ACOUSTICS AND AIR

# CURL CURL NORTH PUBLIC SCHOOL

## CONSTRUCTION & OPERATIONAL NOISE REPORT

**REPORT NO.** 17072
**VERSION** C

MAY 2018

**PREPARED FOR**

DEPARTMENT OF EDUCATION
C/- TKD ARCHITECTS
LEVEL 1, 19 FOSTER STREET
SURRY HILLS NSW 2010

WILKINSON MURRAY

# DOCUMENT CONTROL

| Version | Status | Date | Prepared By | Reviewed By |
|---|---|---|---|---|
| A | Final | 12 May 2017 | George Jenner | Brian Clarke |
| B | Final | 6 March 2018 | George Jenner | Brian Clarke |
| C | Final | 2 May 2018 | George Jenner | Brian Clarke |

**Note**
All materials specified by Wilkinson Murray Pty Limited have been selected solely on the basis of acoustic performance. Any other properties of these materials, such as fire rating, chemical properties etc. should be checked with the suppliers or other specialised bodies for fitness for a given purpose. The information contained in this document produced by Wilkinson Murray is solely for the use of the client identified on the front page of this report. Our client becomes the owner of this document upon full payment of our **Tax Invoice** for its provision. This document must not be used for any purposes other than those of the document's owner. Wilkinson Murray undertakes no duty to or accepts any responsibility to any third party who may rely upon this document.

**Quality Assurance**
Wilkinson Murray operates a Quality Management System which complies with the requirements of AS/NZS ISO 9001:2015. This management system has been externally certified and Licence No. QEC 13457 has been issued.

**AAAC**
This firm is a member firm of the Association of Australasian Acoustical Consultants and the work here reported has been carried out in accordance with the terms of that membership.

**Celebrating 50 Years in 2012**
Wilkinson Murray is an independent firm established in 1962, originally as Carr & Wilkinson. In 1976 Barry Murray joined founding partner Roger Wilkinson and the firm adopted the name which remains today. From a successful operation in Australia, Wilkinson Murray expanded its reach into Asia by opening a Hong Kong office early in 2006. Today, with offices in Sydney, Newcastle, Wollongong, Orange, Queensland and Hong Kong, Wilkinson Murray services the entire Asia-Pacific region.

# TABLE OF CONTENTS

# GLOSSARY OF ACOUSTIC TERMS

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph below, are here defined.

**Maximum Noise Level ($L_{Amax}$) –** The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

**$L_{A1}$ –** The $L_{A1}$ level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the $L_{A1}$ level for 99% of the time.

**$L_{A10}$ –** The $L_{A10}$ level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the $L_{A10}$ level for 90% of the time. The $L_{A10}$ is a common noise descriptor for environmental noise and road traffic noise.

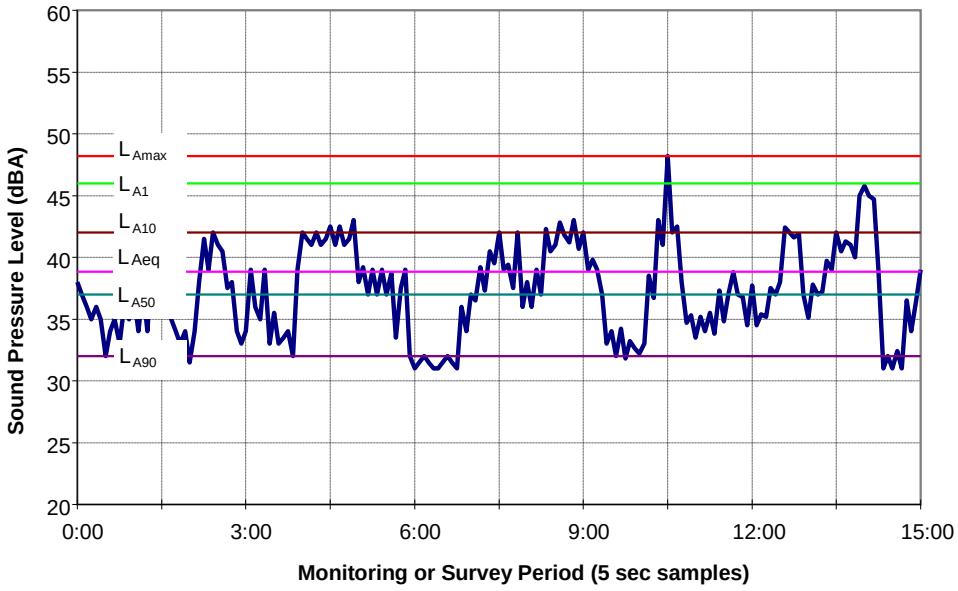
**$L_{A90}$ –** The $L_{A90}$ level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the $L_{A90}$ level for 10% of the time. This measure is commonly referred to as the background noise level.

**$L_{Aeq}$ –** The equivalent continuous sound level ($L_{Aeq}$) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

**ABL –** The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10th percentile (lowest 10th percent) background level ($L_{A90}$) for each period.

**RBL –** The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period – daytime, evening and night time.

**Typical Graph of Sound Pressure Level vs Time**



# 1 INTRODUCTION

This report has been prepared by Wilkinson Murray Pty Limited on behalf of the New South Wales Department of Education (the 'Applicant'). It accompanies an Environmental Impact Statement (EIS) prepared in support of redevelopment of the Curl Curl North Public School. The site is located within the Northern Beaches Council area.

The proposal includes demolition works, alterations and additions to the existing school including the construction of new classrooms, administration and staff building and library. The school proposes to increase student enrolments from the current 920 to a maximum of 1,000.

The purpose of this assessment is to assess potential noise and vibration impacts associated with construction and operation of the school.

Wilkinson Murray has reviewed and assessed the drawings and relevant documentation prepared in respect of this State Significant Development (SSD 8310) submission.

The acoustic requirements are detailed in item 9 of the SEARs as follows:

> 9 Noise and Vibration
>
> Identify and provide a quantitative assessment of the main noise and vibration generating sources during construction and operation, including consideration of any public-address system, school bell and use of any school hall for concerts etc. (both during and outside school hours), and outline measures to minimise and mitigate the potential noise impacts on surrounding occupiers of land. Provide a noise impact of nearby rail corridors and busy roads.
>
> Relevant Policies and Guidelines:
>
> - *NSW Industrial Noise Policy (EPA);*
> - *Assessing Vibration: A technical guideline (EPA);*
> - *Interim Construction Noise Guideline (DECC);*
> - *Development Near Rail Corridors and Busy Roads – Interim Guideline (Department of Planning 2008)*

It is noted that the site is not located near a rail corridor or busy road, therefore the *Development Near Rail Corridors and Busy Roads-Interim Guideline* is not relevant to this project.

Version A of this report was reviewed be stakeholders. Issues raised are discussed in Appendix B and have been incorporated into Version B where relevant.

# 2 SITE DESCRIPTION

## 2.1 Location & Context

The school is located on Abbott Road and Playfair Road, Curl Curl, as shown in Figure 2-1.

**Figure 2-1 Location & Context**


Figure 2-2 shows a closer view of the site. Residential premises border the east and northern sides of the site. To the west are residences across Playfair Road. To the south are sports fields across Abbott Road. Figure 2-2 shows representative residential receiver locations (numbered 1 to 6) which will be used to assess noise emission from the school. There are residential receivers on three sides. The location and description of the representative receivers are described in Table 2-1.

No nearby non-residential noise sensitive receivers were also identified.

**Table 2-1 Description of Noise Sensitive Receivers**

| Number & Description | Potential Noise Source |
|---|---|
| 1 – Playfair Road | Closest to school hall |
| 2 – Playfair Road | Closest west of sports field |
| 3 – Playfair Road | Closest north of sports field |
| 4 – Rear of Ross Street residences | Closest east of sports field |
| 5 – Rear of Ross Street residences | Near cricket nets |
| 6 – Rear of Abbott Road residences | Near classrooms and carpark |

Figure 2-2 also shows the location of a noise logger that has been used to determine the existing ambient background noise levels at residential premises neighbouring the school.

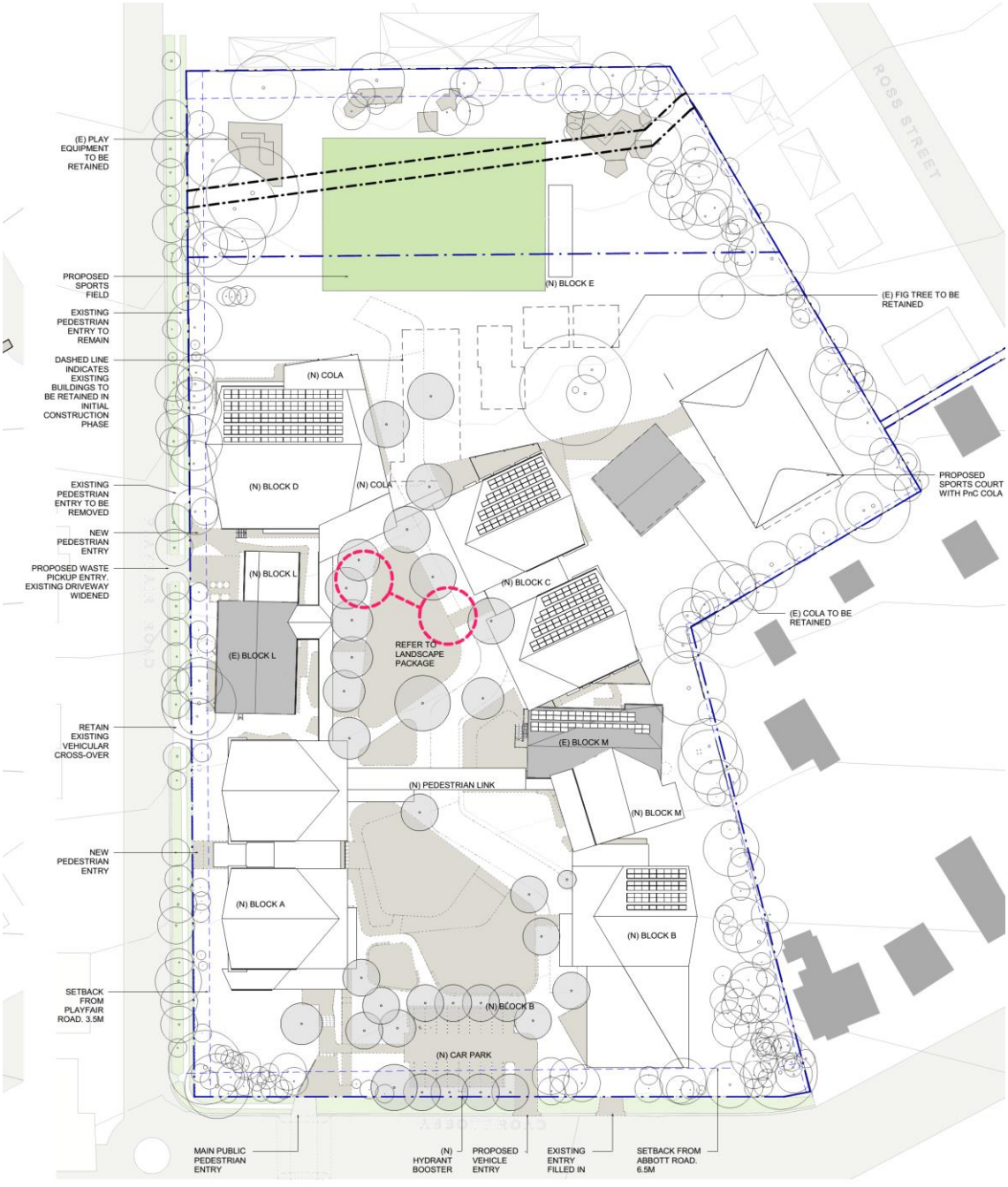
**Figure 2-2 Receivers & Noise Logger**

## 2.2 Proposed Design

An indicative ground level layout is shown in Figure 2-3. Notable elements for noise assessment include:

- A hall at the west of the site adjoining administrative buildings;
- Playground at the north of the site, including a sports field;
- Netball courts and cricket nets to the east of the site.

**Figure 2-3 Proposed Site Plan**



The hall and playing fields may be used outside of regular school hours.

The hall would be mostly used for school purposes, including evening concerts until approximately 10.00pm.

For assessment purposes, potential use of the hall until midnight is addressed.

# 3 AMBIENT NOISE LEVELS

## 3.1 Ambient Noise Levels at Site

### 3.1.1 Noise Logging

In order to quantify the existing noise environment, long-term ambient noise levels were monitored from 24 February to 8 March 2017. The logger location was near the eastern boundary as shown on Figure 2-2, representing the receivers impacted by both construction and operation.

The noise monitoring equipment used for the Wilkinson Murray noise measurements consisted of an ARL Type EL-315 environmental noise logger set to A-weighted, fast response, continuously monitoring over 15-minute sampling periods. This equipment is capable of remotely monitoring and storing noise level descriptors for later detailed analysis. The equipment calibration was checked before and after the survey and no significant drift was noted.

The logger determines $L_{A1}$, $L_{A10}$, $L_{A90}$ and $L_{ea}$ levels of the ambient noise. $L_{A1}$, $L_{A10}$ and $L_{A90}$ are the levels exceeded for 1%, 10% and 90% of the sample time respectively (see Glossary for definitions). The $L_{A1}$ is indicative of maximum noise levels due to individual noise events such as the occasional pass-by of a heavy vehicle. The $L_{A90}$ level is normally taken as the background noise level during the relevant period.

Detailed results for each monitoring location are shown in graphical form in Appendix A. The graphs show measured values of $L_{ea}$, $L_{A90}$, $L_{A10}$ and $L_{A1}$ for each 15-minute monitoring period.

The graphs show a loud noise occurs most days at approximately 8.00pm. This is possibly a mechanical noise such as a pool pump in the neighbouring residence. The periods have been excluded from the data.

### 3.1.2 Attended Measurements

No suitable and secure location for logging was found on the western boundary of the site. Short-term measurements were done in the afternoon after school was finished.

All measurements were conducted using a Brüel & Kjær Type 2250 Sound Level Meter. This sound level meter conforms to Australian Standard 1259 *Acoustics – Sound Level Meters* as a Type 1 Precision Sound Level Meter which has an accuracy suitable for field and laboratory use. The A-Weighting filter of the meter was selected, and the time weighting was set to "Fast". The calibration of the meter was checked before and after the measurements with a Brüel & Kjær Type 4231 sound level calibrator and no significant drift was noted.

The Brüel & Kjær Type 2250 and Type 4231 have been laboratory calibrated within the previous two years in accordance with our in-house Quality Assurance Procedures.

The measurements were done between 4.45-5.00pm on 15 February and 19 February 2018 at the Playfair Road location shown on Figure 2-2. The $L_{A90}$ background noise on both occasions in the absence of any school noise was 44dBA. This is higher than the RBL measured at the eastern boundary. As a conservative measure, the RBL measured at the eastern boundary will be used for all residences.

### 3.2 Results

Table 3-1 summarises the noise results, for daytime, evening and night time periods as defined in the EPA's *Interim Construction Noise Guidelines (ICNG)* and the NSW *Industrial Noise Policy (INP)*. A night time shoulder period from 10.00pm to midnight is also defined to allow assessments of hall operations beyond 10.00pm.

The evening RBL at the eastern boundary was higher than the daytime RBL. In accordance with *INP* procedures the evening level used will be lowered to the daytime level.

**Table 3-1 Summary of Measured Ambient Noise Levels**

| Location | RBL (dBA) | | | | $L_{Aeq,period}$ (dBA) | | |
|---|---|---|---|---|---|---|---|
| | Daytime 7am-6pm | Evening 6-10pm | Night Time 10pm-7am | Night Shoulder 10pm-midnight | Daytime 7am-6pm | Evening 6-10pm | Night Time 10pm-7am |
| East Boundary (Logger) | 39 | 41 (39) | 36 | 36 | 51 | 61 | 43 |
| West Boundary (Attended) | 44 | | | | 58 | | |

# 4 CONSTRUCTION NOISE & VIBRATION ASSESSMENT

This section of the assessment relates to typical construction activities that may occur.

## 4.1 Construction Noise Criteria

The following sections detail the applicable site-specific noise and vibration criteria based on the EPA *Interim Construction Noise Guideline*.

### 4.1.1 Construction Noise Management Levels

The EPA released the "*Interim Construction Noise Guideline*" *(ICNG)* in July 2009. The guideline provides noise goals that assist in assessing the impact of construction noise.

For residences, the basic daytime construction noise goal is that the $L_{Aeq,15min}$ noise management level should not exceed the background noise by more than 10dBA. This is for standard hours Monday to Friday 7.00am-6.00pm, and Saturday 8.00am-1.00pm. Outside the standard hours, where construction is justified, the noise management level would be background + 5dBA. Table 4-1 details the *ICNG* noise management levels.

**Table 4-1 Construction Noise Management Levels at Residences using Quantitative Assessment**

| Time of Day | Management Level $L_{Aeq,15min}$ | How to Apply |
|---|---|---|
| **Recommended Standard Hours:**<br>Monday to Friday<br>7am to 6pm<br>Saturday<br>8am to 1pm<br>No work on Sundays or Public Holidays | Noise affected<br>RBL + 10dBA | The noise affected level represents the point above which there may be some community reaction to noise.<br>Where the predicted or measured $L_{Aeq,15min}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise.<br>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<br>75dBA | The highly noise affected level represents the point above which there may be strong community reaction to noise.<br>Where noise is above this level, the proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level.<br>If no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and by describing any respite periods that will be provided. |

| Time of Day | Management Level $L_{Aeq,15min}$ | How to Apply |
|---|---|---|
| Outside recommended standard hours | Noise affected RBL + 5 dB | A strong justification would typically be required for works outside the recommended standard hours.<br>The proponent should apply all feasible and reasonable work practices to meet the noise affected level.<br>Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community.<br>For guidance on negotiating agreements see Section 7.2.2 of the guideline. |

Based on the above, Table 4-2 presents the applicable noise management levels for construction activities at surrounding receivers that have been adopted for all applications. The table also lists the management levels for schools. The *ICNG* gives a recommended level of 45dBA for inside classrooms. Allowing for 10dBA noise reduction through a façade with open windows, this leads to an external management level of 55dBA at classroom buildings. For playground areas, the management level for "active recreation areas" has been nominated.

**Table 4-2 Site-Specific Construction Noise Management Levels**

| Receiver | Construction Noise Management Level, $L_{Aeq,15min}$ – dBA | | | Highly Noise-Affected Noise Level, $L_{Aeq}$ – dBA |
|---|---|---|---|---|
| | Day | Evening[1] | Night[1] | |
| All residences | 49 | 44 | 41 | 75 |
| Curl Curl Public School Buildings | 55 (external)<br>44 (internal | | | |
| Curl Curl Public School Playgrounds | 65 | | | |

Note 1: Out of hours work is not proposed and would be applied for separately. The NMLs are listed if required in future.

## 4.2 Hours of Operation

The proposed working hours for this project, detailed in the Construction Management Plan are as follows:

- Monday to Friday - 7.00am to 6.00pm
- Saturdays - 8.00am to 1.00pm
- Saturdays -1.00pm to 5.00pm (subject to noise management plan for out-of-hours activities.)
- Sundays and Public Holidays- No work

If required, after hours' permits will be sought from the relevant authorities.

## 4.3 Vibration Criteria

Criteria for assessment of the effects of vibration on human comfort are set out in British Standard 6472-1992. Methods and criteria in that Standard are used to set "preferred" and "maximum" vibration levels in the document "*Assessing Vibration: A Technical Guideline*" (2006) produced by the NSW DECCW.

Acceptable values of human exposure to continuous vibration, such as that associated with drilling, are dependent on the time of day and the activity taking place in the occupied space (e.g. workshop, office, residence or a vibration-critical area). Guidance on preferred values for continuous vibration is set out in Table 4-3.

**Table 4-3 Criteria for Exposure to Continuous Vibration**

| Place | Time | Peak Particle Velocity (mm/s) | |
|---|---|---|---|
| | | Preferred | Maximum |
| Critical working areas (e.g. hospital operating theatres precision laboratories) | Day or night time | 0.14 | 0.28 |
| Residences | Daytime | 0.28 | 0.56 |
| | Night time | 0.20 | 0.40 |
| Offices | Day or night time | 0.56 | 1.1 |
| Workshops | Day or night time | 1.1 | 2.2 |

In the case of intermittent vibration, which is caused by plant such as rock breakers, the criteria are expressed as a Vibration Dose Value (VDV) and are presented in Table 4-4.

**Table 4-4 Acceptable Vibration Dose Values for Intermittent Vibration ($m/s^{1.75}$)**

| Location | Daytime | | Night Time | |
|---|---|---|---|---|
| | Preferred Value | Maximum Value | Preferred Value | Maximum Value |
| Critical areas | 0.10 | 0.20 | 0.10 | 0.20 |
| Residences | 0.20 | 0.40 | 0.13 | 0.26 |
| Offices, schools, educational institutions and places of worship | 0.40 | 0.80 | 0.40 | 0.80 |
| Workshops | 0.80 | 1.60 | 0.80 | 1.60 |

Calculation of VDV requires knowledge of the number of events and their duration in the relevant time period.

### 4.3.1 Building Damage

In terms of the most recent relevant vibration damage objectives, Australian Standard AS 2187: Part 2-2006 *"Explosives – Storage and Use – Part 2: Use of Explosives"* recommends the frequency dependent guideline values and assessment methods given in BS 7385 Part 2-1993 *"Evaluation and measurement for vibration in buildings Part 2"*, as they "are applicable to Australian conditions".

The British Standard sets guide values for building vibration based on the lowest vibration levels above which damage has been credibly demonstrated. These levels are judged to give a minimum risk of vibration-induced damage, where minimal risk for a named effect is usually taken as a 95% probability of no effect.

The recommended limits (guide values) from BS7385 for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in Table 4-5.

**Table 4-5 Transient Vibration Guide Values – Minimal Risk of Cosmetic Damage**

| Type of Building | Peak Component Particle Velocity in Frequency Range of Predominant Pulse | |
|---|---|---|
| | 4 Hz to 15 Hz | 15 Hz and Above |
| Reinforced or framed structures<br>Industrial and heavy commercial buildings | 50mm/s at 4 Hz and above | N/A |
| Un-reinforced or light framed structures<br>Residential or light commercial type buildings | 15mm/s at 4 Hz increasing to 20mm/s at 15 Hz | 20mm/s at 15 Hz increasing to 50mm/s at 40 Hz and above |

The Standard states that the guide values in Table 4-5 relate predominantly to transient vibration which does not give rise to resonant responses in structures, and to low-rise buildings.

The British Standard goes on to state that *"Some data suggests that the probability of damage tends towards zero at 12.5 mm/s peak component particle velocity"*. In addition, a building of historical value should not (unless it is structurally unsound) be assumed to be more sensitive.

## 4.4 Construction Equipment & Noise Source Levels

Sound Power Levels (SWLs) for typical construction plant are identified in Table 4-6. These SWLs have been measured at other similar construction sites. The table gives both Sound Power Level and Sound Pressure Levels (SPL) at 7m for the equipment. Sound Power Level is independent of measurement position.

**Table 4-6 Typical Construction Plant Sound Levels – dBA**

| Plant | Sound Power Level | Sound Pressure Level at 7m |
|---|---|---|
| Concrete Truck | 109 | 84 |
| Angle Grinder | 109 | 84 |
| Concrete Pump – 120 mm diameter / 50 bar | 112 | 87 |
| Mobile Crane | 98 | 73 |
| Dump Truck | 108 | 83 |
| Compressor | 100 | 75 |
| Bobcat | 103 | 78 |
| Hand Tools | 90 | 65 |
| Bulldozer | 114 | 89 |
| Auger Piling Rig | 112 | 87 |
| Crawler Crane | 98 | 73 |
| Front End Loader | 112 | 87 |
| Excavator | 107 | 82 |

## 4.5 Construction Schedule

Construction is scheduled to commence in December 2017 and take approximately 76 weeks in total. Construction will be done in 3 stages in general to facilitate the current school operation.

The approximate schedule is as follows:

- December 2017 – January 2018 – Relocation of classrooms to north of site to demountable classrooms.
- October 2018 – July 2019 – Demolition, excavation and construction of new building to the South of the site.
- July 2019 – January 2020 – Classes to be held in new building. Demolition of remaining classroom to the north of site. Landscape work to finish.

## 4.6 Construction Noise Predictions

Assessment of likely construction noise at surrounding receivers has been conducted for the proposed construction works. Site-related noise emissions were modeled with the "CadnaA" noise prediction program using the ISO 9613 noise prediction algorithms. Factors that are addressed in the noise modeling are:

- Equipment sound level emissions and location;
- Receiver locations;
- Ground topography;
- Noise attenuation due to geometric spreading;
- Ground absorption; and
- Atmospheric absorption.

Modelling has been conducted for a number of construction scenarios. The three works scenarios considered are summarised in Table 4-7.

**Table 4-7 Construction Scenarios for Construction Works**

| Scenario | Description | Works and equipment | Duration |
|---|---|---|---|
| Stage 1 | Relocation of Classrooms | 2x Cranes, trucks | Dec 2017 – Jan 2018 |
| Stage 2 | Excavation, Demolition and Construction | This scenario assumes work at multiple sites across the southern part of the school. 2x excavators, 1x concrete pump, 2x forklifts, 1x compressor, 1x crane, a boom truck assumed to operate in 15minutes. 2x truck movements (concrete or delivery) in 15 minutes assumed: on truck entry by Playfair Road, and one by Abbott Road. | Jul 2018 – Jul 2019 |
| Stage 3 | Landscaping north of site | 2x excavators, 1x roller, 1x truck movement per 15 minutes, entry by Playfair Road | Jul 2019 – Jan 2020 |

Noise modelling has been conducted for each of the above construction scenarios with plant located across the western side of the site.

The modelling assumes a "typical worst-case" scenario whereby all plant, is running continuously. As such, the modelling represents likely noise levels that would occur during intensive periods of construction. Therefore, the presented noise levels can be considered in the upper range of noise levels that can be expected at surrounding receivers when the various construction scenarios occur.

Once noise sources have been applied to the model, the resultant noise levels at identified surrounding receivers are predicted. These results are then compared with established site-specific noise criteria. Table 4-8 details results of construction noise modelling for each scenario.

In addition to the residential receivers identified, the table gives typical noise levels predicted at two school locations: nearest to the construction and furthest from the construction. As these locations will change as the site is developed, the levels are indicative.

**Table 4-8 Predicted Construction Noise Levels at Residence – $L_{Aeq,15\ min}$ – dBA**

| Receiver | Management Level | Stage 1 Move Demountables | Stage 2 Excavation, Demolition, Construction | Stage 3 Landscaping |
|---|---|---|---|---|
| 1 | 49 | 50-55 | 63-68 | 61-66 |
| 2 | 49 | 44-49 | 60-65 | 72-77 |
| 3 | 49 | 48-53 | 46-60 | 82-87 |
| 4 | 49 | 57-62 | 64-70 | 80-85 |

| Receiver | Management Level | Stage 1 Move Demountables | Stage 2 Excavation, Demolition, Construction | Stage 3 Landscaping |
|---|---|---|---|---|
| 5 | 49 | 47-52 | 64-69 | 75-80 |
| 6 | 49 | 42-47 | 56-71 | 60-65 |
| School Nearest | 55 | 60-65 | 67-73 | 83-88 |
| School Furthest | 55 | 45-50 | 59-74 | 63-68 |

## 4.7 Discussion of Results

### 4.7.1 Residences

A review of predicted noise levels detailed in Table 4-8 indicates that daytime NML predicted to be exceeded at all representative noise receivers for some periods during all of the construction phases.

For Stage 1, the moving of demountables to the north of the site, the impact will be for a short period and predicted levels will only exceed the NML by up to 13dBA at relatively few receivers.

For Stage 2, the noise impact is predominantly at receivers at the southern end of the site, as receivers north of the site will be shielded by the newly positioned demountable classrooms.

For Stage 3, the noise impact is predominantly at the north of the site. The higher noise levels occur when equipment is working near the boundaries of the site.

These findings are typical of development sites close to receivers in relatively quiet residential areas. It is important to note that construction noise is variable, and the predictions are intended to show the typical worst-case scenarios. The adoption of reasonable and feasible noise management and mitigation will be required. These measures should be determined in detail when a contractor, with defined construction techniques, has been engaged on the project. However, "in-principle" mitigation measures are detailed in Section 4-9 to 4-11.

### 4.7.2 School

The results indicated that noise from construction will impact the school buildings and playground during Stage 2 and Stage 3. Mitigation measures are discussed in Section 4-9 to 4-11.

## 4.8 Construction Vibration Assessment

Operation of piling rigs or rock breakers and the like generate ground vibration that has the potential to transmit to nearby buildings.

Table 4-10 sets out the typical ground vibration levels at various distances for safe working distances. As the construction method is not yet designed, the actual vibration levels cannot be predicted, and it is unlikely that some of the larger equipment in the table will be used at all.

**Table 4-9 Recommended Safe Working Distances for Vibration-Intensive Plant**

| Item | Description | Safe Working Distance | |
|---|---|---|---|
| | | Cosmetic Damage | Human Response |
| Small Hydraulic Hammer | (300kg – 5 to 12t excavator) | 2m | 7m |
| Medium Hydraulic Hammer | (900kg – 12 to 18t excavator) | 7m | 23m |
| Large Hydraulic Hammer | (1600kg – 18 to 34t excavator) | 22m | 73m |
| Vibratory Pile Driver | Sheet piles | 2m to 20m | 20m |
| Pile Boring | ≤ 800mm | 2m (nominal) | N/A |
| Jackhammer | Hand held | 1m (nominal) | Avoid contact with structure |
| Vibratory Roller | <50 kN (Typically 1-2 tonne) | 5m | 15-20m |

- Construction Noise Strategy, 2012, Transportation Construction Authority

It is noted that nearly all construction activities will be more than 10m from any neighbouring building. Given the type of activities proposed, vibration will be below the criteria for cosmetic damage during most of the project. The use of rock-breakers or vibratory rollers should be carefully managed at distances closer than 20 metres from these residences.

## 4.9 Construction Noise & Vibration Mitigation Measures

Without mitigation, noise levels from construction activities have been predicted to exceed the noise management levels nominated in the guidelines at some surrounding receivers. Therefore, noise control measures are recommended to ensure that noise is reduced where feasible.

The following project-specific mitigation measures are recommended:

- Selection of quietest feasible construction equipment;
- Use of rock saws and ripping in preference to rock breakers if rock removal is required;
- Localised treatment, such as barriers, shrouds and the like around fixed plant, such as pumps, generators and concrete pumps;
- Provision of respite periods, particularly if out of standard hours work is required; and
- Trial testing of vibration levels is conducted where equipment is identified as having the potential to exceed the human comfort criteria.

In addition, the following measures should be included in a Noise and Vibration Management Plan.

- *Plant Noise Audit* – Noise emission levels of all critical items of mobile plant and equipment should be checked for compliance with noise limits appropriate to those items prior to the equipment going into regular service. To this end, testing should be established with the contractor.
- *Operator Instruction* – Operators should be trained in order to raise their awareness of potential noise problems and to increase their use of techniques to minimise noise emission.

- *Equipment Selection* – All fixed plant at the work sites should be appropriately selected, and where necessary, fitted with silencers, acoustical enclosures and other noise attenuation measures in order to ensure that the total noise emission from each work site complies with EPA guidelines.
- *Site Noise Planning* – Where practical, the layout and positioning of noise-producing plant and activities on each work site should be optimised to minimise noise emission levels.

The adoptions of the above measures are aimed at working towards achieving the noise management levels established at surrounding receivers.

#### 4.9.1 Measures Specific to the School

The following management measures should be considered for mitigation of construction noise to the school:

- A solid hoarding up to 2.4m high around the site would reduce noise to the remainder of the school;
- Consider times of exams when scheduling noisy works;
- Schedule noisy works for before and after school, subject to management of noise to residences.

### 4.10 Community Liaison & General Approaches to Mitigation

An effective community relations programme should be put in place to keep the community that has been identified as being potentially affected appraised of progress of the works, and to forewarn potentially affected groups (e.g. by letterbox drop, meetings with surrounding owners / tenants, etc.) of any anticipated changes in noise and vibration emissions prior to critical stages of the works, and to explain complaint procedures and response mechanisms. This programme should include a *Community and Stakeholder Engagement Strategy* developed specifically for the Project.

Close liaison should be maintained between the communities overlooking work sites and the parties associated with the construction works to provide effective feedback in regard to perceived emissions. In this manner, equipment selections and work activities can be coordinated where necessary to minimise disturbance to neighbouring communities, and to ensure prompt response to complaints, should they occur.

### 4.11 Noise & Vibration Management Plan

A construction Noise and Vibration Management Plan, consistent with the preliminary construction management plan, for the site is recommended which should be prepared by the successful contractor. The plan should reference the findings of this assessment. Areas that should be addressed in plan include:

- Noise and vibration mitigation measures
- Noise and vibration monitoring;
- Response to complaints**;**
- Responsibilities;

- Monitoring of noise emissions from plant items;
- Reporting and record keeping;
- Non-compliance and corrective action; and
- Community consultation and complaint handling.

# 5 OPERATIONAL NOISE

Operational noise from the proposed school facilities will be from the following:

- Services noise from mechanical plant;
- School announcements and bells;
- Outdoor play;
- Concerts in the hall; and,
- Potential weekend use of the playing fields.

The school proposes to increase student enrolments from the current 950 to a maximum of 1,000. Acoustically, this is an insignificant increase and, from the point of view of noise emission, the main change from the current situation is that children will play in different parts of the school.

## 5.1 Operational Noise Objectives

Noise impact from the general operation of the proposed facilities is to be assessed with respect to the site-specific noise criteria based on site monitoring and the NSW *Industrial Noise Policy (INP)* intrusive noise criteria.

Table 5-1 presents the intrusiveness criteria for all surrounding residential receiver areas. This was calculated by adding 5dB to the period background noise levels.

Noise criteria for children playing is typically background +10dBA. Depending on the situation, the application of this limit may be time limited, however it is usually seen as appropriate for activities that occur up to 2 hours per day.

**Table 5-1 Operational Intrusive Noise Criteria (All residences)**

| Receiver | Intrusiveness Criterion $L_{Aeq,15min}$ (dBA) | | | |
|---|---|---|---|---|
| | Daytime 7am-6pm | Evening 6-10pm | Night Time 10pm-7am | Night Shoulder 10pm-midnight |
| All residences | 49 (children playing)<br>44 (other noise) | 44 | 36 | 36 |

## 5.2 Operational Mechanical Noise Assessment

Detailed specifications of new mechanical services equipment that would otherwise allow an acoustic assessment of noise emission from the site are not available at this stage of the project as selection and design is conducted after project approval. In line with the approvals for other development, detailed assessment of operational noise emission should form a conditional requirement of the development to be satisfied prior to the issue of the Construction Certificate.

To mitigate noise from mechanical plant, silencers could be incorporated on the outlets of the exhaust fans and any possible roof top plant would be housed in a louvered acoustic barrier if required. The mechanical plant noise emission would be designed to meet the criteria presented in Table 5-1 at the closest receivers.

Plant will be designed to meet the requirements of the *INP* at the nearest receivers to the plant. Criteria are outlined in Table 5-1 and *INP* consideration of tonal and other annoying characteristics should be included in the acoustic design.

## 5.3 School Announcements & Bells

Announcements and school bells are typical activities associated with school operations. Typically, these are produced by the school PA system and can vary significantly depending on the final volume settings of the system.

At this stage, no design of the PA system has been determined. However, the following measures should be adopted to ensure that their impact at all surrounding residences is minimised:

- Speakers should be located and orientated to provide good coverage of the school areas while being directed away from residences. The coverage of the system should be subject of the detail design of the sound system.
- The volume of the system should be adjusted on site so that announcements and bells are clearly audible on the school site without being excessive. The system should initially be set so that noise at surrounding residences does not exceed the ambient noise levels by more than 5dBA.
- Once the appropriate level has been determined on site, the system should be limited to the acceptable level so that staff cannot increase noise levels.
- The system bell should be set so that it only occurs on school days.

## 5.4 Noise from Hall Operations

Noise from normal school activities in class hours are not considered to be acoustically significant however the use of the hall for larger events, such as concerts and sporting contests, particularly outside school hours, has the potential to adversely impact on residences.

The design of the hall is at the concept stage; however, the following assumptions were made in order to assess the noise emission.

- Ventilation would be provided by louvres on the facades and rooftop ventilators;
- Facades would be a mix of louvre, glazing and structural material;
- Ventilation openings on the west and northern facades were assumed to be approximately $6m^2$ each in area;

- It was assumed that 4x 900mm diameter rooftop vents would be required.

Preliminary calculations have been conducted based on internal noise levels of between 90-95dBA which is considered the upper limit of typical events in primary schools. Table 5-2 presents predicted noise levels at residences during these events with louvres and doors open or closed.

**Table 5-2 Predicted Noise Levels at Residences from Concert Events in the Hall – $L_{Aeq,15min}$ dBA**

| Receivers | Windows / Doors | | Criterion, LAeq | |
|---|---|---|---|---|
| | Hall Closed | Ventilation Open | Evening 6pm-10pm | Night Shoulder 10pm-midnight |
| 1 | 35 | 45 | 49 | 41 |
| 2 | 41 | 51 | 49 | 41 |
| 3 | 30 | 40 | 44 | 36 |
| 4 | 24 | 34 | 44 | 36 |
| 5 | 20 | 30 | 44 | 36 |
| 6 | 15 | 24 | 44 | 36 |

A review of the above noise levels indicates that doors and windows on the west and north facades of the hall should be closed during major events to protect the acoustic amenity of surrounding existing and future residences. Some openings would be permissible on the eastern side of the building, depending on the internal activity and time of day.

Based on the assumptions noise will comply at all receivers till midnight. However, if the hall is to be used after 10.00pm, noise limits should be placed on activities. The following assumptions concerning materials should be reviewed at detailed design stage:

- Doors and windows should be able to be closed and have a minimum acoustic rating of $R_W$ 30. Indicative glazing of 10mm monolithic glass should be allowed.
- Any glass ventilation louvres should have an indicative rating of $R_W$ 30, for example the Jalousie Louvred Window System from Safetyline Jalousie.
- Place ventilation openings on the eastern side of the building where possible.
- Walls and roof should have an acoustic rating of at least $R_W$ 45.
- The sound system should have a noise limiter included in the system control so that internal noise levels, particularly low frequency noise, can be controlled.

## 5.5 Noise from Outside Play

The outdoor play area will take up approximately the northern half of the site, as well as the courtyard between the classrooms in the southern half of the site. Fixed facilities include 2x futsal courts and 1x multi-purpose court.

Table 5-3 is a summary of sound power levels associated with sports activities.

**Table 5-3 Summary of Sound Power Levels**

| Activity | Typical SWL ($L_{Aeq,15min}$) |
|---|---|
| ≈ 15 children playing outside during lunch time | 95dBA |
| ≈ 15 adults training rugby union | 91dBA |
| ≈ 15 adults playing rugby union with a small crowd | 98dBA |
| ≈ 15 children playing on a court with a small crowd | 96dBA |

To assess outdoor play, it was assumed that up to approximately half of all the children in the school would be actively playing simultaneously in all areas of the school. The prediction therefore assumes approximately 500 children of mixed ages playing. The predicted levels at the representative receivers are shown in Table 5-2, which gives the range to be expected during lunchtime play.

Under the assumptions stated, noise is predicted to comply at all surrounding receivers. Occasional exceedances could occur if groups of children congregate near a particular house. Note that this is also the case at the existing school.

**Table 5-2 Predicted Level from Children Playing, $L_{Aeq,15min}$ dBA**

| Receiver | Noise Level | Criterion |
|---|---|---|
| 1 | 33-38 | 49 |
| 2 | 43-48 | 49 |
| 3 | 43-48 | 49 |
| 4 | 42-47 | 49 |
| 5 | 33-38 | 49 |
| 6 | 32-37 | 49 |

## 5.6 OOSH Noise Assessment

Out of School Hours (OOSH) care will be provided in buildings on Playfair Road. As shown in the site plan in Figure 2-3, school buildings are arranged along the Playfair Road boundary. Children attending OOSH will play inside or in playgrounds east of the buildings and will therefore be effectively shielded from all receivers. As the number of children attending OOSH care is much lower than the total school population, noise emission is predicted to comply with the relevant criteria.

## 5.7 Weekend use of Playing Fields

There may be weekend use of the playing fields.
In order to minimise reduce the potential impact at residences, the following recommendations made:

- Limit the use of the sporting fields on weekends.
- Schedule any sporting activities during daytime.

- Encourage non-players to congregate at the southern end of the field.
- Noise from PA should be controlled by locating any sports related PA on the western side of the oval facing the oval and the school.

It is recommended that management of noise be included in any site management plan.

# 6 CONCLUSION

A development application construction and operational noise and vibration assessment of the proposed Curl Curl North Public School has been conducted. Site-specific noise criteria that are applicable to the entire project have been established.

A noise and vibration assessment has been conducted for the proposed construction activities associated with the development to determine the potential for noise and vibration impact at surrounding receivers. Exceedances of noise management levels are expected at nearby surrounding receivers.

Vibration associated with on-site construction activities has the potential to impact on residences to the west of the site should large equipment, such as rock breakers be used. Trial monitoring and selection of less vibration intensive equipment is recommended.

Therefore, management of noise and vibration from construction activities will be required to be included in the Site Construction Environmental Management Plan.

Operational noise criteria for mechanical services, school and hall operations have been determined for the project. A review of all plant with respect to site specific noise criteria is required at detailed design stage. At that stage, any necessary noise mitigation can be determined and included in the detailed design of mechanical service so that compliance with site specific noise criteria is achieved.

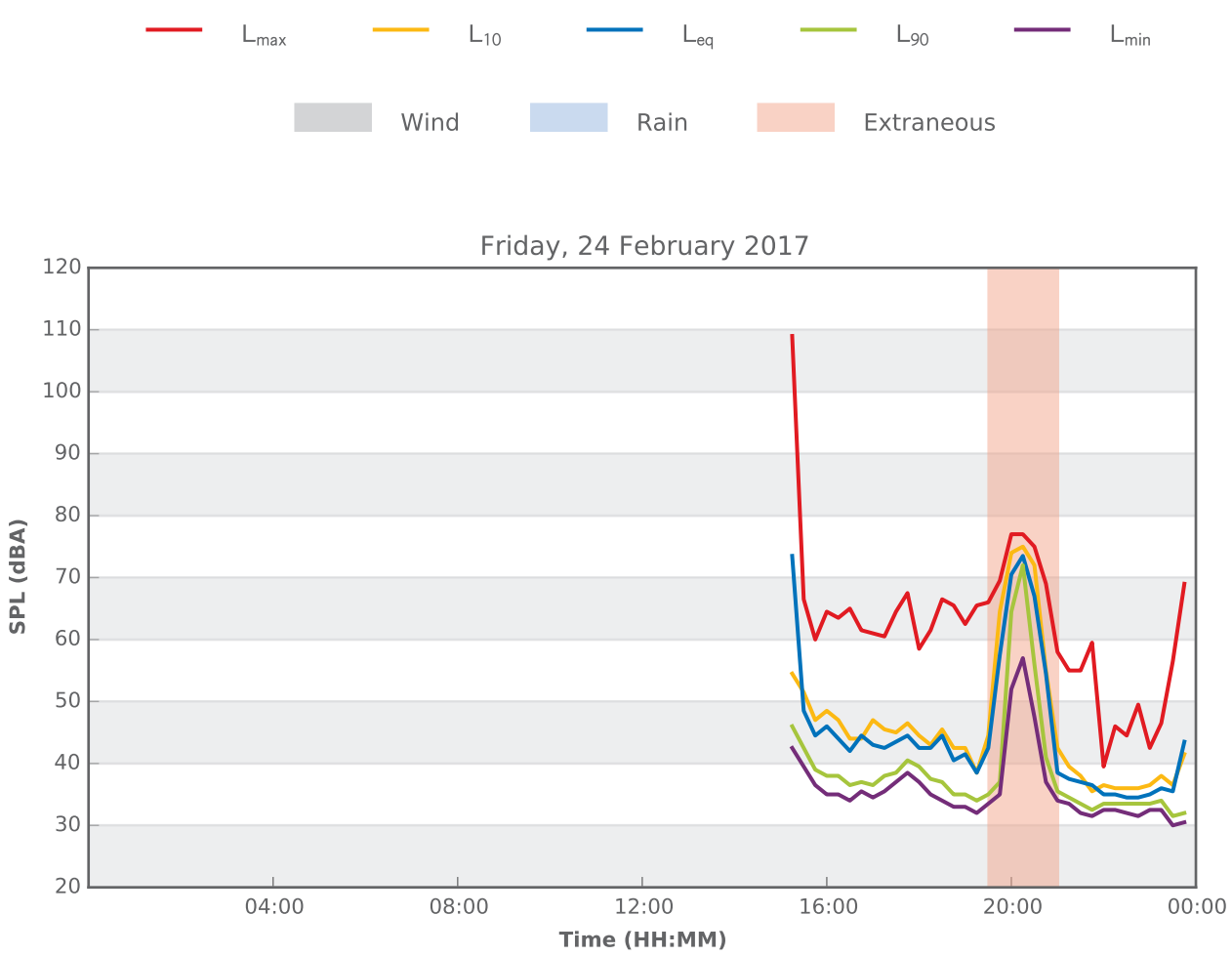
Operation of the Hall outside of normal school hours for major concerts will require doors and windows on western and northern facades to be closed. In addition, walls and roof areas will require improved constructions that should be determined at detailed design stage. Preliminary allowances have been recommended in the report.

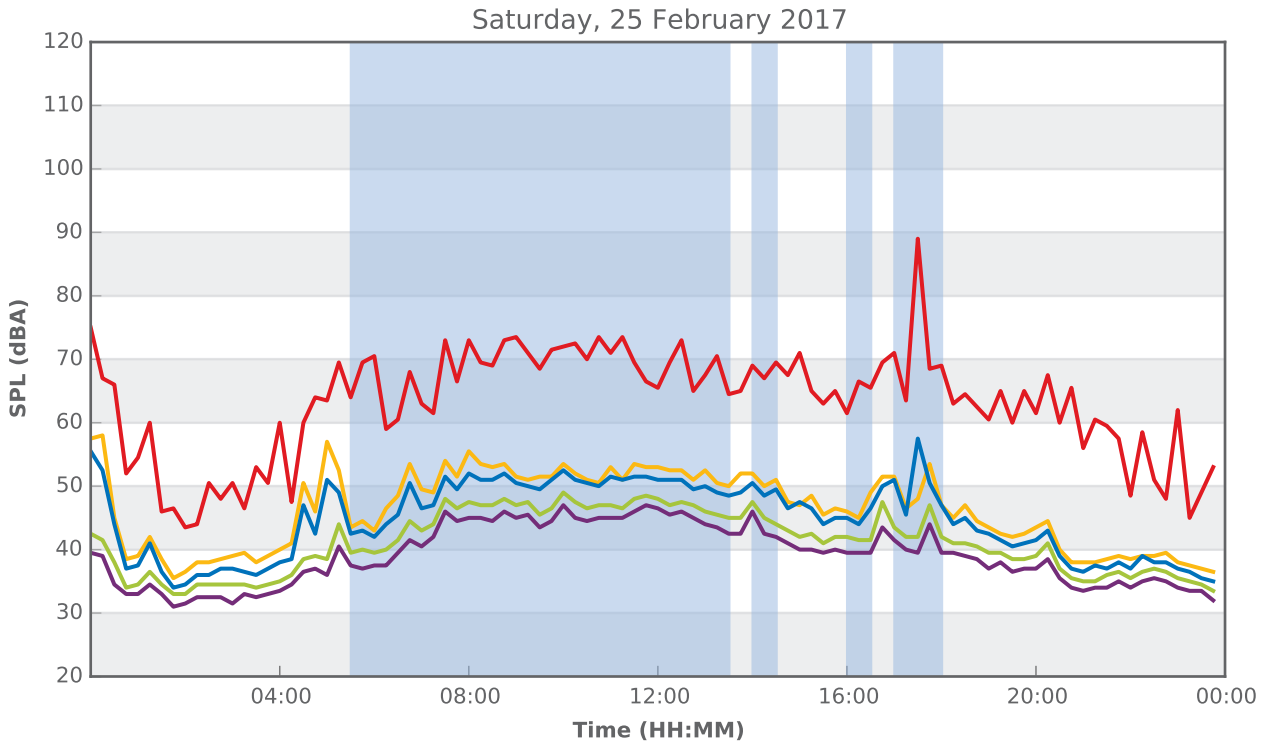
Other school related noise producing activities have been reviewed and recommendations for management of these sources has been provided.

# APPENDIX A

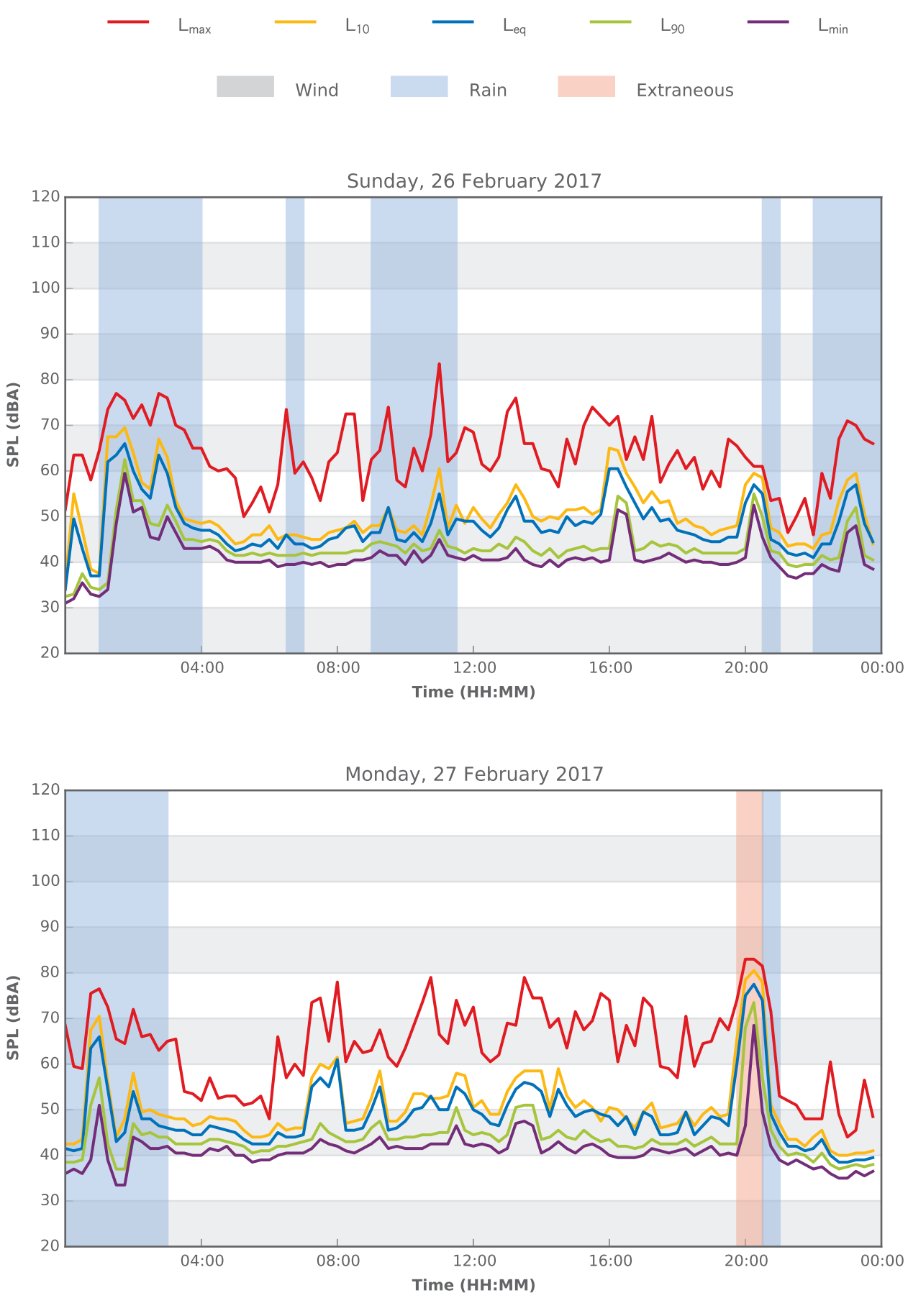
## NOISE MEASUREMENT RESULTS

## Playfair Road North Curl Curl, Warringah Council

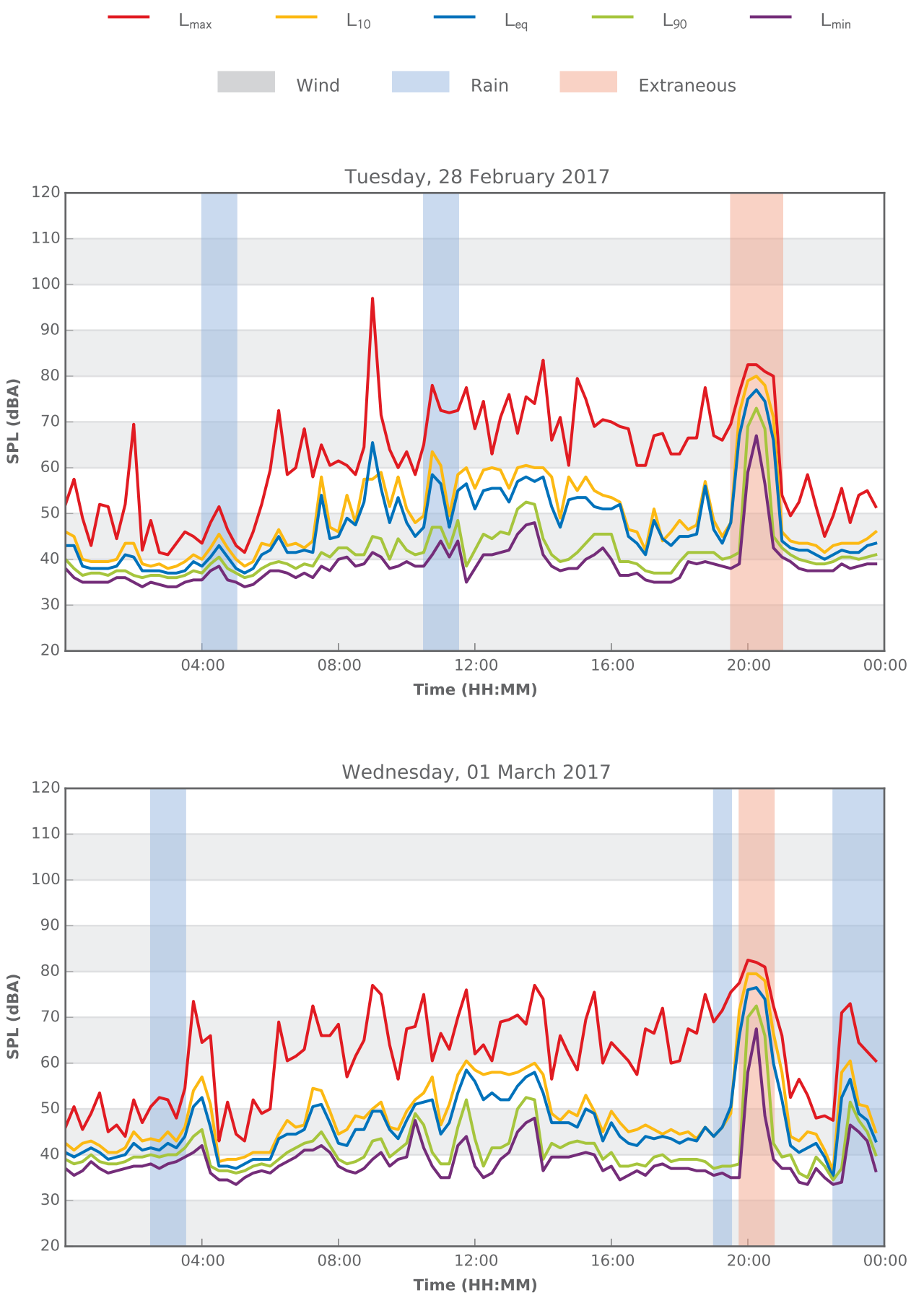


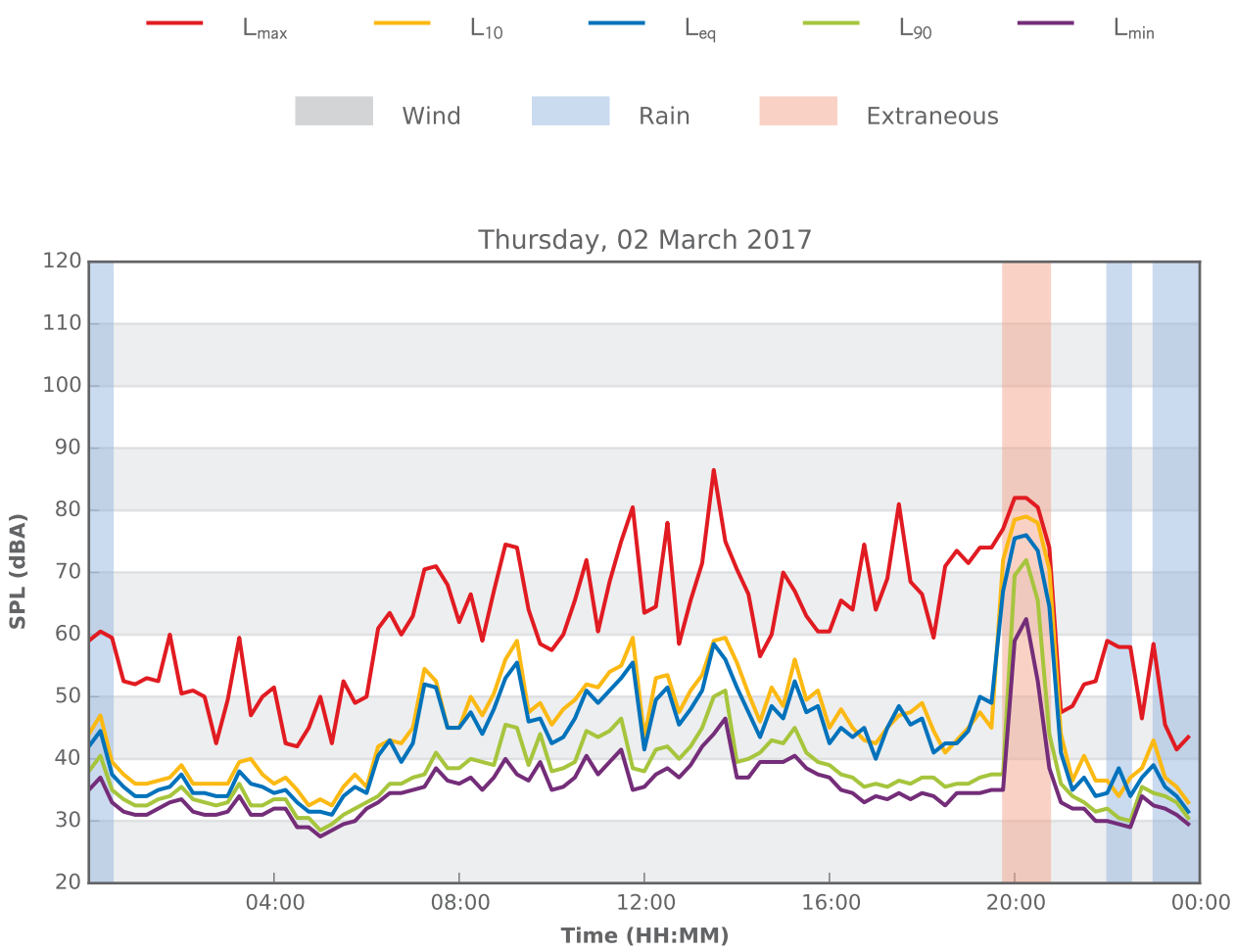
## Playfair Road North Curl Curl, Warringah Council

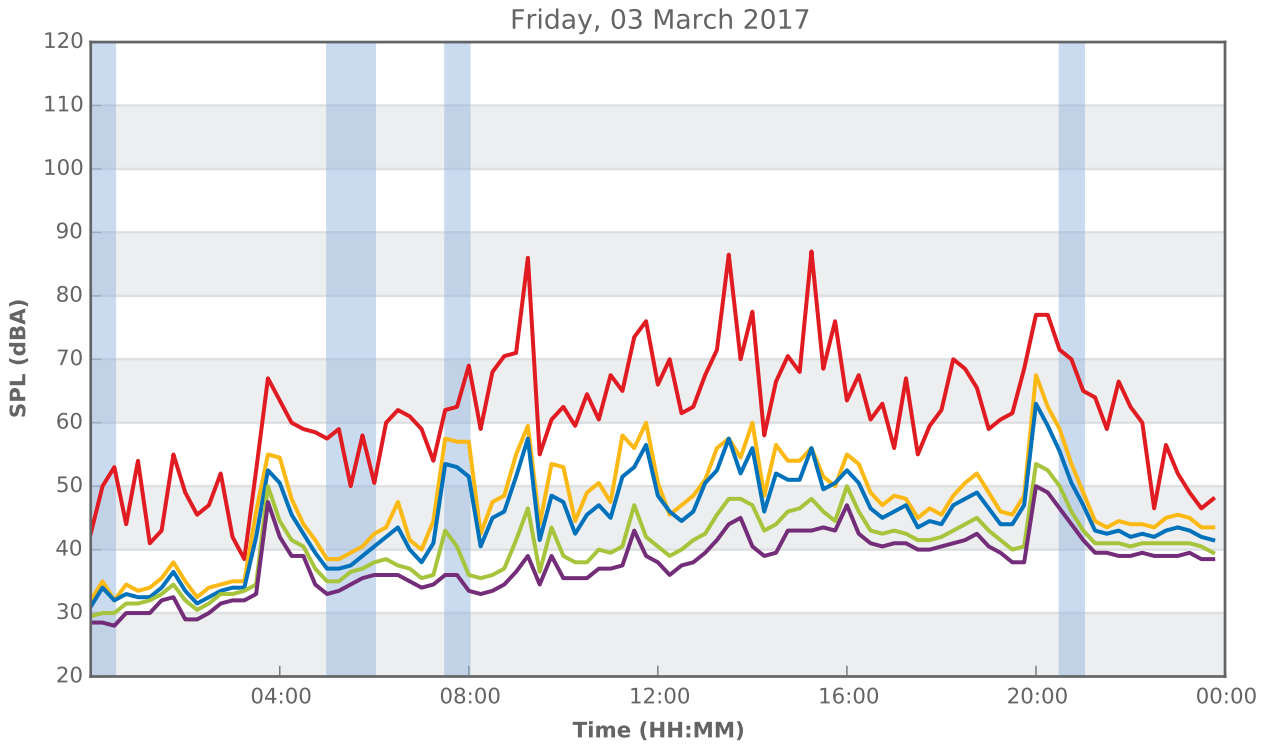


## Playfair Road North Curl Curl, Warringah Council

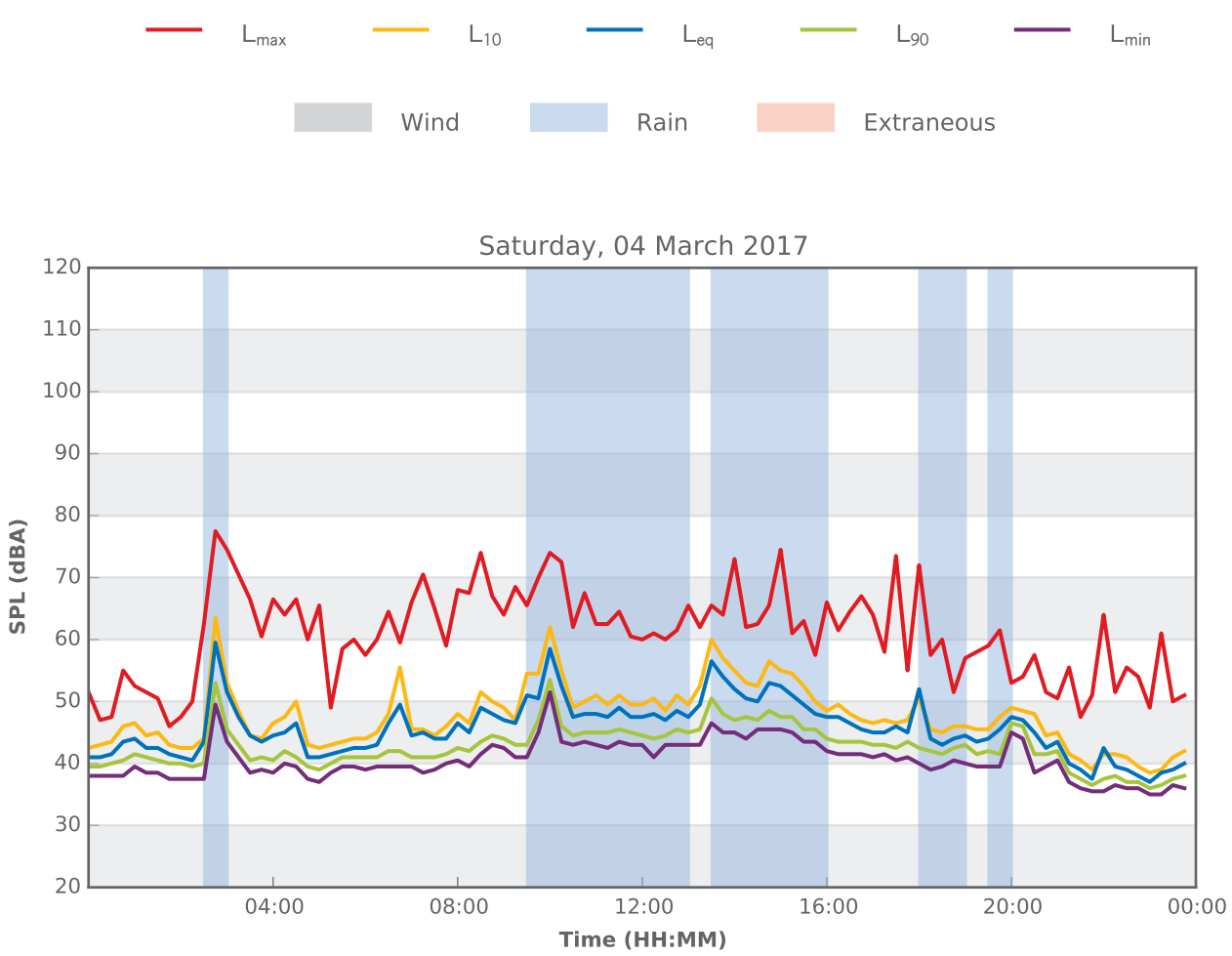


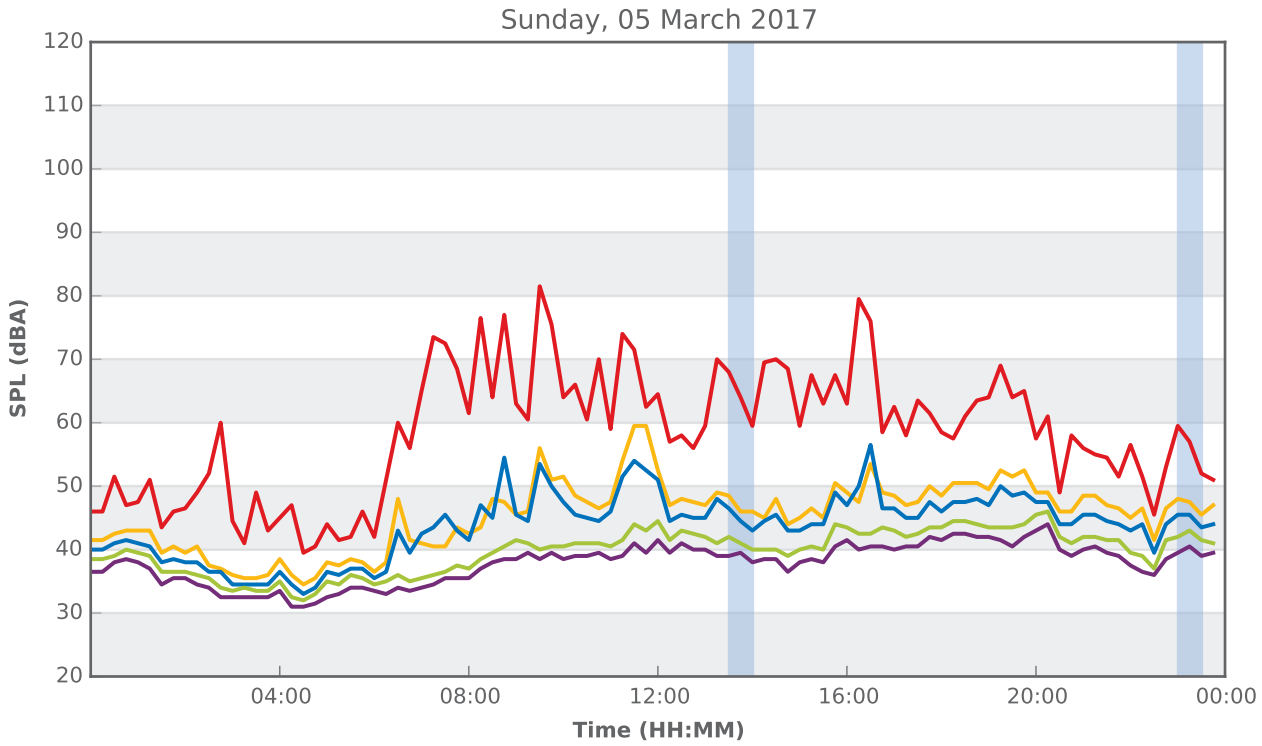
## Playfair Road North Curl Curl, Warringah Council



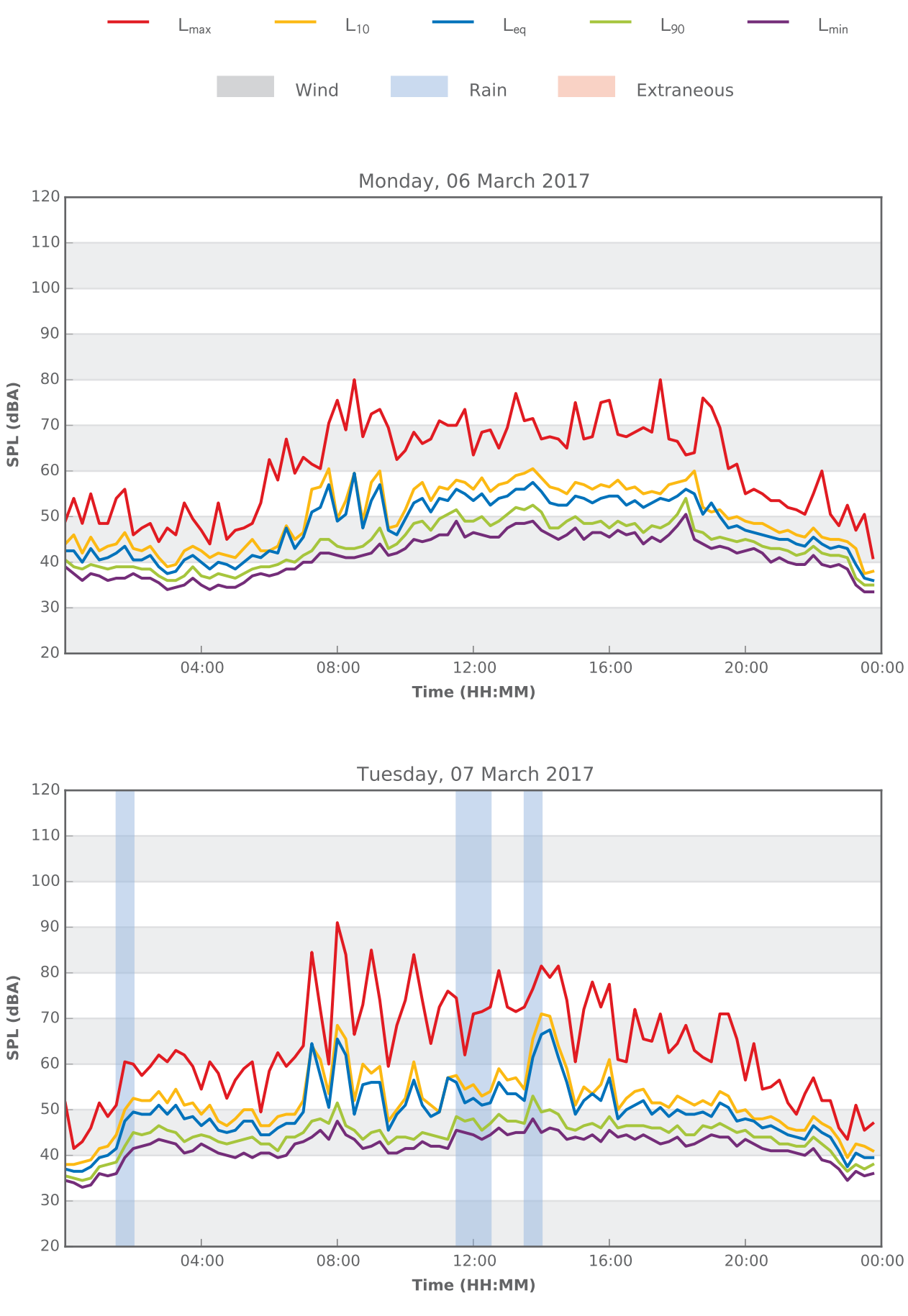



## Playfair Road North Curl Curl, Warringah Council

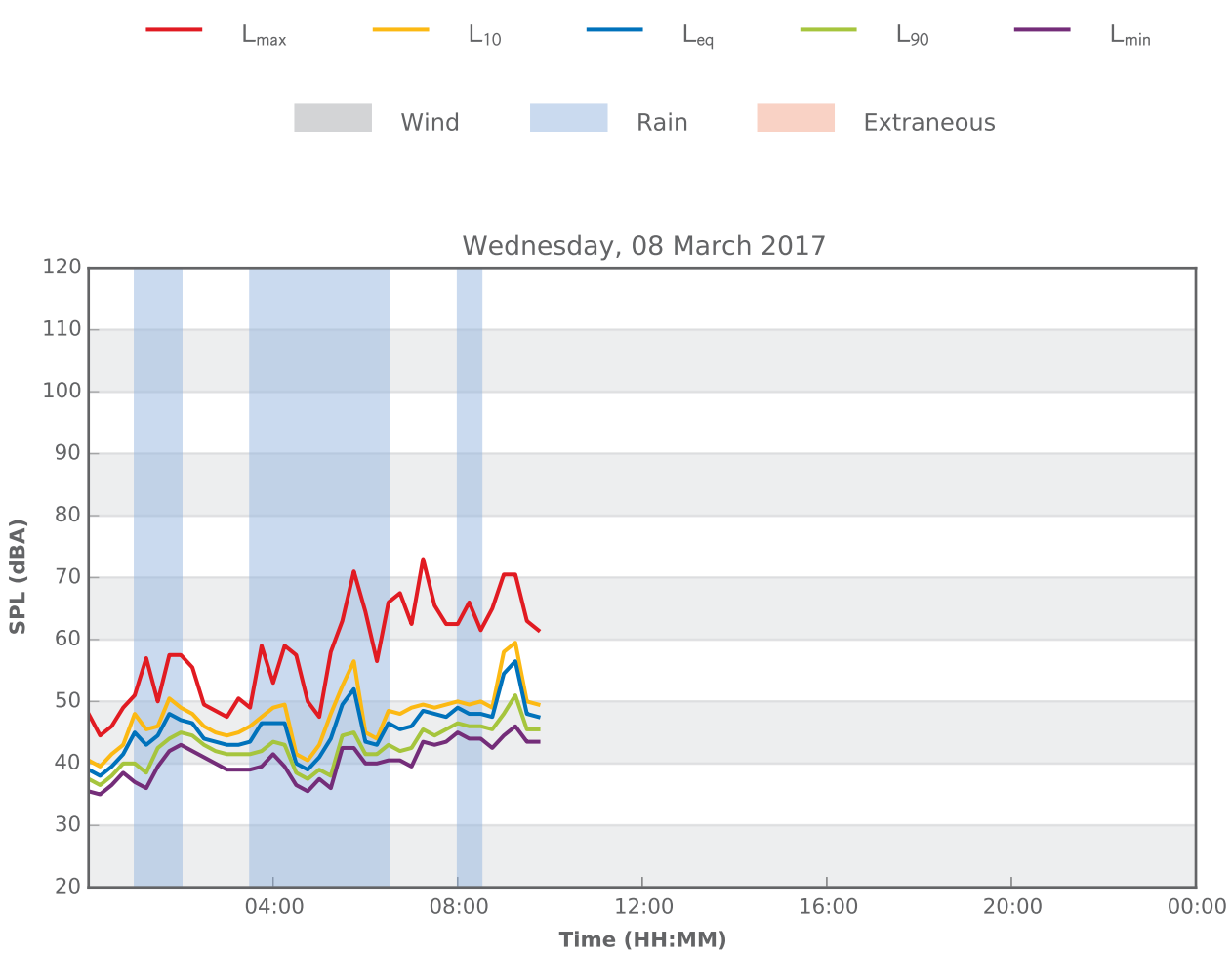


## Playfair Road North Curl Curl, Warringah Council



## Playfair Road North Curl Curl, Warringah Council



# APPENDIX B

## RESPONSE TO SUBMISSIONS

WILKINSON MURRAY

6 March 2018

WM Project Number: 17072
Our Ref: TKD060318 submissions

Chloe Rayfield
TKD Architects
19 Foster Street
SURRY HILLS NSW 2010

Dear Chloe

**Re: North Curl Curl Public School - Response to Acoustic Issues**

Wilkinson Murray Report 17072 Version A of 12 May 2017 was an acoustic report concerning the proposed re-development of Curl Curl North Public School. A number of issues concerning acoustics has been raised by relevant stakeholders. This letter gives our response to those submissions. The acoustic report has been updated accordingly where relevant.

## SUBMISSION FROM NSW ENVIRONMENTAL PROTECTION AUTHORITY

**Issue** – The background noise measurement within the acoustic report was done incorrectly. Accordingly, DoE must either:

- Re-measure background noise levels; or
- Adopt background noise levels 5dB lower than those proposed.

**Response** – We acknowledge that the graphs do not show influence of rain and wind. On close analysis of the data, it was realised the automated meteorological analysis program has used corrupt data from the North Head weather station which is the closest weather station to the school. For Version B of the acoustic report, meteorological data from the Terrey Hills weather station was used. There was some rain during the measurement period, and the exclusions have resulted in slightly lower background noise levels for daytime and evening than previously used.

In a separate submission, the EPA recommended assessment of mechanical services against background measured at the western boundary of the site. No suitable and secure location for logging was found on the western boundary of the site. Short-term measurements were done in the afternoon after school was finished. From those results, it was concluded that the background on the western boundary would be lower than that on the eastern boundary where the logger was located. For a conservative assessment, noise results from the logger were used at all receiver locations.

Concerning the comment with regard to the possibility that noise from the school has influenced the background measurements, we note:

- it was not possible to wait for school holidays to measure background noise levels due to time constraints on the project;

- for this reason, a location was chosen that was well shielded from all playground locations, and in a part of the school where children were not allowed access;
- on a statistical basis, any influence of noise from school activities would not influence the RBL background noise.
- This is supported by the fact that the newly analysed RBL for daytime is lower than the RBL for evening when there are no children in the school. If the RBL had been influenced by school activity, the opposite would be expected.

**Issue** – Any mechanical plant and equipment installed at the site must not generate noise that:

- exceeds 5dBA above the rating background noise level measured at the western boundary of the development site; and
- exhibits tonal or other annoying characteristics.

**Response** – The conditions stated are standard. At detailed design stage, the mechanical plant would be assessed to ensure it complies with the requirements of the *Industrial Noise Policy* which includes the requirements listed (<5dBA above RBL, and nontonal). While our report discusses standard noise criteria, in Version B of the report the criteria are repeated in the section on mechanical plant.

**PUBLIC SUBMISSIONS**

**Issue** – Noise impacts generated by use of shared facilities not during school use.

**Response** – The noise report does assess these activities in brief, with the exception of any mention of extra traffic noise. For a more detailed analysis we would need to know more about the proposed operations. The report notes that noise from public use of the sporting facility could exceed normal noise criteria and management of noise emission would be required. No further analysis can be given at this stage.

**Issue** – Adverse vehicular noise to students in classrooms facing Abbott / Playfair Road

**Response** – The issue of the killer noise into classrooms is outside the scope of the DA report. It is dealt with in detail in the acoustic design report (Wilkinson Murray Report 17072–D).

**SUBMISSION FROM DEPARTMENT OF PLANNING**

**Issue** – Construction and Operation Noise report must be revised to include – Construction noise and vibration impacts on students and teachers at the site, including mitigation measures.

**Response** – Version B of Report 17072 now includes assessment of construction noise impacts on the remainder of the school as requested.

**Issue** – Construction and Operation Noise report must be revised to include – Issue Noise impacts of OOSH onto adjoining neighbours.

**Response** – The OOSH is now assessed in Section 5.6 of Report 17072 Version B.

I trust this information is sufficient. Please contact us if you have any further queries.

Yours faithfully
**WILKINSON MURRAY**

**George Jenner**
Associate