LOT 5 DP 262213, ROPES CREEK
EMPLOYMENT PRECINCT
CONCEPT & STAGE 1 PROJECT APPLICATION

NOISE IMPACT ASSESSMENT

ACOUSTICS AND AIR

REPORT NO. 10096B
VERSION C

WILKINSON MURRAY

LOT 5 DP 262213, ROPES CREEK EMPLOYMENT PRECINCT CONCEPT & STAGE 1 PROJECT APPLICATION

NOISE IMPACT ASSESSMENT

REPORT NO. 10096B
VERSION C

AUGUST 2010

PREPARED FOR

JACFIN PTY LTD

Wilkinson Murray (Sydney) Pty Limited · ABN 39 139 833 060
Level 2, 123 Willoughby Road, Crows Nest NSW 2065, Australia • **Offices in SE Qld & Hong Kong**
t +61 2 9437 4611 • **f** +61 2 9437 4393 • **e** acoustics@wilkinsonmurray.com.au • **w** www.wilkinsonmurray.com.au

TABLE OF CONTENTS

EXECUTIVE SUMMARY

The following Concept Plan and Stage 1 Project Application noise impact report has been prepared in relation to a proposed Business Park known as Lot 5 DP 262213, Ropes Creek Industrial Estate. The site is located to the north of the Sydney Water Pipeline.

The report sets out the design criteria and control concepts in relation to:

- Construction noise;
- Road traffic noise; and
- Operational noise

Conventional methods will be applied where necessary, to address all of these issues:

- Construction noise must be managed to mitigate the noise impact at residences; and
- Noise emissions from the development will be controlled by appropriate orientation of building shielding, plant selection, location and engineering noise controls.

Noise criteria have been established for construction and operational stages of the development. These goals should be adopted in the design development stage of the project. In addition individual Project Applications for new facilities on lots within the Concept Plan should address the criteria established in this assessment.

It is also concluded that appropriate detail design and selection of facilities and mechanical plant should be conducted at the design stage of the project referencing the established criteria and planning recommendations made in this report.

In the case of the Stage 1 Project Application resultant noise levels from the two warehouses have been predicted. It has been determined that the operation of this facility will not adversely impact on the acoustic amenity of surrounding residences.

1 INTRODUCTION

Wilkinson Murray (Sydney) Pty Limited has been engaged by Jacfin Pty Ltd to conduct a construction noise and concept plan noise assessment in relation to proposed employment precinct development at Ropes Creek. In addition, a Stage 1 Project Application of the first two warehouses to be located on the eastern side of the site has been assessed.

The following report sets out the design concepts in relation to:

- Construction noise;
- Road traffic noise on the new link road; and
- Noise emissions from the operation of the development.

In the case of vibration neither construction nor operational activities have the potential to adversely impact on properties based on the distance between the nearest receivers and the site. Therefore this issue will be not considered any further.

The above reflects the Director General's requirements of assessment of "***Noise and Vibration*** *– including construction, operation and traffic noise*."

1.1 Project Description

Jacfin is preparing a concept plan for the Ropes Creek employment precinct development in accordance with the provisions of Part 3A of the Environmental Planning and Assessment Act 1979.

Jacfin proposes to develop the site for employment purposes including, but not limited to warehouse, storage and distribution facilities and manufacturing uses. The proposed Concept Plan will identify the provision of necessary infrastructure including roads, drainage, utility and communications services to support the proposed development.

A concurrent Project Application will be prepared for Stage 1 being the development of the first two warehouse facilities including subdivision, bulk earthworks, the initial road access and utility connections.

This report has been prepared with respect to the overall Concept Plan and a Stage 1 Project Application that is proposed within the site having regard to the natural features of the site and surrounding receivers as indicated in Figure 1-1. The site occurs within a mixed industrial / rural residential setting. Surrounding receivers have been identified as:

- Erskine Park Residences to the west at a distance of approximately 280m (Residential Location A
- Emmaus College and Retirement Village to the west at a distance of approximately 2,200m (Residential Location B)
- Arlington Road Residences to the west at a distance of approximately 2,400m (Residential Location C)
- Greenway Drive Residences to the south at a distance of approximately 1,700m (Residential Location D)
- Burley Road Residences to the south east at a distance of approximately 1,000m (Residential Location E)

Figure 1-1 Proposed Site Layout Showing Surrounding Residences & Noise Measurement Locations

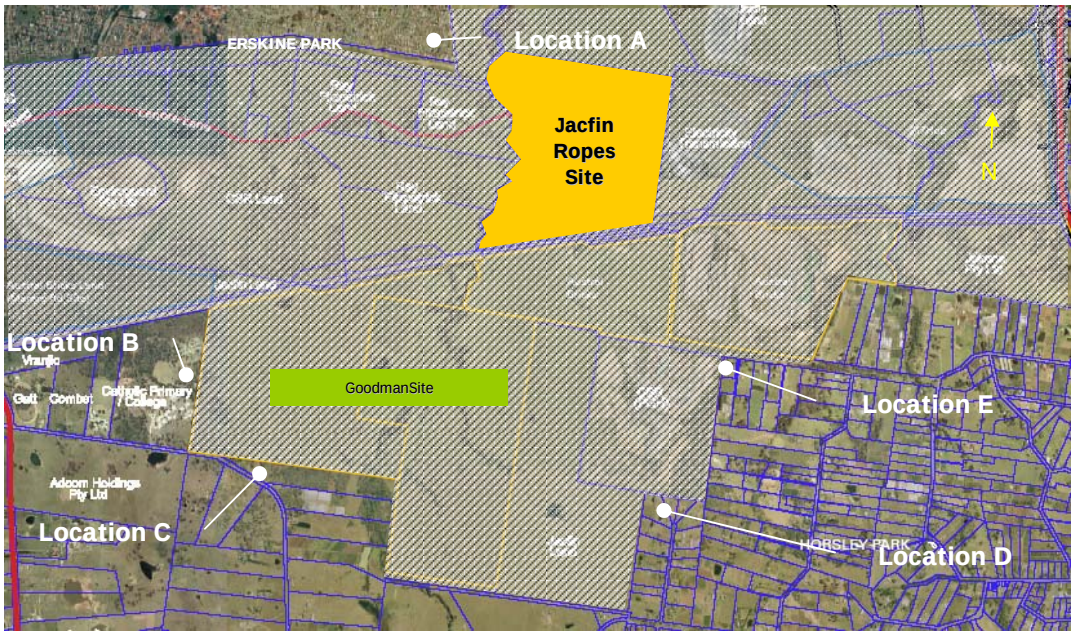


Figure 1-2 illustrates the proposed concept layout. This concept plan shows indicative buildings and access routes which will be detailed at the project application stage.

Figure 1-2 Ropes Creek Concept Site Layout

1.2 Acoustic Terminology

The following report uses specialist acoustic terminology. An explanation of common terms is provided in Appendix C.

2 AMBIENT NOISE LEVELS & SURROUNDING RECEIVERS

Long-term ambient noise levels were monitored at three locations surrounding the site, selected to cover the range of environments in the potentially-affected areas. The locations are presented in Table 2-1. The logger locations are shown in Figures 2-1 to 2-3

Table 2-1 Long-Term Noise Monitoring Locations

Monitoring Site	Address	Relevant Noises Noted on Site Visits
A	58 Weaver Street, Erskine Park	General suburban area remote from transportation noise
C	32 Arlington Road, Kemps Creek	Rural noise
D	41 – 43 Greenway Place, Horsley Park	Rural Residential Area – Quiet area

Noise monitoring was conducted between Monday, 19 July and Monday, 26 July 2010. The noise monitoring equipment used for these measurements consisted of ARL Type EL-215 environmental noise loggers set to A-weighted, fast response, continuously monitoring over 15-minute sampling periods. This equipment is capable of remotely monitoring and storing noise level descriptors for later detailed analysis. The equipment calibration was checked before and after the survey and no significant drift was noted.

The logger determines L_{A1}, L_{A10}, L_{A90} and L_{Aeq} levels of the ambient noise. L_{A1}, L_{A10} and L_{A90} are the levels exceeded for 1%, 10% and 90% of the sample time respectively (see Appendix A for definitions). The L_{A1} is indicative of maximum noise levels due to individual noise events such as the occasional pass-by of a heavy vehicle. The L_{A90} level is normally taken as the background noise level during the relevant period.

Detailed results for each monitoring location are shown in graphical form in Appendix B. The graphs show measured values of L_{Aeq}, L_{A90}, L_{A10} and L_{A1} for each 15-minute monitoring period.

Table 2-2 summarises the noise results, for daytime, evening, night time periods as defined in by the DECCW. The summary noise descriptors are:

- L_{Aeq} (period) – the equivalent continuous L_{Aeq} noise level measured over the assessment period; and
- RBL – Rating Background Level is a measure of typical background noise levels which are used in determining noise criteria.

Table 2-2 Summary of Measured Noise Levels

Noise Logging Site	RBL (dBA)				$L_{Aeq,period}$ (dBA)			
	Daytime 7am-6pm	Evening 6-10pm	Night Time 10pm-7am	Saturday 8am-1pm	Daytime 7am-6pm	Evening 6-10pm	Night Time 10pm-7am	Saturday 8am-1pm
A	34	36	34	31*	51	46	42	*
C	33	34	33	31	47	42	42	47
D	32	32	31	31	47	44	38	48

*Logger battery failed on 23 July therefore noise levels at location 2 has been used for Saturday daytime noise levels.

Background levels at all locations were free of the influence of extraneous noise sources, such as plant or construction activities.

Figure 2-1 Location A– 58 Weaver Street, Erskine Park West of the Site

Figure 2-2 Location C – Arlington Road Residences West of the Site

Figure 2-3 Location D – 41-43 Greenway Place, Horsley Park South of the Site

3 PERFORMANCE CRITERIA

The following sections detail the applicable site specific construction noise and vibration criteria based on the guidelines from DECCW, being;

- *Interim Construction Noise Guideline*, and;
- *NSW Industrial Noise Policy*

3.1 Construction Noise Criteria

DECCW released the "*Interim Construction Noise Guideline*" *(ICNG)* in July 2009 the guideline provides noise goals that assist in assessing the impact of construction noise.

For residences, the basic daytime construction noise goal is that the noise should not exceed the L_{A90} background noise by more than 10dBA. This is for standard hours: Monday to Friday 7.00am to 6.00pm, and Saturday 8.00am to 1.00pm. Outside the standard hours, the criterion would be background + 5dBA. A more complete description of the guidelines is in Table 3-1.

Table 3-1 Construction Noise Goals at Residences using Quantitative Assessment

Time of Day	Management Level $L_{Aeq,(15min)}$ *	How to Apply
Recommended Standard Hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Noise affected RBL + 10dBA	• The noise affected level represents the point above which there may be some community reaction to noise. • Where the predicted or measured $L_{ea,(15min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to minimise noise. • The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dBA	• The highly noise affected level represents the point above which there may be strong community reaction to noise. • Where noise is above this level, the proponent should consider very carefully if there is any other feasible and reasonable way to reduce noise to below this level. • If no quieter work method is feasible and reasonable, and the works proceed, the proponent should communicate with the impacted residents by clearly explaining the duration and noise level of the works, and by describing any respite periods that will be provided.

Time of Day	Management Level $L_{Aeq,(15min)}$ *	How to Apply
Outside recommended standard hours	Noise affected RBL + 5 dB	A strong justification would typically be required for works outside the recommended standard hours. • The proponent should apply all feasible and reasonable work practices to meet the noise affected level. • Where all feasible and reasonable practices have been applied and noise is more than 5dB(A) above the noise affected level, the proponent should negotiate with the community. • For guidance on negotiating agreements see section 7.2.2.

In addition the following construction noise management levels $L_{Aeq\ (15\ min)}$ are recommended for other receivers and areas as follows.

- Active recreation areas (such as parks) external $L_{Aeq\ (15\ min)}$ 65dBA;
- Industrial premises: external $L_{Aeq\ (15\ min)}$ 75dBA; and
- Offices, retail outlets external $L_{Aeq\ (15\ min)}$ 70dBA.

Based on the above, Table 3-2 presents the applicable noise management levels for construction activities.

Table 3-2 Site Specific Construction Noise Management Levels

Location	Construction Noise Management Level, L_{Aeq} (dBA)				Maximum Construction Noise Level, L_{Aeq} (dBA)
	Day	Evening	Night	Saturday	
A – Erskine Park Residences	44	41	39	41	75
B – Retirement Village	43	39	38	41	75
C – Arlington Road	43	39	38	41	75
D – Greenway Place	42	37	36	41	75
E – Burley Road Residences	42	37	36	41	75

3.2 Industrial Noise Criteria

The *NSW Industrial Noise Policy (INP)* recommends two criteria, "Intrusiveness" and "Amenity", both of which are relevant for the assessment of noise. In most situations, one of these is more stringent than the other and dominates the noise assessment. The criteria are based on

the L_{Aeq} descriptor, which is explained in Appendix C.

3.2.1 Intrusiveness Criterion

An intrusiveness criterion applies for residential receivers only.

The intrusiveness criterion requires that the L_{Aeq} noise level from the source being assessed, when measured over 15 minutes, should not exceed the Rating Background Noise Level (RBL) by more than 5dBA. The RBL represents the 'background' noise in the area, and is determined from measurement of L_{A90} noise levels, in the absence of noise from the source. The definition of L_{A90} and RBL is given in Appendix A.

3.2.2 Amenity Criterion

The amenity criterion sets a limit on the total noise level from all industrial noise sources affecting a receiver. Different criteria apply for different types of receiver (e.g. residence, school classroom); different areas (e.g. rural, suburban); and different time periods, namely daytime (7.00am-6.00pm), evening (6.00pm-10.00pm) and night time (10.00pm-7.00am).

The noise level to be compared with this criterion is the L_{Aeq} noise level, measured over the time period in question, due to all industrial noise sources, but excluding non-industrial sources such as transportation.

Where a new noise source is proposed in an area with negligible existing industrial noise, the amenity criterion for that source may be taken as being equal to the overall amenity criterion. However, if there is significant existing industrial noise, the criterion for any new source must be set at a lower value. If existing industrial noise already exceeds the relevant amenity criterion, noise from any new source must be set well below the overall criterion to ensure that any increase in noise levels is negligible. Methods for determining a source-specific amenity criterion where there is existing industrial noise are set out in the *INP.*

Determination of Site Specific Industrial Noise Criteria

Table 3-3 show the relevant noise industrial noise criteria for this project based on a suburban and rural area classification.

Table 3-3 Industrial Intrusiveness & Amenity Criteria

Receiver Area	Time Period	RBL (dBA)	Intrusiveness Criterion $L_{Aeq,15min}$ (dBA)	Project-Specific Amenity Criterion
A	Daytime (7.00am–6.00pm)	34	39	55
	Evening (6.00–10.00pm)	36	41	45
	Night time (10.00pm–7.00am)	34	39	40
B, C	Daytime (7.00am–6.00pm)	33	38	50
	Evening (6.00–10.00pm)	34	39	45
	Night time (10.00pm–7.00am)	33	38	40
D, E	Daytime (7.00am–6.00pm)	32	37	50
	Evening (6.00–10.00pm)	32	37	45
	Night time (10.00pm–7.00am)	31	36	40

In this case, there is insignificant industrial noise existing in the area. Whilst there are quarries around Location E no significant noise was observed during a site visit. Traffic noise levels are unlikely to reduce in the future therefore the full amenity criteria are applicable.

3.2.3 Sleep Disturbance Noise Criteria

Intermittent noises due to activities such as trucks starting and loading dock activities during the night-time period are not directly addressed by the *Industrial Noise Policy*.

The most recent guidance in relation to sleep disturbance are those contained in the DECCW's "Application Notes – *NSW Industrial Noise Policy*" issued in July 2006. The pertinent section of the DECCW's Application Notes states the following:

"*DEC reviewed research on sleep disturbance in the NSW Environmental Criteria for Road Traffic Noise (ECRTN) (EPA, 1999). This review concluded that the range of results is sufficiently diverse that it was not reasonable to issue new noise criteria for sleep disturbance.*

From the research, DEC recognised that current sleep disturbance criterion of an $L_{A1,\ (1\ minute)}$ *not exceeding the* $L_{A90,\ (15\ minute)}$ *by more than 15 dB(A) is not ideal. Nevertheless, as there is insufficient evidence to determine what should replace it, DEC will continue to use it as a guide to identify the likelihood of sleep disturbance. This means that where the criterion is met, sleep disturbance is not likely, but where it is not met, a more detailed analysis is required.*

The detailed analysis should cover the maximum noise level or $L_{A1,\ (1\ minute)}$, *that is, the extent to which the maximum noise level exceeds the background level and the number of times this happens during the night-time period. Some guidance on possible impact is contained in the review of research results in the appendices to the ECRTN. 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 10pm and 7am)*
- *whether there are times of day when there is a clear change in the noise environment (such as during early morning shoulder periods).*

The $L_{A1,\ (1\ minute)}$ *descriptor is meant to represent a maximum noise level measured under 'fast' time response. DEC will accept analysis based on either* $LA_{1,(1\ minute)}$ *or* $L_{A,(Max)}$.

If an exceedance of the above is indicated then further review is recommended referencing the DECCW's *Environmental Criteria for Road Traffic Noise (ECRTN)* http://www.environment.nsw.gov.au/resources/noise/roadnoise.pdf. Appendix B which concludes;

"Considering all of the foregoing information the following conclusions can be drawn:

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

An internal objective of 50–55dBA equates to an external objective of 60-65 dBA assuming a 10dB redirection in noise through an open window.

Table 3-5 details established sleep disturbance screening criteria of background noise level plus 15dBA.

Table 3-5 Sleep Disturbance Screening Criteria.

Receiver Area	Sleep Disturbance Screening Criteria (dBA)
A	49
B, C	48
D, E	46

4 METEOROLOGY

At relatively large distances from a source, the received noise levels will be influenced by meteorological conditions, particularly wind and temperature gradients, and hence can vary from hour to hour and night to night. Where these factors are a feature of an area their effect on resultant noise levels are required to be taken into account.

The procedures described in the *INP* are directed toward finding a single set of meteorological conditions, representing generally adverse conditions for noise propagation, which should be used in noise assessment. It is Wilkinson Murray's view that for complex developments it is more appropriate to assess noise impacts under the entire range of meteorological conditions applying at the location.

However the procedures of the *INP* have been adopted as this is considered adequate for this project, as the site is relatively straight foreword.

4.1 Wind

Wind can increase noise at a receiver when it blows from the direction of the noise source. An increase in wind strength results in a corresponding increase in wind noise at the receiver which masks noise from the source under investigation.

The affectation of noise due to wind should be considered when wind is a feature of the area under consideration. The *INP* defines this as where wind blows at speeds up to 3m/s for more than 30% of the time in any season. In this situation wind is considered to be a feature of the area and noise level predictions must be made under these conditions.

Twelve month weather data for the year 2006 was obtained for the DECCW air quality monitoring station located at St Marys. This data was analysed to determine the frequency of occurrence of seasonal winds up to speeds of 3m/s for the daytime, evening and night periods.

Seasonal wind records indicate that westerly winds of up to 2.6 m/s are a feature of the area during the evening and night periods in the area and these have been used in the noise modelling. Appendix C presents wind roses for the site.

4.2 Temperature Inversion

Temperature inversions can increase noise levels at surrounding receivers by the reflection of sound waves from warmer upper layers of air. Temperature inversions occur predominantly at night. For a temperature inversion to be a significant characteristic of the area it needs to occur for approximately 30% of the total night-time during a season, typically winter.

Inversion data was assessed for the winter night period where a frequency of 11 % was determined for F & G class stability therefore temperature inversion has not been included in the assessment.

5 NOISE SOURCE LEVELS

Noise sources that are likely to be associated with the development are identified in the following sections.

5.1 Construction Noise Sources

Typical Sound Power Levels (SWL) of the plant likely to be used during earthworks and road building when the site is being established at various stages of the works are identified in Table 5-1. These SWLs have recently been measured at other similar construction sites.

Table 5-1 Typical Construction Plant Sound Power Levels (SWL)

Plant	L_{Amax} SWL (dBA)
Excavator	107
Front End - Low Loader	112
Dump Trucks	112
Tower Crane or Mobile Crane	105
Generators	95
Smooth Drum Roller	107
Scrapers	119
Graders	109
Dozer	119
Concrete Trucks	109
Concrete Paver Roller	121
Water Truck	110
Vibratory Rollers	110
Skid Steer loader	112
Concrete Plant	103
Asphalt Plant	114
Paving machine Asphalt	109

5.2 Operational Noise Sources

Whilst noise associated with facilities will be the subject of each particular facility there are a number of sources that are likely to generate noise such as trucks, forklifts, mechanical plant (condensers and fans) and cars.

Table 5-2 presents a summary of the sound power levels utilised in the noise prediction model for the various items of plant and mobile equipment. The noise emission levels are based on typical 15 minute operational cycles.

Table 5-2 Summary of Sound Power Levels Used for Plant and Mobile Equipment

Item	Operating Condition	Overall L_{Aeq} Sound Power Level (dBA)
Semi trailer	Loading / unloading	87
Petrol Forklift	Lifting, moving	96
Exhaust Fan	Operating	95
Semi-tailer	Driving through yard	104
Exhaust Fan	Operating	95
Reverse alarm*	Reversing	95

*Based on a operation for 10 seconds in a 15-minute period with a sound power level of 110dBA and a tonality correction of 5dB, i.e. 110-10log(10/900)+5 = 95dBA.

The following sections detail an assessment of potential noise impact and mitigation based on noise levels presented in this section.

6 CONSTRUCTION NOISE ASSESSMENT

6.1 Construction Noise

Likely airborne noise at surrounding residential receivers has been assessed for construction sites during excavation and construction.

Site related noise emissions were modeled using the ISO 9613 noise prediction algorithm with CONCAWE meteorological conditions implemented in the "CadnaA" acoustic noise prediction software using. Factors that are addressed in the noise modeling are:

- Equipment sound level emissions and location;
- Screening effects from buildings;
- Receiver locations;
- Ground topography;
- Noise attenuation due to geometric spreading;
- Ground Absorption; and;
- Atmospheric absorption.

During the initial site consolidation stage the following works are proposed:

- Construction of the required traffic facilities;
- Upgrade of existing roads and construction of new roads and bridges in the vicinity of the site;
- Construction (and use) of utility connections to the site;
- Demolition, relocation or removal of existing dwellings and structures on the site;
- Sub-division of the site and associated sub-division works including construction of roads; stormwater drainage systems, sewerage and water works, utilities and services; landscaping and earthworks;
- Works for the site water management strategy; and
- Construction and use of buildings and associated works.

The loudest construction period is expected to be the earthmoving phase and, with perhaps six machines including scrapers, excavators, trucks, a dozer and a grader working around the site simultaneously, a total site L_{Aeq} sound power of 116dBA can be expected. Earthmoving activity is likely to occur in the first stages of the development and given the size of the site it would only be that equipment that is in the vicinity of residences that would be acoustically significant.

Table 6-1 presents the results of initial noise calculations at surrounding residential receivers based on distance attenuation alone allowing for the noise source to be generally around the centre of warehouse site.

Table 6-1 Predicted L_{Aeq} Construction Noise Levels at Residential Receivers – dBA

Receiver Area	Predicted Construction Noise (dBA)	Construction Noise Objective (dBA)*	Compliance
A – Erskine Park Residences	45	44 / 41	No
B – Retirement Village	24	43 / 41	Yes
C – Arlington Road,	24	43 / 41	Yes
D – Greenway Place	26	42 / 41	Yes
E – Burley Road Residences	33	42 / 41	Yes

*Normal construction hours and Saturday criteria are shown.

These initial calculations show the construction noise criterion is likely to be exceeded during the earthmoving phase at Erskine Park residences when the north west comer of the site is developed. The identified rural residences on Burley Road or Greenway Place are unlikely to be adversely affected by noise from the site due the distance between the site and residences. Exceedances of construction noise criteria are quite common for construction projects and given the relatively short duration of construction work compared to the life of the development, some tolerance is usually expected.

While it is impractical to require strict compliance with the construction noise criteria at all times, the following noise mitigation measures are considered reasonable and feasible:

- Construction activities that are likely to be audible at any residence must not occur outside the usual hours of 7.00am-6.00pm Monday to Friday and 8.00am-1.00pm on Saturday. Construction vehicles should not approach the site before 7.00am.
- Noisy activities such as earthworks in close proximity to residences should ideally be programmed to avoid early mornings and Saturdays. While this may not be always practical, consideration should be given to surrounding residential receivers when planning the construction program.
- Spoil quantities should be carefully considered to avoid truck movements to minimise the volumes where possible.
- Diesel powered machines such as trucks, bobcats and excavators should be switched off if not required for more than a few minutes rather than left idling unnecessarily.
- Machines used on site should be maintained in good condition, particularly considering the exhaust system on diesel powered machines, to minimise noise emissions. Excessively loud machines should be repaired, modified or removed from the site. Sound pressure level measurements should be conducted on all plant prior to works beginning on-site.
- A representative from the construction contractor should be available to respond to questions and complaints from the community in a professional, considerate and timely manner.
- Reverse alarms should be controlled to the minimum sound level consistent with safety by replacing, shielding or relocating the alarm unit on noisy machines.
- The above noise control recommendations may not necessarily result in the construction noise criteria being met at all times, although they will result in the lowest possible noise impacts consistent with efficient and safe construction work on the site.

- Construction activities that generate noise above the noise criteria detailed in Table 3-2 should only be permitted to occur between the hours of 7.00am-6.00pm on weekdays, 8.00am-1.00pm on Saturdays, and not on Sundays and public holidays.

7 BUSINESS PARK OPERATIONAL NOISE ASSESSMENT

The site is proposed to be located in a rural type area with generally undeveloped industrial land and subsequently, ambient noise levels are relatively low. As a result, noise emissions associated with proposed facilities will need to be managed to protect the acoustic amenity of these surrounding residences. This is particularly important on the north western corner where the nearest industrial building will be in the order of 300 m from residences.

7.1 Facility Noise

Warehouse / distribution type facilities are not typically associated with major manufacturing plant and as such do not require significant noise controls on process plant. Associated stationary noise sources such as fans, air-conditioning and refrigeration plant, compressors and operations within buildings can be controlled by planning, engineering noise control (silencers, acoustic louvers enclosures etc.) or selection of building components (masonry walls etc).

These strategies must be implemented during the plant selection and installation process to optimise the control of noise emission from the mechanical plant and equipment, based on detailed spectral noise data to assess the need for possible tonality corrections in accordance with the *INP*.

The future site activities, operations and associated noise produced by activities in each lot of the proposed development are not currently known. Therefore, the impact of noise can not be definitively established at this early stage of the development. Variables such as the type of use and hours of operations can only be addressed when individual Development / Project Applications for each unit are submitted.

As such, some facilities may generate low noise emissions whilst others may require the implementation of noise control measures within individual lots. As the site is to be operated and managed by Jacfin it is proposed the site will be acoustically modelled to manage the developments against the above criteria. This will allow determination of the cumulative impact of new developments at residences and consider shielding from buildings and topography as well as take into account meteorological effects. Such a planning tool will allow appropriate noise control measures to be adopted along with siting advice on activities that are potentially disruptive to surrounding receivers.

7.2 Indicative Operational Noise Levels

As fixed plant can be controlled by engineering measures the major source of noise emission associated with these facilities is expected to be that from the movement of trucks and loading / unloading operations at the loading bays and yard areas.

Noise predictions associated with the operation of the proposed facility on the adjacent residential area to the north west of the site have been conducted. Noise modelling was used to predict the resultant noise emission levels at the nearby affected residential receivers for 24 hour operation of the development.

Site related cumulative noise emissions were modeled using the CONCAWE algorithms implemented in the “Cadna A” acoustic noise prediction software. Factors that are addressed in the noise modeling are:

- Equipment sound level emissions and location;

- Screening from fences;
- Receiver locations;
- Ground topography;
- Noise attenuation due to geometric spreading;
- Ground Absorption; and;
- Atmospheric absorption.

7.3 Operational Noise

Operational site noise will be mainly associated with roof fans, truck movements and associated dock activities. These activities are proposed to occur on a 24 hour, 7 day a week basis.

Accordingly, assessments of a typical worst case operating scenario has been conducted. The assessment is based on previous measurements conducted at similar facilities including warehouses and storage facilities

7.3.1 Noise Model Scenario

Noise emanating from fans, loading and unloading yard activities associated with the facilities was modelled based on the proposed building layout as presented in Figure 1-2. The modelled noise levels are considered representative of a worst case night period (i.e. 10:00pm to 7:00am). A review of the indicative resultant noise levels at surrounding residences has been conducted based on the concept building layout operation being:

- All buildings operating 24-hours, i.e. night operation;
- 1 truck per site manoeuvring for one minute in the 15 minute assessment period;
- Two to six trucks unloading at each warehouse depending on warehouse size,
- One to three forklifts operating at each warehouse depending on warehouse size,
- One to two reversing alarms per warehouse operating for 10 seconds, and,
- Two to five roof top fans operating at each warehouse depending of warehouse size.

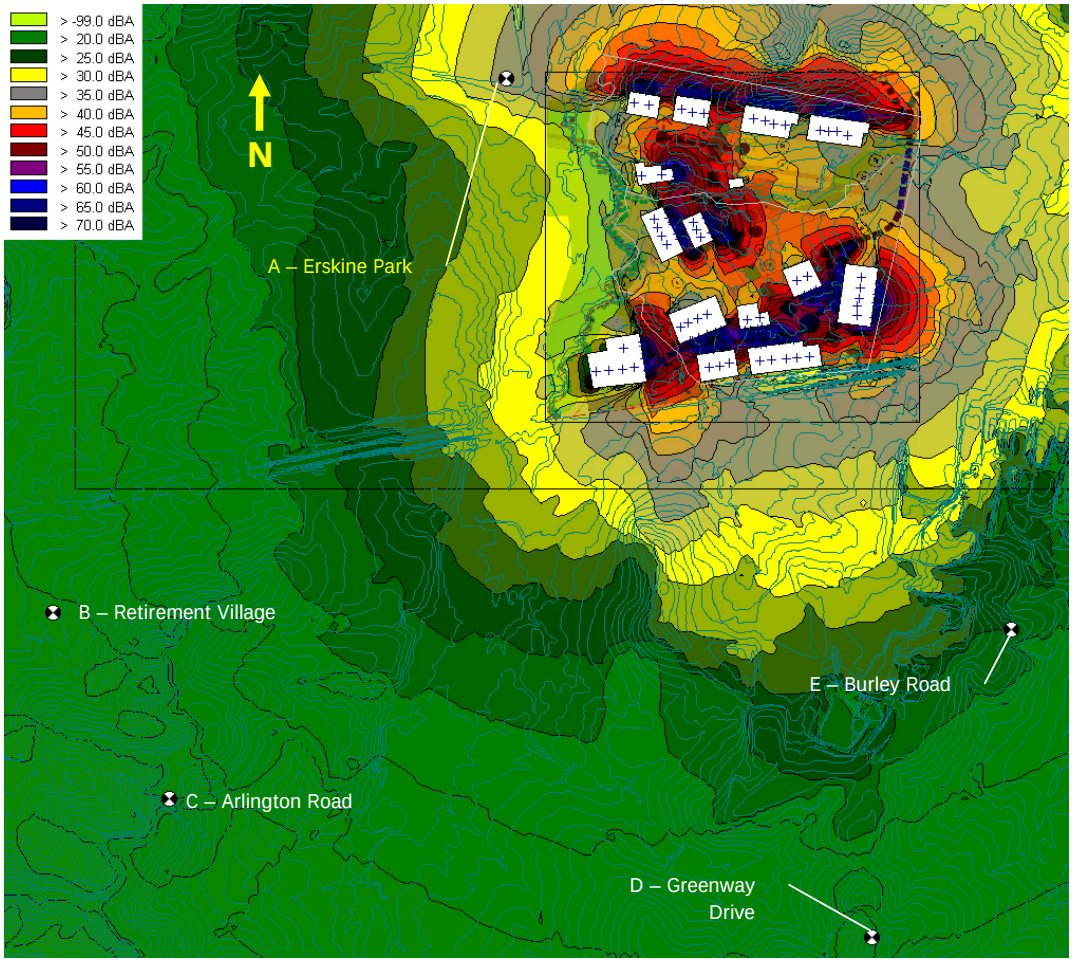
Table 7-1 Predicted $L_{Aeq(15\ minute)}$ Operational Noise at Surrounding Residences

Receiver Location	Predicted Resultant Noise Levels at Residences (dBA)		Intrusiveness Noise Goal	Compliance
	Calm Conditions	Wind Condition[1]	$L_{Aeq,15min}$ (dBA)	
A – Erskine Park Residences	35	29	39	Yes
B – Retirement Village	16	11	38	Yes
C – Arlington Road	16	11	38	Yes
D – Greenway Place	17	21	36	Yes
E – Burley Road Residences	24	29	36	Yes

Note 1: 2.6m/s westerly wind

Figure 7-1 illustrates the noise modelling and predicted noise levels at surrounding residences.

Figure 7-1 Predicted Ropes Operational Noise Levels – $L_{Aeq(15\ minutes)}$



No exceedances are indicated.

7.4 Sleep Disturbance

In the case of noise from events such as reversing alarms, there is the potential for sleep disturbance from areas that potentially operate in the night period. The L_{Amax} noise levels due to reversing alarms have been predicted at surrounding residences. Each predicted noise level is based on an alarm operation on the site closest to each assessed residences thereby representing a “worst case” scenario.

A review of predicted noise levels, presented in, indicates no exceedance of sleep disturbance criteria at residences.

Table 7-2 Predicted Truck Reversing Alarm Noise Levels at Residences – dBA

Receiver Location	Predicted L_{Amax} Noise Level (dBA)		Sleep Disturbance Screening Criterion (dBA)	Compliance
	Calm Conditions	Wind Condition		
A – Erskine Park Residences	45	40	49	Yes
B – Retirement Village	25	18	48	Yes
C – Arlington Road	24	18	48	Yes
D – Greenway Place	24	29	46	Yes
E – Burley Road Residences	32	39	46	Yes

It is noted that a compliance with sleep disturbance screening criterion is indicated

7.5 Cumulative Noise Impact

The *INP* has been designed to provide the means to manage noise from multiple developments with the object of attaining the best possible balance between noise and other relevant socio-economic factors. Applying the principles of the *INP* at the planning stage can avoid future land use conflicts over noise.

Typically when a new industrial estate is proposed, planning studies are carried out and planning instrument is released. This could be in the form of a Masterplan, Precinct Plan or Development Control Plan. These documents often specify the new land use zonings for the area, the permitted types of development for the zone and various other requirements.

In developing the noise control requirements for the new industrial estate, a strategic approach can be set out within the planning instrument.

As the number of residences potentially affected by noise from the operation of the proposed business park are relatively few it is proposed to adopt the "Greystanes" approach (Langgons D, 2001). The approach that was adopted to deal with noise control for the industrial component at the Greystanes site can be summarised as follows:

1. Appropriate amenity noise levels are determined for the residences surrounding the various precincts. The *INP's* "rural" amenity area category noise levels of 50dB(A), 45dB(A) and 40dB(A) levels for daytime, evening and night time respectively are adopted.
2. The industrial land was divided into four zones, in this case corresponding to the four precincts.
3. A noise limit for each zone applies at the nearest residential area. The combined limits for all four zones complied with the adopted noise objectives for the residential area.

The approach aims to minimise the potential for exceedance of the amenity goals, allow for a more equitable share of the noise "budget" and allow some flexibility to the land developer.

A review of the site indicates that most residences are remote from the site with the exception of the residences to the north west at Erskine Park. In this case the allowable noise emissions for each site should initially assessed with a reduced noise goal of 5dB to ensure compliance with criteria. This issue can be addressed by the development of a detailed whole of site acoustic model.

8 BUSINESS PARK TRAFFIC NOISE ASSESSMENT

A link road will be developed by the RTA to service this development and others. Criteria for the assessment of the link road traffic noise are set out in the NSW Government's *Environmental Criteria for Road Traffic Noise (ECRTN)*.

The traffic assessment prepared by Halcrow concludes the following;

- Road access to the site is proposed from the proposed Erskine Park Link Road and from Old Wallgrove Road.
- A regional road in accordance with the SEPP which runs generally north south through the site.
- Traffic requirements for the road system were determined having regard to RTA traffic forecasts prepared for the Erskine Park Link Road.

Therefore the RTA forecasts are consistent with the development of the site. The impact of noise on the proposed Erskine Park Link Road will be assessed by the RTA in the project application stage which is consistent with RTA commitment detailed in the link road concept plan environmental assessment. No separate assessment is provided here.

9 SUMMARY OF BUSINESS PARK RECOMMENDATIONS

Based on our investigations of the site at the Concept Stage of the development the following recommendations have been established.

9.1 Noise Criteria

Noise criteria applying to construction and operation of the full business park development have been established based on noise measurements processed in accordance with DECCW procedures. These criteria should be met by the full park development. It is suggested that lower noise objective be initially applied to each development within the park to ensure that the cumulative noise levels comply with the overall criteria. Depending on proximity to the nearby residential areas at Erskine Park, the criteria may be set 5dB below the overall criteria discussed above.

9.2 Construction Noise

Noise from construction activities will potentially exceed established noise goals. Therefore, the planning and management of construction activities should take into account the sensitivities of surrounding residences to minimise the impact of construction noise at these receivers.

The control of construction noise should form a part of the site Environmental Management Plan where best practice procedures and community consultation is employed.

9.3 Operational Noise

It is predicted that operational noise and intermittent noise from the use of reversing alarms at night (sleep disturbance) will comply with established site specific noise criteria.

Noise from future fixed plant and buildings can be controlled by the implementation of engineering noise controls such as enclosures, silencers and acoustic louvers. These can be adequately addressed at the detail design stage of the project.

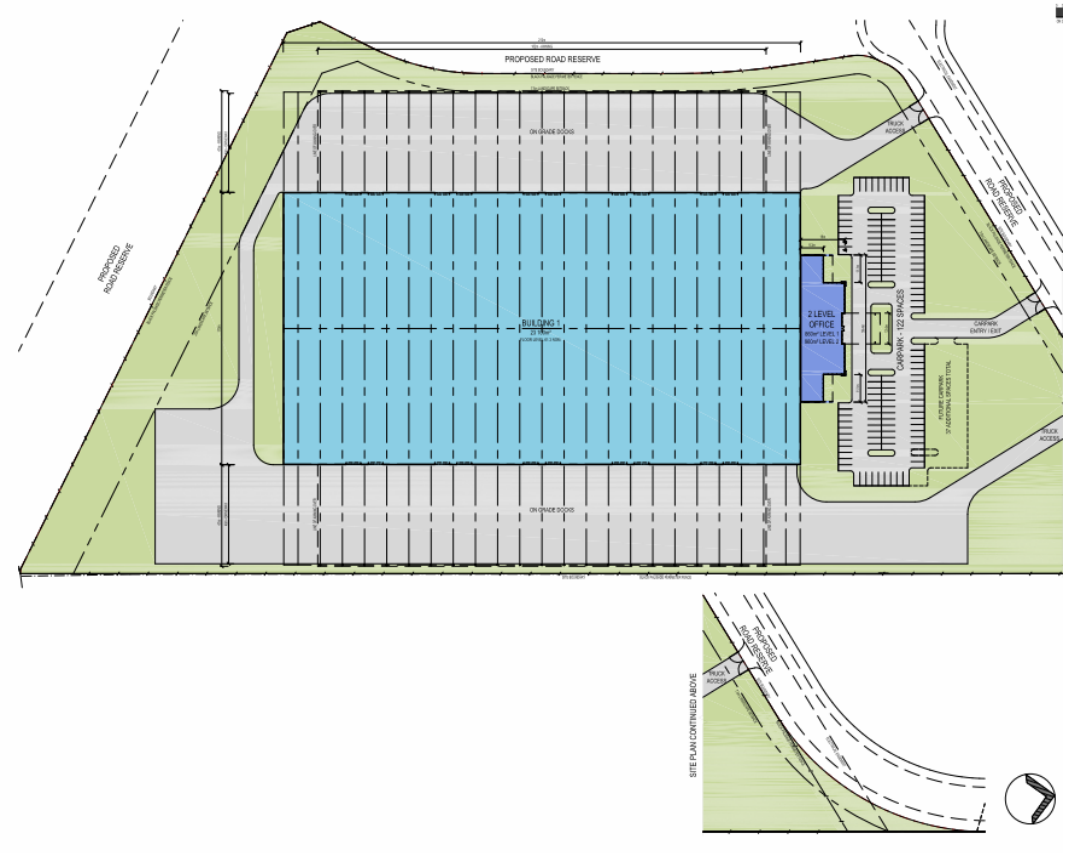
10 STAGE 1 PROJECT APPLICATION NOISE ASSESSMENT

Stage 1 of the development consists of two buildings being:

Building 1

A 23,100m^2 warehouse located at the northern end of the site. The warehouse is to have a two level 1,860m^2 office area located at the northern end of the warehouse. Loading docks are located on the either side of the warehouse as shown in Figure 10-1.

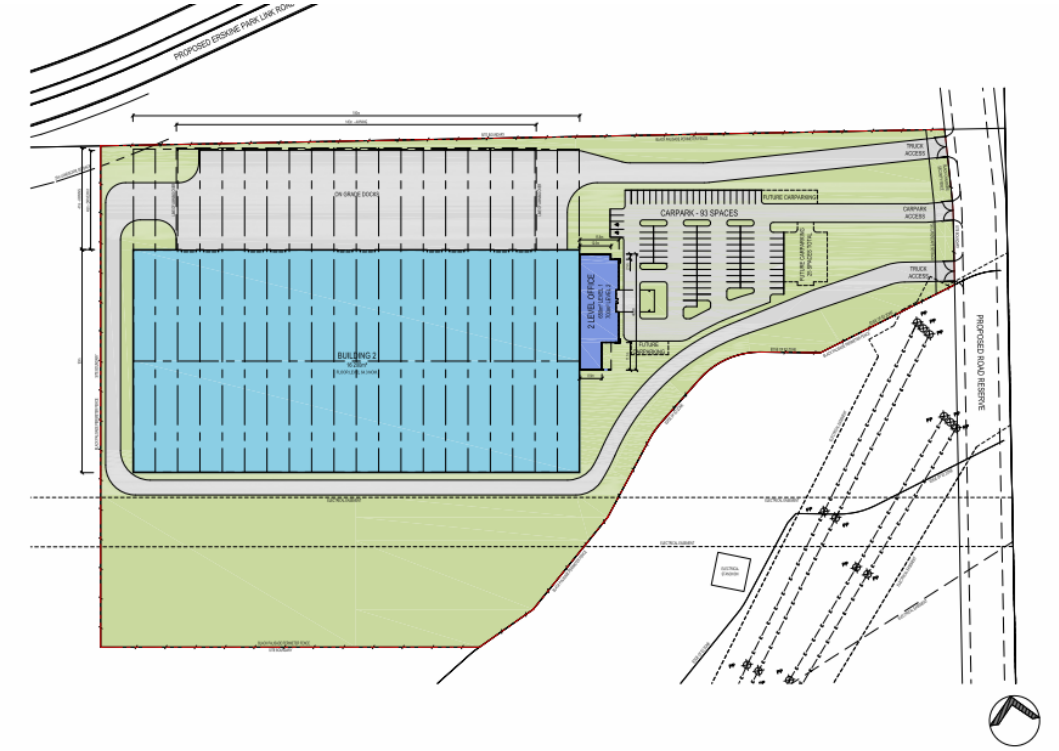
Figure 10-1 Stage 1 Building 1 Site Layout



Building 2

A 16,200m^2 warehouse located at the north eastern corner of the site. The warehouse is to have a two level 1,3560m^2 office area located at the eastern end of the warehouse. Loading docks are located on the northern side of the warehouse as shown in Figure 10-2.

Figure 10-2 Stage 1 Building 2 Site Layout



10.1.1 Stage 1 Construction Noise

Likely airborne construction noise at surrounding residential receivers has been assessed for construction sites during excavation and construction with both building sites being excavated at the same time.

Site related noise emissions were modeled as detailed in section 6.1. Table 10-1 presents the results of initial noise calculations at surrounding residential receivers based on distance attenuation alone allowing for the noise source to be generally around the centre of warehouse site.

Table 10-1 Predicted L_{Aeq} Construction Noise Levels at Residential Receivers

Receiver Area	Predicted Construction Noise (dBA)	Construction Noise Objective (dBA)*	Compliance
A – Erskine Park Residences	34	44 / 41	Yes
B – Retirement Village	17	43 / 41	Yes
C – Arlington Road,	22	43 / 41	Yes
D – Greenway Place	24	42 / 41	Yes
E – Burley Road Residences	31	42 / 41	Yes

*Normal construction hours and Saturday criteria are shown.

These calculations show the construction noise criterion is likely to be acceptable at all residences

10.1.2 Operation Noise

Operational site noise will be mainly associated with roof fans, truck movements and associated dock activities. These activities are proposed to occur on a 24 hour, 7 day per week basis. Accordingly assessments of a typical night time operating scenario were conducted. The assumed noise emission levels are based on noise levels detailed in Table 5-2.

Tables 10-2 and 10-3 present typical "worst case" operational scenarios for the warehouses during night period. Typically noise from such facilities will ebb and flow, and the scenarios presented represent a busy period.

Table 10-2 Warehouse 1 Night Operating Scenario (15 minute period)

Plant/Equipment Type	Number of Items	Description of Modelled Industrial Operations
Semi Trailer	6	Loading/unloading, operating for a period of 15 minutes
Forklift	3	Operating for the entire 15-minute period
Semi Trailer	2	Truck turning (1 minute duration)
Roof Fans	5	Operating for the entire 15-minute period
Reversing Alarms	2	Each operating for 10 seconds

Table 10-4 Warehouse 2 Night Operating Scenario (15-minute period)

Plant/Equipment Type	Number of Items	Description of Modelled Industrial Operations
Semi Trailer	4	Loading/unloading, operating for a period of 15 minutes
Forklift	2	Operating for the entire 15-minute period
Semi Trailer	1	Truck turning (1 minute duration)
Roof Fans	4	Operating for the entire 15-minute period
Reversing Alarms	1	Each operating for 10 seconds

Table 10-5 presents the predicted $L_{Aeq,15min}$ noise levels at adjacent residences due to the night-time operational scenario.

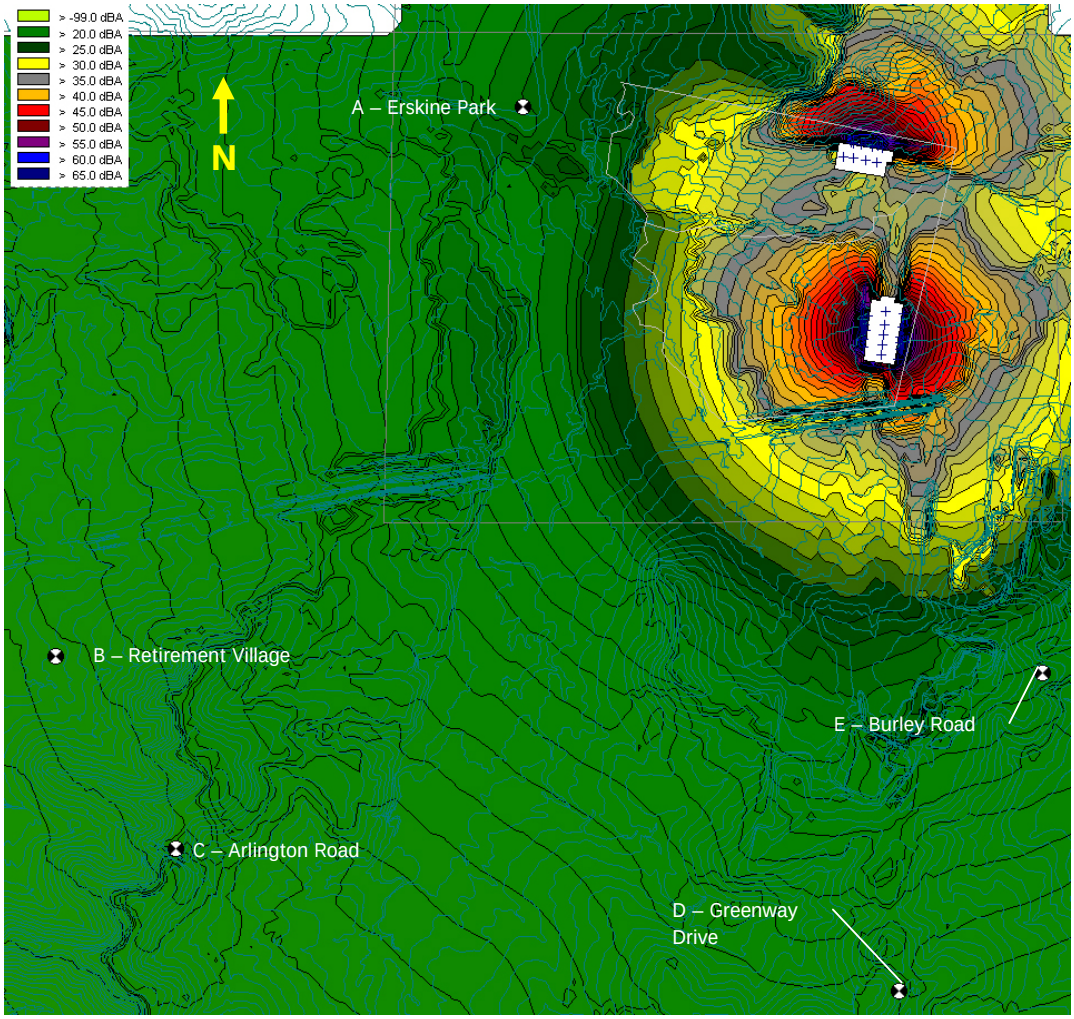
Table 10-5 Predicted $L_{Aeq,15min}$ Noise Levels at Residences due to Night Operating Scenario

Receiver Location	Predicted Resultant Noise Levels at Residences (dBA)		Intrusiveness Noise Goal	Compliance
	Calm Conditions	Wind Condition[1]	$L_{Aeq,15min}$ (dBA)	
A – Erskine Park Residences	22	16	39	Yes
B – Retirement Village	<10	<10	38	Yes
C – Arlington Road	10	<10	38	Yes
D – Greenway Place	13	12	36	Yes
E – Burley Road Residences	20	24	36	Yes

Note 1: 2.6m/s westerly wind

Figure 10-3 illustrates the noise propagation form the site.

Figure 10-3 Predicted Ropes Stage 1 Operational Noise Levels – $L_{Aeq(15\ minutes)}$



10.1.3 Sleep Disturbance Assessment

Based on previous experience of loading dock activities, trucks, trolleys and roller doors tend to produce the highest noise levels. The rumbling and impact noises occur for periods of approximately ten seconds at a time.

Reversing alarm and engine noise occur at the beginning and end of loading dock activities and the entire loading/unloading procedure usually lasts less than half an hour.

Table 10-6 details the loading dock sources that have been considered along with the typical maximum noise levels associated with these activities.

Table 10-6 Typical Loading Dock Activities and Maximum Sound Power Levels - dBA

Noise Source	Sound Power Level
Truck engine	104
Truck along access road	104
Reversing alarm	100 – 115
Roller door	94
Trolley	93
People talking	78
Raised voices	83

Resultant noise levels at residences to the east side have been predicted based on reversing alarms, being the loudest noise source. Predicted resultant noise levels are presented in Table 10-7 as follows:

Table 10-7 Predicted Maximum Noise Levels at Eastern Residences – dBA

Receiver Location	Predicted L_{Amax} noise level (dBA)		Sleep Disturbance Screening Criterion (dBA)	Compliance
	Calm Conditions	Wind Condition		
A – Erskine Park Residences	32	26	49	Yes
B – Retirement Village	14	<10	48	Yes
C – Arlington Road	16	10	48	Yes
D – Greenway Place	21	21	46	Yes
E – Burley Road Residences	29	34	46	Yes

A review of the predicted resultant noise levels for the night “worst case” scenario indicates that the operation of Stage 1 faculty at the Ropes Creek site will meet, not only the overall site noise criteria, but also the 5dB reduced screening criteria. The noise will not adversely impact on surrounding residential receivers. This is due to the fact that the site is remote from residences.

11 CONCLUSION

This assessment establishes that site specific noise criteria can be met for the operation of the proposed Ropes Creek Concept Plan. It is noted that the assessment is indicative only and will require assessment at the project application stage. As a screening process, noise criteria which are 5dB below overall site criteria may be applied initially to each proposed development.

In the case of construction, a small exccedance of construction noise objectives is envisaged when the north western area of the site is developed. Accordingly management of noise is recommended when this area is being developed.

In the case of traffic the RTA forecasts are consistent with the development of the site. The impact of noise from the link road will be assessed by the RTA in the project application stage which is consistent with RTA commitment detailed in the link road concept plan environmental assessment.

Further detailed assessment of the Stage 1 Project Application has determined that compliance with established noise criteria will be achieved at all surrounding residences. Accordingly, this application can be supported from an acoustic perspective.

Note
All materials specified by Wilkinson Murray (Sydney) Pty Limited have been selected solely on the basis of acoustic performance. Any other properties of these materials, such as fire rating, chemical properties etc. should be checked with the suppliers or other specialised bodies for fitness for a given purpose.

Quality Assurance
We are committed to and have implemented AS/NZS ISO 9001:2008 "Quality Management Systems – Requirements". This management system has been externally certified and Licence No. QEC 13457 has been issued.

AAAC
This firm is a member firm of the Association of Australian Acoustical Consultants and the work here reported has been carried out in accordance with the terms of that membership.

Version	Status	Date	Prepared by	Checked by
A	Draft	02 August 2010	Brian Clarke	Barry Murray-
B	Final	04 August 2010	Brian Clarke	Barry Murray
C	Final	18 August 2010	Brian Clarke	Barry Murray

APPENDIX A

GLOSSARY OF TERMS

GLOSSARY

Most environments are affected by environmental noise which continuously varies, largely as a result of road traffic. To describe the overall noise environment, a number of noise descriptors have been developed and these involve statistical and other analysis of the varying noise over sampling periods, typically taken as 15 minutes. These descriptors, which are demonstrated in the graph overleaf, are here defined.

Maximum Noise Level (L_{Amax}) – The maximum noise level over a sample period is the maximum level, measured on fast response, during the sample period.

L_{A1} – The L_{A1} level is the noise level which is exceeded for 1% of the sample period. During the sample period, the noise level is below the L_{A1} level for 99% of the time.

L_{A10} – The L_{A10} level is the noise level which is exceeded for 10% of the sample period. During the sample period, the noise level is below the L_{A10} level for 90% of the time. The L_{A10} is a common noise descriptor for environmental noise and road traffic noise.

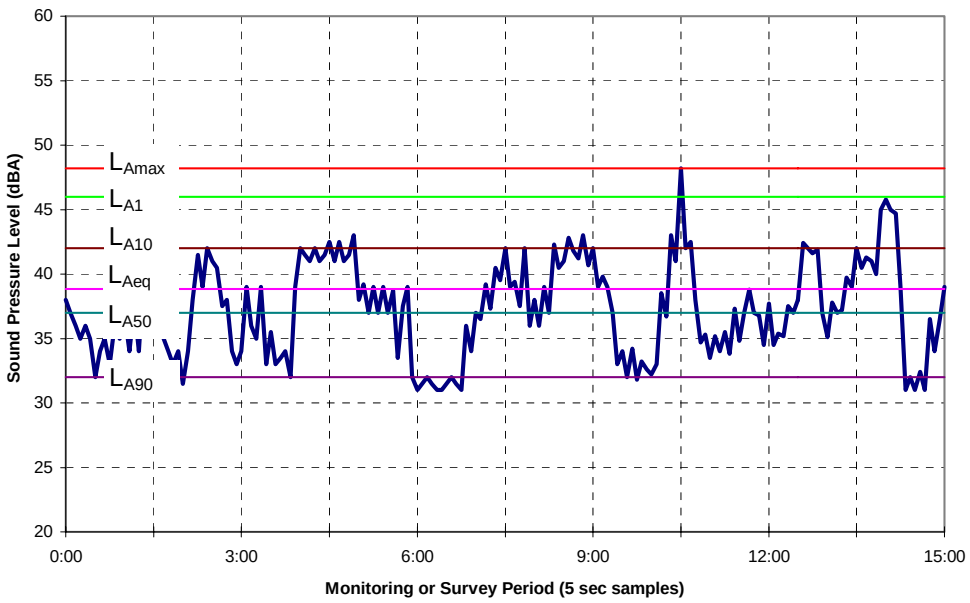
L_{Aeq} – The equivalent continuous sound level (L_{Aeq}) is the energy average of the varying noise over the sample period and is equivalent to the level of a constant noise which contains the same energy as the varying noise environment. This measure is also a common measure of environmental noise and road traffic noise.

L_{A50} – The L_{A50} level is the noise level which is exceeded for 50% of the sample period. During the sample period, the noise level is below the L_{A50} level for 50% of the time.

L_{A90} – The L_{A90} level is the noise level which is exceeded for 90% of the sample period. During the sample period, the noise level is below the L_{A90} level for 10% of the time. This measure is commonly referred to as the background noise level.

ABL – The Assessment Background Level is the single figure background level representing each assessment period (daytime, evening and night time) for each day. It is determined by calculating the 10^{th} percentile (lowest 10^{th} percent) background level (L_{A90}) for each period.

RBL – The Rating Background Level for each period is the median value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period **–** daytime, evening and night time.



Sound pressure level (SPL) or sound level L_p is a logarithmic measure of the effective sound pressure of a sound relative to a reference value. It is measured in decibels (dB) above a standard reference level.

$$L_p = 10 \log_{10} \left(\frac{{p_{\mathrm{rms}}}^2}{{p_{\mathrm{ref}}}^2} \right)$$

where p_{ref} (20 µPa)is the reference sound pressure and p_{rms} is the rms sound pressure being measured.

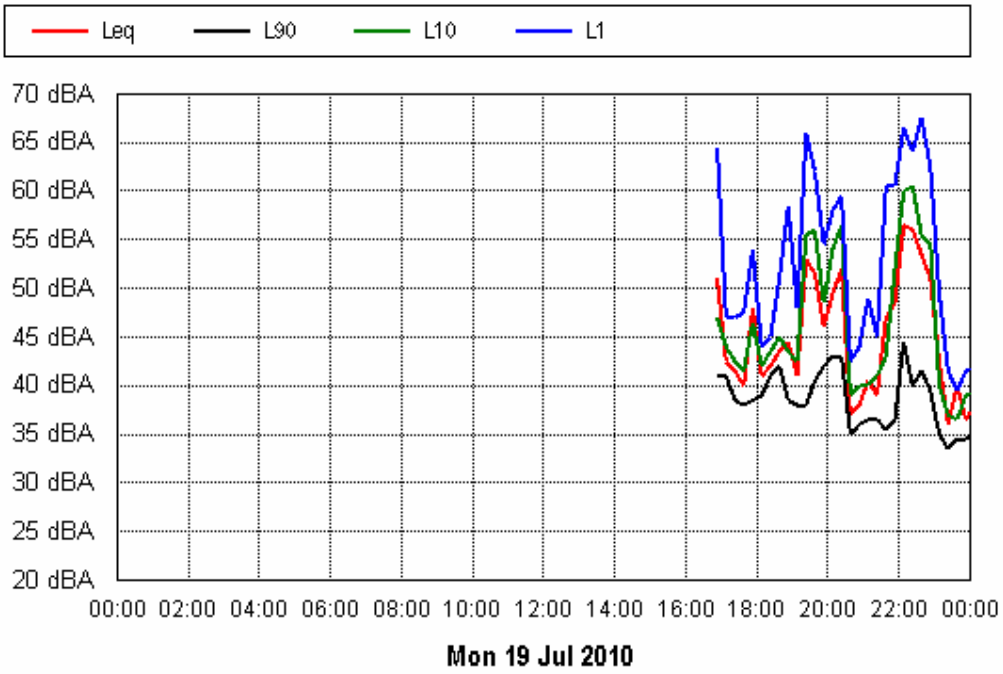
Sound power level is a logarithmic measure of the sound power in comparison to a specified reference level. While sound pressure level is given in decibels SPL, or dB SPL, sound power is given in dB SWL. The dimensionless term "SWL" can be thought of as "sound watts level," the acoustic output power measured relative to a very low base level of watts given as 10^{-12} watts.

$$L_{\mathrm{W}} = 10 \log_{10} \left(\frac{W}{W_0} \right) \ \mathrm{dB}$$

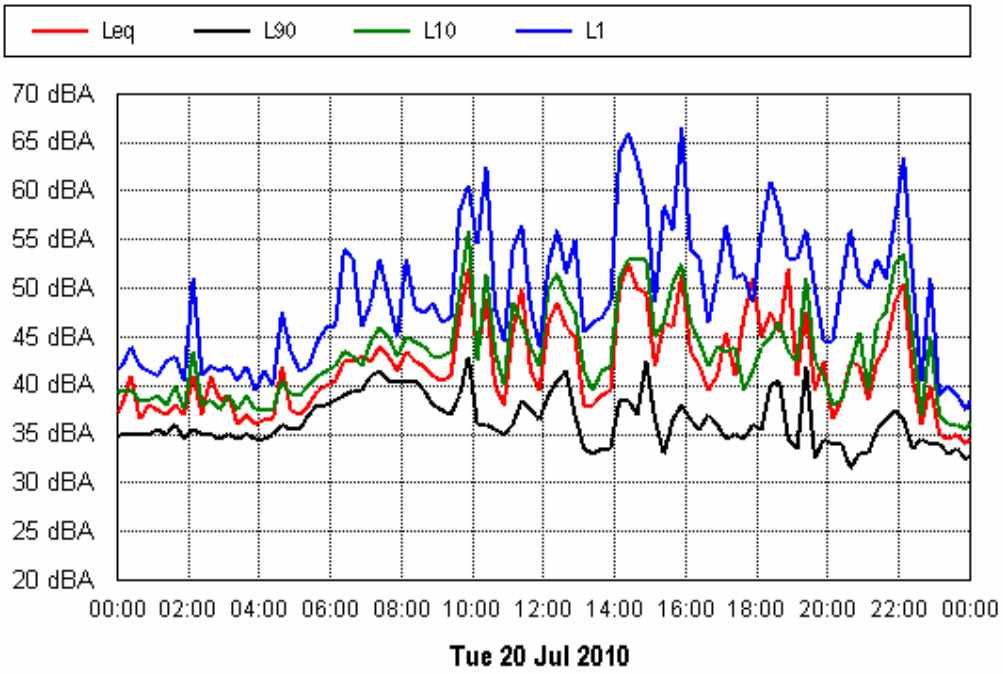
APPENDIX B

NOISE MEASUREMENT RESULTS

Project: Ropes Creek and Horsley Park
Location: 58 Weaver Street

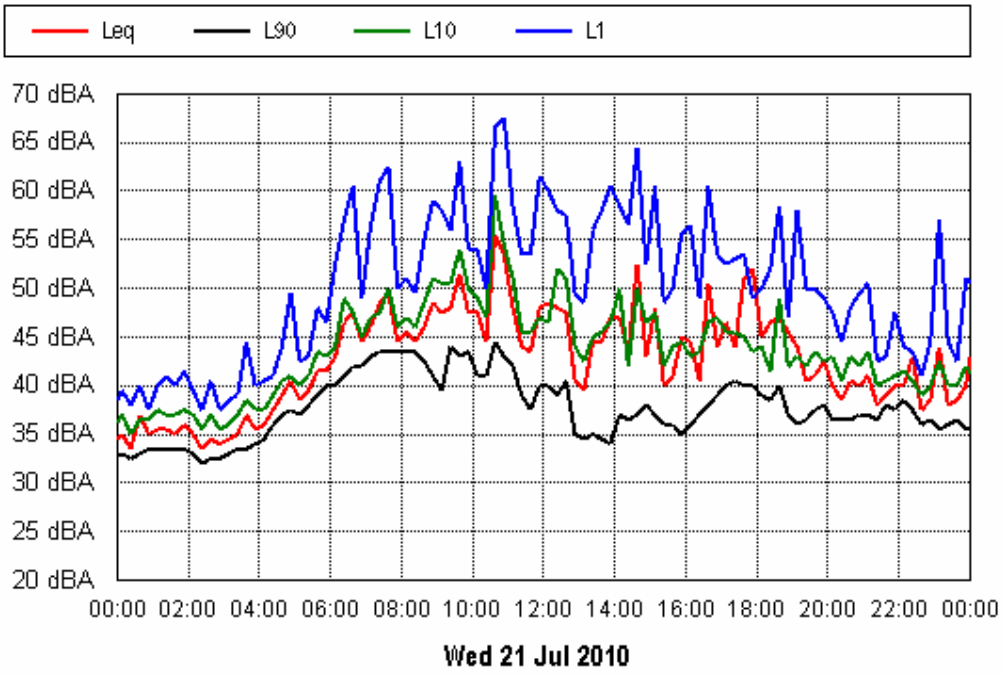


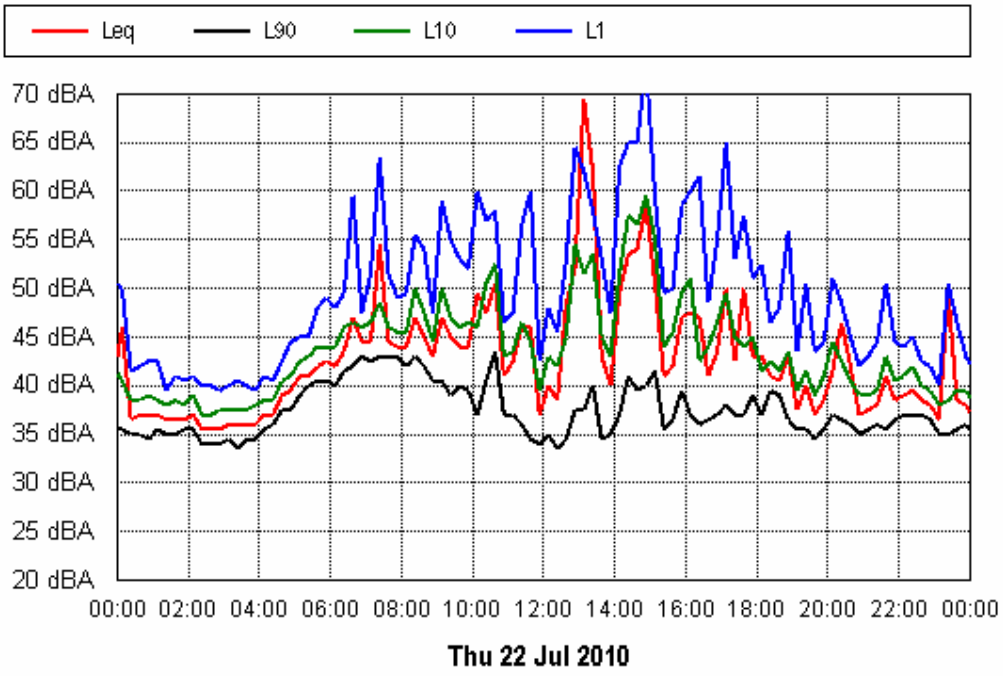
Mon 19 Jul 2010



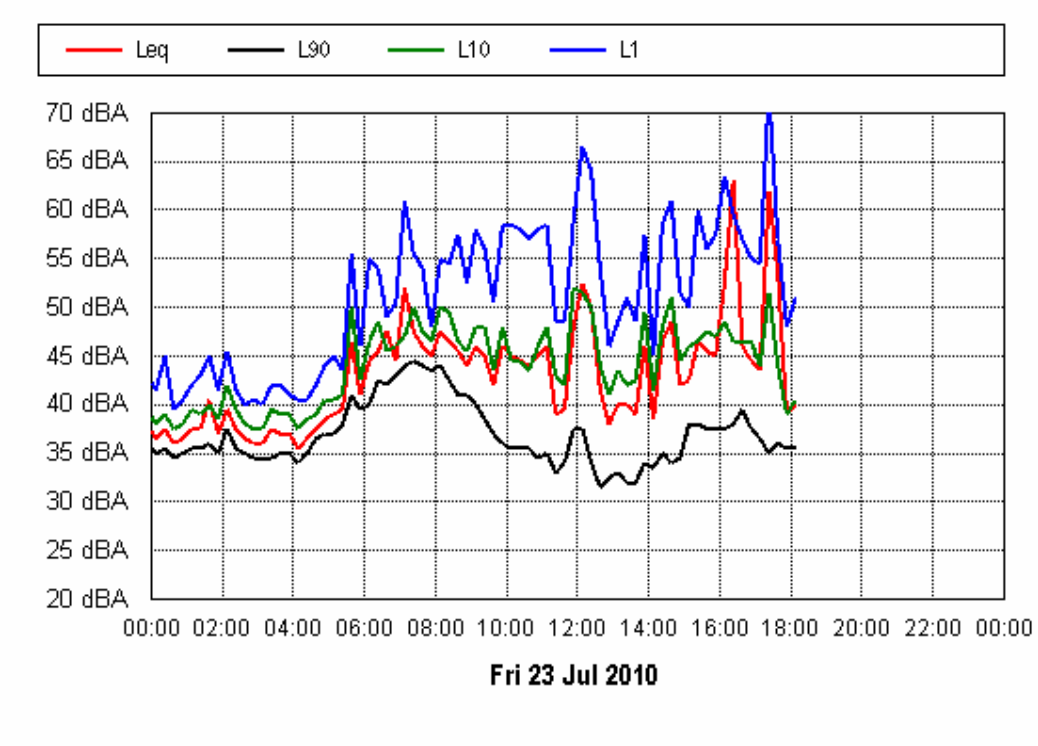
Tue 20 Jul 2010

Project: Ropes Creek and Horsley Park
Location: 58 Weaver Street

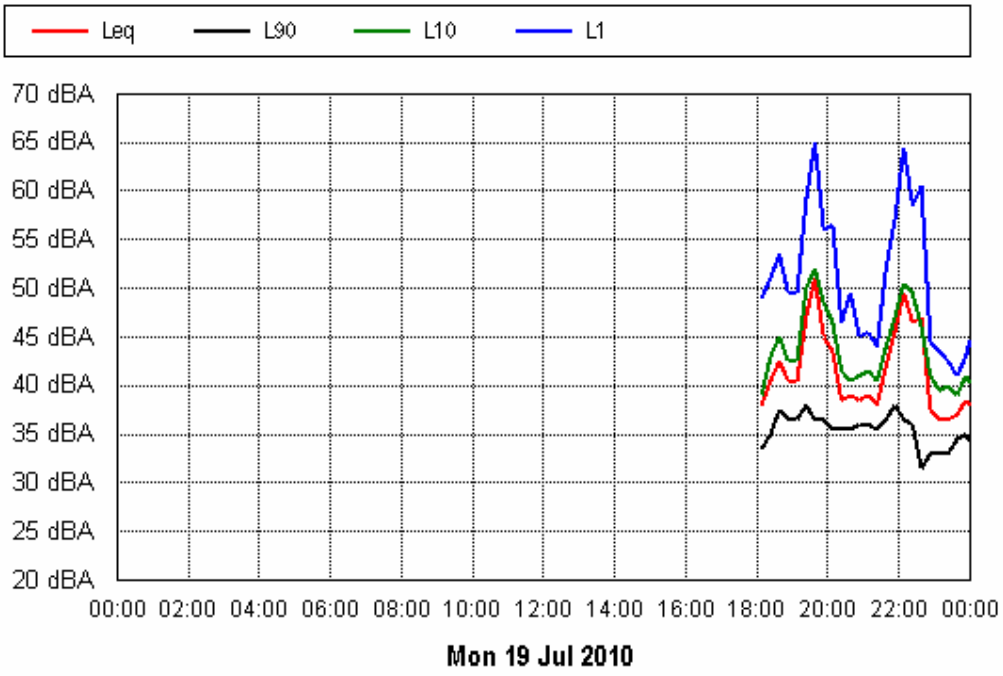




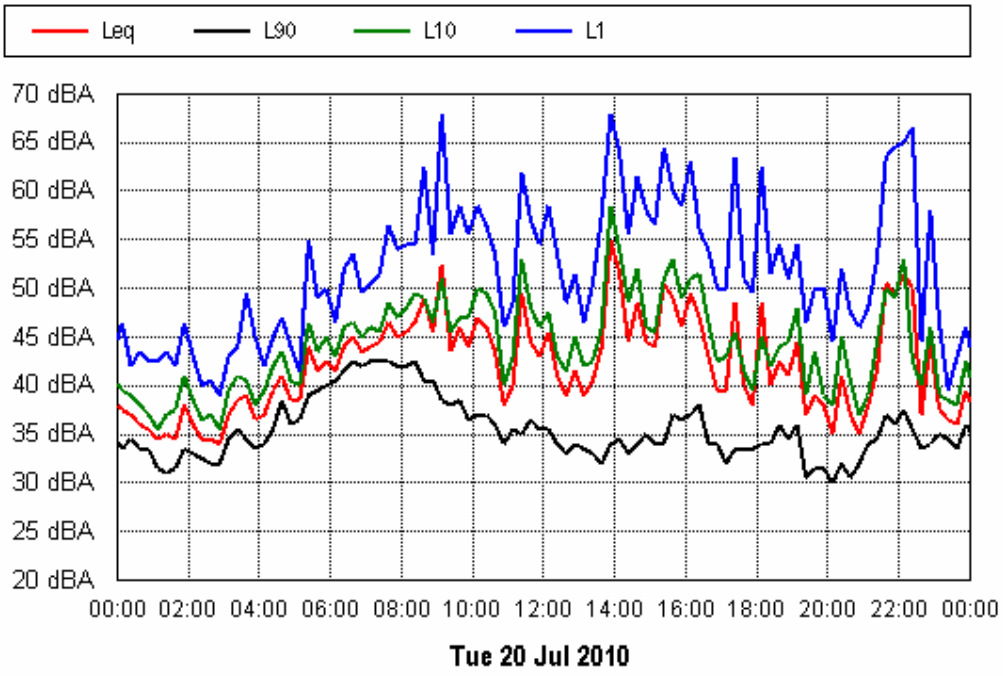
Project: Ropes Creek and Horsley Park
Location: 58 Weaver Street



Project: Ropes Creek and Horsley Park
Location: 20 Bakers Lane

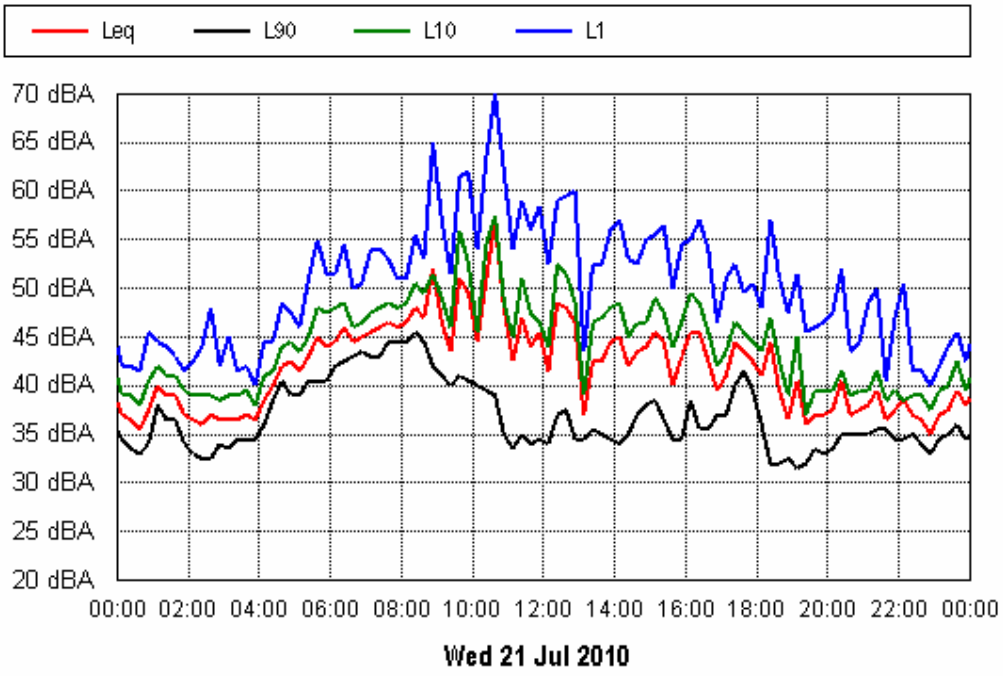


Mon 19 Jul 2010

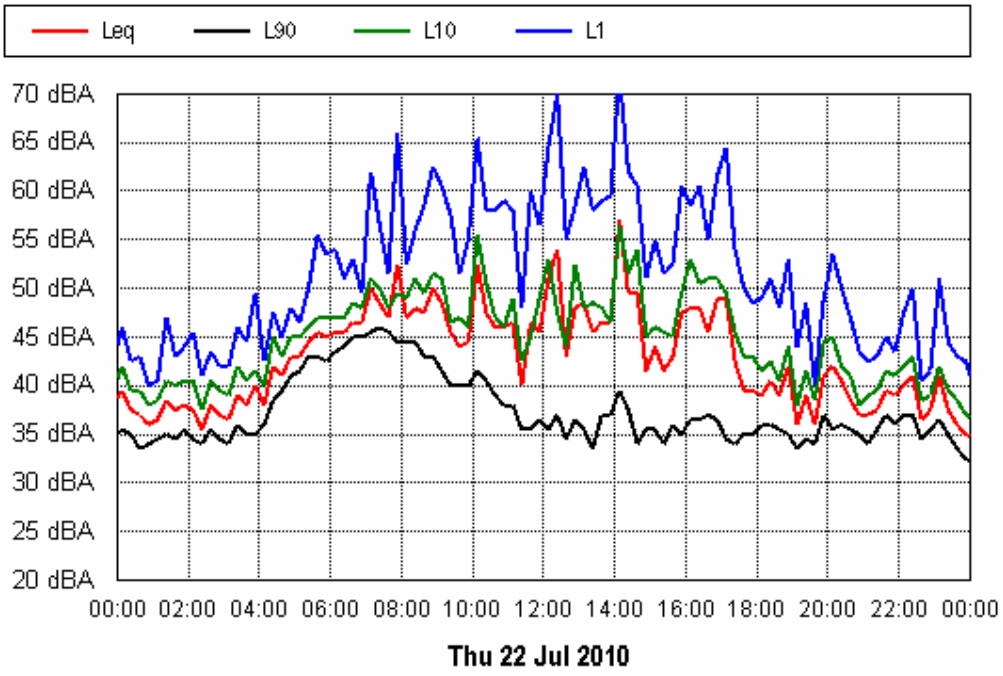


Tue 20 Jul 2010

Project: Ropes Creek and Horsley Park
Location: 20 Bakers Lane

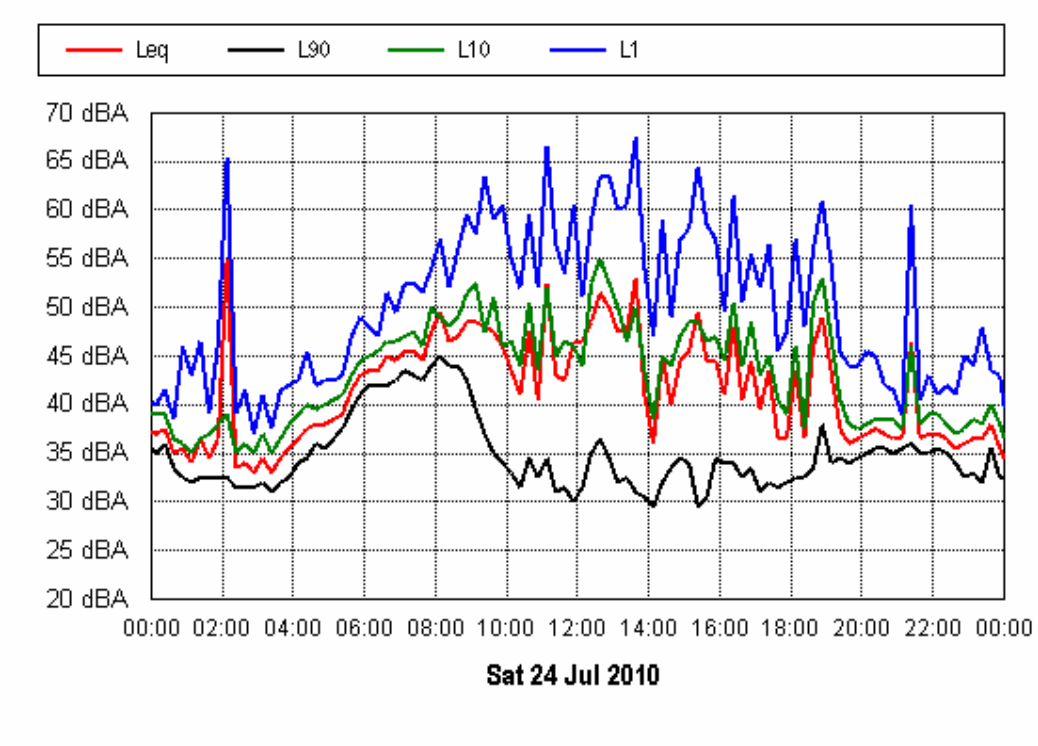


Wed 21 Jul 2010

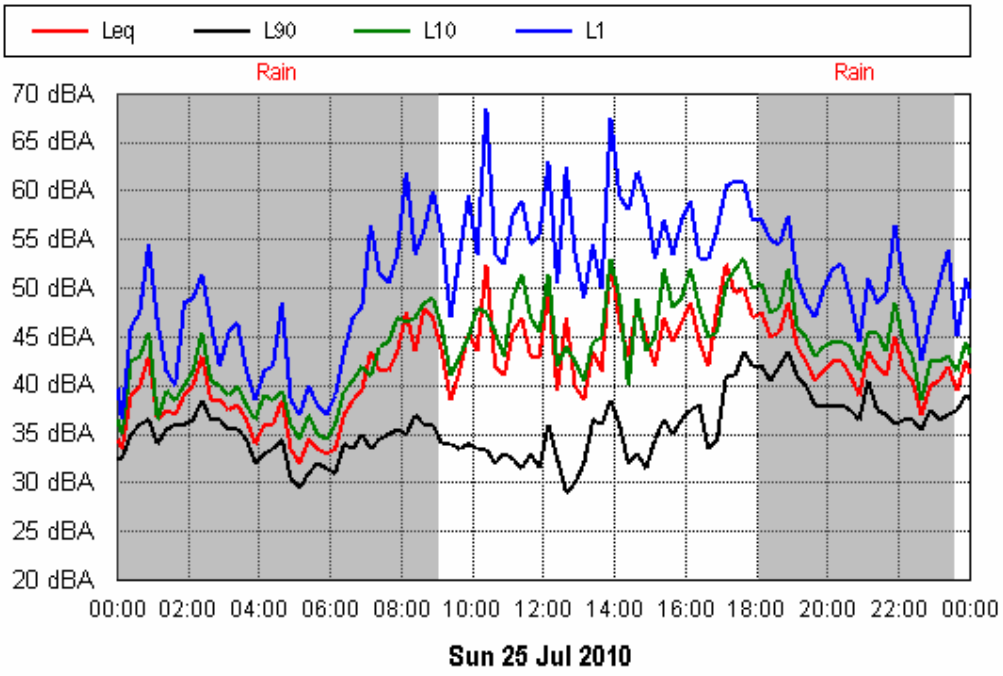


Thu 22 Jul 2010

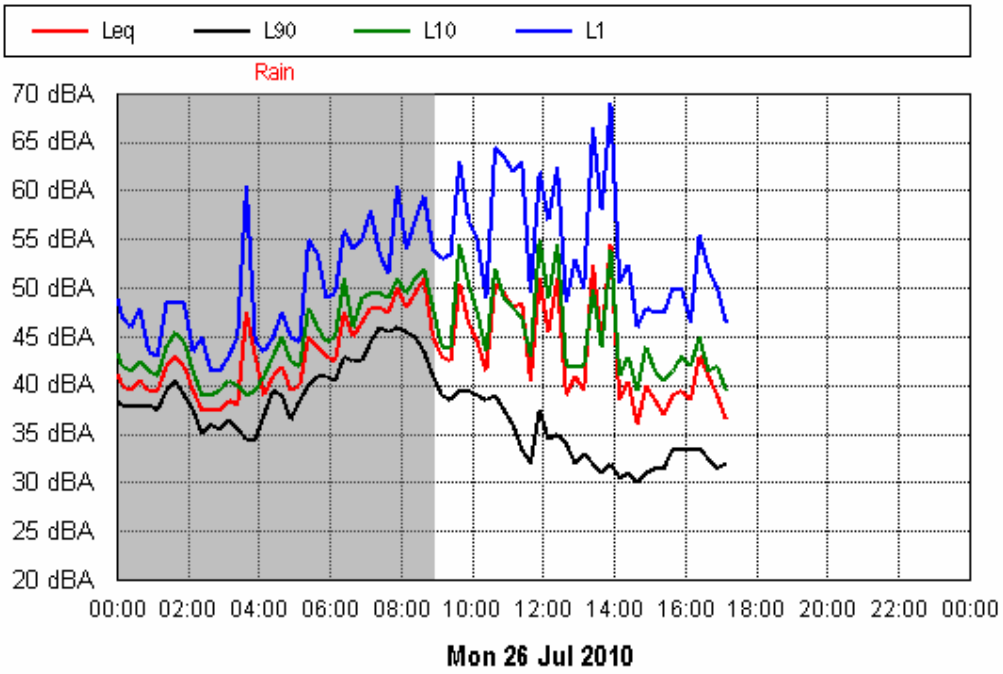
Project: Ropes Creek and Horsley Park
Location: 20 Bakers Lane



Project: Ropes Creek and Horsley Park
Location: 20 Bakers Lane

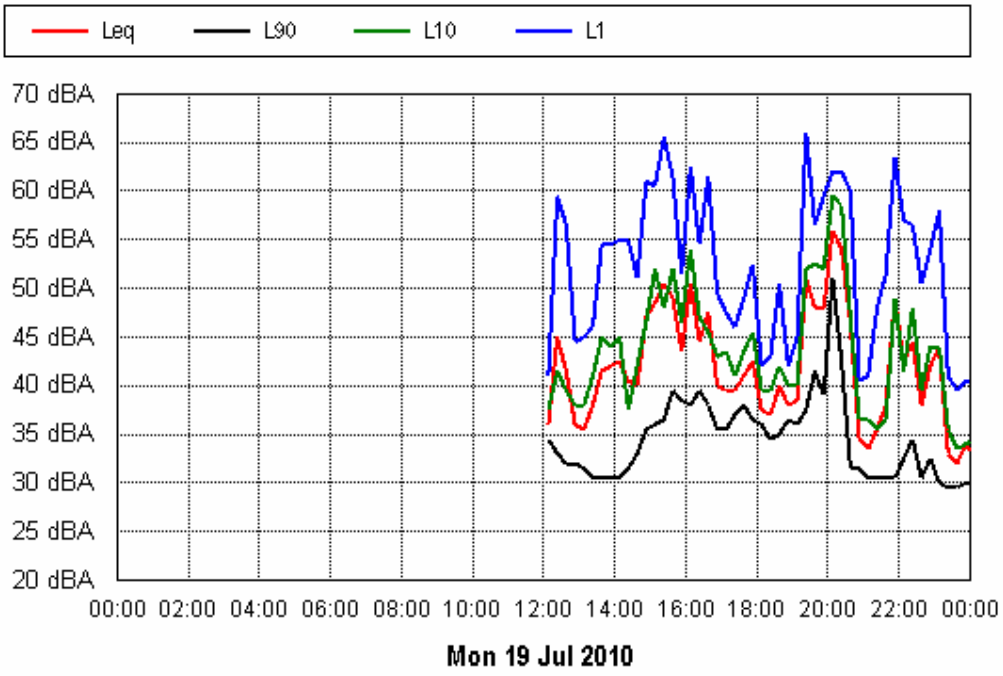


Sun 25 Jul 2010

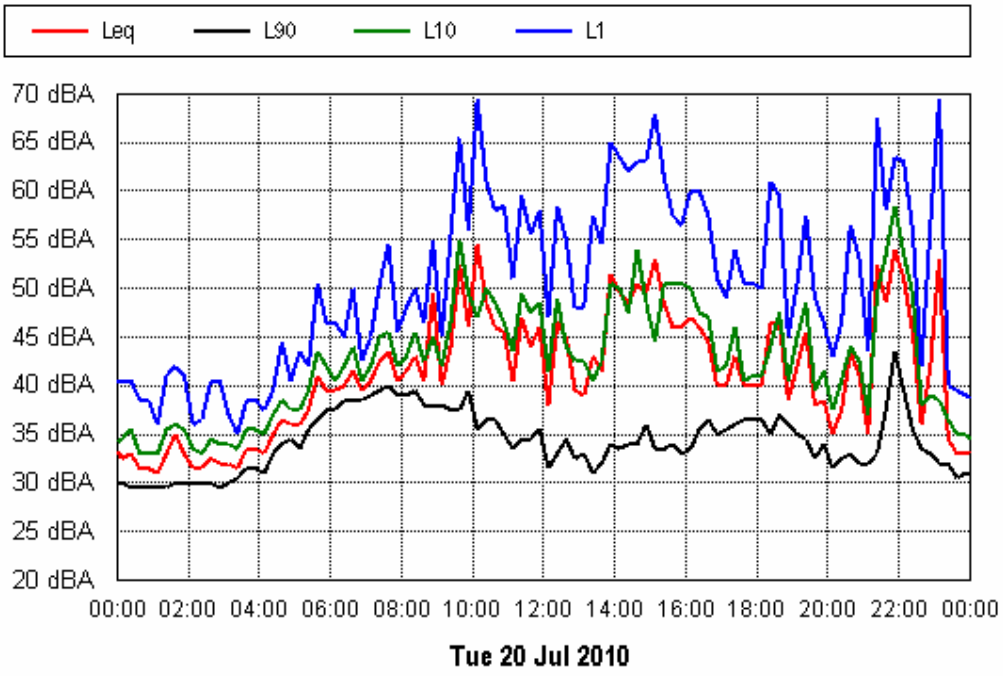


Mon 26 Jul 2010

Project: Ropes Creek and Horsley Park
Location: 41-43 Greenway Place

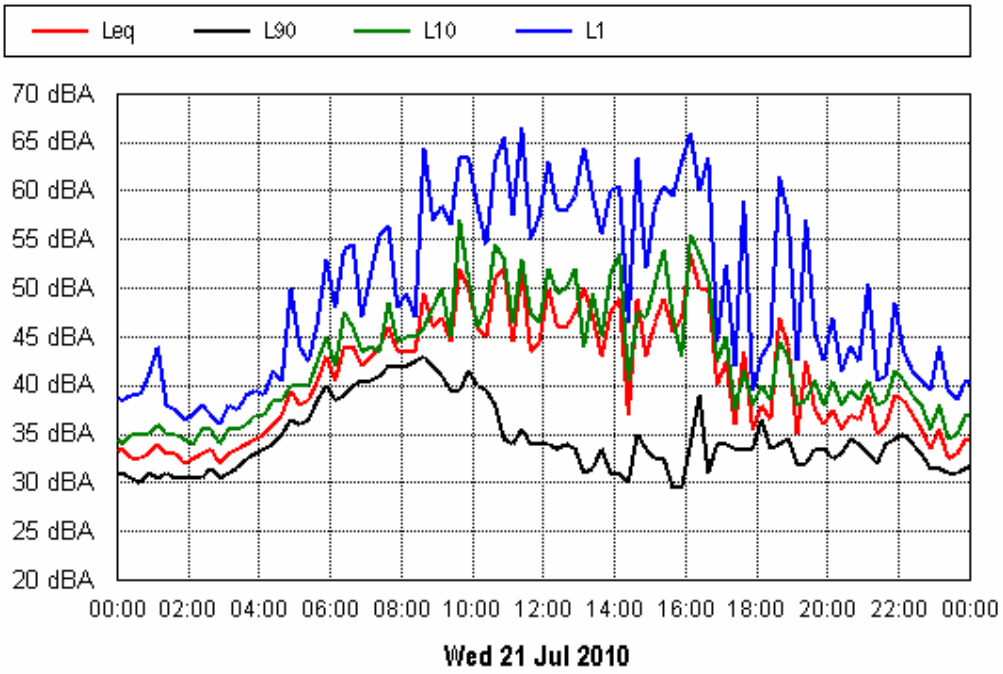


Mon 19 Jul 2010

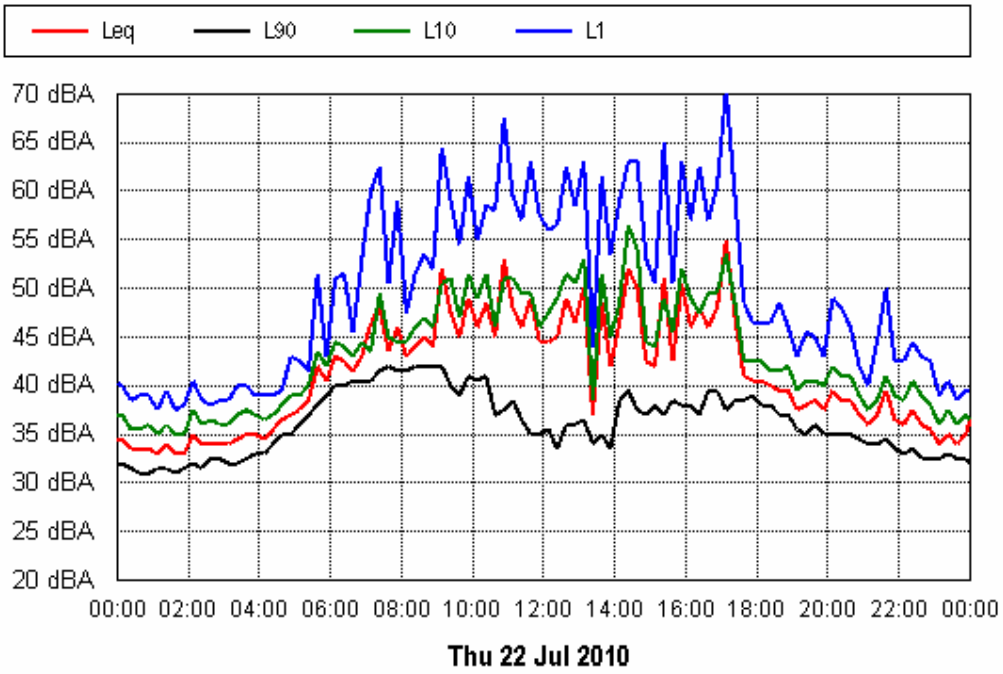


Tue 20 Jul 2010

Project: Ropes Creek and Horsley Park
Location: 41-43 Greenway Place

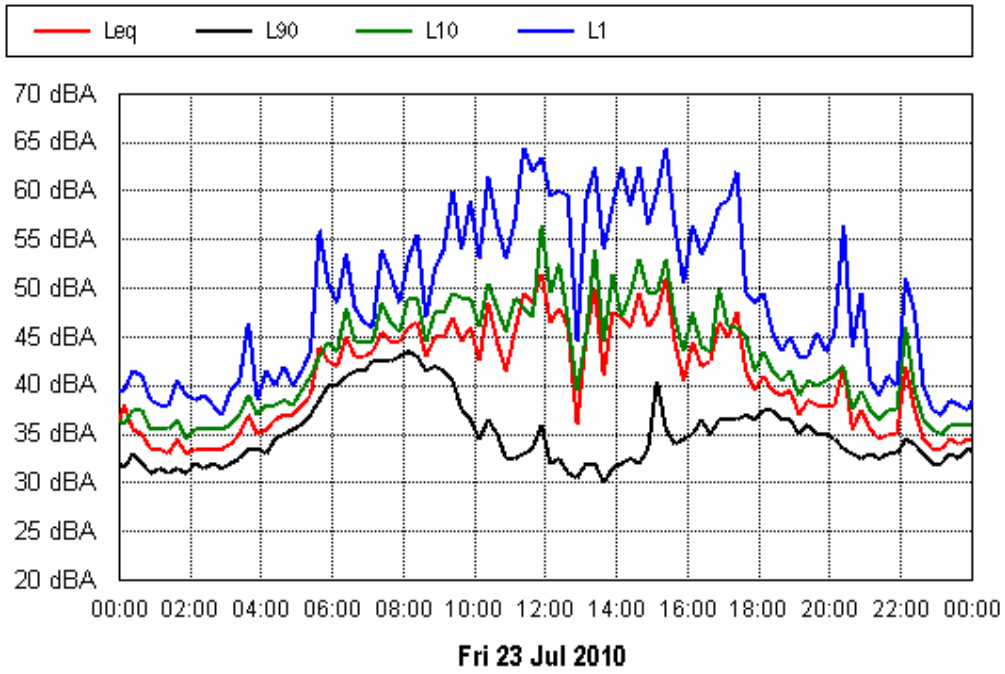


Wed 21 Jul 2010

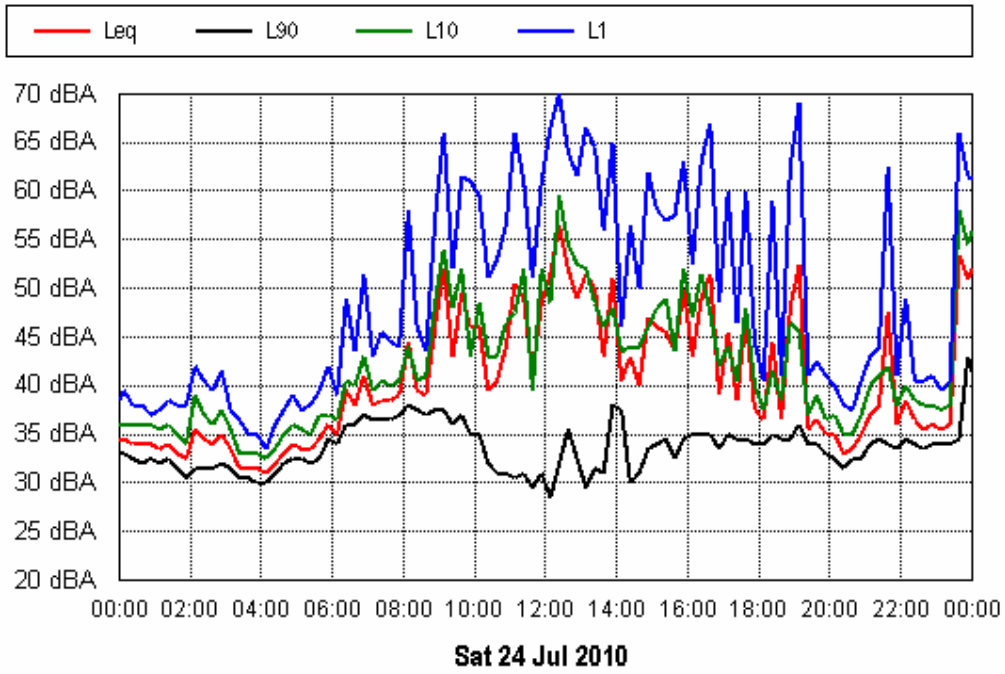


Thu 22 Jul 2010

Project: Ropes Creek and Horsley Park
Location: 41-43 Greenway Place

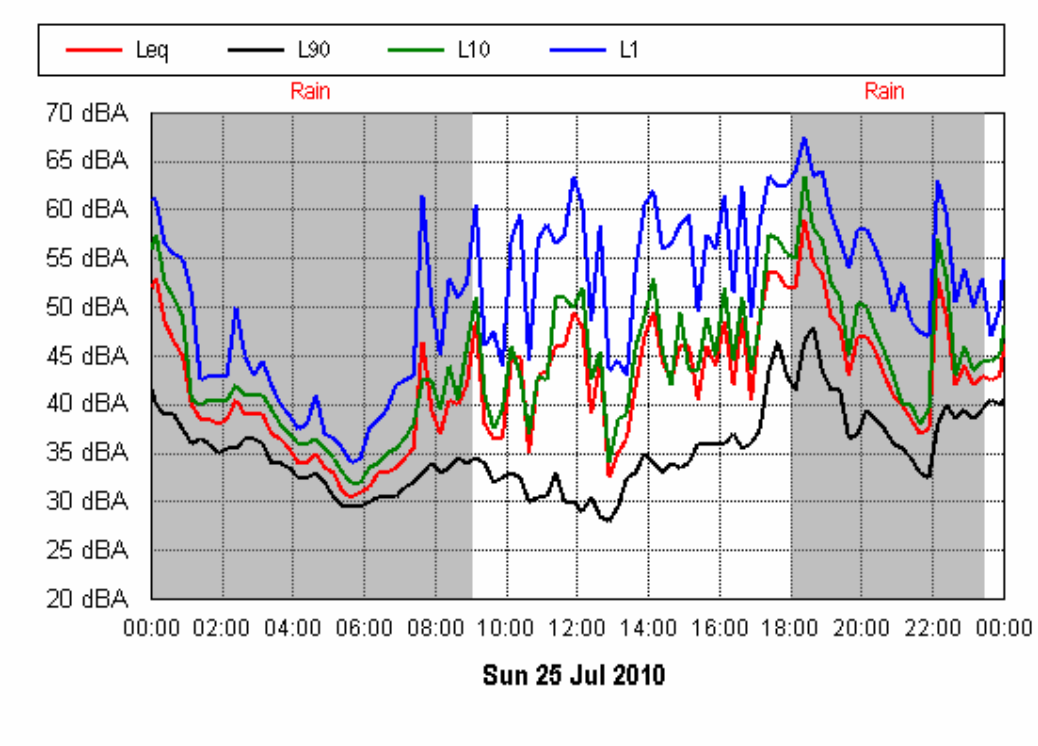


Fri 23 Jul 2010



Sat 24 Jul 2010

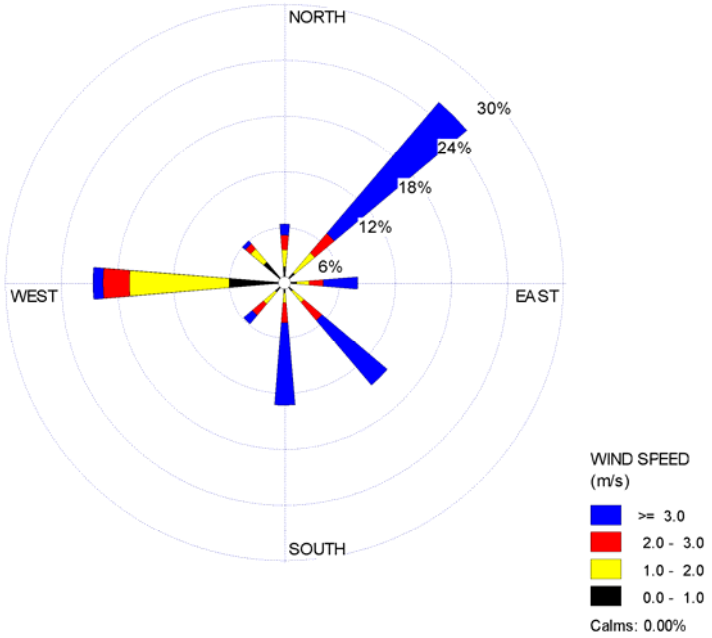
Project: Ropes Creek and Horsley Park
Location: 41-43 Greenway Place



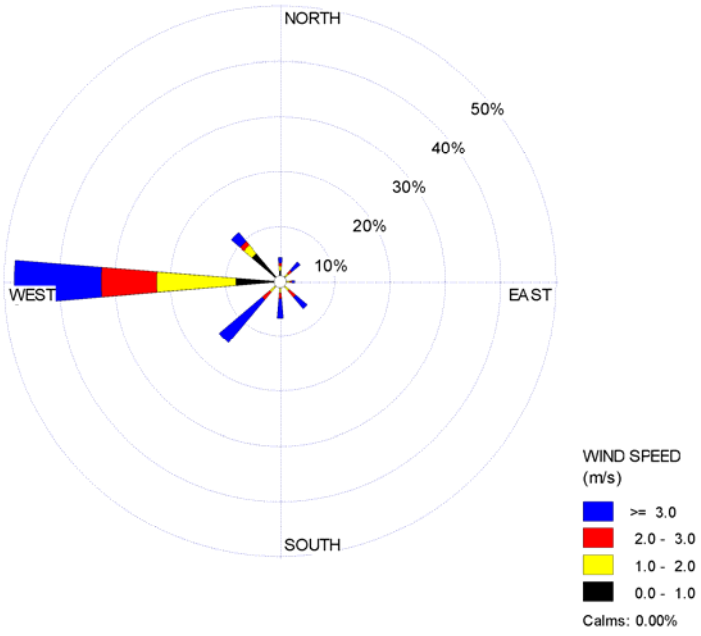
APPENDIX C

WIND ROSES

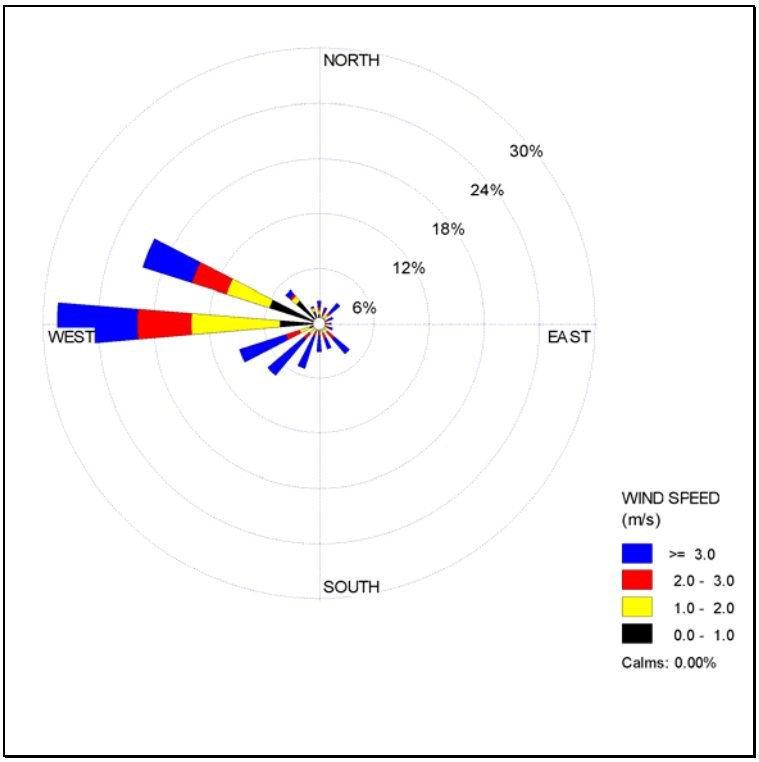
Summer



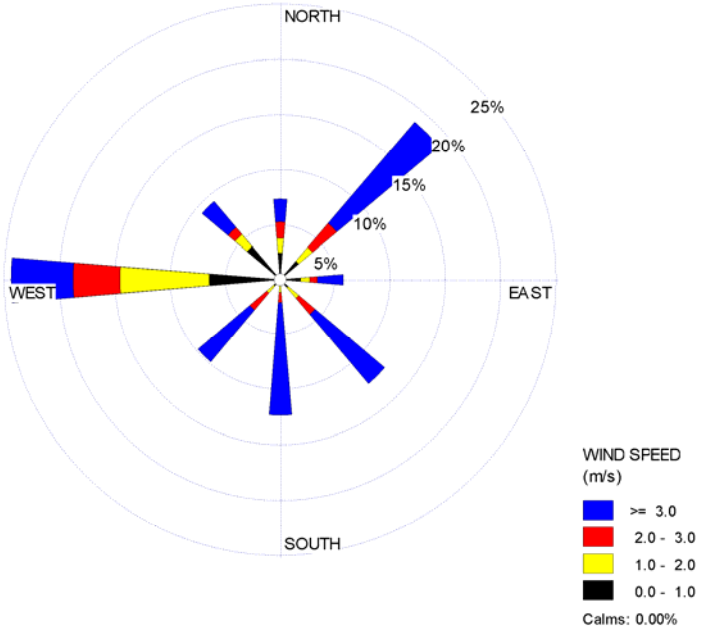
Autumn Winds



Winter Winds



Spring Winds



Yearly Winds