



HEGGIES

REPORT 10-4309R6

Revision 0

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White Bay Berth 4 Bulk Liquids Handling

Aral Wind

Ship Noise Monitoring Report

PREPARED FOR

Sydney Ports Corporation
207 Kent Street
SYDNEY NSW 2000

17 NOVEMBER 2006



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DOCUMENT CONTROL

Reference	Status	Date	Prepared	Checked	Authorised
10-4309R6	Revision 0	17 November 2006	Bojan Sevo	John Sleeman	John Sleeman



EXECUTIVE SUMMARY

Heggies has been commissioned by Sydney Ports Corporation (SPC) to conduct monitoring of noise emissions during the unloading of Aral Wind (a bulk liquids vessel) at White Bay Berth 4 (WB-4), as required by Clause M7.1(1a) of the EPA's Environment Protection Licence (Licence No. 12095).

Noise measurements were carried out at nearby residential receivers during Aral Wind cargo handling operations during the early morning of 29 October 2006. The measured noise levels were found to be dominated by noise emanating from the nearby Glebe Island Berth 1 (GI-1), where car unloading operations were taking place from the Cattleya Ace. A reference noise measurement was therefore carried out in close proximity of the Aral Wind vessel, where the noise environment was dominated by the WB-4 bulk liquids cargo handling noise sources. The reference level was then used to predict noise levels at the representative receivers in absence of the GI-1 activity related noise.

It was found that $L_{Aeq(15\text{ min})}$ predicted noise levels complied with the Licence imposed noise goals at representative locations in both Balmain and Pyrmont. An $L_{Aeq(\text{night})}$ exceedance of 8 dBA occurs in Balmain.

Bulk liquids terminal related maximum (L_{Amax}) noise levels were not observed to cause exceedances at the representative monitoring locations for the duration of attended measurements.

Subject to feasibility, practicality and reasonability, the potential noise control measures that may be considered in order to meet the Licence imposed noise goals (as required by condition R4.1), and ensure noise amenity remains unchanged in the area would therefore consist of an on-site noise management strategy. Noise impact mitigation measures have been evaluated in the Noise Impact Mitigation and Management Strategy (Document No. 10-4309R7-R1), with a list of mitigation measures considered feasible and reasonable identified in the Noise Impact Mitigation Action Plan.



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1 INTRODUCTION

Heggies has been commissioned by Sydney Ports Corporation (SPC) to conduct monitoring of noise emissions during the unloading of Aral Wind (a bulk liquids vessel) at White Bay Berth 4 (WB-4), as required by Clause M7.1(1a) of the EPA's Environment Protection Licence (Licence No. 12095).

Noise measurements have been conducted during cargo handling operations at two locations considered representative of the potentially most exposed residential receivers. Measurements at both representative locations have been conducted during the unloading of cargo from the ship into road tanker trucks via on-board pumps. A car carrier ship "Cattleya Ace" was berthed at the nearby Glebe Island Berth 1 (GI-1) where a car unloading operation was taking place for the duration of Aral Wind's stay at WB-4 during the night.

An additional "reference" noise measurement was carried out in close proximity of the Aral Wind vessel, where the noise environment was dominated by the WB-4 based bulk liquids cargo handling noise sources. The reference level was then used to predict noise levels at the representative receivers in absence of the GI-1 related noise.

The predicted noise levels are assessed against the noise goals set out in Table U1 of the Environment Protection Licence. Feasible and reasonable noise mitigation measures are discussed in broad terms, with the aim of minimising the noise impacts from the operations, where the noise goals are exceeded.



2 SITE DESCRIPTION

The White Bay Port facility is located at the southern end of the Balmain peninsula. The facility sits on about 40 hectares of waterfront land, and forms a crescent around White Bay, with a water frontage of about 2,100 m in length.

The facility layout comprises the following main elements:

- Six multiple-use berths spread along the northern side of White Bay.
- Storage warehouse situated to the north east of White Bay, Berth 4 (WB-4); and
- Internal road continuing from Robert Street, providing truck access to storage areas of docks 1 to 6.

The Glebe Island facility which includes two multiple-use berths and two car terminal berths is located adjacent to the White Bay Port, on a neighbouring peninsula south of White Bay.

Berth 4 is approximately located in the middle of the northern side of White Bay, as shown in **Figure 1**. To the north and north-west of the site is a mixture of residential dwellings consisting of 1 and 2 storey detached houses and terraces. A number of recently constructed 4 and 5 storey residential developments are situated directly west of Berth 4, and incorporate acoustic façade treatments to achieve satisfactory internal noise levels. In addition, buildings in direct view were designed to provide significant acoustical shielding to the rest of the development. The storage warehouse (on port land) to the north-east of WB-4 is about 20 metres at the highest point, and provides significant acoustic shielding to the residential properties directly behind. To the south-east of the site is Glebe Island, another working port area with four berths, two of which are currently used as car terminals, and two as multiple-use berths. To the south east of WB-4, about 550 m across the water is the Pyrmont Peninsula, with a number of high-rise residential apartments near the waterfront.

Glebe Island Berth 1 (GI-1), the location where the car carrier ship Cattle Yard Ace was berthed at time of monitoring is located approximately 500 m south-east from WB-4.

2.1 Measurement Locations

The Noise Impact Assessment (NIA) Study (Report Number 10-4309R1 prepared by Heggies) for the proposed bulk liquid terminal operation has previously identified 5 Waite Street and 36 Refinery Drive as the most affected receiver locations within the Balmain / Rozelle and Pyrmont / Glebe areas respectively.

For the current study, in the Balmain / Rozelle area, monitoring was carried out at 13 Donnelly Street (also assessed in the noise impact assessment) due to the availability of day/night access to the property boundary. Note that noise measurements at 13 Donnelly Street can be carried out off street, whereas at 5 Waite Street, noise measurements require backyard access. Furthermore, the location at 13 Donnelly Street is in close proximity of 5 Waite Street. It is approximately the same distance away and is also directly exposed to unloading operations at WB-4. It is therefore considered to be of similar acoustical environment to that of 5 Waite Street, Balmain.

The monitoring location at 36 Refinery Drive, identified by the NIA as the most affected receiver in the Pyrmont / Glebe area was found to be exposed to high levels of traffic related noise from the Anzac Bridge. Giba Park (a publicly accessible park situated at the top of the 4 level apartment complex at 2 Point Street) was therefore selected as the representative measurement location for the Pyrmont / Glebe area, as it allowed ship noise measurements to be taken in relative absence of traffic noise. Giba Park is considered to be equivalent to level 5, 2 Point Street.



Given that cargo unloading was simultaneously undertaken at two berths within the port, the measurement at each of the above locations contained contributions of two separate noise sources. In order to calculate the noise contribution attributable to the bulk liquids unloading alone, a reference measurement was carried out in close proximity of the bulk liquids vessel Aral Wind, where the noise environment was dominated by the bulk liquids vessel related noise.

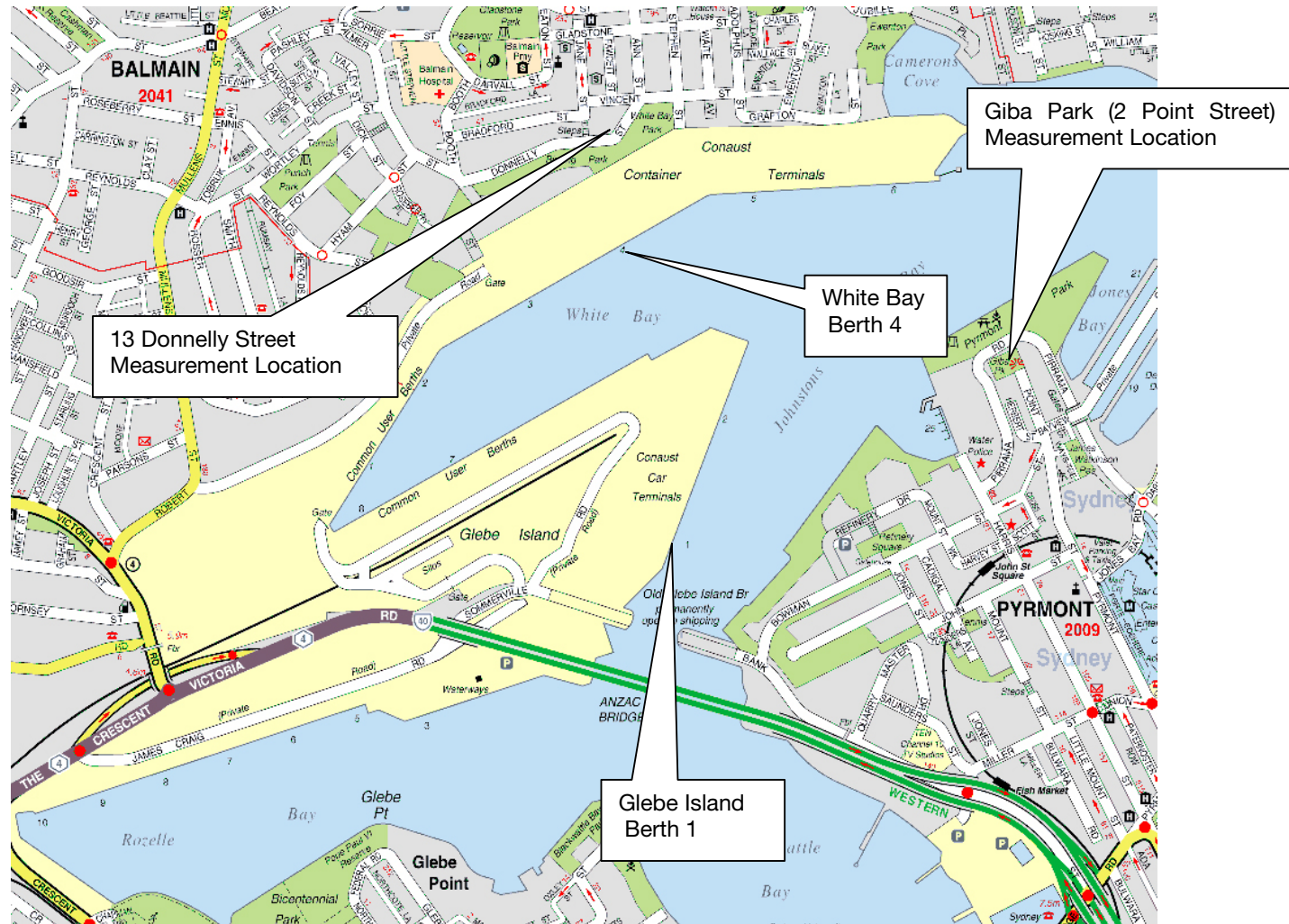
Table 1 below summarises the receiver locations where measurements were conducted in each area, and give a brief description of each location. A more detailed description and photos of the selected monitoring locations are presented in **Appendix B** and **Appendix C**.

Table 1 Representative Receiver Locations

Location	Representative Receiver Location	Description
Balmain and Rozelle	13 Donnelly Street, Balmain	Ground level at the front of residence, about 7 m away from the facade
Pymont and Glebe	2 Point Street, Pymont	At Giba Park, on top of a 4 storey building at 2 Point Street (i.e. height equivalent of a 5 storey building)
Reference Measurement	White Bay Berth 4 Deck	On deck of White Bay Berth 4, 40 m away from the water's edge, and approximately 50 m from the exhaust stack and engine room, the main sources of noise aboard Aral Wind



Figure 1 White Bay / Glebe Island Layout with Attended Noise Monitoring Locations





3 EPA LICENCE NOISE GOALS

For the purpose of the bulk liquid cargo handling operations at White Bay Berth 4 (WB-4), the environment protection licence granted by the EPA sets out the project noise goals at the neighbouring residential communities. The noise goals are set out in Table U1 of the licence conditions and reproduced in **Table 2** below.

Table 2 EPA License Noise Goals (Reproduced from Table U1)

Location	Night		
	LAeq(15 min)	LAeq(night)	LA(max)
Balmain and Rozelle	49 dBA	41 dBA	59 dBA
Pyrmont and Glebe	41 dBA	Not Applicable	51 dBA

Explanatory notes:

1. LA(max) means maximum A-weighted sound pressure level measured on fast time weighting during the time over which sound is measured.
2. All other acoustic terms including 'night' have the same meaning as in the INP.
3. Not Applicable: In instances where the amenity criteria LAeq(night) has been determined to be a higher number than the intrusive criteria LAeq(15 min) that the amenity criteria is less stringent than the intrusive criteria, then the amenity criteria becomes 'not applicable'. This is because compliance with the criteria will ensure compliance with the intrusive criteria will ensure compliance with the amenity criteria.



4 MEASUREMENT METHODOLOGY AND INSTRUMENTATION

The licence calls for L_{Aeq} (A-weighted equivalent continuous) sound pressure level measurements to be carried out at locations representative of those potentially most affected (ie, waterfront) locations during periods of inactivity (eg, ship Auxiliary Power Units (APUs) operating) and during unloading operations (eg, ship pumps and truck activity on the wharf in addition to APUs), in accordance with Clause M7.1 (2).

A window of opportunity to measure ship noise levels during periods of unloading inactivity exists immediately after the ship berths, while the unloading equipment is being set up (hoses unrolled and connected to the ship's manifold etc). The equipment setup phase usually lasts less than 2 hours, after which the unloading is continuous, with at least one road tanker being filled at any one time. Ship noise measurements during periods of activity can be measured at any time after unloading commences.

The previous ship noise monitoring report prepared by Heggies (Report Number 10-4309R2R1) concluded that measurements are best carried out at night (preferably after 1 am). Extraneous noise (not related to the activity) is generally at a minimum at this time and results are likely to be much more meaningful.

The bulk liquids ship Aral Wind was scheduled to berth at 7:00 am on Saturday 28 October 2006. In light of the expected high levels of extraneous noise from peak traffic during this time, noise measurements during ship inactivity prior to unloading commencement were not carried out on this occasion.

Attended noise level measurements were carried out at 1.5 m above ground level at 13 Donnelly Street and 1.5 m above ground level at Giba Park, located on top of the residential apartment complex at 2 Point Street, Pyrmont.

A car carrier ship, "Cattleya Ace" was berthed at the nearby GI-1, approximately 500 m from WB-4 during the night. Taking into consideration the presence of a second significant noise source, a direct measurement of bulk liquids unloading related noise at representative receivers was not possible, as the noise environment at these locations contained noise contributions related to both the car unloading operation at GI-1 as well as the bulk liquids cargo unloading operation at WB-4.

It was instead necessary to carry out a "reference" measurement in close proximity of the Aral Wind, where the noise environment was dominated by bulk liquids unloading related noise. The "reference" measurement was then used as a basis for the estimation of WB-4 activity related noise at the receivers of interest (i.e. in absence of the car terminal related noise at GI-1).

An equivalent ship sound power level was therefore calculated based on the "reference" measurement and noise contributions related to bulk liquids cargo handling estimated at each noise sensitive location.

All measurements were carried out using a precision sound level meter conforming to the requirements of AS 1259-1982 "Sound Level Meters". Calibration was checked prior to and subsequent to the survey. Any drift in calibration was within 0.5 dBA and considered acceptable.

The survey instrumentation used during the studies is set out in **Table 3**.



Table 3 Noise Survey Instrumentation

Type	Serial Number	Instrument Description
2260	2335703	Brüel & Kjær Modular Precision Sound Level Meter
4189	2330802	Brüel & Kjær 12.5 mm Prepolarised Condenser Microphone
4231	2022772	Brüel & Kjær Calibrator

Environmental noise measurements were carried out with reference to the guidelines contained within the NSW Industrial Noise Policy (INP). In circumstances where it was not practical to carry out measurements at the potentially worst affected receiver locations as predicted by the Noise Impact Assessment, locations of similar noise characteristics were chosen, as described in **Section 2.1**.

Given the relatively constant nature of noise related to the bulk liquids cargo handling operations, short term measurements (15 minute duration) were considered to be sufficient to provide an estimate of the $L_{Aeq(night)}$ noise levels at the selected residential receivers. A brief description of acoustic terminology used in this report is presented in **Appendix A**.

Attended measurements during periods of activity were therefore carried out during the early morning of the 29th of October, commencing at approximately 1:20 am, as extraneous ambient noise unrelated to port activities is generally at a minimum at this time. Two separate 15 minute measurements were carried out at the representative Balmain location during cargo handling operations at WB-4. Both measurements however, were “contaminated” by extraneous noise originating at the car terminal at GI-1 (ie, both contained a contribution of noise related to vehicle unloading at GI-1, as well as the bulk liquids cargo handling at WB-4).

Only one 15 minute noise measurement was carried out at the representative receiver at the Pyrmont side, as it was found to be dominated by noise related to the vehicle unloading operation at GI-1.



5 RESULTS AND ANALYSIS

The results of the 15 minute duration attended noise measurements are summarised in **Table 4** below. Discussion of the results is presented in **Section 6** of this report. It should be noted that the measured levels presented below include noise from the bulk liquids cargo handling facility at WB-4 as well as vehicle unloading related noise from the Glebe Island Car Terminal at GI-1.

Table 4 Measured Noise Levels - Unloading Activity

Address	Start Time	LAeq	LA90	WB-4 Related L _{Amax} Range
13 Donnelly Street (Balmain / Rozelle)	01:50 am	52 dBA	51 dBA	54dBA – 56 dBA
	03:10 am	52 dBA	51 dBA	52dBA – 56 dBA
Level 5, 2 Point Street (Pyrmont / Glebe)	03:50 am	50 dBA	49 dBA	None observed during monitoring period

Table 5 presents the “reference” noise measurement, carried out 50 m away from the bulk liquids vessel Aral Wind, where the noise environment was dominated by bulk liquids cargo handling related noise.

Table 5 Aral Wind “Reference” Noise Level

Location	Distance from Source	Height of Source	Start Time	LAeq	LA90
WB-4	50 m	15 m	01:20 am	59 dBA	59 dBA

Noise measurements at both representative locations were contaminated by noise related to the car terminal operation (ie, the measured noise levels contain contributions from the car unloading operation, as well as the unloading operation of interest). The best estimate of the bulk liquids related noise in absence of the car terminal activity is therefore based on the reference measurement taken in close proximity of the Aral Wind, where the noise environment is dominated by bulk liquids unloading related noise.

Calculations performed from the reference measurements taken in close proximity of the Aral Wind vessel indicate bulk liquids unloading related LA_{eq} noise levels at the representative receivers at 13 Donnelly St and 2 Point St of 49 dBA and 37 dBA respectively, as summarised in **Table 6** below.

Table 6 Predicted Bulk Liquids Related Noise Levels at the Representative Receivers

Location	Distance from Source	Source SWL (LA _{eq})	Calculated LA _{eq}
13 Donnelly Street, Balmain	170 m	101 dBA	49 dBA
2 Point Street, Pyrmont	660 m	101 dBA	37 dBA

An assessment of the predicted noise levels against goals listed in the Licence Conditions are presented in **Table 8**, **Table 9** and **Table 10**.

Noise from both the ship’s Auxiliary Power Units (APUs) and pump / fan operations was found to be constant in nature. Noise from trucks was observed to be the main contributor to maximum (L_{Amax}) noise level events. Detailed summary of the L_{Amax} events at Balmain side are presented in **Table 7**. WB-4 related L_{Amax} events were not observed at the Pyrmont monitoring location.

**Table 7 Summary of Attended L_{Amax} Noise Levels at 13 Donnelly Street, Balmain**

L _{Amax} Source	L _{Amax} Range	Notes
Pressure release valve (truck based)	52 dBA – 56 dBA	Truck based pressure release valve noise could be heard from trucks at arrival and immediately prior to departure from the site. The events last for approximately 1 second.
Reversing Alarm	54 dBA – 56 dBA	Reversing alarms were observed during on site truck manoeuvring. The reversing alarms could be heard for approximately 10 seconds at a time, with a duty cycle of approximately 1 second on, 2 seconds off.
Engine revving	54 dBA	Truck engine revving was observed to be maintained at a maximum level for up to several seconds, after which the engine noise quietens down gradually, as the truck moves further away from the measurement location.
Car passing nearby	63 dBA - 67 dBA	Several car pass-by events were observed in the two 15 minute monitoring periods, ranging from 63 dBA to 67 dBA at approximately 5 m away

Table 8 Assessment of Predicted Noise Levels Against L_{Aeq}(15 min) Noise Goals

Prediction Location	Predicted L _{Aeq} Noise Levels	L _{Aeq} (15 min) Noise Goals	L _{Aeq} (15 minute) Exceedance of Licence Goals
13 Donnelly Street (Balmain / Rozelle)	49 dBA	49 dBA	No Exceedance
Level 5, 2 Point Street (Pyrmont / Glebe) ¹	37 dBA	41 dBA	No Exceedance

Table 9 Assessment of Predicted Noise Levels Against L_{Aeq}(night) Noise Goals

Prediction Location	Predicted L _{Aeq} Noise Levels	L _{Aeq} (night) Noise Goals	L _{Aeq} Exceedance of Licence Goals
13 Donnelly Street (Balmain / Rozelle)	49 dBA	41 dBA	8 dBA
Level 5, 2 Point Street (Pyrmont / Glebe)	37 dBA	N/A	N/A

Table 10 Assessment of (WB-4 Related) Measured Noise Levels Against L_{Amax} Noise Goals

Measurement Location	Range of Maximum Measured Levels (L _{Amax} Range)	L _{Amax} Noise Goals	Range of Recorded L _{Amax} Exceedances of the Licence Noise Goals
13 Donnelly Street (Balmain / Rozelle)	52 dBA – 56 dBA	59dBA	No Exceedance
Level 5, 2 Point Street (Pyrmont / Glebe)	N/A ¹	51 dBA	No Exceedance

Note 1 No L_{Amax} events associated with the bulk liquids unloading activity at WB-4 were recorded during the 15 minute monitoring period at 2 Point Street, Pyrmont.



6 DISCUSSION

Predicted $L_{Aeq}(15\text{ min})$ noise levels comply with the Licence imposed noise goals at the representative locations at both Balmain and Pyrmont. An $L_{Aeq}(\text{night})$ exceedance of 8 dBA was predicted at the Balmain representative receiver.

A comparison of predicted noise levels based on Aral Wind measurements with those predicted by the NIA model (based on Botany Treasure) indicates that Aral Wind is relatively a quieter vessel when compared with the Botany Treasure. This observation is supported by noise monitoring results of previously monitored bulk liquids ships to date.

In order to fulfil the requirement of Licence condition R4.1 and in relation to compliance with Licence conditions O4.1 and O4.2, the potential noise control measures are discussed below in concept for the sources identified during attended monitoring.

Bulk liquids terminal related maximum (L_{Amax}) noise levels were not observed to cause exceedances at the representative monitoring locations for the duration of attended measurements.

Based on observations, two significant sources of noise were identified on the ship. These are engine noise emanating from approximately deck height and exhaust noise emanating from the exhaust stack, approximately 15 m above sea level.

A Noise Impact Mitigation and Management Strategy (Document No. 10-4309R7-R1) has been prepared for the operation. Taking into consideration the infrequency and limited duration of the operation, expected costs, development times, uncertainty of effective outcome, and the impact on flexibility in relation to ships that may be used in the operation, the implementation of ship specific engineering noise control measures is not considered practical nor reasonable within the Noise Impact Mitigation and Management Strategy. Instead, the document recommends an on-site mitigation management strategy be implemented based on operator awareness and procedures to identify and repair abnormally noisy equipment, as outlined within the Noise Impact Mitigation Action Plan.



7 CONCLUSION

Noise measurements were carried out during Aral Wind cargo handling operations on the night of 28 October 2006. The measured noise levels were found to be dominated by noise emanating from the nearby Glebe Island Berth 1 (GI-1), where car unloading operations were taking place from aboard the Cattleya Ace. A reference noise measurement was therefore carried out in close proximity of the Aral Wind vessel, where the noise environment was dominated by the WB-4 based bulk liquids cargo handling noise sources. The reference level was then used to predict noise levels at the representative receivers in absence of the GI-1 activity related noise.

It was found that $L_{Aeq(15\text{ min})}$ predicted noise levels complied with the Licence imposed noise goals at representative locations in both Balmain and Pyrmont. An $L_{Aeq(\text{night})}$ exceedance of 8 dBA occurs in Balmain.

Bulk liquids terminal related maximum (L_{Amax}) noise levels were not observed to cause exceedances at the representative monitoring locations for the duration of attended measurements.

Taking into consideration the infrequency and limited duration of the operation, expected costs, development times, uncertainty of effective outcome, and the impact on flexibility in relation to ships that may be used in the operation, the implementation of ship specific engineering noise control measures is not considered practical nor reasonable within the Noise Impact Mitigation and Management Strategy.

Subject to feasibility, practicality and reasonability, the potential noise control measures that may be considered in order to meet the Licence imposed noise goals (as required by condition R4.1), and ensure noise amenity remains unchanged in the area would therefore consist of an on-site noise management strategy. Noise impact mitigation measures have been evaluated in the Noise Impact Mitigation and Management Strategy (Document No. 10-4309R7-R1), with a list of mitigation measures considered feasible and reasonable identified in the Noise Impact Mitigation Action Plan.

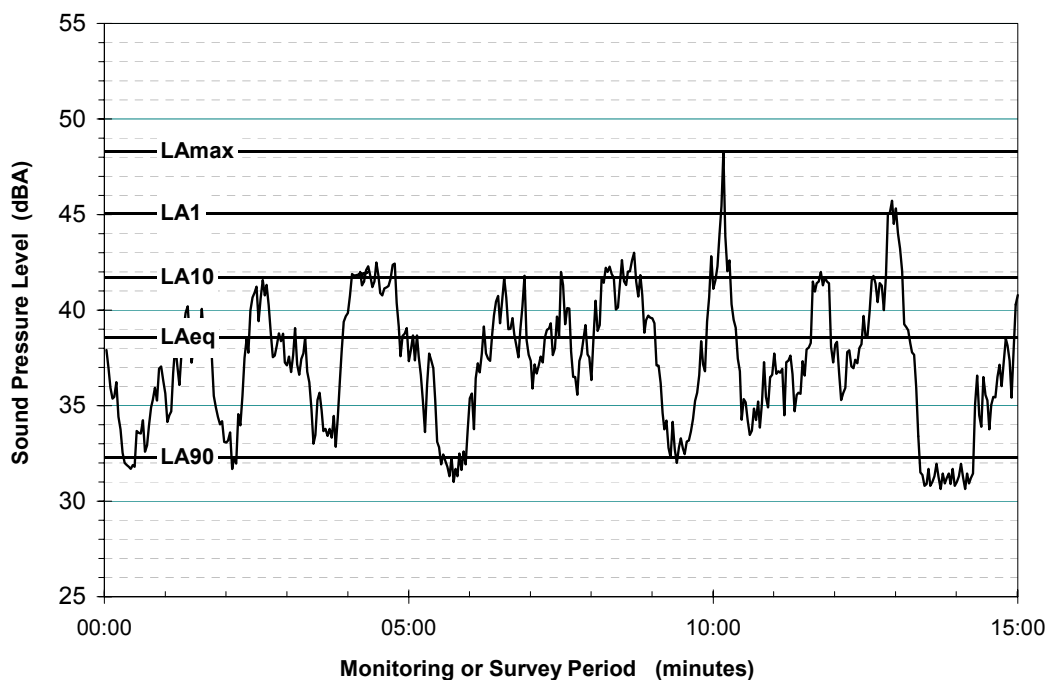
ACOUSTIC TERMINOLOGY USED IN THE REPORT

Typical Noise Indices

This Report makes repeated reference to certain noise level descriptors, in particular the LA10, LA90 and LAeq and LAm_{ax} noise levels.

- The LA10 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 LAeq 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 LAeq(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 LAeq(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 LAeq(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 LA90 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 LAm_{ax} 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

Appendix B

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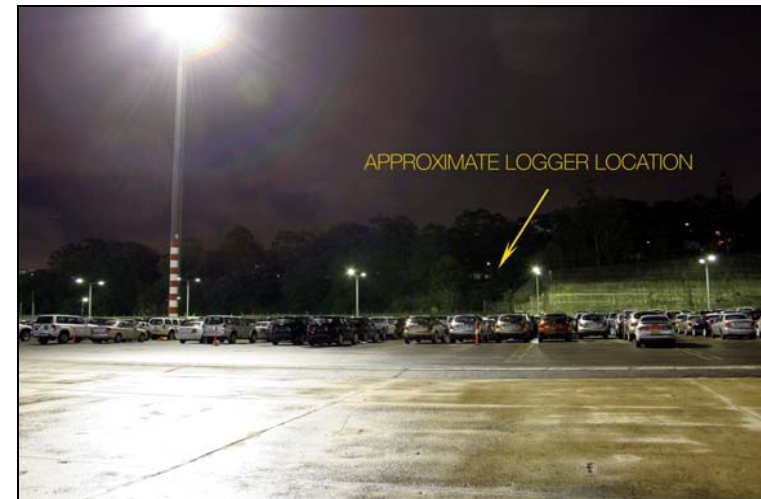
13 DONNELLY STREET, BALMAIN

13 DONNELLY STREET, BALMAIN

The location is situated approximately 170 m away from and directly overlooking White Bay Berth 4 (across the park). It is elevated some 15 m above dock level. The measurement was conducted from street level (from a footpath) with Donnelly Street traffic less than 2 m away.



Aerial Photo showing the monitoring location at 13 Donnelly Street, relative to White Bay Berth 4 (WB-4).



View from WB-4 deck towards 13 Donnelly Street



View from 13 Donnelly St towards Arel Wind, berthed at WB-4

Appendix C

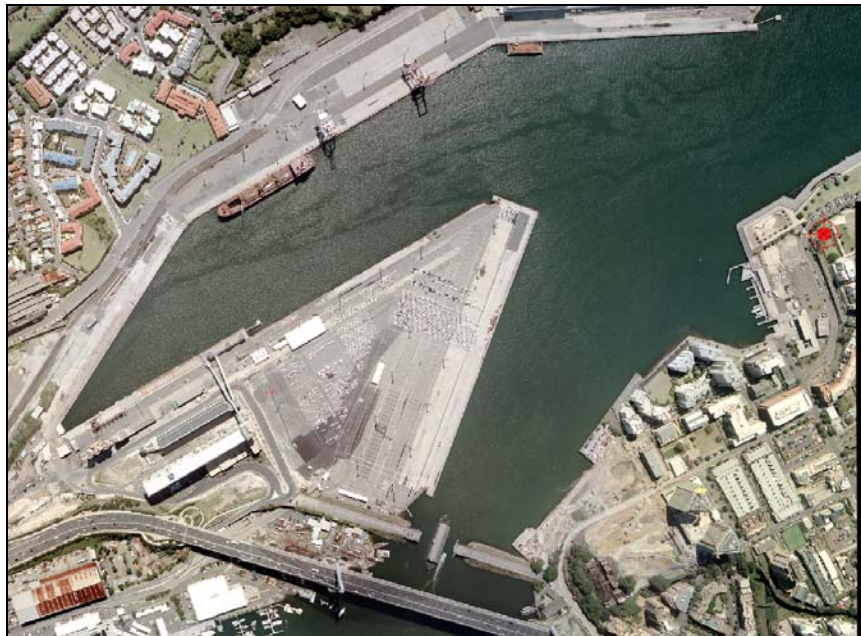
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2 POINT STREET, PYRMONT

2 POINT STREET, PYRMONT

This monitoring location is situated approximately 660 m away from White Bay Berth 4 (across the bay). Monitoring was conducted at a height equivalent of a 5 storey building, on the cliffs edge. Pirrama Road encircles the park from west, north and east sides, approximately 15 m below.



Aerial Photo showing the monitoring location at 2 Point Street, relative to White Bay Berth 4 (WB-4).



View from WB-4 deck towards 2 Point Street



View from 2 Point Street towards the bulk liquids ship berthed at WB-4