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Environmental Noise Assessment

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1 INTRODUCTION

This report presents our external noise intrusion and noise emission assessment for the proposed Taronga Institute of Science & Learning facility proposed within Taronga Zoo. The assessment is based on the relevant Australian Standards and the requirements of NSW EPA Industrial Noise Policy.

The assessment has been based on the architectural drawings provided to this office from NBRS + Partners dated September 2015.

2 SITE DESCRIPTION

The proposed Taronga Institute of Science & Learning facility is located within Taronga Zoo Mosman.

The location of the proposed site and noise level measurements within the proximity of the development are detailed in Figure 1 below.

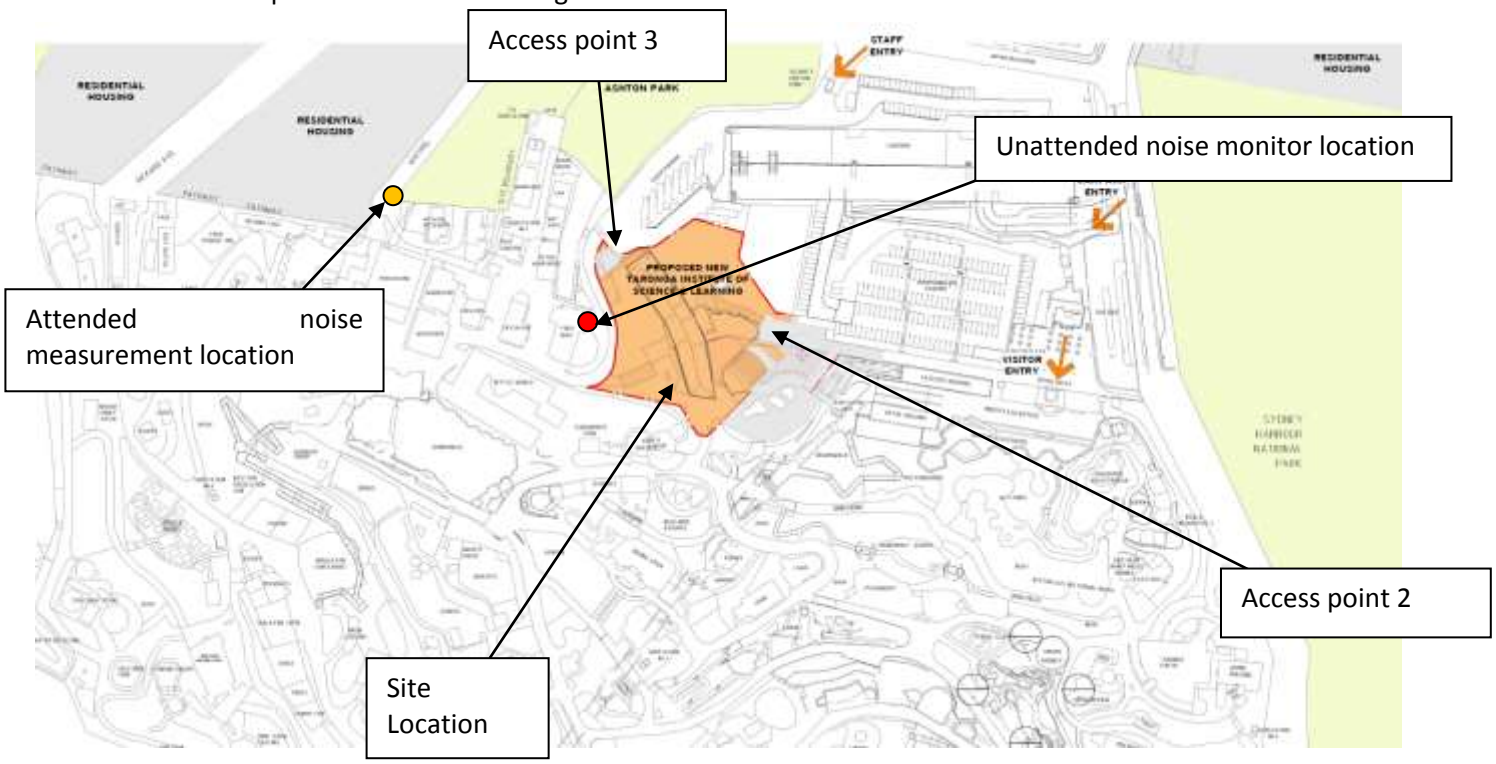


Figure 1 - Site Location and Noise Measurement Possessions

The potentially worst affected neighbouring receivers includes the residential receivers to the north west of the site which are approximately 100m from the site.

The operation of the proposed institute of science and learning include the following:

As per the current operation of the Taronga Education Centre, the Taronga Institute will be operational and include the following:

- Monday to Friday – 7am to 8pm
- Saturday and Sunday – 7am to 5pm
- The Lecture theatre may be use until 10pm for lectures presentations and community events on any evening of the week.

As for programs currently run in the Education Centre, the following actions will also be taken to assist with the management and mitigation of noise impacts:

- all education and community programs run at the Taronga Institute will be supervised by Taronga staff;

- school and other youth groups will be accompanied by teachers and/or designated carers;

- guest entry to and exit from the Taronga Institute will be from within Taronga Zoo grounds during Taronga Zoo opening hours (summer hours 9:30 – 5pm; winter hours 9:30 – 4:30pm);

- guest entry to and exit from the Taronga Institute outside Taronga Zoo opening hours will be via access point number 2. This will provide direct access to the Taronga car park and bus stop on Bradleys Head Road to minimise noise impacts and enable guests to quickly exit the Taronga Zoo site;

- staff / student entry to and exit from the Taronga Institute outside Taronga Zoo opening hours will be via access point #3. This will provide direct access to the Taronga staff car park and coach parking bays to minimise noise impacts and enable staff and students to quickly exit the Taronga Zoo site; and

- Amplified music will not be used externally within the Taronga Institute site.

3 EXTERNAL NOISE EMISSION ASSESSMENT

The proposed development includes a science and learning centre including a number of facilities such a lecture theatre, research laboratories, offices, learning/training rooms and associated services.

The assessment has been undertaken in compliance with the NSW Environmental Protection Authority (EPA) Industrial Noise Policy (INP) for noise emission control which has been used as the basis of this assessment and it detailed in this section of the report.

The proposed development includes up to 42 school children staying overnight within the development, including the relevant supervision.

3.1 EPA REQUIREMENTS

The EPA Industrial Noise Policy provides guidelines for assessing noise impacts from industrial developments. The recommended assessment objectives vary depending on the potentially affected receivers, the time of day, and the type of noise source. The EPA Industrial Noise Policy has two requirements which both have to be complied with, namely an amenity criterion and an intrusiveness criterion. In addition, the EPA in its Environmental Noise Control Manual states that noise controls should be applied with the general intent to protect residences from sleep arousal.

3.1.1 Intrusiveness Criterion

The guideline is intended to limit the audibility of noise emissions at residential receivers and requires that noise emissions measured using the L_{eq} descriptor not exceed the background noise level by more than 5 dB(A). Where applicable, the intrusive noise level should be penalised (increased) to account for any annoying characteristics such as tonality.

3.1.2 Amenity Criterion

The guideline is intended to limit the absolute noise level from all industrial noise sources to a level that is consistent with the general environment.

The EPA's Industrial noise policy sets out acceptable noise levels for various localities. Table 2.1 on page 16 of the policy indicates 4 categories to distinguish different residential areas. They are rural, suburban, urban and urban/industrial interface.

Table 2 provides the recommended ambient noise levels for the urban residential receivers for the day, evening and night periods. For the purposes of this condition:

- Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sundays and Public Holidays;
- Evening is defined as the period from 6pm to 10pm; and
- Night is defined as the period from 10pm to 7am Monday to Saturday and 10pm to 8am Sundays and Public Holidays.

Table 1 – EPA Recommended Amenity Industrial Noise Levels

Type of Receiver	Time of day	Recommended Acceptable Noise Level dB(A) L_{eq}
Residential	Day	60
	Evening	50
	Night	45
Industrial Receivers	When in use	70

3.2 SLEEP AROUSAL

To minimise the potential for sleep arousal the $L_{1\ (1\ minute)}$ noise level of any specific noise source does not exceed the background noise level (L_{90}) by more than 15 dB(A) outside a resident's bedroom window between the hours of 10pm and 7am. The L_1 noise level is the level exceeded for 1 per cent of the time and approximates the typical maximum noise level from a particular source. Where the typical repeatable existing L_1 levels exceed the above requirement then the existing L_1 levels form the basis for, sleep disturbance criteria.

3.3 BACKGROUND NOISE MONITORING

Unattended background noise monitoring was conducted between the 22nd and 29th October, 2015 using an Acoustic Research Laboratories noise monitor set to A-weighted fast response. The monitor was calibrated at the start and end of the monitoring period using a Rion NC-73 calibrator. No significant drift was noted. Noise logger data is provided in Appendix.

Measured background noise levels are presented below. Refer to Appendix for unmanned noise monitoring data.

Table 2– Measured Background Noise Levels

Location	Background noise level dB(A)$L_{90(period)}$		
	Daytime (7am-6pm)	Evening (6pm-10pm)	Night (10pm-12am)
Nearby residences	47	43	35

3.3.1 Meteorological conditions during monitor period

Section 3.4 of the NSW Environment Protection Authority (EPA) Industrial Noise Policy document outlines the following with regards to meteorological impacts on noise monitoring;

"Noise monitoring should not be conducted (or the data should be excluded) when average wind speeds (over 15-minute periods or shorter) at microphone height are greater than 5 m/s, or when rainfall occurs."

However, the same section of this policy also outlines that;

"Exceptions to this rule are allowed, provided the proponent is able to show that the wind-induced noise on the microphone, and sound levels due to rain, are at least 10 dB below the noise levels (that is, background and/or ambient) under investigation."

Weather conditions during the monitoring period have been assessed and the periods of inclement weather are highlighted in Appendix 1. Weatherzone data for observations recorded at Observatory Hill, indicate some periods of inclement weather which have been excluded from the monitoring data in calculation of the rating background noise levels (RBL's) for the daytime, evening and night-time periods, as indicted in Appendix 1.

3.4 ATTENDED NOISE LEVEL MEASUREMENT

Attended short term measurements of environmental noise was also undertaken by this office, to supplement the unattended noise monitoring data. These measurements were undertaken on the 27th October 2015 between 5:00pm and 6:00pm. Measurements were conducted using a SVAN 958 Sound & Vibration Level Analyser. The analyser was set to fast response and calibrated before and after the measurements using a Norsonic Sound Calibrator type 1251. No significant drift was noted.

The results of the attended noise level measurements were used to compare noise levels recorded during the same period by the noise logger. The results of attended noise levels confirm that the location of the noise logger was suitable as a representative location and hen noise levels recorded at the logger location have been used as the basis of this assessment.

3.5 SUMMARY OF ASSESSMENT CRITERIA FOR PROPOSED SITE

The EPA's INP intrusiveness, amenity and sleep arousal criteria for this project have been determined using these guidelines and the noise monitoring results. These are summarised below. We note that the formulation of the assessment criteria has been based on the lowest ambient levels determined from all monitoring data.

3.6 RESULTING NOISE OBJECTIVES

Table 3 below provides a summary of our recommended assessment criteria applicable to the subjected site. The intrusiveness and amenity criteria for this project have been determined using the EPA guidelines and measured background noise levels.

Table 3 - Noise Objectives for Nearest Residential Receiver

Location	Day time Noise Objective dB(A) L_{eq}	Evening Noise Objective dB(A) L_{eq}	Night time Noise Objective dB(A) L_{eq}	Noise Objective for Intermittent Activities dB(A) $L_{1\ (1\ Min)}$ (Background + 15 dB(A))
Residential receivers	52	48	40	50

For commercial receivers within the vicinity of the site noise levels are required to comply with the EPA criteria of 65 dB(A) when these facilities are in operation.

3.6.1 Mechanical Plant

Mechanical plant items are not typically selected at DA stage as selection of plant and equipment has not been conducted at this time.

Detailed review of all external mechanical plant will be undertaken at construction certificate stage (once plant selections and locations are finalised). Acoustic treatments should be determined in order to control plant noise emissions to the levels set out in this report.

A review of the proposed plant locations has been conducted and it is both possible and practical for the equipment to be satisfactorily attenuated to levels complying with noise emission criteria through appropriate location and (if necessary) standard acoustic treatments such as noise screens, enclosures, in-duct treatments (silencers/lined ducting) or similar. Experiences with similar developments indicate that suitable acoustic treatments are both possible and practical.

Plant will be acoustically treated to prevent noise emissions from adversely impacting the surrounding properties in conjunction with the criteria detailed in this report. This may include selecting the quietest plant practicable, or treating the plant with enclosures, barriers, duct lining and silencers, etc as required to comply with the sound level recommendations.

Experience with similar projects indicates that it would be possible to achieve the requirement with appropriate treatment of the plant. General requirements for a number of potential plant items on the site are expanded on below.

3.6.2 Supply / Exhaust fans

Supply and exhaust fans may be located within the underground plant rooms or in rooftop plant areas. These units typically emit high noise levels and require acoustic treatment such as silencers and internal lined ductwork. Silencer requirements would be determined once fan selections have been completed.

3.6.3 Minor Plant

Other minor plant items, such as bathroom or kitchen exhaust fans, may also be required. These items typically emit relatively low noise levels and may require minimal acoustic treatment of a standard nature, such as internally lining of ductwork.

3.7 CONDENSER, HEATING AND REVERSE CYCLING AIR CONDITIONERS

It is at the construction design stage that consideration should be given to the placement of external air conditioning/ heating/ reverse cycle air conditioning units.

The location of heating/cooling units is the most important factor to ensure noise is not going to be intrusive. The location and selection of the proposed units associated with the development will be conducted such that noise impact to both the future residential tenancies and existing receivers will comply with the relevant EPA criteria of the noise standard less 5dB(A) and compliance with this standard inside any other unit in the same complex.

3.8 OVERNIGHT STAYS

As part of this assessment an assessment of the potential noise impacts from the operations of the site including 42 school children during an overnight stay. Based on the proposed activities on the site the children will be undertaking activities within the centre and the zoo and will stay within the building envelope of the development and be under constant supervision.

No use of a Public Address System, load speakers or amplified music/speech is to be used externally as part of the development during nigh time hours.

Based on the proposed operations on the site, including the night time stay of school children compliance with the noise level criteria, including sleep disturbance levels, will be achieved at all surrounding receivers.

3.9 ARRIVAL AND DEPARTURES

Based on the proposed development there will be no intensification of the use of the site and there will be no additional traffic numbers associated with the proposal. As a result of the proposed development there will be no additional noise impact on surrounding roadways.

3.9.1 Patron Noise Arrivals and Departures

As part of this assessment an investigation into patron arrival and departs to the site have been undertaken. This included an assessment of noise generated from the patrons and include 1 in 3 patrons talking at any one time and is detailed in the sample calculation below.

The following is a sample calculation used to predict the noise level at the potentially worst affected residential receiver located within the vicinity of the future project. The noise level used in the assessment has been based on a measured sound power level of a patron taking of 75 dB(A) SWL as detailed below.

Patron Ariiving Departing Sample Calculation

1.	Sound Power Level:	75 dB(A)
2.	Percentage of sound for 1 in 3 patrons taking:	+20 dB
3.	Distance correction to residential receiver :	- 55 dB
4.	Barrier Corrections for line of sight screening:	-8 dB
	Resultant Night Time Noise level at façade (Criteria 40 dB(A) worst case):	39 dB(A)

Based on the results of the assessment detailed above noise from patrons arriving and departing will comply with the projects relevant noise level criteria.

4 CONSTRUCTION NOISE AND VIBRATION

This document presents a specification for the processes, which will be followed to manage noise and vibration associated with the proposed construction activities which are required as part of the Project and the potential for noise and vibration impact to receivers within close proximity.

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

1. Minimised to all surrounding receivers.

2. Is monitored when potentially high noise and vibration generating activities are being used.

This assessment will formulate/present the relevant noise and vibration criteria which construction activities are required to comply with. Additionally effective mitigation measures will be recommended where possible to ensure criteria is achieved and impacts are.

The principal issues, which will be addressed in this report, are:

- Identification of the noise and vibration standards which will be applicable to this project.

- Formulation of a strategy for construction activities to comply with the standards identified in the above point.

4.1 PROJECT OBJECTIVES

The objective of this management plan is to set up a protocol to ensure noise and vibration emissions from the construction works associated with the project comply with applicable standards, recommend required management controls and treatments are adopted where required and detail the required monitoring to ensure standards are met.

4.2 PROJECT DESCRIPTION AND POTENTIALLY EFFECTED PROPERTIES

The proposed project includes the excavation of material including infill and soft sand stone and construction of the development. The expected activities can be expected to include:

1. Demolition of existing buildings.
2. Excavation.
3. Building constructions.

4.3 CONSTRUCTION NOISE CRITERIA

It is proposed to utilise Australian Standard AS2436:1981 *"Guide to noise control on construction, maintenance and demolition sites"*, which is the standard commonly applied by Councils for the regulation of construction noise and the New South Wales Construction Noise Guideline developed by The NSW EPA requirements are presented in this section of the report.

4.3.1 Australian Standard AS2436:1981 "Guide to noise control on construction, maintenance and demolition sites

The Australian Standard AS2436 states that where all reasonable and available measures have been taken to reduce construction noise, mitigation strategies may be put in place to reduce levels noise levels to within a reasonable and acceptable level.

For the control and regulation of noise from construction sites AS2436:1981 *"Guide to noise control on construction, maintenance and demolition sites"* nominates the following:

a. That reasonable suitable noise criterion is established,

b. That all practicable measures be taken on the building site to regulate noise emissions, including the siting of noisy static processes to locations of the site where they can be shielded, selecting less noisy processes, and if required regulating construction hours, and

c. The undertaking of noise monitoring where non-compliance occurs to assist in the management and control of noise emission from the demolition, excavation and construction site.

4.3.2 EPA Construction Noise Guideline

The Department of Environment and Climate Change have developed a specific construction noise guideline in the aid of reducing the impact of construction associated noise.

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

4.3.3 EPA Construction Noise Guideline - Qualitative Assessment Method

The guideline refers to a qualitative assessment method in which construction noise is assessed on a case by case basis with regard to various activities to be conducted on site. This assessment method was developed to smaller scale projects.

Essentially this method of assessment requires that the proponent take into consideration and employ all reasonable and feasible measures to ensure that the impact on noise receivers is minimised. This is generally conducted in the following manner:

- The drafting of a noise management plan outlining all reasonable and feasible mitigation methods for the reduction of noise impact;
- The assessment of high impact equipment such as rock-hammers and piling equipment for lower noise producing methods of construction/excavation;
- The implementation of a complaints handling register and community consultation system;
- Employee (builders, contractors etc) education in effective noise reducing techniques and site etiquette; and
- The operation of plant in a quiet and efficient manner (i.e. turning off machinery when not in use).

This qualitative assessment method has been used for the basis of this report and has been used as the basis for the development of acoustic management and treatments of proposed construction activities.

In addition, the guideline specifies goals which can be used in the effort of minimising noise from construction related activities. These noise goals are presented within the table below.

Table 4 – EPA Recommended Construction Noise Goals

Governing Body	Receiver Type	External sound level Goal, $L_{eq\ 15\ min}$ dB(A)
EPA	Residential	Background + 10 dB(A)[1]
		75 dB(A)[2]

1: Where the predicted or measured LAeq (15 min) is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise. (DECC CNG, 2008).

2: 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. 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. (DECC CNG, 2008).

These criteria for resultant noise from construction activities are aimed at maintaining comfort levels within the surrounding residential dwellings. Additionally, noise mitigation techniques as discussed in this report should be used if noise emissions exceed the above criteria. All work is to be carried out in accordance with AS 2436:1981 *"Guide to noise control on construction, maintenance and demolition sites"*.

4.4 CONSTRUCTION VIBRATION CRITERIA

Construction vibration criteria associated with works on the project when measured at the potentially affected receivers should not exceed the following sets of vibration criteria to ensure no architectural or structural damage to surrounding buildings and human comfort is maintained. These standards have been selected as they are widely used in the assessment of vibration associated with construction activities within Australia, namely:

- German Standard DIN 4150-3 (1999-02): *"Structural Vibration – Effects of Vibration on Structures"*; and
- British Standard BS 6472:1992 *"Guide to Evaluation of Human Exposure to Vibration in Buildings (1Hz to 80Hz)*.

The criteria and the application of these Standards are discussed in separate sections below.

4.4.1 German Standard DIN 4150-3 (1999-02)

German Standard DIN 4150-3 (1999-02) provides vibration velocity guideline levels for use in evaluating the effects of vibration on structures. The criteria presented in DIN 4150-3 (1999-02) are presented in the Table below.

It is noted that the peak velocity is the absolute value of the maximum of any of the three orthogonal component particle velocities as measured at the foundation, and the maximum levels measured in the x- and y-horizontal directions in the plane of the floor of the uppermost storey.

Table 5 – DIN 4150-3 (1999-02) Safe Limits for Building Vibration

TYPE OF STRUCTURE		PEAK PARTICLE VELOCITY (mms^{-1})			
		At Foundation at a Frequency of			**Plane of Floor of Uppermost Storey**
		< 10Hz	**10Hz to 50Hz**	**50Hz to 100Hz**	**All Frequencies**
1	Buildings used in commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
2	Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
3	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (eg buildings that are under a preservation order)	3	3 to 8	8 to 10	8

4.4.2 British Standard BS 6472:1992

British Standard BS 6472:1992 develops criteria relating to levels of building vibration that may be expected to give rise to *"adverse comment"*, in the frequency range most applicable to impacts associated with construction, which is 1 to 80Hz. These threshold values are used as criteria for assessing the loss of amenity and are presented below in Table 3.

Table 6 – BS 6472:1992 Criteria to Avoid "*Adverse Comment*"

Type of Occupancy	Time of Day	Peak Particle Velocity (mms^{-1}) between 1Hz to 80Hz Likely to Cause *"Adverse Comment"*			
		Continuous Vibration		Intermittent Vibration and Impulsive Vibration Excitation with Several Occurrences per day	
		Vertical	Horizontal	Vertical	Horizontal
Residential	Day	0.3 to 0.6	0.8 to 0.6	8.4 to 12.6	24 to 36
	Night	0.2	0.6	2.8	8
Offices	Day	0.6	1.6	18	51
	Night	0.6	1.6	18	51
Workshops	Day	1.2	3.2	18	51
	Night	1.2	3.2	18	51

The limits indicate that people in buildings are significantly less susceptible to horizontal vibration than to vertical vibration. Furthermore, Section 4.1 of BS 6472 notes that situations can exist where vibration magnitudes above those generally corresponding to minimal *"adverse comment"* levels can be tolerated, particularly for temporary disturbances and infrequent and intermittent events such as those associated with construction projects.

4.5 CONSTRUCTION HOURS

Woking hours are subject to planning approval conditions. Typically the hours of work at sites will be:

- 7:00am to 6:00pm Monday to Friday
- 8:00am to 1:00pm on Saturdays
- No work on Sundays, Public Holidays or Saturdays adjacent to a Public Holiday.

Works which are proposed to be conducted outside of these hours will be subject to special approval.

4.6 QUANTITATIVE ASSESSMENT OF POTENTIAL NOISE EMISSIONS

4.6.1 Activities to be Conducted and the Associated Noise Sources

We have been advised of the typical equipment/processes anticipated to be used for the construction of the subject development. Noise impacts from these activities on the amenity of the surrounding identified sensitive receivers, will be predicted in this section. .

The A-weighted sound power levels for the anticipated equipment/processes are outlined in the tables below.

Table 7 – Sound Power Levels

EQUIPMENT /PROCESS	SOUND POWER LEVEL dB(A)
Excavation/demolition	
Excavator (upto 20 tonnes)	108
Piling Rig (CFA Piles)	103
Anchoring Rig	100
Bobcat	105
Trucks (upto 12 tonnes)	100
Concrete Pump	107
Cement Mixing Truck	105
Construction	
Mobile Crane	104
Trucks (upto 12 tonnes)	100
Large Trailers	116
Drilling	94*
Hammering (jackhammers)	120*
Angle grinders	114*
Power Saw	115*
Impact drill	110*
Concrete/Shortcrete Pump	107
Cement Mixing Truck	105

* - includes 5 dB(A) addition for characteristics of noise source.

The noise levels presented in the above table are derived from the following sources:

1. On-site measurements;

2. Table D2 of Australian Standard 2436-1981 & Table A1 of Australian Standard 2436-2010; and

3. Data held by this office from other similar studies.

4.7 NOISE EMISSION PREDICTIONS

4.7.1 Methodology

Noise generated by plant and equipment will be managed to generally comply with the nominated acoustic criteria, and where this noise goal may be exceeded, noise will be managed based on principles consistent with Australian Standard 2436.

Predictions of noise levels at the sensitive receivers identified have been made of the construction processes with the potential to produce significant noise.

It is noted that:

- Many of the noise sources are present over a small period of the day or may be present for a few days with a significant intervening period before the activity occurs again.
- The distance between the noise source and the receiver.
- The screening effect provided by any remaining building structure or building shell. In particular, noise from works done on higher level will be substantially screened by the remaining building structure to receivers located on lower levels.

4.7.2 Residential Receivers

Predicted noise levels to the commercial receivers surrounding the site follows:

Table 8– Predicted Noise Level – Residential Receivers

Equipment / Process	External Noise Goal dB(A) $L_{eq\ (15min)}$	Predicted Level at Receiver dB(A)$L_{eq(15mins)}$	Complies
Early Works or Excavation Stage			
Excavator (upto 20 tonnes)	Background + 5 dB(A) Noise Goal – 57 dB(A) 75 dB(A) (EPA construction noise goal)	57 – 60	Limited Exceedances may occur. Construction activities to be managed as detailed in Sections following.
Piling Rig (CFA Piles)		52 – 55	
Anchoring Rig		59 – 2	
Bobcat		54 – 57	
Trucks (upto 12 tonnes)		45 – 52	
Concrete/Shortcrete Pump		62 – 69	
Cement Mixing Truck		60 – 67	
Construction Stage			
Mobile Crane	Background + 5 dB(A) Noise Goal – 57 dB(A) 75 dB(A) (EPA construction noise goal)	53 – 56	Compliance with Construction Noise Goals
Trucks (upto 12 tonnes)		45 –472	
Truck Deliveries		51 - 58	
Drilling		53 – prior to the construction of building shell 33 – after construction of building shell	Compliance with Construction Noise Goals
Hammering (jackhammers)		69 – prior to the construction of building shell 49 – after construction of building shell	Limited Exceedances may occur. Construction activities to be managed as detailed in Sections following.

Table 8 (continued) – Predicted Noise Level – Commercial Receivers

Equipment / Process	External Noise Goal dB(A) $L_{eq\ (15min)}$	Predicted Level at Receiver dB(A)$L_{eq(15mins)}$	Complies
Angle grinders	Background + 5 dB(A) Noise Goal – 57 dB(A) 75 dB(A) (EPA construction noise goal)	63 – prior to the construction of building shell 43 – after construction of building shell	Limited Exceedances may occur. Construction activities to be managed as detailed in Sections following.
Power Saw		64 – prior to the construction of building shell 44 – after construction of building shell	
Impact drill		55 – prior to the construction of building shell 35 – after construction of building shell	Compliance with Construction Noise Goals
Concrete/Shortcrete Pump		62 – 69	Limited Exceedances may occur. Construction activities to be managed as detailed in Sections following.
Cement Mixing Truck		60 – 67	

4.8 CONTROL OF CONSTRUCTION NOISE AND VIBRATION

As a part of the noise management of noise and vibration on each site the following process should be conducted when investigating the impact and construction activities.

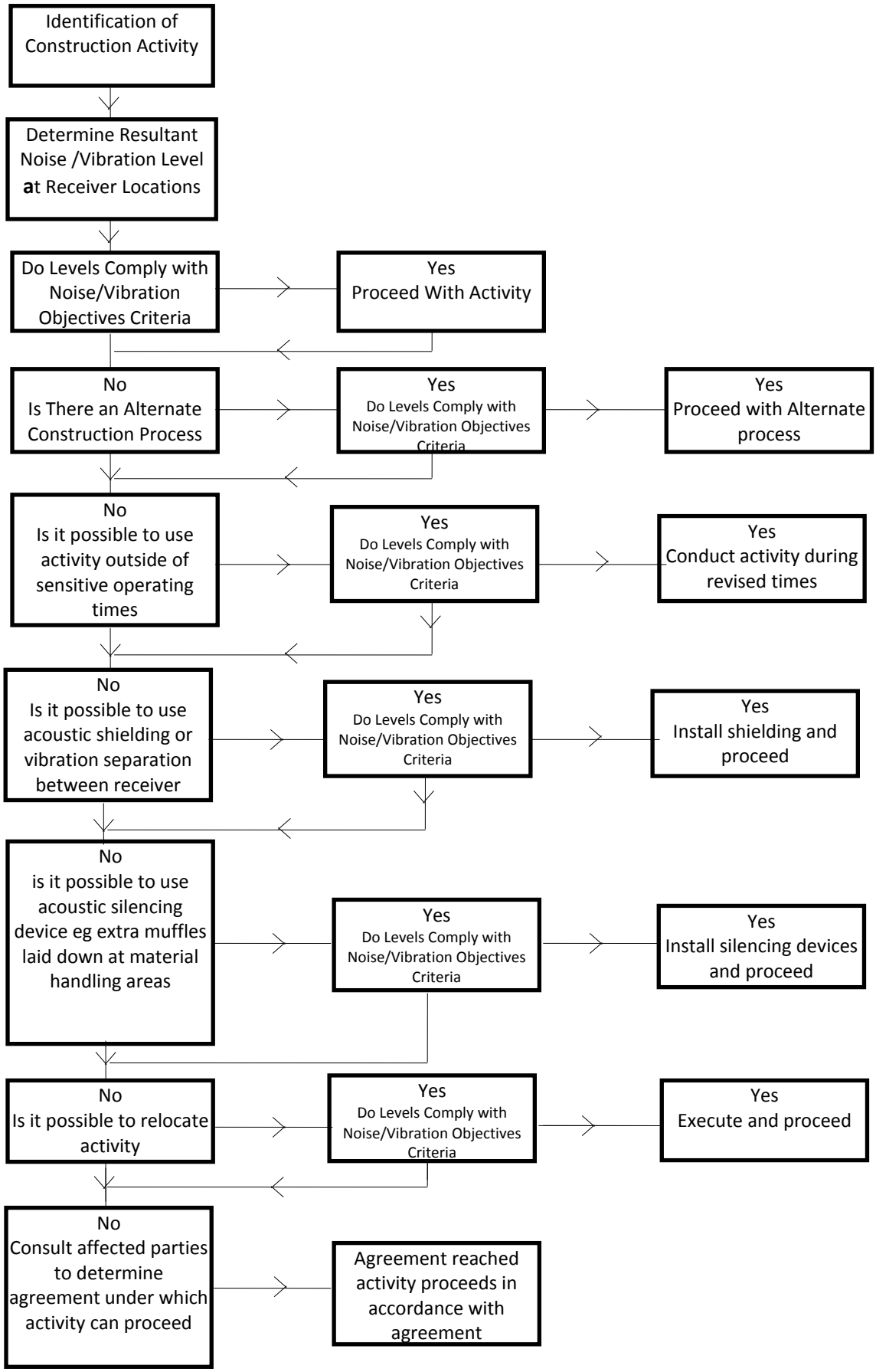


Figure 1 – Process Flowchart

4.9 NOISE AND VIBRATION CONTROL METHODS

The determination of appropriate noise control measures will be dependant on the particular activities and construction appliances. This section provides an outline of available methods.

4.9.1 Selection of alternate appliance or process

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

4.9.2 Acoustic Barrier

Barriers or screens can be an effective means of reducing noise. Barriers can be located either at the source or receiver.

The placement of barriers at the source is generally only effective for static plant (tower cranes). Equipment which is on the move or working in rough or undulating terrain cannot be effectively attenuated by placing barriers at the source.

Barriers can also be placed between the source and the receiver.

The degree of noise reduction provided by barriers is dependant on the amount by which line of sight can be blocked by the barrier. If the receiver is totally shielded from the noise source reductions of up to 15dB(A) can be effected. Where only partial obstruction of line of sight occurs, noise reductions of 5 to 8dB(A) may be achieved. Where no line of sight is obstructed by the barrier, generally no noise reduction will occur.

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

4.9.3 Silencing devices

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

4.9.4 Material handling

The installation of rubber matting over material handling areas can reduce the sound of impacts due to material being dropped by up to 20dB(A).

4.9.5 Reversing Alarms

In the event reversing alarms are identified as generating complaint equipment may be installed with squallers or lights where safety requirements allow.

4.9.6 Treatment of specific equipment

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

4.9.7 Establishment of Site Practices

This involves the formulation of work practices to reduce noise generation. A noise plan will be developed for this project outlining work procedures and methods for minimising noise.

4.9.8 Regular noise checks of equipment

To determine the requirement for silencing devices on machinery it is proposed to undertake fortnightly noise check. Noise levels of all machines on site will be measured and if they are found to be higher than nominated for that equipment type, items such as mufflers and engine shrouds will be examined to ensure they are in good working order.

A record of these measurements will be kept on a form similar to that shown in Appendix 1. This measure is expected to maintain noise at constant levels, and prevent any increases.

4.9.9 Treatment of Existing Equipment

An effective method of mitigating vibration on existing equipment would be to vibration isolated mounts to existing equipment and installations. Vibration isolation would be required to be investigated on a case by case basis and consist of neoprene mounts as specified (such as waffle pads, supershear flex or the like).

Based on investigations conducted at the site the areas which may be suitable for treatment include tables with sensitive equipment such as microscopes and the like.

4.9.10 Noise and vibration Monitoring

Noise and vibration monitoring will be undertaken to determine the effectiveness of measures which are been implemented. The results of monitoring can be used to devise further control measures.

4.9.11 Combination of methods

In some cases it may be necessary that two or more control measures be implemented to minimise noise.

4.9.12 Saw cutting

Introduction of a saw cut to manage vibration impacting on surrounding receivers from construction activities.

5 CONCLUSION

External noise emission from plant service the project site have been carried out with detailed acoustic treatments in Section 3 of this report to ensure that the external noise emissions fully comply with the requirements of NSW EPA Industrial Noise Policy.

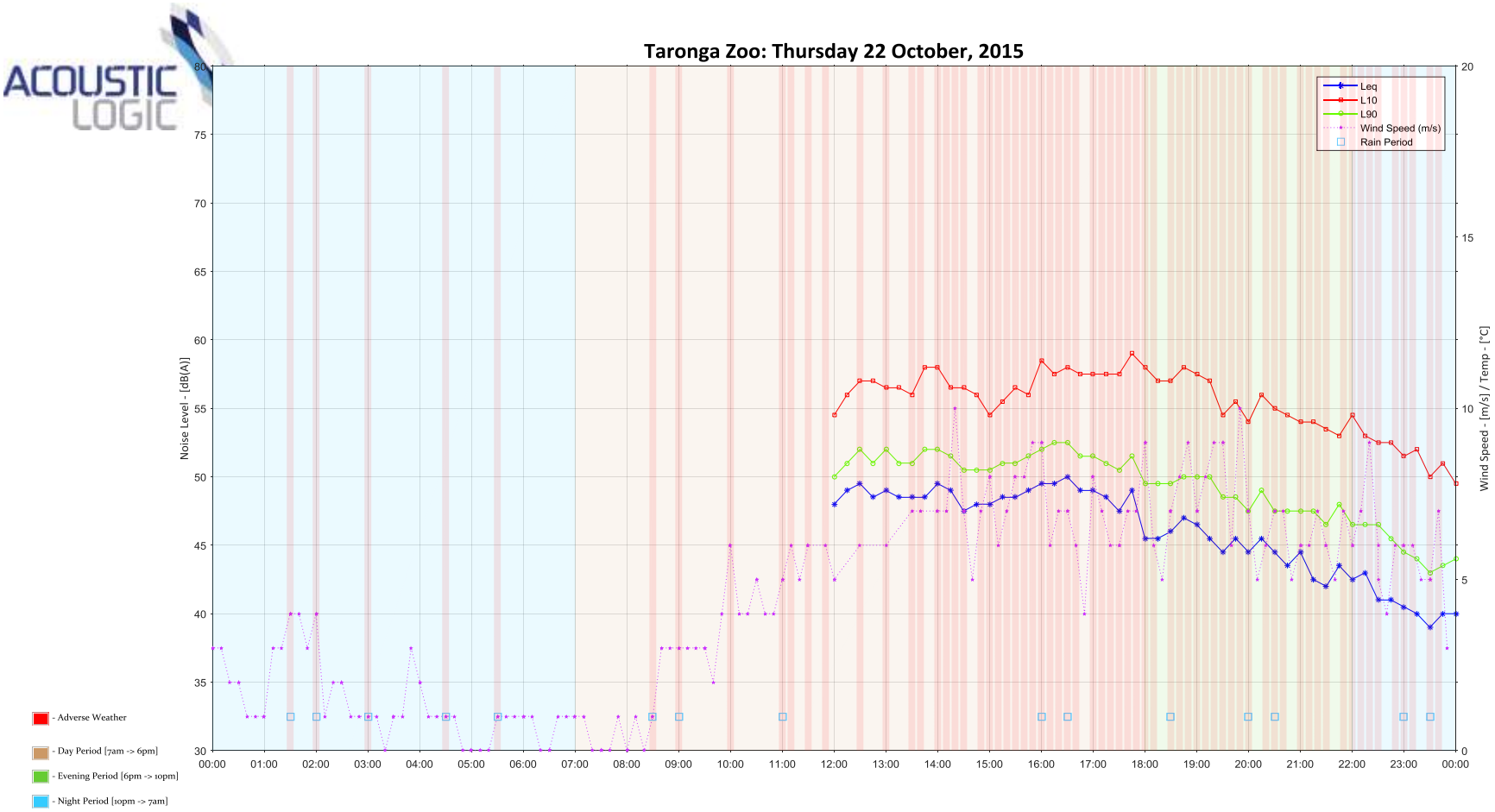
Additionally an assessment construction noise and vibration has been undertaken and the required mitigations methods have been detailed in Section 4 of this report.

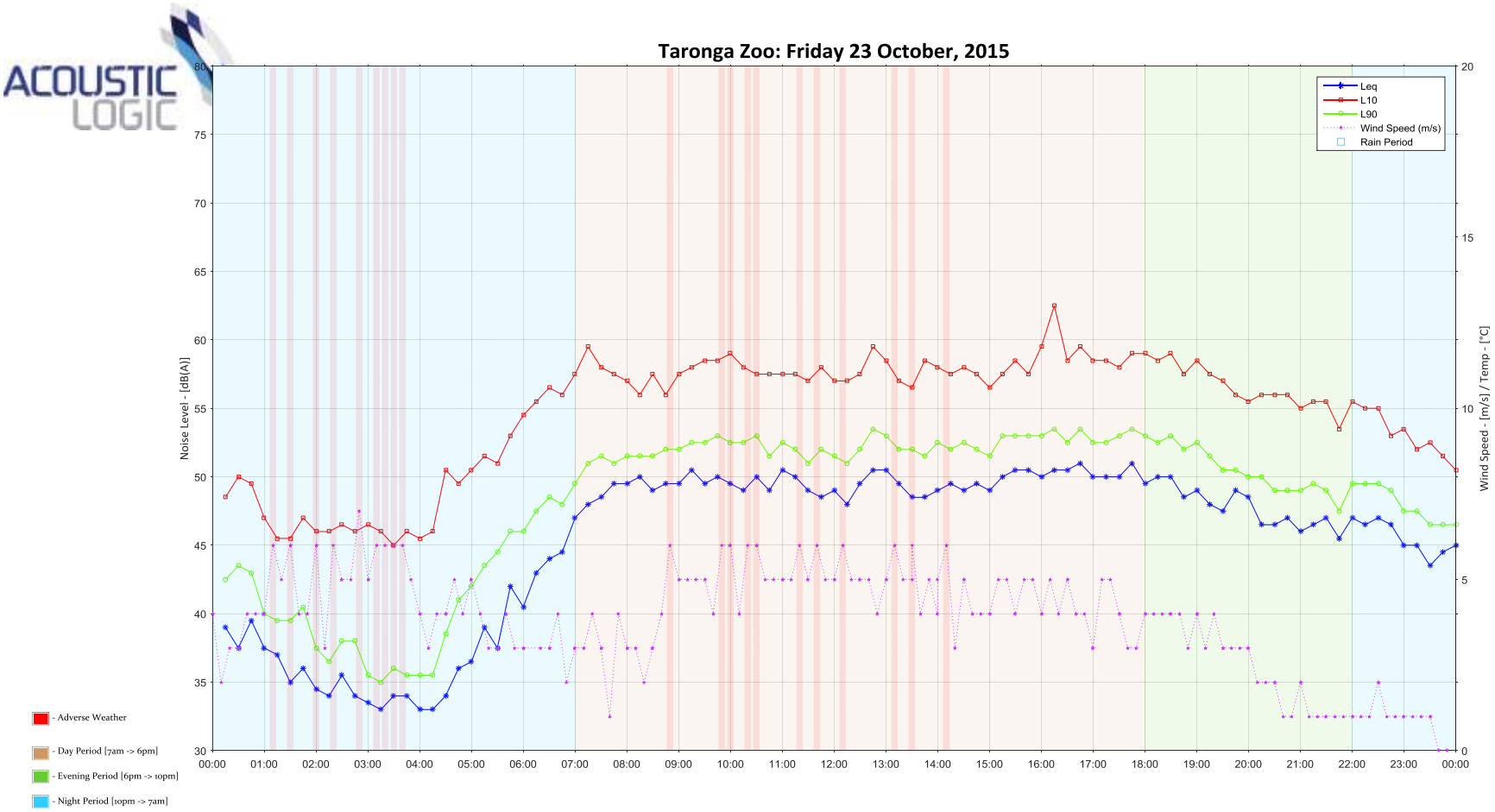
We trust this information is satisfactory. Please contact us should you have any further queries.

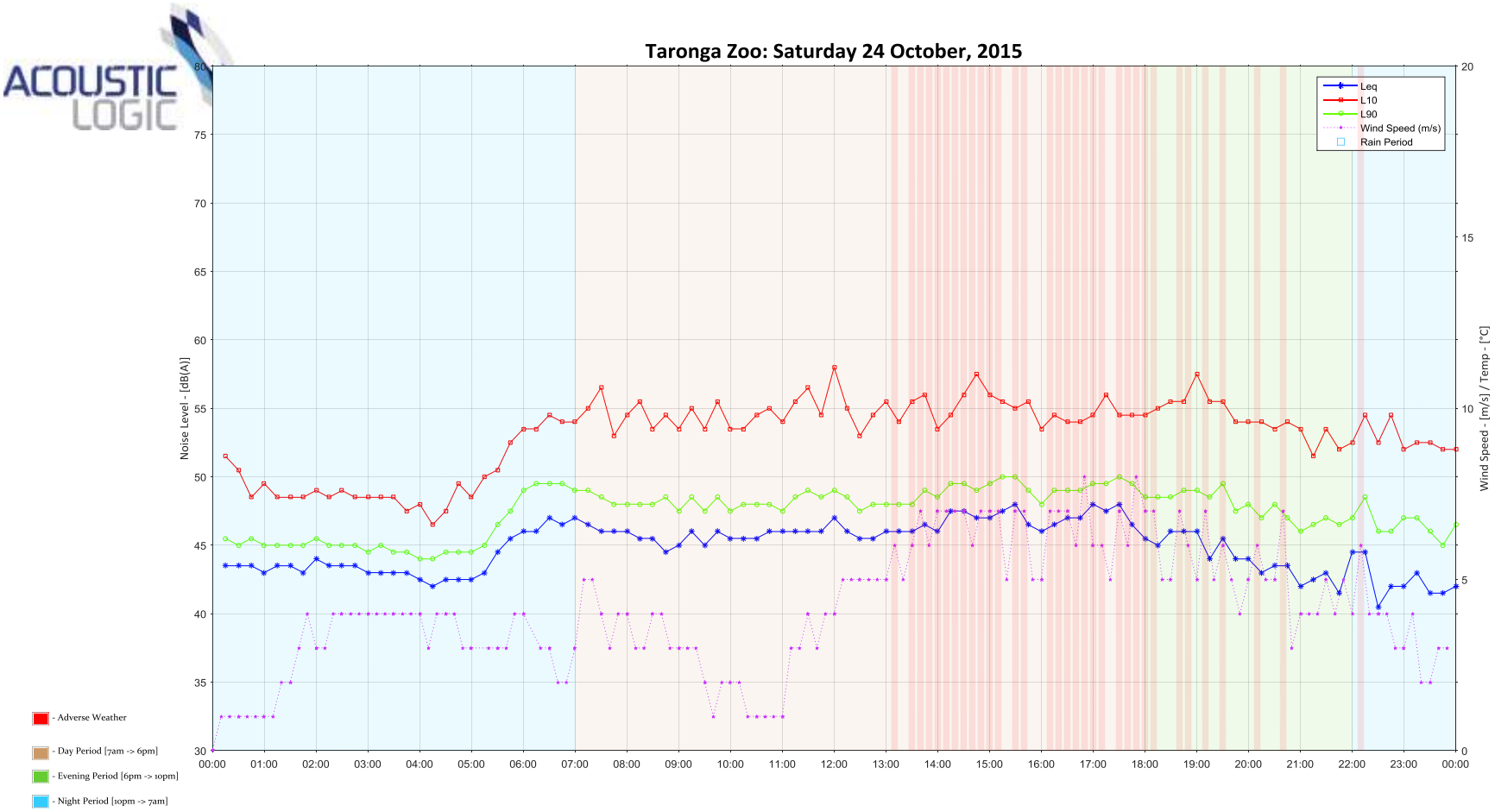
Yours faithfully,

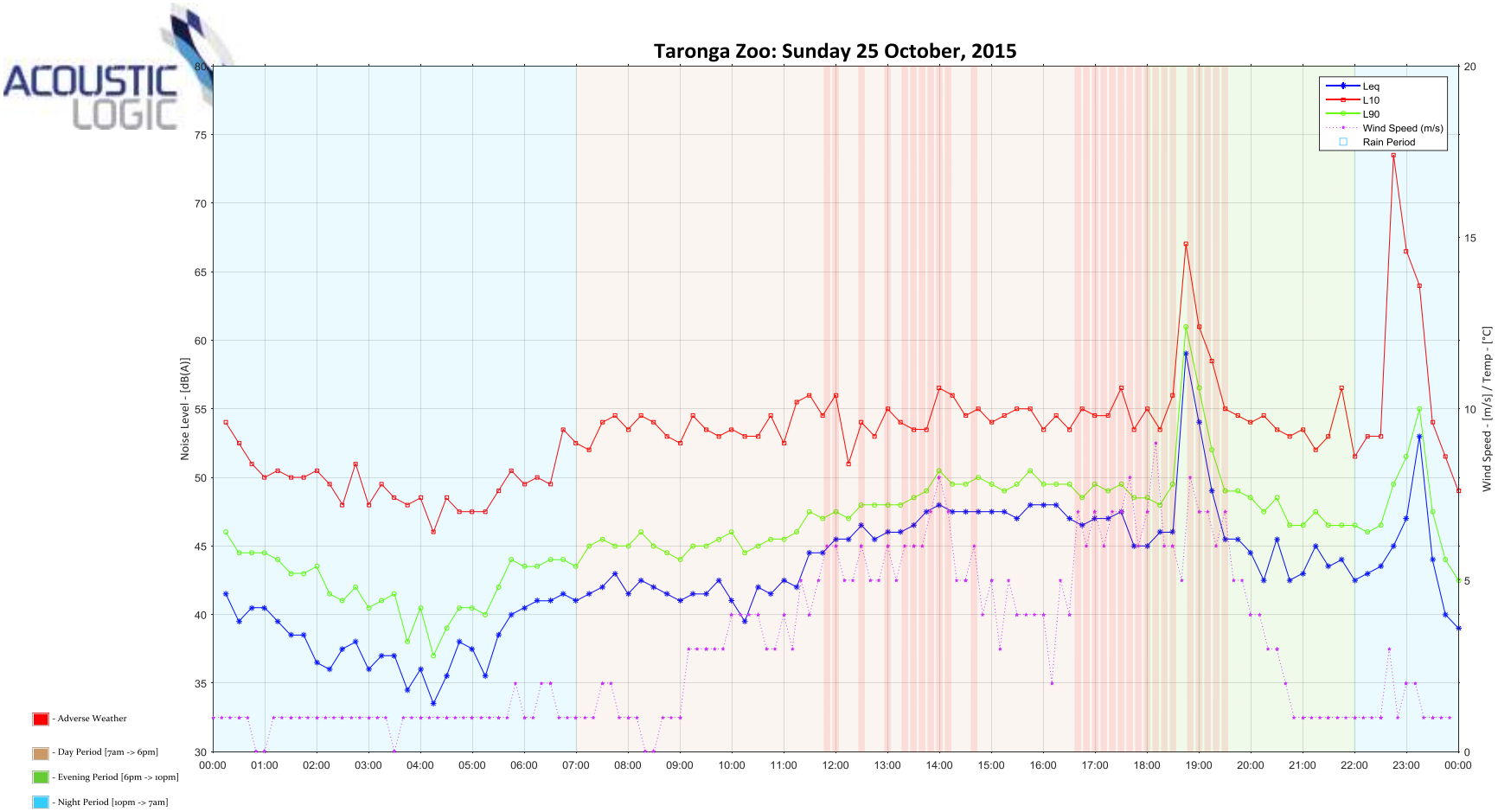
Acoustic Logic Consultancy Pty Ltd
Ben White

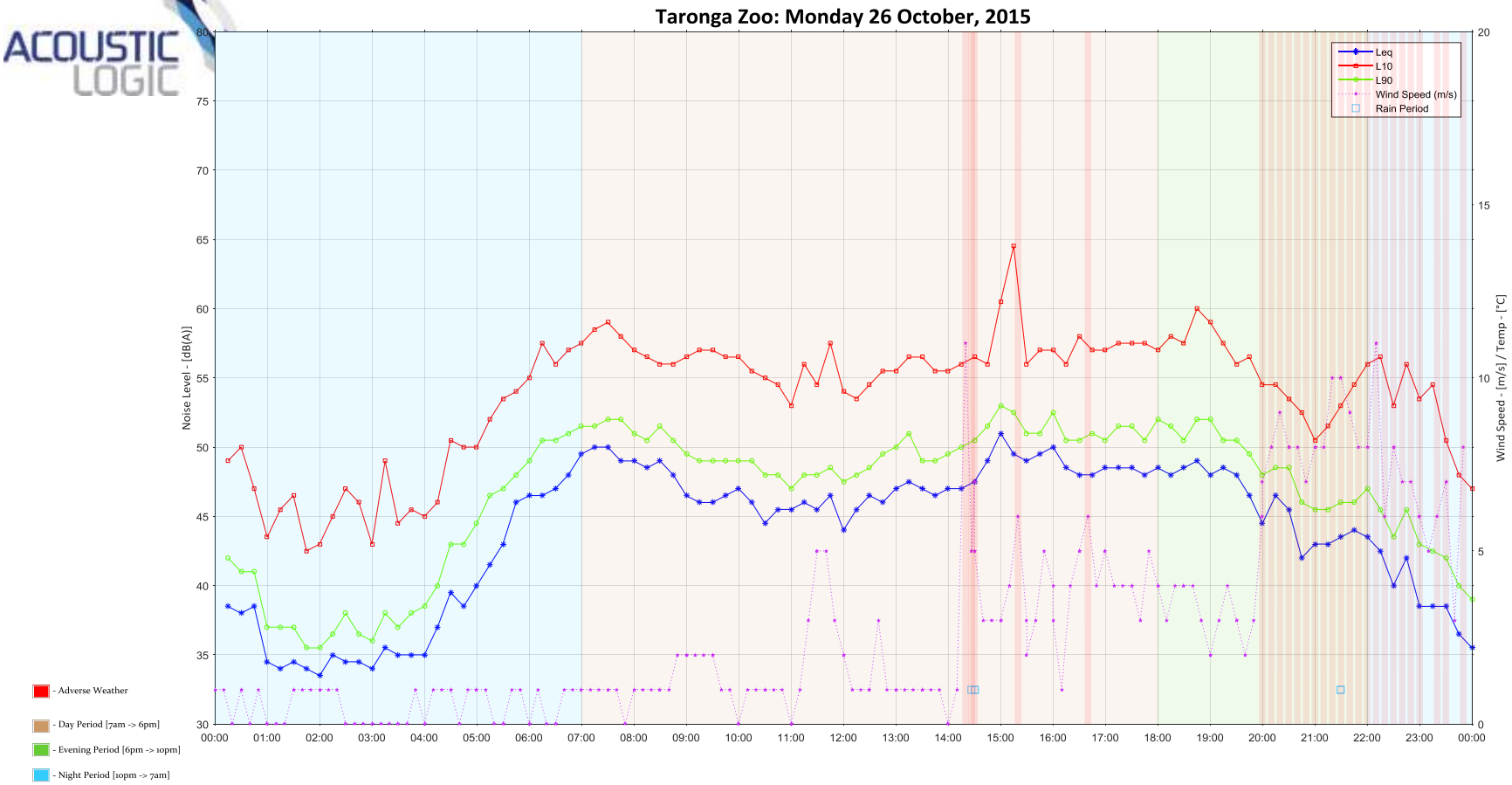
APPENDIX 1: NOISE LOGGING DATA

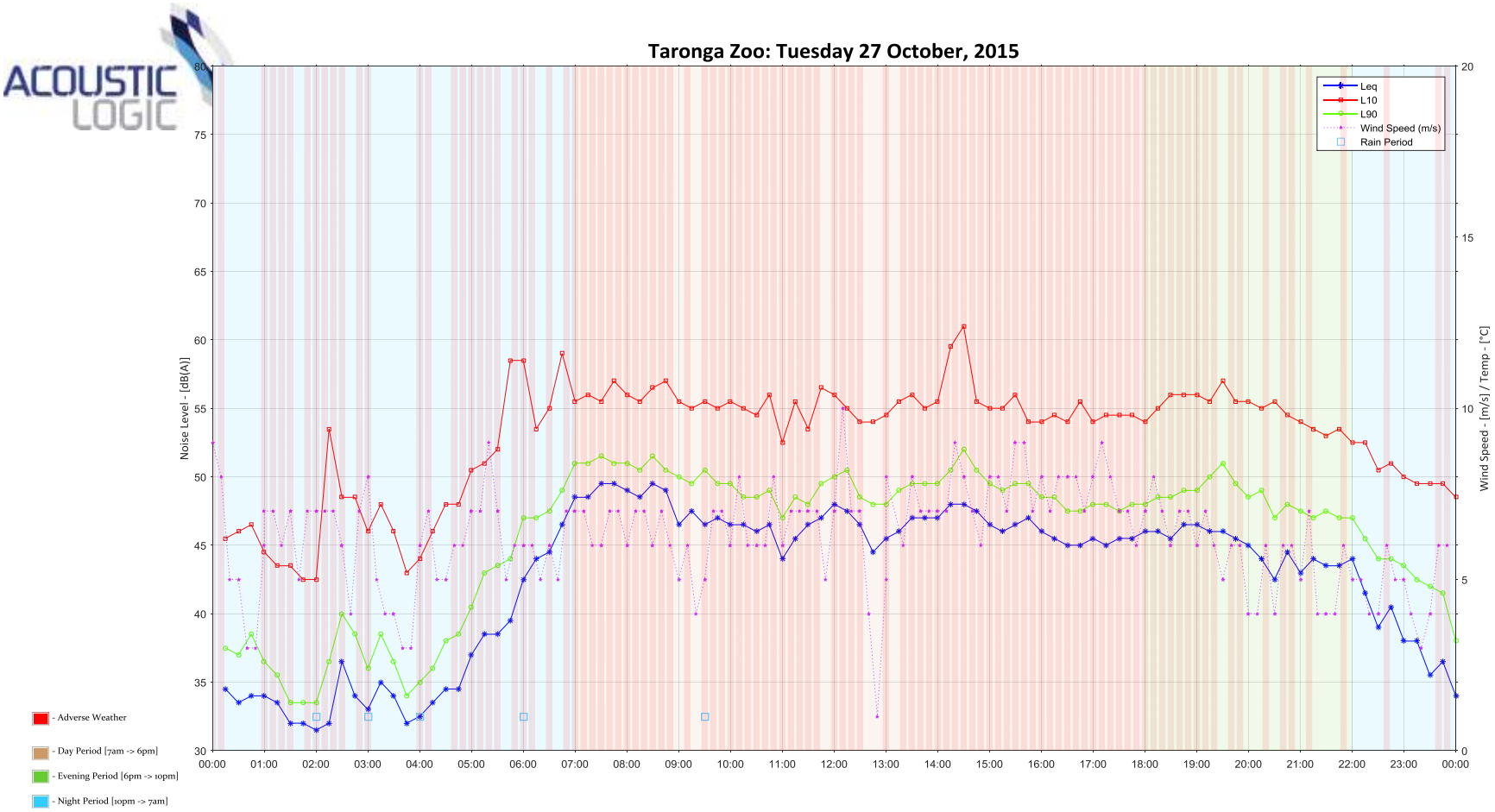

Taronga Zoo: Thursday 22 October, 2015
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

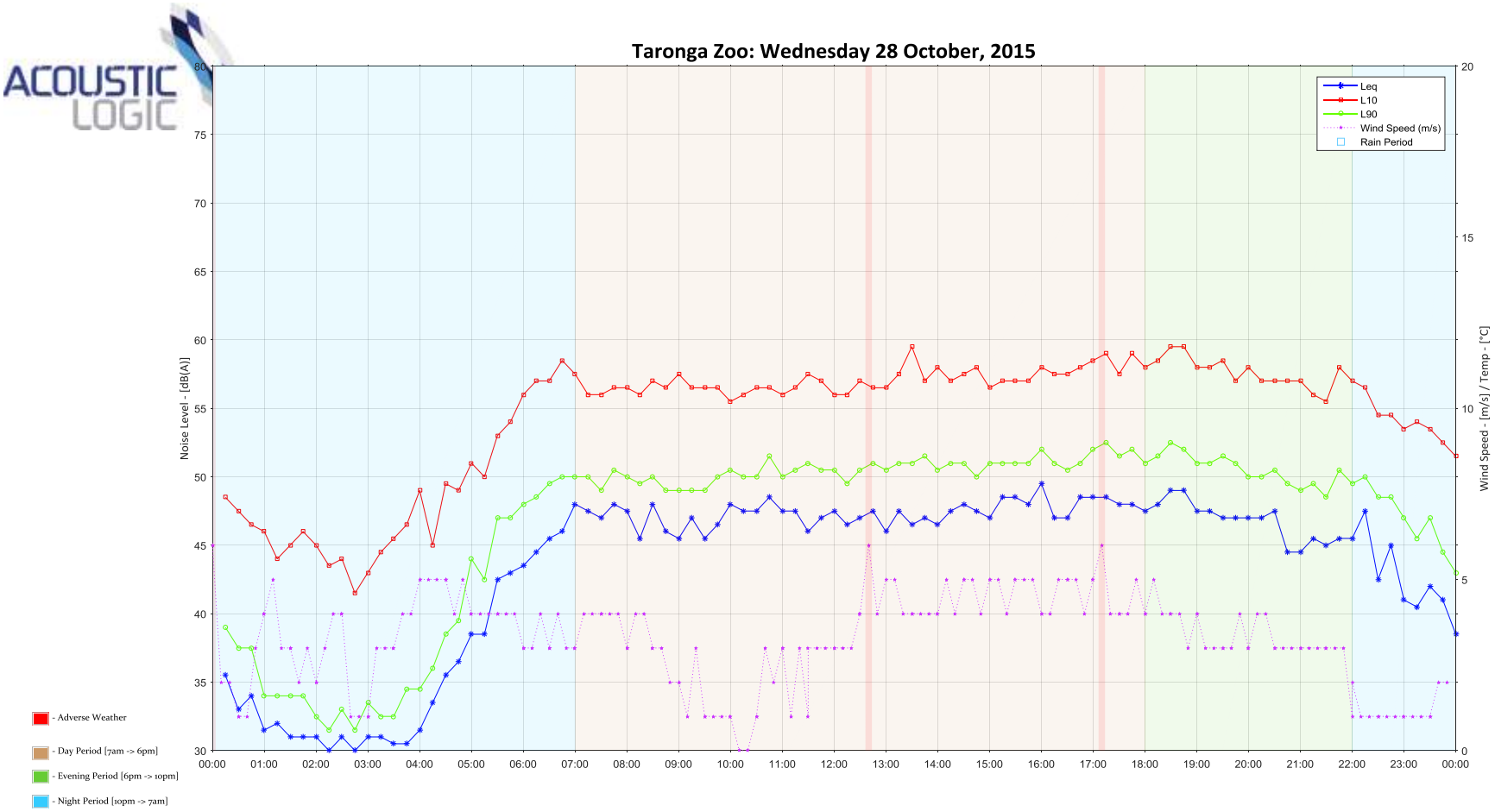

Taronga Zoo: Friday 23 October, 2015
Leq
L10
L90
Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
80
75
70
65
60
55
50
45
40
35
30
20
15
10
5
0
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


Taronga Zoo: Saturday 24 October, 2015
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


Taronga Zoo: Sunday 25 October, 2015
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


Taronga Zoo: Monday 26 October, 2015
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


Taronga Zoo: Tuesday 27 October, 2015
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


Taronga Zoo: Wednesday 28 October, 2015
Leq
L10
L90
Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
80
75
70
65
60
55
50
45
40
35
30
20
15
10
5
0
00:00
01:00
02:00
03:00
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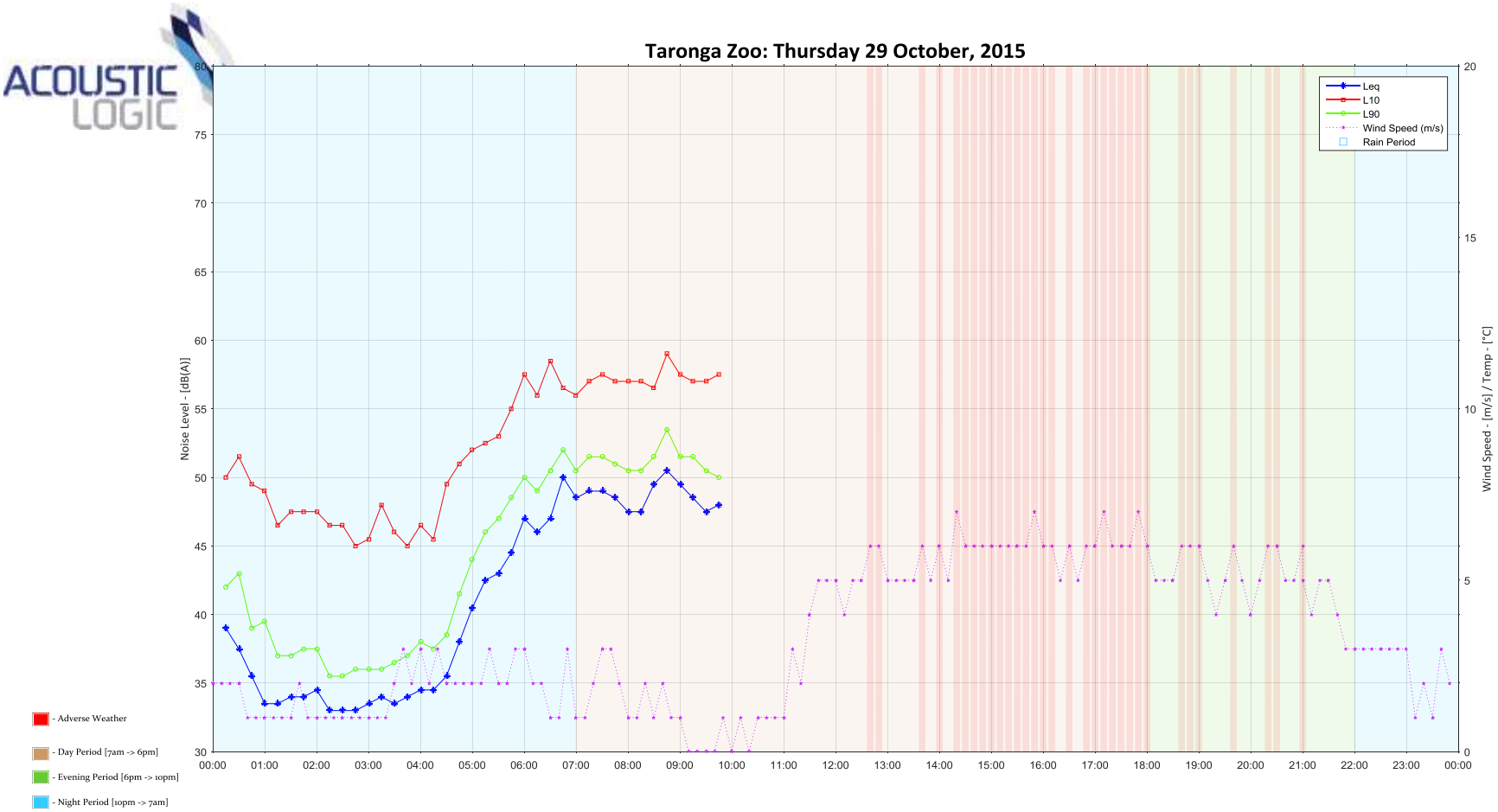
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


Taronga Zoo: Thursday 29 October, 2015
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
Leq
L10
L90
Wind Speed (m/s)
Rain Period
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]