



Transport
Roads & Maritime
Services

APPENDIX B3

Construction Noise and Vibration Management Plan

Woolgoolga to Halfway Creek

Pacific Highway Upgrade

MAY 2015



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Glossary / Abbreviations

CEMP	Construction Environmental Management Plan
CoA	Condition of Approval
dBA	Decibels using the A-weighted scale measured according to the frequency of the human ear.
DECC	NSW Department of Environment and Climate Change (now EPA)
DP&E	NSW Department of Planning and Environment
EIS	Woolgoolga to Ballina Pacific Highway Upgrade Environmental Impact Statement (December, 2012)
EMS	Environmental management system
EP&A Act	NSW Environmental Planning and Assessment Act 1979
EPA	NSW Environment Protection Authority
EPL	NSW Environment Protection Licence under the Protection of the Environment Operations Act 1997.
Environmental aspect	Defined by AS/NZS ISO 14001:2004 as an element of an organisation's activities, products or services that can interact with the environment.
Environmental impact	Defined by AS/NZS ISO 14001:2004 as any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects.
Environmental objective	Defined by AS/NZS ISO 14001:2004 as an overall environmental goal, consistent with the environmental policy, that an organisation sets itself to achieve.
Environmental target	Defined by AS/NZS ISO 14001:2004 as a detailed performance requirement, applicable to the organisation or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.
EPA	NSW Environment Protection Authority
EP&A Act	<i>NSW Environmental Planning and Assessment Act 1979</i>
ER	Environmental Representative
ERG	Environmental Review Group
EWMS	Environmental Work Method Statements
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements..
L _{Aeq} (15min)	The A-weighted equivalent continuous (energy average) A-weighted sound pressure level of the construction works under consideration over a 15-minute period and excludes other noise

	sources such as from industry, road, rail and the community.
L _{A (max)}	the A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a sound level meter.
LGA	Local government area
Minister, the	NSW Minister for Planning
OEH	NSW Office of Environment and Heritage
OHL Y	OHL York Joint Venture
PoEO Act	NSW Protection of the Environment Operations Act 1997
Project, the	Pacific Highway Upgrade – Woolgoolga to Halfway Creek
SPIR	Woolgoolga to Ballina Pacific Highway Upgrade Submissions Preferred Infrastructure Report (November, 2013)
RBL	The Rating Background Level for each period is the medium value of the ABL values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening and night)
RMS	NSW Roads and Maritime Services
Secretary	Secretary of the Department of Planning and Environment
SWP	Sound Power Level
SPL	Sound Pressure Level

1 Introduction

1.1 Context

This construction Noise and Vibration Management Plan (NVMP or Plan) forms part of the Construction Environmental Management Plan (CEMP) for The Woolgoolga to Halfway Creek section (Section 1) of the approved upgrade of the Pacific Highway between Woolgoolga and Ballina.

A detailed description of this Section is included in the CEMP.

This NVMP has been prepared to address the requirements of the Minister's Conditions of Approval (CoA) and the mitigation measures listed in the Pacific Highway Upgrade Woolgoolga to Ballina Environmental Impact Statement (EIS) and all applicable legislation.

There is one tie in project within the Woolgoolga to Halfway Creek project limits, namely the Sapphire to Woolgoolga Project. This tie in project has been approved separately by the Minister for Planning. Relevant conditions of approval for this project has been referenced in the NVMP as appropriate.

1.2 Background

The Pacific Highway Upgrade Woolgoolga to Ballina EIS (RMS 2012) assessed noise and vibration impacts on sensitive receivers and structures from construction of the Project (refer Figure 1-1).

As part of EIS development, a construction and operational noise and vibration assessment was prepared to satisfy the Director General Requirements (DGRs) issued by Planning and Infrastructure. The noise and vibration assessment was included in the EIS as Working Paper: Noise and Vibration.

The EIS concluded that there will be noise and vibration impacts during construction, and the extent will vary depending on the type of activity in progress and the proximity to sensitive receivers.

Additional management measures were provided within the *Woolgoolga to Ballina Submissions / Preferred Infrastructure Report November 2013*, with applicable management measures from that report included as part of this NVMP.

The noise and vibration impacts on sensitive receivers around the Arrawarra Rest Area were assessed in the Environmental Assessment for the Sapphire to Woolgoolga project and the Environmental Assessment for Modification 6 (Arrawarra Rest Area).

1.3 Environmental management systems overview

The overall Environmental Management System for the Project is described in the Construction Environmental Management Plan (CEMP).

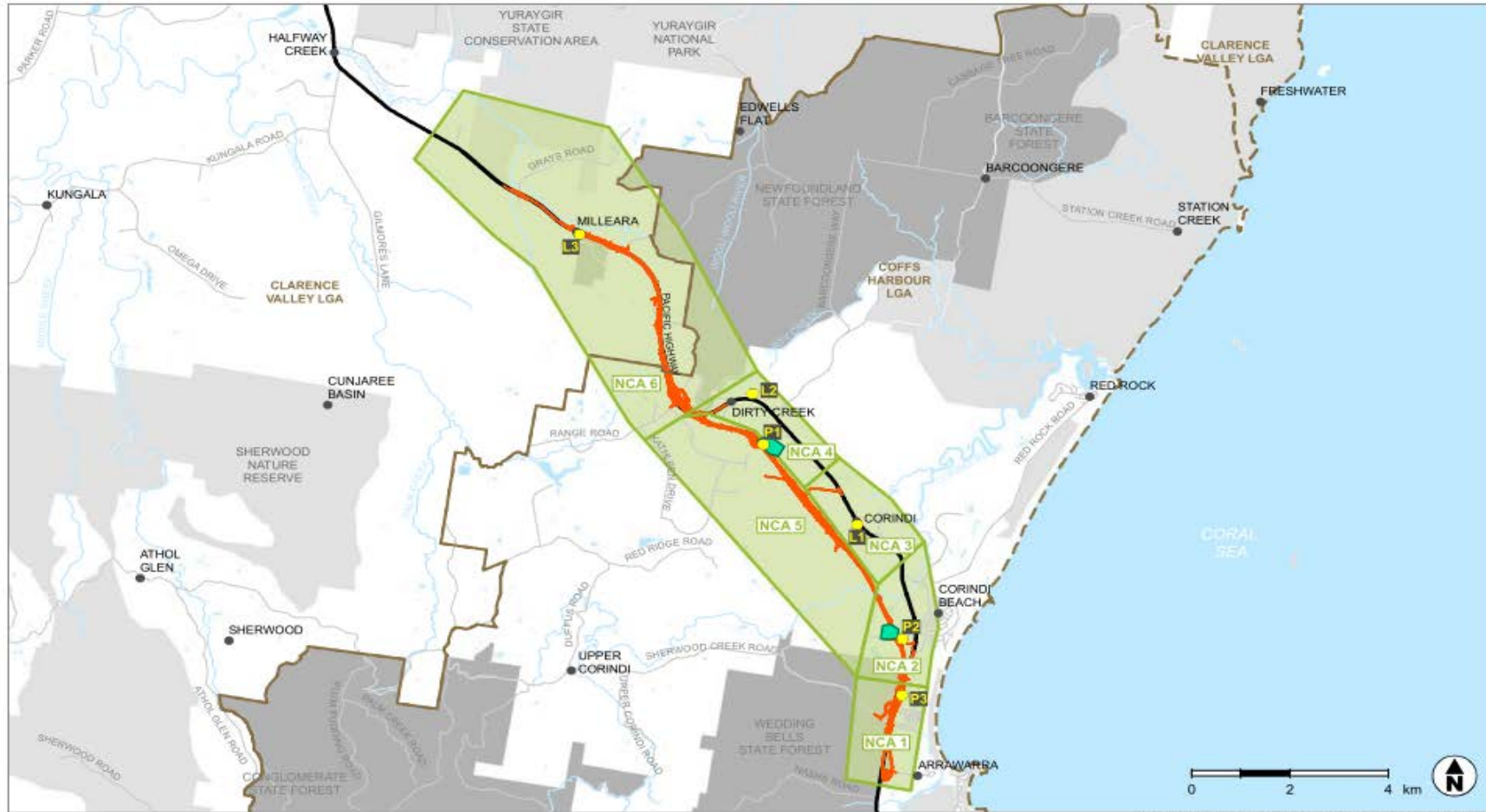
The NVMP is part of the OHL York Joint Venture (OHLY) environmental management framework for the Project, as described in Section 4.1 of the CEMP. This Plan has been developed in accordance with the requirements of CoA D26 (a) and provides practical measures and actions that will be put in place to minimise noise and vibration impacts during pre-construction, construction, and post-construction phases of the Project. This plan provides overall guidance and direction for the management of noise and vibration associated with the construction works.

Management measures identified in this Plan will be incorporated into site or activity specific Environmental Work Method Statements (EWMS). EWMS will be developed and signed off by environment and management representatives prior to associated works and construction

personnel will be required to undertake works in accordance with the identified requirements and associated mitigation measures.

Used together, the CEMP and EWMS form management guides that clearly identify required environmental management actions for reference by OHLV personnel and contractors.

The review and document control processes for this Plan are described in Section 1.6 of the NVMP and Chapter 10 of the CEMP.



— Existing Pacific Highway ■ Monitoring location ■ Noise catchment area ■ Construction compound

Figure 1-1 Project layout, Noise Catchment Areas and noise monitoring locations

2 Purpose and objectives

2.1 Purpose

This construction Noise and Vibration Plan (NVMP), including the Blast Management Plan and Out of Hours Work Plan, forms part of the overarching Construction Environmental Management Plan (CEMP). It details the mitigation measures and monitoring required during the construction phase to manage potential noise and vibration related impacts associated with the construction of the Project. The purpose of the NVMP is to:

- distinguish the potentially affected noise and vibration sensitive receivers based on predictive modelling;
- determine the likely noise and vibration impacts predicted at sensitive receivers by works occurring onsite;
- identify compliance monitoring locations based on occupied residences;
- specify noise and vibration monitoring criteria; and
- identify noise and vibration management strategies to mitigate noise and vibration impacts.

The management of noise and vibration impacts in this Plan is based on the assessment undertaken as part of the EIS. The assessment in the EIS considered the following guidelines and standards:

- NSW Road Noise Policy (RNP) (DECCW 2011).
- NSW Industrial Noise Policy (INP) (EPA 2000).
- RTA Environmental Noise Management Manual (ENMM) (RTA 2001).
- Interim Construction Noise Guideline (ICNG) (DECC 2009).
- Assessing Vibration: A Technical Guideline (DEC 2006).
- British Standard 7385: Part 2 “Evaluation and measurement of vibration in buildings”.
- *German DIN 4150: Part 3 – 1999 Effects of Vibration on Structure* (DIN 1999).
- Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (1990) Australian and New Zealand Environment and Conservation Council (ANZECC).
- Australian Standard AS2187.2-2006: “Explosives – Storage, Transport and Use”.

2.2 Objectives

The key objective of the NVMP is to ensure that impacts to the local community and the built environment from noise and vibration are minimised. Specific objectives include:

- Identifying sensitive receivers and ensure appropriate environmental controls and procedures are implemented during construction activities.
- Minimising potential adverse noise and vibration impacts to the environment and community.
- Predict potential noise and vibration impacts and recommend appropriate mitigation measures in order to manage these impacts.

- Ensure appropriate measures are implemented to comply with all relevant legislation and other requirements as described in Section 3.1 and Section 3.4 of this Plan, and the mitigation measures detailed in the EIS.

2.3 Targets

Targets have been established for the management of noise and vibration impacts during the Project to ensure:

- Full compliance with the relevant legislative requirements and CoA.
- Implement feasible and reasonable noise mitigation measures with the aim of achieving the construction noise management levels detailed in the Interim Construction Noise Guideline (DECC, 2009).
- That blasting activities are only undertaken at designated times and remain within established/agreed criteria.
- Complaints from the community and stakeholders are minimised.

3 Environmental requirements

3.1 Relevant legislation and guidelines

3.1.1 Legislation

Legislation relevant to noise and vibration management includes:

- *Protection of the Environment Operations Act 1997* (POEO Act).
- *Protection of the Environment Operations (Noise Control) Regulation 2008*.

Relevant provisions of the above legislation are explained in the register of legal and other requirements included in Appendix A1 of the CEMP.

3.1.2 Guidelines

The main guidelines, specifications and policy documents relevant to this Plan include:

- RMS QA Specification G36 – Environmental Protection (Management System).
- NSW Road Noise Policy (RNP) (DECCW 2011).
- NSW Industrial Noise Policy (EPA 2000).
- RTA Environmental Noise Management Manual (ENMM) (RTA 2001a).
- Interim Construction Noise Guideline (ICNG) (DECC 2009).
- Assessing Vibration: A Technical Guideline (DEC 2006).
- British Standard 7385: Part 2 “Evaluation and measurement of vibration in buildings”.
- German DIN 4150: Part 3 – 1999 Effects of Vibration on Structure (DIN 1999).
- Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (1990) Australian and New Zealand Environment and Conservation Council (ANZECC).
- Australian Standard AS2187.2-2006: “Explosives – Storage, Transport and Use”.

3.2 Minister’s Conditions of Approval

The CoA relevant to this Plan are listed Table 3-1. A cross reference is also included to indicate where the condition is addressed in this Plan or other project management documents.

Table 3-1 Conditions of Approval relevant to noise and vibration

CoA No.	Condition Requirements	Document Reference
Construction Noise		
B14	<p>The SSI shall be constructed with the aim of achieving the construction noise management levels detailed in the <i>Interim Construction Noise Guideline</i> (DECCW, 2009). All feasible and reasonable noise mitigation measures shall be implemented and any activities that could exceed the construction noise management levels shall be identified and managed in accordance with the Construction Noise and Vibration and Air Blast Management Plan</p> <p><i>Note:</i> <i>The Interim Construction Noise Guideline identifies ‘particularly annoying’ activities that require the addition of 5dB(A) to the predicted level before comparing to the</i></p>	Section 5, Section 8 Appendix B

CoA No.	Condition Requirements	Document Reference
<i>construction NML.</i>		
B15	<p>Construction activities associated with the SSI shall be undertaken during the following standard construction hours:</p> <ul style="list-style-type: none"> (a) 7:00am to 6:00pm Monday to Friday, inclusive; and (b) 8:00am to 5:00pm Saturday; and (c) at no time on Sunday or public holidays. 	Section 5, Section 8 Appendix C
B16	<p>Construction works outside of the standard construction hours identified in condition B15 may be undertaken in the following circumstances:</p> <ul style="list-style-type: none"> (a) construction works that generate noise that is: <ul style="list-style-type: none"> (i) no more than 5 dB(A) above rating background level at any residence in accordance with the <i>Interim Construction Noise Guideline</i> (Department of Environment and Climate Change, 2009); and (ii) no more than the noise management levels specified in Table 3 of the <i>Interim Construction Noise Guideline</i> (Department of Environment and Climate Change, 2009) at other sensitive receivers; or (b) for the delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons; or (c) where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm; or (d) between 6.00am and 7.00am and 6.00pm and 7.00pm Monday to Friday (except public holidays) in sparsely populated areas (these construction hours may be reviewed and/or revoked by the Director General in consultation with the EPA in the case of unresolved noise complaints); or (e) low noise impact activities and work as follows: <ul style="list-style-type: none"> (i) between 6.00am and 7.00am Monday to Friday; and/or (ii) between 6.00pm and 7.00pm Monday to Friday; or (f) works approved through an EPL; or (g) works approved by a Construction Environment Management Plan or Construction Noise and Vibration and Air Blast Management Plan for the SSI 	Section 0Appendix C
B17	<p>Construction activities which cannot be undertaken during the standard construction hours for technical or other justifiable reasons (Out of Hours work) may be permitted outside the construction hours specified in condition B15 with the approval of the Environmental Representative. Out of Hours work shall be undertaken in accordance with an approved Construction Environment Management Plan or Construction Noise and Vibration and Air Blast Management Plan for the SSI, where that plan provides a process for the consideration of Out of Hours work. This consideration includes:</p> <ul style="list-style-type: none"> (a) process for obtaining the Environmental Representative's approval for Out of Hours work; (b) details of the nature and need for activities to be conducted during the varied construction hours; (c) justifies the varied construction hours in accordance with the <i>Interim Construction Noise Guideline</i> (DECCW, 2009); (d) provides evidence that consultation with potentially affected receivers and notification of the relevant council has been undertaken, that the issues raised have been addressed and all feasible and reasonable mitigation measures have been put in place; and (e) provides evidence of consultation with the EPA on the proposed variation in standard construction hours. 	Section 0 Appendix C
B18	<p>Construction activities resulting in impulsive or tonal noise emission (such as rock breaking, rock hammering, pile driving) shall only be undertaken:</p> <ul style="list-style-type: none"> (a) between the hours of 8:00am to 5:00pm Monday to Friday; 	Section 8

- (b) between the hours of 8:00am to 1:00pm Saturday; and
- (c) in continuous blocks not exceeding three hours each with a minimum respite from those activities and works of not less than one hour between each block.

For the purposes of this condition 'continuous' includes any period during which there is less than a one hour respite between ceasing and recommencing any of the work the subject of this condition.

The works subject to this condition may be undertaken in sparsely populated areas within the construction hours specified in condition B15.

B19	The Applicant shall, where feasible and reasonable, limit high noise impact activities and work to the mid-morning and mid-afternoon periods, except in sparsely populated areas.	Section 8
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Construction Vibration

B20	<p>The SSI shall be constructed with the aim of achieving the following construction vibration goals:</p> <ul style="list-style-type: none"> (a) for structural damage to heritage structures, the vibration limits set out in the German Standard <i>DIN 4150-3: Structural Vibration – Part 3 Effects of vibration on structures</i>; (b) for damage to other buildings and/or structures, the vibration limits set out in the British Standard <i>BS 7385-1:1990 – Evaluation and measurement of vibration in buildings</i> (and referenced in Australian Standard 2187.2 – 2006 <i>Explosives – Storage and use – Use of explosives</i>). Guide for measurement of vibration and evaluation of their effects on buildings; and (c) for human exposure, the acceptable vibration values set out in <i>Assessing Vibration: A Technical Guideline</i> (Department of Environment and Conservation, 2006). 	Section 7.3.1
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B21	<p>Blasting associated with the SSI shall only be undertaken during the following hours:</p> <ul style="list-style-type: none"> (a) 9:00am to 5:00pm, Monday to Friday, inclusive; (b) 9:00am to 1:00pm on Saturday; and (c) at no time on Sunday or public holidays. <p>Blasting outside the above hours and in accordance with the standard construction hours where:</p> <ul style="list-style-type: none"> (i) no sensitive receivers in sparsely populated areas would be impacted by blasting; or (ii) an agreement has been made with receivers within 200 metres of the blast zone to permit blasting in accordance with the standard construction hours. <p>This condition does not apply in the event of a direction from the NSW Police Force or other relevant authority for safety or emergency reasons to avoid loss of life, property loss and/or to prevent environmental harm.</p>	<p>Section 7.3.2</p> <p>Section 8 Appendix B</p>
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B22	<p>The Applicant shall ensure that Airblast overpressure generated by blasting associated with the SSI shall not exceed the criteria specified in Table 1 when measured at the most affected residence or other sensitive receiver.</p> <p>Table 1 - Airblast overpressure limits for human comfort</p>	<p>Section 7.3.2</p> <p>Section 8 Appendix B</p>
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Receiver	Type of blasting operations	Airblast Overpressure Limit
Sensitive site	Blasting operations lasting more than 12 months or more than 20 blasts	115 dBL for 95% of blasts per year
		120 dBL maximum limit
Sensitive site	Blasting operations lasting less than 12	120 dBL for 95% of blasts per year

	months or less than 20 blasts in total	125 dBL maximum limit
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	125 dBL maximum limit. For sites containing equipment sensitive to vibration, the vibration level should be kept below manufacturer's specifications or levels that can be shown to adversely affect the equipment operation

Note – a sensitive site includes houses and low rise residential buildings, theatres, schools and other similar buildings occupied by people.

Source – Table J5.4(A) – AS 2187.2 – 2006

B23

The Applicant shall ensure that Ground vibration generated by blasting associated with the SSI shall not exceed the criteria specified in Table 2 and Table 3 when measured at the most affected residence or other sensitive receiver.

Section
7.3.2

Section 8

Appendix B

Table 2 – Ground vibration limits for human comfort

Receiver	Type of blasting operations	Peak component particle velocity (mm/s)
Sensitive site	Blasting operations lasting more than 12 months or more than 20 blasts	5 mm/s for 95% of blasts per year
		10 mm/s maximum limit
Sensitive site	Blasting operations lasting less than 12 months or less than 20 blasts in total	10 mm/s maximum limit
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	25 mm/s maximum limit. For sites containing equipment sensitive to vibration, the vibration level should be kept below manufacturer's specifications or levels that can be shown to adversely affect the equipment operation

Note – a sensitive site includes houses and low rise residential buildings, theatres, schools and other similar buildings occupied by people.

Source – Table J4.5(A) – AS 2187.2 – 2006.

Table 3 – Ground vibration limits for control of damage to structures

Receiver	Type of blasting operations	Peak component particle velocity (mm/s)
Other structures or architectural elements that include masonry, plaster and plasterboard in their construction ¹		15 mm/s 4 Hz to 15 Hz, except for heritage structures where a frequency dependent vibration criteria would be determined in accordance with AS 2187.2 – 2006. 20 mm/s 15 Hz and above

Reinforced or framed structures. Industrial and heavy commercial buildings ²	All blasting	50 mm/s at 4 Hz and above	
Unreinforced or light framed structure. Residential or light commercial type building ²	All blasting	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
Unoccupied structures of reinforced concrete or steel construction	All blasting	100 mm/s maximum, where agreed with the structure owner.	
Infrastructure service structures, such as pipelines, power lines, cables and reservoirs.	All blasting	Limits to be determined by structural design methodology in consultation with the infrastructure service provider.	

Source:

1 - Table J4.5(B) – AS 2187.2 – 2006.

2 - Table J4.4.2.1 – AS 2187.2 – 2006 (BS 7385-2).

B24	<p>The blasting criteria specified in conditions B22 and/or B23 may be increased where the Applicant has obtained the written agreement of the relevant landowner to increase the criteria. In obtaining the agreement the Applicant shall make available to the landowner:</p> <ul style="list-style-type: none"> (a) details of the proposed blasting program and justification for the proposed increase to blasting criteria including alternatives considered (where relevant); (b) the environmental impacts of the increased blast limits on the surrounding environment and most affected residences or other sensitive receivers including, but not limited to noise, vibration and air quality and any risk to surrounding utilities, services or other structures; and (c) the blast management and mitigation measures, and monitoring procedures to be implemented to monitor blasting impacts. <p>The Applicant shall provide a copy of the written agreement to the Director General and the EPA, including details of the consultation undertaken (with clear identification of proposed blast limits and potential property impacts) prior to commencing blasting at the increased limits.</p> <p>Unless otherwise agreed by the Secretary, the following exclusions apply to the application of this condition:</p> <ul style="list-style-type: none"> (a) Any agreements reached may be terminated by the landowner at any time should concerns about the increased blasting limits be unresolved. Should an agreement be terminated by a landowner, the Applicant shall not exceed the criteria specified in conditions B22 and/or B23 for future blasting at that receiver. (b) The blasting limit agreed to under any agreement for an occupied residential building can at no time exceed a maximum Peak Particle Velocity vibration level of 25 mm/s or maximum Airblast Overpressure level of 125 dBL. 	Section 7.3.2 Section 8 Appendix B
B25	Wherever feasible and reasonable, piling activities shall be undertaken using quieter construction methods, such as bored piles or vibrated piles rather than impact or percussion piling methods.	Section 8
B26	Prior to the use of the dynamic compaction construction method, the Applicant shall undertake an assessment of vibration generated by dynamic compaction on nearby sensitive receivers. Feasible and reasonable mitigation measures shall be implemented to minimise vibration impacts.	Section 8

CoA No.	Condition Requirements	Document Reference
B27	During construction, affected educational institutions shall be consulted and reasonable steps taken to ensure that noise generating construction works in the vicinity of affected buildings are not timetabled during examination periods where practicable, unless other reasonable arrangements to the affected institutions are made at no cost to the affected institution.	No education facilities
Land Use Survey		
D10	Prior to the commencement of construction, the Applicant shall undertake a land use survey to identify areas that are sensitive to construction vibration and construction ground-borne noise impacts. The results of the survey shall be incorporated into the Construction Noise and Vibration and Air Blast Management Plan.	Section 4.1
Construction Environmental Management Plan		
D26 (a)	As part of the Construction Environmental Management Plan for the SSI, the Applicant shall prepare and implement:	This plan
	(a) a Construction Noise and Vibration and Air Blast Management Plan to detail how construction noise and vibration impacts will be minimised and managed. The Plan shall be developed in consultation with the EPA and shall be consistent with the guidelines contained in the <i>Interim Construction Noise Guidelines</i> (DECC, 2009) and shall include, but not necessarily be limited to:	
	(i) identification of sensitive receivers and relevant construction noise and vibration goals applicable to the SSI stipulated in this approval;	Section 4.1
	(ii) details of construction activities and an indicative schedule for construction works; including the identification of key noise and/or vibration generating construction activities (based on representative construction scenarios, including at ancillary facilities) that have the potential to generate noise and/or vibration impacts on surrounding sensitive receivers, particularly residential areas;	Section 7.1
	(iii) identification of feasible and reasonable measures proposed to be implemented to minimise and manage construction noise and vibration impacts (including construction traffic noise impacts);	Section 8
	(iv) procedures and mitigation measures to ensure relevant vibration and blasting criteria are achieved, including a suitable blast program, applicable buffer distances for vibration intensive works, use of low-vibration generating equipment/vibration dampeners or alternative construction methodology, and pre- and post-construction dilapidation surveys of sensitive structures where blasting and/or vibration is likely to result in damage to buildings and structures (including surveys being undertaken immediately following a monitored exceedance of the criteria); and	Section 8 Appendix B
	(v) a description of how the effectiveness of these actions and measures would be monitored during the proposed works, clearly indicating how often this monitoring would be conducted, the locations where monitoring would take place, how the results of this monitoring would be recorded and reported, and, if any exceedance is detected, how any non-compliance would be rectified;	Section 9
	(vi) an out-of-hours work (OOHW) protocol for the assessment, management and approval of works outside of standard construction hours as defined in condition B15 including a risk assessment process under which the Environmental Representative may approve out-of-hour construction activities. The OOHW protocol shall detail standard assessment, mitigation and notification requirements for high and low risk out-of-hour works, consultation procedures with the EPA, the relevant council and affected landowners;	Section 0 Appendix C
	(vii) procedures for notifying sensitive receivers of construction activities that are likely to affect their noise and vibration amenity, as well as procedures for dealing with and responding to noise complaints;	Section 8 Section 9.3

- (viii) a program for construction noise and vibration monitoring clearly indicating monitoring frequency, location, how the results of this monitoring would be recorded and, procedures to be followed where exceedences of relevant noise and vibration goals are detected; and
- (ix) mechanisms for the monitoring, review and amendment of this plan.

Section 9

Sapphire to Woolgoolga Conditions of Approval Modification 6
Arwarra Rest Area

- 2.17 Standard Construction Hours for the duration of construction are:
- a) 7:00am to 6:00pm Mondays to Fridays, inclusive; and
 - b) 8:00am to 1pm Saturday's; and
 - c) at no time on Sunday's or Public Holidays
-

3.3 RMS Project Requirements – QA Specifications

Table 3-2 RMS Requirements relevant to the NVMP

Original Reference	Relevant Requirement	Response	
QA Specification G36 ENVIRONMENTAL PROTECTION (July 2014)			
G36.4.6	<p>Prepare and implement a <i>Construction Noise and Vibration Management Sub-Plan</i> as part of the CEMP, or include mitigation strategies within the CEMP, to minimise the impact of noise from your operations on adjacent properties. The Noise Management Plan must be prepared by a suitably qualified and experienced acoustic consultant (i.e. a member of the Australian Acoustical Society, the Institution of Engineers, or the Association of Australian Acoustical Consultants). The Construction Noise and Vibration Management Sub-Plan or mitigation strategies must include proposed environmental control measures for all significant noise generating activities.</p> <p>The Construction Noise and Vibration Management Plan must cover all significant noise generating activities. Include in the Plan measures to minimise the impact of noise, including:</p> <ul style="list-style-type: none"> (i) substitution by an alternative process; (ii) restricting times and durations when noisy work is carried out; (iii) placement of work compounds, parking areas, equipment and material stockpile sites away from noise-sensitive locations; (iv) where noise barriers / walls are to be constructed, programming this as early as possible in the project duration to reduce noise impacts from other construction work on neighbouring residents; (v) acoustic screening or enclosures around fixed plant under regular operation that may impact upon noise sensitive receivers; (vi) sawcutting operations to minimise noise impacts; (vii) switching off engines when equipment is not in use for extended periods; (viii) undertaking noisy work (such as use of a concrete saw or hydraulic hammer) during the day, or early in the evening if required to be undertaken at night; avoiding short sharp sounds from impacts during night work to minimise sleep disturbance to neighbouring residents; (ix) use of manually adjustable or ambient noise sensitive or “quacker” type reversing alarms on plant and/or use of flashing lights at night; (x) undertaking maintenance work on construction plant away from noise sensitive receivers and within the hours nominated in Clause 3.6; (xi) methods to remove underwater structures that minimise impacts on fish, water quality and noise and vibration levels; and, (xii) consultation with affected residents. <p>After the options above have been exhausted, consider other best practice physical controls to construction equipment and activities, such as those suggested in Australian Standard 2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites', to achieve the noise goals.</p> <p>The Construction Noise and Vibration Management Plan must show the locations of all occupied noise sensitive premises on a map (including aged care facilities, schools, child care centres/ preschools and churches) and provide details of noise control measures to be undertaken during construction, including:</p> <ul style="list-style-type: none"> (a) identification of all noise generating tasks (including truck movements), duration and predicted airborne noise levels; (b) impacts from site compounds/ construction depots, and the delivery of material to these locations; 	This Plan	Section 8
		Section 4.1	
		Section 7.1	
		Section 7.2.3	

Original Reference	Relevant Requirement	Response
	<p>(c) location, type and timing of mitigation measures to reduce excessive noise such as:</p> <ul style="list-style-type: none"> • maximising the offset distance between noisy plant items and nearby noise sensitive receivers; • orientating equipment away from noise-sensitive areas; • selecting site access points and roads as far away as possible from sensitive receptors; • erection of any temporary and permanent noise barriers; <p>(d) specific physical and managerial measures for controlling noise to comply with the relevant EPA guidelines;</p> <p>(e) noise monitoring procedures to assess the performance of the implemented noise control measures, including reporting and response procedures;</p> <p>(f) internal audits of compliance of all vehicles, plant and equipment prior to commencing work and during construction;</p> <p>(g) construction timetabling on potential noisy activities for works outside normal hours, to minimise noise impacts;</p> <p>(h) procedures for notifying residents and business premises about noise-generating activities likely to affect their amenity;</p> <p>(i) contingency plans to be implemented in the event of non-compliance and/or noise complaints; and</p> <p>(j) procedures for regularly reviewing the effectiveness of the Construction Noise & Vibration Plan.</p> <p>If noise monitoring indicates that mitigation measures are not fully effective or if noise complaints are received during construction, determine if additional noise mitigation controls are needed and amend the Construction Noise and Vibration Management Plan accordingly.</p> <p>All construction plant and equipment used on Site must be, in addition to other requirements:</p> <ul style="list-style-type: none"> (a) fitted with properly maintained high efficiency noise suppression devices in accordance with manufacturer's specifications; (b) regularly inspected and maintained in an efficient condition; and (c) operated in a proper and efficient manner. 	<p>Section 8</p> <p>Section 8</p> <p>Section 9.3</p> <p>Section 8</p> <p>Section 8</p> <p>Section 8</p> <p>Section 9.4</p> <p>Section 10</p> <p>Section 9.5</p> <p>Section 8</p>
G36.4.7	<p>GROUND VIBRATION AND AIR BLAST</p> <p>Take due care in all construction activities to prevent damage to adjacent public utilities, structures and buildings resulting from construction vibration and air blast.</p> <p>To protect the amenity of the occupiers of buildings, carry out any blasting activities in accordance with the requirements of the ANZECC publication "Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration - September 1990". Where the amenity guidelines are likely to be exceeded, manage the impacts in consultation with, and in accordance with, the requirements stipulated by EPA.</p> <p>Meet the requirements of EPA "Environmental Noise Management Assessing Vibration: A Technical Guideline". Where the requirements are likely to be exceeded, manage the impacts in consultation with, and in accordance with, the requirements stipulated by EPA.</p> <p>To reduce the potential for structural damage, carry out the activities to meet the requirements of BS 7385 and German Standard DIN 4150:1999 – Structural Vibrations in Buildings(for heritage structures). If structural damage is observed that could reasonably be assumed to have resulted from construction activities, re-assess any previously acceptable vibration limit.</p> <p>Where there is a risk that vibration or air blast activities may cause damage</p>	<p>Section 7.3.1</p> <p>Section 7.3.2</p> <p>Appendix B</p>

Original Reference	Relevant Requirement	Response
	<p>to nearby structures and buildings, or if these are located within the distance from the construction activity specified in Annexure G36/E, undertake a building condition inspection and prepare a Building Condition Inspection Report for every property or structure likely to be affected.</p> <p>Prepare, as part of the Construction Noise and Vibration Management Plan, a description of the environmental controls to be implemented during construction to minimise the impact of vibration and air blast on adjacent properties and residents. Include measures to minimise the impact of vibration and air blast, including:</p> <ul style="list-style-type: none"> (a) substitution by an alternative process; (b) restricting times when work is carried out; (c) screening or enclosures; (d) consultation with affected residents. 	

4 Existing environment

4.1 Sensitive receivers

The Project is located in the Coffs Harbour (CHCC) and Clarence Valley (CVC) local government areas (LGA) and extends from Woolgoolga to Halfway Creek, including Arrawarra, Corindi and isolated dwellings along the route. The northern section of the project is generally confined to the existing Pacific Highway road corridor, while the southern section includes a new road alignment, broadly passing through rural and agricultural land use areas.

The EIS noise and vibration assessment identified and considered potential noise impacts for each individual dwelling along the entire Woolgoolga to Ballina alignment, whereas this document has focussed on potential construction noise and vibration impacts associated with Section 1, Woolgoolga to Halfway Creek.

This assessment has identified 423 potentially noise sensitive receivers. The locations of the receivers covered in this assessment are shown in Appendix D.

4.2 Noise Catchment Areas

For ease of reference, and to allow more complete assessment of a variety of receivers, specific areas of the Project have been grouped together into noise catchment areas (NCAs). These have been presented in Table 4-1 which describes the location of each noise catchment area.

Table 4-1 Noise catchment areas

Noise Catchment Area	Location
NCA 1	Properties along the existing (and upgraded) Pacific Highway alignment in the vicinity of Arrawarra and Darlington Beach.
NCA 2	Properties along the existing (and upgraded) Pacific Highway alignment in the vicinity of Corindi Beach.
NCA 3	Properties along the existing Pacific Highway alignment in the vicinity of Corindi.
NCA 4	Properties along the existing Pacific Highway alignment south of Dirty Creek.
NCA 5	Rural properties along the upgraded Pacific Highway between Dirty Creek and Corindi Beach.
NCA 6	Properties along the existing (and upgraded) Pacific Highway alignment north of Dirty Creek and south of Halfway Creek.

4.3 Ambient noise

Noise monitoring was conducted as part of the Operational Noise Assessment for the Woolgoolga to Ballina project in 2011 and 2012. The monitoring was undertaken to provide background noise levels and, among other purposes, to establish appropriate construction noise assessment criteria. Locations were selected to be representative of receivers that would experience a noise impact from the existing highway or from the Project (see Figure 1-1 for monitoring locations).

In order that existing levels of ambient noise could be adequately assessed across all NCAs, additional noise monitoring was carried out at three locations during February and March 2015. All locations were selected to be representative of receivers that may be impacted by construction noise during the project.

A summary of the noise monitoring results is provided in Table 4-2.

Table 4-2 Ambient noise monitoring results for Section 1

Location	Address	NCA		RBL dB(A)		
			Shoulder (am peak 6:00 - 7:00)	Day (7:00 - 18:00)	Evening (18:00 - 22:00)	Night (22:00 - 7:00)
P3*	160 - 174 Eggin's Close, Arrawarra	1	47	47	45	41
P2*	31 Kangaroo Trail Road, Corindi Beach	2	45	42	43	44
L1	3683 Pacific Highway Corindi Beach	3	50	48	44	44
L2	4028 Pacific Highway, Dirty Creek	4	49	48	43	42
P1*	16 Hawthorn Close, Corindi Beach	5	47	42	42	40
L3	11 Dunmar Lane, Halfway Creek	6	44	48	44	38

* 2015 noise monitoring locations

Locations P3, L1, L2 and L3 are located on the existing highway alignment and the noise environment at these locations is dominated by road traffic noise, in particular heavy vehicles.

P2 is located approximately 250m from the highway, and although traffic noise contributes to background noise levels, particularly during night time hours, it does not contribute to maximum levels.

Location P1 is rural. Noise sources at this site are generally natural, such as insects and birds. Rural noise sources including farm machinery and local traffic is occasionally audible. Traffic on the Pacific Highway is audible at low levels during night time hours.

5 Noise and vibration criteria for NSW

The EPA recommends management levels and goals when assessing construction noise and vibration. These are outlined in:

- Interim Construction Noise Guideline (ICNG).
- Road Noise Policy (RNP)
- Assessing Vibration: a technical guideline.
- The ANZECC Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration.

Relevant elements of these documents are summarised and discussed in this Chapter.

5.1 Construction noise and assessment objectives

The DECC Interim Construction Noise Guideline (ICNG, July 2009) provides guidelines for the assessment and management of construction noise. The RNP refers to the use of the ICNG for the assessment of construction noise impacts.

The ICNG focuses on applying a range of work practices to minimise construction noise impacts rather than focusing on achieving numeric noise levels.

The main objectives of the ICNG are to:

- Identify and minimise noise from construction works.
- Focus on applying all 'feasible' and 'reasonable' work practices to minimise construction noise impacts.
- Encourage construction during the recommended standard hours only, unless approval is given for works that cannot be undertaken during these hours.
- Reduce time spent dealing with complaints at the project implementation stage.
- Provide flexibility in selecting site-specific feasible and reasonable work practices to minimise noise impacts.

5.2 Quantitative noise assessment criteria

Construction noise assessment goals presented in the ICNG are referenced to noise management levels for residential, sensitive land uses and commercial/ industrial premises.

Residential premises

Table 5-1 sets out management levels for noise at residences and how they are to be applied.

In Table 5-1 the rating background level (RBL) is used when determining the management level. The RBL is the overall single-figure background noise level measured in each relevant assessment period (during or outside the recommended standard hours). The term RBL is described in detail in the NSW Industrial Noise Policy (EPA, 2000).

Table 5-1 Noise at residents using quantitative assessment

Time of day	Management Level $L_{Aeq(15\text{ min})}$ *	How to apply
Recommended standard hours: Monday to Friday 7 am to 6 pm Saturday 8 am to 5 pm (excluding Arrawarra Rest Area – 8am to 1pm) No work on Sundays or public holidays	Noise affected RBL + 10 dB	The noise affected level represents the point above which there may be some community reaction to noise. <ul style="list-style-type: none"> Where the predicted or measured $L_{Aeq(15\text{ min})}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. 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 75 dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. <ul style="list-style-type: none"> Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: <ul style="list-style-type: none"> times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences if the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5 dB	<ul style="list-style-type: none"> 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 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

* Noise levels apply at the property boundary that is most exposed to construction noise, and at a height of 1.5m above ground level. If the property boundary is more than 30m from the residence, the location for measuring or predicting noise levels is at the most noise-affected point within 30 m of the residence. Noise levels may be higher at upper floors of the noise affected residence.

Other land uses

Other sensitive land uses, such as schools, typically find noise from construction to be disruptive when the properties are being used (such as during school times). Table 5-2 presents management levels for noise at other sensitive land uses based on the principle that the characteristic activities for each of these land uses should not be unduly disturbed. Consultation should be undertaken with noise sensitive land use occupants likely to be affected by noise from the works to schedule the project's work hours to achieve a reasonable noise outcome.

Internal noise levels are assessed at the centre of the occupied room. External noise levels are assessed at the most affected point within 50 metres of the area boundary. Where internal noise levels cannot be measured, external noise levels may be used. A conservative estimate of the difference between internal and external noise levels is 10dB for buildings other than residences. Some buildings may achieve greater performance, such as

where windows are fixed (that is, cannot be opened). The management levels in Table 5-2 are 5dB above the corresponding road traffic noise criteria in the Road Noise Policy (RNP) (and the 'maximum' levels in the NSW Industrial Noise Policy (EPA 2000) for commercial and industrial uses) to account for the variable and short-term nature of construction noise.

Table 5-2 Noise at sensitive land uses (non-residents) using quantitative assessment

Land use	Noise assessment location	Noise management level ($L_{Aeq,15min}$) dB(A)
Classrooms at schools and other educational institutions	Internal	45
Hospitals and operating theatres		
Places of worship		
Active recreation areas ¹	External	65
Passive recreation areas ²	External	60
Community centres	Dependent on intended use	Maximum internal levels recommended in AS2107 for specific use
Industrial premises	External	75
Office, retail outlets	External	70
Other noise sensitive businesses	Investigation to determine suitable noise levels on project-by-project basis	

Notes:

1. Active recreation areas are characterised by sporting activities and activities which generate their own noise or focus for participants, making them less sensitive to external noise intrusion.
2. Passive recreation areas are characterised by contemplative activities that generate little noise and where benefits are compromised by external noise intrusion (eg. reading, meditation).

5.3 Sleep disturbance criteria

Criteria for the assessment of potential sleep disturbance impacts have been discussed further below.

An accurate representation of sleep disturbance impacts on a community from a noise source is particularly difficult to quantify mainly due to differing responses of individuals to sleep disturbance - this is found even within a single subject monitored at different stages of a single night's sleep or during different periods of sleep. In addition the differing grades of sleep state make a definitive definition difficult, and even where sleep disturbance is not noted by the subject, factors such as heart rate, mood and performance can still be negatively affected (WHO, 1995).

An assessment of sleep disturbance should consider the maximum noise level or $L_{A1(1\text{ minute})}$, and the extent to which the maximum noise level exceeds the background level and the number of times this may happen during the night-time period. 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); and
- whether there are times of day when there is a clear change in the existing noise environment (such as during early morning shoulder periods).

Currently the information relating to sleep disturbance impacts indicates that:

- Maximum noise levels below 50-55 dB(A) are unlikely to cause an awakening from a sleep state.
- One or two noise events per night with maximum internal noise levels of 65-70 dB(A) are not likely to affect health and wellbeing significantly.

As such, an assessment of sleep disturbance should consider the maximum noise level or $L_{A1(1 \text{ minute})}$, and the extent to which the maximum noise level exceeds the background level and the number of times this may happen during the night-time period.

The sleep disturbance screening criterion for construction noise impacts will be determined by an $L_{A1(1 \text{ minute})}$ noise level not exceeding the $L_{A90(15 \text{ minute})}$ by more than 15 dB(A).

5.4 Construction traffic noise criteria

Road construction will last for a substantial amount of time, and it is therefore necessary to consider potential impacts of construction generated road traffic. For existing residences and other sensitive land uses affected by additional traffic on existing roads, The NSW Road Noise Policy states that for noise associated with increased road traffic generated by land use developments, any increase in the total traffic noise level should be limited to 2dB during both day and night time periods. 2dB represents a minor impact that is considered barely perceptible to the average person.

5.5 Adopted project noise management levels

Based on measured noise levels described in Section 4.2, the project-specific construction noise objectives for each representative monitoring location have been determined and are presented in Table 5-3. Considering the possibility of works outside standard construction hours additional management levels for these times are also included in the construction noise objectives.

Table 5-3 Project-specific construction noise objectives

NCA	Standard hours - Day (7am-6pm)		Extended hours – morning (6am-7am)		Extended hours – Evening (6pm-10pm)		Night time works (other hours)		Sleep disturbance	
	RBL dB(A)	Noise objective $L_{Aeq}(15min)$	RBL dB(A)	Noise objective $L_{Aeq}(15min)$	RBL dB(A)	Noise objective $L_{Aeq}(15min)$	RBL dB(A)	Noise objective $L_{Aeq}(15min)$	RBL dB(A)	Noise objective $L_{A1}(1min)$
1	47	57	47	52	45	50	41	46	41	56
2	42	52	45	50	43	48	44	49	44	59
3	48	58	50	55	44	49	44	49	44	59
4	48	58	49	54	43	48	42	47	42	57
5	42	52	47	52	42	47	40	45	40	55
6	48	58	44	49	44	49	38	43	38	53

5.6 Vibration criteria

Effects of ground borne vibration on buildings may be segregated into the following three categories:

- Human exposure – disturbance to building occupants: vibration in which the occupants or users of the building are inconvenienced or possibly disturbed.
- Effects on building contents –where vibration can cause damage to fixtures, fittings and other non-building related objects.
- Effects on building structures – where vibration can compromise the integrity of the building or structure itself.

The first of these vibration effects relating specifically to the human comfort aspects of the project are taken from the DEC (2006) document Assessing Vibration – A Technical Guideline. This type of impact can be further categorised and assessed using the appropriate criterion as follows:

- Continuous vibration – from uninterrupted sources (see Table 5-4).
- Impulsive vibration – up to three instances of sudden impact eg dropping heavy items, per monitoring period (see Table 5-5).
- Intermittent vibration – such as from drilling, compacting or activities that would result in continuous vibration if operated continuously (see Table 5-6).

Table 5-4 Continuous vibration acceleration criteria (m/s²) 1-80Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.010	0.0071	0.020	0.014
	Night-time	0.007	0.005	0.014	0.010
Offices, schools, educational institutions and places of worship	Day or night-time	0.020	0.014	0.040	0.028
		0.04	0.029	0.080	0.058
Workshops	Day or night-time	0.04	0.029	0.080	0.058

Table 5-5 Impulsive vibration acceleration criteria (m/s²) 1-80Hz

Location	Assessment period	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis
Residences	Daytime	0.30	0.21	0.60	0.42
	Night-time	0.10	0.071	0.20	0.14
Offices, schools, educational institutions and places of worship	Day or night-time	0.64	0.46	1.28	0.92
Workshops	Day or night-	0.64	0.46	1.28	0.92

Location	Assessment period time	Preferred Values		Maximum Values	
		z-axis	x- and y-axis	z-axis	x- and y-axis

Table 5-6 Intermittent vibration impacts criteria (m/s²) 1-80Hz

Location	Daytime		Night-time	
	Preferred Values	Maximum Values	Preferred Values	Maximum Values
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

The other two effects relate to impacts on the building itself and are assessed against international standards as flows:

- British Standard 7385: Part 2-1993 Evaluation and measurement for vibration in buildings Part 2: Guide to damage levels from ground borne vibration (BSI 1993)
- German DIN 4150: Part 3 – 1999 Effects of Vibration on Structure (DIN 1999).

The German standard provides the most stringent criteria and will be used in this NVMP. The DIN guideline values for peak particle velocity (mm/s) measured at the foundation of the building are summarised in Table 5-7. The criteria are frequency dependent and specific to particular categories of structure.

Table 5-7 Structural damage criteria

Type of Structure	Peak Component Particle Velocity, mm/s			
	Vibration at the foundation at a frequency of			Vibration of horizontal plane of highest floor at all frequencies
	1 Hz to 10 Hz	10 Hz to 50 Hz	50 Hz to 100 Hz*	
Buildings used for commercial purposes, industrial buildings and buildings of similar design	20	20 to 40	40 to 50	40
Dwellings and buildings of similar design and/or use	5	5 to 15	15 to 20	15
Structures that, because of their sensitivity to vibration, do not correspond to those listed in lines 1 and 2 and are of great intrinsic value (e.g. buildings that are under a preservation order)	3	3 to 8	8 to 10	8

* For frequencies above 100Hz, at least the values specified in this column shall be applied.

5.7 Blast criteria

Guidelines documented in the ANZECC "Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration" has been used to establish goals for assessing blast air-blast overpressure and ground vibration.

(CoA B22) Airblast overpressure generated by blasting associated with the SSI shall not exceed the criteria specified in Table 5-8 when measured at the most affected residence or other sensitive receiver.

Table 5-8 - Airblast overpressure limits for human comfort

Receiver	Type of blasting operations	Airblast Overpressure Limit
Sensitive site	Blasting operations lasting more than 12 months or more than 20 blasts	115 dBL for 95% of blasts per year
		120 dBL maximum limit
Sensitive site	Blasting operations lasting less than 12 months or less than 20 blasts in total	120 dBL for 95% of blasts per year
		125 dBL maximum limit
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	125 dBL maximum limit. For sites containing equipment sensitive to vibration, the vibration level should be kept below manufacturer's specifications or levels that can be shown to adversely affect the equipment operation

Note – a sensitive site includes houses and low rise residential buildings, theatres, schools and other similar buildings occupied by people.

Source – Table J5.4(A) – AS 2187.2 – 2006

(CoA B23) Ground vibration generated by blasting associated with the SSI shall not exceed the criteria specified in Table 2 and Table 3 when measured at the most affected residence or other sensitive receiver.

Table 5-9 – Ground vibration limits for human comfort

Receiver	Type of blasting operations	Peak component particle velocity (mm/s)
Sensitive site	Blasting operations lasting more than 12 months or more than 20 blasts	5 mm/s for 95% of blasts per year
		10 mm/s maximum limit
Sensitive site	Blasting operations lasting less than 12 months or less than 20 blasts in total	10 mm/s maximum limit
		10 mm/s maximum limit
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	25 mm/s maximum limit. For sites containing equipment sensitive to vibration, the vibration level should be kept below manufacturer's specifications or levels that can be shown to adversely affect the equipment operation

Note – a sensitive site includes houses and low rise residential buildings, theatres, schools and other similar buildings occupied by people.

Source – Table J4.5(A) – AS 2187.2 – 2006.

Table 5-10 – Ground vibration limits for control of damage to structures

Receiver	Type of blasting operations	Peak component particle velocity (mm/s)
Other structures or architectural elements that include masonry, plaster and plasterboard in their construction 1		15 mm/s 4 Hz to 15 Hz, except for heritage structures where a frequency dependent vibration criteria would be determined in accordance with AS 2187.2 – 2006. 20 mm/s 15 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings 2	All blasting	50 mm/s at 4 Hz and above
Unreinforced or light framed structure. Residential or light commercial type building 2	All blasting	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz 20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
Unoccupied structures of reinforced concrete or steel construction	All blasting	100 mm/s maximum, where agreed with the structure owner.
Infrastructure service structures, such as pipelines, powerlines, cables and reservoirs.	All blasting	Limits to be determined by structural design methodology in consultation with the infrastructure service provider.

Source:

1 - Table J4.5(B) – AS 2187.2 – 2006.

2 - Table J4.4.2.1 – AS 2187.2 – 2006 (BS 7385-2).

For assessment of air-blast overpressure the DECC/ANZECC guidelines recommend measurement at any sensitive receiver at least 3.5 metres from building or structure, and ground vibration measured at any point on the noise sensitive site at least the longest dimension of the foundations of a building or structure away from the building or structure.

The blasting criteria specified in CoA B22 and/or CoA B23 may be increased where the Applicant has obtained the written agreement of the relevant landowner to increase the criteria, in accordance with CoA B24.

6 Environmental aspects and impacts

6.1 Environmental aspects

The Project will involve a range of activities incorporating various heavy machinery, plant and equipment that will operate in a number of locations across the Project. In order to assess the level of potential impact on noise and vibration sensitive receivers, the broad categories of construction activity likely to interact with these receivers are identified below:

- Site establishment.
- Clearing and grubbing.
- Demolition.
- Earthworks and drainage.
- Drilling and blasting.
- Quarrying – crushing and screening and rock hammering.
- Concrete & asphalt batch plants
- Bridgeworks (piling).
- Paving and concrete saw cutting.
- Road furnishing.
- Establishment and operation of ancillary facilities.

Key aspects, potential impacts and risk analysis for the Project are listed in Table 6-1.

Table 6-1 – Key Activities, Potential Impacts and Risk Analysis

Activity	Potential impact	Current Risk Category	Mitigation Measure (Refer to Section 8)	Revised Risk Category
Vegetation clearing and Grubbing	Noise generated by machinery including bulldozers, chainsaws and mobile chippers	High	General / Planning Reasonable & Feasible	Medium
Bulk earthworks (site preparation, site offices, excavation)	Vibrations and noise associated with compaction and bulk earthworks impacting on sensitive receivers.	High	General / Planning Reasonable & Feasible	Medium
	Excessive noise generated during bulk earthworks resulting in a community complaint.	Extreme	General / Planning Reasonable & Feasible	High
	Excessive noise from crushing plant(s) resulting in community complaints	Extreme	General / Planning Reasonable & Feasible	Medium
Construction Phase	Excessive noise generated by construction fleet resulting in community complaints or public nuisance.	Extreme	General / Planning Reasonable & Feasible	Medium
	Damage to structural buildings due to vibration impacts associated with construction activities.	Extreme	General / Planning Reasonable & Feasible	Medium

Activity	Potential impact	Current Risk Category	Mitigation Measure (Refer to Section 8)	Revised Risk Category
	Excessive noise from concrete/asphalt batching plant(s) resulting in community complaints	Extreme	General / Planning Reasonable & Feasible	Medium
Blasting Activities	Air blast overpressure from blasting activities resulting in community complaints or property damage.	Extreme	General / Planning Reasonable & Feasible Blasting	Medium
	Ground vibration as a result of blasting activities resulting in structural damage to existing infrastructure or community complaints	Extreme	General / Planning Reasonable & Feasible Blasting	Medium
	Ground vibration as a result of blasting activities resulting in damage to surrounding fauna habitat	Medium	General / Planning Reasonable & Feasible Blasting	Low

6.2 Impacts

The potential for noise and vibration impacts on sensitive receivers or structures will depend on a number of factors. Typically these might include:

- The type of equipment in use.
- The number of equipment simultaneously in use.
- Ground condition.
- Topography and other physical barriers.
- Proximity to sensitive receivers.
- The condition of sensitive receivers.
- Hours/duration of construction works.
- Proximity of heavy traffic areas such as the highway.

Relevant aspects and the potential for related impacts have been considered in a risk assessment at Table 6-1.

Noise and vibration impacts attributable to the Project are anticipated. Chapter 8 provides a suite of mitigation measures that will be implemented to avoid or minimise impacts on the receiving community and/or built environment.

7 Construction noise and vibration assessment

A range of plant and equipment will be required to undertake activities associated with the Project. A summary of anticipated construction scenarios and predicted noise levels are provided below. This information will be used to determine potential impacts on the receiving community. An adaptive management approach will be applied to the implementation of mitigation measures to minimise impacts on the community.

7.1 Construction activities

Table 7-1 provides a summary of construction scenarios, and associated plant and equipment required for the works. Due to the nature of construction activities, this plant and equipment may be used in isolation or simultaneously at any time during each phase of work. The overall sound power levels refer to the full equipment list for each phase. Appendix A provides a detailed list of equipment and corresponding individual sound power levels.

Table 7-1 Construction scenarios and associated plant and equipment

Scenario reference	Construction scenario	Chainage	Typical plant and equipment required	Overall Sound Power Level Lw dB(A)
01_GEO	Geotechnical works	-500 to 16200	1 x Piling rig small (bored) 1 x Backhoe 7.5t 1 x Excavator 20t 1 x Generator	110
02_DCL	Discrete clearing	0 to 1900, 9850 to 16200	2 x Excavator 20t 1 x Chipper 2 x Dump truck	110
03_BCL	Broad clearing	1900-9850	2 x Excavator 20t 2 x Chipper 2 x Dump truck	111
04_CUT	Earthworks - Cut	-500 to 16200	2 x Excavator 30t 1 x Excavator 12t (breaker)* 1 x Water cart 2 x Dump truck 1 x Dozer 3 x Articulated truck	124
05_DRL	Earthworks – Drill and blasting	7600 to 8100	1 x Drilling rig 1 x Backhoe 7.5t 1 x Truck	113
06_FIL	Earthworks – Fill and compact	-500 to 16200	2 x Compactor 1 x Grader 1 x Water cart 1 x Roller (non-vibratory)* 1 x Smooth drum roller* 3 x Articulated truck	116
07_SER	Services and drainage installation	-500 to 16200	1 x Suction truck 1 x Excavator 20t 1 x Bogie 2 x Hand tools	110

Scenario reference	Construction scenario	Chainage	Typical plant and equipment required	Overall Sound Power Level Lw dB(A)
08_BAS	Construction of water quality basins	250 to 450, 800 to 900 (W), 1300 to 1400 (W), 1600 to 1800 (W), 2900 (E), 3450 to 3550 (W), 4650 to 4700 (E), 4800 to 4900 (E), 5700 to 5800 (E & W), 6250 to 6300 (E), 8320 to 8350 (W), 10300 (E), 12550 (W)	1 x Excavator 20t 1 x Bogie 1 x Water pump	106
09_HAU	Plant and materials haulage	-500 to 16200	1 x Low loader 1 x Water cart 2 x Dumper	111
10_VMW	Verge and median works	-500 to 16200	1 x Bogie 1 x Grader 1 x Bobcat 1 x Roller (non-vibratory)* 1 x Water cart	112
11_ENV	Installation of environmental controls	-500 to 16200	1 x Backhoe 7.5t 1 x Grader 2 x Hand tools	108
12_KCB	Kerb and barrier works	-500 to 16200	1 x Kerb slipform machine <u>or</u> 1 x Barrier slipform machine 2 x Concrete truck/agitator	113
13_CCP	Carriageway concrete paving	-500 to 16200	1 x Paving machine Skidsteer 2 x Concrete truck/agitator Light vehicle	114
14_CSC	Soft concrete saw cutting	-500 to 16200	1 x Saw cutting machine* 1 x Daymaker	110
15_SCP	Shoulder concrete paving	-500 to 16200	1 x Shoulder paving machine 1 x water tanker 1 x Concrete truck/agitator 1 x Light vehicle	113
16_SPS	Spray sealing activities	-500 to 16200	1 x Bitumen spray truck 1 x Bogie 1 x Multi tyred roller* 1 x Light vehicle	109
17_LMK	Line marking	-500 to 16200	1 x Line marking plant 1 x Road sweeper	107
18_WLI	Wall installation	-500 to -450	1 x Mobile crane 50t 1 x Franna crane 1 x Flatbed truck	107
19_BDG	Bridge installations – bored piling	1000, 2500 to 2600, 3500 to 3600, 4000 to 4300, 4700 to 4800, 6100 to 6200 (E & W), 9800 to 9900	1 x Piling rig large (bored) 2 x Mobile crane 100t 2 x Flatbed truck	112

Scenario reference	Construction scenario	Chainage	Typical plant and equipment required	Overall Sound Power Level Lw dB(A)
			1 x Generator 4 x Hand tools	
20_SGN	Signage installation	-500 to 16200	1 x Excavator 6t 1 x Truck 10t 2 x Hand tools 1 x Rattle gun (hand-held)	106
21_MCP	Main compound	2550 to 2875	2 x Truck 1 x Franna crane 1 x Front end loader 1 x Generator 5 x Light vehicle	113
22_CCP	Crushing compound	7200 - 7800	1 x Excavator (30T) 1 x Generator 1 x Excavator 12t (breaker)* 2 x Front end loader 1 x Mobile jaw crusher (50T)* 2 x Dump truck 1 x Water cart 1 x Mobile screen	125

* Indicates 5dB(A) penalty applied for tonal, annoying or impulsive sound sources in accordance with ICNG.

Typical construction equipment noise levels have been obtained from 'Appendix A' of AS 2436 – 2010 *Guide to noise and vibration control on construction, demolition and maintenance site*; BS 5228-2009 *Code of practice for noise and vibration control on construction and open sites*, UK Department for Environment, Food and Rural Affairs databases (DEFRA), and Jacobs internal noise database. Levels include a correction to allow for typical on site usage during a normal 15 minute period. The default usage factors are based on the US Federal Highway Administration's Roadway Construction Noise Model or similar values.

Potential construction noise impacts were modelled for each receiver using the CONCAWE algorithm in the SoundPLAN noise modelling software.

Construction noise predictions assume that all equipment is operating at the same time at the nearest point to the receiver.

7.2 Construction noise impacts

7.2.1 General construction

Table 7-3 and Table 7-4 provide a summary of predicted noise impacts from each related construction scenario. Noise management level targets for each key sensitive receiver location have also been provided. Predicted noise levels for each construction scenario have been derived by calculating the combined noise output from the sound power levels of each piece of equipment under maximum typical operating conditions listed in Table 7-1.

Terrain used in the model considers the final alignment, with noise sources placed in the centre of the construction corridor at a height of 2m. Modelled noise levels in cutting areas may be up to 3dB(A) above those modelled when work commences however will approach

modelled levels as work progresses. Likewise modelled noise levels in fill areas may be up to 3dB(A) below those modelled at the start of construction however will increase as the elevation of the alignment increases.

As noise sources are modelled at the centre of the alignment, some increase / decrease in noise may occur when works are underway at the road boundary. The average distance between the road boundary and the centre of the corridor is approximately 40m. A correction to the likely change in noise level using simple distance attenuation has been presented in Table 7-2. This quantification of impacts along the width of the corridor allows for greater flexibility in programming out of hours works (in particular an allowance for activities away from sensitive receivers during such periods).

Table 7-2 Change in noise level as work approaches project boundary

	Distance of receiver from centre of alignment (m)						
	100m	150m	200m	250m	500m	750m	1000m
Change in noise level	± 4dB(A)	± 3dB(A)	± 2.5dB(A)	± 2dB(A)	± 1dB(A)	± 0.5dB(A)	No change

Predicted impacts are the maximum predicted noise level of each construction scenario, i.e. where works are at their shortest distance from receivers. Hence, noise levels will increase as activity moves toward this nearest point and will then decrease as it moves away again. The distances listed in the table are the shortest distance between the centre of the corridor and receiver; however, where works are at the corridor boundary, higher noise levels are expected, as discussed below.

For activities considered to be annoying such as rock drilling, vibratory rolling, road profiling, impact piling and rock hammering, a 5 dB(A) penalty has been applied to predicted levels in line with the ICNG.

Although results have been presented in Table 7-3 and Table 7-4, potential noise impacts associated with compounds and crushing have been discussed in Section 7.2.3.

Predictions of both maximum $L_{Aeq(15\text{ minute})}$ noise levels and internal $L_{A1(1\text{ minute})}$ noise levels are summarised in Table 7-3 and Table 7-4 with the following highlights for quick analysis:

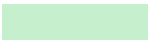



	expected to exceed the night NML
	expected to exceed the night and morning NML
	expected to exceed the night, morning and evening NML
	expected to exceed the all NMLs

Table 7-3 Predicted construction noise levels - Activity set A

NCA	Receiver	NML dB(A)				Predicted maximum LAeq(15 minute) [dB(A)]										
		Morning	Day	Evening	Night	01_GEO	02_DCL	03_BCL	04_CUT	05_DRL	06_FIL	07_SER	08_BAS	09_HAU	10_VMW	11_ENV
1	4	52	57	50	46	49	46	20	62	2	56	49	41	50	51	47
1	5	52	57	50	46	49	47	20	62	2	56	49	44	50	51	47
1	7	52	57	50	46	48	47	22	61	2	55	48	45	49	50	46
1	9	52	57	50	46	40	40	26	53	2	47	40	35	41	42	38
1	10	52	57	50	46	42	42	26	55	2	49	42	37	43	44	40
1	11	52	57	50	46	42	42	26	55	2	49	42	37	43	44	40
1	12	52	57	50	46	41	41	26	54	2	48	41	36	42	43	39
1	13	52	57	50	46	39	39	26	52	2	46	39	34	40	41	37
1	14	52	57	50	46	41	41	24	54	2	48	41	38	42	43	39
1	15	52	57	50	46	39	39	26	52	2	46	39	35	40	41	37
1	16	52	57	50	46	38	38	26	51	2	45	38	34	39	40	36
1	17	52	57	50	46	42	42	13	55	2	49	42	38	43	44	40
1	18	52	57	50	46	37	37	26	50	2	44	37	34	38	39	35
1	19	52	57	50	46	39	39	26	52	2	46	39	35	40	41	37
1	20	52	57	50	46	38	38	26	51	2	45	38	34	39	40	36
1	21	52	57	50	46	40	40	26	53	2	47	40	35	41	42	38
1	22	52	57	50	46	42	42	11	55	2	49	42	39	43	44	40
1	23	52	57	50	46	44	44	9	57	2	51	44	40	45	46	42
1	24	52	57	50	46	37	37	26	50	2	44	37	34	38	39	35
1	25	52	57	50	46	47	47	9	60	2	54	47	40	48	49	45
1	26	52	57	50	46	40	40	26	53	2	47	40	36	41	42	38
1	27	52	57	50	46	39	39	26	52	2	46	39	35	40	41	37
1	28	52	57	50	46	43	43	13	56	2	50	43	35	44	45	41
1	29	52	57	50	46	45	45	10	58	2	52	45	41	46	47	43
1	30	52	57	50	46	38	38	26	51	2	45	38	34	39	40	36
1	31	52	57	50	46	46	46	10	59	2	53	46	42	47	48	44
1	32	52	57	50	46	41	41	26	54	2	48	41	36	42	43	39
1	33	52	57	50	46	39	39	26	52	2	46	39	35	40	41	37
1	34	52	57	50	46	40	40	26	53	2	47	40	36	41	42	38
1	35	52	57	50	46	42	42	26	55	2	49	42	35	43	44	40
1	36	52	57	50	46	48	47	9	61	2	55	48	43	49	50	46
1	37	52	57	50	46	38	38	26	51	2	45	38	34	39	40	36
1	38	52	57	50	46	47	47	10	60	2	54	47	42	48	49	45
1	39	52	57	50	46	41	41	26	54	2	48	41	37	42	43	39
1	40	52	57	50	46	48	48	9	61	2	55	48	44	49	50	46
1	41	52	57	50	46	43	43	27	56	2	50	43	35	44	45	41
1	42	52	57	50	46	49	51	10	62	2	56	49	44	50	51	47
1	43	52	57	50	46	40	40	27	53	2	47	40	36	41	42	38
1	44	52	57	50	46	37	37	26	50	2	44	37	33	38	39	35
1	45	52	57	50	46	39	39	26	52	2	46	39	35	40	41	37
1	46	52	57	50	46	38	38	26	51	2	45	38	34	39	40	36

NCA	Receiver	NML dB(A)				Predicted maximum LAeq(15 minute) [dB(A)]										
		Morning	Day	Evening	Night	01_GEO	02_DCL	03_BCL	04_CUT	05_DRL	06_FIL	07_SER	08_BAS	09_HAU	10_VMW	11_ENV
1	47	52	57	50	46	48	48	7	61	2	55	48	43	49	50	46
1	48	52	57	50	46	46	46	27	59	2	53	46	37	47	48	44
1	49	52	57	50	46	43	43	27	56	2	50	43	37	44	45	41
1	50	52	57	50	46	41	41	27	54	2	48	41	36	42	43	39
1	51	52	57	50	46	37	37	26	50	2	44	37	33	38	39	35
1	52	52	57	50	46	40	40	27	53	2	47	40	35	41	42	38
1	53	52	57	50	46	46	48	25	59	2	53	46	38	47	48	44
1	54	52	57	50	46	42	42	27	55	2	49	42	37	43	44	40
1	55	52	57	50	46	38	38	27	51	2	45	38	34	39	40	36
1	56	52	57	50	46	39	39	27	52	2	46	39	34	40	41	37
1	57	52	57	50	46	52	52	27	65	2	59	52	46	53	54	50
1	58	52	57	50	46	50	50	27	63	2	57	50	44	51	52	48
1	59	52	57	50	46	44	44	27	57	2	51	44	37	45	46	42
1	60	52	57	50	46	41	41	27	54	2	48	41	36	42	43	39
1	61	52	57	50	46	37	37	27	50	2	44	37	33	38	39	35
1	62	52	57	50	46	40	40	27	53	2	47	40	35	41	42	38
1	63	52	57	50	46	47	47	12	60	2	54	47	40	48	49	45
1	64	52	57	50	46	42	42	27	55	2	49	42	37	43	44	40
1	65	52	57	50	46	52	52	27	65	2	59	52	45	53	54	50
1	66	52	57	50	46	38	38	27	51	2	45	38	33	39	40	36
1	67	52	57	50	46	39	39	27	52	2	46	39	34	40	41	37
1	68	52	57	50	46	48	48	12	61	2	55	48	41	49	50	46
1	69	52	57	50	46	40	40	27	53	2	47	40	36	41	42	38
1	70	52	57	50	46	44	44	27	57	2	51	44	38	45	46	42
1	71	52	57	50	46	37	37	27	50	2	44	37	32	38	39	35
1	72	52	57	50	46	49	49	12	62	2	56	49	42	50	51	47
1	73	52	57	50	46	40	39	27	53	2	47	40	35	41	42	38
1	74	52	57	50	46	42	42	27	55	2	49	42	37	43	44	40
1	75	52	57	50	46	43	43	27	56	2	50	43	38	44	45	41
1	76	52	57	50	46	52	52	27	65	2	59	52	44	53	54	50
1	77	52	57	50	46	49	49	27	62	2	56	49	43	50	51	47
1	78	52	57	50	46	38	38	27	51	2	45	38	33	39	40	36
1	79	52	57	50	46	40	40	27	53	2	47	40	35	41	42	38
1	80	52	57	50	46	40	40	27	53	2	47	40	35	41	42	38
1	81	52	57	50	46	39	38	27	52	2	46	39	34	40	41	37
1	82	52	57	50	46	45	45	27	58	2	52	45	37	46	47	43
1	83	52	57	50	46	42	41	27	55	2	49	42	36	43	44	40
1	84	52	57	50	46	37	37	27	50	2	44	37	32	38	39	35
1	85	52	57	50	46	39	39	27	52	2	46	39	35	40	41	37
1	86	52	57	50	46	48	47	27	61	2	55	48	39	49	50	46
1	87	52	57	50	46	52	52	27	65	2	59	52	44	53	54	50
1	88	52	57	50	46	38	38	27	51	2	45	38	33	39	40	36
1	89	52	57	50	46	37	37	27	50	2	44	37	32	38	39	35

NCA	Receiver	NML dB(A)				Predicted maximum LAeq(15 minute) [dB(A)]										
		Morning	Day	Evening	Night	01_GEO	02_DCL	03_BCL	04_CUT	05_DRL	06_FIL	07_SER	08_BAS	09_HAU	10_VMW	11_ENV
1	90	52	57	50	46	40	40	27	53	2	47	40	35	41	42	38
1	91	52	57	50	46	38	38	27	51	2	45	38	34	39	40	36
1	92	52	57	50	46	43	43	27	56	2	50	43	37	44	45	41
1	93	52	57	50	46	39	39	27	52	2	46	39	34	40	41	37
1	94	52	57	50	46	41	41	27	54	2	48	41	36	42	43	39
1	95	52	57	50	46	51	51	28	64	2	58	51	43	52	53	49
1	96	52	57	50	46	37	37	27	50	2	44	37	33	38	39	35
1	97	52	57	50	46	44	44	27	57	2	51	44	38	45	46	42
1	98	52	57	50	46	36	36	27	49	2	43	36	32	37	38	34
1	99	52	57	50	46	40	40	27	53	2	47	40	35	41	42	38
1	100	52	57	50	46	38	38	27	51	2	45	38	33	39	40	36
1	101	52	57	50	46	42	42	27	55	2	49	42	37	43	44	40
1	102	52	57	50	46	41	41	27	54	2	48	41	36	42	43	39
1	103	52	57	50	46	47	47	12	60	2	54	47	40	48	49	45
1	104	52	57	50	46	51	51	28	64	2	58	51	42	52	53	49
1	105	52	57	50	46	39	39	27	52	2	46	39	34	40	41	37
1	106	52	57	50	46	37	37	27	50	2	44	37	32	38	39	35
1	107	52	57	50	46	44	44	27	57	2	51	44	38	45	46	42
1	108	52	57	50	46	36	36	27	49	2	43	36	31	37	38	34
1	109	52	57	50	46	40	40	27	53	2	47	40	35	41	42	38
1	110	52	57	50	46	42	42	27	55	2	49	42	36	43	44	40
1	111	52	57	50	46	38	38	27	51	2	45	38	33	39	40	36
1	112	52	57	50	46	41	41	27	54	2	48	41	35	42	43	39
1	113	52	57	50	46	49	47	12	62	2	56	49	41	50	51	47
1	114	52	57	50	46	37	37	27	50	2	44	37	32	38	39	35
1	115	52	57	50	46	39	39	27	52	2	46	39	34	40	41	37
1	116	52	57	50	46	50	50	28	63	2	57	50	42	51	52	48
1	117	52	57	50	46	42	42	28	55	2	49	42	36	43	44	40
1	118	52	57	50	46	40	40	28	53	2	47	40	35	41	42	38
1	119	52	57	50	46	41	41	28	54	2	48	41	36	42	43	39
1	120	52	57	50	46	37	37	27	50	2	44	37	32	38	39	35
1	121	52	57	50	46	44	44	28	57	2	51	44	37	45	46	42
1	122	52	57	50	46	42	42	28	55	2	49	42	36	43	44	40
1	123	52	57	50	46	43	43	28	56	2	50	43	37	44	45	41
1	124	52	57	50	46	39	39	28	52	2	46	39	34	40	41	37
1	125	52	57	50	46	38	38	28	51	2	45	38	33	39	40	36
1	126	52	57	50	46	36	36	27	49	2	43	36	31	37	38	34
1	127	52	57	50	46	43	43	28	56	2	50	43	37	44	45	41
1	128	52	57	50	46	49	49	28	62	2	56	49	42	50	51	47
1	129	52	57	50	46	41	41	28	54	2	48	41	36	42	43	39
1	130	52	57	50	46	48	48	28	61	2	55	48	41	49	50	46
1	131	52	57	50	46	37	37	28	50	2	44	37	33	38	39	35
1	132	52	57	50	46	36	36	28	49	2	43	36	31	37	38	34

NCA	Receiver	NML dB(A)				Predicted maximum LAeq(15 minute) [dB(A)]										
		Morning	Day	Evening	Night	01_GEO	02_DCL	03_BCL	04_CUT	05_DRL	06_FIL	07_SER	08_BAS	09_HAU	10_VMW	11_ENV
1	133	52	57	50	46	38	38	28	51	2	45	38	33	39	40	36
1	134	52	57	50	46	37	37	28	50	2	44	37	32	38	39	35
1	135	52	57	50	46	47	47	27	60	2	54	47	41	48	49	45
1	136	52	57	50	46	37	37	28	50	2	44	37	33	38	39	35
1	137	52	57	50	46	41	41	28	54	2	48	41	36	42	43	39
1	138	52	57	50	46	38	38	28	51	2	45	38	33	39	40	36
1	139	52	57	50	46	42	42	28	55	2	49	42	37	43	44	40
1	140	52	57	50	46	36	37	28	49	2	43	36	32	37	38	34
1	141	52	57	50	46	41	41	28	54	2	48	41	36	42	43	39
1	142	52	57	50	46	48	48	29	61	2	55	48	42	49	50	46
1	143	52	57	50	46	42	42	28	55	2	49	42	37	43	44	40
1	144	52	57	50	46	45	45	25	58	2	52	45	39	46	47	43
1	145	52	57	50	46	39	40	28	52	2	46	39	35	40	41	37
1	146	52	57	50	46	44	44	28	57	2	51	44	38	45	46	42
1	147	52	57	50	46	41	41	28	54	2	48	41	36	42	43	39
1	148	52	57	50	46	36	36	28	49	2	43	36	31	37	38	34
1	149	52	57	50	46	40	40	28	53	2	47	40	35	41	42	38
1	150	52	57	50	46	44	44	18	57	2	51	44	39	45	46	42
1	151	52	57	50	46	39	39	28	52	2	46	39	34	40	41	37
1	152	52	57	50	46	39	39	28	52	2	46	39	35	40	41	37
1	153	52	57	50	46	42	42	29	55	2	49	42	37	43	44	40
1	154	52	57	50	46	47	47	29	60	2	54	47	41	48	49	45
1	155	52	57	50	46	36	37	28	49	2	43	36	32	37	38	34
1	156	52	57	50	46	42	42	29	55	2	49	42	35	43	44	40
1	157	52	57	50	46	53	53	29	66	2	60	53	46	54	55	51
1	158	52	57	50	46	37	37	28	50	2	44	37	32	38	39	35
1	159	52	57	50	46	46	46	29	59	2	53	46	40	47	48	44
1	160	52	57	50	46	40	40	29	53	2	47	40	35	41	42	38
1	161	52	57	50	46	36	36	28	49	2	43	36	31	37	38	34
1	162	52	57	50	46	36	36	28	49	2	43	36	31	37	38	34
1	163	52	57	50	46	41	41	29	54	2	48	41	36	42	43	39
1	164	52	57	50	46	37	37	28	50	2	44	37	32	38	39	35
1	165	52	57	50	46	41	41	29	54	2	48	41	36	42	43	39
1	166	52	57	50	46	41	41	29	54	2	48	41	34	42	43	39
1	167	52	57	50	46	46	46	29	59	2	53	46	40	47	48	44
1	168	52	57	50	46	37	37	28	50	2	44	37	32	38	39	35
1	169	52	57	50	46	42	42	29	55	2	49	42	37	43	44	40
1	170	52	57	50	46	39	40	29	52	2	46	39	35	40	41	37
1	171	52	57	50	46	36	36	28	49	2	43	36	31	37	38	34
1	172	52	57	50	46	43	44	29	56	2	50	43	38	44	45	41
1	173	52	57	50	46	37	37	29	50	2	44	37	32	38	39	35
1	174	52	57	50	46	44	42	29	57	2	51	44	39	45	46	42
1	175	52	57	50	46	36	36	29	49	2	43	36	31	37	38	34

NCA	Receiver	NML dB(A)				Predicted maximum LAeq(15 minute) [dB(A)]										
		Morning	Day	Evening	Night	01_GEO	02_DCL	03_BCL	04_CUT	05_DRL	06_FIL	07_SER	08_BAS	09_HAU	10_VMW	11_ENV
1	176	52	57	50	46	47	47	25	60	2	54	47	41	48	49	45
1	177	52	57	50	46	37	37	29	50	2	44	37	32	38	39	35
1	178	52	57	50	46	40	40	29	53	2	47	40	35	41	42	38
1	179	52	57	50	46	43	43	29	56	2	50	43	37	44	45	41
1	180	52	57	50	46	44	44	29	57	2	51	44	38	45	46	42
1	181	52	57	50	46	41	41	29	54	2	48	41	36	42	43	39
1	182	52	57	50	46	43	43	29	56	2	50	43	35	44	45	41
1	183	52	57	50	46	47	47	25	60	2	54	47	42	48	49	45
1	184	52	57	50	46	37	37	29	50	2	44	37	32	38	39	35
1	185	52	57	50	46	40	40	28	53	2	47	40	35	41	42	38
1	186	52	57	50	46	44	44	29	57	2	51	44	38	45	46	42
1	187	52	57	50	46	40	40	29	53	2	47	40	35	41	42	38
1	188	52	57	50	46	39	39	25	52	2	46	39	34	40	41	37
1	189	52	57	50	46	36	36	29	49	2	43	36	31	37	38	34
1	190	52	57	50	46	42	42	25	55	2	49	42	34	43	44	40
1	191	52	57	50	46	37	37	29	50	2	44	37	32	38	39	35
1	192	52	57	50	46	41	41	29	54	2	48	41	36	42	43	39
1	193	52	57	50	46	48	47	18	61	2	55	48	38	49	50	46
1	194	52	57	50	46	48	48	18	61	2	55	48	42	49	50	46
1	195	52	57	50	46	49	50	30	62	2	56	49	43	50	51	47
1	196	52	57	50	46	39	40	29	52	2	46	39	35	40	41	37
1	197	52	57	50	46	37	37	29	50	2	44	37	32	38	39	35
1	198	52	57	50	46	36	36	29	49	2	43	36	31	37	38	34
1	199	52	57	50	46	36	36	29	49	2	43	36	31	37	38	34
1	200	52	57	50	46	45	46	26	58	2	52	45	40	46	47	43
1	201	52	57	50	46	37	37	29	50	2	44	37	32	38	39	35
1	202	52	57	50	46	41	41	28	54	2	48	41	36	42	43	39
1	203	52	57	50	46	40	40	22	53	2	47	40	35	41	42	38
1	204	52	57	50	46	49	49	16	62	2	56	49	40	50	51	47
1	205	52	57	50	46	36	36	29	49	2	43	36	31	37	38	34
1	206	52	57	50	46	42	42	24	55	2	49	42	35	43	44	40
1	207	52	57	50	46	36	36	29	49	2	43	36	31	37	38	34
1	208	52	57	50	46	48	48	24	61	2	55	48	42	49	50	46
1	209	52	57	50	46	52	52	25	65	2	59	52	45	53	54	50
1	210	52	57	50	46	37	37	29	50	2	44	37	32	38	39	35
1	211	52	57	50	46	47	47	30	60	2	54	47	41	48	49	45
1	212	52	57	50	46	47	47	30	60	2	54	47	41	48	49	45
1	213	52	57	50	46	43	43	30	56	2	50	43	38	44	45	41
1	214	52	57	50	46	37	37	29	50	2	44	37	32	38	39	35
1	215	52	57	50	46	40	40	30	53	2	47	40	35	41	42	38
1	216	52	57	50	46	39	39	30	52	2	46	39	30	40	41	37
1	217	52	57	50	46	48	48	30	61	2	55	48	43	49	50	46
1	218	52	57	50	46	50	51	15	63	2	57	50	45	51	52	48

NCA	Receiver	NML dB(A)				Predicted maximum LAeq(15 minute) [dB(A)]										
		Morning	Day	Evening	Night	01_GEO	02_DCL	03_BCL	04_CUT	05_DRL	06_FIL	07_SER	08_BAS	09_HAU	10_VMW	11_ENV
1	219	52	57	50	46	38	38	29	51	2	45	38	33	39	40	36
1	220	52	57	50	46	41	41	30	54	2	48	41	36	42	43	39
1	221	52	57	50	46	53	53	16	66	2	60	53	46	54	55	51
1	222	52	57	50	46	51	51	30	64	2	58	51	45	52	53	49
1	223	52	57	50	46	50	50	30	63	2	57	50	45	51	52	48
1	224	52	57	50	46	46	47	30	59	2	53	46	39	47	48	44
1	225	52	57	50	46	51	50	31	64	2	58	51	45	52	53	49
1	226	52	57	50	46	45	45	30	58	2	52	45	40	46	47	43
1	227	52	57	50	46	49	49	31	62	2	56	49	43	50	51	47
1	229	52	57	50	46	42	43	30	55	2	49	42	37	43	44	40
1	231	52	57	50	46	39	39	18	52	2	46	39	33	40	41	37
1	232	52	57	50	46	40	40	30	53	2	47	40	34	41	42	38
1	233	52	57	50	46	41	41	28	54	2	48	41	34	42	43	39
1	234	52	57	50	46	41	42	29	54	2	48	41	35	42	43	39
1	235	52	57	50	46	39	39	30	52	2	46	39	33	40	41	37
1	236	52	57	50	46	41	41	21	54	2	48	41	33	42	43	39
1	237	52	57	50	46	39	40	32	52	2	46	39	31	40	41	37
1	238	52	57	50	46	42	43	28	55	2	49	42	35	43	44	40
1	239	52	57	50	46	40	40	28	53	2	47	40	33	41	42	38
1	240	52	57	50	46	39	39	30	52	2	46	39	32	40	41	37
1	241	52	57	50	46	41	41	29	54	2	48	41	34	42	43	39
1	242	52	57	50	46	40	40	31	53	2	47	40	35	41	42	38
1	243	52	57	50	46	43	43	30	56	2	50	43	35	44	45	41
1	244	52	57	50	46	40	40	26	53	2	47	40	35	41	42	38
1	245	52	57	50	46	44	44	34	57	2	51	44	37	45	46	42
1	246	52	57	50	46	34	34	28	47	2	41	34	27	35	36	32
1	247	52	57	50	46	37	37	29	50	2	44	37	31	38	39	35
1	248	52	57	50	46	41	41	17	54	2	48	41	33	42	43	39
1	249	52	57	50	46	44	44	17	57	2	51	44	30	45	46	42
1	250	52	57	50	46	42	42	17	55	2	49	42	34	43	44	40
1	251	52	57	50	46	43	45	17	56	2	50	43	35	44	45	41
1	252	52	57	50	46	41	41	31	54	2	48	41	29	42	43	39
1	253	52	57	50	46	43	43	18	56	2	50	43	33	44	45	41
1	254	52	57	50	46	43	43	18	56	2	50	43	35	44	45	41
1	255	52	57	50	46	44	44	34	57	2	51	44	37	45	46	42
1	256	52	57	50	46	41	41	18	54	2	48	41	28	42	43	39
1	257	52	57	50	46	49	47	19	62	2	56	49	37	50	51	47
1	258	52	57	50	46	41	41	29	54	2	48	41	28	42	43	39
1	259	52	57	50	46	49	49	20	62	2	56	49	37	50	51	47
1	260	52	57	50	46	41	40	31	54	2	48	41	35	42	43	39
1	261	52	57	50	46	42	42	18	55	2	49	42	27	43	44	40
1	262	52	57	50	46	34	34	18	47	2	41	34	28	35	36	32
1	263	52	57	50	46	43	45	18	56	2	50	43	28	44	45	41

NCA	Receiver	NML dB(A)				Predicted maximum LAeq(15 minute) [dB(A)]										
		Morning	Day	Evening	Night	01_GEO	02_DCL	03_BCL	04_CUT	05_DRL	06_FIL	07_SER	08_BAS	09_HAU	10_VMW	11_ENV
1	264	52	57	50	46	51	51	20	64	2	58	51	37	52	53	49
1	265	52	57	50	46	43	43	18	56	2	50	43	30	44	45	41
1	266	52	57	50	46	40	40	29	53	2	47	40	28	41	42	38
1	267	52	57	50	46	44	44	18	57	2	51	44	30	45	46	42
1	268	52	57	50	46	39	39	31	52	2	46	39	32	40	41	37
1	269	52	57	50	46	44	45	34	57	2	51	44	37	45	46	42
1	270	52	57	50	46	40	40	30	53	2	47	40	33	41	42	38
1	271	52	57	50	46	43	44	31	56	2	50	43	37	44	45	41
1	272	52	57	50	46	41	41	31	54	2	48	41	36	42	43	39
1	273	52	57	50	46	40	40	25	53	2	47	40	24	41	42	38
1	274	52	57	50	46	50	50	35	63	2	57	50	42	51	52	48
1	275	52	57	50	46	46	46	19	59	2	53	46	31	47	48	44
1	276	52	57	50	46	42	42	29	55	2	49	42	34	43	44	40
1	277	52	57	50	46	47	47	19	60	2	54	47	32	48	49	45
1	278	52	57	50	46	47	47	19	60	2	54	47	31	48	49	45
1	279	52	57	50	46	39	38	33	52	2	46	39	31	40	41	37
1	280	52	57	50	46	48	48	19	61	2	55	48	31	49	50	46
1	281	52	57	50	46	43	43	34	56	2	50	43	36	44	45	41
1	282	52	57	50	46	39	39	33	52	2	46	39	33	40	41	37
1	283	52	57	50	46	42	42	30	55	2	49	42	35	43	44	40
1	284	52	57	50	46	45	45	28	58	2	52	45	35	46	47	43
1	285	52	57	50	46	51	51	20	64	2	58	51	31	52	53	49
1	286	52	57	50	46	51	51	20	64	2	58	51	31	52	53	49
1	287	52	57	50	46	43	43	35	56	2	50	43	36	44	45	41
1	288	52	57	50	46	46	46	30	59	2	53	46	29	47	48	44
1	289	52	57	50	46	50	50	35	63	2	57	50	42	51	52	48
1	290	52	57	50	46	40	40	34	53	2	47	40	35	41	42	38
1	291	52	57	50	46	47	47	31	60	2	54	47	30	48	49	45
1	292	52	57	50	46	43	43	35	56	2	50	43	36	44	45	41
1	293	52	57	50	46	40	40	34	53	2	47	40	33	41	42	38
1	294	52	57	50	46	45	45	35	58	2	52	45	38	46	47	43
1	295	52	57	50	46	42	41	35	55	2	49	42	35	43	44	40
1	296	52	57	50	46	50	50	20	63	2	57	50	30	51	52	48
1	297	52	57	50	46	40	40	34	53	2	47	40	33	41	42	38
1	299	52	57	50	46	42	42	35	55	2	49	42	36	43	44	40
1	300	52	57	50	46	48	48	31	61	2	55	48	31	49	50	46
1	301	52	57	50	46	41	41	35	54	2	48	41	35	42	43	39
1	302	52	57	50	46	48	48	31	61	2	55	48	30	49	50	46
1	304	52	57	50	46	50	50	35	63	2	57	50	39	51	52	48
1	305	52	57	50	46	52	52	35	65	2	59	52	44	53	54	50
1	306	52	57	50	46	46	46	31	59	2	53	46	29	47	48	44
1	307	52	57	50	46	49	49	30	62	2	56	49	29	50	51	47
1	309	52	57	50	46	52	52	36	65	2	59	52	44	53	54	50

NCA	Receiver	NML dB(A)				Predicted maximum LAeq(15 minute) [dB(A)]										
		Morning	Day	Evening	Night	01_GEO	02_DCL	03_BCL	04_CUT	05_DRL	06_FIL	07_SER	08_BAS	09_HAU	10_VMW	11_ENV
1	310	52	57	50	46	50	47	33	63	2	57	50	34	51	52	48
1	311	52	57	50	46	45	45	36	58	2	52	45	37	46	47	43
1	312	52	57	50	46	47	47	36	60	2	54	47	37	48	49	45
1	313	52	57	50	46	51	51	36	64	2	58	51	43	52	53	49
1	314	52	57	50	46	52	52	36	65	2	59	52	44	53	54	50
1	315	52	57	50	46	47	47	36	60	2	54	47	39	48	49	45
1	316	52	57	50	46	47	47	31	60	2	54	47	40	48	49	45
1	317	52	57	50	46	49	49	34	62	2	56	49	42	50	51	47
1	318	52	57	50	46	47	47	33	60	2	54	47	41	48	49	45
1	319	52	57	50	46	50	50	37	63	2	57	50	43	51	52	48
1	320	52	57	50	46	48	48	37	61	2	55	48	41	49	50	46
1	321	52	57	50	46	45	45	37	58	2	52	45	39	46	47	43
2	322	50	52	48	49	50	50	41	63	2	57	50	46	51	52	48
2	323	50	52	48	49	41	38	42	54	2	48	41	26	42	43	39
2	324	50	52	48	49	40	35	41	53	2	47	40	33	41	42	38
2	325	50	52	48	49	40	37	41	53	2	47	40	33	41	42	38
2	326	50	52	48	49	40	37	41	53	2	47	40	32	41	42	38
2	327	50	52	48	49	39	36	40	52	2	46	39	32	40	41	37
2	328	50	52	48	49	37	36	38	50	2	44	37	31	38	39	35
2	329	50	52	48	49	37	31	38	50	2	44	37	28	38	39	35
2	330	50	52	48	49	40	37	41	53	2	47	40	32	41	42	38
2	331	50	52	48	49	38	36	39	51	2	45	38	31	39	40	36
2	332	50	52	48	49	40	36	41	53	2	47	40	32	41	42	38
2	333	50	52	48	49	39	36	40	52	2	46	39	31	40	41	37
2	334	50	52	48	49	38	36	39	51	2	45	38	31	39	40	36
2	335	50	52	48	49	58	40	59	71	2	65	58	34	59	60	56
2	336	50	52	48	49	36	35	38	49	2	43	36	31	37	38	34
2	337	50	52	48	49	38	35	39	51	2	45	38	30	39	40	36
2	338	50	52	48	49	37	34	37	50	2	44	37	30	38	39	35
2	339	50	52	48	49	39	34	40	52	2	46	39	31	40	41	37
2	341	50	52	48	49	38	35	39	51	2	45	38	30	39	40	36
2	343	50	52	48	49	36	35	36	49	2	43	36	30	37	38	34
2	344	50	52	48	49	59	31	59	72	2	66	59	34	60	61	57
2	345	50	52	48	49	33	33	33	46	2	40	33	30	34	35	31
2	346	50	52	48	49	33	33	32	46	2	40	33	30	34	35	31
2	349	50	52	48	49	40	35	41	53	2	47	40	30	41	42	38
2	350	50	52	48	49	37	34	38	50	2	44	37	29	38	39	35
2	351	50	52	48	49	49	26	56	62	2	56	49	32	50	51	47
2	353	50	52	48	49	37	33	38	50	2	44	37	29	38	39	35
2	355	50	52	48	49	37	33	38	50	2	44	37	29	38	39	35
2	356	50	52	48	49	37	33	37	50	2	44	37	27	38	39	35
2	357	50	52	48	49	37	33	38	50	2	44	37	28	38	39	35
2	358	50	52	48	49	37	33	38	50	2	44	37	28	38	39	35

NCA	Receiver	NML dB(A)				Predicted maximum LAeq(15 minute) [dB(A)]										
		Morning	Day	Evening	Night	01_GEO	02_DCL	03_BCL	04_CUT	05_DRL	06_FIL	07_SER	08_BAS	09_HAU	10_VMW	11_ENV
2	359	50	52	48	49	37	33	38	50	2	44	37	28	38	39	35
2	360	50	52	48	49	37	33	38	50	2	44	37	28	38	39	35
2	361	50	52	48	49	37	33	39	50	2	44	37	28	38	39	35
2	362	50	52	48	49	35	32	37	48	2	42	35	28	36	37	33
2	363	50	52	48	49	34	31	35	47	2	41	34	26	35	36	32
2	364	50	52	48	49	36	23	38	49	2	43	36	23	37	38	34
2	365	50	52	48	49	36	22	38	49	2	43	36	22	37	38	34
2	366	50	52	48	49	33	32	34	46	2	40	33	28	34	35	31
2	367	50	52	48	49	45	31	46	58	2	52	45	36	46	47	43
2	368	50	52	48	49	35	32	36	48	2	42	35	27	36	37	33
2	371	50	52	48	49	36	32	39	49	2	43	36	27	37	38	34
2	372	50	52	48	49	36	32	37	49	2	43	36	27	37	38	34
2	374	50	52	48	49	36	32	39	49	2	43	36	27	37	38	34
2	375	50	52	48	49	35	29	36	48	2	42	35	27	36	37	33
2	377	50	52	48	49	36	32	38	49	2	43	36	27	37	38	34
2	378	50	52	48	49	32	27	34	45	2	39	32	22	33	34	30
2	379	50	52	48	49	36	31	38	49	2	43	36	27	37	38	34
2	380	50	52	48	49	36	24	38	49	2	43	36	25	37	38	34
2	381	50	52	48	49	35	31	38	48	2	42	35	26	36	37	33
2	382	50	52	48	49	36	23	37	49	2	43	36	23	37	38	34
2	383	50	52	48	49	38	31	39	51	2	45	38	29	39	40	36
2	393	50	52	48	49	40	14	41	53	2	47	40	37	41	42	38
3	396	55	58	49	49	47	14	48	60	12	54	47	44	48	49	45
3	399	55	58	49	49	43	14	44	56	10	50	43	40	44	45	41
3	402	55	58	49	49	56	3	57	69	22	63	56	36	57	58	54
3	403	55	58	49	49	42	3	43	55	20	49	42	38	43	44	40
3	404	55	58	49	49	53	3	55	66	22	60	53	36	54	55	51
3	411	55	58	49	49	40	3	41	53	20	47	40	25	41	42	38
3	414	55	58	49	49	38	14	39	51	3	45	38	35	39	40	36
3	415	55	58	49	49	40	3	42	53	21	47	40	31	41	42	38
3	416	55	58	49	49	39	3	40	52	20	46	39	30	40	41	37
3	419	55	58	49	49	40	3	41	53	21	47	40	35	41	42	38
3	420	55	58	49	49	40	3	41	53	21	47	40	31	41	42	38
3	422	55	58	49	49	38	3	39	51	21	45	38	31	39	40	36
3	423	55	58	49	49	38	3	39	51	21	45	38	31	39	40	36
3	429	55	58	49	49	38	11	39	51	24	45	38	36	39	40	36
4	432	54	58	48	47	20	3	21	33	15	27	20	16	21	22	18
4	434	54	58	48	47	38	10	39	51	33	45	38	31	39	40	36
4	435	54	58	48	47	44	3	45	57	28	51	44	28	45	46	42
4	448	54	58	48	47	29	11	30	42	33	36	29	8	30	31	27
4	453	54	58	48	47	38	17	38	51	18	45	38	23	39	40	36
4	455	54	58	48	47	49	4	49	62	29	56	49	29	50	51	47
4	456	54	58	48	47	30	18	31	43	20	37	30	12	31	32	28

NCA	Receiver	NML dB(A)				Predicted maximum LAeq(15 minute) [dB(A)]										
		Morning	Day	Evening	Night	01_GEO	02_DCL	03_BCL	04_CUT	05_DRL	06_FIL	07_SER	08_BAS	09_HAU	10_VMW	11_ENV
4	464	54	58	48	47	36	12	37	49	14	43	36	10	37	38	34
4	468	54	58	48	47	37	13	38	50	18	44	37	19	38	39	35
5	431	52	52	47	45	37	3	38	50	30	44	37	24	38	39	35
5	439	52	52	47	45	29	7	30	42	32	36	29	23	30	31	27
5	451	52	52	47	45	43	25	44	56	40	50	43	29	44	45	41
6	458	49	58	49	43	51	36	52	64	29	58	51	27	52	53	49
6	459	49	58	49	43	50	39	50	63	29	57	50	28	51	52	48
6	474	49	58	49	43	38	38	38	51	13	45	38	33	39	40	36
6	476	49	58	49	43	48	48	34	61	22	55	48	39	49	50	46
6	481	49	58	49	43	61	61	13	74	2	68	61	24	62	63	59
6	484	49	58	49	43	47	47	25	60	17	54	47	25	48	49	45
6	491	49	58	49	43	44	45	1	57	2	51	44	34	45	46	42
6	493	49	58	49	43	38	38	1	51	2	45	38	34	39	40	36
6	495	49	58	49	43	68	68	18	81	2	75	68	43	69	70	66
6	502	49	58	49	43	48	48	1	61	2	55	48	8	49	50	46
6	506	49	58	49	43	51	50	12	64	2	58	51	22	52	53	49
6	510	49	58	49	43	56	56	1	69	2	63	56	24	57	58	54
6	512	49	58	49	43	60	60	1	73	2	67	60	25	61	62	58
6	519	49	58	49	43	69	69	1	82	2	76	69	4	70	71	67
6	522	49	58	49	43	62	62	1	75	2	69	62	21	63	64	60
6	526	49	58	49	43	49	49	1	62	2	56	49	20	50	51	47
6	529	49	58	49	43	62	63	1	75	2	69	62	18	63	64	60
6	531	49	58	49	43	46	46	1	59	2	53	46	20	47	48	44
6	533	49	58	49	43	47	47	1	60	2	54	47	16	48	49	45
6	537	49	58	49	43	41	40	1	54	2	48	41	14	42	43	39
6	541	49	58	49	43	46	45	1	59	2	53	46	4	47	48	44
6	542	49	58	49	43	53	54	1	66	2	60	53	4	54	55	51
6	551	49	58	49	43	33	33	1	46	2	40	33	4	34	35	31
6	558	49	58	49	43	37	37	1	50	2	44	37	4	38	39	35
6	561	49	58	49	43	58	59	1	71	2	65	58	10	59	60	56
6	564	49	58	49	43	62	62	1	75	2	69	62	10	63	64	60
6	565	49	58	49	43	43	43	1	56	2	50	43	4	44	45	41
6	568	49	58	49	43	46	46	1	59	2	53	46	11	47	48	44
6	571	49	58	49	43	42	42	1	55	2	49	42	4	43	44	40
6	575	49	58	49	43	31	31	1	44	2	38	31	4	32	33	29

Table 7-4 Predicted construction noise levels - Activity set B

NCA	Receiver	NML dB(A)				Predicted maximum LAeq(15 minute) [dB(A)]										
		Morning	Day	Evening	Night	12_KCB	13_CCP	14_CSC	15_SCP	16_SPS	17_LMK	18_WLI	19_BDG	20_SGN	21_MCP	22_CCP
1	4	52	57	50	46	52	53	49	52	48	46	32	33	45	20	3
1	5	52	57	50	46	52	53	49	52	48	46	31	34	45	21	3
1	7	52	57	50	46	51	52	48	51	47	45	28	37	44	22	3
1	9	52	57	50	46	43	44	40	43	39	37	12	33	36	23	3
1	10	52	57	50	46	45	46	42	45	41	39	12	37	38	23	3
1	11	52	57	50	46	45	46	42	45	41	39	11	37	38	23	3
1	12	52	57	50	46	44	45	41	44	40	38	11	37	37	23	3
1	13	52	57	50	46	42	43	39	42	38	36	11	37	35	23	3
1	14	52	57	50	46	44	45	41	44	40	38	26	38	37	23	3
1	15	52	57	50	46	42	43	39	42	38	36	25	37	35	22	3
1	16	52	57	50	46	41	42	38	41	37	35	22	37	34	22	3
1	17	52	57	50	46	45	46	42	45	41	39	26	33	38	14	3
1	18	52	57	50	46	40	41	37	40	36	34	22	36	33	22	3
1	19	52	57	50	46	42	43	39	42	38	36	25	37	35	23	3
1	20	52	57	50	46	41	42	38	41	37	35	25	37	34	23	3
1	21	52	57	50	46	43	44	40	43	39	37	17	37	36	23	3
1	22	52	57	50	46	45	46	42	45	41	39	26	34	38	9	3
1	23	52	57	50	46	47	48	44	47	43	41	26	22	40	7	3
1	24	52	57	50	46	40	41	37	40	36	34	25	37	33	23	3
1	25	52	57	50	46	50	51	47	50	46	44	26	24	43	7	3
1	26	52	57	50	46	43	44	40	43	39	37	25	38	36	23	3
1	27	52	57	50	46	42	43	39	42	38	36	25	37	35	23	3
1	28	52	57	50	46	46	47	43	46	42	40	26	39	39	15	3
1	29	52	57	50	46	48	49	45	48	44	42	26	24	41	7	3
1	30	52	57	50	46	41	42	38	41	37	35	25	37	34	23	3
1	31	52	57	50	46	49	50	46	49	45	43	26	24	42	7	3
1	32	52	57	50	46	44	45	41	44	40	38	25	38	37	23	3
1	33	52	57	50	46	42	43	39	42	38	36	25	37	35	23	3
1	34	52	57	50	46	43	44	40	43	39	37	25	38	36	23	3
1	35	52	57	50	46	45	46	42	45	41	39	20	39	38	23	3
1	36	52	57	50	46	51	52	48	51	47	45	26	25	44	7	3
1	37	52	57	50	46	41	42	38	41	37	35	25	37	34	23	3
1	38	52	57	50	46	50	51	47	50	46	44	26	24	43	7	3
1	39	52	57	50	46	44	45	41	44	40	38	25	38	37	23	3
1	40	52	57	50	46	51	52	48	51	47	45	26	25	44	8	3
1	41	52	57	50	46	46	47	43	46	42	40	25	39	39	23	3
1	42	52	57	50	46	52	53	49	52	48	46	26	25	45	8	3
1	43	52	57	50	46	43	44	40	43	39	37	25	38	36	23	3
1	44	52	57	50	46	40	41	37	40	36	34	24	37	33	23	3
1	45	52	57	50	46	42	43	39	42	38	36	25	38	35	23	3

NCA	Receiver	NML dB(A)				Predicted maximum LAeq(15 minute) [dB(A)]											
		Morning	Day	Evening	Night	12_KCB	13_CCP	14_CSC	15_SCP	16_SPS	17_LMK	18_WLI	19_BDG	20_SGN	21_MCP	22_CCP	
1	46	52	57	50	46	41	42	38	41	37	35	25	37	34	23	3	
1	47	52	57	50	46	51	52	48	51	47	45	26	23	44	6	3	
1	48	52	57	50	46	49	50	46	49	45	43	21	39	42	23	3	
1	49	52	57	50	46	46	47	43	46	42	40	25	39	39	23	3	
1	50	52	57	50	46	44	45	41	44	40	38	25	39	37	23	3	
1	51	52	57	50	46	40	41	37	40	36	34	24	37	33	23	3	
1	52	52	57	50	46	43	44	40	43	39	37	25	38	36	23	3	
1	53	52	57	50	46	49	50	46	49	45	43	18	43	42	26	3	
1	54	52	57	50	46	45	46	42	45	41	39	25	39	38	23	3	
1	55	52	57	50	46	41	42	38	41	37	35	24	37	34	23	3	
1	56	52	57	50	46	42	43	39	42	38	36	25	38	35	23	3	
1	57	52	57	50	46	55	56	52	55	51	49	19	41	48	24	3	
1	58	52	57	50	46	53	54	50	53	49	47	16	41	46	24	3	
1	59	52	57	50	46	47	48	44	47	43	41	21	40	40	23	3	
1	60	52	57	50	46	44	45	41	44	40	38	25	39	37	23	3	
1	61	52	57	50	46	40	41	37	40	36	34	24	37	33	23	3	
1	62	52	57	50	46	43	44	40	43	39	37	25	38	36	23	3	
1	63	52	57	50	46	50	51	47	50	46	44	26	27	43	10	3	
1	64	52	57	50	46	45	46	42	45	41	39	25	39	38	23	3	
1	65	52	57	50	46	55	56	52	55	51	49	16	42	48	24	3	
1	66	52	57	50	46	41	42	38	41	37	35	24	38	34	23	3	
1	67	52	57	50	46	42	43	39	42	38	36	24	38	35	23	3	
1	68	52	57	50	46	51	52	48	51	47	45	26	28	44	10	3	
1	69	52	57	50	46	43	44	40	43	39	37	25	39	36	23	3	
1	70	52	57	50	46	47	48	44	47	43	41	21	40	40	23	3	
1	71	52	57	50	46	40	41	37	40	36	34	24	37	33	23	3	
1	72	52	57	50	46	52	53	49	52	48	46	26	28	45	10	3	
1	73	52	57	50	46	43	44	40	43	39	37	24	39	36	23	3	
1	74	52	57	50	46	45	46	42	45	41	39	25	39	38	23	3	
1	75	52	57	50	46	46	47	43	46	42	40	25	40	39	23	3	
1	76	52	57	50	46	55	56	52	55	51	49	15	42	48	24	3	
1	77	52	57	50	46	52	53	49	52	48	46	18	41	45	24	3	
1	78	52	57	50	46	41	42	38	41	37	35	24	38	34	23	3	
1	79	52	57	50	46	43	44	40	43	39	37	25	39	36	23	3	
1	80	52	57	50	46	43	44	40	43	39	37	25	39	36	23	3	
1	81	52	57	50	46	42	43	39	42	38	36	24	38	35	23	3	
1	82	52	57	50	46	48	49	45	48	44	42	25	37	41	23	3	
1	83	52	57	50	46	45	46	42	45	41	39	25	40	38	23	3	
1	84	52	57	50	46	40	41	37	40	36	34	24	37	33	23	3	
1	85	52	57	50	46	42	43	39	42	38	36	24	39	35	23	3	
1	86	52	57	50	46	51	52	48	51	47	45	13	42	44	24	3	
1	87	52	57	50	46	55	56	52	55	51	49	15	42	48	24	3	
1	88	52	57	50	46	41	42	38	41	37	35	24	38	34	23	3	

NCA	Receiver	NML dB(A)				Predicted maximum LAeq(15 minute) [dB(A)]											
		Morning	Day	Evening	Night	12_KCB	13_CCP	14_CSC	15_SCP	16_SPS	17_LMK	18_WLI	19_BDG	20_SGN	21_MCP	22_CCP	
1	89	52	57	50	46	40	41	37	40	36	34	24	37	33	23	3	
1	90	52	57	50	46	43	44	40	43	39	37	24	39	36	23	3	
1	91	52	57	50	46	41	42	38	41	37	35	24	38	34	23	3	
1	92	52	57	50	46	46	47	43	46	42	40	25	40	39	23	3	
1	93	52	57	50	46	42	43	39	42	38	36	24	39	35	23	3	
1	94	52	57	50	46	44	45	41	44	40	38	24	40	37	23	3	
1	95	52	57	50	46	54	55	51	54	50	48	15	43	47	24	3	
1	96	52	57	50	46	40	41	37	40	36	34	24	38	33	23	3	
1	97	52	57	50	46	47	48	44	47	43	41	25	41	40	24	3	
1	98	52	57	50	46	39	40	36	39	35	33	24	37	32	23	3	
1	99	52	57	50	46	43	44	40	43	39	37	24	39	36	23	3	
1	100	52	57	50	46	41	42	38	41	37	35	24	39	34	23	3	
1	101	52	57	50	46	45	46	42	45	41	39	24	40	38	24	3	
1	102	52	57	50	46	44	45	41	44	40	38	24	40	37	24	3	
1	103	52	57	50	46	50	51	47	50	46	44	25	28	43	9	3	
1	104	52	57	50	46	54	55	51	54	50	48	11	43	47	24	3	
1	105	52	57	50	46	42	43	39	42	38	36	24	39	35	23	3	
1	106	52	57	50	46	40	41	37	40	36	34	24	38	33	23	3	
1	107	52	57	50	46	47	48	44	47	43	41	24	41	40	24	3	
1	108	52	57	50	46	39	40	36	39	35	33	23	37	32	23	3	
1	109	52	57	50	46	43	44	40	43	39	37	24	40	36	24	3	
1	110	52	57	50	46	45	46	42	45	41	39	24	41	38	24	3	
1	111	52	57	50	46	41	42	38	41	37	35	24	39	34	23	3	
1	112	52	57	50	46	44	45	41	44	40	38	24	40	37	24	3	
1	113	52	57	50	46	52	53	49	52	48	46	25	28	45	9	3	
1	114	52	57	50	46	40	41	37	40	36	34	24	38	33	23	3	
1	115	52	57	50	46	42	43	39	42	38	36	24	39	35	24	3	
1	116	52	57	50	46	53	54	50	53	49	47	12	43	46	24	3	
1	117	52	57	50	46	45	46	42	45	41	39	24	41	38	24	3	
1	118	52	57	50	46	43	44	40	43	39	37	24	40	36	24	3	
1	119	52	57	50	46	44	45	41	44	40	38	24	40	37	24	3	
1	120	52	57	50	46	40	41	37	40	36	34	23	38	33	23	3	
1	121	52	57	50	46	47	48	44	47	43	41	24	42	40	24	3	
1	122	52	57	50	46	45	46	42	45	41	39	24	41	38	24	3	
1	123	52	57	50	46	46	47	43	46	42	40	24	42	39	24	3	
1	124	52	57	50	46	42	43	39	42	38	36	24	39	35	24	3	
1	125	52	57	50	46	41	42	38	41	37	35	23	39	34	24	3	
1	126	52	57	50	46	39	40	36	39	35	33	23	38	32	24	3	
1	127	52	57	50	46	46	47	43	46	42	40	24	42	39	24	3	
1	128	52	57	50	46	52	53	49	52	48	46	21	44	45	24	3	
1	129	52	57	50	46	44	45	41	44	40	38	24	41	37	24	3	
1	130	52	57	50	46	51	52	48	51	47	45	18	44	44	24	3	
1	131	52	57	50	46	40	41	37	40	36	34	23	39	33	24	3	

NCA	Receiver	NML dB(A)				Predicted maximum LAeq(15 minute) [dB(A)]											
		Morning	Day	Evening	Night	12_KCB	13_CCP	14_CSC	15_SCP	16_SPS	17_LMK	18_WLI	19_BDG	20_SGN	21_MCP	22_CCP	
1	132	52	57	50	46	39	40	36	39	35	33	23	38	32	24	3	
1	133	52	57	50	46	41	42	38	41	37	35	23	39	34	24	3	
1	134	52	57	50	46	40	41	37	40	36	34	23	38	33	24	3	
1	135	52	57	50	46	50	51	47	50	46	44	14	44	43	24	3	
1	136	52	57	50	46	40	41	37	40	36	34	23	39	33	24	3	
1	137	52	57	50	46	44	45	41	44	40	38	24	41	37	24	3	
1	138	52	57	50	46	41	42	38	41	37	35	23	39	34	24	3	
1	139	52	57	50	46	45	46	42	45	41	39	24	42	38	24	3	
1	140	52	57	50	46	39	40	36	39	35	33	23	38	32	24	3	
1	141	52	57	50	46	44	45	41	44	40	38	23	42	37	24	3	
1	142	52	57	50	46	51	52	48	51	47	45	23	45	44	25	3	
1	143	52	57	50	46	45	46	42	45	41	39	23	43	38	24	3	
1	144	52	57	50	46	48	49	45	48	44	42	24	43	41	24	3	
1	145	52	57	50	46	42	43	39	42	38	36	23	41	35	24	3	
1	146	52	57	50	46	47	48	44	47	43	41	23	38	40	23	3	
1	147	52	57	50	46	44	45	41	44	40	38	23	42	37	24	3	
1	148	52	57	50	46	39	40	36	39	35	33	22	38	32	24	3	
1	149	52	57	50	46	43	44	40	43	39	37	23	41	36	24	3	
1	150	52	57	50	46	47	48	44	47	43	41	23	44	40	17	3	
1	151	52	57	50	46	42	43	39	42	38	36	23	40	35	24	3	
1	152	52	57	50	46	42	43	39	42	38	36	23	41	35	24	3	
1	153	52	57	50	46	45	46	42	45	41	39	23	43	38	24	3	
1	154	52	57	50	46	50	51	47	50	46	44	15	46	43	25	3	
1	155	52	57	50	46	39	40	36	39	35	33	22	39	32	24	3	
1	156	52	57	50	46	45	46	42	45	41	39	23	42	38	24	3	
1	157	52	57	50	46	56	57	53	56	52	50	16	48	49	25	3	
1	158	52	57	50	46	40	41	37	40	36	34	22	39	33	24	3	
1	159	52	57	50	46	49	50	46	49	45	43	18	46	42	25	3	
1	160	52	57	50	46	43	44	40	43	39	37	23	42	36	24	3	
1	161	52	57	50	46	39	40	36	39	35	33	22	38	32	24	3	
1	162	52	57	50	46	39	40	36	39	35	33	22	38	32	24	3	
1	163	52	57	50	46	44	45	41	44	40	38	23	43	37	24	3	
1	164	52	57	50	46	40	41	37	40	36	34	22	39	33	24	3	
1	165	52	57	50	46	44	45	41	44	40	38	23	42	37	25	3	
1	166	52	57	50	46	44	45	41	44	40	38	23	44	37	25	3	
1	167	52	57	50	46	49	50	46	49	45	43	12	44	42	25	3	
1	168	52	57	50	46	40	41	37	40	36	34	22	39	33	24	3	
1	169	52	57	50	46	45	46	42	45	41	39	23	44	38	25	3	
1	170	52	57	50	46	42	43	39	42	38	36	23	41	35	25	3	
1	171	52	57	50	46	39	40	36	39	35	33	22	38	32	24	3	
1	172	52	57	50	46	46	47	43	46	42	40	23	45	39	25	3	
1	173	52	57	50	46	40	41	37	40	36	34	22	39	33	24	3	
1	174	52	57	50	46	47	48	44	47	43	41	18	40	40	25	3	

NCA	Receiver	NML dB(A)				Predicted maximum LAeq(15 minute) [dB(A)]											
		Morning	Day	Evening	Night	12_KCB	13_CCP	14_CSC	15_SCP	16_SPS	17_LMK	18_WLI	19_BDG	20_SGN	21_MCP	22_CCP	
1	175	52	57	50	46	39	40	36	39	35	33	22	38	32	24	3	
1	176	52	57	50	46	50	51	47	50	46	44	16	47	43	22	3	
1	177	52	57	50	46	40	41	37	40	36	34	22	39	33	24	3	
1	178	52	57	50	46	43	44	40	43	39	37	22	42	36	25	3	
1	179	52	57	50	46	46	47	43	46	42	40	23	44	39	25	3	
1	180	52	57	50	46	47	48	44	47	43	41	23	45	40	25	3	
1	181	52	57	50	46	44	45	41	44	40	38	23	43	37	25	3	
1	182	52	57	50	46	46	47	43	46	42	40	23	46	39	25	3	
1	183	52	57	50	46	50	51	47	50	46	44	18	45	43	21	3	
1	184	52	57	50	46	40	41	37	40	36	34	22	39	33	25	3	
1	185	52	57	50	46	43	44	40	43	39	37	22	42	36	25	3	
1	186	52	57	50	46	47	48	44	47	43	41	20	46	40	25	3	
1	187	52	57	50	46	43	44	40	43	39	37	22	42	36	25	3	
1	188	52	57	50	46	42	43	39	42	38	36	22	41	35	25	3	
1	189	52	57	50	46	39	40	36	39	35	33	22	38	32	24	3	
1	190	52	57	50	46	45	46	42	45	41	39	14	42	38	25	3	
1	191	52	57	50	46	40	41	37	40	36	34	22	39	33	25	3	
1	192	52	57	50	46	44	45	41	44	40	38	22	43	37	25	3	
1	193	52	57	50	46	51	52	48	51	47	45	23	37	44	14	3	
1	194	52	57	50	46	51	52	48	51	47	45	23	36	44	14	3	
1	195	52	57	50	46	52	53	49	52	48	46	17	47	45	25	3	
1	196	52	57	50	46	42	43	39	42	38	36	22	42	35	25	3	
1	197	52	57	50	46	40	41	37	40	36	34	22	39	33	25	3	
1	198	52	57	50	46	39	40	36	39	35	33	22	39	32	25	3	
1	199	52	57	50	46	39	40	36	39	35	33	22	38	32	25	3	
1	200	52	57	50	46	48	49	45	48	44	42	18	46	41	25	3	
1	201	52	57	50	46	40	41	37	40	36	34	22	39	33	25	3	
1	202	52	57	50	46	44	45	41	44	40	38	22	42	37	25	3	
1	203	52	57	50	46	43	44	40	43	39	37	22	43	36	25	3	
1	204	52	57	50	46	52	53	49	52	48	46	23	47	45	20	3	
1	205	52	57	50	46	39	40	36	39	35	33	22	39	32	25	3	
1	206	52	57	50	46	45	46	42	45	41	39	23	44	38	25	3	
1	207	52	57	50	46	39	40	36	39	35	33	21	38	32	25	3	
1	208	52	57	50	46	51	52	48	51	47	45	17	48	44	25	3	
1	209	52	57	50	46	55	56	52	55	51	49	23	48	48	22	3	
1	210	52	57	50	46	40	41	37	40	36	34	22	40	33	25	3	
1	211	52	57	50	46	50	51	47	50	46	44	22	48	43	25	3	
1	212	52	57	50	46	50	51	47	50	46	44	18	48	43	22	3	
1	213	52	57	50	46	46	47	43	46	42	40	18	46	39	25	3	
1	214	52	57	50	46	40	41	37	40	36	34	22	39	33	25	3	
1	215	52	57	50	46	43	44	40	43	39	37	22	43	36	25	3	
1	216	52	57	50	46	42	43	39	42	38	36	8	42	35	25	3	
1	217	52	57	50	46	51	52	48	51	47	45	19	45	44	25	3	

NCA	Receiver	NML dB(A)				Predicted maximum LAeq(15 minute) [dB(A)]										
		Morning	Day	Evening	Night	12_KCB	13_CCP	14_CSC	15_SCP	16_SPS	17_LMK	18_WLI	19_BDG	20_SGN	21_MCP	22_CCP
1	218	52	57	50	46	53	54	50	53	49	47	23	37	46	11	3
1	219	52	57	50	46	41	42	38	41	37	35	22	40	34	25	3
1	220	52	57	50	46	44	45	41	44	40	38	19	44	37	25	3
1	221	52	57	50	46	56	57	53	56	52	50	23	39	49	11	3
1	222	52	57	50	46	54	55	51	54	50	48	8	53	47	26	3
1	223	52	57	50	46	53	54	50	53	49	47	8	52	46	26	3
1	224	52	57	50	46	49	50	46	49	45	43	8	50	42	26	3
1	225	52	57	50	46	54	55	51	54	50	48	9	52	47	26	3
1	226	52	57	50	46	48	49	45	48	44	42	7	48	41	26	3
1	227	52	57	50	46	52	53	49	52	48	46	7	52	45	26	3
1	229	52	57	50	46	45	46	42	45	41	39	18	45	38	26	3
1	231	52	57	50	46	42	43	39	42	38	36	20	38	35	26	3
1	232	52	57	50	46	43	44	40	43	39	37	20	42	36	27	3
1	233	52	57	50	46	44	45	41	44	40	38	23	44	37	24	3
1	234	52	57	50	46	44	45	41	44	40	38	13	44	37	25	3
1	235	52	57	50	46	42	43	39	42	38	36	20	41	35	27	3
1	236	52	57	50	46	44	45	41	44	40	38	13	42	37	26	3
1	237	52	57	50	46	42	43	39	42	38	36	20	39	35	27	3
1	238	52	57	50	46	45	46	42	45	41	39	14	45	38	23	3
1	239	52	57	50	46	43	44	40	43	39	37	15	37	36	24	3
1	240	52	57	50	46	42	43	39	42	38	36	15	40	35	27	3
1	241	52	57	50	46	44	45	41	44	40	38	20	37	37	26	3
1	242	52	57	50	46	43	44	40	43	39	37	15	40	36	28	3
1	243	52	57	50	46	46	47	43	46	42	40	20	38	39	25	3
1	244	52	57	50	46	43	44	40	43	39	37	14	39	36	27	3
1	245	52	57	50	46	47	48	44	47	43	41	20	47	40	28	3
1	246	52	57	50	46	37	38	34	37	33	31	20	32	30	23	3
1	247	52	57	50	46	40	41	37	40	36	34	20	34	33	24	3
1	248	52	57	50	46	44	45	41	44	40	38	16	43	37	12	3
1	249	52	57	50	46	47	48	44	47	43	41	20	44	40	12	3
1	250	52	57	50	46	45	46	42	45	41	39	15	44	38	12	3
1	251	52	57	50	46	46	47	43	46	42	40	20	45	39	12	3
1	252	52	57	50	46	44	45	41	44	40	38	12	44	37	27	3
1	253	52	57	50	46	46	47	43	46	42	40	20	45	39	12	3
1	254	52	57	50	46	46	47	43	46	42	40	20	46	39	12	3
1	255	52	57	50	46	47	48	44	47	43	41	20	46	40	28	3
1	256	52	57	50	46	44	45	41	44	40	38	20	43	37	12	3
1	257	52	57	50	46	52	53	49	52	48	46	20	48	45	13	3
1	258	52	57	50	46	44	45	41	44	40	38	20	43	37	25	3
1	259	52	57	50	46	52	53	49	52	48	46	20	49	45	15	3
1	260	52	57	50	46	44	45	41	44	40	38	20	41	37	28	3
1	261	52	57	50	46	45	46	42	45	41	39	20	39	38	22	3
1	262	52	57	50	46	37	38	34	37	33	31	20	36	30	12	3

NCA	Receiver	NML dB(A)				Predicted maximum LAeq(15 minute) [dB(A)]											
		Morning	Day	Evening	Night	12_KCB	13_CCP	14_CSC	15_SCP	16_SPS	17_LMK	18_WLI	19_BDG	20_SGN	21_MCP	22_CCP	
1	263	52	57	50	46	46	47	43	46	42	40	13	40	39	22	3	
1	264	52	57	50	46	54	55	51	54	50	48	20	49	47	12	3	
1	265	52	57	50	46	46	47	43	46	42	40	12	40	39	12	3	
1	266	52	57	50	46	43	44	40	43	39	37	11	32	36	26	3	
1	267	52	57	50	46	47	48	44	47	43	41	14	46	40	12	3	
1	268	52	57	50	46	42	43	39	42	38	36	13	40	35	26	3	
1	269	52	57	50	46	47	48	44	47	43	41	20	46	40	28	3	
1	270	52	57	50	46	43	44	40	43	39	37	14	34	36	27	3	
1	271	52	57	50	46	46	47	43	46	42	40	15	47	39	28	3	
1	272	52	57	50	46	44	45	41	44	40	38	11	43	37	26	3	
1	273	52	57	50	46	43	44	40	43	39	37	9	37	36	19	3	
1	274	52	57	50	46	53	54	50	53	49	47	20	51	46	28	3	
1	275	52	57	50	46	49	50	46	49	45	43	20	46	42	13	3	
1	276	52	57	50	46	45	46	42	45	41	39	5	43	38	24	3	
1	277	52	57	50	46	50	51	47	50	46	44	17	45	43	13	3	
1	278	52	57	50	46	50	51	47	50	46	44	15	45	43	12	3	
1	279	52	57	50	46	42	43	39	42	38	36	15	40	35	28	3	
1	280	52	57	50	46	51	52	48	51	47	45	15	46	44	13	3	
1	281	52	57	50	46	46	47	43	46	42	40	5	44	39	28	3	
1	282	52	57	50	46	42	43	39	42	38	36	19	40	35	28	3	
1	283	52	57	50	46	45	46	42	45	41	39	6	42	38	24	3	
1	284	52	57	50	46	48	49	45	48	44	42	22	45	41	28	3	
1	285	52	57	50	46	54	55	51	54	50	48	15	45	47	13	3	
1	286	52	57	50	46	54	55	51	54	50	48	15	49	47	14	3	
1	287	52	57	50	46	46	47	43	46	42	40	6	44	39	28	3	
1	288	52	57	50	46	49	50	46	49	45	43	14	43	42	13	3	
1	289	52	57	50	46	53	54	50	53	49	47	16	50	46	29	3	
1	290	52	57	50	46	43	44	40	43	39	37	5	40	36	28	3	
1	291	52	57	50	46	50	51	47	50	46	44	14	43	43	13	3	
1	292	52	57	50	46	46	47	43	46	42	40	5	43	39	28	3	
1	293	52	57	50	46	43	44	40	43	39	37	19	36	36	28	3	
1	294	52	57	50	46	48	49	45	48	44	42	19	46	41	28	3	
1	295	52	57	50	46	45	46	42	45	41	39	5	39	38	28	3	
1	296	52	57	50	46	53	54	50	53	49	47	15	43	46	13	3	
1	297	52	57	50	46	43	44	40	43	39	37	19	33	36	28	3	
1	299	52	57	50	46	45	46	42	45	41	39	5	43	38	28	3	
1	300	52	57	50	46	51	52	48	51	47	45	14	44	44	26	3	
1	301	52	57	50	46	44	45	41	44	40	38	5	40	37	28	3	
1	302	52	57	50	46	51	52	48	51	47	45	14	47	44	13	3	
1	304	52	57	50	46	53	54	50	53	49	47	20	48	46	29	3	
1	305	52	57	50	46	55	56	52	55	51	49	10	51	48	29	3	
1	306	52	57	50	46	49	50	46	49	45	43	13	41	42	13	3	
1	307	52	57	50	46	52	53	49	52	48	46	14	41	45	13	3	

NCA	Receiver	NML dB(A)				Predicted maximum LAeq(15 minute) [dB(A)]										
		Morning	Day	Evening	Night	12_KCB	13_CCP	14_CSC	15_SCP	16_SPS	17_LMK	18_WLI	19_BDG	20_SGN	21_MCP	22_CCP
1	309	52	57	50	46	55	56	52	55	51	49	15	50	48	29	3
1	310	52	57	50	46	53	54	50	53	49	47	14	43	46	14	3
1	311	52	57	50	46	48	49	45	48	44	42	14	45	41	29	3
1	312	52	57	50	46	50	51	47	50	46	44	15	48	43	29	3
1	313	52	57	50	46	54	55	51	54	50	48	16	45	47	29	3
1	314	52	57	50	46	55	56	52	55	51	49	11	50	48	29	3
1	315	52	57	50	46	50	51	47	50	46	44	19	46	43	29	3
1	316	52	57	50	46	50	51	47	50	46	44	19	45	43	29	3
1	317	52	57	50	46	52	53	49	52	48	46	11	47	45	29	3
1	318	52	57	50	46	50	51	47	50	46	44	19	44	43	32	3
1	319	52	57	50	46	53	54	50	53	49	47	11	46	46	30	3
1	320	52	57	50	46	51	52	48	51	47	45	5	31	44	30	3
1	321	52	57	50	46	48	49	45	48	44	42	5	41	41	30	3
2	322	50	52	48	49	53	54	50	53	49	47	5	32	46	31	3
2	323	50	52	48	49	44	45	41	44	40	38	5	41	37	38	3
2	324	50	52	48	49	43	44	40	43	39	37	5	40	36	37	3
2	325	50	52	48	49	43	44	40	43	39	37	13	40	36	37	3
2	326	50	52	48	49	43	44	40	43	39	37	8	40	36	37	3
2	327	50	52	48	49	42	43	39	42	38	36	12	39	35	36	3
2	328	50	52	48	49	40	41	37	40	36	34	12	39	33	36	3
2	329	50	52	48	49	40	41	37	40	36	34	12	38	33	36	3
2	330	50	52	48	49	43	44	40	43	39	37	12	40	36	37	3
2	331	50	52	48	49	41	42	38	41	37	35	12	38	34	36	3
2	332	50	52	48	49	43	44	40	43	39	37	12	41	36	38	3
2	333	50	52	48	49	42	43	39	42	38	36	13	38	35	34	3
2	334	50	52	48	49	41	42	38	41	37	35	10	40	34	37	3
2	335	50	52	48	49	61	62	58	61	57	55	13	57	54	48	3
2	336	50	52	48	49	39	40	36	39	35	33	12	41	32	38	3
2	337	50	52	48	49	41	42	38	41	37	35	9	40	34	37	3
2	338	50	52	48	49	40	41	37	40	36	34	12	39	33	36	3
2	339	50	52	48	49	42	43	39	42	38	36	8	41	35	38	3
2	341	50	52	48	49	41	42	38	41	37	35	12	38	34	35	3
2	343	50	52	48	49	39	40	36	39	35	33	5	34	32	31	3
2	344	50	52	48	49	62	63	59	62	58	56	7	65	55	51	3
2	345	50	52	48	49	36	37	33	36	32	30	12	37	29	33	3
2	346	50	52	48	49	36	37	33	36	32	30	7	33	29	30	3
2	349	50	52	48	49	43	44	40	43	39	37	5	43	36	39	3
2	350	50	52	48	49	40	41	37	40	36	34	11	40	33	37	3
2	351	50	52	48	49	52	53	49	52	48	46	8	65	45	52	3
2	353	50	52	48	49	40	41	37	40	36	34	11	33	33	30	3
2	355	50	52	48	49	40	41	37	40	36	34	11	40	33	30	3
2	356	50	52	48	49	40	41	37	40	36	34	11	39	33	37	3
2	357	50	52	48	49	40	41	37	40	36	34	11	40	33	37	3

NCA	Receiver	NML dB(A)				Predicted maximum LAeq(15 minute) [dB(A)]										
		Morning	Day	Evening	Night	12_KCB	13_CCP	14_CSC	15_SCP	16_SPS	17_LMK	18_WLI	19_BDG	20_SGN	21_MCP	22_CCP
2	358	50	52	48	49	40	41	37	40	36	34	11	40	33	37	3
2	359	50	52	48	49	40	41	37	40	36	34	11	41	33	38	3
2	360	50	52	48	49	40	41	37	40	36	34	11	41	33	38	3
2	361	50	52	48	49	40	41	37	40	36	34	11	41	33	38	3
2	362	50	52	48	49	38	39	35	38	34	32	5	40	31	37	3
2	363	50	52	48	49	37	38	34	37	33	31	10	39	30	35	3
2	364	50	52	48	49	39	40	36	39	35	33	5	40	32	37	3
2	365	50	52	48	49	39	40	36	39	35	33	5	41	32	38	3
2	366	50	52	48	49	36	37	33	36	32	30	11	37	29	33	3
2	367	50	52	48	49	48	49	45	48	44	42	9	50	41	45	3
2	368	50	52	48	49	38	39	35	38	34	32	11	37	31	31	3
2	371	50	52	48	49	39	40	36	39	35	33	11	41	32	38	3
2	372	50	52	48	49	39	40	36	39	35	33	11	41	32	33	3
2	374	50	52	48	49	39	40	36	39	35	33	11	41	32	38	3
2	375	50	52	48	49	38	39	35	38	34	32	11	33	31	36	3
2	377	50	52	48	49	39	40	36	39	35	33	11	41	32	38	3
2	378	50	52	48	49	35	36	32	35	31	29	7	37	28	38	3
2	379	50	52	48	49	39	40	36	39	35	33	10	41	32	38	3
2	380	50	52	48	49	39	40	36	39	35	33	5	40	32	38	3
2	381	50	52	48	49	38	39	35	38	34	32	5	40	31	38	3
2	382	50	52	48	49	39	40	36	39	35	33	5	40	32	37	3
2	383	50	52	48	49	41	42	38	41	37	35	6	41	34	39	3
2	393	50	52	48	49	43	44	40	43	39	37	5	43	36	33	27
3	396	55	58	49	49	50	51	47	50	46	44	5	47	43	22	24
3	399	55	58	49	49	46	47	43	46	42	40	5	44	39	22	24
3	402	55	58	49	49	59	60	56	59	55	53	5	33	52	5	36
3	403	55	58	49	49	45	46	42	45	41	39	5	36	38	7	35
3	404	55	58	49	49	56	57	53	56	52	50	5	34	49	4	36
3	411	55	58	49	49	43	44	40	43	39	37	5	30	36	4	35
3	414	55	58	49	49	41	42	38	41	37	35	5	40	34	21	16
3	415	55	58	49	49	43	44	40	43	39	37	5	31	36	7	35
3	416	55	58	49	49	42	43	39	42	38	36	5	31	35	5	35
3	419	55	58	49	49	43	44	40	43	39	37	5	40	36	7	35
3	420	55	58	49	49	43	44	40	43	39	37	5	31	36	8	35
3	422	55	58	49	49	41	42	38	41	37	35	5	31	34	6	35
3	423	55	58	49	49	41	42	38	41	37	35	5	38	34	9	35
3	429	55	58	49	49	41	42	38	41	37	35	5	36	34	18	38
4	432	54	58	48	47	23	24	20	23	19	17	5	22	16	0	48
4	434	54	58	48	47	41	42	38	41	37	35	5	36	34	0	53
4	435	54	58	48	47	47	48	44	47	43	41	5	33	40	3	65
4	448	54	58	48	47	32	33	29	32	28	26	5	13	25	3	63
4	453	54	58	48	47	41	42	38	41	37	35	5	30	34	3	27
4	455	54	58	48	47	52	53	49	52	48	46	5	18	45	3	32

NCA	Receiver	NML dB(A)				Predicted maximum LAeq(15 minute) [dB(A)]										
		Morning	Day	Evening	Night	12_KCB	13_CCP	14_CSC	15_SCP	16_SPS	17_LMK	18_WLI	19_BDG	20_SGN	21_MCP	22_CCP
4	456	54	58	48	47	33	34	30	33	29	27	5	24	26	3	33
4	464	54	58	48	47	39	40	36	39	35	33	5	29	32	3	21
4	468	54	58	48	47	40	41	37	40	36	34	5	32	33	3	24
5	431	52	52	47	45	40	41	37	40	36	34	5	30	33	3	50
5	439	52	52	47	45	32	33	29	32	28	26	5	16	25	3	32
5	451	52	52	47	45	46	47	43	46	42	40	5	28	39	3	46
6	458	49	58	49	43	54	55	51	54	50	48	5	44	47	3	38
6	459	49	58	49	43	53	54	50	53	49	47	5	45	46	3	38
6	474	49	58	49	43	41	42	38	41	37	35	5	41	34	3	22
6	476	49	58	49	43	51	52	48	51	47	45	5	36	44	3	32
6	481	49	58	49	43	64	65	61	64	60	58	5	18	57	3	4
6	484	49	58	49	43	50	51	47	50	46	44	5	26	43	3	27
6	491	49	58	49	43	47	48	44	47	43	41	5	3	40	3	3
6	493	49	58	49	43	41	42	38	41	37	35	5	1	34	3	3
6	495	49	58	49	43	71	72	68	71	67	65	5	20	64	3	3
6	502	49	58	49	43	51	52	48	51	47	45	5	1	44	3	3
6	506	49	58	49	43	54	55	51	54	50	48	5	11	47	3	3
6	510	49	58	49	43	59	60	56	59	55	53	5	1	52	3	3
6	512	49	58	49	43	63	64	60	63	59	57	5	1	56	3	3
6	519	49	58	49	43	72	73	69	72	68	66	5	1	65	3	3
6	522	49	58	49	43	65	66	62	65	61	59	5	1	58	3	3
6	526	49	58	49	43	52	53	49	52	48	46	5	1	45	3	3
6	529	49	58	49	43	65	66	62	65	61	59	5	1	58	3	3
6	531	49	58	49	43	49	50	46	49	45	43	5	1	42	3	3
6	533	49	58	49	43	50	51	47	50	46	44	5	1	43	3	3
6	537	49	58	49	43	44	45	41	44	40	38	5	1	37	3	3
6	541	49	58	49	43	49	50	46	49	45	43	5	1	42	3	3
6	542	49	58	49	43	56	57	53	56	52	50	5	1	49	3	3
6	551	49	58	49	43	36	37	33	36	32	30	5	1	29	3	3
6	558	49	58	49	43	40	41	37	40	36	34	5	1	33	3	3
6	561	49	58	49	43	61	62	58	61	57	55	5	1	54	3	3
6	564	49	58	49	43	65	66	62	65	61	59	5	1	58	3	3
6	565	49	58	49	43	46	47	43	46	42	40	5	1	39	3	3
6	568	49	58	49	43	49	50	46	49	45	43	5	1	42	3	3
6	571	49	58	49	43	45	46	42	45	41	39	5	1	38	3	3
6	575	49	58	49	43	34	35	31	34	30	28	5	1	27	3	3

7.2.2 Summary of predicted impacts

Receiver identifications are provided in Appendix D.

Table 7-3 and Table 7-4 show that exceedances of the project NMLs are likely during a number of work stages, with the highest levels predicted to occur during cut and fill activities. These works are expected to generate a number of low level exceedances in NCA 1 and 2, with more substantial exceedances predicted to occur in NCA 6. Concrete paving is also expected to result in some exceedances in these areas.

NCA 1 (Darlington Beach) is predicted to contain the highest number of exceedances, however these are generally predicted to be of a low level. NCA 6 contains receivers where the highest noise impacts are predicted to occur, primarily at receivers located along the existing Pacific Highway. Table 7-5 shows the extent of daytime exceedances predicted for each NCA.

Table 7-5 Extent of project NML exceedances – Construction activities (Daytime)

NCA	Number of receivers exceeding the daytime NML by		
	0-10 dB	10-20 dB	20 + dB
1	91	-	-
2	8	4	-
3	2	1	-
4	3	-	-
5	1	-	-
6	11	7	2

The lowest noise impacts are predicted to occur during the following activities:

- Blasting preparation
- Construction of water quality basins
- Wall installation
- Bridge installation

These activities are generally localised events, which will not be carried out along the full length of the alignment.

Generally, exceedances have been predicted for locations where a clear line of sight exists between the source and receiver location, in particular at locations within 400m of the alignment.

Geographically, primary areas of exceedance include:

- Residents on the Pacific Highway, north of Dirty Creek
- Darlington Beach (Eggs Close and Darlington Beach Resort)

The 'Highly Impacted' level outlined in the NSW ICNG is 75dB(A) during daytime hours, in instances where construction noise levels exceed this, additional feasible and reasonable mitigation measures will be considered and determined following consultation with the

relevant stakeholders. Noise levels marginally greater than 75dB(A) have been predicted to occur at two properties only. These receivers are presented below:

Table 7-6 Highly impacted properties

Reference	Location	Work stages [predicted noise level dB(A)]
495	NCA 6 - Existing Pacific Highway	Cutting [76]
519	NCA 6 - Existing Pacific Highway	Cutting [77]

Mitigation measures to address all potential exceedences are presented in Section 8.

7.2.3 Compound and stockpile operation (including access)

The Project will require a main site compound, and a number ancillary facilities and stockpile sites. These compound and ancillary facilities will accommodate a range of activities, plant and equipment including, but not limited to:

- Office accommodation.
- Staff amenities.
- Light vehicle parking and access.
- A plant and equipment maintenance workshop.
- Material and chemical storage.
- Concrete batching plant.
- Equipment storage.
- Material storage.
- Concrete casting areas.
- Concrete & asphalt batch plants.

Not all sites will serve the same purpose and may include only one, or many combinations of the activities listed above. Table 7-1 summarises the likely combination of activities, plant and equipment anticipated at facilities for the project. Appendix A4 of the CEMP provides a list and assessment of all ancillary facilities and stockpile sites on the Project.

The location of each compound is presented on Figure 1-1.

Not all sites will serve the same purpose and may include only one, or many combinations of the activities listed above. Table 7-9 summaries the likely combination of activities, plant and equipment anticipated at facilities for the project. Appendix A4 of the CEMP provides a list and assessment of all ancillary facilities and stockpile sites on the Project.

Table 7-7 provides typical predicted noise levels at various distances from each facility type. It is noted that these calculations only include distance attenuation and do not include terrain and building shielding effects.

Table 7-7 Predicted Noise Levels From Facility Type (L_{Aeq} 15min)

Facility reference no.	Distance from facility				
	50 metres	100 metres	200 metres	300 metres	500 metres
21_MCP	70 dB(A)	64 dB(A)	58 dB(A)	54 dB(A)	50 dB(A)
22_CCP	83 dB(A)	77 dB(A)	71 dB(A)	67 dB(A)	62 dB(A)

Activities 21 (Main site compound) and 22 (Crushing compound) in Table 7-3 and Table 7-4 provide the predicted noise levels at the most affected residence from the assessed ancillary facilities. The results are based on a likely maximum $L_{Aeq(15 \text{ minute})}$ noise level. Cumulative impacts include noise from the facility in addition to the maximum predicted construction noise from staged work outlined in Section 7.1.

Table 7-8 Summary of predicted noise levels from identified facilities ($L_{Aeq 15min}$)

Facility	NCA	Affected Receiver (s)	NML			Ancillary Activity	
			Day	Evening	Night	Compound as dominant noise source	Cumulative impact (Compound and earthworks)
Main site compound Kangaroo Trail road	2	344	52	48	49	51	72
		351	52	48	49	52	65
Crushing compound	4	434	58	48	47	53	54
		435	58	48	47	65	65
		448	58	48	47	63	63
	5	431	52	47	45	50	53

Appendix E presents noise contours for each ancillary facility.

Exceedances of the night time NMLs are predicted to occur at several properties where ancillary facilities are operated outside standard hours, which are Monday to Friday 7am to 6pm, Saturday 8am to 5pm (excluding Arrawarra Rest Area Saturday 8am to 1pm) and no work on Sunday or Public Holidays. Two receivers in NCA 4 are predicted to be impacted at noise levels greater than the daytime noise criteria.

At all locations affected by noise from the crushing plant, this is expected to be the dominant noise source at each property.

Specific noise mitigation measures for the crushing compound are outlined in Section 8 of this plan.

Other locations are likely to have low levels of noise impact and levels will be managed in accordance with the general mitigation measures outlined in Section 8.

Vibration impacts from the operation of compound and ancillary facilities are not anticipated.

7.2.4 Construction Traffic Noise

Heavy vehicles will be required for the following haulage tasks:

- construction and mechanical equipment (semi-trailers)
- ready mixed concrete (6m³ capacity trucks)
- quarry materials (truck & dogs)
- reinforcement steel (semi-trailers)
- prefabricated concrete structures (semi-trailers).

All substantial truck movements will be limited to the construction alignment where possible. Where this is not possible, movements will be limited to the existing Pacific Highway.

A likely figure for peak maximum truck movements on the existing Pacific Highway will be approximately 30 heavy vehicles per direction per hour whilst bulk earthworks are occurring. These additional movements would not occur outside of standard working hours.

An assessment of likely traffic noise associated with Project heavy vehicles using the existing road network has been carried out for receivers at a nominal separation distance of 100m from the highway. The inputs and results of this calculation are presented in Table 7-9.

Table 7-9 Existing and predicted noise levels associated with additional heavy vehicles on Pacific Highway

	Day				Night			
	Light Vehicles	Heavy vehicles	% Heavy vehicles	L _{Aeq(15hour)} **	Light Vehicles	Heavy vehicles	% Heavy vehicles	L _{Aeq(9hour)} **
Existing traffic noise (no Project traffic)*								
North	2755	812	23	66.0	244	406	62	61.4
South	3112	934	23	66.6	246	277	53	60.0
Predicted traffic noise (including Project traffic)								
North	2755	1262	31	67.3	244	676	73	63.5
South	3112	1384	31	67.8	246	547	69	62.6

* from Woolgoolga to Glenugie Operational Noise Report (Coral Street to Range Road)

** Assumptions: 140° field of view, 90km/hr average speed, DGR road surface, soft ground, flat and neutral meteorological conditions

The calculations show that given the existing high traffic volumes and high presence of heavy vehicle traffic on the existing highway, a maximum increase in traffic noise of approximately 1dB(A) may be experienced at a typical receiver location during daytime hours. An increase of this magnitude would not be perceivable to most sensitive receivers. This level is below the permissible 2dB(A) presented in Section 5.4.

Increases of marginally above 2dB(A) are predicted during night time hours which represents a level of impact that may be noticeable at nearby receivers.

Heavy vehicles attending the site would be restricted to Standard Construction Hours to minimise the risk of sleep disturbance. Early morning oversized deliveries may be required on occasion for some of the construction works and would occur outside the recommended construction hours. Mitigation measures detailed in Section 6 would be implemented to reduce the impact of sleep disturbance. All drivers would be sensitised to the potential for sleep disturbance on local residents and would be expected to take practical and reasonable measures to minimise the impact during the course of their delivery activities. Residents to be impacted by such activities outside of normal construction hours will be notified as early as possible prior to activity (pending approval from the Department of Planning).

7.2.5 Out of Hours Work

The majority of construction activities will take place within the approved standard construction hours as defined in CoA B15. However CoA B16 and B17 allow for certain construction activities to occur outside the construction hours specified in CoA B15 with prior approval (Out of Hours Works or OOHW). Requests for OOHW approval must be for technical or other justifiable reasons and will be considered on a case by case or activity-specific basis.

Circumstances where works may be required outside of the approved standard construction hours include soft cutting of concrete. Additionally, the ICNG outlines five categories of works that may be undertaken outside the recommended standard hours. These are:

1. The delivery of oversized plant or structures that police or other authorities determine require special arrangements to transport along public roads.
2. Emergency work to avoid the loss of life or damage to property, or to prevent environmental harm.
3. Maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours.
4. Public infrastructure works that shorten the length of the project and are supported by the affected community.
5. Works where a proponent demonstrates and justifies a need to operate outside the recommended standard hours.

Consistent with points four and five above, the Project will require that certain activities take place outside of standard construction hours during the evening and night-time periods. Out of hours work may be required due to technical considerations (such as the need to meet particular concrete quality specifications), to facilitate an accelerated construction program (and minimise disruption to the community, local business, motorists, pedestrians and cyclists as work would be completed earlier), or to maintain the safety of road users or construction workers (undertaking certain works during cooler periods in summer, e.g. steel fixing).

In order to manage these OOHW and to address CoA B17, an OOHW Procedure has been developed and is included as Appendix C to this NVMP. The aim of the OOHW Procedure is to ensure that all OOHW follow a rigorous process to ensure the following outcomes:

- Potential OOHW are identified as early as possible;
- Justification is provided for each OOHW proposed;
- Appropriate levels of consultation are undertaken for all the OOHW activities; and
- Potential impacts from the OOHW are identified and feasible and reasonable noise mitigation measures implemented to minimise impact on the surrounding environment and community.

It is essential that effective community consultation occurs for OOHW. The OOHW Procedure outlines how the stakeholders will be informed and/or consulted prior to OOHW activities on the Project. It identifies the stakeholders, the approach and tools that will be used to communicate the key messages and impacts to stakeholders, including predicted exceedances of the noise management levels as indicated in Table 5-3. The OOHW Procedure also includes how complaints will be managed consistent with Section 6.3 of the CEMP. Written approval must be obtained prior to any OOH works occurring as per the OOHW Procedure.

The following information presents a discussion of the predicted night time noise levels outlined in Table 7-3 and Table 7-4. Table 7-10 shows the extent of night time exceedances predicted for each NCA.

Table 7-10 Extent of project NML exceedances – Construction activities (Night time)

NCA	Number of receivers exceeding the night NML by		
	0-10 dB	10-20 dB	20 + dB
1	194	116	-
2	27	2	2

3	11	3	-
4	5	3	-
5	1	1	-
6	5	12	13

The predictions show that exceedances of the project NMLs are likely during a number of work stages, with the highest levels predicted to occur during cut and fill activities. It is noted that cut and fill activities are unlikely to be carried out during OOH. Where these works are removed, only 5 receivers in NCA 1 are predicted to exceed the night time criteria by more than 10dB(A), with none of these being greater than 20dB(A).

OOH works are expected to generate a number of low level exceedances in NCA 1 and 2, with more substantial exceedances predicted to occur in NCA 6. This is due to the close proximity of these residences to the existing Pacific Highway alignment.

7.2.6 Sleep Disturbance

Monitoring carried out at active construction sites by Jacobs on recent projects, has shown that $L_{A1(1\text{ minute})}$ noise levels for standard operating construction equipment typically are in the order of 5 – 10 dB(A) greater than the L_{Aeq} levels. For the purposes of this assessment a conservative level of 10dB(A) will be assumed.

Predictions of potential $L_{A1(1\text{ minute})}$ sleep disturbance noise levels have been calculated and a summary of these results is presented below in Table 7-11.

Table 7-11 Predicted exceedances for sleep disturbance

NCA	Number of receivers exceeding the sleep disturbance NML by		
	0-10 dB	10-20 dB	20 + dB
1	193	115	1
2	30	3	1
3	11	3	-
4	5	3	-
5	1	1	-
6	5	25	-

Many residences in NCA 1, and several properties in NCA 2 and 6 may be impacted by OOHW during most work stages.

Other NCAs are expected to experience minor and infrequent sleep disturbance impacts.

The most severe impacts are expected to occur during OOH cutting and fill activities, concrete paving and bridge works.

Any OOHW will require approval from the Project Environmental Manager in accordance with the OOHW procedure in Appendix C of this Plan.

Where noise levels in excess of these criteria are predicted, a more detailed assessment is required.

Section 5.3 states that maximum internal noise levels of less than 50 - 55dB(A) are unlikely to cause an awakening from a sleep state. Noise will typically decrease by approximately

10dB(A) across an open window, and as such, an external noise level of 60-65dB(A) will not typically generate sleep disturbance impacts.

Table 7-12 below presents the number of residences for each NCA where external night time $L_{A1(1 \text{ minute})}$ noise levels may exceed 65dB(A). These results exclude cut / fill activities, as this work is unlikely to be carried out during night time hours.

Table 7-12 Predicted exceedances for sleep disturbance

NCA	Number of receivers exceeding the internal sleep disturbance NML by		
	0-10 dB	10-20 dB	20+ dB
1	13	-	-
2	-	3	-
3	2	-	-
4	-	2	-
5	-	-	-
6	3	6	2

These result show that where work is conducted between the hours of 10pm and 7am, minor sleep disturbance impacts are possible at several properties, particularly those located adjacent to the Pacific Highway in NCA 6.

Although exceedances are predicted in other NCAs, these are likely to be minor. Environmental control measures to minimise sleep disturbance impacts should be employed and are outlined in Section 8.

7.3 Construction vibration and blasting assessment

7.3.1 Vibration assessment

Table 7-13 lists vibration intensive plant likely to be used during construction while Table 7-14 and Table 7-15 provide predicted ground vibration levels at various distances from the plant. The vibration levels are indicative only and will vary depending on the particular item of plant and geotechnical conditions.

Table 7-13 Typical plant vibration levels

<i>Item</i>	<i>Peak particle velocity at 10m (mm/s)</i>
Piling	12-30 ¹
Loader Breaking Kerbs	6-8
15 Tonne Compactor	7-8
7 Tonne Compactor	5-7
Roller	5-6
Pavement Breaker	4.5-6
Dozer	2.5-4
Backhoe	1

Item	Peak particle velocity at 10m (mm/s)
Jackhammer	0.5

Note:¹ Vibration generated by piling has the potential to generate significant vibrations levels. Piling is expected to be associated with the construction of the bridges, as far as possible, bored piling would be used in lieu of standard pile-driving. This would minimise vibration impacts from piling activities and, as such, piling vibration estimations have been based on 12 mm/s at 10 m.

Based on the above levels, the maximum potential vibration impacts of these activities at various distances are shown in Table 7-14 and Table 7-15 below.




	expected to comply with vibration criteria
	expected to exceed the recommended vibration criteria
	expected to exceed the maximum vibration criteria

Table 7-14 Typical plant vibration levels (ground vibration)

Plant description	Building damage				
	Vibration level (mm/s) ¹				
	5 metres	10 metres	25 metres	50 metres	100m
Criterion	<i>5 (typical) / 3 (heritage)</i>				
Vibratory roller (3-8 tonne) ²	7	3	0.7	0.3	0.1
Vibratory roller (8-13 tonne) ²	19	9	2	1	0.4
Vibratory roller (13-18 tonne) ²	22	10	3	1	0.4
Vibratory roller (>18 tonne) ²	28	13	4	1	0.5
Hydraulic hammer	6	2	0.5	0.2	0.1
Impact Pile driver ³	76	30	9	3.8	1.5
Vibratory pile driver ⁴	28	11	3	1	0.4
Drilling of blasting holes	6	2	0.5	0.2	0.1
Pile boring	6	2	0.5	0.2	0.1
Jackhammer (hand held)	2	0.8	0.2	<0.1	-

Table 7-15 Typical plant vibration levels (human comfort)

Plant description	Human comfort				
	5 metres	10 metres	25 metres	50 metres	100m
Criterion	0.2 daytime / 0.1 night time				
Vibratory roller (3-8 tonne) ²	5.9	2.3	0.6	0.2	0.1
Vibratory roller (8-13 tonne) ²	16.2	7.3	2.2	0.8	0.3
Vibratory roller (13-18 tonne) ²	18.2	8.2	2.5	0.9	0.3
Vibratory roller (>18 tonne) ²	23.7	10.7	3.2	1.2	0.4
Hydraulic hammer	5	1.8	0.5	0.2	0.1
Impact Pile driver ³	65	26	8	3.2	1.3
Vibratory pile driver ⁴	23	9	2.5	0.9	0.4
Drilling of blasting holes	5	1.8	0.5	0.2	0.1
Pile boring	5	1.8	0.5	0.2	0.1
Jackhammer (hand held)	1.9	0.7	0.2	<0.1	-

1 - Calculated in accordance with BS5228 – Code of practice for noise and vibration control on construction and open sites (95% confidence) / FTA Guidance Manual for Transit Noise and Vibration Impact Assessment

2 - Mid amplitude setting

3 – Assumes soft ground, 380kJ per stroke (30T Ram, 1.3m stroke)

4 – Steady state operation (startup / shutdown may be higher)

5 – Calculated in accordance with Appendix B2 ‘Assessing vibration a technical guideline’ and assumes 6hrs per day of intermittent vibration

Vibration impacts are unlikely at any properties located further than 50m from the centre alignment during small scale vibration inducing works. In addition to the information presented above, compliance with human comfort criteria during vibratory piling works is predicted to occur at a maximum distance of approximately 200m from the work site. However this distance shall be confirmed with monitoring at the commencement of works.

To minimise the likelihood of vibration impacts the mitigation measures outlined in Table 8-1 will be implemented along with the requirements of RMS specification G36, Clause 6.8 – Ground Vibration and Air Blast.

Where vibratory piling activities are undertaken within 50m of a heritage item, mitigation measures should be observed in accordance with Section 8.

Where heavy vibratory compaction or piling (either impact or vibratory) are undertaken within the distances outlined in Table 7-15 of a residential property, potential exceedances of human comfort levels may be experienced and as such mitigation measures shall be observed.

7.3.2 Blasting assessment

Blasting may be required to remove rock outcrops. Blast holes will be drilled and filled with an explosive charge and detonated with the aid of primers and detonators. Impacts associated with blasting normally relate to air blast overpressure and ground vibration.

Potential vibration and air blast overpressure impacts generated through blasting will be managed primarily through a site and blast-specific assessment in conjunction with preliminary small scale testing conducted at each proposed blast site prior to the commencement of full scale blasting. Further assessment of potential blasting impacts is discussed in this Blast Management Program contained in Appendix B.

8 Environmental control measures

A range of environmental requirements and control measures are identified in the various environmental documents, including the EIS, Submissions / Preferred Infrastructure Report, Conditions of Approval and RMS documents. Specific measures and requirements to address impacts from noise and vibration are outlined in Table 8-1.

Table 8-1 Noise and vibration management and mitigation measures

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
GENERAL					
NV1	Training will be provided to all project personnel, including relevant sub-contractors on noise and vibration requirements from this plan through inductions, toolboxes and targeted awareness training. Noise and vibration training requirements will be as per Section 9.2 of this plan.		Pre-construction, construction	Environmental Manager	G36, Section 9.2
NV2	Work compounds, parking areas, equipment and material stockpile sites will be positioned away from noise-sensitive locations in accordance with the criteria in Section 3.7.2 and Appendix A2 of the CEMP, and Appendix I of the CSWQMP.		Construction	Environment Manager	G36
NV3	Site entry and exit points will be located as far as possible from sensitive receivers, taking into account the importance of safe access.		Construction	Foreman	Submissions / PIR(CNV3)
NV4	Truck routes to and from the worksite will be via major roads where possible, in accordance with the Construction Traffic and Access Management Plan.		Construction	Superintendent	Submissions / PIR (CNV9)
NV5	Operational noise mitigation measures eg at property treatments, noise mounds, will be installed as early as possible during construction.		Construction	Construction Manager	G36
NV6	Where piling, hydraulic hammering or dynamic compaction is proposed within 50 metres of any structure or service, a building condition survey would be conducted and preliminary vibration monitoring undertaken by a qualified contractor.		Construction	Construction Manager	Submissions / PIR (CNV15)
NV7	Where piling, hydraulic hammering or dynamic compaction is proposed within 50 metres of any heritage structure or potentially structurally unsound service, a building condition survey would be conducted and preliminary vibration monitoring undertaken by a qualified contractor. A follow-up survey would be conducted in response to any vibration complaints.		Construction	Construction Manager	Submissions / PIR (CNV16)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
NV8	Prior to the use of the dynamic compaction construction method, the Applicant shall undertake an assessment of vibration generated by dynamic compaction on nearby sensitive receivers. Feasible and reasonable mitigation measures shall be implemented to minimise vibration impacts.		Construction	Construction Manager	CoA B26
PLANT AND EQUIPMENT					
NV9	Where feasible and reasonable noisy equipment and/or construction processes will be substituted by alternative low noise emitting equipment and/or construction process. For example; (CoA B25) where feasible and reasonable, piling activities shall be undertaken using quieter construction methods, such as bored piles or vibrated piles rather than impact or percussion piling methods.		Construction	Foreman	G36, Submissions / PIR (CNV5, CNV 9 and CNV 14) CoA B25
NV10	Static noise sources, such as generators, pumps and lighting towers, will be located as far as possible from sensitive receivers. Place screening or enclosures around fixed plant under regular operation that may impact upon noise sensitive receivers. The use of temporary noise shielding will be determined following community consultation.		Construction	Foreman	G36, Submissions / PIR (CNV11 and CNV12)
NV11	Undertake saw-cutting operations wherever possible to minimise noise impacts		Construction	Foreman	G36
NV12	Plant or machinery will not be permitted to 'warm-up' before the Standard Construction Hours.		Construction	Operators	Submissions / PIR (CNV8)
NV13	Switching off engines when equipment is not in use for extended periods (ie 30 minutes).		Construction	Operators	G36
NV14	Unless required for technical reasons, undertake high noise generating work (such as use of a concrete saw or hydraulic hammer) during the day, or early in the evening if required to be undertaken at night; avoiding short sharp sounds from impacts during night work to minimise sleep disturbance to neighbouring residents.		Construction	Foreman	G36

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
NV15	Manually adjustable or ambient noise sensitive or 'quacker' type reversing alarms on plant and/or flashing lights will be used at night.		Construction	Superintendent	G36, Submissions / PIR (CNV6)
NV16	Where possible, maintenance work on construction plant will be undertaken away from noise sensitive receivers.		Construction	Foreman	G36
NV17	All construction plant and equipment used on the site will be, in addition to other relevant requirements: <ul style="list-style-type: none"> Fitted with properly maintained noise suppression devices in accordance with the manufacturer's specifications. Maintained in an efficient condition. Operated in a proper and efficient manner 		Construction	Superintendent	G36, Submissions / PIR Submissions / PIR (CNV4) B80
NV18	Loading and unloading will be carried out as far as practical away from sensitive receivers.		Construction	Foreman	Good practice
NV19	Truck movements will be kept to a minimum, ie that trucks are sufficiently utilised for each trip.		Construction	Foreman	Good practice
NV20	Trucks will not queue up outside residential properties. No trucks will arrive on site or be permitted to queue near sensitive receivers prior to the 7.00 am start time unless required by road safety considerations.		Construction	Foreman	Good practice
NV21	Noisy plant working simultaneously close together will be avoided to the greatest extent practical adjacent to noise affected sensitive receivers.		Construction	Foreman	Good practice
NV22	Whenever practical, at the end of shifts, excavation and/or ripping plant will be taken from their work areas and left overnight away from the immediate vicinity of sensitive receivers. Warming up of the plant will then be conducted away from such receivers.		Construction	Foreman	Good practice
NV23	Truck drivers will limit compression braking as far as practicable.		Construction	Operators	Good practice
NV24	Where possible, noise generating equipment will be strategically positioned to take advantage of natural screening from geographical features or other structures to		Construction	Foreman	Good practice

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	reduce the transmission of noise between work sites and receiver locations.				
NV25	Appropriately sized equipment would be selected in order to minimise vibration emissions, where required.		Construction	Foreman	Submissions / PIR (CNV17)
CONSTRUCTION HOURS					
NV26	<p>Construction works associated with the Project, other than blasting, will only be undertaken during the following hours:</p> <ul style="list-style-type: none"> • 7:00am to 6:00pm Mondays to Fridays, inclusive; and • 8:00am to 5:00pm Saturdays; and • at no time on Sundays or public holidays. <p>Unless otherwise assessed and justified in the CEMP or this Plan.</p>		Construction	Construction Manager	CoA B15
NV27	<p>Works outside of the construction hours identified in CoA B15 will only be undertaken in the following circumstances:</p> <p>a) works that generate noise that is</p> <ol style="list-style-type: none"> (i) no more than 5 dB(A) above rating background level at any residence in accordance with the Interim Construction Noise Guideline (Department of Environment and Climate Change, 2009); and (ii) no more than the noise management levels specified in Table 3 of the Interim Construction Noise Guideline (Department of Environment and Climate Change, 2009) at other sensitive receivers; or <p>b) for delivery of materials required outside these hours by the Police or other authorities for safety reasons; or</p> <p>c) where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm; or</p> <p>d) between 6.00am and 7.00am and 6.00pm and 7.00pm Monday to Friday (except public holidays) in sparsely populated areas (these construction hours may be reviewed and/or revoked by the Director General in</p>		Construction	Construction Manager	CoA B16

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	<p>consultation with the EPA in the case of unresolved noise complaints); or</p> <p>e) low noise impact activities and work as follows:</p> <p>(i) between 6.00am and 7.00am Monday to Friday; and/or</p> <p>(ii) between 6.00pm and 7.00pm Monday to Friday;</p> <p>f) works approved through an EPL or</p> <p>g) works approved by a Construction Environment Management Plan or Construction Noise and Vibration Management Plan for the SSI in accordance with CoA B19.</p>				
NV28	<p>The Applicant shall, where feasible and reasonable, limit high noise impact activities and work to the mid -morning and mid-afternoon periods, except in sparsely populated areas.</p> <p>Rock breaking, rock hammering, sheet piling, pile driving and any similar activity will be scheduled only between the hours of 9am to 12pm and 2pm to 5pm, Monday to Friday; and 9am to 12pm, Saturday except where works are to be undertaken outside proposed construction hours as outlined above.</p> <p>These activities, if undertaken in continuous blocks and where there is an impact on a sensitive receiver, must not exceed 3-hours in duration, particularly if work extends outside the standard construction hours. A minimum respite period of 1 hour shall be scheduled before activities recommence.</p>		Construction	Construction Manager	CoA B19, Submissions / PIR (CNV2)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
NV29	<p>Construction activities resulting in impulsive or tonal noise emission (such as rock breaking, rock hammering, pile driving) shall only be undertaken:</p> <ul style="list-style-type: none"> (a) between the hours of 8:00am to 5:00pm Monday to Friday; (b) between the hours of 8:00am to 1:00pm Saturday; and (c) in continuous blocks not exceeding three hours each with a minimum respite from those activities and works of not less than one hour between each block. <p><i>For the purposes of this condition 'continuous' includes any period during which there is less than a one hour respite between ceasing and recommencing any of the work the subject of this condition.</i></p> <p><i>The works subject to this condition may be undertaken in sparsely populated areas within the construction hours specified in condition CoA B15.</i></p>		Construction	Foreman	Submissions / PIR (CNV2) CoA B18
NV30	Any proposal to undertake works outside of the standard working hours identified in CoA B15 will be subject to CoA B17 and the processes and assessment requirement contained in the out of hours works procedure (see Appendix C).		Construction	Construction Manager	CoA B17
NV31	Affected receivers would be consulted prior to the commencement of out of hours work.		Construction	Communications Manager	Submissions / PIR (CNV1)
NV32	Affected educational institutions shall be consulted and reasonable steps taken to ensure that noise generating construction works in the vicinity of affected buildings are not timetabled during examination periods where practicable, unless other reasonable arrangements to the affected institutions are made at no cost to the affected institution.		Construction	Construction Manager	CoA B27
BLAST MANAGEMENT					
NV33	Blasting will be undertaken in accordance with the blast		Construction	Foreman	Submissions / PIR

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	management plan provided in Appendix B.				(CNV18)
NV34	Where sensitive receivers are located close to the blast site, a series of trials will be undertaken at a reduced scale to determine site-specific blast response characteristics, in order to define allowable blast sizes to occur within the criteria.		Construction	Foreman	Submissions / PIR (CNV19)
NV35	Controlled blasting activities will only be undertaken between the hours of: a) 9am to 5pm, Monday to Friday b) 9am to 1pm, Saturday; and c) at no time on Sunday or public holidays Blasting may occur in accordance with the construction hours specified in CoA B15 where no sensitive receivers would be impacted by blasting in sparsely populated areas or that an agreement has been made with receivers within 200 metres of the blast zone to permit blasting in accordance with the construction hours specified in CoA B15. Where the blast management plan has identified potential impacts on sensitive receivers, these hours will be subject to change. <i>This condition does not apply in the event of a direction from the NSW Police Force or other relevant authority for safety or emergency reasons to avoid loss of life, property loss and/or to prevent environmental harm.</i>		Construction	Construction Manager	Submissions / PIR (CNV20) CoA B21
NV36	A minimum of 24 hours' notice will be provided to all residences located within 500 metres of any blast, including an indication of blasting times and a contact name and telephone number.		Construction	Communications Manager	EIS (CNV21)
NV37	Monitoring of overpressure and vibration levels will be undertaken for each blast at the potentially most affected receivers.		Construction	Foreman	EIS (CNV22)
NV38	A building condition survey will be undertaken for all buildings located within 200 metres of the proposed blasting area prior to the start of blasting and any damage occurring from the blasting rectified at no cost to the		Construction	Construction Manager	EIS (CNV23)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	property owner.				
NV39	The maximum instantaneous charge (MIC) will be reduced to the lowest possible level by the use of delays, reduced diameter holes, and/or deck loading.		Construction	Foreman	Submissions / PIR (CNV25)
NV40	Adequate stemming will be provided and exposed detonating cord will be eliminated (by covering with at least 300 millimetres of quarry dust or road base).		Construction	Foreman	Submissions / PIR (CNV26)
NV41	Secondary blasting will be eliminated. (A rock breaker or drop hammer will be used instead of popping). Effort will be made to eliminate the need for toe shots (eg by better control of drill patterns).		Construction	Foreman	Submissions / PIR (CNV27)
NV42	Weather conditions at the time of the blast will be assessed. Blasting will be avoided where possible during heavy cloud cover and/or if a strong wind is blowing towards residences. Days of severe temperature inversion will be avoided where possible or, (if not possible) blasting would occur between 11am and 1pm.		Construction	Foreman	Submissions / PIR (CNV28)
NV43	Strict control will be exercised over the spacing and orientation of all blast drill holes. Holes will be spaced in such a manner that the explosive force is just sufficient to break the stone to the required size.		Construction	Foreman	Submissions / PIR (CNV29)
NV44	Controlled blasting times will be determined in consideration of site-specific conditions and in consultation with affected residents and take place, where possible, when impacts are likely to be the least intrusive (eg all blasts would be fired at a set time acceptable to residents and preferably when the background noise is highest).		Construction	Foreman	Submissions / PIR (CNV30)
CONSULTATION AND COMPLAINTS MANAGEMENT					
NV45	Residents / sensitive receivers will be notified of construction activities that are likely to affect their noise and vibration amenity in accordance with the Community Communications Strategy. Information provided will		Pre-construction / Construction	Communications Manager	Submissions / PIR (CNV31)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	include: (i) The types of activities to be undertaken. (ii) The timing of activities including expected start and finish. (iii) The location of activities. (iv) Details of the community information line and how to make an enquiry and/or complaint				
NV46	Affected receivers will be consulted prior to the commencement of out of hours work.		Construction	Superintendent / Communications Manager	Submissions / PIR (CNV1)
NV47	Circumstances may arise during construction where works outside of standard construction hours are essential and sensitive receivers are assessed to be highly noise affected (ie experience noise levels greater than 75 dBA). Where this is the case, opportunities to minimise impacts on highly noise effected receivers, including the provision of alternative accommodation, would be considered in consultation with those affected receiver(s).		Construction	Communications Manager	Good practice
NV48	All complaints received will be managed in accordance with the Community Communications Strategy & the complaints management system in the CEMP.		Construction	Communications Manager	Submissions / PIR (CNV7)
NV49	Where it has been identified as necessary (eg in response to community complaints), noise monitoring will be undertaken to check that noise mitigation measures are effective.		Construction	Construction Manager / Communications Manager	Submissions / PIR (CNV10)
SURVEY, MONITORING AND REPORTING					
NV50	Initial noise monitoring of plant and equipment will be undertaken to ensure the noise performance levels predicted in this NVMP are being met.		Pre-construction / Construction	Environmental Officer / Noise Specialist	Good practice
NV51	Noise and vibration monitoring will be undertaken in accordance with Section 9.3. The program for construction noise and vibration monitoring indicates monitoring frequency, location, how the results of this monitoring are recorded and, procedures that are followed where		Construction	Environmental Officer / Noise Specialist	Submissions / PIR (CNV13)

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
	significant exceedances of relevant noise and vibration goals are detected.				
NV52	<p>Building Condition Inspections for each public utility, structure and building will be carried out where:</p> <p>(i) Blasting operations are within 500 metres or the distance at which the calculated 95th percentile Peak Velocity of ground vibration from the proposed blast is 2 mm/s, whichever is the greater.</p> <p>(ii) Pile driving activities are within 250 metres or the distance at which the calculated 95th percentile Peak Velocity of ground vibration from the proposed pile driving is 2 mm/s, whichever is the greater</p> <p>(iii) Other vibration causing activities where the distance at which the calculated 95th percentile Peak Velocity of ground vibration is 2 mm/s.</p>		Pre-construction / Construction	Project Engineer	G36
NV53	<p>The Building Condition Inspection report will include as a minimum:</p> <p>(i) Floor plan of the subject building.</p> <p>(ii) Record site details - age, construction, site slope and provision for drainage, presence of trees.</p> <p>(iii) Type of defects and their positions and extents on the floor plan.</p> <p>(iv) Photograph of external view and photograph of all defects of significance (especially if of concern to the owner), or typical examples of say, hairline plaster cornice cracks.</p> <p>(v) How doors sit in the jambs - out of line may indicate foundation settlement.</p> <p>(vi) External signs of reactive clay foundation soil, e.g. lifting of slabs, uneven kerbing.</p>		Pre-construction / Construction	Project Engineer	G36
NV54	All complaints, including those related to property damage, will be managed in accordance with the RMS Complaints and Enquiries Procedure – see section 6.3.2 of the CEMP.		Construction	Communications Manager	Good practice

CONSTRUCTION COMPOUNDS AND ANCILLARY FACILITIES

ID	Measure / Requirement	Resources needed	When to implement	Responsibility	Reference
NV55	Where possible, stockpiles will be positioned on the east and southern boundaries of the crushing compound, in order to break a line of sight between major noise sources and receivers 448 and 435.	Construction	Construction Manager	CoA B19, Submissions / PIR (CNV2)	Construction
NV56	Crushing operations will only be undertaken: <ul style="list-style-type: none"> (a) between the hours of 8:00am to 5:00pm Monday to Friday; (b) between the hours of 8:00am to 1:00pm Saturday; and (c) in continuous blocks not exceeding three hours each with a minimum respite from those activities and works of not less than one hour between each block. 	Construction	Construction Manager	CoA B19, Submissions / PIR (CNV2)	Construction
NV57	Rock breaking, rock hammering, operation of mobile crushing plants (outside of the crushing compound) and any similar activity will be scheduled only between the hours of 9am to 12pm and 2pm to 5pm, Monday to Friday; and 9am to 12pm, Saturday except where works are to be undertaken outside proposed construction hours as outlined above.	Construction	Construction Manager	CoA B19, Submissions / PIR (CNV2)	Construction
NV58	No trucks will arrive on site or be permitted to queue near sensitive receivers prior to the 7.00 am start time unless required by road safety considerations.	Construction	Construction Manager	CoA B19, Submissions / PIR (CNV2)	Construction

9 Compliance management

9.1 Roles and responsibilities

The OHL York Project Team's organisational structure and overall roles and responsibilities are outlined in Section 4.2 of the CEMP. Specific responsibilities for the implementation of environmental controls are detailed in Chapter 8 of this Plan.

9.2 Training

All employees, contractors and utility staff working on site will undergo site induction training that includes construction noise and vibration management issues. The induction training will address elements related to noise and vibration management including:

- Existence and requirements of this sub-plan.
- Relevant legislation.
- Normal construction hours.
- The process for seeking approval for out of hours works, including consultation.
- Location of noise sensitive areas.
- Complaints reporting.
- General noise and vibration management measures.
- Specific responsibilities to minimise impacts on the community and built environment from noise and vibration associated with the works.
- Minimisation of noise impacts at ancillary sites during Out of Hours Work, particularly at the beginning, end and during meal breaks (e.g. arrival and exit of vehicles and personnel).

Further details regarding staff induction and training are outlined in Section 5 of the CEMP.

9.3 Inspections and monitoring

Weekly and other routine inspections by Environmental Officers, RMS, ERG representatives and ER will occur throughout construction. Detail on the nature and frequency of these inspections are documented in Section 8.2 of the CEMP.

Noise and vibration monitoring will also occur routinely for the duration of the Project. Monitoring will be undertaken by an Acoustic Consultant or the Environmental Officer during the construction phase of the Project.

9.3.1 Noise monitoring

The following noise monitoring will be undertaken:

- Periodic noise monitoring at nominated sensitive receiver locations (refer to section 4.1 of this plan) to determine the effectiveness of mitigation measures against predicted impacts.
- Where complaints are received, additional noise monitoring may be undertaken at sensitive receivers to determine if the actual construction noise generated exceeds the predicted 'worst case' construction noise levels identified in Section 7.2 of this Plan.
- Noise monitoring may be carried out for the purpose of refining construction methods or techniques to minimise noise.

- Ongoing spot checks of noise intensive plant and equipment will be undertaken throughout construction to ensure compliance with manufactures specifications.

Where actual noise levels are found to exceed the predicted worst case levels, the source of excessive noise generations will be identified, and any additional feasible and reasonable measures available will be implemented to either reduce noise emissions or reduce the impacts on receivers.

Details of site activity and equipment usage will be noted during construction noise monitoring.

Acoustic instrumentation employed in the noise monitoring surveys will comply with the requirements of AS1259.2-1990 Acoustics – Sound Level Meters, Part 2: Integrating – Averaging and carry appropriate NATA (or manufacturer) calibration certificates.

Within six months of commencing construction, the contractor shall, in consultation with the EPA, prepare to the satisfaction of the Secretary, a review of the operational noise mitigation measures proposed to be implemented for the SSI. The review may be submitted in stages to suit the staged construction of the SSI. This Operational Noise Review is to be completed in accordance with CoA D11.

9.3.2 Vibration monitoring

The following vibration monitoring will be undertaken:

- For the protection of buildings, monitoring will be carried out at the commencement of vibratory compaction work within 50 metres of buildings to ensure that safe vibration levels specified in Section 7.3.1 are not exceeded and to confirm safe working distances.
- When vibration intensive activities are required, vibration monitoring will be carried out within the established buffer zones, or where there is considered to be a risk that levels may exceed the relevant structural damage goals.
- During blasting operations, both to determine compliance and in response to complaints.
- Vibration monitoring may be carried out in response to complaints, exceedances, or for the purpose of refining construction methods or techniques to minimise vibrations.
- Vibration monitoring will continue throughout construction, where appropriate, at nominated sensitive receiver locations to determine the effectiveness of mitigation strategies.

Table 9-1 Vibration monitoring requirements

Item	Requirement
1	The measurements will include peak particle velocity (PPV) and x,y,z component velocities.
2	The measurements will include frequency response spectrum.
3	Vibration monitoring shall be undertaken by personnel suitably qualified and experienced in undertaking vibration measurements.
4	Vibration monitoring at structures will be conducted at the nearest location to the works that is adjacent to the foundations of the relevant sensitive structure. If monitoring is not able to be undertaken adjacent to the structure, a suitable location at a representative location from the works will be selected.
5	Vibration monitors will include tri-axial vibration sensors measuring over a frequency range from 1 to 500 Hz, in accordance with DIN 4150. The sensors will be mounted in general accordance with Australian Standard AS 2775-2004 Mechanical vibration and shock – Mechanical mounting of accelerometers.
6	Vibration monitoring results will be compared to both the human exposure, structural damage criteria outlined in DIN 4150 and the ANZECC blasting criteria. Where the criteria are found to be exceeded based on measurement results, construction activities shall be altered as necessary to achieve compliance with the criteria.

Where vibration is found to exceed safe levels, impacts will be avoided by changing work methods and/or equipment, or through the provision of building protection measures where possible. In the event a complaint relating to property damage is received, an inspection of the property would be undertaken and an interim building condition survey prepared.

Vibration monitoring will be carried out with the aim of achieving the following construction vibration goals (CoA B20):

- a) for structural damage to heritage structures, the vibration limits set out in the German Standard DIN 4150-3: Structural Vibration – Part 3 Effects of vibration on structures;
- b) for damage to other buildings and/or structures, the vibration limits set out in the British Standard BS 7385-1:1990 – Evaluation and measurement of vibration in buildings (and referenced in Australian Standard 2187.2 – 2006 Explosives – Storage and use – Use of explosives). Guide for measurement of vibration and evaluation of their effects on buildings; and
- c) for human exposure, the acceptable vibration values set out in Assessing Vibration: A Technical Guideline (Department of Environment and Conservation, 2006).

9.4 Non-conformances

If this sub-plan has not been followed or implemented appropriately, as found during an inspection of the site, a non-conformance will be raised. Non-conformances in general will be dealt with and documented in accordance with Section 8.6 of the CEMP.

9.5 Complaints

Complaints will be recorded in accordance with the Community Communications Strategy (CCS). Information to be recorded will include location of complainant, time/s of occurrence of alleged noise or vibration impacts (including nature of impact particularly with respect to vibration), perceived source, prevailing weather conditions and similar details that could be utilised to assist in the investigation of the complaint. All resident complaints will be responded to in a timely manner and action taken recorded in accordance with the CCS.

9.6 Auditing

Audits (both internal and external) will be undertaken to assess the effectiveness of environmental controls, compliance with this plan, CoA and other relevant approvals, licenses and guidelines.

Audit requirements are detailed in Section 8.3 of the CEMP.

9.7 Reporting

Reporting requirements and responsibilities are documented in Section 8.3 of the CEMP.

Specific reports prepared in response to noise and vibration monitoring will capture detail including, but not limited, to:

- The locations and description of monitoring undertaken.
- A tabulation of results (eg for noise including L_{MAX} , L_{10} , L_{90} and L_{Aeq} noise levels) together with notes identifying the principle sources and operations.
- Summary of any measurements exceeding the nominated criteria, and descriptions of the plant or operations causing these exceedances.
- Detail of any corrective actions and confirmation of their successful implementation.

10 Review and improvement

10.1 Continuous improvement

Continuous improvement of this Plan will be achieved by the ongoing evaluation of environmental management performance against environmental policies, objectives and targets for the purpose of identifying opportunities for improvement.

The continuous improvement process will be designed to:

- Identify areas of opportunity for improvement of environmental management and performance.
- Determine the cause or causes of non-conformances and deficiencies.
- Develop and implement a plan of corrective and preventative action to address any non-conformances and deficiencies.
- Verify the effectiveness of the corrective and preventative actions.
- Document any changes in procedures resulting from process improvement.
- Make comparisons with objectives and targets.

10.2 Update and amendment

The processes described in Section 8 and Section 9 of the CEMP may result in the need to update or revise this Plan. This will occur as needed.

Only the Environment Manager, or delegate, has the authority to change any of the environmental management documentation.

A copy of the updated plan and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure – refer to Section 10.2 of the CEMP.

Appendix A

Plant and equipment sound power levels

Reference	Equipment Description	Typical SWL [$L_{Aeq(15\text{minute})}$] dB(A)
1	Air Blower (Leaf Blower)	109
2	Asphalt rotomill	111
4	Auger (hand)	106
5	Auger Drill Rig	103
6	Back Hoe (7.5 tonne JCB)	96
7	Bitumen Spray Truck	100
8	Bobcat	107
9	Bogies	99
12	Cable winch	85
13	Chain saw	106
14	Chipper (mulcher)	106
15	Chipper (large)	114
16	Circular Saw (Battery Operated)*	97
17	Circular Saw*	104
18	Compactor	100
19	Compressor	93
21	Concrete Pump	110
22	Concrete Saw (Soft-Cut)*	99
23	Concrete Saw (Std)*	113
24	Concrete Truck / Agitator - discharging	103
25	Concrete Vibrator	102
26	Core drill	98
28	Daymakers (4 Aspects)	93
29	Diamond Saw*	100
30	Diesel Bowser	117
31	Dozer	109
32	Drill rig	112
33	Dump Truck (approx. 15 tonne)	106
34	Dumper (5 tonne)	104
35	Elevated Working Platform	92
37	Excavator (1.5 tonne)	90
38	Excavator (3 tonne)	93
39	Excavator (6 tonne)	96
40	Excavator (10 tonne)	100
41	Excavator (12 tonne)	104
42	Excavator (15 tonne)	104
43	Excavator (20 tonne)	105
44	Excavator (25 tonne)	105
45	Excavator (30 tonne)	110

Reference	Equipment Description	Typical SWL [$L_{Aeq(15\text{minute})}$] dB(A)
46	Excavator (40 tonne)	115
47	Excavator 8 t (Breaker)*	112
48	Excavator 20 t (Breaker)*	121
49	Excavator 12 t (Breaker)*	118
54	Forklift	106
55	Franna Crane	98
56	Front End Loader	110
57	Generator	102
58	Generator (small and silent)	87
59	Generator (small)	94
60	Grader	107
61	Grinder 4 inch	93
62	Grinder 9 inch	103
63	Hammer Drill*	110
65	Hand tools	94
66	Hand Drill	93
67	Hand saw	93
68	Hand Tools (electric)	95
69	Hydraulic Post Driver (Impact)	108
75	Hydromulching Equipment	100
77	Impact Wrench (pneumatic)	110
78	Jackhammer*	108
79	Line Marking Plant	104
82	Line Marking Removal Plant	100
83	Mobile Crushing Plant	118
84	Mobile Crane (100 tonne)	100
85	Mobile Crane (25 tonne)	98
88	Mobile Crane (300 tonne)	106
89	Mobile Crane (50 tonne)	100
90	Mobile Crane (all terrain) (20 tonne)	101
91	Mobile Jaw Crusher (50 tonne)*	114
92	Multi Tyred Roller	100
93	Paving Machine	112
94	Petrol Drill	108
95	Piling Rig mini (Bored)	104
96	Piling rig small (bored)	107
97	Piling rig large (bored)	111
98	Piling Rig (Impact)*	116
99	Piling Rig (Vibratory)*	116

Reference	Equipment Description	Typical SWL [$L_{Aeq(15\text{minute})}$] dB(A)
100	Rattle Gun (Hand held)	101
101	Road Profiler	110
102	Road Sweeper	104
103	Rock Anchor Drill*	102
104	Saw Cutting Machine*	105
105	Scissor Lift	92
106	Shotcrete pump - truck mounted	99
107	Skidsteer Loaders (approx 1/2 tonne)	109
108	Slip Form Machine	100
109	Smooth Drum Roller*	101
110	Suction Truck	107
111	Telehandler	106
112	Tipper Truck	105
113	Tower Crane	104
114	Truck (10 tonne)	103
115	Truck (12-15 tonne)	105
116	Truck (25t)	107
117	Truck, dump articulated	108
118	Truck 30 t on access road	110
119	Truck (HIAB)	105
120	Tub Grinder	96
121	Vehicle (Light commercial e.g. 4WD)	88
122	Vibratory Roller (10-12 tonne)*	109
123	Vibratory Roller (Light)*	105
124	Wacker Rammer*	93
125	Water Tanker (8000 litre)	107
126	Whipper snipper	100
127	Welding Equipment	105

Appendix B
Blast management plan



APPENDIX B

Blast Management Program Woolgoolga to Halfway Creek Pacific Highway Upgrade

MAY 2015



Document control

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Glossary / Abbreviations

CEMP	Construction Environmental Management Plan
CoA	Condition of Approval
dBA	Decibels using the A-weighted scale measured according to the frequency of the human ear.
DECC	Department of Environment and Climate Change (now EPA)
EA	Environmental Assessment
EMS	Environmental management system
Environmental aspect	Defined by AS/NZS ISO 14001:2004 as an element of an organisation's activities, products or services that can interact with the environment.
Environmental impact	Defined by AS/NZS ISO 14001:2004 as any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects.
Environmental objective	Defined by AS/NZS ISO 14001:2004 as an overall environmental goal, consistent with the environmental policy, that an organisation sets itself to achieve.
Environmental target	Defined by AS/NZS ISO 14001:2004 as a detailed performance requirement, applicable to the organisation or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.
EPA	Environment Protection Authority
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
ER	Environmental Representative
ERG	Environmental Review Group
EWMS	Environmental Work Method Statements
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements..
L _{Aeq} (15min)	The A-weighted equivalent continuous (energy average) A-weighted sound pressure level of the construction works under consideration over a 15-minute period and excludes other noise sources such as from industry, road, rail and the community.
L _A (max)	the A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a sound level meter.
OEH	Office of Environment and Heritage
OOHW	Out of hours work
RBL	The Rating Background Level for each period is the medium

	value of the RBL values for the period over all of the days measured. There is therefore an RBL value for each period (day, evening and night)
RMS	Roads and Maritime Services
SWP	Sound Power Level
SPL	Sound Pressure Level
W2HC	Woolgoolga to Halfway Creek

1 Introduction

1.1 Context

This Blast Management Program (BMP) forms part of the Construction Noise and Vibration Management Sub Plan (CNVMP or Plan) which forms part of the Construction Environmental Management Plan (CEMP) for the Woolgoolga to Halfway Creek section (Section 1) of the approved upgrade of the Pacific Highway between Woolgoolga and Ballina.

This BMP has been prepared to address the requirements of the Minister's Conditions of Approval (CoA), the RMS Statement of Commitments (SoC), the mitigation measures listed in the Pacific Highway Upgrade Woolgoolga to Ballina Environmental Impact Statement (EIS) and all applicable legislation.

There are four tie in projects within the Woolgoolga to Ballina project limits, namely the Sapphire to Woolgoolga, Glenugie Upgrade, Devils Pulpit and Ballina Bypass projects. These tie in projects have been approved separately by the Department of Planning and Environment. Relevant conditions of approval for these projects have been referenced in the CEMP and plans as appropriate.

1.2 Scope

This document specifies the blast management procedure and includes methods for undertaking over-pressure and vibration monitoring during blasting activities and for maintaining flyrock, airblast and ground borne vibration impacts at a minimum.

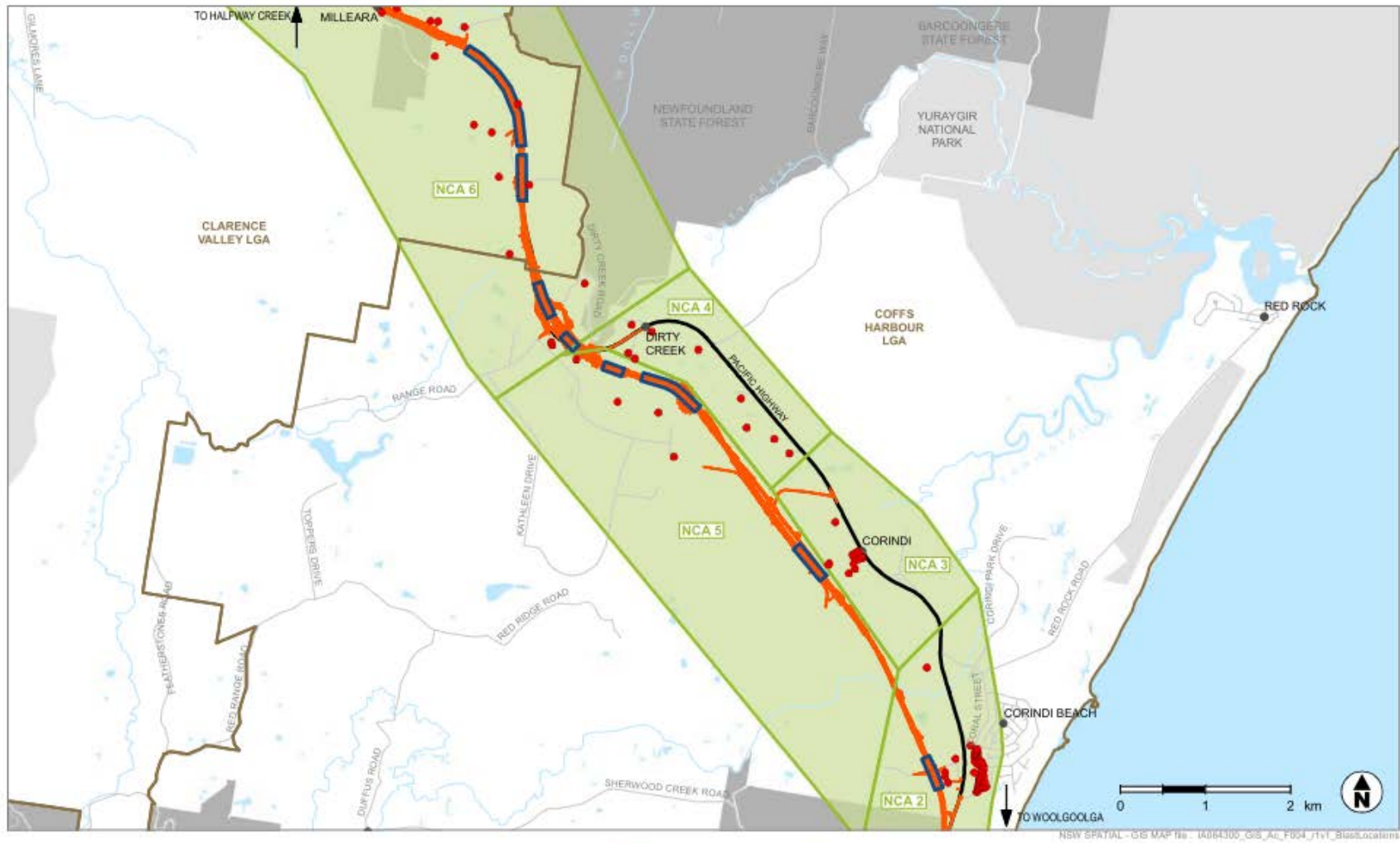


Figure 1-1 Potential blast locations and sensitive receiver locations

2 Environmental requirements

2.1 Guidelines

The main guidelines, specifications and policy documents relevant to this Plan include:

- RMS QA Specification G36 – Environmental Protection (Management System).
- British Standard 7385: Part 2 “Evaluation and measurement of vibration in buildings”.
- German DIN 4150: Part 3 – 1999 Effects of Vibration on Structure (DIN 1999).
- Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration (1990) Australian and New Zealand Environment and Conservation Council (ANZECC).
- Australian Standard AS2187.2-2006: “Explosives – Storage, Transport and Use”.

2.2 Minister’s Conditions of Approval

The CoA relevant to this Plan are listed Table 2-1.

Table 2-1 Conditions of Approval relevant to blasting

CoA No.	Condition Requirements
B14	The SSI shall be constructed with the aim of achieving the construction noise management levels detailed in the <i>Interim Construction Noise Guideline</i> (DECCW, 2009). All feasible and reasonable noise mitigation measures shall be implemented and any activities that could exceed the construction noise management levels shall be identified and managed in accordance with the Construction Noise and Vibration and Management Plan
B20	The SSI shall be constructed with the aim of achieving the following construction vibration goals: <ul style="list-style-type: none"> (a) For structural damage to heritage structures, the vibration limits set out in the German Standard DIN 4150-3: <i>Structural Vibration – Part 3 Effects of Vibration on Structures</i> (b) For damage to other buildings and/or structures, the vibration limits set out in the British Standards <i>BS7385-1:1990 - Evaluation and measurement of vibration in buildings – Guide for measurement of vibration and evaluation of their effects on buildings</i> (and referenced in Australian Standard 2187.2-2006 <i>Explosives – Storage and Use – Use of Explosives</i>); and (c) For human exposure, the acceptable vibration values set out in <i>Assessing Vibration: A Technical Guideline</i> (Department of Environment and Conservation, 2006).
B21	Blasting associated with the SSI shall only be undertaken during the following hours: <ul style="list-style-type: none"> (a) 9:00am to 5:00pm, Monday to Friday, inclusive; (b) 9:00am to 1:00pm on Saturday; and (c) at no time on Sunday or public holidays. Blasting outside the above hours and in accordance with the standard construction hours where: <ul style="list-style-type: none"> (i) no sensitive receivers in sparsely populated areas would be impacted by blasting; or (ii) an agreement has been made with receivers within 200 metres of the blast zone to permit blasting in accordance with the standard construction hours. This condition does not apply in the event of a direction from the NSW Police Force or other relevant authority for safety or emergency reasons to avoid loss of life, property loss and/or to prevent environmental harm.
B22	The Applicant shall ensure that Airblast overpressure generated by blasting associated with the SSI shall not exceed the criteria specified in Table 1 when measured at the most affected residence or other sensitive receiver.

Table 1 - Airblast overpressure limits for human comfort

Receiver	Type of blasting operations	Airblast Overpressure Limit
Sensitive site	Blasting operations lasting more than 12 months or more than 20 blasts	115 dBL for 95% of blasts per year
		120 dBL maximum limit
Sensitive site	Blasting operations lasting less than 12 months or less than 20 blasts in total	120 dBL for 95% of blasts per year
		125 dBL maximum limit
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	125 dBL maximum limit. For sites containing equipment sensitive to vibration, the vibration level should be kept below manufacturer's specifications or levels that can be shown to adversely affect the equipment operation

Note – a sensitive site includes houses and low rise residential buildings, theatres, schools and other similar buildings occupied by people.

Source – Table J5.4(A) – AS 2187.2 – 2006

B23

The Applicant shall ensure that Ground vibration generated by blasting associated with the SSI shall not exceed the criteria specified in Table 2 and Table 3 when measured at the most affected residence or other sensitive receiver.

Table 2 – Ground vibration limits for human comfort

Receiver	Type of blasting operations	Peak component particle velocity (mm/s)
Sensitive site	Blasting operations lasting more than 12 months or more than 20 blasts	5 mm/s for 95% of blasts per year
		10 mm/s maximum limit
Sensitive site	Blasting operations lasting less than 12 months or less than 20 blasts in total	10 mm/s maximum limit
Occupied non-sensitive sites, such as factories and commercial premises	All blasting	25 mm/s maximum limit. For sites containing equipment sensitive to vibration, the vibration level should be kept below manufacturer's specifications or levels that can be shown to adversely affect the equipment operation

Note – a sensitive site includes houses and low rise residential buildings, theatres, schools and other similar buildings occupied by people.

Source – Table J4.5(A) – AS 2187.2 – 2006.

Table 3 – Ground vibration limits for control of damage to structures

Receiver	Type of blasting operations	Peak component particle velocity (mm/s)	
Other structures or architectural elements that include masonry, plaster and plasterboard in their construction ¹		15 mm/s 4 Hz to 15 Hz, except for heritage structures where a frequency dependent vibration criteria would be determined in accordance with AS 2187.2 – 2006.	20 mm/s 15 Hz and above
Reinforced or framed structures. Industrial and heavy commercial buildings ²	All blasting	50 mm/s at 4 Hz and above	
Unreinforced or light framed structure. Residential or light commercial type building ²	All blasting	15 mm/s at 4 Hz increasing to 20 mm/s at 15 Hz	20 mm/s at 15 Hz increasing to 50 mm/s at 40 Hz and above
Unoccupied structures of reinforced concrete or steel construction	All blasting	100 mm/s maximum, where agreed with the structure owner.	
Infrastructure service structures, such as pipelines, power lines, cables and reservoirs.	All blasting	Limits to be determined by structural design methodology in consultation with the infrastructure service provider.	

Source:

1 - Table J4.5(B) – AS 2187.2 – 2006.

2 - Table J4.4.2.1 – AS 2187.2 – 2006 (BS 7385-2).

B24 The blasting criteria identified in conditions B22 and/or B23 may be increased where the Applicant has obtained the written agreement of the relevant landowner to increase the criteria. In obtaining the agreement the Applicant shall make available to the landowner:

- details of the proposed blasting programme and justification for the proposed increase to blasting criteria including alternatives considered (where relevant);
- the environmental impacts of the increased blast limits on the surrounding environment and most affected residences or other sensitive receivers including, but not limited to noise, vibration and air quality and any risk to surrounding utilities, services or other structures;
- The blast management and mitigation measures, and the procedures to be implemented to monitor blasting impacts.

The Applicant shall provide a copy of the written agreement to the Secretary and the EPA, including details on the consultation undertaken (with clear identification of proposed blast limits and potential property impacts) prior to commencing blasting at the increased limits.

Unless otherwise agreed by the Secretary, the following exclusions apply to the application of this condition:

- Any agreements reached may be terminated by the landowner at any time should concerns about the increased blasting limits be unresolved. Should an agreement be terminated by a landowner, the Applicant shall not exceed the criteria specified in Conditions B22 and/or B23 for future blasting at that receiver.
- The blasting limit agreed to under any agreement for an occupied residential building can at no time exceed a maximum Peak Particle Velocity vibration level of 25mm/s or maximum Airblast Overpressure level of 125dB_L.

CoA No.	Condition Requirements
---------	------------------------

- | | |
|---------|--|
| D26 (a) | <p>As part of the Construction Environmental Management Plan for the SSI, the Applicant shall prepare and implement:</p> <p>(a) a Construction Noise and Vibration Management Plan to detail how construction noise and vibration impacts will be minimised and managed. The Plan shall be developed in consultation with the EPA and shall be consistent with the guidelines contained in the <i>Interim Construction Noise Guidelines</i> (DECC, 2009) and shall include, but not necessarily be limited to:</p> <ul style="list-style-type: none">(i) identification of sensitive receivers and relevant construction noise and vibration goals applicable to the SSI stipulated in this approval;(ii) details of construction activities and an indicative schedule for construction works; including the identification of key noise and/or vibration generating construction activities (based on representative construction scenarios, including at ancillary facilities) that have the potential to generate noise and/or vibration impacts on surrounding sensitive receivers, particularly residential areas;(iii) identification of feasible and reasonable measures proposed to be implemented to minimise and manage construction noise and vibration impacts (including construction traffic noise impacts);(iv) procedures and mitigation measures to ensure relevant vibration and blasting criteria are achieved, including a suitable blast program, applicable buffer distances for vibration intensive works, use of low-vibration generating equipment/vibration dampeners or alternative construction methodology, and pre- and post-construction dilapidation surveys of sensitive structures where blasting and/or vibration is likely to result in damage to buildings and structures (including surveys being undertaken immediately following a monitored exceedance of the criteria); and(v) a description of how the effectiveness of these actions and measures would be monitored during the proposed works, clearly indicating how often this monitoring would be conducted, the locations where monitoring would take place, how the results of this monitoring would be recorded and reported, and, if any exceedance is detected, how any non-compliance would be rectified;(vi) an out-of-hours work (OOHW) protocol for the assessment, management and approval of works outside of standard construction hours as defined in condition B15 including a risk assessment process under which the Environmental Representative may approve out-of-hour construction activities. The OOHW protocol shall detail standard assessment, mitigation and notification requirements for high and low risk out-of-hour works, consultation procedures with the EPA, the relevant council and affected landowners;(vii) procedures for notifying sensitive receivers of construction activities that are likely to affect their noise and vibration amenity, as well as procedures for dealing with and responding to noise complaints;(viii) a program for construction noise and vibration monitoring clearly indicating monitoring frequency, location, how the results of this monitoring would be recorded and, procedures to be followed where exceedances of relevant noise and vibration goals are detected; and(ix) mechanisms for the monitoring, review and amendment of this plan. |
|---------|--|

2.3 RMS Project Requirements – QA Specifications

Table 3-2 RMS Requirements relevant to the NVMP

Original Reference	Relevant Requirement
QA Specification G36 ENVIRONMENTAL PROTECTION (July 2014)	
G36.4.7	<p>GROUND VIBRATION AND AIR BLAST</p> <p>Take due care in all construction activities to prevent damage to adjacent public utilities, structures and buildings resulting from construction vibration and air blast.</p> <p>To protect the amenity of the occupiers of buildings, carry out any blasting activities in accordance with the requirements of the ANZECC publication “Technical Basis for Guidelines to Minimise Annoyance Due to Blasting Overpressure and Ground Vibration - September 1990”. Where the amenity guidelines are likely to be exceeded, manage the impacts in consultation with, and in accordance with, the requirements stipulated by EPA.</p> <p>Meet the requirements of EPA “Environmental Noise Management Assessing Vibration: A Technical Guideline”. Where the requirements are likely to be exceeded, manage the impacts in consultation with, and in accordance with, the requirements stipulated by EPA.</p> <p>To reduce the potential for structural damage, carry out the activities to meet the requirements of BS 7385 and German Standard DIN 4150:1999 – Structural Vibrations in Buildings(for heritage structures). If structural damage is observed that could reasonably be assumed to have resulted from construction activities, re-assess any previously acceptable vibration limit.</p> <p>Where there is a risk that vibration or air blast activities may cause damage to nearby structures and buildings, or if these are located within the distance from the construction activity specified in Annexure G36/E, undertake a building condition inspection and prepare a Building Condition Inspection Report for every property or structure likely to be affected.</p> <p>Prepare, as part of the Construction Noise and Vibration Management Plan, a description of the environmental controls to be implemented during construction to minimise the impact of vibration and air blast on adjacent properties and residents. Include measures to minimise the impact of vibration and air blast, including:</p> <ul style="list-style-type: none"> (a) substitution by an alternative process; (b) restricting times when work is carried out; (c) screening or enclosures; <p>consultation with affected residents.</p>

2.4 ANZECC guidelines

Guidelines documented in the ANZECC *Technical Basis for Guidelines to Minimise Annoyance due to Blasting Overpressure and Ground Vibration* has been used to establish goals for assessing blast air-blast overpressure and ground vibration.

The following blast assessment parameters, as detailed in CoA C9 and C10 have been adopted for assessing and managing blast impacts.

As detailed in CoA B24 do not apply where the Proponent has a written agreement with the relevant landowners to exceed and the Director General has approved the terms of the written agreement.

Table 2-3 Airblast overpressure criteria

Airblast overpressure (dB(Lin Peak))	Allowable exceedance
115	5% of total number of blasts over a 12 month period
120	0%

Table 2-4 Peak particle velocity criteria

Peak particle velocity (mms-1)	Allowable exceedance
5	5% of total number of blasts over a 12 month period
10	0%

For assessment of air-blast overpressure the DECC/ANZECC guidelines recommend measurement at any sensitive receiver at least 3.5 metres from building or structure, and ground vibration measured at any point on the noise sensitive site at least the longest dimension of the foundations of a building or structure away from the building or structure.

2.5 Heritage structure ground vibration guidelines

No known heritage buildings are located within the vicinity of the proposed blasting locations. If any are subsequently identified, the following ground vibration guidelines will apply.

The ANZECC guidelines do not contain criteria relevant to these property types and, as such, the adoption of relevant ground vibration criteria would be considered appropriate. German Standard DIN 4150-3 *Structural Vibration Part 3: Effects of Vibration on Structures* contains vibration guidelines for buildings of “great intrinsic value (eg listed buildings under a preservation order)”. The vibration criteria in Table 2-5 should be applied at these locations.

Table 2-5 DIN 4150: Structural damage limits for building vibration

Group	Group- Type of Structure	Vibration Velocity in mm/s			
		At Foundation at a Frequency of			Plan of Floor of Uppermost Storey
		Less than 10Hz	10 – 50 Hz	50-100Hz	All Frequencies
1.	Buildings used for commercial purposes, industrial buildings and buildings of similar design.	20	20-40	40-50	40
2.	Dwellings and buildings of similar design and/or use.	5	5-15	15-20	15
3.	Structures that because of their particular sensitivity to vibration, do not correspond to those listed in Lines 1 or 2 and have intrinsic value (e.g. buildings that are under a preservation order).	3	3-8	8-10	8

Note: For frequencies above 100 Hz, the higher values in the 50 Hz to 100 Hz column should be used.

3 Details of blasting

3.1 Blasting times

Blasting operations will be confined to the following times:

- 9:00 am to 5:00 pm, Mondays to Fridays, inclusive;
- 9:00 am to 1:00 pm on Saturdays; and
- at no time on Sundays or public holidays.

Blasting outside the above hours and in accordance with the standard construction hours is permitted where:

- no sensitive receivers in sparsely populated areas would be impacted by blasting; or
- an agreement has been made with receivers within 200 metres of the blast zone to permit blasting in accordance with the standard construction hours.

This condition does not apply in the event of a direction from police or other relevant authority for safety or emergency reasons to avoid loss of life, property loss and/or to prevent environmental harm.

3.2 Justification for blasting

In order to optimise the alignment of the Project, several 'cut' areas have been identified where the removal of soil and rock material is required. Soil at these sites will be excavated using dozers, scrapers or excavators, whilst soft rock material will generally be removed using ripping and / or hammering techniques.

Geotechnical surveys have however identified the presence of hard rock in the lower levels of some cut locations. In addition a large volume of rock to the south of Dirty Creek is required to be moved. Where this rock is identified as being too hard to be removed using typical extraction techniques, blasting may be required. However, blasting will only be undertaken where no other reasonable or feasible extraction methods are able to be employed.

3.3 Blasting methodology

All blasts will be planned foremost with consideration of the protection of people and property in the vicinity of the proposed blast, including trial blasts. This will be achieved through the preparation of a blast management plan prior to each blast which will be prepared by the blast contractor and will address potential risks and control measures. This plan will be prepared in accordance with Section 4 of AS 2187.2-2006 *Australian Standard Explosives – Storage and Use, Part 2: Use of Explosives*.

Potential blasting impacts can include the following:

3.3.1 Flyrock risk

Flyrock is often a result of under-burden or over-charging, and is the projection of large rock pieces from the face of the blast. Flyrock from a face is most likely to be projected perpendicular to the face and least likely to be projected parallel to the face. The clearance distance design for blasts is relative to the maximum throw of flyrock. Safety factors are introduced for plant and personnel as follows:

- The clearance distance for plant and equipment is double the maximum throw
- The clearance distance for personnel is four times the maximum throw

With further evaluation of site specific conditions, additional measures can also be considered to reduce clearance distances required.

3.3.2 Ground Vibration

Vibration is generated at the moment of the blast and is transmitted through the ground. The effects of vibration can be divided into three main categories:

- where occupants or users of the building are disturbed or inconvenienced
- those in which the building contents may be affected
- circumstances in which the integrity of the building or the structure itself may be prejudiced

Vibration is measured by monitoring the movement of the ground through the three orthogonal axis, and producing a figure to represent the vector sum of this movements. The vibration levels at which human discomfort is perceived are well below the levels at which building damage may be caused. The main on site influences on ground vibration during a blast are as follows:

- Maximum Instantaneous Charge (MIC)
- delay interval
- direction of initiation
- charge confinement
- blast hole deviation
- geological conditions
- water saturation of ground

In general terms, ground vibration increases with increased charge mass and reduces with distance.

3.3.3 Airblast Overpressure

Air blast or overpressure is an air pressure wave that is generated by explosive movement of rock and gases at the triggering of a blast and is transmitted through the air. During a blasting event, the major influences on air blast levels include:

- delay interval
- burden
- spacing
- the amount and type of stemming used
- direction of initiation of the blast
- the charge depth
- covering of the detonation cord
- charge confinement

- blast hole deviation
- geological conditions
- meteorological conditions

3.4 Proposed blast locations

Blasting works have been identified as potentially required in eight of the larger cuts along the works corridor. Table 3-1 below summarises the location of cuts identified in the geotechnical investigation where material may be difficult to remove and the estimated volume of material that may require blasting.

Table 3-1 Potential blasting locations

Start chainage	End chainage	Volume (m ³)	Location	Likelihood of blasting
2300	2703	182,261	Kangaroo Trail Road (Cut 3)	Yes
5146	5622	84,661	North of Cassons Creek (Cut 5)	Unlikely
7608	8370	1,200,448	(Cut 8)	Yes
8608	8868	86,391	(Cut 9)	Possible
9250	9482	67,201	(Cut 12)	Yes
9731	10152	307,687	Range Road Interchange Overpass (Cut 13)	Yes
11140	11689	149,371	(Cut 15)	Possible
11796	13144	85,353	Falconers Lane (Cut 16)	Possible

These locations are presented graphically in Figure 1-1, and in more detail in Appendix D of the CNVMP.

4 Blasting assessment

4.1 Blast sensitive receivers

The nearest representative sensitive receivers to the proposed blast locations are summarised Table 5-1. This includes properties from residential areas to a radius of 500m.

Table 4-1 Blast sensitive receivers (<500m)

Start chainage	End chainage	Location	Blasting required	Receivers	Distance
2300	2703	Kangaroo Trail Road (Cut 3)	Yes	335	120
				344	120
				351	130
				367	300
5146	5622	North of Cassons Creek (Cut 5)	Unlikely	402	120
				404	150
				396	300
				399	370
				403	390
				415	425
				411	485
				419	440
				420	465
7608	8370	(Cut 8)	Yes	453	215
				455	320
				451	410
				439	320
8608	8868	(Cut 9)	Possible	453	220
				455	230
				446	355
				451	330
9250	9482	(Cut 12)	Yes	459	170
				458	160
				451	120
9731	10152	Range Road Interchange Overpass (Cut 13)	Yes	476	480
				474	490
11140	11689	(Cut 15)	Possible	481	70
				484	260
				491	430
11796	13144	Falconers Lane (Cut 16)	Possible	491	315
				493	500
				495	40
				484	440
				502	380
				506	260
				510	460

No education institutions, hospitals or places of worship are located within 1 kilometre of the proposed blasting locations.

4.2 Blast assessment

Specific blasting and seismic details will need to be assessed on a site and blast specific basis. It is important that the actual buffer zone distances, associated specifically with this project, be identified and appropriate measures taken to limit overpressure and vibration to

acceptable levels at critical locations. Blast charge and blast configurations must therefore be selected to ensure that objectives outlined in Section 2 are not exceeded.

Estimated maximum instantaneous charges have been provided in Table 4-2 and Figure 4-1 to provide an indication of acceptable blast sizes.

The distance limits relating to vibration and airblast overpressure set out in Table 4-2 have been determined using formula as outlined in Australian Standard 2187.2-1993, applicable to free-face blasting in 'average field conditions' which states:

Vibration Formula:
$$V = 1140 \left(\frac{R}{Q^{1/2}} \right)^{-1.6}$$

and

Overpressure Formula:
$$P = 516 \left(\frac{R}{Q^{1/3}} \right)^{-1.45}$$

Where:

P = Pressure (pascals)

V = ground vibration as peak particle velocity in mm/s

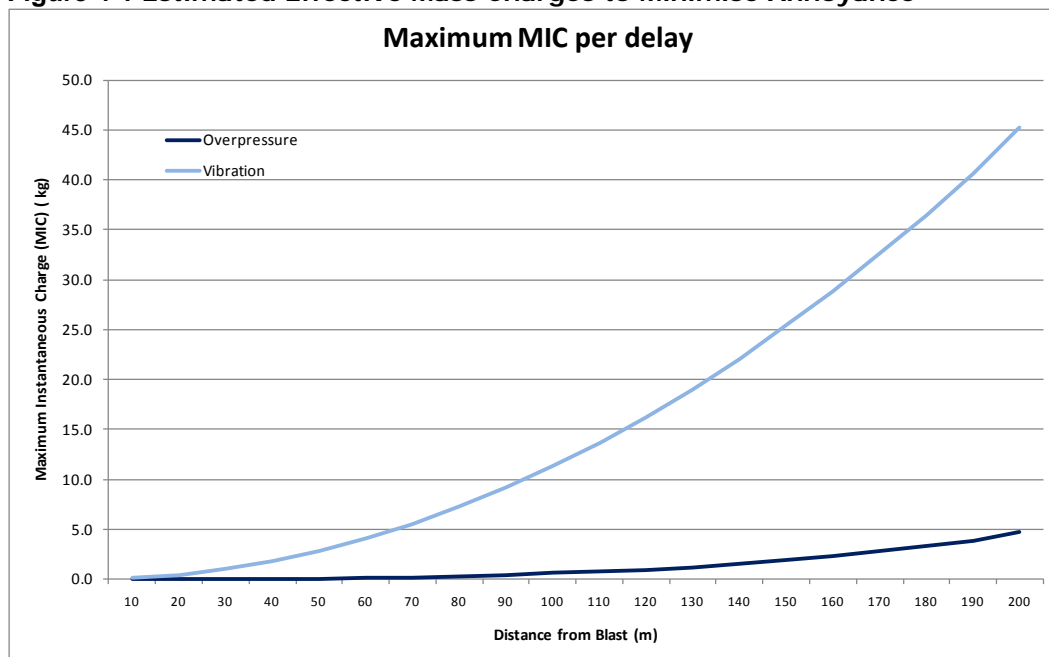
R = distance between charge and point of measurement in metres

Q = effective charge mass per delay or maximum instantaneous charge in kilograms

The distance limits per nominated MIC may vary significantly depending on the geological conditions, local shielding and meteorological factors at the site.

In view of the proximity of some buildings to blasting, it is important that blasting be monitored at the initial stages at critical locations surrounding the site to confirm predicted over-pressure and vibration levels and to in turn modify the blast design and buffer zones accordingly around the site.

Figure 4-1 Estimated Effective Mass Charges to Minimise Annoyance



These calculations show that ground vibration is unlikely to impact receiver comfort during most blasts, however overpressure may exceed guidelines to a distance of several hundred meters (depending on the MIC size).

The following calculations show the likely maximum MIC per blast for each cutting area. The calculations are based on an assumption of average free face rock and apply the formulas outlined above. They are to be used as a guideline for assessing potential blast impacts and it is essential that a site specific blast plan confirms potential blast impacts prior to each blast.

Table 4-2 Estimated Effective Mass Charges to Meet Blast Criteria

Start Chainage	End Chainage	Location	Nearest Receiver	Distance 'D' (m)	Maximum instantaneous charge (MIC), kg	
					Air blast	Vibration
2300	2703	Kangaroo Trail Road (Cut 3)	335 / 344	120	1.2	16.3
5146	5622	North of Cassons Creek (Cut 5)	402	120	1.2	16.3
7608	8370	(Cut 8)	453	215	7.2	52.2
8608	8868	(Cut 9)	453	220	7.7	54.6
9250	9482	(Cut 12)	451	120	1.2	16.3
9731	10152	Range Road Interchange Overpass (Cut 13)	476	480	81.8	260.1
11140	11689	(Cut 15)	481	70	0.2	5.5
11796	13144	Falconers Lane (Cut 16)	495	40	<0.1	1.8

These calculations show that Cut 15 and 16 contain the most blast sensitive receivers. In addition, cuts 3, 5 and 12 will require careful planning by the blast contractor to minimise air blast impacts.

5 Environmental control measures

5.1 Introduction

Blast performance should be regularly reviewed and possible improvements implemented to ensure a good relationship is maintained with persons who may be affected by the blast and the regulatory authorities. Appropriate action for the management of airblast overpressure and ground borne vibration impacts is summarised in Table 5-1.

Table 5-1 Blast management actions.

Action	Responsibility	Timing/frequency
Reduce the maximum instantaneous charge (MIC) to the lowest possible level by use of delays, reduced hole diameter, and/or deck loading.	Blast manager	Ongoing
Ensure stemming is adequate and eliminate exposed detonating cord. (Cover with at least 300 mm of quarry dust or road base)	Blast manager	Ongoing
Eliminate secondary blasting. (Instead of popping, use rock breaker or drop hammer). Also make extra efforts to eliminate the need for toe shots, (e.g. better control of drill patterns).	Blast manager	As required
Assess weather conditions at the time of the blast. Avoid heavy cloud cover and avoid firing if a strong wind is blowing towards residences. In particular, avoid days of severe temperature inversion but if not possible blast between 11 am and 1 pm. Consider not loading a shot with explosives if the weather forecast is unfavourable.	Blast manager Environmental Construction Manager	As required
Exercise strict control over the spacing and orientation of all blast drill holes. Ensure that the holes are spaced in such a manner that the explosive force is just sufficient to break the stone to the required size.	Blast manager	Ongoing
Establish times of blasting to suit the situation, e.g. fire all blasts at a set time acceptable to neighbours and preferably when background noise is highest. It is preferable to fire at times when neighbours are out or active, rather than when they are seated for meals.	Blast manager Environmental Construction Manager	Pre-blast

A range of environmental requirements and control measures are identified in the various environmental documents, including the EA, Statement of Commitments, Conditions of Approval and RMS documents. Specific measures and requirements to address impacts from noise and vibration are outlined in Table 5-2.

Table 5-2 Noise and vibration management and mitigation measures

ID	Measure / Requirement	When to implement	Responsibility
GENERAL			
NV31	<p>Blasting shall only be undertaken during the following hours</p> <ul style="list-style-type: none"> • 9:00 am to 5:00 pm, Mondays to Fridays, inclusive; • 9:00 am to 1:00 pm on Saturdays; and • at no time on Sundays or public holidays. <p>Unless a direction from police or other relevant authority for safety or emergency reasons to avoid loss of life, property loss and/or to prevent environmental harm is received.</p>	Construction	Construction Manager
NV32	<p>All blasting associated with the Project will be conducted within the air blast overpressure and Peak Particle Velocity Criteria outlined within Table 3-3 and Table 3-4. This requirement does not apply where written agreement from the affected landowners and/or Director-General is obtained, and subject to the additional requirements in Table 3-1 and condition C.11.</p>	Construction	Foreman / Specialist Sub-contractor
NV45	<p>Residents / sensitive receivers will be notified of construction activities that are likely to affect their noise and vibration amenity in accordance with the Community Communications Strategy. Information provided will include:</p> <ul style="list-style-type: none"> • The types of activities to be undertaken. • The timing of activities including expected start and finish. • The location of activities. • Details of the community information line and how to make an enquiry and/or complaint 	Pre- construction, Construction	Communications Manager
NV47	<p>Circumstances may arise during construction where works outside of standard construction hours are essential and sensitive receivers are assessed to be highly noise affected (ie experience noise levels greater than 75 dBA). Where this is the case, opportunities to minimise impacts on highly noise effected receivers, including the provision of alternative accommodation, would be considered in consultation with those affected receiver(s).</p>	Construction	Communications Manager
NV48	<p>All complaints received will be managed in accordance with the Community Communications Strategy.</p>	Construction	Communications Manager
NV50	<p>Initial noise monitoring of plant and equipment will be undertaken to ensure the noise performance levels predicted in this CNVMP are being met.</p>	Pre-construction, Construction	Environmental Officer, Noise Specialist
NV51	<p>Noise and vibration monitoring will be undertaken in accordance with Section 9.3. The program for construction noise and vibration monitoring indicates monitoring frequency, location, how the results of this monitoring are recorded and, procedures that are followed where significant exceedances of relevant noise and vibration goals are detected.</p>	Construction	Environmental Officer, Noise Specialist

ID	Measure / Requirement	When to implement	Responsibility
NV52	Building Condition Inspections for each public utility, structure and building will be carried out where: <ul style="list-style-type: none"> • Blasting operations are within 500 metres or the distance at which the calculated 95th percentile Peak Velocity of ground vibration from the proposed blast is 2 mm/s, whichever is the greater. • Pile driving activities are within 250 metres or the distance at which the calculated 95th percentile Peak Velocity of ground vibration from the proposed pile driving is 2 mm/s, whichever is the greater • Other vibration causing activities where the distance at which the calculated 95th percentile Peak Velocity of ground vibration is 2 mm/s. 	Pre-construction, Construction	Engineer
NV38	The Building Condition Inspection report will include as a minimum: <ul style="list-style-type: none"> • Floor plan of the subject building. • Record site details - age, construction, site slope and provision for drainage, presence of trees. • Type of defects and their positions and extents on the floor plan. • Photograph of external view and photograph of all defects of significance (especially if of concern to the owner), or typical examples of say, hairline plaster cornice cracks. • How doors sit in the jambs - out of line may indicate foundation settlement. • External signs of reactive clay foundation soil, e.g. lifting of slabs, uneven kerbing. 	Pre-construction, Construction	Engineer
NV48	All complaints, including those related to property damage, will be managed in accordance with the RMS Complaints and Enquiries Procedure – see section 6.3.2 of the CEMP.	Construction	Communications Manager

6 Compliance management

6.1 Roles and responsibilities

The OHL York Project Team's organisational structure and overall roles and responsibilities are outlined in Section 4.2 of the CEMP. Specific responsibilities for the implementation of environmental controls are detailed in Chapter 8 of this Plan.

6.2 Training

Blasting contractors will be informed of their responsibilities under this plan and provided with a copy of this document. All employees, contractors and utility staff associated with blast planning will undergo site induction training that includes construction blast management issues. The induction training will address elements related to noise and vibration management including:

- Existence and requirements of this sub-plan.
- Relevant legislation.
- Permitted blasting hours
- Location of noise sensitive areas
- Complaints reporting
- Monitoring requirements
- Blast management measures
- Specific responsibilities to minimise impacts on the community and built environment from noise and vibration associated with blasting.

Further details regarding staff induction and training are outlined in Section 5 of the CEMP.

6.3 Notification

Residents and other sensitive receivers located within 500m of a blast location will be notified at least 48hrs prior to each blast. Information provided will include:

- The location of the blast
- A schedule of blast times
- Details of an onsite contact person (name and telephone number) that can deal directly with any complaints or concerns.

Typically this contact will be by telephone or face to face, however where contact cannot be made, a letterbox drop may suffice.

6.3.1 Monitoring procedures

For the purposes of checking compliance with the airblast overpressure and ground vibration conditions and for investigating complaints of noise and vibration annoyance, monitoring must be undertaken. Monitoring will be undertaken by a suitably qualified representative. This representative may be the blast contractor, an Acoustic Consultant or an experienced Environmental Officer.

Where access to a potential noise-affected property for monitoring purposes is not feasible, the measurement may be undertaken at the appropriate property boundary and the results extrapolated to reflect the impact at the receptor premises.

The proposed monitoring system for this project will include a portable near-field unit placed within close proximity to the blast area and up to three (3) additional blast monitoring units located at critical assessment locations.

The blast monitoring locations are to include areas within the surrounding community recognised as potentially sensitive or susceptible to blast impacts mostly because of their close proximity to the blasting. The monitoring locations to be considered shall be representative of the worst-affected premises surrounding the blast sites.

6.3.2 Measurement of airblast overpressure

Blast monitoring equipment consists of a computer and display unit connected by cable to a geophone transducer which senses vibration, and to a microphone with low-frequency measurement characteristics which senses air blast overpressure. Vibration and overpressure levels are monitored concurrently upon detection of a trigger, and the data is processed and stored in the computer memory. The operator may either retrieve the data at the conclusion of each monitoring period either in person or via a telephone modem if the logger is fitted with a mobile phone option.

Noise from blasting shall be measured using noise measurement equipment with a lower limiting frequency of 2Hz (- 3dB response point of the measurement system) and a detector onset time of not greater than 100 µs as assessed in accordance with AS –1259.1 clauses 8.5 and 10.4.

Measurement of airblast overpressure should be taken at an appropriate location that is exposed to the direction of blasting and at least 4 m from any noise-affected building or structure or within the boundary of a noise sensitive place, at a position between 1.2 m and 1.5 m above the ground.

Blast monitoring instrumentation will be installed and maintained in accordance with relevant Australian Standards (e.g. AS2187.2 - 1993) or as otherwise prescribed by the DECC. Monitoring units should be calibrated annually to standards that are traceable to Australian Physical Standards held by the National Measurement Laboratory (CSIRO Division of Applied Physics).

6.3.3 Measurement of ground vibration

For assessment of air-blast overpressure the DECC/ANZECC guidelines recommend measurement at any sensitive receiver at least 3.5 metres from building or structure, and ground vibration measured at any point on the noise sensitive site at least the longest dimension of the foundations of a building or structure away from the building or structure (towards the blast site).

Vibration instrumentation must be capable of measurement over the range 0.1 mm/s to 300 mm/s with accuracy within 5 % and have a frequency response flat to within 5 % over the frequency range of 4.5 Hz to 250 Hz.

The ground-borne vibration transducer (or array) must be attached to a mass of at least 30 kg to ensure good coupling with the ground where the blast site and the measurement site cannot be shown to be on the same underlying strata. The mass shall be buried so that its uppermost surface is at the same level as the ground surface.

6.3.4 Recording

Blast monitoring records provide the data for determining any improvements in blast outcomes, including the management and control of ground vibration and airblast. As a minimum, blast monitoring records should include the following. A copy of these records should be included in the site blast records.

- a) The size of the blast, i.e. number of blastholes and quantity of explosives in each blasthole (MIC)
- b) The method of initiation and the timing sequence to be used in the blast
- c) The date and time of the blast
- d) The location of the measurement transducers (geophones, accelerometers, microphones)
- e) Instrument trigger-levels
- f) Measurement equipment and operator details
- g) The location of the blast
- h) The location of any structures and/or persons who may be affected by the blast
- i) The measured ground vibration (PPV) and airblast values (dB(L) peak) including the peak particle velocity values for each of the triaxial components, a derived vector peak particle value
- j) Weather conditions, especially temperature, wind speed and direction, cloud cover, relative humidity, and any other notable conditions such as rain
- k) Any subjective information from the shotfirer and any persons who may be affected by the blast
- l) Location, date and time of recording

6.4 Non-conformances

Non-conformances in general will be dealt with and documented in accordance with Section 8.6 of the CEMP.

6.5 Complaints

Complaints will be recorded in accordance with the Community Communications Strategy (CCS). Information to be recorded will include location of complainant, time/s of occurrence of alleged noise or vibration impacts (including nature of impact particularly with respect to vibration), perceived source, prevailing weather conditions and similar details that could be utilised to assist in the investigation of the complaint. All resident complaints will be responded to in a timely manner and action taken recorded in accordance with the CCS.

6.6 Auditing

Audits (both internal and external) will be undertaken to assess the effectiveness of environmental controls, compliance with this sub plan, CoA and other relevant approvals, licenses and guidelines.

Audit requirements are detailed in Section 8.3 of the CEMP.

6.7 Reporting

Reporting requirements and responsibilities are documented in Section 8.3 of the CEMP.

Specific reports prepared in response to noise and vibration monitoring will capture detail including, but not limited, to:

- The locations and description of monitoring undertaken.
- A tabulation of results (eg for noise including L_{MAX} , L_{10} , L_{90} and L_{Aeq} noise levels) together with notes identifying the principle sources and operations.
- Summary of any measurements exceeding the nominated criteria, and descriptions of the plant or operations causing these exceedances.
- Detail of any corrective actions and confirmation of their successful implementation.

7 Review and improvement

7.1 Continuous improvement

Continuous improvement of this Plan will be achieved by the ongoing evaluation of environmental management performance against environmental policies, objectives and targets for the purpose of identifying opportunities for improvement.

The continuous improvement process will be designed to:

- Identify areas of opportunity for improvement of environmental management and performance.
- Determine the cause or causes of non-conformances and deficiencies.
- Develop and implement a plan of corrective and preventative action to address any non-conformances and deficiencies.
- Verify the effectiveness of the corrective and preventative actions.
- Document any changes in procedures resulting from process improvement.
- Make comparisons with objectives and targets.

7.2 Update and amendment

The processes described in Section 8 and Section 9 of the CEMP may result in the need to update or revise this Plan. This will occur as needed.

Only the Environment Manager, or delegate, has the authority to change any of the environmental management documentation.

A copy of the updated plan and changes will be distributed to all relevant stakeholders in accordance with the approved document control procedure – refer to Section 10.2 of the CEMP.

Appendix C

Out of hours works procedure



APPENDIX C

Out of Hours Works Procedure

MAY 2015



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Glossary / Abbreviations

CEMP	Construction Environmental Management Plan
CoA	Condition of Approval
dBA	Decibels using the A-weighted scale measured according to the frequency of the human ear.
DECC	Department of Environment and Climate Change (now EPA)
EA	Environmental Assessment
EMS	Environmental management system
Environmental aspect	Defined by AS/NZS ISO 14001:2004 as an element of an organisation's activities, products or services that can interact with the environment.
Environmental impact	Defined by AS/NZS ISO 14001:2004 as any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organisation's environmental aspects.
Environmental objective	Defined by AS/NZS ISO 14001:2004 as an overall environmental goal, consistent with the environmental policy, that an organisation sets itself to achieve.
Environmental target	Defined by AS/NZS ISO 14001:2004 as a detailed performance requirement, applicable to the organisation or parts thereof, that arises from the environmental objectives and that needs to be set and met in order to achieve those objectives.
EPA	Environment Protection Authority
EP&A Act	<i>Environmental Planning and Assessment Act 1979</i>
ER	Environmental Representative
ERG	Environmental Review Group
EWMS	Environmental Work Method Statements
Feasible and reasonable	Consideration of best practice taking into account the benefit of proposed measures and their technological and associated operational application in the NSW and Australian context. Feasible relates to engineering considerations and what is practical to build. Reasonable relates to the application of judgement in arriving at a decision, taking into account mitigation benefits and cost of mitigation versus benefits provided, community views and nature and extent of potential improvements..
L _{Aeq} (15min)	The A-weighted equivalent continuous (energy average) A-weighted sound pressure level of the construction works under consideration over a 15-minute period and excludes other noise sources such as from industry, road, rail and the community.
L _A (max)	the A-weighted maximum noise level only from the construction works under consideration, measured using the fast time weighting on a sound level meter.
OEH	Office of Environment and Heritage
OOHW	Out of hours work
RBL	The Rating Background Level for each period is the medium value of the ABL values for the period over all of the days

1 Introduction

1.1 Context

This Out of Hours Works (OOHW) Procedure forms part of the Noise and Vibration Management Sub Plan (NVMP) which forms part of the Construction Environmental Management Plan (CEMP) for the upgrade of the Pacific Highway between Woolgoolga and Halfway Creek (the Project).

This OOHW procedure has been prepared to address the requirements of the Minister's Conditions of Approval (CoA), the RMS Statement of Commitments (SoC), the mitigation measures listed in the Woolgoolga to Ballina Environmental Assessment (EA) and all applicable legislation.

1.2 Scope

This document specifies the procedure to be followed when conducting Out of Hours Work, and includes methods for assessing, approving and monitoring work outside of normal construction hours.

The aim of the OOHW Procedure is to ensure that all OOHW follow a rigorous process to ensure the following outcomes:

- Potential OOHW are identified as early as possible;
- Justification is provided for each OOHW proposed;
- Appropriate levels of consultation are undertaken for all the OOHW activities; and
- Potential impacts from the OOHW are identified and feasible and reasonable noise mitigation measures implemented to minimise impact on the surrounding environment and community.

2 Environmental requirements

2.1 Guidelines

The main guidelines, specifications and policy documents relevant to this Plan include:

- RMS QA Specification G36 – Environmental Protection (Management System).
- *NSW Road Noise Policy, March 2011, DECCW.*
- NSW Industrial Noise Policy (EPA 2000).
- RTA Environmental Noise Management Manual (ENMM) (RTA 2001a).
- Interim Construction Noise Guideline (ICNG) (DECCW 2009).

2.2 Minister’s Conditions of Approval

The CoA relevant to this Plan are listed Table 2-1.

Table 2-1 Conditions of Approval relevant to noise and vibration

CoA No.	Condition Requirements	Document Reference
Construction Noise		
B14	<p>The SSI shall be constructed with the aim of achieving the construction noise management levels detailed in the <i>Interim Construction Noise Guideline</i> (DECCW, 2009). All feasible and reasonable noise mitigation measures shall be implemented and any activities that could exceed the construction noise management levels shall be identified and managed in accordance with the Construction Noise and Vibration and Air Blast Management Plan</p> <p><i>Note:</i></p> <p><i>The Interim Construction Noise Guideline identifies ‘particularly annoying’ activities that require the addition of 5dB(A) to the predicted level before comparing to the construction NML.</i></p>	This plan
B15	<p>Construction activities associated with the SSI shall be undertaken during the following standard construction hours:</p> <p>(a) 7:00am to 6:00pm Monday to Friday, inclusive; and</p> <p>(b) 8:00am to 5:00pm Saturday; and</p> <p>(c) at no time on Sunday or public holidays.</p>	This plan

CoA No.	Condition Requirements	Document Reference
B16	<p>Construction works outside of the standard construction hours identified in condition B15 may be undertaken in the following circumstances:</p> <ul style="list-style-type: none"> (a) construction works that generate noise that is: <ul style="list-style-type: none"> (i) no more than 5 dB(A) above rating background level at any residence in accordance with the <i>Interim Construction Noise Guideline</i> (Department of Environment and Climate Change, 2009); and (ii) no more than the noise management levels specified in Table 3 of the <i>Interim Construction Noise Guideline</i> (Department of Environment and Climate Change, 2009) at other sensitive receivers; or (b) for the delivery of materials required outside these hours by the NSW Police Force or other authorities for safety reasons; or (c) where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm; or (d) between 6.00am and 7.00am and 6.00pm and 7.00pm Monday to Friday (except public holidays) in sparsely populated areas (these construction hours may be reviewed and/or revoked by the Director General in consultation with the EPA in the case of unresolved noise complaints); or (e) low noise impact activities and work as follows: <ul style="list-style-type: none"> (i) between 6.00am and 7.00am Monday to Friday; and/or (ii) between 6.00pm and 7.00pm Monday to Friday; or (f) works approved through an EPL; or (g) works approved by a Construction Environment Management Plan or Construction Noise and Vibration and Air Blast Management Plan for the SSI 	This plan Appendix C
B17	<p>Construction activities which cannot be undertaken during the standard construction hours for technical or other justifiable reasons (Out of Hours work) may be permitted outside the construction hours specified in condition B15 with the approval of the Environmental Representative. Out of Hours work shall be undertaken in accordance with an approved Construction Environment Management Plan or Construction Noise and Vibration and Air Blast Management Plan for the SSI, where that plan provides a process for the consideration of Out of Hours work. This consideration includes:</p> <ul style="list-style-type: none"> (a) process for obtaining the Environmental Representative's approval for Out of Hours work; (b) details of the nature and need for activities to be conducted during the varied construction hours; (c) justifies the varied construction hours in accordance with the <i>Interim Construction Noise Guideline</i> (DECCW, 2009); (d) provides evidence that consultation with potentially affected receivers and notification of the relevant council has been undertaken, that the issues raised have been addressed and all feasible and reasonable mitigation measures have been put in place; and (e) provides evidence of consultation with the EPA on the proposed variation in standard construction hours. 	This plan Appendix C
B18	<p>Construction activities resulting in impulsive or tonal noise emission (such as rock breaking, rock hammering, pile driving) shall only be undertaken:</p> <ul style="list-style-type: none"> (a) between the hours of 8:00am to 5:00pm Monday to Friday; (b) between the hours of 8:00am to 1:00pm Saturday; and (c) in continuous blocks not exceeding three hours each with a minimum respite from those activities and works of not less than one hour between each block. <p>For the purposes of this condition 'continuous' includes any period during which there is less than a one hour respite between ceasing and recommencing any of the work the subject of this condition.</p> <p>The works subject to this condition may be undertaken in sparsely populated areas</p>	This plan

CoA No.	Condition Requirements	Document Reference
	within the construction hours specified in condition B15.	
B19	The Applicant shall, where feasible and reasonable, limit high noise impact activities and work to the mid-morning and mid-afternoon periods, except in sparsely populated areas.	This plan
Construction Environmental Management Plan		
D26 (a)	As part of the Construction Environmental Management Plan for the SSI, the Applicant shall prepare and implement:	This plan
	<p>(a) a Construction Noise and Vibration and Air Blast Management Plan to detail how construction noise and vibration impacts will be minimised and managed. The Plan shall be developed in consultation with the EPA and shall be consistent with the guidelines contained in the <i>Interim Construction Noise Guidelines</i> (DECC, 2009) and shall include, but not necessarily be limited to:</p> <ul style="list-style-type: none"> (i) identification of sensitive receivers and relevant construction noise and vibration goals applicable to the SSI stipulated in this approval; (ii) details of construction activities and an indicative schedule for construction works; including the identification of key noise and/or vibration generating construction activities (based on representative construction scenarios, including at ancillary facilities) that have the potential to generate noise and/or vibration impacts on surrounding sensitive receivers, particularly residential areas; (iii) identification of feasible and reasonable measures proposed to be implemented to minimise and manage construction noise and vibration impacts (including construction traffic noise impacts); (iv) procedures and mitigation measures to ensure relevant vibration and blasting criteria are achieved, including a suitable blast program, applicable buffer distances for vibration intensive works, use of low-vibration generating equipment/vibration dampeners or alternative construction methodology, and pre- and post-construction dilapidation surveys of sensitive structures where blasting and/or vibration is likely to result in damage to buildings and structures (including surveys being undertaken immediately following a monitored exceedance of the criteria); and (v) a description of how the effectiveness of these actions and measures would be monitored during the proposed works, clearly indicating how often this monitoring would be conducted, the locations where monitoring would take place, how the results of this monitoring would be recorded and reported, and, if any exceedance is detected, how any non-compliance would be rectified; (vi) an out-of-hours work (OOHW) protocol for the assessment, management and approval of works outside of standard construction hours as defined in condition B15 including a risk assessment process under which the Environmental Representative may approve out-of-hour construction activities. The OOHW protocol shall detail standard assessment, mitigation and notification requirements for high and low risk out-of-hour works, consultation procedures with the EPA, the relevant council and affected landowners; (vii) procedures for notifying sensitive receivers of construction activities that are likely to affect their noise and vibration amenity, as well as procedures for dealing with and responding to noise complaints; (viii) a program for construction noise and vibration monitoring clearly indicating monitoring frequency, location, how the results of this monitoring would be recorded and, procedures to be followed where exceedances of relevant noise and vibration goals are detected; and (ix) mechanisms for the monitoring, review and amendment of this plan. 	

CoA No.	Condition Requirements	Document Reference
Sapphire to Woolgoolga CoA 2.17 Arrawarra Rest Area only	Standard construction hours for the duration of construction are: a) 7:00 to 6:00pm Mondays to Fridays; inclusive; and b) 8:00am to 1:00pm Saturday's; and c) at no time on Sunday's or Public Holidays The following exceptions (without further approval) to standard construction hours apply: i) any works that do not cause construction noise to be audible at any sensitive receiver; or ii) for delivery of materials required outside these hours by the Police or other relevant authorities for safety reasons; or iii) where it is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm.	This document
Sapphire to Woolgoolga CoA 2.18 Arrawarra Rest Area only	Certain construction activities (out of hours works) may be allowed to occur outside the standard construction hours with the prior written approval of the Director-General. Requests for out of hours approval will be considered for construction activities which cannot be undertaken during standard construction hours for technical or justifiable reasons and will be considered on a case by case or activity-specific basis. Any requests for Out of Hours Works must be accompanied by: a) details of the nature and need for activities to be conducted during the varied construction hours; b) written evidence to the EPA and the Director-General that activities undertaken during the varied construction hours are justified, appropriate consultation with potentially affected receivers and notification of Council has been undertaken, issues raised have been addressed, and all feasible and reasonable mitigation measures have been put in place; and c) evidence of consultation with the EPA on the proposed variation in standard construction hours. Despite the above, Out of Hours Works may also occur where a process for considering the above on a case by case or activity specific basis by the Proponent, including factors a) to c) above, has been approved as part of the Sapphire to Woolgoolga Construction Environmental Management Plan.	

2.3 RMS Project Requirements – QA Specifications

Table 2-2 RMS Requirements relevant to the NVMP

Original Reference	Relevant Requirement	Response
QA Specification G36 ENVIRONMENTAL PROTECTION (July 2014)		
G36.4.6	Prepare and implement a <i>Construction Noise and Vibration Management Sub-Plan</i> as part of the CEMP, or include mitigation strategies within the CEMP, to minimise the impact of noise from your operations on adjacent properties. The Noise Management Plan must be prepared by a suitably qualified and experienced acoustic consultant (i.e. a member of the Australian Acoustical Society, the Institution of Engineers, or the Association of Australian Acoustical Consultants). The Construction Noise and Vibration Management Sub-Plan or mitigation strategies must include proposed environmental control measures for all significant noise generating activities. The Construction Noise and Vibration Management Plan must cover all significant noise generating activities. Include in the Plan measures to minimise the impact of noise, including:	This Plan

Original Reference	Relevant Requirement	Response
	<p>(i) substitution by an alternative process;</p> <p>(ii) restricting times and durations when noisy work is carried out;</p> <p>(iii) placement of work compounds, parking areas, equipment and material stockpile sites away from noise-sensitive locations;</p> <p>(iv) where noise barriers / walls are to be constructed, programming this as early as possible in the project duration to reduce noise impacts from other construction work on neighbouring residents;</p> <p>(v) acoustic screening or enclosures around fixed plant under regular operation that may impact upon noise sensitive receivers;</p> <p>(vi) sawcutting operations to minimise noise impacts;</p> <p>(vii) switching off engines when equipment is not in use for extended periods;</p> <p>(viii) undertaking noisy work (such as use of a concrete saw or hydraulic hammer) during the day, or early in the evening if required to be undertaken at night; avoiding short sharp sounds from impacts during night work to minimise sleep disturbance to neighbouring residents;</p> <p>(ix) use of manually adjustable or ambient noise sensitive or “quacker” type reversing alarms on plant and/or use of flashing lights at night;</p> <p>(x) undertaking maintenance work on construction plant away from noise sensitive receivers and within the hours nominated in Clause 3.6;</p> <p>(xi) methods to remove underwater structures that minimise impacts on fish, water quality and noise and vibration levels; and,</p> <p>(xii) consultation with affected residents.</p> <p>After the options above have been exhausted, consider other best practice physical controls to construction equipment and activities, such as those suggested in Australian Standard 2436-1981 Guide to Noise Control on Construction, Maintenance and Demolition Sites', to achieve the noise goals.</p> <p>The Construction Noise and Vibration Management Plan must show the locations of all occupied noise sensitive premises on a map (including aged care facilities, schools, child care centres/ preschools and churches) and provide details of noise control measures to be undertaken during construction, including:</p> <p>(a) identification of all noise generating tasks (including truck movements), duration and predicted airborne noise levels;</p> <p>(b) impacts from site compounds/ construction depots, and the delivery of material to these locations;</p> <p>(c) location, type and timing of mitigation measures to reduce excessive noise such as:</p> <ul style="list-style-type: none"> • maximising the offset distance between noisy plant items and nearby noise sensitive receivers; • orientating equipment away from noise-sensitive areas; • selecting site access points and roads as far away as possible from sensitive receptors; • erection of any temporary and permanent noise barriers; <p>(d) specific physical and managerial measures for controlling noise to comply with the relevant EPA guidelines;</p> <p>(e) noise monitoring procedures to assess the performance of the implemented noise control measures, including reporting and response procedures;</p> <p>(f) internal audits of compliance of all vehicles, plant and equipment prior to commencing work and during construction;</p> <p>(g) construction timetabling on potential noisy activities for works outside normal hours, to minimise noise impacts;</p>	

Original Reference	Relevant Requirement	Response
	<p>(h) procedures for notifying residents and business premises about noise-generating activities likely to affect their amenity;</p> <p>(i) contingency plans to be implemented in the event of non-compliance and/or noise complaints; and</p> <p>(j) procedures for regularly reviewing the effectiveness of the Construction Noise & Vibration Plan.</p> <p>If noise monitoring indicates that mitigation measures are not fully effective or if noise complaints are received during construction, determine if additional noise mitigation controls are needed and amend the Construction Noise and Vibration Management Plan accordingly.</p> <p>All construction plant and equipment used on Site must be, in addition to other requirements:</p> <p>(a) fitted with properly maintained high efficiency noise suppression devices in accordance with manufacturer's specifications;</p> <p>(b) regularly inspected and maintained in an efficient condition; and</p> <p>(c) operated in a proper and efficient manner.</p>	

3 Scope and justification of extended construction hours

3.1 Overview

The majority of construction activities will take place within the approved standard construction hours, as defined in CoA B15. However, CoA B16 and B17 allow for certain construction activities (Out of Hours Works or OOHW) to occur outside the construction hours specified in CoA B15 with prior approval. Requests for OOHW approval must be for technical or other justifiable reasons and will be considered on a case by case basis.

The EA details circumstances where works may be required to be undertaken outside of the approved standard construction hours. Additionally, the ICNG outlines five categories of works that may be undertaken outside the recommended standard hours. These are:

1. The delivery of oversized plant or structures that police or other authorities determine requires special arrangements to transport along public roads.
2. Emergency work to avoid the loss of life or damage to property, or to prevent environmental harm.
3. Maintenance and repair of public infrastructure where disruption to essential services and/or considerations of worker safety do not allow work within standard hours.
4. Public infrastructure works that shorten the length of the project and are supported by the affected community.
5. Works where a proponent demonstrates and justifies a need to operate outside the recommended standard hours.

Consistent with points four and five above, the Project will require that certain activities take place outside of standard construction hours during the evening and night-time periods. Out of hours work may be required due to technical considerations (such as the need to meet particular concrete quality specifications), to facilitate an accelerated construction program (and minimise disruption to the community, local business, motorists, pedestrians and cyclists as work would be completed earlier), or to maintain the safety of road users or construction workers (undertaking certain works during cooler periods in summer, eg steel fixing). The delivery of fly ash and cement outside the standard construction hours may be considered in terms of Chapter 2.3, points 4 & 5 of Chapter 3.1 of the OOHW procedure.

Potential noise impacts associated with OOHW will be considered on a case by case basis.

3.2 Paving

Paving quality specifications require that no paving will be undertaken under hot conditions (greater than 32°C). On average, maximum temperatures are reached during the mid afternoon at approximately 3 pm and, since paving must cease half an hour prior to the temperature reaching 32°C a shut down on these days would need to occur at 2:30pm.

In order to maximise the duration of paving during summer months, where weather conditions are forecast to exceed the maximum temperature threshold, a start time before 7am may be required. Refuelling, maintenance, wash-down and finishing activities may be included in this timeframe.

Paving is expected to progress between 200 m and 500 m per day (temperature dependent); therefore the duration of out-of-hours impact on any one receiver location will be limited to

one or two days each for paving of the sub-base and base. Shoulder paving will require a smaller paving machine and will progress at a rate of 500 m to 600 m per day, resulting in a shorter impact duration.

3.3 Cutting

Plain concrete pavement (PCP) used on this project is an unreinforced pavement, with drying shrinkage cracking controlled through the use of closely spaced saw cuts. Uncontrolled cracking is aesthetically undesirable and can reduce the lifespan and safety of the pavement surface. These cuts create a line of weakness through the pavement, allowing a controlled cracking to occur through the concrete.

The timing of cutting is critical to the quality of the pavement and acceptance of the finished product. Cutting too late will result in unacceptable, random cracking throughout the road surface, whereas if cuts are attempted too early cracks will re-seal (ravelling), and additionally the pavement may not be strong enough to support the necessary equipment, resulting in scarring of the road surface.

Concrete cutting is governed by the dehydration rate of the pavement and requires cutting at some time between 4 and 24 hours after paving (typically 8 to 12 hours), and generally in the longer range in cold weather, with a “cutting window” as short as half an hour. Considering this constraint, paving and / or concrete cutting may need to be undertaken at any time, including outside the approved construction hours.

Up to 2 diamond blade “soft-cut” saws would be used at one time, one for the longitudinal and one for the transverse cuts. Just one pass is required to cut the mainline base, however, a second pass will be undertaken to cut the shoulder.

3.4 Deliveries

The substantial volumes and rates of consumption of cement and fly-ash require that suppliers are permitted to deliver these materials as required, and this will include periods that are out of the currently approved hours of construction, including weekends, as discussed in Chapter 2.3 and 3.1 of this procedure. This delivery schedule is constrained by the suppliers’ production and transport logistics, with an average of six deliveries expected between 7:00 pm and 7:00 am, seven days per week, with a conservative maximum of ten. Deliveries could occur at any time during these periods.

Some light vehicle movements (in addition to the above) will occur outside of approved construction hours, for worker transport and unscheduled smaller deliveries.

4 Noise and vibration criteria for NSW

The EPA recommends management levels and goals when assessing construction noise and vibration. These are outlined in the Interim Construction Noise Guideline (ICNG). Relevant elements of this document is summarised and discussed in this Chapter.

4.1 OOH Construction noise objectives

The DECC Interim Construction Noise Guideline (ICNG, July 2009) provides guidelines for the assessment and management of construction noise. The ICNG focuses on applying a range of work practices to minimise construction noise impacts rather than focusing on achieving numeric noise levels.

Full noise criteria are presented in the CNVMP for the Project, however a summary of construction noise criteria is provided below:

Table 4-1 Project-Specific Construction Noise Objectives

NCA	Standard hours (7am-6pm)		Extended hours – morning (6am-7am)		Extended hours – evening (6pm-7pm)		Night time works (other hours)		Sleep disturbance	
	RBL dB(A)	Noise objective L _{Aeq} (15min)	RBL dB(A)	Noise objective L _{Aeq} (15min)	RBL dB(A)	Noise objective L _{Aeq} (15min)	RBL dB(A)	Noise objective L _{Aeq} (15min)	RBL dB(A)	Noise objective L _{A1} (1min)
1	47	57	41	46	45	50	41	46	41	56
2	42	52	44	49	43	48	44	49	44	59
3	48	58	44	49	44	49	44	49	44	59
4	48	58	42	47	43	48	42	47	42	57
5	42	52	40	45	42	47	40	45	40	55
6	48	58	38	43	44	49	38	43	38	53

5 Out of Hours construction noise assessment

A range of plant and equipment will be required to undertake activities associated with the Project. An assessment of potential construction noise impacts during construction is presented in the CNVMP for the Project, and a summary of the relevant conclusions is provided below.

This information will be used to determine potential impacts on the receiving community. An adaptive management approach will be applied to the implementation of mitigation measures to minimise impacts on the community.

5.1 Out of Hours Work

Complete results for night time works are contained in Section 7 of the NVMP, however the following information provides a summary of the predicted impacts during night time work.

Table 5-1 Extent of project NML exceedences – Construction activities (Night time)

NCA	Number of receivers exceeding the night NML by		
	0-10 dB	10-20 dB	20 + dB
1	197	47	-
2	2	3	2
3	3	2	-
4	1	3	-
5	2	1	-
6	7	12	9

The predictions show that exceedences of the project NMLs are likely during a number of work stages, with the highest levels predicted to occur during cut and fill activities. These works are expected to generate a number of low level exceedences in NCA 1 and 2, with more substantial exceedences predicted to occur in NCA 6. Concrete paving is also expected to result in some exceedences in these areas.

NCA 1 (Darlington Beach) is predicted to contain the highest number of exceedences, however these are generally predicted to be of a low level. NCA 6 contains receivers where the highest noise impacts are predicted to occur, primarily at receivers located along the existing Pacific Highway. Table 5-1 shows the extent of night time exceedences predicted for each NCA.

Any OOHW will require approval from the Project Environmental Manager and the Environmental Representative as per CoA B17a, in accordance with this Plan.

5.2 Sleep Disturbance

A summary of potential $L_{A1(1min)}$ sleep disturbance noise levels is presented below in Table 5-2.

Table 5-2 Predicted exceedances for sleep disturbance

NCA	Number of receivers exceeding the sleep disturbance NML by		
	0-10 dB	10-20 dB	20 + dB
1	41	-	-
2	3	2	-
3	2	-	-
4	2	-	-
5	-	1	-
6	11	7	2

Numerous properties in NCA 6, along the existing Pacific Highway north of Dirty Creek may be impacted by OOHW during most work stages.

Other NCAs are expected to experience minor and infrequent sleep disturbance impacts.

It is noted that these results include cutting and fill activities, which are unlikely to be carried out during OOH. Where these works are removed, only three receivers in NCA are predicted to exceed the night time criteria. This is predicted to occur during concrete paving and bridge works.

Any OOHW will require approval from the Project Environmental Manager and the Environmental Representative as per CoA B17a, in accordance with this Plan.

6 Out of Hours Work Protocol

To manage the potential impacts on any adjacent sensitive receivers and to minimise community concerns, the following out-of-hours approval process will be followed to ensure the appropriate assessment and approval for OOH work occurs. All out-of-hours, with the exception of those activities specified within MCoA B16, will require approval by the Project Environmental Representative.

6.1 Complete an OOH Works Application Form

Any staff member who determines the requirement to undertake work outside standard construction hours (i.e. out-of-hour works) is required to follow the procedure outlined below:

Table 6-1 Procedure for OOHW

1. Out of hours work request
<p>INAUDIBLE WORK</p> <ul style="list-style-type: none"> Where work will effectively be inaudible at the nearest sensitive receiver (i.e. no more than 5 dB(A) above rating background level at any residence in accordance with the <i>Interim Construction Noise Guideline</i> (DECC, 2009) no more than the noise management levels specified in Table 3 of the <i>Interim Construction Noise Guideline</i> (DECC, 2009) at other sensitive receivers), complete an Inaudible Works Permit and submit to the Environmental Manager (EM) for approval. The EM will notify EPA of such work within 24 hours. <p>AUDIBLE WORK</p> <ul style="list-style-type: none"> Where work will be audible at the nearest sensitive receiver, complete an Out of Hours Work Request Form and submit to the Environmental Representative (ER). For OOHW approval requests, the request must address condition B17 b and B17 c, and provide evidence of consultation with affected sensitive receivers and the EPA (CoA B17d-e). Proceed to step 2. Note that in accordance with condition B16, work can be approved by the EM: <ul style="list-style-type: none"> (h) <i>between 6.00am and 7.00am and 6.00pm and 7.00pm Monday to Friday (except public holidays) in sparsely populated areas (these construction hours may be reviewed and/or revoked by the Director General in consultation with the EPA in the case of unresolved noise complaints); or</i> (i) <i>low noise impact activities and work as follows:</i> <ul style="list-style-type: none"> (iii) <i>between 6.00am and 7.00am Monday to Friday; and/or</i> (iv) <i>between 6.00pm and 7.00pm Monday to Friday; or</i> <p>MCoA B16 EXCEPTIONS</p> <ul style="list-style-type: none"> Where the delivery of materials is required by police or other authorities for safety reasons proceed with the work as necessary, informing the EM as soon as practicable. The EM will notify EPA of such work within 24 hours. Where work is required in an emergency to avoid the loss of lives, property and/or to prevent environmental harm proceed with the work as necessary, informing the EM as soon as practicable. The EM will notify EPA of such work within 24 hours.
2. Environmental representative approval of audible out of hours work
<p>Where OOHW activities identified in Tables 1 and 2 are required to be undertaken, which will be audible at a sensitive receiver (i.e. more than 5 dB(A) above rating background level at any residence in accordance with the <i>Interim Construction Noise Guideline</i> (DECC, 2009) or more than the noise management levels specified in Table 3 of the <i>Interim Construction Noise Guideline</i> (DECC, 2009) at other sensitive receivers), the EM will submit a request to the ER for approval and consult with the affected community. OOHW activities identified within the Arrawarra Rest Area will require written</p>

evidence to the EPA and the Director General of the activities undertaken as per CoA 2.18 (Sapphire to Woolgoolga CoA).

The request to the ER will be accompanied by:

- Details of the nature and justification for activities to be conducted during the varied construction hours;
- A noise impact assessment of predicted noise levels in each noise catchment area (NCA), with the number of residents predicted to be affected;
- Details of what additional (beyond standard) noise mitigation measures have been investigated and adopted to reduce construction noise impacts;
- Details of any additional proposed noise monitoring activity; and
- Evidence that appropriate consultation with potentially affected sensitive receivers has or will be undertaken and that all reasonable and feasible mitigation measures have been put in place.

3. Notification of approved OOH

OOH approvals shall be reported to the regular ERG meetings.

Where practicable, upcoming proposed OOH shall be discussed at the regular ERG meetings.

6.2 Internal Review and Consideration

Following completion of the OOH Work Application Form, it will be submitted to the Environmental Manager for consideration. The Environmental Manager will head the approval process via the Project Environmental Representative (ER). Following their approval, the Environmental Manager will pass the application onto the ER and Community Manager who will lead community notification (refer CEMP) in accordance with the Community Consultation Plan.

It should be noted that the project ER and potentially the EPA will require details of community notification distributed, responses or feedback as a result of the notification and details of how OOH have addressed responses, when determining whether OOH approval is granted.

6.3 OOH Community Notification

It is essential that effective community consultation occurs for OOH. Consultation should identify the stakeholders, and communicate the key messages and impacts, including predicted exceedances of the noise management levels as identified during the OOH approval process.

Prior to any OOH works other than works approved under MCoA B16 / B17, community notification will occur in accordance with the Community Consultation Plan in order to allow proactive management of potential issues from OOH construction noise.

6.4 OOH Approval

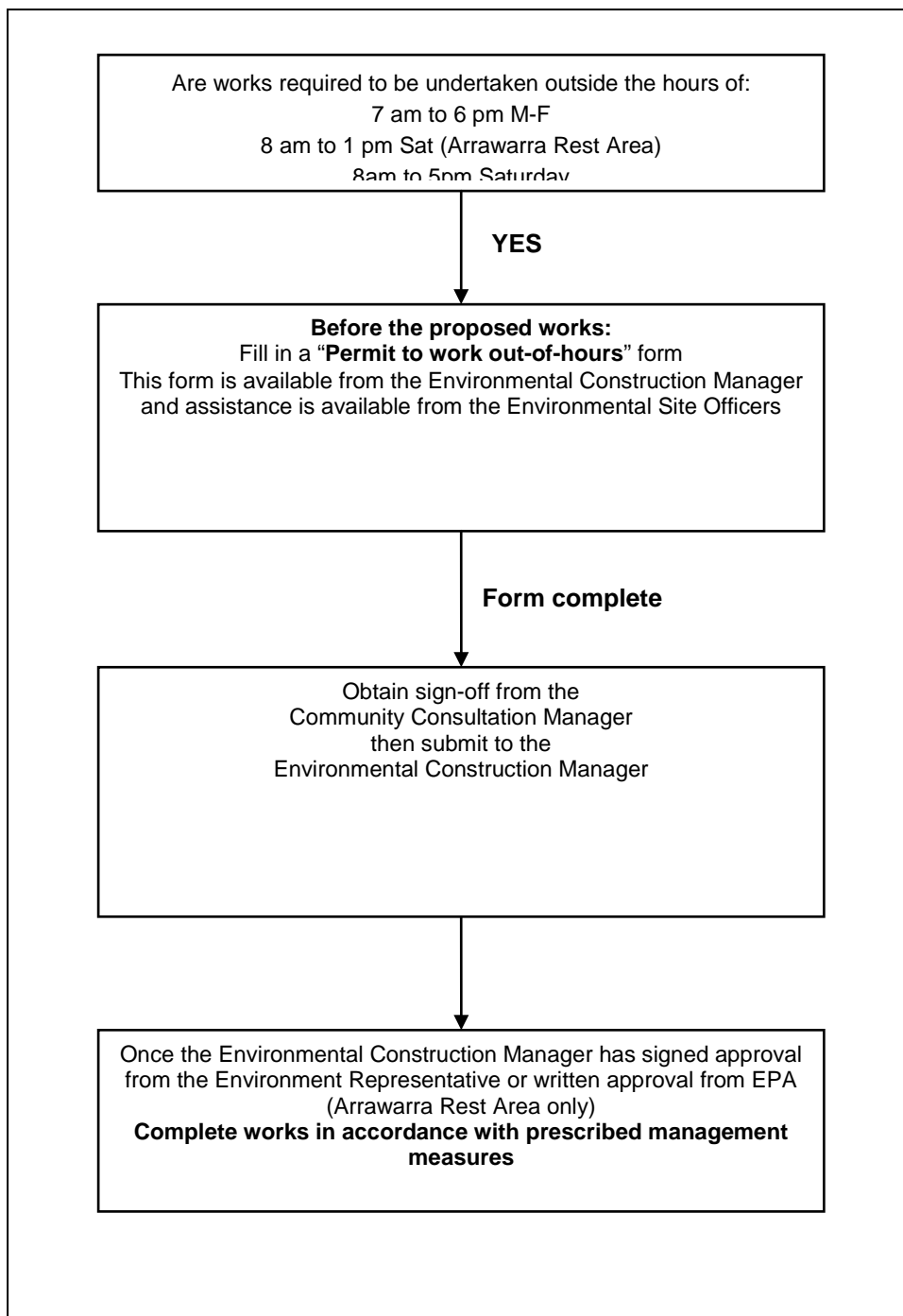
As detailed above, OOH work will require approval from the Project Environmental Manager or for large scale work, the ER. Works requiring ER approval will require an Out of Hours Assessment Report submitted to the ER at least 48 hours in advance of the proposed OOH works.

Where necessary, the EPA will be included in the approval process. It must be noted that ER and/or EPA reserve the right not to approve the proposal if it is of the opinion that the OOH work are not suitably justified and community concerns have not been suitably addressed.

Where required, relevant councils, Police and RMS will also be consulted and notified of proposed OOH works.

OOH works will not commence until written approval has been issued and all prescribed conditions of approval implemented.

Figure 7-1 Out of Hours Flowchart

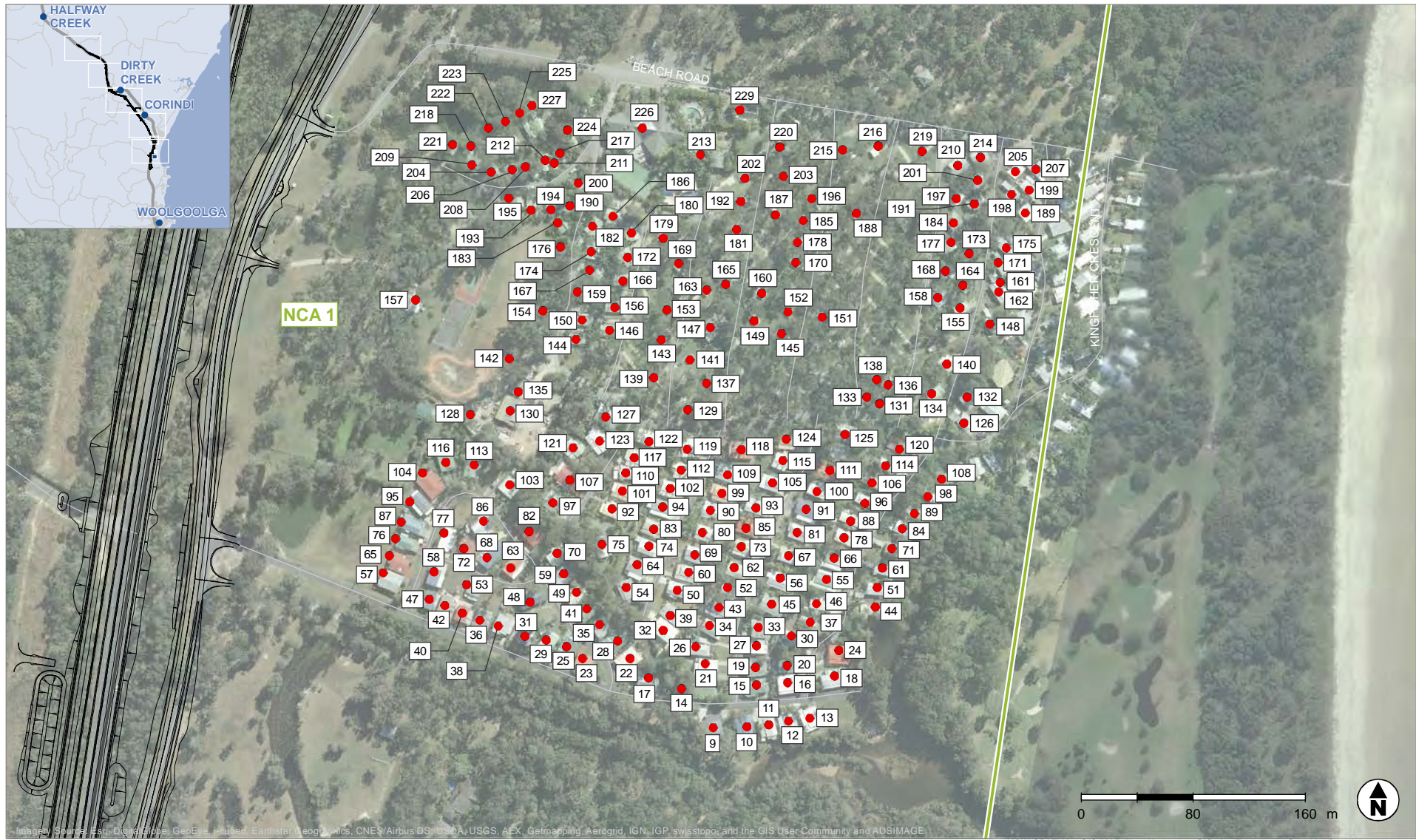


Appendix D

Sensitive receiver locations



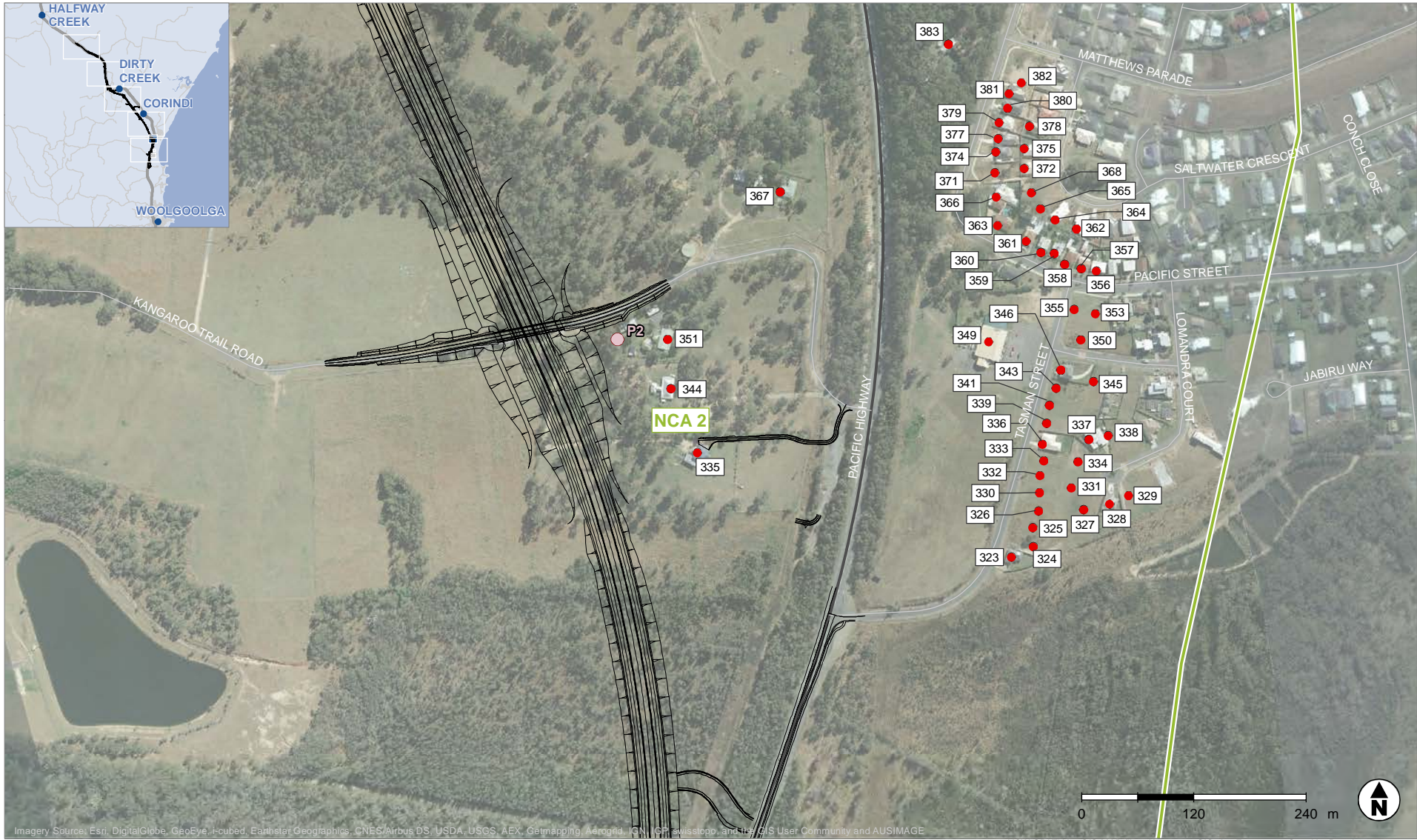
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— Design ● Sensitive receiver ● Monitoring location ▭ Noise catchment area



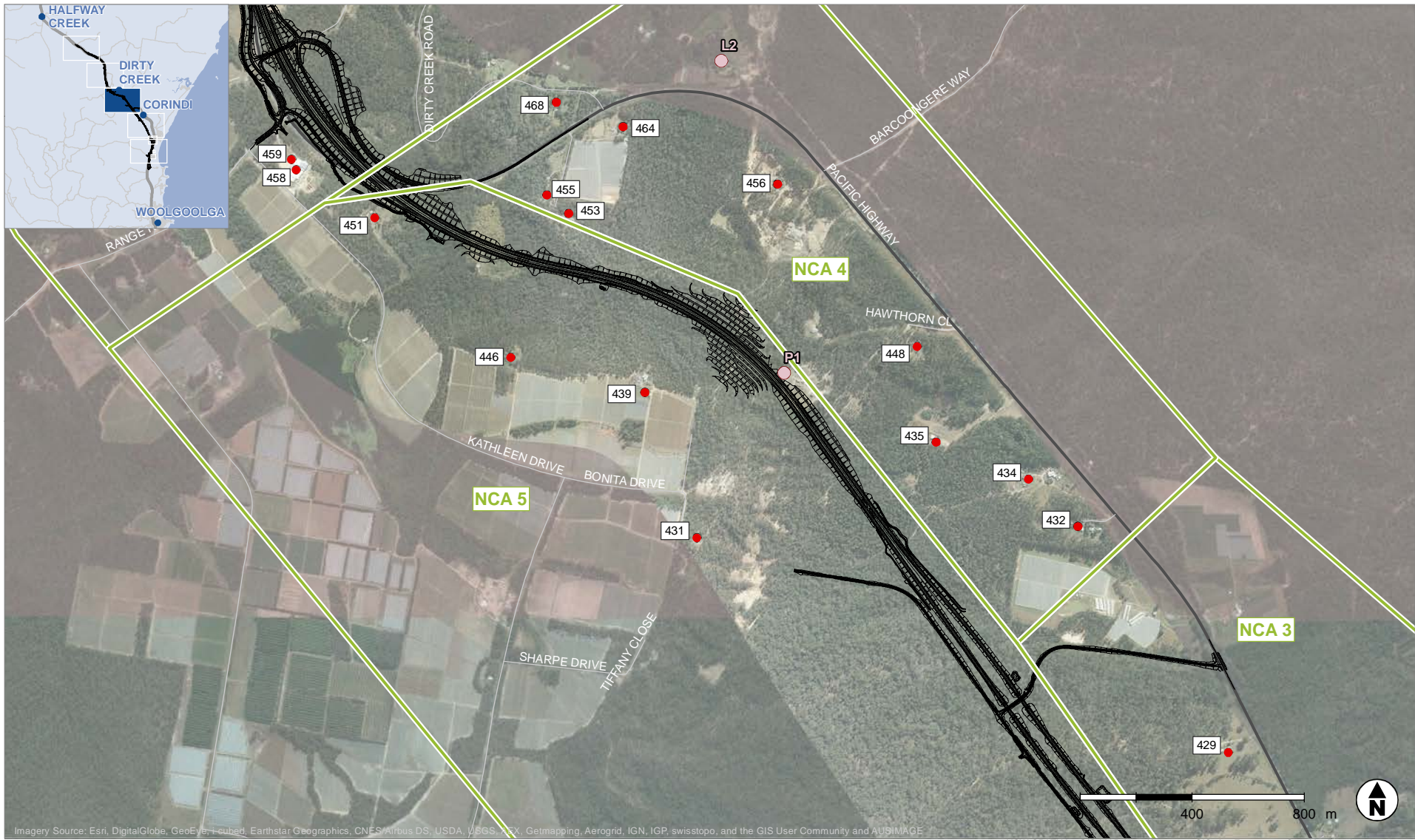
— Design ● Sensitive receiver ● Monitoring location □ Noise catchment area



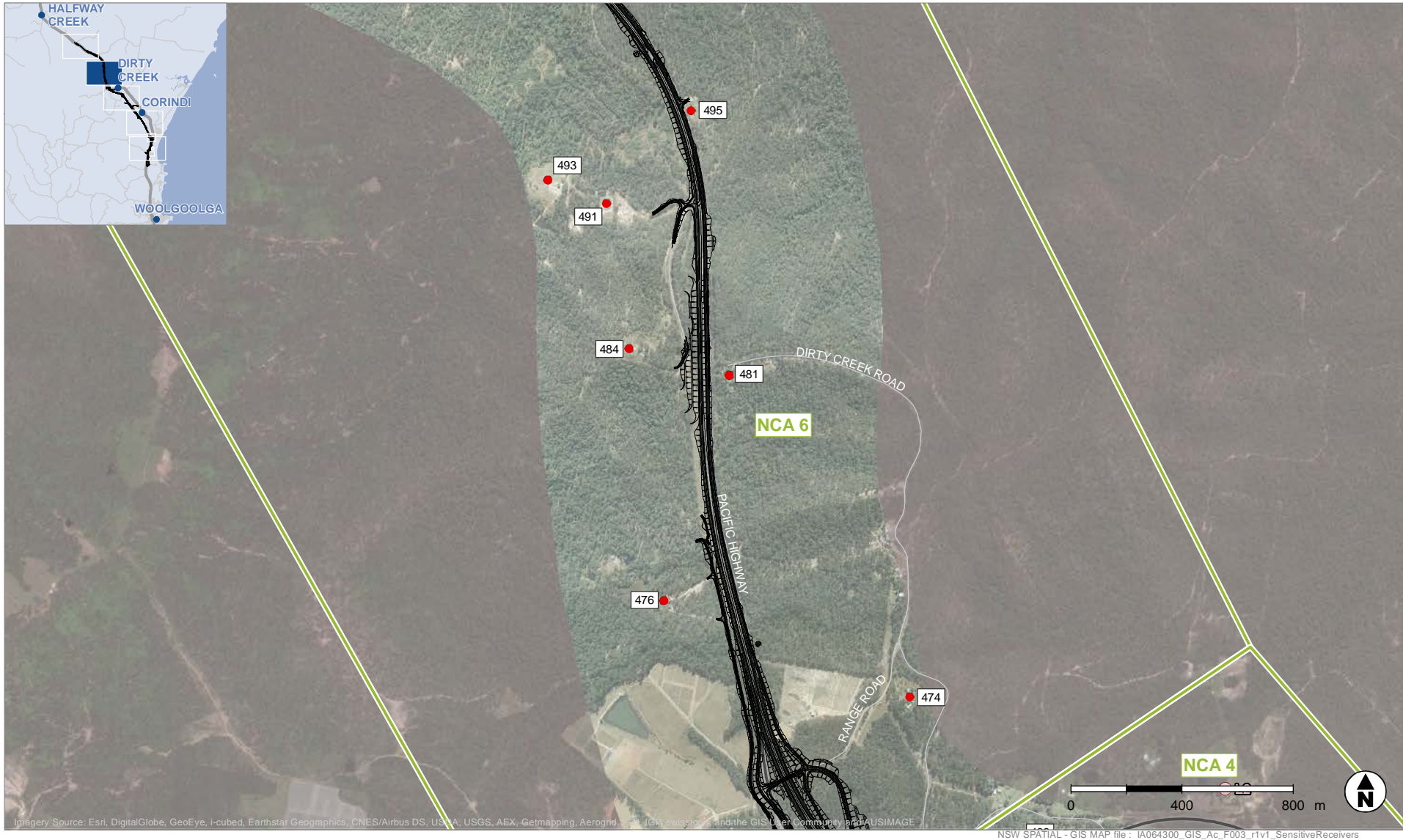
Design
 Sensitive receiver
 Monitoring location
 Noise catchment area



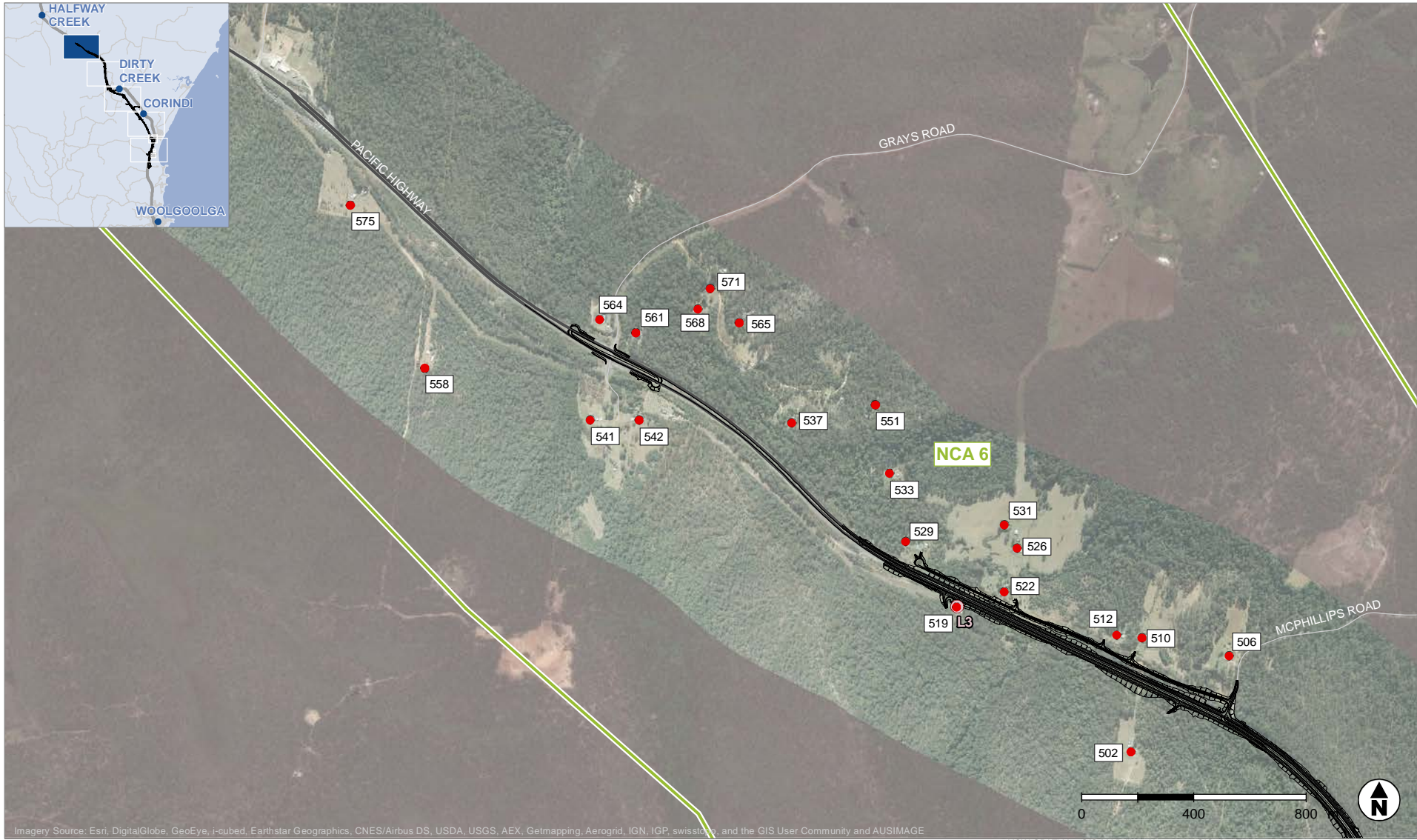
— Design ● Sensitive receiver ● Monitoring location ▭ Noise catchment area



Design
 Sensitive receiver
 Monitoring location
 Noise catchment area



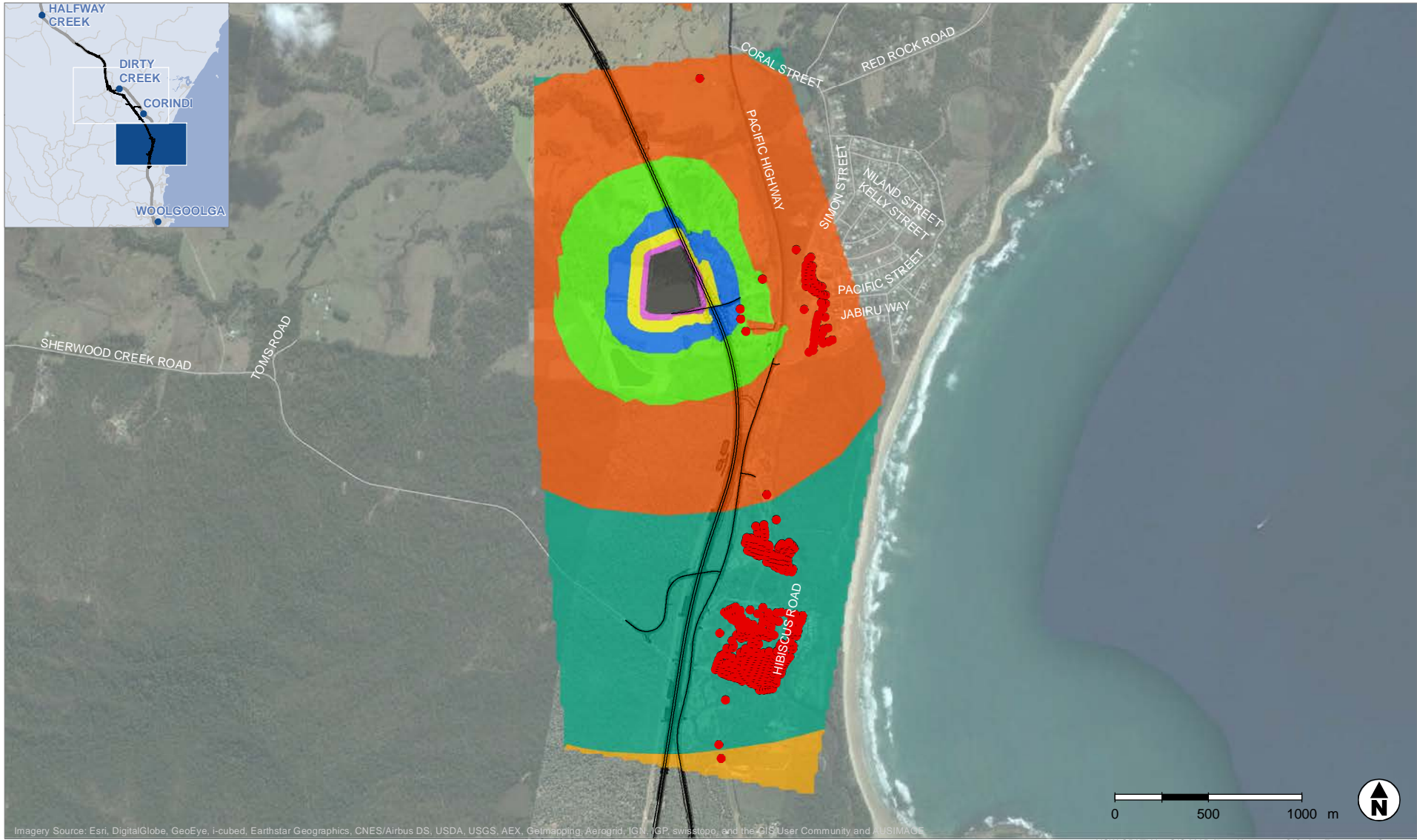
— Design ● Sensitive receiver ○ Monitoring location ▭ Noise catchment area



— Design ● Sensitive receiver ● Monitoring location Noise catchment area

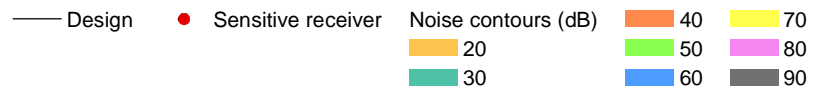
Appendix E

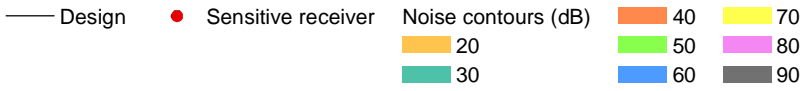
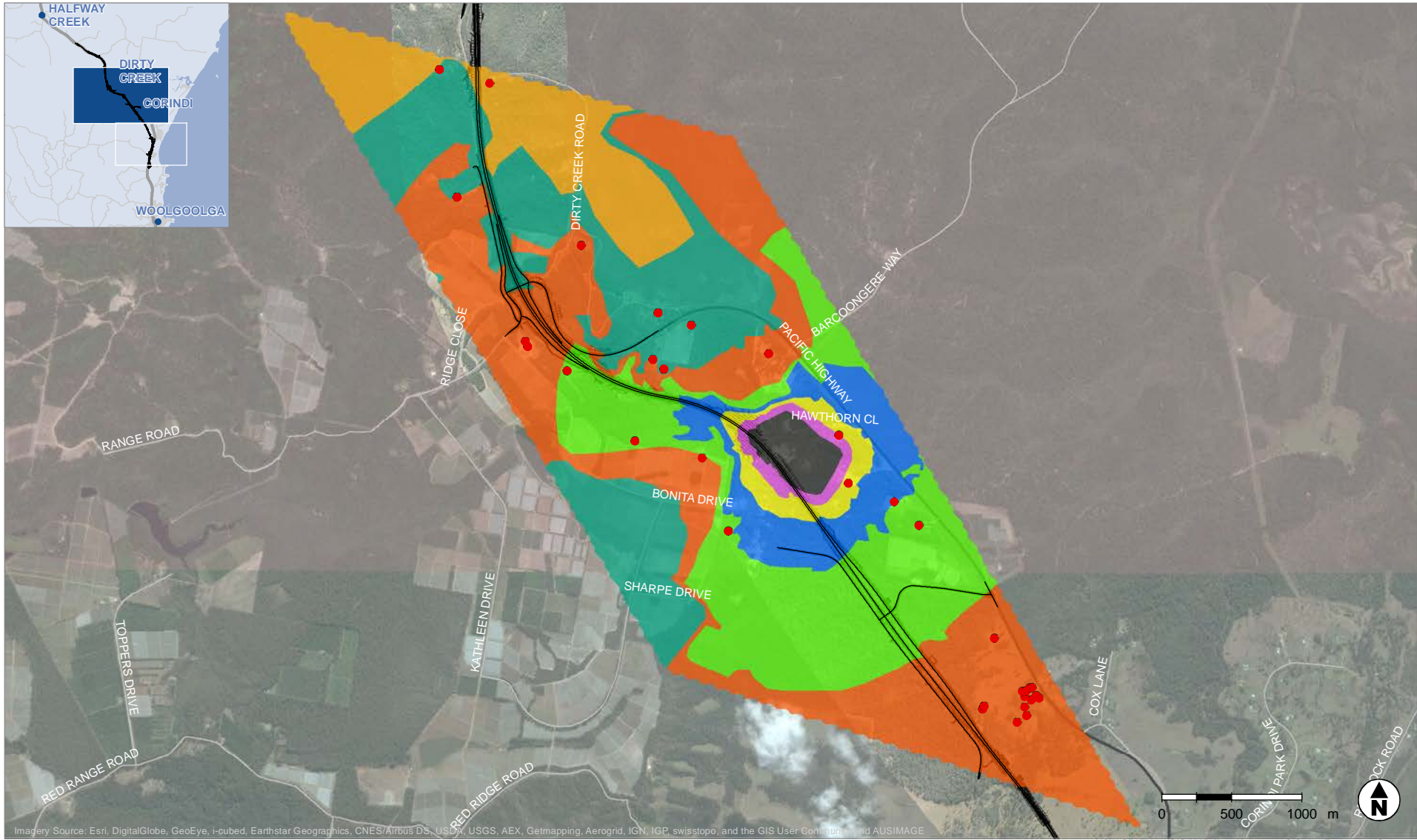
Construction compounds - Noise contours



Imagery Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Geomapping, Aerogrid, IGN, iGP, swisstopo, and the GIS User Community and AUSIMAGIS

NSW SPATIAL - GIS MAP file : IA064300_GIS_Ac_F005_r2v1_Contours

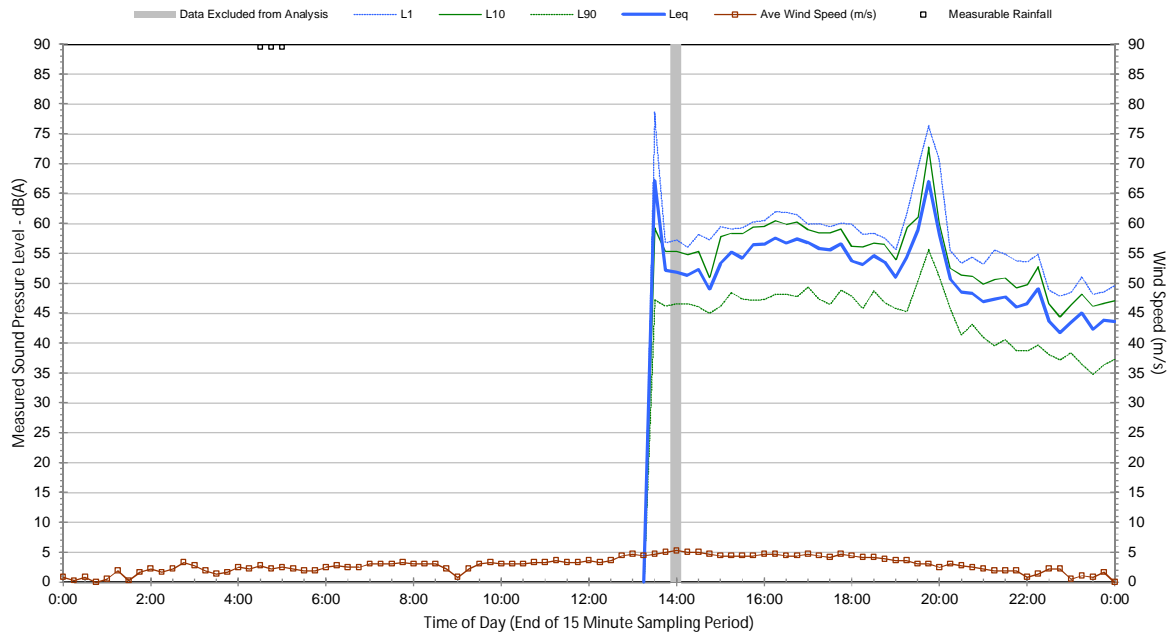




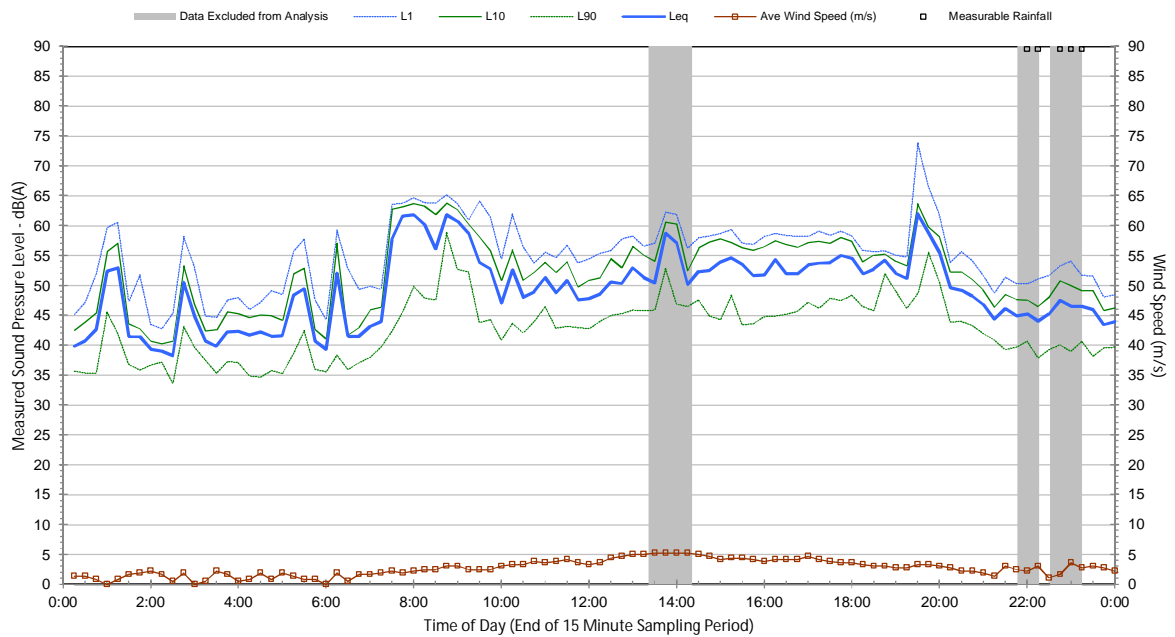
Appendix F

Unattended noise monitoring results

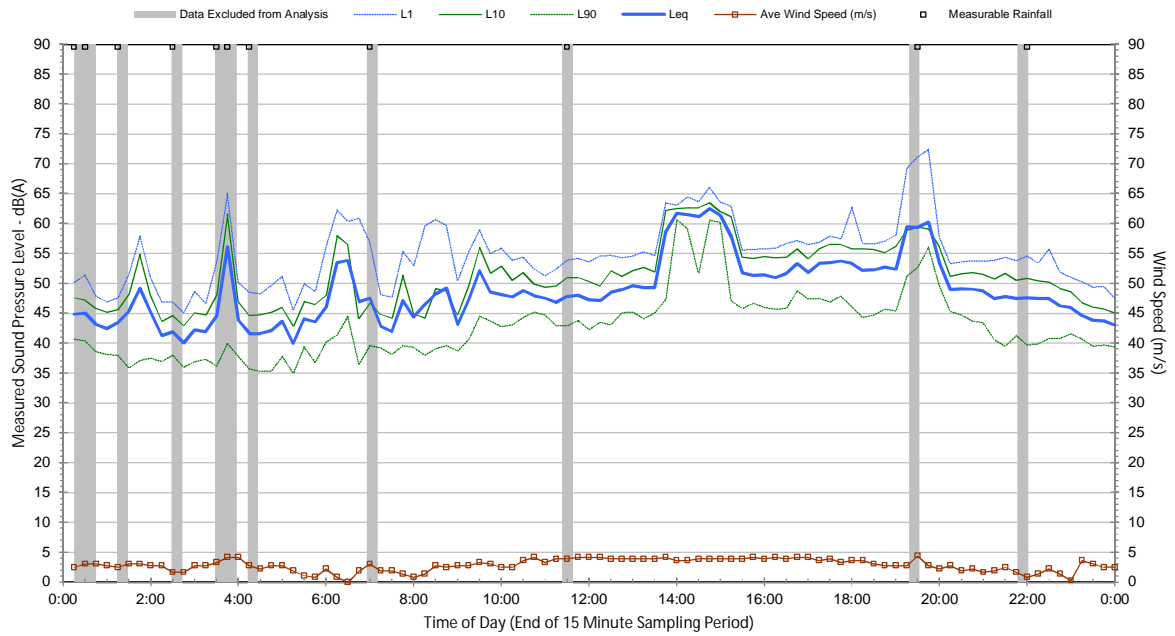
Unattended noise monitoring results - Hawthorn Close, Location P1
Monday 16 February 2015



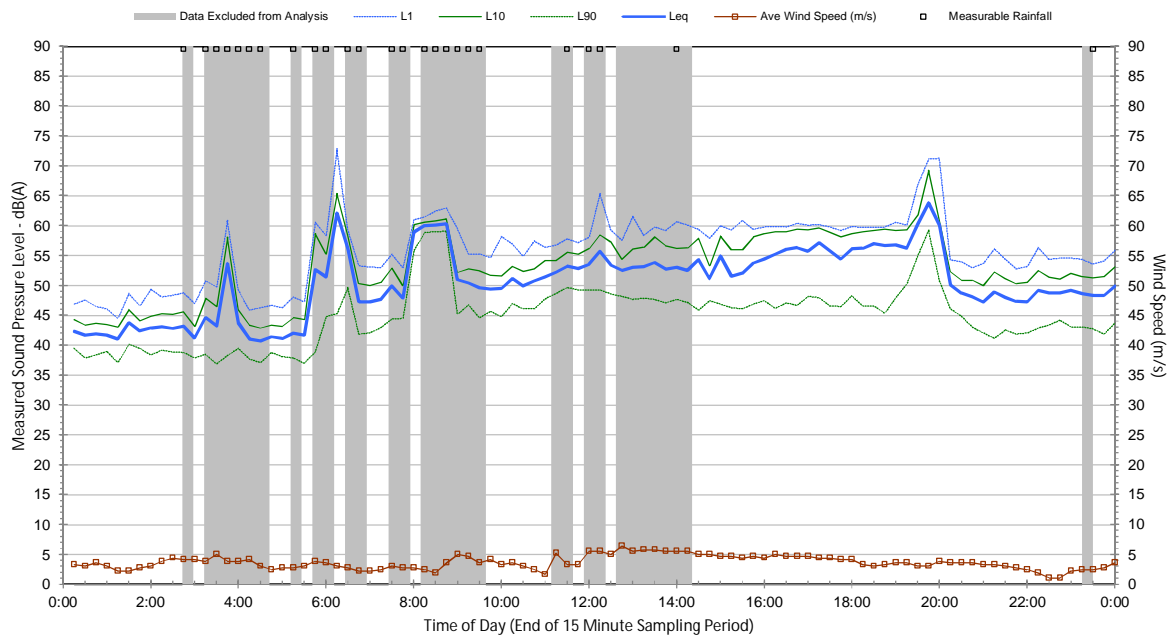
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Tuesday 17 February 2015



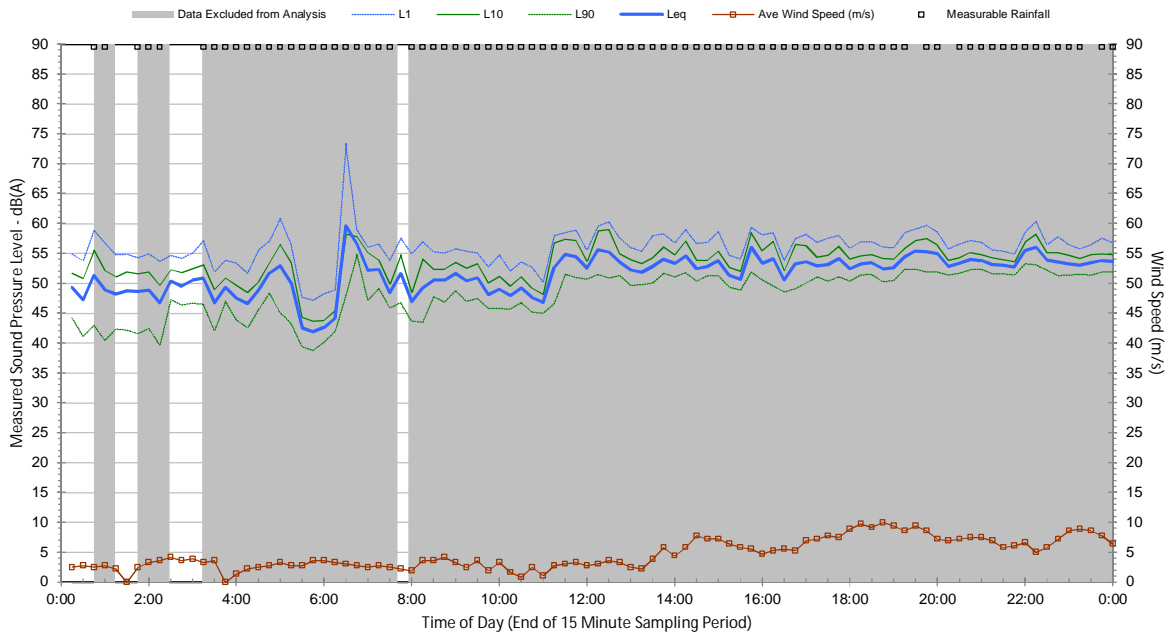
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Wednesday 18 February 2015



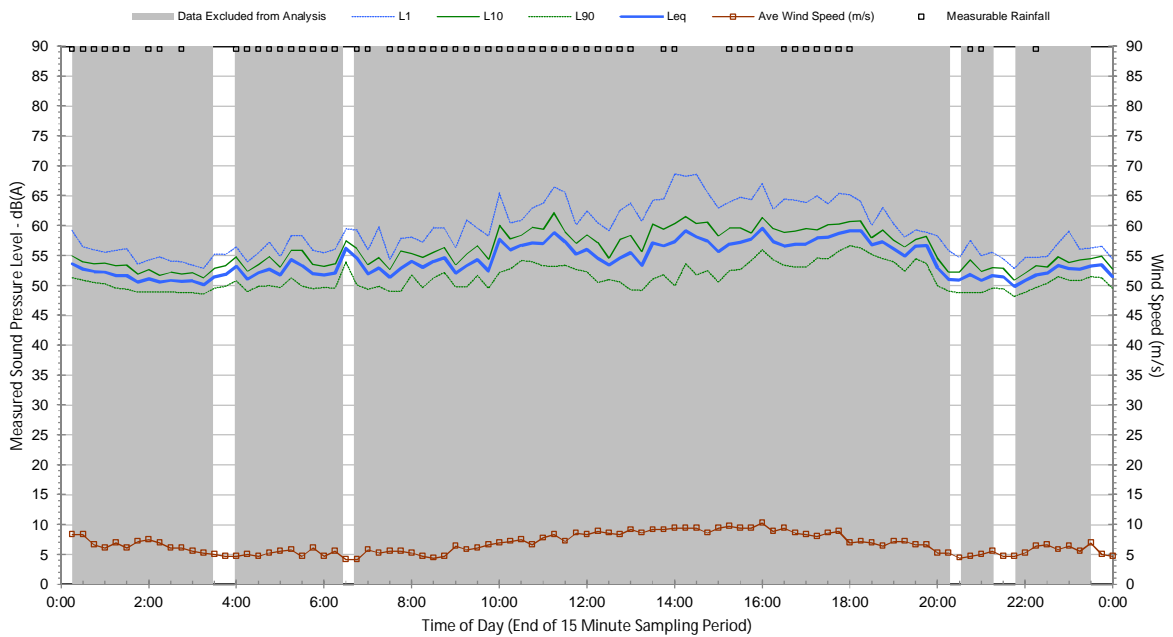
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Thursday 19 February 2015



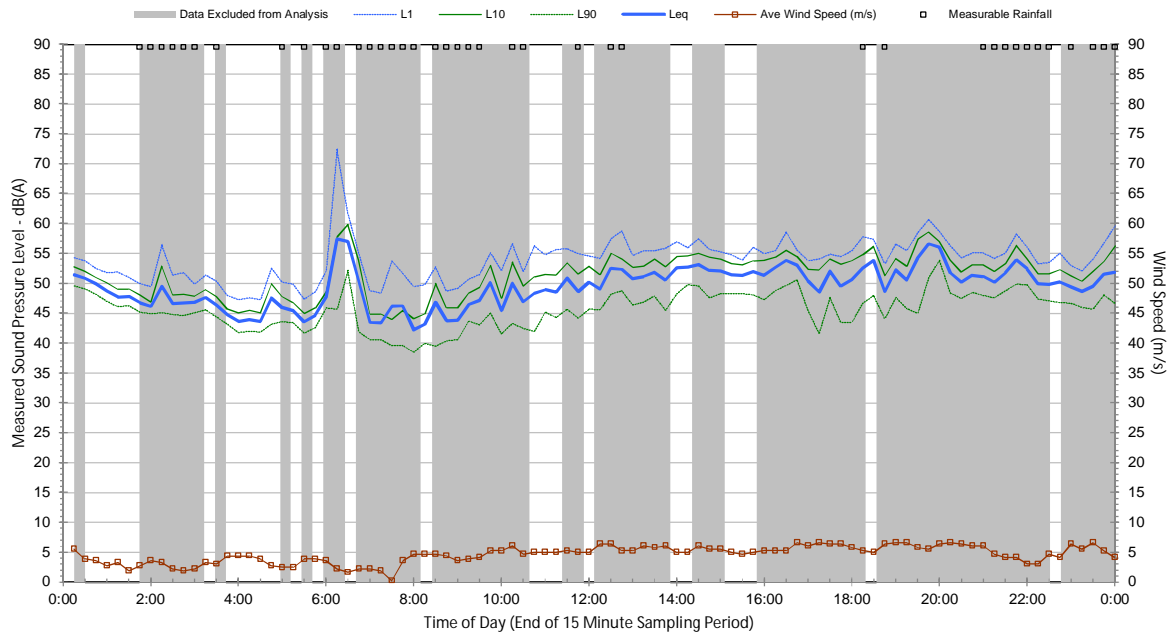
Unattended noise monitoring results - Hawthorn Close, Location P1 Friday 20 February 2015



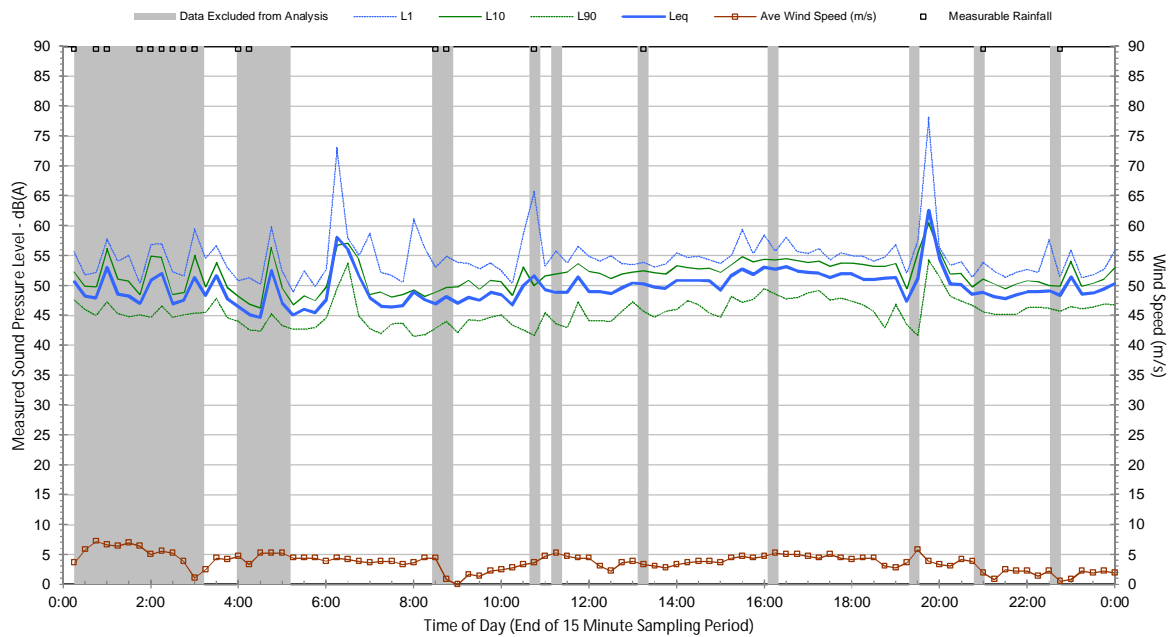
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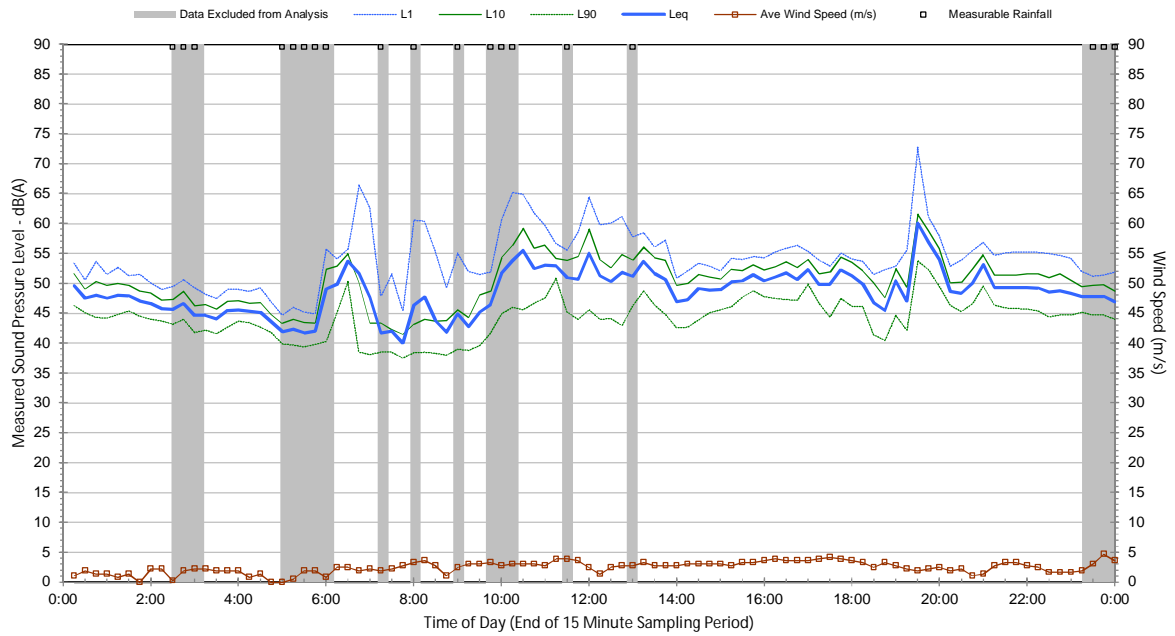
Unattended noise monitoring results - Hawthorn Close, Location P1
Sunday 22 February 2015



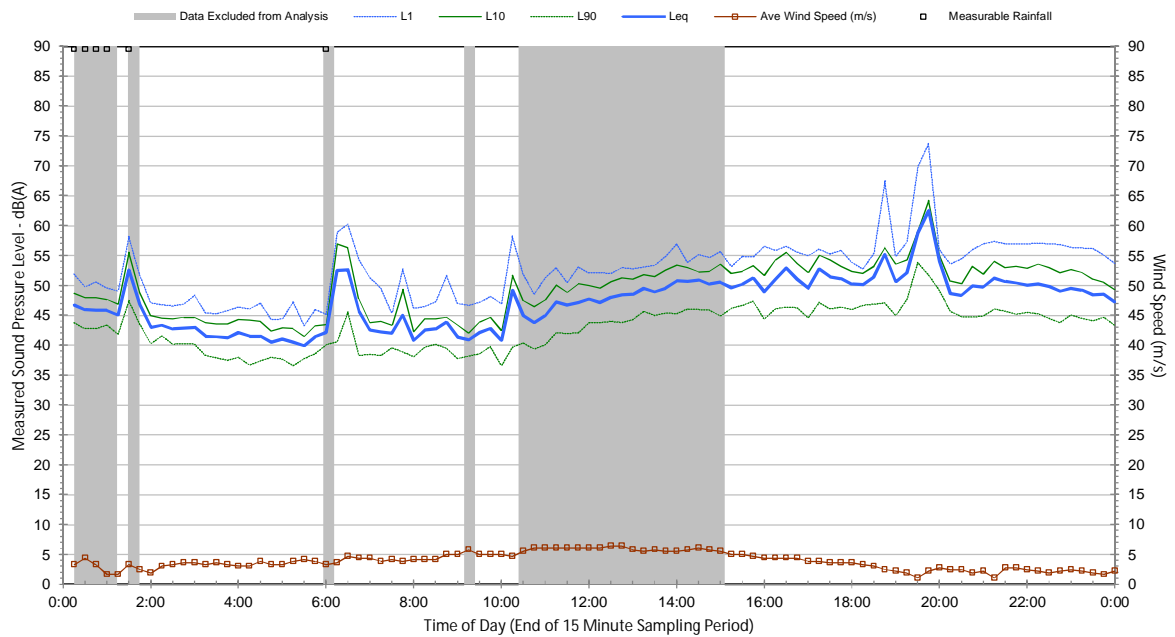
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Monday 23 February 2015



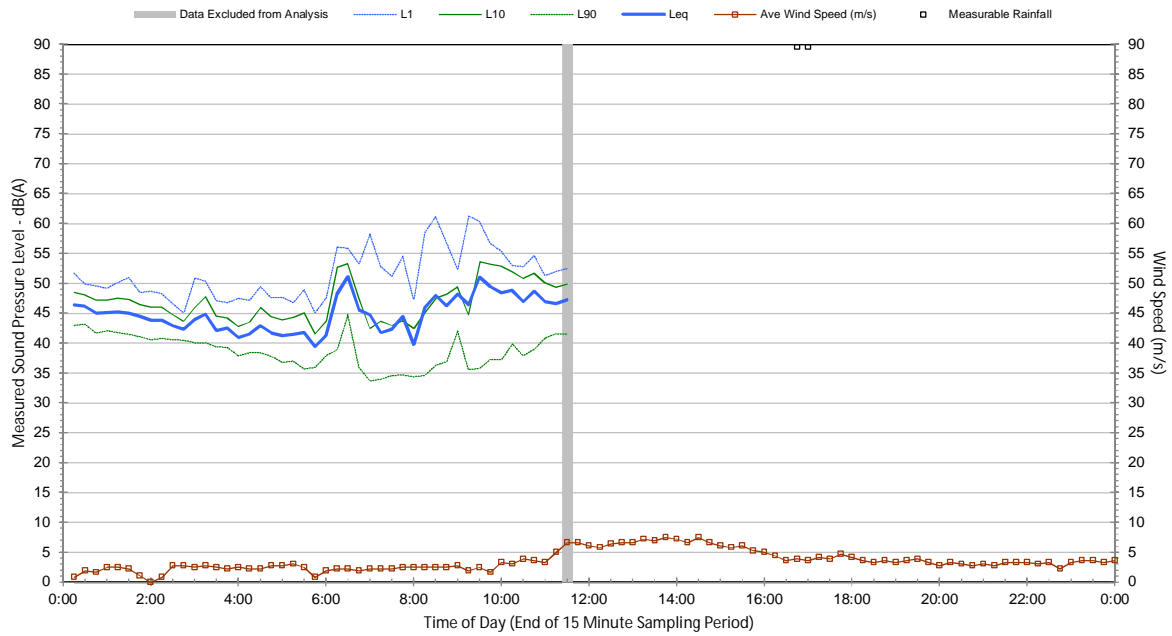
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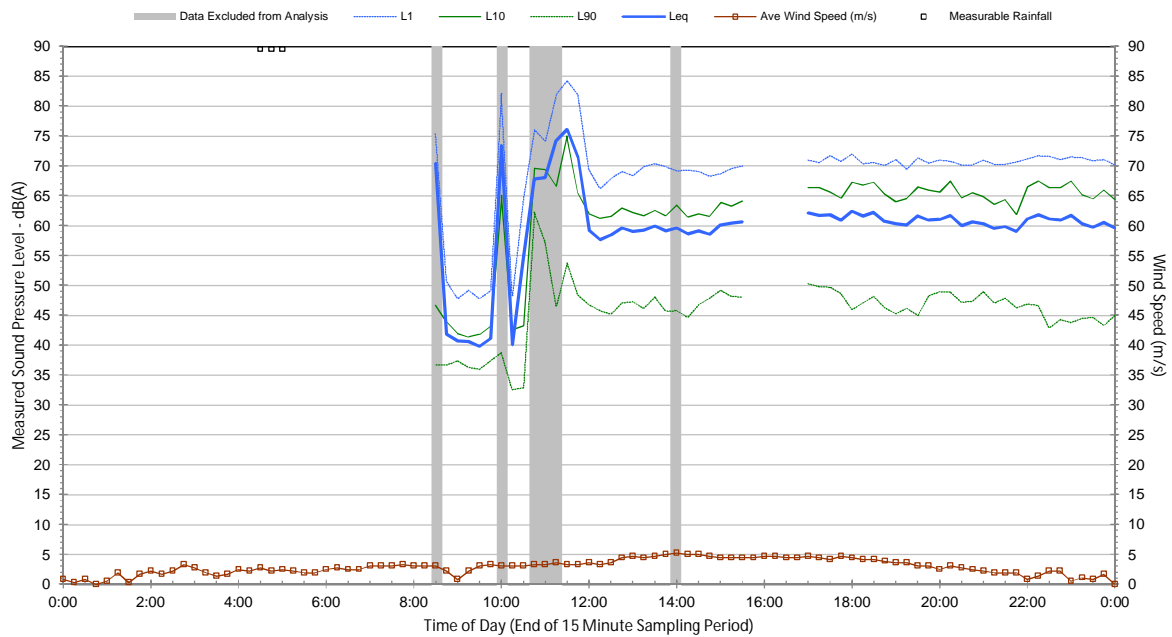
Unattended noise monitoring results - Hawthorn Close, Location P1 Wednesday 25 February 2015



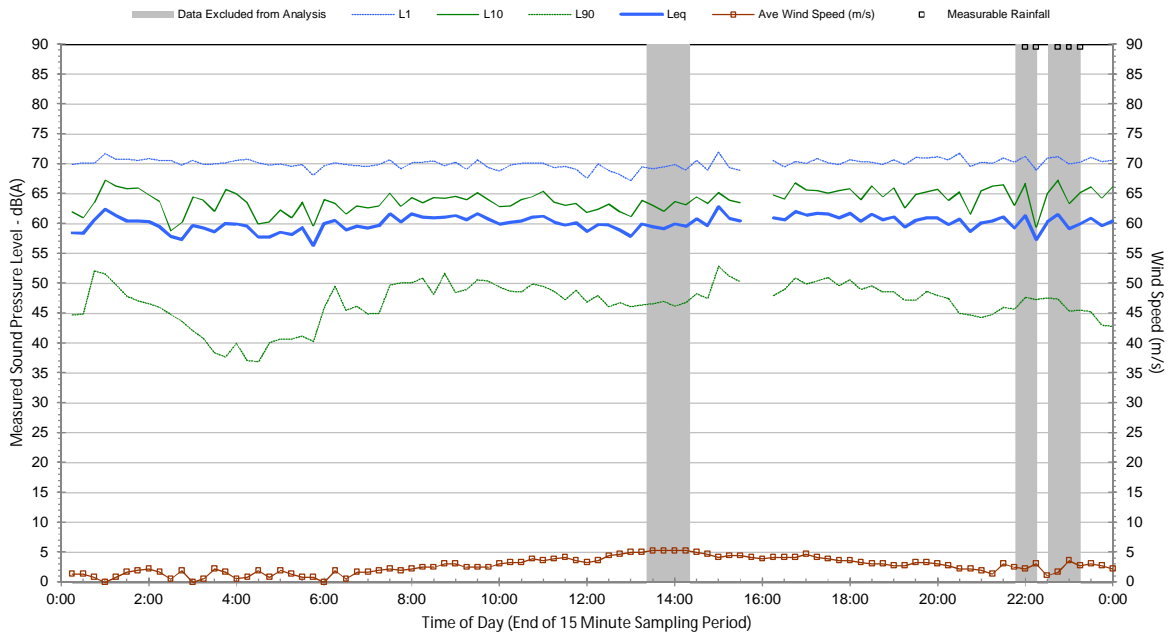
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Thursday 26 February 2015



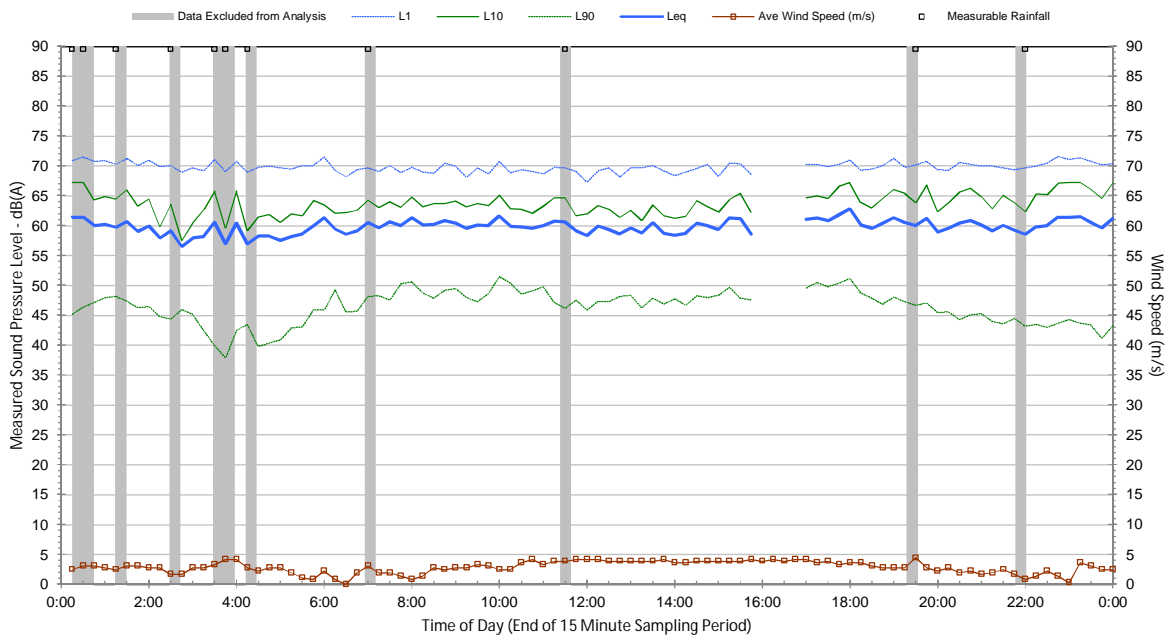
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Monday 16 February 2015



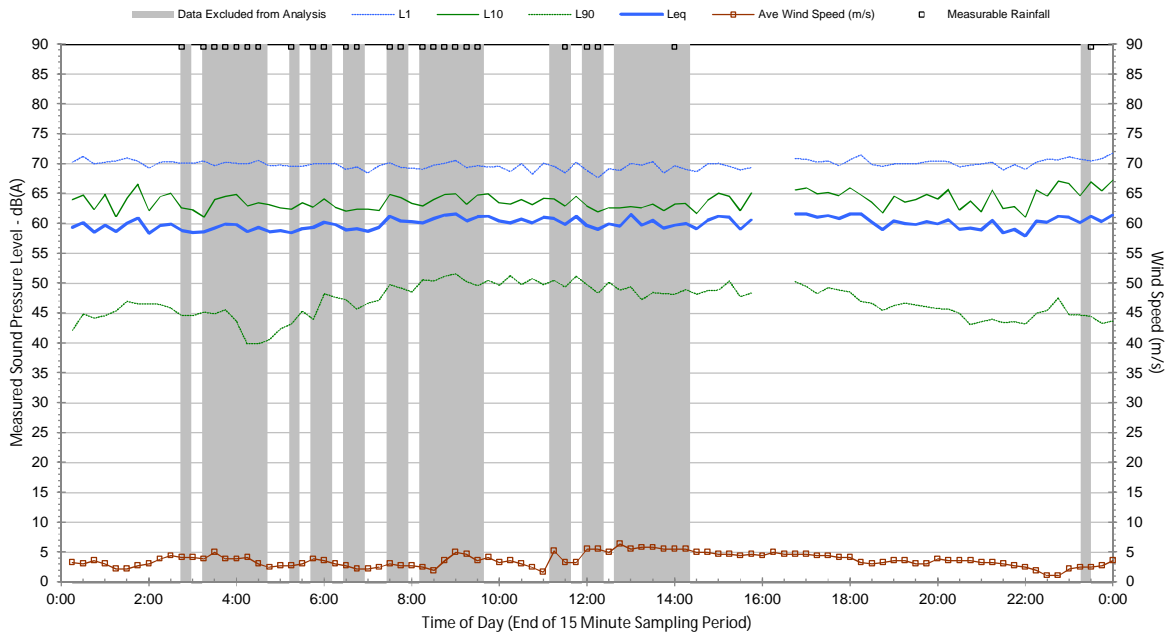
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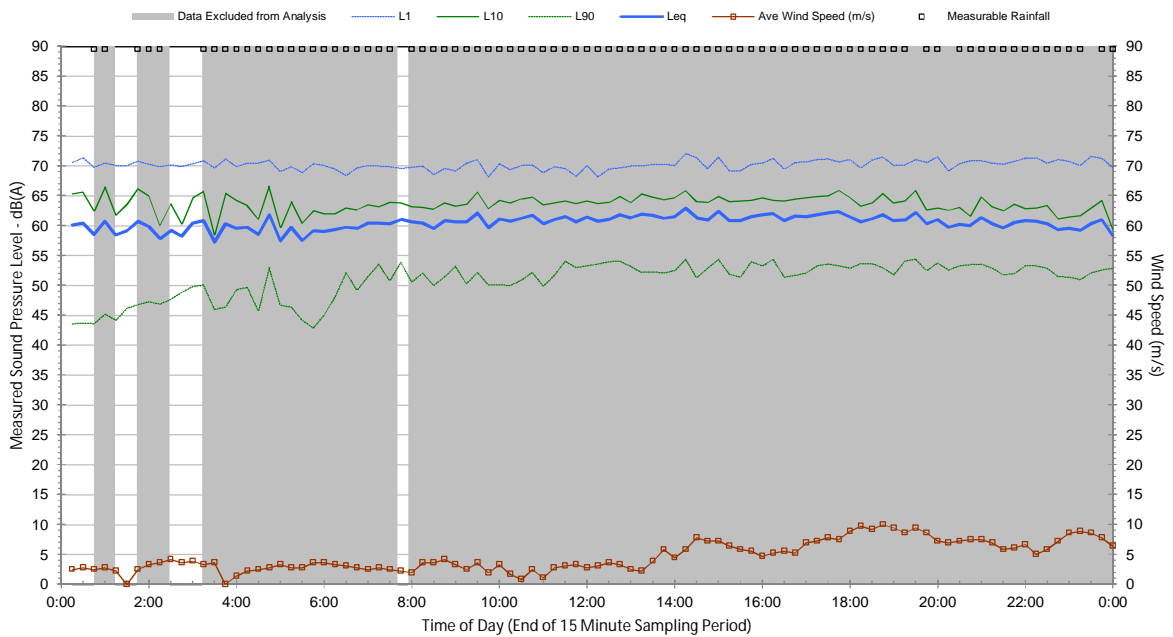
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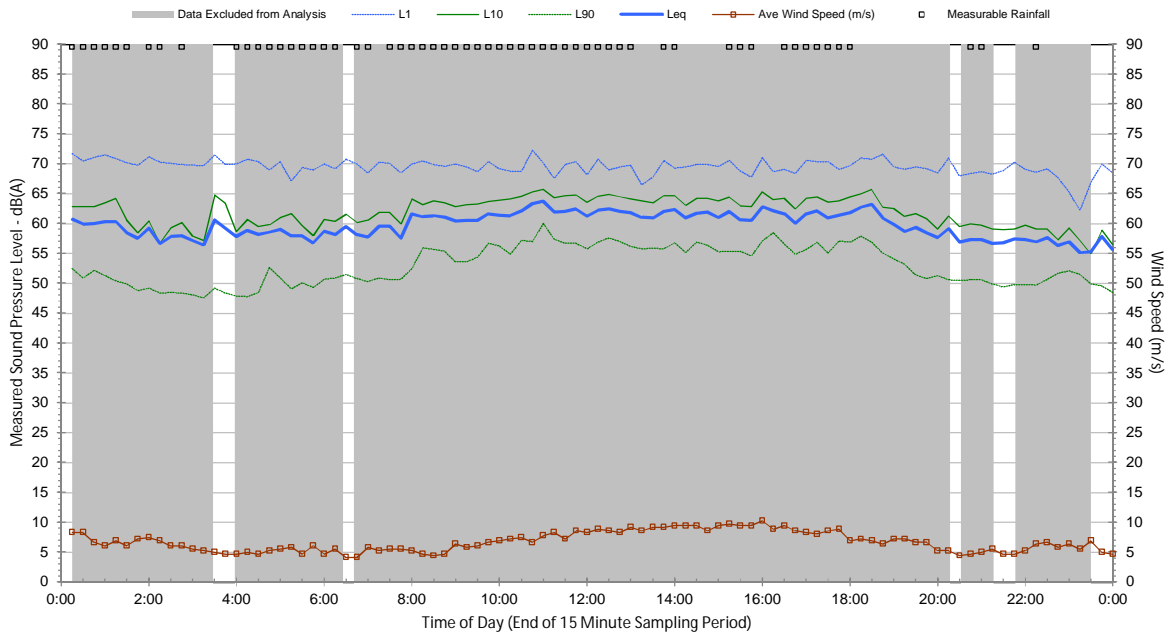
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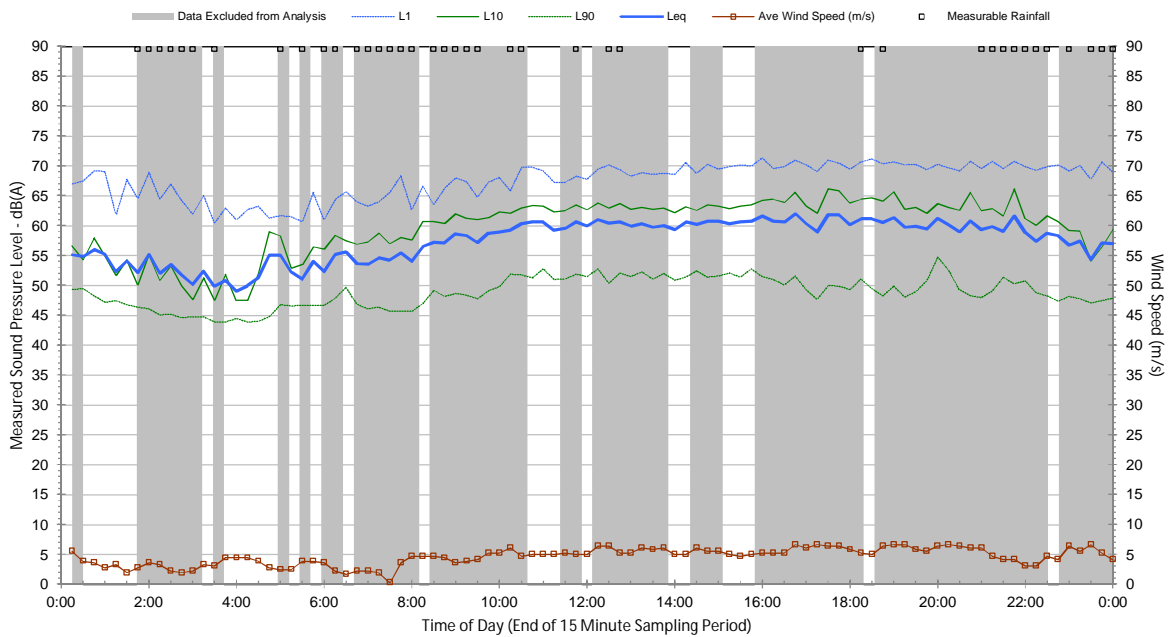
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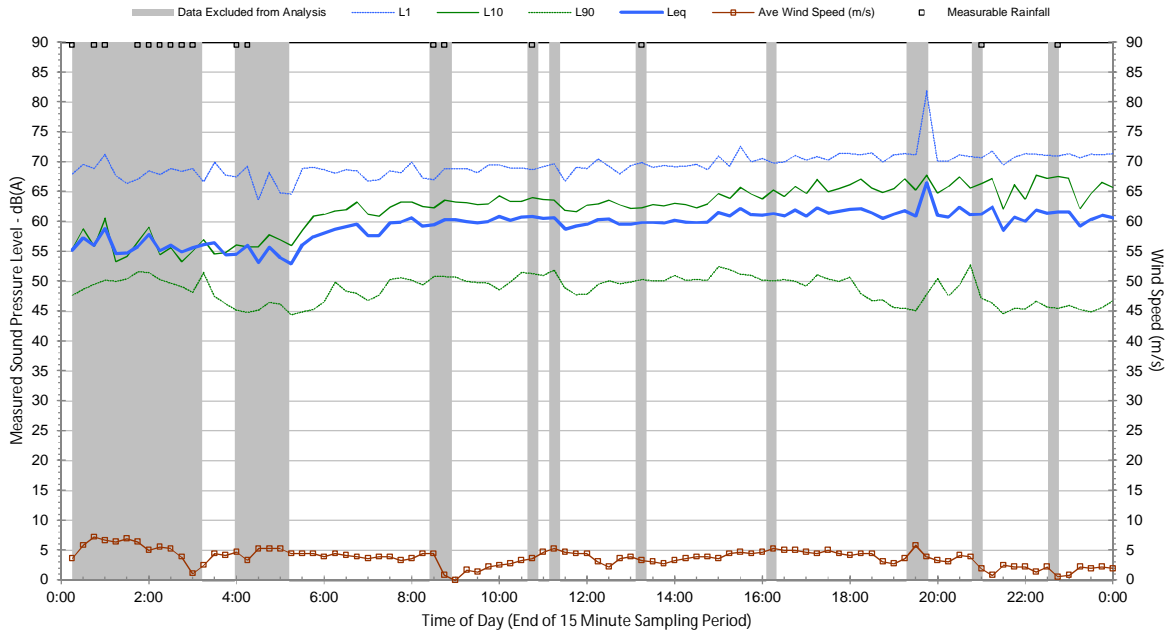
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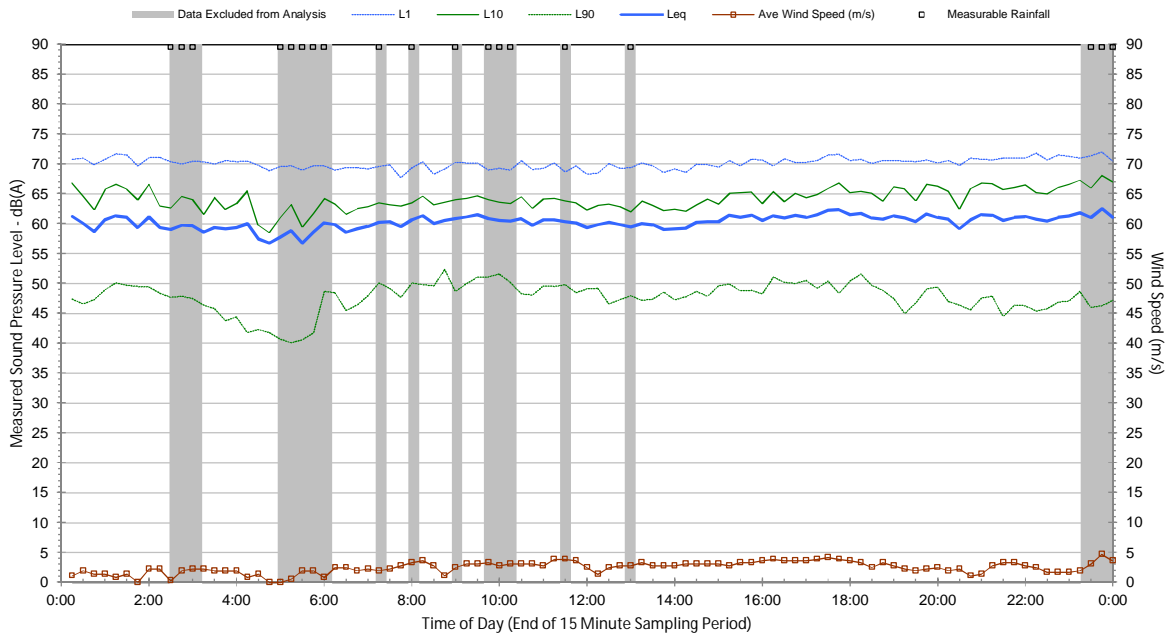
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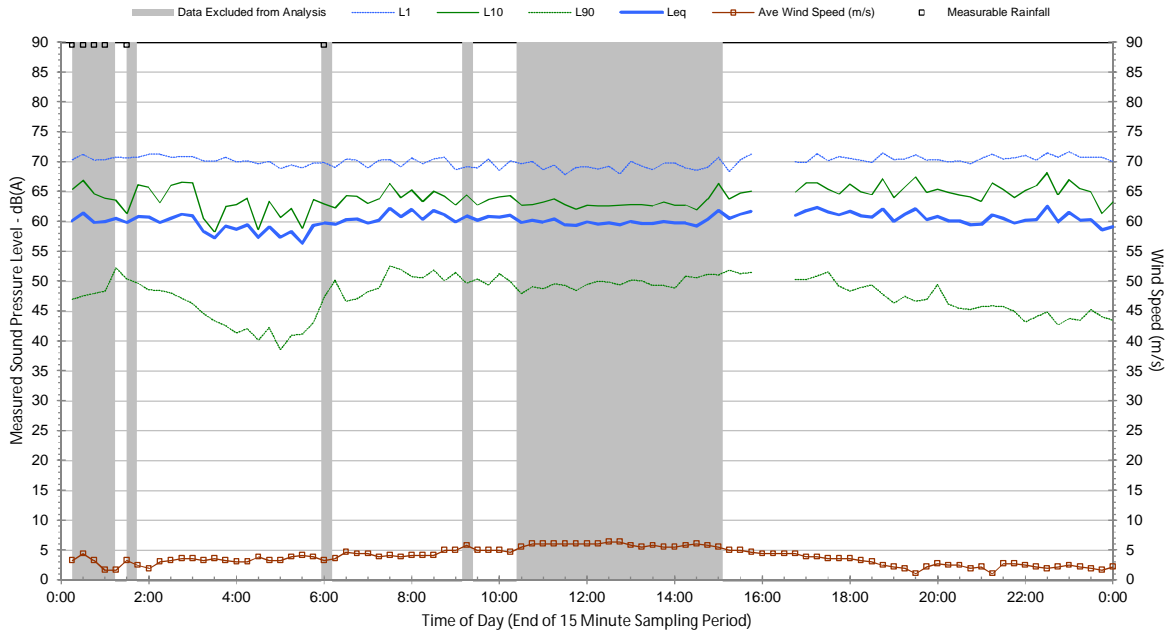
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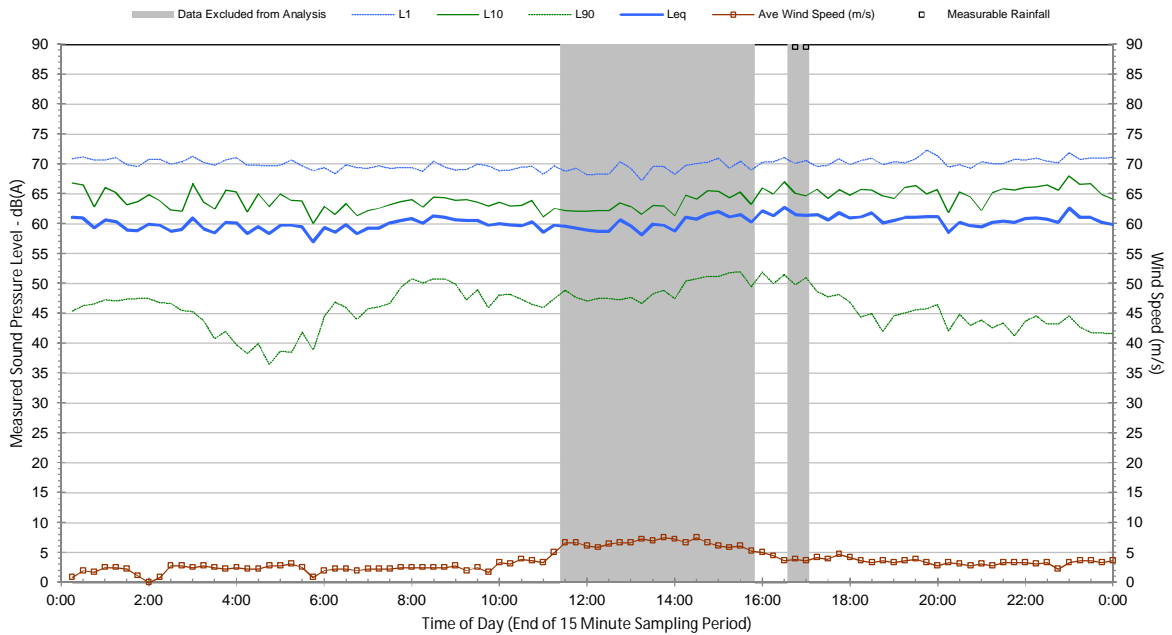
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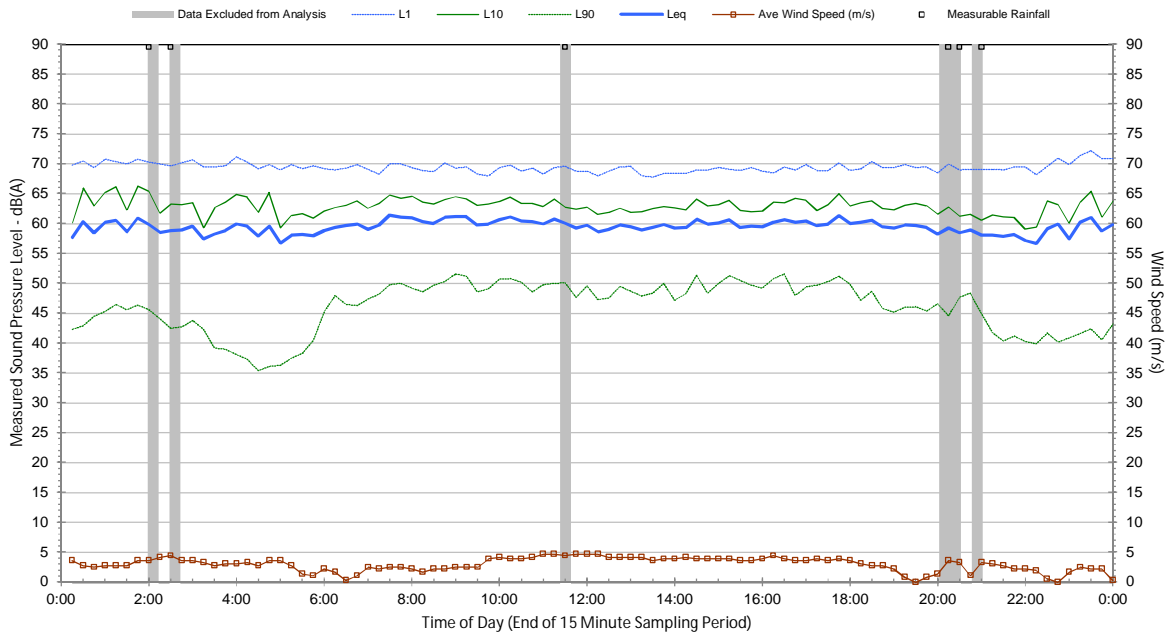
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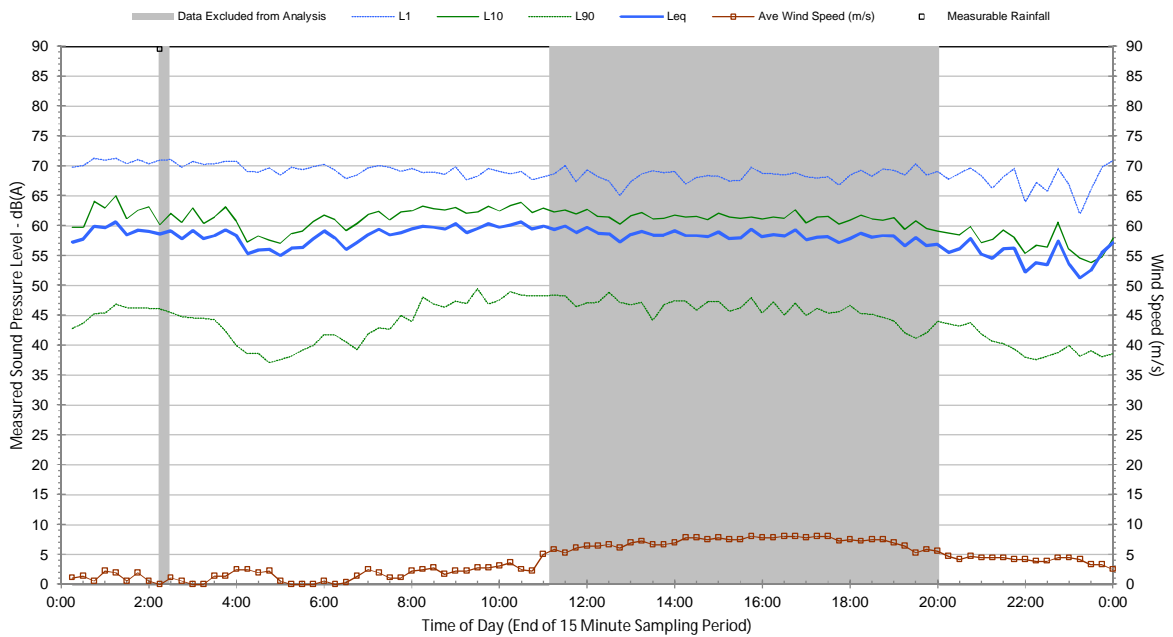
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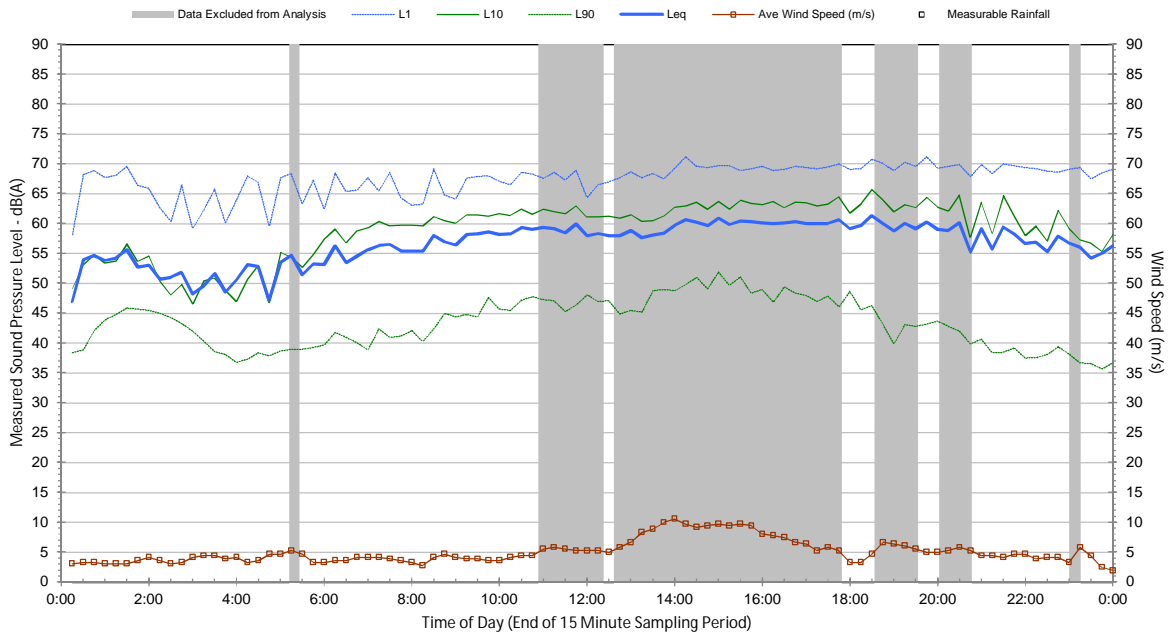
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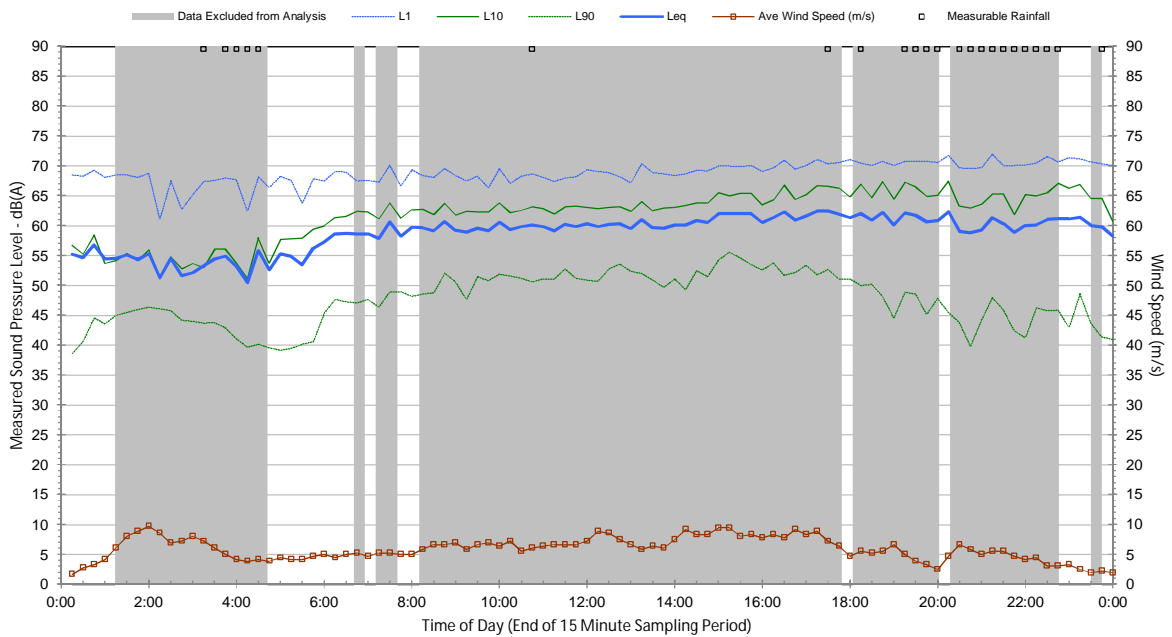
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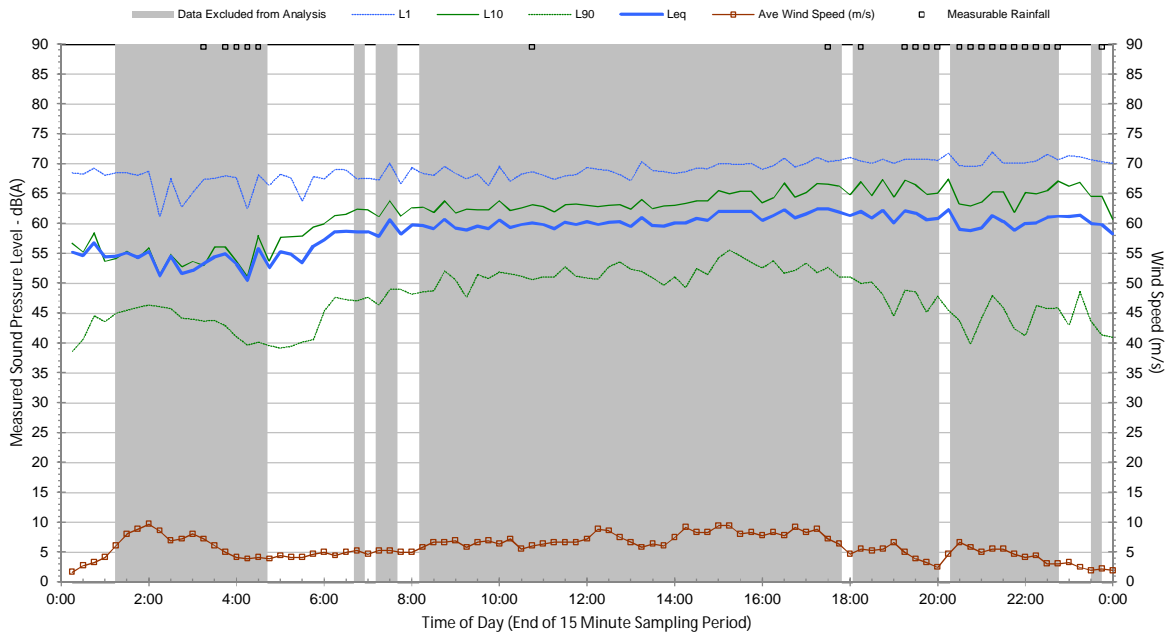
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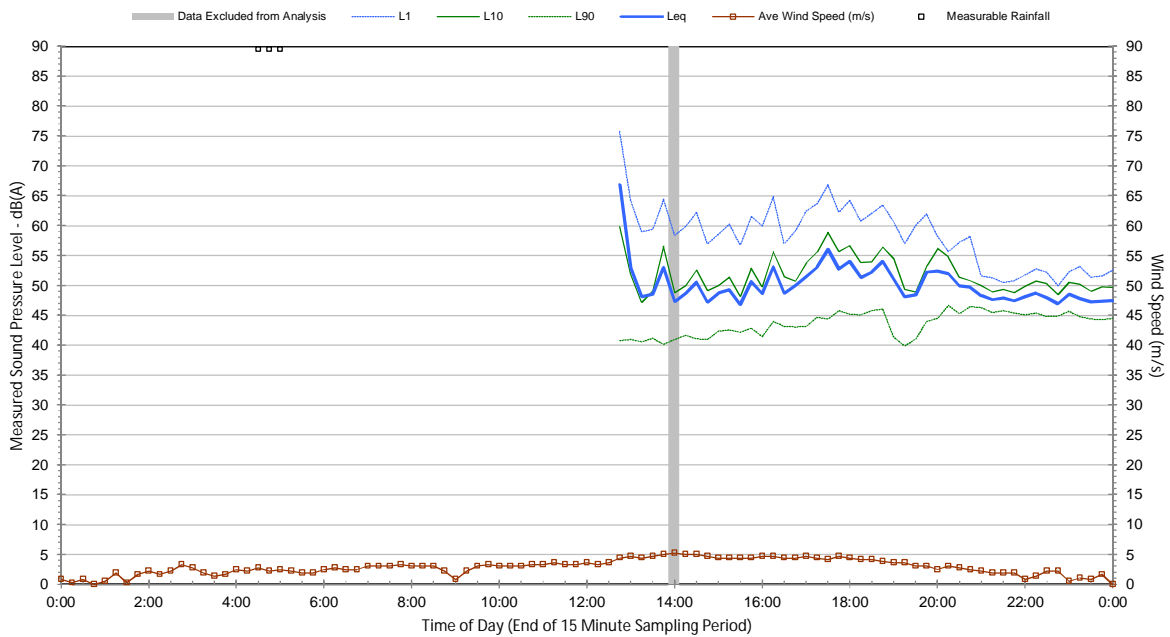
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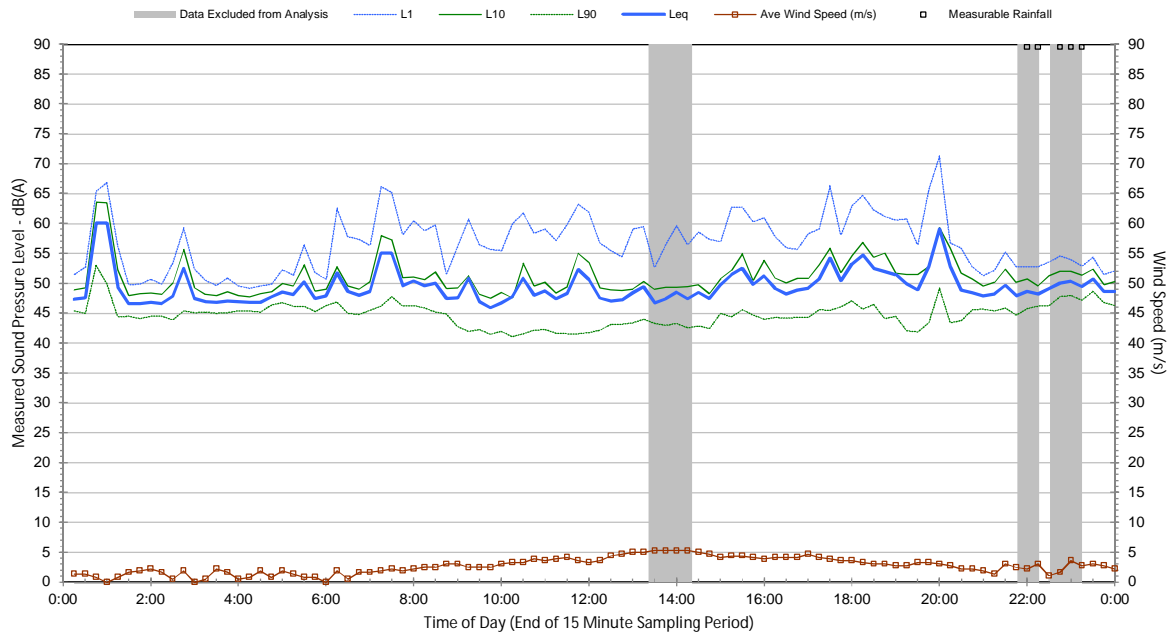
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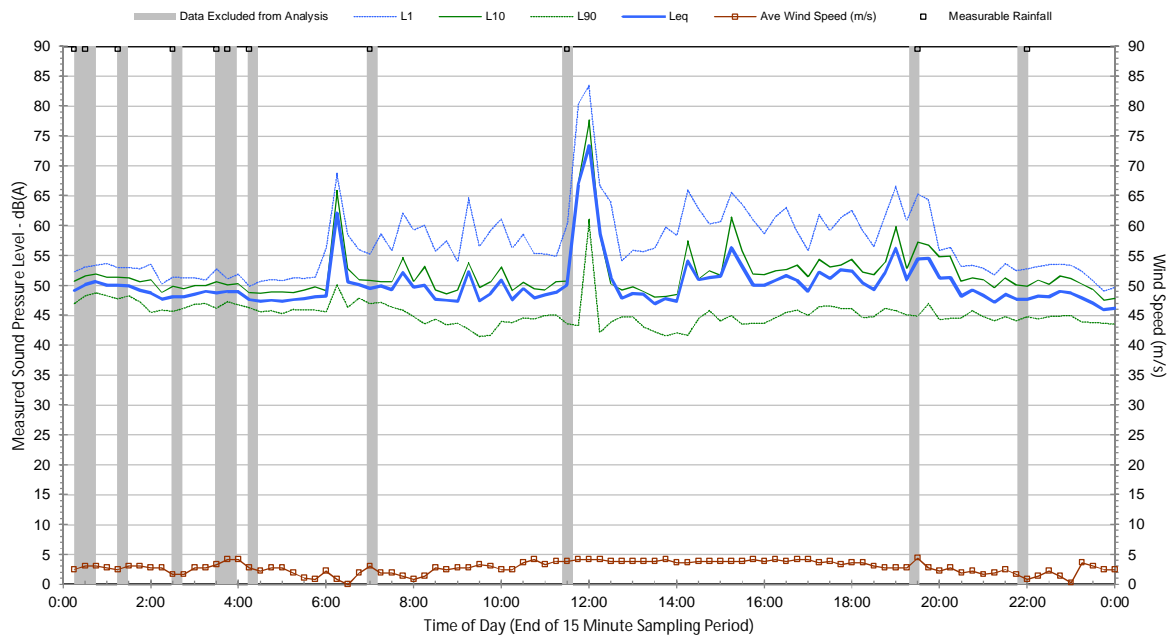
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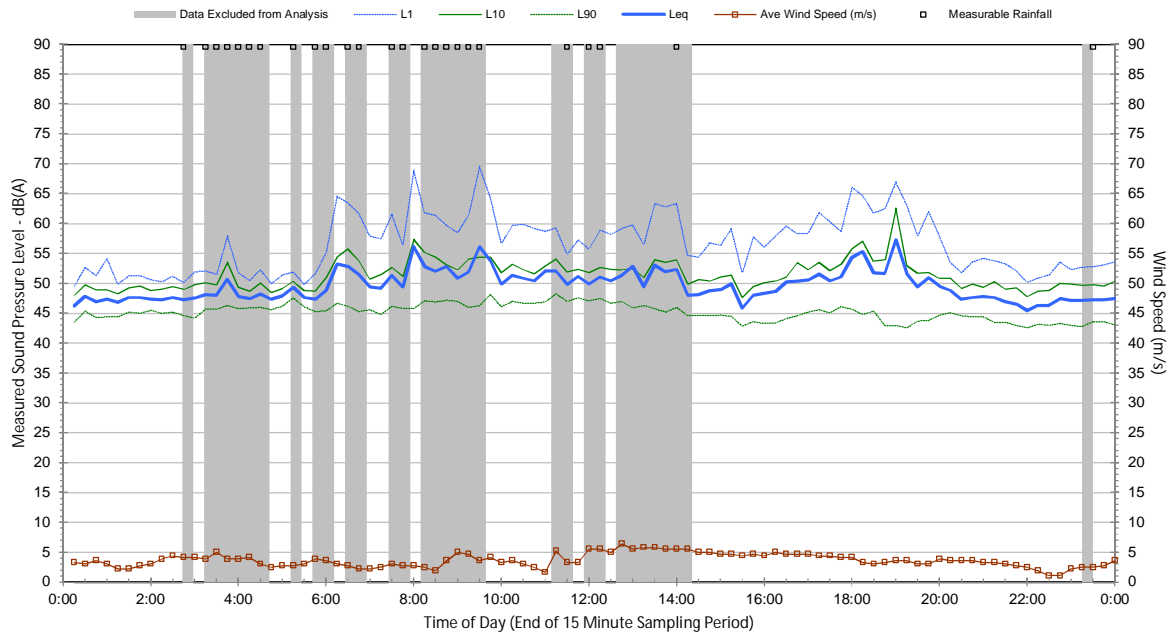
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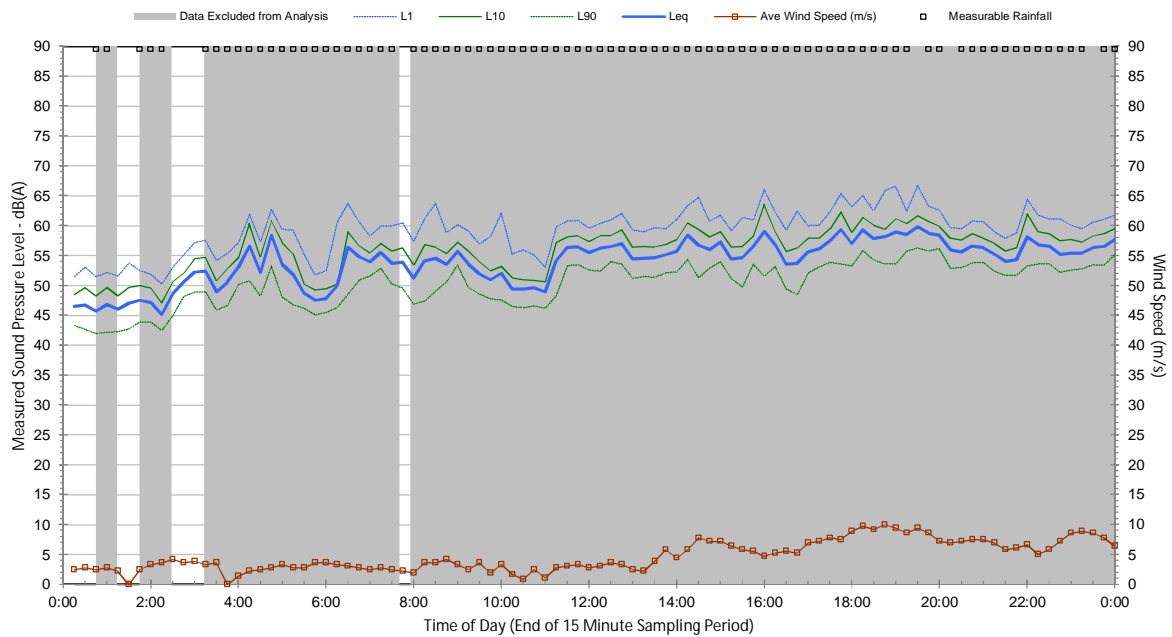
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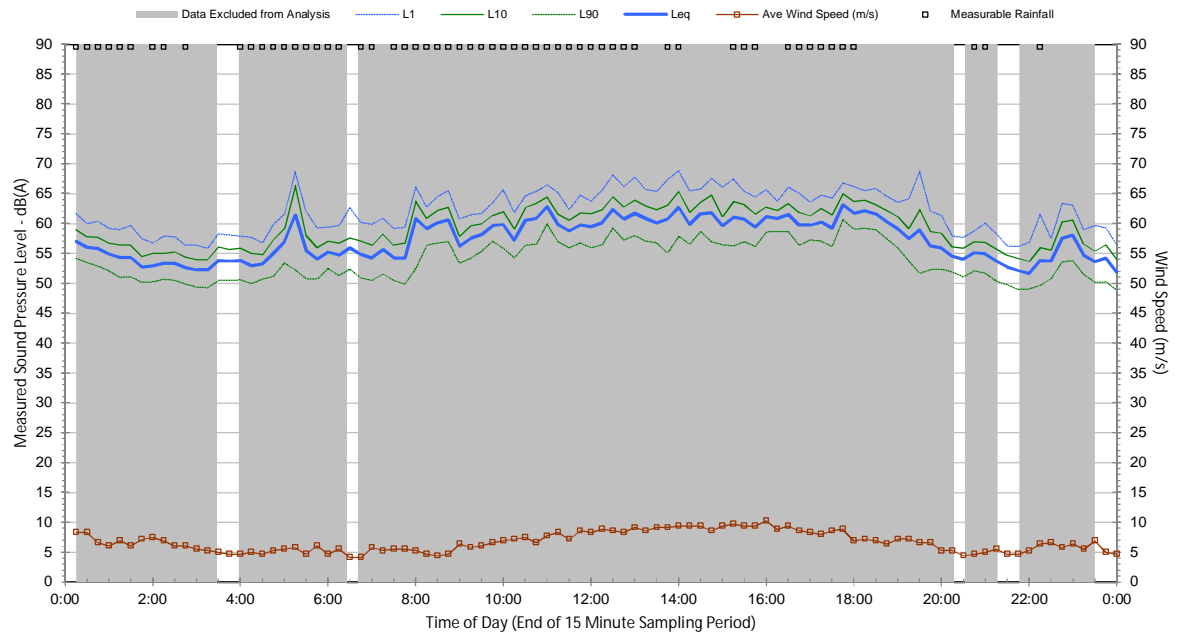
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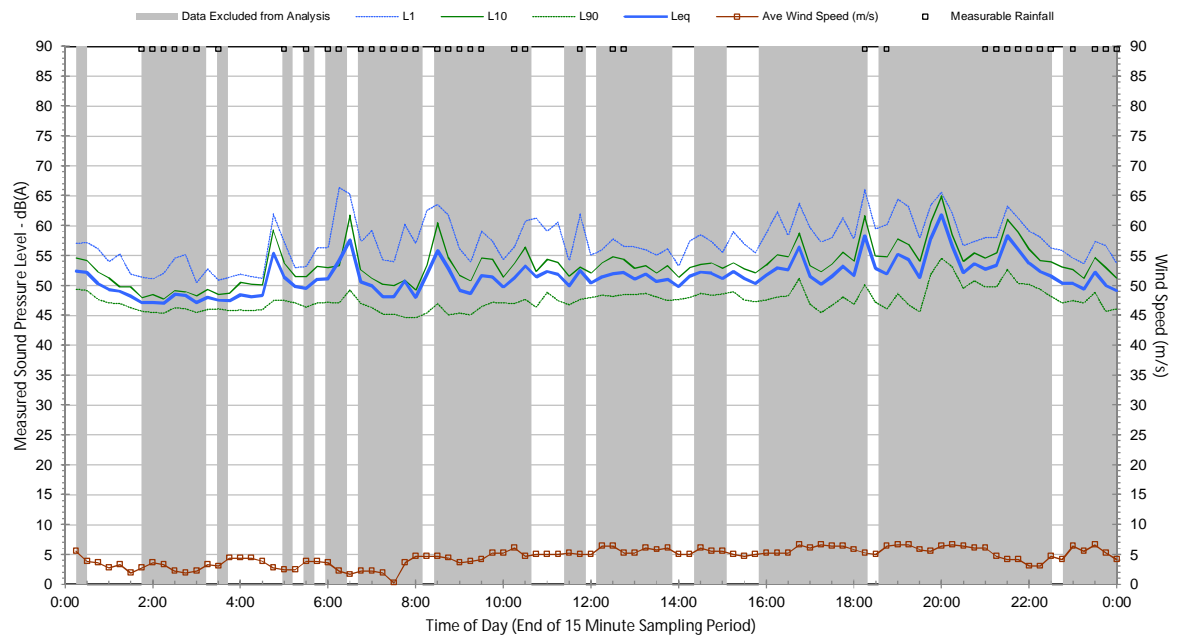
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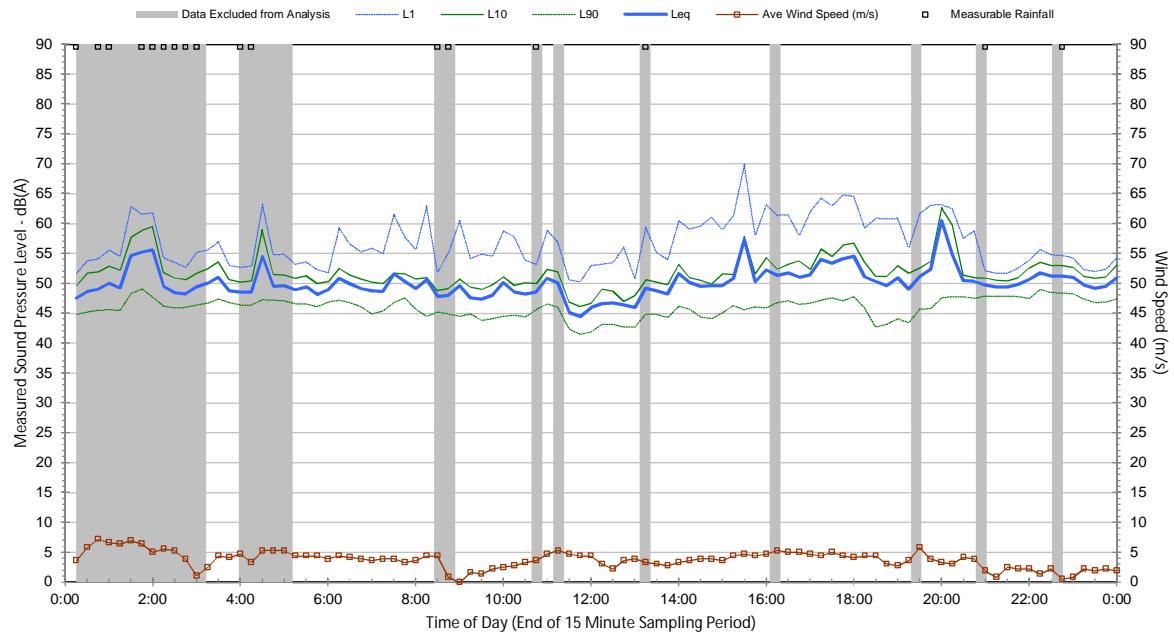
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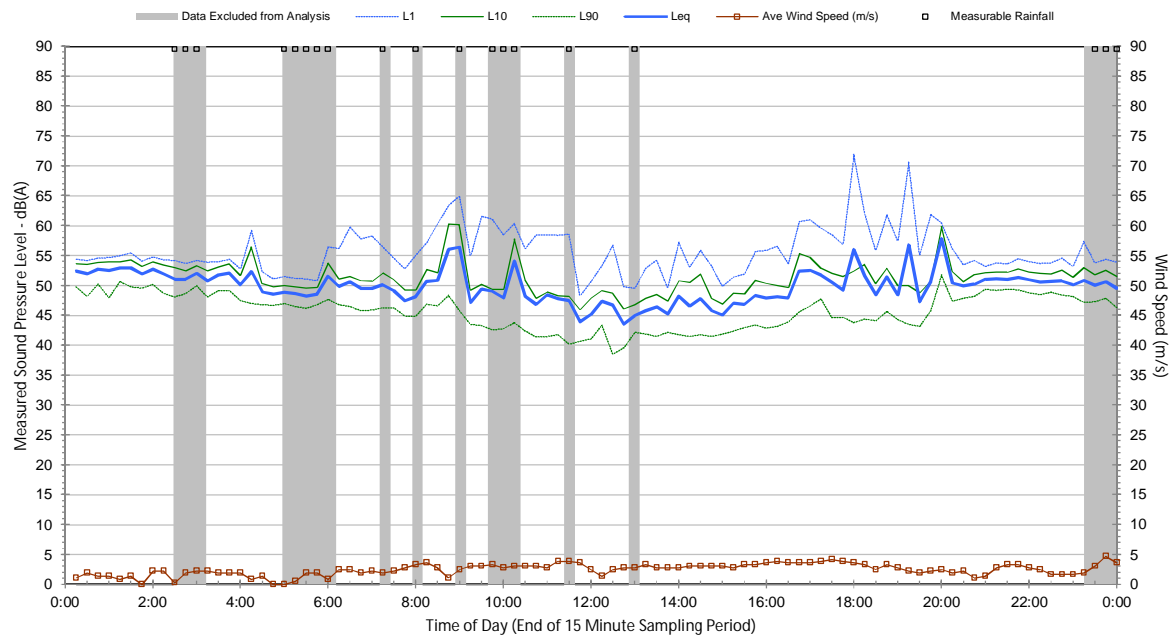
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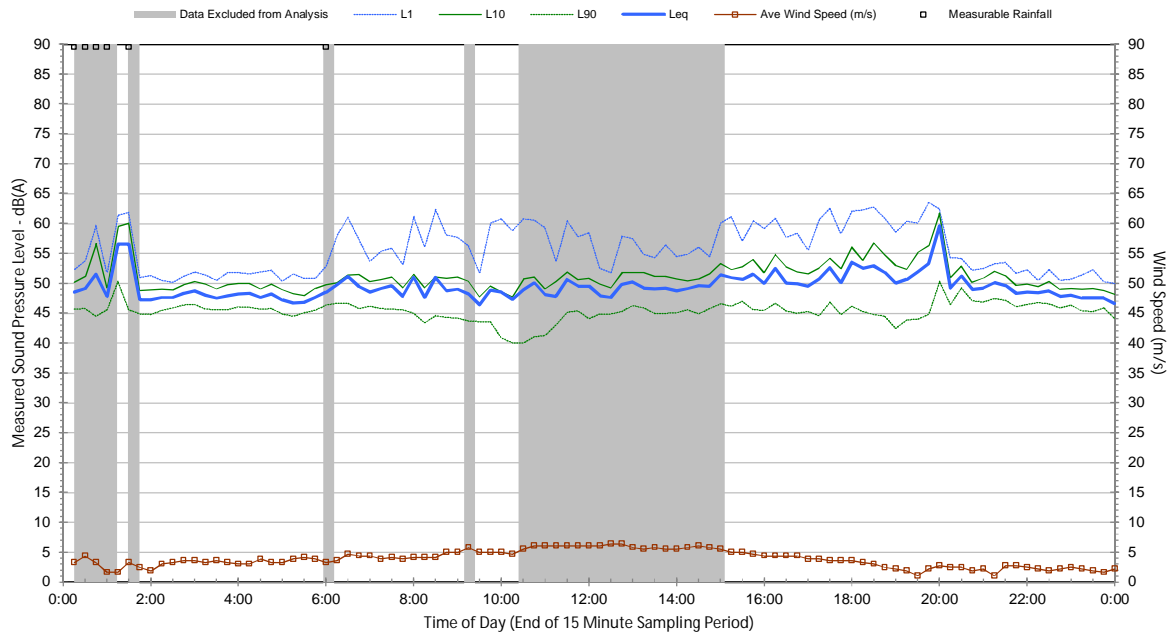
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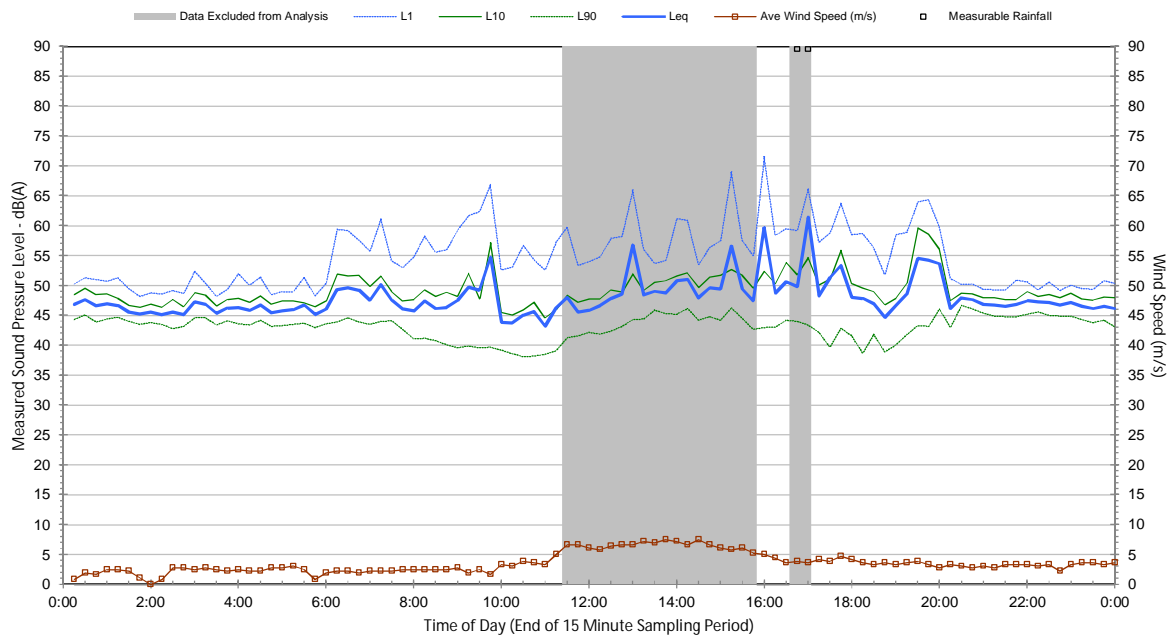
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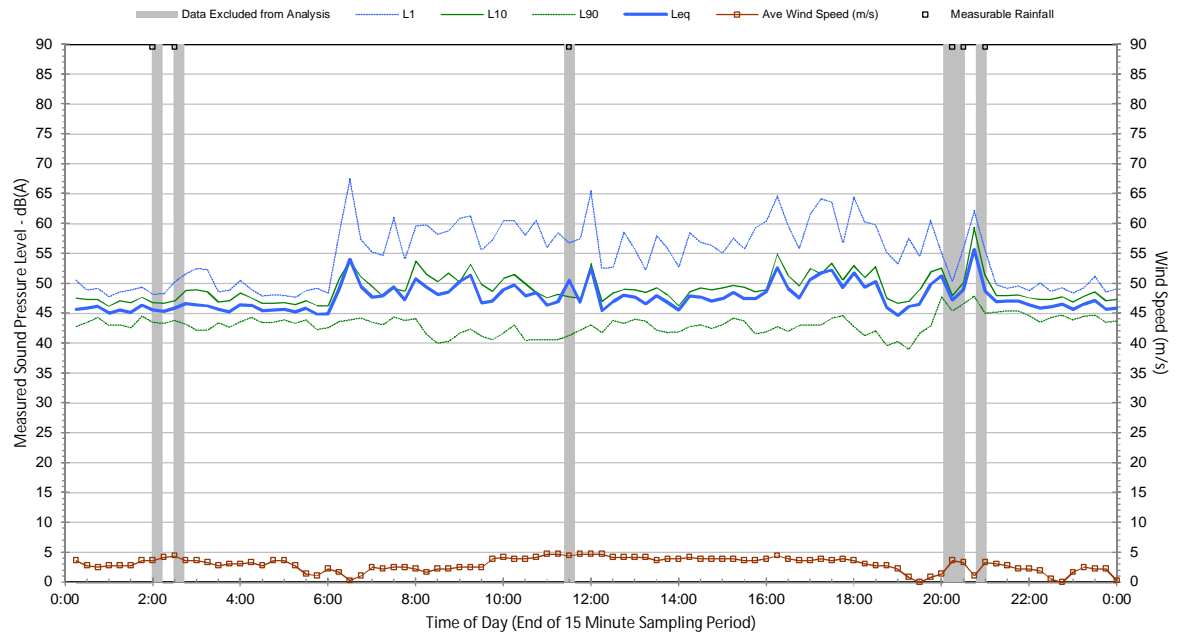
Unattended noise monitoring results - Kangaroo Trail Drive, Location P2
Wednesday 25 February 2015



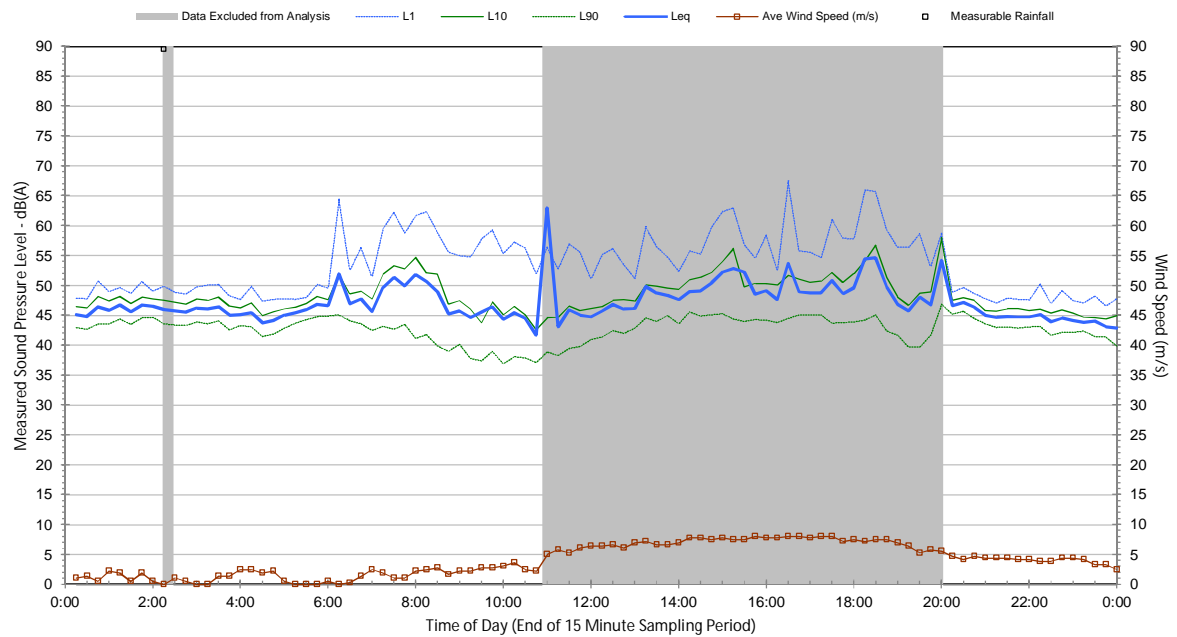
Unattended noise monitoring results - Kangaroo Trail Drive, Location P2
Thursday 26 February 2015



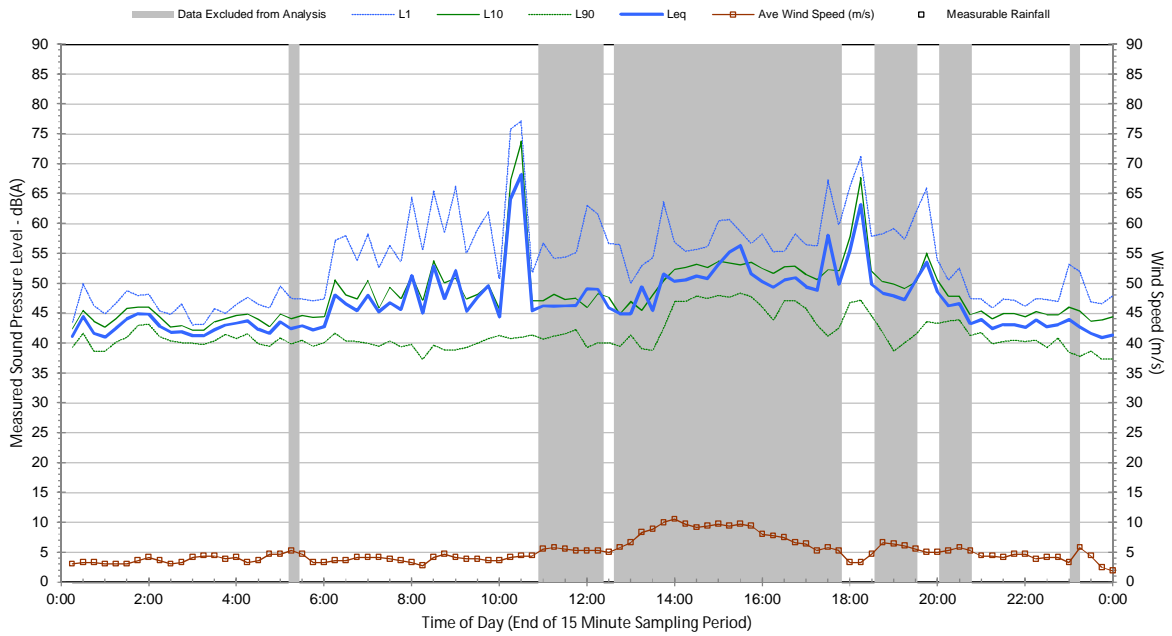
Unattended noise monitoring results - Kangaroo Trail Drive, Location P2
Friday 27 February 2015



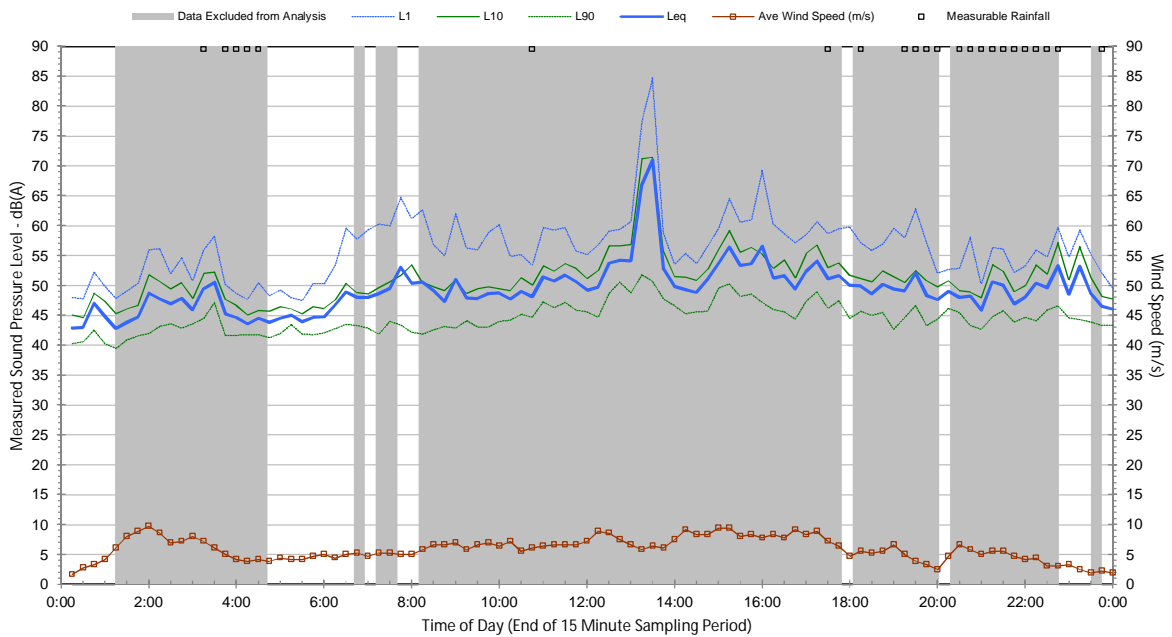
Unattended noise monitoring results - Kangaroo Trail Drive, Location P2
Saturday 28 February 2015



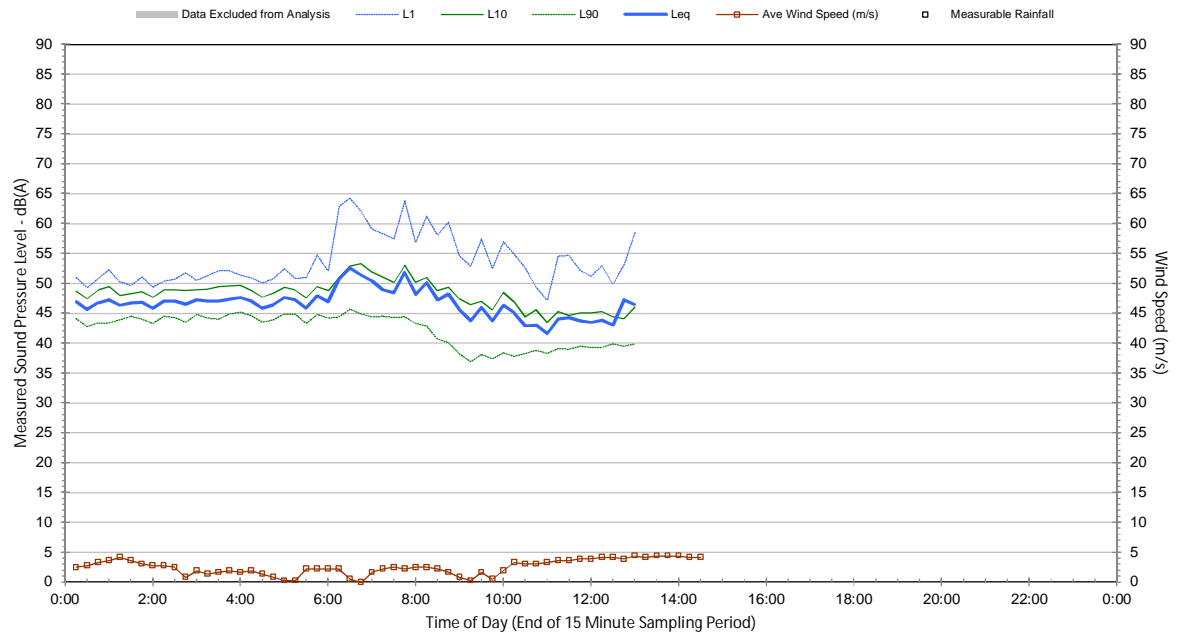
Unattended noise monitoring results - Kangaroo Trail Drive, Location P2
Sunday 1 March 2015



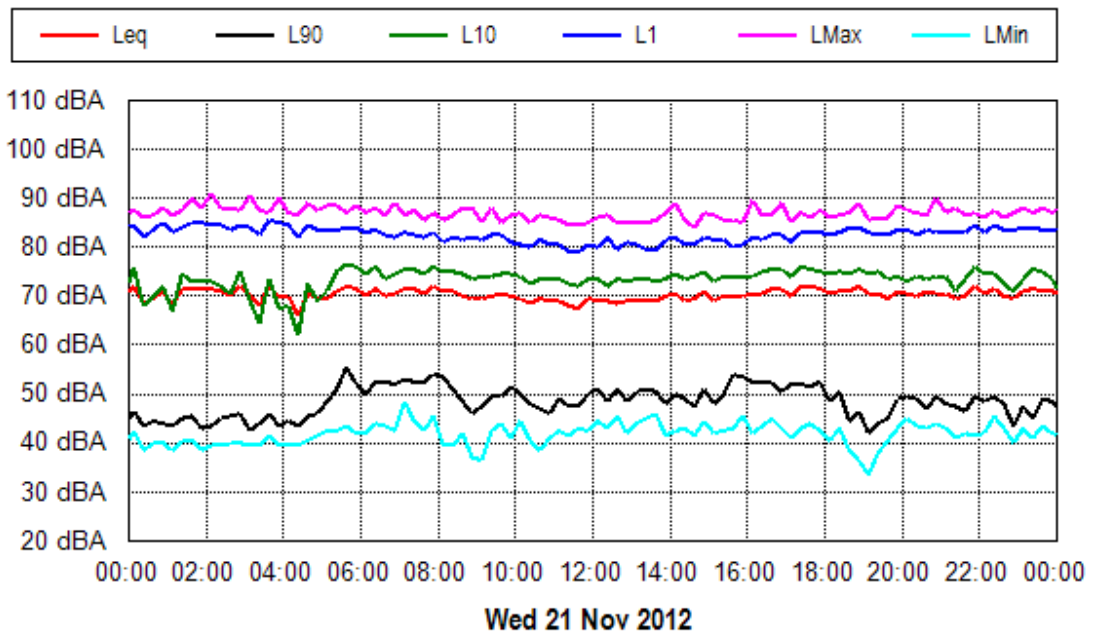
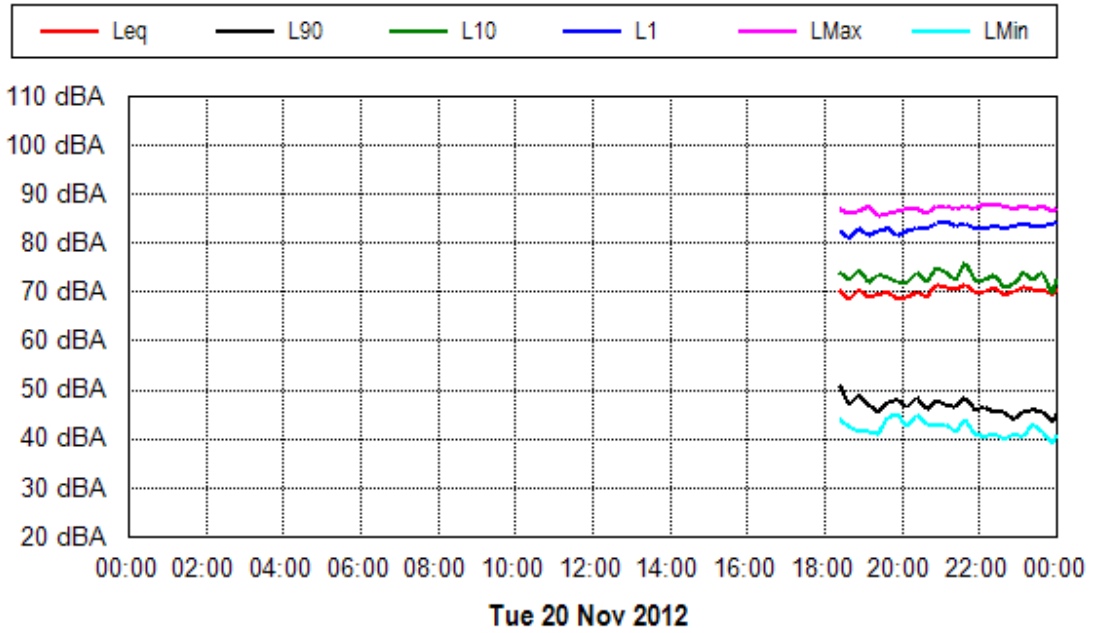
Unattended noise monitoring results - Kangaroo Trail Drive, Location P2
Monday 2 March 2015



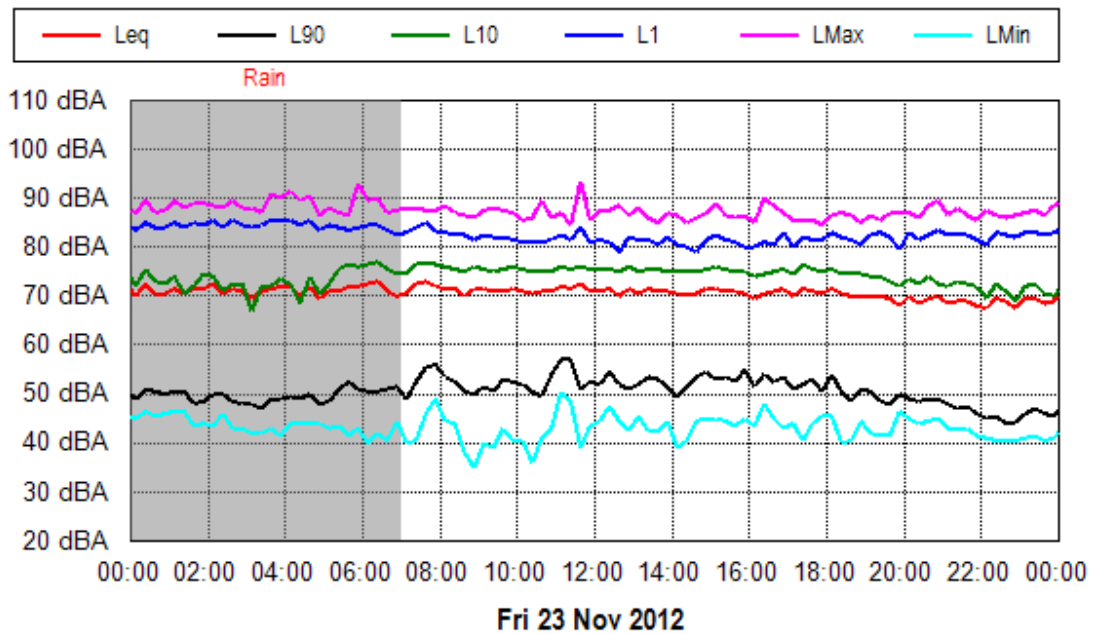
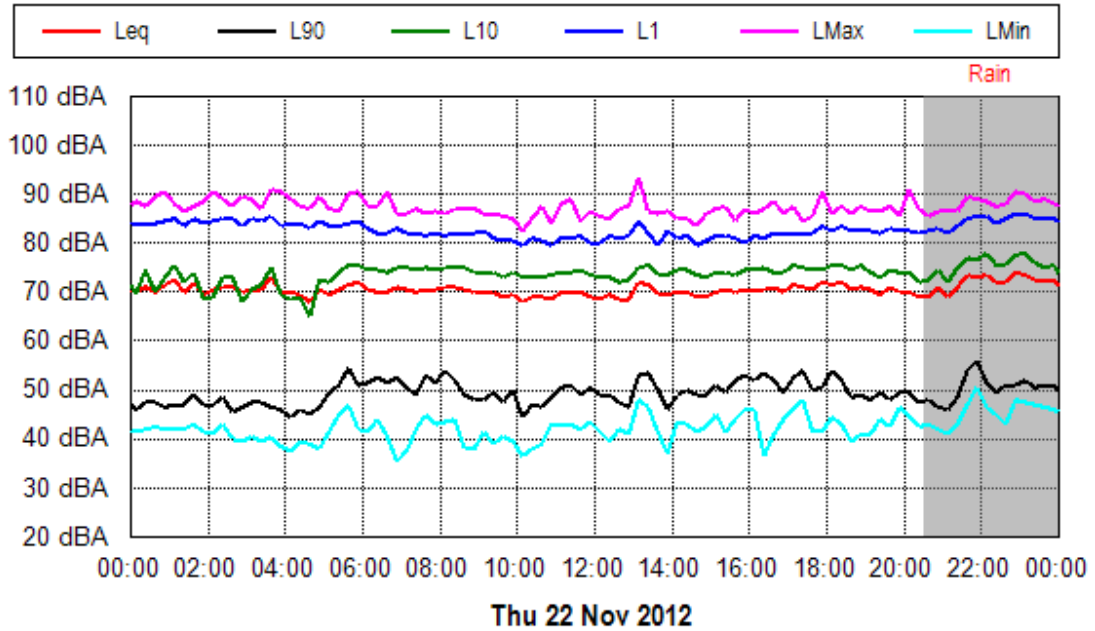
Unattended noise monitoring results - Kangaroo Trail Drive, Location P2
Tuesday 3 March 2015



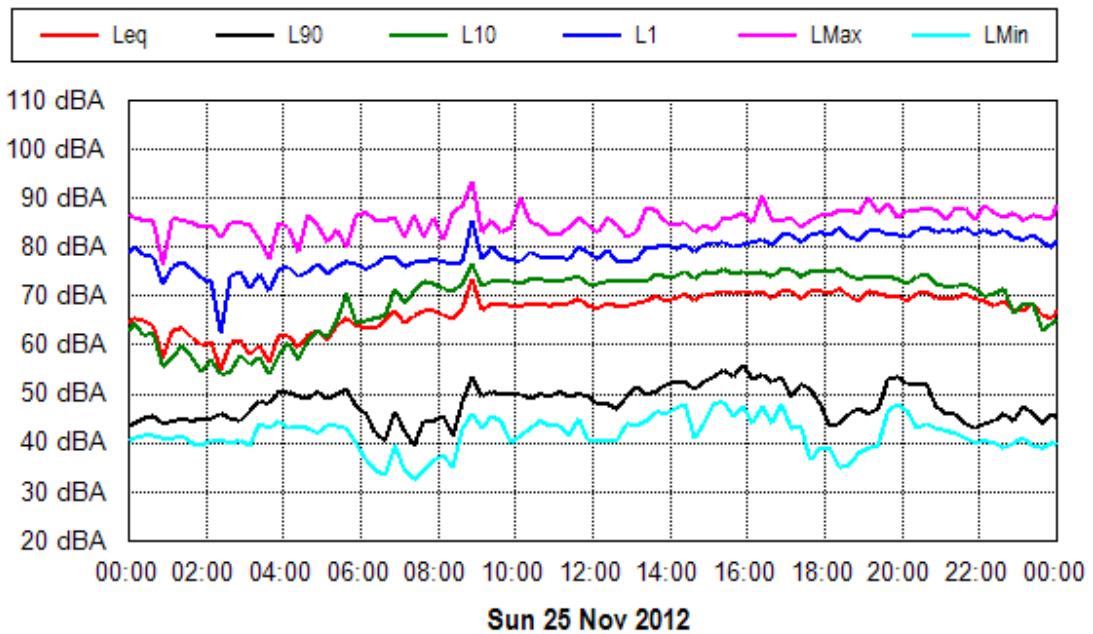
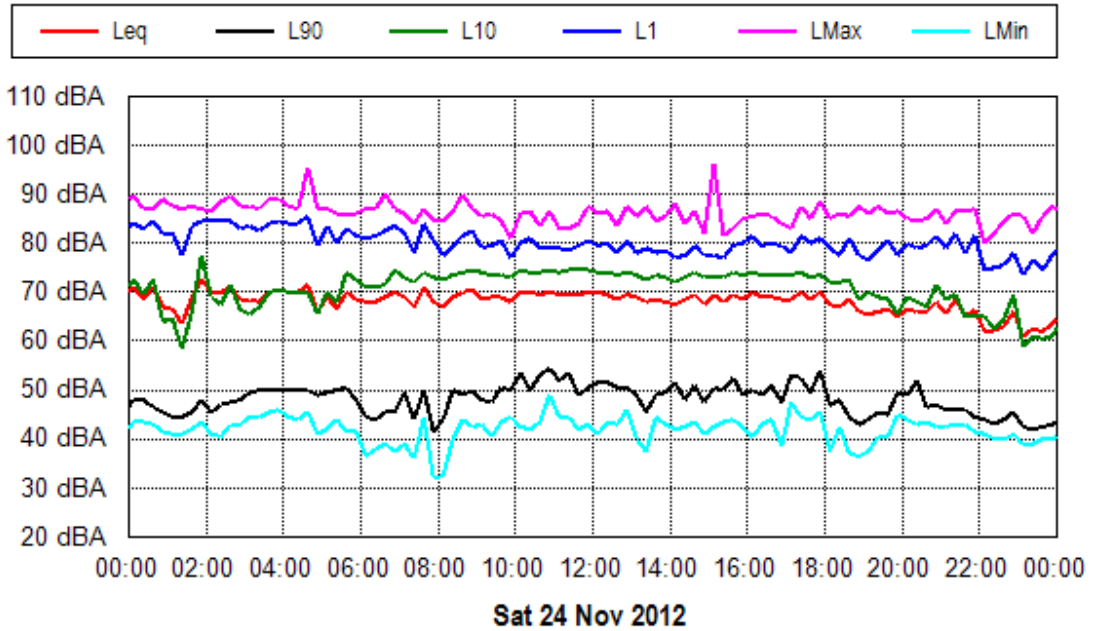
Project: W2G
Location: 3674 Pacific Highway
Filter: A
Criterion:



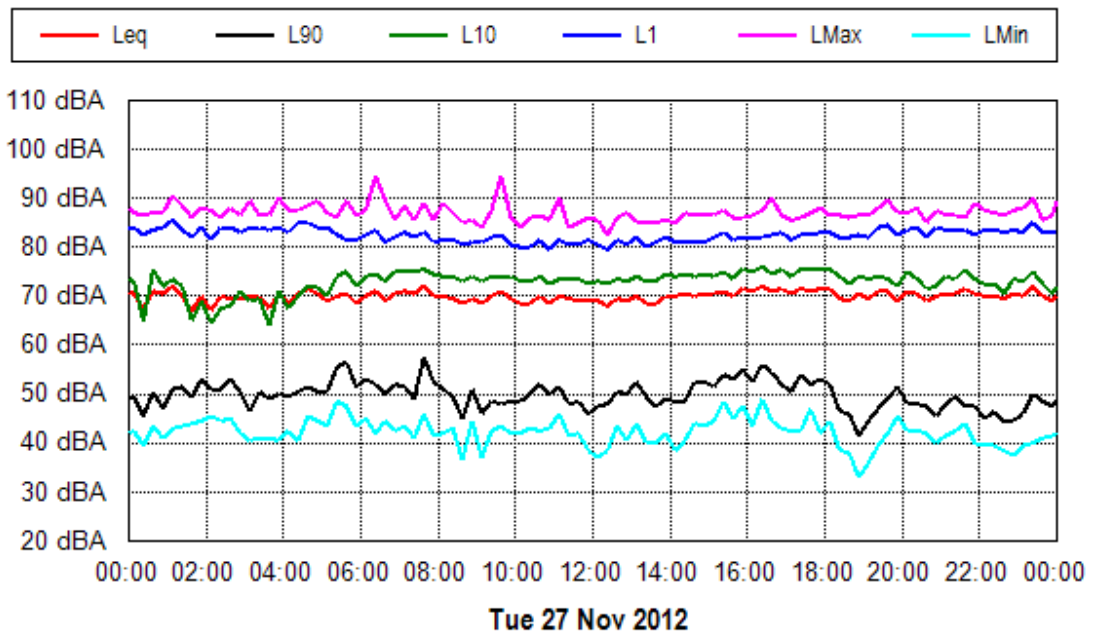
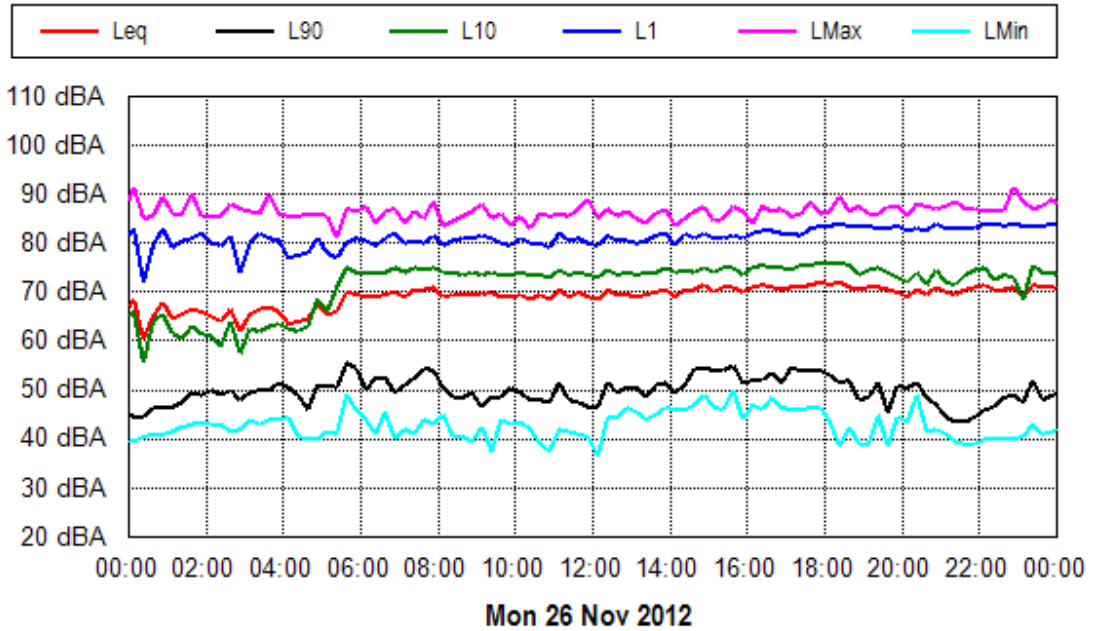
Project: W2G
Location: 3674 Pacific Highway
Filter: A
Criterion:



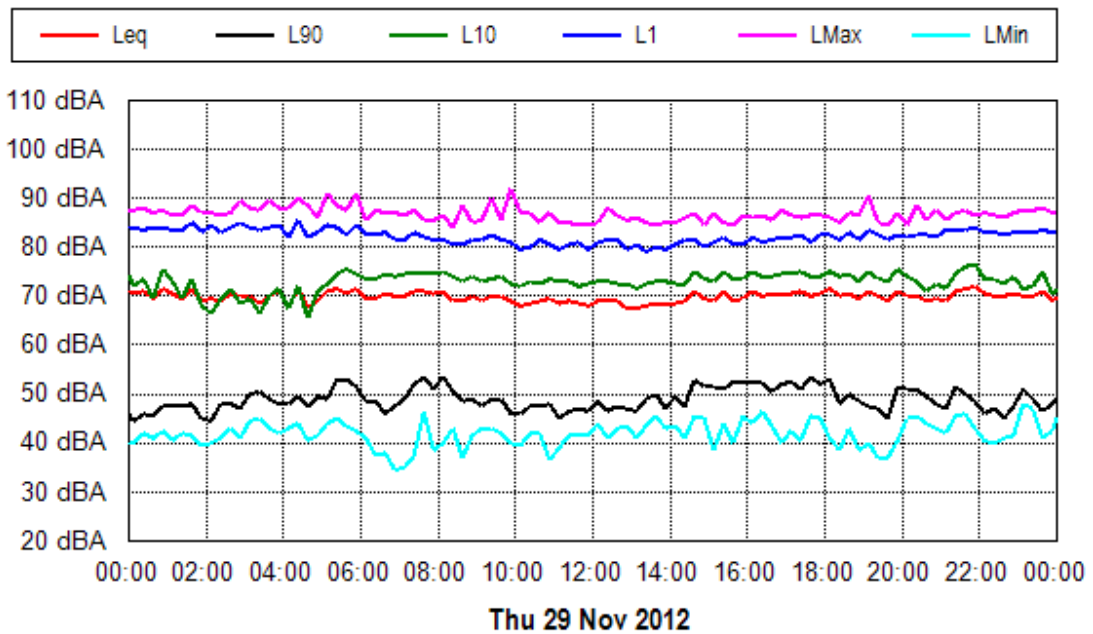
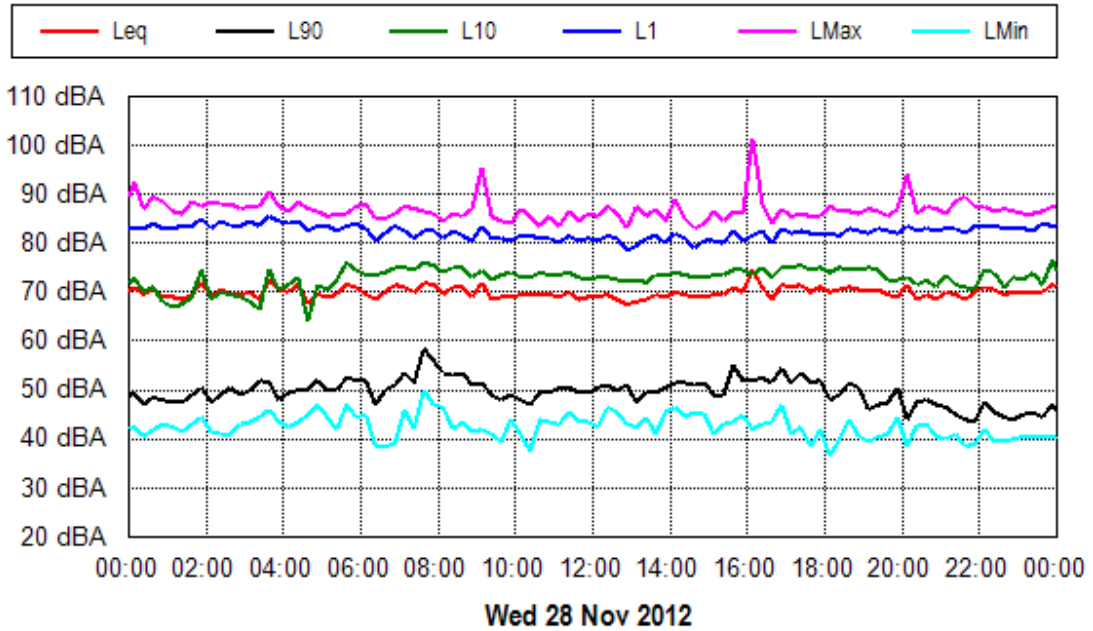
Project: W2G
Location: 3674 Pacific Highway
Filter: A
Criterion:



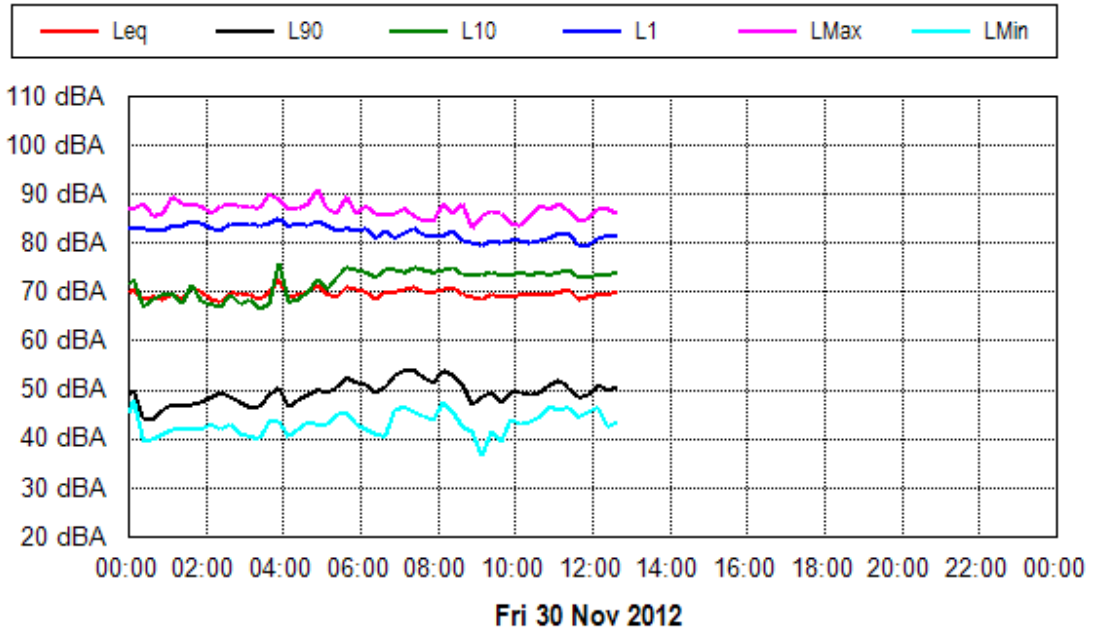
Project: W2G
Location: 3674 Pacific Highway
Filter: A
Criterion:



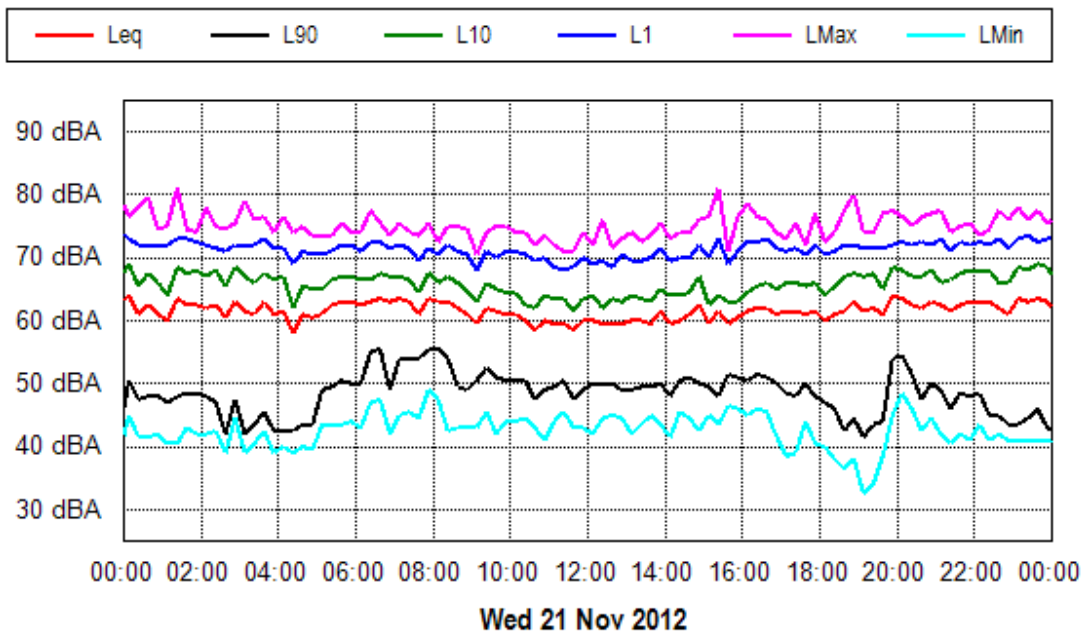
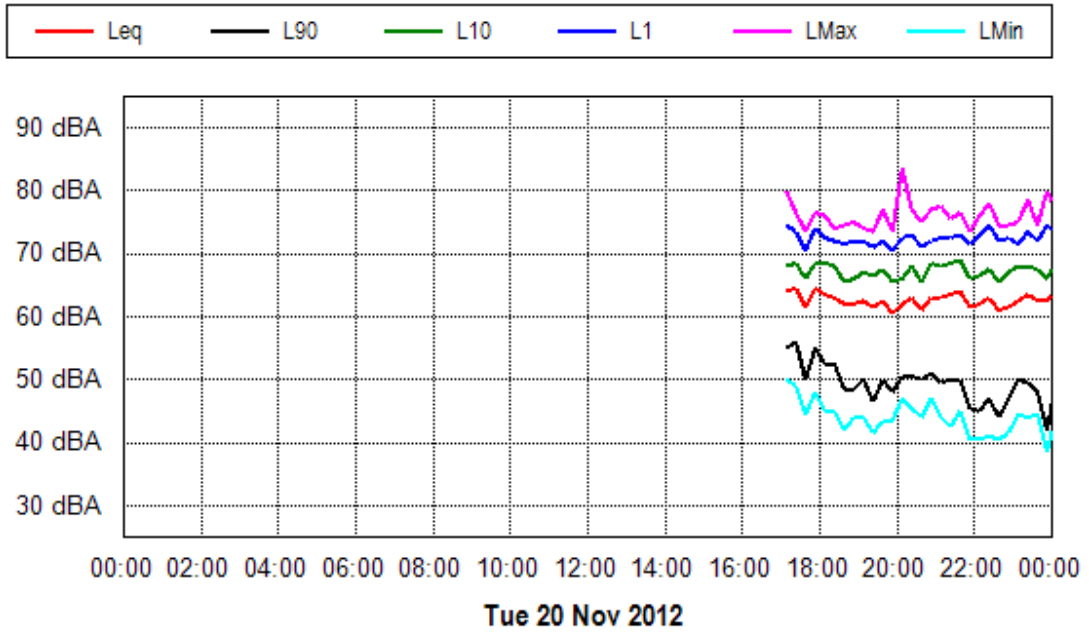
Project: W2G
Location: 3674 Pacific Highway
Filter: A
Criterion:



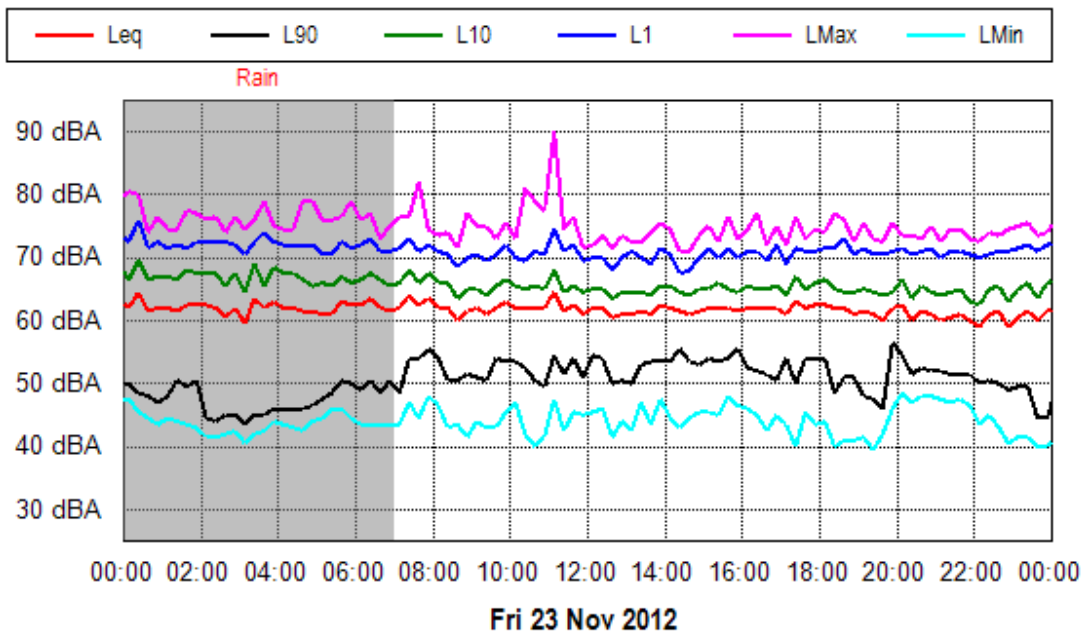
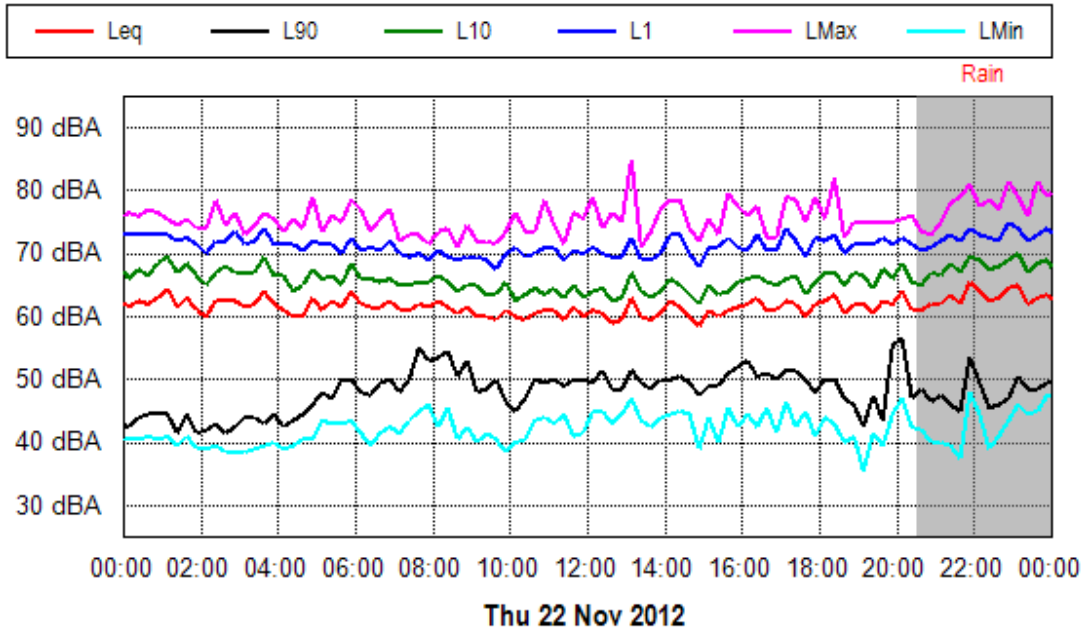
Project: W2G
Location: 3674 Pacific Highway
Filter: A
Criterion:



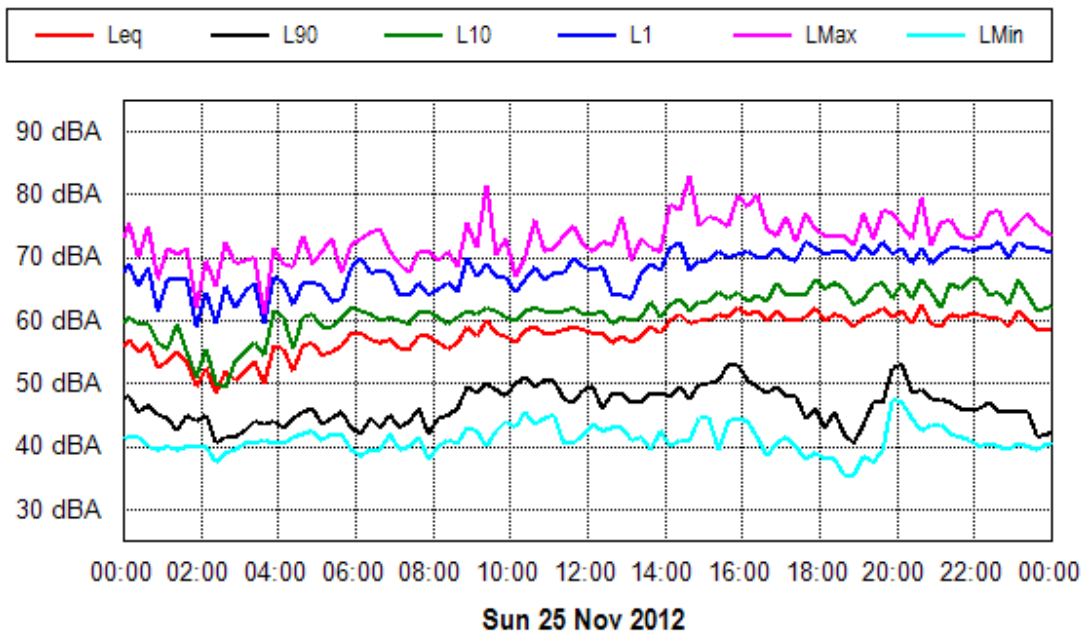
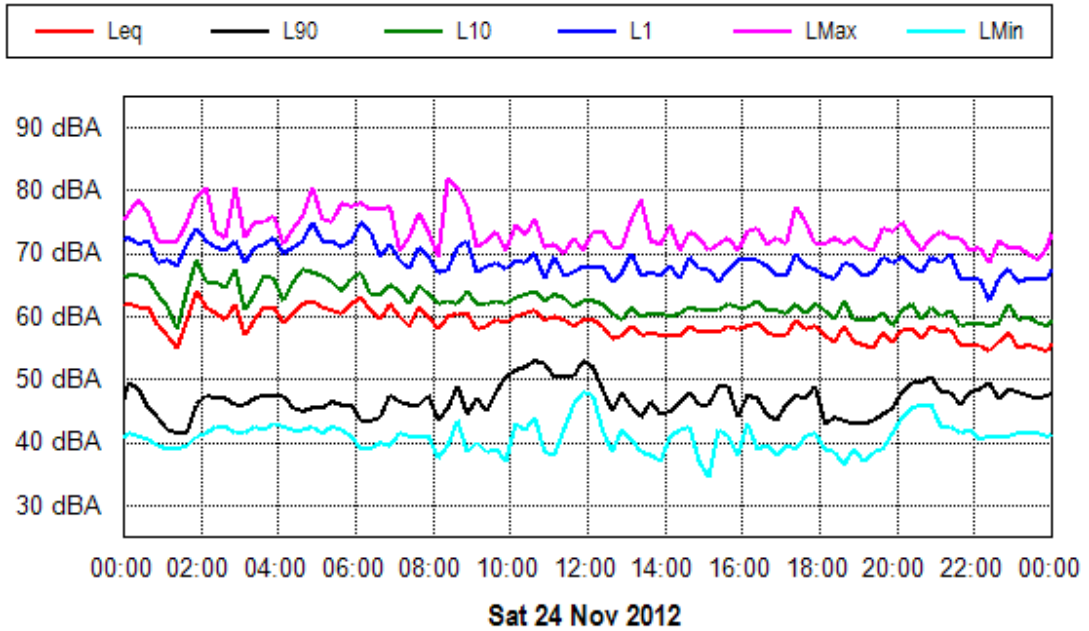
Project: W2G
Location: 4028 Pacific Highway
Filter: A
Criterion:



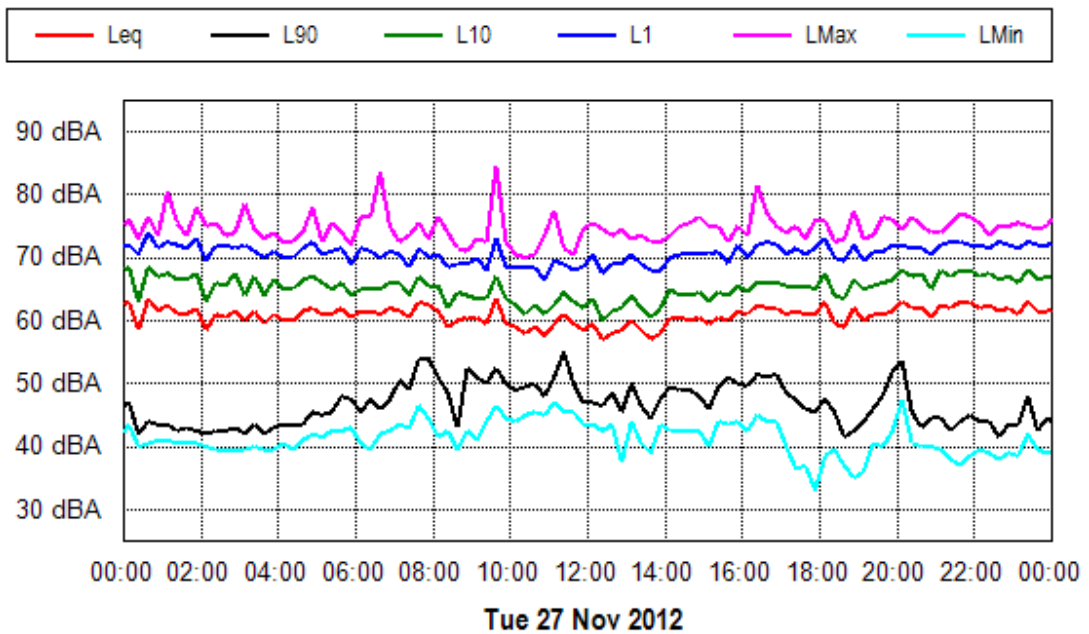
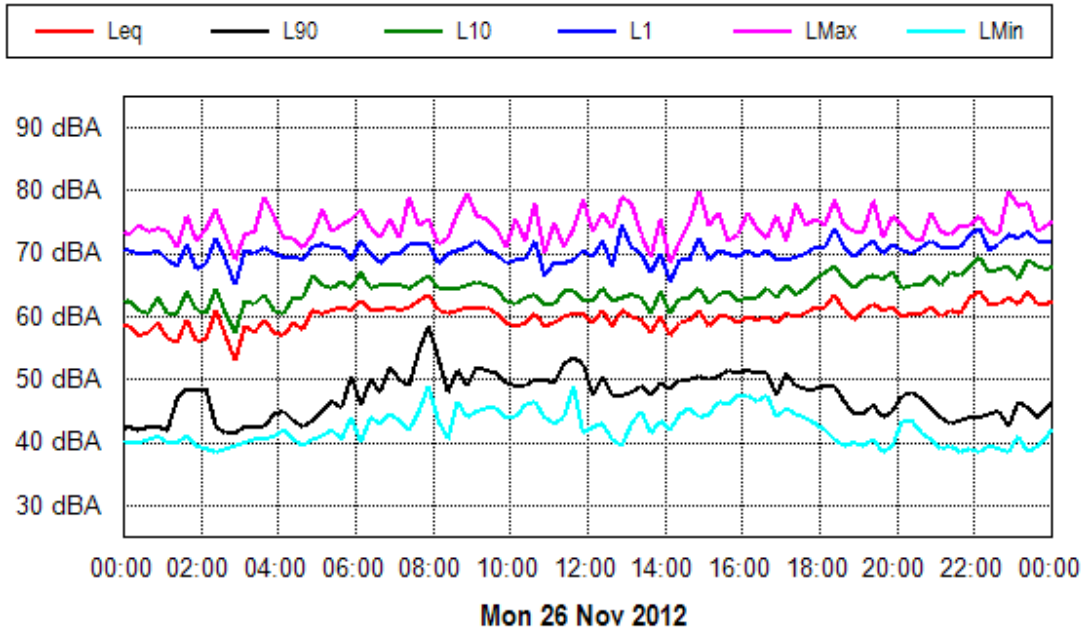
Project: W2G
Location: 4028 Pacific Highway
Filter: A
Criterion:



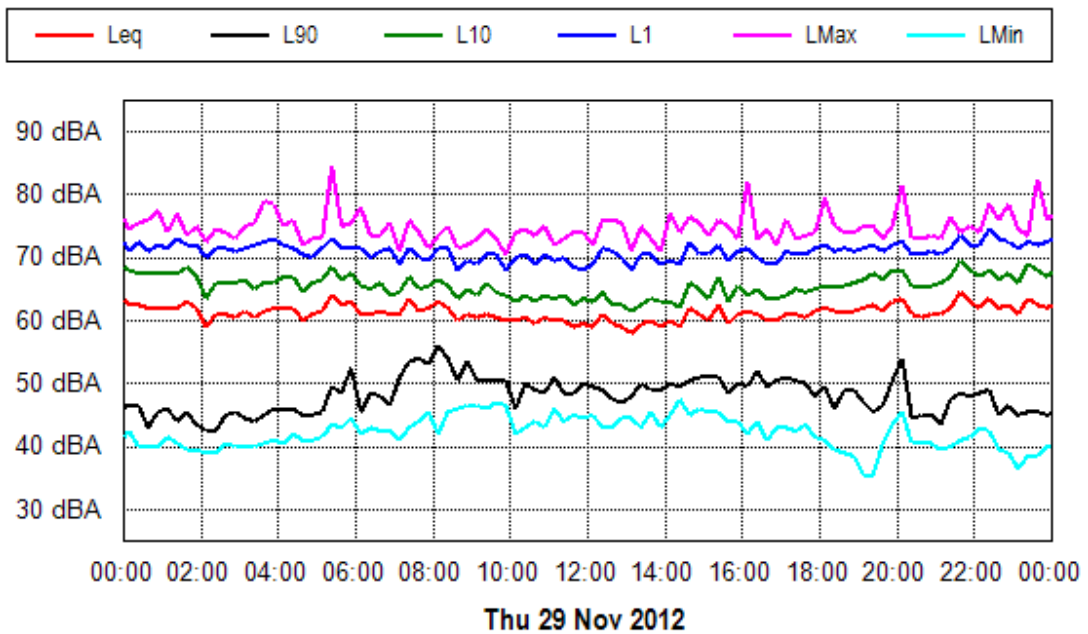
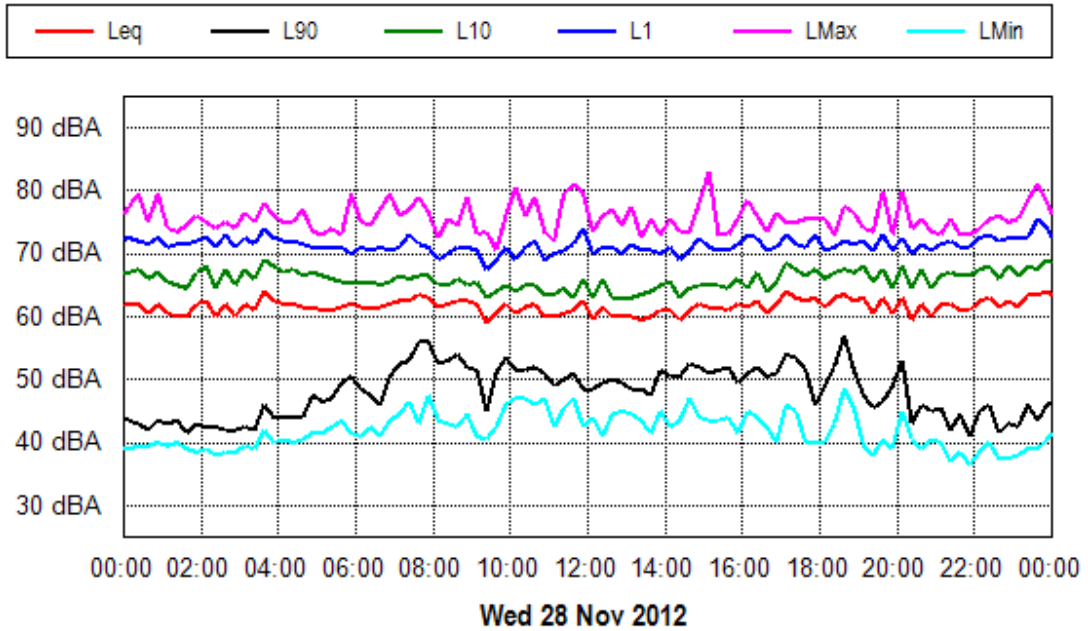
Project: W2G
Location: 4028 Pacific Highway
Filter: A
Criterion:



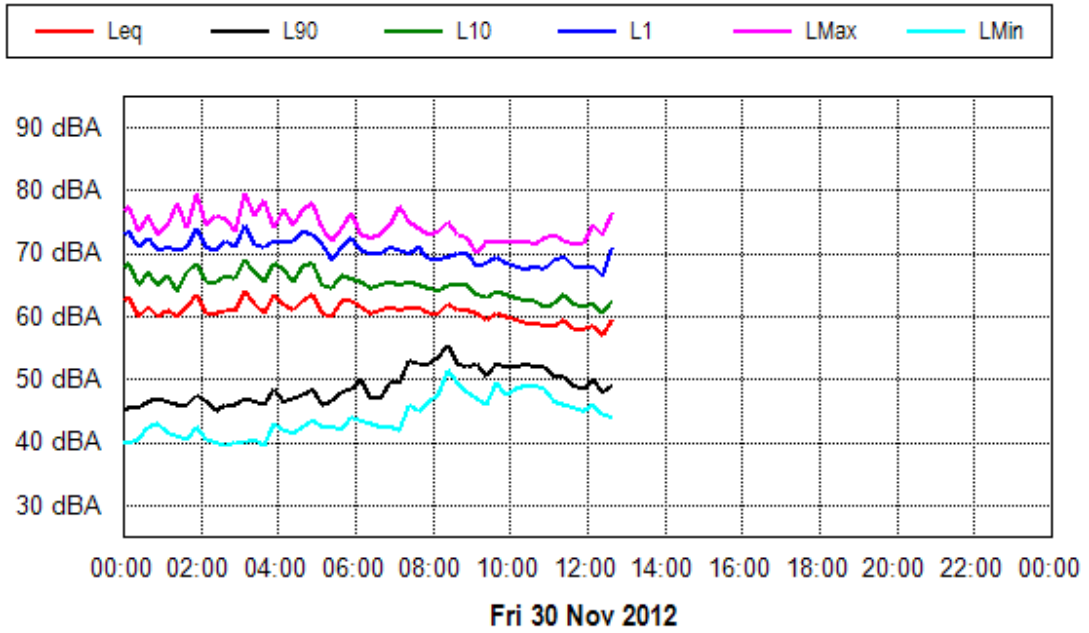
Project: W2G
Location: 4028 Pacific Highway
Filter: A
Criterion:



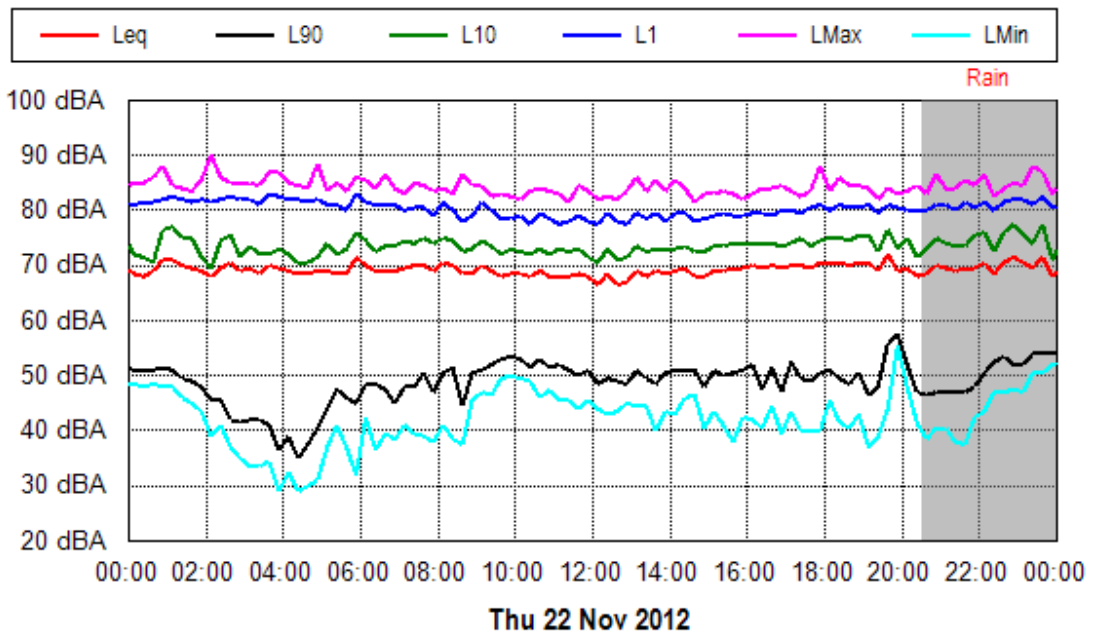
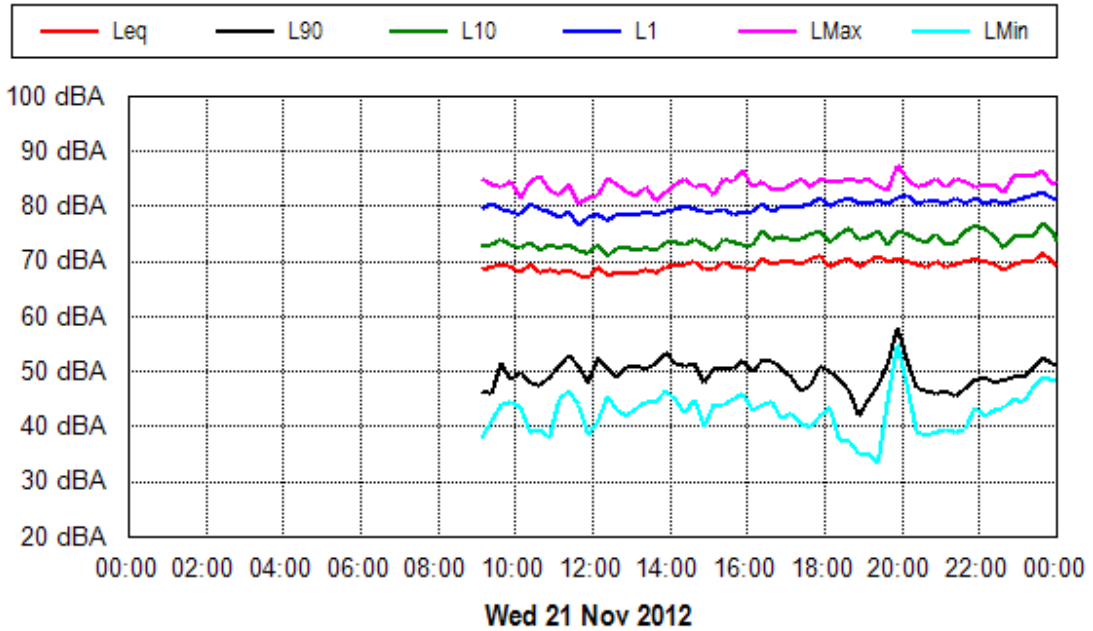
Project: W2G
Location: 4028 Pacific Highway
Filter: A
Criterion:



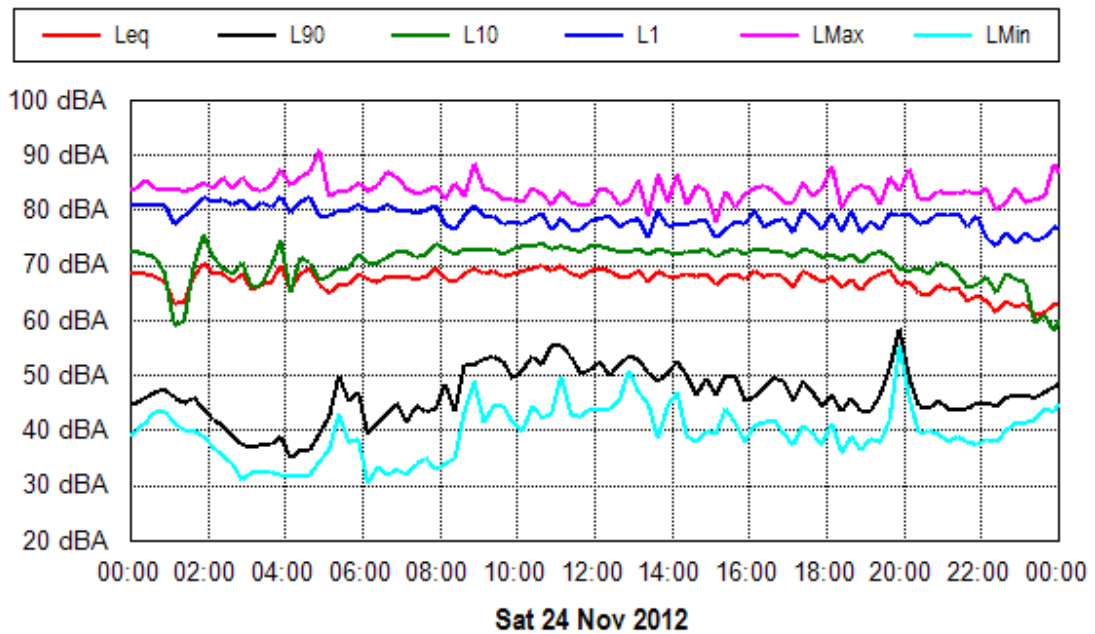
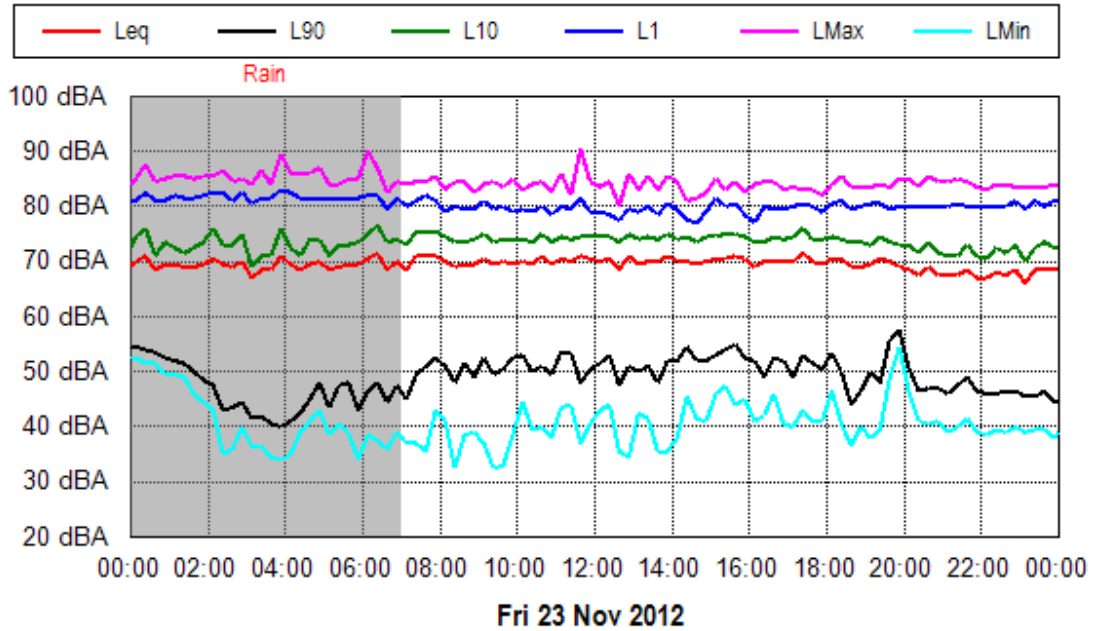
Project: W2G
Location: 4028 Pacific Highway
Filter: A
Criterion:



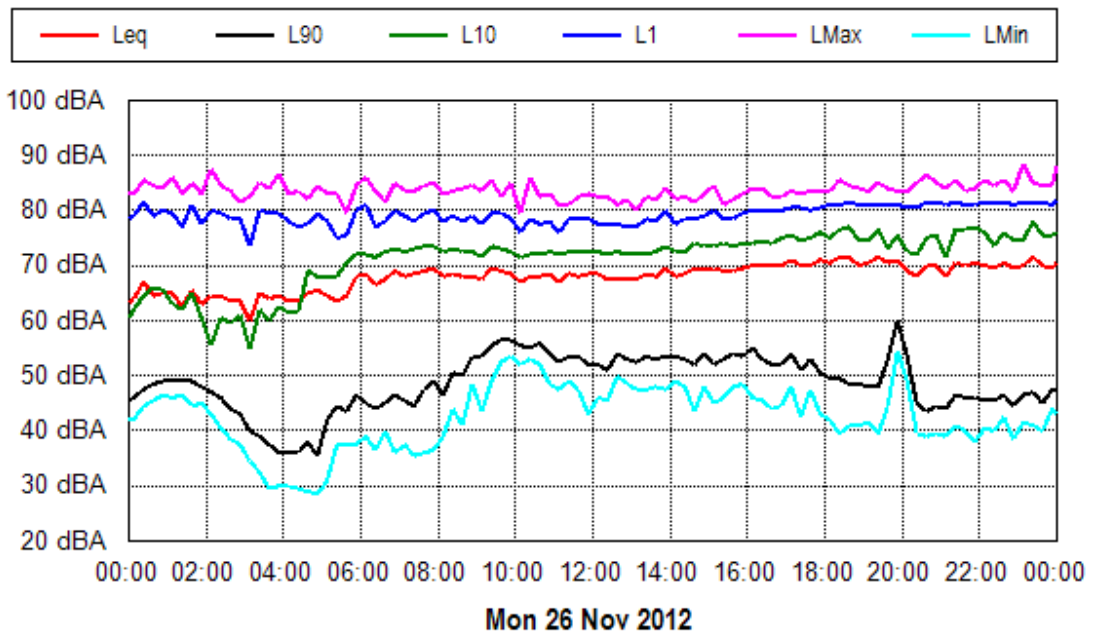
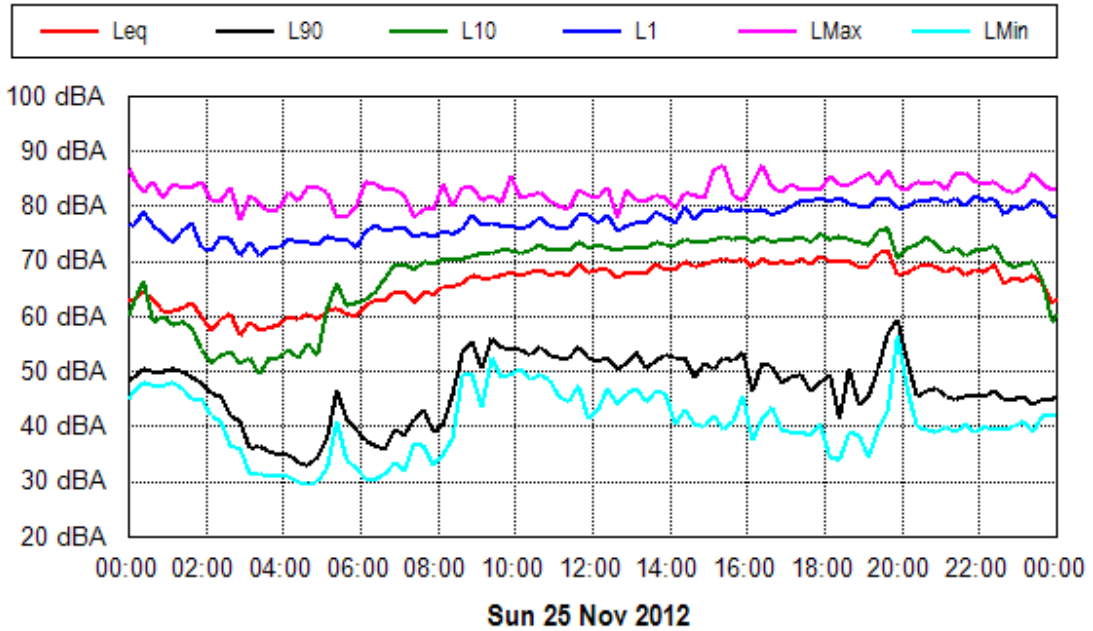
Project: W2G
Location: 11 Dunmar Lane (facade)
Filter: A
Criterion:



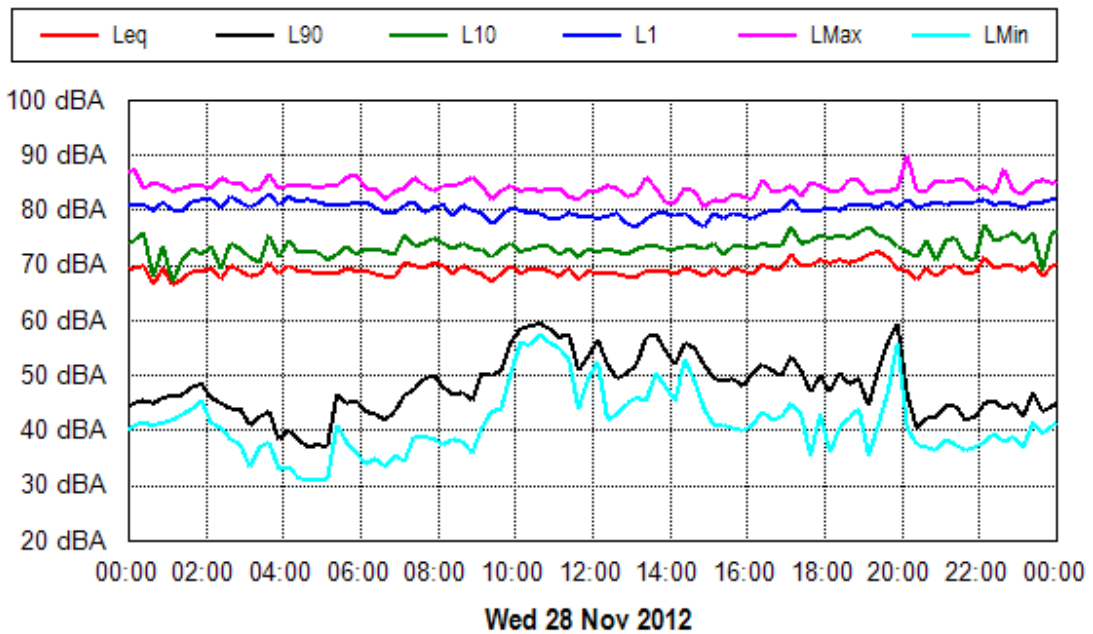
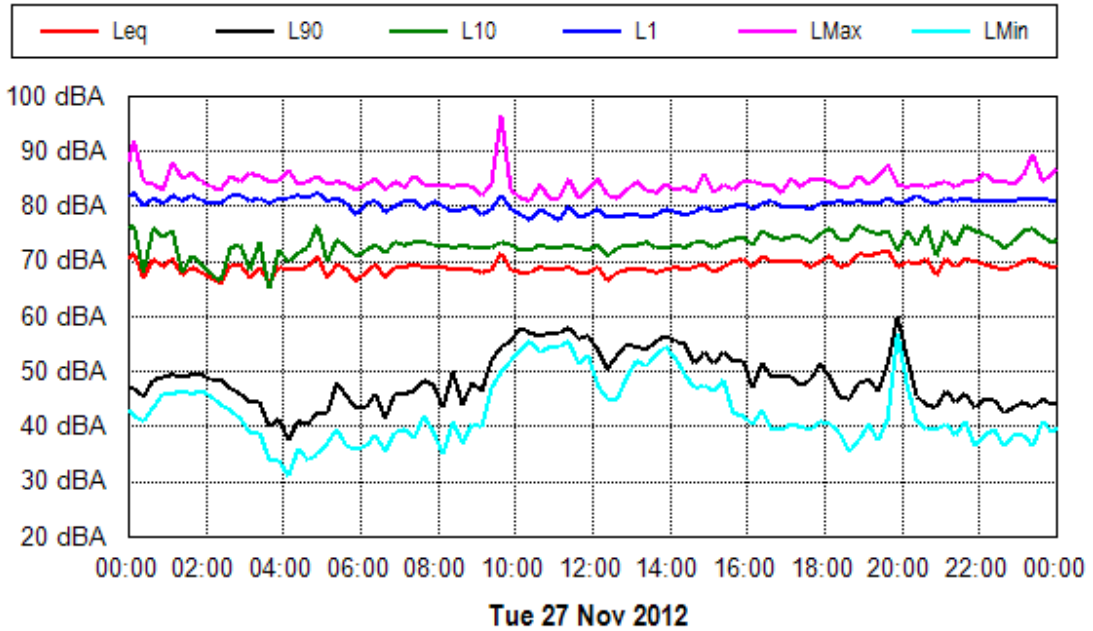
Project: W2G
Location: 11 Dunmar Lane (facade)
Filter: A
Criterion:



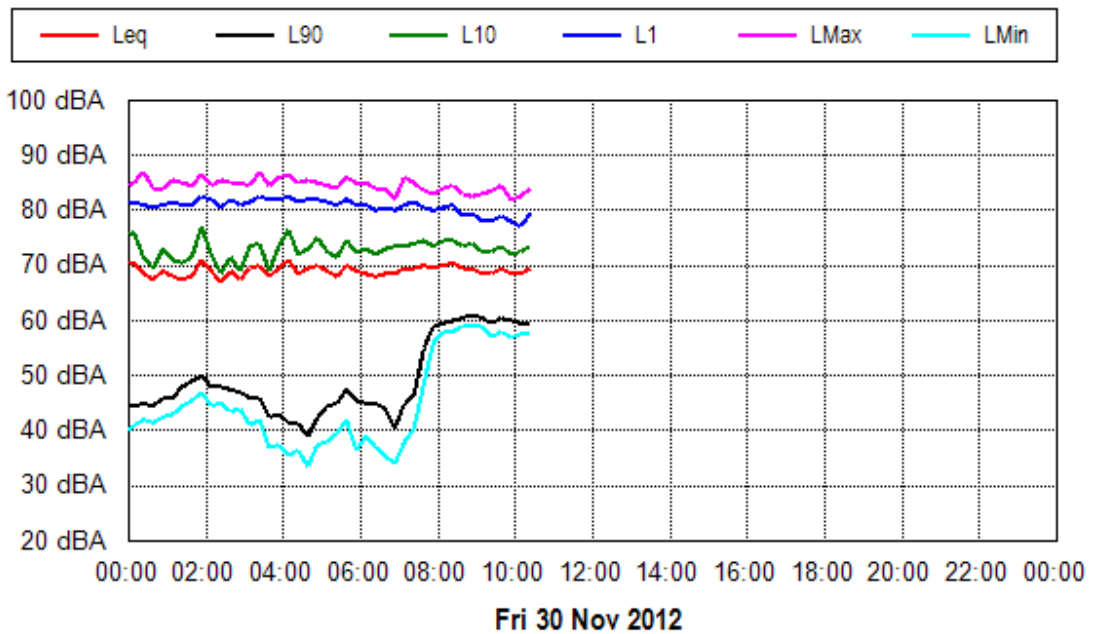
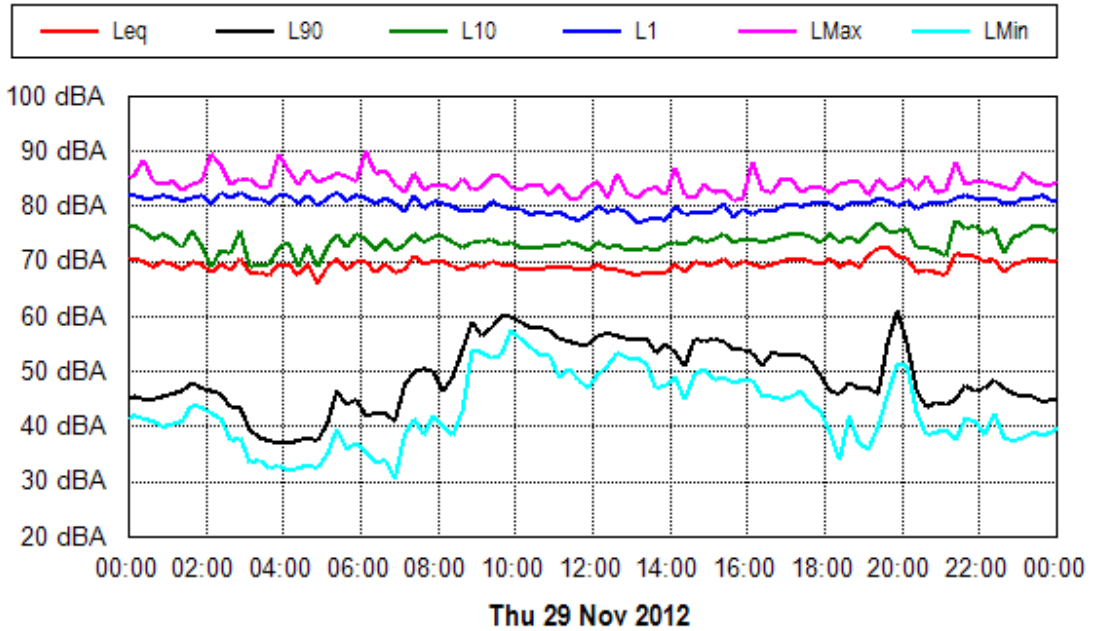
Project: W2G
Location: 11 Dunmar Lane (facade)
Filter: A
Criterion:



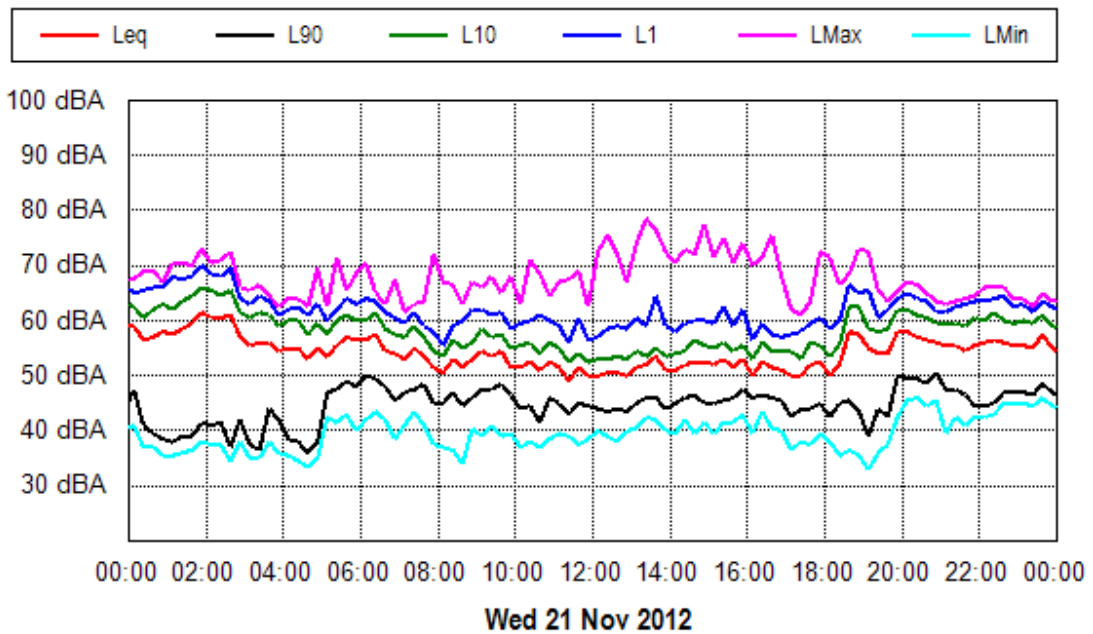
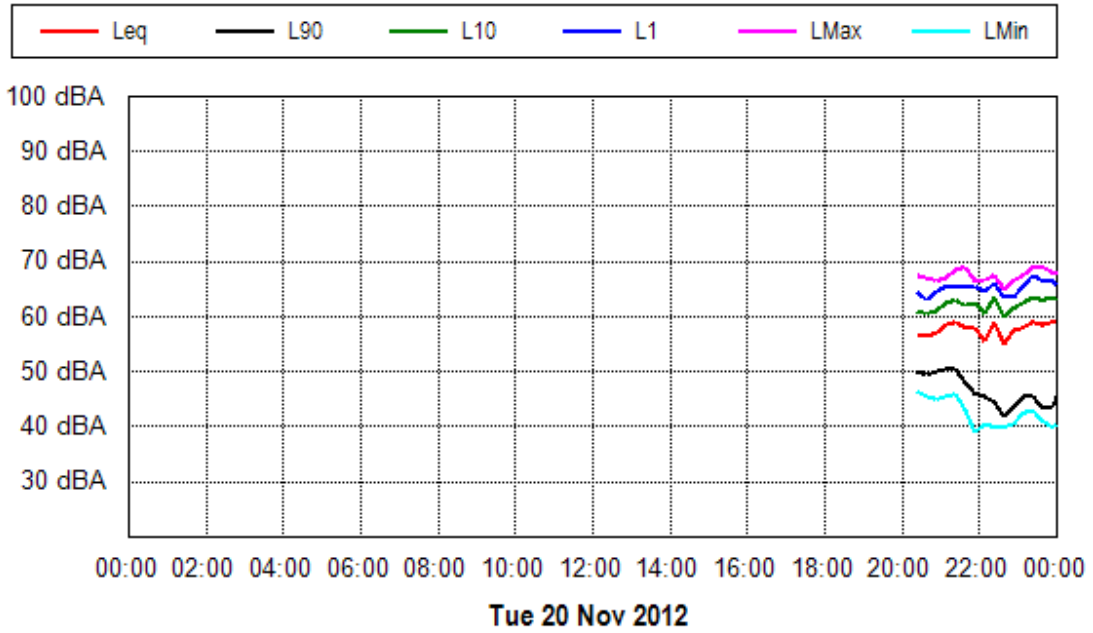
Project: W2G
Location: 11 Dunmar Lane (facade)
Filter: A
Criterion:



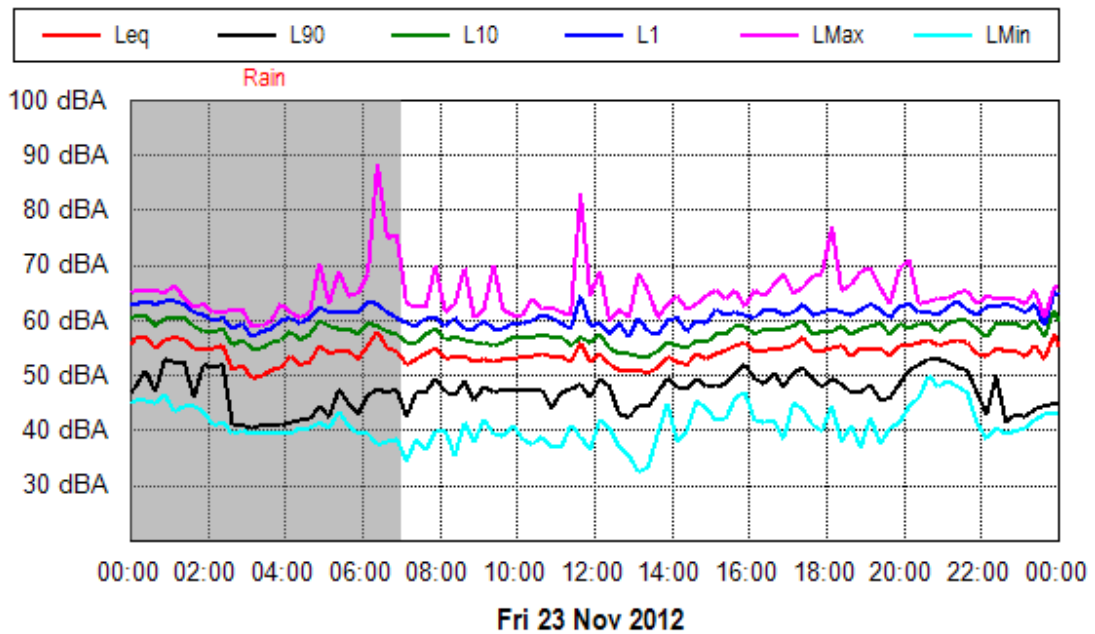
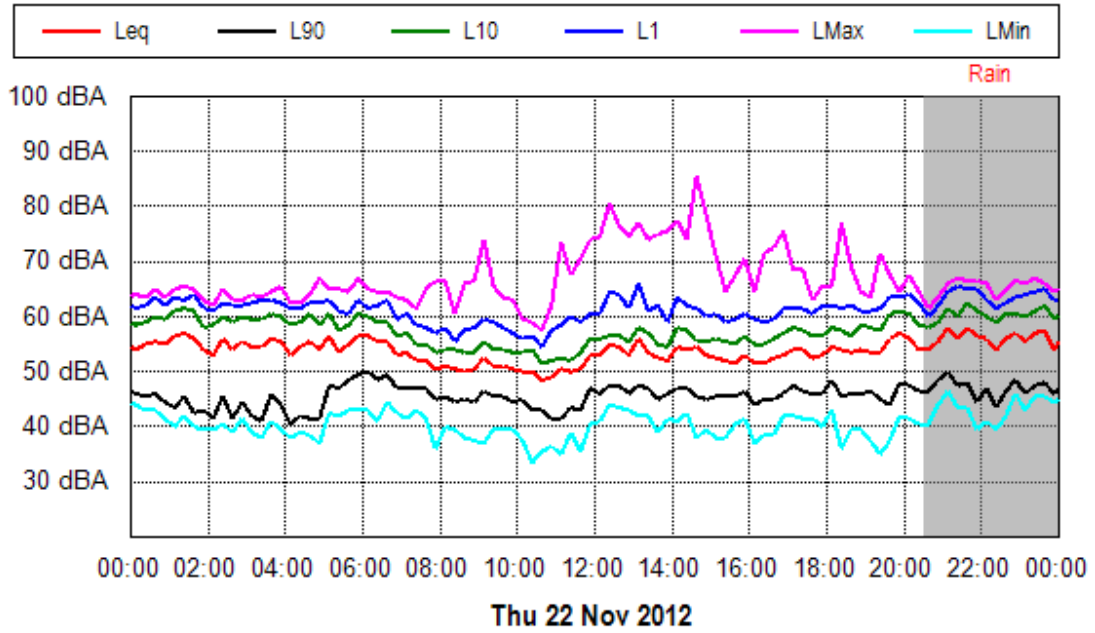
Project: W2G
Location: 11 Dunmar Lane (facade)
Filter: A
Criterion:



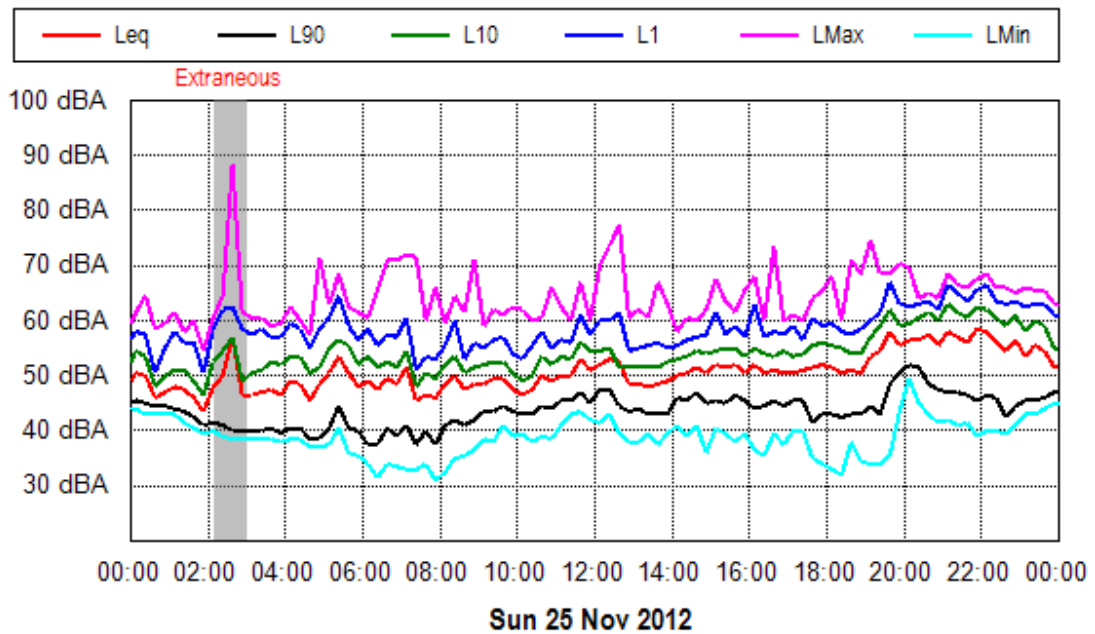
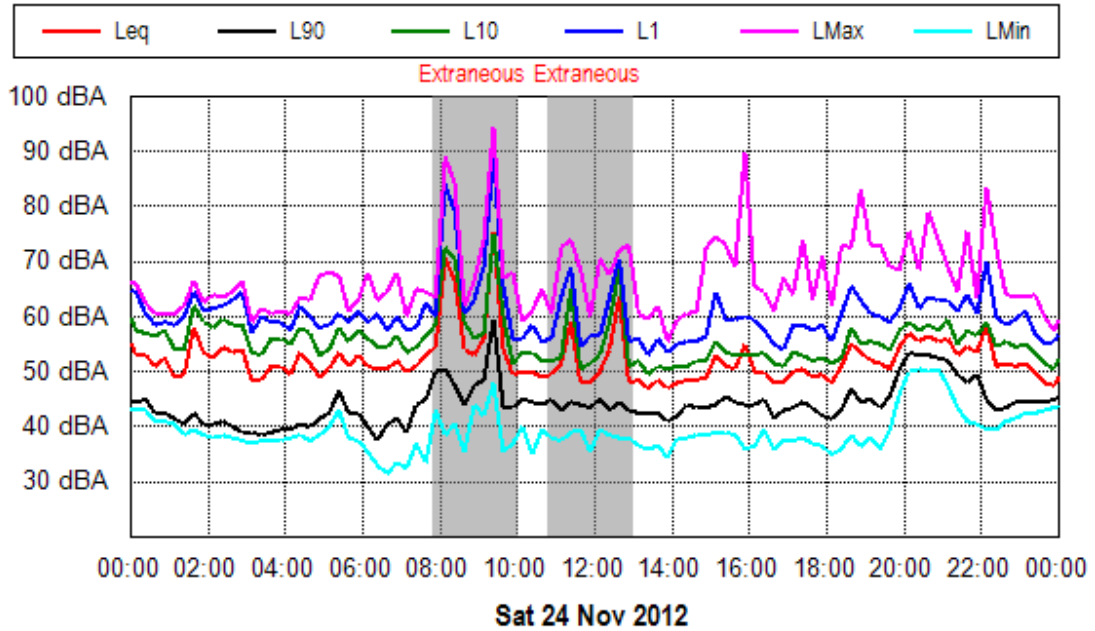
Project: W2G
Location: 5092 Pacific Highway
Filter: A
Criterion:



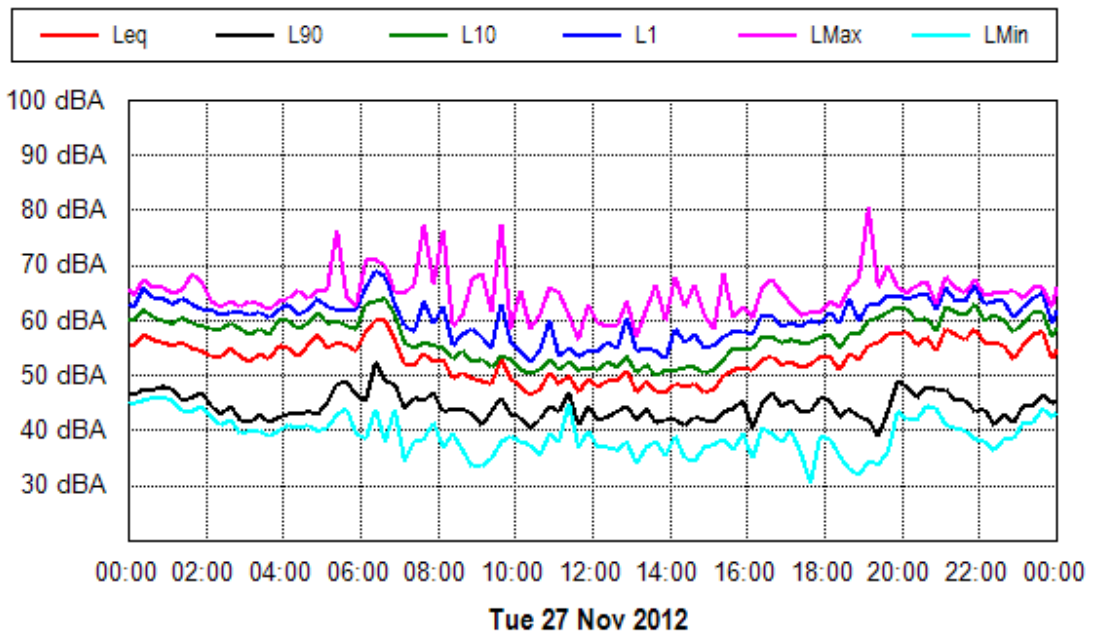
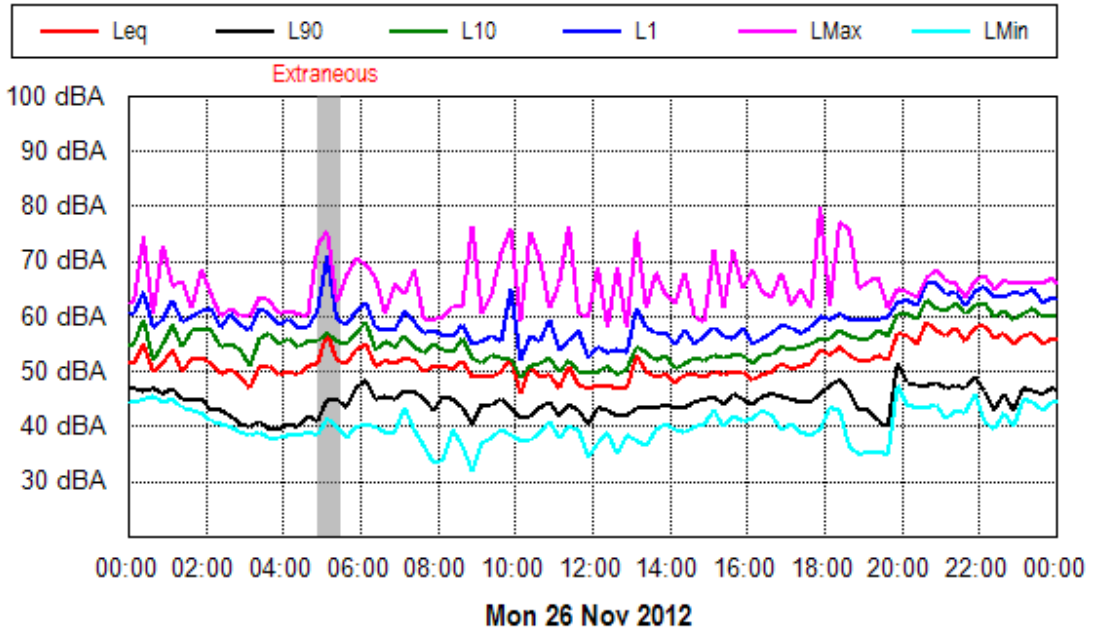
Project: W2G
Location: 5092 Pacific Highway
Filter: A
Criterion:



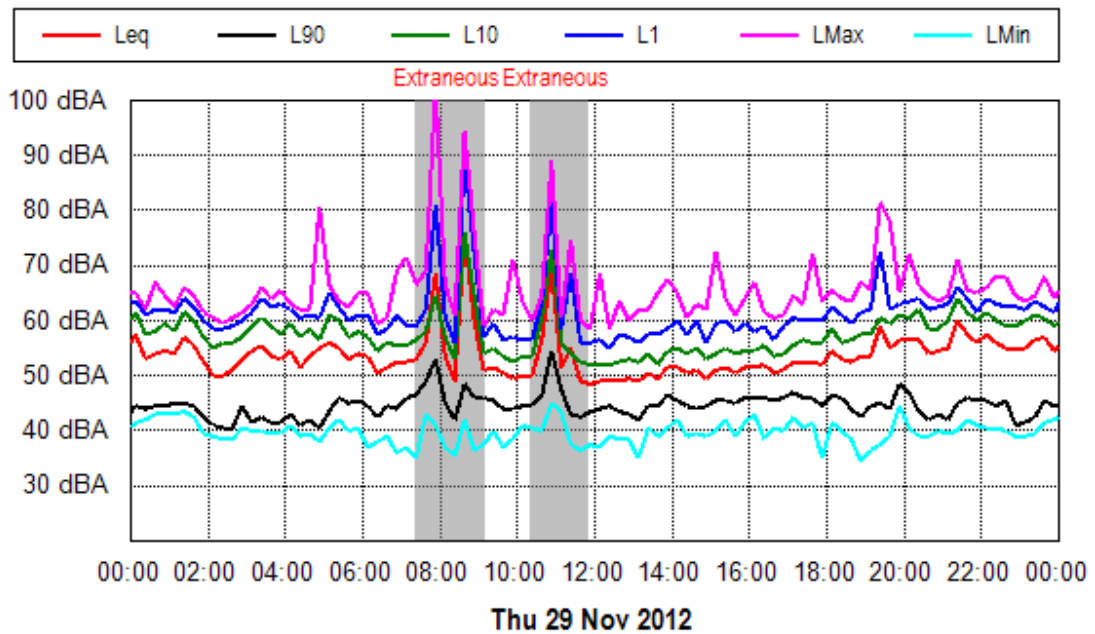
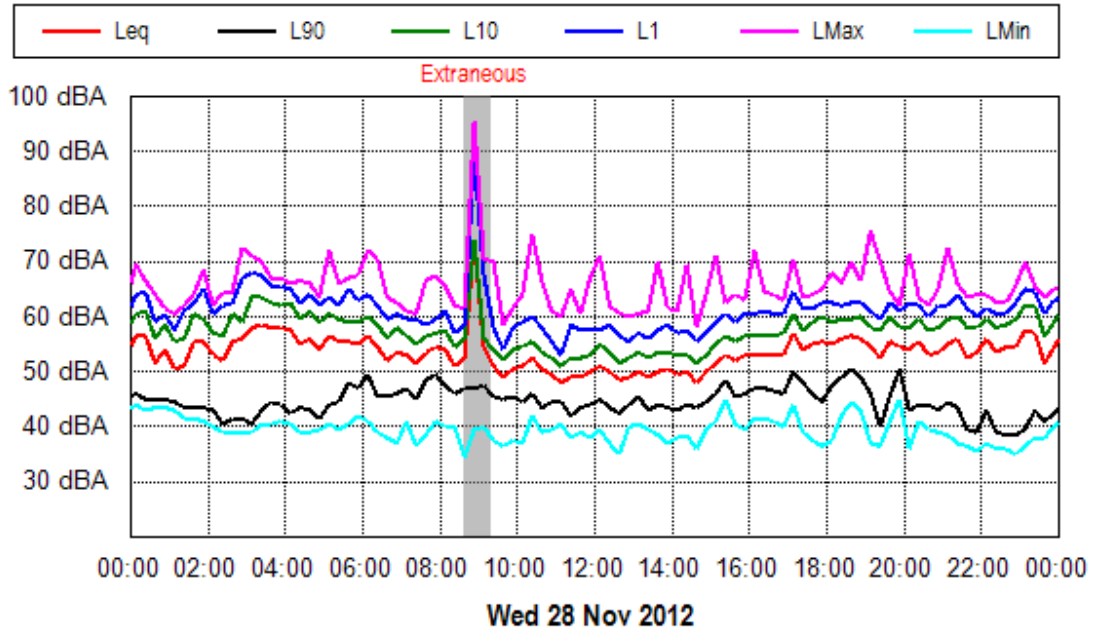
Project: W2G
Location: 5092 Pacific Highway
Filter: A
Criterion:



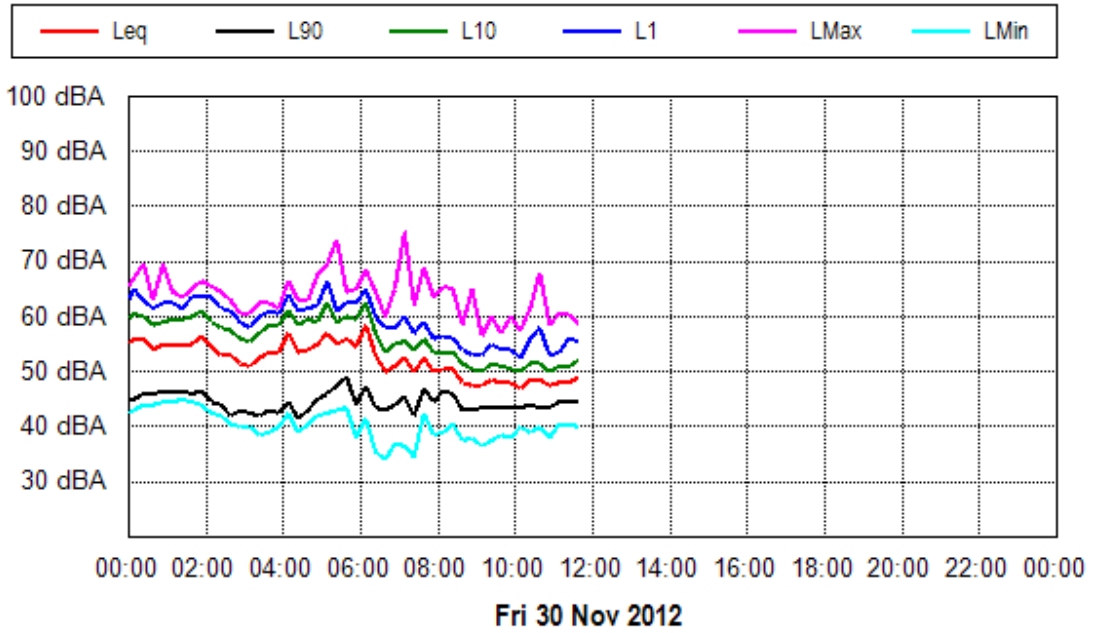
Project: W2G
Location: 5092 Pacific Highway
Filter: A
Criterion:



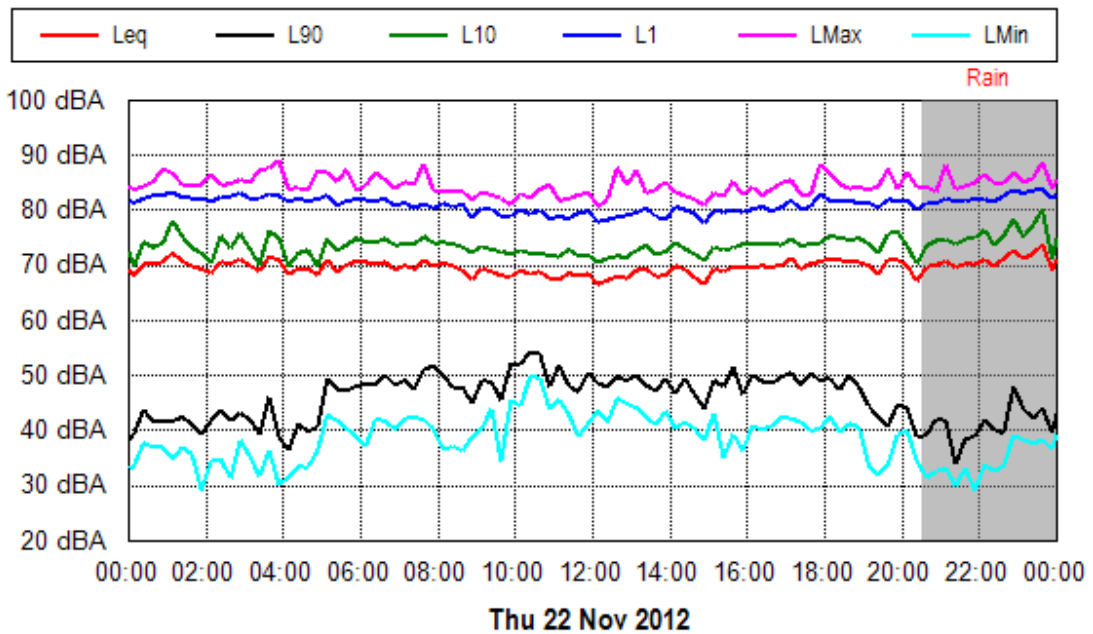
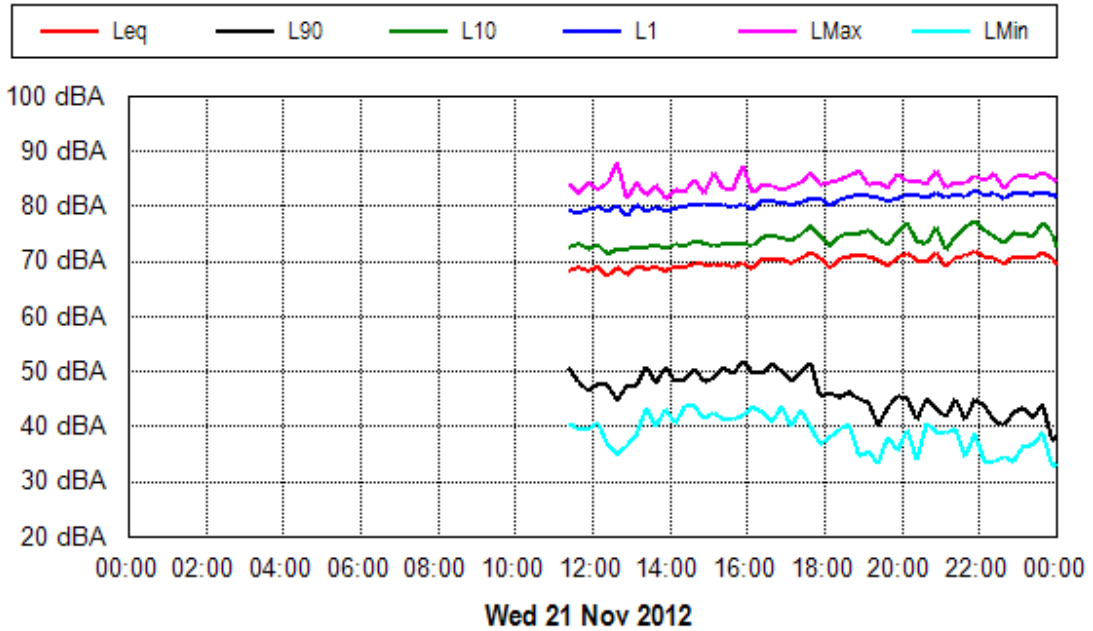
Project: W2G
Location: 5092 Pacific Highway
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Criterion:



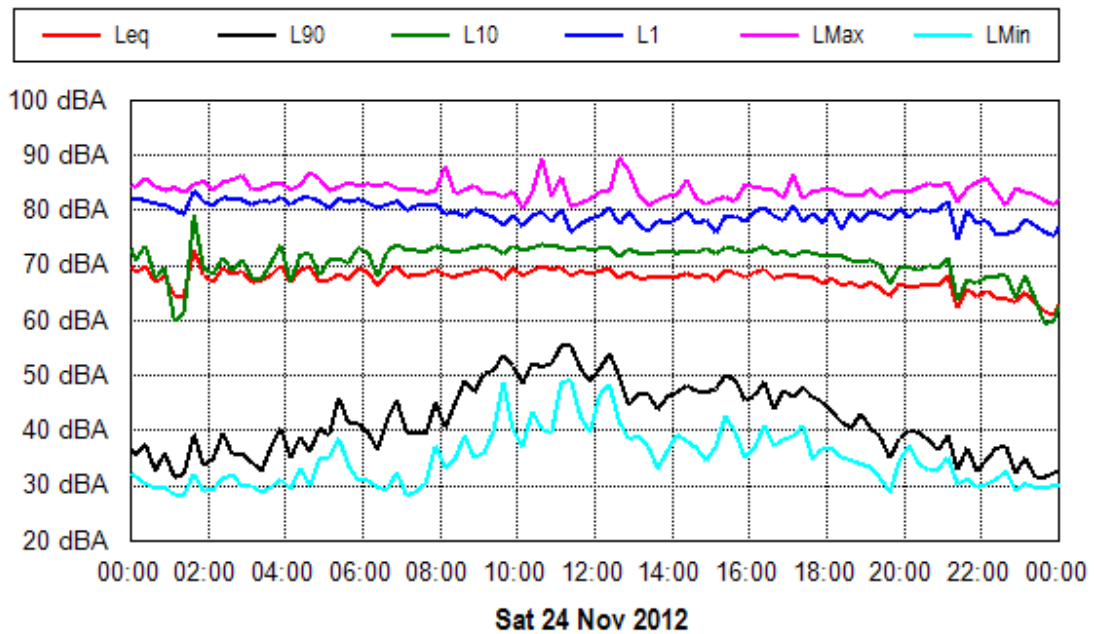
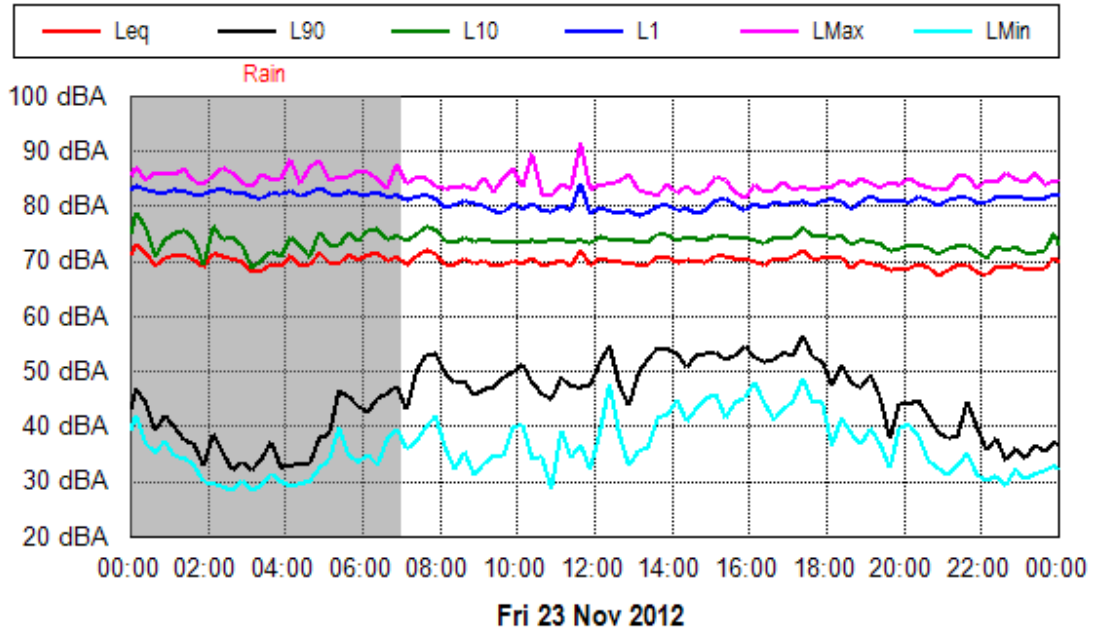
Project: W2G
Location: 5092 Pacific Highway
Filter: A
Criterion:



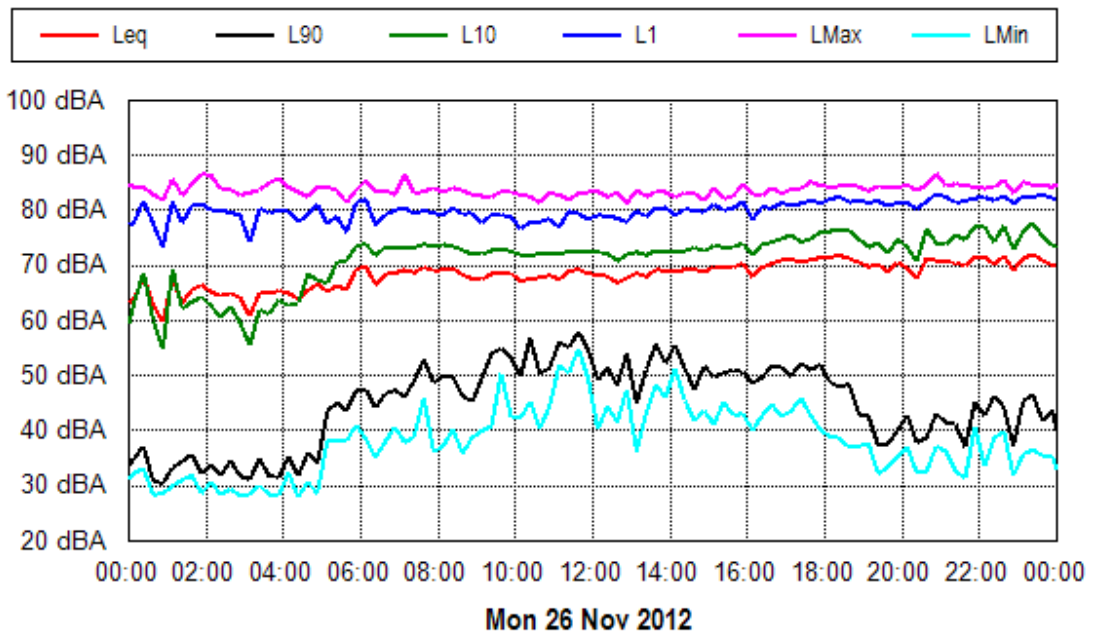
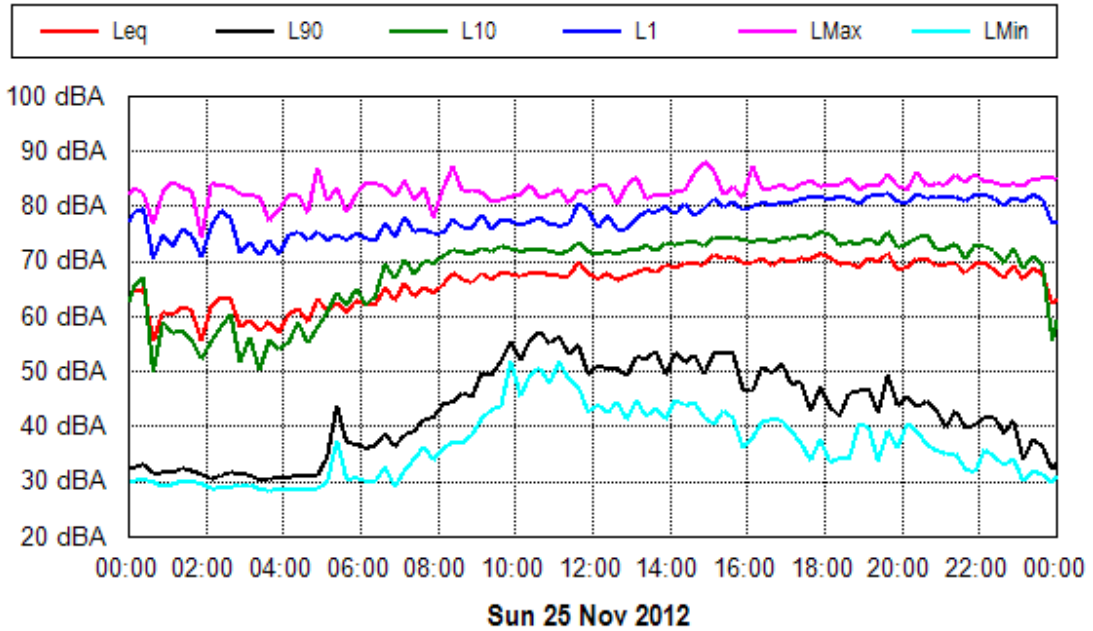
Project: W2G
Location: Side of road (Foliage)
Filter: A
Criterion:



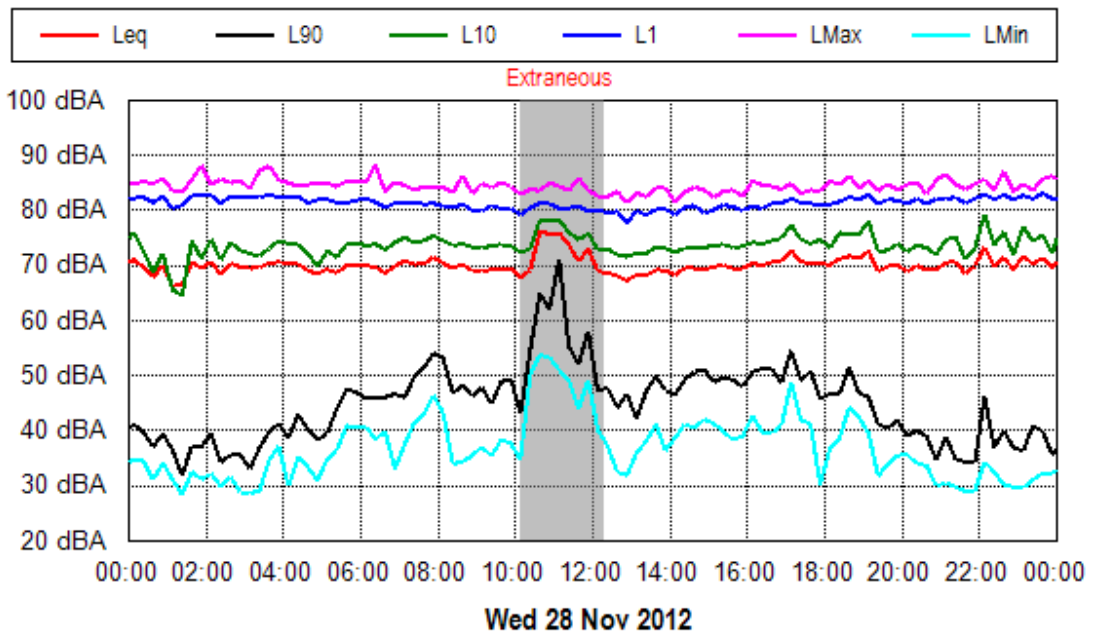
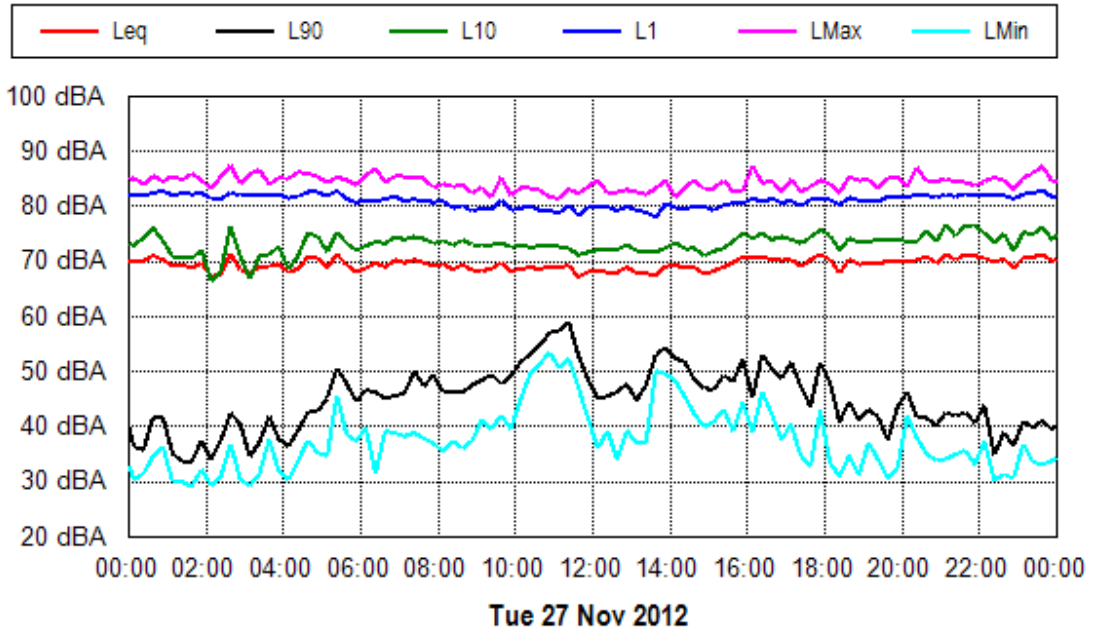
Project: W2G
Location: Side of road (Foliage)
Filter: A
Criterion:



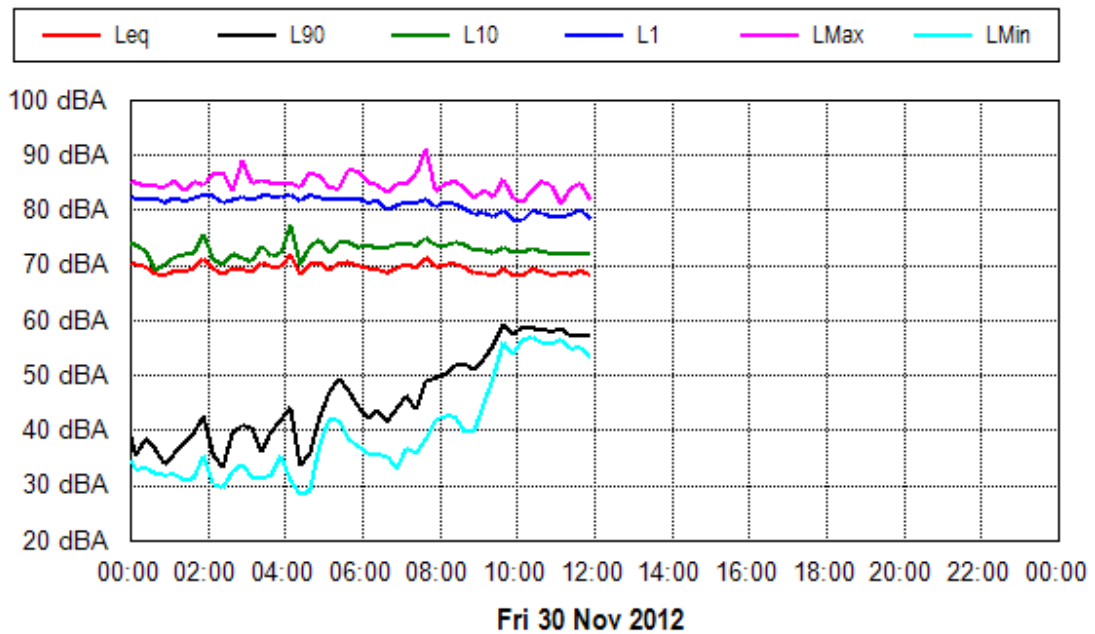
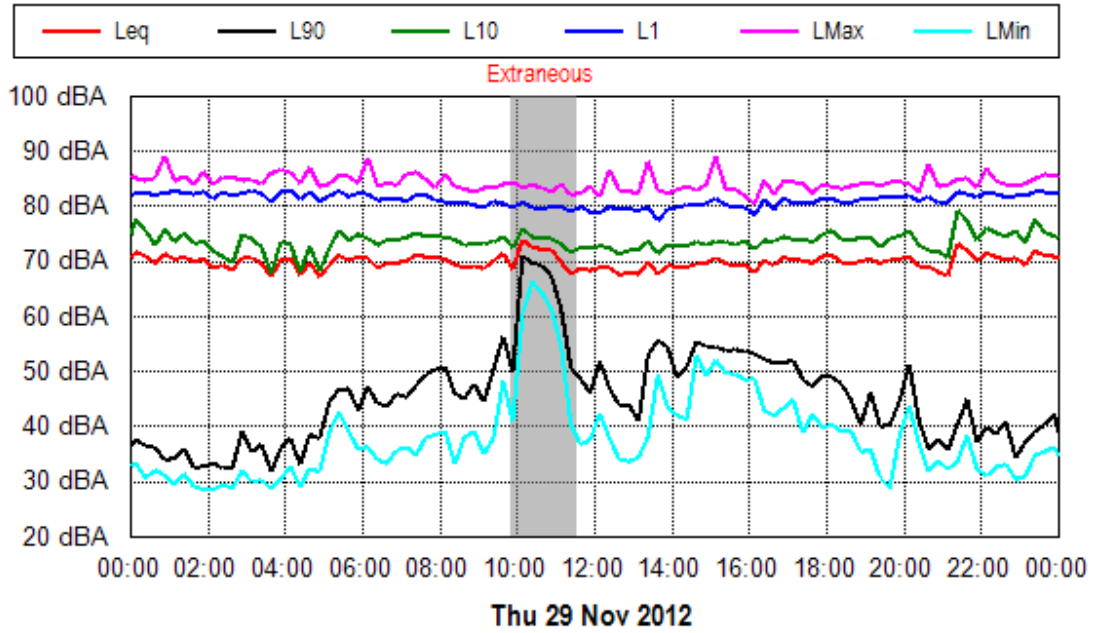
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Filter: A
Criterion:



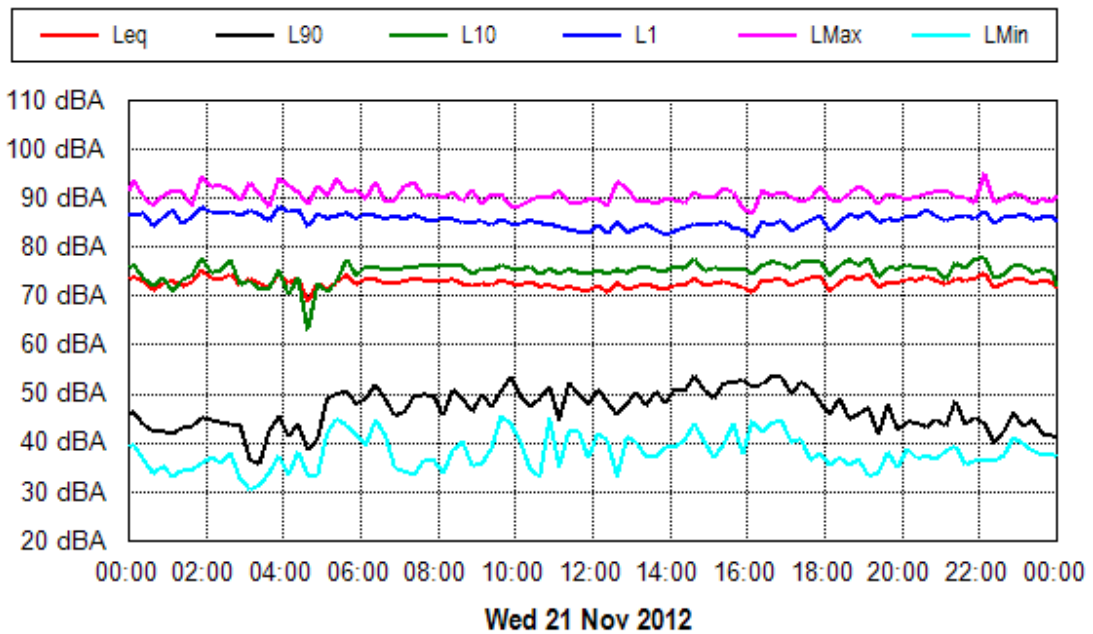
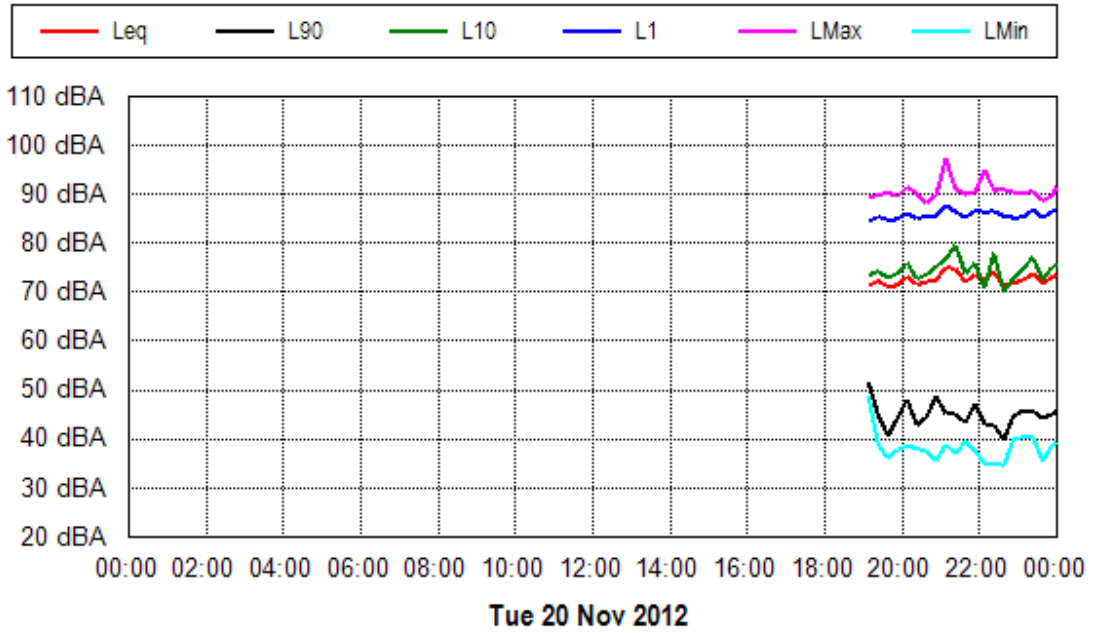
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Location: Side of road (Foliage)
Filter: A
Criterion:



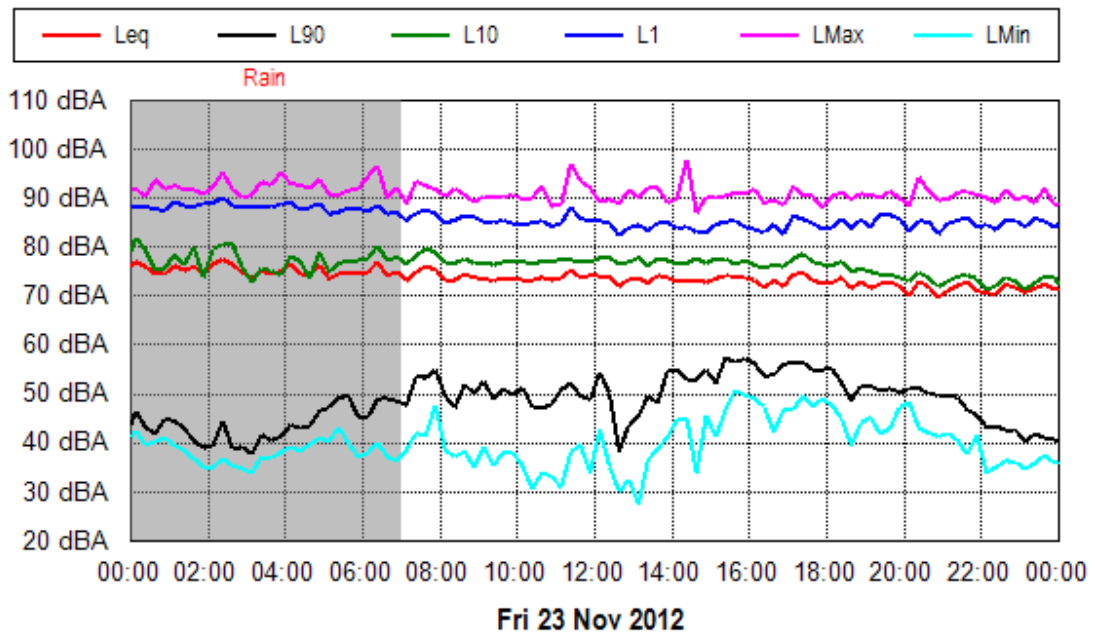
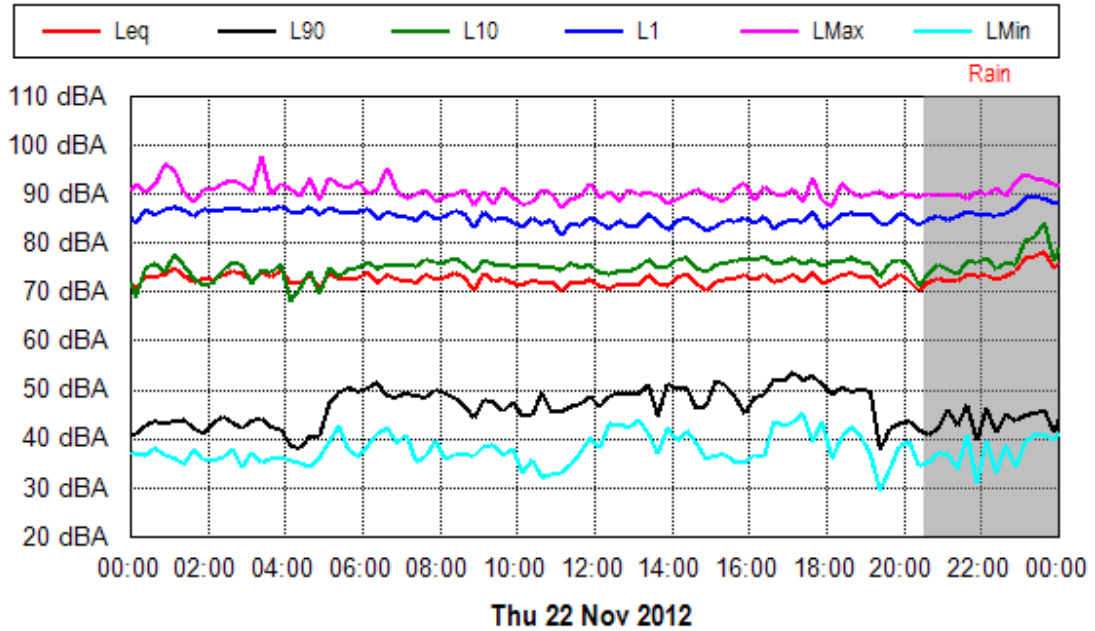
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Location: Side of road (Foliage)
Filter: A
Criterion:



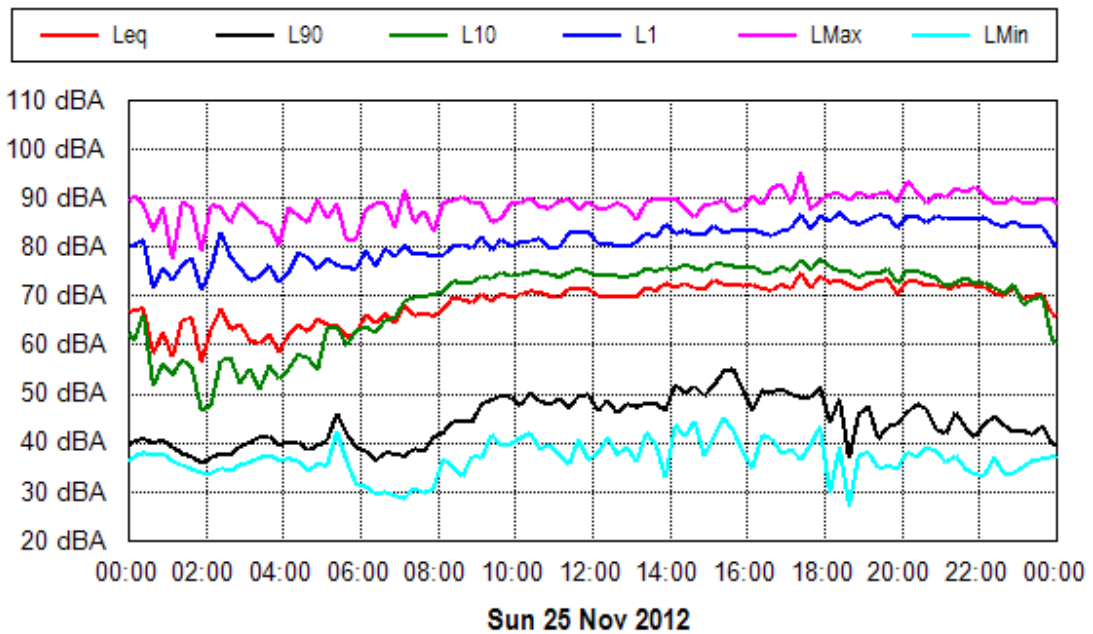
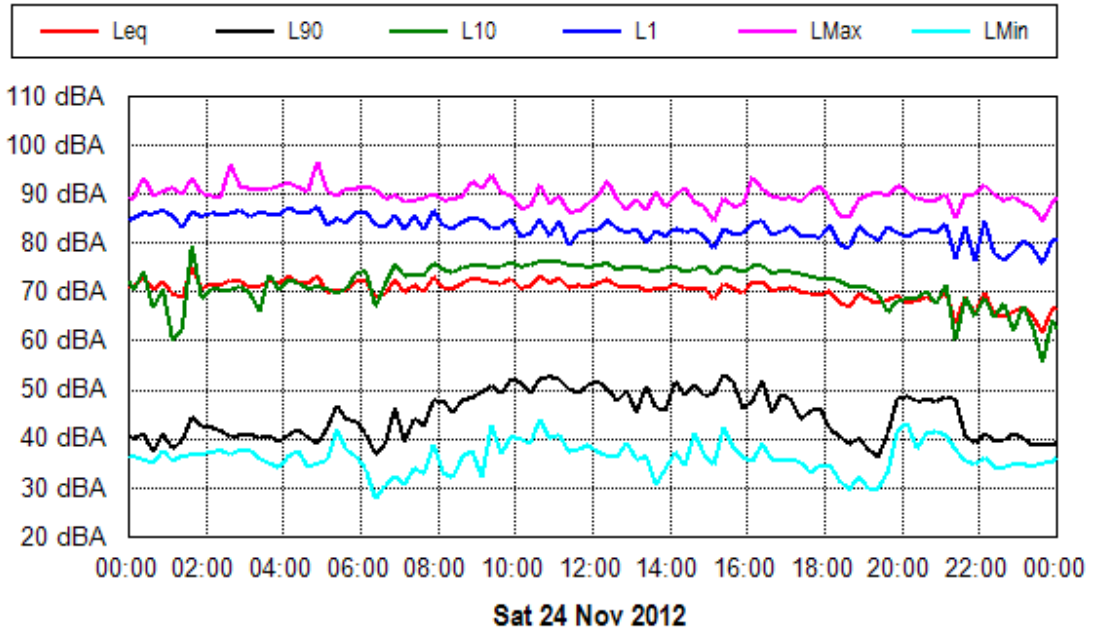
Project: W2G
Location: 5631 Pacific Highway
Filter: A
Criterion:



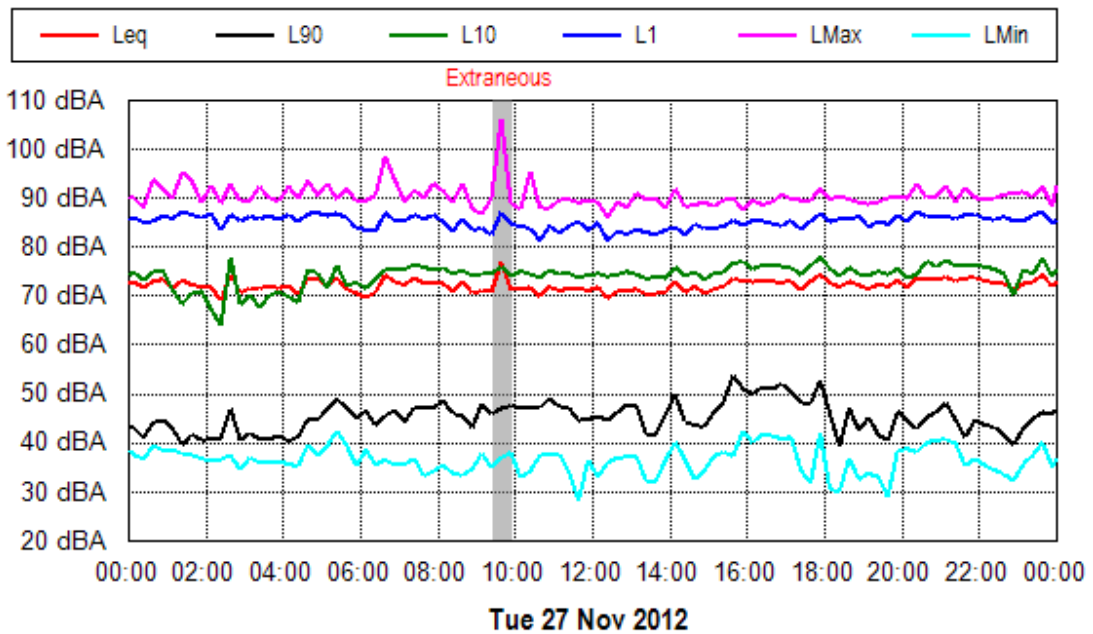
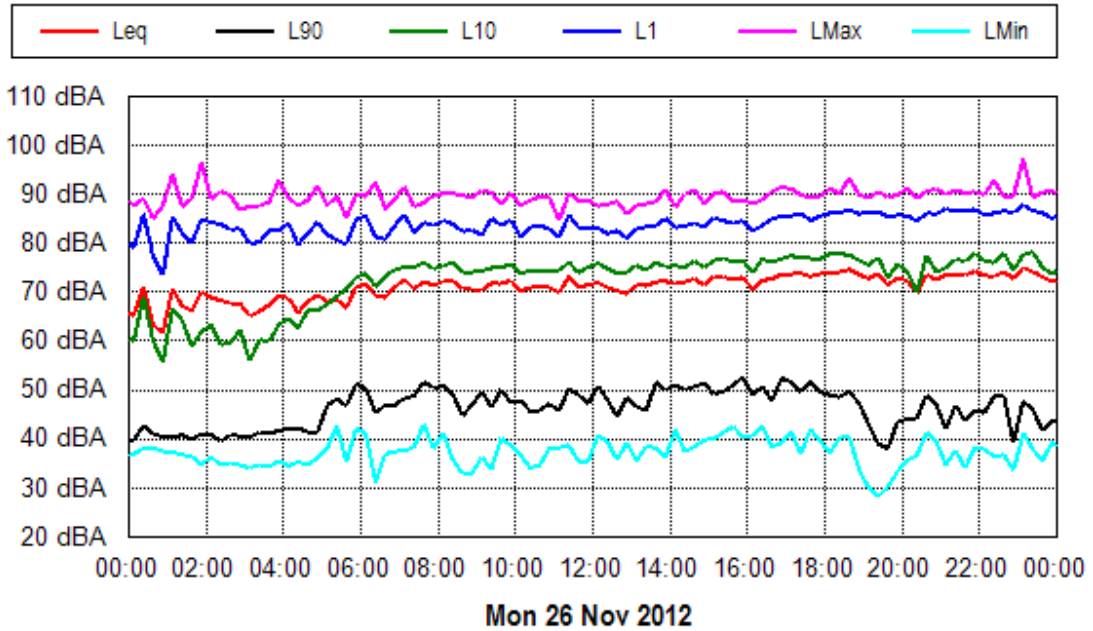
Project: W2G
Location: 5631 Pacific Highway
Filter: A
Criterion:



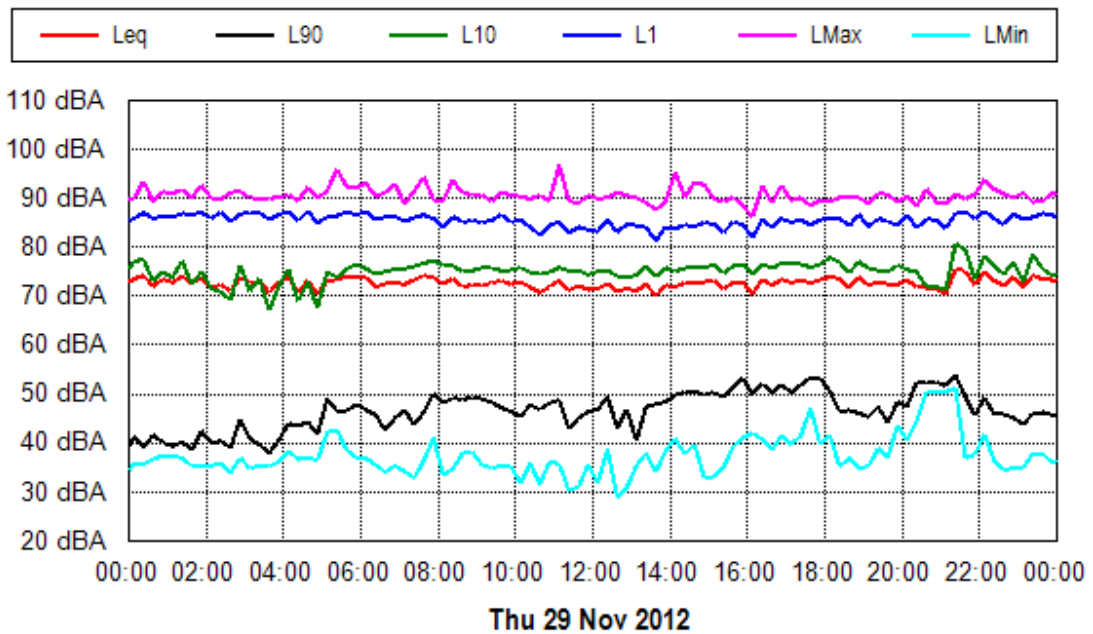
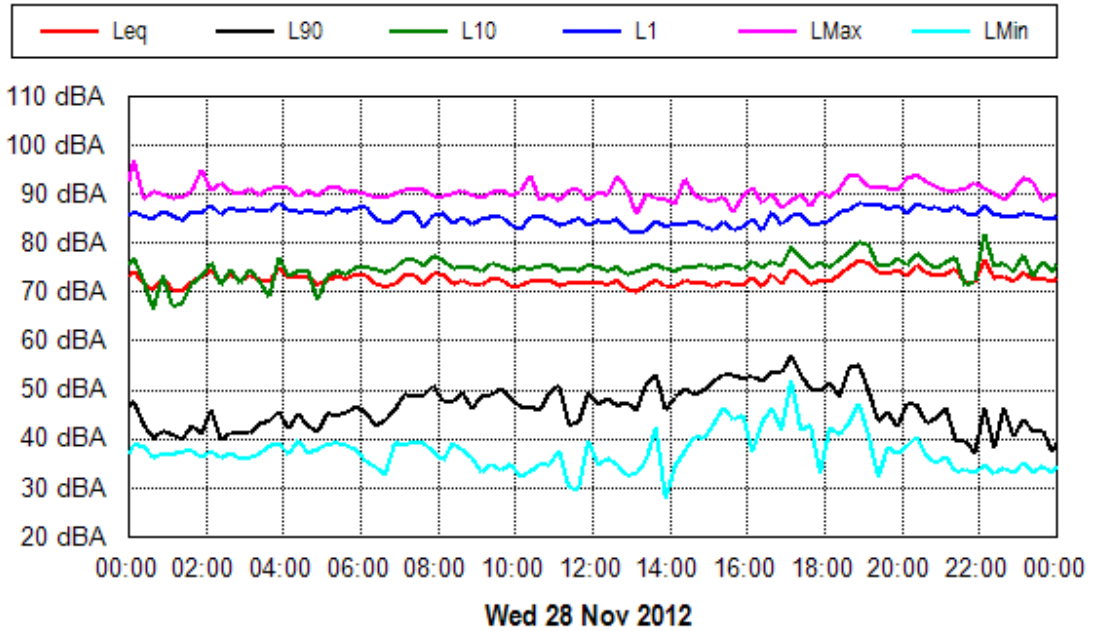
Project: W2G
Location: 5631 Pacific Highway
Filter: A
Criterion:



Project: W2G
Location: 5631 Pacific Highway
Filter: A
Criterion:



Project: W2G
Location: 5631 Pacific Highway
Filter: A
Criterion:



Project: W2G
Location: 5631 Pacific Highway
Filter: A
Criterion:

