Acoustic Impact Assessment

Acoustic Logic

Appendix W

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Cockle Bay Wharf Redevelopment

Noise Impact Assessment - Stage 1 Development Application

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1 INTRODUCTION

Acoustic Logic Consultancy have been engaged to conduct an acoustic assessment of noise impacts associated with the proposed Cockle Bay redevelopment, Darling Harbour.

This assessment has been commissioned to address aspects of noise impact generated by the site including:

- Traffic noise generation from additional vehicle movements on public roads;
- Plant and equipment (in principle)
- Retail and commercial uses (in principle).
- Construction noise and vibration impacts.

Noise impacts have been assessed with consideration to the following guidelines, regulations and Australian Standards:

- NSW Environment Protection Authority
    - Industrial Noise Policy (INP)
    - Road Noise Policy (RNP)
    - Interim Construction Noise Guideline (ICNG)
- Independent Liquor and Gaming Authority
- State Environmental Planning Policy (Infrastructure) 2007.

An assessment of noise impacts associated with the development has determined that the proposal can achieve the requirements of the aforementioned authorities and regulations for the all periods of the day, evening and night.

Noise levels have been predicted at the receiver locations using SoundPlan™ modelling software implementing the ISO 9613-2:1996 *"Acoustics – Attenuation of Sound During Propagation Outdoors – Part 2: General Method of Calculation"* noise propagation standard.

2 SITE PROPOSAL AND LOCATION

2.1 PRECINCT PROPOSAL

The proposed Cockle Bay Wharf development is to include:

- redevelopment of the existing Cockle Bay Wharf precinct;
- construction of a new public domain over the Western Distributer; and
- the construction of an additional commercial tower as part of the Darling Park precinct.

2.2 EXISTING USES AND ROAD NETWORK

The proposal is to be located in place of the existing Cockle Bay Wharf development, Darling Harbour. The development will extend over the Western Distributer to the existing podium outdoor terrace as part of the Darling Park development.

The existing Cockle Bay Wharf precinct generally encompasses:

- small retail;
- licensed and unlicensed food and beverage;
- associated loading docks and parking.

The surrounding road network consists of:

- Western Distributer to the East of CBW, which carries high volumes of passenger, commercial and heavy vehicle traffic.
- Wheat Road to the East of CBW (underneath and joining into WD eastbound) which carries traffic typically from the City to the King Street Wharf precinct and Millers Point.
- Harbour Street to the East of CBW which typically carries traffic from the Western Distributer (westbound) to the Darling Harbour precinct.

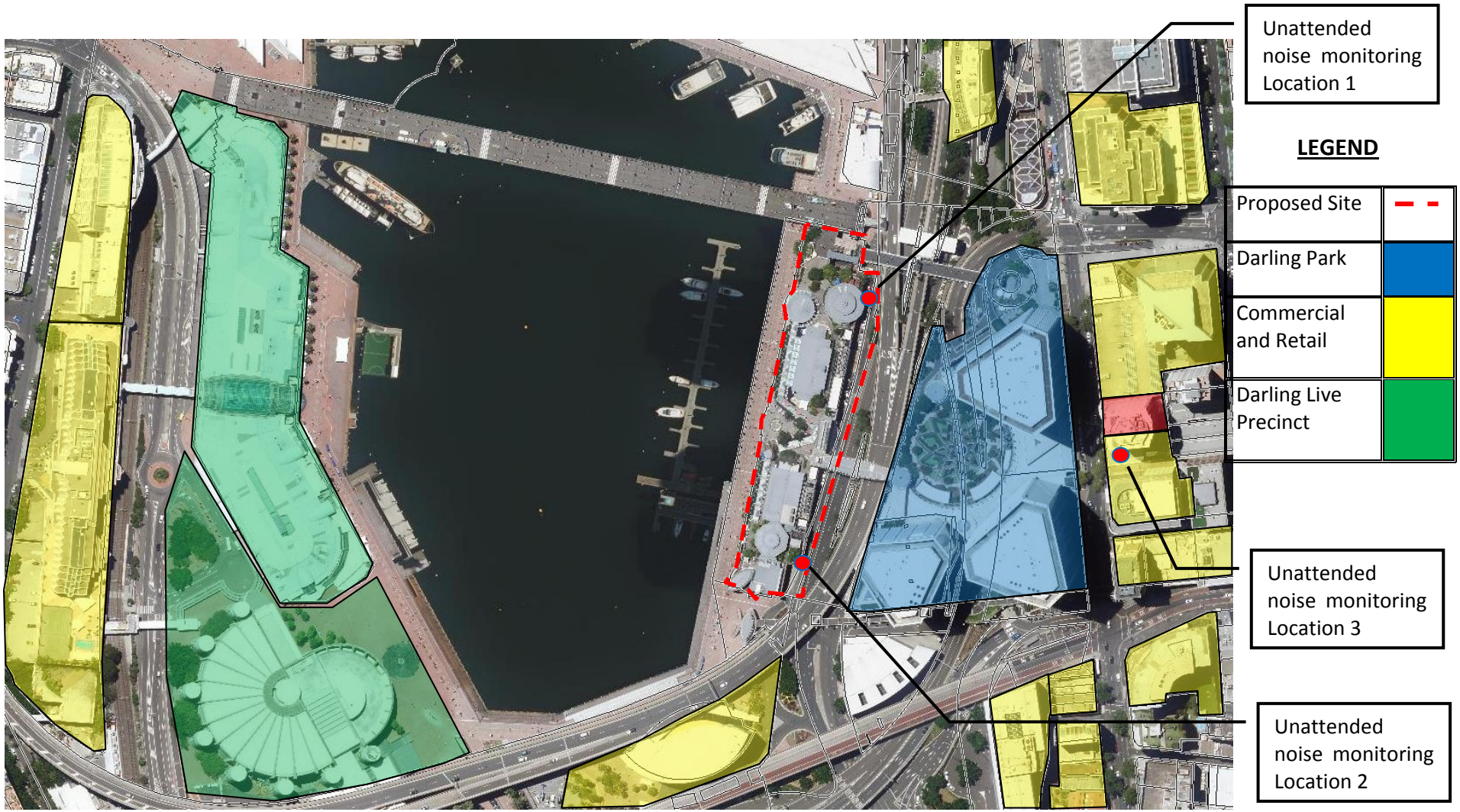


Figure 1: Proposed Development and Immediate Surrounding Uses

3 EXISTING ACOUSTIC ENVIRONMENT

The existing acoustic environment is categorised by the following:

- High background noise levels during the day, evening and night due to direct and latent traffic noise from the Western Distributer.
- Consistent noise levels associated with urban hum.
- Moderate traffic noise levels associated with city streets.

Noise monitoring was conducted at the site to establish typical background and ambient noise levels associated with the surrounding uses and road carriageways.

3.1 ENVIRONMENTAL NOISE DESCRIPTORS

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

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

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

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

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

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

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

3.2 AMBIENT NOISE MONITORING

A series of attended and unattended noise measurements were conducted at the site to establish the existing ambient noise environment.

This includes background noise levels and intrusive noise sources such as traffic noise from surrounding road carriageways.

3.2.1 Measurement Equipment

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

Attended noise measurements were obtained using a Norsonic 140 Sound Level Analyser, set on A-weighted fast response. The sound level meter was calibrated before and after the measurements using a Norsonic 1251 Sound Level Calibrator. No significant drift was recorded.

3.2.2 Measurement Locations

Unattended noise monitoring was conducted at the site as indicated in Figure 1.

3.2.3 Measurement Period

Noise monitoring was conducted during the following periods:

- Unattended monitoring (Refer to Figure 1 for locations):
    - Loc 1 – NE corner, Level 2 of existing Cockle Bay structure - 18 July to 26 July, 2016;
    - Loc 2 – SE corner, Level 2 of existing Cockle Bay structure - 18 July to 26 July, 2016;
    - Loc 3 – 234 Sussex Street - 10 Nov to 18 Nov, 2015.
    - 311-316 Sussex Street – 6th July to 13th July, 2016.
- Attended noise measurements on:
    - Mon 18 July, 2016
    - Tues 26 July, 2016

Noise levels for the receivers across Darling Harbour along Murray Street and within the Goldsborough Apartments have been adopted from noise monitoring conducted in 2013 prior to the demolition and construction of the Sydney International Convention, Exhibition and Entertainment Centre.

Given attributing construction noise levels at this location, background noise levels are expected to have marginally increased since 2013. The background noise levels recorded during this period, that being 2013) have been used as a basis for the assessment of tenancies as part of the Darling Harbour Live redevelopment and as such are considered appropriate for determining the potential for noise impact from the Cockle Bay redevelopment.

Representative background noise levels for receivers North of King Street have been adopted from noise monitoring carried out in 2015 for the development located at 65-67 Sussex Street. Shielded background noise levels at this location are representative of background noise levels across the Western Distributer.

3.3 UNATTENDED NOISE MONITORING RESULTS

Noise levels established from the unattended noise monitoring period are presented below. These have been determined in accordance with the guidelines contained in the INP.

Table 1 – Background Noise Levels

Logger Location	Background Noise Level, dB(A) L_{90}			Average Noise Energy, L_{eq} dB(A)		
	Day	Evening	Night	Day	Evening	Night
Loc 1	66	64	54	71	70	68
Loc 2	71	70	58	76	75	73
Loc 3	56	52	49	58	57	52
311-316 Sussex Street	62	61	55	64	62	60
Southern Terrace of Novotel[1]	58	59	52	67	67	62
Sussex Street	66	61	55	70	69	63

Note[1]: Monitoring conducted by Aecom for the SICEEP development.

4 TRAFFIC NOISE INTRUSION

Traffic noise impacts on development adjacent major roads is addressed under the State Environment Planning Policy (Infrastructure) 2007.

4.1 STATE ENVIRONMENT PLANNING POLICY (INFRASTRUCTURE) 2007

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

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

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

(a) a building for residential use,

(b) a place of public worship,

(c) a hospital,

(d) an educational establishment or child care centre.

The proposal has provisions for retail and commercial uses which are not considered under the SEPP (Infrastructure) requirements. On this basis, traffic noise intrusion need not be considered any further for compliance with Clause 102 of the SEPP (Infrastructure) 2007.

5 ACOUSTIC CRITERIA

The development will include retail and commercial uses. Noise emission requirements to govern these uses have been established against requirements of the NSW Environment Protection Authority and the Independent Liquor and Gaming Authority (ILGA).

Criteria to govern noise emissions generated from the various noise sources as part of the site are summarised in the Table below.

Table 2 – Summary of Noise Emission Regulations and Authorities

Noise Sources	Noise Regulation / Authority
Noise in General	EPA Industrial Noise Policy
Patron / music noise within licensed areas	Liquor and Gaming
Traffic Generation on Public Roads	EPA Road Noise Policy

5.1 EPA - INDUSTRIAL NOISE POLICY

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

Intrusiveness Criterion

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

Rating background noise levels for the area have been established from long term unattended noise monitoring as detailed in Section 3.2.

Amenity Criterion

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

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

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

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

Urban - an area with an acoustical environment that:

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

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

ALC would determine the existing and future precinct sites as an 'Urban' noise environment given that:

- The site is surrounded by significant road carriageways including the Western Distributer.
- The evening environment would not be defined by the natural environment and infrequent human activity.

The corresponding Amenity Criteria noise emission goals are presented below.

Table 3 – INP Amenity Acceptable Noise Levels

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

The aforementioned acceptable levels are to be adjusted in accordance with Section 2.2 of the INP. ALC notes that the background noise levels in the vicinity of the site are largely controlled by traffic noise from the Western Distributer and surrounding city streets. On this basis, no additional adjustments to the amenity criterion are required.

5.2 LIQUOR AND GAMING

When assessing noise emissions from licensed premises, noise emissions must comply with the acoustic requirements imposed by the Industrial Noise Policy and ultimately Liquor and Gaming.

These guidelines relate to noise generated by patrons and by music. The requirements are set out below:

- *That the L_{10} noise level emitted from the premises shall not exceed 5dB above the background L_{90} sound level in any Octave Band Centre Frequency (31.5kHz to 8kHz inclusive) between the hours of 7.00am to 12.00 midnight when assessed at the boundary of the nearest affected residential premises.*

- *L_{10} noise level emitted from the premises shall not exceed the background L_{90} sound level in any Octave Band Centre Frequency (31.5kHz to 8kHz inclusive) after midnight when assessed at the boundary of the nearest affected residential premises.*

After midnight, noise emissions from the Place of Public Entertainment are to be inaudible within any habitable rooms in nearby residential properties.

5.3 EPA ROAD NOISE POLICY

For land use developments with the potential to create additional traffic the development should comply with the requirements for new developments detailed in the EPA Road Noise Policy, criteria as follows.

The policy ensures that noise generated by additional traffic volumes associated with proposed developments does not create an unacceptable noise impact on existing land use developments.

Table 4 - Criteria for Traffic Noise for New Developments (Residential)

Land Use Development	Time of day	Criteria for Acceptable Traffic Noise Level Arterial / Sub-arterial Roads - dB(A)	Criteria for Acceptable Traffic Noise Level Local Roads- dB(A)
Residential	Day (7am to 10pm)	60 $L_{Aeq\ (15hr)}$	55 $L_{Aeq\ (1\ hour)}$
	Night (10pm to 7am)	55 $L_{Aeq\ (9hr)}$	50 $L_{Aeq\ (1\ hour)}$

However, if existing noise levels exceed those in the table above, the provisions of section 3.4 of the Road Noise Policy will apply.

If practicable, noise on public roads as a result of increased traffic generation should not result in an increase in traffic noise level of more than 2dB(A). In this regard, the Policy relevantly states "*an increase of up to 2dB represents a minor impact that is considered barely perceptible to the average person*".

6 ASSESSMENT OF NOISE IMPACTS FROM THE DEVELOPMENT

Noise impacts from the development have been addressed for the following:

- Retail food and beverage uses;
- Additional traffic noise on public roads;
- Mechanical plant in principle.

Each of these uses are to be addressed in greater deal with each individual use development application. Notwithstanding, commentary in this regard has been provided in principle.

6.1 ADDITIONAL TRAFFIC ON PUBLIC ROADS

Access to the site is provided by Wheat Road to the East of the site. Wheat Road runs up to King Street Wharf with an off-ramp from the Western Distributer Northbound adjacent to the Aquarium.

The primary thoroughfare of cars and commercial vehicles from the site will follow this path through to King Street and Shelley Street.

In this regard, we note that:

- There are no sensitive uses along the length of Wheat Road which may be impacted by traffic noise from the site.
- The residential dwellings on Shelley Street are heavily impacted by traffic noise from the Western Distributer. In comparison with the heavy traffic volumes and inherently traffic noise from the Western Distributer, potential increases associated with the site will be negligible.

On this basis, impacts from traffic noise generated by the development will be negligible in comparison with existing traffic noise levels and as such will be compliant with the Road Noise Policy.

6.2 MECHANICAL PLANT

The proposal will include ancillary mechanical services plant *(e.g. condensing units, exhaust fans, etc).* As detailed plant selections and plans are not available at this stage, it is not possible to carry out a detailed examination of the ameliorative measures that may be required in order to achieve the project acoustic objectives.

6.3 RETAIL AND LICENSED PREMISES

Retail food and beverage uses will make up a significant component of the development. Noise impacts to residential dwellings from licensed tenancies as part of these uses are required to be comply with the requirements of NSW Liquor and Gaming.

The existing cockle bay wharf incorporates licensed tenancies facing onto Darling Harbour. The redevelopment of the wharf would therefore not be out of context with existing noise emissions from the site.

Noise from licensed food and beverage tenancies (i.e restaurants and bars) will be typically associated with:

- Patron noise;
- Music; and
- Mechanical plant.

Each of these noise sources will be addressed as part of the individual use development applications in compliance with the NSW EPA and OLGR noise emission requirements.

Notwithstanding, the predominant source of noise from the uses will be associated with patrons utilising external dining areas. Noise from indicative external dining areas have been assessed in principle based on likely patron numbers and noise levels. In this regard, the likely cumulative noise impacts of the development as a whole can be determined. Noise emissions from these uses have been based on the following:

- A sound power level per patron of 77dB(A) L_{10} with 1 in 2 talking at any one time.
- Noise breakout from internal areas can be mitigated via acoustic treatments and management controls and as such will be minimal in comparison with outdoor patrons.
- Given the current layouts, outdoor numbers have been based on 1 patron per m^2. This amounts to the following indicative patrons. The location of outdoor dining areas is indicated in Figure 2.

Table 5 – Patron Numbers

Level	Patron Numbers
Ground	450
1	490
2	270
3	750

Predicted noise levels have been assessed at the nearest residential dwellings, that being:

- the Astoria Tower on Sussex Street approximately 150m to the East;
- Millennium Towers located at 289 Sussex Street approximately 200m to the Southeast; and
- The Goldsbrough Apartments approximately 420m to the West.

Predicted noise levels are presented against the noise criteria at the corresponding locations.

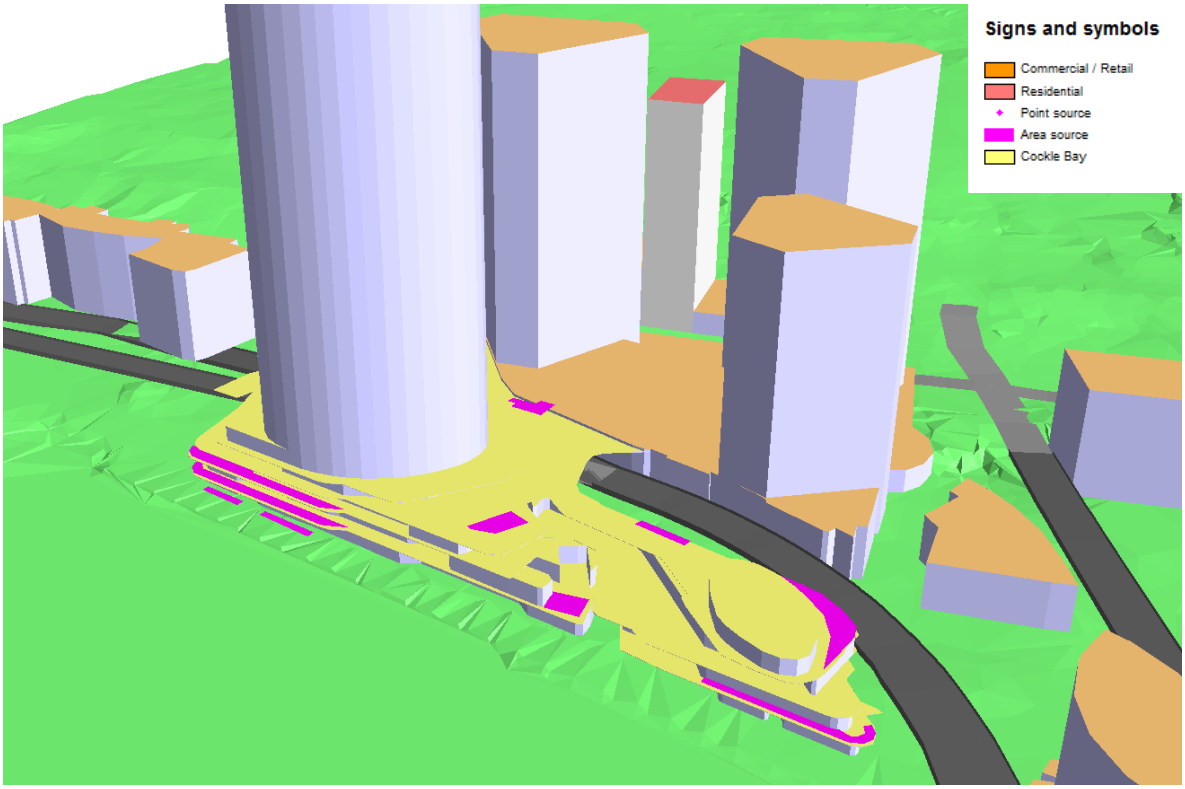


Figure 2: SoundPlan Model

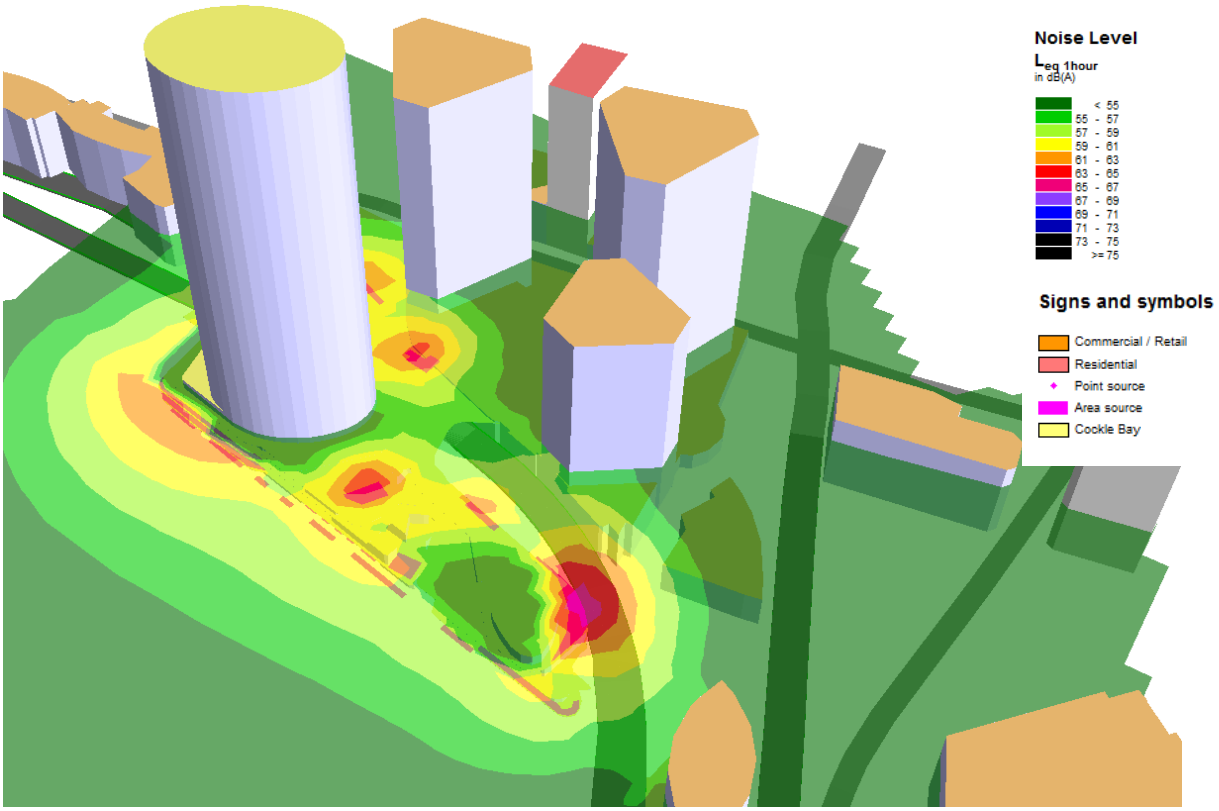


Figure 3: SoundPlan Model – Patron Noise Emissions

Table 6 – Predicted Noise Levels

Situation	Receiver Location	Time of Day		Octave Band Noise Levels, dB								
				31.5Hz	**63Hz**	**125Hz**	**250Hz**	**500Hz**	**1kHz**	**2kHz**	**4kHz**	**8kHz**
External Patrons	Astoria Tower	Night (Up to 12am)	Predicted Noise Level	28	28	31	36	41	42	36	25	1
			Criteria – BG + 5	65	65	62	58	57	55	50	45	38
			Exceedance	-37	-37	-31	-22	-16	-13	-14	-20	-37
	Goldsbrough	Night (Up to 12am)	Predicted Noise Level	29	29	31	34	39	40	33	13	0
			Criteria – BG + 5	71	71	68	66	64	64	61	50	44
			Exceedance	-42	-42	-37	-32	-25	-24	-28	-37	-44
	Millennium Towers	Night (Up to 12am)	Predicted Noise Level	27	27	31	37	43	44	38	24	0
			Criteria – BG + 5	63	63	59	58	57	56	52	46	36
			Exceedance	-36	-36	-28	-21	-14	-12	-14	-22	-36

6.4 DISCUSSION

Predicted noise levels from patrons utilising external dining areas have been conducted. In this regard we note:

- Predicted noise levels at the worst case residential receiver location, that being the Astoria Tower, are at least 13dB below the noise emission criteria.
- There will be some contribution from internal noise breakout and mechanical plant operation, however this would not be significant, likely in the order of 1-2dB at worst.

On this basis, noise emissions from the cumulative operation of the development can comply with the IGLA noise emission requirements.

7 CONSTRUCTION NOISE AND VIBRATION

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

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

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

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

The principal issues to be addressed in this Section are:

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

The expected activities can be expected to include:

1. Demolition of existing structure and detailed excavation of soil and soft sand stone.
2. Construction of proposed facility.

7.1 CONSTRUCTION NOISE MANAGEMENT LEVELS

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

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

Residential dwellings are discussed in Section 4.1.1 of the ICNG.

Table 7 – Construction Noise Management Levels

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

Section 4.1.3 of the ICNG provides guidance on construction noise management levels for sensitive uses other than residential dwellings. These uses as detailed in the following Table.

Table 8 – Construction Noise Management Levels

Land Use	Management level, $L_{Aeq\ (15min)}$ (applies when properties are being used)
Commercial and Retail Outlets	70dB(A)

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

Table 9 – Construction Noise Emission Objectives

Location	"Noise Affected" Level dB(A) $L_{eq\ (15min)}$	"Highly Noise Affected" Level dB(A)$L_{eq(15min)}$
Residences	RBL + 10dB(A)	75
Commercial Development	70	N/A

7.2 CONSTRUCTION VIBRATION

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

Table 10 – Construction Vibration Objectives

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

7.3 ASSESSMENT OF CONSTRUCTION NOISE

With respect to general construction noise, the impacts on nearby development will be dependent on the activity in question and where on the site the activity is undertaken.

The site is located next to the Western Distributer which in itself generates significant levels of noise. Receivers within the general vicinity of this noise source are in most circumstances therefore acoustically treated appropriately to mitigate traffic noise intrusion. In this regard, acoustic treatments to existing building facades and the like work also to mitigate construction noise impacts.

The construction processes involved in the project are discussed below. It should be noted that finite construction processes are developed as part of the early works package and as such expected construction appliances are addressed in principle.

7.3.1 Demolition and Excavation Works

Demolition of the existing CBW structure. Bulk excavation works are not proposed. Excavation works will be detailed in nature.

During the demolition and excavation periods, it is the use of hydraulic hammers, excavators and concrete saws which will present the loudest sources of noise to surrounding receiver locations. Likely worst case noise levels are presented in Table 12.

Table 11 – Excavation and Demolition Works

Construction Plant	Plant Noise Level dB(A)	Receiver Location	Predicted Worst Case Noise Level dB(A) L_{eq}	Construction Noise Objective dB(A) L_{eq}
Hammering	120	Harbourside	63	70
		Sydney Aquarium	67	70
		Sheraton	72	70
		Astoria Tower	64	66
		Darling Park Towers	82	70
		Park Royal	67	70
		Millennium Towers	62	74
Excavator	114	Harbourside	57	70
		Sydney Aquarium	61	70
		Sheraton	66	70
		Astoria Tower	58	66
		Darling Park Towers	76	70
		Park Royal	61	70
		Millennium Towers	56	74

With regard to the demolition and detailed excavation works, we note the following:

- There are no residential receivers within close proximity to the site which may be affected by construction noise exceeding that in the ambient noise environment.
- Predicted noise levels during hammering works are only likely to exceed the 70dB(A) L_{eq} noise level at the Sheraton and Darling Park towers.
    - The Darling Park Towers are expected to be separately managed with respect to construction noise given the developers interest in the towers.

The Sheraton is impacted by traffic noise levels up to 70dB(A) L_{eq}. On this basis, the construction noise during the worst case period (that being hammering in the North-east corner of the site) will only marginally exceed this level. For the most part, construction noise levels at this location are expected to be significantly less.

7.3.2 General Construction Works

During erection of structure, it is the use of hand tools (angle grinders etc.) and the tower crane which are the loudest typical activity (sound power levels of approximately 100-114dB(A) $L_{eq(15min)}$). Likely worst case noise levels are presented in Table 12.

Table 12 – General Construction Works

Construction Plant	Plant Noise Level dB(A)	Receiver Location	Predicted Worst Case Noise Level dB(A) L_{eq}	Construction Noise Objective dB(A) L_{eq}
Angle Grinders	114	Harbourside	57	70
		Sydney Aquarium	61	70
		Sheraton	66	70
		Astoria Tower	58	66
		Darling Park Towers	76	70
		Park Royal	61	70
		Millennium Towers	56	74
Tower Crane	105	Harbourside	48	70
		Sydney Aquarium	52	70
		Sheraton	57	70
		Astoria Tower	49	66
		Darling Park Towers	67	70
		Park Royal	52	70
		Millennium Towers	47	74
Helicopter Floats	100	Harbourside	43	70
		Sydney Aquarium	47	70
		Sheraton	52	70
		Astoria Tower	44	66
		Darling Park Towers	62	70
		Park Royal	47	70
		Millennium Towers	42	74

- Predicted noise levels during angle grinding works are only likely to exceed the 70dB(A) L_{eq} noise level at the Darling Park towers. The Darling Park Towers are expected to be separately managed with respect to construction noise given the developers interest in the towers.
- Work zones are likely to occur off Wheat Road on the Eastern portion of the site. Noise from construction vehicles and material handling will negligible impact on surrounding uses given the lower elevation of the ground level in relation to receiver locations.
- Slab finishing works (use of helicopter floats or similar) will have negligible impact on surrounding receiver locations in comparison with traffic noise from the Western Distributer and surrounding roadways
- Once construction of the building shell is complete, noise from hand tools will be relatively low, as the new building façade will provide considerable noise attenuation. Once the building shell is largely complete, use of hand tools in internal areas is highly unlikely to exceed EPA recommended levels at any receiver locations.

7.4 DISCUSSION

In light of the above, we note the following;

- Construction noise impacts at residential receivers are likely to comply with the "Noise Management"/"Background+10dB(A)" noise level for all construction works.
- Some exceedances will occur at the Sheraton during hydraulic hammering processes however this will only occur when in close proximity to the boundary. In any case, the noise levels experienced at the facades of these buildings, namely the Sheraton, will be masked by traffic noise from the Western Distributer in any case.
- Construction noise impacts at all other surrounding commercial properties outside of the Darling Park precinct will also comply with the recommended construction noise management levels.

Noise impacts on nearby developments can be suitably managed to prevent unreasonable impact. Management processes for dealing with construction noise complaints and response procedures are addressed in Section 7.6.

7.5 CONSTRUCTION VIBRATION

Given the proximity to surrounding receiver locations, no significant vibration impacts are expected due to the construction works.

7.6 NOISE AND VIBRATION MONITORING, REPORTING AND RESPONSE PROCEDURES

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

1. Determining the offending plant/equipment/process
2. Locating the plant/equipment/process further away from the affected receiver(s) if possible.
3. Implementing additional acoustic treatment in the form of localised barriers, silencers etc.
4. Selecting alternative equipment/processes

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

7.6.1 Reporting requirements

The following shall be kept on site:

1. A register of complaints received/communication with the local community shall be maintained and kept on site with information as detailed below.
2. Where noise/vibration complaints require noise/vibration monitoring, results from monitoring shall be retained on site at all times.
3. Any noise exceedances occurring including, the actions taken and results of follow up monitoring.
4. A report detailing complaints received and actions taken shall be presented.
5. All monitoring and reporting shall be conducted in conjunction with the conditions of consent.

7.6.2 Response procedures

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

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

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

7.6.3 Control of Construction Noise

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

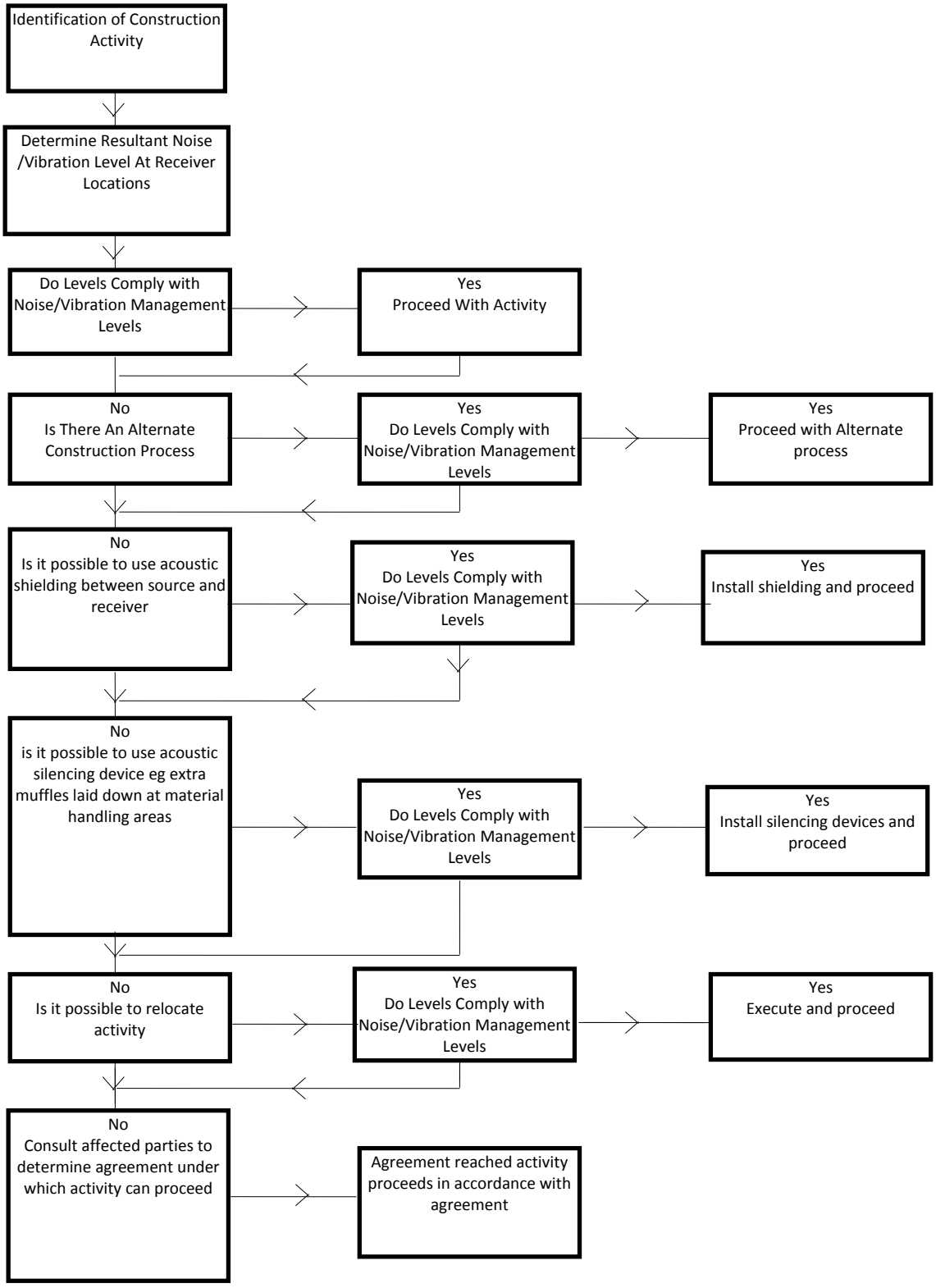


Figure 2 – Process Flowchart

7.7 NOISE CONTROL METHODS

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

7.7.1 Selection of Alternate Appliance or Process

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

7.7.2 Acoustic Barriers

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

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

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

7.7.3 Silencing Devices

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

7.7.4 Treatment of Specific Equipment

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

7.7.5 Establishment of Site Practices

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

8 CONCLUSION

This report presents the assessment of noise impacts associated with the proposed redevelopment of the Cockle Bay Wharf development, Darling Harbour.

It has been concluded that:

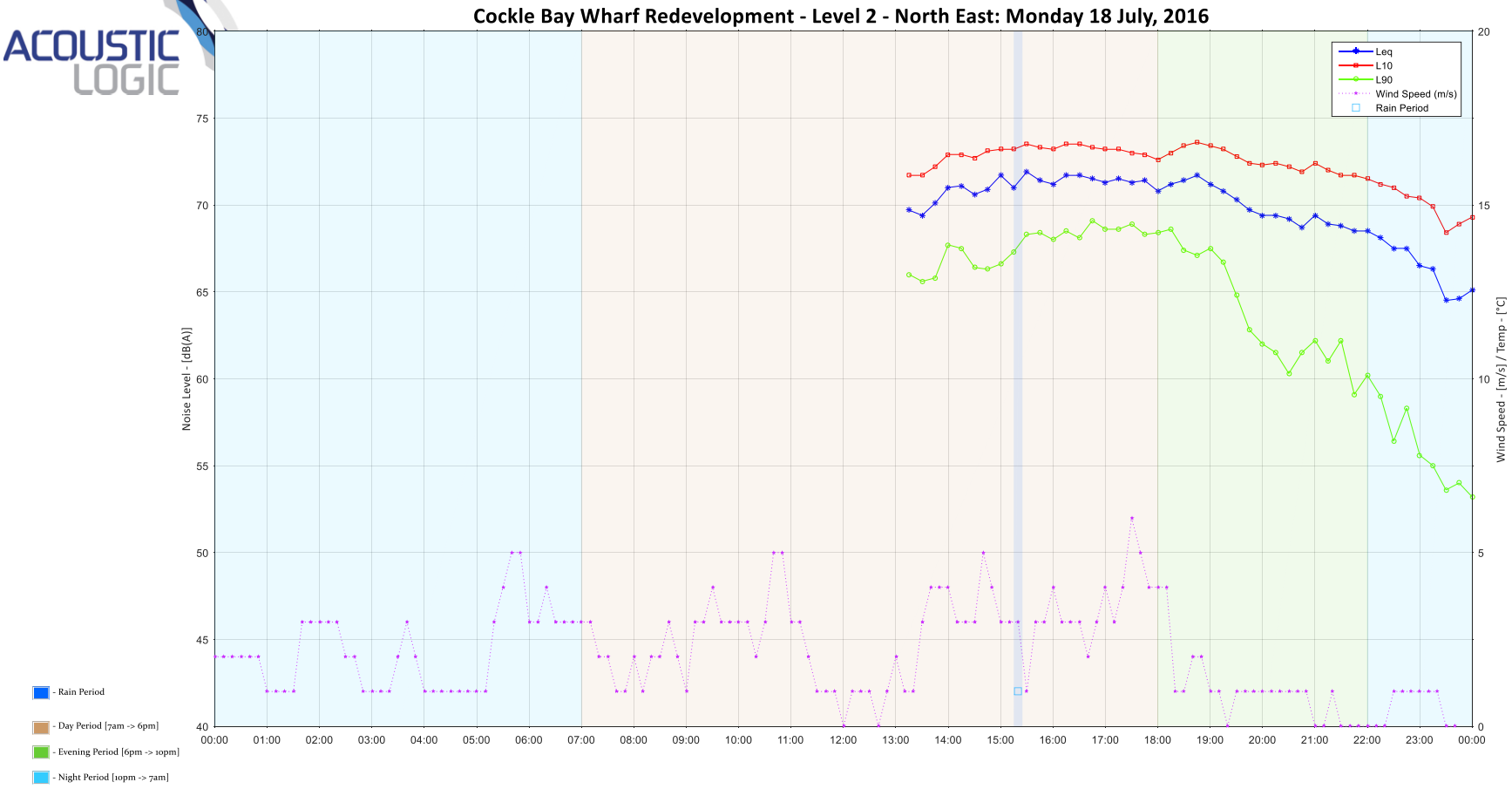
- Traffic noise generation due to vehicles associated with the development will be negligible given the respective traffic volumes and inherent noise levels on surrounding roadways.
- A preliminary evaluation of noise associated with the cumulative impact of patrons utilising external dining areas indicate compliance with the requirements of the Independent Liquor and Gaming Authority during the day, evening and night time period. A detailed analysis of noise emissions associated with each tenancy use should be conducted as part of the individual use development applications.
- Mechanical noise emanating from the site will be addressed upon selection of mechanical equipment and the finalisation of the mechanical scheme.
- Potential impacts associated with construction noise emanating from the site have been assessed. Predicted noise levels indicate minor exceedances of the recommended management levels of the EPA Interim Construction Noise Guideline and only during the worst case construction operations. Noise associated with the construction works are likely to be masked by traffic noise at these locations in any case.

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

Yours faithfully,

James Small
Acoustic Logic Consultancy Pty Ltd

APPENDIX ONE – UNATTENDED NOISE MONITORING – LOCATION 1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Leq
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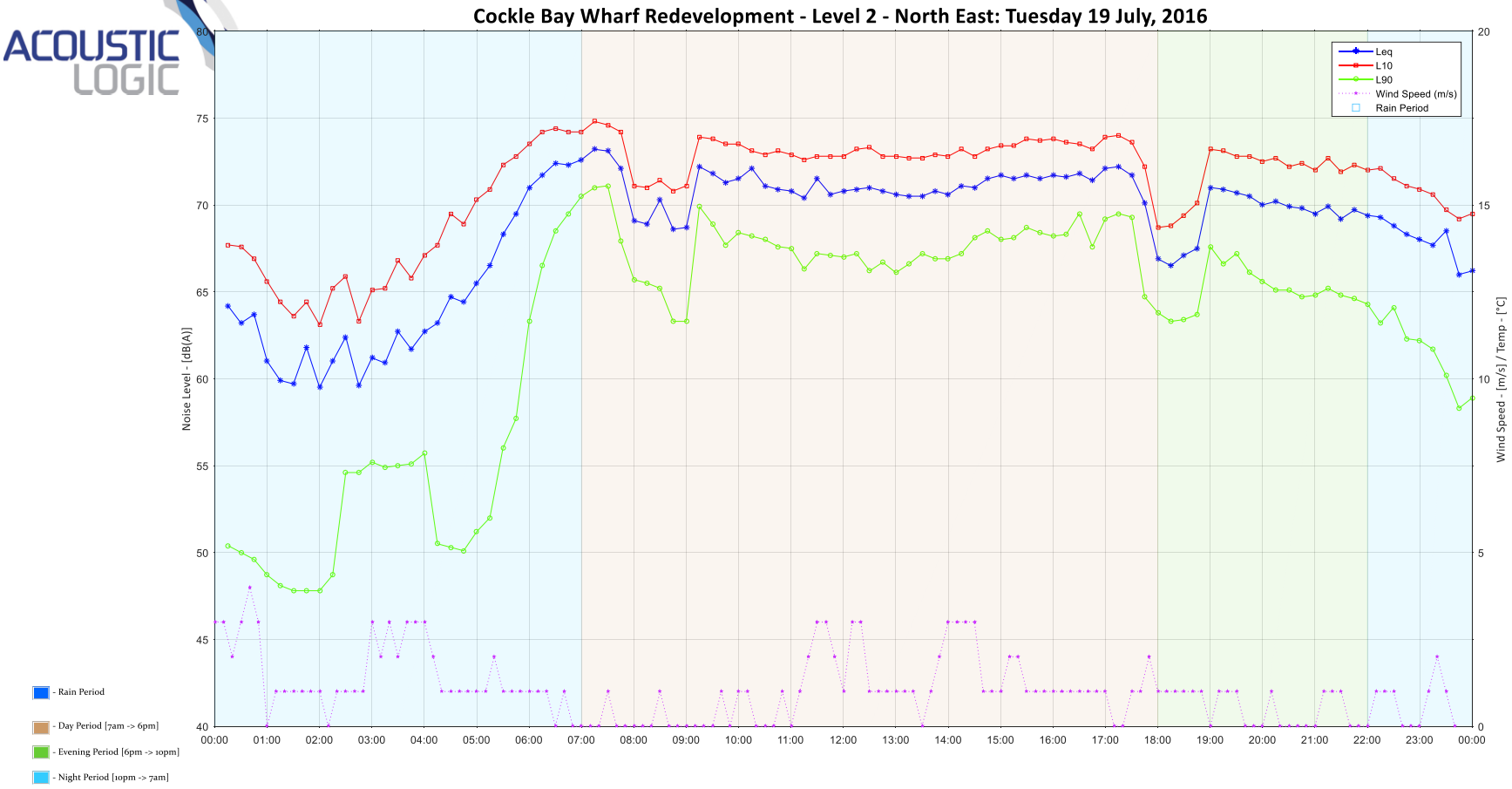
Wind Speed (m/s)
Rain Period
- Rain Period
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]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Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
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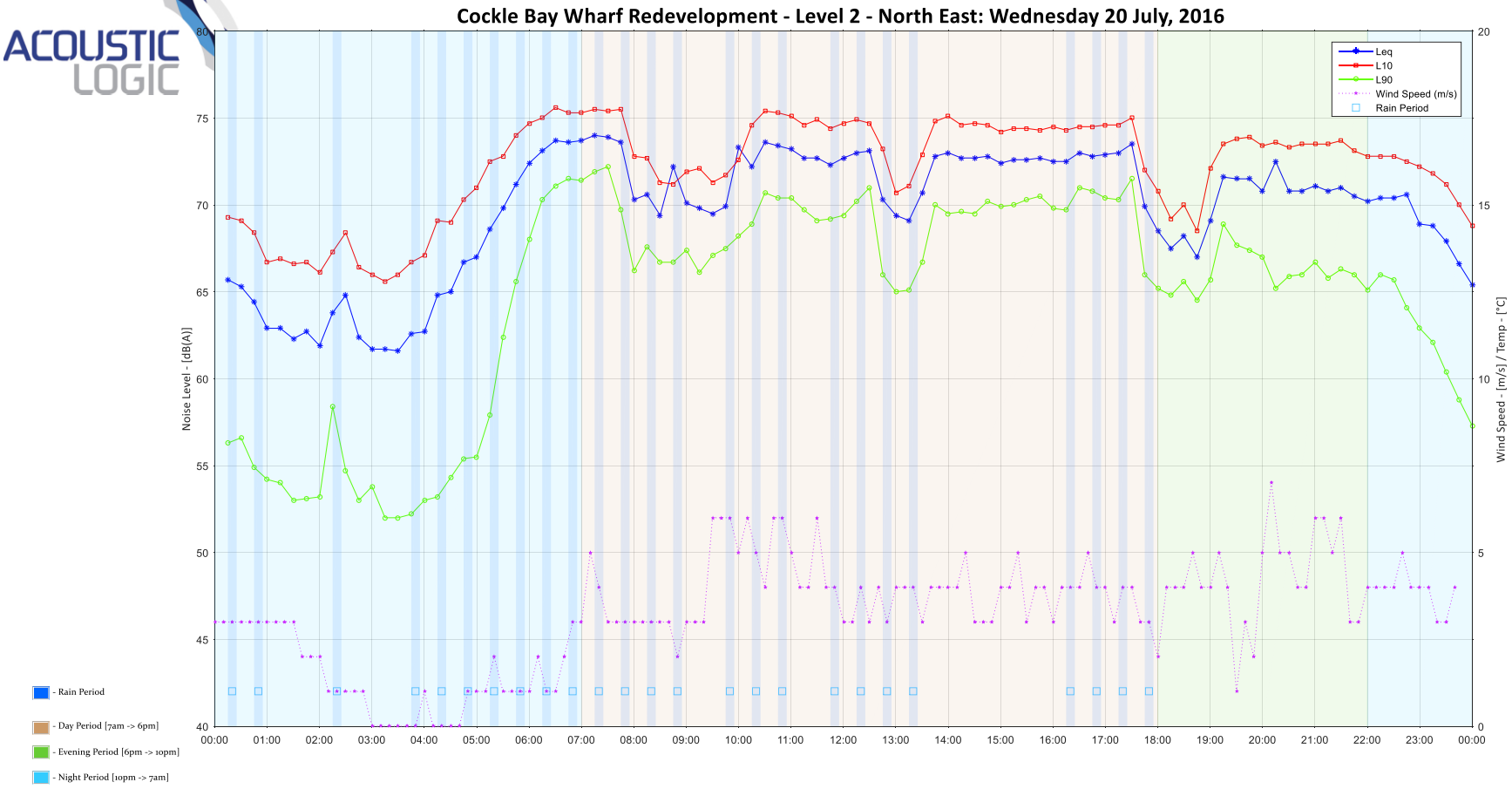
- Rain Period
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]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Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
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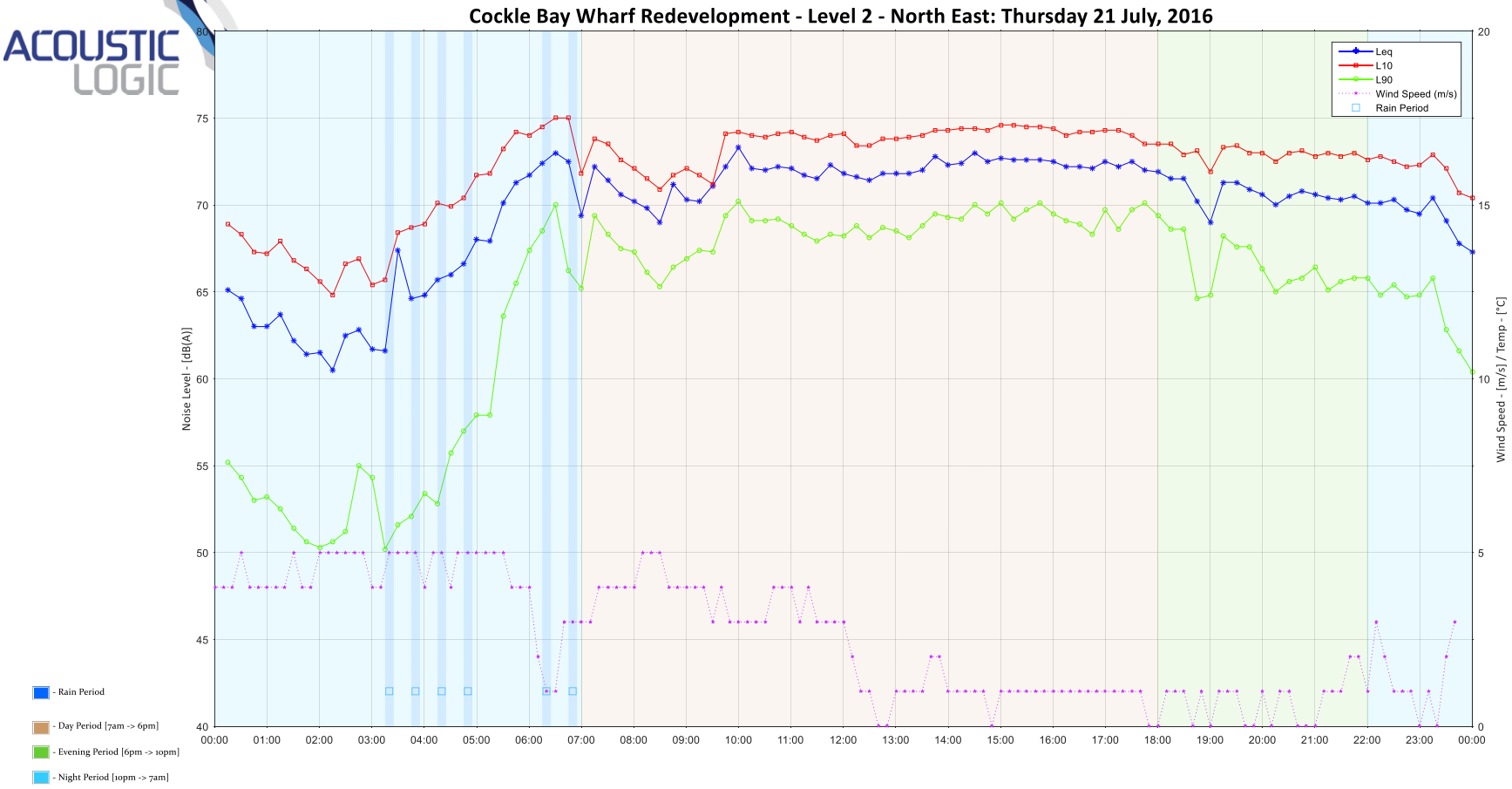
- Rain Period
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]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Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
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- Rain Period
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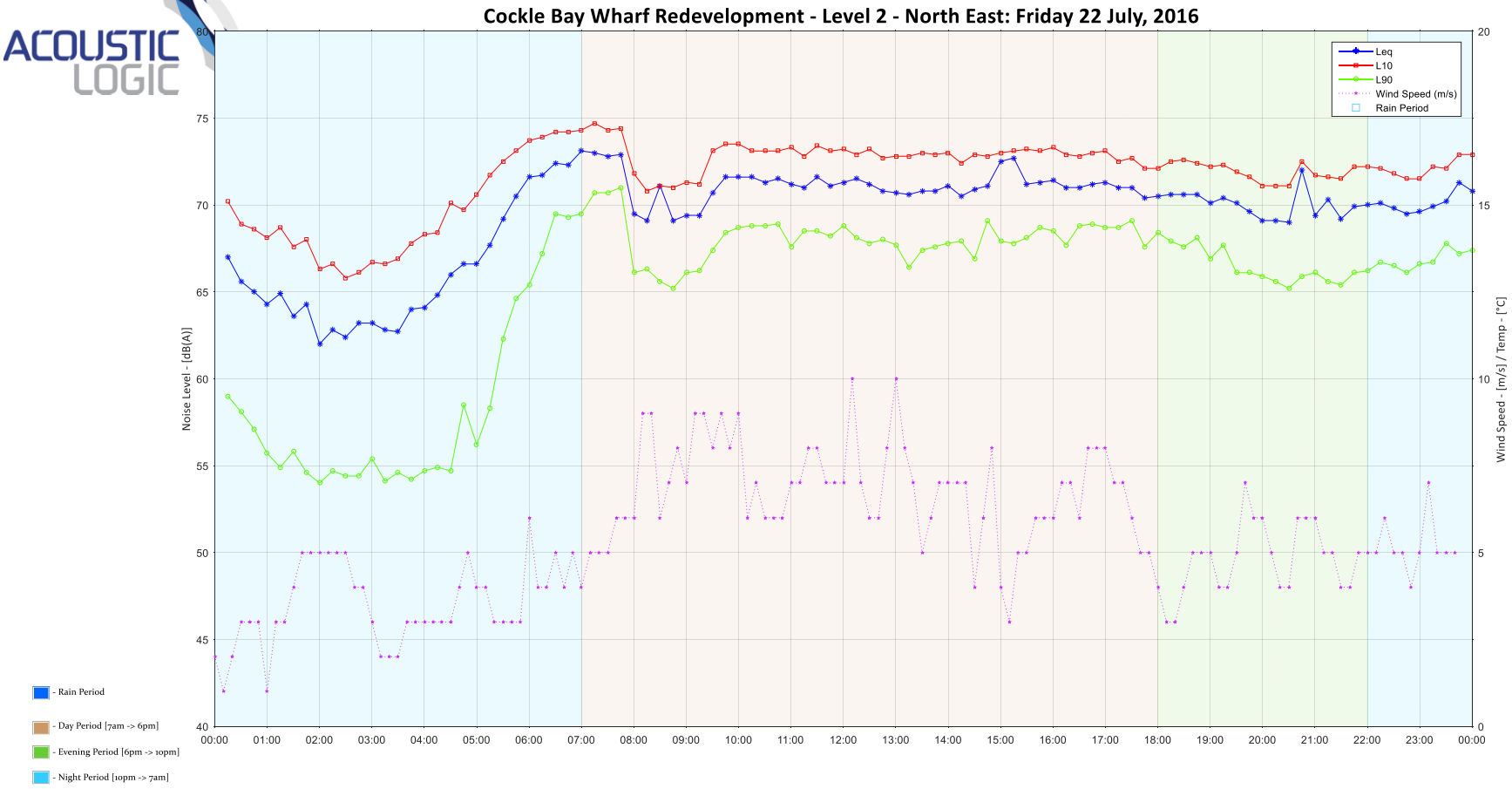
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Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
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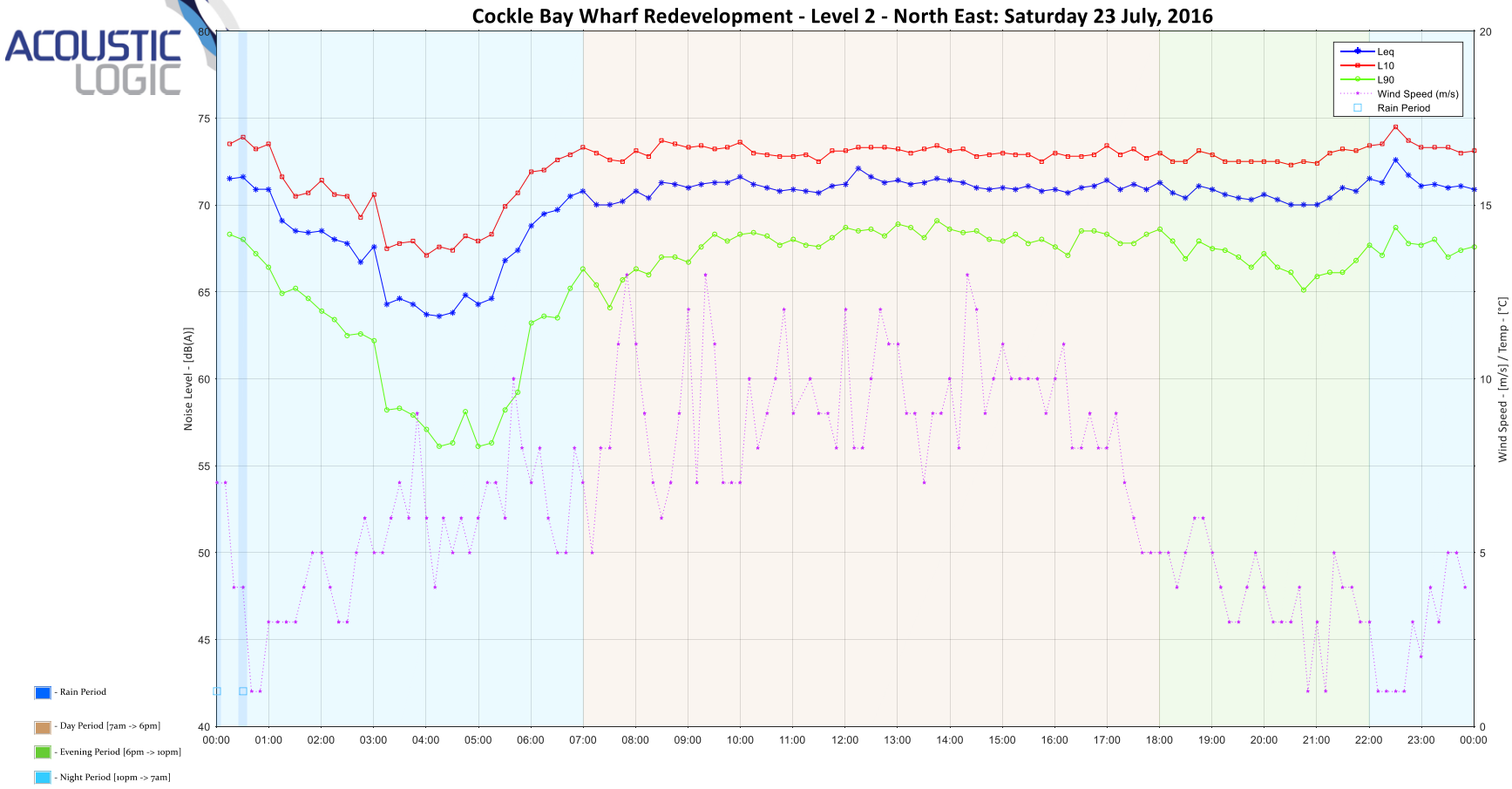
- Rain Period
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]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Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
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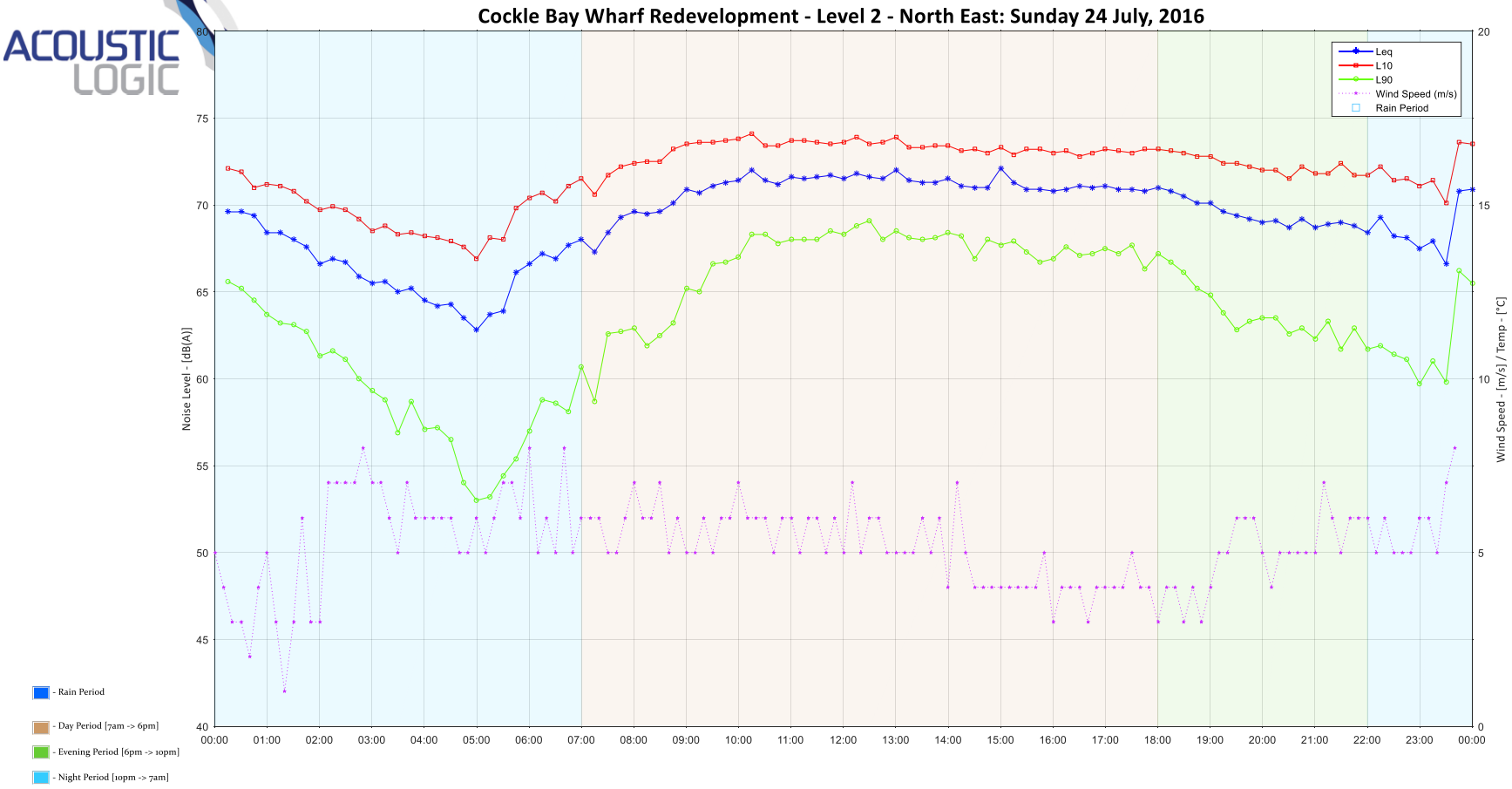
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Wind Speed (m/s)
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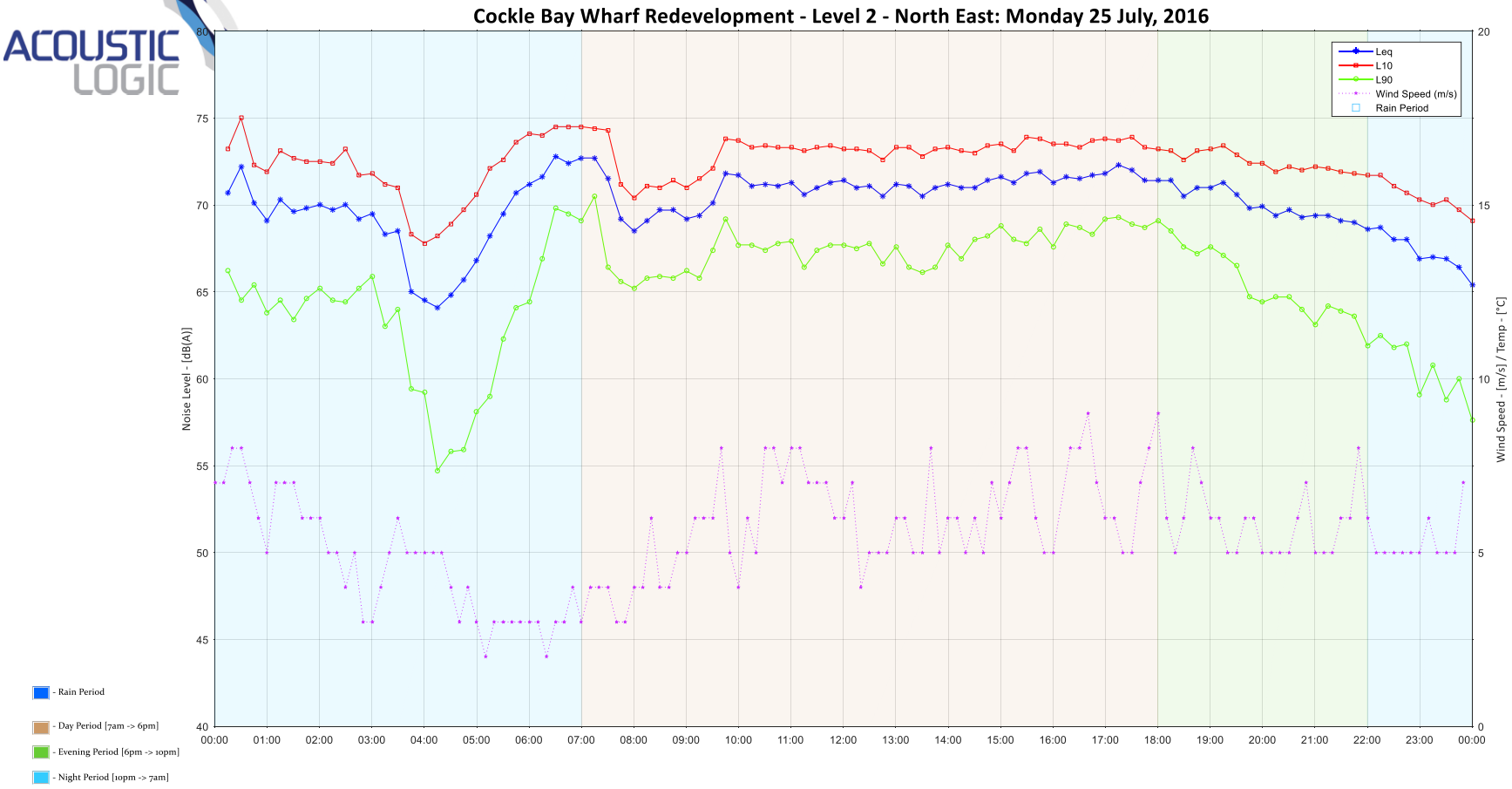
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]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Wind Speed (m/s)
Rain Period
Noise Level - [dB(A)]
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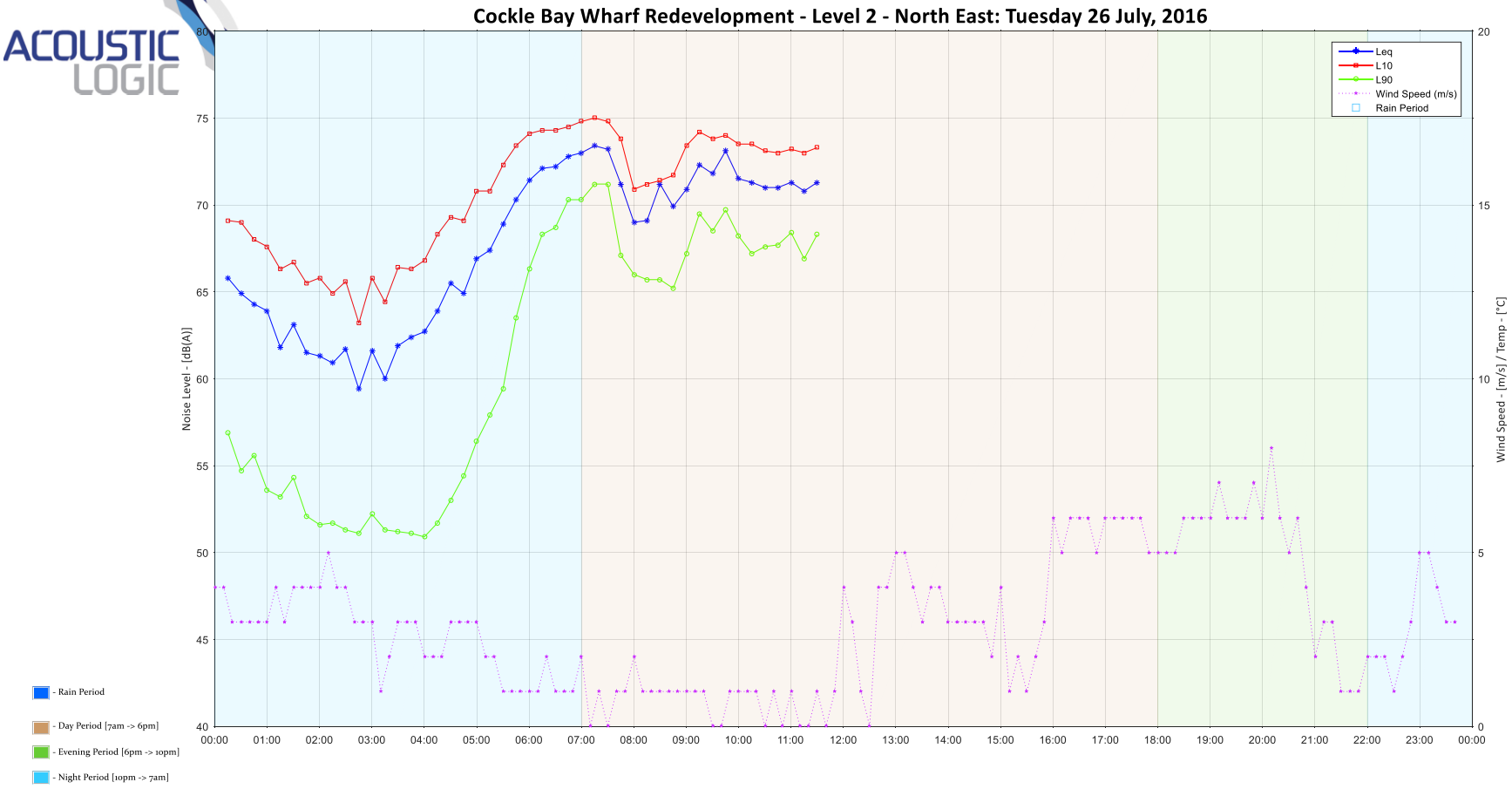
- Night Period [10pm -> 7am]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Wind Speed - [m/s] / Temp - [°C]
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Wind Speed (m/s)
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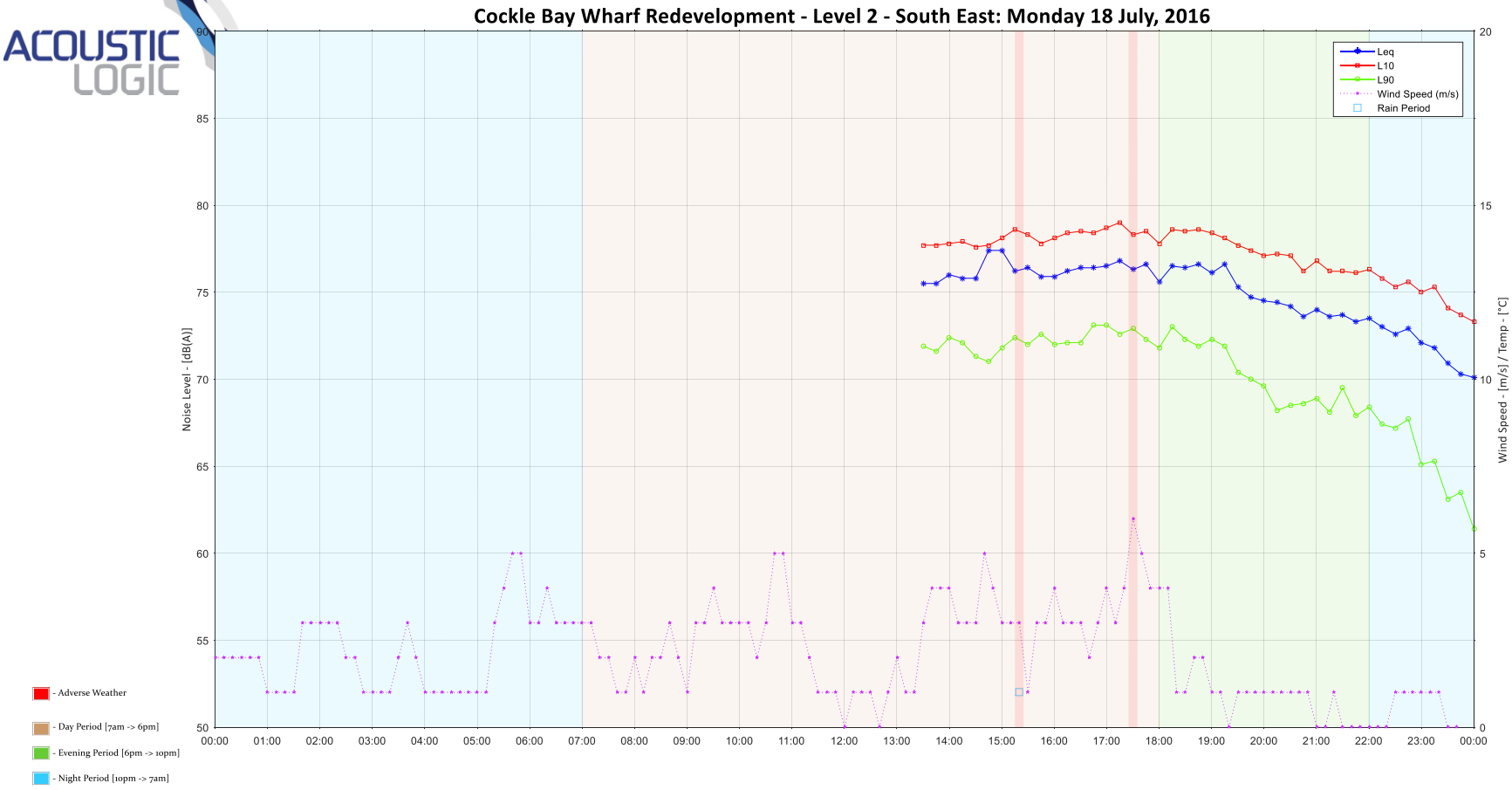
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

APPENDIX TWO – UNATTENDED NOISE MONITORING – LOCATION 2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Noise Level - [dB(A)]
Wind Speed - [m/s] / Temp - [°C]
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Wind Speed (m/s)
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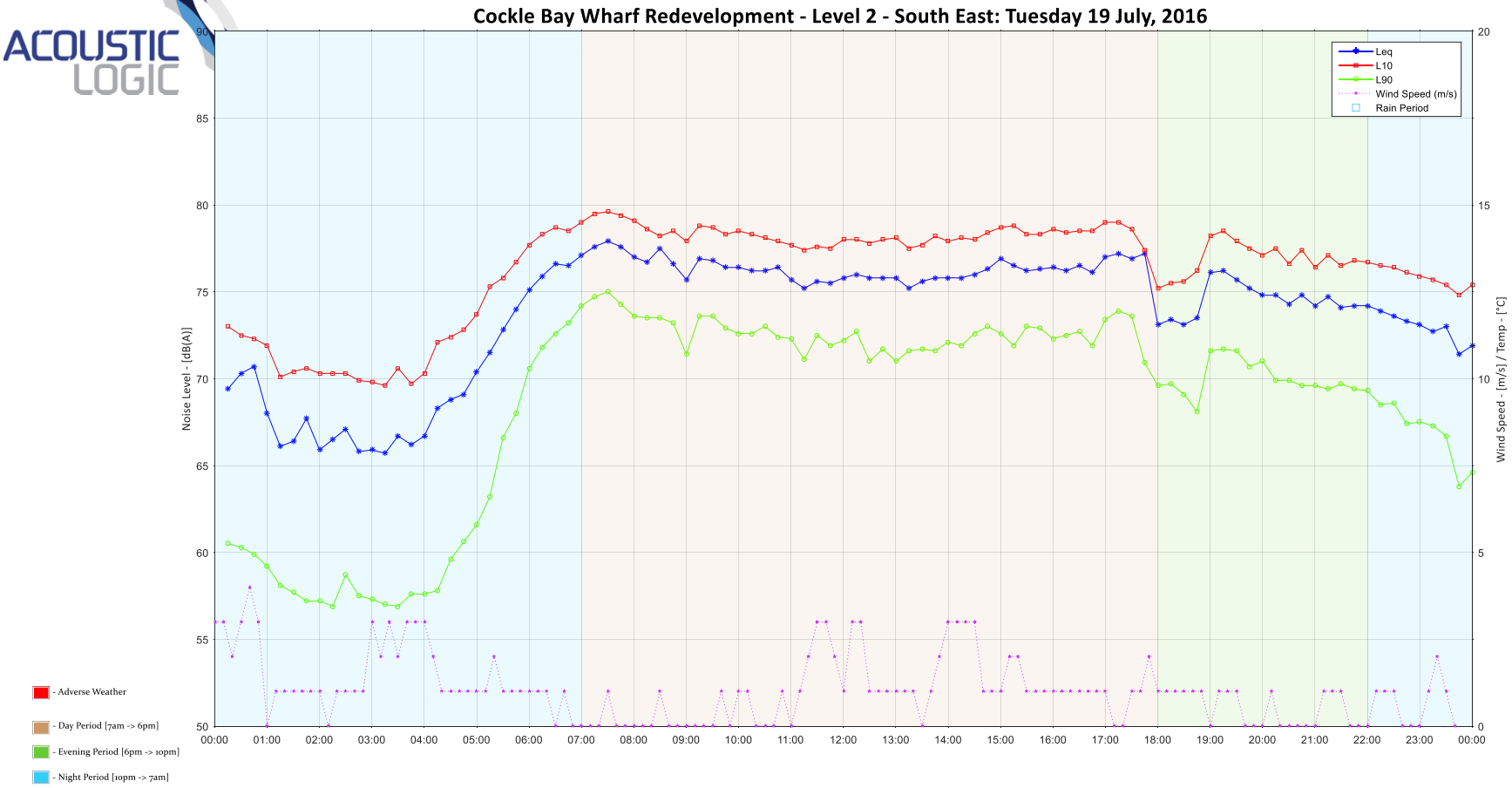
- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]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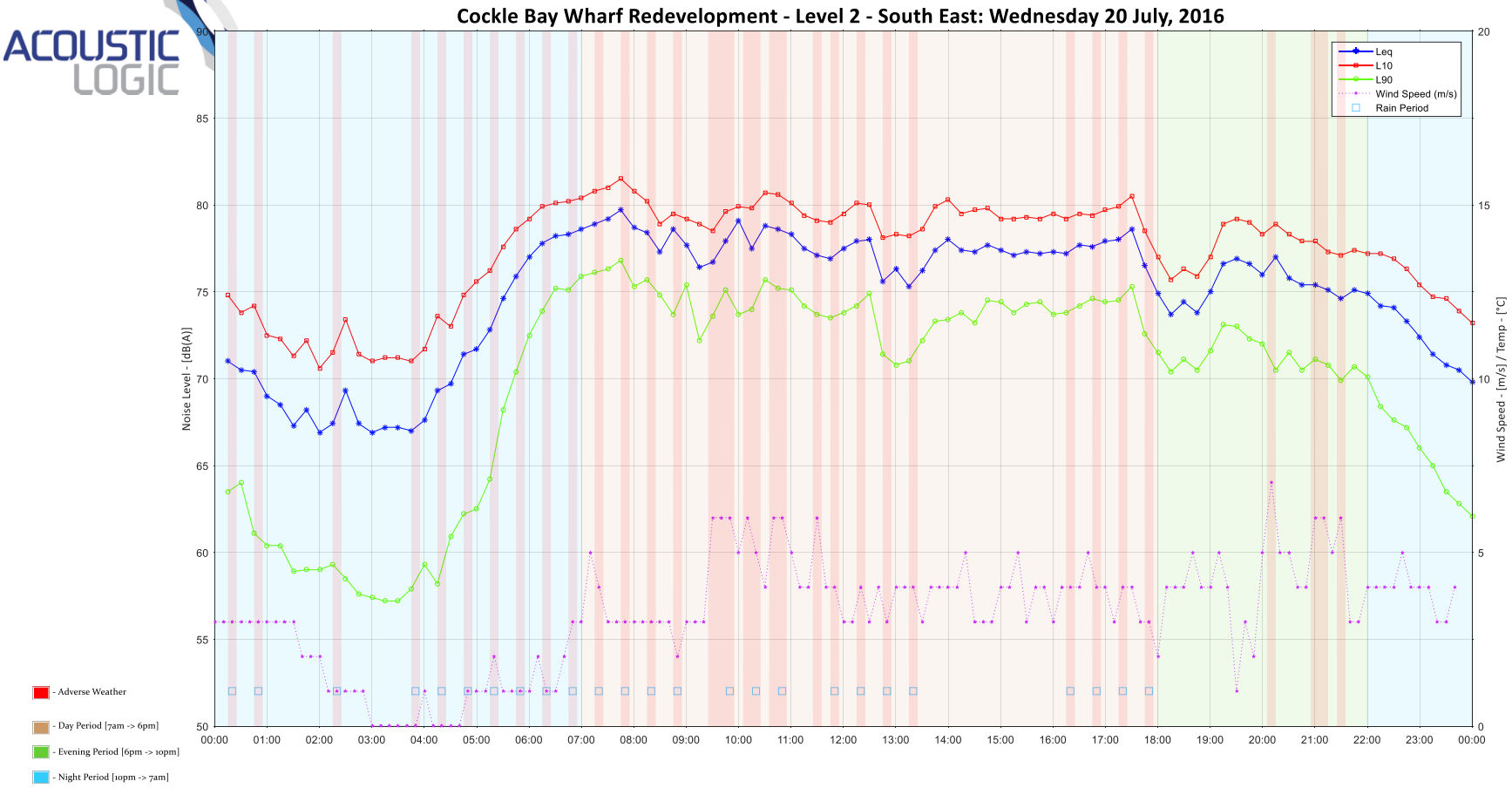
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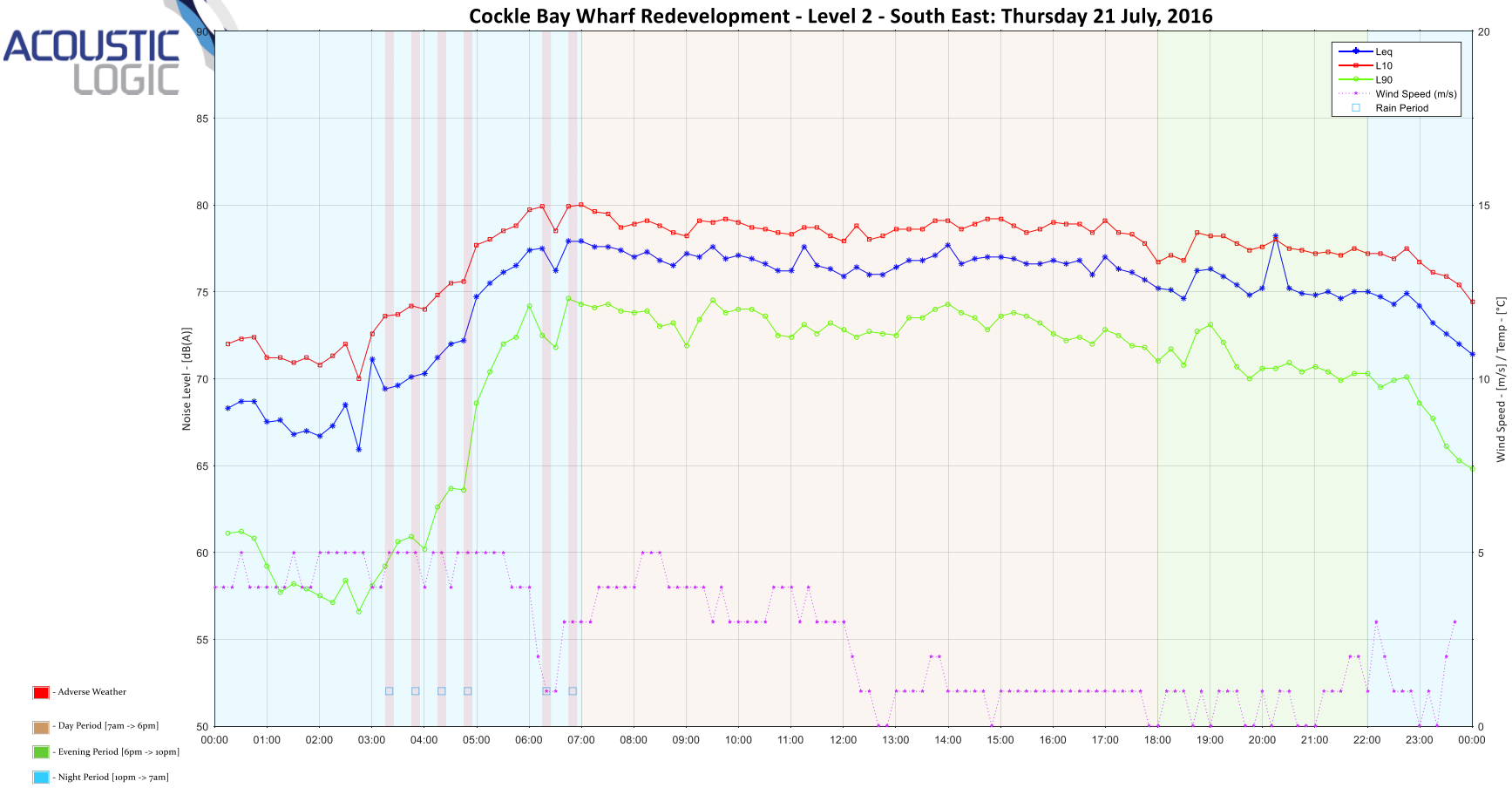
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- Adverse Weather
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
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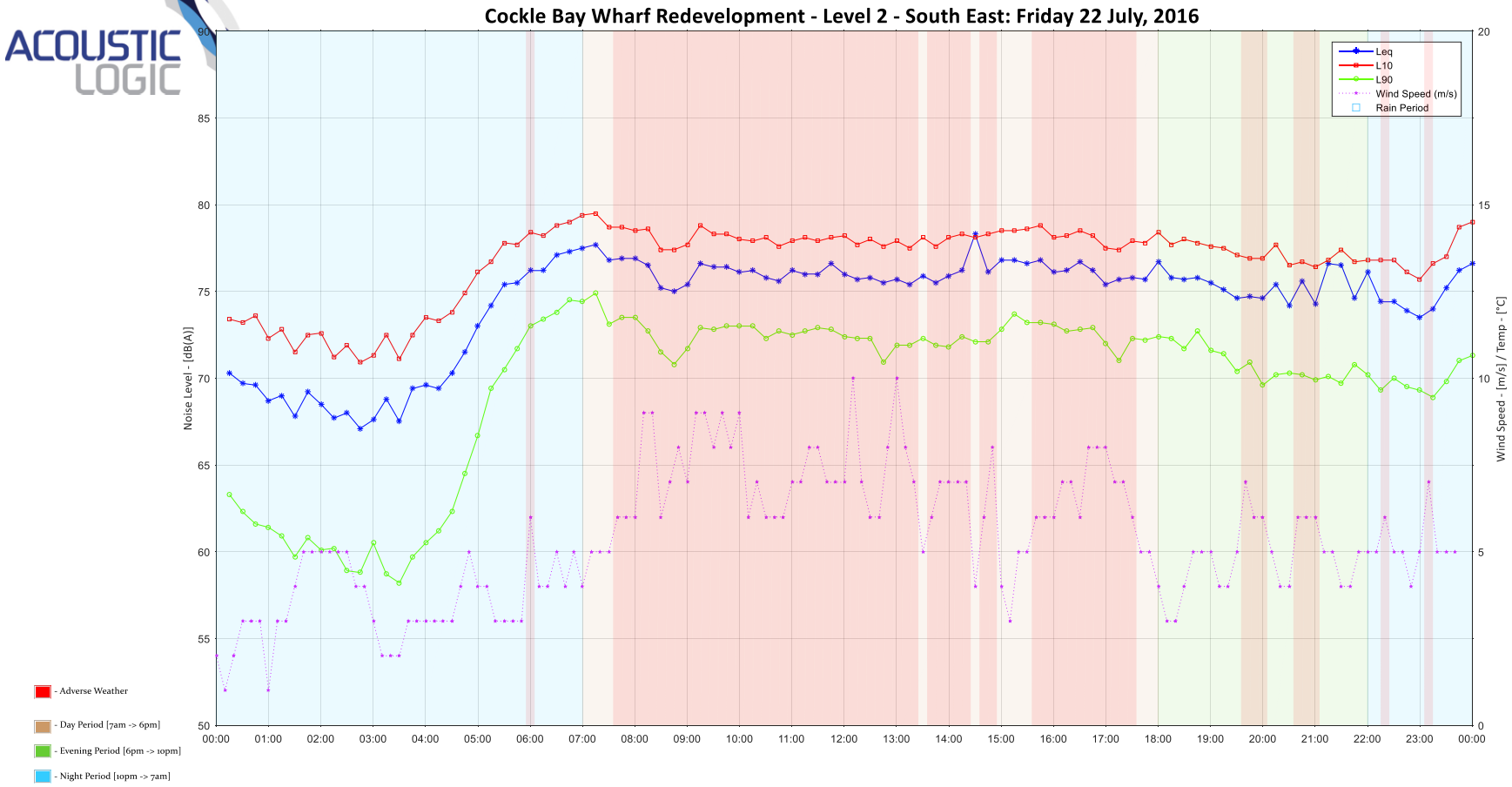
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Wind Speed - [m/s] / Temp - [°C]
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Wind Speed (m/s)
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- Evening Period [6pm -> 10pm]
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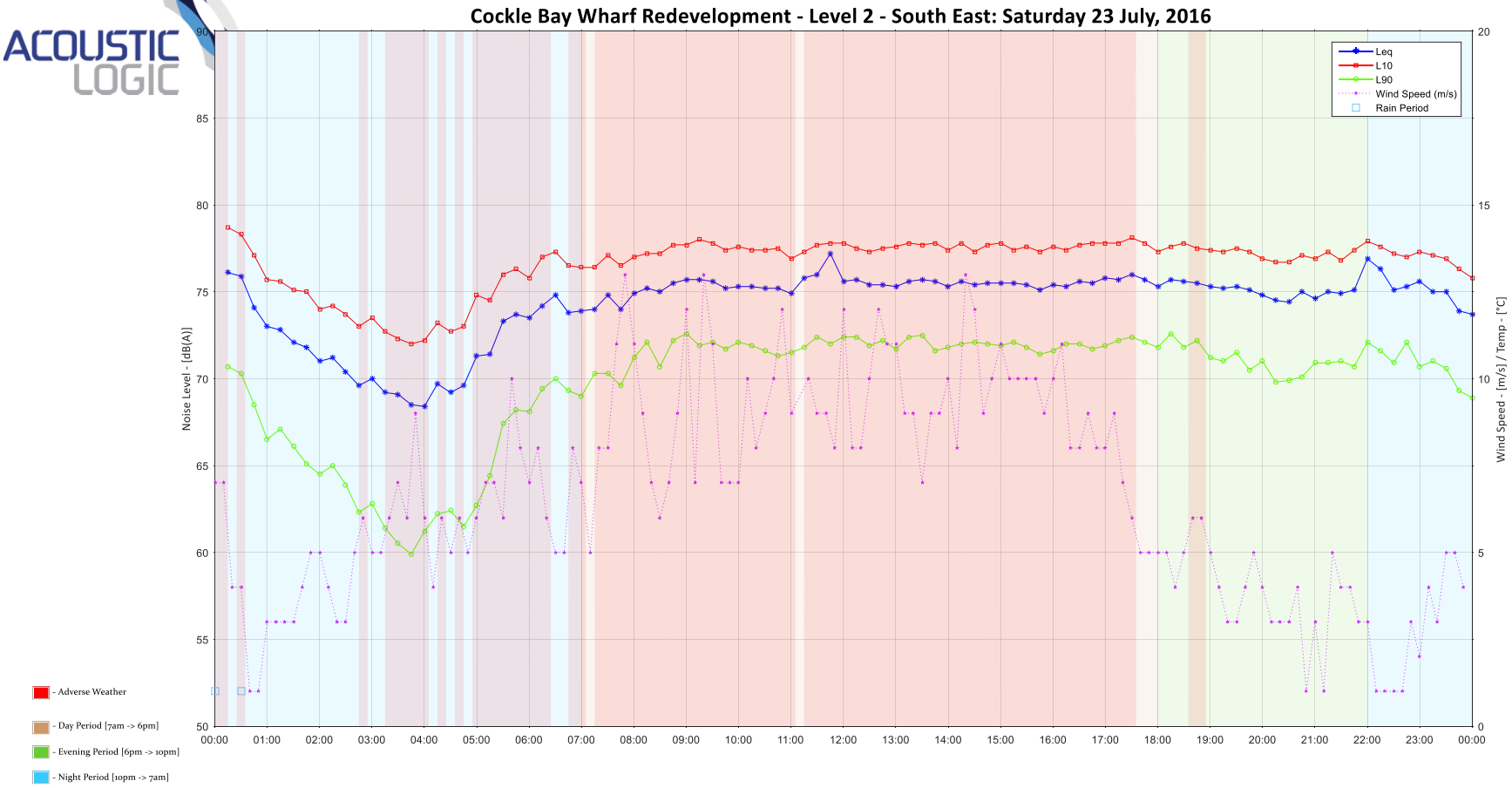
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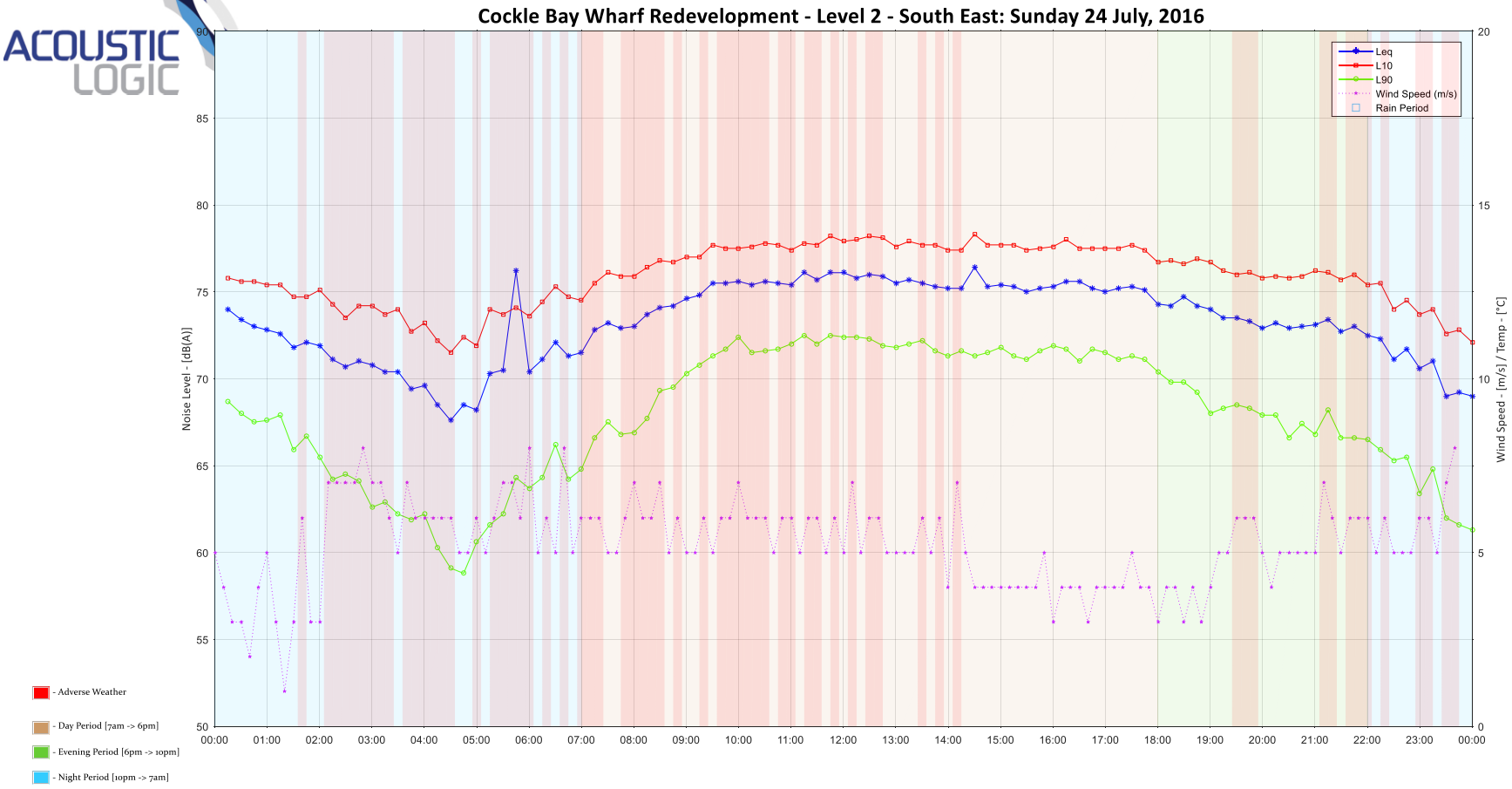
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Noise Level - [dB(A)]
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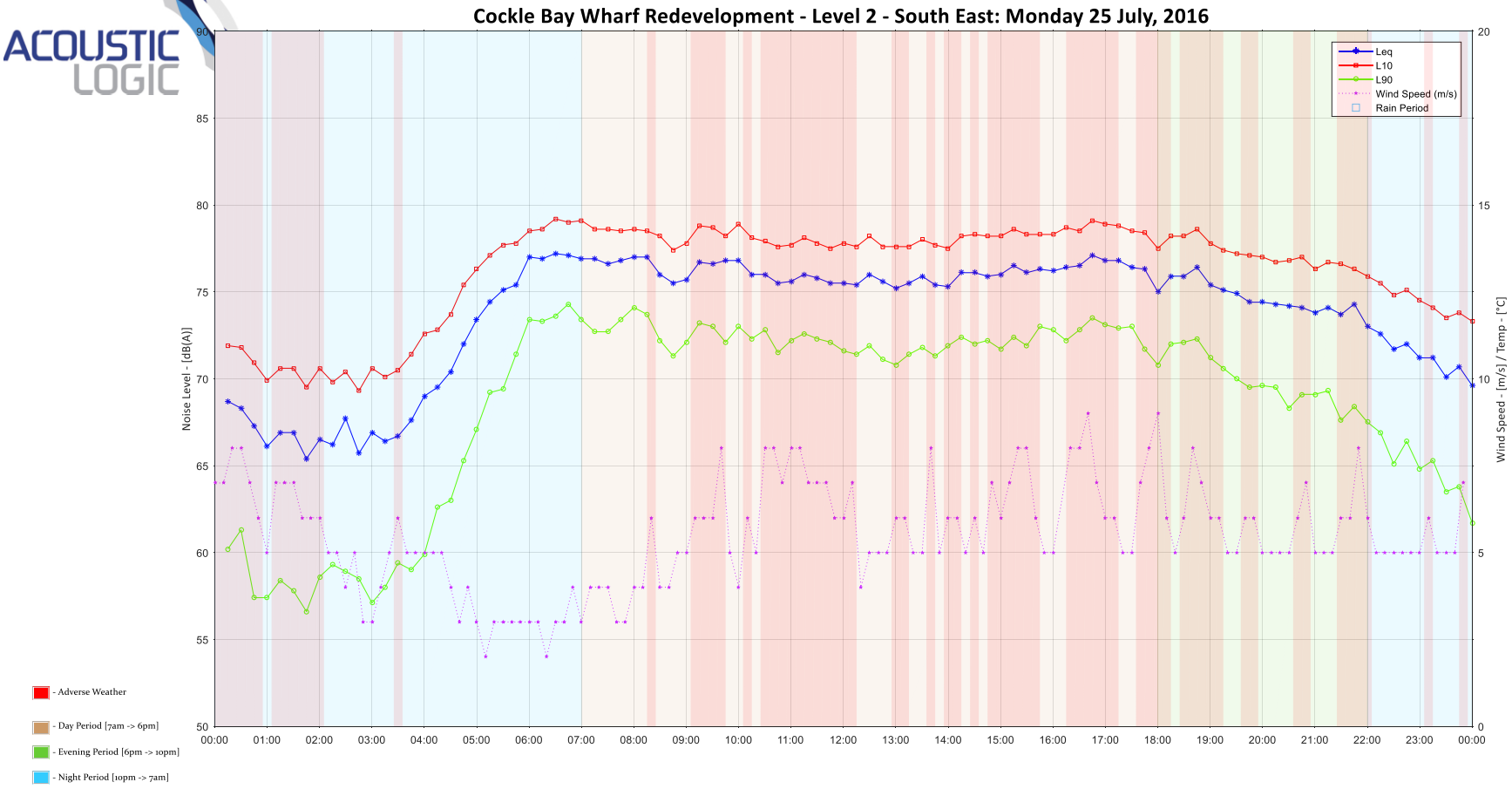
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Wind Speed (m/s)
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- Evening Period [6pm -> 10pm]
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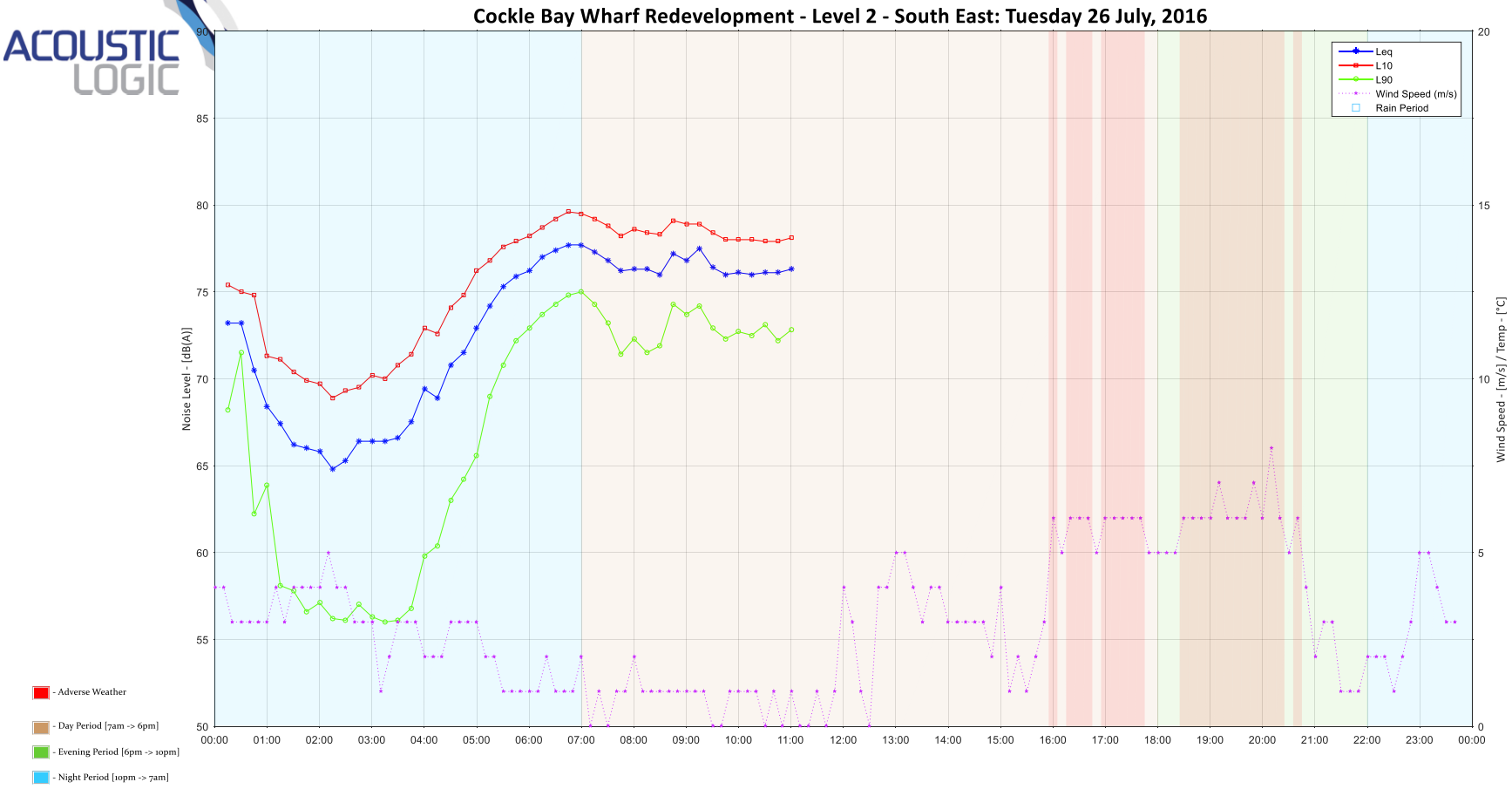
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Wind Speed (m/s)
Rain Period
- Adverse Weather
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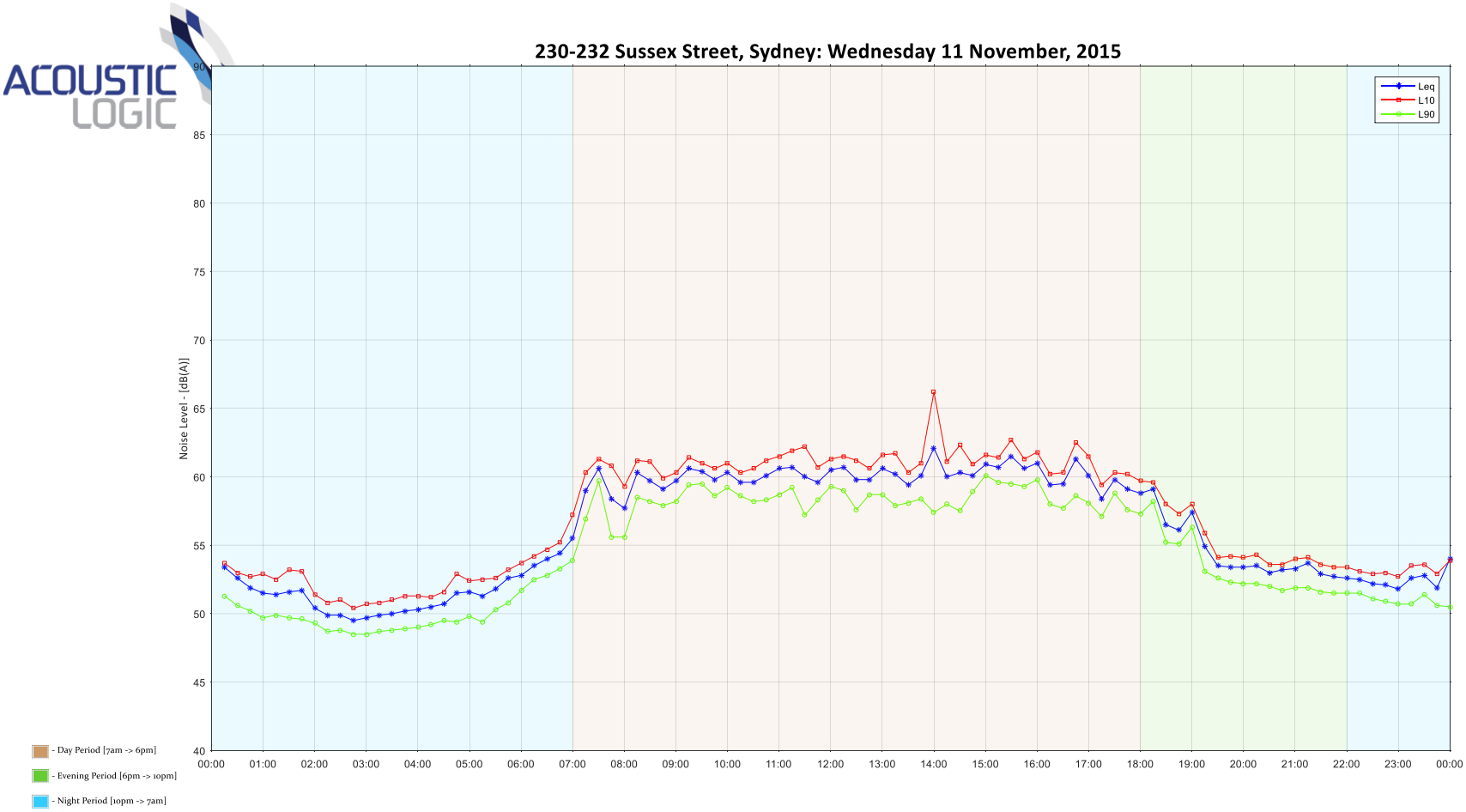
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

APPENDIX TWO – UNATTENDED NOISE MONITORING – LOCATION 3


230-232 Sussex Street, Sydney: Wednesday 11 November, 2015
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- Day Period [7am -> 6pm]
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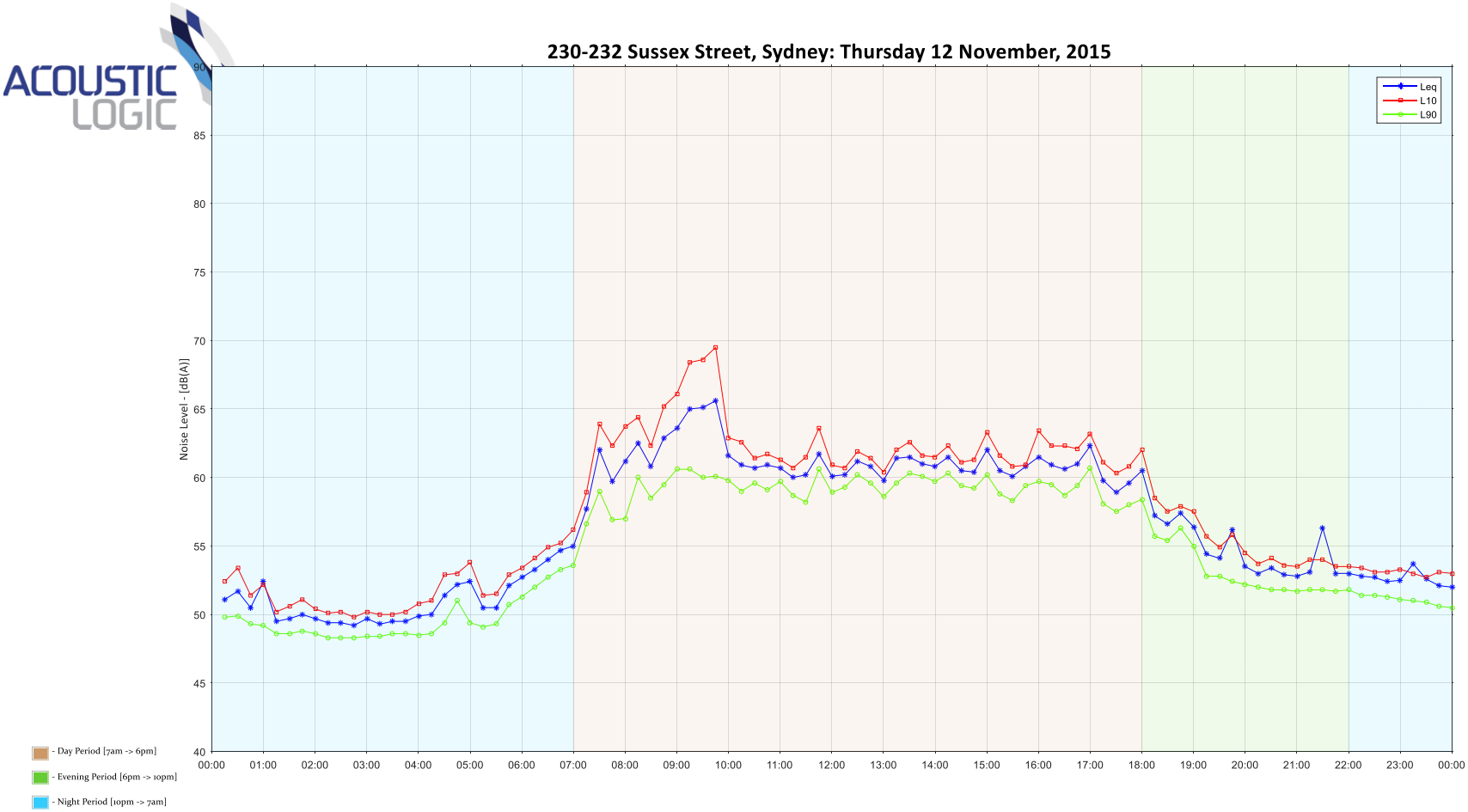
- Night Period [10pm -> 7am]


230-232 Sussex Street, Sydney: Thursday 12 November, 2015
Noise Level - [dB(A)]
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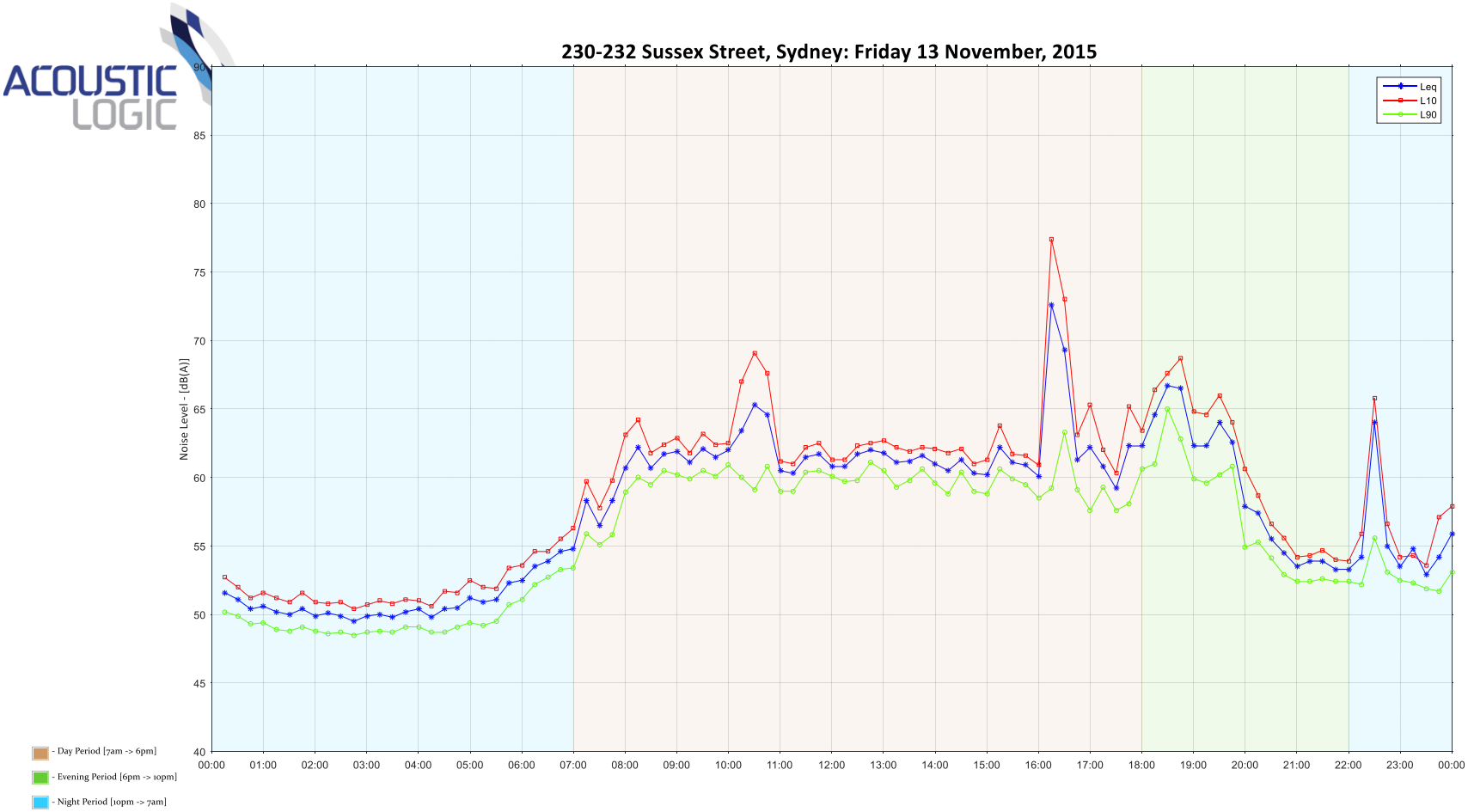
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


230-232 Sussex Street, Sydney: Friday 13 November, 2015
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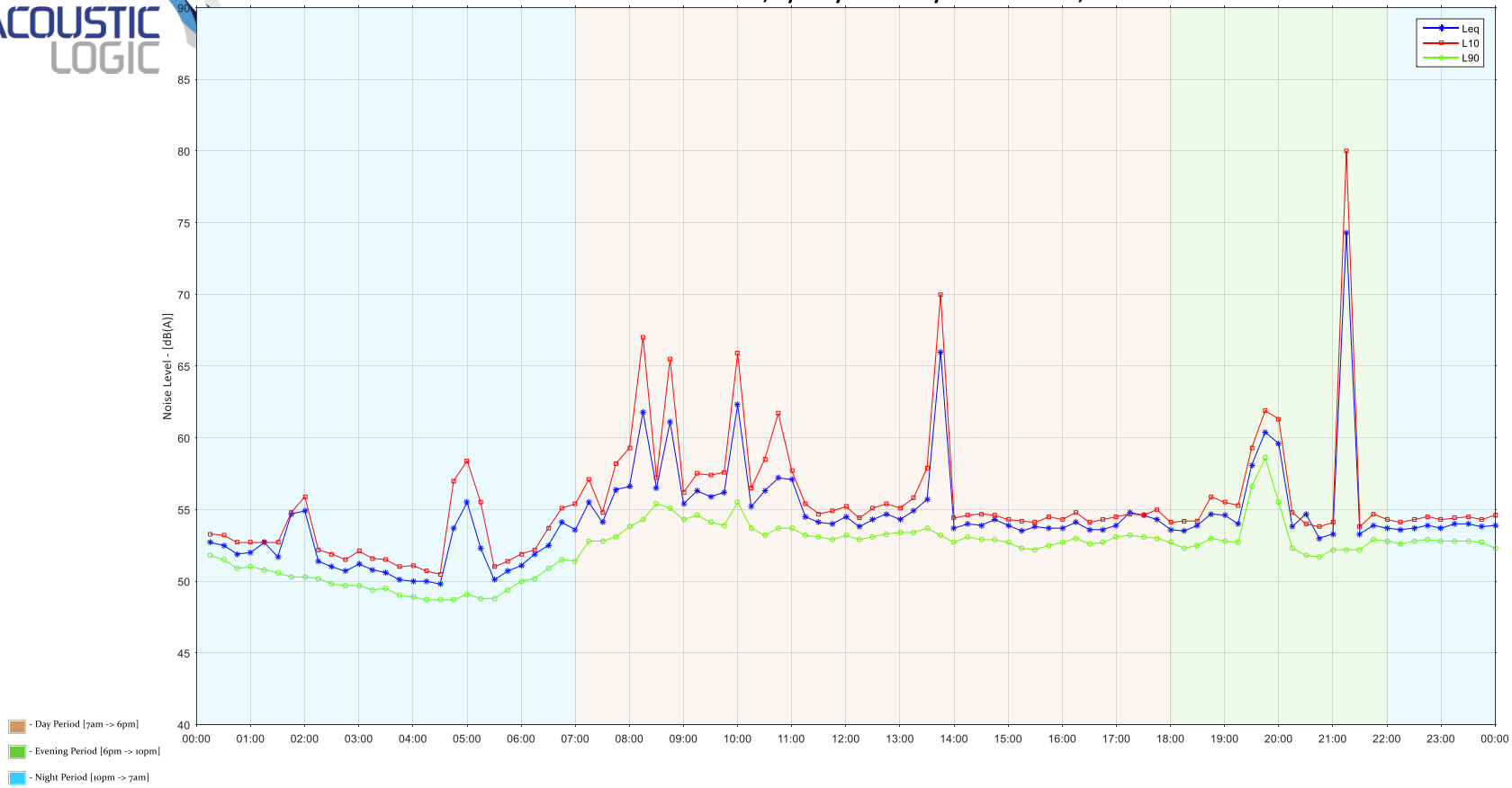
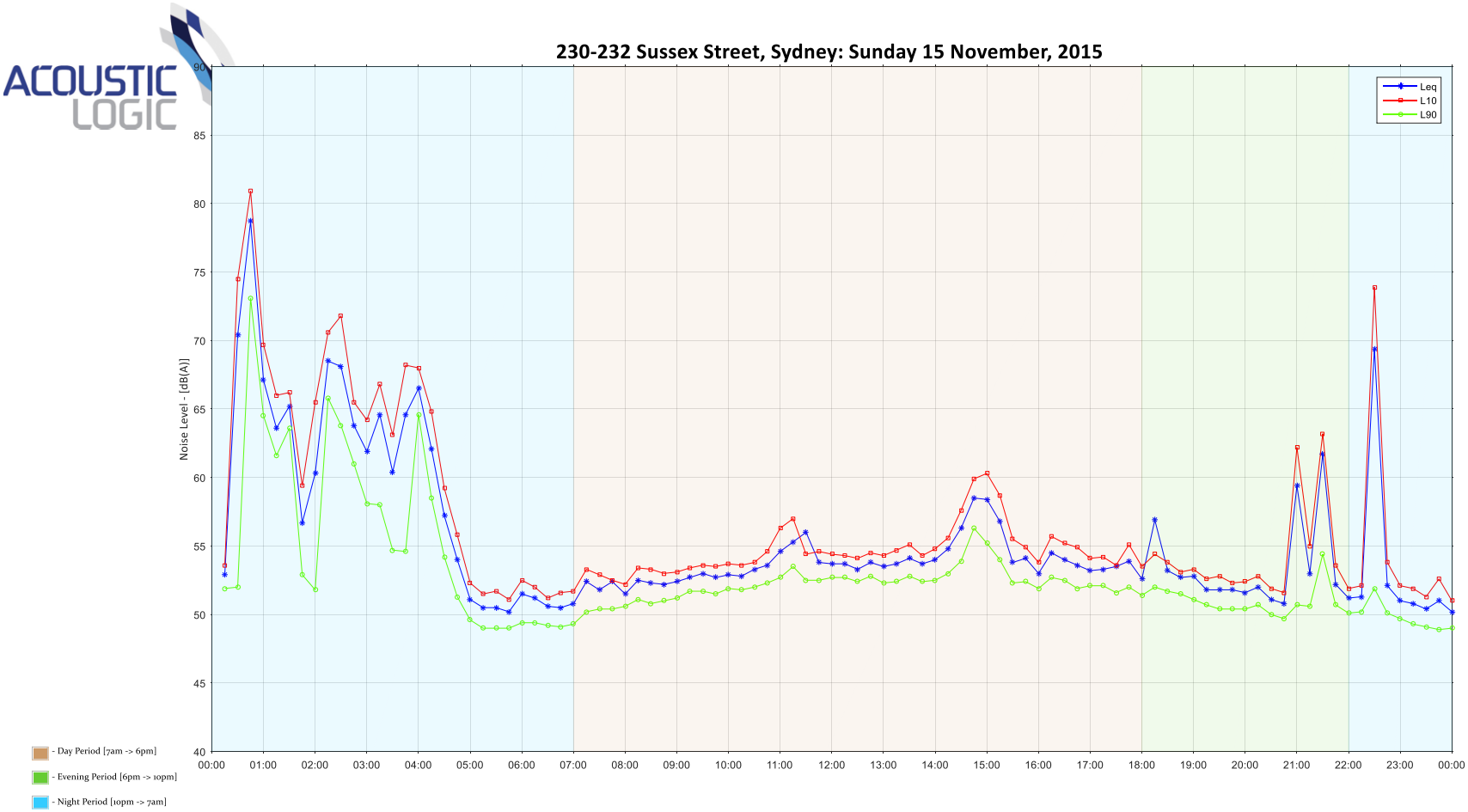
Leq
L10
L90
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

230-232 Sussex Street, Sydney: Saturday 14 November, 2015




230-232 Sussex Street, Sydney: Sunday 15 November, 2015
Leq
L10
L90
Noise Level - [dB(A)]
90
85
80
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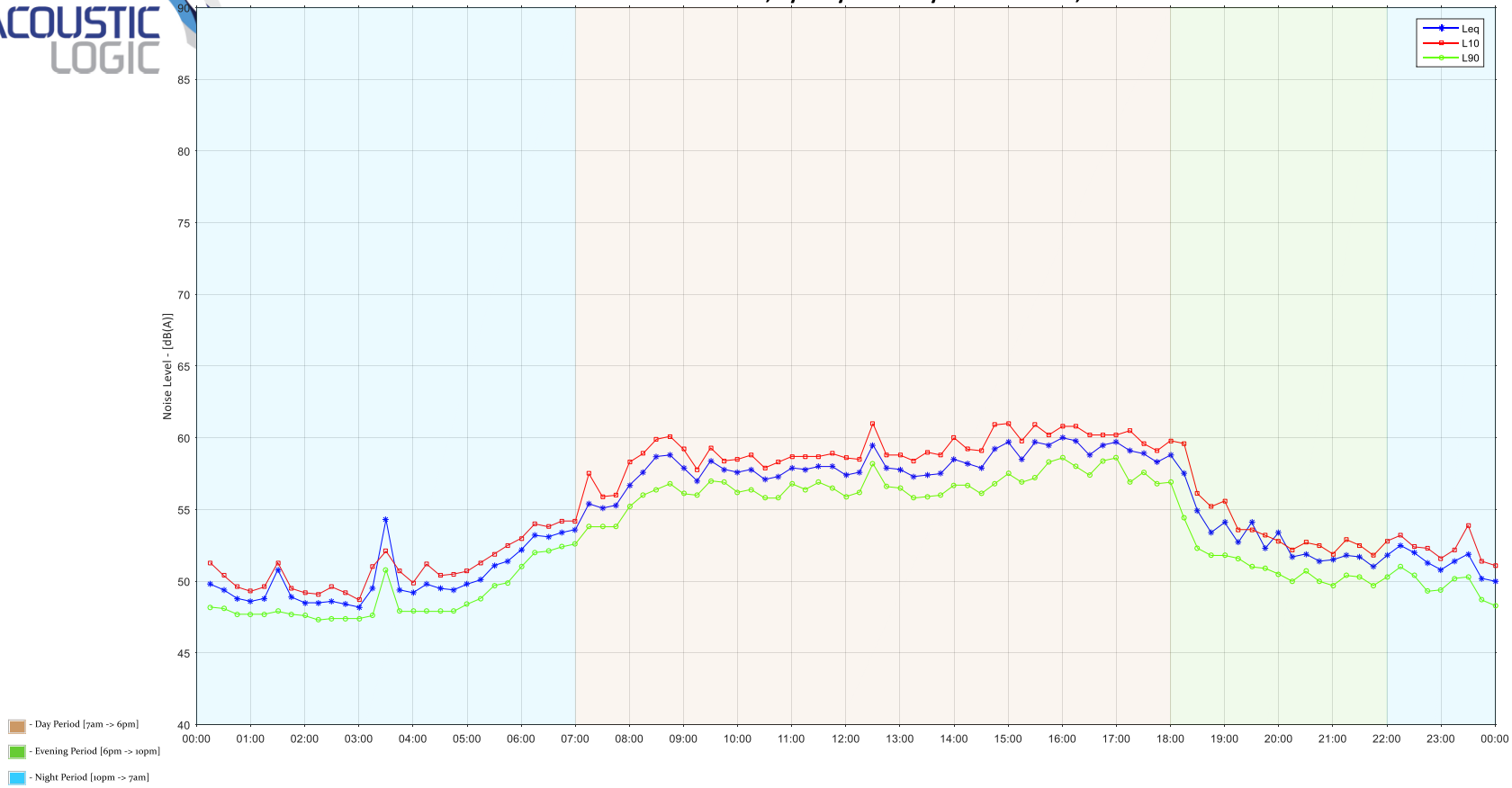
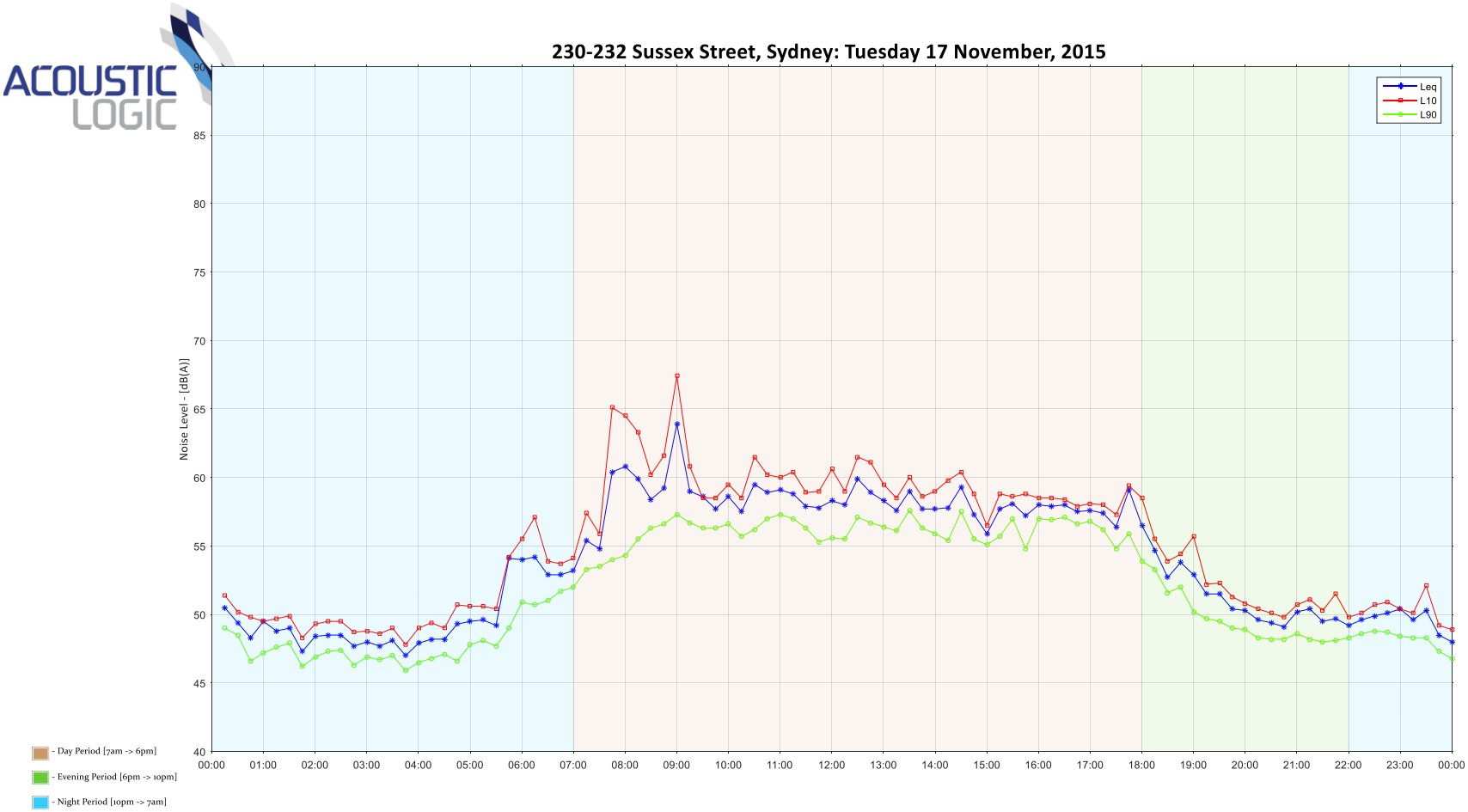
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]

230-232 Sussex Street, Sydney: Monday 16 November, 2015




230-232 Sussex Street, Sydney: Tuesday 17 November, 2015
Leq
L10
L90
Noise Level - [dB(A)]
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60
55
50
45
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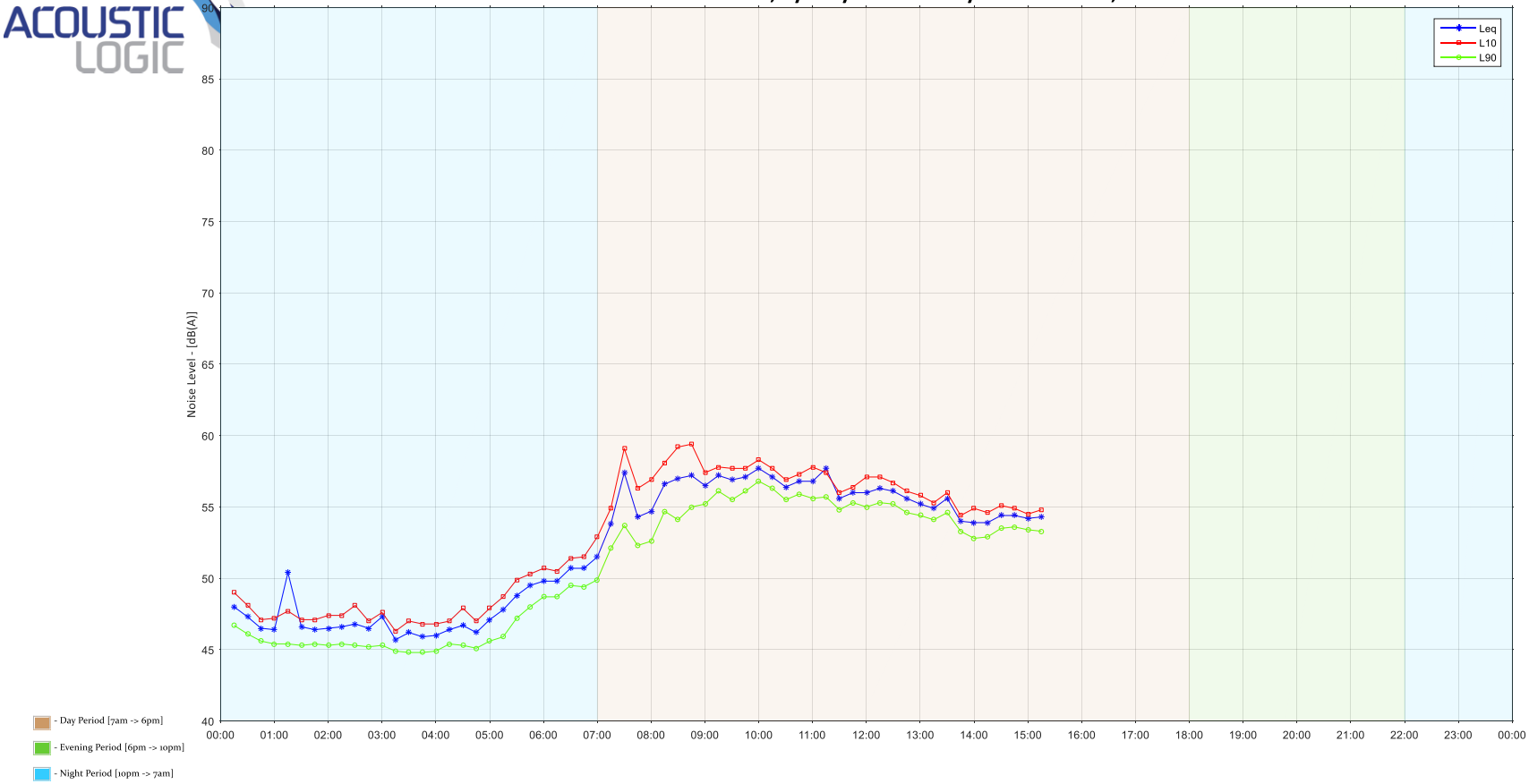
- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]


230-232 Sussex Street, Sydney: Wednesday 18 November, 2015
Leq
L10
L90
Noise Level - [dB(A)]
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55
50
45
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01:00
02:00
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- Day Period [7am -> 6pm]
- Evening Period [6pm -> 10pm]
- Night Period [10pm -> 7am]