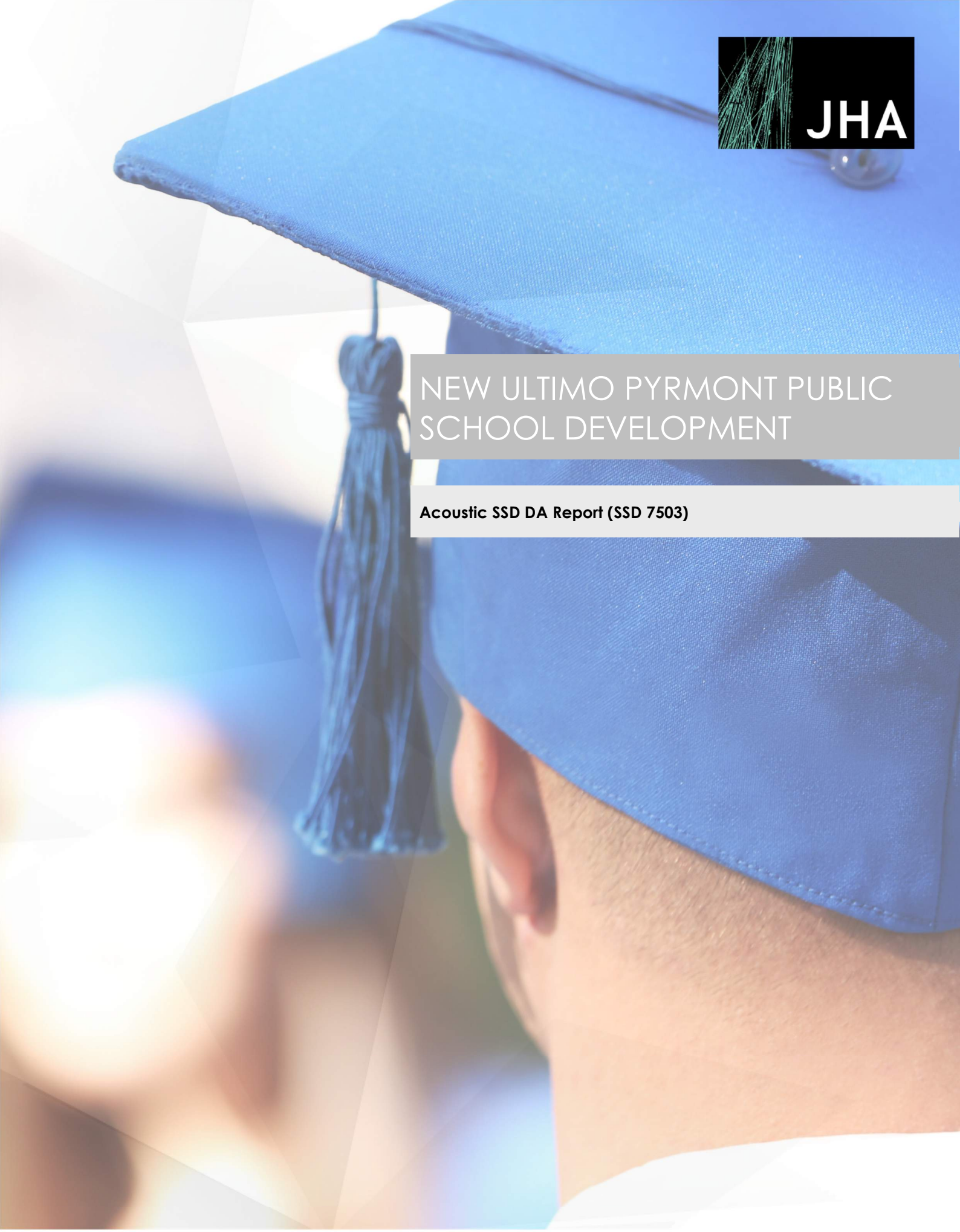

NEW ULTIMO PYRMONT PUBLIC SCHOOL DEVELOPMENT

Acoustic SSD DA Report (SSD 7503)

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Document Control Sheet

Title	**Acoustic SSD DA Report (SSD 7503)**
Project	New Ultimo Pyrmont Public School Redevelopment
Description	Report for Acoustic SSD DA
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CONTENTS

1. EXECUTIVE SUMMARY

This report has been prepared by JHA to identify and summarise the proposed Acoustic requirements which will be incorporated into the design of the proposed New Ultimo Pyrmont Public School Development.

This report demonstrates compliance with the Secretary's Environmental Assessment Requirements (SEARS) which apply to the project and has been prepared to accompany a State Significant Development Application to the NSW Department of Planning and Environment. This report should be read in conjunction with the Architectural design drawings and other consultant design reports submitted as part of the application.

The requirements of the State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017 have also been taken in into consideration in this report and the proposed New Ultimo Pyrmont Public School will comply with the requirements when the recommendations in this report are implemented.

In summary, the following are the statutory requirements pertaining to noise and vibration for the development that has to be achieved as discussed in this report.

1. The noise criteria as determined by the NSW Industrial Noise Policy (2000) at the nearest apartments at 55 Jones St Ultimo for noise emanating from the as follows.
    a. Day Period (7am to 6pm Monday to Saturday & 8am to 6pm Sunday) is 54dB $L_{Aeq,15min.}$
    b. Evening Period (6pm to 10pm Monday to Sunday) is 50dB $L_{Aeq,Evening.}$
    c. Night Period (10pm Sunday to 7am Sunday to Saturday & 10pm Saturday to 8am Sunday) is 45dB $L_{Aeq,Night.}$
2. The State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017 requirements pertaining to noise and noise control applicable to schools are as follows.

    a. Air Conditioning

    Noise level must not exceed 5dB above the rating background noise level when measured at the boundary of the most affected residential premises (or potentially most affected residential premises), determined in accordance with the Noise Policy.

    Source noise must not exhibit tonal noise, as defined in the Noise Policy (being noise containing a prominent frequency and characterised by a definite pitch).

    In these standards, the Noise Policy means the document entitled **NSW Industrial Noise Policy** (ISBN 0 7313 2715 2) published in January 2000 by the Environment Protection Authority."

    b. Noise from new school buildings

    A new building or (if the development is an alteration or addition to an existing building for the purpose of changing its use) an existing building that is to be used for the purpose of a school or school-based child care must be designed so as not to emit noise exceeding an LAeq of 5 dB(A) above background noise when measured at any lot boundary."

c. School Amenity

Schools should provide pleasant and engaging spaces that are accessible for a wide range of educational, informal and community activities, while also considering the amenity of adjacent development and the local neighbourhood.

Schools located near busy roads or near rail corridors should incorporate appropriate noise mitigation measures to ensure a high level of amenity for occupants."

3. Vibration originating from the proposed development must be managed in accordance with the NSW Office of Environment & Heritage "Assessing Vibration: A Technical Guideline 2006". The vibration levels at the neighbouring residences and within the school, during construction and school operations following completion shall comply with "Assessing Vibration: A Technical Guideline 2006" document.

2. INTRODUCTION

2.1 Project Description

The New Ultimo Pyrmont Public School Development is planned to meet the School Infrastructure NSW's need to provide suitable teaching spaces that meet increased demand in the area. Based on scarce available land in high density areas, the School Infrastructure NSW plans to construct a new four storey school to serve the surrounding community. Ultimo is an inner suburb of Sydney located adjacent to the CBD. The new building will replace the existing Ultimo Public School located on the same site which no longer offers the facilities or capacity to serve the increased demographics of the area. The existing school has been demolished and to be replaced with a new facility that will accommodate up to 800 students and 33 staff.

2.2 Site Location

The existing site, as shown below, is bounded by Jones Street, Quarry Street and Wattle Street and is 0.54ha. It is situated in the heart of the inner-Sydney suburb of Ultimo, located approximately 200 metres from two nearby light rail stations—Exhibition Centre and Wentworth Park—and less than 1 kilometre from the Town Hall railway station.

Figure 1 Aerial View of the Site

2.3 Secretary's Environmental Assessment Requirements (SEARs)

This report acknowledges the SEARS prepared by the Secretary which notes the following in Section 9 of the document:

9. 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 occupiers of land.
~ Relevant Policies and Guidelines:

- *NSW Industrial Noise Policy (EPA)*
- *Interim Construction Noise Guideline (OECC)*
- Assessing *Vibration:* A *Technical Guideline 2006*
- *Relevant SEARs Key Issue Requirements*

The relevant SEARs Key Issue Requirements are as follows.
SEAR key issue 1
The SEAR key issue 1 relates to the Infrastructure SEPP (specifically, cl. 102) are as follows.
"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 transitway 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."
Wattle St has an annual average daily traffic volume of less than 40,000 vehicles per day and hence does not come under the requirements of SEAR key issue 1 as shown in Figure 2 below.

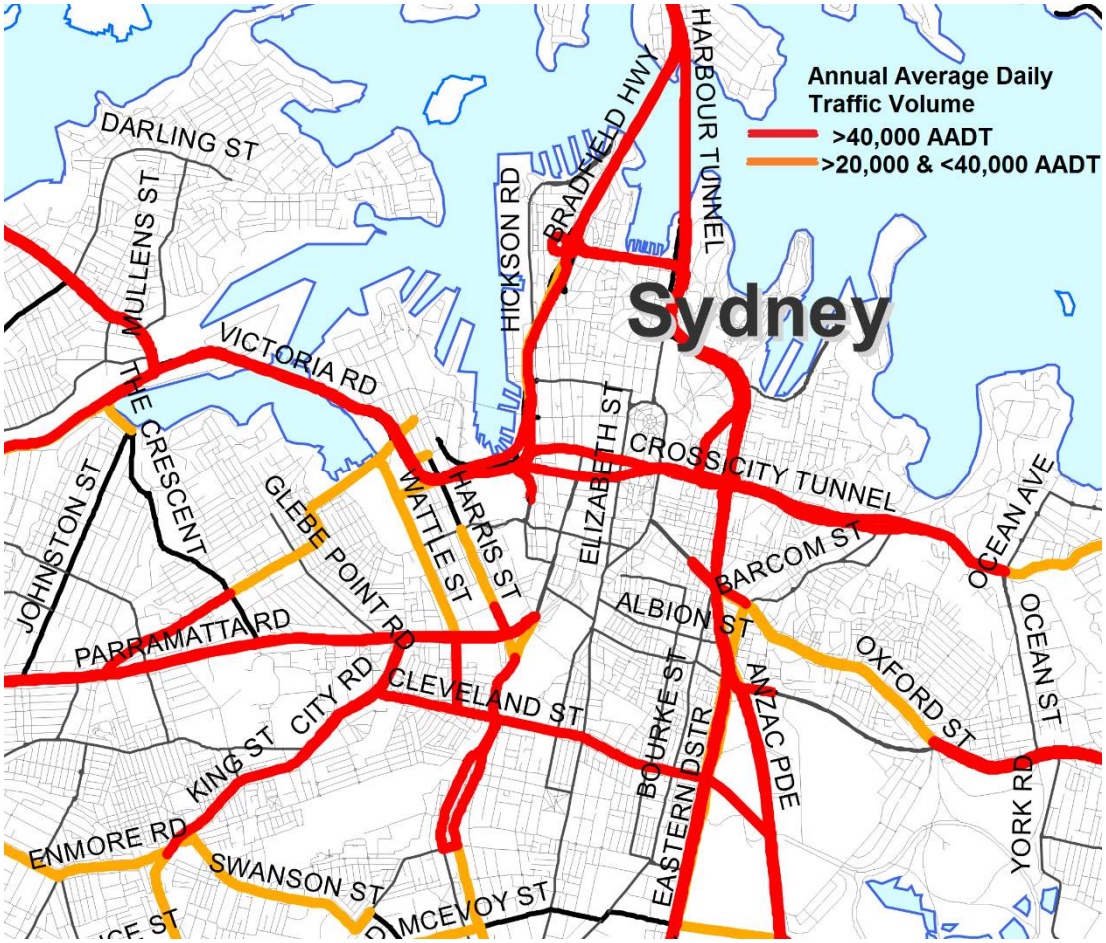


Figure 2 Annual Average Daily Traffic Volume of Various Major Roads in the City of Sydney including Wattle St taken from RMS site "Traffic volume maps for Infrastructure SEPP".

SEAR Key Issue 4
1. The project must be informed by consultation, including with relevant government agencies, infrastructure and service providers, special interest groups, affected landowners, businesses and the community. The consultation process must be undertaken in accordance with the current guidelines.
2. The Proponent must document the consultation process, and demonstrate how the project has responded to the inputs received.
3. The Proponent must describe the timing and type of community consultation proposed during the design and delivery of the project, the mechanisms for community feedback, the mechanisms for keeping the community informed, and procedures for complaints handling and resolution.

The above relevant policies and guidelines and the SEARS Key Issue 4 requirements are addressed in sections 3, 4, 5 and 6 of this report respectively.

2.4 State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017

The sections of the State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017 pertaining to noise and noise control applicable to schools are as follows.

Schedule 1 of the State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017 provides the following development standards for noise levels.
"Air Conditioning
Noise level must not exceed 5dB above the rating background noise level when measured at the boundary of the most affected residential premises (or potentially most affected residential premises), determined in accordance with the Noise Policy.
Source noise must not exhibit tonal noise, as defined in the Noise Policy (being noise containing a prominent frequency and characterised by a definite pitch).
In these standards, the Noise Policy means the document entitled **NSW Industrial Noise Policy** (ISBN 0 7313 2715 2) published in January 2000 by the Environment Protection Authority."

Schedule 2 of the State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017 provides the following development standards for noise levels.
"6 - Noise
A new building or (if the development is an alteration or addition to an existing building for the purpose of changing its use) an existing building that is to be used for the purpose of a school or school-based child care must be designed so as not to emit noise exceeding an LAeq of 5 dB(A) above background noise when measured at any lot boundary."

Schedule 4 of the State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017 provides the following development standards for noise levels.
"Principle 5—Amenity
Schools should provide pleasant and engaging spaces that are accessible for a wide range of educational, informal and community activities, while also considering the amenity of adjacent development and the local neighbourhood.
Schools located near busy roads or near rail corridors should incorporate appropriate noise mitigation measures to ensure a high level of amenity for occupants."

3. APPLICABLE NOISE CRITERIA

The applicable noise and vibration criteria development as determined by the SEARs for the New Ultimo Pyrmont Public School (SSD 7505) dated 7/3/16 and the SEPP (Educational Establishments and Child Care Facilities) 2017 requirements are as follows:

3.1 NSW Industrial Noise Policy

The NSW Industrial Noise Policy (INP) (2000) assessment procedure for industrial noise sources consists of two components.
They are:

- Controlling intrusive noise impacts in the short term for residences
- Maintaining noise level amenity for particular land uses for residences and land users.

The intrusiveness of an industrial noise source is considered acceptable if the continuous (energy average) A-weighted level of noise from the source measured over a 15-minute period does not exceed the background noise level measured in the absence of the source by more than 5dB. The Rating Background Level (RBL) is the background level used for the assessment purposes and the $L_{A90,\ 15minute}$ measure as recommended in the INP is used in the determination.
To limit the continuing increases in noise levels and maintain noise level amenity, the INP has set recommended and maximum noise for the various land usages. The criteria for amenity noise applicable to this proposed development in Table 1 below.

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level, dB(A)	
			Acceptable	Recommended Maximum
Residence	Urban	Day	60	65
		Evening	50	55
		Night	45	50
School Classroom - Internal	All	Noisiest 1-hour period when in use	35	40

Table 1 INP Recommended Noise Levels

3.2 Existing Noise Levels at Residential Boundaries

3.2.1 Long Term Noise Monitoring

To determine the intrusive noise criteria in accordance with the INP, long term noise logger monitoring and short term (15-minutes) operator attended noise measurements were conducted at the proposed development site. Automatic logging noise measurements were performed at the site to document the existing acoustic environment, including traffic noise.

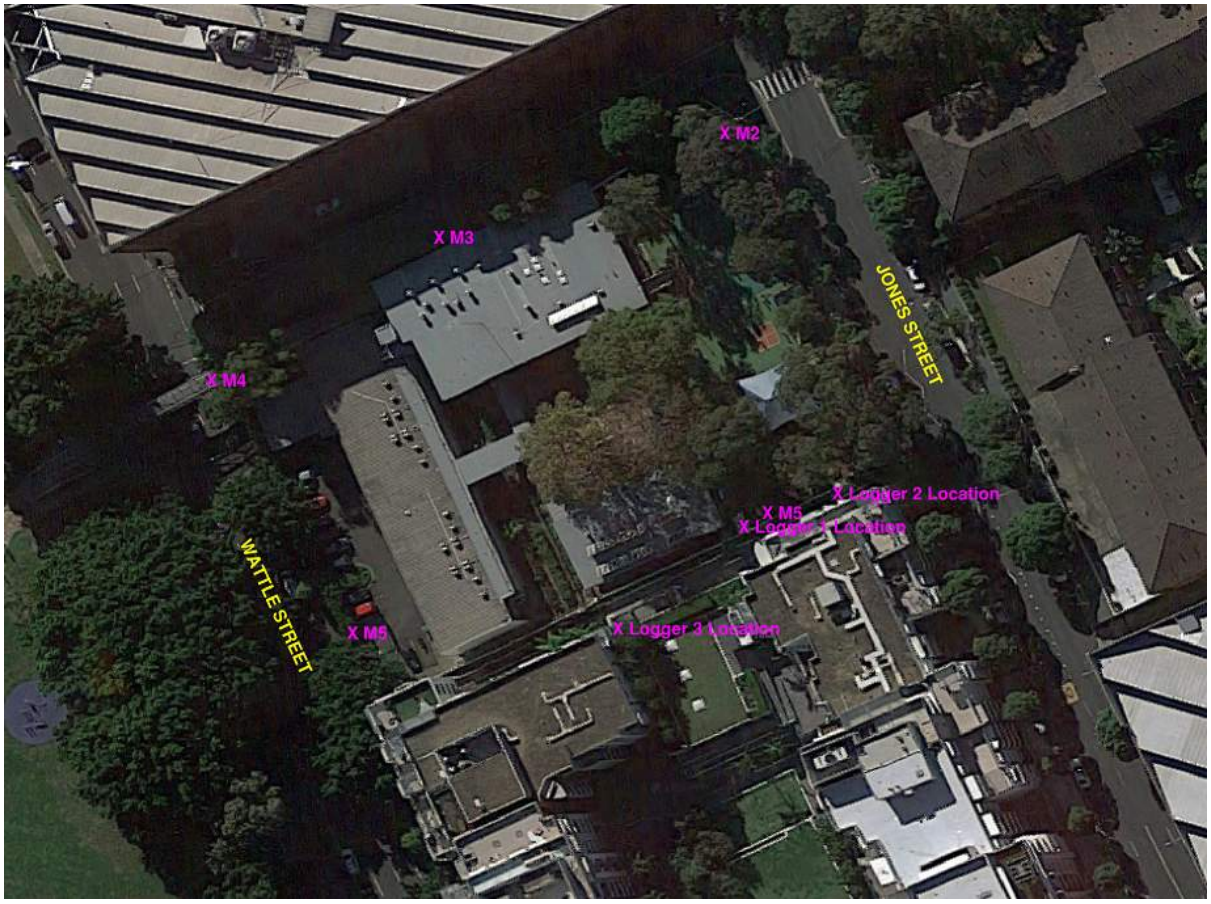


Figure 3 Aerial View of the Site with Nearest Affected Receiver Locations, Operator Attended Measurements and Logger Position

Figure 4 Noise Logger 1 (circled) located near the boundary with the apartments at 55 Jones St

Figure 5 Noise Logger 2 (circled) located near the school boundary the bedroom window of apartments at 55 Jones St.

Figure 6 Noise Logger 3 (circled) located beside apartment balcony at 55 Jones St (midway between Jones and Wattle St near the school boundary.

Long term noise monitoring with a Rion NL-52 Type 1 noise logging sound level meter were conducted between Monday 24th of April 2017 and Friday 5th of May 2017 at the Logger 1 location shown in Figures 3 and 4 above. Additional noise logging were conducted on the site of the apartment block at 55 Jones Street between Monday 9th of October 2017 and Saturday 21st of October 2017 (See Figures 3, 5 & 6 above). The logger sound level meters were calibrated before and after the measurements using a Bruel & Kjaer Acoustic Calibrator. No calibration deviations were recorded. Detailed results of the logger measurements are shown in Appendix B.

The results of the automatic logging measurements and the site notes are tabulated below. The LA90 rating background noise levels were determined using the methodology as described in Section 3.1 of the NSW INP.

Start Date and Time	End Date and Time	Logging Period	Assessment Period	$L_{A90,15min}$ dB	$L_{Aeq,15min}$ dB	Logger Location
24/04/2017 at 11.00 AM	5/05/2017 at 05.15 AM	15 min intervals	Day Period	50	54	Near boundary with 55 Jones Street Apartments
24/04/2017 at 11.00 AM	5/05/2017 at 05.15 AM	15 min intervals	Evening Period	47	51	Near boundary with 55 Jones Street Apartments
24/04/2017 at 11.00 AM	5/05/2017 at 05.15 AM	15 min intervals	Night Period	42	46	Near boundary with 55 Jones Street Apartments

Table 2 Results for Long Term Noise Monitoring for Logger 1

Start Date and Time	End Date and Time	Logging Period	Assessment Period	$L_{A90,15min}$ dB	$L_{Aeq,15min}$ dB	Logger Location
09/10/2017 at 09.00 AM	21/10/2017 at 12.00 PM	15 min intervals	Day Period	51	57	At 55 Jones St Apts near Jones St and school boundary near apartment window
09/10/2017 at 09.00 AM	21/10/2017 at 12.00 PM	15 min intervals	Evening Period	47	54	At 55 Jones St Apts near Jones St and school boundary near apartment window
09/10/2017 at 09.00 AM	21/10/2017 at 12.00 PM	15 min intervals	Night Period	43	49	At 55 Jones St Apts near Jones St and school boundary near apartment window

Table 3 Results for Long Term Noise Monitoring for Logger 2

Start Date and Time	End Date and Time	Logging Period	Assessment Period	$L_{A90,15min}$ dB	$L_{Aeq,15min}$ dB	Logger Location
09/10/2017 at 09.00 AM	21/10/2017 at 12.00 PM	15 min intervals	Day Period	49	53	At 55 Jones St Apt balcony near school boundary midpoint between Jones St and Wattle St
09/10/2017 at 09.00 AM	21/10/2017 at 12.00 PM	15 min intervals	Evening Period	47	51	At 55 Jones St Apt balcony near school boundary midpoint between Jones St and Wattle St
09/10/2017 at 09.00 AM	21/10/2017 at 12.00 PM	15 min intervals	Night Period	42	47	At 55 Jones St Apt balcony near school boundary midpoint between Jones St and Wattle St

Table 4 Results for Long Term Noise Monitoring for Logger 3

3.2.2 Operator Attended Noise Measurements

Operator attended noise measurement survey was conducted with an integrating Type 1 sound level meter and windshield. Measurements were taken continuously and the microphone was set to receive direct frontal sound and facing the direction of sound emission.
The survey was conducted with the following instruments:
NTI Precision Integrating Octave Band Sound Level Meter, Type XL2 with 1/3 Oct band filter unit, which conforms to applicable standards of IEC 61672-1:2002-05 CLASS1 & IEC 60651 TYPE1.
The sound level meter calibration was verified before and after the measurements using a Bruel & Kjaer Acoustic Calibrator. No calibration deviations were recorded.
The operator attended noise measurements were performed on Thursday 27th of March 2017 between 1.05 pm and 1.25 pm and Friday 24th of April 2017 between 10.40am and 11.55 am. (see Figures 7, 8, 9, 10 & 11 below). The results of the measurements are presented in Table 5 below.

Date	Time	Duration	L_{Aeq} dB	L_{AF90} dB	Location	Notes
24/04/2017	10.49 AM	15 min	53	47	M1	Jones St Traffic Noise
	11.05 AM	15 min	57	47	M2	Quarry & Jones St Traffic Noise
	11.23 AM	15 min	62	51	M3	Wattle St Traffic Noise
	11.39 AM	15 min	68	57	M4	Wattle St Traffic Noise
27/03/2017	13.07 PM	15 min	71	61	M5	Wattle St Traffic Noise

Table 5 Operator Attended Measurements Results and Corresponding Locations

Figure 7 Operator Attended Measurement at Location M1 near the boundary with the Apartments at 55 Jones St.

Figure 8 Operator Attended Measurement at Location M2 on the school premises at the corner of Jones and Quarry St

Figure 9 Operator Attended Measurement at Location M3 on Quarry Street

Figure 10 Operator Attended Measurement at Location M4 on footbridge over the school boundary with Wattle Street.

Figure 11 Operator Attended Measurement at Location M5 on Wattle Street

3.3 Noise Criteria at the nearest Residential Boundary at 55 Jones St

The NSW INP requires that any noise generated by the proposed development must be acoustically treated so that:

(a) "The emission of noise associated with the use of the premises including the operation of any mechanical plant and equipment shall comply with the following criteria:

(i) The LAeq,15minute noise level emitted from use must not exceed background noise level LA90,15minute by more than 5dB when assessed at boundary of any affected residence.

(ii) The LAeq,15minute noise level shall be adjusted for modifying factors in accordance with Part 4 of the environmental Protection Authority (EPA) NSW Industrial Noise Policy."

Based on the above Logger 1, Logger 2 and Logger 3 measurements and assessment in accordance with the NSW INP, the criteria for the project intrusiveness and amenity noise criteria (in bold) at the front boundary of the nearest affected residence at the 55 Jones St Apartments, Ultimo is shown in Table 6 below:

Time of Day	Intrusiveness Criterion	Amenity Criterion	Compliance on Completion of the Works Yes/No
Day (7am to 6pm Monday to Saturday & 8am to 6pm Sunday)	**54 $L_{Aeq,15min}$** (49+5)	60 $L_{Aeq, Day}$	**Yes**
Evening (6pm to 10pm Monday to Sunday)	52 $L_{Aeq,15min}$ (47+5)	**50 $L_{Aeq, Evening}$**	**Yes**
Night (10pm Sunday to 7am Sunday to Saturday & 10pm Saturday to 8am Sunday)	47 $L_{Aeq,15min}$ (42+5)	**45 $L_{Aeq, Night}$**	**Yes**

Table 6 Noise Criteria at Nearest Affected Receiver at 55 Jones Street Apartments, Ultimo

Following completion of the works and implementation of recommended acoustic treatments, the above noise criteria in Table 6 will be met.

4. NOISE AND VIBRATION AT THE PROPOSED DEVELOPMENT

4.1 Road Traffic Noise

The high level of traffic noise from Wattle Street will require significant acoustic treatment to achieve an ambient noise level of 35dB(A) in the indoor learning and teaching spaces. The specifications of the building envelope and building glazing has been incorporated in the design documentation for the building.

The noise level from student set downs and pickups on Jones and Quarry Streets will be similar to existing. Delivery and maintenance vehicles will access the future school building from Wattle Street and will not affect the residents at apartments at 55 Jones Street, Ultimo.

The NSW Department of Planning document "Development Near Rail Corridors and Busy Roads – Interim Guideline" (December 2008) refers to SEPP (State Environmental Planning Policy (Infrastructure) 2007 that requires the following:

Clauses: Road corridors

"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 transitway 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 RMS) 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."

The traffic volume on Wattle Street daily traffic volume on Wattle Street is less than 40,000 vehicles based on the latest available data. Accordingly, the requirement of Clause 102 of SEPP (State Environmental Planning Policy (Infrastructure) 2007 is not applicable to this development.

4.2 Rail Traffic Noise

The proposed development site is not affected by rail traffic noise.

4.3 Mechanical Plant Noise

The mechanical plant for the New Ultimo Pyrmont Public School Development will be acoustically treated to achieve the amenity and intrusiveness noise criteria in Table 6 above at the nearest affected residence as determined in accordance with the NSW Industrial Noise Policy.

The noise criteria at the nearest affected residence are **54 $L_{Aeq,15min}$** during the day period, **50 $L_{Aeq,\ Evening}$** during the evening period **and 45 $L_{Aeq,\ Night}$** during the night period.

The acoustic treatments for the mechanical plant has been designed to achieve the above criteria.

4.4 Review of Latest Architectural Drawings

The latest issue of architectural drawings listed in Appendix B have been reviewed and meets the requirements set out in this acoustic report.

4.5 Students and Sporting Activity Noise from the Development

General students' activities and activities on the basketball court will be between 8am and 6pm Monday to Friday. Weekend use of the basketball courts will be restricted to 8am to 6pm. The anticipated noise from these activities are not anticipated to exceed the criteria of **54 $L_{Aeq,15min}$** during the day period.

4.6 Vibration from the Development

All vibration generating equipment (such as mechanical plant) and activities (basketball court) will be vibration isolated such that the vibration transmission does not exceed the recommended levels as specified in the NSW Office of Environment & Heritage "Assessing Vibration: A Technical Guideline 2006" at the neighbouring residences and within the school, following completion of the school. Construction noise and vibration are addressed in Section 5 of this report.

The main source of vibration from the proposed development during its normal operation are the rooftop basketball court and from mechanical plant. The basketball court floor will be vibration isolated from the rest of the building structure, and major vibration generating mechanical plant will be vibration isolated from the building elements they are attached to.

5. CONSTRUCTION NOISE AND VIBRATION CONTROL

5.1 Noise and Vibration Regulations and Approval Conditions for the Construction Works

Construction site operators must comply with construction noise and vibration control requirements of the NSW statutory requirements and the conditions set out in the NSW Critical State Significant Infrastructure Standard Secretary's Environmental Assessment Requirements (SEARs) 2015.

The Protection of the Environment Operations Act 1997 (NSW) Act is the key piece of environment protection legislation, and the Protection of the Environment Operations (Noise Control) Regulation 2008 (NSW) provides for inspection and testing of noise emissions.

The "Interim Construction Noise Guidelines" (2009) published by the NSW Environment Protection Authority (EPA), deals with the assessment of noise from construction activities and advises on best practice approaches to minimise noise impacts. It is aimed at managing noise from construction works regulated by Office of Environment and Heritage, and is used to set statutory conditions in licences or other regulatory instruments.

The "Assessing vibration: A Technical Guideline" (2006) published by the NSW EPA, is based on guidelines contained in BS 6472-1992, and presents preferred and maximum vibration values for use in assessing human responses to vibration and provides recommendations for measurement and evaluation techniques. It does not address motion sickness, occupational vibration, blasting vibration effects or vibration-induced damage to buildings or structures.

General guidelines on Construction Noise and Vibration criteria and management are shown in Appendix A.

5.2 Hours of Construction Works

The following are the permitted construction hours as recommended in the New Ultimo Pyrmont Public School Development.

Monday to Friday: 7.00am to 6.00pm

Saturday: 7.00am to 5.00pm

Sundays and Public Holidays: No work permitted.

Blasting is not permitted.

5.3 Construction Noise Criteria during Construction Works

The daytime 'rated background noise level' (RBL) at the nearest residence at 55 Jones St of 50dB(A) as determined in Tables 2, 3 & 4 above. In accordance with Table 7 below in Section 10.2 Appendix A, construction noise levels at the residential boundary of 60dB$_{LAeq15mins}$ (50dB$_{LAeq15mins}$ RBL plus 10dB construction noise allowance) or less is acceptable during the construction periods.

Where it is anticipated that the construction noise are likely to exceed to 60dB$_{LAeq15mins}$ at the nearest residence, the builder shall contact the affected residents prior to commencement of the construction work in accordance with the EPA "Interim Construction Noise Guideline" (2009) where the relevant sections are shown in Appendix A of this report.

6. COMMUNITY ENGAGEMENT DURING CONSTRUCTION

6.1 Neighbouring Community Engagement

The most impacted community during the construction phase of the New Ultimo Pyrmont public school are the residents in apartments at 55 Jones Street, Ultimo facing the proposed construction site.

From a community point of view, there is a need for a range of actions and processes which are required by the guidelines of the Secretary's Environmental Assessment Requirements (SEARs) guidelines for the construction works that aim to reduce noise and vibration impacts from the construction activities while encouraging community involvement.

As a project moves towards the construction phase, further details normally become available on the planned work methods, scheduling, location of plant and equipment.

For the New Ultimo Pyrmont public school redevelopment construction works, contact with the nearest affected community is desirable once approval has been given to commence works and should be undertaken prior to any work beginning. The type of community engagement should relate to the likelihood and extent of noise and vibration impacts from the construction works.

The aim of community engagement is to:

- Establish good working relationships between the development owner, builder, the community and other stakeholders in relation to the construction project

- Receive feedback on the project's environmental performance, discuss community concerns and identify opportunities for the resolution of community complaints and concerns
- Gain advice on how best to communicate relevant information on the project and its environmental performance to the broader community
- Work cooperatively towards outcomes of benefit to the project, immediate neighbours and the local and regional community.

The New Ultimo Pyrmont public school redevelopment Project Manager shall nominate the construction site manager as a community liaison officer for the project as a point of contact for the community regarding issues related to the construction of the development, including issues relating to noise and vibration. Any formal complaints received regarding noise and vibration matters at the construction site shall be passed on to the Project Manager for the complaints to be addressed and resolved.

6.2 Keeping the Noise Affected Community Informed

Being up-front with the noise affected community from the outset can assist in transferring information to the affected community. An example of being up-front is to present noise and vibration related information on the construction works to noise affected community before commencing works.

6.3 Dealing with Community and Public Complaints during Construction

Complaints from the community and public can arise when accidental or unintentional noise and/or vibration are generated due to unforeseen circumstances or error of judgement made by the construction team. The community and public generally understand when this happens once or not too often. The complaints must be handled in a serious and respectful way. The complaints should be recorded and logged in a noise and vibration complaints log book and followed up by the construction site manager. Following resolution of the noise or vibration problem, the complainant should be informed of the remedial actions taken before the complaint can be recorded as being resolved.

7. CONSTRUCTION WORK SCHEDULE AND TRAFFIC MANAGEMENT

The construction work schedules and proposed construction traffic routes to minimise noise intrusion into neighbouring residential properties will be confirmed following engagement of a builder for the project.

The builder will be required to provide a construction programme for the works, from site establishment and site works to practical completion. The noisy phases will be monitored so as to avoid and minimise potential complaints from neighbouring and other affected properties. The builder will be required to provide construction traffic routes, proposed frequency of vehicular movements and the estimated total gross weights of the vehicles to assess the traffic generated noise in the vicinity of the development. Traffic noise will be monitored where potentially noisy construction traffic movement periods could cause complaints to arise from the affected residential properties.

Preliminary Construction Noise Management Plan and Construction Traffic Noise Management Plan are required by the SEARs (Plans & Documents) and this section will be augmented once these have been completed.

8. TRAINING

The site manager shall implement appropriate training and induction in the requirements of this construction noise management plan. All employees, contractors and utility staff working on site will undergo site induction training which includes Environmental Due Diligence Training. The induction will address:

- This Construction Noise Management Plan
- The existence of noise legislation and what this means for the project, i.e. OEH and Noise Management Levels
- Delivery hours and locations.
- Reporting and recording environmental incidents related to noise and vibration.
- Noise and vibration minimisation measures.
- The importance of regular maintenance noise and vibration generating plant.

Records will be kept of all personnel undertaking the site induction and training, including the contents of the training, date and name of trainer/s. Key staff will undertake more comprehensive training relevant to their position and/or responsibility. This training may be provided as “toolbox” talk training.

9. CONCLUSION

The NSW Critical State Significant Infrastructure Standard Secretary’s Environmental Assessment Requirements SEARs for the New Ultimo Pyrmont Public School (SSD 7503) dated 7/3/16, the State Environmental Planning Policy (Educational Establishments and Child Care Facilities) 2017 and the NSW Industrial Noise Policy (INP) 2000 requirements pertaining to the environmental noise impact of the proposed development of the New Ultimo Pyrmont public school on the neighbouring properties, in particular on the noise impact of the development at the nearest affected residence has been addressed.

The noise impact from the proposed development including the following activities has been addressed:

- Noise emissions from children outdoor recreational activities
- Noise from mechanical plant, carpark and cleaning and maintenance issues

The recommended noise mitigation management strategies including glazing, noise barriers and noise management strategies have been provided for the proposed development to meet the criteria outlined in the SEARs (SSD7503) requirements, SEPP (Educational Establishments and Child Care Facilities) 2017 and the NSW EPA Industrial Noise Policy (INP) 2000.

The noise criteria as determined by the NSW Industrial Noise Policy (2000) at the nearest apartments at 55 Jones St Ultimo for noise emanating from the as follows.
Day Period (7am to 6pm Monday to Saturday & 8am to 6pm Sunday) is 54dB $L_{Aeq,15min.}$
Evening Period (6pm to 10pm Monday to Sunday) is 50dB $L_{Aeq,Evening.}$
Night Period (10pm Sunday to 7am Sunday to Saturday & 10pm Saturday to 8am Sunday) is 45dB $L_{Aeq,Night.}$

Following completion of the works and implementation of the consultant’s acoustic and vibration treatment, the noise and vibration criteria outlined in this report will be met.

10. APPENDIX A – CONSTRUCTION NOISE AND VIBRATION MANAGEMENT GUIDELINES

The following section addresses the site specific construction noise and vibration criteria, measurement procedures and the various noise levels of construction equipment likely to be used at the site.

10.1 Recommended Standard Hours for Construction Work

The hours for construction work shall be as described in Paragraph 8.2 above.

Section 2.2 of the EPA "Interim Construction Noise Guideline" (2009) specifies categories of work that might be taken outside the standard hours. The categories relevant to this project are:

- The delivery of oversized plant or structures that police or other authorities determine requires special arrangements to transport along public roads.
- Emergency work to avoid loss of life or damage to property, or to prevent environmental harm.
- Maintenance and repair of public infrastructure where disruption to essential services and/or consideration of worker safety do not allow work within the standard hours.

10.2 Airborne Construction Affecting Nearby Properties

Table 7 below shows an extract from the table Section 4.1.1 of the EPA "Interim Construction Noise Guideline" (2009) which sets out the management levels for construction noise at residences and nearby properties. The determination of the Rated Background Noise Level (RBL) is shown in Appendix B.

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

Table 7 Extracted from Tabe in Section 4.1.1 of the EPA "Interim Construction Noise Guideline (2009)".

The Interim Construction Noise Guideline (2009) notes that there may be some community reaction to noise from major construction projects where this is more than 10 decibels above the background noise level for work during the daytime. This recognises that construction noise is generally temporary with the community having a slightly higher tolerance for it.

The best management practices involve adopting particular operational procedures that minimise noise while retaining production efficiency. Some common noise reduction strategies include:

- Changing the activity to reduce the noise impact or disturbance (e.g. reorganising the way the activity is carried out).
- Choosing a suitable time — schedule noisy activity to less sensitive times of the day. There are sensitive times of the day for different people, for example, residences during evenings, night and weekends. Where several noisy pieces of equipment are used, their operation should be scheduled to minimise impacts.
- Keeping neighbours informed of a planned noisy activity, its duration and the reasons for the activity. Neighbours may be more accepting of temporary noise if they know when and why the noise is happening, and how long it will last.
- Educating staff and contractors about noise and quiet work practices. This could include signage, for example, some construction sites have signs reminding contractors to consider neighbours and be quiet, and to not start noisy work too early (e.g. before 7.00 am).

Noise can be controlled in the transmission path by using separation distances, barriers and sound absorptive materials.

- Increasing the separation distance (distance attenuation) between the noise source and receiver reduces the noise level. As a rule of thumb, each doubling of the distance from a noise source equates to a reduction of sound pressure level of 6 dB (the inverse square law). This does not apply close to a loud noise source.
- Careful site selection for a new noisy activity can help minimise noise impacts where it is possible to provide adequate separation distances.
- Barriers are most effective when they are located close to the noise source and block the line of sight between the source and receiver. The amount of noise reduction achieved depends on the height and mass of the barrier and the frequency of the noise (barriers are less effective for low-frequency noise). Noise barriers should have no gaps. Use of absorptive material on the side of the barrier facing the noise source can also help to reduce noise levels by reducing noise reflections. Trees or other vegetation do not provide an effective noise barrier. Some limited attenuation may be gained where trees are densely planted but little attenuation is achieved for low frequencies.
- Sound-absorptive materials reduce the level of reflected sound. They are porous materials such as glass fibre, wool and mineral wool. Thin layers are capable of absorbing only high frequencies, whereas thicker layers can absorb a wider frequency range.

10.3 Equipment Noise Levels for the Proposed Construction works

The construction activities associated with the proposed development will consist of various plant and equipment as detailed above. The sound power levels of the noisy plant and equipment likely to be used during the construction works are provided below, listed from high to low.

Plant	Sound Power Level dBW	Estimated Sound Pressure Level dB(A) at	
		7m	18m
Bulldozer	114	89	81
Excavator	108	83	75
Rotary Hoe	109	84	76
Mobile Crane	104	79	71
Concrete Truck	109	84	76
Angle Grinder	109	84	76
Concrete Pump - 120 mm diameter / 50 bar	112	87	79
Sheet metal forming (grinding, hammering)	105	80	72
Concrete Saw	116	91	83
Crawler Cranes	98	73	65
Mobile Crane	98	73	65
Rotary Boring Drill Rig	107	82	74
Site Cranes	104	79	71
Dump Truck	108	83	75
Front End Loader	112	87	79
Excavator	107	82	74
Piling - Vibrating	108	83	75
Concrete Saw	113	88	80
Compressor	100	75	67
Bobcat	103	78	70
Hand Tools	90	65	57
Jackhammer	105	80	72

Table 8 Typical construction equipment & sound pressure levels at 7 metres in dB(A). Noise levels at larger distances can be extrapolated

The sound power levels for the plant and equipment presented in the above table are based on maximum levels given in "AS 2436-2010 Guide to noise and vibration control on construction, demolition and maintenance sites" and cross-checked with our measured levels on past projects.

10.4 Noise Criteria at the Nearest Affected Neighbouring Properties

Distance between the boundary of the development and 55 Jones Street Apartments is 7 metres. Typical noise levels from construction machinery are presented in Table 9.

10.5 Temporary Sound Barrier Walls

It is recommended that a temporary sound barrier wall be erected enclosing the construction site, along all boundaries to block the direct line of sight between the noise generating activities on site and adjoining boundaries at 55 Jones Street.

A suitable barrier shall have a minimum of 2.4 metre high and constructed using steel posts and 19mm thick plywood. Alternative barriers are subject to approval by the acoustic consultant. The barrier shall be erected prior to commencement of earthworks.

10.6 Vibration Criteria Objectives

The management objective for the site is to limit vibration from construction activities so as to avoid building damage and human discomfort associated with the construction works. It is noted that buildings

in the vicinity of development are residential. Vibration impacts on the buildings and their occupants should be considered for the assessment of structural damage and human annoyance, respectively.

10.7 Vibration Sources

Typical vibration levels from construction plant equipment most likely to cause significant vibration are summarised in the table below.

Activity	Typical ground vibration
Bulldozers/ Excavators	Typical ground vibration from bulldozers range from 1mm/s to 2mm/s at distances of approximately 5m and at distances greater than 20m, vibration levels are usually below 0.2mm/s.
Jack Hammers	Typical ground vibrations from jack hammers are generally greater than 5mm/s at distances of 1m and no more than 2mm/s for distances of 5m or more.
Truck traffic	Typical vibration from heavy trucks passing over normal (smooth) road surfaces generate relatively low vibration in the range 0.01-0.2mm/s at the footings of buildings located 10-20m from a roadway. In general ground vibration from trucks is usually imperceptible in nearby buildings.

Table 9 Typical ground vibration generated by construction plant

Therefore, vibration management strategies implemented on site shall consider these items of plant and construction activities involving these items of plant.

10.8 Vibration Criteria

The following criteria are considered applicable when assessing vibration emission levels from the construction works.

The effects of ground vibration on buildings near construction sites may be broadly defined by the following three categories:

1. Disturbance to building occupants - Vibration in which the occupants or users of the building are inconvenienced or possibly disturbed,
2. Effects on building contents - Vibration where the building contents may be affected, and,
3. Effects on building structures - Vibration in which the integrity of the building or structure itself may be prejudiced.

In general, vibration criteria for human disturbance (1) are more stringent than vibration criteria for effects on building contents (2) and building structural damage (3). Hence, compliance with the more stringent limits dictated by Category 1, would allow for compliance to be achieved for the other two categories.

<u>Category 1</u> – Disturbance to Buildings Occupants

For disturbance to human occupants of buildings, we refer to the EPA's *'Assessing Vibration; a technical guideline'*, published in February 2006. This document provides criteria which are based on the British Standard BS 6472-1992, *'Evaluation of human exposure to vibration in buildings (1-80Hz)'*.

Vibration sources are defined as C*ontinuous, Impulsive or Intermittent.* Section 2 of the technical guideline defines each type of vibration as follows:

> ***'Continuous*** *vibration continues uninterrupted for a defined period (usually throughout the day-time and/or night-time).*
>
> ***Impulsive*** *vibration is a rapid build-up to a peak followed by a damped decay that may or may not involve several cycles of vibration (depending on frequency and damping). It can also consist of a sudden application of several cycles at*

approximately the same amplitude, providing that the duration is short, typically less than 2 seconds.

***Intermittent** vibration can be defined as interrupted periods of continuous or repeated periods of impulsive vibration that varies significantly in magnitude'.*

The criteria are to be applied to a single weighted root mean square (rms) acceleration source level in each orthogonal axis. Section 2.3 of the guideline states:

'Evidence from research suggests that there are summation effects for vibrations at different frequencies. Therefore, for evaluation of vibration in relation to annoyance and comfort, overall weighted rms acceleration values of the vibration in each orthogonal axis are preferred (BS 6472).'

Preferred and maximum values for continuous and impulsive vibration are defined in below in Table 10 extracted from "Table 2.2 of the guideline" and the values for residential type buildings are reproduced below.

Location	Assessment period[1]	Preferred values		Maximum values	
		z axis	x & y axis	z axis	x & y axis
Continuous vibration					
Residences	Daytime (7am-10pm)	0.010	0.0071	0.020	0.014
Impulsive vibration					
Residences	Daytime (7am-10pm)	0.30	0.21	0.60	0.42

Notes: 1. Daytime is 7.00 am to 10.00 pm and night-time is 10.00pm to 7.00 am

Table 10 Preferred and Maximum Weighted RMS Values for Continuous and Impulsive Vibration Acceleration (m/s2) 1-80Hz

Intermittent vibration is to be assessed using vibration dose values (VDVs). The VDV method is a fourth power approach which is more sensitive to peaks in the acceleration waveform and makes corrections to the criteria based on the duration of the source's operation.

The VDV can be calculated using the overall weighted rms acceleration of the vibrating source in each orthogonal axis and the total period during which the vibration may occur. Weighting curves are provided in each orthogonal axis in the guideline.

Preferred and maximum VDV values are defined in Table 11 below extracted from "Table 2.4 of the guideline" and VDV values for residential type buildings are reproduced below.

Location	Daytime (7am-10pm) [1]		Night-time (10pm-7am) [1]	
	Preferred values	Maximum values	Preferred values	Maximum values
Residences	0.20	0.40	0.13	0.26

Notes: 1. Daytime is 7.00 am to 10.00 pm and night-time is 10.00pm to 7.00 am

Table 11 Preferred and Maximum VDV Values

10.8.1 Buffer Distances for Vibration Control

The relationship between vibration and the probability of causing human annoyance or damage to structures is complex. This complexity is mostly due to the magnitude of the vibration source, the particular ground conditions between the source and receiver, the foundation-to-footing interaction and the large range of structures that exist in terms of design (i.e. dimensions, materials, type and quality of construction and footing conditions).

The intensity, duration, frequency content and number of occurrences of a vibration, all play an important role in both the annoyance caused and the strains induced in structures.

As the pattern of vibration radiation is very different to the pattern of airborne noise radiation, and is very site specific, below are some indicative minimum 'buffer' distances determined for some common construction plant with data available from recent projects, which assist to avoid human discomfort in terms of perceptible (or tactile) vibration during daytime construction hours:

Plant Item	Recommended Minimum Buffer Distance (m)
CFA (Continuous Flight Auger) Piling rig	10
Excavators	10
Jack hammers	5

Table 12 Recommended Minimum Buffer Distances for Construction Plant

From the Table 12 above it can be seen that the nearest receivers are less than 10m from the site, and as such, vibration may cause discomfort to occupants during piling activities.

Therefore, site specific buffer distances should be determined for piling activities once vibration emission levels are measured from the piling rig prior to the commencement of its regular use on site.

10.8.2 Vibration Management Measures

Further to buffer distances, to ensure vibration impacts are minimised during the construction period, the following vibration management control measures are provided:

1. The proper implementation of a vibration management plan is required to avoid adverse vibration disturbance to affected occupancies. Consultation with occupants and property owners is recommended and should be aimed at providing a communication path directly to the Project Manager.
2. A management procedure will be implemented to deal with vibration complaints. Each complaint will be investigated and where vibration levels are established as exceeding the set limits, appropriate amelioration measures shall be put in place to mitigate future occurrences
3. Where vibration is found to be excessive, management measures shall be implemented to ensure vibration compliance is achieved. Management measures may include modification of construction methods such as using smaller units, establishment of safe buffer zones and if necessary, time restrictions for the most excessive vibration activities. Time restrictions are to be negotiated with affected receivers.

11. APPENDIX B – DRAWINGS REFERRED TO FOR THIS REPORT

The following are the architectural drawings referred to in this report.

Drawing Title	Dwg No	Date
GROUND - LOWER GROUND FLOOR	AR-2300 Rev Q	20/10/2017
LEVEL 01 – LIBRARY	AR-2301 Rev Q	20/10/2017
LEVEL 02 - MIDDLE PLAYGROUND	AR-2302 Rev Q	20/10/2017
LEVEL 03 - UPPER PLAYGROUND	AR-2303 Rev Q	20/10/2017
LEVEL 04 – COLA	AR-2304 Rev Q	20/10/2017
ROOF LEVEL	AR-2305 Rev Q	20/10/2017
NORTH ELEVATION	DA-3001 Rev J	20/10/2017
EAST ELEVATION	DA-3002 Rev J	20/10/2017
SOUTH ELEVATION	DA-3003 Rev D	20/09/2017
WEST ELEVATION	DA-3004 Rev D	20/10/2017
BUILDING SECTIONS	DA-4001 Rev J	20/10/2017
BUILDING SECTIONS	DA-4002 Rev J	20/10/2017
PERSPECTIVE - AXONOMETRIC NW	DA-9002 Rev B	20/10/2017
PERSPECTIVE - AXONOMETRIC NW	DA-9003 Rev B	20/10/2017
PERSPECTIVE - AXONOMETRIC NW	DA-9004 Rev B	20/10/2017
PERSPECTIVE - AXONOMETRIC NW	DA-9005 Rev B	20/10/2017

12. APPENDIX C – LOGGER GRAPHS

The details are of the noise logging measurements are shown below.

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. Data collected during inclement weather conditions are shaded blue and excluded in the assessments. These descriptors, which are demonstrated in the graph below, are here defined.

Maximum Noise Level (LAmax) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

LA10 – The LA10 level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the LA10 level for 90% of the time. The LA10 is a common noise descriptor for environmental noise and road traffic noise.

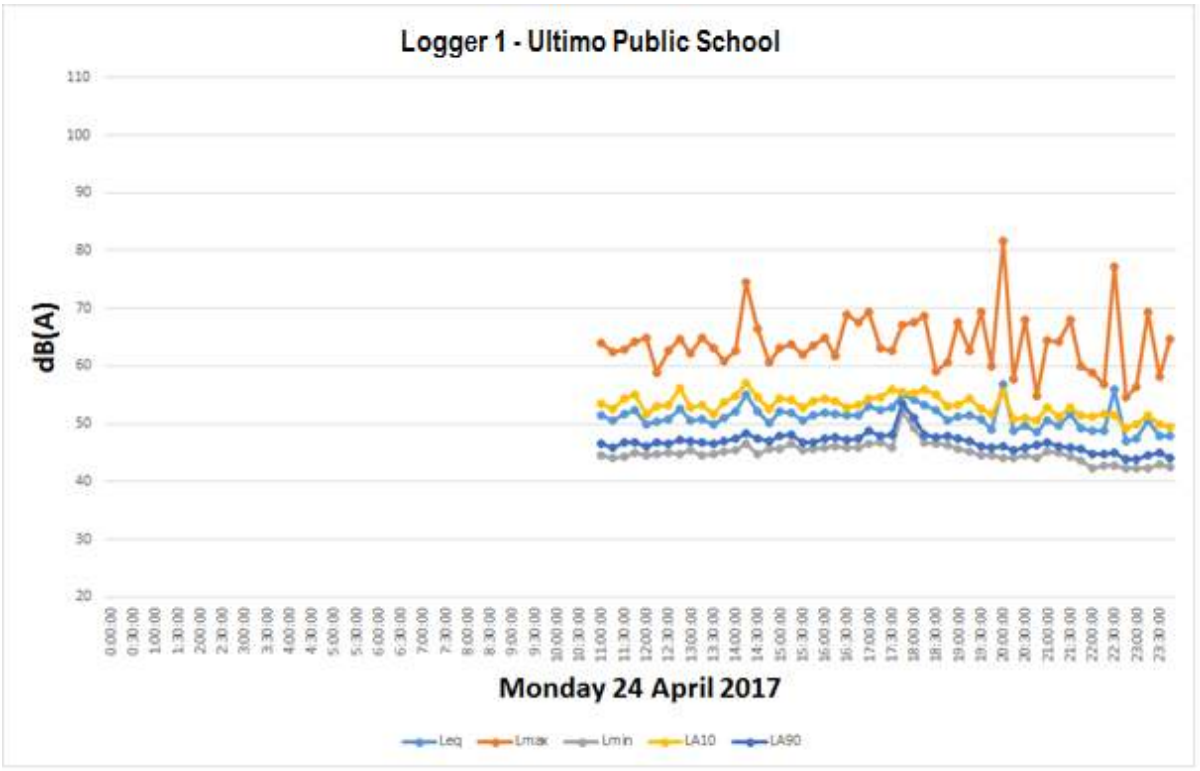
LA90 – The LA90 level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the LA90 level for 10% of the time. This measure is commonly referred to as the background noise level.

LAeq – The equivalent continuous sound level (LAeq) 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.

Minimum Noise Level (LAmin) – The minimum noise level over a sample period is the minimum level, measured on fast response, during the sample period.

The noise levels detected in the logger data below are as follows:

1. Traffic Noise from Wattle Street, Continuous.
2. Traffic Noise from Jones Street, Continuous.
3. School Children Noise, 8.00am to 4.00pm Monday to Friday.
4. Mechanical Services noise from the school and other nearby buildings.


Logger 1 - Ultimo Public School
dB(A)
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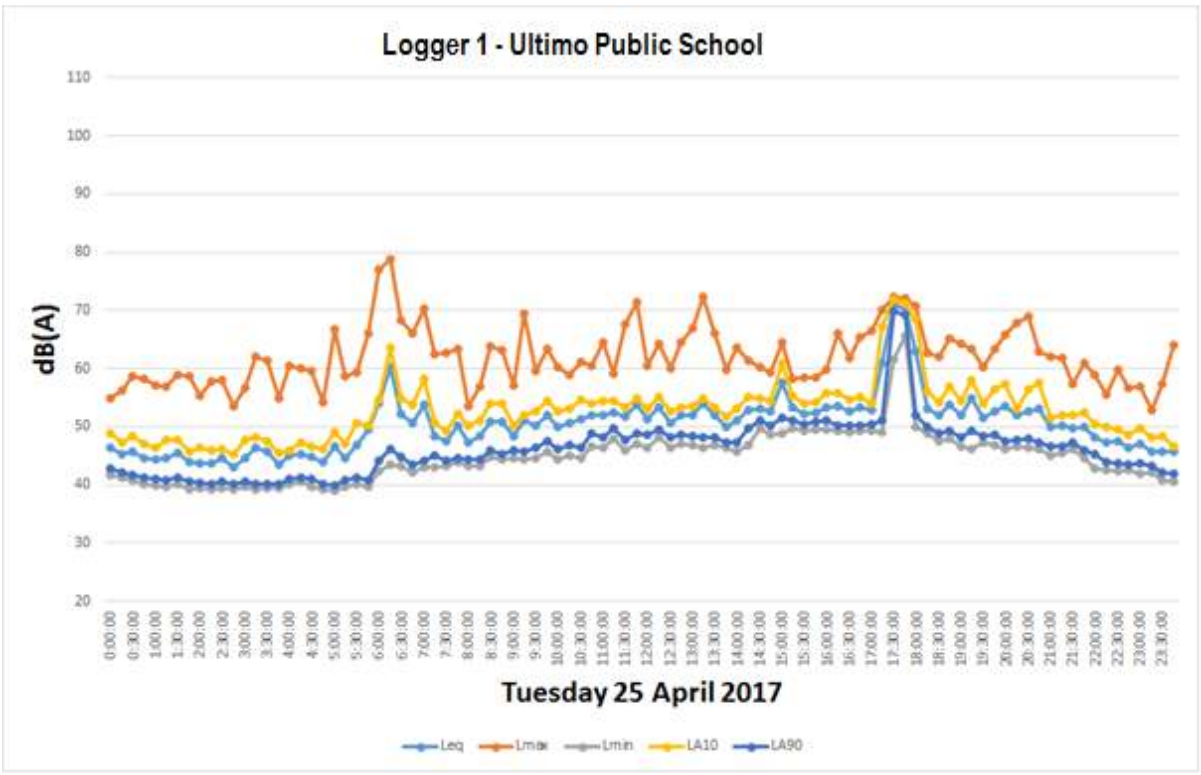
Leq
Lmax
Lmin
LA10
LA90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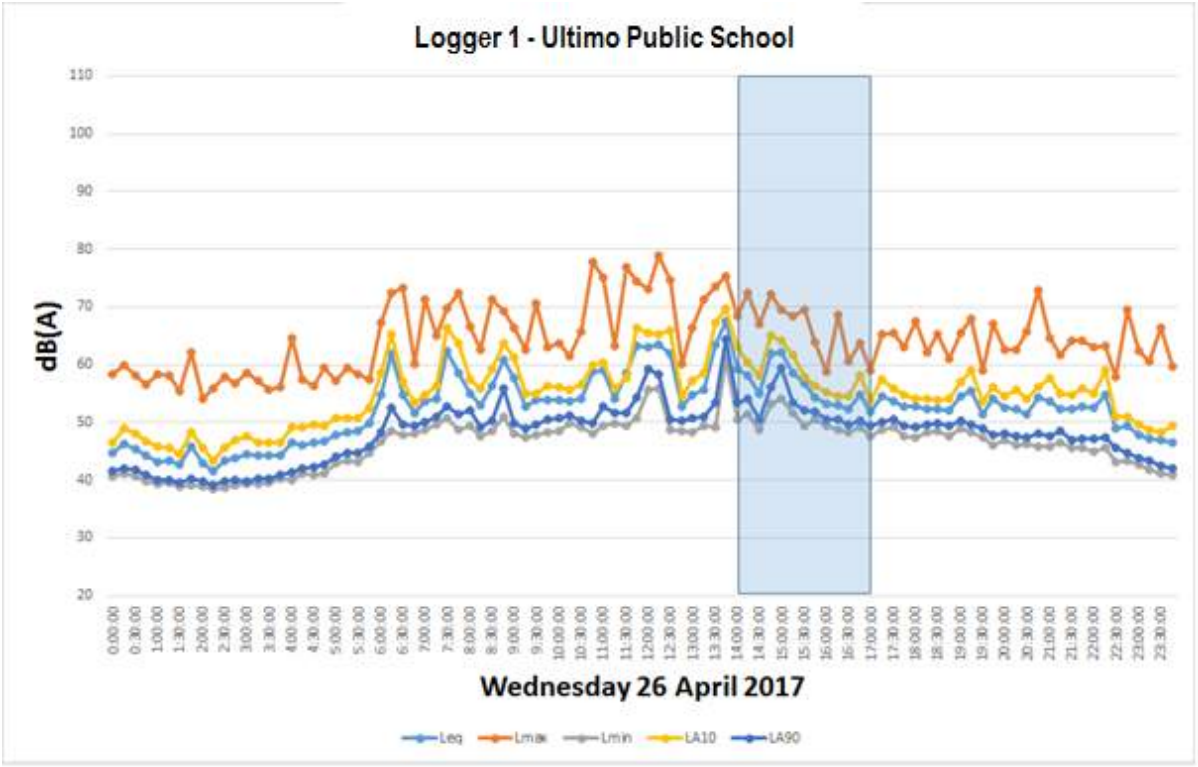
dB(A)
Tuesday 25 April 2017
Leq
Lmax
Lmin
LA10
LA90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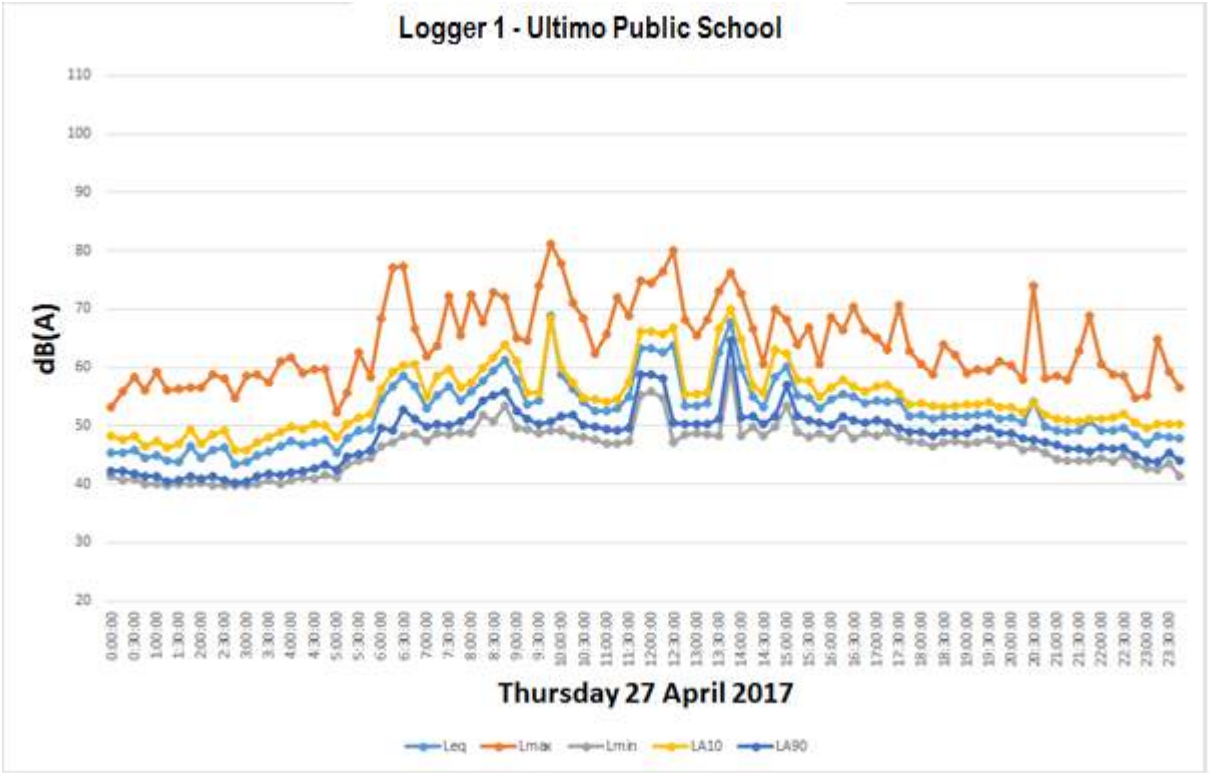
Leq
Lmax
Lmin
LA10
LA90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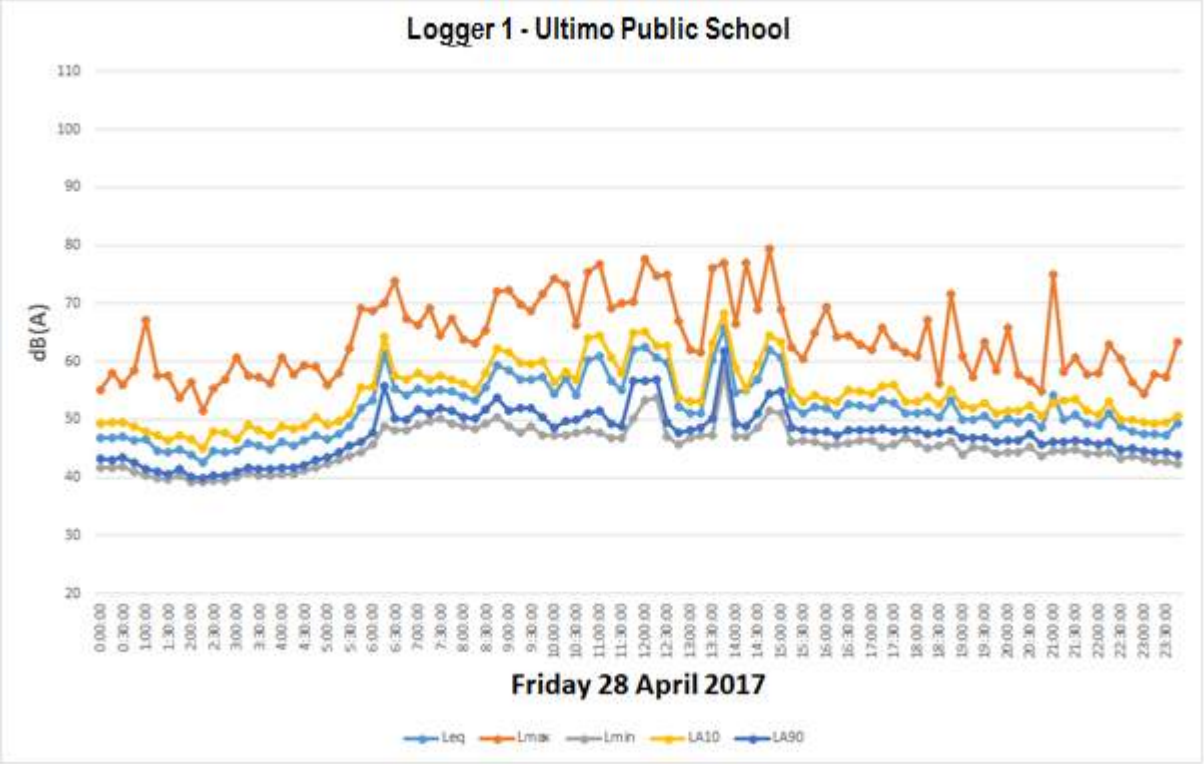
Lmin
LA10
LA90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dB(A)
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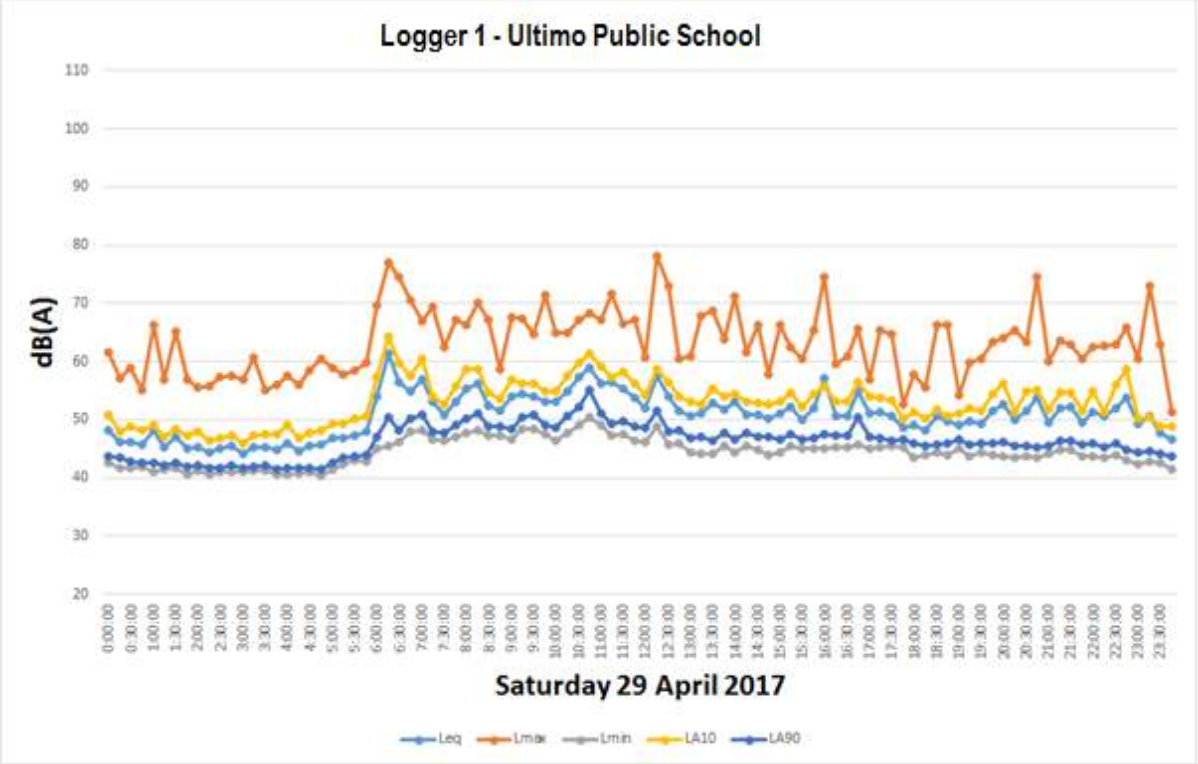
Lmax
Lmin
LA10
LA90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dB(A)
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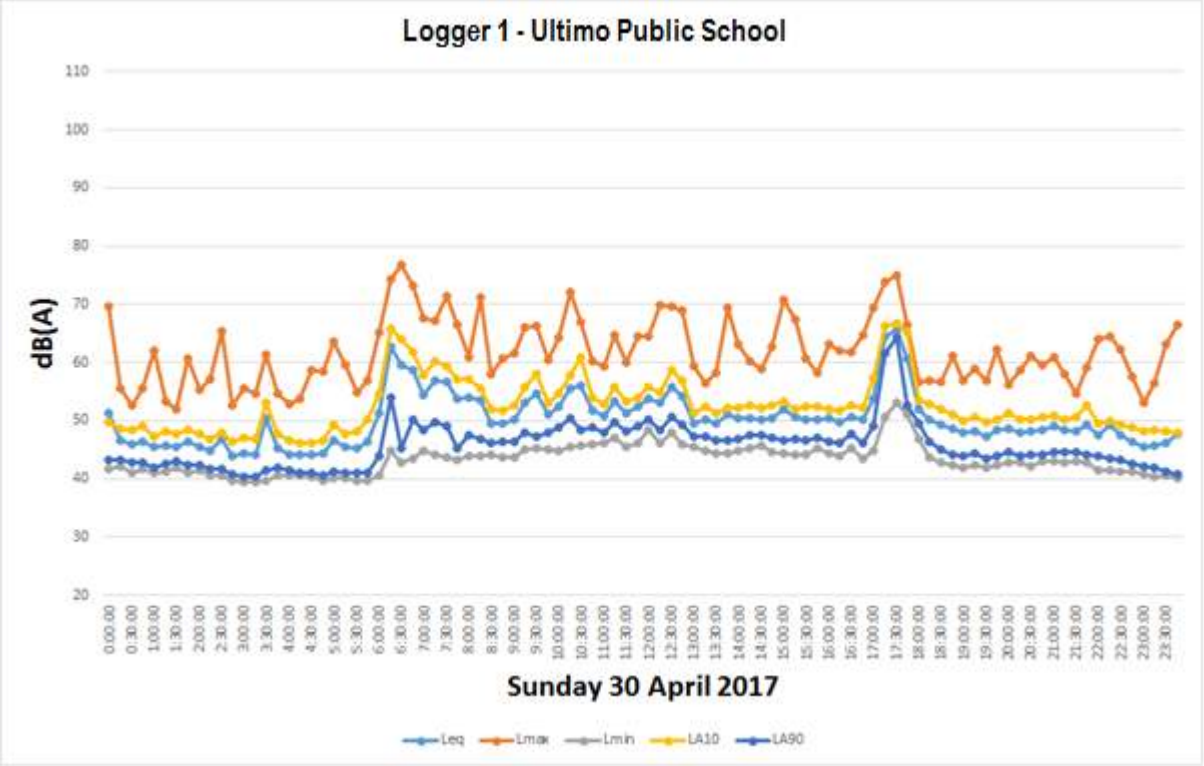
Lmin
LA10
LA90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dB(A)
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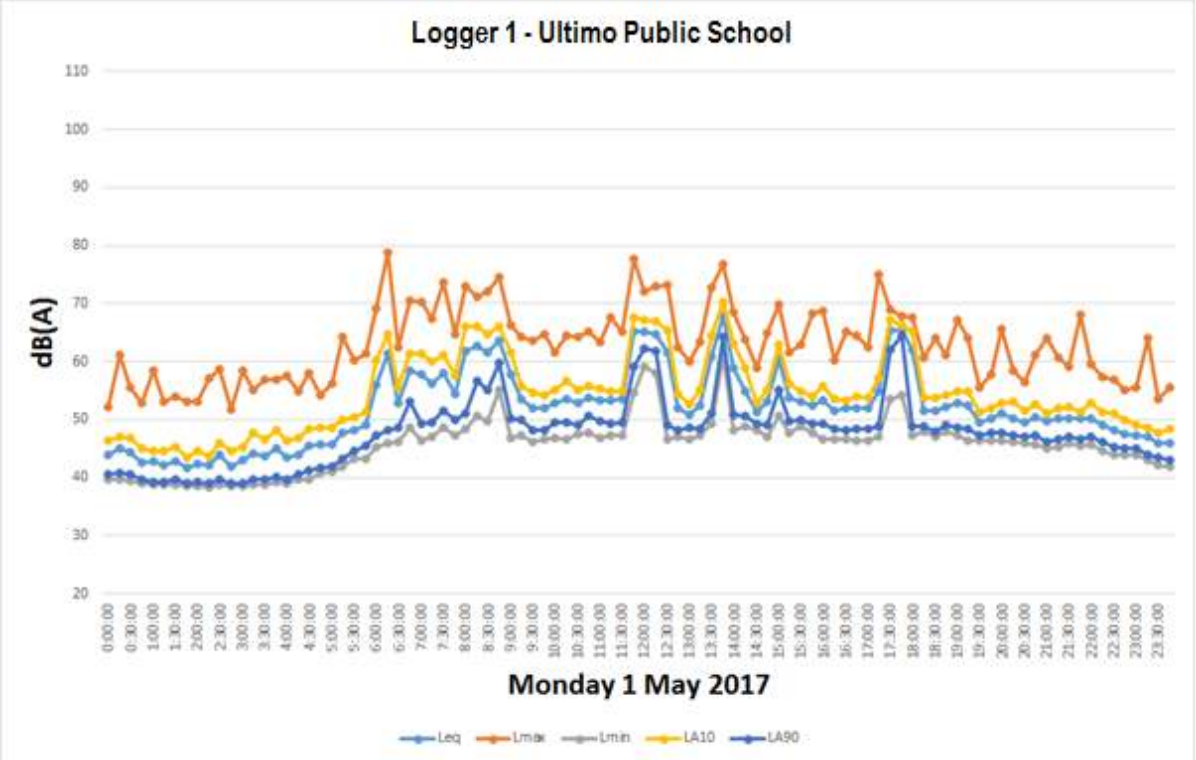
Lmin
LA10
LA90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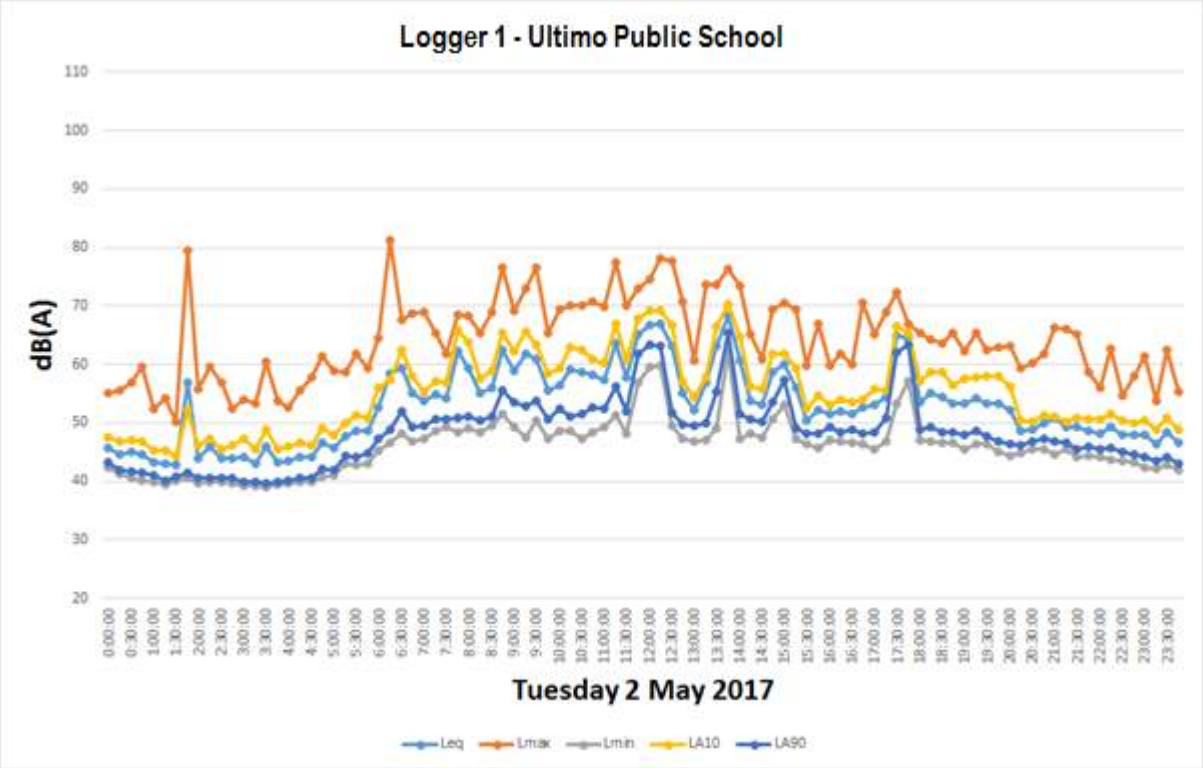
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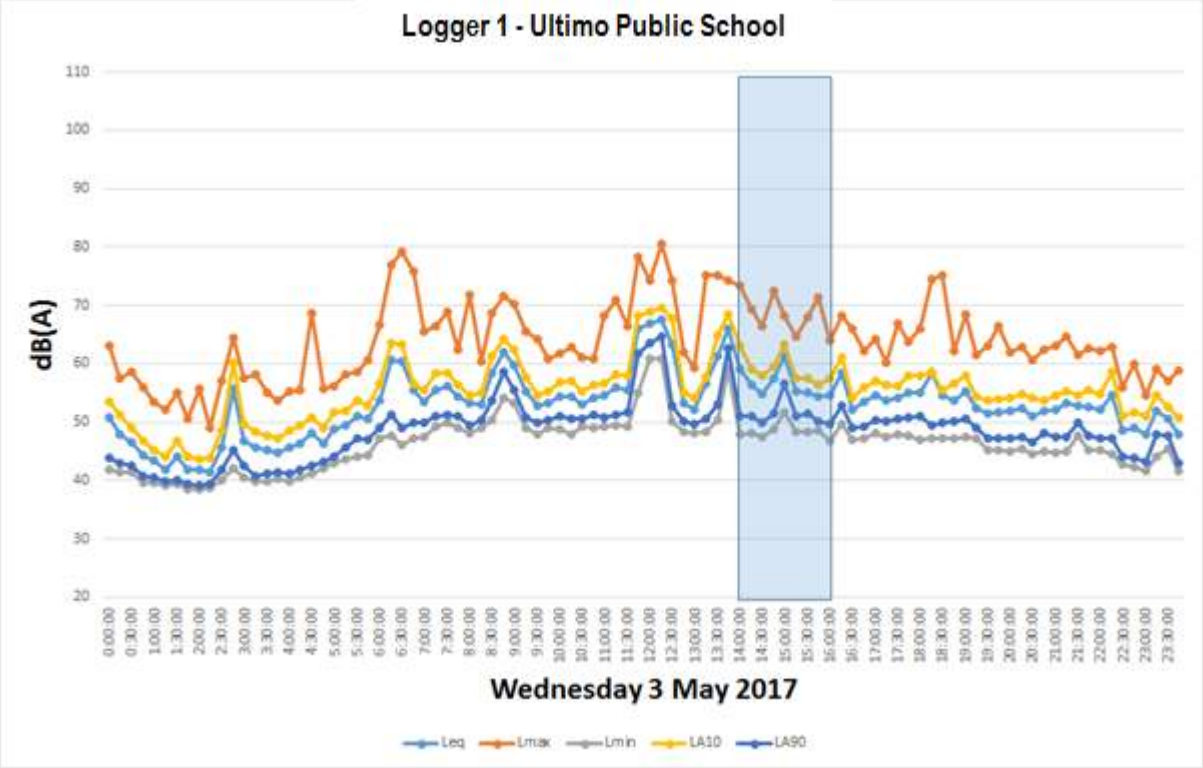
Lmin
LA10
LA90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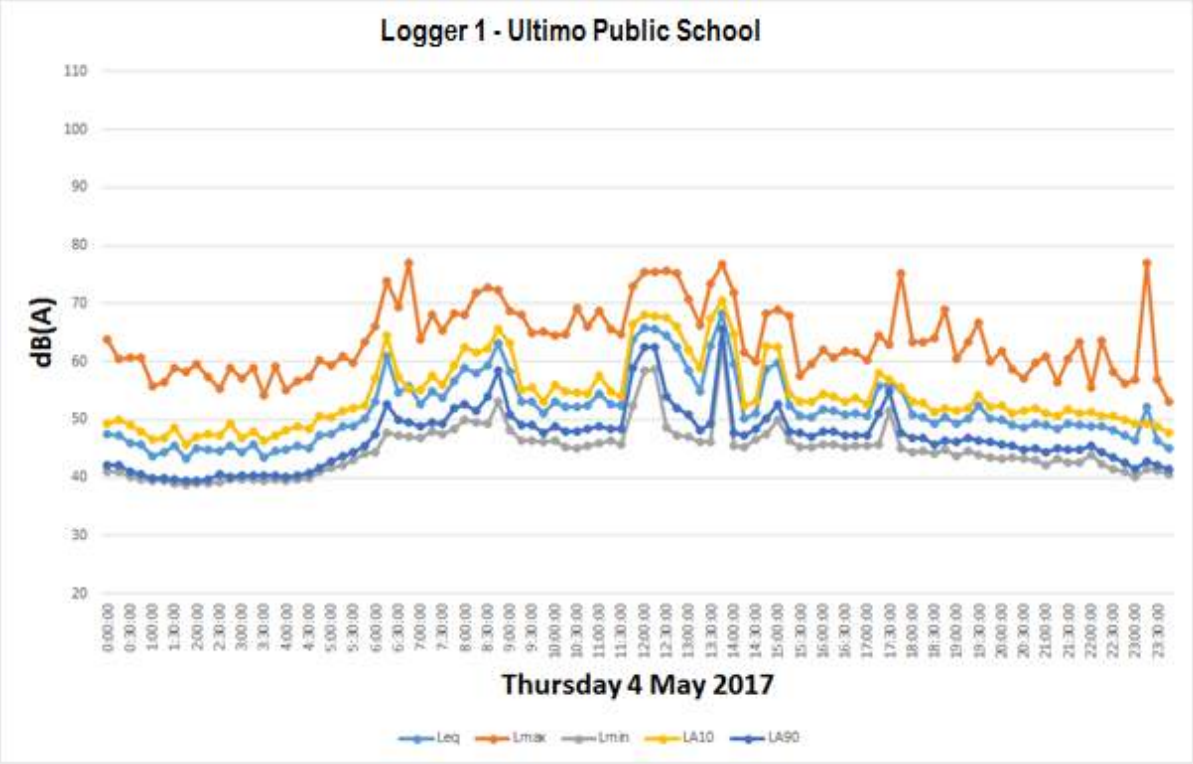
Lmin
LA10
LA90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dB(A)
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LA10
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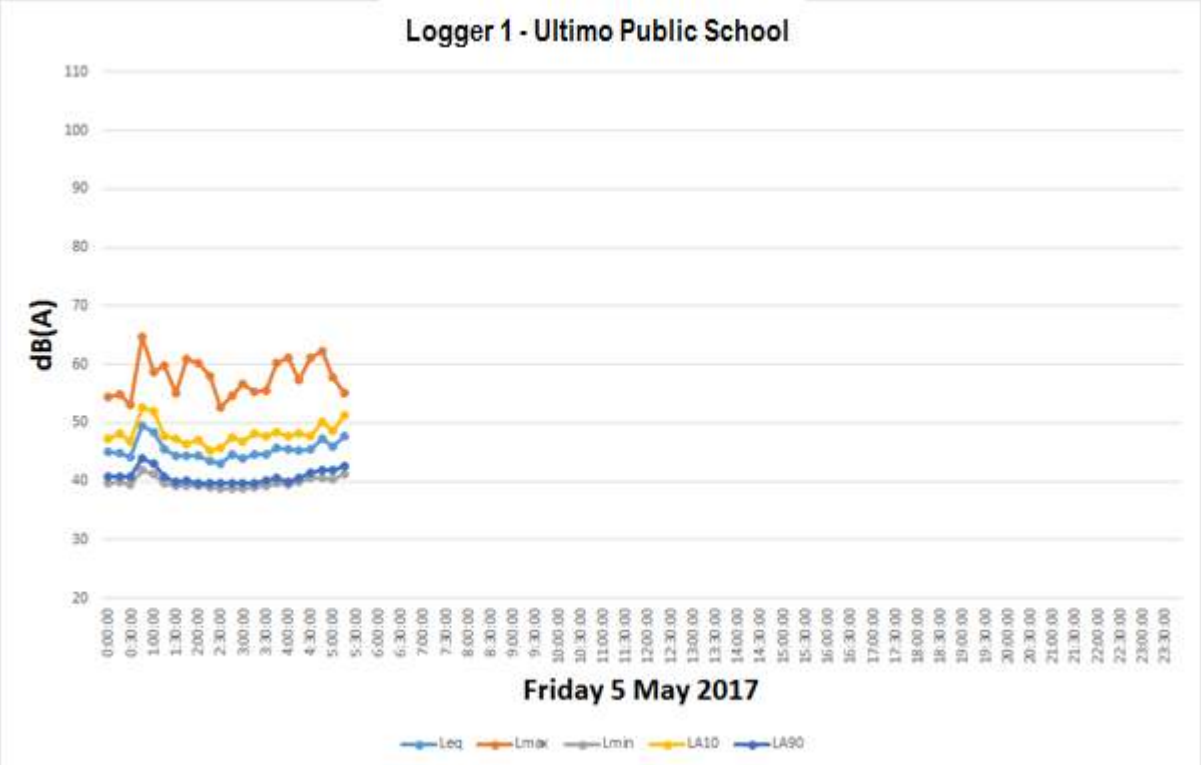
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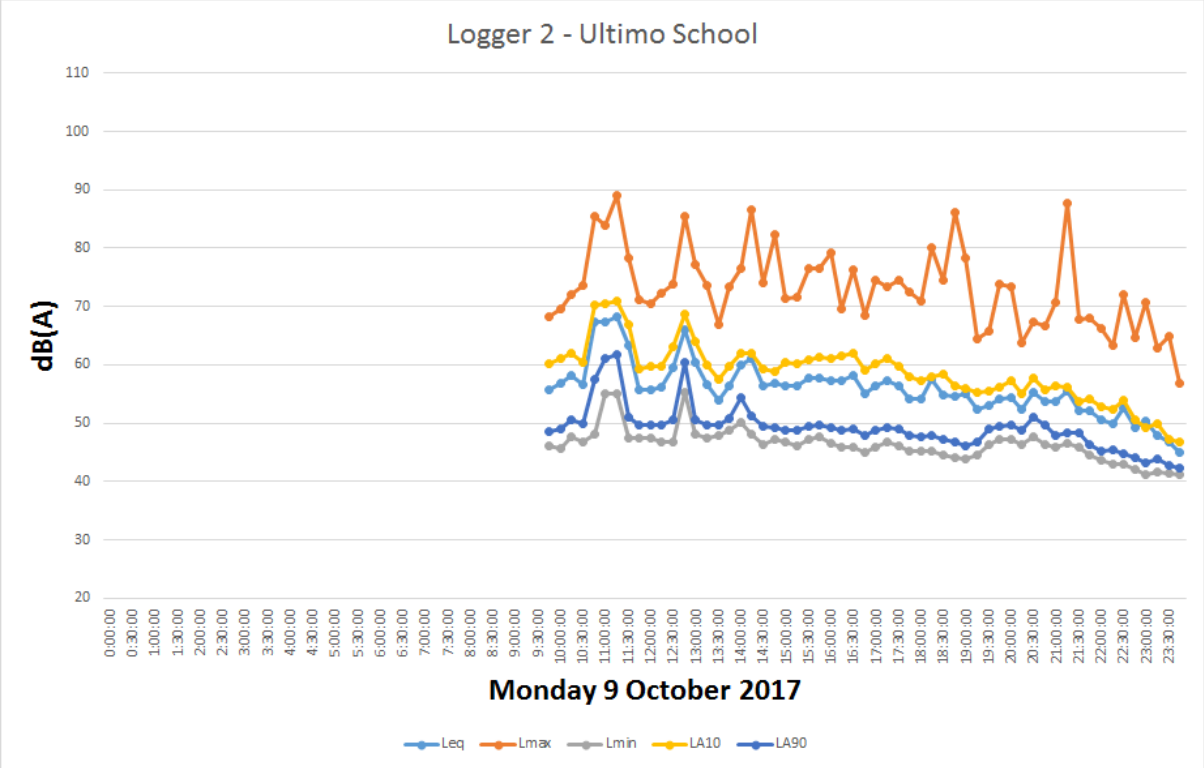
Logger 2 - Ultimo School
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Monday 9 October 2017
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Lmax
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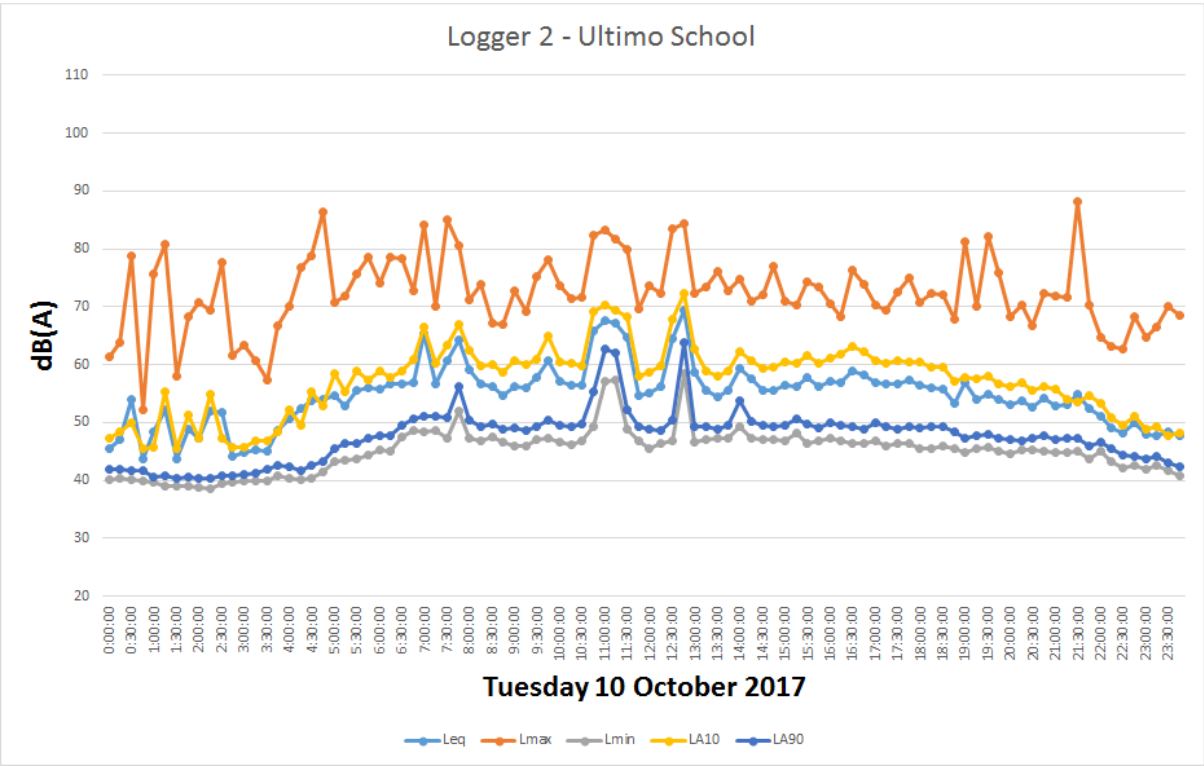
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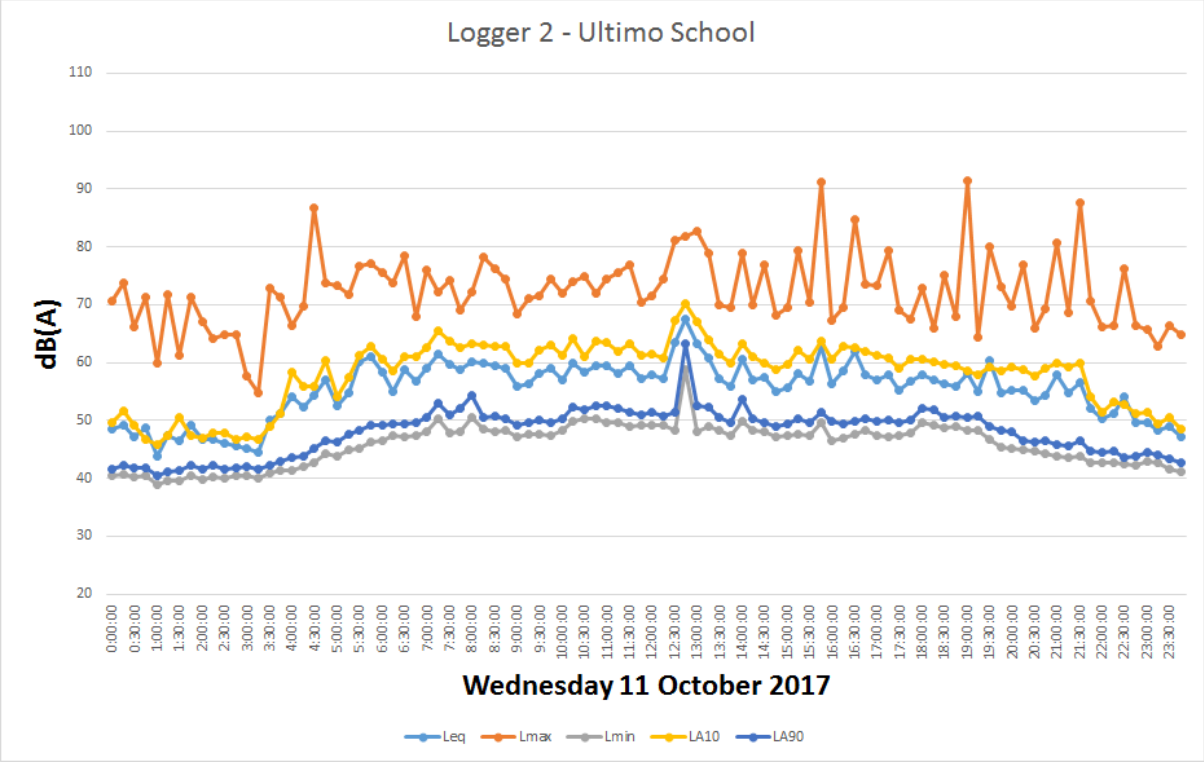
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Wednesday 11 October 2017
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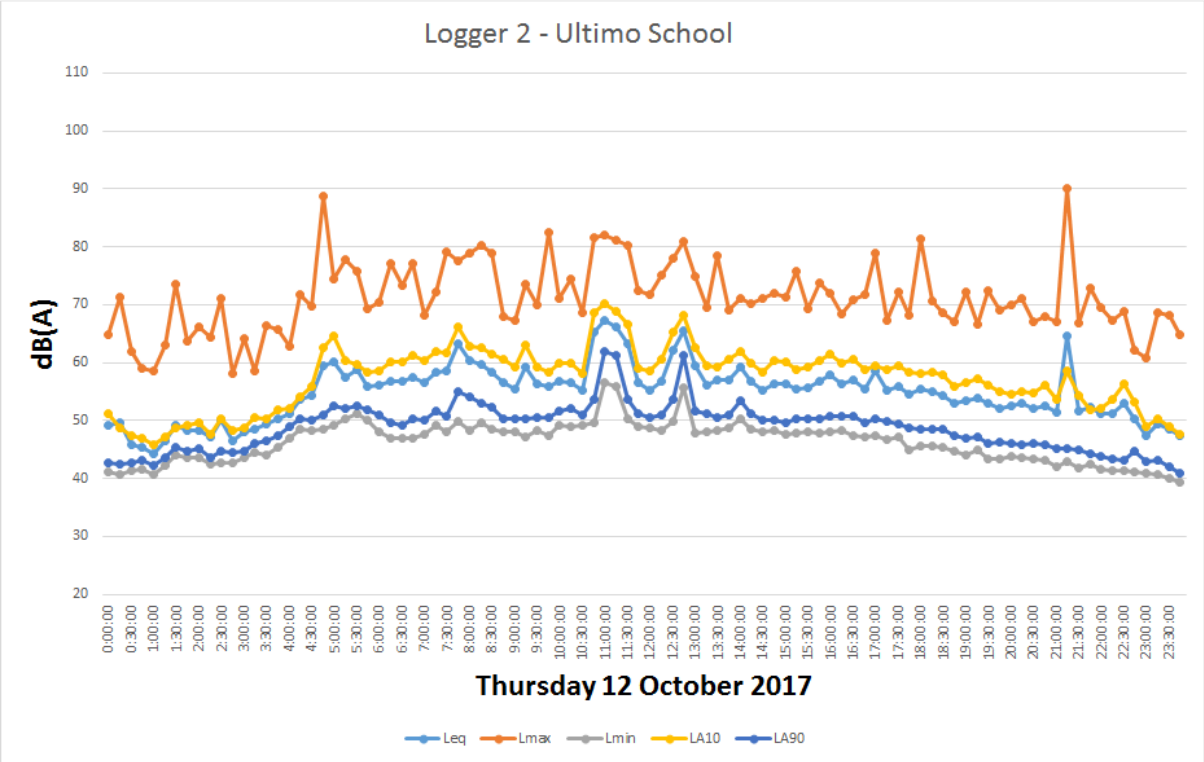
Logger 2 - Ultimo School
dB(A)
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Thursday 12 October 2017
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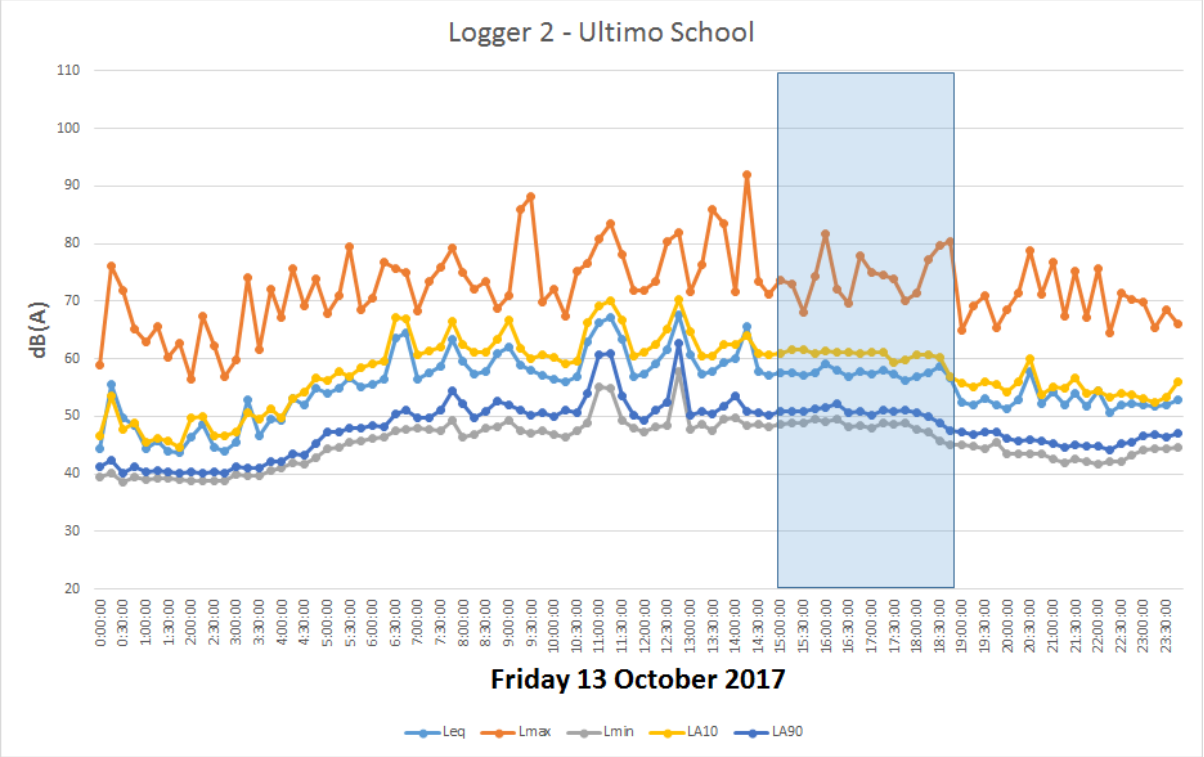
Logger 2 - Ultimo School
dB(A)
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Friday 13 October 2017
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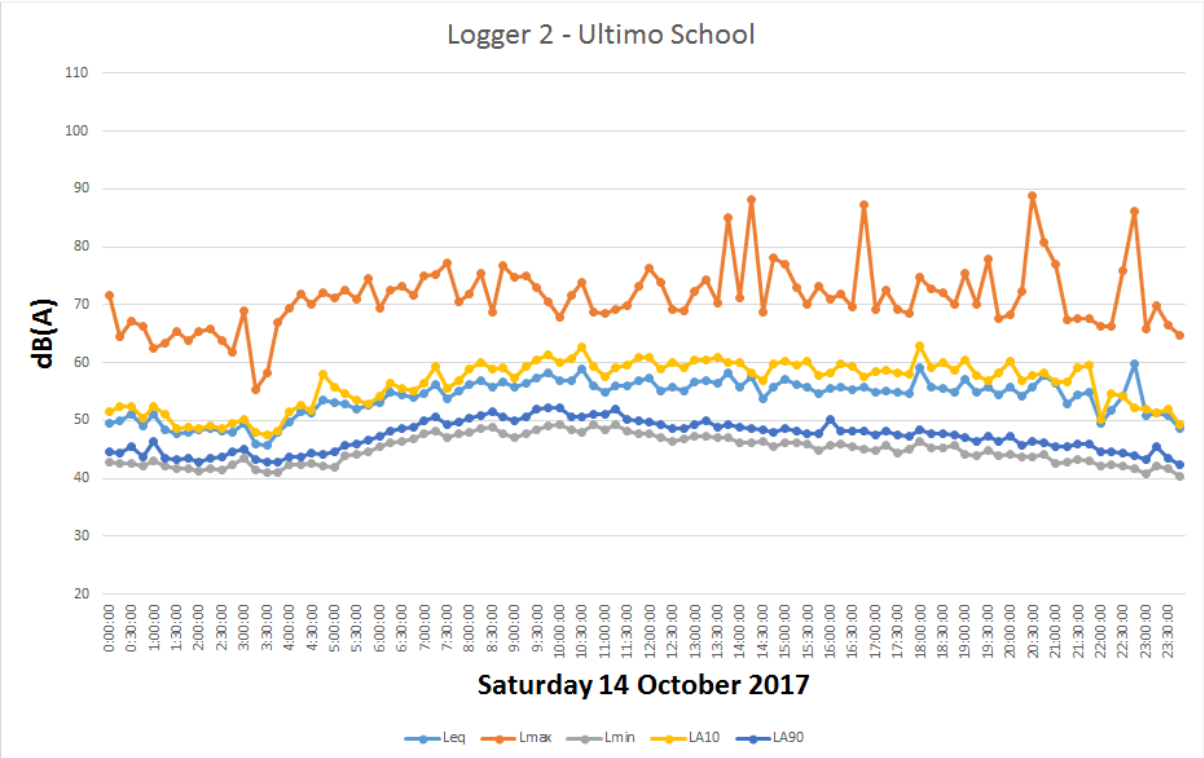
Logger 2 - Ultimo School
dB(A)
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Saturday 14 October 2017
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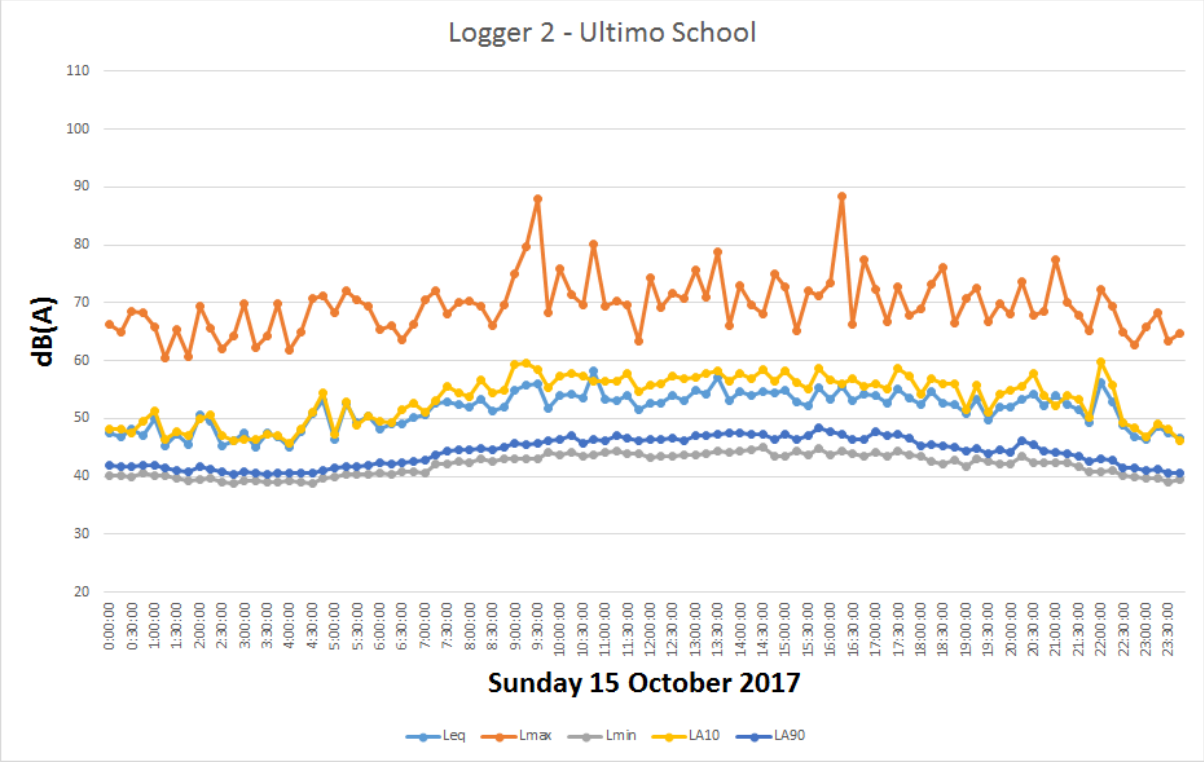
Logger 2 - Ultimo School
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Sunday 15 October 2017
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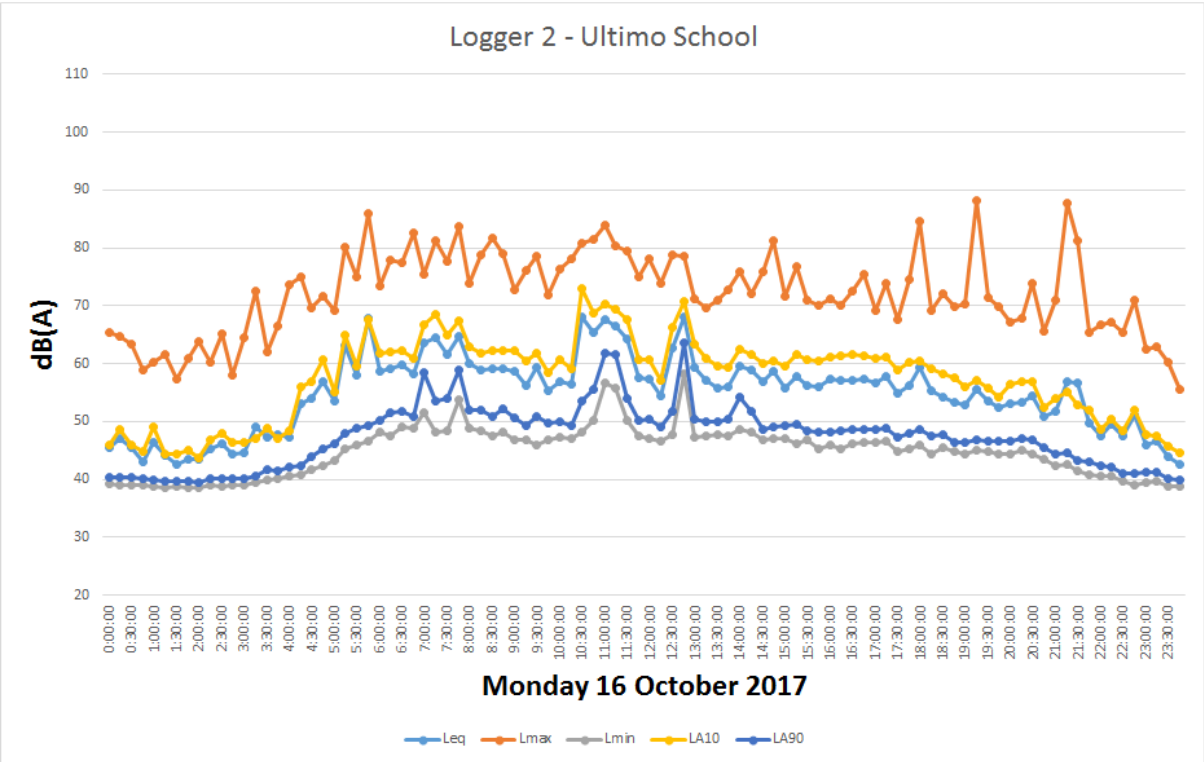
Logger 2 - Ultimo School
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Monday 16 October 2017
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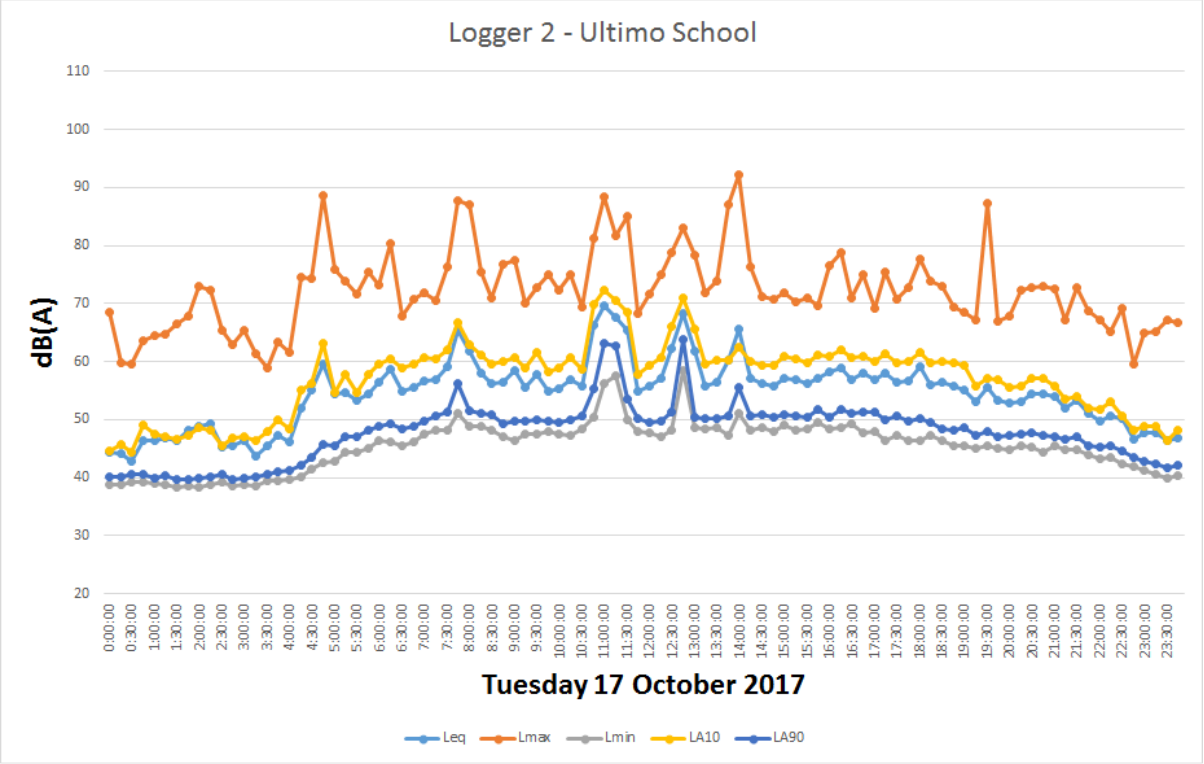
Logger 2 - Ultimo School
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Tuesday 17 October 2017
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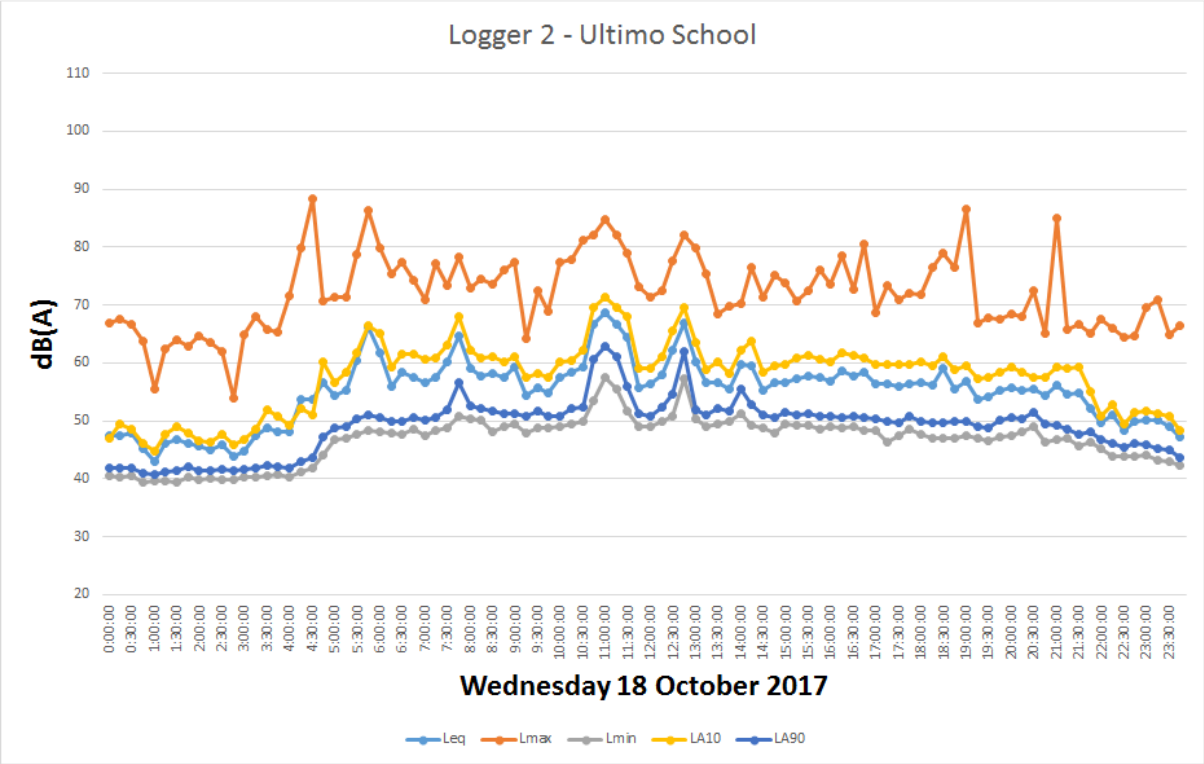
Logger 2 - Ultimo School
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Wednesday 18 October 2017
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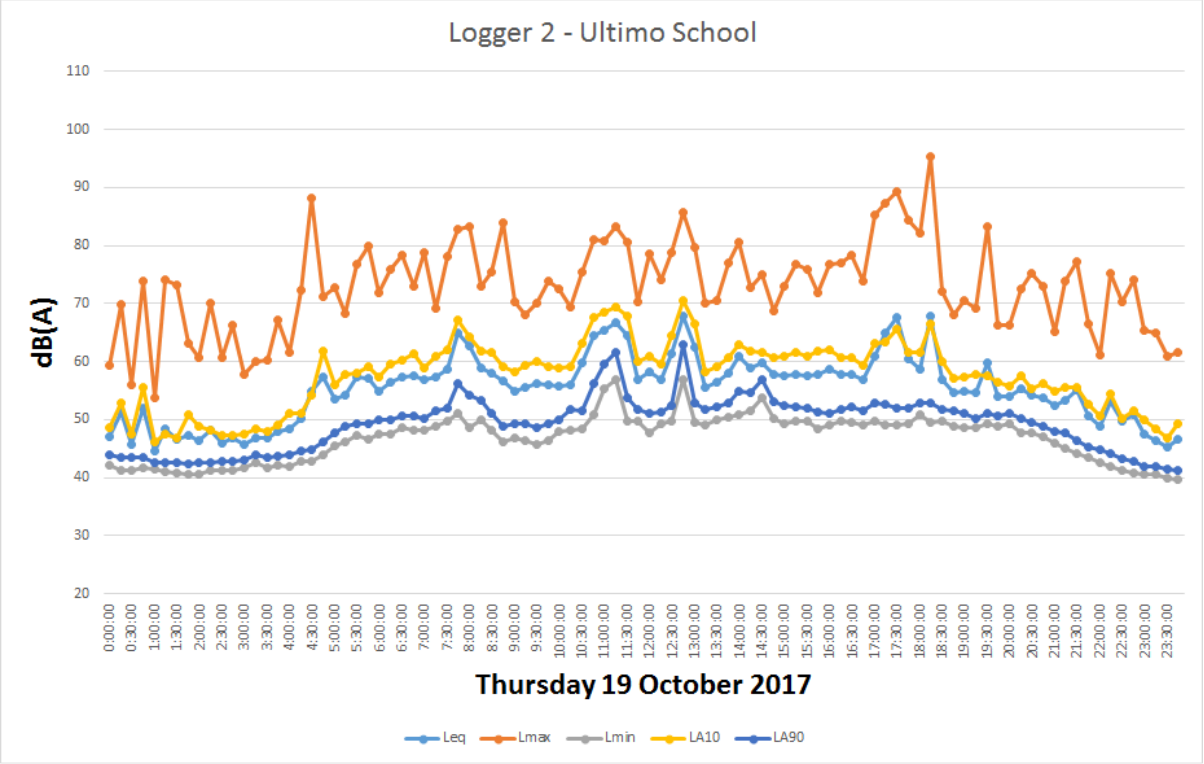
Logger 2 - Ultimo School
dB(A)
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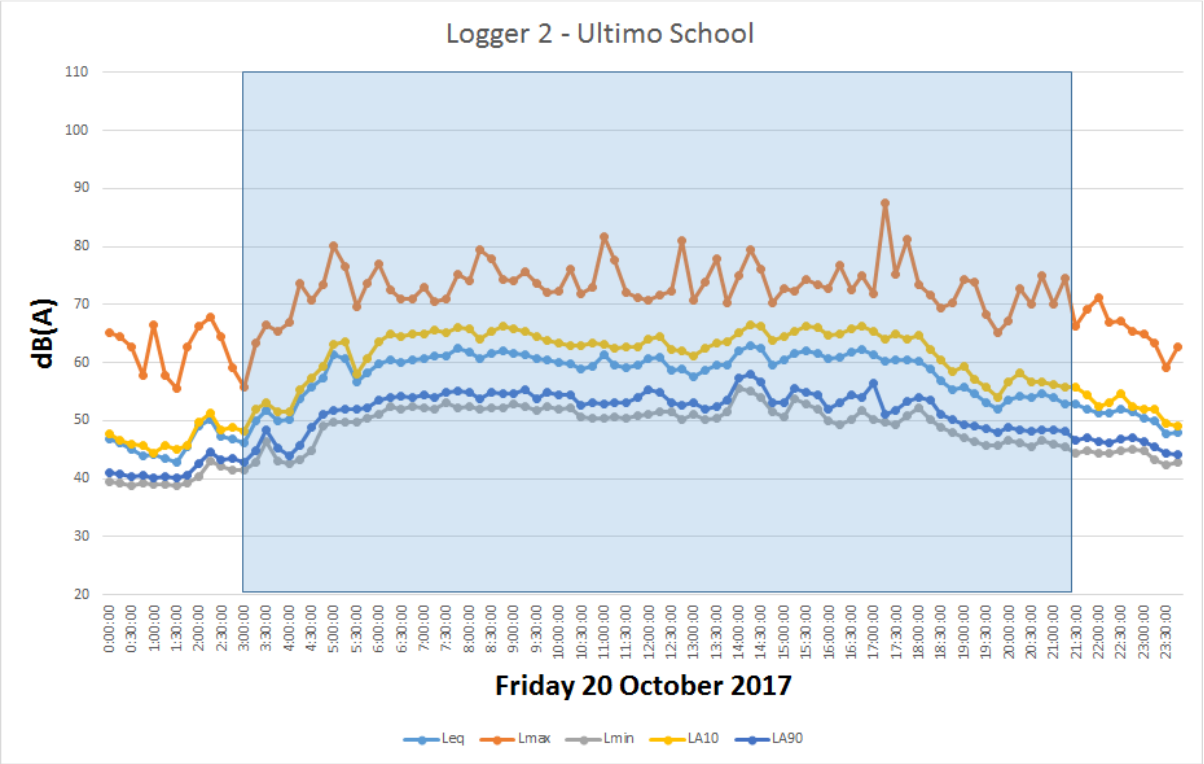
Logger 2 - Ultimo School
dB(A)
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Friday 20 October 2017
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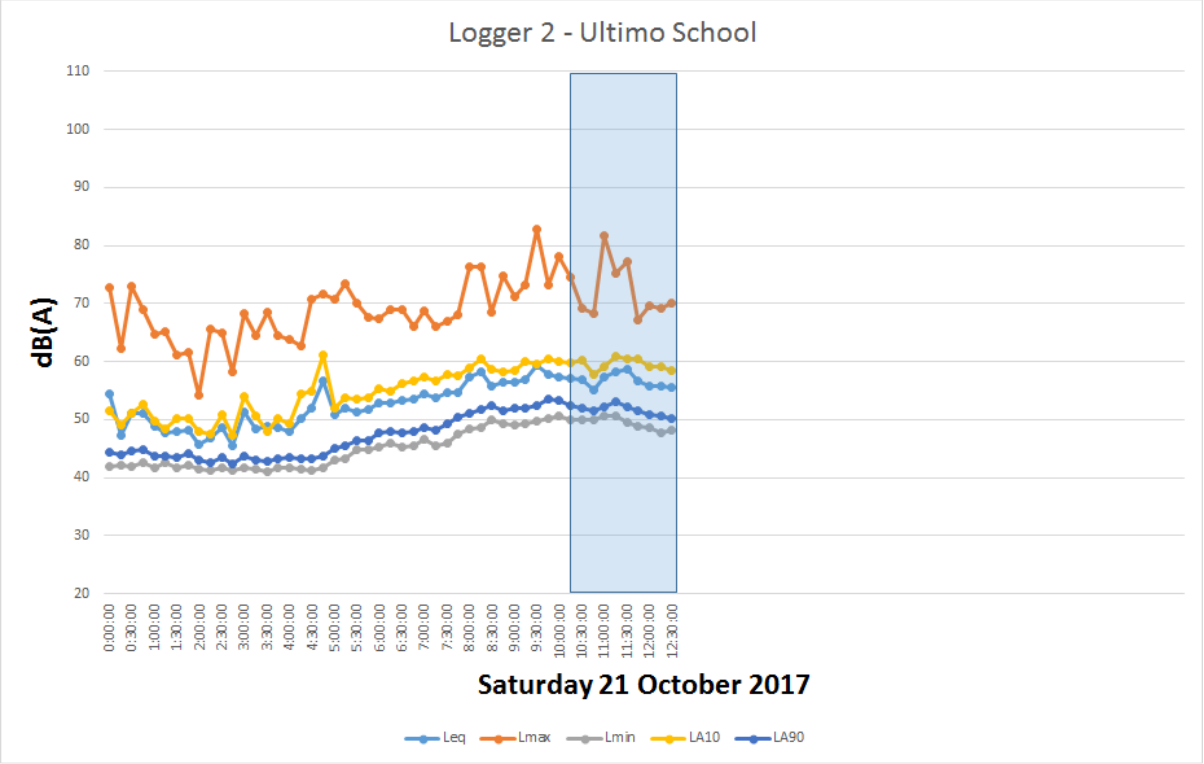
Logger 2 - Ultimo School
dB(A)
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Saturday 21 October 2017
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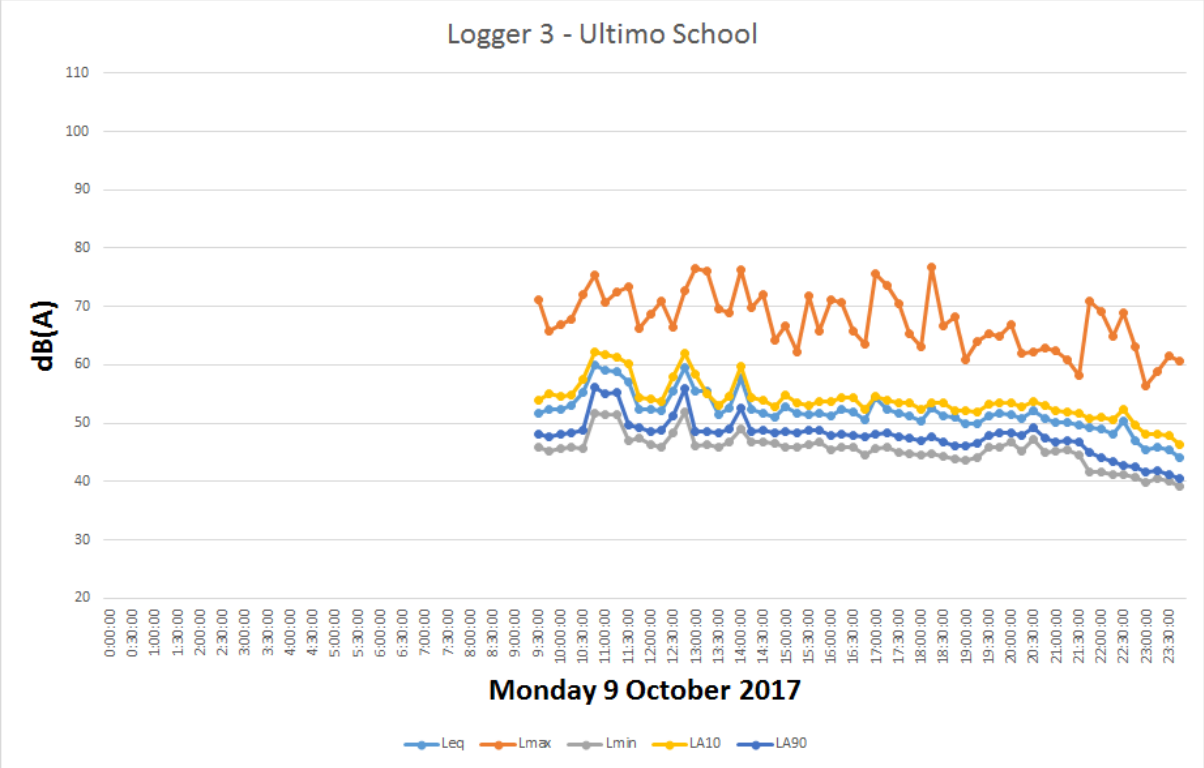
Logger 3 - Ultimo School
dB(A)
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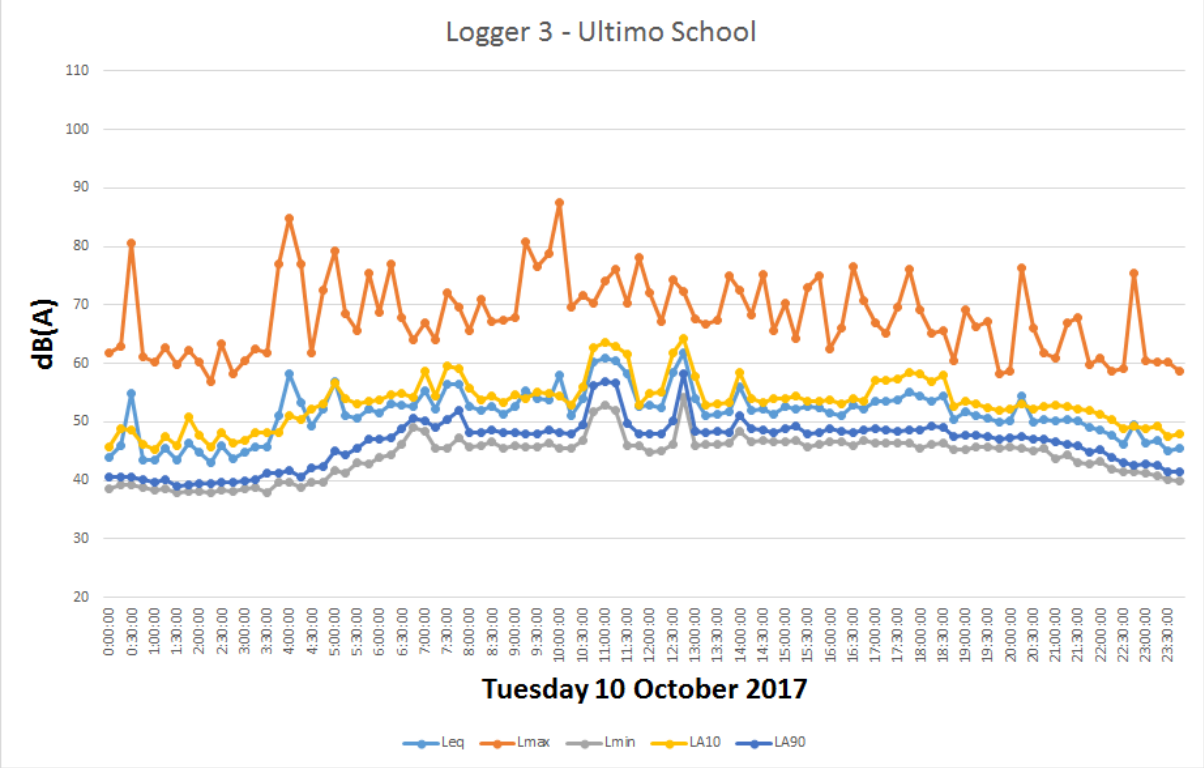
Logger 3 - Ultimo School
dB(A)
Tuesday 10 October 2017
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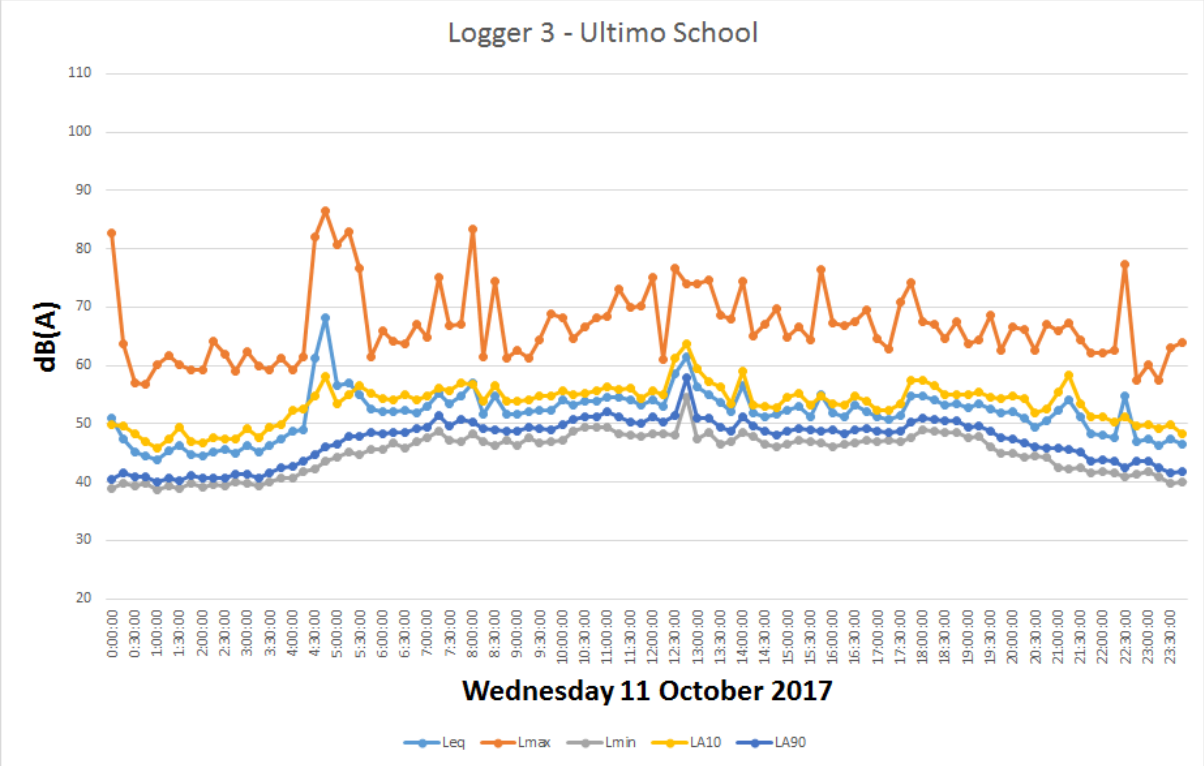
Logger 3 - Ultimo School
dB(A)
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Wednesday 11 October 2017
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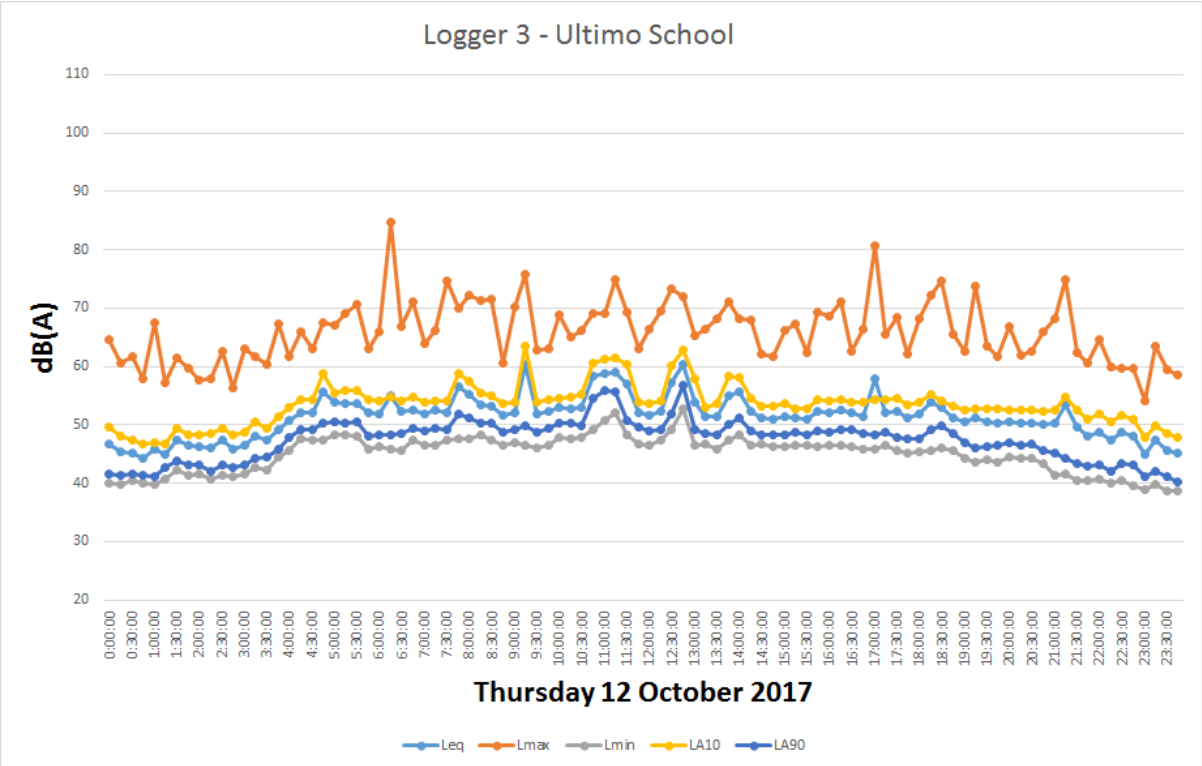
Logger 3 - Ultimo School
dB(A)
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Thursday 12 October 2017
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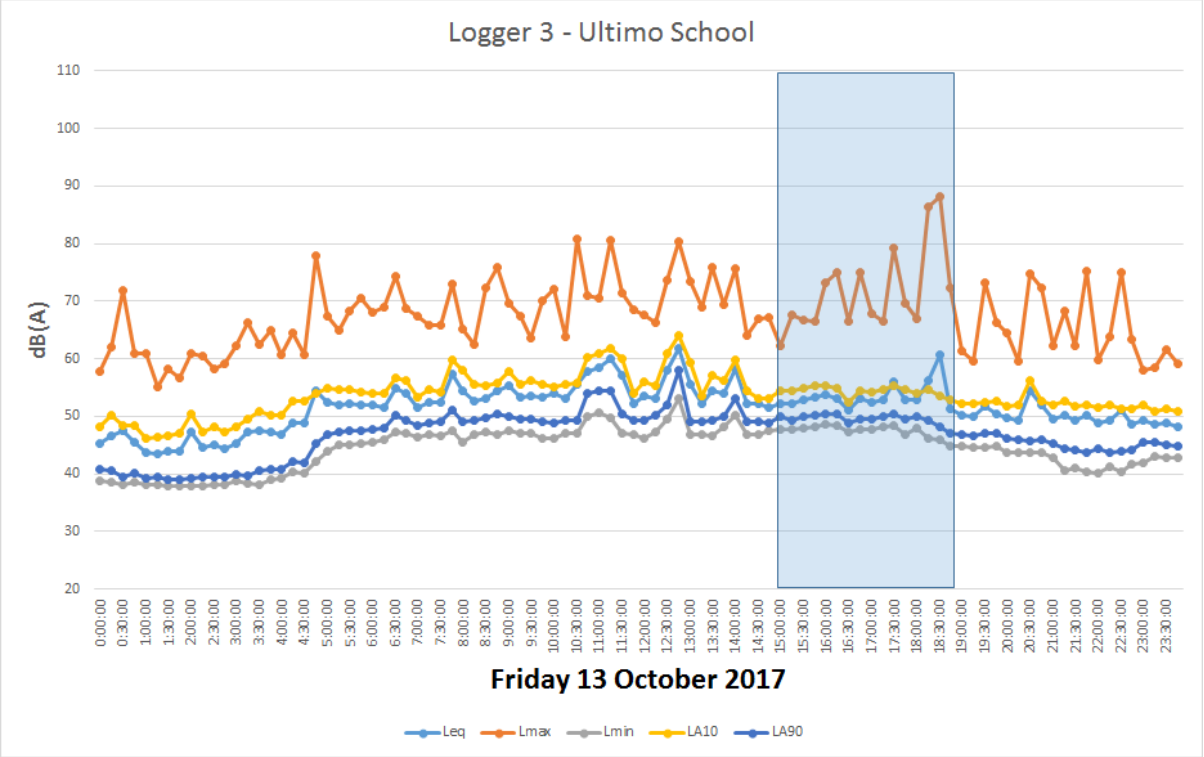
Logger 3 - Ultimo School
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Friday 13 October 2017
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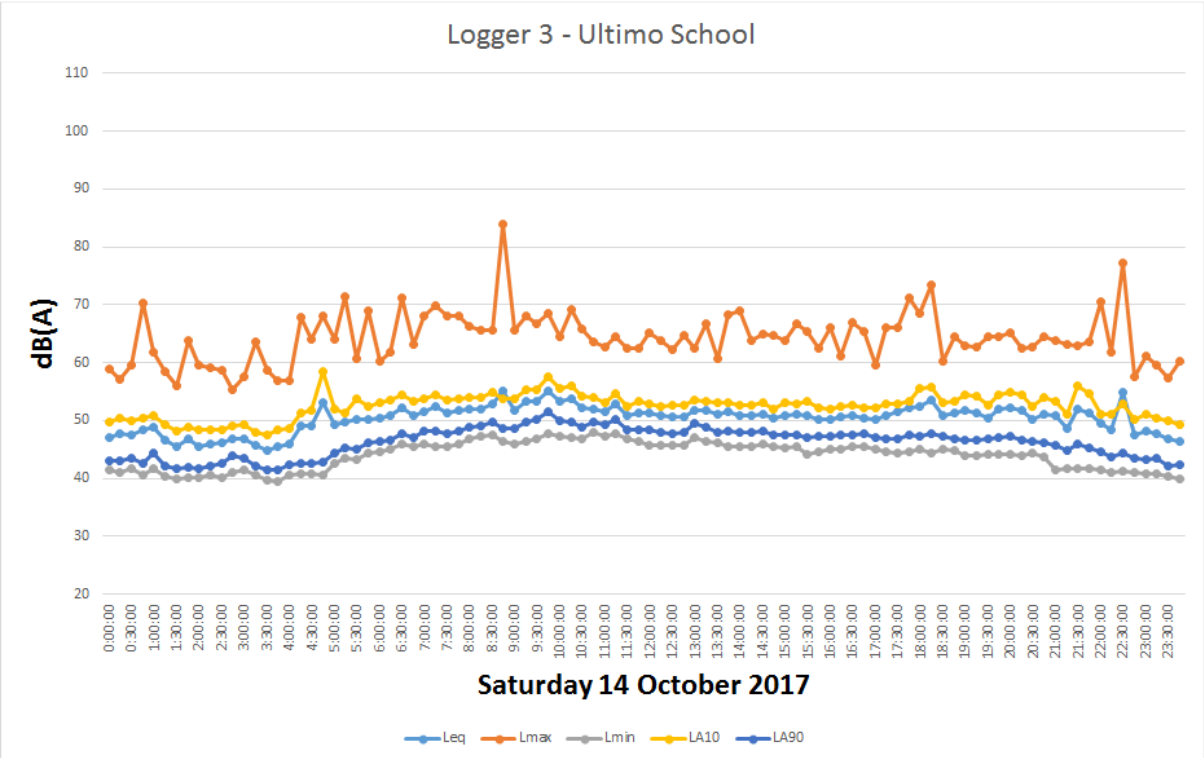
Logger 3 - Ultimo School
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Saturday 14 October 2017
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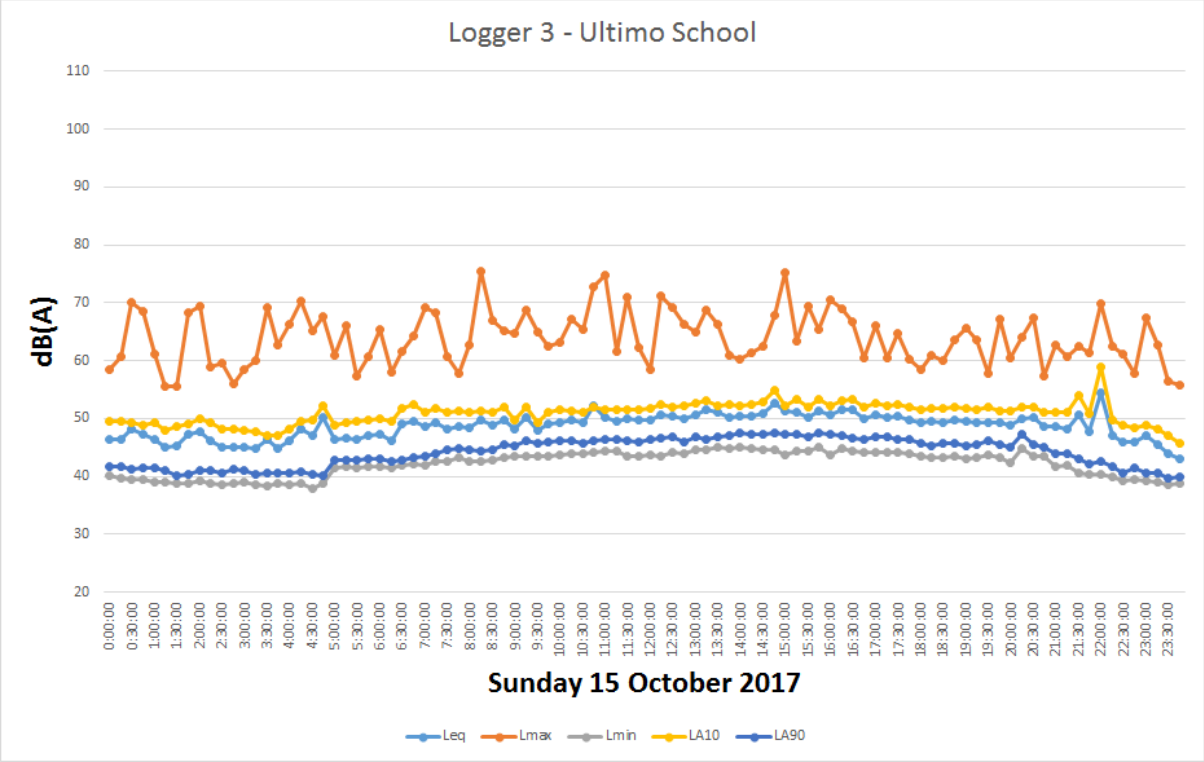
Logger 3 - Ultimo School
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Sunday 15 October 2017
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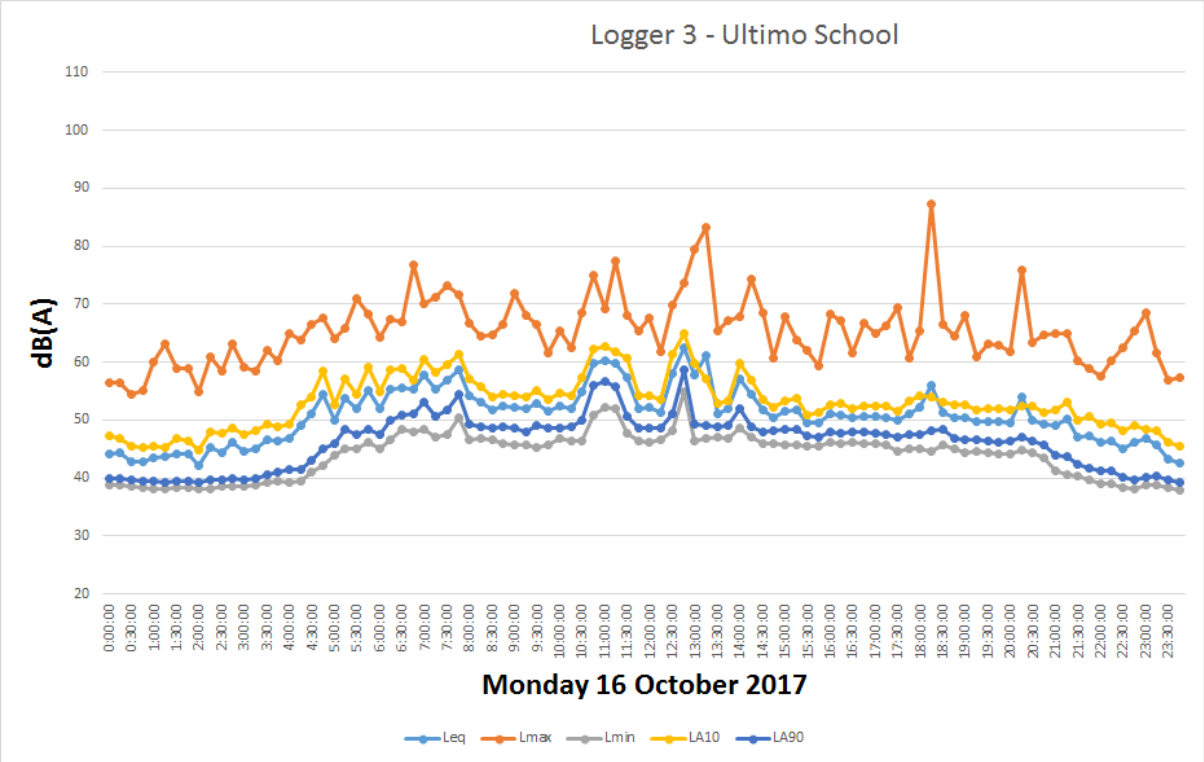
Logger 3 - Ultimo School
dB(A)
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Monday 16 October 2017
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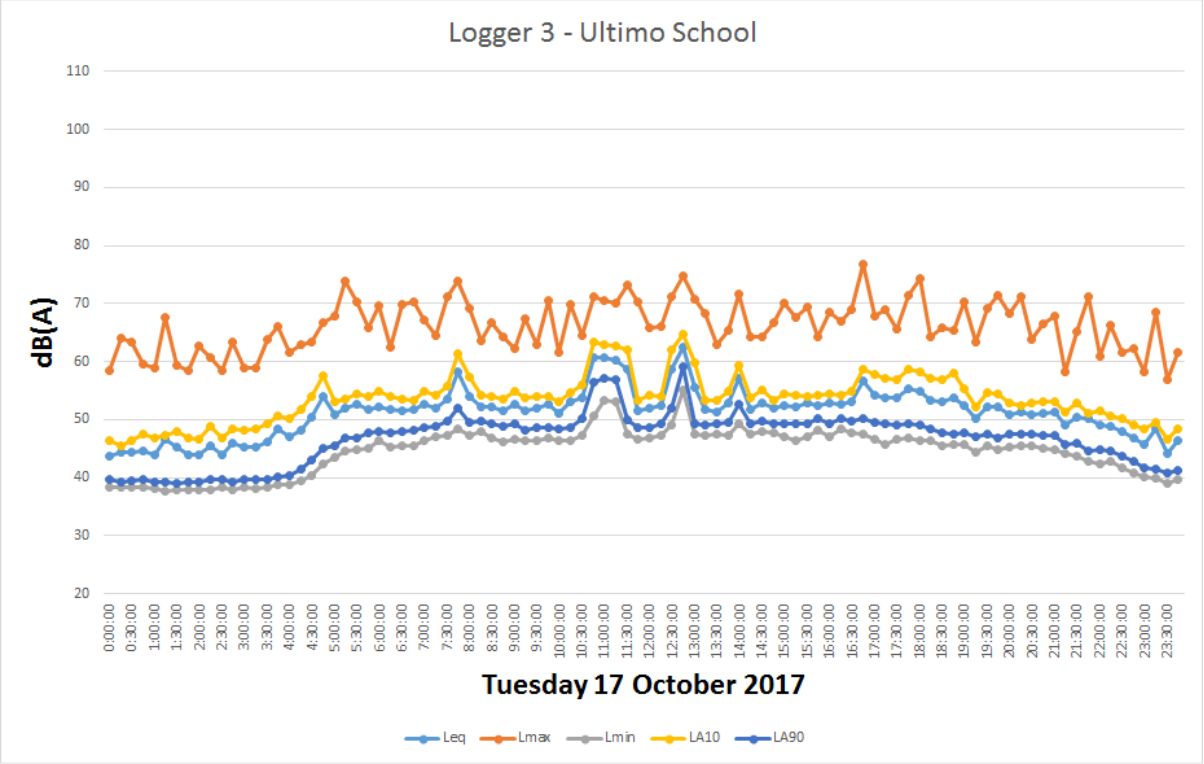
Logger 3 - Ultimo School
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Tuesday 17 October 2017
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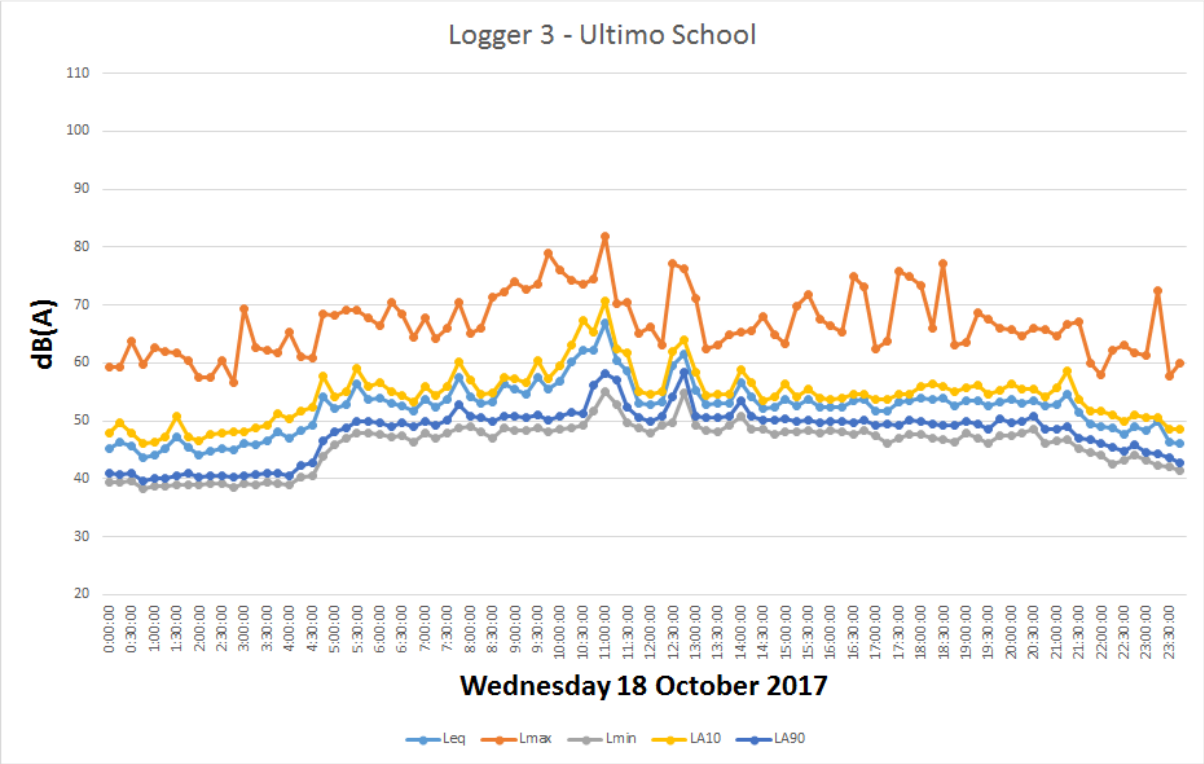
Logger 3 - Ultimo School
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Wednesday 18 October 2017
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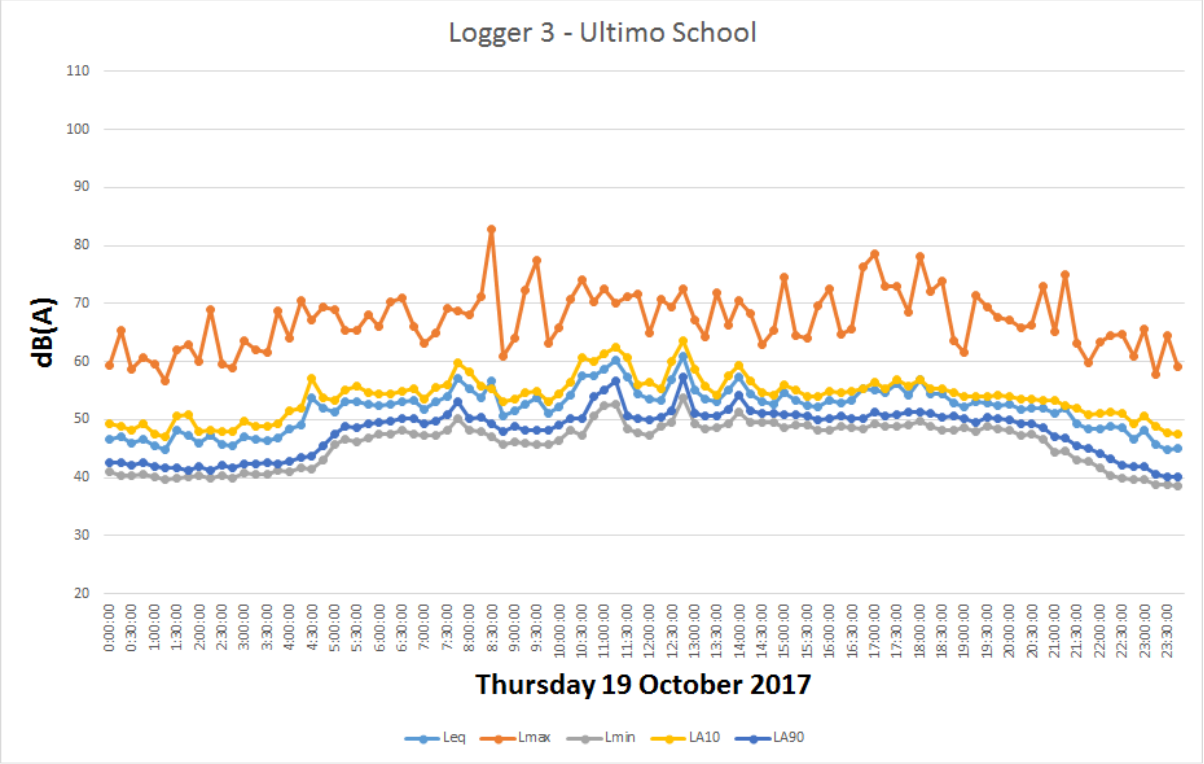
Logger 3 - Ultimo School
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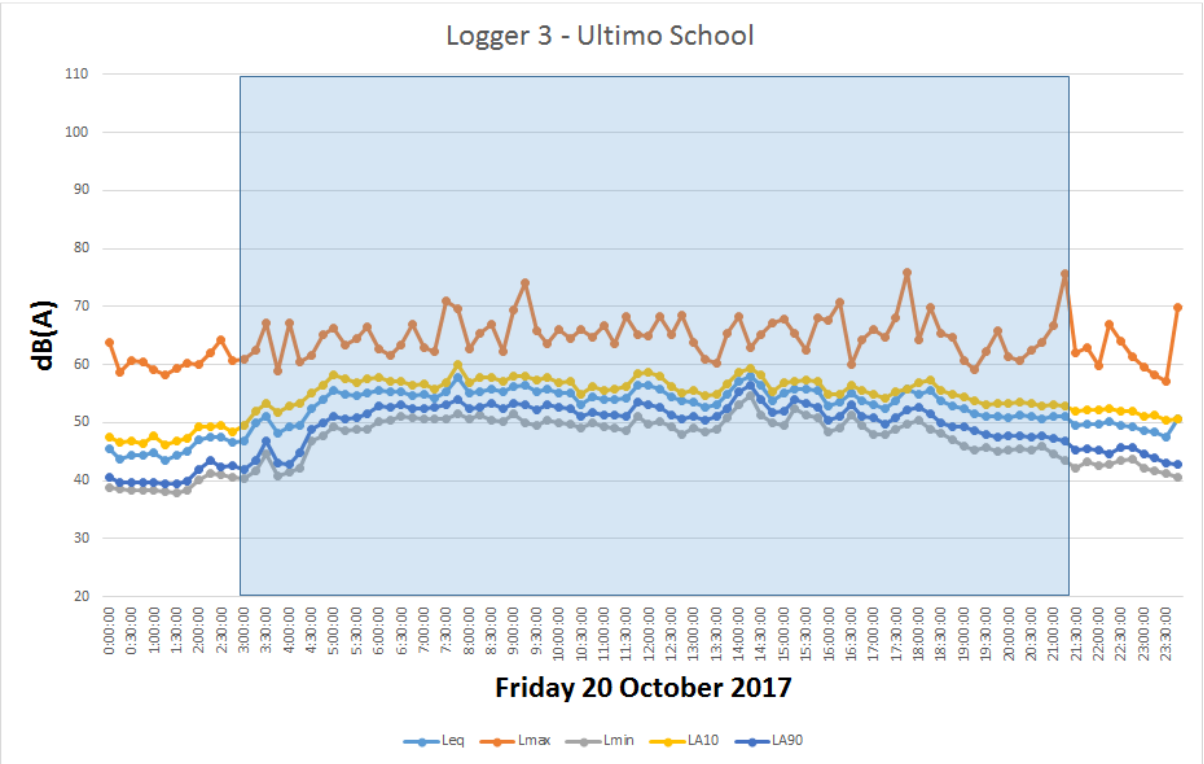
Logger 3 - Ultimo School
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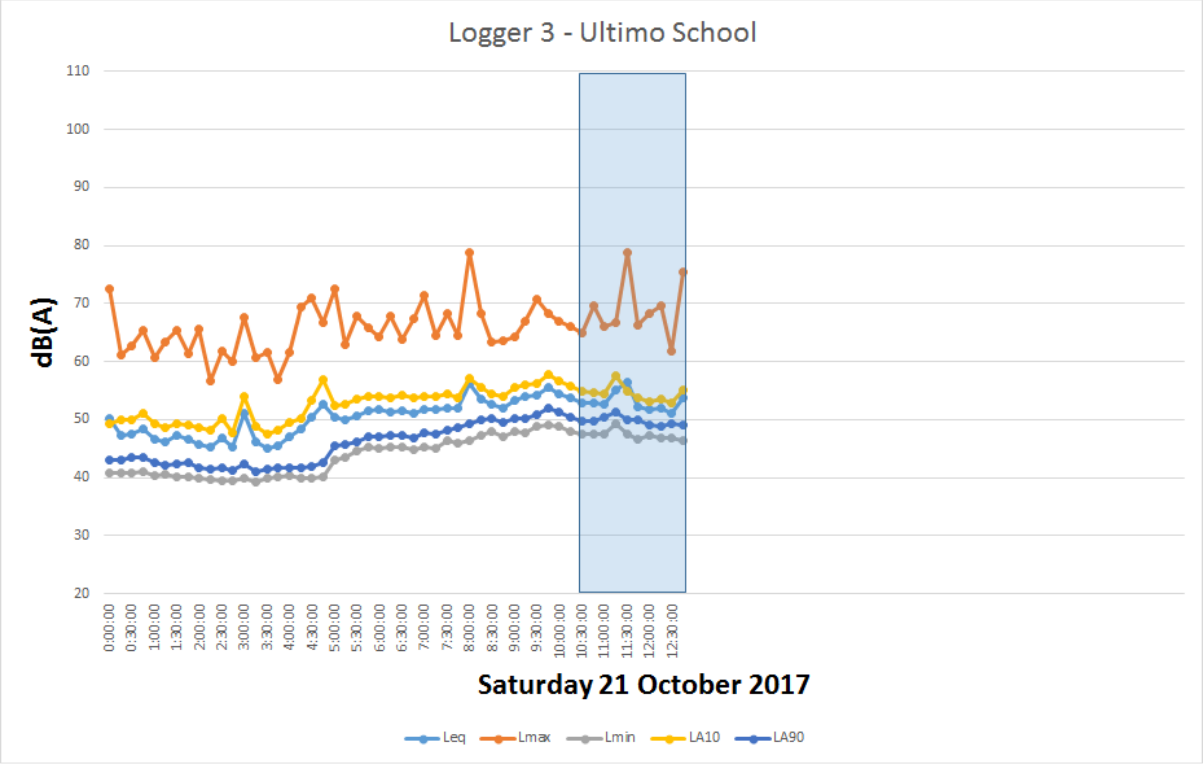
Logger 3 - Ultimo School
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Saturday 21 October 2017
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