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Noise Impact Assessment

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1 INTRODUCTION

Acoustic Logic Consultancy have been engaged to conduct an acoustic assessment of noise impacts associated with the proposed University of Sydney Faculty of Arts and Social Sciences (FASS) building as part of the Camperdown Campus, City Road.

This assessment discusses potential noise impacts associated with development, which will typically include:

- Rooftop functions;
- Mechanical plant operation; and
- Noise associated with the construction of the proposed development.

This assessment has been undertaken using the architectural drawing set provided by Architectus.

Noise impacts have been addressed in accordance with the following standards and regulations as detailed in the Secretary's Environmental Assessment Requirements (SEARs) noted below:

- New South Wales Environmental Protection Authority –
    - *Industrial Noise Policy.*
    - *Interim Construction Noise Guideline.*
    - *Assessing Vibration: A Technical Guideline 2006*

Further guidance on the assessment of noise impacts associated with the site has been adopted from the following:

- State Environment Planning Policy (Infrastructure) 2007
- EPA *Road Noise Policy*

This assessment indicates that the construction and ongoing operation of the proposed administration building can comply with the aforementioned requirements.

2 SECRETARY'S ENVIRONMENTAL ASSESSMENT REQUIREMENTS

The SEAR requirements for this project have been addressed for the following state significant developments:

- SSD-7081 – Faculty of Arts and Social Sciences Building
  - Item 7
- SSD-6123 – Campus Improvement Program
  - Items B20, B21 and B22

The requirements detailed in each of these SSD-6123 applications/approvals are provided below.

2.1 SSD-7081

7. Noise and Vibration

Identify and provide a quantitative assessment of the main noise and vibration generating sources during construction and operation. Outline measures to minimise and mitigate the potential noise impacts on surrounding sensitive receivers.

2.2 SSD-6123

B20

All future development applications for new built form shall be accompanies by a noise and vibration assessment that identifies and provides a qualitative assessment of the main noise generating sources and activities at all stages of construction, and any noise sources during operation. Details are to be provided outlining any mitigation measures to ensure the amenity of adjoining sensitive land uses is protected throughout the construction and operational periods.

B21

All future development applications for new built form shall detail any noise mitigation measures associated with operational and mechanical plant noise impacts, and demonstrate that any noise generated plant will comply with the noise criteria detailed within noise and vibration assessments

B22

All future development applications for new built form shall consider potential noise impacts on adjoining residences, including noise generated from student and staff activities and broader associated ancillary community uses of buildings and other University facilities.

3 DEVELOPMENT PROPOSAL

The proposed site is located along the Northern boundary of the University of Sydney Camperdown Campus adjoining Parramatta Road.

3.1 PROPOSED STRUCTURES

The proposed structure is to include the following:

- Six levels incorporating:
  - Lecture theatre and teaching spaces;
  - Research areas;
  - General offices; and
  - Meeting rooms.
- A function/seminar room and associated function terrace is located on the sixth floor of the development.
- Plant equipment will be located on Level One and the Level Six.

3.2 PROPOSED OPERATION

The use of the development be primarily associated with:

- Lecture and teaching spaces;
- Offices for university staff and researchers;
- Meeting rooms; and
- Function space.

The proposed hours of operation are as follows:

- Standard office hours for the learning spaces and offices;
- Up to 10pm for the operation of the function space and terrace;

3.3 SURROUNDING USES AND NOISE SENSITIVE RECEIVERS

The site is bounded by the following uses:

- University buildings to the West, South and East;
- Commercial and residential buildings across Parramatta Road to the North;

The nearest most affected noise sensitive receivers will include the following (refer also to Figure 1).

Receiver 1. Residential terraces and multi-level apartment building along Arundel Street across Parramatta Road;

Receiver 2. Royal Prince Alfred hospital approximately 350m to the Southwest.

LEGEND

FASS Site Envelope	
Residential Receivers	
Commercial Receivers	
University Receivers	

Figure 1: Site Survey and Monitoring Positions

4 EXISTING ACOUSTIC ENVIRONMENT

The acoustic environment is categorised by high background noise levels during the day, evening and night associated with traffic noise from Parramatta Road.

4.1 ENVIRONMENTAL NOISE DESCRIPTORS

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

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

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

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

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

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

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

4.2 BACKGROUND NOISE LEVELS

Background noise levels which will be used as a basis for this assessment are detailed in the following sections.

4.2.1 Measurement Equipment

Unattended noise monitoring was conducting using Acoustic Research Laboratories Pty Ltd noise logger. The logger was programmed to store 15-minute statistical noise levels throughout the monitoring period. The equipment was calibrated at the beginning and the end of the measurement using a Rion NC-73 calibrator; no significant drift was detected. All measurements were taken on A-weighted fast response mode.

4.2.2 Measurement Location

Noise logging was conducted at the front of the demountable buildings as indicated in Figure 1. This location will be representative of background noise levels for the most potentially impacts sensitive receivers across Parramatta Road.

4.2.3 Measurement Period

The logger was on site from 30 March to 4 April, 2016. Refer to Appendix 1 for unattended long term noise monitoring data.

4.2.4 Ambient Noise Levels

The ambient noise levels established from the unattended noise monitoring are detailed in the Table below.

Table 1 – Rating Background Noise Level

Time of Day	Rating Background Noise Level dB(A) L_{90}	Existing Noise Level dB(A) L_{eq}
Day (7am to 6pm)	63	73
Evening (6pm to 10pm)	62	72
Night (10pm to 7am)	53	70

4.2.5 Weather Affected Noise Data

Weather affected noise data (as determined by Sydney Observatory – Observatory Hill) has been used to determine potentially affected weather data. Rain affected noise data has been removed from the data set.

For the most part, there is negligible difference between the recorded background noise levels during winds exceeding 5m/s and winds less than 5m/s. This is due to the fact that the monitor was shielded from the majority of wind.

On this basis, ALC would deem the background noise data acceptable.

5 NOISE CRITERIA

Noise emissions from the site will be assessed in accordance with the requirements of the Secretary's Environmental Assessment Requirements (SEARs) associated with application number SSD-7081 and SSD-6123 as detailed in Section 2.

The assessment of traffic noise impacts are addressed in Section 5.2.

5.1 EPA - INDUSTRIAL NOISE POLICY (INP)

The INP provides guidelines for assessing noise impacts from industrial developments. The recommended assessment objectives vary depending on the potentially affected receivers, the time of day, and the type of noise source. The INP has two requirements which both have to be complied with, namely an amenity criterion and an intrusiveness criterion.

Intrusiveness Criterion

The guideline is intended to limit the audibility of noise emissions at residential receivers and requires that noise emissions measured using the L_{eq} descriptor not exceed the background noise level by more than 5 dB(A).

Rating background noise levels for the area have been established from long term unattended noise monitoring as detailed in Section 4.2. Intrusive criteria based on the noise monitoring conducted at the site are detailed in Table 2.

Table 2 – INP Intrusiveness Criteria

Time of day	Background Noise Level dB(A)L_{90}	Intrusiveness Criteria (Background+5dB(A)) dB(A)L_{eq}
Day	63	68
Evening	62	67
Night	53	58

Amenity Criterion

The guideline is intended to limit the absolute noise level from all noise sources to a level that is consistent with the general environment. The Industrial Noise Policy sets out acceptable noise levels for various land uses. Table 2.1 on Page 16 of the policy has four categories to distinguish different residential areas. They are rural, suburban, urban and urban/industrial interface.

Pursuant to Section 2.2.1 of the INP, 'Suburban' and 'Urban' are defined as areas which have acoustical environments which incorporate the following characteristics.

Suburban - An area that has local traffic with characteristically intermittent traffic flows or with some limited commerce or industry. This area often has the following characteristics:

- Decreasing noise levels in the evening period (1800-2200); and/or
- Evening ambient noise levels defined by the natural environment and infrequent human activity.

Urban - an area with an acoustical environment that:

- Is dominated by 'urban hum' or industrial source noise
- Has through traffic characteristically heavy and continuous traffic flows during peak periods
- Is near commercial districts or industrial districts
- Has any combination of the above,

  Where 'urban hum' means the aggregate sound of many unidentifiable, mostly traffic-related sound sources.

ALC would determine the site an 'Urban' noise environment given:

- Its proximity to Parramatta Road which carries heavy and continuous traffic.
- Whilst there is a minor decrease in the evening background noise level (drops 1dB(A) from the day) the evening ambient noise levels would not be defined by the natural environment and infrequent human activity.

The corresponding Amenity Criteria noise emission goals are presented below.

Table 3 – INP Amenity Acceptable Noise Levels

Type of Receiver	Indicative Noise Amenity Area	Time of day	Recommended Acceptable Noise Level dB(A) L_{eq}
Residence	Urban	Day	60
		Evening	50
		Night	45
Commercial premises	All	When in use	65
Hospital Ward (External)	All	Noisiest 1-hour period	50

The aforementioned acceptable levels are to be adjusted in accordance with Section 2.2 of the INP. The existing L_{eq} noise levels (including industrial sources and road traffic) recorded at the site are as follows:

- Day – 68dB(A) L_{eq}
- Evening – 67dB(A) L_{eq}
- Night – 58dB(A) L_{eq}

In relation to the aforementioned noise levels, ALC notes the following:

- The contribution from industrial noise sources, that being mechanical plant associated with the adjoining University of Sydney buildings was inaudible.
- The resultant L_{eq} noise level in the vicinity of the site is almost entirely controlled by traffic noise from Parramatta Road.

Further to above, given that the site is located within a high traffic noise impact zone, the amenity criterion shall be adjusted accordingly as per Section 2.2.3 of the INP. The INP states that high levels of transportation noise may render an industrial source effectively inaudible even though the L_{Aeq} noise level from that industrial noise source may exceed the recommended acceptable amenity noise level. The methodology associated with this assessment is as follows:

- Establish the L_{Aeq} (time period) noise level at the most affected residence from the operation of the facility.
- If the L_{Aeq} (time period) is more than 10dB(A) above the established recommended amenity criterion for the area, the new planning objective becomes 10dB(A) below the L_{Aeq} (time period).

Utilising the modification factors in Table 2.2 of the INP and the traffic noise levels as per above, the amenity criteria becomes the following:

Table 4 – INP Adjusted Amenity Noise Criteria

Time of Day	Acceptable noise level, dB(A) L_{eq} (period)	Existing L_{eq} noise level from industrial noise sources, dB(A)	Existing L_{eq} noise level from traffic sources, dB(A)	Modification factor	Adjusted Amenity criterion, dB(A) $L_{eq\ (period)}$
Day	60	Negligible	73	L_{eq} – 10dB(A)	63
Evening	50	Negligible	72	L_{eq} – 10dB(A)	62
Night	45	Negligible	70	L_{eq} – 10dB(A)	60

5.2 STATE ENVIRONMENT PLANNING POLICY (INFRASTRUCTURE) 2007

The SEPP (Infrastructure) 2007 provides guidance for traffic noise impact on developments located near major roads. Clause 102 states the following:

Clause 102 - Impact of road noise or vibration on non-road development

(1) This clause applies to development for any of the following purposes that is on land in or adjacent to the road corridor for a freeway, a tollway or a transit way or any other road with an annual average daily traffic volume of more than 40,000 vehicles (based on the traffic volume data published on the website of the RTA) and that the consent authority considers is likely to be adversely affected by road noise or vibration:

(a) a building for residential use,

(b) a place of public worship,

(c) a hospital,

(d) an educational establishment or child care centre.

Whilst the proposed forms part of an educational establishment, there are no specific guidelines or noise criteria which are to be adopted as part of the SEPP (Infrastructure) 2007.

Notwithstanding, traffic noise intrusion into the development will be considered as part of the detailed design phase of the project to ensure that a suitable level of acoustic amenity is maintained which ALC believes satisfies the intent of Clause 102 of the SEPP (Infrastructure) 2007.

6 ASSESSMENT OF NOISE IMPACTS

Noise emissions from the general operation of the proposed administration building have been addressed for the following noise sources:

- Noise associated with rooftop function areas; and
- A preliminary assessment of noise from mechanical plant.

ALC notes that there is no car parking associated with the proposal and as such traffic generation and noise associated with on-site movements have not been assessed.

A preliminary assessment of construction noise has also been included.

6.1 LEVEL 6 TERRACE

May be used for formal functions, awards events and alumni events. The function room has an associated outdoor terrace which faces South. Amplified speech and music may be utilised internally. Amplified speech and/or music is not expected externally.

The function room capacity on Level 6 is for 50 patrons. For the purposes of this assessment, ALC have assumed that 100 patrons will be in attendance, with a 50/50 mix between the internal and external areas.

The function room has been modelled as minimum 6mm / 12mm / 6mm glazing to the façade and 0.42mm sheet metal roof with insulated sarking. At this stage, a perforated ceiling has been assumed which will provide minimal acoustic benefit for noise breaking out of the venue.

6.1.1 Assumed Noise Levels

The operation of the Level 6 function room and terrace has been assessed against the following assumptions.

Table 5 – Assumed Noise Levels and Operation for Internal Spaces

Space	Hours of Operation	Amplified Music	Amplified Speech	Internal Sound Pressure Level, dB(A) L_{eq}
Level 6 Function Room	7am to 10pm	Yes	Yes	90

The operation of the outdoor terraces and balconies have been assessed against the following assumptions.

Table 6 – Assumed Noise Levels and Operation for Outdoor Areas / Balconies

Space	Hours of Operation	Amplified Music or Speech	Number of Patrons on Balcony	Patron Sound Power Level, dB(A) L_{eq}
Level 6 Function Terrace	7am to 10pm	No	50 1 in 3 talking	74

6.2 PREDICTED NOISE LEVELS

The assessment has been assessed for the expected worst case operation for each time period as per Table 7.

Predicted noise levels from the operation of the proposed development have been assessed for the cumulative noise level from all components of the development respective to the time of day.

Table 7 – Worst Case Operational Activities

Time of Day	Noise sources assessed
Day 7am to 6pm	Mechanical Plant Level 6 - Outdoor Terrace – Refer to Section 6.1
Evening 6pm to 10pm	Mechanical Plant Level 6 - Outdoor Terrace – Refer to Section 6.1
Night 10pm to 7am	Mechanical Plant

Note: Operation does not include mechanical plant which will be assessed at a later stage upon selection of mechanical plant (refer to Section 6.3 of this report).

The predicted noise levels are presented in the following Table.

Table 8 – Function Room and Terrace Operation

Time of Day	Receiver Location	Predicted Noise Level, dB(A) $L_{eq\ 15min}$	Noise Emission Objectives[1], dB(A) $L_{eq\ 15min}$
Evening 6pm to 10pm	North Receivers	35	62
	Royal Prince Alfred	31	50

Note[1]: Noise emission objectives based on the strictest noise criteria out of the intrusiveness and amenity criterion respective to the period of the day.

6.3 NOISE FROM MECHANICAL PLANT

Detailed acoustic design of mechanical plant cannot be undertaken at approval stage, as plant selections and locations are not finalised. However, an indicative assessment of primary plant items is presented below.

Primary plant items may include:

- Cooling towers (located on roof top of the building).
- Air handling plant (air handling units, supply/exhaust/outside air fans).
- Water cooled chillers.

With respect to the above, we note:

- Cooling tower.
    - The cooling tower is located on Level 6 within an enclosed plant room. The air intakes are via the Western façade with vertical discharge through the plant room roof.
    - Based on the preliminary selection of the cooling tower with a sound power level of 98dB(A) running at 100% speed, predicted noise levels at the receivers across Parramatta Road will comply with the noise emission criteria for all periods of the day.
- Water Cooled Chillers
    - Chillers are proposed to be located within the Level 6 plant room. Given that the plant room is fully enclosed, chillers will have negligible acoustic impact on surrounding receivers.
    - Any ventilation openings or fans will be acoustically treated to satisfy the noise emission requirements.
- Fans and air-handling units.
    - Detailed acoustic review of all plant rooms to be undertaken following equipment selection, in particular if there are louvres facing North. Ideally, fans/air handling units will be ducted to the external louvre (with the remainder of the louvre blanked off to prevent noise escape) as opposed to the being large louvre areas open directly into the plant room (which may necessitate acoustic louvres).
    - Air handling units do not typically require extensive acoustic treatment to ensure compliant noise emissions at nearby properties.
    - Air handling unit exhaust and outside air ducting (both of which are typically ducted to outside) are to be acoustically reviewed following layout design by mechanical engineer/contractor to determine whether internal lining to this ductwork is required.
    - Major fans (typically with a sound power over 85(A) – major toilet exhaust and major relief air fans) are not likely to require acoustic treatment. Notwithstanding, all fans are to be reviewed as part of the detailed design process. Acoustic treatment (where required) may include internal lining to any external ductwork.

Cumulative assessment of both plant noise with other noise sources is recommended when conducting acoustic design of plant items. This is particularly important for plant noise near the western property boundary, where cumulative assessment with the car park/vehicle noise is to be considered.

Compliance with INP acoustic criteria as set out in Section 5.2 will be achievable, provided that detailed acoustic review of plant items is undertaken once plant is selected, and acoustic treatments similar to those outlined above are adopted.

6.4 OPERATIONAL VIBRATION IMPACTS

Sources of vibration associated with the development will be generally attributed to sporadic vehicle movements in and out of the carpark/loading area and the operation of mechanical plant servicing the development. In this regard, ALC note the following:

- Vibration associated with vehicle movements on site will have negligible impact on surrounding receivers (specifically the future 'Academic House' residents) given their proximity to the site. In any case, vibration impacts will be no greater than that associated with movements along Fisher Road.
- Mechanical plant will be located within the site and will have no vibration impact on surrounding receivers.

On this basis, the development will be fully compliant with the criteria detailed in the EPA document *'Assessing Vibration: A Technical Guideline 2006'*.

7 CONSTRUCTION IMPACTS

This section presents processes to manage noise and vibration impacts associated with the proposed construction activities for the facility and the potential for noise and vibration impact to surrounding receivers.

The principal objective of this study is to undertake an evaluation of works to be performed during the operation of the various activities during construction and develop a management plan to ensure noise and vibration:

1. Does not excessively impact on the sensitive receivers.
2. Is minimised to all surrounding receivers.
3. Does not exceed OH&S standards at surrounding receivers.
4. Is monitored when potentially high noise and vibration generating activities are being used.

This assessment will formulate/present the relevant noise and vibration objectives for which construction activities should be managed to comply with. Additionally, effective mitigation measures have been recommended where possible to ensure noise and vibration objectives are achieved and impacts are minimised.

The principal issues to be addressed in this Section are:

- Identification of the noise and vibration standards which will be applicable to this project.
- Formulation of a strategy for construction activities to comply with the standards identified in the above point.
- Development of demolition and excavation methods which will minimise the impact on surrounding uses.

The expected activities can be expected to include:

1. Excavation of soil and soft sand stone.
2. Construction of proposed facility.

7.1 CONSTRUCTION NOISE MANAGEMENT LEVELS

Noise emanating from the construction site has been assessed in accordance with the recommendations of the EPA *Interim Construction Noise Guideline*.

The guideline reflects on feasible and reasonable mitigation strategies, management controls and public liaising in the effort to reach realistic compromises between construction sites and potential noise affected receivers.

Residential dwellings are discussed in Section 4.1.1 of the ICNG.

Table 9 – Construction Noise Management Levels

Management level, L_{Aeq} (15min)	**How to apply**
Noise affected RBL + 10dB	The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured LAeq (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
Highly noise affected 75 dB(A)	• The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences 2. if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

Section 4.1.2 of the ICNG provides guidance on construction noise management levels for sensitive uses other than residential dwellings. These uses as detailed in the following Table.

Table 10 – Construction Noise Management Levels

Land Use	Management level, $L_{Aeq\ (15min)}$ (applies when properties are being used)
Commercial	70dB(A)
Hospital Wards and Operating Theatres	45dB(A) internally / 65dB(A) externally[1]

Note[1]: ALC have assumed a 20dB(A) drop across a closed façade.

A summary of noise emission goals for both standard hours of construction and outside standard hours are presented.

Table 11 – Construction Noise Emission Objectives

Location	"Noise Affected" Level dB(A) $L_{eq\ (15min)}$	"Highly Noise Affected" Level dB(A)$L_{eq(15min)}$
Residences	73 (Standard Construction Hours)	75
Commercial Development	70	N/A
Hospital Wards	45dB(A) internally / 65dB(A) externally[1]	N/A

7.2 CONSTRUCTION VIBRATION

Vibration goals for the amenity of nearby land users are those recommended by the EPA document *Assessing Vibration: A technical guideline.* These levels are presented below:

Table 12 – Construction Vibration Objectives

Location	Time	Peak velocity (mm/s)	
		Preferred	Maximum
Continuous Vibration			
Residences	Daytime	0.28	0.56
Commercial	When in use	0.56	1.12
Impulsive Vibration			
Residences	Daytime	8.6	17
Commercial	When in use	18	36

7.3 ASSESSMENT OF CONSTRUCTION NOISE

With respect to general construction noise, the impacts on nearby development will be dependent on the activity in question and where on the site the activity is undertaken. Excavation and piling works tend to be the loudest typical construction activity. Work close to the northern boundary will have greatest potential impact on nearby sensitive receivers.

7.3.1 Demolition and Excavation Works

Demolition works on the site are expected to be minimal and will be restricted to the break-up of existing slabs / sports courts. Excavation of Level 1 and partially level 2 may incorporate some heavy machinery works which are discussed below.

Excavation of fill for lower levels may require rock hammering which would likely present the loudest typical noise events associated with the construction period.

- During the demolition and excavation periods, it is the use of rock hammers which will present the loudest sources of noise to surrounding receiver locations.
    - Noise levels from excavators on site are unlikely to exceed the EPA "Noise Effected"/"Background+10dB(A)" at the receivers across Parramatta Road.

      Slight exceedances of the "Highly Noise Effected" level of 75dB(A) are only likely to occur for rock hammering.
    - Noise levels from all processes (excavators / rock hammers) are unlikely to exceed the 65dB(A) external criteria and inherently the 45dB(A) internal criteria at Royal Prince Alfred.

7.3.2 General Construction Works

- During erection of structure, it is the use of hand tools (angle grinders etc.) and concrete pumps which are the loudest typical activity (sound power levels of approximately 105dB(A)$L_{eq(15min)}$).
    - Noise levels exceeding EPA "Noise Effected"/"Background+10dB(A)" are not likely to occur at any receiver location. Exceedances of the "Highly Noise Effected" level 75dB(A) are also highly unlikely.
- Work zones are likely to be located off Science Road. Noise from construction vehicles and material handling will negligible impact on surrounding sensitive receivers.
- Slab finishing works (use of helicopter floats or similar) will potentially extend into the evening depending on the size of the slab and weather conditions. Noise levels exceeding the "Noise Effected"/"Background+10dB(A)" at sensitive receiver locations are unlikely to occur. Noise levels exceeding the 65dB(A) external criteria at Royal Prince Alfred are also unlikely to occur.
- Once construction of the building shell is complete, noise from hand tools will be relatively low, as the new building façade will provide considerable noise attenuation. Once the building shell is largely complete, noise impacts from the use of hand tools in internal areas will have negligible impact on sensitive receiver locations.

7.4 DISCUSSION

In light of the above, we recommend:

- Use of augured rather than driven or vibratory piling will be considered if feasible.
- Location of the concrete pump away from Parramatta Road if practical. If this is not possible, in the event of complaint, temporary screening of the pump should be considered (plywood hoarding, or plywood sheet fixed to temporary fencing.
- For activities where acoustic controls and management techniques still cannot guarantee compliance with "Noise Management"/"Background+10dB(A)" noise levels, implement a notification process whereby nearby development is made aware of the time and duration of noise intensive construction processes. This may include days of heavy hammering and excavation works.
- Implementation of a noise monitoring program (attended noise measurements during key stages of construction) during construction to provide feedback back to the Builder to ascertain whether construction noise goals are being exceeded and determine additional management strategies. This would be expected at commencement of excavation works.

Through adoption of the above, noise impacts on nearby development can be suitably managed to prevent unreasonable impact. Management processes for dealing with construction noise complaints and response procedures are addressed in Section 7.6.

7.5 CONSTRUCTION VIBRATION

Given the proximity to surrounding receiver locations, there will be no significant vibration impact associated with the construction works.

7.6 NOISE AND VIBRATION MONITORING, REPORTING AND RESPONSE PROCEDURES

Noise and vibration monitoring may either consist of manned and/or unmanned measurements. Active monitoring may be undertaken during the construction work phase of the project if required in the event complaints are received from neighbours. In the event complaint are received from neighbours the following process will be followed:

1. Determining the offending plant/equipment/process

2. Locating the plant/equipment/process further away from the affected receiver(s) if possible.

3. Implementing additional acoustic treatment in the form of localised barriers, silencers etc.

4. Selecting alternative equipment/processes

Where monitoring is required and indicates exceedances of the noise limits immediate action should be taken to identify any further controls as required to reduce noise emissions so that the noise limits are complied with. Monitoring of the activities following the implementation of these additional controls will be undertaken to confirm compliance.

7.6.1 Reporting requirements

The following shall be kept on site:

1. A register of complaints received/communication with the local community shall be maintained and kept on site with information as detailed below.

2. Where noise/vibration complaints require noise/vibration monitoring, results from monitoring shall be retained on site at all times.

3. Any noise exceedances occurring including, the actions taken and results of follow up monitoring.

4. A report detailing complaints received and actions taken shall be presented.

5. All monitoring and reporting shall be conducted in conjunction with the conditions of consent.

7.6.2 Response procedures

Complaints associated with noise and vibration generated by site activities shall be recorded on a Noise Complaint Form. The person(s) responsible for complaint handling and contact details for receiving of complaints shall be established on site prior to construction works commencing. A sign shall be displayed at the site indicating the Site Manager and the general public and their contact telephone number

If a noise complaint is received the complaint should be recorded on a Noise Complaint Form. The complaint form should list:

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

7.6.3 Control of Construction Noise

The flow charts that follow illustrate the process followed to assess construction activities prior to the start of work on site and well as the ongoing investigation into noise during the construction period.

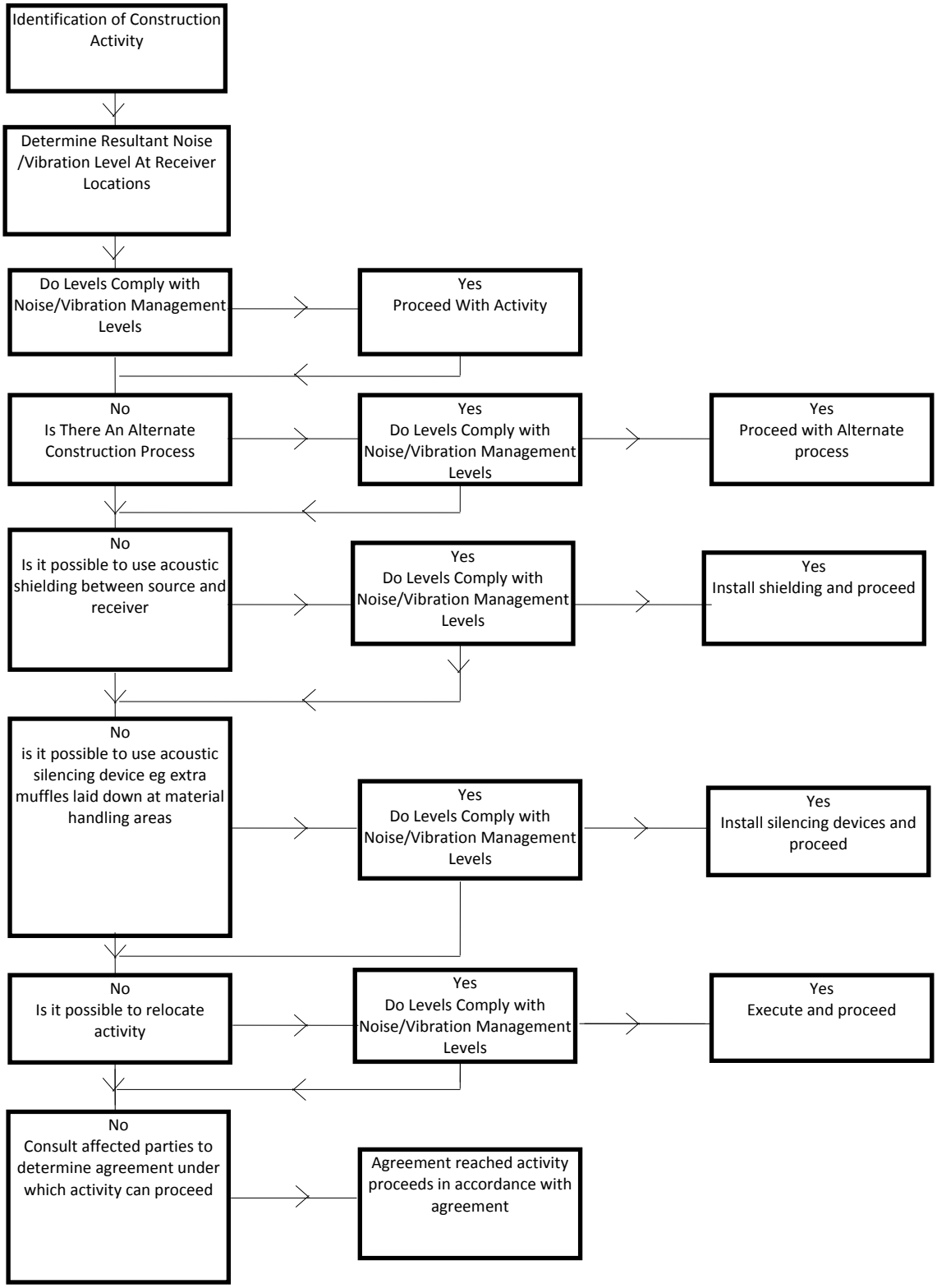


Figure 2 – Process Flowchart

7.7 NOISE CONTROL METHODS

The determination of appropriate additional noise control measures will be dependent on the particular activities and construction appliances identified as requiring future acoustic treatments to those already identified in this report. This section provides an outline of available methods which have previously been used on similar construction sites and may be possible on this site.

7.7.1 Selection of Alternate Appliance or Process

Where a particular activity or construction appliance is found to generate noise levels that exceed the criteria, it may be possible to select an alternative approach or appliance. For example; the use of a hydraulic hammer on certain areas of the site may potentially generate high levels of noise. By carrying this activity by use of pneumatic hammers, bulldozers ripping and/or milling machines lower levels of noise will result.

7.7.2 Acoustic Barriers

The placement of barriers at the source is generally only effective for static plant (tower cranes). Placing barriers at the source cannot effectively attenuate equipment which is on the move or working in rough or undulating terrain.

The degree of noise reduction provided by barriers is dependent on the amount by which line of sight can be blocked by the barrier. If the receiver is totally shielded from the noise source reductions of up to 15 dB(A) can be effected. Where only partial obstruction of line of sight occurs, noise reductions of 5 to 8 dB(A) may be achieved. Where the barrier does not obstruct line of sight, generally no noise reduction will occur.

As barriers are used to provide shielding and do not act as an enclosure, the material they are constructed from should have a noise reduction performance which is approximately 10dB(A) greater than the maximum reduction provided by the barrier. In this case the use of a material such as 10 or 15mm plywood would be acceptable for the barriers. A double paled or lapped and capped fencing construction is recommended for such barriers.

7.7.3 Silencing Devices

Where construction process or appliances are noisy, the use of silencing devices may be possible. These may take the form of engine shrouding, or special industrial silencers fitted to exhausts.

7.7.4 Treatment of Specific Equipment

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

7.7.5 Establishment of Site Practices

This involves the formulation of work practices to reduce noise generation. This includes locating fixed plant items as far as possible from residents as well as rotating plant and equipment to provide respite to receivers.

8 RECOMMENDATIONS

We recommend the following acoustic treatments/management controls to ensure compliance with EPA noise emission guidelines.

- Detailed acoustic review of all external plant items following equipment selection and duct layout design. Initial analysis (Section 6.3) indicates that with acoustic treatment, all plant items will be capable of meeting noise emission requirements. This may require:
  - Acoustic treatment to fan casing and lining of external ducting for major external fans if located outside of plant rooms or discharging to the North.
  - Possible upgrade of light weight plant room wall for any plant room housing chiller plant.
  - Detailed acoustic review of external louvres for any plant room to determine whether acoustic louvres/attenuators are required.
- Construction noise and vibration should be managed using the procedures nominated in Section 7.

9 CONCLUSION

Noise emissions associated with the proposed University of Sydney Faculty of Arts and Social Science Building has been assessed with reference to relevant EPA acoustic guidelines in order to comply with Secretary of the Environment Requirements detailed in Section 2.

An analysis of typical operational noise (functions, mechanical equipment) indicates that the site is capable of complying with relevant noise emission criteria.

Detailed acoustic review of mechanical plant will be undertaken once the design is further progressed (plant selections finalised etc.). In-principal review indicates that acoustic treatment to major plant items may be required (screens, in-duct attenuation and enclosures) however through appropriate treatment, noise emissions are capable of complying with EPA Industrial Noise Policy and Council requirements.

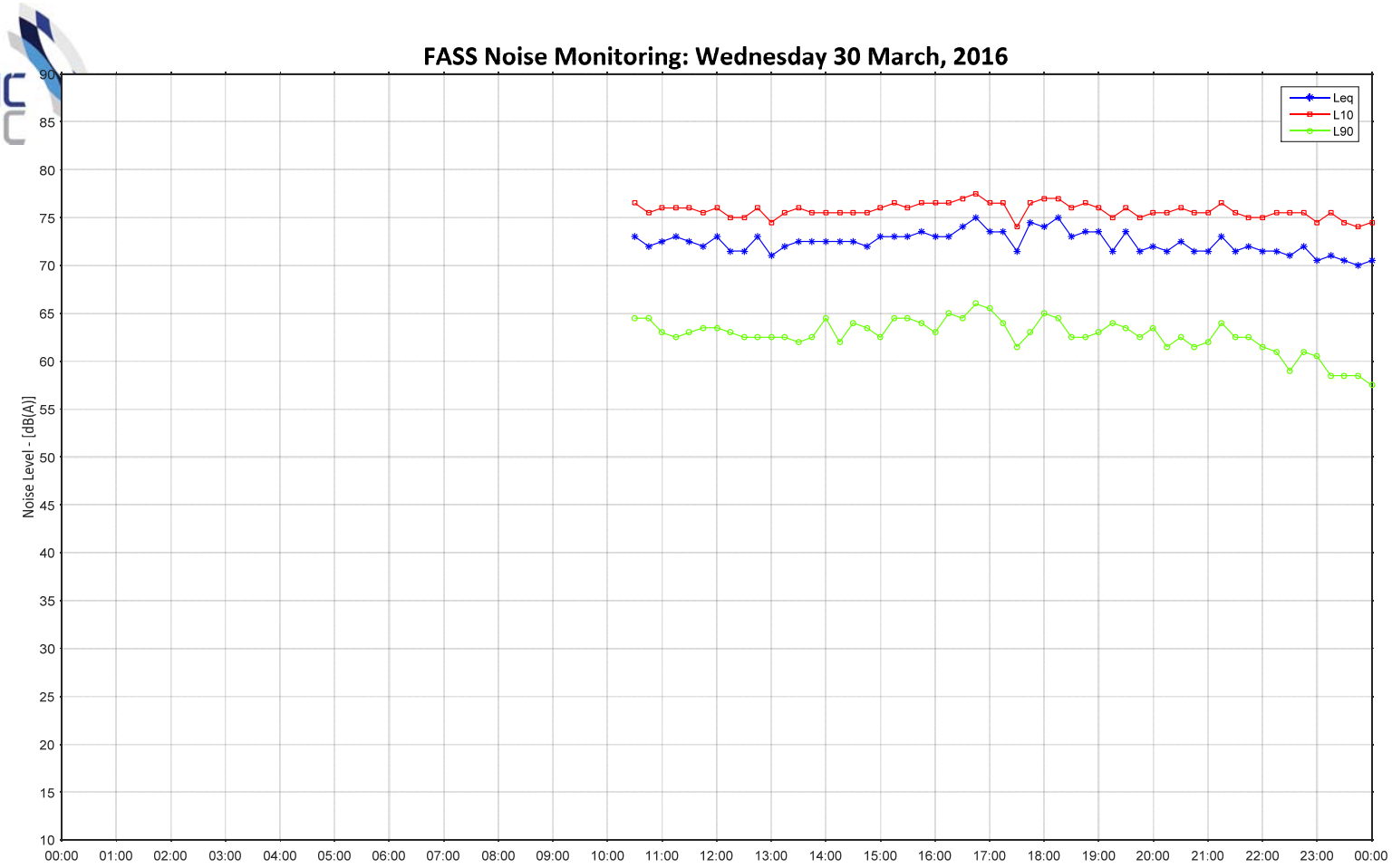
Similarly, detailed noise management practices will be implemented for the control of construction noise. In principle, the acoustic review indicates that heavy excavation works such as hammering may have the potential to exceed EPA Interim Construction Noise Policy guidelines, particularly when working in areas near the Northern property boundary. Noise mitigation through work scheduling and equipment selection will be considered. This should be implemented via a Noise/Vibration Management Plan, which should be determined once a construction program is complete.

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

Yours faithfully,

Acoustic Logic Consultancy Pty Ltd
James Small

APPENDIX ONE – UNATTENDED NOISE MONITORING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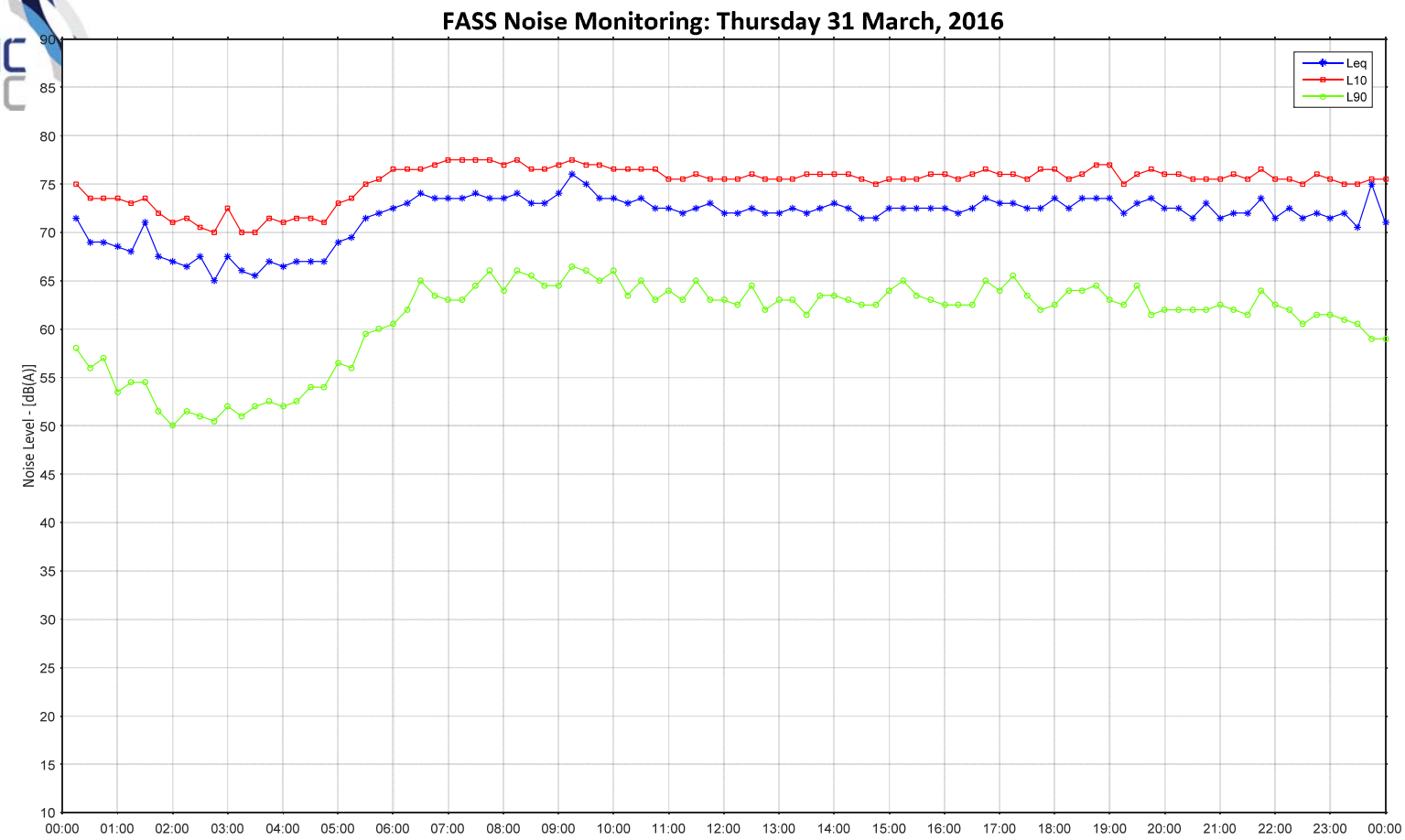
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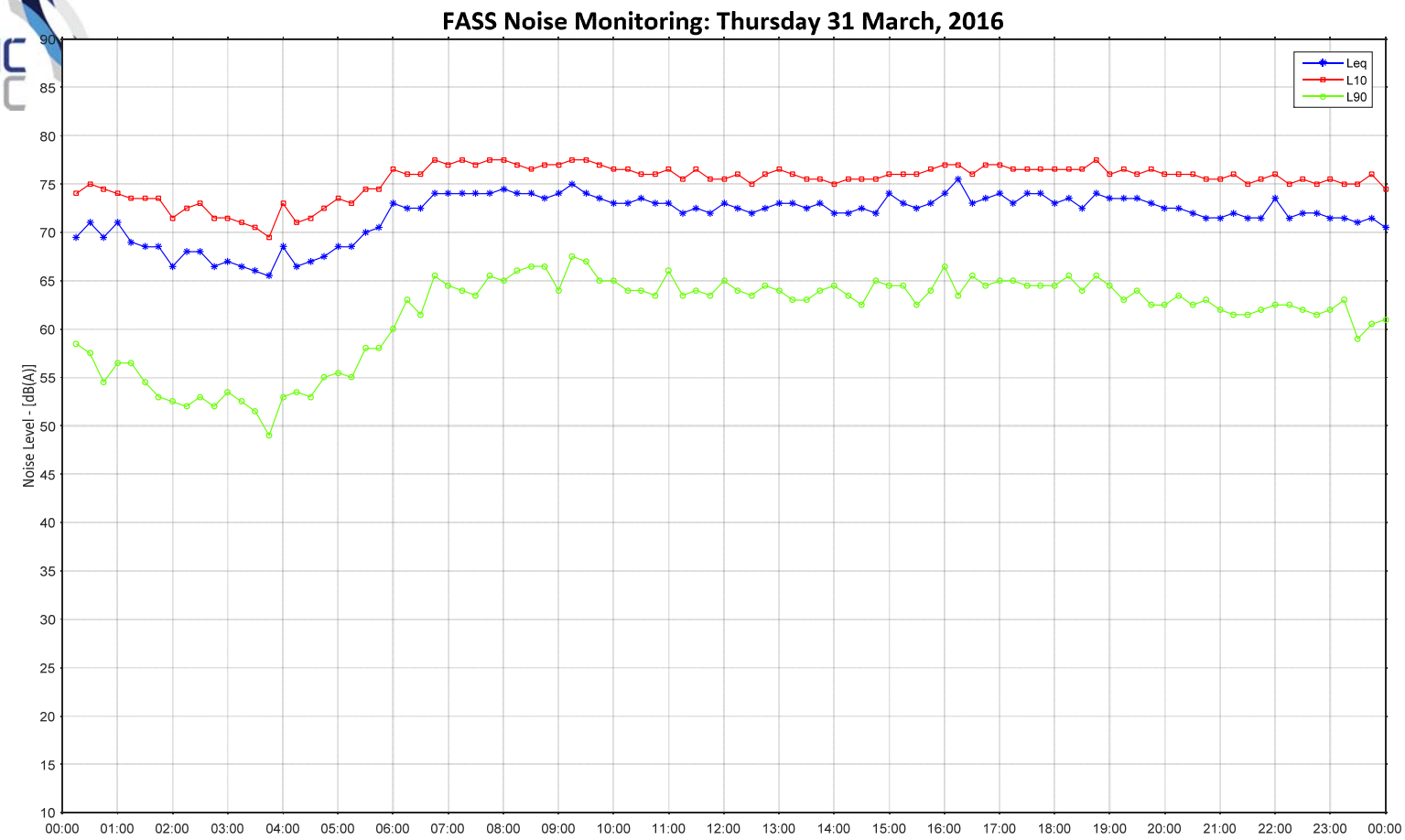
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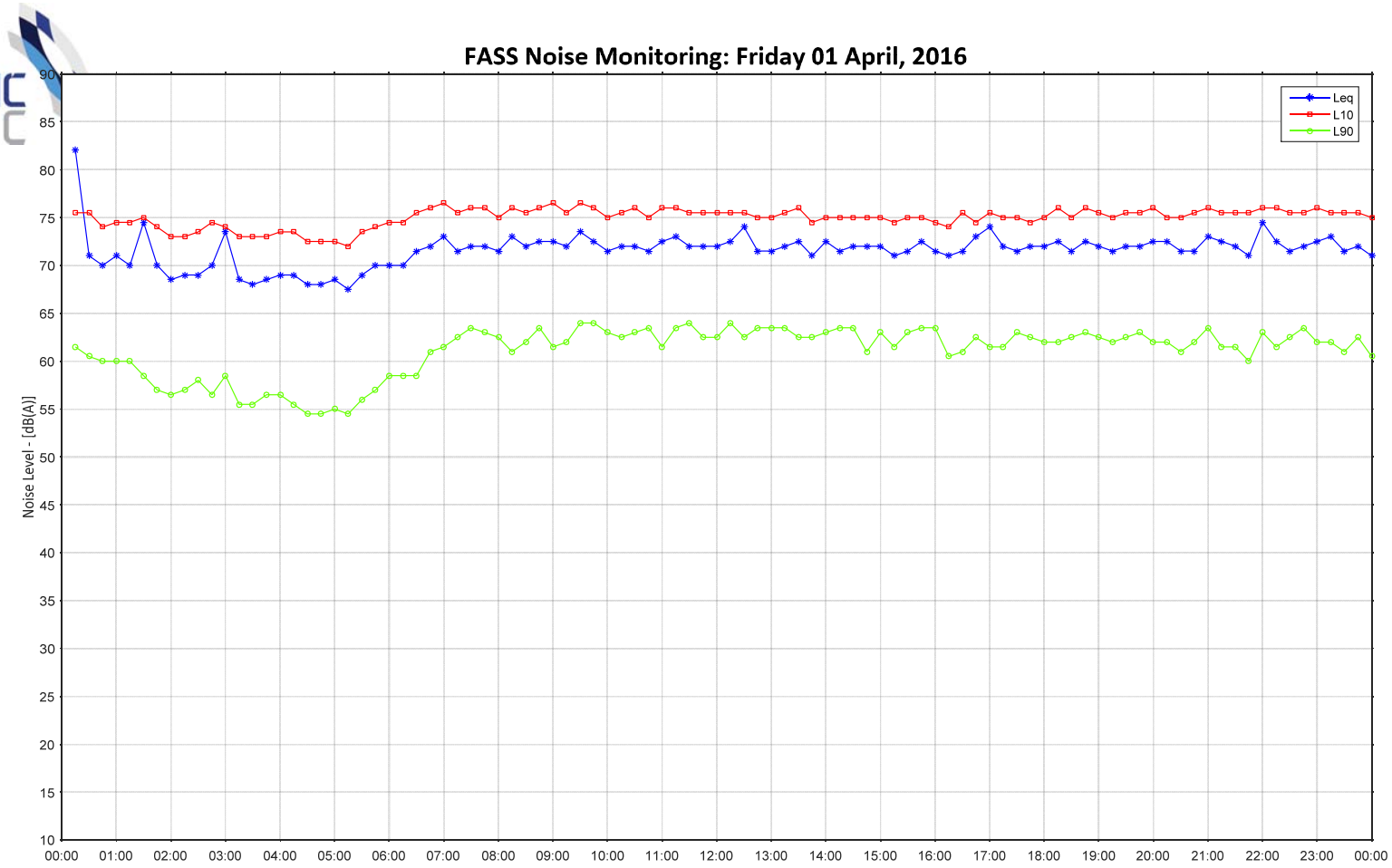
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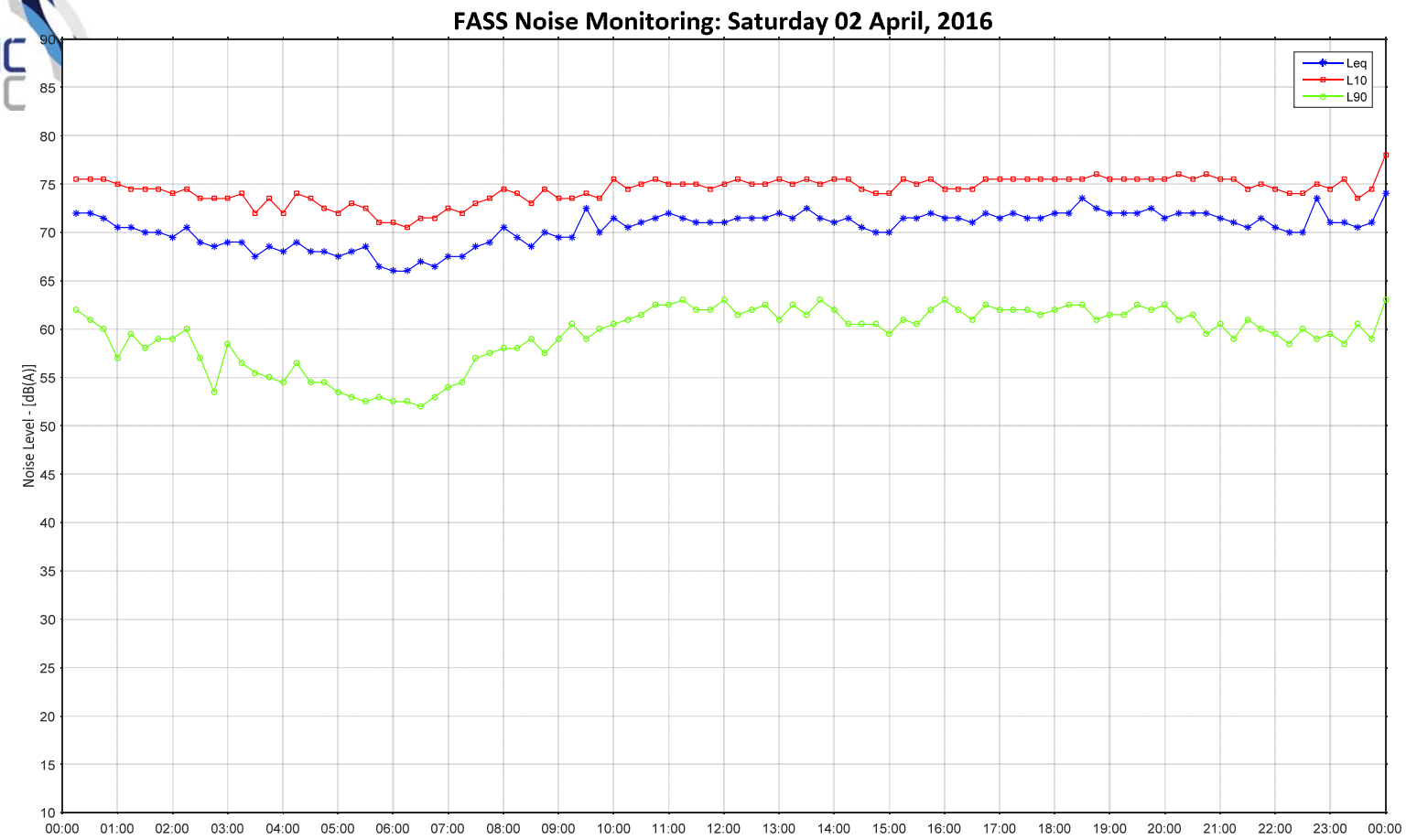
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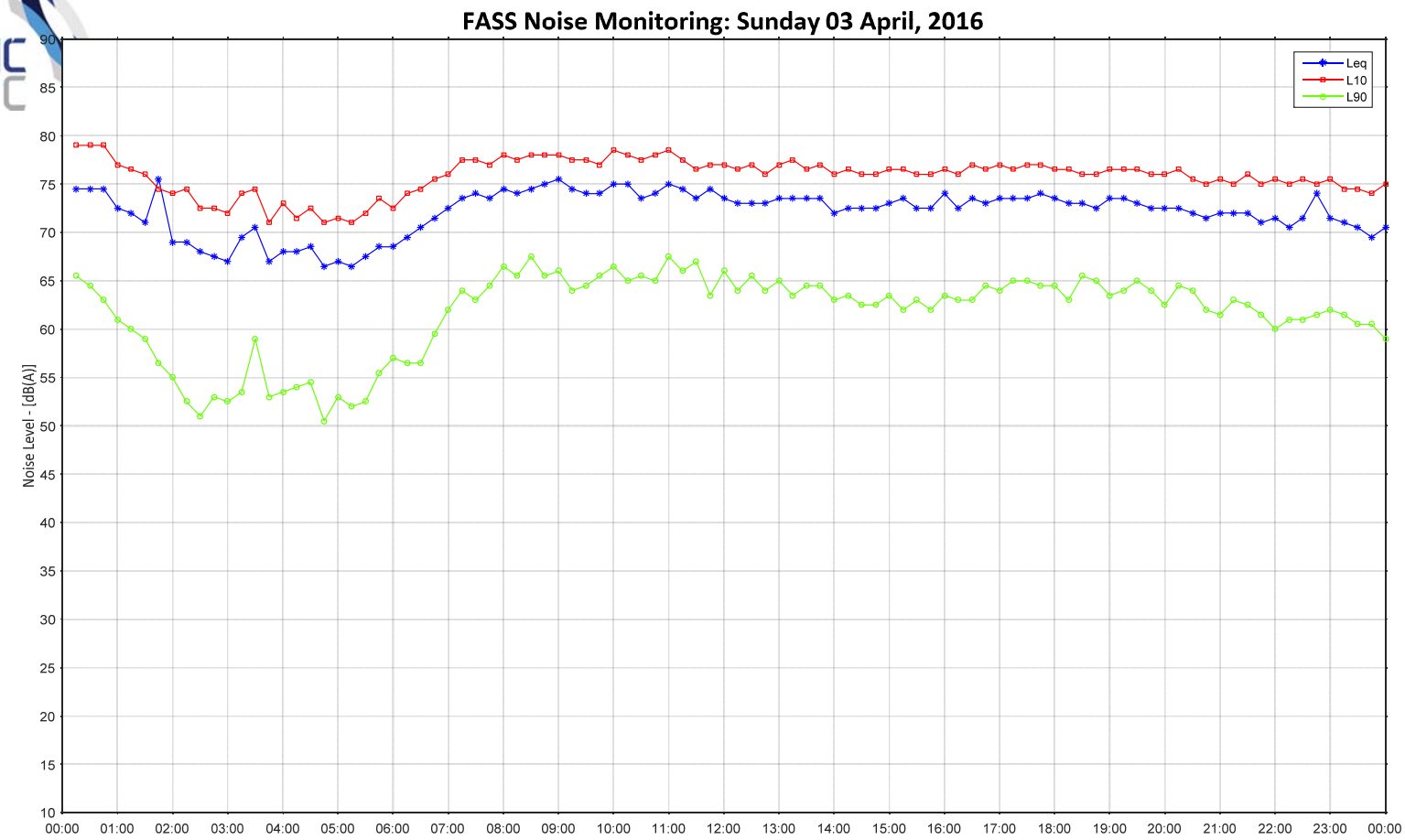
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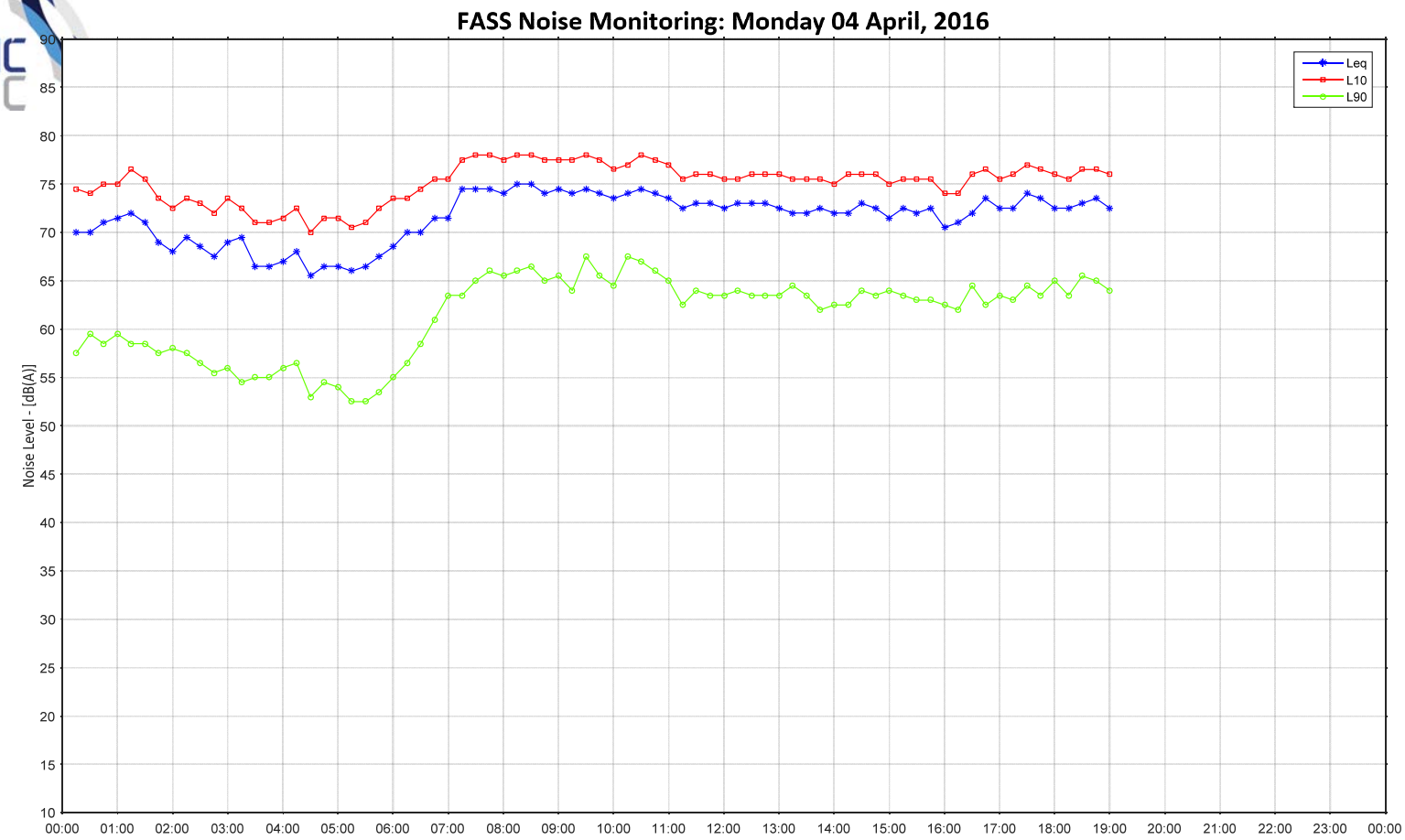
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MANAGING DIRECTORS
MATTHEW PALAVIDIS
VICTOR FATTORETTO

DIRECTORS
MATTHEW SHIELDS
BEN WHITE

20160442.1/2906A/R0/JS

29/06/2016

Lend Lease Building Pty Ltd ABN: 97 000 098 162
Level 4, 30 The Bond
30 Hickson Road
MILLERS POINT NSW 2000

ATTN: RYAN THOMAS

University of Sydney Faculty of Arts and Social Sciences - Response to Department of Planning Request for Information

Acoustic Logic Consultancy (ALC) have conducted an assessment of potential noise impacts associated with the proposed University of Sydney Faculty of Arts and Social Sciences building to be located along Parramatta Road. The outcomes of this investigation were provided in the ALC report (ref: 20160442.1/1106A/R1/JS).

The NSW Department of Planning has raised the following query regarding the report. ALC's response is presented below.

Department of Planning

The Noise Impact Assessment prepared by Acoustic Logic is not considered acceptable for exhibition. The location of noise monitoring adjacent to the development site and not at the nearest sensitive residential receiver does not provide an adequate assessment of background noise levels. Whilst it is acknowledged that the background noise level will be impacted on by existing road traffic noise from Parramatta Road, the Department requires additional background noise monitoring at the nearest sensitive residential receiver be undertaken and factored into a revised noise assessment and conclusions/recommendation.

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SYDNEY MELBOURNE BRISBANE CANBERRA
LONDON DUBAI SINGAPORE GREECE

ABN: 11 068 954 343

ALC Response

As indicated by Figure 1 of the submitted acoustic report, the noise logger was located on University of Sydney grounds approximately 35m to the South of the nearest residential receiver. The location of the noise monitor was determined based on the following:

- The noise logger was concealed from view of the public via the hedge along Parramatta Road and as such provided the highest degree of security from interference and/or theft. The hedge is acoustically transparent and as such would have negligible impact on the measured noise levels. Noise monitoring in front of the of the nearest receiver location to the North is a public thoroughfare and does not provide sufficient opportunity for the monitor to be concealed from the public.
- Notwithstanding above, the ambient noise levels at the logger location and at the nearest receiver location are almost entirely driven by noise associated with Parramatta Road. The nearest affected receiver is susceptible to the same levels of traffic noise as that associated with the logger location. Provided that the noise logger is not affected by any noise source in the immediate vicinity of the site (which it wasn't), the background noise levels will not change when crossing to the other side of the road.

On this basis, noise levels recorded as a result of the selected logger location will be representative of background noise levels at the nearest affected receiver location and as such is acoustically acceptable in the formulation of noise emission criteria to govern impacts to the nearest sensitive receivers.

Noise impacts have been assessed against the noise emission criteria established using the background noise level as discussed above and will have no adverse impacts on the existing residential dwellings across Parramatta Road as detailed in the submitted acoustic report.

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

Yours faithfully,

Acoustic Logic Consultancy Pty Ltd
James Small