



HEGGIES

REPORT 10-5947-R1

Revision 0

**Dwyers-Oxford Site Re-Development -
Concept Design
31 Crown Street, Wollongong
Acoustic Assessment**

PREPARED FOR

Belmorgan Property Development Pty Ltd
Suite 2, Level 2
67 - 71 King Street
WARRAWONG NSW 2502

10 OCTOBER 2007

HEGGIES PTY LTD
ABN 29 001 584 612

Incorporating

New Environment

Graeme E. Harding & Associates

Eric Taylor Acoustics



Dwyers-Oxford Site Re-Development - Concept Design 31 Crown Street, Wollongong Acoustic Assessment

PREPARED BY:

Heggies Pty Ltd
2 Lincoln Street Lane Cove NSW 2066 Australia
(PO Box 176 Lane Cove NSW 1595 Australia)
Telephone 61 2 9427 8100 Facsimile 61 2 9427 8200
Email sydney@heggies.com Web www.heggies.com

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DOCUMENT CONTROL

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10-5947-R1	Revision 0	10 October 2007	Lee Hudson	Peter Georgiou	Peter Georgiou



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1 INTRODUCTION

Heggies Pty Ltd (Heggies) has been engaged by Belmorgan Property Development Pty Ltd to re-examine the acoustic impact of the proposed Concept Plan (Option 1) Re-Development involving both the Dwyers Site (bounded by Crown, Corrimal and Burelli Streets and lying on the east side of Corrimal Street) and the Oxford Site (bounded by Crown, Corrimal and Burelli Streets and lying on the west side of Corrimal Street) located within the Wollongong CBD precinct.

The project site (refer **Figure 1**) is located in the eastern half of the central Wollongong CBD area and is surrounded by a mix of mainly low- to medium-rise retail and residential developments. The eastern half of the site (Dwyers Site) has previously received development approval.

The purpose of this assessment is to forward our acoustic recommendations for the proposed Concept Design of the re-development. The assessment was carried out in accordance with NSW regulatory requirements.

The report sets out applicable noise criteria along with control concepts in relation to:

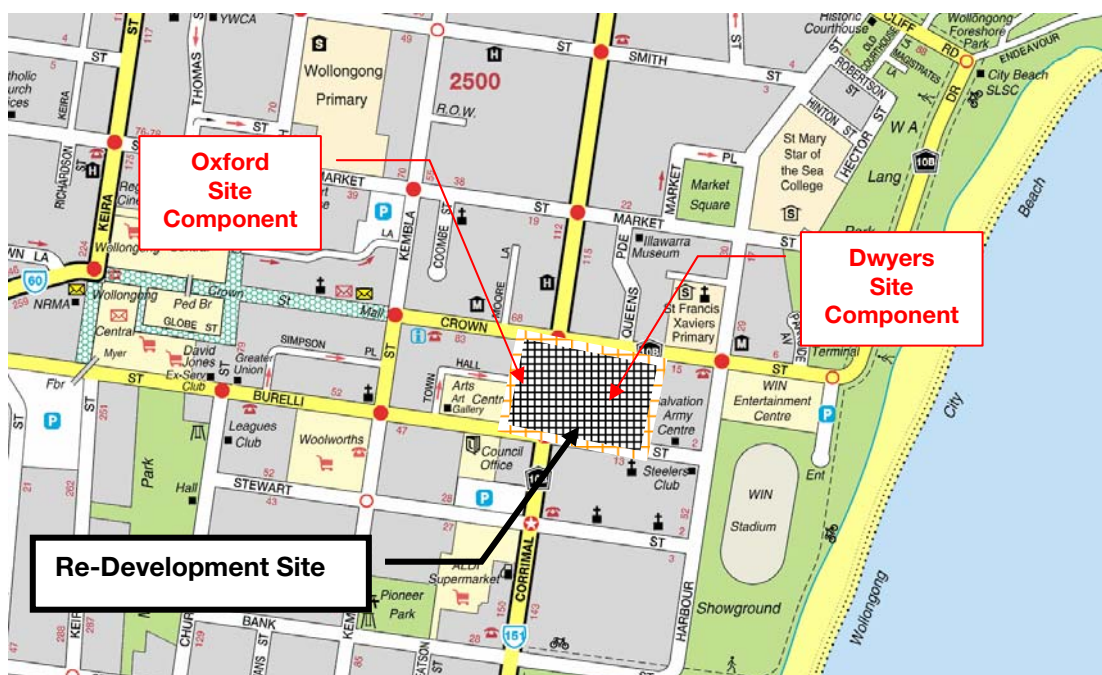
- Noise emissions from the development.
- Road traffic noise intrusion.
- Internal noise isolation (Building Code of Australia acoustic requirements).



2 DEVELOPMENT SITE

The project site (refer **Figure 1**) is bisected by Corrimal Street and bounded by Crown Street to the north and Burelli Street to the south. The site is located just to the east of the central Wollongong CBD area and is surrounded by a mix of mainly low to medium rise retail and residential developments. The already DA-approved Dwyers Site is located on the east side of Corrimal Street. The Oxford Site components are located on the west side of Corrimal Street.

Figure 1 Site Location Map for the Dwyers-Oxford Site Development



2.1 Development Description

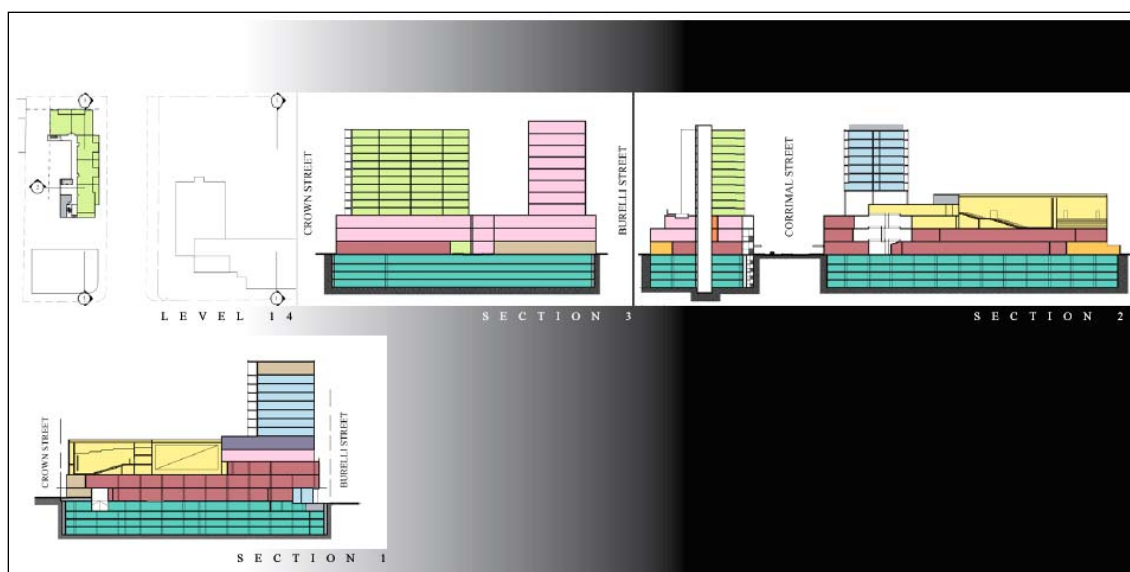
Based upon architectural drawings supplied by DBI Design (March-July 2007), the proposed redevelopment of the Dwyers and Oxford Sites (refer **Figure 2**) will comprise the following stages:

- Stage 1 – Dwyers Site
 - Basement carparking Levels B1 - B4.
 - Podium retail and commercial Levels 1 - 4.
- Stage 2 – Dwyers Site
 - Hotel Levels 5 - 12 plus Restaurant Level 13.
- Stage 3 – Oxford Site
 - Basement carparking Levels B1 - B4.
 - Podium Office Levels 1 - 4.
 - Office Tower Levels 5 - 12.
 - Residential Building Levels 5 - 15.



Elevation views of the proposed redevelopment showing the design concept are presented in **Figure 2**.

Figure 2 Dwyer-Oxford Site Re-Development - Conceptual Design





3 NOISE CRITERIA

Noise emission criteria have been established from noise survey results which are presented and discussed in **Appendix A**. The criteria for noise emission emanating from the development site itself have been set using the lower (more stringent) data from the two noise loggers.

The following criteria and recommended noise levels have been adopted to assess:

- Noise emission from, and
- Noise intrusion into, the proposed development.

3.1 Mechanical Noise Emissions

The noise emission from any mechanical plant associated with the proposed mixed use development, such as air conditioning condensers and exhaust fans, should be controlled to avoid impacting upon the acoustic amenity of nearby noise sensitive receivers. This assumes that the adjacent sites are residential or will be developed for residential land uses commensurate with the subject development.

Appropriate noise criteria have been established based on the Department of Environment and Conservation (DEC) Industrial Noise Policy (INP). The INP criteria are presented in **Section 3.1.1**.

3.1.1 Mechanical Noise Emissions - Industrial Noise Policy (INP)

Responsibility for the control of noise emission in New South Wales is vested in Local Government and the DEC, (formerly EPA). The DEC now oversees the Industrial Noise Policy (INP), released by the EPA in January 2000 which provides a framework and process for deriving noise criteria for consents and licences that will enable the DEC and others to regulate premises that are scheduled under the Protection of the Environment Operations Act 1997. The INP criteria for industrial noise sources have two components: to control *intrusive* noise and to maintain a level of *acoustic amenity*.

Intrusive Noise

For assessing intrusiveness, the background noise generally needs to be measured. The intrusiveness criterion essentially means that the equivalent continuous noise level (L_{Aeq}) of the source should not be more than 5 dBA above the measured Rated Background Level (RBL), over any 15 minute period.

Acoustic Amenity

The amenity criterion is based on land use and associated activities (and their sensitivity to noise emission). The cumulative effect of noise from industrial sources needs to be considered in assessing the impact. The criteria relate only to other industrial-type noise sources and do not include road, rail or community noise. The existing noise level from industry is measured. If it approaches the criterion value, then noise levels from new industrial-type noise sources, (including air-conditioning mechanical plant) need to be designed so that the cumulative effect does not produce total noise levels that would significantly exceed the criterion. For areas of high road traffic, there are further considerations that influence the selection of the noise criterion.



Area Classification

The INP classifies the noise environment of the subject area as:

- “Urban” for north, south, east and west of the site.

The INP characterises the “Urban” noise environment as an area:

- where the acoustical environment is dominated by ‘urban hum’ or industrial noise sources (e.g. continuous mechanical plant noise).
- where through traffic with characteristically heavy and continuous traffic flows occurs during peak periods.
- near commercial districts or industrial districts.

Having defined the area type, the processed results of the unattended noise monitoring, (refer to **Appendix A**), have been used to establish the project specific noise criteria presented in **Table 1**.

Table 1 Criteria for Mechanical Noise Emissions to Nearby Residences

Time of Day	Noise Level dBA re 20 µPa				
	ANL ¹ (period)	Measured RBL LA90(15minute) ²	Measured LAeq (15minute)	INP Criteria	
				Intrusive	Amenity
				LAeq(15minute) Criterion for New Sources	LAeq(Period) Criterion for New Sources ³
North and East of the site (Urban)					
Day	60	56	67	61	57
Evening	50	53	66	58	55
Night	45	45	61	50	51
South and West of the site (Urban)					
Day	60	52	61	57	52
Evening	50	51	61	56	51
Night	45	43	59	48	49

Note 1: ANL Acceptable Noise Level for a Rural and Suburban area.

Note 2: RBL Rating Background Level.

Note 3: Assuming existing noise levels unlikely to decrease.

Note 4: Project Specific Criteria are shown in bold.

In summary, the project specific noise emission criteria established by the INP for this site are presented in **Table 2**.

Table 2 Project Specific Industrial Noise Emission Criteria

Time of Day	North and East of the Site	South and West of the Site
Day	57 dBA	52 dBA
Evening	55 dBA	51 dBA
Night	50 dBA	48 dBA

Assuming continuous and constant mechanical noise emission throughout the day, evening and night time periods, the controlling criterion is the night time criterion of **48 dBA** at the nearest residential boundary. The assessment procedure relating to industrial type noise emissions is presented in **Section 4.1**.



3.2 Road Traffic Noise

The proposed Dwyers-Oxford Site Redevelopment will potentially be impacted by traffic noise from Crown Street, Burelli Street and Corrimal Street.

3.2.1 External Traffic Noise Criteria

Responsibility for the control of noise emission in New South Wales is vested in Local Government and the Department of Environment and Conservation (DEC), formerly the Environment Protection Authority (EPA). Traffic noise emission impacting on the proposed development should therefore be assessed in accordance with:

- The NSW Government's *Environmental Criteria for Road Traffic Noise* (ECRTN) for vehicle-related noise emissions on public roads.

The ECRTN document presents recommended road traffic noise criteria for various types of road and land use developments. The relevant criteria relating to new residential land use developments affected by "collector" traffic noise is summarised in **Table 3**.

Table 3 DEC's Guidelines for Road Traffic Noise at Residences

Type of Development	Criteria		Where Criteria are Already Exceeded
	Day (7.00 am to 10.00 pm)	Night (10.00 pm to 7.00 am)	
New residential developments affected by collector traffic noise	LAeq(1hr) 60 dBA	LAeq(1hr) 55 dBA	Where feasible and reasonable, existing noise levels should be reduced to meet the noise criteria via judicious design construction of the development. Locations, internal layouts, building materials and construction should be chosen so as to minimise noise impact.

Definitions: New residential development affected by traffic noise - addresses the acceptable level of road traffic noise impact for new residential developments at 1m from the facade of the new residences.

It should be noted that the noise criteria presented within the ECRTN noise policy document are guidelines and non-mandatory. In achieving compliance with the noise criteria, consideration needs to be given to aesthetics, cost implications, equity, community preferences and practicality.

Where noise criteria cannot be achieved in consideration of the above, social and other benefits of the project would need to be evaluated and weighed up against the acoustical impacts.

3.2.2 Internal Traffic Noise Noise Criteria

The planning standards and guidelines that are pertinent to the site are:

- AS/NZS 2107-2000, "Acoustics - Recommended Design Sound Levels and Reverberation Times for Building Interiors".
- AS 3671-1989, "Acoustics - Road Traffic Noise Intrusion - Building siting and Construction".
- NSW DEC, "Environmental Criteria for Road Traffic Noise (ECRTN)".

AS/NZS 2107 is primarily concerned with establishing internal noise levels for relatively steady noise sources, such as air conditioning plant and continuous road traffic noise.

Table 4 provides a summary of recommended noise levels for residential buildings near "major" roads given in AS/NZS 2107. The guideline noise levels are described as "satisfactory" and "maximum".



Table 4 Recommended Sound Levels and Reverberation Times (AS/NZS 2107)

Type of Occupancy/Activity	Recommended Design Sound Level	
	Satisfactory	Maximum
Houses and apartments near major roads		
Living areas	35 dBA	45 dBA
Sleeping areas	30 dBA	40 dBA
Work areas	35 dBA	45 dBA

AS 3671 is concerned with “guidelines for the selection of building envelope construction required to achieve indoor sound levels recommended as satisfactory in AS 2107”.

The **ECRTN** recommends that internal noise level criteria be set by the local planning or building authority. As sleeping areas are the most sensitive, and in the absence of local codes, internal levels of 35 dBA to 40 dBA at night are recommended by the DEC. These levels are consistent with AS/NZS 2107.

Summary

AS/NZS 2107 recommends levels of 35 dBA to 45 dBA for living and work areas and 30 dBA to 40 dBA for sleeping areas for dwellings near major roads. This description is considered relevant for the urban area surrounding the development site.

The “satisfactory” levels of 35 dBA and 30 dBA for living and sleeping areas respectively are often impractical to achieve. The more stringent “satisfactory” noise criteria can also be counter-productive as lower background noise levels inside residential apartments may result in other noise sources such as plumbing, door slamming, footfall, etc, becoming more noticeable, especially during the night-time period. However they are useful as ideal planning objectives where practical, or where the required ameliorative treatment(s) remain cost-effective.

Therefore the following internal noise levels are recommended for the assessment of road traffic noise for this development which are in agreement with the planning documents described earlier:

- Living and Working Areas 40 dBA
- Sleeping Areas 35 dBA

The assessment procedure is presented in **Section 4.2**.

3.3 Internal Sound Insulation Requirements (BCA 2007)

The residential components of the development will be required to comply with the current BCA requirements **Table 5** details the minimum acoustic performance required for the project.



Table 5 BCA 2007 Sound Insulation Requirements

Construction	2007 BCA	
	Laboratory Rating	Verification
Walls between sole occupancy units	$R_w + C_{tr}$ not < 50	$D_{nT,w} + C_{tr}$ not < 45
Walls between a bathroom, sanitary compartment, laundry or kitchen in one sole occupancy unit and a habitable room (other than a kitchen) in an adjoining unit	$R_w + C_{tr}$ not < 50 AND Must have a minimum 20 mm cavity between two separate leaves	$D_{nT,w} + C_{tr}$ not < 45 “Expert Judgment” Comparison to the “Deemed to satisfy” Provisions
Walls between sole occupancy units and a plant room or lift shaft	R_w not < 50 AND Must have a minimum 20 mm cavity between two separate leaves¹	$D_{nT,w}$ not < 45
Walls between sole occupancy units and a stairway, public corridor, public lobby or the like, or parts of a different classification	R_w not < 50	$D_{nT,w}$ not < 45
Door assemblies located in a wall between a sole-occupancy unit and a stairway, public corridor, public lobby or the like	R_w not < 30 ²	$D_{nT,w}$ not < 25
Floors between sole-occupancy units or between a sole-occupancy unit and a plant room, lift shaft, stairway, public corridor, public lobby or the like, or parts of a different classification.	$R_w + C_{tr}$ not < 50 $L_{n,w} + C_l$ not > 62	$D_{nT,w} + C_{tr}$ not < 45 $L'_{nT,w} + C_l$ not > 55
Soil, waste, water supply and stormwater pipes and ductwork to habitable rooms	$R_w + C_{tr}$ not < 40	n/a
Soil, waste, water supply and stormwater pipes and ductwork to kitchens and other rooms	$R_w + C_{tr}$ not < 25	n/a
Intra-tenancy Walls	R_w 40 ³	$D_{nT,w}$ not < 35
Note 1. A wall must be of “discontinuous construction” if it separates a sole occupancy unit from a plant room or lift shaft. Clause F5.3(c) defines “discontinuous construction” as a wall having a minimum 20 mm cavity between two separate leaves with no mechanical linkage except at the periphery. Note 2. Clause FP5.3(b) in the 2007 BCA states that the required insulation of a floor or wall must not be compromised by a door assembly. Note 3. There is no statutory requirement for airborne isolation via intra-tenancy walls.		



4 NOISE ASSESSMENT

4.1 Mechanical Noise Emission

Mechanical plant associated with the proposed residential mixed use development has the potential to impact on nearby residential properties. However at this stage of the project the location and selection of mechanical plant (exhaust fans, condenser units, etc) has not been established. Therefore appropriate assessment will need to be conducted during the Construction Certificate stage of the project.

It is envisaged that the mechanical plant noise sources will be controllable by common engineering methods that may consist of:

- Silencers.
- Acoustic louvres.
- Variable speed controls.
- Barriers.
- Acoustically lined ductwork.

The selected mechanical equipment must be reviewed and assessed for conformance with established criteria at the detailed design stage of the project when specific plant selection and location is determined. At the Construction Certificate stage of the project appropriate noise control measures can be determined.

4.2 Road Traffic Noise

4.2.1 External Traffic Noise

A review of the data indicates that the maximum $L_{Aeq}(1 \text{ hr})$ noise level at the exposed residential building facades will be as shown in **Table 6**.

Table 6 Maximum L_{Aeq} Road Traffic Noise Levels

Time Period	Facade Noise Levels ($L_{Aeq}(1\text{hr})$)	
	North and East	South and West
Daytime (7:00 am - 10:00 pm)	68	62
Night-time (10:00 pm - 7:00 am)	64	62

The predicted $L_{Aeq}(1\text{hr})$ noise levels are 8 dBA for the daytime and 9 dBA for the night-time above the ECRTN recommended noise levels. Therefore orientation of buildings on the site; planning internal layouts and choosing the most appropriate building materials; and using good construction techniques will need to be considered to satisfy acceptable internal noise levels within occupied spaces.

4.2.2 Internal Traffic Noise

Standard window glazing of a building will typically attenuate the above predicted external noise levels by at least 20 dBA with windows closed and 10 dBA with windows open (allowing for natural ventilation). The predicted internal noise levels for standard facade glazing are presented in **Table 7** for the windows open and windows closed scenarios.

**Table 7 Predicted Internal Road Traffic Noise Levels (dBA) - Standard Glazing**

Facade	Internal Noise Level		Internal Noise Criteria
Type of Occupancy	Windows Open	Windows Closed	
North and East			
Living Areas (daytime)	58	48	40
Sleeping Areas (night-time)	54	44	35
South and West			
Living Areas (daytime)	52	42	40
Sleeping Areas (night-time)	52	42	35

The predicted internal noise levels indicate exceedances of up to of 8 dBA and 9 dBA for living and sleeping areas respectively. The predicted exceedance of the criteria indicates that some acoustic treatment will be required. As with many residential developments in city urban areas it will be necessary to keep windows closed to preserve the internal acoustic amenity of residents during peak hour traffic periods. Therefore, design of the ventilation for these rooms should be such that occupants can leave windows closed, if they so desire.

Concept Design - Glazing Recommendations

Preliminary calculations have been conducted to determine the necessary glazing to meet design criteria. These recommendations are detailed in **Table 8** as follows:

Table 8 Preliminary Glazing Recommendations

Type of Occupancy	North and East	South and West
Living Areas (daytime)	10.38mm laminated	6.38mm laminated
Sleeping Areas (night-time)	10.38mm laminated	10.38mm laminated

All glass should be fitted with good quality acoustic rated seals in an acoustic rated frame so that the acoustic performance of the glazing systems is not significantly degraded. Ensure that all gaps between brick work and frame are fully sealed on installation. Hinged windows are preferred as they provide a positive seal.

We recommend that the glazing selection be confirmed at the detail design stage of the project. Alternative selections can be adopted on this project should other disciplines, such as mechanical designers, dictate the need for these systems.

4.3 Internal Sound Insulation Requirements (BCA 2007)

4.3.1 Inter-Tenancy Walls

The required acoustic ratings are to be achieved at the detailed design stage by judicious selection of wall types.



Issues that need to be identified and controlled at the time of construction include:

- No back-to-back power points.
- All chasing to be grouted up.
- All junctions with the facade to be acoustically sealed.

4.3.2 Soil and Wastepipes

The BCA requires a construction between wastewater pipework from one sole occupancy unit to another that will achieve a rating of R_w+C_{tr} 40.

A minimum construction that consists of a two layer 13 mm plasterboard ceiling plus acoustic pipewrap and acoustic insulation will achieve conformance with BCA requirements.

Where waste water pipework occurs in a ceiling above a non habitable space such as bathrooms, a construction acoustic rating of R_w+C_{tr} 25 is required. This rating can be achieved by a single layer 13 mm plasterboard ceiling construction plus acoustic pipewrap and acoustic insulation.

Pipework in vertical risers should achieve the same ratings as previously detailed.

4.3.3 Floor Impact Isolation

The impact isolation requirements will be achieved either by the use of carpeted flooring above habitable areas or acoustic impact treatment where hard floor surfaces, such as tiles or timber, are installed above other sole occupancy units or areas of a different classification.

In the case of hard floor surfaces above habitable areas the use of a resilient layer below the hard flooring and/or an appropriate suspended ceiling can be adopted to meet the impact noise requirement of $L'_{n,w}+C_i$ 62. Details of appropriate treatment are to be determined at the detailed design stage of the project.



5 CONCLUSION AND STATEMENT OF COMMITMENTS

5.1 Summary

Heggies Pty Ltd has conducted an acoustic assessment of the Concept Design proposed for the re-development of the Dwyer-Oxford Site in support of the integrated Project Application submission to the NSW Department of Planning.

The scope of the assessment includes the impact of existing noise on the amenity of the proposed residential components of the development, provides criteria for noise emission from the development and establishes sound insulation requirements between residential apartments.

The key findings of this assessment are as follows:

Mechanical Noise Emission - Specific plant selections have not been made at this stage of the project. This issue is to be reviewed at the detailed design stage to ensure that compliance with the established criteria is achieved at all residential receivers. NR noise level criteria have been specified in the Mechanical Services Report for the Concept Design. Standard acoustic design control solutions (eg enclosures, attenuators, silencers, etc) will be used to satisfy these criteria.

Road Traffic Noise Intrusion - Measured external noise levels indicate that it will be necessary to consider location and orientation of noise sensitive areas, and the incorporation of improved glazing, in order to satisfy the proposed internal noise criteria. These recommendations are typical for a residential development in an urban area affected by road traffic noise. This issue should be reviewed at the detailed design stage to ensure that compliance with noise criteria will be achieved.

Sound Insulation Requirements - Compliance with the sound insulation requirements of BCA 2007 are to be achieved by the residential components of the proposed development.

5.2 Statement of Commitments

Prior to the Construction Certificate stage of the project, all of the above elements concerning the control of noise intrusion into the re-development (eg road traffic noise for residential units) and the control of noise emanating from the re-development itself (eg rooftop mechanical plant) will be reviewed in detail.

1. Façade solutions will be developed and specified (eg including specific glazing selections, external wall types, etc) to ensure that the project complies with criteria relevant to noise intrusion into the re-development from external noise sources (eg road traffic).
2. Inter-tenancy solutions for all elements of the re-development will be developed and specified (eg inter-tenancy walls, intra-tenancy walls, etc) to ensure that the re-development complies with all relevant BCA and local council noise requirements.
3. Noise control solutions will be developed and specified to ensure that the mechanical systems within the re-development comply with NSW criteria relevant to external noise emissions from the project itself (eg roof top mechanical plant, car park mechanical plant noise emissions, etc).

A1 Unattended Noise Monitoring

Unattended noise monitoring has been conducted on site in order to determine project specific criteria for the proposed residential development on the existing Dwyer Site.

Unattended noise monitoring was conducted at two (2) selected locations on site between Tuesday 1 November 2005 and Wednesday 9 November 2005 as indicated in **Figure 1**. Two (2) ARL type 315 noise loggers were deployed during this time to continuously record the ambient noise levels. The noise loggers were calibrated before and after the noise monitoring with a drift in noise levels not exceeding ± 0.5 dBA. The sample time interval was set at 15 minutes and the time weighting function set to "Fast".

The noise loggers were deployed at the selected locations in order to approximate the different noise environments likely to be experienced on different parts of the site and to assess noise intrusion into the proposed development. Specifically, the loggers were located as follows:

- Location 1: Near the northern boundary of the site on Crown Street to assess noise intrusion from Crown Street and approximate the noise environment experienced to the north and east of the site.
- Location 2: Near the southern boundary of the site on Burelli Street to approximate the noise environment experienced to the south and west of site.

The following graphs (**Figure A1** and **Figure A2**) show representative 24 hour periods of site noise levels at the two (2) monitoring locations:

Figure A1 **Results of Unattended Noise Monitoring - Location 1, Crown Street
(North of Site)**

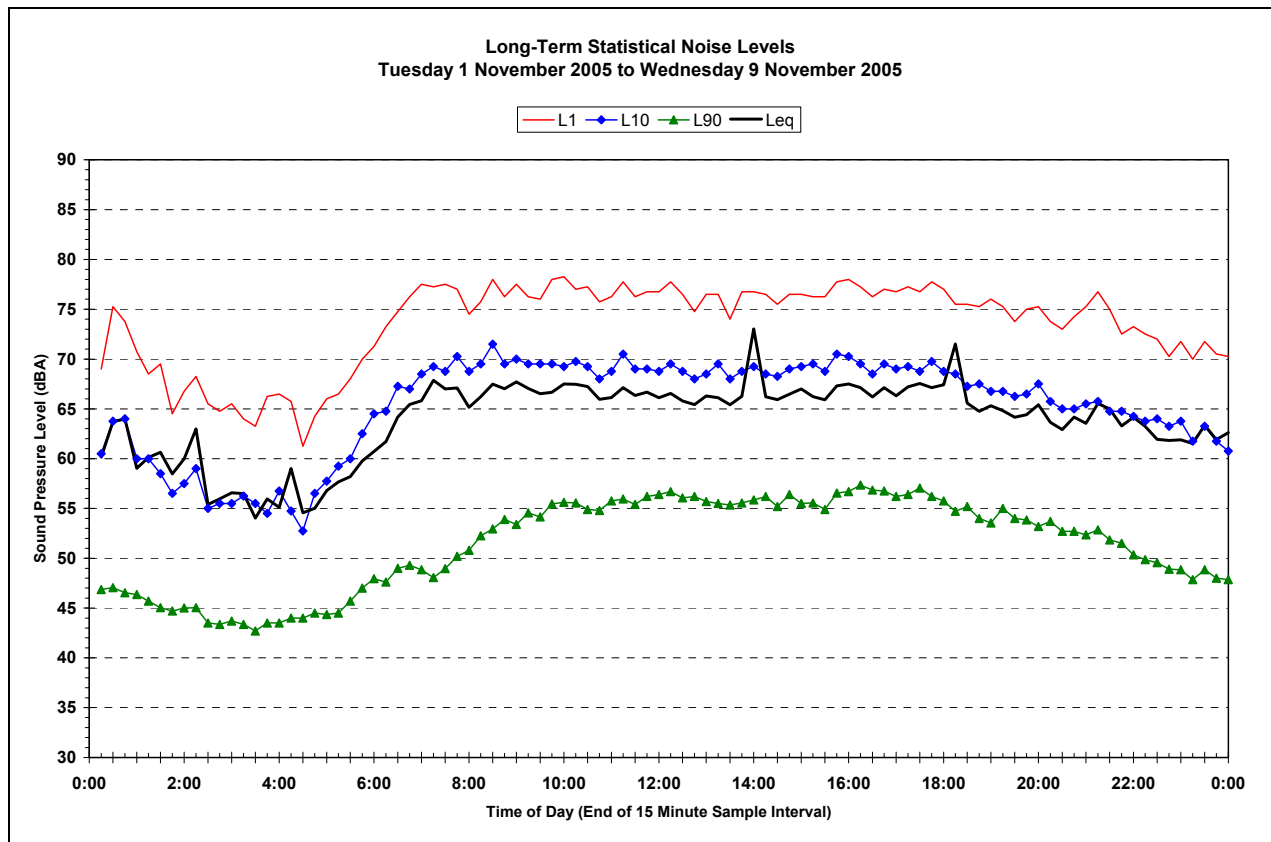
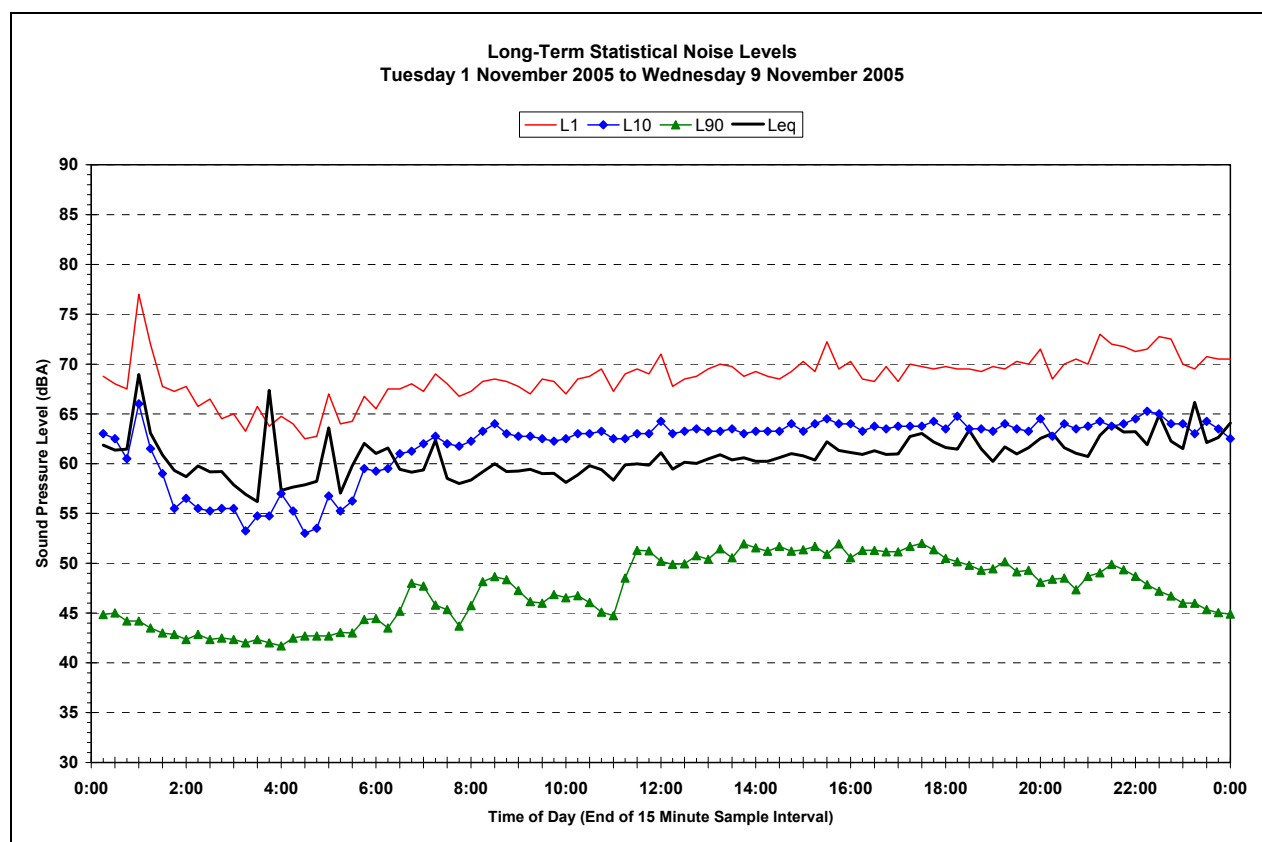


Figure A2 Results of Unattended Noise Monitoring – Location 2, Burelli Street (South of Site)



A1.1 Statistical Noise Levels

The statistical descriptors shown on the graphs are described below:

LA90 The noise level exceeded for 90% of the sample time (15 minutes). The LA90 noise level is described as the average minimum background sound level or simply the background level.

LA10 The noise level exceeded for 10% of the sample time (15 minutes) and is typically described as the average maximum noise level.

LA1 The noise level exceeded for 1% of the sample time (15 minutes) and representative of the highest noise level events, (eg passing heavy vehicles, aircraft etc).

LAeq The LAeq is the energy-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.

A2 Unattended Noise Monitoring

The noise environment at the site was contributed to by:

- Aggregate “urban hum”.
- Road traffic noise from nearby arterial roads.
- Nearby commercial and retail activities.

The noise levels from the nearby roads will control the design for noise intrusion into the development during the daytime and night-time period and this noise sources will remain when the development is constructed. It is also noted that that area surrounding the Dwyer Site is dominated by low and mid rise commercial and retail developments. These buildings have

In view of the above considerations, the logged noise data obtained from the site has been used unfiltered.

The results of the ambient noise surveys are presented in **Table A1** and **Table A2**. The criteria established from these measured levels are presented and discussed in **Section 3.1**.

The results of the unattended noise monitoring have been processed in accordance with the procedures contained in the Department of Environment and Conservation (DEC)’s Industrial Noise Policy (INP) so as to establish representative noise levels that can be expected on site. The results of this analysis are presented in **Table A1** (noise levels rounded to the nearest 1 dBA).

Table A1 Summary of Existing LA90 (RBL) and Existing LAeq Noise Levels

Location	Industrial Noise Indices - dBA re 20 µPa					
	Daytime 7.00 am – 6.00 pm		Evening 6.00 pm – 10.00 pm		Night-time 10.00 pm – 7.00 am	
	RBL	LAeq	RBL	LAeq	RBL	LAeq
Location 1 (North of Site)	56	67	53	66	45	61
Location 2 (South of Site)	52	61	51	61	43	59

RBL - Rating Background Noise Level (RBL) is representative of the average minimum background sound level (in the absence of the source under consideration), or simply the background level. It is the median of the daily background noise levels during each assessment period, being day, evening and night.

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.

The results of the unattended noise monitoring have also been processed in accordance with procedures within the Department of Environment and Conservation (DEC) document Environmental Criteria for Road Traffic Noise (ECRTN) to establish the typical worst one hour traffic noise levels that could be expected at the worst affected facade of the proposed development. These noise levels are presented in **Table A2** (noise levels rounded to the nearest 1 dBA).

Table A2 **Measured Traffic Noise Levels - ECRTN**

Location	Noise Level - dBA re 20 µPa			
	Daytime 7.00 am – 10.00 pm		Night-time 10.00 pm – 7.00 am	
	L _{Aeq} (15hour)	L _{Aeq} (1hour)	L _{Aeq} (9hour)	L _{Aeq} (1hour)
Location 1 (North of Site)	67	68	61	64
Location 2 (South of Site)	60	62	60	62

These L_{Aeq}(1hour) levels have been used to predict the internal noise levels presented in **Section 3.2**.