BlueScope Steel (AIS) Pty Ltd
25-55 Templar Road Erskine Park NSW 2759
PO Box 3003 St Mary's South NSW 2760
P 02 8856 8600 | **M** 0413 210 650
W www.bluescopesteel.com

5 July 2017

Mrs Joanna Bakopanos
Team Leader-Industry Assessments
NSW Planning and Environment
GPO Box 39
SYDNEY NSW 2001

Dear Joanna

Request to modify Development Application DA-206-8-2004-i for Western Sydney Service Centre (WSSC) Paint Line

As per our phone conversation 4th May 2017, BlueScope (BSL) would like to modify Development Application (DA) DA-206-8-2004-i. The request is to increase the night time sleep disturbance limit in the development consent to align with Environment Protection Licence (EPL) 12495 for the site.

1.0 Background to Western Sydney Service Centre

BlueScope Steel Western Sydney Service Centre is a steel paint line and manufacturing facility created to meet the needs of customers in building and manufacturing sectors in NSW. The paint line is a continuous production line designed to organically coat hot dipped metal coated steel (strip) into pre-painted steel products through a complex painting process. Located in Erskine Park, West of Sydney the paint line produces a range of products, such as metal roofs, wall cladding, and metal fencing. WSSC has an annual production capacity of 120,000 tonnes and employs approximately 70 full time employees.

2.0 Proposed Modification

To avoid duplication of differing sample limits in both the Development Consent and Environment Protection Licence (EPL) 12495, it is requested that either:

1. The night time sleep disturbance limit is aligned with the EPL 12495 limit. The current EPL night time sleep disturbance limit is 54dB(A) due to a recent licence variation issued on 27th April 2017. The development consent night time sleep disturbance limit is currently 47dB(A),

   Or

2. Remove the table of noise limits (section 2.8 of the consent) and replace the table with a statement such as "the applicant must comply with all operational noise limit requirements as specified by the EPA in the EPL for the site".

3.0 Supporting Evidence

BlueScope Steel Limited is requesting to increase the night time sleep disturbance limit based on the evidence:

1. Since commissioning in 2007 there has been no noise complaints received from the community.

2. EPL 12495 night time sleep disturbance Limit is 54dB(A) as per accepted licence variation request (27th April 2017 variation)

3. There have been no modifications to plant operations and there are no plans for changes.

4. Noise sampling is conducted annually and all results are reported in the AEMR and the EPA Annual Return – refer to table 1 for all noise sampling results.

5. A Noise Management Plan is in place and reviewed every two years (last reviewed May 2017). The plan contains information on noisy activities on site and a summary of current noise management and mitigation measures. The plan is attached in Appendix A – Environment Management Plan. If this development consent variation is approved, the Environment Management Plan will be amended to reflect the night time sleep disturbance limit adjustment. All management practices will remain the same.

6. Computer Noise Modeling Assessment completed April 2017 as requested by Alexander Spaller (EPA Regional Operations Officer) and Larry Clark (Manager of Noise Assessments Unit –Noise Policy). Recommendations and report attached in Appendix B (Refer to Section 7.0: Summary of Findings)

7. From 2007-2017 there has been 12 noise samples collected for WSSC. Refer to Table 1 for the summary of results. All results have met the noise criteria apart from sampling carried out in 2015 when a truck and forklift horn exceeded the night time sleep disturbance limit.

4.0 Justification for Modification Proposal

The initial request to the EPA to increase the night time sleep disturbance limit was due to an outcome of noise sampling conducted at WSSC on 17th November 2015 resulting in a licence non-compliance for condition L4.1 (b). The night time sleep disturbance criteria is 47 dB(A) LA 1, 1 minute, however a forklift horn was measured at 49 dB(A) and a truck horn measured 56 dB(A).

Truck and forklift horns are mandatory safety precautions when entering and exiting the buildings. Both forklifts horns have been tested and risk assessed and their volumes were reduced where practicable.

The licence variation application along with supporting evidence was submitted to the EPA Regional Operations Officer in October 2016. The EPA then forwarded the application on to Mr Larry Clark (Manager of Noise Assessments Unit) where he declined the variation pending additional information including a noise computer modeling assessment.

SLR Global Environmental Solutions conducted a Noise Computer Modelling Assessment in response to the EPA's recommendations. Assessing the noise emissions generated using vehicle horns against the site licence conditions for sleep disturbance, and against the sleep disturbance noise criteria derived through the procedures outlined in the NSW EPA's Industrial Noise Policy (INP). The assessment addressed the influences of meteorological effects on predicted noise levels and the influence of the surrounding environment on the propagation of noise from the WSSC to the surrounding sensitive receivers.

Please refer to the attached “Computer Noise Modeling Assessment Report” conducted by SLR (Appendix B Section 7.0 Summary of Findings).

In summary, the ambient noise environment surrounding residential receivers closest to the WSSC was measured during 2007 and more recently in 2015. The noise monitoring results indicate that the night-time LA90 noise levels were approximately 1 dB to 2 dB higher in 2015 compared to 2007 due to a significant increase in industrial developments from 2007 to current (refer to Figure 1).

Figure 1 Erskine Park Growth 2007 Vs. 2017

The night time sleep disturbance criteria of 47 dB(A) is specified in the EPL, and is more stringent than the Industrial Noise Policy (INP) of 54 dB(A).

An LA1 (1 minute) night time sleep disturbance criterion of 54 dB(A) is considered reasonable for the assessment of potential awakening events for the following reasons:

- This is consistent with the procedures outlined in the INP.
- This level is based on ambient noise monitoring data which was measured and processed in accordance with the procedures outlined in INP.
- Ambient noise monitoring performed in 2007 and 2015 indicate that the existing ambient noise environment is frequently subject to short-term noise events more than this level.

Table 1: Summary of results for noise monitoring conducted at WSSC 2007-2017

Date	La(eq) 15 minute Daytime Limit:35dBA	La(eq) 15 minute Evening Limit:35dBA	La(eq) 15 minute Nighttime Limit:35dBA	La(eq) 15 minute Sleep Disturbance Limit:47dBA	Truck Horn	Forklift Horn	Comments
8/11/2007	31	31	31	41	No	No	Nil
5/08/2008	35	35	35	41	No	No	Nil
17/04/2009	31	31	31	40	No	No	Nil
29/10/2009	31	31	31	43	No	No	Nil
29/04/2010	27	27	27	43	No	No	Nil
07/06/2011	32	32	32	45	No	No	Facility door closing and vehicle braking
10/05/2012	31	31	31	42	No	No	Heavy vehicle movements
30/10/2012	33	33	33	38	Yes	No	Medium truck horn blast
21/10/2013	34	34	34	41	No	No	Vehicle exit gate and vehicle braking
24/10/2014	20	20	20	38	Yes	No	Truck horn short blast 2 times at despatch
17/11/2015	25	25	25	56 (truck horn) 49 (forklift horn) 33 (no horns)	Yes	Yes	Full horn blast 00:10 and forklift horn
16/05/2017	27	27	27	42 (New EPL Limit 54dBA)	Yes	No	Nil

If you would like to discuss this request in further detail, please contact Cherie Sammut Senior Environment Advisor on 0413 210 650

Yours Sincerely,

K. Wijekulasuriya.

Kamini Wijekulasuriya
Western Sydney Services Centre Manufacturing Manager
BlueScope Steel Limited.

Appendix A

Environment Management Plan

(Note: the Noise section of the plan is only attached)

Erskine Park

Western Sydney Service Centre

Environment Management Plans

Required
(Post Development Consent)

NEXT REVIEW DATE: **June 2019**

DOCUMENT OWNER: **WSSC ENVIRONMENTAL ADVISOR**

Rev.	Recent Revision Reasons	Authorised By	Date
1	Consolidate all existing Environment Management Plans into single controlled document. Minor changes in objectives, site description, include referencing.	Manufacturing Manager	01/09/2011
2	Minor changes; Groundwater monitoring frequency changed, waste training requirements and procedure references updated.	Manufacturing Manager	06/05/2013
3	Minor Changes; Section 8.2 removed the NPI sampling requirements. Section 9.0 removed some statements and the noise criteria table. Added the maintenance schedule to the noise table. Section 9.2 removed the background levels from the table	Manufacturing Manager	11/06/2015

4	Removed waste type and disposal table and replaced it with the WSSC SEQ Waste Register Link. Changed Noise EPL Limit. Removed ANZECC Guidelines table and replaced with link to the guidelines. Changed Reliability Manager to Manufacturing Manager. Updated air emission sampling requirements	Manufacturing Manager	30/05/2017

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SECTION 1 - OBJECTIVES AND PRINCIPLES

The aim of Western Sydney Service Centre (WSSC) Environment Management Plan is to comply with the requirements of Penrith City Council's Development Control Plan 2004 and conditions required as part of consent approval.

The following areas are included:

- Waste Management
- Ground Water Management
- Harvested Water Management
- Road Traffic Management
- Air Quality Management
- Noise Management Plan

1.1 REFERENCES

Environmental Management System - ENVIRONMENT-ENV-001

Summary of Legislative requirements:

- Minimum Environmental Legislative Requirement –WSSC SEQ
- Penrith City Council Development Control Plans;
    - Erskine Park Employment Area

SECTION 2 - SITE DESCRIPTION

The Western Sydney Service Centre is a key part of BlueScope Steel's supply chain, focused on servicing the customers in the building, manufacturing and automotive markets.

The facility is situated in Precinct 2 of the Employment Zone located at Templar Road, Erskine Park. The Western Sydney complex comprises a continuous Paint line capable of producing 120,000 tonnes of painted steel per year.

In addition to the Paint line there are a number of support processes, for example Waste Water Treatment Plant, Evaporative Cooling Tower, Rainwater Harvesting Storage. The purpose of these support processes is to maximise the sites ability to reuse and recycle and minimise waste generation.

Section 3: - Waste Management: The site will produce a range of waste from general to classified, with some not suitable for reuse or recycling therefore require a disposal option. Further details regarding these wastes are contained within.

Section 4: - Ground Water: The site has a ground water table is approximately 20m below the surface. Prior to occupation and development the site was lightly covered by grass species indicative of degraded pastoral land. Discharge of this aquifer is currently unknown.

Section 5: - Harvested Water: The plan will describe how the facility will collect, use and overflow harvested rain water on site.

Section 6 -Storm Water: The plan will describe this aspect and the controls to ensure the quality of stormwater runoff is not compromised by onsite activities. Another benefit of effective stormwater management is to prevent excessive degradation of top soil in the immediate area of the Erskine Park site.

Section 7: - Road Traffic: The aim of Traffic Management is to identify source(s) and consider controls to minimize the potential impact of noise generated from vehicle movements on the surrounding community.

Section 8: - Air Quality: The aim of Western Sydney Service Centre (WSSC) Air Quality Management is to identify and assess the impact of air emissions to ensure compliance requirements are met.

Section 9: - Noise: The aim of Western Sydney Service Centre (WSSC) Noise Management Plan is to provide a framework for minimising the impact of excessive noise on the surrounding community of the Erskine Park site due to operational activities.

Section 10 – Recommendations for Further Management Controls: Environmental Compliance Register tool is used to verify legislative requirements.

Appendix A: **Site plan showing location of bund areas for waste storage.**
Appendix B: **Site plan showing location of bore holes.**
Appendix C: **Groundwater Contour Map**
Appendix D: **Site plan showing location of harvested water tanks.**
Appendix E: **Plan showing delivery and dispatch routes.**
Appendix F: **Site plan showing stack locations**

SECTION 9 - NOISE MANAGEMENT

The Western Sydney Service Centre site has established a noise management program to assess or control operational impacts since commissioning in 2007.

Monitoring for the Statement of Environmental Effect has noted the following:

- the nearest residential suburb to the development at Erskine Park:
    - this suburb is approximately 800m from the development;
    - Note: the closest residence is 850m

The noise testing regime implemented since the plant has been operational has shown no significant impacts on the nearest residential boundary properties in Erskine Park.

The Noise Management will:

i) identify all major sources of noise that may be emitted as a result of the operation of the development;
ii) specify the noise criteria as it applies to the particular activity;
iii) identify procedures for the monitoring of noise emissions from the development, in accordance with any requirements of the EPA;
iv) identify protocols for the minimisation of noise emissions;
v) description of procedures to be undertaken if any non-compliance is detected.

9.1 MAJOR SOURCES OF NOISE EMISSIONS

Areas/Activities onsite with a potential to generate consistent noise include:

- Building associated noise;
    - Motors;
    - Hydraulics;
- Extractor Fans;
- Cranes;
- Forklifts;
- Vehicle Movements from Deliveries onsite;
- Down day equipment/activities;
    - mobile air compressor.

9.2 NOISE CRITERIA

The governing criteria for all noise sources onsite are Intrusiveness, as consistent with the definition in the POEO (Noise Control) Regulations 2000.

	Day	Evening	Night
Noise at premises must not exceed	35 dB (A)	35 dB (A)	35 dB (A)
Night time sleep disturbance criteria			54 dB (A) EPL Limit and 47dB(A) Development Consent Limit (current application submitted to align with EPL Limit

Area of Potential Contamination	Infrastructure	Responsibility/Practice/Procedure
Operations		
Building associated noise - motors; - hydraulics.	Wall structure; Windows; Facility Doors.	**Manufacturing Manager** to: - Ensure windows are shut during night shift. - Maintenance schedule to ensure gates/doors are lubricated and are in good (non-noise) condition.
Extractor Fans	Insulation; Motors/Fans Balanced.	**Manufacturing Manager** to: - Maintenance schedule to ensure motors/fans are in good (non-noise/vibration developing) condition.
Cranes	Wall structure; Windows; Facility Doors.	**Manufacturing Manager** to: - Ensure windows are shut during night shift.
Forklifts		Ensure horns are not too loud.
Deliveries onsite	Speed Limit onsite.	**Manufacturing Manager** to: - Develop, communicate and enforce speed limit onsite. - Horns upon exiting/entering buidlings on site are short blasts not full blasts.
Overall Site		**WSSC Environment Advisor** to: - Maintain established noise monitoring program.
Down day equipment/activities - mobile air compressor.	Wall structure; Windows; Facility Doors.	**Manufacturing Manager** to: - Develop spec to ensure services provided meet noise limitation; - Change Management Plan to ensure ordering new equipment meets these noise guidelines.

Appendix B

Noise Computer Modeling Assessment Report

global environmental solutions

BlueScope Steel

Western Sydney Service Centre - Paint Line

Heavy Vehicle Horn Noise Assessment

Report Number 610.06077-R12

7 April 2017

BlueScope Steel Ltd

25-55 Templar Road

ERSKINE PARK NSW 2759

Version: v1.0

BlueScope Steel

Western Sydney Service Centre - Paint Line

Heavy Vehicle Horn Noise Assessment

PREPARED BY:

SLR Consulting Australia Pty Ltd
ABN 29 001 584 612
2 Lincoln Street
Lane Cove NSW 2066 Australia
(PO Box 176 Lane Cove NSW 1595 Australia)
T: +61 2 9427 8100 F: +61 2 9427 8200
sydney@slrconsulting.com www.slrconsulting.com

DOCUMENT CONTROL

Reference	Date	Prepared	Checked	Authorised
610.06077-R12-v1.0	7 April 2017	Dominic Sburlati Clemence Terraz	Robert Hall	Dominic Sburlati

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TABLES

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1 INTRODUCTION

SLR Consulting Australia Pty Ltd (SLR) has been engaged by BlueScope Steel Limited (BlueScope) to carry out an assessment of noise generated by the use of vehicle horns within the dispatch area of its Western Sydney Service Centre (WSSC) located at Templar Road, Erskine Park.

The purpose of this assessment is to assess the noise emission generated by the use of vehicle horns against the current site licence conditions for sleep disturbance, and against the sleep disturbance noise criteria derived through the procedures outlined in the NSW EPA's *Industrial Noise Policy* (INP). This assessment addresses the influence of meteorological effects on predicted noise levels and the influence of the surrounding environment on the propagation of noise from the WSSC to the surrounding sensitive receivers.

2 BACKGROUND

Previous predictions (based on measurements near the source) of the heavy vehicle horns within the dispatch area of the WSSC may exceed the nominated Environmental Protection Licence (EPL) sleep disturbance criteria for the site. As the use of the vehicle horns is considered a safety issue, options to control noise at source are limited and no feasible solutions have been identified.

In 2016 BlueScope Steel requested that the EPA modify the WSSC's licence condition by removing the sleep disturbance noise limits. The NSW EPA has in turn requested that a detailed assessment of the heavy vehicle horn noise impacts and ambient noise environment be undertaken to support any licence modifications.

3 AMBIENT NOISE ENVIRONMENT

Environmental noise monitoring was conducted by SLR in the vicinity of the WSSC in 2007 after facility commissioning was completed in 2006. At this time, the WSSC was one of only a few industrial developments in the Erskine Park Business Park. Since this time, the number of industrial facilities within the business park has grown as depicted in **Figure 1**.

Figure 1 Erskine Park Growth 2007 Vs. 2017

The location where unattended background noise monitoring was undertaken between Wednesday 3 October 2007 and Wednesday 10 October 2007 at the location depicted in **Figure 2** as 'BG.2007'.

Additional unattended background noise monitoring was undertaken between Friday 24 April 2015 and Tuesday 5 May 2015 at the location depicted in **Figure 2** as 'BG.2015'

Figure 2 Ambient Noise Monitoring Locations

All acoustic instrumentation employed throughout the monitoring programme complied with the requirements of AS IEC 61672.1-2004 "*Electroacoustics - Sound Level Meters – Part 1: Specifications"* and carried appropriate and current NATA (or manufacturer) calibration certificates. Descriptions of the instrumentation, designated type and serial numbers are presented in **Table 1**.

Table 1 Acoustic Instrumentation

Location	Description	Type or Class	Serial Number
BG.2007	ARL EL-215 Environmental Noise Logger[1]	Type 1	193410
BG.2015	ARL 316 Environmental Noise Logger[1]	Type 1	16203525

Note: Equipment fitted with a microphone windshield

All instrumentation was programmed to continuously record statistical noise level indices in 15 minute intervals, which included the L_{Amax}, L_{A1}, L_{A10}, L_{A50}, L_{A90} and the L_{Aeq}.

Instrument calibration was checked before and after each measurement survey, with the variation in calibrated levels not exceeding the acceptable variation of ±0.5 dBA (AS 1055).

Continuous weather data was obtained from the nearby Horsley Park weather station, in order to identify periods of adverse weather during the unattended noise logging survey at location BG.2015. The Horsley Park Weather Station was selected as it is a station providing detailed meteorological data that falls within the guideline offset distance and topographical basin as nominated in the NSW Department of Environment Climate and Water Changes (now the NSW Environment Protection Authority (EPA)) *Industrial Noise Policy* (INP). Data corresponding to periods of high winds and/or rain were excluded from the background noise analysis. The removal of the weather affected noise data did not significantly affect the resulting background noise levels.

The results of the unattended noise surveys are presented in tabular form in **Table 2** and graphically in **Appendix B**. The statistical descriptors shown on the graphs are described in **Appendix A**.

The noise data were processed in accordance with the procedures documented in the INP.

Table 2 presents the Rating Background Levels (RBLs) or background (L_{A90}) noise levels for the noise monitoring locations.

Table 2 Summary of Existing $L_{A90(15minute)}$ Rating Background Levels (RBLs) and Existing $L_{Aeq(period)}$ Ambient Noise Levels - dBA re 20 µPa

Location	$L_{A90(15minute)}$ Rating Background Level (RBL)			$L_{Aeq(period)}$ Existing Ambient Noise Level			L_{A1} Existing Ambient Noise Level		
	Daytime	Evening	Night	Daytime	Evening	Night	Daytime	Evening	Night
BG.2007	41	40	37	57	46	48	58	51	48
BG.2015	43	41	39	51	53	48	56	53	52

The noise monitoring results presented in **Table 2** indicate that the night-time L_{A90} noise levels were approximately 1 dB to 2 dB higher in 2015 compared to 2007.

4 SITE OPERATING CRITERIA

The applicable noise criteria for all operations at the WSSC are stipulated in Environment Protection Licence (EPL) 12495 (review date 9 June 2017). This includes limits for the $L_{A1(1\ minute)}$ sleep disturbance criteria.

Where an industrial premise does not have an EPL, the site specific operational noise criteria should be developed using the method outlined in the INP. This assessment also presents the INP defined sleep disturbance criteria for comparison against the limits in the WSSC's EPL.

The INP also specifies the process for assessment of prevailing meteorological effects and the framework for implementation of prevailing meteorological effects on the prediction of noise levels.

4.1 Environmental Protection Licence Condition

Relevant section of the EPL No 12495 (review date 9 June 2017) to noise is reproduced below:

L4 Noise Limits

L4.1 Noise generated at the premises must not exceed:

(a) 35 dB(A) LAeq(15 minute) during the day, evening or night; and

Acoustic Terminology

1 Sound Level or Noise Level

The terms "sound" and "noise" are almost interchangeable, except that in common usage "noise" is often used to refer to unwanted sound.

Sound (or noise) consists of minute fluctuations in atmospheric pressure capable of evoking the sense of hearing. The human ear responds to changes in sound pressure over a very wide range. The loudest sound pressure to which the human ear responds is ten million times greater than the softest. The decibel (abbreviated as dB) scale reduces this ratio to a more manageable size by the use of logarithms.

The symbols SPL, L or L_P are commonly used to represent Sound Pressure Level. The symbol L_A represents A-weighted Sound Pressure Level. The standard reference unit for Sound Pressure Levels expressed in decibels is 2×10^{-5} Pa.

2 "A" Weighted Sound Pressure Level

The overall level of a sound is usually expressed in terms of dBA, which is measured using a sound level meter with an "A-weighting" filter. This is an electronic filter having 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 loud.

A change of 1 dBA or 2 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. The table below lists examples of typical noise levels

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

Other weightings (eg B, C and D) are less commonly used than A-weighting. Sound Levels measured without any weighting are referred to as "linear", and the units are expressed as dB(lin) or dB.

3 Sound Power Level

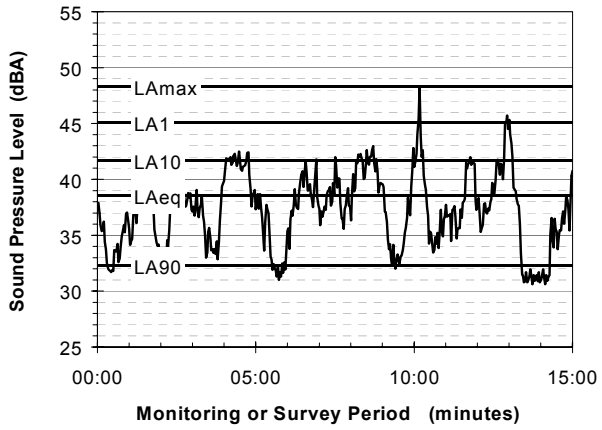
The Sound Power of a source is the rate at which it emits acoustic energy. As with Sound Pressure Levels, Sound Power Levels are expressed in decibel units (dB or dBA), but may be identified by the symbols SWL or L_W, or by the reference unit 10^{-12} W.

The relationship between Sound Power and Sound Pressure may be likened to an electric radiator, which is characterised by a power rating, but has an effect on the surrounding environment that can be measured in terms of a different parameter, temperature.

4 Statistical Noise Levels

Sounds that vary in level over time, such as road traffic noise and most community noise, are commonly described in terms of the statistical exceedance levels L_{AN}, where L_{AN} is the A-weighted sound pressure level exceeded for N% of a given measurement period. For example, the L_{A1} is the noise level exceeded for 1% of the time, L_{A10} the noise exceeded for 10% of the time, and so on.

The following figure presents a hypothetical 15 minute noise survey, illustrating various common statistical indices of interest.



Of particular relevance, are:

L_{A1} The noise level exceeded for 1% of the 15 minute interval.

L_{A10} The noise level exceed for 10% of the 15 minute interval. This is commonly referred to as the average maximum noise level.

L_{A90} The noise level exceeded for 90% of the sample period. This noise level is described as the average minimum background sound level (in the absence of the source under consideration), or simply the background level.

L_{Aeq} The A-weighted equivalent noise level (basically the average noise level). It is defined as the steady sound level that contains the same amount of acoustical energy as the corresponding time-varying sound.

When dealing with numerous days of statistical noise data, it is sometimes necessary to define the typical noise levels at a given monitoring location for a particular time of day. A standardised method is available for determining these representative levels.

This method produces a level representing the "repeatable minimum" L_{A90} noise level over the daytime and night-time measurement periods, as required by the EPA. In addition the method produces mean or "average" levels representative of the other descriptors (L_{Aeq}, L_{A10}, etc).

5 Tonality

Tonal noise contains one or more prominent tones (ie distinct frequency components), and is normally regarded as more offensive than "broad band" noise.

6 Impulsiveness

An impulsive noise is characterised by one or more short sharp peaks in the time domain, such as occurs during hammering.

7 Frequency Analysis

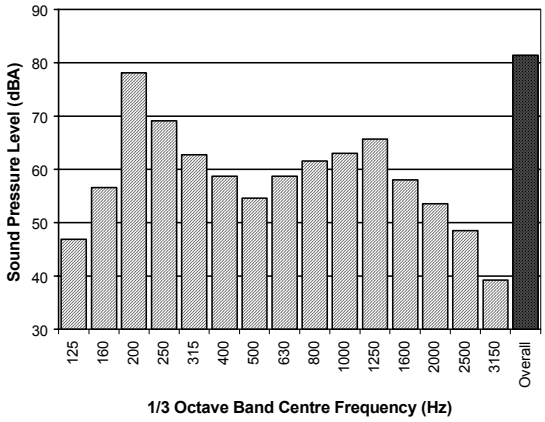
Frequency analysis is the process used to examine the tones (or frequency components) which make up the overall noise or vibration signal. This analysis was traditionally carried out using analogue electronic filters, but is now normally carried out using Fast Fourier Transform (FFT) analysers.

The units for frequency are Hertz (Hz), which represent the number of cycles per second.

Frequency analysis can be in:

- Octave bands (where the centre frequency and width of each band is double the previous band)
- 1/3 octave bands (3 bands in each octave band)
- Narrow band (where the spectrum is divided into 400 or more bands of equal width)

The following figure shows a 1/3 octave band frequency analysis where the noise is dominated by the 200 Hz band. Note that the indicated level of each individual band is less than the overall level, which is the logarithmic sum of the bands.



8 Vibration

Vibration may be defined as cyclic or transient motion. This motion can be measured in terms of its displacement, velocity or acceleration. Most assessments of human response to vibration or the risk of damage to buildings use measurements of vibration velocity. These may be expressed in terms of "peak" velocity or "rms" velocity.

The former is the maximum instantaneous velocity, without any averaging, and is sometimes referred to as "peak particle velocity", or PPV. The latter incorporates "root mean squared" averaging over some defined time period.

Vibration measurements may be carried out in a single axis or alternatively as triaxial measurements. Where triaxial measurements are used, the axes are commonly designated vertical, longitudinal (aligned toward the source) and transverse.

The common units for velocity are millimetres per second (mm/s). As with noise, decibel units can also be used, in which case the reference level should always be stated. A vibration level V, expressed in mm/s can be converted to decibels by the formula 20 log (V/V_o), where V_o is the reference level (10^{-9} m/s). Care is required in this regard, as other reference levels may be used by some organizations.

9 Human Perception of Vibration

People are able to "feel" vibration at levels lower than those required to cause even superficial damage to the most susceptible classes of building (even though they may not be disturbed by the motion). An individual's perception of motion or response to vibration depends very strongly on previous experience and expectations, and on other connotations associated with the perceived source of the vibration. For example, the vibration that a person responds to as "normal" in a car, bus or train is considerably higher than what is perceived as "normal" in a shop, office or dwelling.

10 Over-Pressure

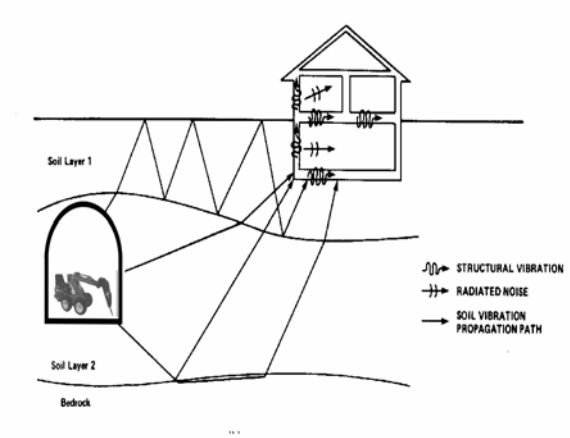
The term "over-pressure" is used to describe the air pressure pulse emitted during blasting or similar events. The peak level of an event is normally measured using a microphone in the same manner as linear noise (ie unweighted), at frequencies both in and below the audible range.

11 Ground-borne Noise, Structure-borne Noise and Regenerated Noise

Noise that propagates through a structure as vibration and is radiated by vibrating wall and floor surfaces is termed "structure-borne noise", "ground-borne noise" or "regenerated noise". This noise originates as vibration and propagates between the source and receiver through the ground and/or building structural elements, rather than through the air.

Typical sources of ground-borne or structure-borne noise include tunnelling works, underground railways, excavation plant (eg rockbreakers), and building services plant (eg fans, compressors and generators).

The following figure presents the various paths by which vibration and ground-borne noise may be transmitted between a source and receiver for construction activities occurring within a tunnel.

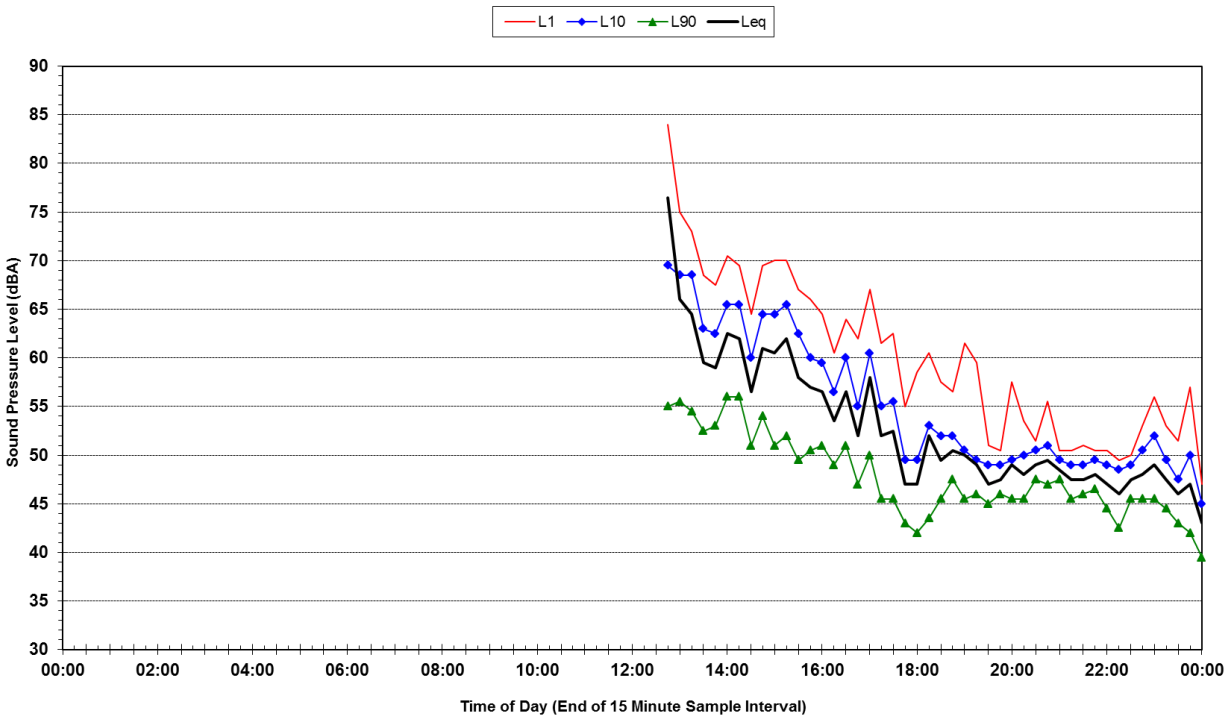


The term "regenerated noise" is also used in other instances where energy is converted to noise away from the primary source. One example would be a fan blowing air through a discharge grill. The fan is the energy source and primary noise source. Additional noise may be created by the aerodynamic effect of the discharge grill in the airstream. This secondary noise is referred to as regenerated noise

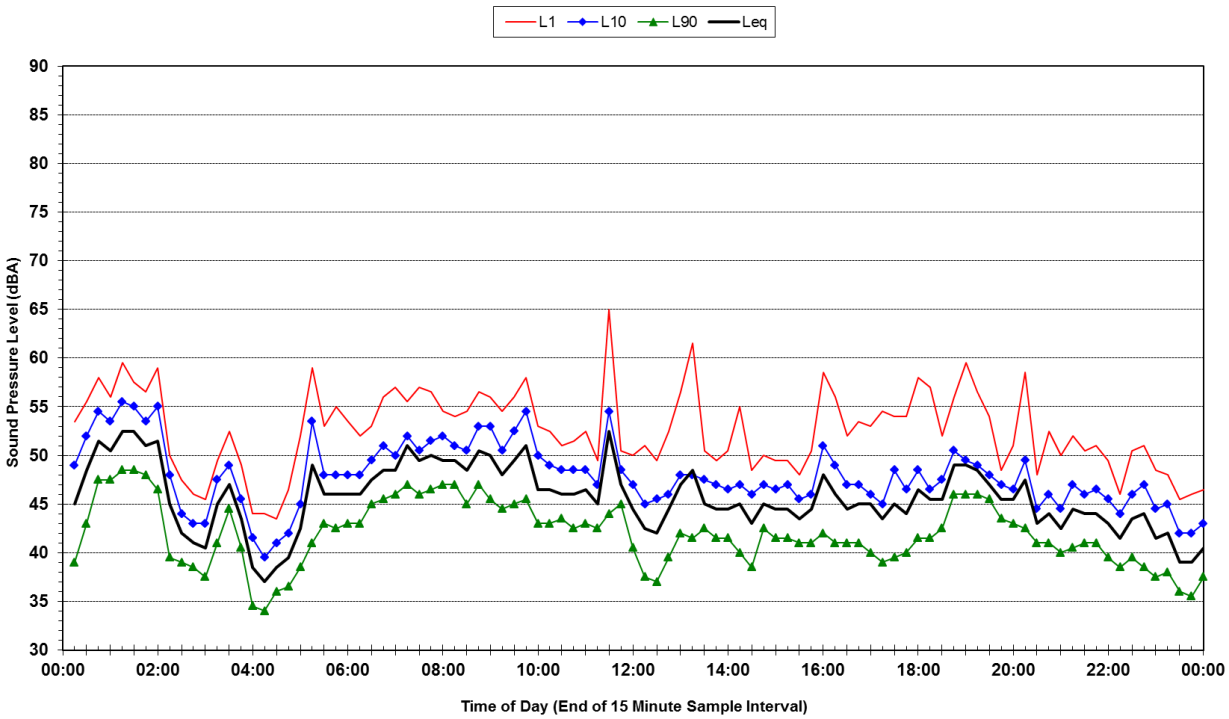
INDEX

BG.2007

Statistical Ambient Noise Levels
Erskine Park Residential - Wednesday 3 October 2007

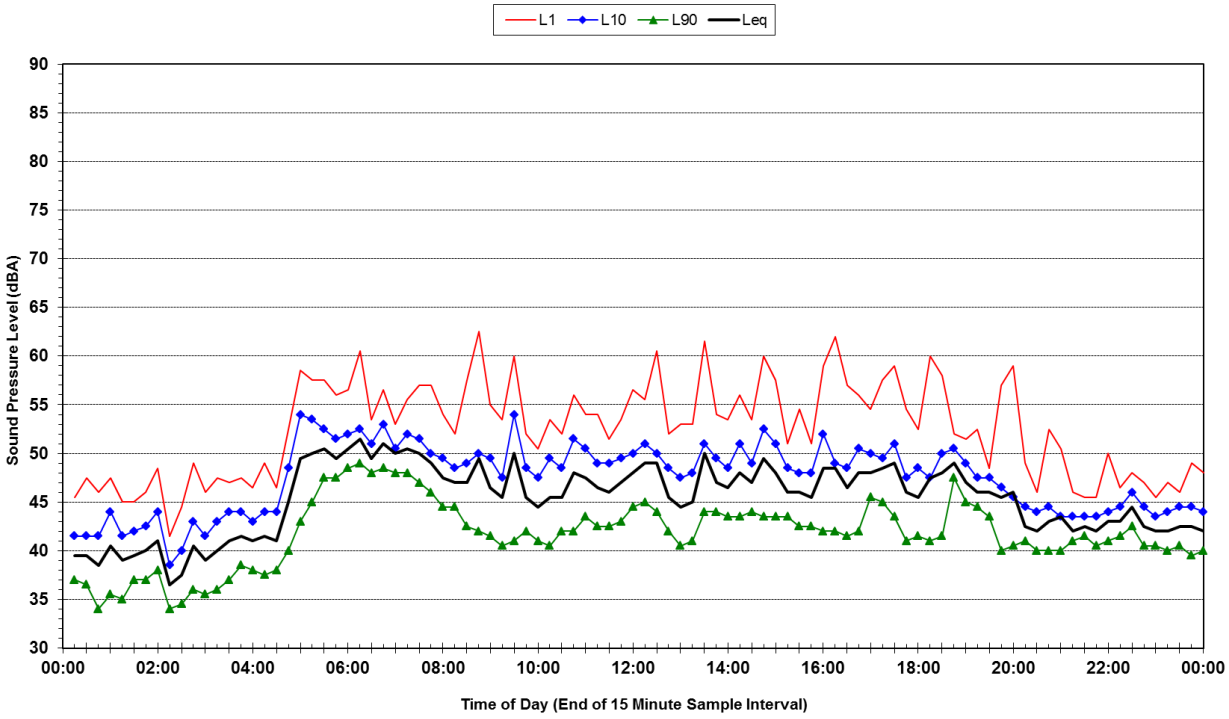


Statistical Ambient Noise Levels
Erskine Park Residential - Thursday 4 October 2007

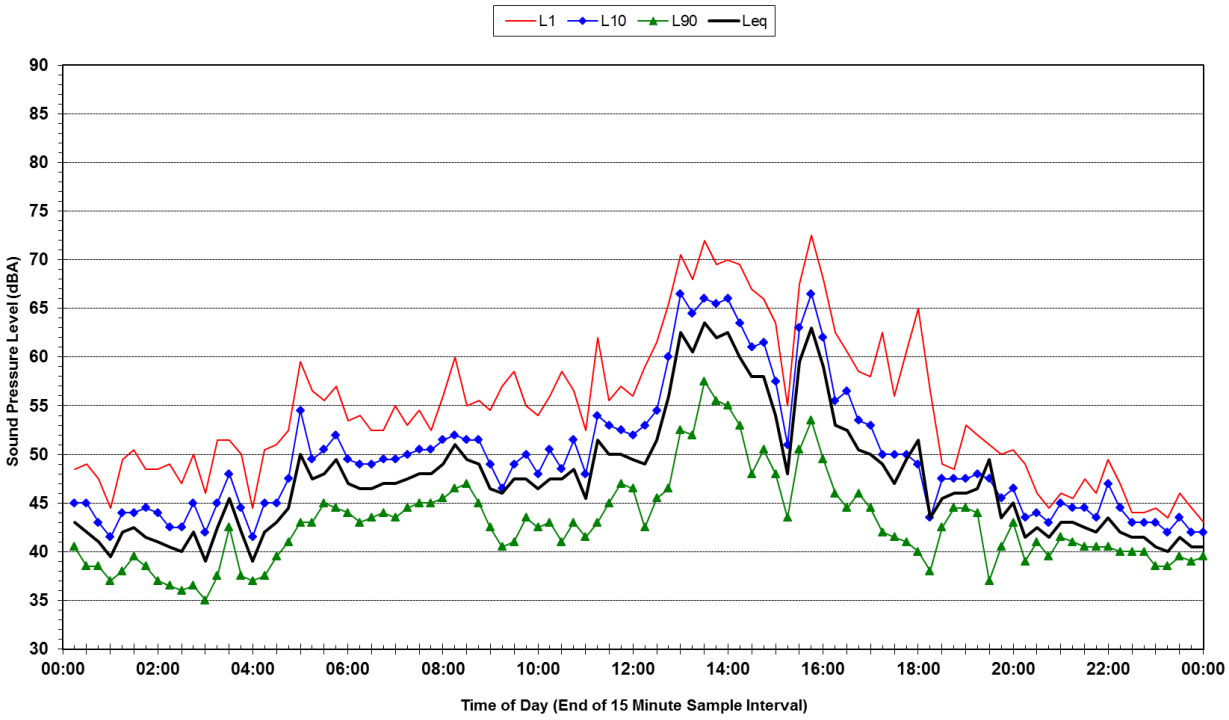


BG.2007

Statistical Ambient Noise Levels
Erskine Park Residential - Friday 5 October 2007

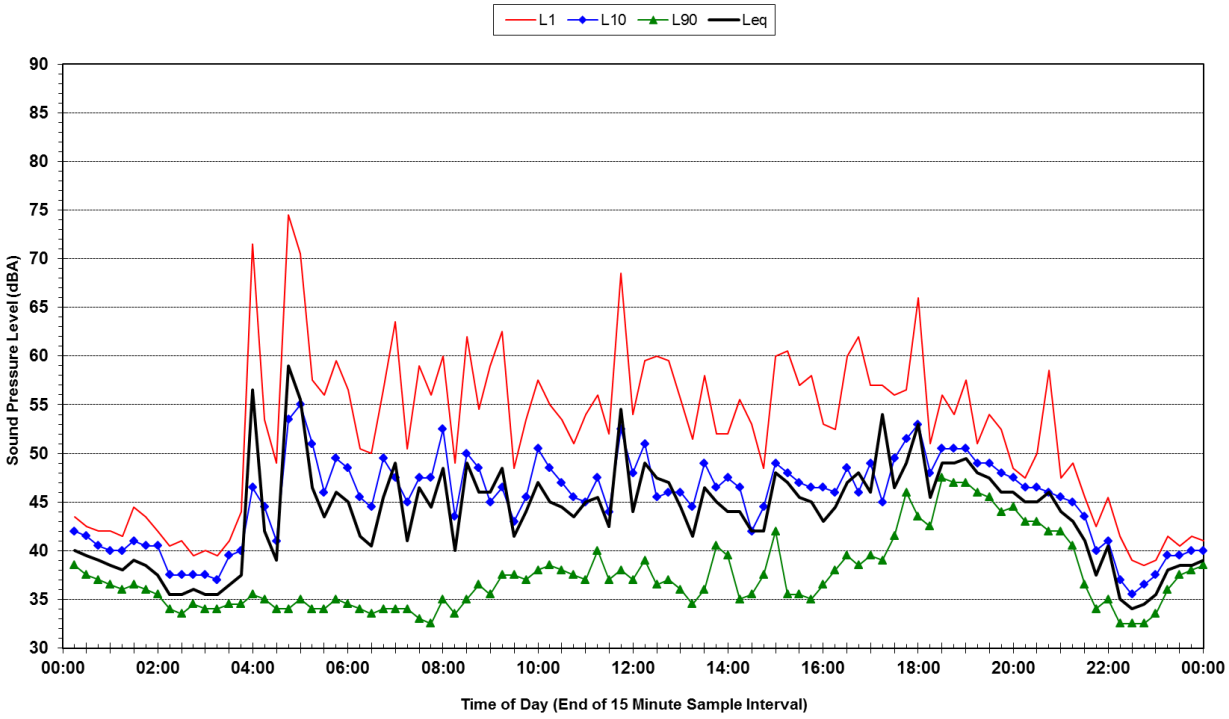


Statistical Ambient Noise Levels
Erskine Park Residential - Saturday 6 October 2007

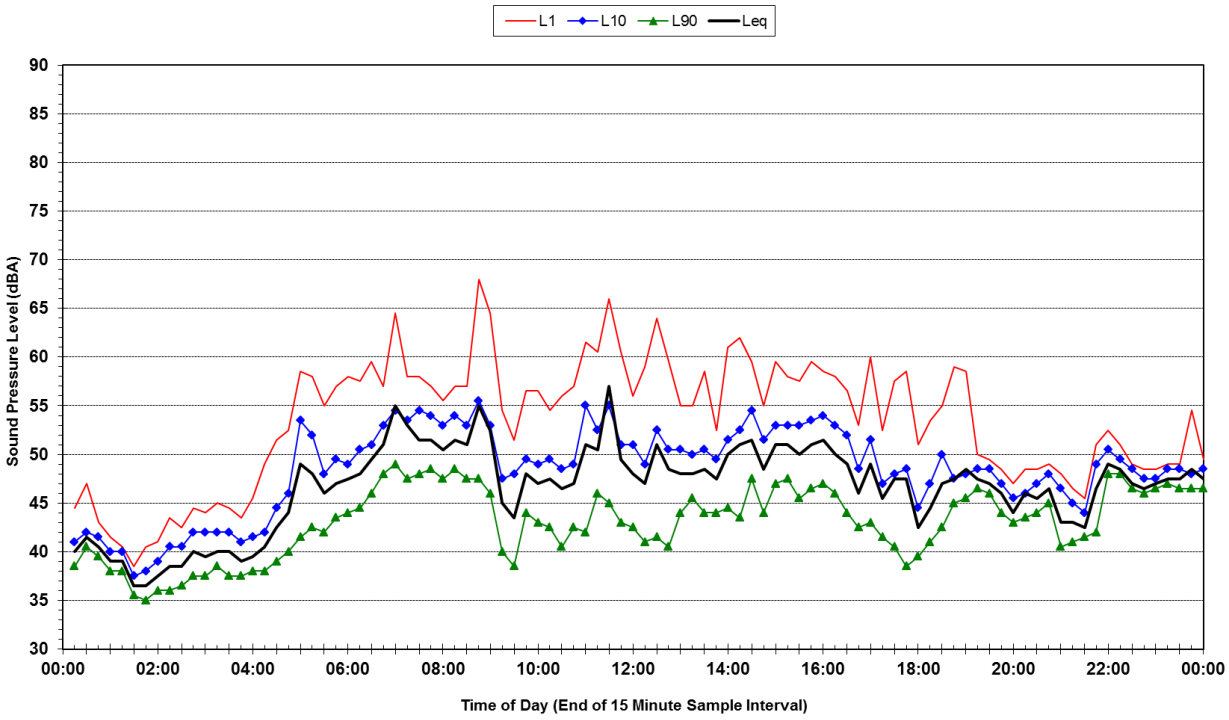


BG.2007

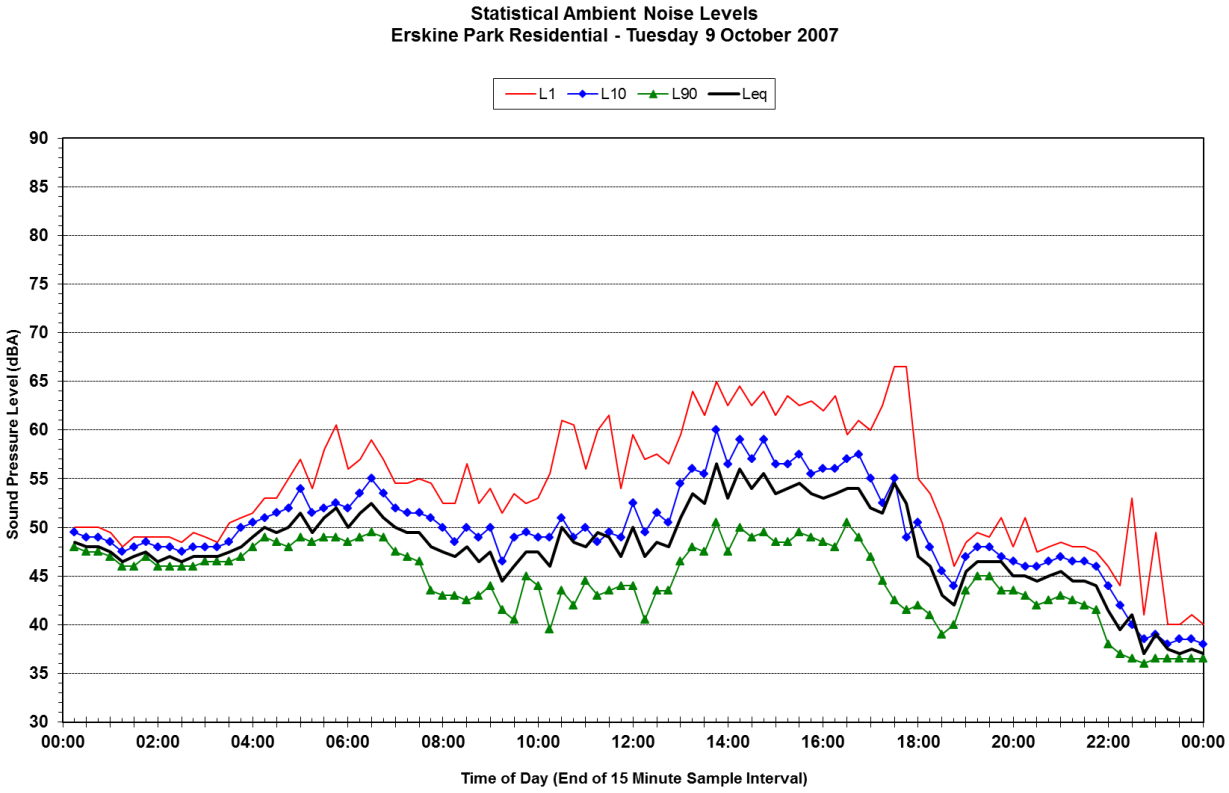
Statistical Ambient Noise Levels
Erskine Park Residential - Sunday 7 October 2007

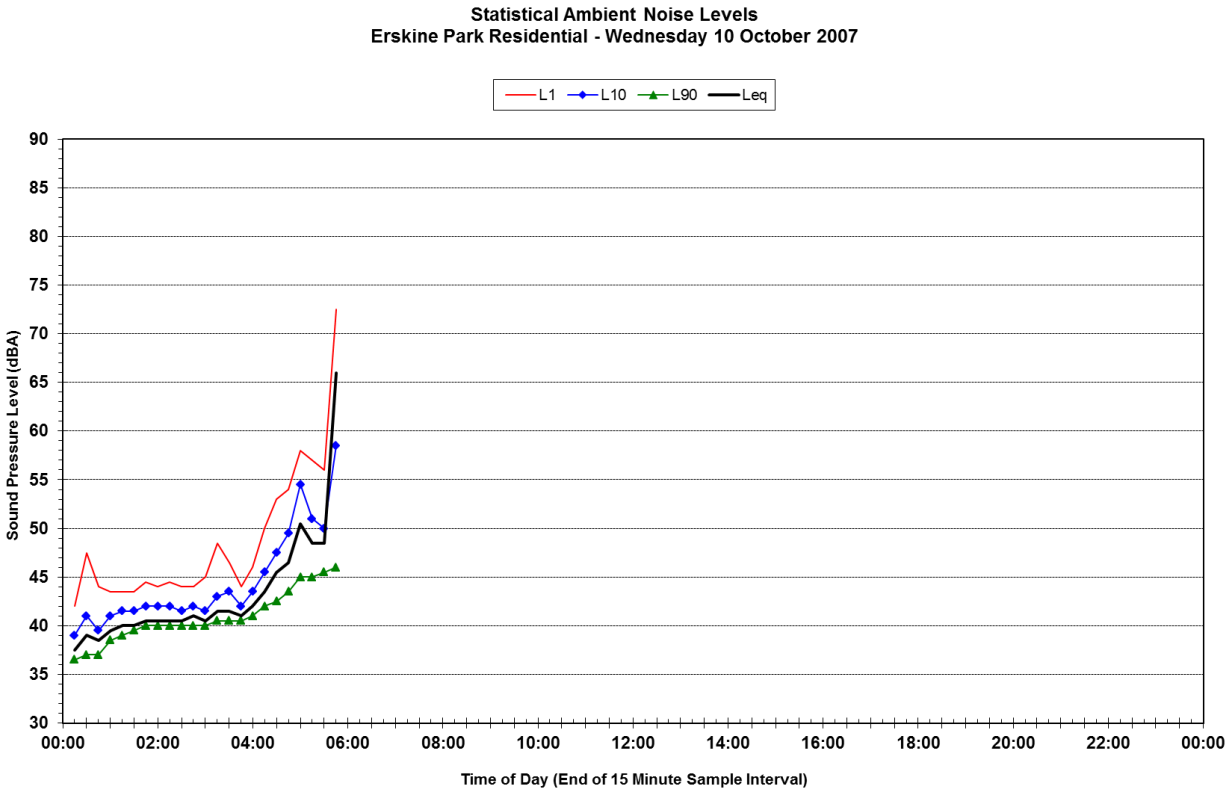


Statistical Ambient Noise Levels
Erskine Park Residential - Monday 8 October 2007



BG.2007

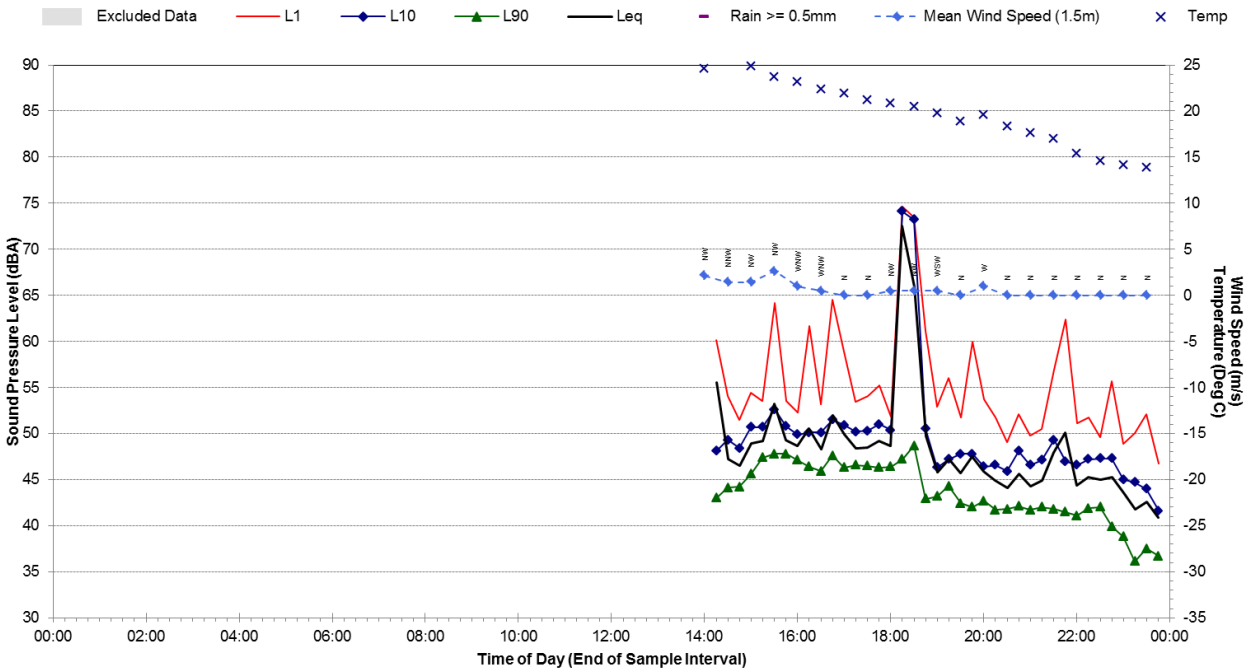

Statistical Ambient Noise Levels
Erskine Park Residential - Tuesday 9 October 2007
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
60
55
50
45
40
35
30
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Erskine Park Residential - Wednesday 10 October 2007
L1
L10
L90
Leq
Sound Pressure Level (dBA)
90
85
80
75
70
65
60
55
50
45
40
35
30
00:00
02:00
04:00
06:00
08:00
10:00
12:00
14:00
16:00
18:00
20:00
22:00
00:00
Time of Day (End of 15 Minute Sample Interval)

BG.2015

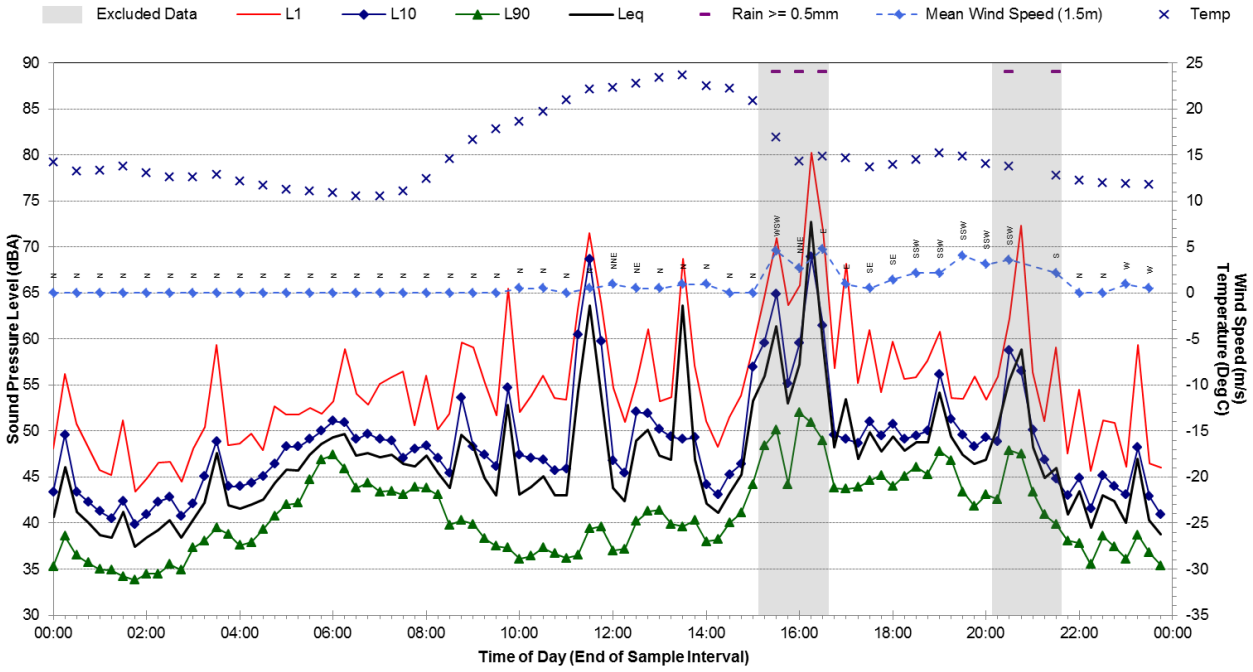
Statistical Ambient Noise Levels

BG.2015 - Friday, 24 April 2015



Statistical Ambient Noise Levels

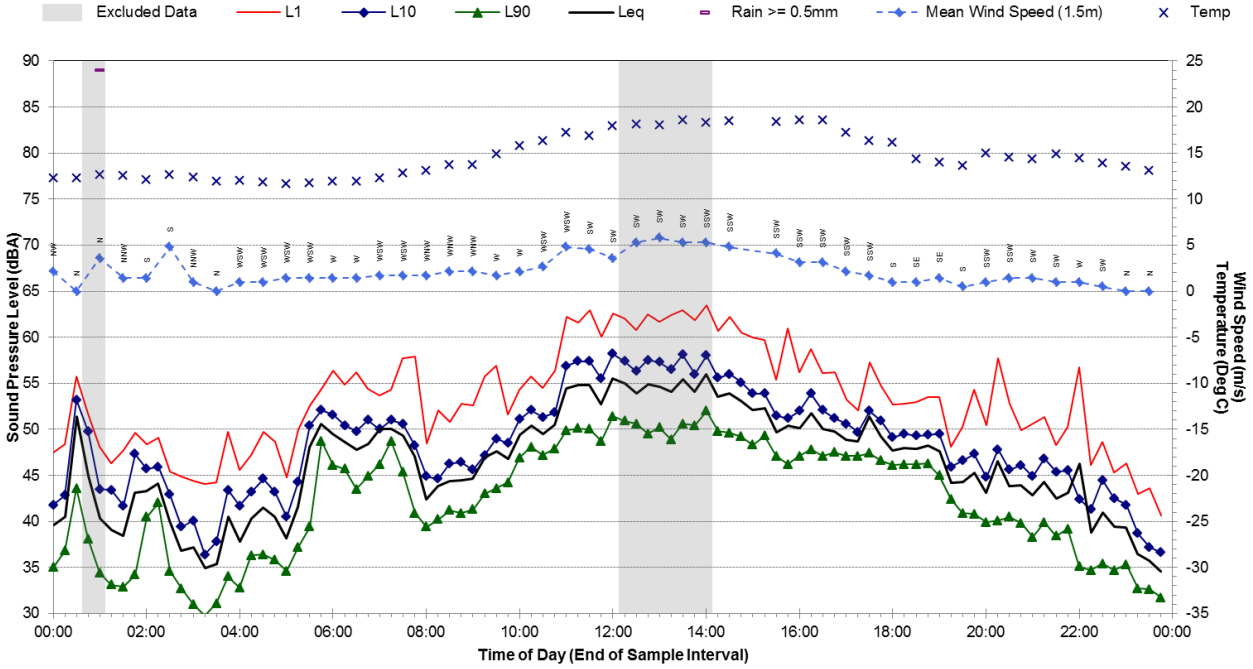
BG.2015 - Saturday, 25 April 2015



BG.2015

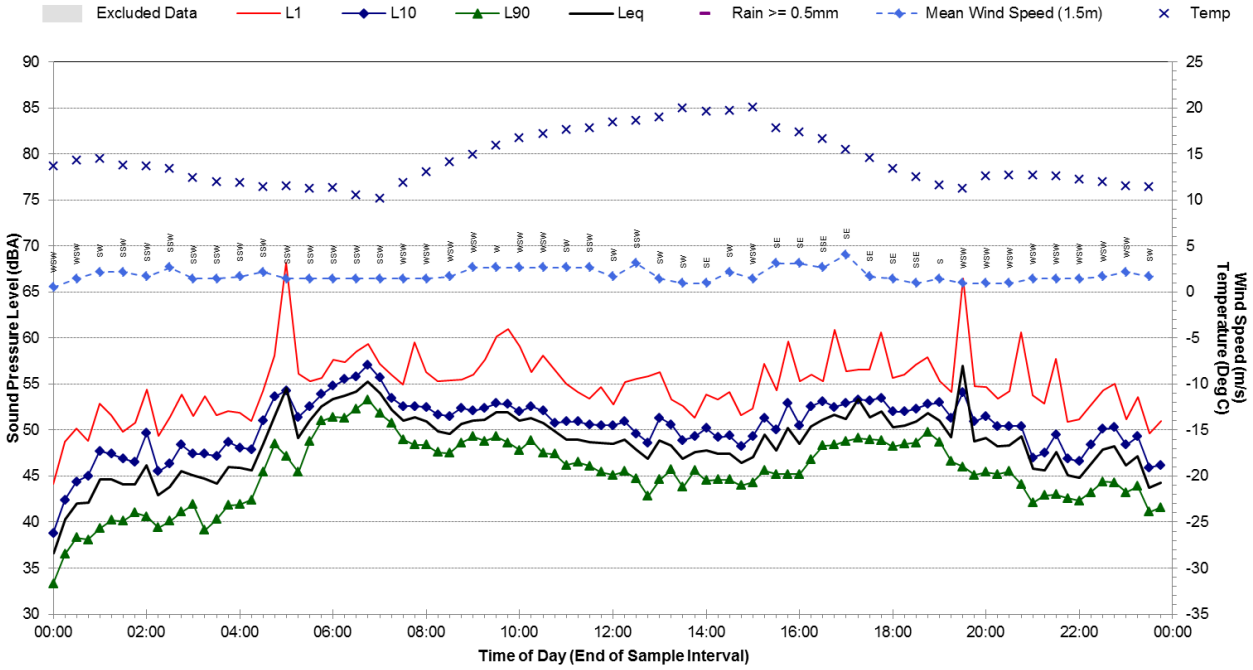
Statistical Ambient Noise Levels

BG.2015 - Sunday, 26 April 2015



Statistical Ambient Noise Levels

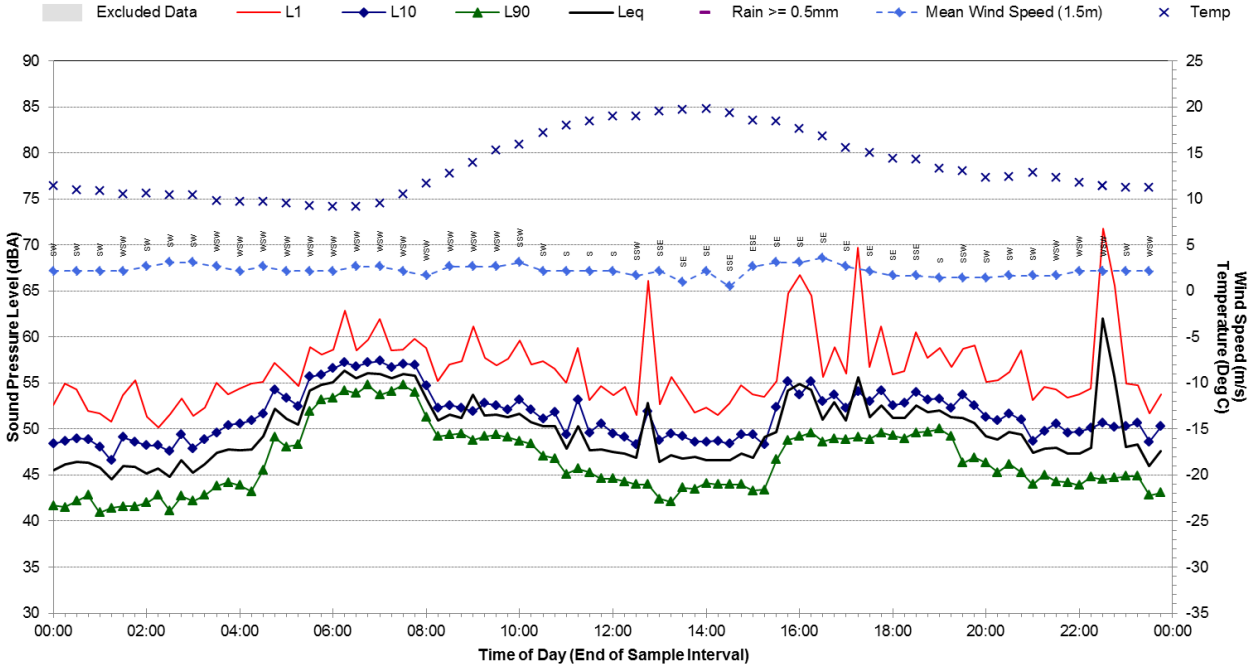
BG.2015 - Monday, 27 April 2015



BG.2015

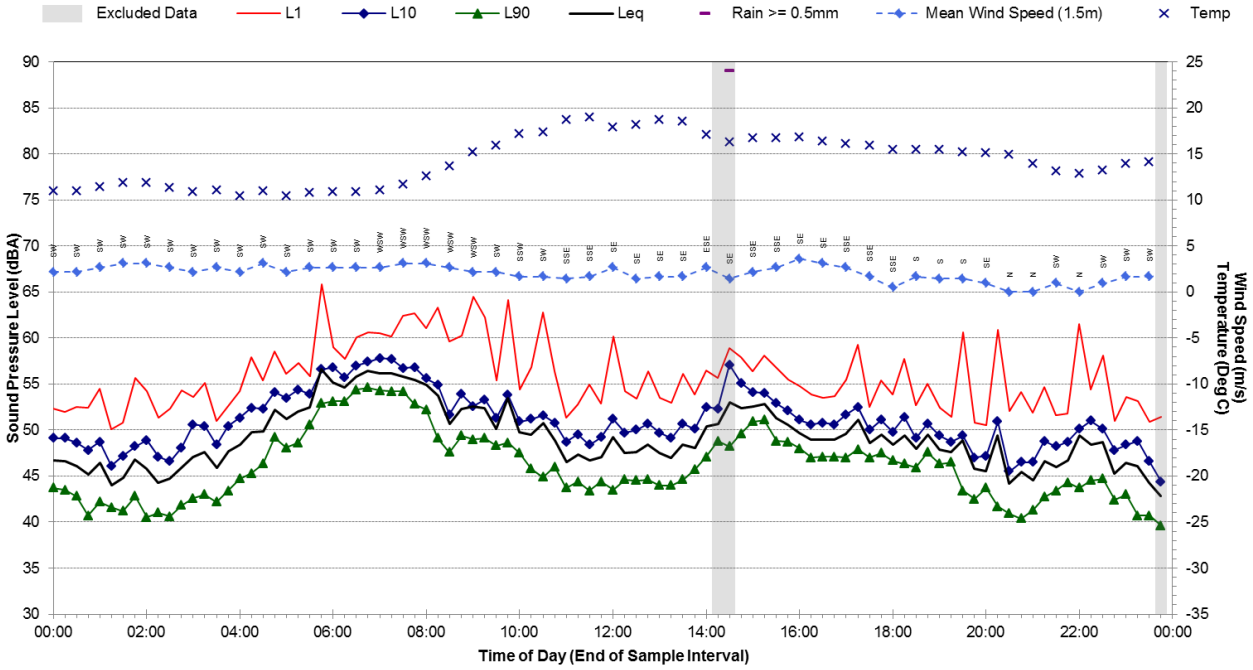
Statistical Ambient Noise Levels

BG.2015 - Tuesday, 28 April 2015



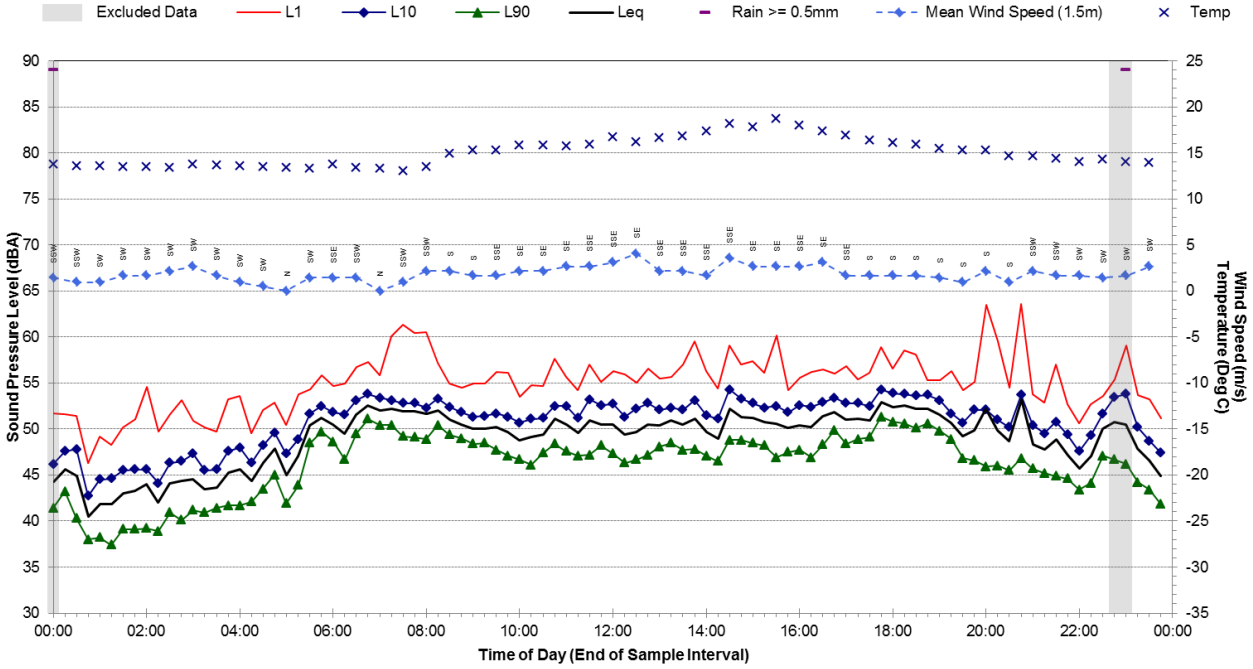
Statistical Ambient Noise Levels

BG.2015 - Wednesday, 29 April 2015

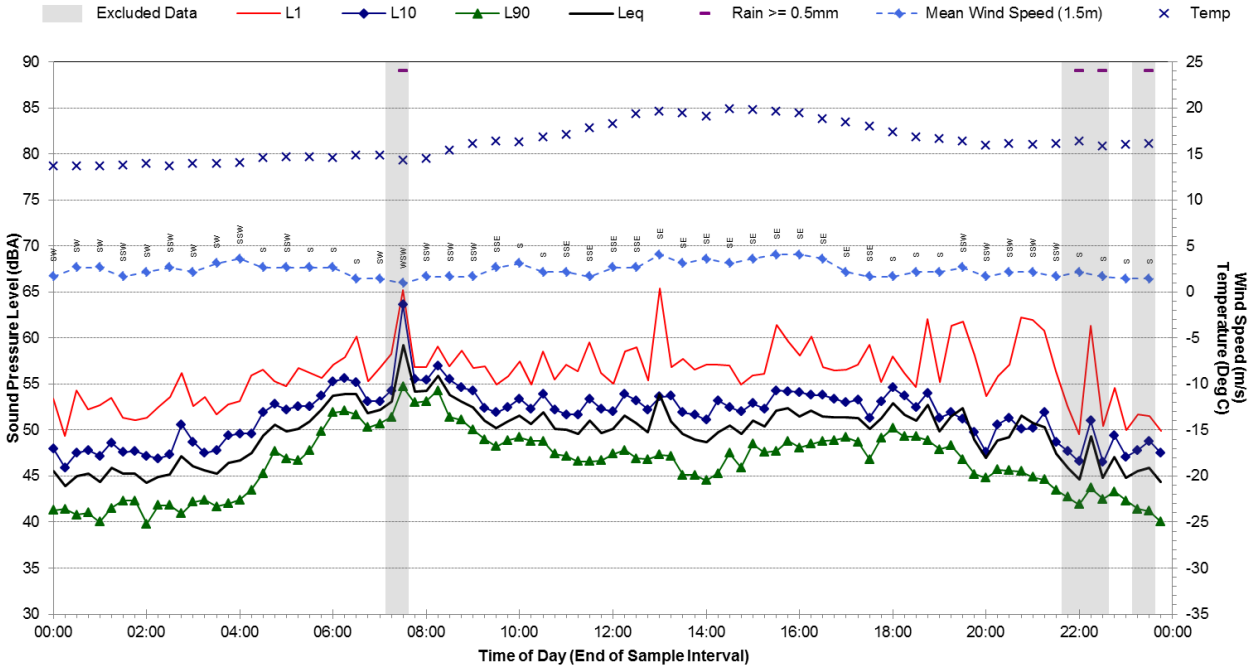


BG.2015

Statistical Ambient Noise Levels
BG.2015 - Thursday, 30 April 2015



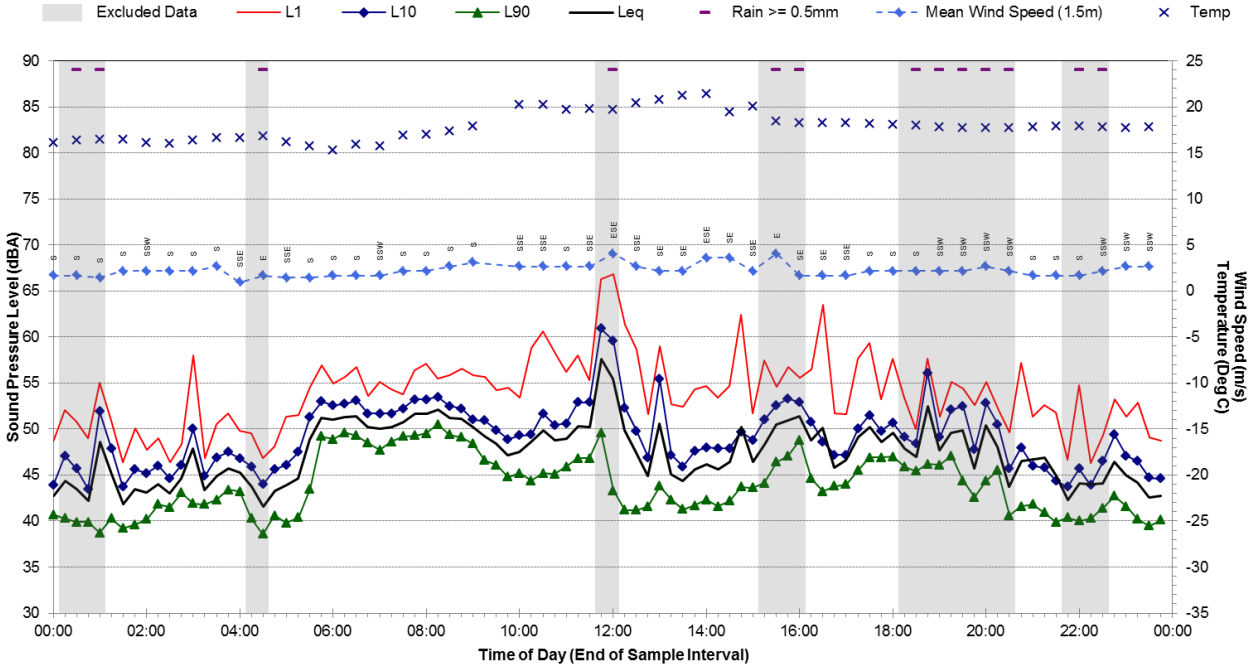
Statistical Ambient Noise Levels
BG.2015 - Friday, 1 May 2015



BG.2015

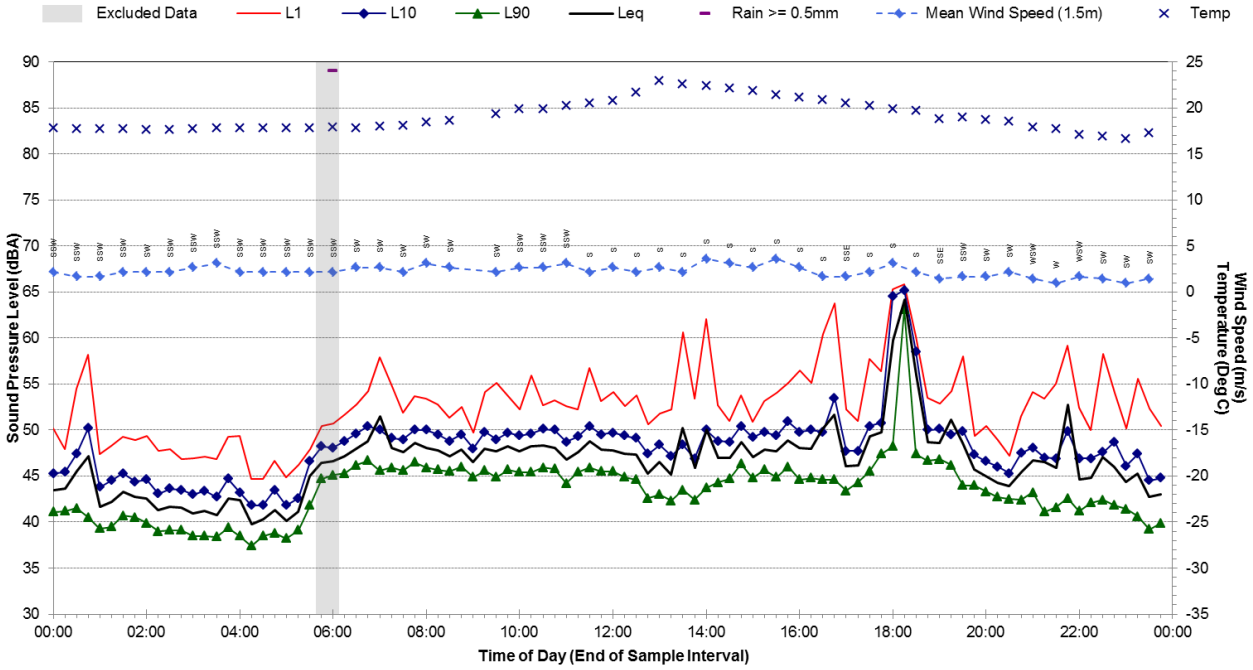
Statistical Ambient Noise Levels

BG.2015 - Saturday, 2 May 2015



Statistical Ambient Noise Levels

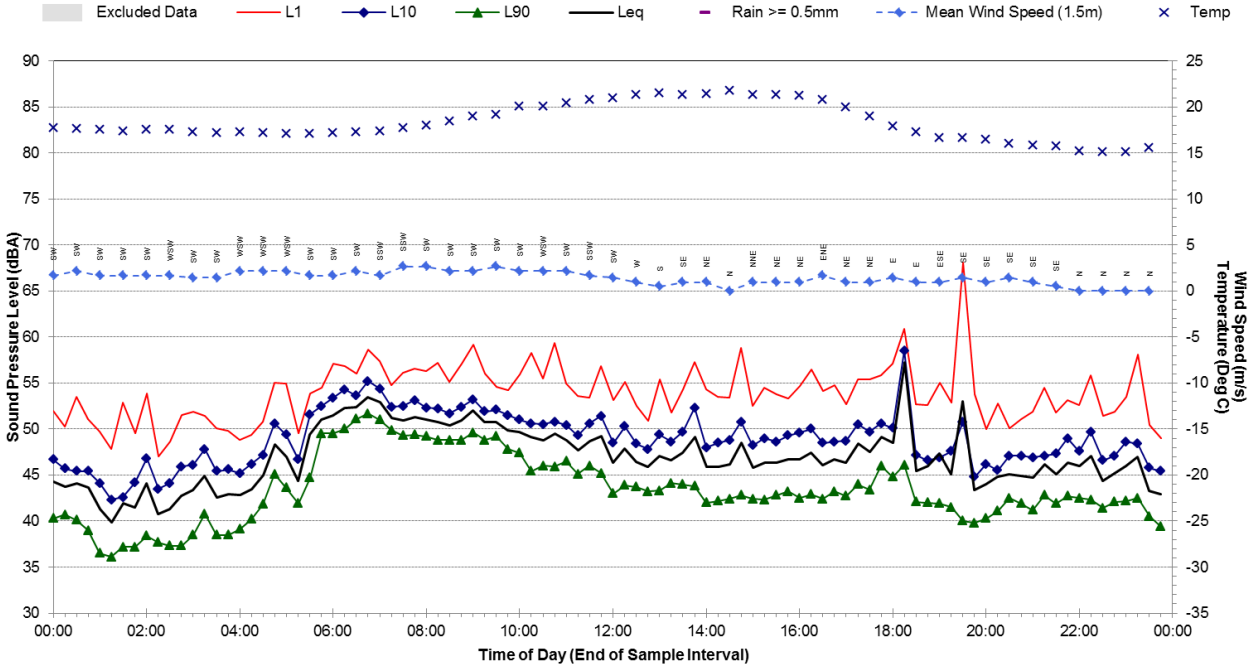
BG.2015 - Sunday, 3 May 2015



BG.2015

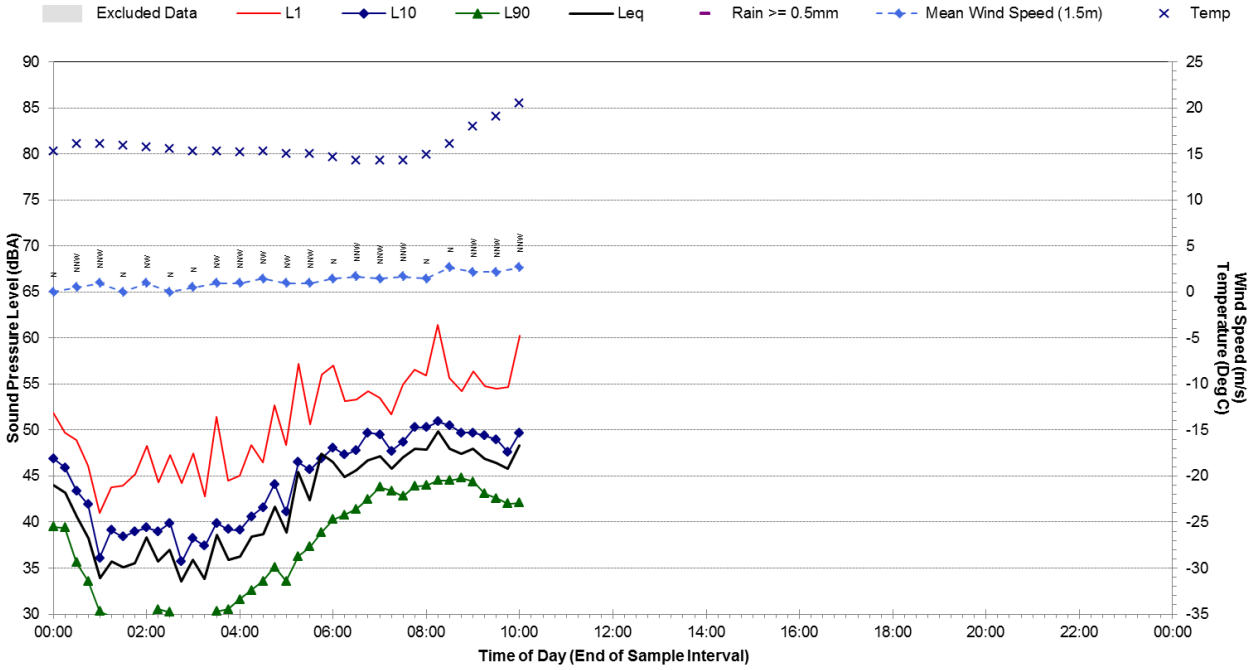
Statistical Ambient Noise Levels

BG.2015 - Monday, 4 May 2015



Statistical Ambient Noise Levels

BG.2015 - Tuesday, 5 May 2015



(b) a night time sleep disturbance criteria of 47 dB(A) LA1, 1minute at the nearest affected residential receivers within the residential areas of Erskine and St Clair Park.

Where LAeq means the equivalent continuous noise level – the level of noise equivalent to the energy-average of noise levels occurring over a measurement period.

Note: For the purpose of Condition L4.1: ·

- Day is defined as the period from 7am to 6pm Monday to Saturday and 8am to 6pm Sundays and Public Holidays;
- Evening is defined as the period from 6pm to 10pm;
- Night is defined as the period from 10pm to 7am Monday to Saturday and 10pm to 8am Sundays and Public Holidays.

L4.2 To determine compliance with Condition L4.1, noise from the premises is to be measured at the receivers specified in Condition L4.1 at the most affected point within the residential boundary, or at the most affected point within 30 metres of the dwelling where the dwelling is more than 30 metres from the boundary. Where internal noise levels are to be measured the measurement should be conducted with windows open to provide normal ventilation where required.

Where it can be demonstrated that direct measurement of noise from the premises is impractical, the EPA may accept alternative means of determining compliance (see Chapter 11 of the NSW Industrial Noise Policy, January 2000).

A modifying factor correction must be applied for tonal, impulsive or intermittent noise in accordance with the "Environmental Noise Management – NSW Industrial Noise Policy, January 2000".

L4.3 Noise from the premises is to be measured at 1m from the dwelling façade of a residential receiver (specified in Condition L4.1) to determine compliance with the LA1, 1minute noise limits in Condition L4.1.

L4.4 Noise from the premises associated with reversing alarms, amplified telephones or external announcement or amplified pager systems or any other alarm or system likely to cause disturbance must not be audible at the nearest affected receivers during the evening period between 6:00pm until 10:00pm and the night time period which extends from 10:00pm until 7:00am during any 24 hour period.

L4.5 The noise emission limits identified in this licence apply under all meteorological conditions except:

a) during rain and wind speeds (at 10m height) greater than 3m/s; and

b) under "non-significant weather conditions".

Note Field meteorological indicators for non-significant weather conditions are described in the NSW Industrial Noise Policy, Chapter 5 and Appendix E in relation to wind and temperature inversions.

4.2 INDUSTRIAL NOISE POLICY

Noise objectives for the assessment of industrial/commercial facilities at residential receivers are detailed in the Industrial Noise Policy, as administered by the EPA. The policy is normally applied at the residential property boundary.

This report is focused on the use of vehicle horns within the boundary of the WSSC and the assessment of sleep disturbance from noise emissions generated by these events. Therefore, this report focuses on the INP's sleep disturbance assessment framework alone and does not consider other INP objectives.

4.2.1 INP Assessment of Prevailing Weather Conditions

4.2.1.1 Wind

Wind has the potential to increase noise at a receiver when it is light and stable and blows from the direction of the noise source. As the strength of the wind increases the noise produced by the wind will obscure noise from most industrial and transport sources.

When the source to receiver wind component is at speeds of up to 3 m/s for 30% or more of the time in any seasonal period (ie daytime, evening or night-time), then wind is considered to be a feature of the area and noise level predictions must be made under these conditions.

The NSW INP Section 5.3, Wind Effects, states that:

> *"Wind effects need to be assessed where wind is a feature of the area. Wind is considered to be a feature where source to receiver wind speeds (at 10 m height) of 3 m/s or below occur for 30 percent of the time or more in any assessment period in any season."*

An assessment of existing wind conditions has been prepared from the meteorological data recorded by the Bureau of Meteorology at the Horsley Park weather station for the period May 2012 to May 2015. This weather station is located approximately 7.5 km from the proposed Erskine Park Transfer Station and the recorded weather conditions are considered representative of those in the vicinity of the proposed Erskine Park Transfer Station.

Any prevailing winds of speed less than (or equal to) 3 m/s with a frequency of occurrence greater than (or equal to) 30%, and considered to be a feature of the project site in accordance with the INP, are presented in **Table 3**.

Table 3 Project Site Prevailing Wind Conditions in Accordance with the INP

Season	Winds ±45° ≤3m/s with Frequency of Occurrence ≥30%		
	Daytime	Evening	Night-Time
Summer	Nil	Nil	Nil
Autumn	Nil	Nil	**32.9% SW, 32.3% WSW**
Winter	Nil	**29.8% SW, 29.6% WSW**	**34.0% WSW, 31.6% W, 30.6% SW**
Spring	Nil	Nil	Nil

Temperature inversions, when they occur, have the ability to increase noise levels by focusing sound waves. Temperature inversions occur predominantly at night during the winter months. For a temperature inversion to be a significant characteristic of the area it needs to occur for 30% or more of the total night-time during winter or about two nights per week. The NSW INP states that temperature inversions need only be considered for the night-time noise assessment period ie 10.00 pm to 7.00 am.

4.2.1.2 Temperature Inversion

The NSW INP Section 5.2, Temperature Inversions, states:

> *"Assessment of impacts is confined to the night noise assessment period (10:00 pm to 7:00 am), as this is the time likely to have the greatest impact - that is, when temperature inversions usually occur and disturbance to sleep is possible."*
>
> *"Where inversion conditions are predicted for at least 30% (or approximately two nights per week) of total night-time in winter, then inversion effects are considered to be significant and should be taken into account in the noise assessment."*

In the absence of measured data, the INP nominates default inversion parameters for non-arid areas where the average rainfall is greater than 500 mm namely:

> *"3°C/100 m temperature inversion for all receivers, plus a 2 m/s source-to-receiver component drainage-flow wind speed for those receivers where applicable."*

An assessment of atmospheric stability has been prepared from the meteorological data set at Horsley Park and the evening and night-time frequency of occurrences of atmospheric stability classes for the period May 2012 to May 2015 are presented in **Table 4** together with the estimated Environmental Lapse Rates (ELR).

Table 4 Prevailing Atmospheric Stability Frequency - Evening and Night-time - May 2012 to May 2015

Stability Class	Frequency of Occurrence				Estimated ELR °C/100 m	Qualitative Description
	Summer	Autumn	Winter	Spring		
A	0.0%	0.0%	0.0%	0.0%	<-1.9	Lapse
B	0.0%	0.0%	0.0%	0.0%	-1.9 to -1.7	Lapse
C	0.0%	0.0%	0.0%	0.0%	-1.7 to -1.5	Lapse
D	50.6%	42.4%	44.3%	45.5%	-1.5 to -0.5	Neutral
E	9.3%	11.5%	12.0%	9.5%	-0.5 to 1.5	Weak Inversion
F	8.7%	11.2%	14.2%	10.7%	1.5 to 4	Moderate Inversion
G	31.4%	34.9%	29.5%	34.4%	>4.0	Strong Inversion

Note 1: ELR (Environmental Lapse Rate).

In accordance with the INP, as the frequency of occurrence of strong (ie >4.0°C/100 m) temperature inversions are greater than 30% during the combined evening and night-time period, temperature inversion requires assessment.

4.2.2 Modifying Factors

Where a noise source contains certain characteristics that may cause greater annoyance to receivers such as tonality or low frequency, the INP provides modifying factors that should be applied to the noise source level at the receiver before comparison with the amenity or intrusiveness criteria. Modifying factors are therefore not applicable when comparing noise levels against the sleep disturbance criteria and are not considered further in this assessment.

4.2.3 Sleep Disturbance

The EPA's most recent policy (refer to EPA's INP Application Notes) considers sleep disturbance as the emergence of the $L_{A1(1minute)}$ level above the $L_{A90(15minute)}$ level at the time. Appropriate screening criteria for sleep disturbance are nominated in the INP to be an $L_{A1(1minute)}$ level 15 dBA above the Rating Background Level (RBL) for the night-time period (10.00 pm to 7.00 am).

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

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

- How often high noise events will occur
- Time of day (normally between 10.00 pm and 7.00 pm)
- Whether there are times of the day when there is a clear change in the noise environment (such as during early morning shoulder periods).

A substantial portion of the NSW *Environmental Criteria for Road Traffic Noise* (ECRTN) is a review of international sleep disturbance research, indicating that:

- A 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 65-70 dBA are not likely to significantly affect health and wellbeing.

4.2.4 Project Specific Sleep Disturbance Criteria

The WSSC operational noise emission criteria have been determined with reference to the INP, as outlined in **Section 4.2** for comparison against the limits in the EPL. However, it is noted that the limits stipulated in the EPL are the applicable limits for determination of operational noise compliance.

The INP defined operational sleep disturbance criteria are provided in **Table 5**.

Table 5 INP Project Specific Noise Assessment Criteria (dBA re 20 µPa)

Location	Measured Noise Level[1]	Project Specific Sleep Disturbance Criteria
	Night-time RBL ($L_{A90(15minute)}$)	Night-time ($L_{A1(1\ minute)}$)
BG.2007	37	52
BG.2015	39	54

Note 1: Measured ambient noise levels presented in **Section 3**

4.3 WSSC EPL Criteria vs 2017 Updated INP Sleep Disturbance Criteria

A comparison of the sleep disturbance criteria stipulated in the WSSC's EPL and the project specific sleep disturbance criteria derived from the processes outlined in the INP is presented in **Table 6**.

Table 6 Sleep Disturbance Criteria Comparison

Sleep Disturbance Criterion - Night-time (LA1(1 minute)) dBA		
EPL No 12495	**INP Project Specific Sleep Disturbance Criteria[1]**	
	BG.2007	**BG.2015**
47	52	54

Note 1: Based on measured ambient noise levels presented in **Section 3**. Refer **Section 4.2.4**.

Based on the sleep disturbance criteria comparison in **Table 6**, it can be seen that the EPL sleep disturbance criteria of 47 dBA, is more stringent than the INP project specific sleep disturbance criteria based on ambient noise monitoring performed in 2007 and 2015.

Based on the most recent noise monitoring data, the project specific sleep disturbance criterion derived in accordance with the procedures outlined in the INP is 54 dBA.

A review of the 2007 and 2015 ambient noise monitoring results presented in **Appendix B** indicate that night time $L_{A1(15\ minute)}$ noise levels in excess of 55 dBA occur frequently during the night-time period. As such, the generation of short-term noise events below this level would be of similar magnitude to the existing noise environment.

Based on the above information, an $L_{A1(1\ minute)}$ sleep disturbance criterion of 54 dBA is considered reasonable for the assessment of potential awakening events for the following reasons:

- This is consistent with the procedures outlined in the INP.
- This level is based on ambient noise monitoring data which was measured and processed in accordance with the procedures outlined in INP.
- Ambient noise monitoring performed in 2007 and 2015 indicate that the existing ambient noise environment is frequently subject to short-term noise events in excess of this level.

5 ANNUAL OPERATIONAL NOISE COMPLAINCE ASSESSMENT

5.1 Previous Compliance Assessment - 2007 to 2015

Typically, noise emissions from the operation of the WSSC were found to be not clearly discernible at the nearest sensitive receivers. As such the contribution of the WSSC was not directly measurable. Therefore, measurements at the WSSC boundary where undertaken, where noise from the WSSC was clearly audible, in order predict the noise from the WSSC at the nearest residential receivers to the north of the site.

The noise predictions were undertaken using spreadsheet calculations. The noise predictions account for distance and meteorological effects. A summary of the compliance assessment results is shown in **Table 7**.

Table 7 Summary of the Compliance Assessment Results from 2007 to 2015

Noise Descriptor	Report Number - Date										
	R1 – Oct 2007	R2 – Aug 2008	R3 – Apr 2009	R4 – Oct 2009	R5 – Apr 2010	R6 – Jun 2011	R7 – May 2012	R8 – Sep 2012	R9 – Sep 2013	R10 – Oct 2014	R11 – Dec 2015
LAeq(15 minute) - Daytime	31	35	31	31	27	32	31	33	34	20	25
LAeq(15 minute) - Evening	31	35	31	31	27	32	31	33	34	20	25
LAeq(15 minute) – Night-time	31	35	31	31	27	32	31	33	34	20	25
LA1(1 minute) – Sleep Disturbance – Standard Operation	41	41	40	43	43	45	42	38	41	38	33
LA1(1 minute) – Sleep Disturbance – Including truck horn event	-	-	-	-	-	-	-	**56**	-	-	**56**

Note: Results presented in **BOLD** indicate an exceedance of EPL noise criteria.

The results provided in **Table 7** show that the noise emissions resulting from the operation of the WSSC comply with the EPL intrusive $L_{Aeq(15minute)}$ criterion for each assessment period.

The results provided in **Table 7** indicate that the WSSC complies with the EPL sleep disturbance criterion of 47 dBA for all noise events except where vehicle horns are used on the premises. The use of delivery vehicle horns within the dispatch area is predicted to exceed the EPL sleep disturbance criterion by up to 9 dB.

Results provided in **Table 7** indicate that the WSSC complies with the project specific INP sleep disturbance criterion of 54 dBA (based on the 2015 measurements) for all noise events except where vehicle horns are used on the premises. The use of delivery vehicle horns within the dispatch area is predicted to exceed the INP sleep disturbance criterion (based on the 2015 measurements) by up to 2 dB.

6 ENVIRONMENTAL COMPUTER NOISE MODELLING

In order to refine the calculated maximum noise contribution from the use of vehicle horns within the WSSC during night, a SoundPLAN computer model was developed which incorporates the key noise sources and the intervening terrain to the closest potentially affected receivers.

The computer model was prepared using the SoundPLAN V7.1 Industrial Noise Module, a commercial software system developed by Braunstein and Berndt GmbH in Germany. The software allows the use of various internationally recognised noise prediction algorithms. The CONCAWE algorithm, suitable for the assessment of large industrial plants, has been selected for this assessment as it also enables meteorological influences to be assessed.

The noise modelling takes into account source sound level emissions and locations, screening effects, receiver locations, meteorological effects, ground topography and noise attenuation due to spherical spreading and atmospheric absorption.

6.1 Meteorological Parameters

The noise modelling meteorological parameters presented in **Table 8** are based on the meteorological conditions presented in **Section 4.2.1**.

Table 8 Operational Noise Modelling Meteorological Parameters

Season	Period	Air Temp	Relative Humidity	Wind Velocity	Temperature Gradient
Non-adverse Annual	Daytime	20°C	58%	0m/s	0°C/100m
Non-Adverse Annual	Evening	17°C	68%	0m/s	0°C/100m
Adverse Winter SW Wind	Evening	12°C	70%	3m/s SW	0°C/100m
Adverse Winter WSW Wind	Evening	12°C	70%	3m/s WSW	0°C/100m
Non-Adverse Annual	Night-time	14°C	81%	0m/s	0°C/100m
Adverse Winter WSW Wind	Night-time	9°C	80%	3m/s WSW	0°C/100m
Adverse Winter W Wind	Night-time	9°C	80%	3m/s W	0°C/100m

Season	Period	Air Temp	Relative Humidity	Wind Velocity	Temperature Gradient
Adverse Winter SW Wind	Night-time	9°C	80%	3m/s SW	0°C/100m
Adverse Winter Temperature Inversion	Night-time	9°C	80%	0m/s	3°C/100m[1]

Note 1: Using INP default inversion parameter for non-arid areas

6.2 Noise Source Sound Power Levels

Noise emissions from vehicle horns were measured during compliance monitoring works in September 2012, October 2014 and December 2015 (Refer to reports R8, R10 and R11). Sound power levels derived from measurements during those measurements have been adopted for this study.

6.3 Operational Scenarios Modelled

Based on the meteorological parameters presented in **Table 8**, the following worse case operational noise modelling scenarios were derived:

- WSSC Truck Horn Operations - Night-time - Calm Weather, Annual
- WSSC Truck Horn Operations - Night-time - Adverse Winter Weather, SW Wind
- WSSC Truck Horn Operations - Night-time - Adverse Winter Weather, WSW Wind
- WSSC Truck Horn Operations - Night-time - Adverse Winter Weather Including Temperature Inversion and Wind (all directions)

6.4 Sleep Disturbance Noise Impact Assessment

Predicted WSSC vehicle horn $L_{A1(1minute)}$ noise levels are presented in **Table 9** together with the EPL and 2015 INP project specific sleep disturbance criteria.

Table 9 Predicted WSSC Vehicle Horn LA1(1minute) Noise Levels

Predicted Noise Level (LA1(1 minute)) dBA		Sleep Disturbance Criteria			
Modelling Scenario		EPL 12495	Compliant?	INP criteria[1]	Compliant?
Calm	46	47	Yes	54	Yes
Adverse Weather: Wind SW	51		No		Yes
Adverse Weather: Wind WSW	52		No		Yes
Adverse Weather: Temperature Inversion and Wind	52		No		Yes

Note 1: INP project specific sleep disturbance criteria. Based on measured ambient noise levels presented in **Section 3**.

6.5 Discussion

Based on the $L_{A1(1minute)}$ noise levels presented in **Table 9** it is predicted that the use of heavy vehicle horns within the WSSC grounds would comply with the EPL and the INP project specific sleep disturbance noise criteria under calm weather conditions.

Under adverse weather conditions, the predicted the $L_{A1(1minute)}$ noise levels presented in **Table 9** exceed the EPL sleep disturbance noise criteria by up to 5 dB. However, the same noise levels are found to comply with the INP project specific sleep disturbance noise criteria of 54 dB.

7 SUMMARY OF FINDINGS

7.1 Ambient Noise Environment

The ambient noise environment surrounding residential receivers closest to the WSSC was measured during 2007 and more recently on 2015. The noise monitoring results indicate that the night-time L_{A90} noise levels were approximately 1 dB to 2 dB higher in 2015 compared to 2007.

7.2 Prevailing Meteorological Conditions

An analysis of the meteorological data recorded by the Bureau of Meteorology at the Horsley Park weather station for the period of May 2012 to May 2015 has been performed. This information indicated that assessment of noise levels must consider meteorological effects including temperature inversion and wind effects.

7.3 Noise Criteria

The limits stipulated in the EPL are used for determination of operational noise compliance.

Measured ambient noise levels used to derive INP sleep disturbance criteria are presented in this report for information purposes.

7.4 INP Modifying Factors

Modifying factors are not applicable when comparing noise levels against the sleep disturbance criteria and are therefore not considered further this assessment.

7.5 INP Defined Project Specific Sleep Disturbance Criteria

Based on the sleep disturbance criteria comparison presented in this report, sleep disturbance criteria of 47 dBA as specified in the EPL, is more stringent than the INP project specific sleep disturbance criteria based on ambient noise monitoring performed in 2007 and 2015.

Based on the most recent noise monitoring data, the project specific sleep disturbance criterion derived in accordance with the procedures outlined in the INP is 54 dBA.

An $L_{A1(1\ minute)}$ sleep disturbance criterion of 54 dBA is considered reasonable for the assessment of potential awakening events for the following reasons:

- This is consistent with the procedures outlined in the INP.
- This level is based on ambient noise monitoring data which was measured and processed in accordance with the procedures outlined in INP.
- Ambient noise monitoring performed in 2007 and 2015 indicate that the existing ambient noise environment is frequently subject to short-term noise events in excess of this level.

7.6 Detailed 3D Environmental Noise Modelling

The noise impacts associated with the use of heavy vehicle horns within the WSSC grounds has been modelled using calibrated SoundPLAN 3D noise prediction software. This model includes:

- The nearest potentially most affected residential receivers
- The surrounding built environment including commercial and industrial buildings
- The surrounding 3D topography as defined by recent LiDAR survey (SLR Database)
- The surrounding ground absorption
- The WSSC facility and truck horn noise source

The results of the computer noise modelling indicate that the predicted noise from the use of heavy vehicle horns within the WSSC grounds would comply with the EPL and the INP project specific sleep disturbance noise criteria under *calm* weather conditions, but would exceed the EPL sleep disturbance criteria under *enhanced* weather conditions. However, the same *enhanced* weather noise levels are found to comply with the INP sleep disturbance noise criteria of 54 dB.