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Interim Exhibition Facility

Glebe Island

White Bay & Wharves 4 & 5

Noise Impact Assessment

Report Number 610.11854-R1

7 November 2012

APP Corporation Pty Limited
PO Box 1573,
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Interim Exhibition Facility

Glebe Island

White Bay & Wharves 4 & 5

Noise Impact Assessment

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1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR Consulting) has been engaged by APP Corporation Pty Ltd (APP Corporation) on behalf of Infrastructure NSW to prepare a Noise Impact Assessment (NIA) of noise emissions associated with the use of Glebe Island (including White Bay and Wharves 5 & 6) as the Interim Exhibition Facility (IEF) (The Project).

This report presents the results and findings of a NIA covering all activities related to the use of GIebe Island (including White Bay and Wharves 5 & 6) as the IEF. The assessment considers the following:

- the impact of noise emissions from all activities associated with the operation of the IEF on Glebe Island to the nearest receivers
- the cumulative impact of noise emissions from all activities associated with the operation of the IEF on Glebe Island and from non-project related port activities to the nearest receivers
- the impacts of noise emissions from non-project related port activities onto the interim IEF.

The activities associated with the operation of the IEF on Glebe Island include the movement of cars, buses, trucks and the use of exhibition areas (including their setup and dismantling).

The non-project related port activities include activities from the Cruise Passenger Terminal, activities from the proposed Sydney Superyacht Marina development and current loading/unloading from vessels at White Bay and Glebe Island.

Calculated noise emissions are assessed against noise goals which have been set in accordance with the NSW Environment Protection Authority's (EPA's) Industrial Noise Policy (INP). These noise goals are based on ambient noise measurements conducted in the surrounding residential areas.

Acoustic terminology used in this report is presented in **Appendix A**.

2 DESCRIPTION OF THE PROPOSAL

The IEF Glebe Island site (Project Site) comprises an area of approximately 2 hectares (25,000m^2) and is located off Sommerville Road, on the Balmain peninsula. Glebe Island is located approximately 2 km to the west of Sydney Central Business District and, with the exception of an existing Sydney Ports Depot along part of the site's northern boundary, the site is largely vacant hardstand. An aerial of the site and its surrounds is presented in **Figure 2**.

The site forms part of an existing working port within Sydney Harbour which currently provides for the unloading of dry bulk cargo ships. The immediate surrounding area is characterised by port related activities and water ways. The nearest residential areas are located in Balmain to the west and north-west, in Pyrmont to the east and on the other side of Anzac Bridge to the south in Glebe.

The proposed interim IEF is shown in **Figure 1** and will include the construction of a new purpose-built interim facility comprising:

- construction and use of a new purpose-built temporary exhibition facility comprising:
  - 25,000m^2 of exhibition space (part of which may only be used intermittently);;
  - formal entrance and foyer area;
  - registration / reception area;
  - pre-function space; and
  - public facilities including food and beverage outlets and bathroom amenities;
- use of the site as a 'function centre' and 'food and drink premises';
- building signage and advertising structures;

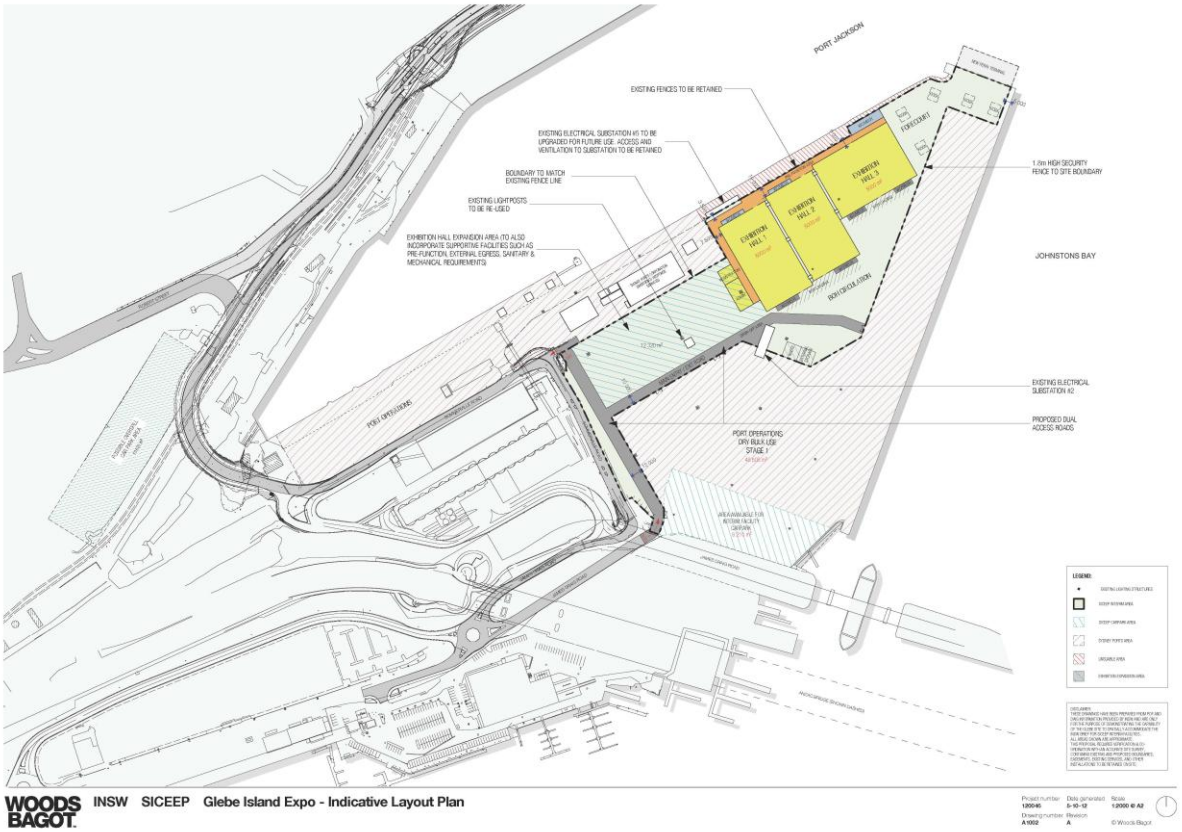
- design and construction of a new link road onto Robert Street and roundabout on Sommerville Road;
- vehicular access from James Craig Road to the south-west and exit onto Sommerville Road and Robert Street to the north-west;
- construction of internal access roads;
- car parking for 1,000 vehicles;
- construction of a temporary private wharf within the waterway adjacent to the north-east corner of the site; and
- the dismantling and removal of all structures.

The DA also seeks development consent for the use of the short-stay car park at White Bay 5 as detailed in the approved White Bay Cruise Passenger Terminal Part 3A project (MD 10_0069) when the Cruise Passenger Terminal is not in use and land at White Bay 4 for overflow car parking.

Development consent is sought for a period of four (4) years.

It is proposed that construction on the interim IEF facility would commence in July 2013. The interim facility would be completely removed by April 2017.

Figure 1 Location of the Proposed IEF Glebe Island Site



3 EXISTING NOISE ENVIRONMENT

3.1 Noise Monitoring

Environmental noise monitoring was conducted at the potentially most affected (representative) noise-sensitive locations in order to:

- Characterise the existing noise environment in the vicinity of the site; and
- Establish the noise levels upon which to base the operational noise emission objectives.

The noise monitoring locations were selected after a detailed inspection of the residential areas around Glebe Island. Consideration of other noise sources which may influence the measurement results and concern for the security of the noise monitoring devices also determined where the monitoring equipment was located.

Four noise loggers were located at:

- 1 Batty Street, Balmain;
- 17 Donnelly Street, Balmain;
- 22 Refinery Drive, Pyrmont; and
- 53 Leichhardt Street, Glebe

The monitoring locations are shown in **Figure 2**. These locations were selected because they are relatively shielded from traffic on major roads and the background noise levels at these locations were considered to be representative of the nearest residential receivers.

Figure 2 Ambient Noise Monitoring and Assessment Locations

The noise monitoring was conducted between Monday 17 September 2012 and Tuesday 25 September 2012.

Continuous weather data was obtained from the Bureau of Meteorology (BOM) weather station located on nearby Sydney Observatory Hill in order to identify periods of adverse weather during the unattended noise logging survey. The Sydney Observatory Hill site was selected as it is a station providing detailed meteorological data that falls within the guideline offset distance nominated in the INP. Data corresponding to periods of high winds and/or rain were excluded from the noise analysis. The removal of the weather affected noise data did not affect the resulting background noise levels.

3.2 Noise Monitoring Instrumentation

Equipment for the continuous unattended noise surveys consisted of Acoustic Research Laboratories EL 316 precision noise loggers fitted with a microphone windshield. Equipment serial numbers are 16-207-021, 16-306-047, 16-207-049 and 16-207-050. Calibration of each noise logger was checked prior to and following measurements using a Brüel & Kjær Electronic Calibrator Type 4230.

Acoustic Research Laboratories EL 316 precision noise loggers are designed to comply with the requirements of AS IEC 61672.1-2004: *"Electroacoustics-Sound level meters-Specifications"* and carried appropriate and current NATA (or manufacturer) calibration certificates.

The unattended noise loggers were programmed to continuously monitor the ambient noise levels, recording relevant environmental statistical noise descriptors at the end of each 15 minute period throughout the survey.

3.3 Ambient Noise Monitoring Results

The results of the noise surveys are presented in tabular form in **Table 1** and graphically in **Appendix B**. The statistical descriptors shown on the graphs are described in **Appendix A**.

The noise data was processed in accordance with the procedures documented in the NSW Government's Environment Protection Authority's (EPA), (also known previously as the OEH and DECCW) Industrial Noise Policy (INP).

Table 1 presents the Rating Background Level (RBL) or background (L_{A90}) and L_{Aeq} ambient noise levels for the noise monitoring locations adjacent to the Project site. Note, the ambient noise levels include noise from traffic and existing industrial facilities and other local activities.

Table 1 Summary of Existing RBLs and L_{Aeq} Ambient Noise Levels - dBA

Monitoring Locations	RBL			$L_{Aeq(Period)}$ Ambient		
	Daytime 0700-1800 Hours	Evening 1800-2200 Hours	Night-time 2200-0700 Hours	Daytime 0700-1800 Hours	Evening 1800-2200 Hours	Night-time 2200-0700 Hours
1 Batty Street, Balmain	51	48	45	63	57	55
17 Donnelly Street, Balmain	47	45	40	57	54	51
22 Refinery Drive, Pyrmont	50	49	47	56	55	53
53 Leichhardt Street, Glebe	46	46	40	58	55	53

3.4 Summary of Previous Ambient Noise Studies

Previous ambient noise studies have been conducted in the area surrounding the Project. The ambient survey at Batty Street was conducted as part of the CBD Metro project in 2009, and provides ambient data measured in the absence of port activity. The ambient survey at Refinery drive was conducted in 2002, and indicates there may have been a minor increase in the ambient noise environment at that location.

A summary of the RBLs and the L_{Aeq} noise levels from the previous ambient noise studies is presented in **Table 2**.

Table 2 Summary of RBL and L_{Aeq} Noise Levels from Previous Ambient Noise Studies

Monitoring Locations	RBL			L_{Aeq}		
	Daytime 0700-1800 Hours	Evening 1800-2200 Hours	Night-time 2200-0700 Hours	Daytime 0700-1800 Hours	Evening 1800-2200 Hours	Night-time 2200-0700 Hours
Balmain - Batty Street	51	49	42	57	53	47
Pyrmont - Refinery Drive	50	48	46	55	55	50

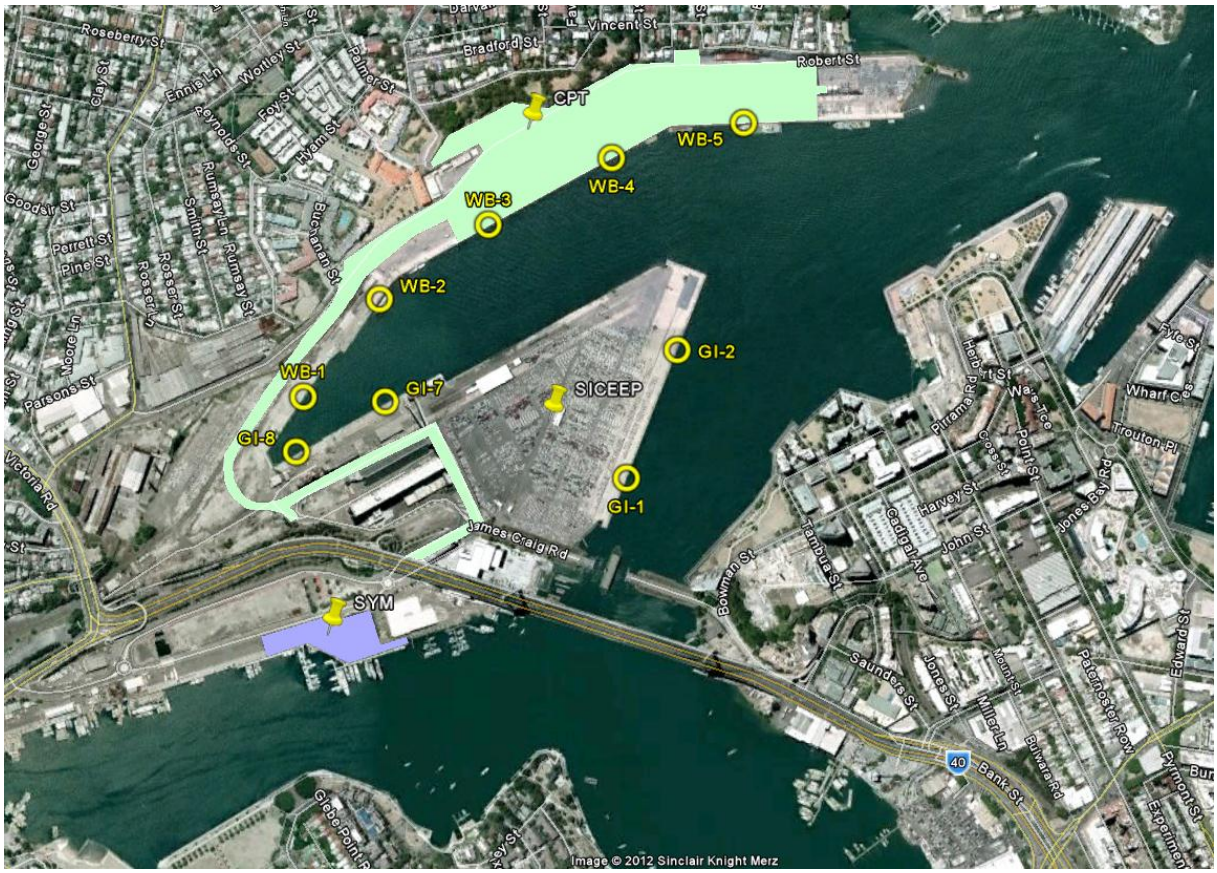
3.5 Approved Industrial Developments

A summary of the major existing and proposed industrial developments in the vicinity of the IEF is presented in **Table 3**. The locations of these projects are shown on the Project Interactions in **Figure 3**. The estimated operating LAeq(amenity period) noise levels from each of these developments have been based on the data provided in the respective Noise Impact Assessment prepared for each developments. The amenity period noise levels are those LAeq activity noise levels averaged out (on an energy basis) for the entire day, evening and nighttime

Table 3 Approved Industrial Developments in the vicinity of the IEF

Development Sites	Status	Source of Noise Data
Sydney Superyacht Marina (SYM)	Approved / Operating (Modifications proposed)	*"Environmental Noise Impact Assessment, Proposed Superyacht Marina, Rozelle Bay"*, Benbow Environmental, Report 110056_Rep_Rev1 dated October 2010
White Bay Cruise Passenger Terminal (CPT)	Approved / Operating	*"White Bay Passenger Terminal Noise Assessment"*, Wilkinson Murray, Report 08209-R Version F dated September 2010 *"Cruise Passenger Terminal, Wharf 5 White Bay Concept Design Acoustic Report for Venue Operation"*, Renzo Tonin & Associates (NSW) Pty Ltd, Report TE052-04F01 (Rev3) dated 28 September 2010
Sydney Port Activities	Approved / Operating	Various SLR Consulting Reports

Figure 3 Project Interactions



SYM – Sydney Syperyacht Marina, CPT – White Bay Cruise Passenger Terminal, GI – Glebe Island, WB – White Bay

Sydney Superyacht Marina (SYM)

The Superyacht Marina located at Rozelle Bay is currently managed by Sydney Superyacht Marina Pty Ltd. There is a current development consent for the waterbased area which involves the re-arrangement of existing berths and the upgrading and reconfiguration of the pontoon layout. In addition to the approved waterbased redevelopment, Sydney Superyacht Marina Pty Ltd proposes to redevelop the land by constructing two additional buildings comprising a workshop, service and operational facilities for the Marina, retail commercial and restaurants with outdoor areas, office and marina related dormitory accommodation and function areas. The existing parking is also proposed to be upgraded as well as public access to the foreshore area.

A NIA was prepared by Benbow Environmental (BE) for the Sydney Superyacht Marina (refer to Report No 110056_Rep_Rev1 dated October 2010). The predicted intrusive $L_{Aeq(15minute)}$ noise levels in the NIA were extrapolated to the receivers of interest for this assessment. The amenity $L_{Aeq(Period)}$ noise levels were estimated to be 5 dBA less than the intrusive levels during daytime and night-time periods and similar to the intrusive $L_{Aeq(15minute)}$ noise levels during the evening (due to possible music emissions). The daytime, evening and night-time SYM amenity $L_{Aeq(Period)}$ noise levels are summarised in **Table 4**, **Table 5** and **Table 6** respectively.

Note, the NIA included an assessment of the noise emissions associated with activities on land. No data are available for the noise coming from the water (which is assumed to be negligible).

White Bay Cruise Passenger Terminal (CPT)

On 2 February 2011, the Minister of Planning approved the relocation of the Darling Harbour No. 8 Cruise Passenger Terminal to White Bay 5, in accordance with the recommendation from the Passenger Cruise Terminal Steering Committee.

Two NIAs were prepared for the CPT to assess the noise impacts from water and land activities (refer to Wilkinson Murray report 08209-R and Renzo Tonin report TE052-04F01 respectively). The intrusive and amenity assessment results of the NIA relating to water activities were used for this assessment. The intrusive results relating to land activities were remodelled by SLR Consulting based on the report assumptions then extrapolated to the receivers of interest. The amenity $L_{Aeq(Period)}$ noise levels were estimated to be 5 dBA less than the intrusive levels during daytime and night-time periods and similar to the intrusive $L_{Aeq(15minute)}$ noise levels during the evening (due to possible music emissions).

Sydney Port Activities (Unloading/Loading Activities at White Bay and Glebe Island)

Sydney Port Corporation currently manage the port activities at White Bay and Glebe Island. The White Bay Port facility is located at the southern end of the Balmain peninsula and comprises five multiple-use berths (WB-1 to WB-5). The Glebe Island facility, which includes four multiple-use berths (GI-1, GI-2, GI-7 and GI-8) is located adjacent to the White Bay Port on a neighbouring peninsula south of White Bay (Refer to **Figure 3**).

Glebe Island and White Bay are used for receiving, storing and distributing dry bulk good via its 7 berths.

Based on numerous ship noise monitoring surveys and subsequent reports undertaken by SLR Consulting (Refer to SLR Consulting reports Number 10-4309-R2 to 10-4309-R46), the following worst-case scenarios (for the receivers of interest) were modelled:

- 2 x Ships unloading and loading simultaneously at GI-7 and GI-8
- 2 x Ships unloading and loading simultaneously at GI-7 and WB-4

- 1 x Ship unloading and loading at GI-1

The amenity $L_{Aeq(Period)}$ noise levels were estimated to be similar to the intrusive $L_{Aeq(15minute)}$ noise levels during the daytime, evening and night-time periods.

3.6 Approved Cumulative Industrial Noise Amenity Levels

In accordance with the INP Chapter 2 Industrial Noise Criteria (Section 2.2.4), the daytime, evening and night-time cumulative sum of the existing and proposed developments $L_{Aeq(period)}$ noise amenity period levels have been determined as presented in **Table 4**, **Table 5** and **Table 6** respectively. It should be noted that for each of the developments noted below, the likelihood of the existing and proposed developments emitting simultaneous maximum noise emissions is remote. This cumulative assessment is therefore considered to be conservative.

Note: The cumulative assessment has been undertaken for calm meteorological conditions only: data for the CPT water assessment under adverse conditions is not available.

This cumulative assessment is used to determine the project specific amenity criteria.

Table 4 Cumulative Daytime $L_{Aeq(11hour)}$ Noise Amenity Levels - dBA

Assessment Locations	CPT		SYM	Sydney Port Activities	Calculated Noise Amenity Level
	Land	Water	Land		
Balmain - Batty Street	52	46	28	57	59
Balmain - Donnelly Street	41	52	13	52	55
Pyrmont – Refinery Drive	38	43	26	49	50
Glebe - Leichhardt Street	31	37	33	46	47

Note 1: All predicted noise levels from the worst case scenarios

Table 5 Cumulative Evening $L_{Aeq(4hour)}$ Noise Amenity Levels - dBA

Assessment Locations	CPT		SYM	Sydney Port Activities	Calculated Noise Amenity Level
	Land	Water	Land		
Balmain - Batty Street	57	46	33	57	60
Balmain - Donnelly Street	46	50	18	52	55
Pyrmont – Refinery Drive	43	41	31	49	51
Glebe - Leichhardt Street	36	35	38	46	47

Note 1: All predicted noise levels from the worst case scenarios

Table 6 Cumulative Night-time LAeq(9hour) Noise Amenity Levels - dBA

Assessment Locations	CPT		SYM	Sydney Port Activities	Calculated Noise Amenity Level
	Land	Water	Land		
Balmain - Batty Street	52	41	28	57	58
Balmain - Donnelly Street	41	48	13	52	54
Pyrmont – Refinery Drive	38	41	26	49	50
Glebe - Leichhardt Street	31	34	33	46	46

Note 1: All predicted noise levels from the worst case scenarios

4 NOISE ASSESSMENT CRITERIA

This assessment considers the construction and operation of the IEF at Glebe Island and the movement of vehicles to and from the site on public roads. Operation of the IEF will include the settling up and dismantling, as well as the operation, of exhibitions and other associated activities such as evening dinners. The one-off works involving the initial erection of the temporary structures and upgrading/installation of site fencing etc, are considered construction related activities and therefore assessed against the relevant construction guidelines.

4.1 Construction Noise

When dealing with noise from construction works, the NSW Environment Protection Authority (EPA) recognises that higher levels of noise are likely to be tolerated by people in view of the relatively short duration of the works. As a result, the EPA has published the "*Interim Construction Noise Guideline*" (ICNG, DECC 2009) for the management of construction works noise.

The ICNG recommends the following approaches to mitigating adverse noise impacts from construction sites.

Hours of Construction

The ICNG recommend confining permissible work times as outlined in **Table 7**.

Table 7 Preferred Hours of Construction

Day	Preferred Construction Hours
Monday to Friday	7.00 am to 6.00 pm
Saturdays	8.00 am to 1.00 pm
Sundays or Public Holidays	No construction

Construction Noise Assessment Method

The ICNG recognises that people are usually annoyed more by noise from longer-term works than by the same type of works occurring for only a few days. For this reason the Guideline identifies two methods of assessing noise from construction:

- The quantitative assessment method which applies to long-term duration work.
- The qualitative assessment method which applies to short-term duration work.

Quantitative Assessment Method

The ICNG recommends that the LAeq(15minute) noise levels arising from a construction project, measured within the curtilage of an occupied noise-sensitive premises (ie at boundary or within 30 m of the residence, whichever is the lesser), should not exceed the levels indicated in **Table 8**. These noise management levels are generally consistent with community reaction to construction noise. The ICNG also recognises other kinds of noise sensitive receivers and provides recommended construction noise levels for them. Those specific receivers and their recommended noise levels are presented in **Table 9**.

Table 8 Recommended General Noise Management Levels for Construction Works

Period of Noise Exposure	$L_{Aeq(15minute)}$ Construction Noise Management Level
Recommended Standard Hours	Noise affected[1] RBL[2] + 10 dBA
	Highly Noise affected[3] 75 dBA
Outside Recommended Standard Hours	Noise affected[1] RBL + 5 dBA

Note 1: The noise affected level represents the point above which there may be some community reaction to noise.
Note 2: Refer to **Appendix A**.
Note 3: The highly noise affected level represents the point above which there may be strong community reaction to noise.

Table 9 Noise at sensitive land uses (other than residences)

Land use	$L_{Aeq(15minute)}$ Construction Noise Management Level
Classrooms at schools and other educational institutions	Internal noise level 45 dBA
Hospital wards and operating theatres	Internal noise level 45 dBA
Places of worship	Internal noise level 45 dBA
Active recreation areas (characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion)	External noise level 65 dBA
Passive recreation areas (characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion, for example, reading, meditation)	External noise level 60 dBA
Community centres	Depends on the intended use of the centre

Where internal Noise Management Levels are presented in the table above, the corresponding external noise level (which the assessments are based upon) would typically be determined on the assumption that a 10 dBA reduction from outside to inside noise levels is applicable for an operable window, and a 20 dBA reduction where mechanical ventilation has been provided and windows are able to remain shut.

Scope for Exceedances

Where predicted or measured levels exceed the Noise Management Levels the ICNG recommends that the proponent apply all “feasible and reasonable” work practices in order to minimise noise.

Where $L_{Aeq(15minute)}$ construction noise levels are predicted to be "highly noise affected" (ie above 75 dBA) the relevant authority (consent, determining or regulatory) may require respite periods to be observed. This may include restricting the hours that the very noisy activities can occur, taking into account:

- 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).
- If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.

The implementation of an effective community consultation and liaison programme is emphasised as being a critical tool in successfully handling adverse noise impacts from construction works.

The ICNG provides comprehensive guidance for work practices which aim to achieve *"desired environmental outcomes - there are no prescribed noise controls for construction works."*

Qualitative Assessment Method

The qualitative method for assessing construction noise is a simplified way to identify the cause of potential noise impacts. It avoids the need to perform complex predictions by using a checklist approach to assessing and managing noise. Short-term means that the works are not likely to affect an individual or sensitive land use for more than three weeks in total.

The following checklist for work practice can be used:

- Community notification.
- Operate plant in a quiet and efficient manner.
- Involve workers in minimising noise.
- Handle complaints.

The quantitative assessment method is considered the appropriate method for the IEF Site works as the construction works are likely to operate for more than 3 weeks.

4.2 Operational Noise

The NSW EPA's INP provides guidelines for the assessment of noise impacts associated with industrial activities. It aims to balance the need for industrial activity with the desire for quiet within the community. The criteria selected are designed to protect at least 90 per cent of the population living in the vicinity of the industrial noise sources for at least 90 per cent of the time.

The INP's objectives are:

- To establish noise criteria that would protect the community from excessive noise.
- To preserve the amenity for specific land uses.
- To use the criteria for deriving project specific land uses.
- To promote uniform methods to estimate and measure noise impacts, including a procedure for evaluating meteorological effects.

Implementation is achieved by ensuring:

- That noise from any single source does not intrude greatly above the prevailing background noise level. This is known as the intrusive noise criterion.
- The background noise level does not exceed the level appropriate for the particular locality and land use. This is known as the amenity criterion.

In order to satisfy the above two requirements, an Amenity and an Intrusive noise criterion is recommended of which generally the lower applies, noting the intrusive criteria applies to any 15 minute period and the amenity criteria applies to the noise 'averaged' over the relevant period of the day (i.e. day, evening and night).

4.2.1 Intrusiveness Criterion

In setting an "Intrusive" noise goal, an estimate of the ambient (background) L_{A90} noise level, termed the Rating Background Level (RBL), needs to be established at the nearest sensitive receivers in the absence of the intruding source. An "RBL plus 5 dBA" criterion is then applied to the 15-minute L_{Aeq} noise emissions of the noise source in question at the receivers of interest (normally at their property boundary).

4.2.2 Amenity Criteria

The INP provides non-mandatory noise amenity assessment guidelines that address existing and successive industrial development by setting acceptable (and maximum) cumulative $L_{Aeq(period)}$ noise amenity levels for all industrial noise sources only (ie non-transport related) for a particular land use. It is noted that the INP does not set acceptable cumulative $L_{Aeq(15minute)}$ intrusive criteria for all industrial noise sources, but rather seeks to control cumulative noise via the $L_{Aeq(period)}$ noise amenity criterion.

Under the INP, two types of noise amenity assessments are to be considered:

- Cumulative Amenity Level Assessment
- Amenity Level Assessment

Cumulative Amenity Level Assessment

The EPA provides recommended acceptable noise levels for residents located in "Rural", "Suburban", "Urban" and "Urban/Industrial" areas. Those recommended acceptable noise levels are for the control of noise from all industrial operations (ie existing/approved and proposed developments). In accordance with the INP, residences surrounding the subject site would be considered Urban/Industrial. The recommended acceptable levels are shown in **Table 10**. The cumulative noise amenity assessment criteria are presented in **Table 11**.

Table 10 Amenity Criteria - Recommended L_{Aeq} Noise Levels from Industrial Noise Sources

Type of Receiver	Indicative Noise Amenity Area [1,2]	Time of Day	Recommended L_{Aeq} Noise Level	
			Acceptable	Recommended Maximum
Residence	Urban/Industrial Interface - for existing situations only	Day	65 dBA	70 dBA
		Evening	55 dBA	60 dBA
		Night	50 dBA	55 dBA

Note 1: For Monday to Saturday, Daytime 0700 hours - 1800 hours; Evening 1800 hours - 2200 hours; Night-time 2200 hours - 0700 hours.

Note 2: On Sundays and Public Holidays, Daytime 0800 hours - 1800 hours; Evening 1800 hours - 2200 hours; Night-time 2200 hours - 0800 hours.

Table 11 INP Recommended Noise Amenity Levels (dBA re 20 µPa)

Assessment Locations	Cumulative Amenity $L_{Aeq(Period)}$ Assessment Criteria					
	Acceptable			Maximum		
	Day (0700-1800)	Evening (1800-2200)	Night (2200-0700)	Day (0700-1800)	Evening (1800-2200)	Night (2200-0700)
1 Batty Street, Balmain	65	55	50	70	60	55
17 Donnelly Street, Balmain	65	55	50	70	60	55
22 Refinery Drive, Pyrmont	65	55	50	70	60	55
53 Leichhardt Street, Glebe	65	55	50	70	60	55

Amenity Level Assessment

The resulting Project Specific amenity criterion placed upon noise emissions of a new facility then depends upon whether existing industrial/commercial-related $L_{Aeq(period)}$ noise levels are lower or higher than the recommended amenity level.

In areas where the existing industrial/commercial-related noise levels are already high, the Project Specific amenity noise goal acts to limit new industrial noise emissions so that the cumulative impact of all industrial/commercial noise emissions does not increase.

Conversely, in areas where there is no existing industrial/commercial noise, the amenity noise goal would be set at a level which allows new industrial/commercial noise emissions up to the recommended amenity levels for the area.

Accordingly, to arrive at the Project Specific Amenity Levels, the recommended acceptable amenity levels presented in **Table 11** are modified in accordance with **Table 12**.

Table 12 Modification to Acceptable Noise Level (ANL)[1] to Account for Existing Level of Industrial Noise

Total existing L_{Aeq} noise level from industrial sources, dB(A)	Maximum L_{Aeq} noise level for noise from new sources alone, dB(A)
≥ Acceptable noise level plus 2	If existing noise level is likely to decrease in future: acceptable noise level minus 10 If existing noise level is unlikely to decrease in future: existing level minus 10
Acceptable noise level plus 1	Acceptable noise level minus 8
Acceptable noise level	Acceptable noise level minus 8
Acceptable noise level minus 1	Acceptable noise level minus 6
Acceptable noise level minus 2	Acceptable noise level minus 4
Acceptable noise level minus 3	Acceptable noise level minus 3
Acceptable noise level minus 4	Acceptable noise level minus 2
Acceptable noise level minus 5	Acceptable noise level minus 2
Acceptable noise level minus 6	Acceptable noise level minus 1
< Acceptable noise level minus 6	Acceptable noise level

Note 1: ANL = recommended acceptable L_{Aeq} noise level for the specific receiver, area and time of day from **Table 10**.

4.2.3 Project Specific (Operational) Noise Levels (PSNLs)

The intrusive PSNLs are based on the background levels presented in **Table 1** and **Table 2** and are presented in **Table 13**.

Table 13 INP Project Specific Intrusive Noise Assessment Criteria (dBA re 20 µPa)

	Project Specific Intrusive $L_{Aeq(15minute)}$ Assessment Criteria [1]		
	Day (0700-1800)	Evening (1800-2200)	Night (2200-0700)
1 Batty Street, Balmain [2]	56	54	47
17 Donnelly Street, Balmain [3]	52	50	45
22 Refinery Drive, Pyrmont [3]	55	54	52
53 Leichhardt Street, Glebe [3]	51	51	45

Note 1: The intrusive criterion is applicable over any 15 minute period.
Note 2: Based on **Table 2**.
Note 3: Based on **Table 1**.

The amenity PSNLs are based on the recommended acceptable amenity levels in **Table 11** adjusted in accordance with **Table 12** and based on existing amenity levels from **Table 4**, **Table 5** and **Table 6** and are presented in **Table 14**.

Table 14 INP Project Specific Noise Amenity Assessment Criteria (dBA re 20 µPa)

Assessment Locations	Acceptable Project Specific Amenity $L_{Aeq(Period)}$ Assessment Criteria		
	Day (0700-1800)	Evening (1800-2200)	Night (2200-0700)
1 Batty Street, Balmain	64	50	48
17 Donnelly Street, Balmain	65	47	44
22 Refinery Drive, Pyrmont	65	53	42
53 Leichhardt Street, Glebe	65	55	48

4.3 Sleep Disturbance Criteria

The EPA's policy on sleep disturbance is to provide a screening test which assesses the emergence of the maximum or $L_{A1(1minute)}$ noise level above the $L_{A90(15minute)}$ level present at the time. An appropriate screening criteria for sleep disturbance is therefore an $L_{A1(1minute)}$ level 15 dBA above the RBL for the night-time period (2200 to 0700 hours).

When the screening level is not met, a more detailed analysis may be required which should cover the maximum noise level or $L_{A1(1minute)}$, the extent that the maximum noise level exceeds the background level and the number of times this occurs during the night-time period. Some guidance on possible impacts is contained in the review of relevant sleep disturbance research contained in the EPA's "*NSW Road Noise Policy",* 2011 (RNP).

Other factors that may be important in assessing the extent of impacts on sleep include:

- How often high noise events will occur;
- Time of day (normally between 2200 and 0700 hours); andhether there are times of the day when there is a clear change in the noise environment (such as during early morning shoulder periods).

It is noteworthy that there are no specific criteria for sleep disturbance nominated in the INP, in the INP Application Notes, the RNP or in the ICNG. This is consistent with the statements in the RNP that "*Triggers for, and effects of sleep disturbance from, exposure to intermittent noise such as noise from road traffic are still being studied.",* and that *'There appears to be insufficient evidence to set new indicators for potential sleep disturbance due to road traffic noise'.*

The RNP concludes from the research on sleep disturbance that:

- *A maximum internal noise levels below 50-55 dBA are unlikely to cause awakening reactions; and*
- *One or two noise events per night with maximum internal noise levels 65-70 dBA are not likely to significantly affect health and wellbeing.*

Based on the ambient noise survey results, the sleep arousal screening levels are 57 dBA at Batty Street, 55 dBA at Donnelly Street, 62 dBA at Refinery Drive and 55 dBA at Leichhardt Street.

4.4 Traffic Noise

The EPA's NSW Road Noise Policy (RNP) presents the NSW Government's noise design goals for the assessment of road traffic noise.

The RNP presents recommended road traffic noise criteria for various types of road and land use developments. The site access roads of City West Link, Victoria Road and the Western Distributor perform the role of arterial roads.

The relevant criteria for this assessment applicable to residences is summarised in **Table 15**.

Table 15 RNP Assessment Criteria

Road category	Type of project/land use	Assessment Criteria	
		Day (0700 to 2200hours)	**Night (2200 to 0700 hours)**
Freeway/arterial/ sub-arterial roads	Existing residences affected by additional traffic on existing freeways/arterial/sub-arterial roads generated by land use developments	LAeq(15hour) 60 dBA	LAeq(9hour) 55 dBA

Furthermore in applying the assessment criteria the RNP recommends '*for existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, any increase in the total traffic noise level should be limited to 2 dB above that of the corresponding 'no build option*'.

5 CONSTRUCTION NOISE ASSESSMENT

The proposed interim IEF area, as illustrated in **Figure 1,** is currently bitumen hardstand, hence limited construction activities are required. Whilst the majority of activities associated with the interim IEF are operational such as setting up and dismantling of exhibition facilities, nevertheless the following construction/development works will be required to be undertaken and have been assessed:

- Installation of security fencing, gates, barriers (eg jersey kerbs) and portable buildings for the guard house / checkpoints
- Road and car parking space line marking
- Installation of business identification and directional signage
- Installation of the exhibition buildings which comprise a sprung structure consisting of a metal frame and heavy duty fabric.

Noise levels have been calculated at the nearest residential facades to access the impact of the Project area construction. Calculations have utilised the SoundPlan computer model developed to assess operational noise (Refer to Section **6.2**) and include distance attenuation, the natural topography, buildings, air absorption and ground effects.

It is assumed that construction works will be undertaken during the ICNG preferred hours of construction (Refer to Section **4.1**).

The typical worst case scenario for construction activities is likely to involve operation of two mobile cranes, a generator and the delivery of materials. The following construction equipment LAeq(15min) sound power levels (SWLs) have been adopted for this study:

- Mobile Crane 104 dBA
- Generator 104 dBA
- Truck passby (20 km/hr) 104 dBA

Predicted noise levels during the construction activities are presented in **Table 16**.

Table 16 Predicted $L_{Aeq(15\ minute)}$ Construction Noise Emissions at Nearest Receivers - dBA

Location	Predicted $L_{Aeq(15min)}$	NMLs [1]
Balmain - Batty Street	44	61
Balmain - Donnelly Street	42	57
Pyrmont – Refinery Drive	47	60
Glebe - Leichhardt Street	38	56

Note 1: ICNG preferred hours of construction: Monday to Friday 0700 to 1800, Saturdays 0800 to 1300 and no work on Sundays or Public Holidays

The noise levels from construction activities presented in **Table 16** are predicted to comply with the NMLs.

6 OPERATIONAL NOISE ASSESSMENT

6.1 Expected Operations

The following scenarios have been developed based on expected operations at Glebe Island. These scenarios are considered to represent the typical worst case for the daytime, evening and night-time periods:

- Daytime - Scenario 1
  Exhibition in Halls 1, 2, 3, 4 and 5. A typical exhibition will occur in Halls 1, 2 and 3 with the larger exhibitions consisting of an additional two halls.
- Evening - Scenario 2
  Evening function in Hall 3.
- Night-time - Scenario 3
  Dismantling of an exhibition in Halls 1, 2, 3, 4 and 5. One forklift and 5 hand tool operations have been modelled in each Hall, with 40 truck movements per hour. This scenario represents the likely worst case between 2200 and 2400 hours, with the number of truck movements after midnight limited to 15 per hour (one every 4 minutes).

6.2 Computer Modelling

In order to facilitate the computation of environmental noise emissions from the operations of the proposed facility at Glebe Island, a three dimensional computer noise model has been developed, based on available ground topography and aerial photography of the study area.

Noise emission modelling was undertaken using SoundPLAN v7.0 noise prediction software, based on the CONCAWE industrial noise algorithm. The noise modelling algorithms account for the octave band SWLs of the sources, their heights, the distances to the receivers, the natural topography, buildings, air absorption and ground effects. The model incorporates estimated SWLs derived from the White Bay passenger terminal assessment and previous measurement of ships, forklifts and trucks from SLR Consulting database.

A site plan showing the location of the exhibition halls, vehicle access routes and carparking area used in the model is shown **Figure 1**.

The following equipment $L_{Aeq(15min)}$ SWLs have been adopted for this study. SWLs are $L_{Aeq(15min)}$ unless specified otherwise.

- Petrol/Diesel powered forklift 101 dBA
- Delivery truck 103 dBA

- Hand tools to dismantle and setup 95 dBA
- Bus/Truck passby (20km/hr) 104 dBA
- Truck L_{Amax} 107 dBA
- Truck L_{Amax} handbrake (air release) 122 dBA
- Construction L_{Amax} impact 112 dBA
- Car passby (20km/hr) 97 dBA
- Shuttle bus (20km/hr) 100 dBA
- Reverberant level in each exhibition hall 70 dBA
- Reverberant level in an exhibition hall function 80 dBA
- Airconditioning Plant 89 dBA
- People talking (SWL per person) 66 dBA

6.3 Meteorological Conditions

Meteorological conditions for the site were studied in 2001 and the information included in the HLA-Eurosciences report of July 2003 *"Noise Impact Assessment – 24 hr Trucking at the Bulk Gypsum Unloading Terminal - GRA Terminal Glebe Island"*. An analysis of data from the Bureau of Meteorology for 2001 for the Fort Denison weather station over 24 hour periods was converted into day, evening and night-time wind roses for each season, for winds of speeds up to 3 m/s.

The meteorological data showed that Autumn, Winter and Spring were significantly dominated (above 30% occurrence for a quadrant) by westerly winds, for day, evening and night-time periods. Summer was significantly dominated by winds from the east, and periods of calm, as they occurred for greater than 30% of the period.

Based on the above, modelling was undertaken for the following meteorological conditions;

Summer;

- 20ºC, 70% RH and calm (no wind)
- 20ºC, 70% RH and a 3 m/s easterly wind

Winter;

- 10ºC, 70% RH and a 3 m/s westerly wind

6.4 Operational Noise Impact Assessment

Predicted noise levels for activities corresponding to the daytime, evening and night-time scenarios described above are presented in **Table 17** to **Table 19** for both the intrusive $L_{Aeq(15min)}$ and amenity $L_{Aeq(Period)}$ noise levels.

Table 17 Scenario 1 - Daytime Predicted Noise Emissions - dBA

Assessment Locations	Predicted Intrusive Noise Levels			Predicted Amenity Noise Levels [1]			PSNL	
	Summer Calm	Summer Easterly winds	Winter Westerly wind	Summer Calm	Summer Easterly winds	Winter Westerly wind	$L_{Aeq(15min)}$	$L_{Aeq(11hour)}$
Balmain - Batty Street	44	46	42	39	41	37	56	64
Balmain - Donnelly Street	41	40	44	36	35	39	52	65
Pyrmont – Refinery Drive	46	43	51	41	38	46	55	65
Glebe - Leichhardt Street	40	39	42	35	34	37	51	65

Note 1: Assume a 5 dBA difference between Intrusive and Amenity Levels

Table 18 Scenario 2 - Evening Predicted Noise Emissions - dBA

Assessment Locations	Predicted Intrusive Noise Levels			Predicted Amenity Noise Levels [1]			PSNL	
	Summer Calm	Summer Easterly winds	Winter Westerly wind	Summer Calm	Summer Easterly winds	Winter Westerly wind	$L_{Aeq(15min)}$	$L_{Aeq(4hour)}$
Balmain - Batty Street	43	46	42	38	41	37	54	50
Balmain - Donnelly Street	44	44	45	39	39	40	50	47
Pyrmont – Refinery Drive	47	46	51	42	41	46	54	53
Glebe - Leichhardt Street	38	38	41	33	33	36	51	55

Note 1: Assume a 5 dBA difference between Intrusive and Amenity Levels

Table 19 Scenario 3 - Night-time Predicted Noise Emissions - dBA

Assessment Locations	Predicted Intrusive Noise Levels			Predicted Amenity Noise Levels [1]			PSNL	
	Summer Calm	Summer Easterly winds	Winter Westerly wind	Summer Calm	Summer Easterly winds	Winter Westerly wind	$L_{Aeq(15min)}$	$L_{Aeq(9hour)}$
Balmain - Batty Street	46	48	45	41	43	40	47	48
Balmain - Donnelly Street	43	43	43	38	38	38	45	44
Pyrmont – Refinery Drive	48	47	52	43	42	47	52	42
Glebe - Leichhardt Street	40	40	40	35	35	35	45	48

Note 1: Assume a 5 dBA difference between Intrusive and Amenity Levels

Discussion

The results for the IEF operations presented in **Table 17** to **Table 19** are summarised in the following points:

Intrusive Assessment

- **Table 17** shows that compliance with the daytime intrusive PSNL is achieved at all locations under all meteorological conditions.
- **Table 18** shows that compliance with the evening intrusive PSNL is achieved at all locations under all meteorological conditions.
- **Table 19** shows that compliance with the night-time intrusive PSNL is achieved at all locations under all meteorological conditions except at Balmain-Batty Street where the noise levels are predicted to be above the intrusive night-time PSNL by a marginal 1 dBA under easterly winds.

Amenity Assessment

- **Table 17** shows that compliance with the daytime amenity PSNL is achieved at all locations under all meteorological conditions.
- **Table 18** shows that compliance with the evening amenity PSNL is achieved at all locations under all meteorological conditions.
- **Table 19** shows that compliance with the night-time amenity PSNL is achieved at all locations under all meteorological conditions except at Pyrmont-Refinery Drive where the noise levels are predicted to be above the night-time amenity PSNL by a marginal 1 dBA under calm conditions and by up to 5 dBA under westerly winds.

  It is noted that for the night-time period, the average noise level from 10pm to 7am will be less than the worst case 15 minute period (which is based on dismantling all 5 halls and up to 40 truck movements to and from the site per hour, and note after midnight the truck movements reduce to 15 per hour). The difference between the intrusive levels and the amenity levels is likely to be more than 5 dB resulting in compliance with the recommended amenity PSNL (although there *may be* a marginal exceedance of 1 dB to 2 dB depending on the accuracy of the assumed operational scenario).

6.5 Sleep Disturbance from IEF Development

Noise levels were predicted from potential sleep disturbance events occurring during the night-time setup phase such as trucks entering and leaving site, the release of air upon engagement of truck handbrake and general impact noise. The range of levels is presented in **Table 20**, with the lower level corresponding to general impact or truck passby noise, and the higher truck handbrake (air release) noise. The predicted noise levels comply with the screening level, and no further investigation is therefore required.

Table 20 Night-time Impact Predicted L_{Amax} Noise Emissions- dBA

Assessment Locations	Predicted L_{AMax} Levels [1]	Screening level - L_{Amax}
Balmain - Batty Street	54	57
Balmain - Donnelly Street	51	55
Pyrmont – Refinery Drive	59	62
Glebe - Leichhardt Street	48	55

Note 1: The range of noise levels correspond to those for different impact events at the multi-storey receivers in the area.

6.6 Cumulative Noise Assessment

In accordance with the INP Chapter 2 Industrial Noise Criteria (Section 2.2.4), the daytime, evening and night-time cumulative sum of the approved developments $L_{Aeq(period)}$ noise amenity levels have been determined as presented in **Table 21** to **Table 23** respectively (Refer to **Table 10** for the criteria). It should be noted that for each of the developments noted below, the likelihood of the existing and proposed developments emitting simultaneous maximum noise emissions is remote. This cumulative assessment is therefore considered to be conservative.

Note: The cumulative assessment has been undertaken for calm conditions only: data for the CPT water assessment under adverse conditions is not available.

Table 21 Cumulative Daytime $L_{Aeq(11hour)}$ Noise Amenity Levels - dBA

Assessment Locations	CPT		SYM	Non-Project Related Sydney Port Activities	IEF	Cumulative Amenity Levels		Recommended Amenity Criteria	
	Land	Water	Land			Without IEF	With IEF	Acceptable	Maximum
Balmain - Batty Street	52	46	28	57	39	59	59	65	70
Balmain - Donnelly Street	41	52	13	52	36	55	55	65	70
Pyrmont – Refinery Drive	38	43	26	49	41	50	51	65	70
Glebe - Leichhardt Street	31	37	33	46	35	47	47	65	70

Note 1: All predicted noise levels from the worst case scenarios

Table 22 Cumulative Evening $L_{Aeq(4hour)}$ Noise Amenity Levels - dBA

Assessment Locations	CPT		SYM	Non-Project Related Sydney Port Activities	IEF	Cumulative Amenity Levels		Recommended Amenity Criteria	
	Land	Water	Land			Without IEF	With IEF	Acceptable	Maximum
Balmain - Batty Street	57	46	33	57	38	60	60	55	60
Balmain - Donnelly Street	46	50	18	52	39	55	55	55	60
Pyrmont – Refinery Drive	43	41	31	49	42	51	51	55	60
Glebe - Leichhardt Street	36	35	38	46	33	47	47	55	60

Note 1: All predicted noise levels from the worst case scenarios

Table 23 Cumulative Night-time LAeq(9hour) Noise Amenity Levels - dBA

Assessment Locations	CPT		SYM	Non-Project Related Sydney Port Activities	IEF	Cumulative Amenity Levels		Recommended Amenity Criteria	
	Land	Water	Land			Without IEF	With IEF	Acceptable	Maximum
Balmain - Batty Street	52	41	28	57	41	58	59	50	55
Balmain - Donnelly Street	41	48	13	52	38	54	54	50	55
Pyrmont – Refinery Drive	38	41	26	49	43	50	51	50	55
Glebe - Leichhardt Street	31	34	33	46	35	46	47	50	55

Note 1: All predicted noise levels from the worst case scenarios

Cumulative Impact Assessment

In summary, the predicted cumulative $L_{Aeq(period)}$ noise amenity levels show that:

- The INP recommended acceptable daytime amenity criteria are met at all receivers under calm conditions with the IEF operations.
- The INP recommended maximum evening amenity criterion is met at all receivers under calm conditions with the IEF development. The INP recommended acceptable evening amenity criteria is exceeded by up to 5 dBA at the receivers located in Balmain – Batty Street. However, it should be noted that the criterion is already exceeded by up to 5 dBA without the operation of the IEF. The IEF activities noise contributions are more than 10 dBA below the Sydney port activities noise contributions and therefore have a negligible effect on the overall level at this location.
- The INP recommended acceptable and maximum night-time amenity criteria are exceeded by up to 9 dBA and 4 dBA at the receivers located in Balmain – Batty Street respectively. The recommended night-time amenity criteria are exceeded by up to 4 dBA at the receivers located in Balmain-Donnelly Street with the IEF development. The INP recommended night-time amenity criterion is exceeded by up to 1 dBA at the receivers located in Pyrmont – Refinery Drive under calm conditions with the IEF Operations. However, it should be noted that the INP recommended acceptable and maximum night-time amenity criteria are already exceeded by up to 8 dBA and 3 dBA at the receivers located in Balmain-Batty Street respectively, up to 4 dBA at the receivers located in Balmain-Donnelly Street without the IEF development. The IEF activities noise contributions are more than 10 dBA below the Sydney port activities noise contributions and therefore have a negligible effect on the overall level at those locations.

6.7 Impact from Existing, Approved and Proposed Developments to IEF

Table 24 below presents the results of the impact of the existing, approved and proposed developments onto the IEF development.

A 10 dBA reduction is assumed for noise ingress.

Table 24 Maximum Noise Ingress (Intrusive Noise Levels) - dBA

Assessment Locations	Noise Ingress / Noise Contributions LAeq(internal)[1]			
	CPT		SYM	Non-Project Related Sydney Port Activities
	Land	Water	Land	
Exhibition Hall 1	38	43	21	49
Exhibition Hall 2	38	42	22	52
Exhibition Hall 3	39	41	22	52
Boat Show Hall 4	45	38	13	52
Boat Show Hall 5	41	39	20	51

Note 1 : Assume a 10 dBA reduction from outside to inside

Noise Ingress Assessment

According to **Table 24**, internal noise levels are predicted to be up to 52 dBA inside the IEF. It should be noted that for each of the developments noted above, the likelihood of the existing and proposed developments emitting simultaneous maximum noise emissions is remote.

6.8 Noise mitigation

Whilst there is compliance with the intrusive criteria, and likely compliance with the amenity criteria, noise mitigation measures should be considered to minimise impacts.

It is recommended that the following mitigation measures be implemented during the operation of the IEF:

- The mandatory use of non-tonal broadband warning alarms for forklifts and other mobile plant.
- All trucks are to enter and leave the site in a forward direction.
- All trucks to operate at the premises in a forward direction where possible.
- Trucks to have parking brake (air release) silencers fitted.
- Consideration to dismantling the 5 halls for the major exhibition over more than one night-time period, for example halls 1 to 3 on a separate night to halls 4 and 5.
- Control of amplified music and public address systems in the functions hall to limit the reverberant noise level to 80 dBA.
- Noise monitoring should be conducted by a qualified acoustic consultant at the potentially affected residences to confirm compliance with the design criteria.

6.9 Operational Traffic Noise Assessment

In order to assess the potential impacts of traffic noise at existing residences on the access roads to the site, noise level modelling was carried out using the UK Department of Transport, *"Calculation of Road Traffic Noise"* (CORTN 1988) algorithms. The modelling allows for traffic volume and mix, type of road surface, vehicle speed and ground absorption. The algorithm output of CORTN has been modified to calculate the relevant L_{Aeq} road traffic noise emission descriptors, as required by the EPA guidelines.

The calculated noise levels are determined by taking into account overall traffic volumes, vehicle speed and percentage of heavy vehicles. Data used in the calculations were based on information provided by the Project traffic consultant, AECOM.

Traffic will arrive and leave the site via City West link and James Road intersection and then via either the City West Link, Victoria Road or Anzac Bridge. Based on the AECOM data, traffic generated by the proposal can potentially increase the flows on each of these arterial roads by 3%.

The corresponding increase in traffic noise is estimated to be less than 0.1 dBA on all 3 arterial roads, which complies with the EPA's RNP 2 dBA 'increase' criteria.

7 CONCLUSION

SLR Consulting has been engaged by APP Corporation on behalf of Instrustructure NSW to prepare a Noise Impact Assessment of noise emissions associated with the use of Glebe Island as the interim IEF.

Construction Noise Assessment

Construction noise levels as a result of the Project meet the management levels of the NSW EPA's ICNG.

Operational Noise Assessment

In accordance with the NSW EPA's INP requirements, the cumulative amenity criteria for the receivers was established based on ambient measurements made by SLR Consulting and previous Glebe Island studies undertaken by other consultants. The project specific intrusive and amenity criteria were derived from the ambient measurements and the cumulative amenity criteria.

Noise emission modelling was undertaken using SoundPLAN v7.0 noise prediction software, based on the CONCAWE industrial noise algorithm.

Intrusive Assessment

Calculated noise emissions for the use of the project site as the interim IEF predicts that:

- Compliance with the daytime intrusive PSNL is achieved at all locations under all meteorological conditions.
- Compliance with the evening intrusive PSNL is achieved at all locations under all meteorological conditions.
- Compliance with the night-time intrusive PSNL is achieved at all locations under all meteorological conditions except at Balmain-Batty Street where the noise levels are predicted to be above the intrusive night-time PSNL by a marginal 1 dBA under easterly winds.

Amenity Assessment

Calculated noise emissions for the use of the project site as the interim IEF predicts that:

- Compliance with the daytime amenity PSNL is achieved at all locations under all meteorological conditions.
- Compliance with the evening amenity PSNL is achieved at all locations under all meteorological conditions.
- Compliance with the night-time amenity PSNL is achieved at all locations under all meteorological conditions except at Pyrmont-Refinery Drive where the noise levels are predicted to be above the night-time amenity PSNL by a marginal 1 dBA under calm conditions and by up to 5 dBA under westerly winds.

It is noted that for the night-time period, the average noise level from 10pm to 7am will be less than the worst case 15 minute period (which is based on dismantling all 5 halls and up to 40 truck movements to and from the site per hour, and note after midnight the truck movements reduce to 15 per hour). The difference between the intrusive levels and the amenity levels is likely to be more than 5 dB resulting in compliance with the recommended amenity PSNL (although there *may be* a marginal exceedance of 1 dB to 2 dB depending on the accuracy of the assumed operational scenario).

Cumulative Noise Assessment

The predicted cumulative $L_{Aeq(period)}$ noise amenity levels show that:

- The INP recommended acceptable daytime amenity criteria are met at all receivers under calm conditions with the IEF operations.
- The INP recommended maximum evening amenity criterion is met at all receivers under calm conditions with the IEF development. The INP recommended acceptable evening amenity criteria is exceeded by up to 5 dBA at the receivers located in Balmain – Batty Street. However, it should be noted that the criterion is already exceeded by up to 5 dBA without the operation of the IEF. The IEF activities noise contributions are more than 10 dBA below the Sydney port activities noise contributions and therefore have a negligible effect on the overall level at this location.
- The INP recommended acceptable and maximum night-time amenity criteria are exceeded by up to 9 dBA and 4 dBA at the receivers located in Balmain – Batty Street respectively. The recommended night-time amenity criteria are exceeded by up to 4 dBA at the receivers located in Balmain-Donnelly Street with the IEF development. The INP recommended night-time amenity criterion is exceeded by up to 1 dBA at the receivers located in Pyrmont – Refinery Drive under calm conditions with the IEF Operations. However, it should be noted that the INP recommended acceptable and maximum night-time amenity criteria are already exceeded by up to 8 dBA and 3 dBA at the receivers located in Balmain-Batty Street respectively, up to 4 dBA at the receivers located in Balmain-Donnelly Street without the IEF development. The IEF activities noise contributions are more than 10 dBA below the Sydney port activities noise contributions and therefore have a negligible effect on the overall level at those locations.

Sleep Disturbance Assessment

Sleep disturbing events have been assessed against the NSW EPA's guidelines and comply with the screening level.

Traffic Noise Assessment

Changes in traffic noise levels as a result of the proposal comply with the NSW EPA's RNP on access roads to and from the site.

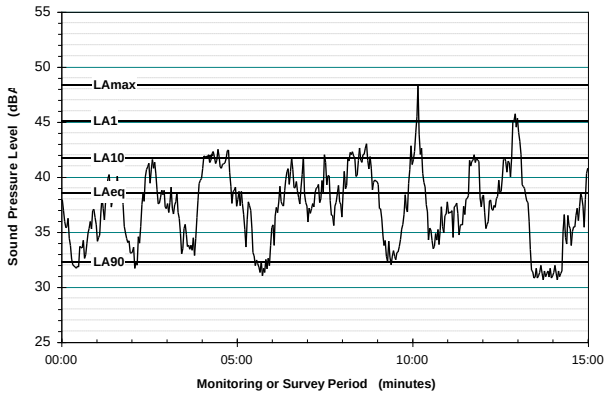
ACOUSTIC TERMINOLOGY

Typical Noise Indices

This Report makes repeated reference to certain noise level descriptors, in particular the L_{A10}, L_{A90} and L_{Aeq} and L_{Amax} noise levels.

- The L_{A10} is the A-weighted sound pressure level exceeded 10% of a given measurement period and is utilised normally to characterise typical maximum noise levels.
- The L_{Aeq} is essentially the average sound level. It is defined as the steady sound level that contains the same amount of acoustical energy as a given time-varying sound over the same measurement period. The $L_{Aeq(15hour)}$ is the measurement parameter used to describe the road traffic noise level over the entire daytime (7.00 am to 10.00 pm) period. The $L_{Aeq(9hour)}$ is the measurement parameter used to describe the road traffic noise level over the entire night-time (10.00 pm to 7.00 am) period. Similarly, the $L_{Aeq(1hour)}$ is the measurement parameter used to describe the road traffic noise level during the loudest 1-hour period during the daytime or night-time periods.
- The L_{A90} noise level is the A-weighted sound pressure level exceeded 90% of a given measurement period and is representative of the average minimum background sound level (in the absence of the source under consideration), or simply the "background" level.
- The L_{Amax} noise level is the maximum A-weighted noise level associated with road traffic movements.

Graphical Display of Typical Noise Indices



Typical Noise Levels

The following table presents examples of typical noise levels.

Typical Noise Levels

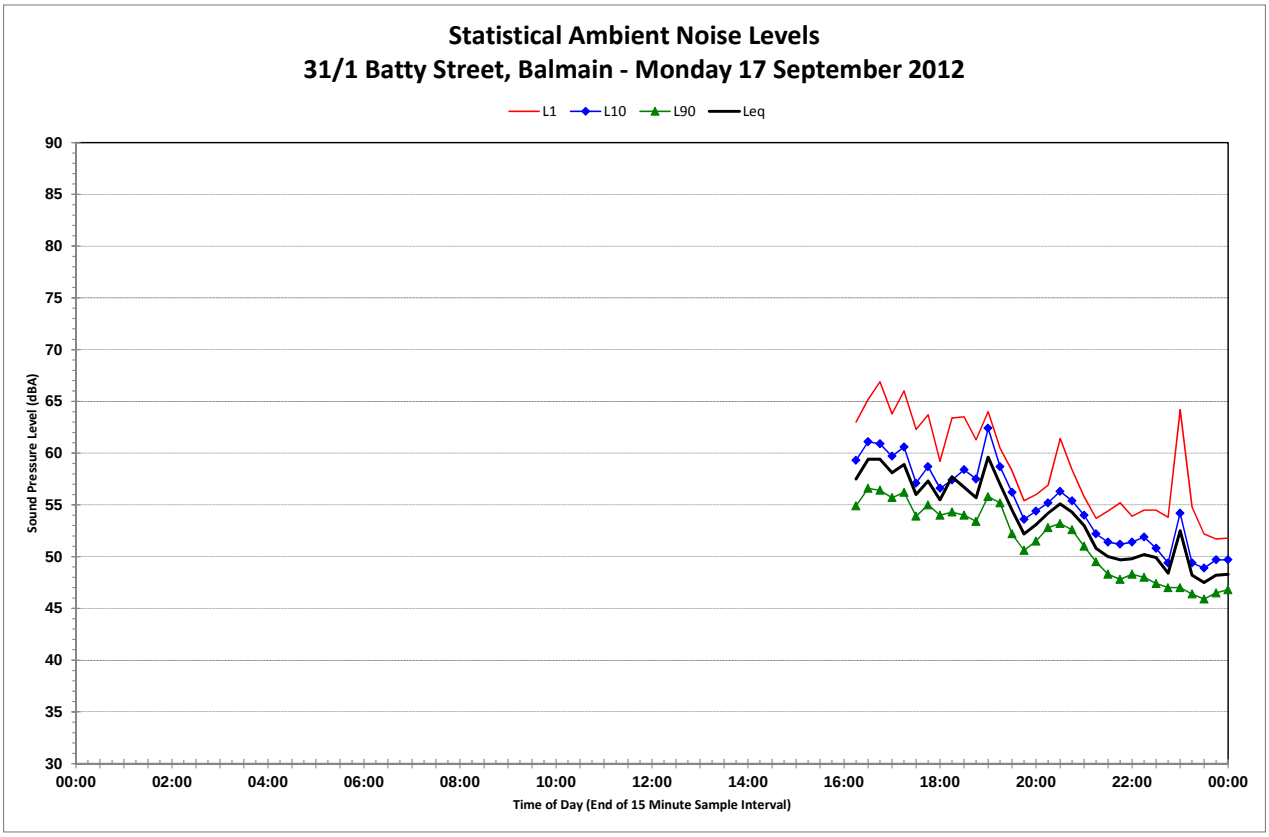
Sound Pressure Level (dBA)	Typical Source	Subjective Evaluation
130 120 110	Threshold of pain Heavy rock concert Grinding on steel	Intolerable Extremely noisy
100 90	Loud car horn at 3 m Construction site with pneumatic hammering	Very noisy
80 70	Kerb side of busy street Loud radio or television	Loud
60 50	Department store General Office	Moderate to Quiet
40 30	Inside private office Inside bedroom	Quiet to Very quiet
20	Unoccupied recording studio	Almost silent

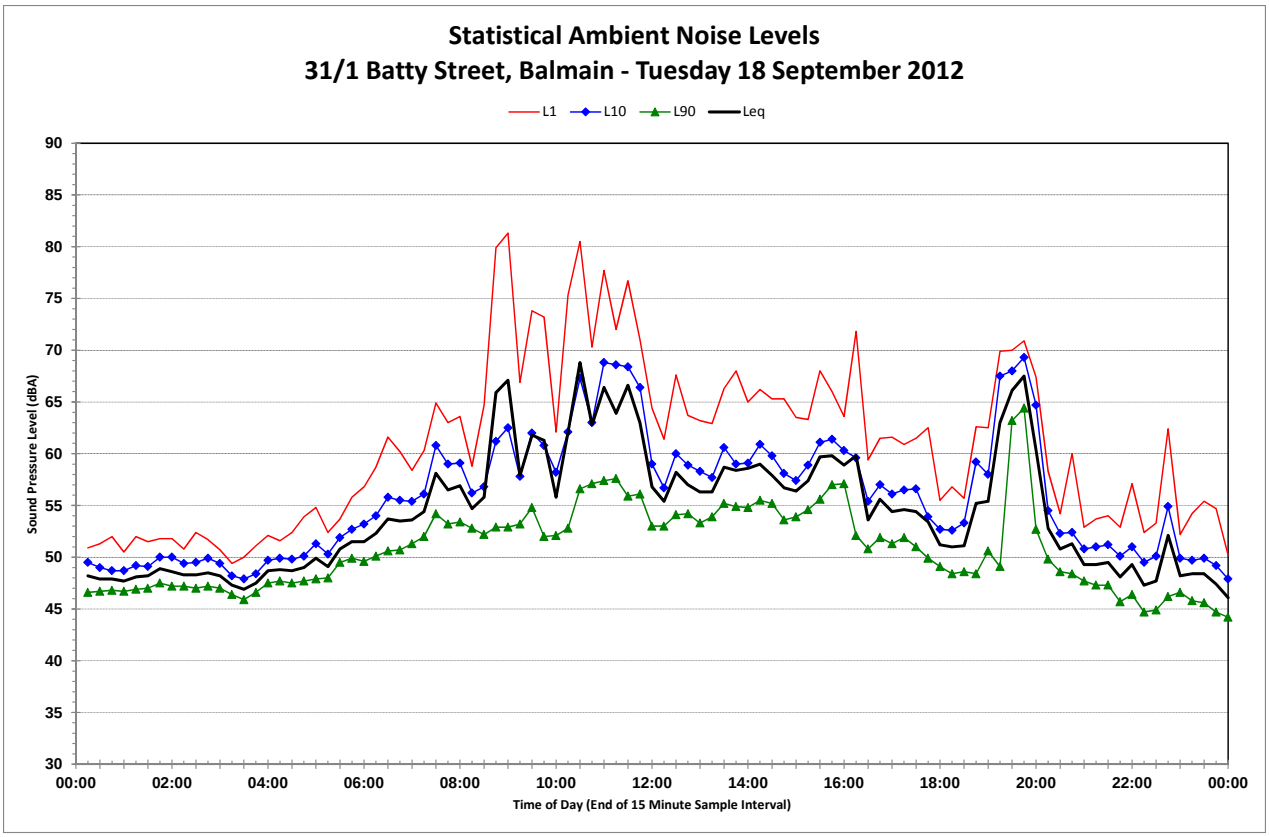
A-Weighting or dBA Noise Levels

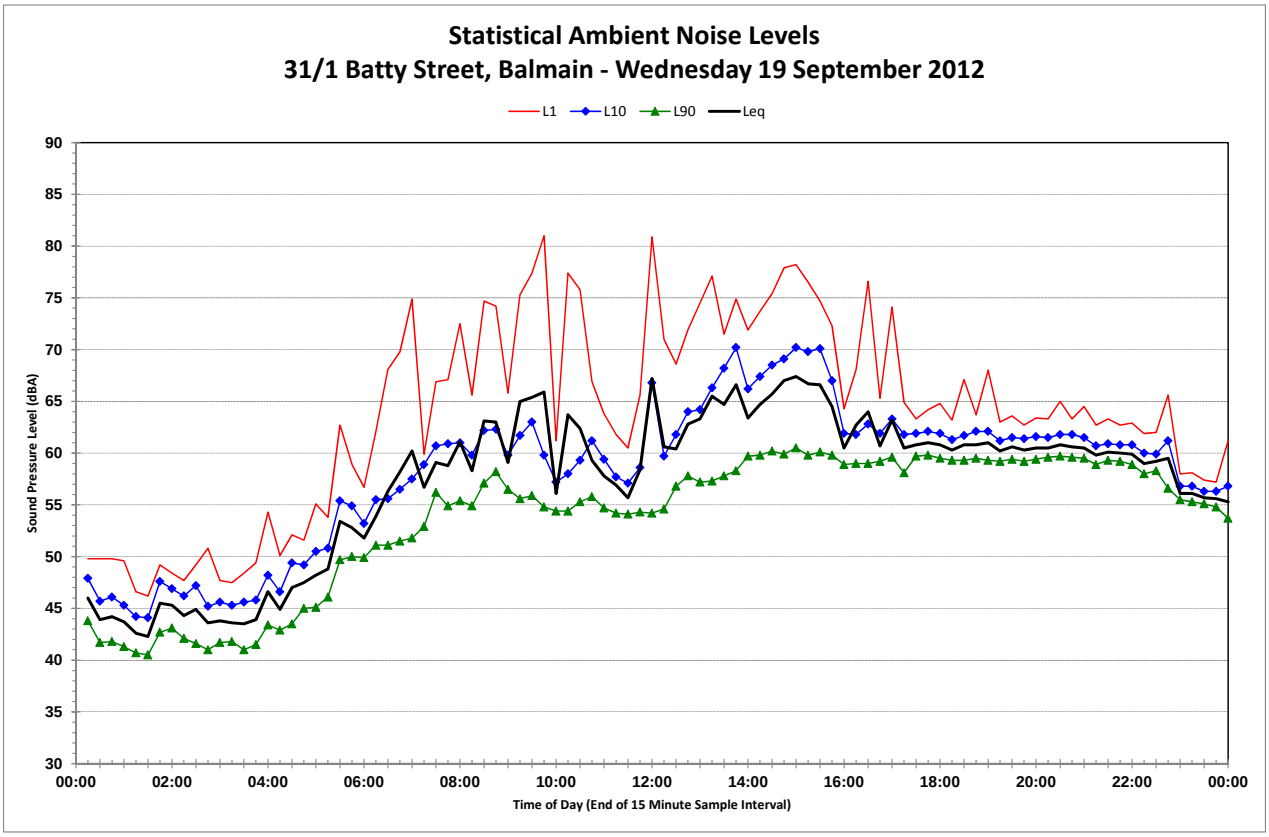
The overall level of a sound is usually expressed in terms of dBA, which is measured using the "A-weighting" filter incorporated in sound level meters. These filters have a frequency response corresponding approximately to that of human hearing. People's hearing is most sensitive to sounds at mid frequencies (500 Hz to 4000 Hz), and less sensitive at lower and higher frequencies. Thus, the level of a sound in dBA is a good measure of the "loudness" of that sound. Different sources having the same dBA level generally sound about equally as loud, although the perceived loudness can also be affected by the character of the sound (eg the loudness of human speech and a distant motorbike may be perceived differently, although they are of the same dBA level).

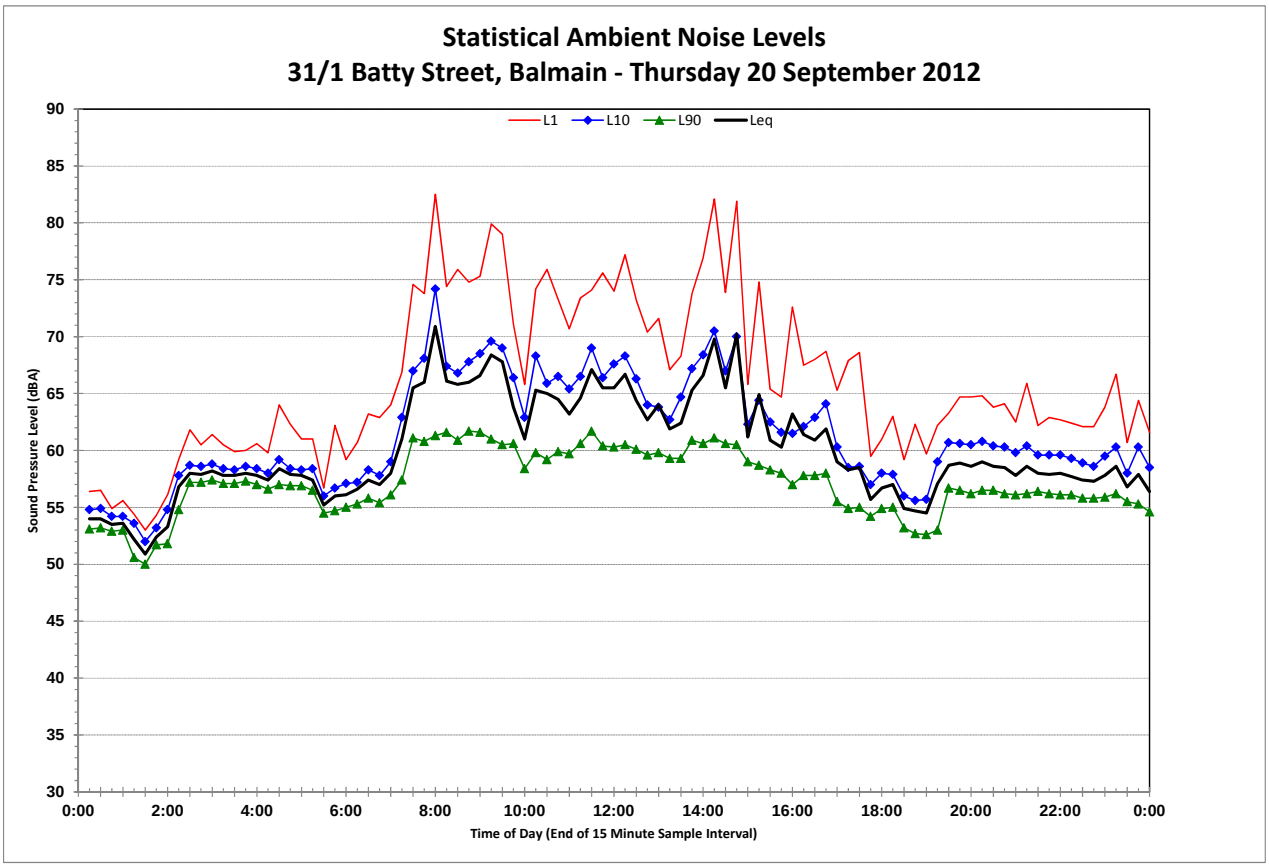
Sensitivity of People to Noise Level Changes

A change of up to 3 dBA in the level of a sound is difficult for most people to detect, whilst a 3 dBA to 5 dBA change corresponds to a small but noticeable change in loudness. A 10 dBA change corresponds to an approximate doubling or halving in loudness.


Statistical Ambient Noise Levels
31/1 Batty Street, Balmain - Monday 17 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
60
55
50
45
40
35
30
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
31/1 Batty Street, Balmain - Tuesday 18 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
60
55
50
45
40
35
30
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
31/1 Batty Street, Balmain - Wednesday 19 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
60
55
50
45
40
35
30
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
31/1 Batty Street, Balmain - Thursday 20 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
60
55
50
45
40
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2:00
4:00
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12:00
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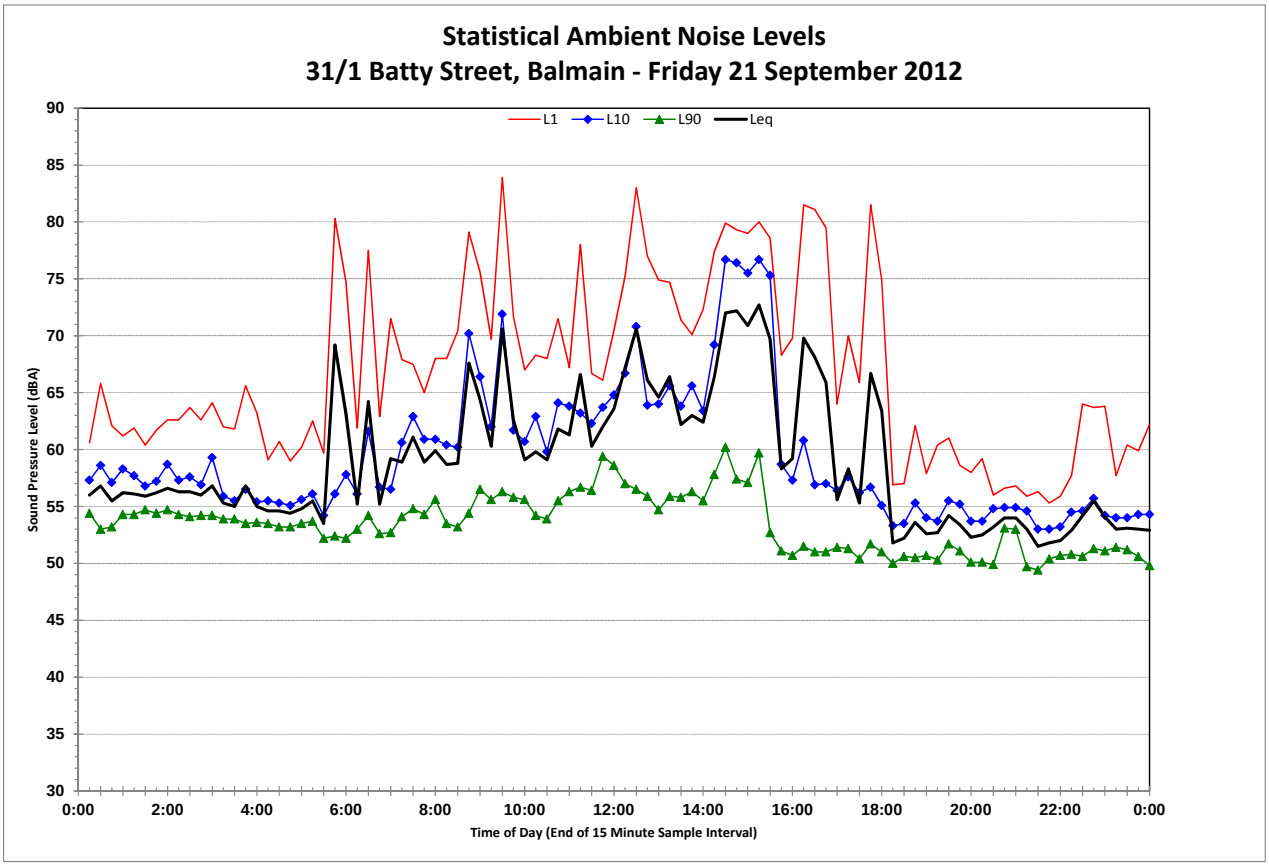
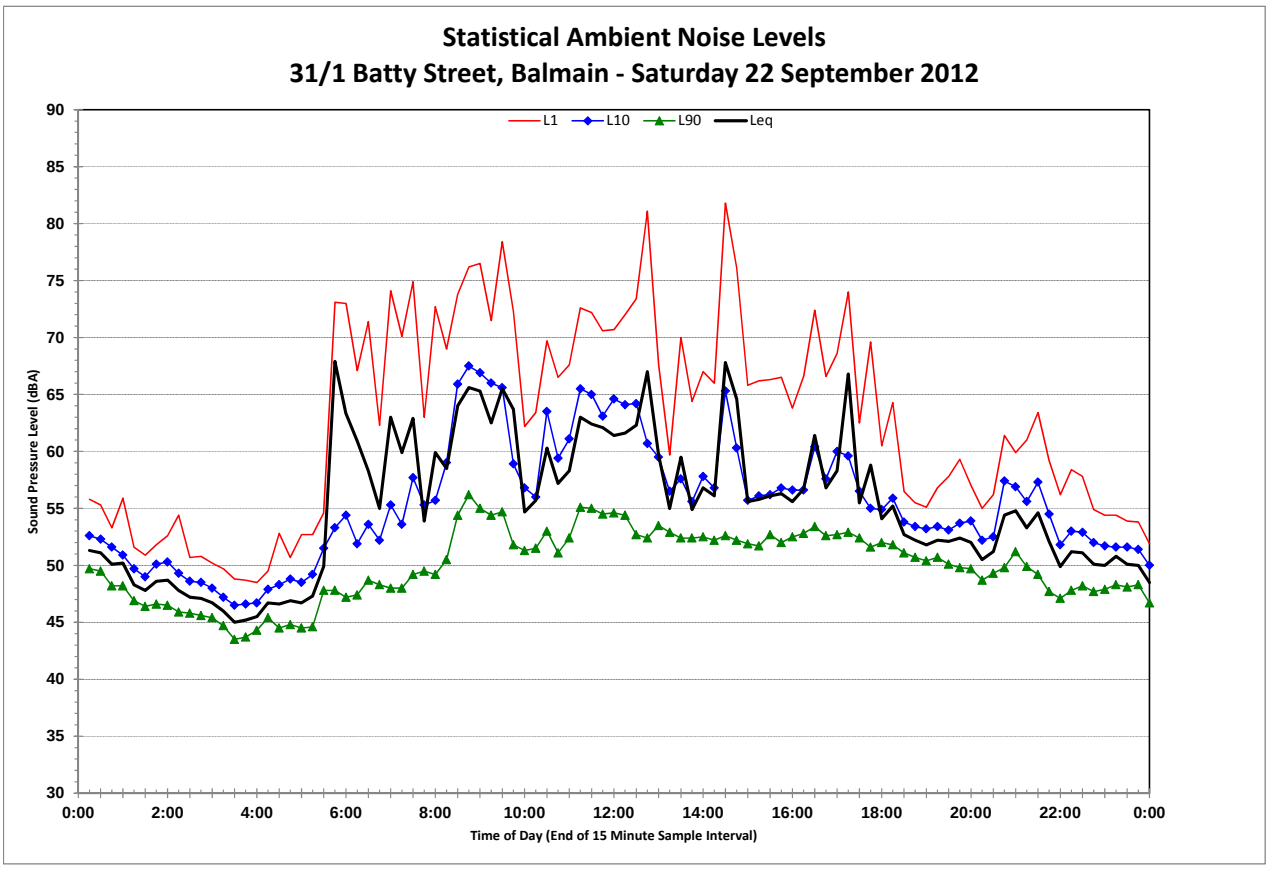
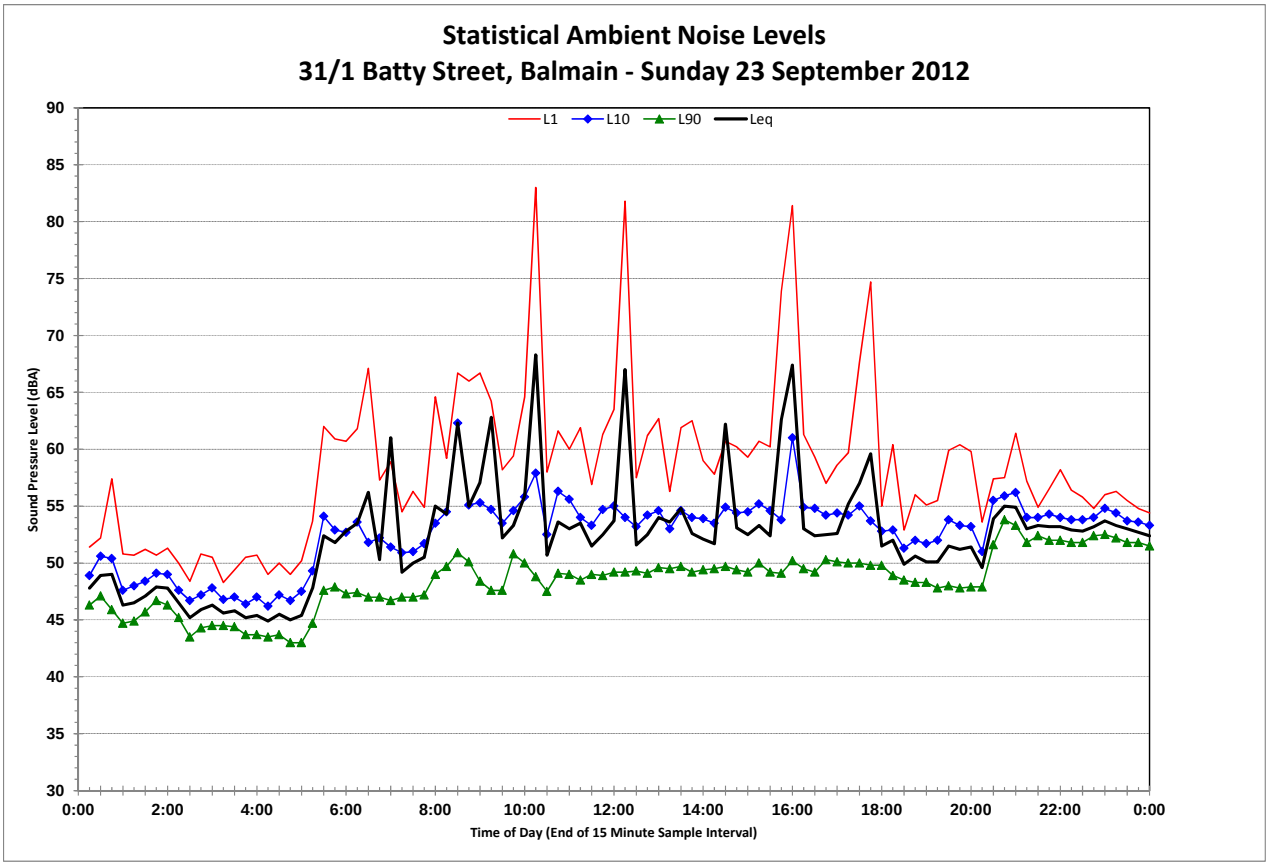
18:00
20:00
22:00
0:00
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
31/1 Batty Street, Balmain - Friday 21 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
31/1 Batty Street, Balmain - Saturday 22 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
31/1 Batty Street, Balmain - Sunday 23 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
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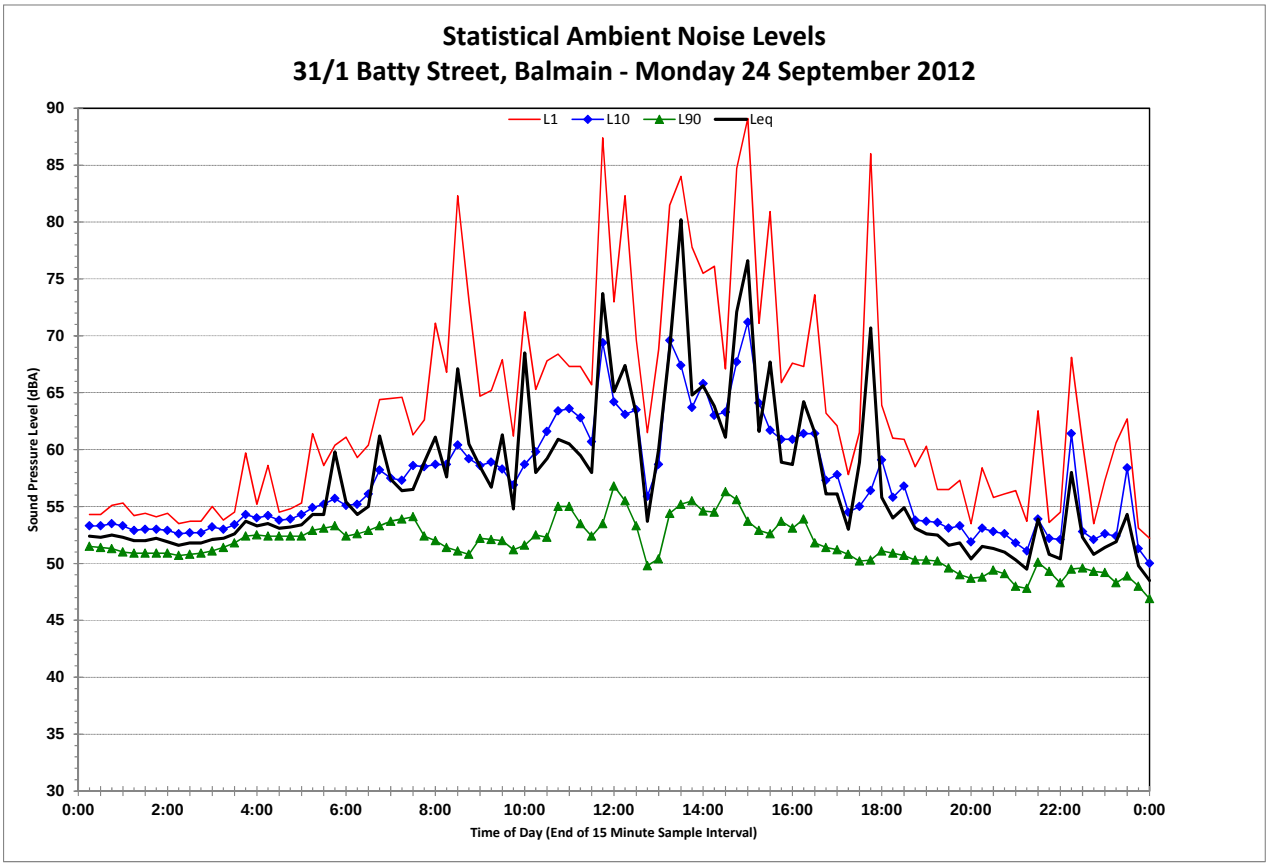
20:00
22:00
0:00
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
31/1 Batty Street, Balmain - Monday 24 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
60
55
50
45
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35
30
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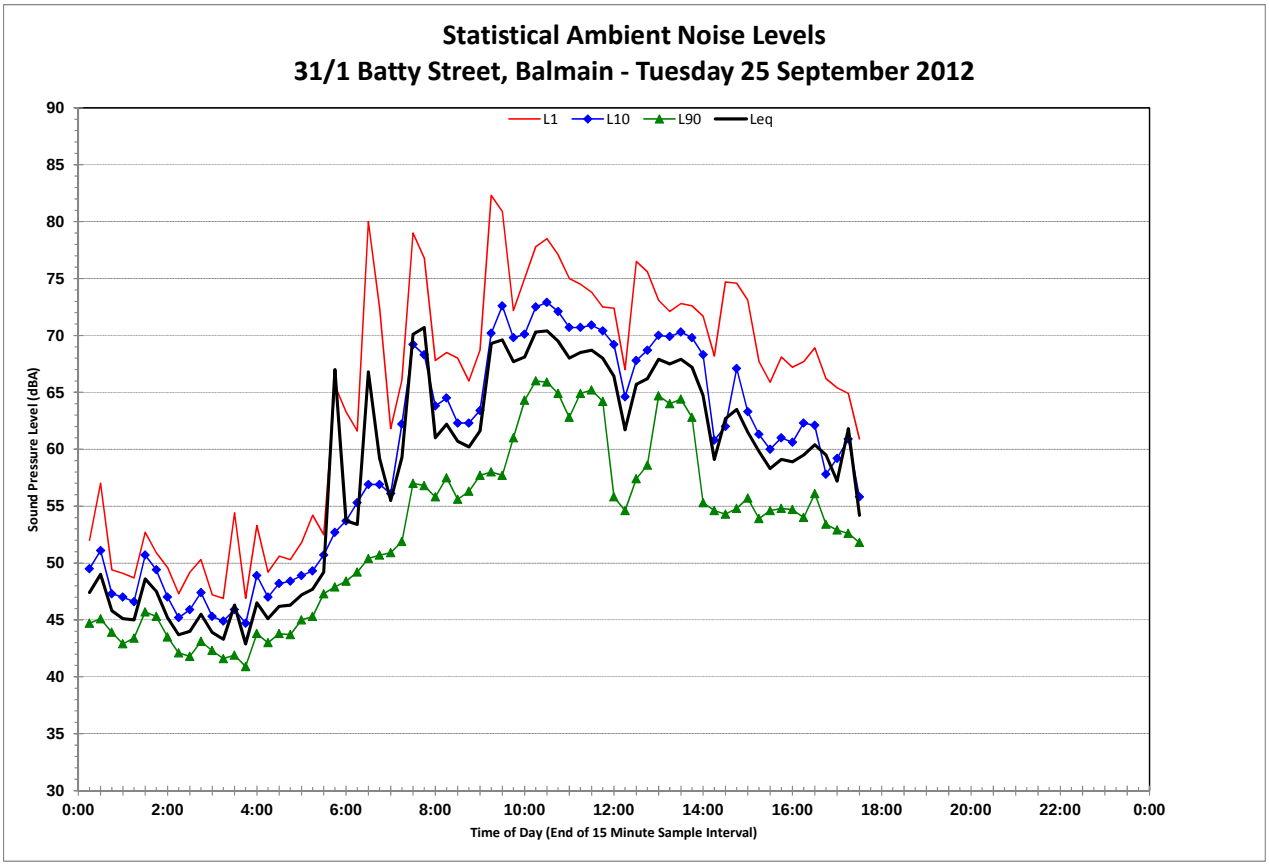
20:00
22:00
0:00
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
31/1 Batty Street, Balmain - Tuesday 25 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
60
55
50
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35
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22:00
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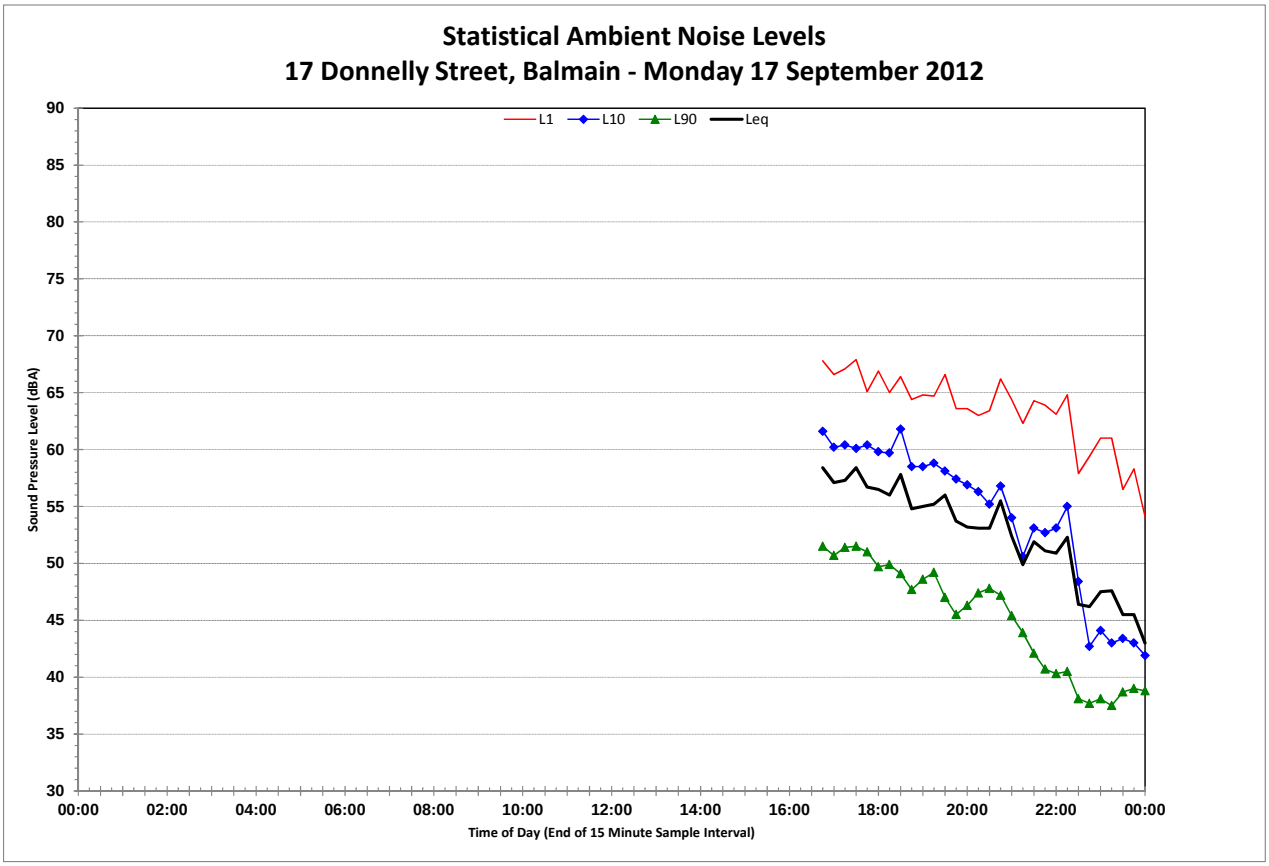
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
17 Donnelly Street, Balmain - Monday 17 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
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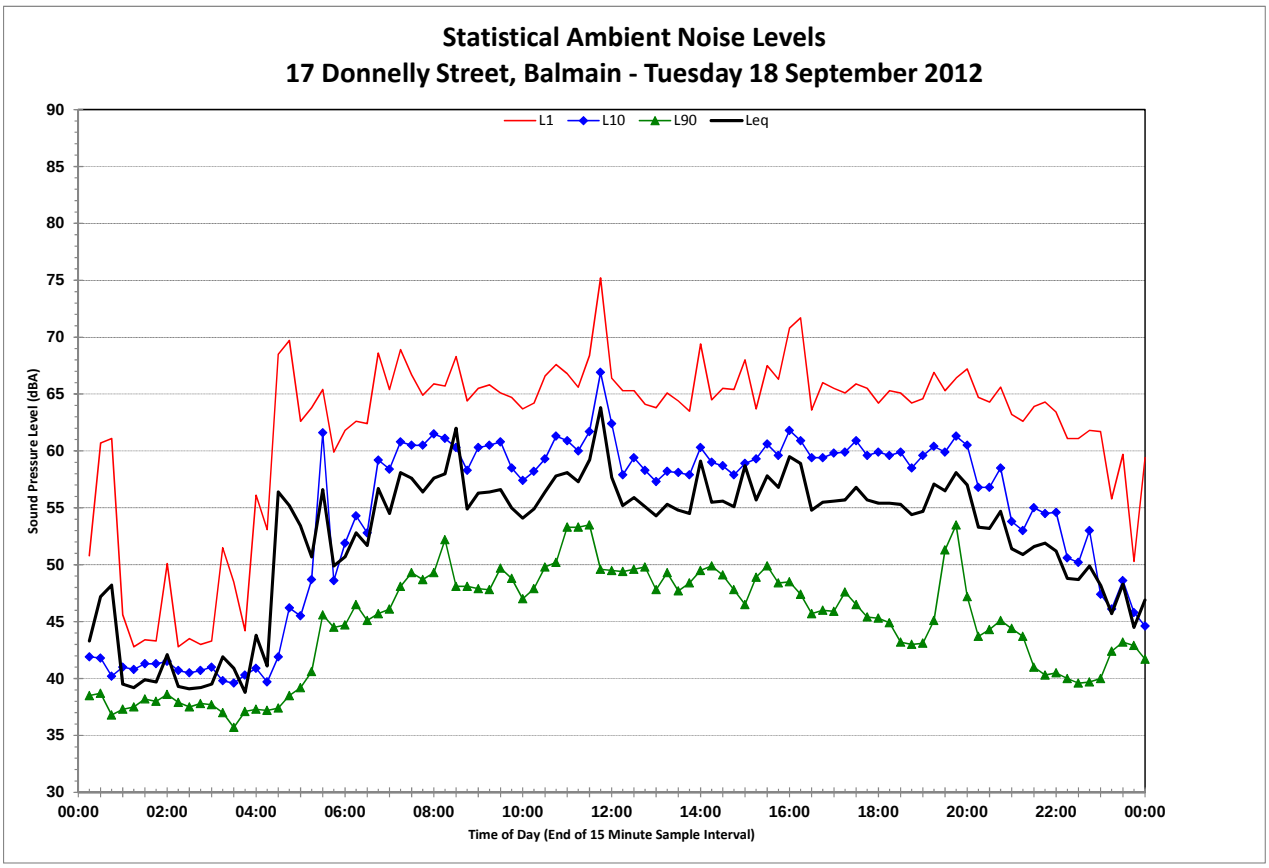
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
17 Donnelly Street, Balmain - Tuesday 18 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
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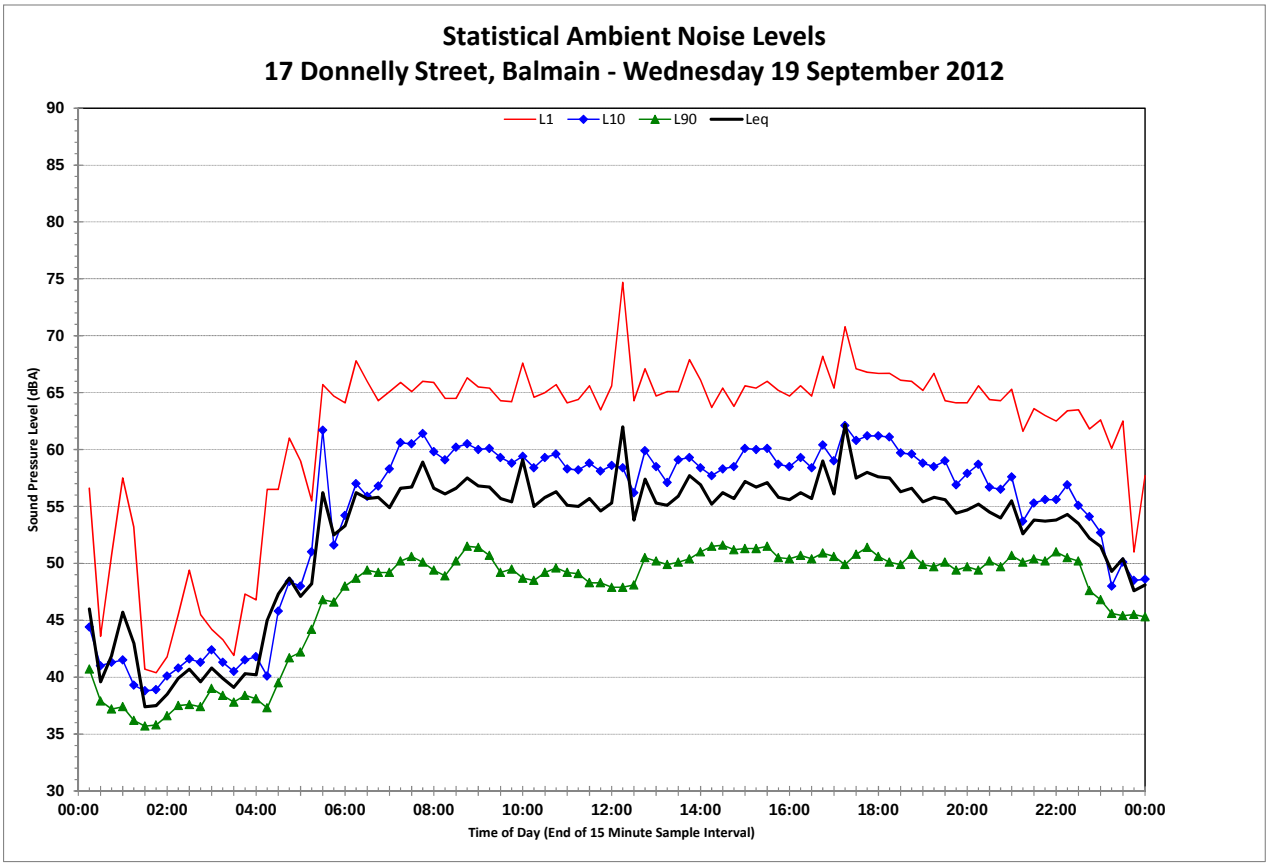
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
17 Donnelly Street, Balmain - Wednesday 19 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
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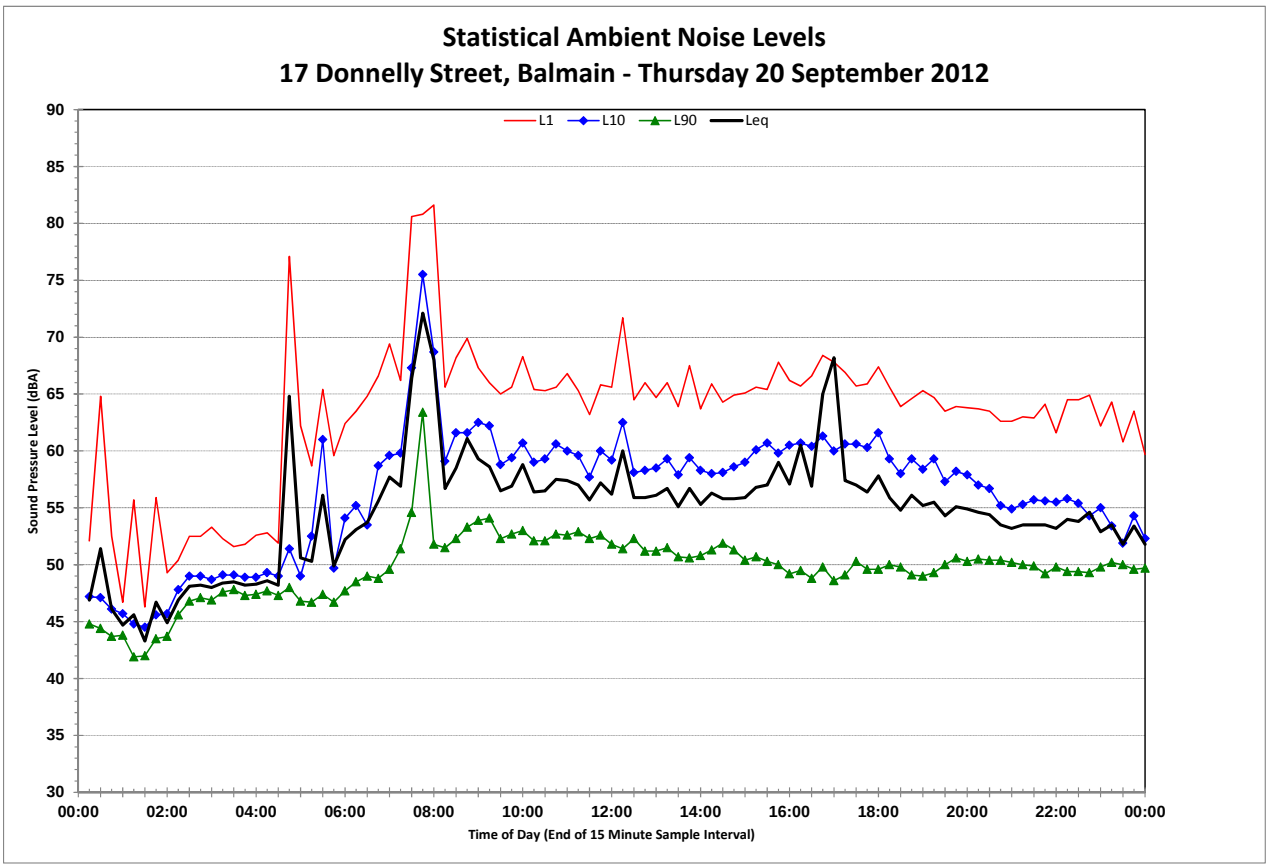
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
17 Donnelly Street, Balmain - Thursday 20 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
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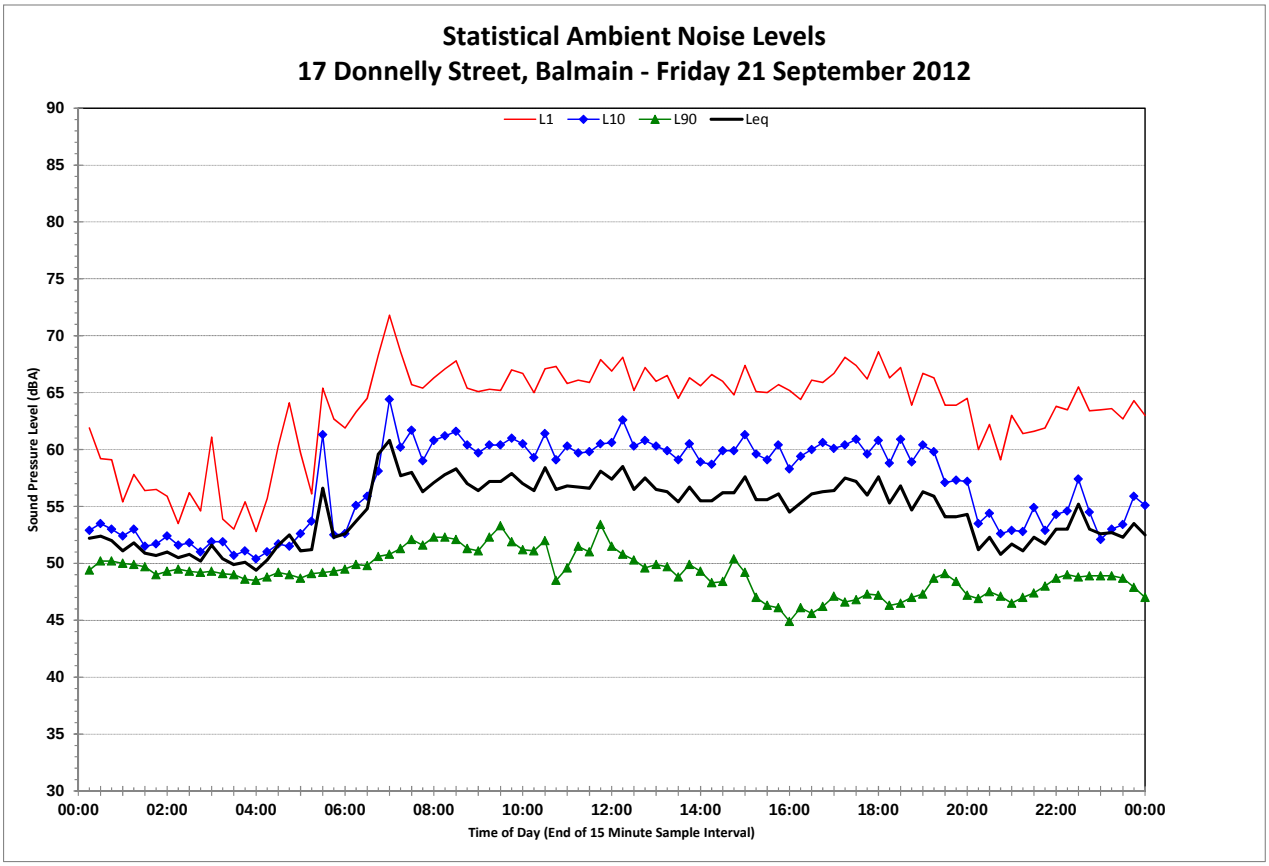
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
17 Donnelly Street, Balmain - Friday 21 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
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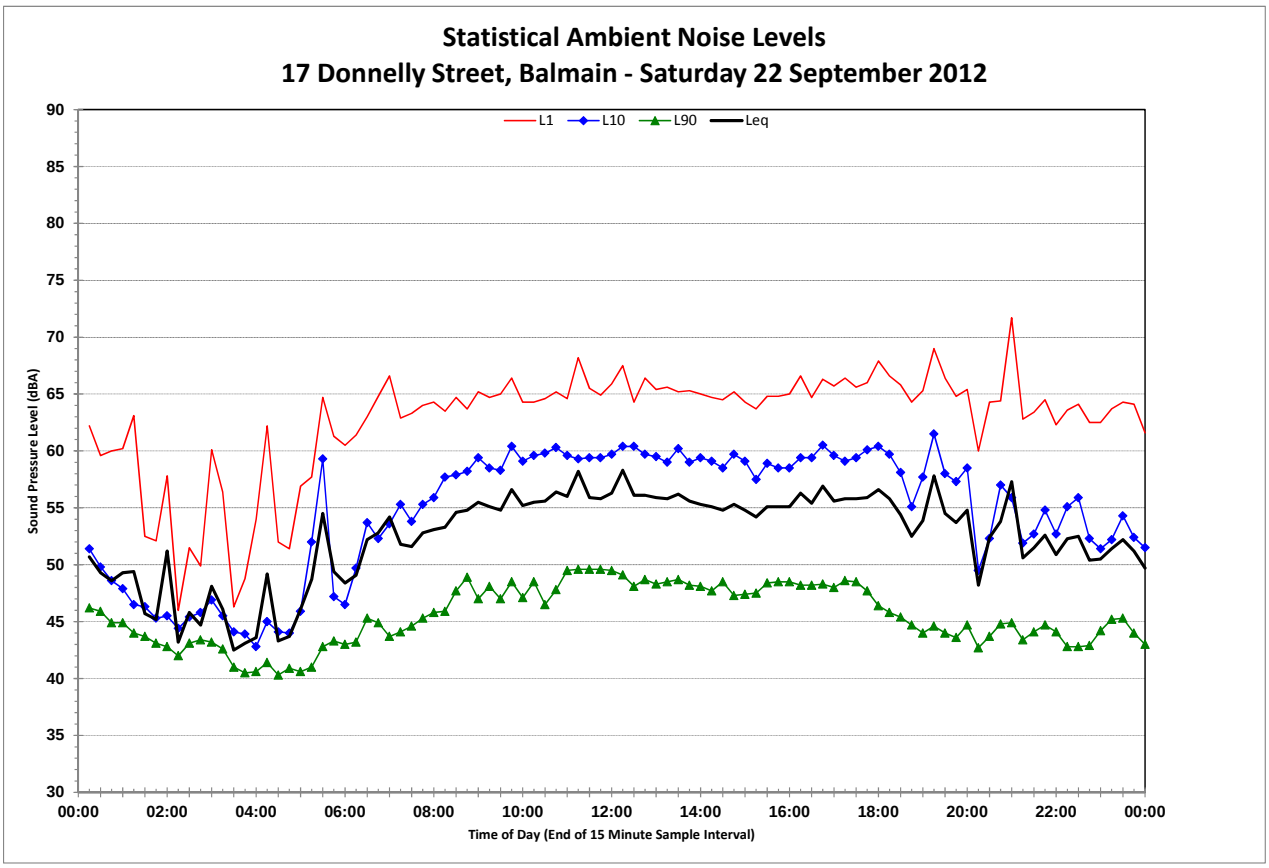
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
17 Donnelly Street, Balmain - Saturday 22 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
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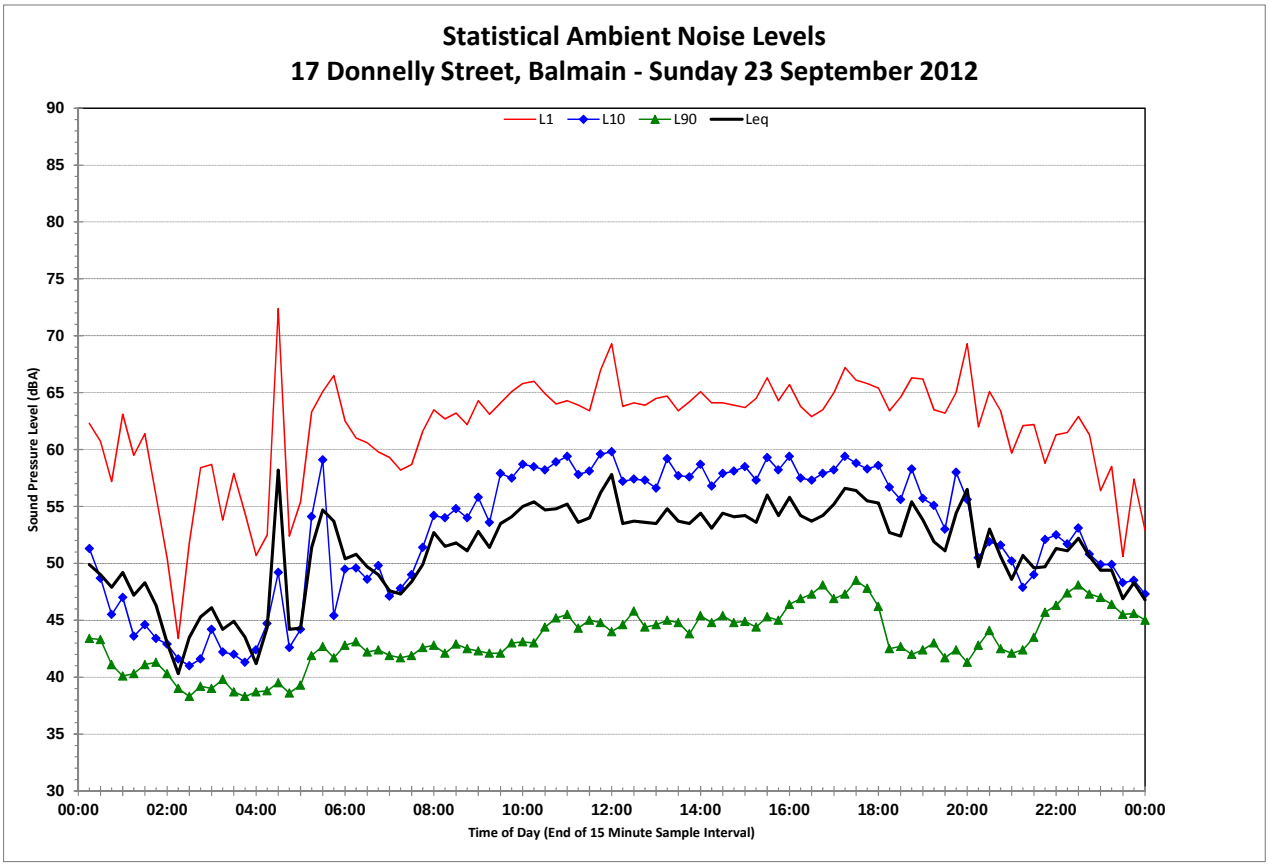
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
17 Donnelly Street, Balmain - Sunday 23 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
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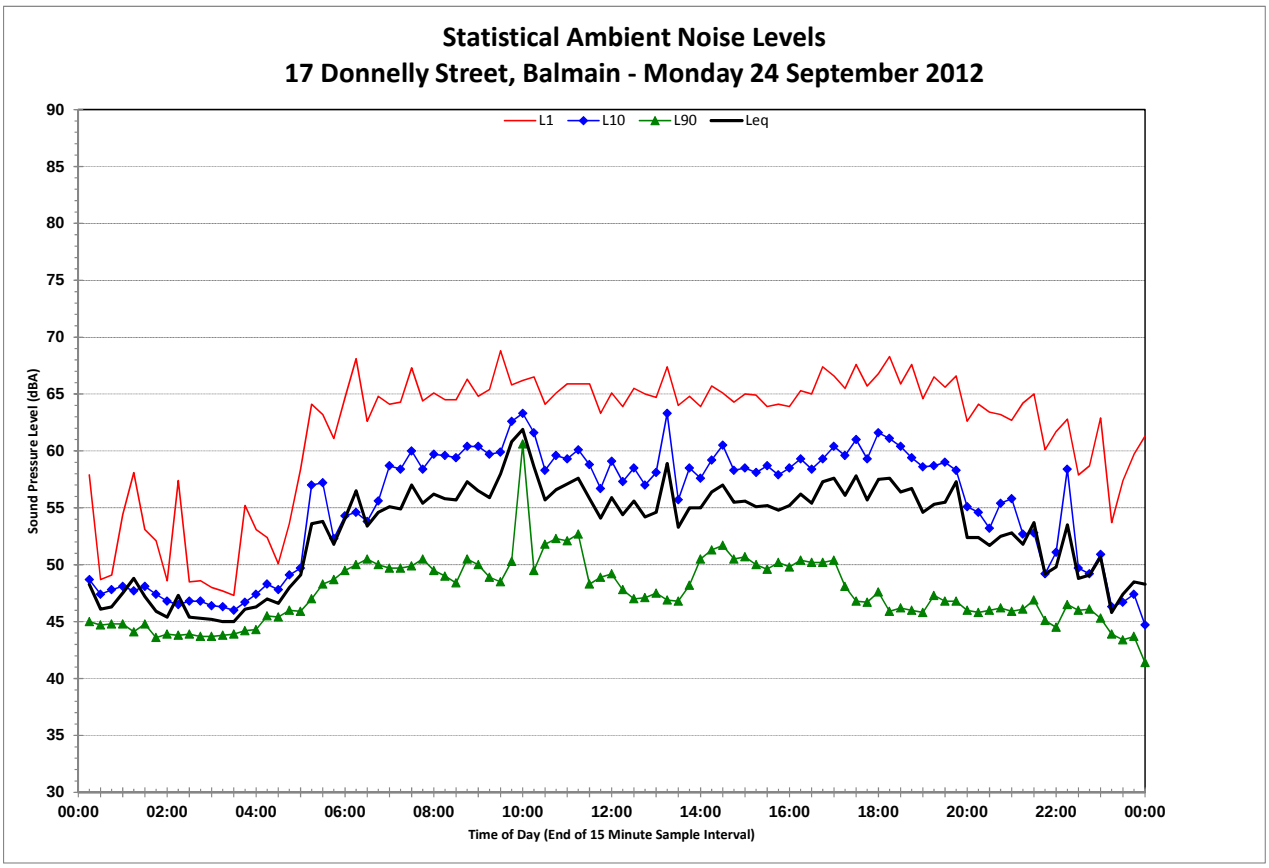
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
17 Donnelly Street, Balmain - Monday 24 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
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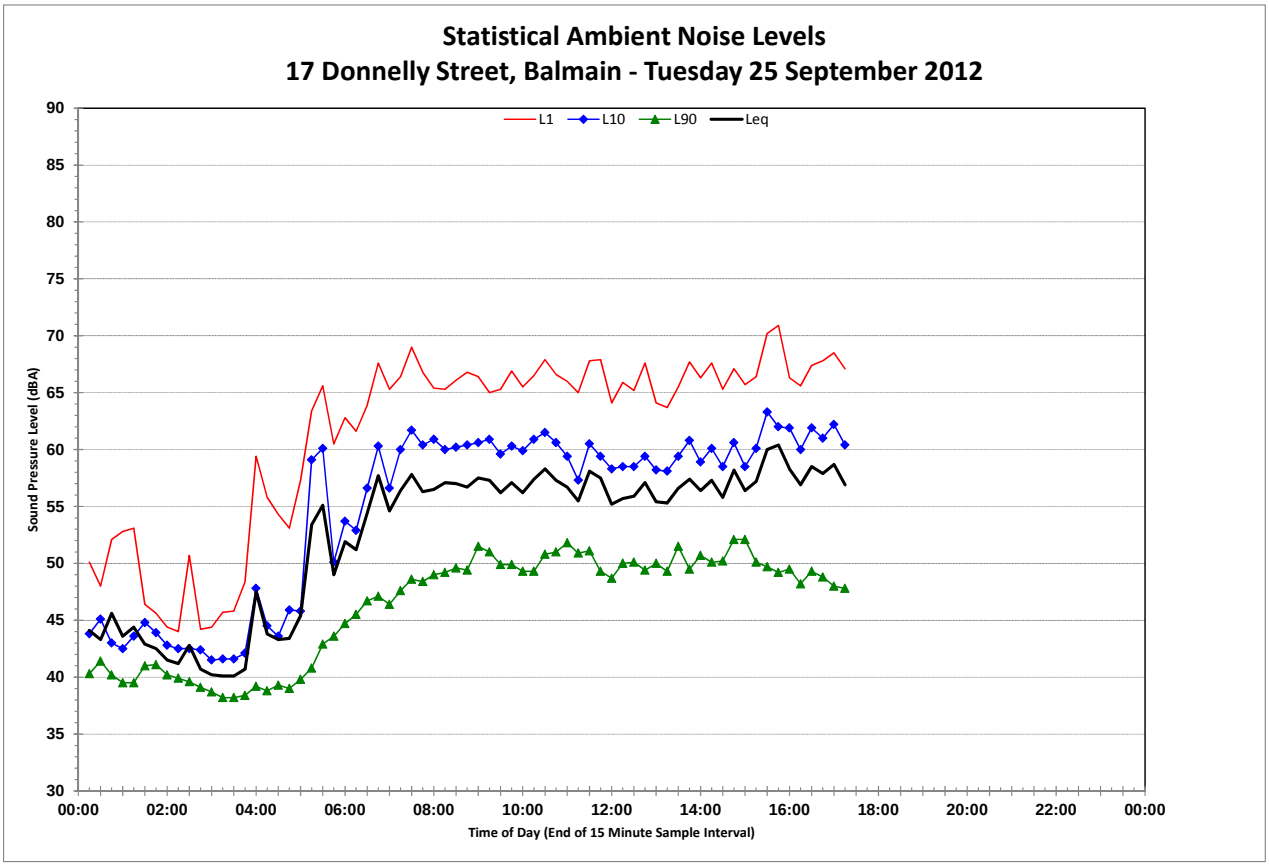
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
17 Donnelly Street, Balmain - Tuesday 25 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
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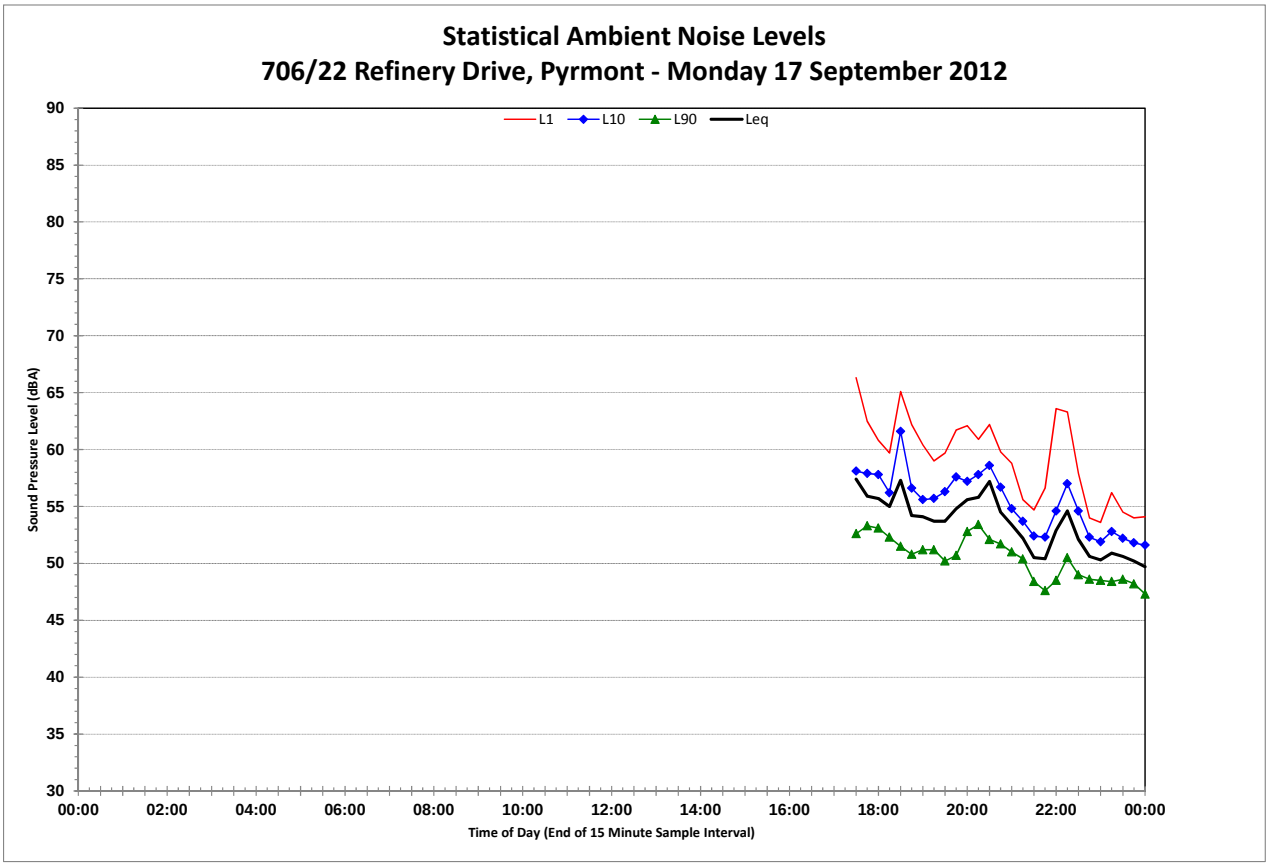
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
706/22 Refinery Drive, Pyrmont - Monday 17 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
60
55
50
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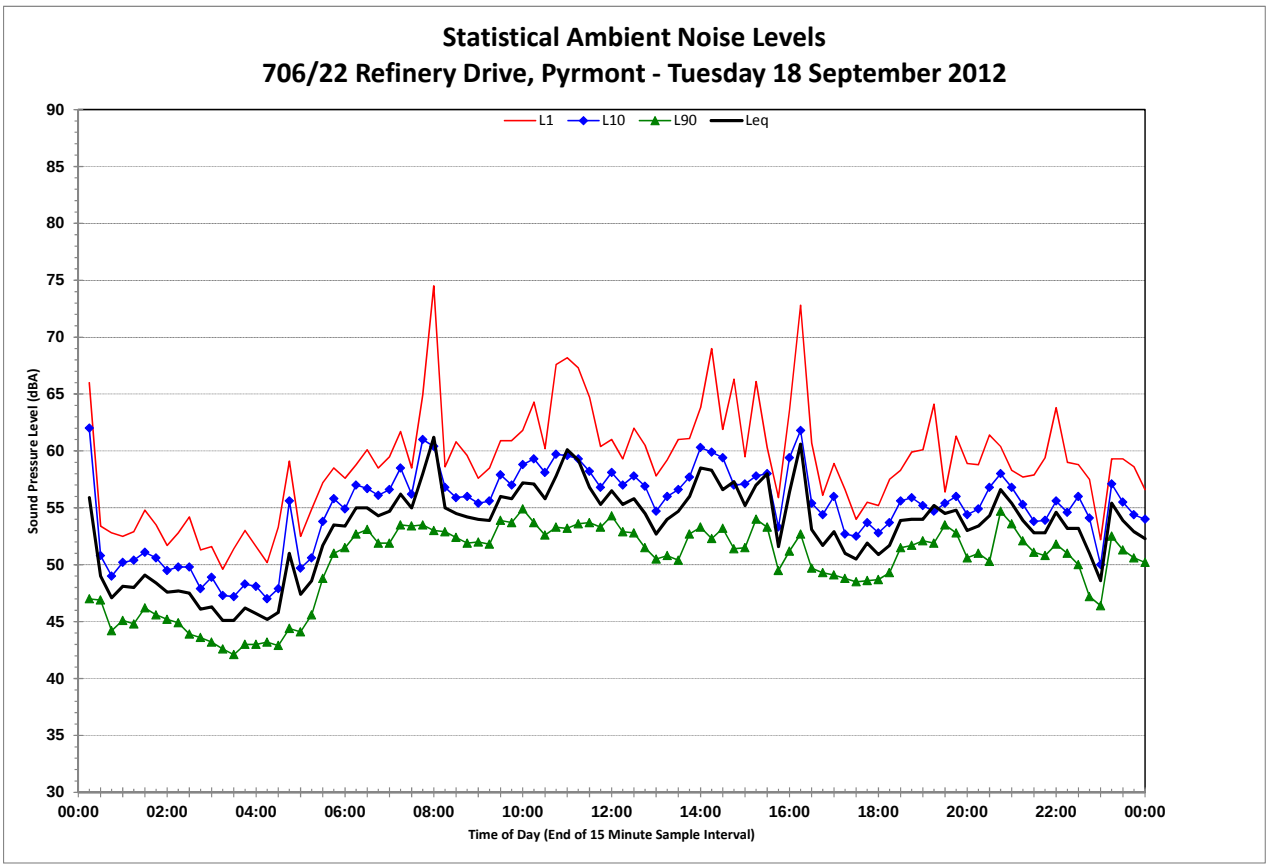
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
706/22 Refinery Drive, Pyrmont - Tuesday 18 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
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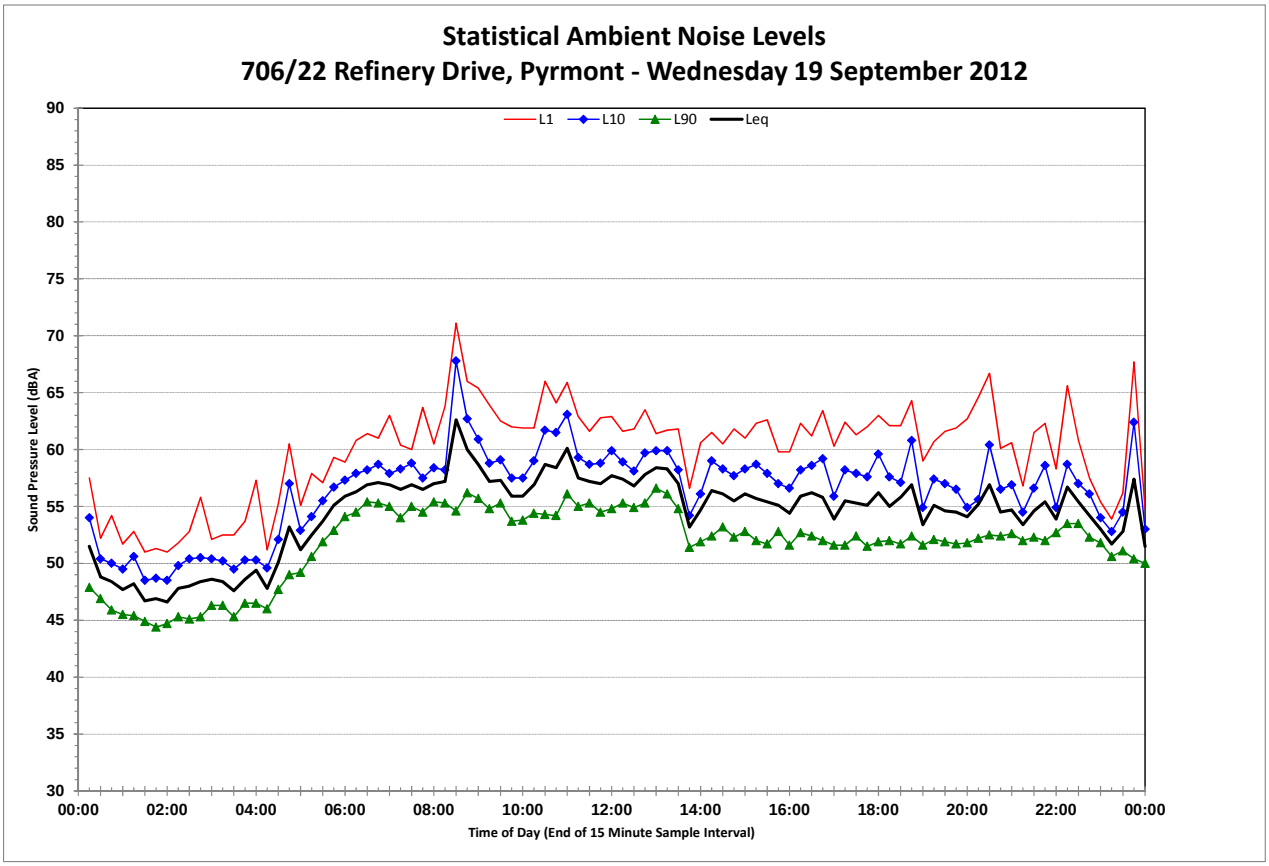
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
706/22 Refinery Drive, Pyrmont - Wednesday 19 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
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85
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75
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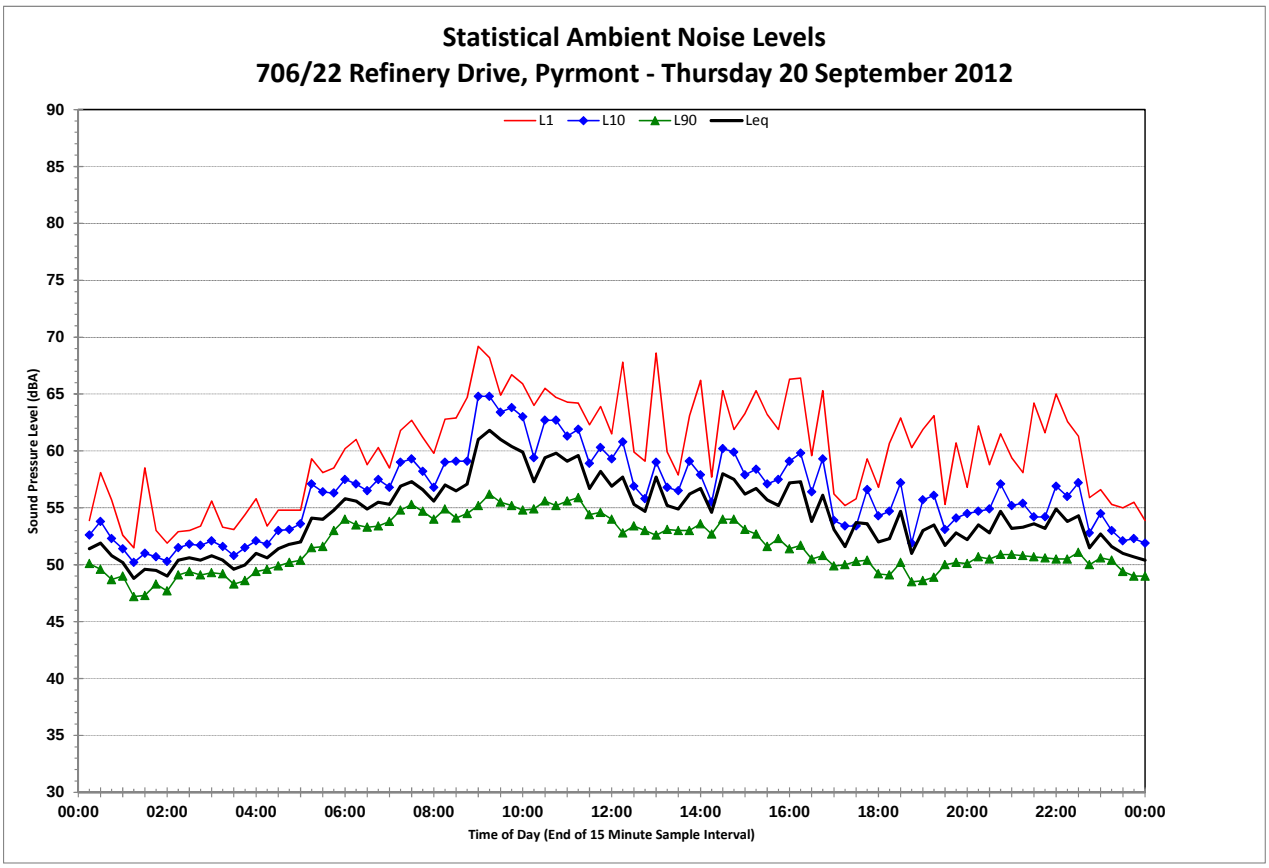
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
706/22 Refinery Drive, Pyrmont - Thursday 20 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
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65
60
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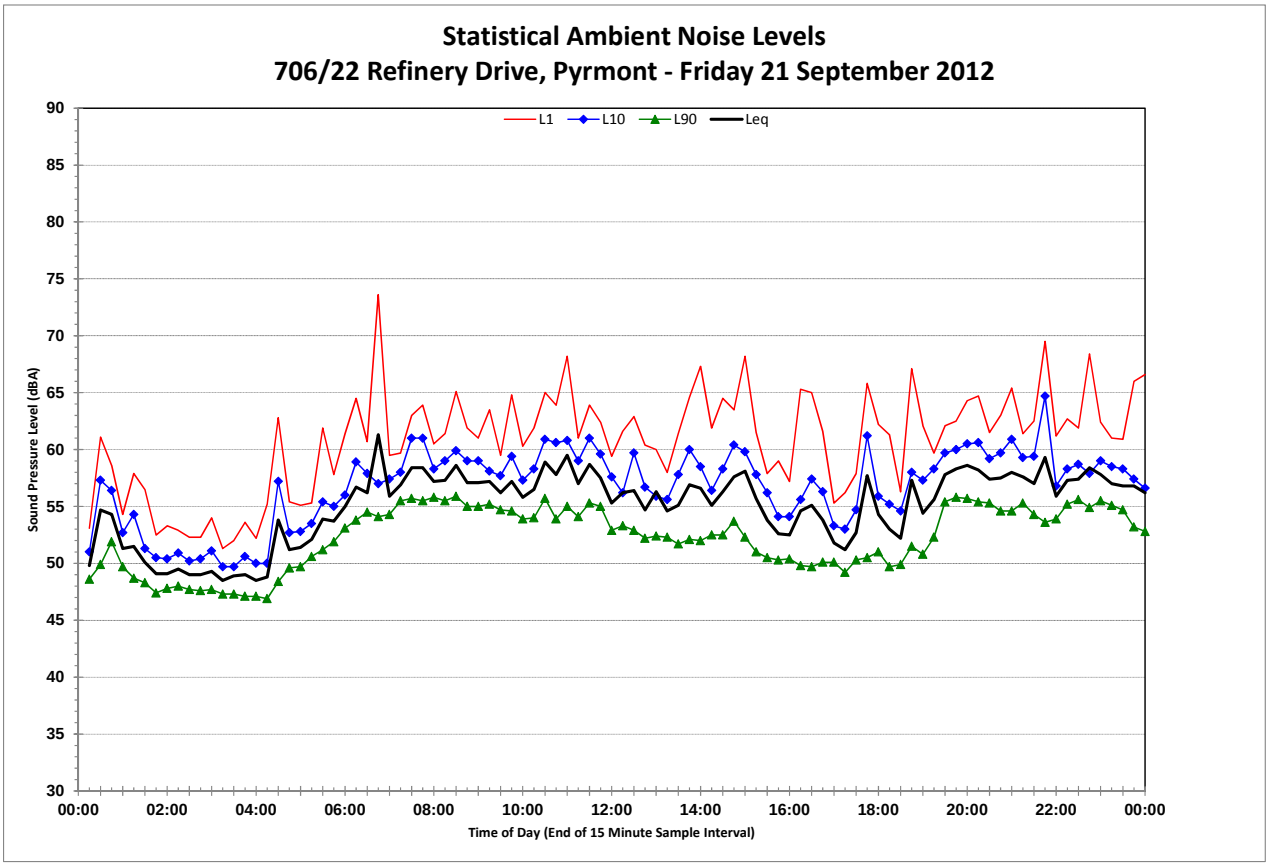
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
706/22 Refinery Drive, Pyrmont - Friday 21 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
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65
60
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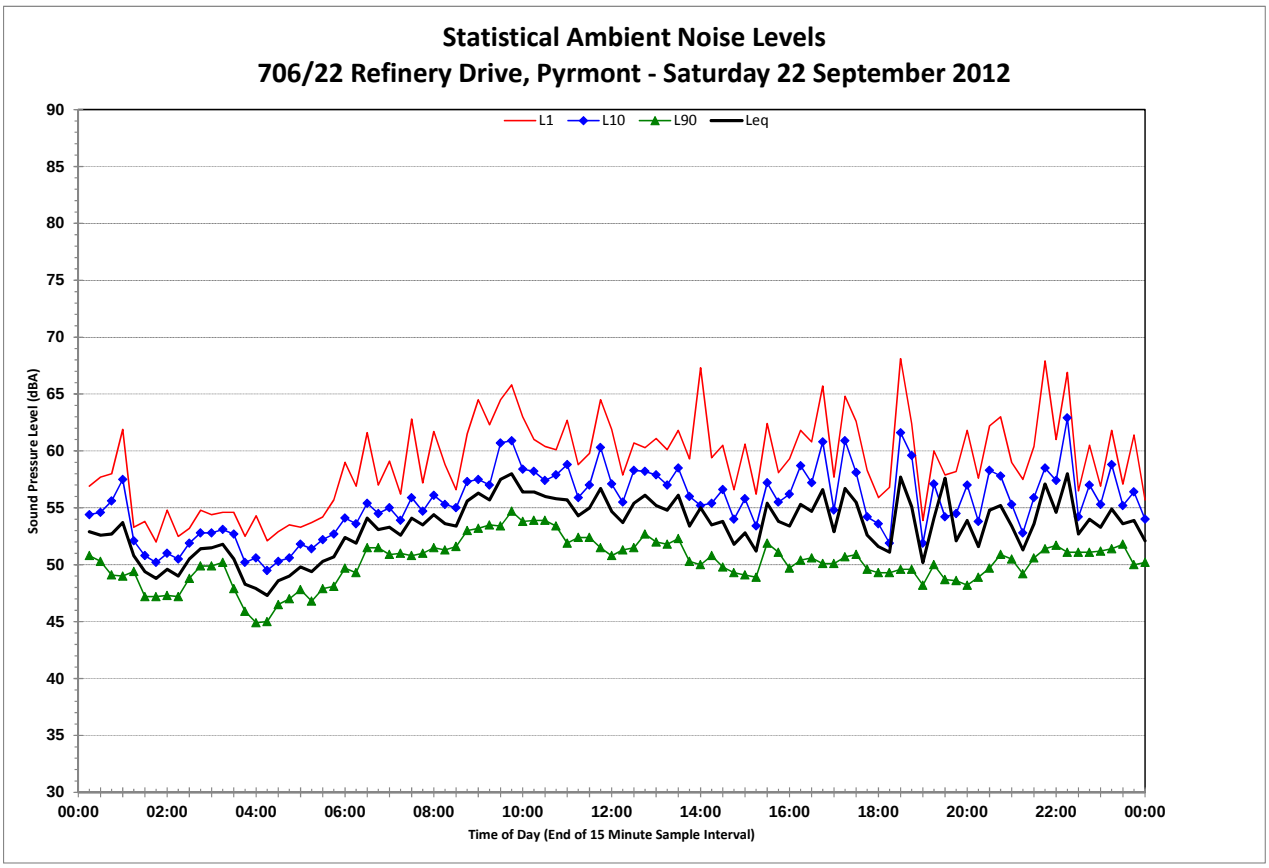
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
706/22 Refinery Drive, Pyrmont - Saturday 22 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
60
55
50
45
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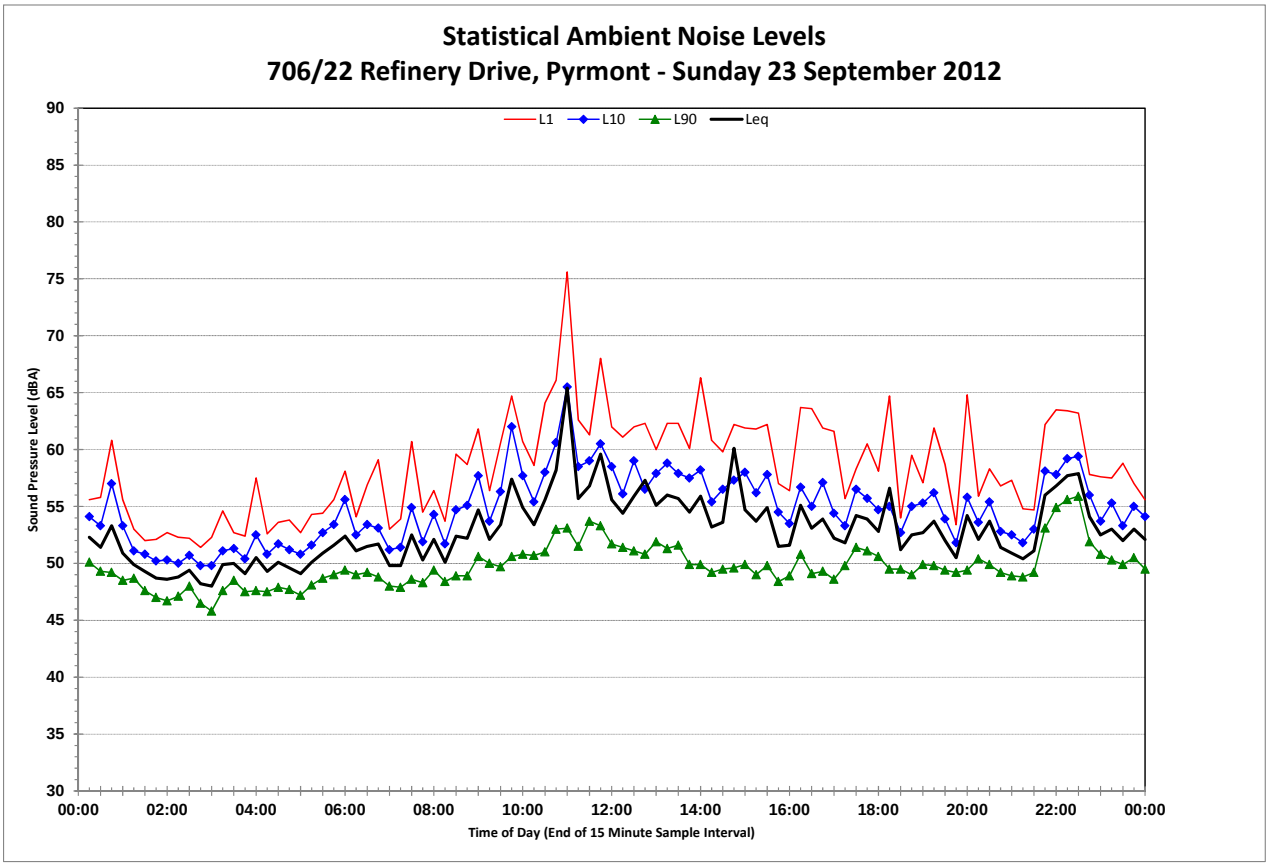
18:00
20:00
22:00
00:00
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
706/22 Refinery Drive, Pyrmont - Sunday 23 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
60
55
50
45
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20:00
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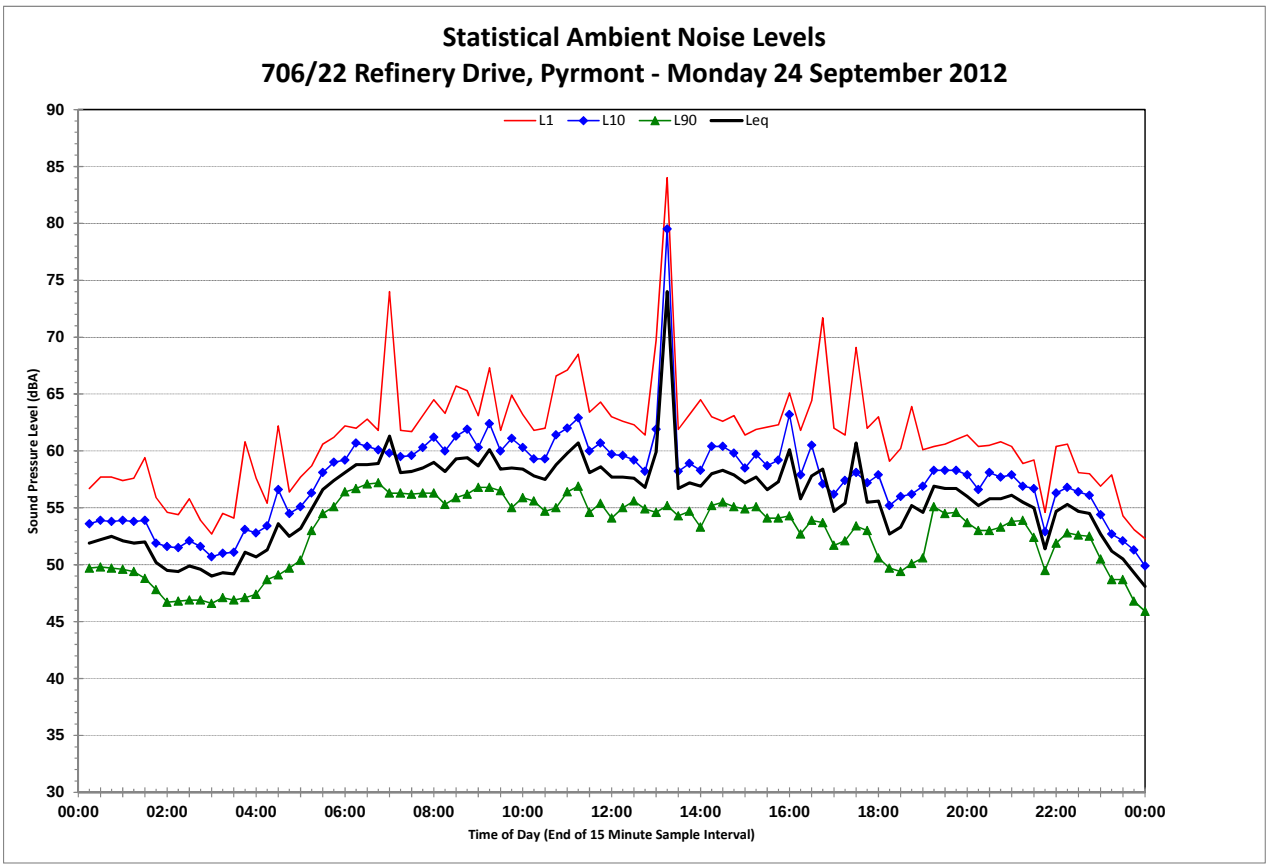
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
706/22 Refinery Drive, Pyrmont - Monday 24 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
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65
60
55
50
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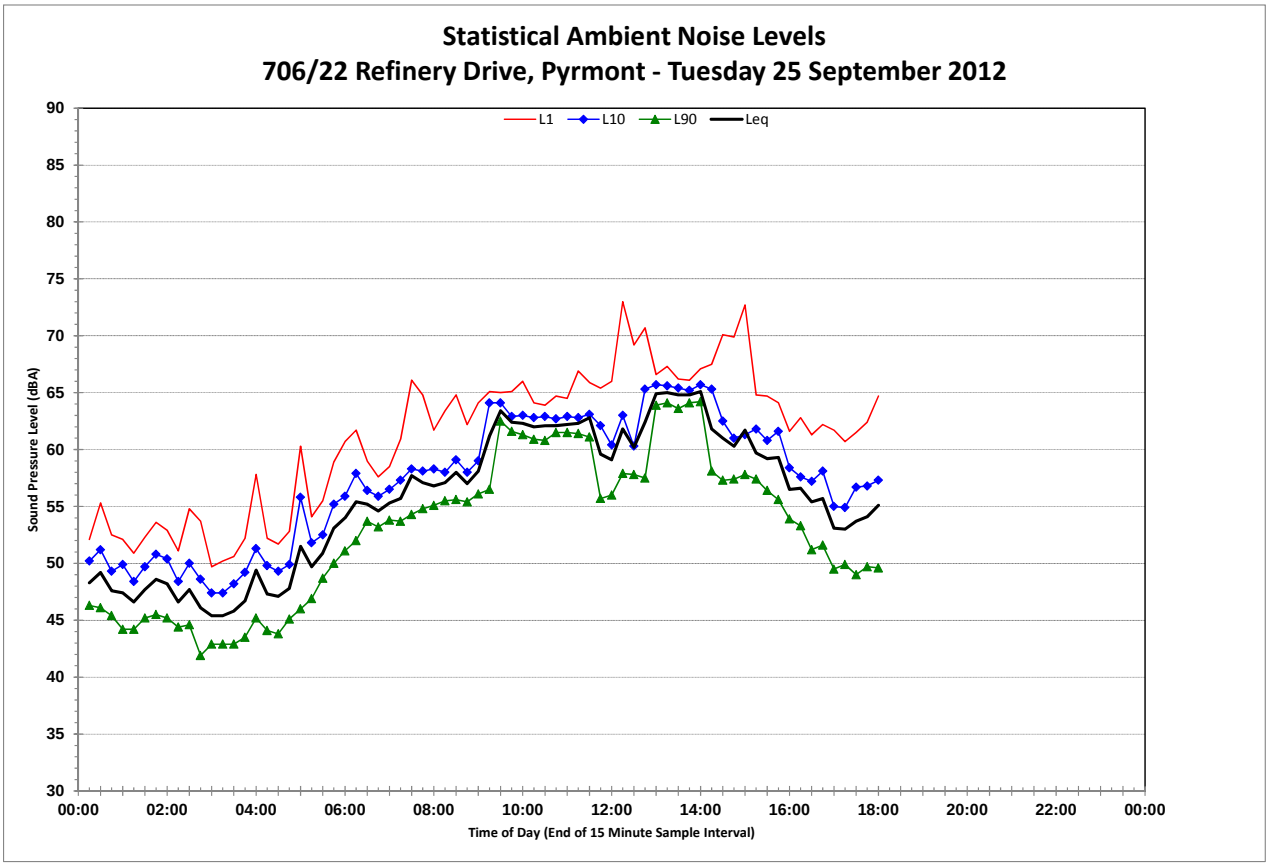
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
706/22 Refinery Drive, Pyrmont - Tuesday 25 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
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65
60
55
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20:00
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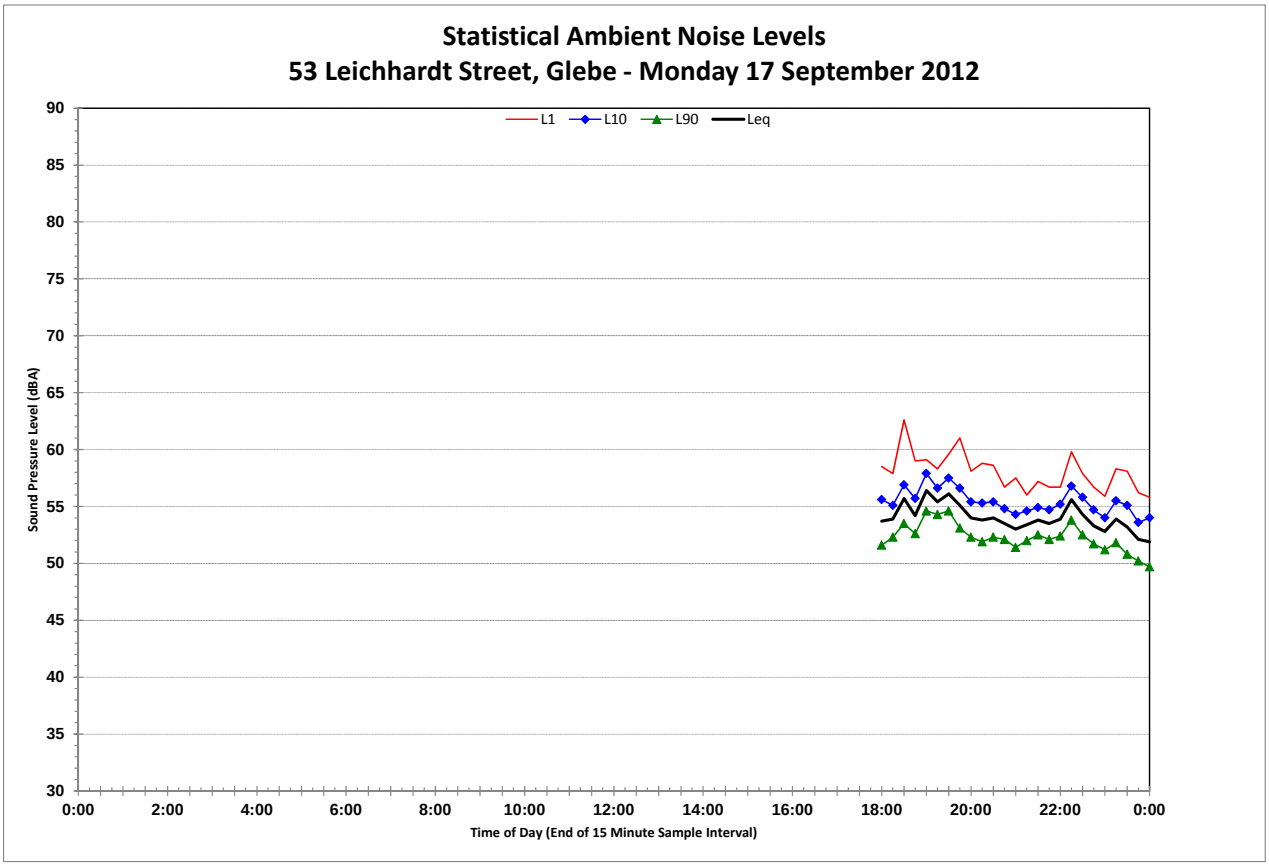
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
53 Leichhardt Street, Glebe - Monday 17 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
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75
70
65
60
55
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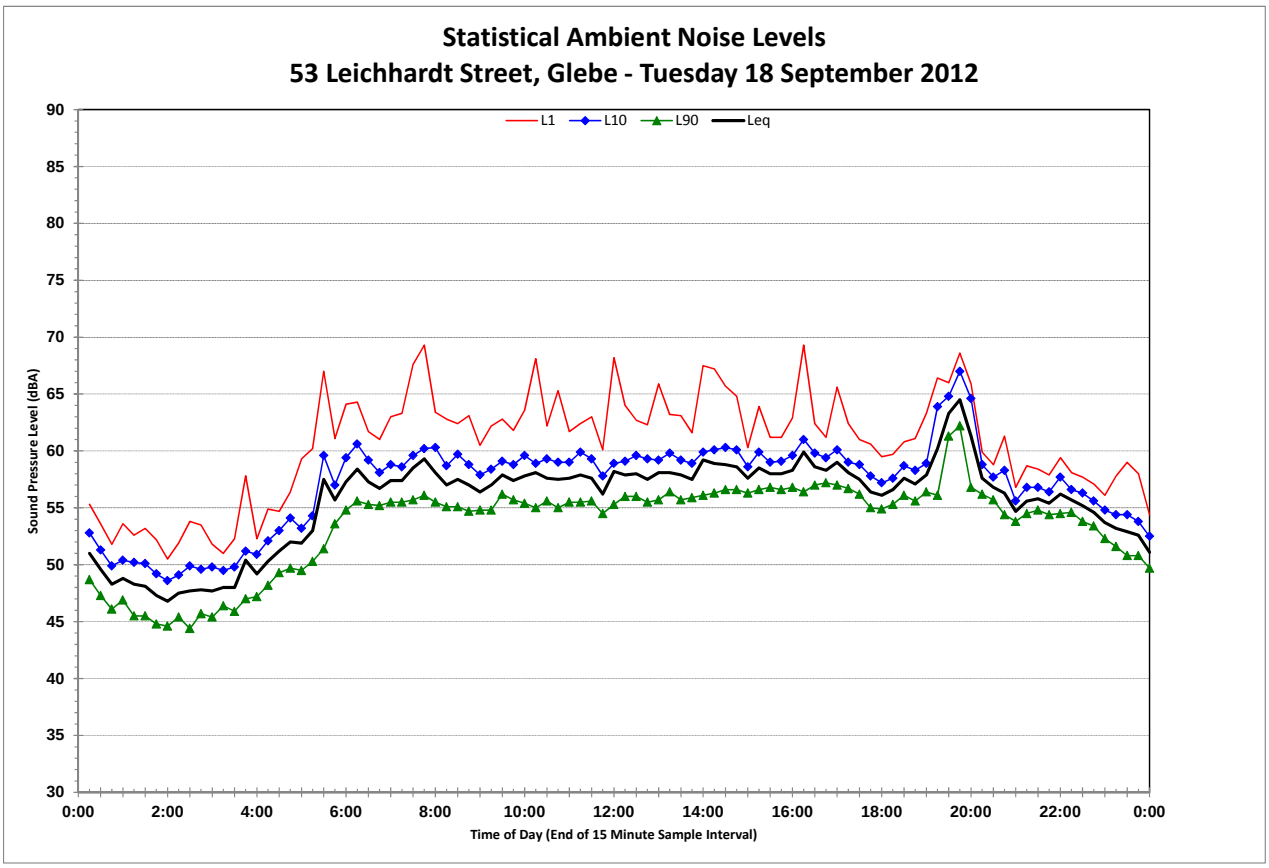
16:00
18:00
20:00
22:00
0:00
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
53 Leichhardt Street, Glebe - Tuesday 18 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
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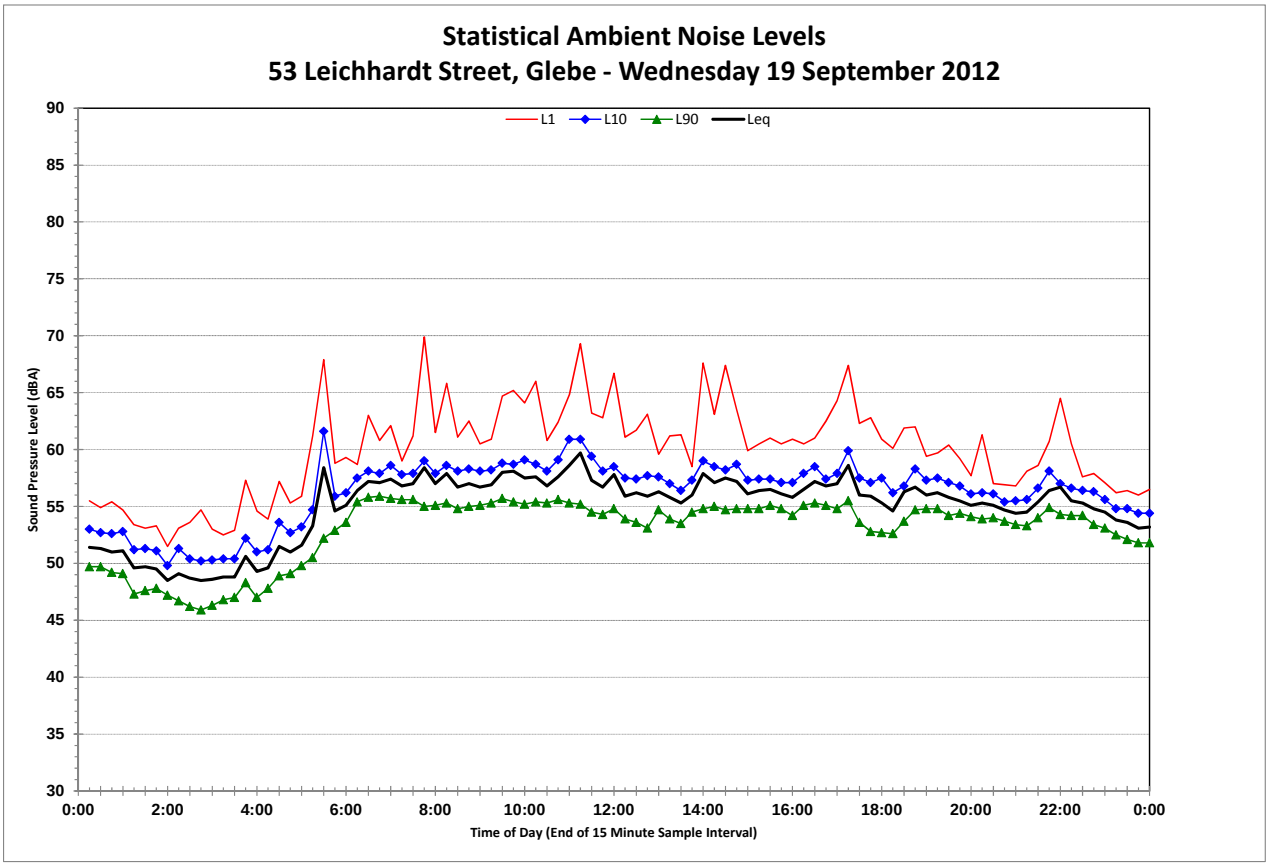
18:00
20:00
22:00
0:00
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
53 Leichhardt Street, Glebe - Wednesday 19 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
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75
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22:00
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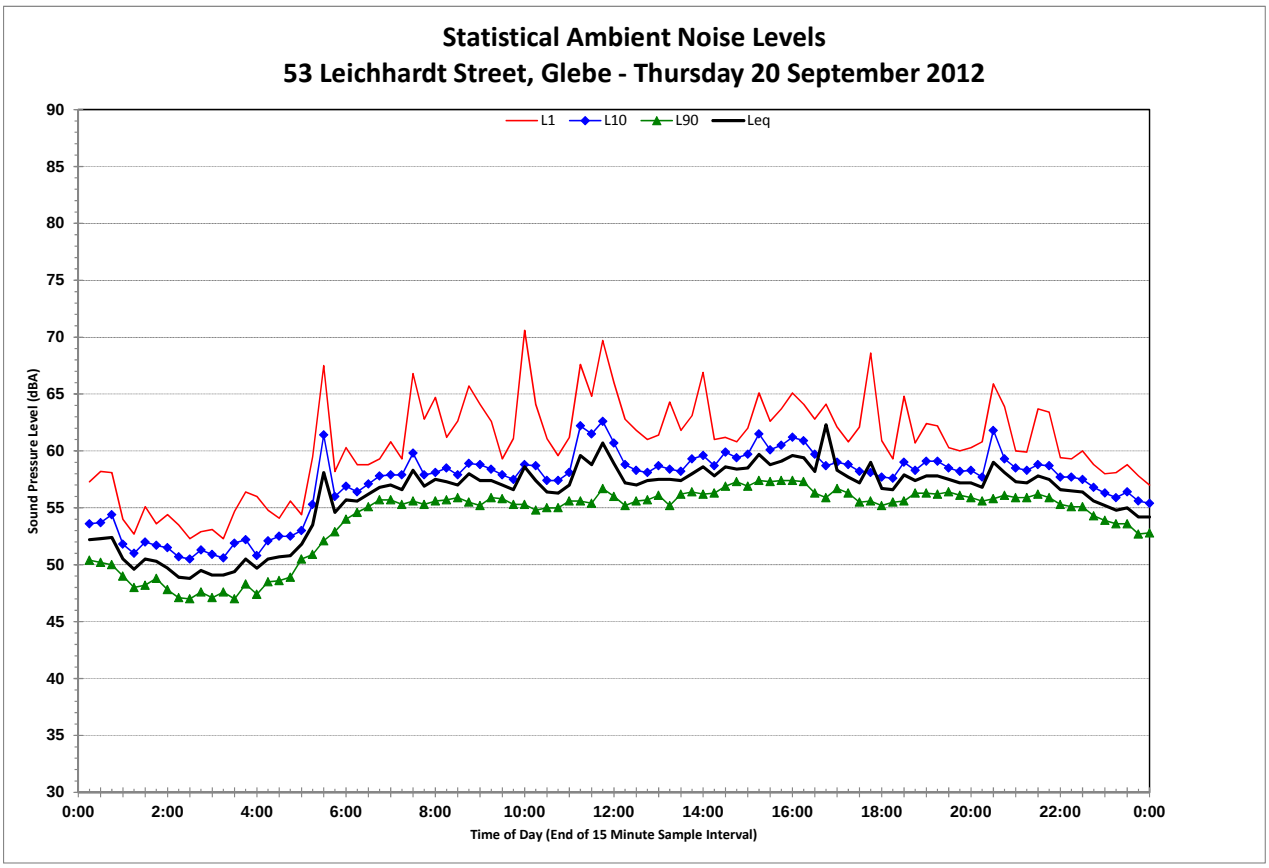
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
53 Leichhardt Street, Glebe - Thursday 20 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
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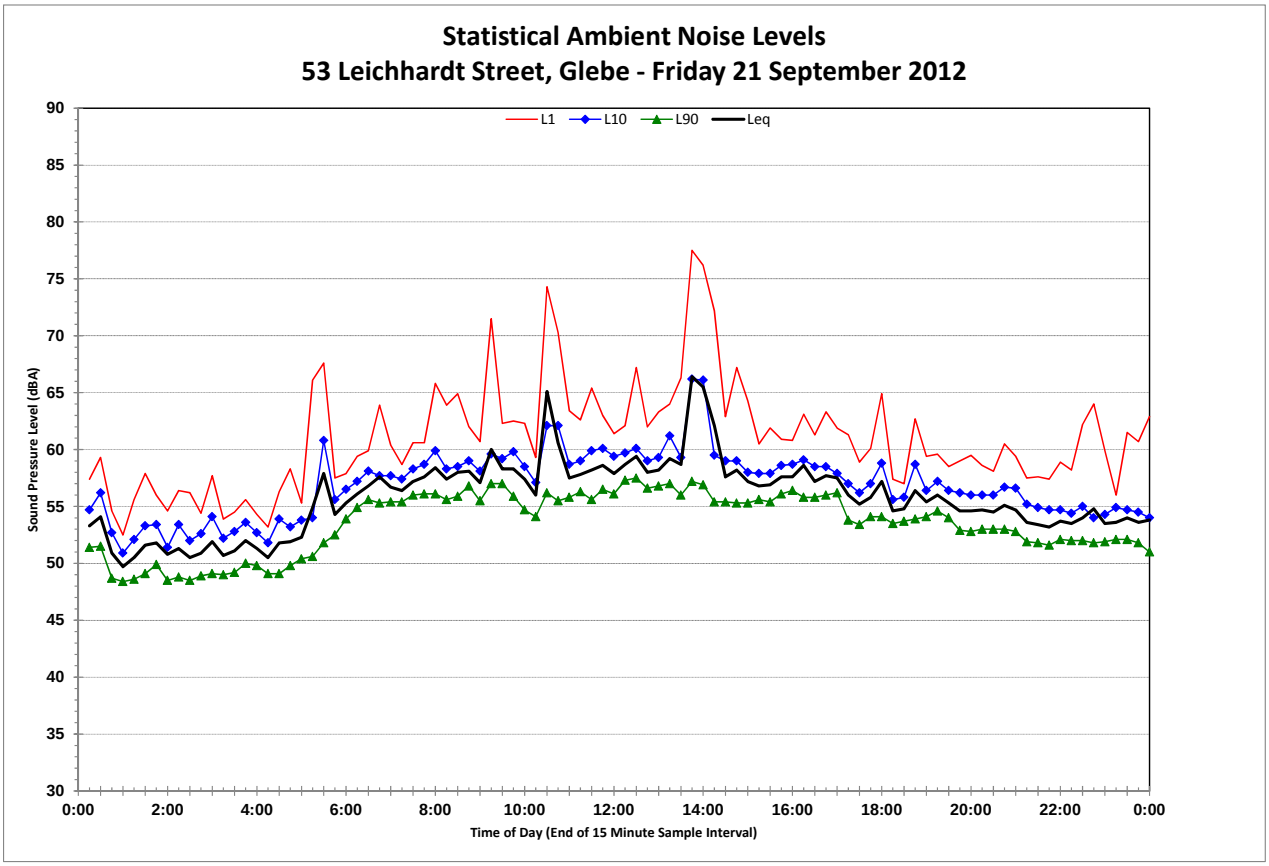
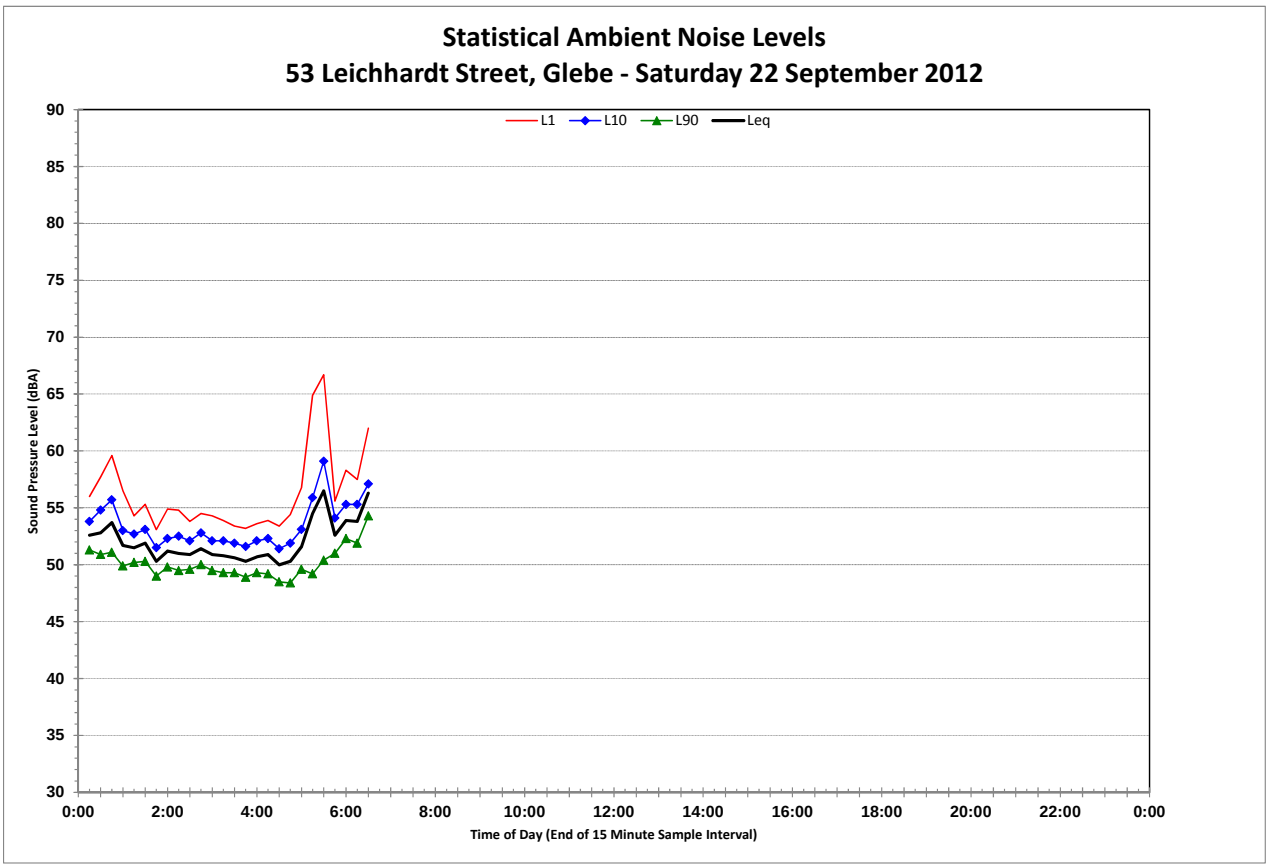
14:00
16:00
18:00
20:00
22:00
0:00
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
53 Leichhardt Street, Glebe - Friday 21 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
0:00
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
53 Leichhardt Street, Glebe - Saturday 22 September 2012
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
60
55
50
45
40
35
30
0:00
2:00
4:00
6:00
8:00
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16:00
18:00
20:00
22:00
0:00
Time of Day (End of 15 Minute Sample Interval)