*60*
Computer rooms - Laboratories	*Average*	*Medium*	*60*
Conference room	*Average*	*Low*	*55*
Corridors and lobbies	*Average*	*High*	*65*
Dance Studios	*High*	*Very low*	*55*

Room	Source room activity noise	Receiving room noise tolerance	Impact sound insulation rating (L'_{nTw})
Dining rooms	*High*	*Medium*	*65*
Drama Studios	*High*	*Very low*	*55*
Duplicating rooms/stores	*High*	*High*	*65*
Engineering workshops	*High*	*High*	*65*
Gymnasiums	*High*	*Medium*	*65*
Interview/counselling rooms	*Average*	*Low*	*55*
Kitchens	*High*	*High*	*-*
Laboratories - Teaching	*Average*	*Low*	*60*
Laboratories - Working	*Average*	*Medium*	*65*
Lecture rooms - up to 50 seats	*Average*	*Low*	*55*
Lecture theatres - without speech reinforcement and >50 seats	*Average*	*Very low*	*50*
Lecture theatres - with speech reinforcement	*Average*	*Low*	*50*
Libraries - General areas	*Low*	*Low*	*55*
Libraries - Reading areas	*Low*	*Low*	*55*
Libraries - Stack areas	*Average*	*Medium*	*55*
Manual arts workshops	*Average*	*Medium*	*65*
Medical rooms (First aid)	*Average*	*Low*	*60*
Music practice rooms	*Very high*	*Low*	*55*
Music studios	*Very high*	*Very low*	*50*
Office areas	*Low*	*Low*	*55*
Open plan teaching areas	*Average*	*Medium*	*55*
Plant Room	*High*	*High*	*-*
Professional and administrative offices	*Low*	*Low*	*60*
Staff common rooms	*Average*	*Medium*	*60*
Study Rooms	*Low*	*Low*	*55*
Teaching spaces – Hearing impaired	*Average*	*Very low*	*50*
Teaching spaces – Primary schools	*Average*	*Low*	*55*
Teaching spaces – Secondary schools	*Average*	*Low*	*55*
Toilet/change/showers	*Average*	*High*	*-*

Table 11.06.3 – Sound insulation requirements (minimum design R_w) for adjacent rooms without operable walls, entry doors or glazed panels

Activity noise in source room				
	Low	***Average***	***High***	***Very high***
High	*30*	*35*	*45*	*55*
Medium	*35*	*40*	*50*	*55*
Low	*40*	*45*	*55*	*55*
Very low	*45*	*50*	*55*	*60*

2.9 INSTRUMENTATION & MEASUREMENT STANDARDS

All noise measurements are conducted in accordance with Australian Standard 1055.1-1997, *"Acoustics - Description and Measurement of Environmental Noise Part 1: General Procedures"*. Acoustic Dynamics' sound measurements are conducted using precision sound level meters conforming to the requirements of IEC 61672-2002 *"Electroacoustics: Sound Level Meters – Part 1: Specifications"*. The survey instrumentation used during the survey is set out in **Table 2.3**.

2.3 Noise Survey Instrumentation

Type	Serial Number	Instrument Description
2270	2664115	Brüel & Kjaer Modular Precision Sound Level Meter
4189	2650956	Brüel & Kjaer 12.5 mm Prepolarised Condenser Microphone
4230	909240	Brüel & Kjaer Acoustic Calibrator
XL2	A2A-05048-E0	NTI Audio XL2 Environmental Noise Logger
XL2	A2A-05090-E0	NTI Audio XL2 Environmental Noise Logger

The reference sound pressure level was checked prior to and after the measurements using the acoustic calibrator and remained within acceptable limits.

3 EXTERNAL NOISE INTRUSION ASSESSMENT

3.1 EXTERNAL NOISE INTRUSION ASSESSMENT

Based on the measured noise levels at the subject site (as shown in **Table 2.1**) Acoustic Dynamics has calculated the maximum external noise level, shown in **Table 3.1** below, at the most exposed facade of the proposed development.

Table 3.1 Measured Maximum $L_{Aeq(1\ hr)}$ Noise Levels

Measurement Location	Time of Day	Maximum Measured $L_{Aeq(1\ hr)}$ Noise Level[1] [dB]
26 Bancroft Ave (Southern Fence)	Daytime (7am – 10pm)	57
	Night-time (10pm – 7am)	56
37 Bancroft Ave (Eastern Fence)	Daytime (7am – 10pm)	57
	Night-time (10pm – 7am)	50

Note: 1) Measured noise levels at 1.5m above relative first floor height and a minimum of 1m from a facade.

In addition to the existing road traffic noise levels, Acoustic Dynamics has calculated the potential external noise levels due to vehicle movements within the Level 1 and Level 2 carparks and driveways: (**$L_{Aeq(1\ hr)}$ = 67 dB)**.

Acoustic Dynamics has been provided with the (vehicle) trip surveys which determined the total number of site associated vehicle movements during the morning and afternoon peak periods. A total of 78 vehicle movements (50% inbound and 50% outbound) occur during the morning peak period (being 7:30am to 8:30am). A total of 71 vehicle movements occur during the afternoon peak period (being 3:15pm to 4:15pm).

Predicted vehicle noise levels have been determined based on an assumed 60 vehicle movements within a 15 minute time period, at an average distance of 2 metres from the nearest facades of the proposed development (southern and western), which is deemed to be a highly conservative **worst-case** scenario.

Acoustic Dynamics has conducted calculations to determine the minimum required component noise attenuation performance (R_w) for the various building components, to achieve the relevant required internal noise levels. The minimum required component R_w's are also detailed in **Table 3.2** below.

3.2 INTERNAL DESIGN SOUND LEVELS

The internal design sound level for a particular area of the subject development is the maximum permissible $L_{Aeq(1\ hour)}$ noise level within that area, with external windows and doors closed.

The internal design sound levels applicable to the critical areas of any educational facility developments have been determined in accordance with the criteria and guidelines are presented in **Table 3.2** below.

Acoustic Dynamics has used the highest measured maximum $L_{Aeq(1\ hour)}$ noise levels from **Table 3.1** above.

3.3 TRAFFIC NOISE ATTENUATION (TNA) AND R_W

The likely vehicle Traffic Noise Attenuation (TNA_c) and R_W for required components have been determined for the education facility. The likely TNA_c and R_w have been determined in accordance with the guidelines set out in Australian Standard 3671. The likely required TNA_c and R_W values are presented in **Table 3.2** below.

Table 3.2 Likely TNR, Component Noise Attenuation & R_w for Proposed Education Facility

Type of Area	Maximum Indoor Design Sound Level (windows closed) [dB][1]	Calculated Maximum External Noise Level [dB][2]	Required TNR [dB]	Required Component Traffic Noise Attenuation					
				Walls		Windows/ Glass Door		Roof (Top Floor Only)	
				TNA_c	R_w	TNA_c	R_w	TNA_c	R_w
Level 1									
Pool Hall	<50	67[3]	8	21	27	10	16	N/A	
Store Rooms	<55	67[3]	3	17	23	N/A	N/A	N/A	
Toilets and Change Rooms	<55	67[3]	3	11	17	N/A	N/A	N/A	
Foyer / Lift / Lobby / Stair	<50	67[3]	8	16	22	N/A	N/A	N/A	
Level 2									
GLA 01 to 04	35	67[3]	32	26	32	32	38	N/A	
Gym	<50	57	22	17	23	16	22	N/A	
Foyer / Lift / Lobby / Stair	<50	67[3]	18	26	32	N/A	N/A	N/A	
Level 3									
GLA 05 to 08	35	67[3]	32	26	32	32	38	35	41
Food Technology Room	35	67[3]	32	26	32	32	38	34	40
Breakout Space	35	57	22	23	29	20	26	24	30
All other Rooms – Standard facade construction will be adequate to achieve internal sound level criteria.									

Note: 1) Indoor design sound level based on AS2107 and NSW EFSG recommended design sound level for spaces near roads.

2) The Calculated Maximum External (Road) Traffic Noise Levels are $L_{Aeq(1\ hr)}$ noise levels, based on the measured daytime/night-time noise levels, and include adjustments to take account of distance losses and shielding.

3) Calculated external road traffic noise level determined based on an assumed 60 vehicle movements within a 15 minute time period within the driveways and carpark areas, at an average distance of 2 metres from the nearest facades (southern, western and northern).

The Australian Standard 3671 provides the following note:

> *"Either STC or R_W may be used as a guide to the selection of components able to provide a desired TNA_c value, provided that approximate allowance is made for the spectral composition of the noise as follows-*
>
> $$TNA_c \approx R_w - 6 \text{ or } R'_w - 6"$$

During peak periods of high traffic noise levels, the calculated noise levels within some of the rooms for any potential development may exceed the relevant internal noise level criteria by more than 10 dB, with the windows and/or glass doors open.

Acoustic Dynamics advises that air-conditioning should be installed to service any proposed development. This will provide the option for mechanical ventilation of the development, and provide building occupants with the option to leave external doors and windows closed, during peak periods of high traffic noise levels.

3.3.1 RAIN NOISE ASSESSMENT

In accordance with the requirements of NSW EFSG, rain noise has been assessed for all relevant areas of the development. Rain noise was assessed using the one year annual recurrence (using data from 2017, 2018 and 2019) as reported by the Bureau of Meteorology.

The **worst-case** scenario 1 hour rainfall event for the development site was calculated using the methodology as prescribed within ISO 140-18:2006, and was determined to be approximately **10-15mm per hour**.

Construction systems and materials should be selected to provide the required design noise reduction shown in **Table 3.3** and to adequately mitigate rain noise, for the respective areas within the development.

4 RECOMMENDED DESIGN – ROAD TRAFFIC NOISE INTRUSION

Acoustic Dynamics advises that at this stage, a detailed construction design for the development is yet to be resolved. Acoustic Dynamics' analysis and prediction calculations indicate the following recommendations should be incorporated into the proposed design of the development, as a minimum, to ensure that the internal design sound levels are achieved in relation to external (road traffic) noise intrusion and typical worst-case 1 hour rain events (10-15mm per hour).

A review of the detailed construction and design can be conducted prior to the construction certification.

4.1 EXTERNAL WALL SYSTEMS

Acoustic Dynamics understands that the external wall system for the proposed development is proposed to be a mixture of 200mm AFS Logic Wall, insulated cavity brick and lightweight construction. The following table details the minimum proposed external wall construction that will ensure compliance with the internal design sound levels and objectives is achieved.

Table 4.1 Proposed Logic Wall Construction for External Wall System[1] ($R_w + C_{tr} \geq 32$)

External Wall Leaf
1. Minimum 120mm AFS Logic Wall; to
2. Rondo furring channel No 129 and Betagrip clips; to
3. 1 layer of 13mm Gyprock Standard Plasterboard.

Note. 1) Wall system based on CSR System Number **5430**.

Table 4.2 Proposed Brick Construction for External Wall System[1] ($R_w + C_{tr} \geq 32$)

External Wall Leaf
1. 90mm thick brickwork; to
2. 1 layer of Bradford Wallwrap sarking (or equivalent); with
Cavity
3. 40mm minimum cavity; to
Internal Wall Leaf
4. Steel studs at 600mm maximum centres; with
5. 75mm Acoustigard R1.7; to
6. 1 layer of 10mm Gyprock Plus Plasterboard.

Note. 1) Wall system based on CSR System Number **5403(a)**.

Table 4.3 Proposed Light Weight Construction for External Wall System[1] ($R_w + C_{tr} \geq 32$)

External Wall Leaf
1. Cemintel Weatherboard (or equivalent); with
2. 1 layer of Bradford Wallwrap sarking (or equivalent); with
3. Cemintel Thermal break; with
Insulation
4. 75mm Acoustigard R1.7; to
Internal Wall Leaf
5. Steel studs at 600mm maximum centres; with
6. 1 layer of 10mm Gyprock Plus Plasterboard.

Note. 1) Wall system based on CSR System Number **5026(a)**.

The wall systems detailed within **Table 4.1**, **Table 4.2** and **Table 4.3** above will achieve the minimum required design sound transmission performance and will ensure compliance with the internal design sound levels.

4.2 ROOF SYSTEM

Acoustic Dynamics understands that the proposed roof construction for the development is to be of metal construction or suspended concrete. The following tables detail the proposed construction that will ensure the internal design sound levels are achieved. In addition, the proposed construction will achieve compliance with the internal design sound levels and objectives during a typical **worst-case** scenario 1 hour rainfall event (10-15mm per hour).

Table 4.4 Recommended Metal Roof Construction for Roof System[1] ($R_w + C_{tr} \geq 41$)

External
1. Selected metal roof sheeting (minimum 0.42mm BMT); to 2. Bradford Anticon 60 MD insulation over purlins; to 3. 150mm timber or steel purlins; with
Insulation
4. Minimum 165mm Bradford Gold Batts 3.0; with
Internal
5. Rondo Furring Channel at 600mm maximum centres; with 6. 2 layers of 16mm Gyprock Fyrcheck plasterboard (in learning spaces); or 7. 1 layer of 13mm Gyprock Fyrcheck plasterboard (in all other spaces)

Note. 1) Wall system based on CSR System Number **6644(a)**.

Table 4.5 Recommended Concrete Roof Construction for Roof System[1] ($R_w + C_{tr} \geq 41$)

External
1. Minimum 150mm thick concrete slab; with 2. Clips direct fixed to concrete slab at 1200mm centres; to
Cavity
3. Minimum 40mm thick cavity; with
Internal
4. Rondo Furring Channel No 129 at 450mm maximum centres; to 5. 1 layer of 10mm Gyprock Plus Plasterboard.

Note. 1) Wall system based on CSR System Number **6303(a)**.

The proposed roof systems detailed within **Table 4.4** and **Table 4.5** above will achieve the minimum required design sound transmission performance and will ensure compliance with the internal design sound levels.

4.3 WINDOWS / GLASS DOORS

The following table sets out the minimum required glazing for the windows and glass doors throughout the proposed development to ensure that the internal design sound levels are achieved.

Table 4.6 Window & Glass Door Glazing Thickness Schedule

Area	Window	Required R_W	Minimum Glazing Recommended[1]	
			Option 1	Option 2
Pool Hall	Facade Glazing	16	6.38mm Vlam	6mm Monolithic
	Skylights	16	6.38mm Vlam	6mm Monolithic
GLA 01-04	Facade Glazing	38	12.5mm Vlam Hush	**Double Glazing** 8mm VFloat / 16mm Gap / 10.5mm Hush
Gym	Facade Glazing	16	6.38mm Vlam	6mm Monolithic
GLA 05-08	Facade Glazing	38	12.5mm Vlam Hush	**Double Glazing** 8mm VFloat / 16mm Gap / 10.5mm Hush
Food Technology Room	Facade Glazing	38	12.5mm Vlam Hush	**Double Glazing** 8mm VFloat / 16mm Gap / 10.5mm Hush
Breakout Space	Facade Glazing	26	6.38mm Vlam	6mm Monolithic

Note: 1) Minimum glazing has been specified to meet acoustic requirements. Acoustic Dynamics advises that some windows/glass doors may also need to meet applicable safety standards. Additional advice should be sought to verify such requirements.

Acoustic Dynamics advises that the installation of all windows, glass doors and skylights must ensure an adequate acoustic (air tight) seal when closed. Any sound flanking paths around the windows must be sealed to provide adequate acoustic insulation. All gaps between the window frame and the wall structure should be sealed using polystyrene rods and silicone mastic sealant, prior to the fitting of architraves.

It is advised that the acoustic performance of the selected windows frames should be confirmed with the suppliers, to ensure that the glazing and frame systems will achieve the minimum acoustic performance levels (R_w) recommended in **Table 4.6** above.

Note is made that the glazing specified within **Table 4.6** is for the best available, physically feasible glazing solutions, however the glazing specified and resulting internal noise levels may fall marginally short of the required internal noise levels. Such a shortfall is likely to be acoustically insignificant.

5 EXTERNAL NOISE EMISSION ASSESSMENT

5.1.1 EXTERNAL NOISE EMISSION ASSUMPTIONS

The following section provides an assessment of the maximum noise emission associated with the use of the proposed educational facility, at the subject site boundary, against the various noise criteria and objectives outlined in **Section 2** above.

Acoustic Dynamics advises that no specific mechanical plant has been determined at this stage of the development. The assessment includes noise emission associated with mechanical plant (such as the items listed within **Table 5.1** below) which have been modelled as venting to the south-western corner of the proposed rooftop sporting area at a height of 1.2 metres above the relative ground level at Level 3 (see mark-up in **Appendix A**).

In addition, the pool heating pumps are to be installed within an external plant room, located on the south eastern corner of the development. Acoustic Dynamics has conducted noise emission calculations inclusive of the pool pumps located within an external pool pump enclosure (with a louvred facade).

Once detailed mechanical plant specifications have been determined, noise emission resulting from the operation of the subject mechanical plant can be appropriately conditioned to protect the acoustic amenity of the adjacent sensitive receivers.

Accordingly, Acoustic Dynamics has undertaken calculations and modelling to assess the **maximum** external noise emission levels associated with the following noise sources and equipment proposed to be installed for the development:

Table 5.1Assumed Noise Levels of Various Noise Sources

Noise Source	Noise Level	Operating Period
Carpark Supply Fan (ducted to rooftop)	SWL = 75 dB	24 hours
Carpark Exhaust Fan (ducted to rooftop)	SWL = 75 dB	24 hours
Pool Hall Supply Fan (ducted to rooftop)	SWL = 75 dB	24 hours
Pool Hall Exhaust Fan (ducted to rooftop)	SWL = 75 dB	24 hours
Plant Room Supply Fan (ducted to rooftop)	SWL = 75 dB	24 hours
Plant Room Exhaust Fan (ducted to rooftop)	SWL = 75 dB	24 hours
Change Rooms Supply Fan (ducted to rooftop)	SWL = 75 dB	24 hours
Change Rooms Exhaust Fan (ducted to rooftop)	SWL = 75 dB	24 hours
2 x Pool Pumps Located Within an External Enclosure	SWL = 90 dB (per pump)	24 hours
Staff/Student/Parent Ingress Egress[1]	$L_{Aeq15minute}$ = 60 dB	Monday to Friday, 7:30am to 10:15pm and Saturday 7:00am to 2:00pm
Vehicle Movements / Passby (60 per 15 minutes)[2]	$L_{Aeq15minute}$ = 77 dB	

Note. 1) Acoustic Dynamics understands that access to the development will primarily be through the existing doors located on the southern side of the development (from Recreation Avenue).

2) Acoustic Dynamics understands that there is no expectation for vehicles to park on the surrounding streets and vehicles will be accessing the onsite car parks via Recreation Avenue.

In addition, Acoustic Dynamics has previously carried out short-term operator-attended noise measurements representative of the noise emitted from the sporting activities proposed on the subject site. Such noises include raised speech, laughter, crowd noise, ball impacts, blown whistles and players during a competition.

The following table presents a summary of the various measured noise levels of representative activities associated with the use of similar sporting facilities and courts.

Table 5.2 Measured Noise Levels of Various Sporting Activities

Description of Noise Sources	Distance from Noise Source [m]	Measured $L_{Aeq(15min)}$ [dB]	Measured L_{A10} [dB]
Training session on 3 adjacent courts – coaches' raised voices dominant, occasional ball bounce (no blowing of whistles)	10	61	64
Netball competition games on 3 adjacent courts – frequent whistle blowing along perimeter of courts	10	72	72

5.1.2 EXTERNAL NOISE EMISSION RESULTS

The calculated maximum noise emission levels at the subject site boundary (external to the building), resulting from the use and operation of the various noise source items, are presented against the relevant noise emission objectives in **Table 5.3** and **Table 5.4** and include the acoustic benefit of mitigation measures and management practices as detailed within **Section 6.1**.

Note should be made that the calculated noise emission levels are based on **worst-case** scenarios for the various external noise sources (i.e. **maximum** number of noise sources operating at **maximum** capacity). Acoustic Dynamics advises that typical sound power levels have been used in the prediction of the noise emission and prior to installation all chosen equipment should be checked for suitability by a qualified acoustic consultant.

Acoustic Dynamics advises that the typical external noise emission generated by the use of the development is likely to be below the noise emission levels presented above.

Mechanical Emission Scenario - With External Pool Pump

Pool pumps (2) are located within an external enclosure located on the south-eastern corner of the development. Noise emission associated with the pool pump enclosure included the benefit of an acoustic louvre on the **southern** facade. All other items of mechanical plant are located within internal plant rooms and venting to the south-western corner of the roof top sporting area.

Table 5.3 Calculated Maximum External $L_{Aeq(15minute)}$ Noise Emission & Objectives (Night-Time Period)

Receiver Location	Activity / Noise Source[3]	Relevant Assessment Period	Calculated Maximum L_{Aeq} Noise Level[1] [dB]	L_{Aeq} Noise Emission Objective [dB]	Complies?
Residential Receivers at 26 to 32 Bancroft Ave (North)	Mechanical Plant	Night-time[2] (10pm to 7am)	25	**36**	**Yes**
	Ingress & Egress		17		
	Cumulative Total		**26**		
Residential Receivers at 39 Bancroft Ave (East)	Mechanical Plant	Night-time[2] (10pm to 7am)	31	**36**	**Yes**
	Ingress & Egress		21		
	Cumulative Total		**31**		
Residential Receivers at 23 Bancroft Ave (West)	Mechanical Plant	Night-time[2] (10pm to 7am)	11	**36**	**Yes**
	Ingress & Egress		2		
	Cumulative Total		**11**		
Residential Receivers at 33 to 41 Victoria St (South)	Mechanical Plant	Night-time[2] (10pm to 7am)	27	**36**	**Yes**
	Ingress & Egress		13		
	Cumulative Total		**27**		

Notes: 1) External noise emission levels calculated at the most affected boundary location to the relevant source
2) Compliance during night time assessment periods will also result in compliance during day and evening.
3) As rooftop sporting activities are to be ceased by 10:00pm, the associated noise emission has not been assessed during the night period.

Table 5.4 Calculated Maximum External $L_{Aeq(15minute)}$ Noise Emission & Objectives (Day/Evening Period)

Receiver Location	Activity / Noise Source	Relevant Assessment Period	Calculated Maximum L_{Aeq} Noise Level[1] [dB]	L_{Aeq} Noise Emission Objective [dB]	Complies?
Residential Receivers at 26 to 32 Bancroft Ave (North)	Mechanical Plant	Evening[2] (6pm to 10pm)	25	41	Yes
	Ingress & Egress		17		
	Rooftop Sport Activities (60 Participants)[3]		40		
	Cumulative Total		**40**		
Residential Receivers at 39 Bancroft Ave (East)	Mechanical Plant	Evening[2] (6pm to 10pm)	31	41	Yes
	Ingress & Egress		21		
	Rooftop Sport Activities (60 Participants)[3]		41		
	Cumulative Total		**41**		
Residential Receivers at 23 Bancroft Ave (West)	Mechanical Plant	Evening[2] (6pm to 10pm)	11	41	Yes
	Ingress & Egress		2		
	Rooftop Sport Activities (60 Participants)[3]		31		
	Cumulative Total		**31**		
Residential Receivers at 33 to 41 Victoria St (South)	Mechanical Plant	Evening[2] (6pm to 10pm)	27	41	Yes
	Ingress & Egress		13		
	Rooftop Sport Activities (60 Participants)[3]		27		
	Cumulative Total		**30**		

Notes: 1) External noise emission levels calculated at the most affected boundary location to the relevant source

2) Compliance during evening time assessment periods will also result in compliance during day and evening.

3) Activities modelled as groups of five participants (point sources) located on the rooftop at an average height of 1.5 metres above the court ground level. Each group of five participants has an assumed sound power level = 85 dB(A). Calculation is based on noise associated with half of all participants (i.e. 30) simultaneously emitting/generating maximum noise levels which is deemed to be highly conservative.

Acoustic Dynamics advises that the noise emission associated with the various noise sources is predicted to comply with the relevant noise emission criteria and requirements. We understand that an acoustic consultant is to be engaged to provide advice and certification when the specific items of mechanical plant are being or have been selected.

The noise emission levels are likely to be **significantly lower** than those presented above during a typical daily scenario.

We advise that noise emission associated with the use and operation of the subject development, when conditioned appropriately, will **achieve compliance** with the relevant noise emission criteria and requirements of Ku-ring-gai Council and the NSW EPA.

5.1.3 OFF-SITE ROAD TRAFFIC ACTIVITY

Calculated maximum noise emissions for off-site traffic are presented in **Table 5.5** below**.** The calculations are based on 60 vehicles per 15 minutes accessing the onsite car parks from Recreation Avenue to the south and include allowances for relevant distance, direction and shielding/topography losses.

Based on the provided traffic survey data, Acoustic Dynamics advise the vehicle pass-by numbers used in the assessment is a highly unlikely scenario. Conducting the traffic assessment with such a conservative methodology will ensure the acoustic amenity of neighbouring properties is protected even during a **worst-case** vehicle pass-by scenario.

Table 5.5 Vehicle Movement Noise Emission Levels and RNP Criterion

Receiver Location	Activity / Noise Source	Quietest Period Source Operates	Relevant $L_{Aeq(1hr)}$ Objective [dB]	Calculated Maximum $L_{Aeq(1hr)}$ Noise Level [dB]	Achieves Objective / Complies?
Nearest Residential Receivers along Bancroft Ave and Victoria St	Off-site Traffic	Night	50	47[1]	**Yes**

Note: 1) Calculated L_{Aeq} noise level is the maximum noise level within a 1 hour period between proposed operating hours (7am and 10:15pm).

Based on the above, Acoustic Dynamics advises that the noise emission due to traffic movements is predicted to achieve compliance the NSW EPA's Road Noise Policy.

NB. Acoustic Dynamics understands that there have been concerns voiced by local residents (along Bancroft Avenue) that there may an increase in noise levels due to the noise from traffic reflecting off the proposed northern facing facade.

Whilst there are likely to be reflections from the facade, due to the distance to the nearest receivers (approximately 30 metres) and the topography of the land, there will be no discernible increase in road traffic noise during a vehicle pass-by event at the nearest receiver properties.

5.2 SLEEP DISTURBANCE ASSESSMENT

Acoustic Dynamics has determined the potential maximum noise emission from the proposed development to be:

- **$L_{A1(60sec)}$ ≤ 43 dB** at the nearest residential receivers located to the east (residential receivers at 39 Bancroft Street);
- **$L_{A1(60sec)}$ ≤ 43 dB** at the nearest residential receivers located to the north (residential receivers at 26 to 32 Bancroft Street);
- **$L_{A1(60sec)}$ ≤ 40 dB** at the nearest residential receivers located to the west (residential receivers at 23 Bancroft Street); and
- **$L_{A1(60sec)}$ ≤ 35 dB** at the nearest residential receivers located to the south (residential receivers at Victoria Street).

These activities assessed include the slamming of car doors within the carpark, during the night time shoulder period (10:00pm to 10:15pm).

These activities achieve compliance with the EPA's sleep disturbance screening criterion of **$L_{A1(60sec)}$ ≤ 52 dB** during night-time shoulder hours. It is advised that calculations are based on noise emission from a closed car door within the car parks located on the development site and includes the acoustic benefit of shielding provided by the development layout.

Acoustic Dynamics advises that although there may be car door slamming events that exceed the external $L_{A1(60sec)}$ objective (**$L_{A1(60sec)}$ ≤ 52 dB**) at the nearest residential receivers, the maximum instantaneous internal noise levels are predicted to comply with the NSW EPA internal noise guideline (**$L_{A1(60sec)}$ ≤ 50-55 dB(A)**) and is unlikely to cause awakening reactions.

6 RECOMMENDATIONS – EXTERNAL NOISE EMISSION

6.1 MECHANICAL PLANT

Detailed mechanical plant specifications are yet to be determined, however Acoustic Dynamics advises that all mechanical plant has been modelled using typical plant sound power levels (SWL). Acoustic Dynamics recommends that mechanical plant associated with the operation of the proposed education facility incorporates the following:

1. Car park exhaust outlet vents should not exceed a total sound pressure level (SPL) at 1m of **61 dB(A)**;
2. Car park supply inlet vents should not exceed a total sound pressure level (SPL) at 1m of **61 dB(A)**;

3. Pool hall exhaust outlet vents should not exceed a total sound pressure level (SPL) at 1m of **61 dB(A)**;

4. Pool hall supply inlet vents should not exceed a total sound pressure level (SPL) at 1m of **61 dB(A)**;

5. Plant room exhaust outlet vents should not exceed a total sound pressure level (SPL) at 1m of **61 dB(A)**;

6. Plant room supply inlet vents should not exceed a total sound pressure level (SPL) at 1m of **61 dB(A)**;

7. Change room exhaust outlet vents should not exceed a total sound pressure level (SPL) at 1m of **61 dB(A)**;

8. Change room supply inlet vents should not exceed a total sound pressure level (SPL) at 1m of **61 dB(A)**;

9. We would recommend installation of silencers to achieve the necessary sound level reduction at each vent. The silencers should have a minimum insertion loss of 10 dB, however this can be confirmed during the detailed mechanical design; and

10. Where feasible, all exhaust and supply vents should be orientated toward the west (away from nearby sensitive receivers).

Acoustic Dynamics advises that based on the proposed pool pump noise emission data, the sealed external enclosure must be designed to the following minimum specification:

1. The sealed acoustic enclosure should extend from the floor to minimum 1 metre above the highest installed pool pump and should be continuous from the adjacent facade of the development;

2. The facades and ceiling of the enclosure must provide a minimum surface density of **15kg/m^2** and contain no gaps along its surface. All gaps are to be adequately sealed using a flexible mastic sealant. Acoustic Dynamics advises that the enclosure could be constructed to be:
    - A double layer Custom Blue Orb ® Colorbond^{TM} (or equivalent) sheeting; or
    - Masonry (brick or concrete) construction; or
    - A minimum 2 x 9mm fibros-cement sheeting on a timber or steel stud; or
    - Other suitable material (minimum surface density of **15 kg/m^2**);

3. The enclosure must be airtight to the floor and adjacent building (to prevent the transmission of noise below and via the edges of the facade);

4. Design of the enclosure must be verified by a suitably qualified contractor to ensure sufficient structural and wind loading support is provided;

5. The access door required to service the subject mechanical plant should have a minimum surface density of 15 kg/m2, and contain no gaps along its surface. All gaps are to be adequately sealed with a flexible mastic sealant at the door perimeter;

6. An acoustic louvre will be required for airflow. The acoustic louvre should be located on the **south facing** facade to reduce noise transmission to the adjacent eastern receivers;

   NB. Acoustic Dynamics advises the insertion loss required by the acoustic louvre can be determined following the selection of pool pumps;

7. The internal enclosure facades (with the exception of the floor) are to be lined with a minimum 50mm thick absorptive material to prevent the build-up of reverberant energy (E.g. Stratocell Whisper or equivalent); and

8. The airflow requirements are to be confirmed with the mechanical contractor /consultant prior to the installation of the pool pumps.

   NB: A manufacturer of pre-fabricated acoustic enclosures is ACRAN (Ph: 07 3217 0055, www.acran.com.au).

Notwithstanding the above, noise emission resulting from the operation of the subject mechanical equipment can be appropriately conditioned during the detailed mechanical design stage to protect the acoustic amenity of the adjacent sensitive receivers.

6.2 ROOFTOP SPORT AREA

Acoustic Dynamics advises that our calculations and modelling include the acoustic benefit of shielding provided by proposed screens/barriers along the perimeter of the rooftop sport area (as shown on the mark-up within **Appendix A**). Noise emission to the nearest receivers has been modelled inclusive of a 2 metre high screen with 1 metre high cantilevered canopy (overall height of 3 metres) or a 3 metre high screen, along the perimeter of the rooftop sports area.

Acoustic Dynamics advises that proposed barriers (as shown within the mark-up in **Appendix A**) will provide adequate shielding to the adjacent receivers and should be constructed to the following specifications:

1. A 2 metre high noise barrier with 1 metre high cantilevered canopy (or 3 metre high noise barrier) should be constructed along the northern and north-western boundary (to Bancroft Avenue) and the eastern boundary adjacent to the covered area (to 39 Bancroft Avenue);

2. The acoustic barrier must contain no gaps along the surface area, and be constructed from the floor of the sports area to a height of 3 metres (to prevent the transmission of noise below the barrier);

3. Small penetrations for drainage are allowable at a minimum spacing of 1000mm. Penetrations should be no larger than 30mm x 30mm;

4. The acoustic barrier(s) could be constructed to be:
    - A double layer Colorbond™ (Custom Blue Orb™ or equivalent) barrier(s); or
    - Masonry (brick or concrete) construction; or
    - A minimum 9mm thick compressed fibros-cement sheeting on a timber or steel stud; or
    - Other suitable material (minimum surface density of 15 kg/m2) such as Perspex, ModularWalls™ or equivalent; and

5. Design of the barrier supports of the acoustic barrier(s) must be verified by a suitably qualified contractor to ensure sufficient structural and wind loading support is provided.

In addition to the mitigation outlined above, Acoustic Dynamics recommends the implementation of an appropriate plan of management to ensure no loss of amenity to nearby sensitive receivers. Acoustic Dynamics advises that incorporation of the following management strategy will minimise the noise impact resulting from the use of the proposed rooftop sports area.

1. Any installed speakers used for the broadcast of warning signals, amplified instructions or music should be installed at a maximum height of 500mm below the top of the adjacent perimeter barrier and must be orientated away from adjacent receivers;

2. The maximum noise level ($L_{Aeq(period)}$) from broadcast warning signals, amplified instructions or music can be set to ensure that adjacent residential receivers are not adversely affected, following the installation of the speaker system;

3. Sporting activities should cease at 9:45pm sharp with no amplified music, instructions or warning signals to be broadcast after this time;

4. Consideration should be given to installing a resilient lining material along the surface of the northern and eastern perimeter barrier to reduce noise associated with ball impacts on the barrier;

5. All activities should be supervised by an appropriately trained member of staff at all times. Staff should be instructed to prevent overly noise behaviour during the evening and night time assessment periods; and

6. Use of whistles should be restricted to handheld low noise emitting “squeezy whistles” such as the Gilbert ‘*Whizzball*’ (www.woolmersales.co.uk/product/gilbert-whizzball-squeezy-whistle/).

7 RECOMMENDATIONS AND INTERNAL DESIGN ADVICE

In accordance with the requirements of the NSW Department of Education, Australian Standard 2107 and the internal guidelines of the AAAC, Acoustic Dynamics' analysis and calculations indicate the following recommendations are required to be incorporated into the proposed facility, as a minimum, to ensure that the required internal sound transmission performance levels are achieved and the internal acoustic environment is comfortable for the building occupants.

7.1 RECOMMENDATIONS FOR INTERNAL WALL PARTITIONS

7.1.1 WALLS SEPARATING GLA & FOOD TECH. ROOMS FROM ADJACENT AREAS

Acoustic Dynamics advises that all internal walls separating GLA and Food Technology rooms from the adjacent common areas within the proposed development should achieve a minimum sound transmission performance of $\mathbf{R_w + C_{tr} = 50}$ (see mark-up in **Appendix A**). Careful consideration and extreme care should be given to the construction of partitions and junctions of different partition elements as it is in these junctions that acoustic performance can be significantly compromised. The following wall system (or equivalent) will achieve compliance with the internal requirements of the NSW EFSG, the design objectives of AS2107 and the recommendations of the AAAC.

Table 7.1 Recommended Minimum Construction for GLA & Food Tech Walls ($R_w + C_{tr} = 50$)

First Layer of Construction
1. 1 layer of 13mm Gyprock Fyrchek plasterboard; to 2. 1 layer of 13mm Gyprock Standard plasterboard; to 3. 70mm timber studs at 600mm maximum centres; with
Airgap
4. Minimum 20mm airgap; to
Second Layer of Construction
5. 70mm timber studs at 600mm maximum centres; with 6. 1 layer of 75mm Gold Batts 1.5; to 7. 1 layer of 13mm Gyprock Fyrchek plasterboard; to 8. 1 layer of 13mm Gyprock Standard plasterboard.

Note: 1) Wall system from CSR Redbook. System Number **CSR2336(b)**. Refer to CSR Redbook.

Acoustic Dynamics recommends the above partition wall construction system be installed to continue full wall height, continuing from the concrete floor slab to the underside of the soffit slab above and is required to be well sealed (i.e. no gaps). Extreme care should be exercised during construction to ensure that acoustic performance of the constructed wall partition system is not compromised including care with penetrations and ensuring power and data points are not placed back-to-back.

We advise that the above wall constructions will meet the minimum sound insulation requirement of the NSW EFSG. Acoustic Dynamics advises that installation of internal wall

systems in accordance with the above recommendations, or wall systems exceeding the above recommendations, should achieve compliance with the relevant internal sound transmission performance requirements.

7.1.2 WALLS SEPARATING GLA ROOMS

Acoustic Dynamics advises that all internal walls (including operable walls) separating the GLA rooms within the proposed development should achieve a minimum sound transmission performance of **R_w = 45** (see mark-up in **Appendix A**). Careful consideration and extreme care should be given to the construction of partitions and junctions of different partition elements as it is in these junctions that acoustic performance can be significantly compromised. The following wall system (or equivalent) will achieve compliance with the internal requirements of the NSW EFSG, the design objectives of AS2107 and the recommendations of the AAAC.

Table 7.2 Recommended Minimum Construction for GLA Walls (R_w = 45)

First Layer of Construction
1. 2 layers of 10mm Gyprock Soundchek plasterboard; to 2. 90mm timber studs at 600mm maximum centres; with
Insulation
3. 75mm Gold Batts 1.5; to
Second Layer of Construction
4. 2 layers of 10mm Gyprock Soundchek plasterboard.

Note: 1) Wall system from CSR Redbook. System Number **CSR2030(b)**. Refer to CSR Redbook.

Acoustic Dynamics recommends the above partition wall construction system be installed to continue the full wall height, continuing from the concrete floor slab to the underside of the soffit slab above and is required to be well sealed (i.e. no gaps). Extreme care should be exercised during construction to ensure that acoustic performance of the constructed wall partition system is not compromised including care with penetrations and ensuring power and data points are not placed back-to-back.

We advise that the above wall constructions will meet the minimum sound insulation requirement of the EFSG. Acoustic Dynamics advises that installation of internal wall systems in accordance with the above recommendations, or wall systems exceeding the above recommendations, will achieve compliance with the relevant internal sound transmission performance requirements.

7.1.3 WALLS SEPARATING GYM AREA FROM ADJACENT AREAS

Acoustic Dynamics advises that all internal walls separating the strength and conditioning room from adjacent internal areas within the proposed development should achieve a minimum sound transmission performance of **R_w = 45** (see mark-up in **Appendix A**). Careful consideration and extreme care should be given to the construction of partitions and junctions of different partition elements as it is in these junctions that acoustic performance can be significantly compromised. The following wall system (or equivalent) will achieve compliance with the internal requirements of the NSW EFSG the design objectives of AS2107 and the recommendations of the AAAC.

Table 7.3 Recommended Minimum Construction for Gym Walls (R_w = 45)

First Layer of Construction
1. 2 layers of 10mm Gyprock Soundchek plasterboard; to 2. 90mm timber studs at 600mm maximum centres; with
Insulation
3. 75mm Gold Batts 1.5; to
Second Layer of Construction
4. 2 layers of 10mm Gyprock Soundchek plasterboard.

Note: 1) Wall system from CSR Redbook. System Number **CSR2030(b)**. Refer to CSR Redbook.

Acoustic Dynamics recommends the above partition wall construction system be installed to continue the full wall height, continuing from the concrete floor slab to the underside of the soffit slab above and is required to be well sealed (i.e. no gaps). Extreme care should be exercised during construction to ensure that acoustic performance of the constructed wall partition system is not compromised including care with penetrations and ensuring power and data points are not placed back-to-back.

We advise that the above wall constructions will meet the minimum sound insulation requirement of the EFSG. Acoustic Dynamics advises that installation of internal wall systems in accordance with the above recommendations, or wall systems exceeding the above recommendations, will achieve compliance with the relevant internal sound transmission performance requirements.

7.1.4 WALLS SEPARATING RECEPTION & FIRST AID FROM CHANGE ROOMS & TOILETS

Acoustic Dynamics advises that all internal walls separating the Level 1 Reception and First Aid room from the adjacent toilets and change room within the proposed development should achieve a minimum sound transmission performance of **$R_w + C_{tr} = 50$** (see mark-up in **Appendix A**). Careful consideration and extreme care should be given to the construction of partitions and junctions of different partition elements as it is in these junctions that acoustic performance can be significantly compromised. The following wall system (or equivalent) will achieve compliance with the internal requirements of the NSW EFSG the design objectives of AS2107 and the recommendations of the AAAC.

Table 7.4 Recommended Minimum Construction for Reception & First Aid Walls ($R_w + C_{tr}$ = 50)

First Layer of Construction
1. 2 layers of 13mm Gyprock Fyrchek plasterboard; to 2. 70mm timber studs at 600mm maximum centres; with 3. 1 layer of 75mm Gold Batts 2.0; with
Airgap
4. Minimum 20mm airgap; to
Second Layer of Construction
5. 70mm timber studs at 600mm maximum centres; with 6. 1 layer of 75mm Gold Batts 2.0; to 7. 1 layer of 6mm CeminSeal wallboard; to 8. 1 layer of 13mm Aquachek plasterboard.

Note: 1) Wall system from CSR Redbook. System Number **CSR2410(a)**. Refer to CSR Redbook.

Acoustic Dynamics recommends the above partition wall construction system be installed to continue full wall height, continuing from the concrete floor slab to the underside of the soffit slab above and is required to be well sealed (i.e. no gaps). Extreme care should be exercised during construction to ensure that acoustic performance of the constructed wall partition system is not compromised including care with penetrations and ensuring power and data points are not placed back-to-back.

We advise that the above wall constructions will meet the minimum sound insulation requirement of the NSW EFSG. Acoustic Dynamics advises that installation of internal wall systems in accordance with the above recommendations, or wall systems exceeding the above recommendations, should achieve compliance with the relevant internal sound transmission performance requirements.

7.1.5 WALLS SEPARATING LIFT FROM ADJACENT AREAS

Acoustic Dynamics advises that all internal walls separating the lift shaft from the adjacent rooms within the proposed development should achieve a minimum sound transmission performance of $\mathbf{R_w + C_{tr} = 50}$ (see mark-up in **Appendix A**). Careful consideration and extreme care should be given to the construction of partitions and junctions of different partition elements as it is in these junctions that acoustic performance can be significantly compromised. The following wall system (or equivalent) will achieve compliance with the internal requirements of the NSW EFSG the design objectives of AS2107 and the recommendations of the AAAC.

Table 7.5 Recommended Construction for Walls Separating Lift from Adjacent Areas ($R_w \geq 50$)[1]

First Layer of Construction
1. 1 layer of 6mm CeminSeal wallboard; to 2. Steel stud framing at 600mm maximum centres; with
Insulation
3. 1 layer of 75mm Acoustigard 11kg; to 4. Minimum 12mm cavity between framing and adjacent masonry wall; to
Second Layer of Construction
5. Single brick, block or concrete wall (with Rw ≥ 45); to 6. 1 layer of 13mm Gyprock Standard plasterboard.

Note: 1) Wall system from CSR Redbook. System Number **CSR4005a**.

Acoustic Dynamics recommends the above partition wall construction system be installed to continue full wall height, continuing from the concrete floor slab to the underside of the soffit slab above and is required to be well sealed (i.e. no gaps). Extreme care should be exercised during construction to ensure that acoustic performance of the constructed wall partition system is not compromised including care with penetrations and ensuring power and data points are not placed back-to-back.

We advise that the above wall constructions will meet the minimum sound insulation requirement of the NSW EFSG. Acoustic Dynamics advises that installation of internal wall systems in accordance with the above recommendations, or wall systems exceeding the

above recommendations, should achieve compliance with the relevant internal sound transmission performance requirements.

7.1.6 GLAZED PARTITIONS

Acoustic Dynamics advises that windows / glass partitions should be designed in a way as to maintain the acoustic integrity of the partition wall systems. Acoustic Dynamics advises that the glazing needs to provide high performance within the highly sensitive learning areas to maintain the acoustic performance of the constructed wall partition system. Acoustically, glazing or a glazed wall partition is likely to provide less acoustic privacy than a well-constructed, solid wall system.

Acoustic Dynamics advises that if higher sound attenuation (**$R_w \geq 45$**) via the glazing is required, then the use of double glazing systems is likely to be necessary. Note that these systems will require a much larger partition depth than a single glazed partition wall.

Acoustic Dynamics advises the installation of all glass windows/partitions must ensure gaps between the window frame and the wall structure should be well sealed using polystyrene rods and silicone mastic sealant, prior to the fitting of the architraves.

7.1.7 ROOM ENTRY DOORS

Acoustic Dynamics understands that glass sliding doors are proposed to be installed for access to all the GLA and Food Technology rooms.

Accordingly, the following recommendations are provided for doors to achieve compliance with the requirements of the EFSG:

- All glazed GLA and Food Technology sliding doors should be minimum 10.38mm Vlam laminated glass.

For all other doors to non-learning spaces we advise installation of the following doors:

- All entry doors must be **solid-core doors**, and be a minimum thickness of **40mm**;

- Acoustic seals are required to be installed around the door frame and door bottom. We recommend the installation of the following door seals:
    - Door frame seals: Raven^{TM} RP47 (or equivalent); and
    - Door bottom seals: Raven^{TM} RP38 (or equivalent).

Acoustic Dynamics advises that the acoustic performance of a door will be limited by any gaps around the perimeter and any door grilles. Acoustic Dynamics advises that the installation of all doors must ensure an adequate acoustic (air tight) seal when closed. Any sound flanking paths around the doors must be sealed to provide the adequate acoustic insulation. All gaps between the door frame and the wall structure should be sealed using polystyrene rods and silicone mastic sealant.

7.2 RECOMMENDATIONS FOR FLOOR/CEILING SYSTEMS

Acoustic Dynamics has assumed that the floor/ceiling partition systems separating the various areas within the proposed development will be 200mm thick concrete with a suspended plasterboard ceiling. The following recommendations for floor/ceiling partition construction systems are to be incorporated into the design and construction of the development, where relevant.

7.2.1 FLOORS ABOVE / ADJACENT TO LEARNING AREAS

Where floors are proposed above or directly adjacent to learning areas, the following floor/ceiling partition construction is recommended, to ensure compliance with the impact sound insulation requirements of the NSW EFSG (**$L'_{nTw} \leq 55$**).

Table 7.6 Recommended Minimum Construction for Tile Floors

Flooring
1. Selected stone or ceramic tiles; to 2. Layer of waterproofing (where required); to 3. Layer of adhesive, as per Regupol™ (or other manufacturer) specifications; to ***(Note: A minimum 10mm isolation air gap is required between the above floor components and the walls, at all wall/floor junctions. The gap to the wall is to be treated with installation of a foam backing rod and flexible coloured polyurethane sealant).*** 4. 2 x layers of Fibre Cement Sheeting; 5. Layer of impact isolation underlay: • Minimum – 17/8mm thick Regupol™ 6010 (or equivalent); to 6. Layer of adhesive, as per Regupol™ (or other manufacturer) specifications; to
Concrete Slab
7. Minimum 200mm thick reinforced concrete slab; to 8. Suspended 13mm standard plasterboard ceiling with minimum 50mm insulation.

Table 7.7 Recommended Minimum Construction for Timber Floors

Flooring
1. Selected timber or hardwood flooring; to 2. Layer of waterproofing (where required – see manufacturer's specifications); to 3. Layer of adhesive, as per Regupol™ (or other manufacturer) specifications; to ***(Note: A minimum 10mm isolation air gap is required between the above floor components and the walls, at all wall/floor junctions. The gap to the wall is to be treated with installation of a foam backing rod and flexible coloured polyurethane sealant).*** 4. Layer of impact isolation underlay: • Recommended – 17/8mm thick Regupol™ 6010 dimple profile (or equivalent); or 5. Layer of adhesive, as per Regupol™ (or other manufacturer) specifications; to
Concrete Slab
6. Minimum 200mm thick reinforced concrete slab; to 7. Suspended 13mm standard plasterboard ceiling with minimum 50mm insulation.

Table 7.8 Recommended Minimum Construction for Carpeted Floors

Flooring
1. Selected commercial grade carpet; to 2. 1 layer of “Premium” standard carpet underlay; to
Concrete Slab
3. Minimum 200mm thick reinforced concrete slab; to 4. Suspended 13mm standard plasterboard ceiling with minimum 50mm insulation.

Note: A minimum 10mm isolation air gap is required between the finished tile floor and all walls, architraves and door jambs. This gap can be treated with installation of foam backing rods and flexible coloured polyurethane sealant.

Acoustic Dynamics advises that the above floor/ceiling construction systems will meet the relevant required acoustic criteria (being an **L'_{nTw} (impact) ≤ 55**).

7.2.2 FLOORS ABOVE / ADJACENT TO NON-LEARNING AREAS

Where floors are proposed above or directly adjacent to non-learning areas, the following floor/ceiling partition construction is recommended, to ensure compliance with the impact sound insulation requirements of the NSW EFSG (**L'_{nTw} ≤ 65).**

Table 7.9 Recommended Minimum Construction for Tile Floors

Flooring
1. Selected stone or ceramic tiles; to 2. Layer of waterproofing (where required); to 3. Layer of adhesive, as per Regupol™ (or other manufacturer) specifications; to ***(Note: A minimum 10mm isolation air gap is required between the above floor components and the walls, at all wall/floor junctions. The gap to the wall is to be treated with installation of a foam backing rod and flexible coloured polyurethane sealant).*** 4. 1 x layer of Fibre Cement Sheeting; 5. Layer of impact isolation underlay: • Minimum – 5mm thick Regupol™ 5512 (or equivalent); to 6. Layer of adhesive, as per Regupol™ (or other manufacturer) specifications; to
Concrete Slab
7. Minimum 200mm thick reinforced concrete slab; to 8. Suspended 13mm standard plasterboard ceiling with minimum 50mm insulation.

Table 7.10 Recommended Minimum Construction for Timber Floors

Flooring
1. Selected timber or hardwood flooring; to 2. Layer of waterproofing (where required – see manufacturer's specifications); to 3. Layer of adhesive, as per Regupol™ (or other manufacturer) specifications; to ***(Note: A minimum 10mm isolation air gap is required between the above floor components and the walls, at all wall/floor junctions. The gap to the wall is to be treated with installation of a foam backing rod and flexible coloured polyurethane sealant).*** 4. Layer of impact isolation underlay: • Recommended – 5mm thick Regupol™ 5512 (or equivalent); or 5. Layer of adhesive, as per Regupol™ (or other manufacturer) specifications; to
Concrete Slab
6. Minimum 200mm thick reinforced concrete slab; to 7. Suspended 13mm standard plasterboard ceiling with minimum 50mm insulation.

Table 7.11 Recommended Minimum Construction for Carpeted Floors

Flooring
1. Selected commercial grade carpet; to 2. 1 layer of "Premium" standard carpet underlay; to
Concrete Slab
3. Minimum 200mm thick reinforced concrete slab; to 4. Suspended 13mm standard plasterboard ceiling with minimum 50mm insulation.

Note: A minimum 10mm isolation air gap is required between the finished tile floor and all walls, architraves and door jambs. This gap can be treated with installation of foam backing rods and flexible coloured polyurethane sealant.

Acoustic Dynamics advises that the above floor/ceiling construction systems will meet the relevant required acoustic criteria (being an **L'_{nTw} (impact) ≤ 65**).

7.2.3 STRENGTH AND CONDITIONING ROOM FLOOR

Acoustic Dynamics has made recommendations, based on previous gym floor vibration experience, to reduce the transmission of regenerated noise and vibration resulting from the use of weights and treadmills within the proposed gym area to the adjacent sensitive spaces within the development. We understand that weight areas and treadmills are proposed within various areas of the floor space of the proposed gym area. In lieu of specific testing to determine the best and most suitable flooring solution, based on extensive experience with other similar gyms and conditioning studios, Acoustic Dynamics recommends the following floor systems to be installed in **Table 7.12** below.

Table 7.12 Recommended Floor Systems

Areas	Finished Floor Topping	Energy Absorbing Layer
Treadmills/Cardio	8mm thick Regupol Everroll rubber gym floor topping	N/A
Free-weight/ Functional training areas	8mm thick Regupol Everroll rubber gym floor topping	1 layer of 40mm thick Regupol™ 4080 impact isolation underlay (Density 260kg/m^3)

Acoustic Dynamics advises that the structure-borne noise emission associated with the typical use and operation of the proposed strength and conditioning room is predicted to be acceptable within the nearest adjacent sensitive receiver locations.

7.2.4 RECOMMENDATIONS FOR PIN & PLATE LOADED WEIGHTS EQUIPMENT

Acoustic Dynamics recommends the incorporation of springs into pin and plate loaded weights equipment where feasible.

Although unlikely to offer such treatments without prompting or specific request, Acoustic Dynamics understands that most manufacturers/suppliers of pin and plate loaded weights equipment are now able to fit springs and/or soft rubber supports/mounts to the pin and plate loaded weights equipment they supply.

Acoustic Dynamics understands that a number of manufacturers/suppliers of pin and plate loaded weights equipment have liaised with various spring suppliers including Embelton Australia (Ph: 1800 339 638) to obtain suitable spring and soft rubber mounts for their equipment. Once sourced, we understand that the service technicians for these equipment manufacturers/suppliers can fit these to the equipment.

7.3 RECOMMENDATIONS FOR HYDRAULIC & OTHER SERVICES

Acoustic Dynamics advises that construction separating a duct, soil waste or water supply pipes from an occupied space shall achieve a sound transmission performance **R_w 40**. Where adjacent to an occupied space (and not serving that space), hydraulic supply pipework and wastewater pipework shall be separated from the adjacent occupied space with construction that is of a '**staggered stud'** arrangement or otherwise **discontinuous** (i.e. minimum 20mm cavity separating two separate leaves).

We advise that the following recommended construction systems be installed, where relevant, to ensure compliance with the acoustic performance requirements of the NSW EFSG:

Table 7.13 Recommended Minimum Construction – Including Pipe Lagging

Lagging
1. Pipes lagged with a 4kg/m^2 loaded vinyl sheet bonded with minimum 25mm thick foam, equivalent to Pyrotek 4525C or Acoustop Flexilagg AFL/4-24; to
Ceiling/Wall cavity
2. Minimum 75mm thick glasswool insulation batts (14kg/m^3), or equivalent, within the ceiling or wall cavity
Ceiling/Wall Lining
3. **1 layer** of minimum 13mm thick plasterboard, or **1 layer** of minimum 9mm thick FC sheeting, fixed as per architectural specifications

Table 7.14 Recommended Type 4 Minimum Construction – No Pipe Lagging

Pipework/Ductwork
1. Duct or pipework unlagged; to
Ceiling/Wall cavity
2. Minimum 75mm thick glasswool insulation batts (14kg/m^3), or equivalent, within the ceiling or wall cavity; to
Ceiling/Wall Lining
3. **3 layers** of minimum 16mm thick fire-rated plasterboard, or **2 layers** of minimum 12mm thick FC sheeting, fixed as per architectural specifications

Acoustic Dynamics advises that the above construction will sufficiently reduce noise transmission into the relevant areas of the proposed development, and is designed to achieve compliance with the design objectives.

7.4 FINISHES AND PENETRATIONS

Acoustic Dynamics provides the following recommendations regarding room finishes and penetrations:

- Penetrations for electrical and mechanical services should be offset by installing in separate stud cavities. Outlets should be sealed with an appropriate acoustic sealant;
- Care must be given to the installation of mounts for joinery that share a common partition. These should be offset if possible to avoid a reduction in sound isolation; and
- The use of fabric curtains or absorptive acoustic tiles through each of the learning spaces will assist in the improvement of speech intelligibility.

7.5 REVERBERATION TIMES AND CONTROL

To control excess reverberation within a room, it is recommended to cover reflective wall surfaces with absorptive material where possible. In addition to the proposed fabric curtains, large absorptive panels placed on walls can be used to reduce reverberation within the subject GLA and Food Technology rooms. To keep with the desired aesthetic of the client, Acoustic Dynamics advises absorptive panels are available that incorporate various colours or designs.

Should detailed absorption design be sought, Acoustic Dynamics is able to conduct relevant calculations to determine absorption design options. A list of acoustic panel suppliers is provided in **Appendix A.**

7.6 SPEECH INTELLIGIBILITY

Acoustic Dynamics understands that speech intelligibility specifically within the highly sensitive rooms is integral. Speech intelligibility can be rated in terms of Articulation Index (AI) and is a rating from 0 to 1, where the higher rating represents minimal attenuation of signal between the source and the listener. In simple terms, the listener can hear the speaker clearly. Good speech intelligibility is achieved by controlling three vital components within the room. These components consist of:

- The background noise;
- The source (occupants) sound pressure level; and
- The reverberation time.

Should detailed speech intelligibility design be sought, Acoustic Dynamics is able to conduct relevant calculations to determine appropriate design options.

Following construction, prior to final fit-out, consideration could be given to conducting acoustic testing to determine reverberation times and speech intelligibility to ensure that the acoustic environment is designed to the optimal design noise levels, reverberation times and speech intelligibility.

7.6.1 GENERAL RECOMMENDATIONS FOR SERVICES

The following recommendations are made to achieve compliance with the relevant acoustic provisions of the NSW EFSG for noise intrusion from hydraulic and other services:

1. The building contractor shall ensure that all duct, soil waste or water supply pipes, including ducts or pipes that are located in walls, wall cavities or ceiling cavities are separated from the various areas of the proposed development by construction achieving the Rw ratings presented within **Table 7.13** and **Table 7.14** above;

2. All intra-area walls constructed around bathrooms, plant room, kitchens and any other room or riser containing soil and waste pipes serving a different area in the ceiling space or riser (as the case may be) shall be constructed full height to the soffit slab above;

3. The walls shall be sealed at the soffit on both sides with approved acoustic mastic sealant;

4. Penetrations in the wall shall be acoustically treated to ensure that the wall Rw rating is not diminished;

5. Electrical outlets located on either side of an acoustically rated partition wall must be offset by no less than 100mm;

6. We recommend the use of acoustically rated boxes for all general power outlets, light switches, telephone connections, television outlets, etc. located within acoustically rated partition walls;

7. All hot and cold water pipes, gas pipes, soil and waste pipes located in risers and ceiling cavities shall be isolated from the adjoining construction with Flexistrut 'S Series' Acoustic Pipe Clips (or equivalent); and

8. Water velocities in hot and cold water pipes shall not exceed 1.5m/s.

8 CONSTRUCTION NOISE AND VIBRATION

Acoustic Dynamics advises that at this stage of the development, assessing the impacts of construction noise and vibration is problematic as the construction details are yet to be established. Typical noise and vibration generating equipment and activities that may occur on site during the works period include demolition of existing structures, excavation, the use of pneumatic drills and hammers, power tools and vehicular access to and from the site.

The following measures may be implemented to minimise noise and vibration emission from the site to ensure the amenity of all nearby sensitive receivers is adequately protected:

- Limiting the hours of construction;
- Noise & vibration induction of all site staff;
- Implementation of an appropriate community liaison procedure — including a noise and vibration management and noise and vibration complaint procedure;
- Implementation of a noise and vibration monitoring and reporting programme;
- The use of temporary noise barriers around particularly noisy activities;
- Use of quietest available equipment and lowest vibration generating equipment for works;
- Where excavation of rock is required, an appropriate excavation methodology should be adopted;
- Where there is any risk of damage, a dilapidation survey of adjacent buildings and structures should be completed prior to the commencement of any excavation works;
- Implementation of periods of respite, where highly intensive activities produce loud noise (i.e. greater than 75 dB(A) at nearby residences) to minimise disturbance on nearby receivers; and
- Should trucks or other vehicles be required to be on site for longer than five minutes, Acoustic Dynamics advises that engines should be switched off for the duration.

Acoustic Dynamics advises once detailed construction specifications and schedules have been determined, a quantitative assessment can be conducted of the predicted noise impact at the nearest potentially affected receivers resulting from the proposed demolition and construction works and associated activities. Following the assessment, advice can be provided to ensure noise and vibration emission from the subject works is appropriately conditioned and can comply with the requirements of the NSW EPAs *Interim Construction Noise Guideline*, the NSW EPAs *Assessing Vibration: A Technical Guideline* and relevant Australian Standards.

9 CONCLUSION

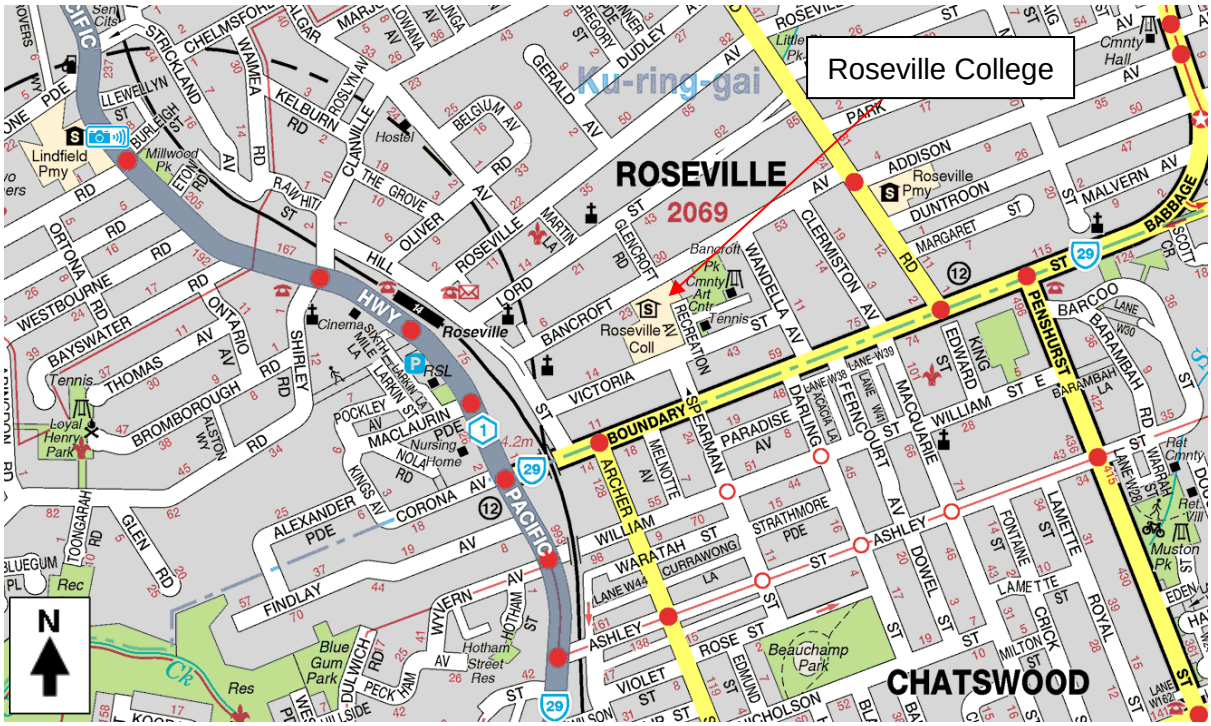
Acoustic Dynamics has conducted an assessment of road traffic noise intrusion, external noise emission and assessment and advice relating to internal acoustic privacy for the proposed education facility development at 29-37 Bancroft Avenue, Roseville, NSW. A review of applicable noise standards and local authority noise criteria was conducted. Noise intrusion, noise emission levels and internal privacy were assessed in accordance with the requirements of:

(a) Ku-ring-gai Council;
(b) NSW Department of Planning & Infrastructure;
(c) NSW Department of Education;
(d) Environment Protection Authority (EPA); and
(e) Australian Standards.

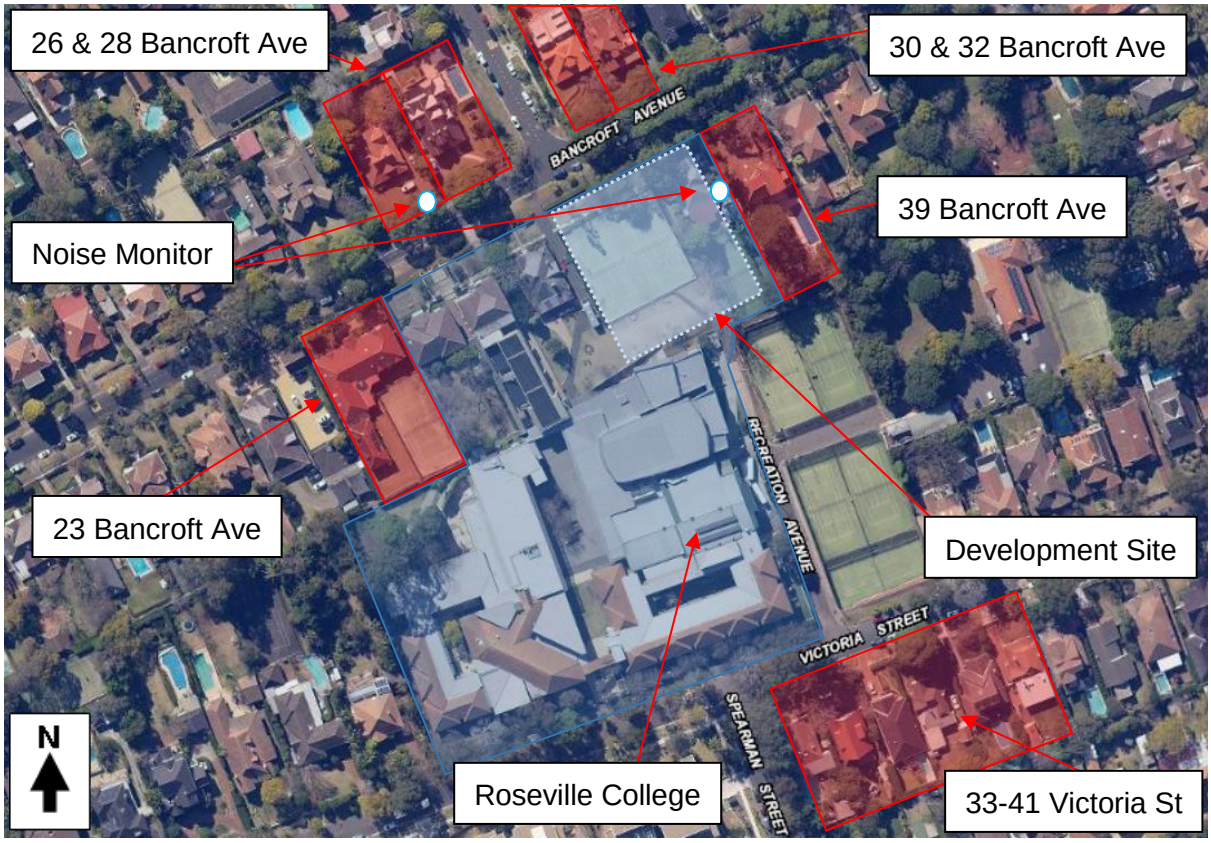
Acoustic Dynamics advises that the incorporation of the recommendations of this report into the design and construction of the proposed development will achieve compliance with the relevant acoustic design requirements of Ku-ring-gai Council, the NSW Department of Planning & Infrastructure and the NSW Department of Education.

APPENDIX A – LOCATION MAP, AERIAL PHOTO AND ARCHITECTURAL PLANS

A.1 LOCATION MAP

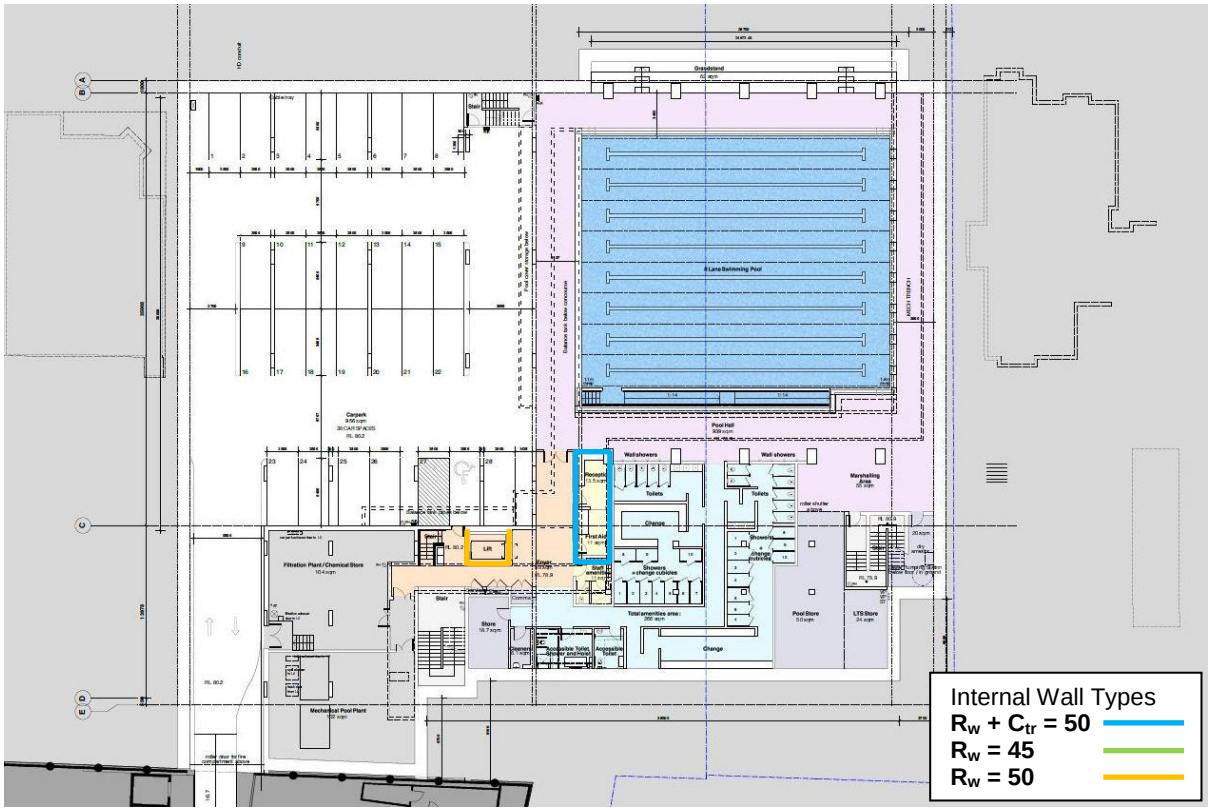


A.2 AERIAL PHOTO

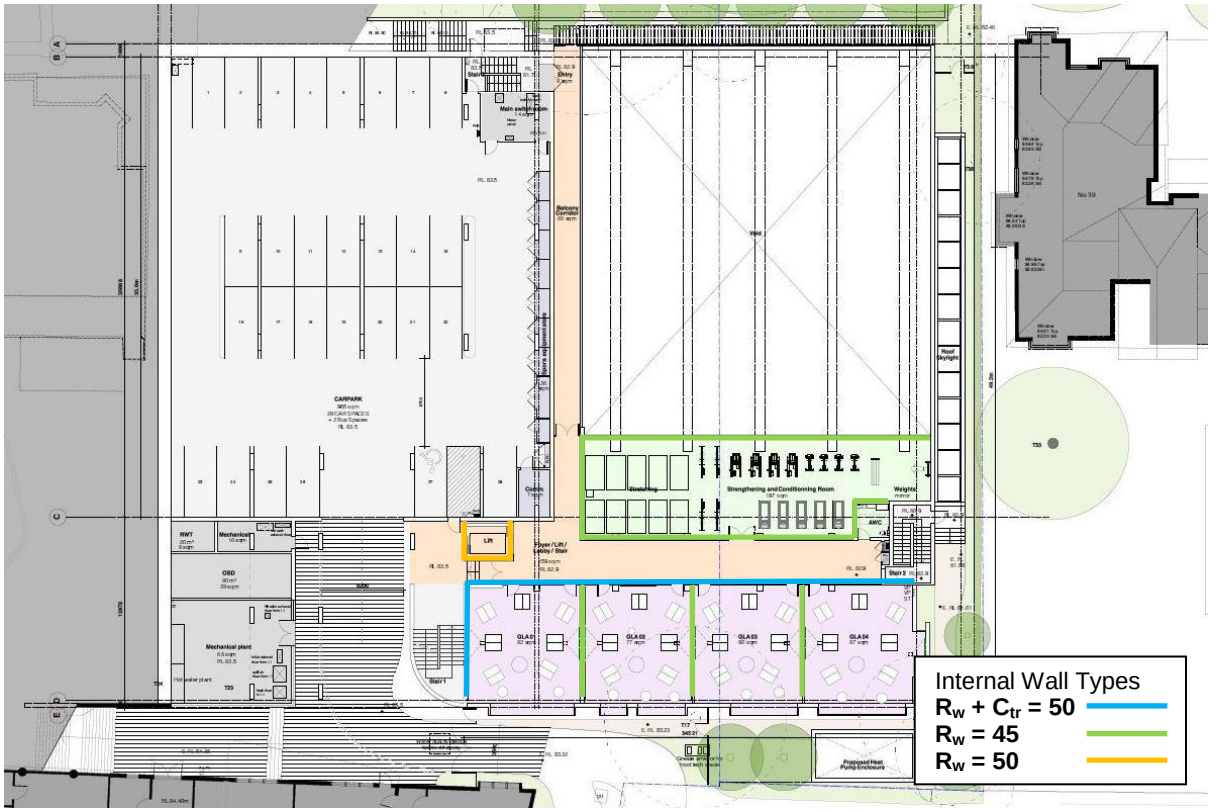


A.3 ARCHITECTURAL PLAN DRAWINGS (DA DESIGN STAGE)

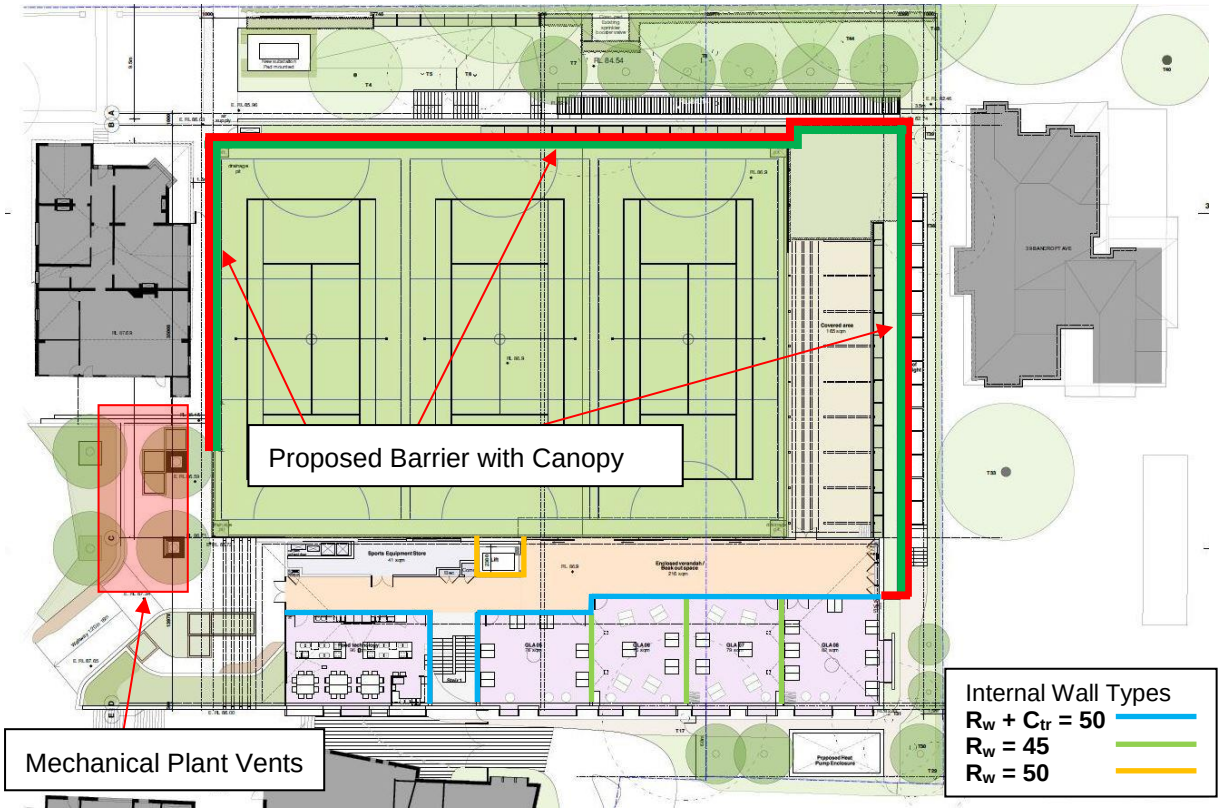
A.3.1 LEVEL 1 PLAN



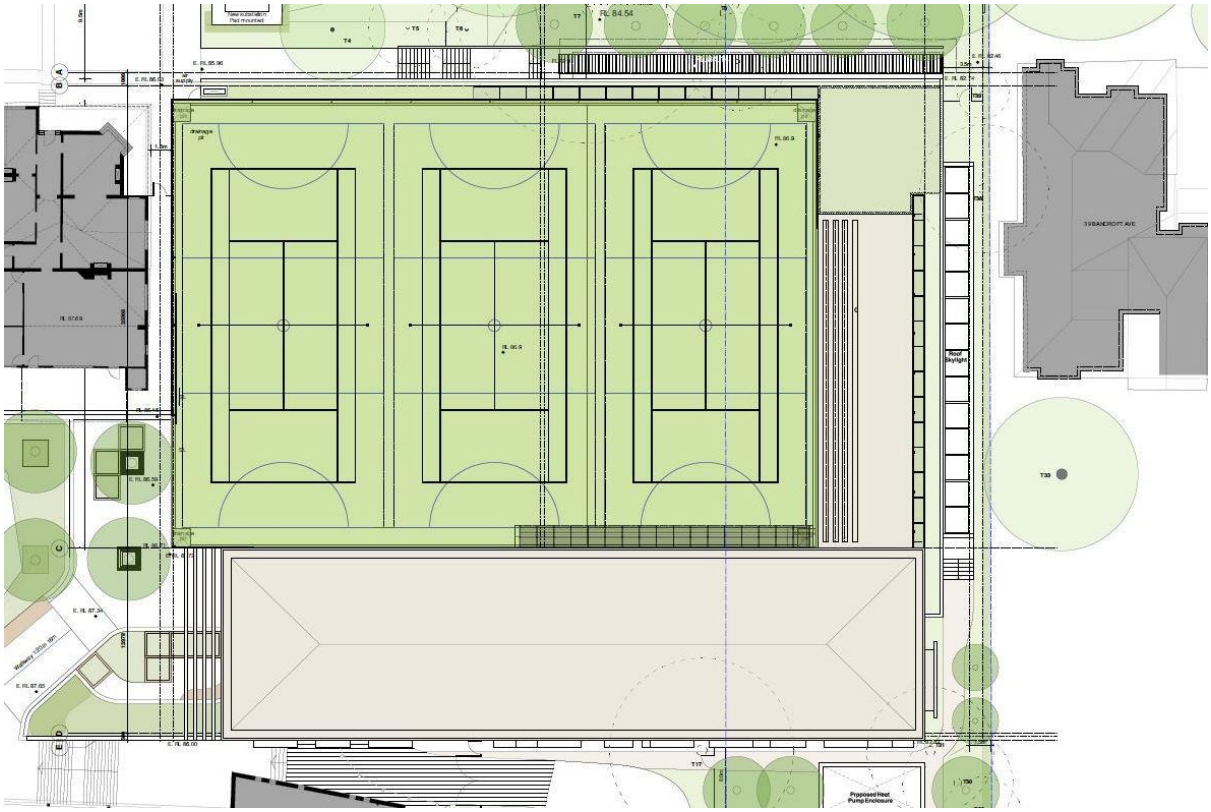
A3.2 LEVEL 2 PLAN



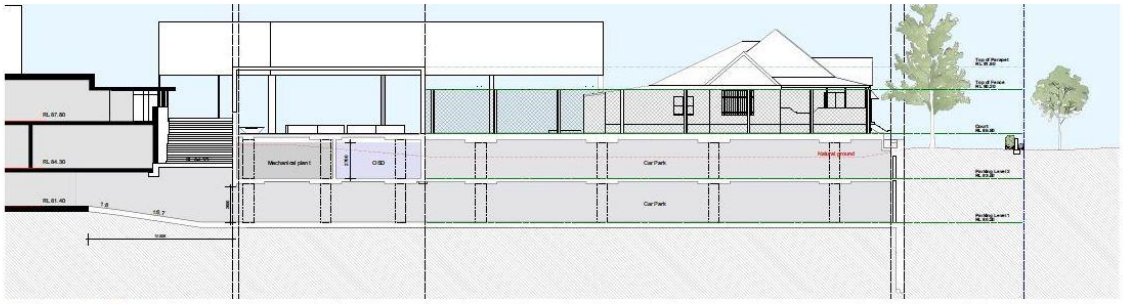
A.3.3 LEVEL 3 PLAN



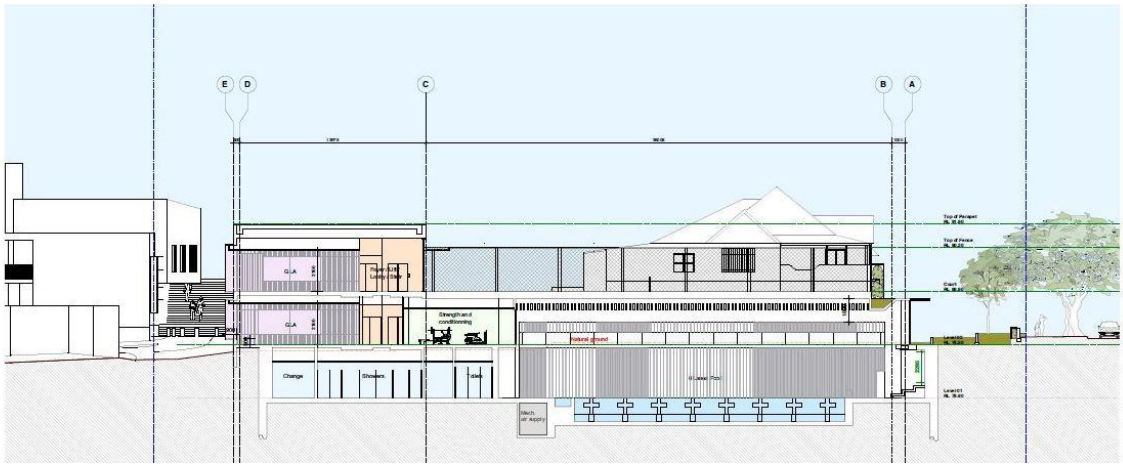
A.3.4 ROOF PLAN



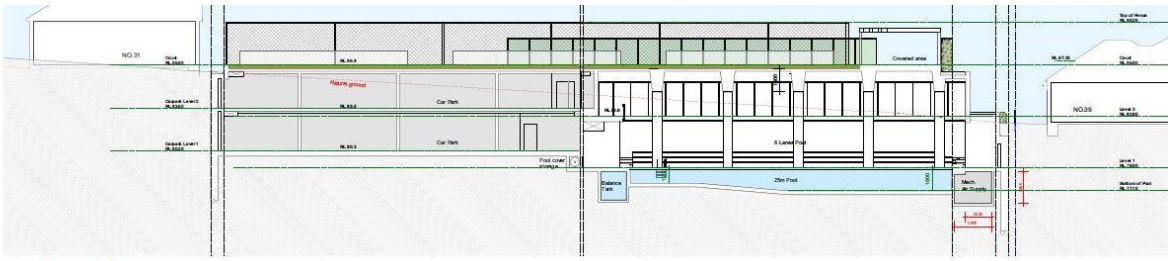
A.3.5 SECTION 01



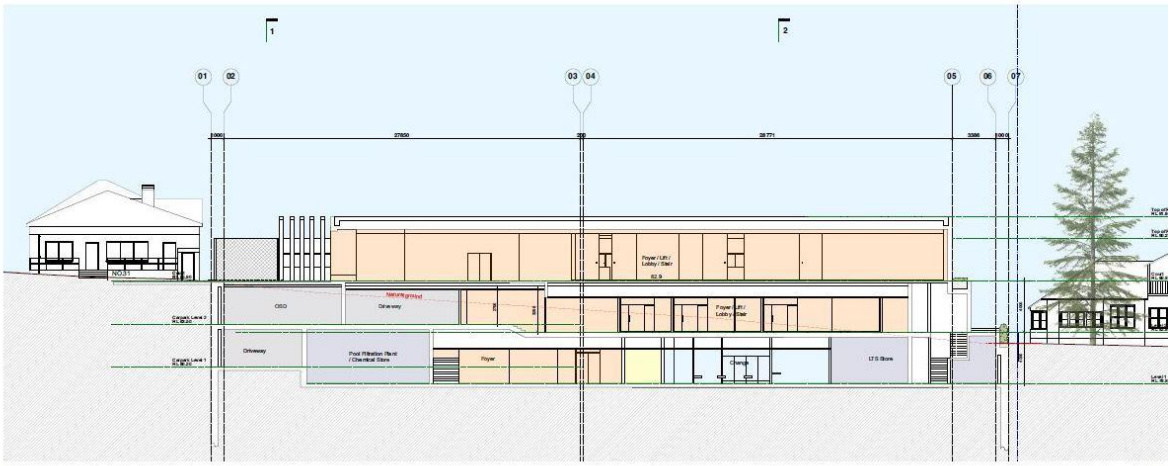
Section 01



A.3.6 SECTION 02

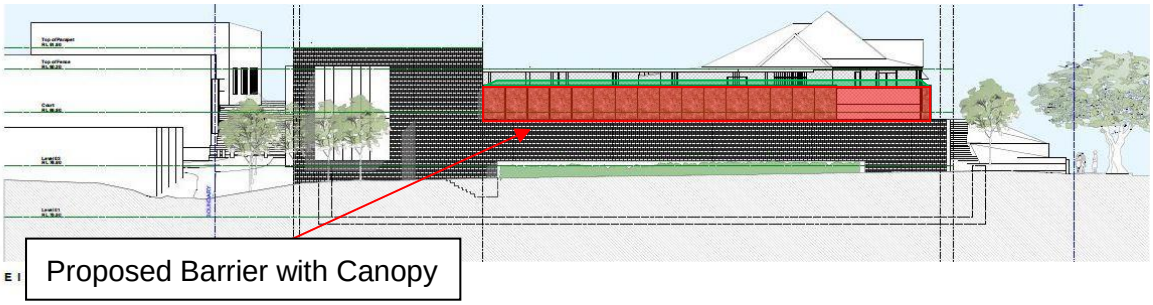


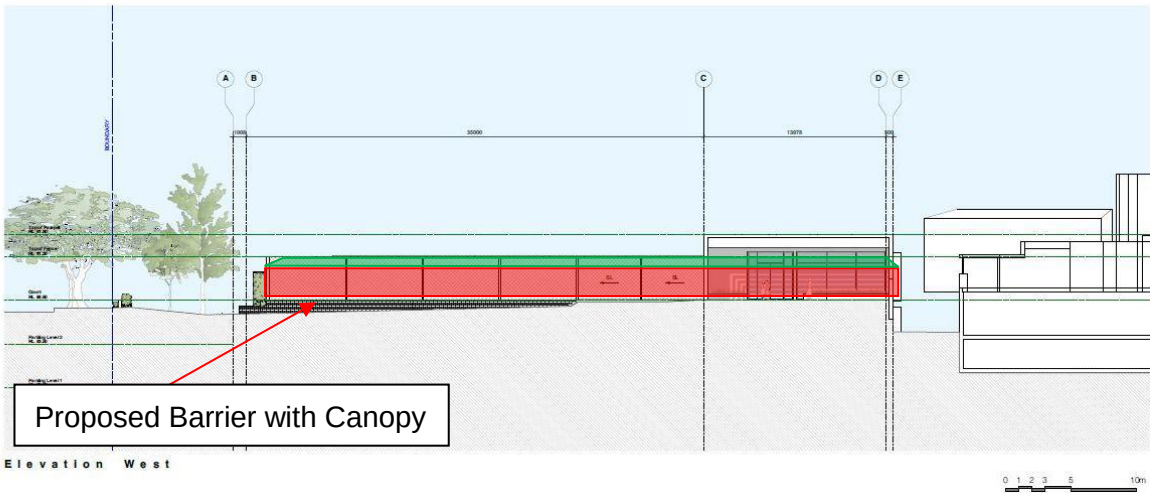
Section 03



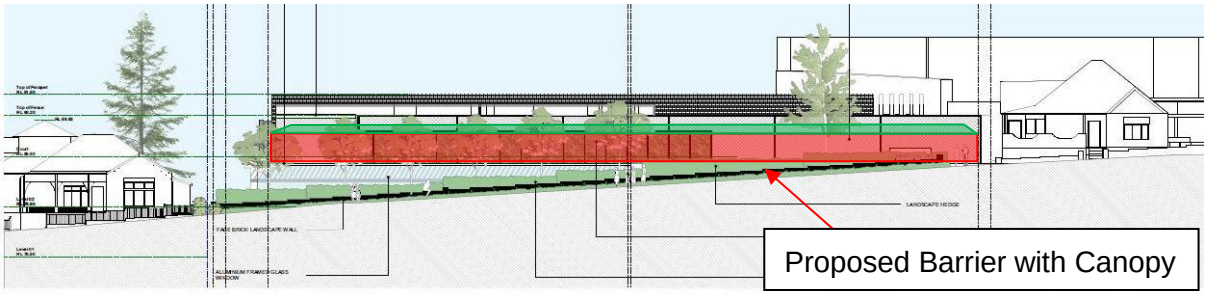
Section 04

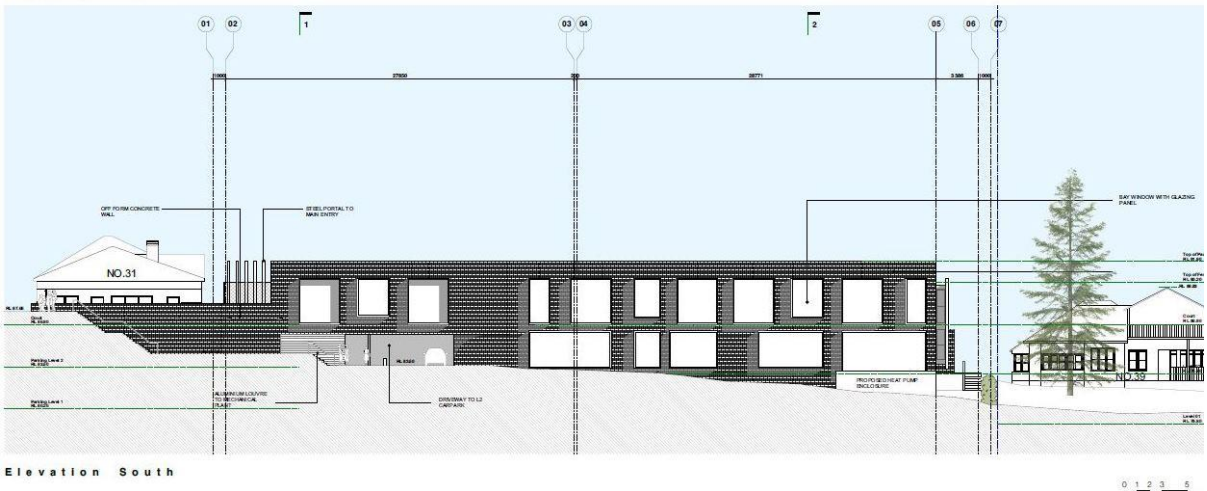
A.3.7 EAST & WEST ELEVATIONS



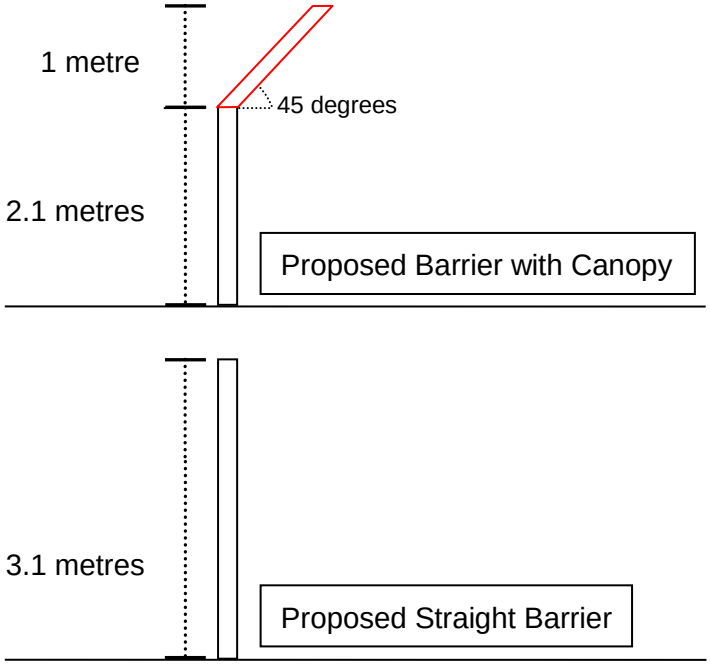


A.3.8 NORTH & SOUTH ELEVATIONS





A.3.9 BARRIER DETAIL



A.3.10 ACOUSTIC PANEL SUPPLIERS

Company	Phone Number	Website
Acoustica	(02) 9428 8400	www.acoustica.com.au
Autex	(02) 9756 3122	www.autex.com.au
Baresque	1300 306 399	www.baresque.com.au
CSR Martini	1300 767 776	www.csrmartini.com.au
Europanel	(02) 8284 6410	www.europanel.com.au
Pyrotek	(02) 8868 2088	www.pyroteknc.com
Woven Image	(02) 9913 8668	www.wovenimage.com

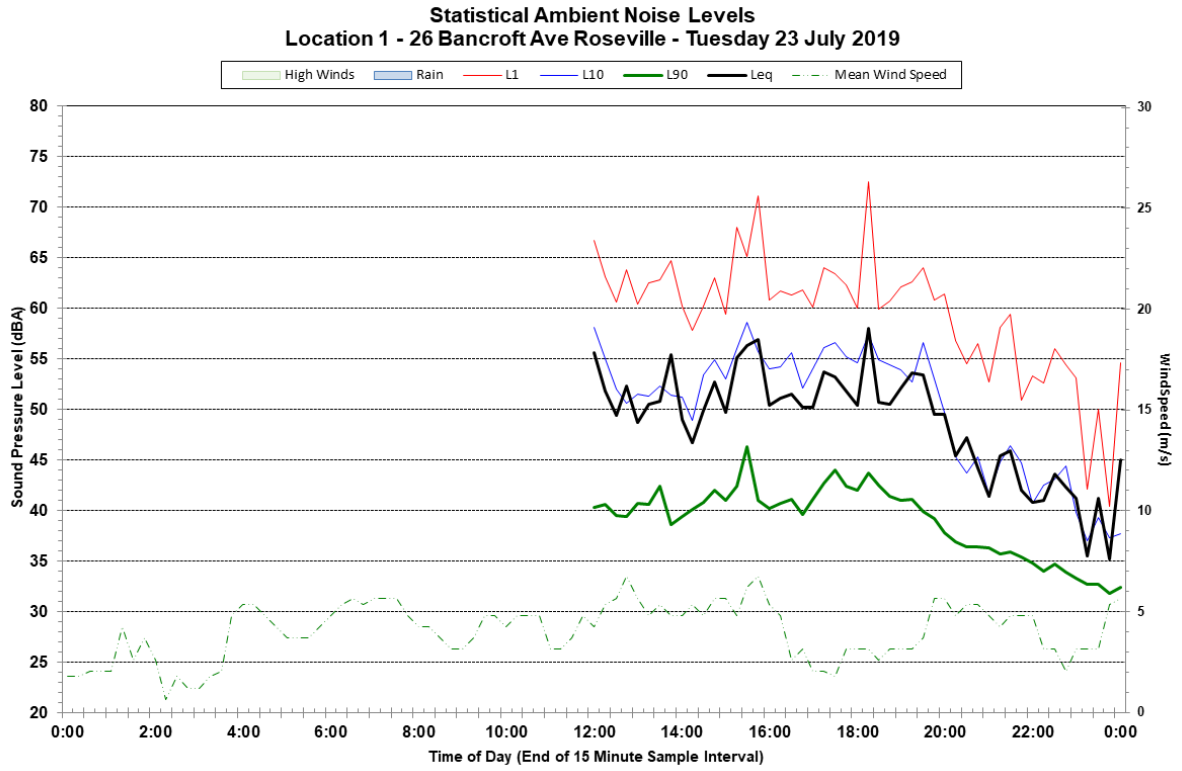
A.3.11 ACOUSTIC BARRIER EXAMPLES

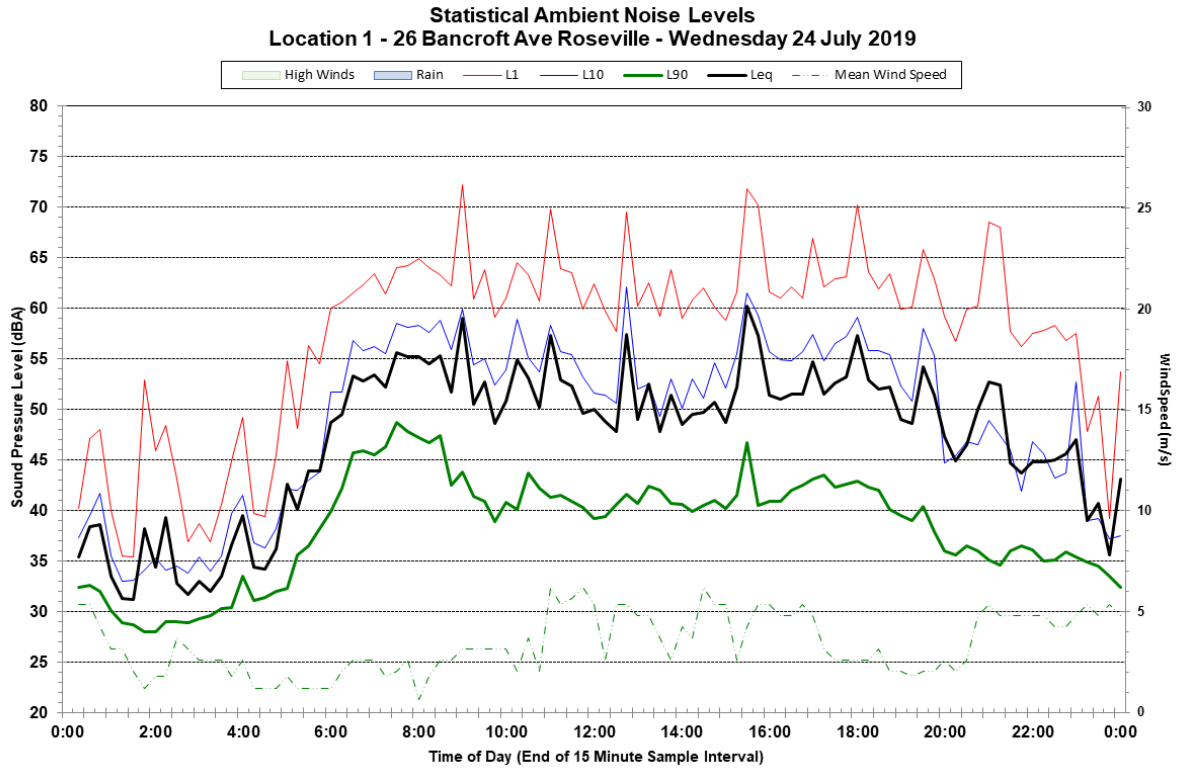

Straight Barrier


Cantilevered Barrier

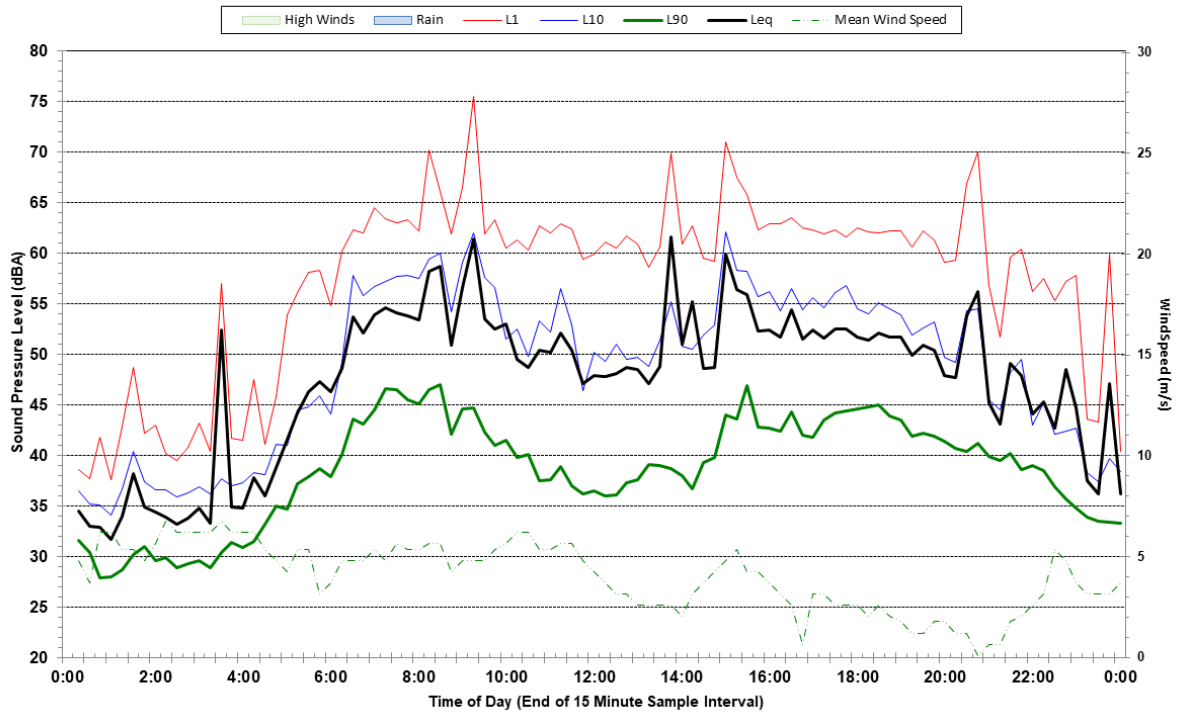
APPENDIX B – UNATTENDED NOISE LOGGER DATA

B.1 LOCATION 1 – 26 BANCROFT AVENUE

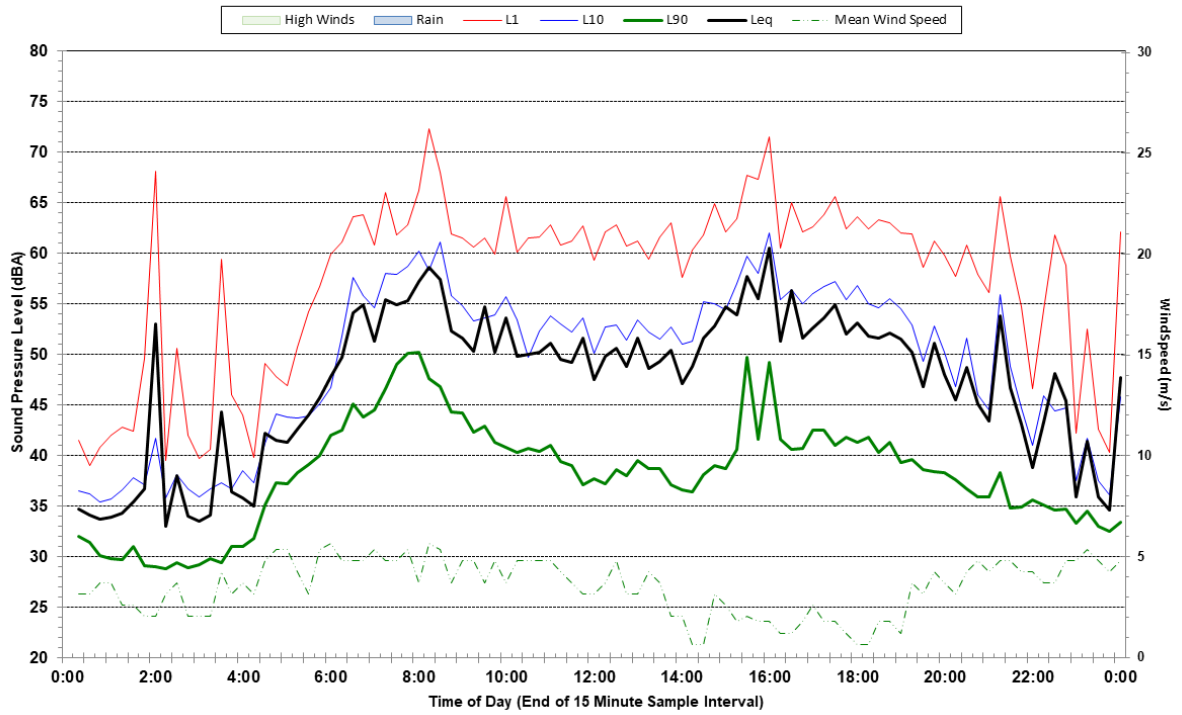




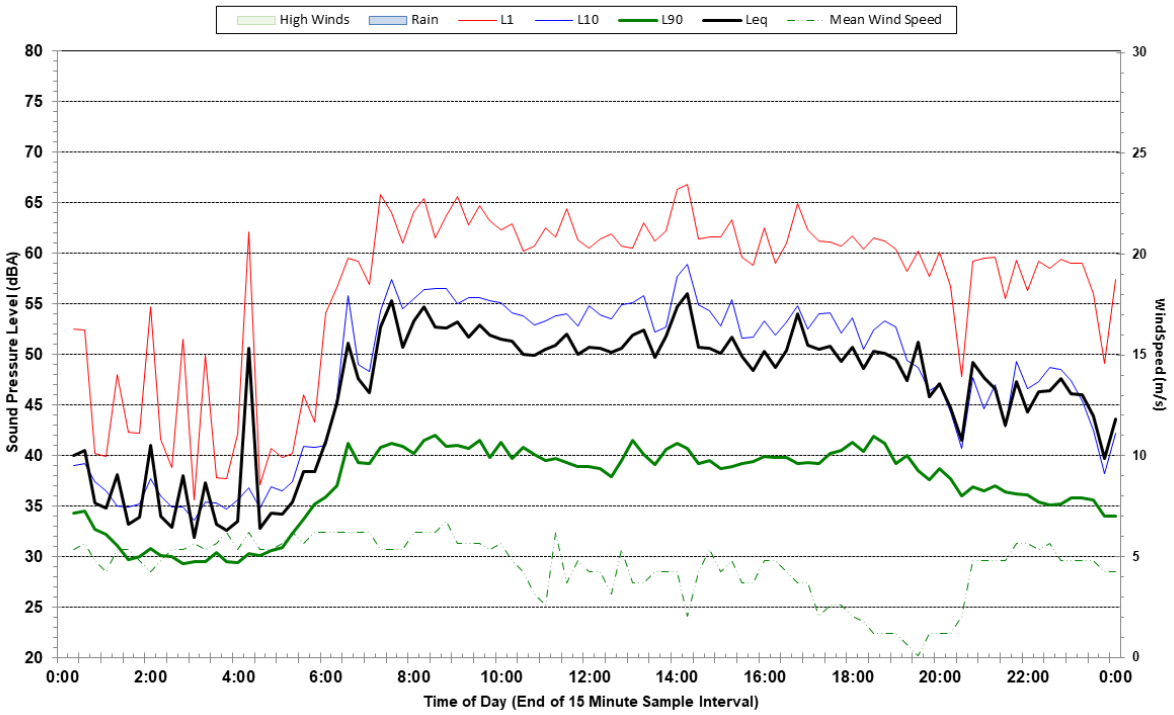
Statistical Ambient Noise Levels
Location 1 - 26 Bancroft Ave Roseville - Thursday 25 July 2019



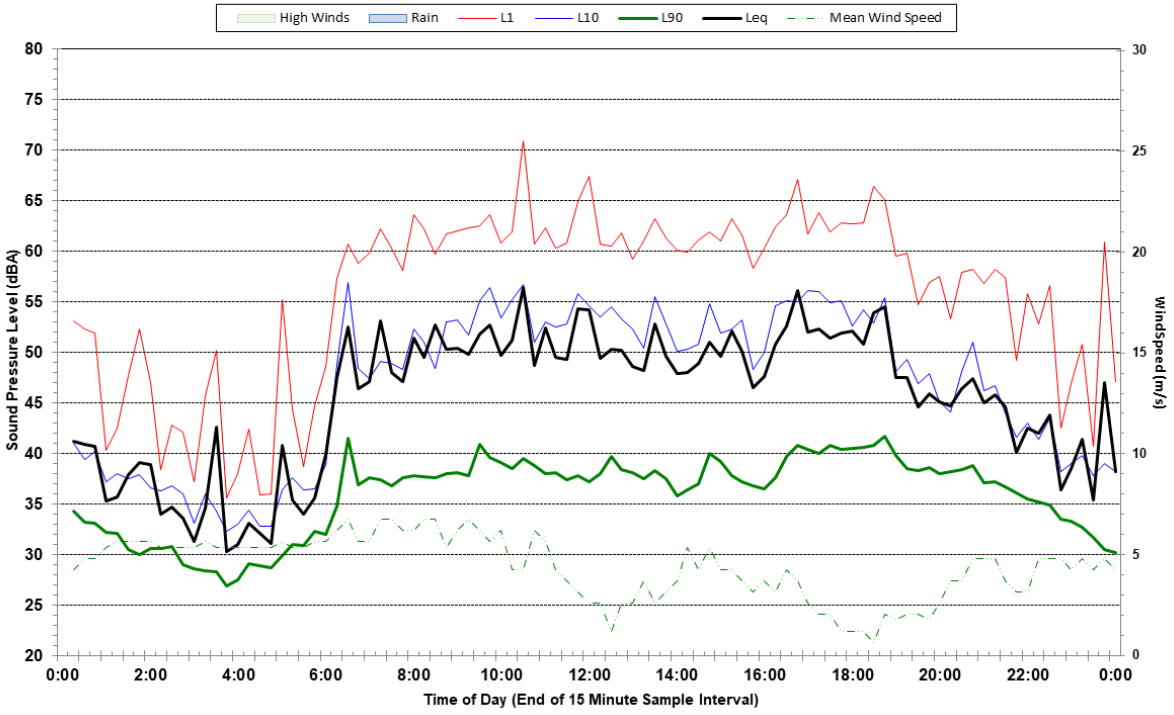
Statistical Ambient Noise Levels
Location 1 - 26 Bancroft Ave Roseville - Friday 26 July 2019

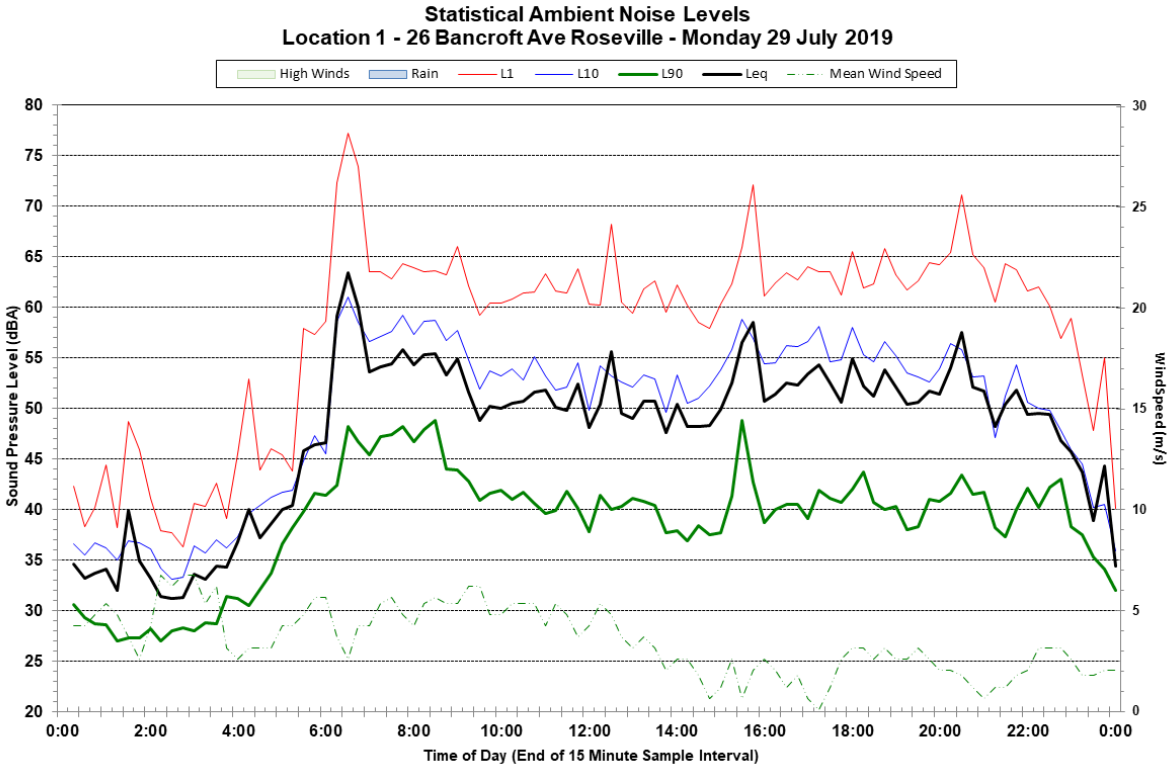


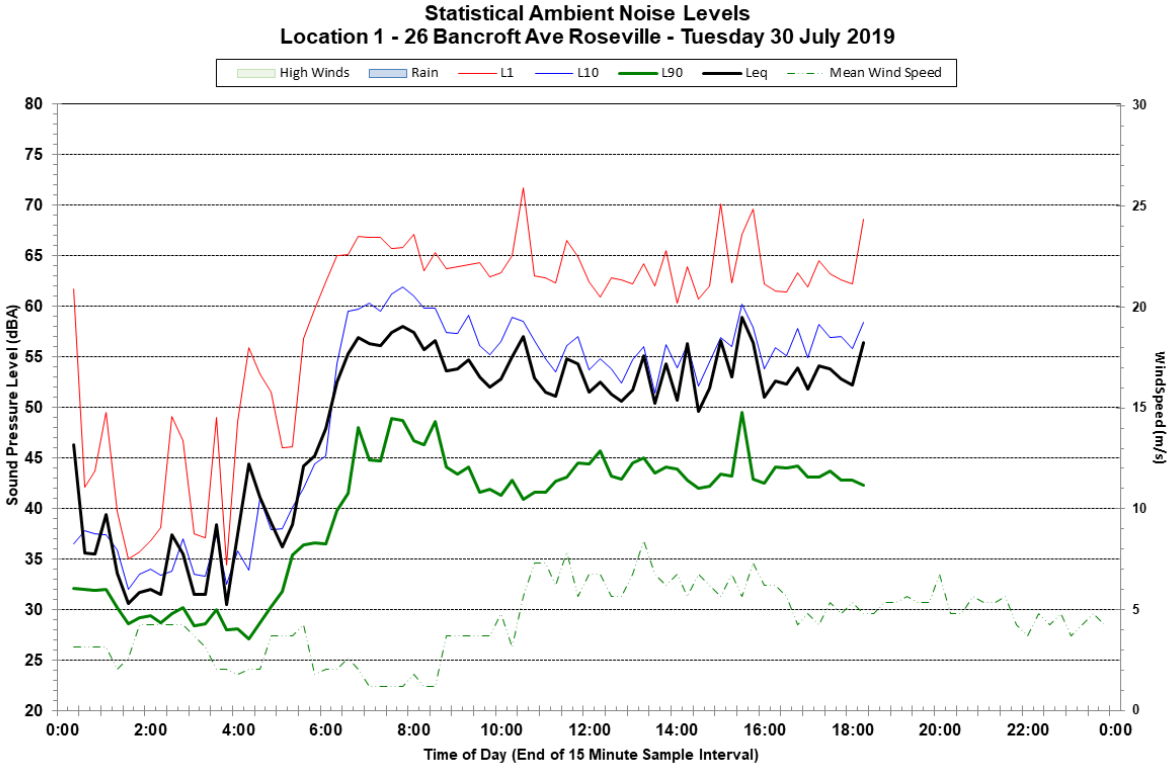
Statistical Ambient Noise Levels
Location 1 - 26 Bancroft Ave Roseville - Saturday 27 July 2019



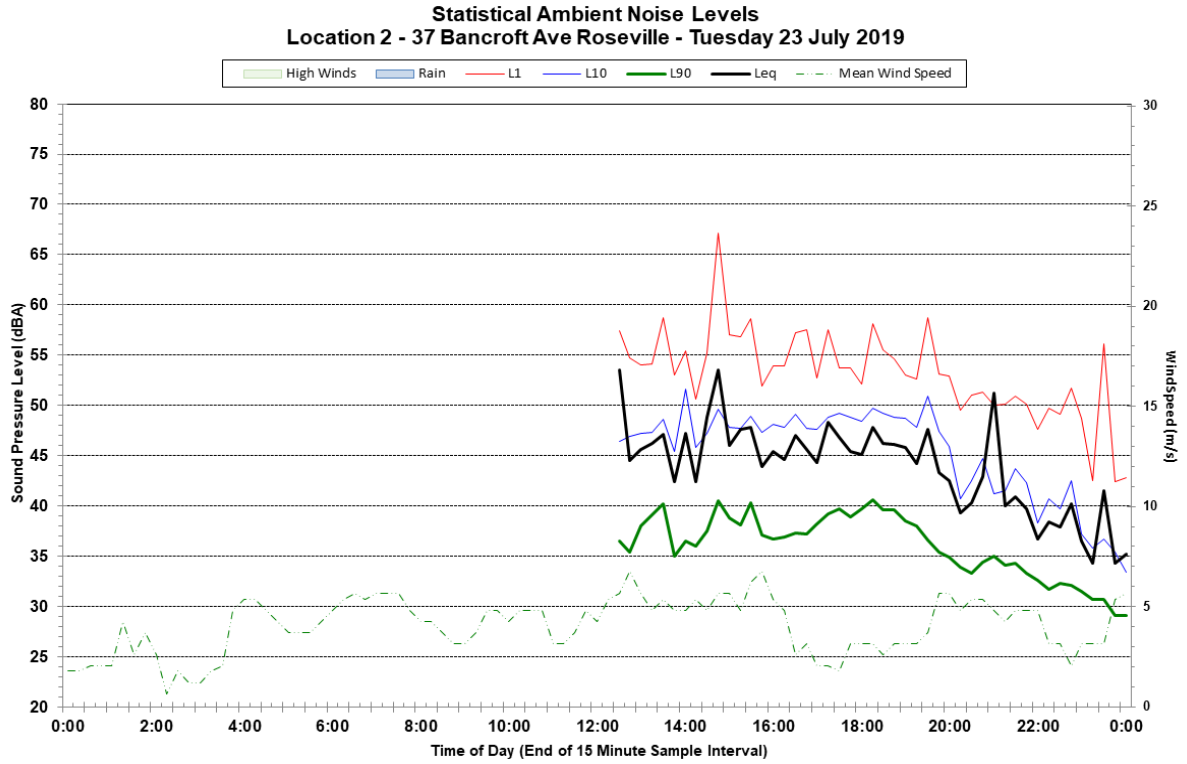
Statistical Ambient Noise Levels
Location 1 - 26 Bancroft Ave Roseville - Sunday 28 July 2019

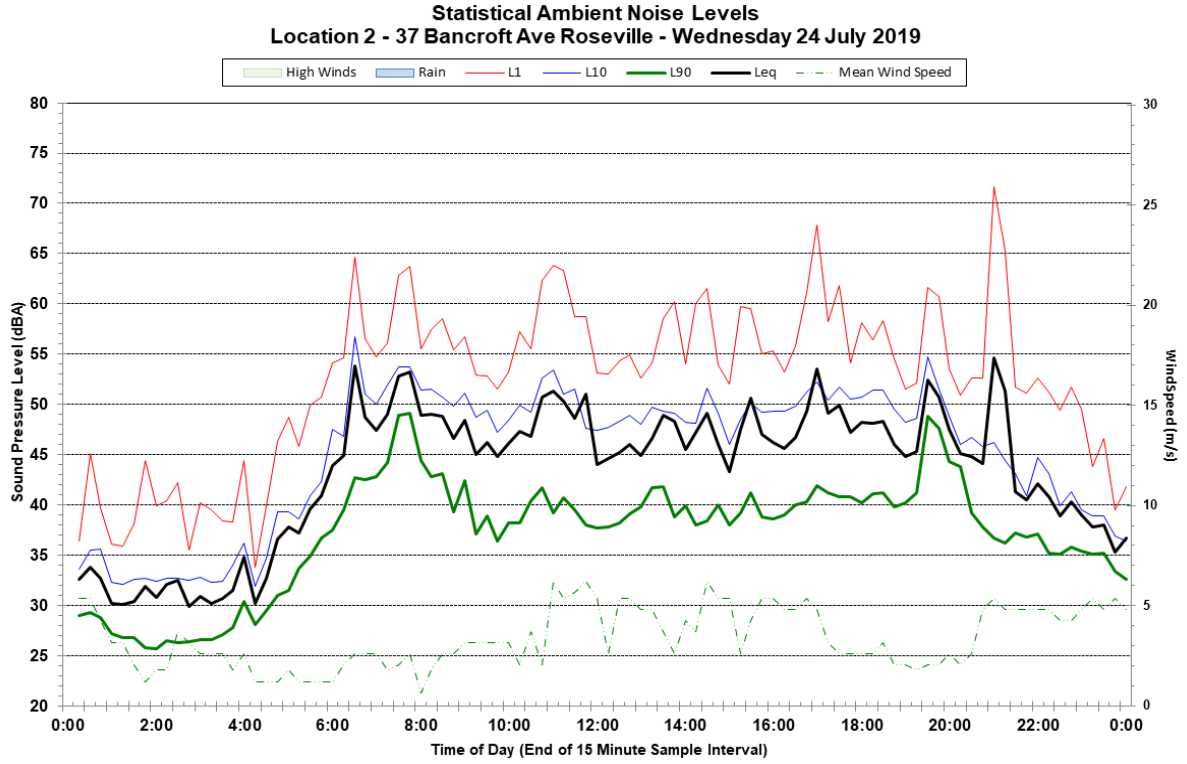



Statistical Ambient Noise Levels
Location 1 - 26 Bancroft Ave Roseville - Monday 29 July 2019
High Winds
Rain
L1
L10
L90
Leq
Mean Wind Speed
Sound Pressure Level (dBA)
WindSpeed (m/s)
Time of Day (End of 15 Minute Sample Interval)

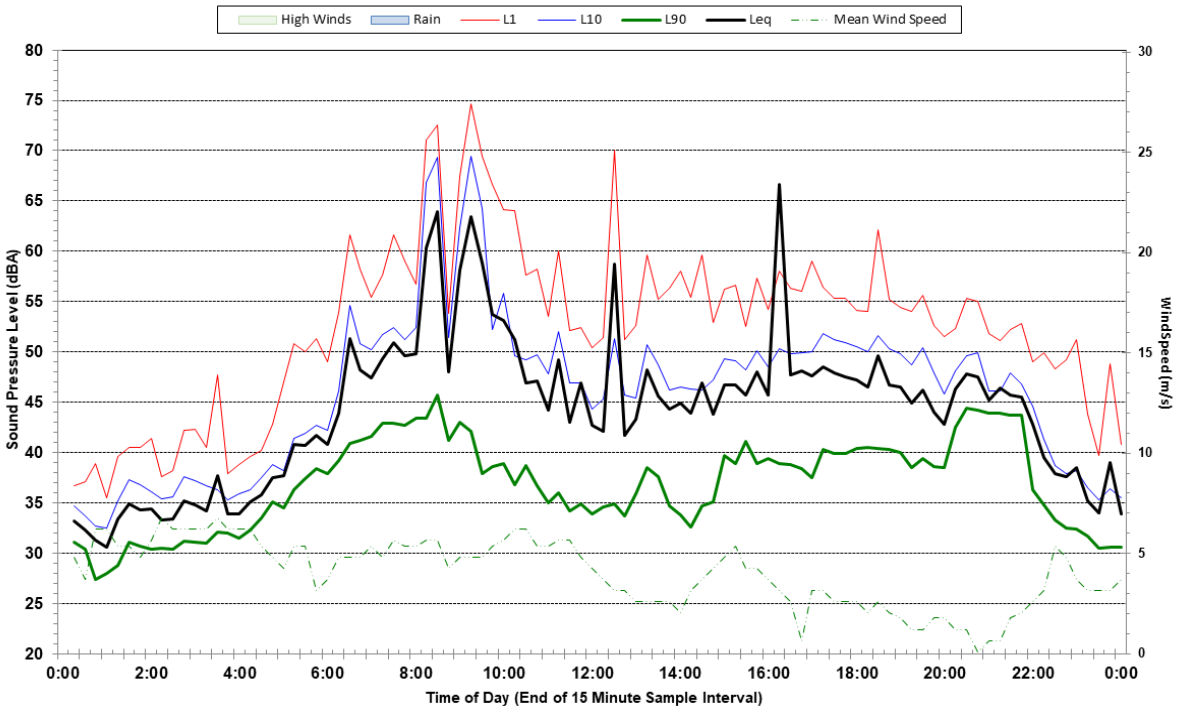

Statistical Ambient Noise Levels
Location 1 - 26 Bancroft Ave Roseville - Tuesday 30 July 2019
High Winds
Rain
L1
L10
L90
Leq
Mean Wind Speed
Sound Pressure Level (dBA)
WindSpeed (m/s)
Time of Day (End of 15 Minute Sample Interval)

B.2 LOCATION 2 – 37 BANCROFT AVENUE

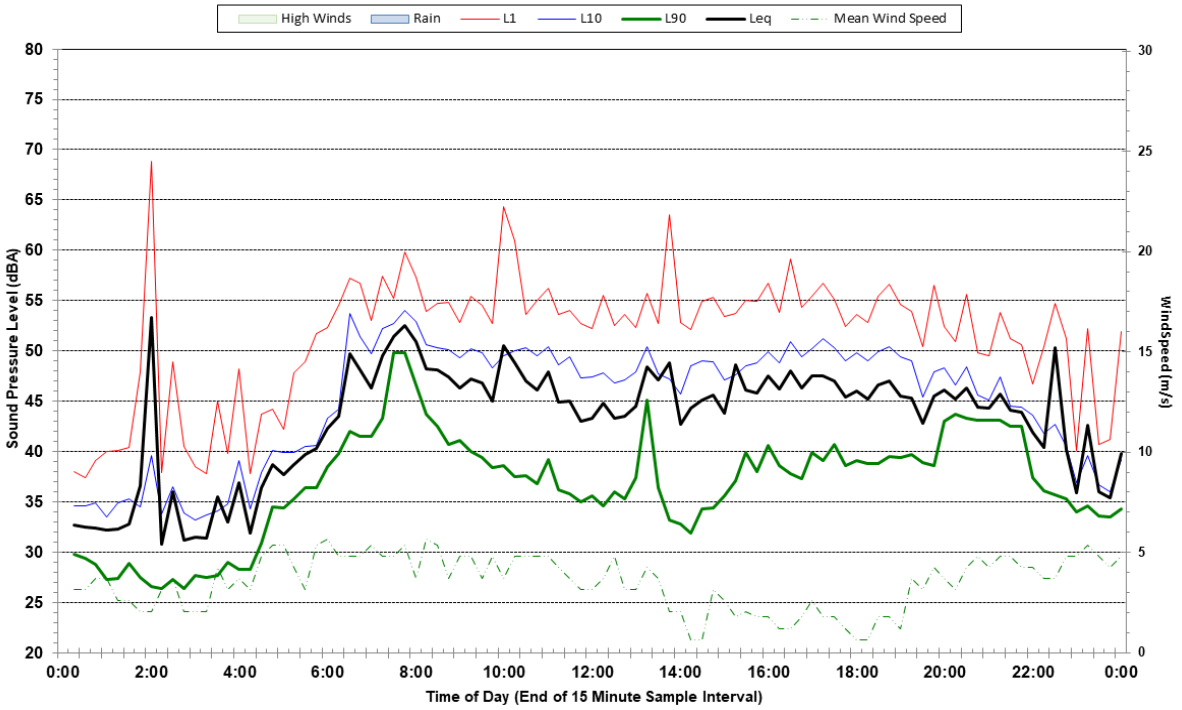




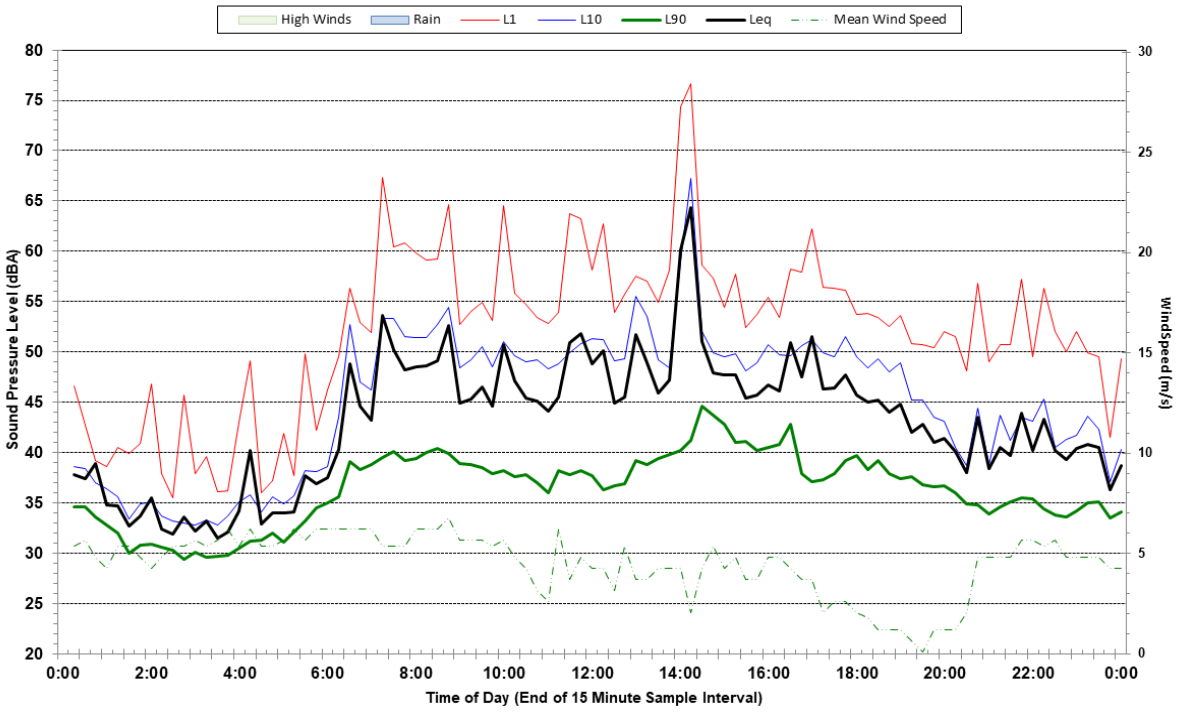
Statistical Ambient Noise Levels
Location 2 - 37 Bancroft Ave Roseville - Thursday 25 July 2019



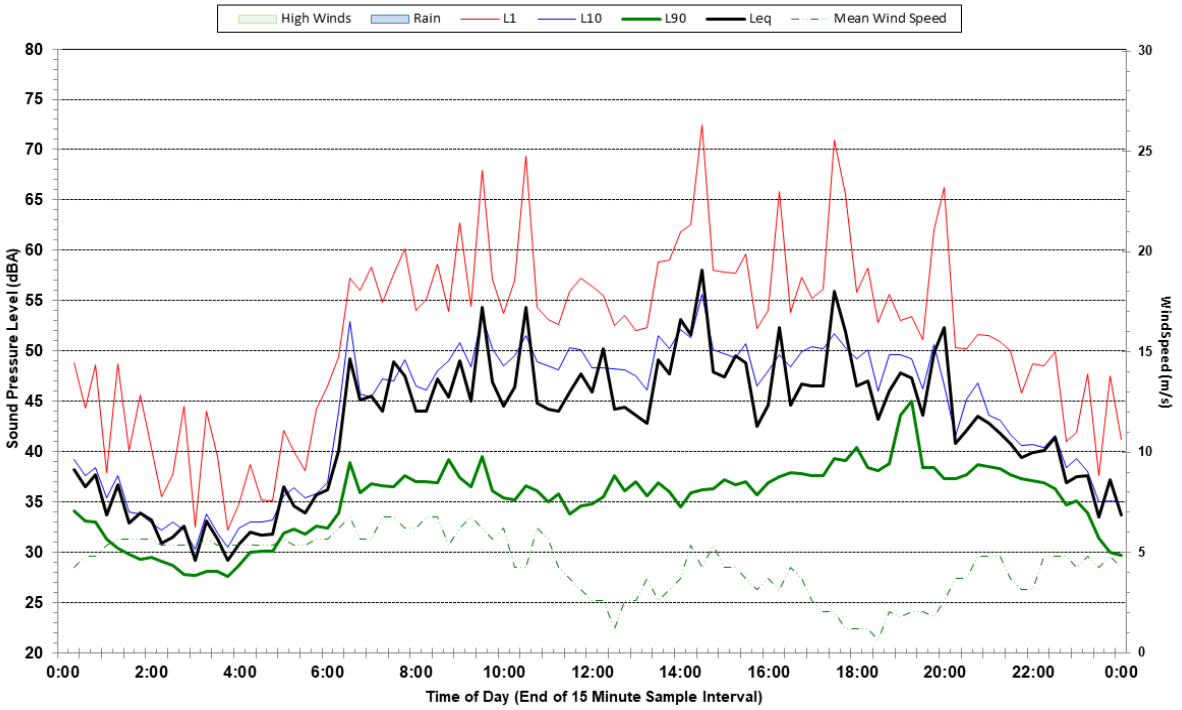
Statistical Ambient Noise Levels
Location 2 - 37 Bancroft Ave Roseville - Friday 26 July 2019



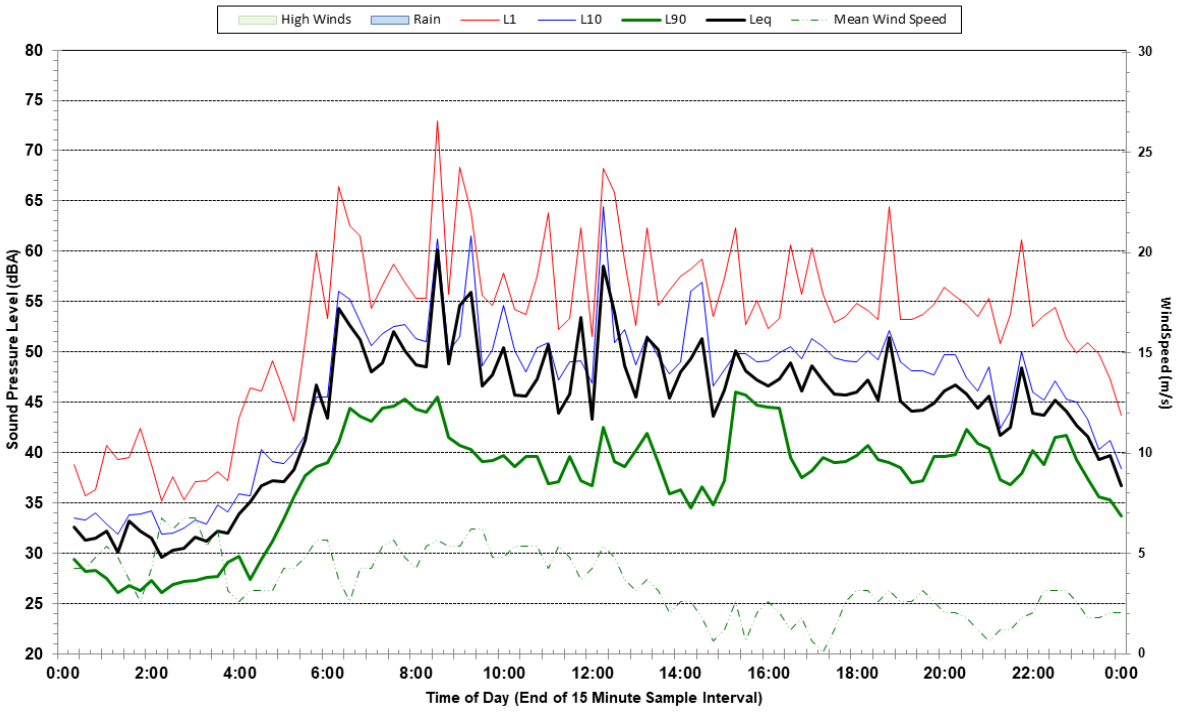
Statistical Ambient Noise Levels
Location 2 - 37 Bancroft Ave Roseville - Saturday 27 July 2019



Statistical Ambient Noise Levels
Location 2 - 37 Bancroft Ave Roseville - Sunday 28 July 2019



Statistical Ambient Noise Levels
Location 2 - 37 Bancroft Ave Roseville - Monday 29 July 2019



Statistical Ambient Noise Levels
Location 2 - 37 Bancroft Ave Roseville - Tuesday 30 July 2019