Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project SEIS

Report for Updated Mine Noise and Vibration Assessment

18 October 2013

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Executive summary

Adani Mining Pty Ltd (Adani, the Proponent), commenced an Environmental Impact Statement (EIS) process for the Carmichael Coal Mine and Rail Project (the Project) in 2010. On 26 November 2010, the Queensland (Qld) Office of the Coordinator General declared the Project a 'significant project' and the Project was referred to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (referral No. 2010/5736). The Project was assessed to be a controlled action on the 6 January 2011 under section 75 and section 87 of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

Project components are as follows:

- The Project (Mine): a greenfield coal mine over EPC 1690 and the eastern portion of EPC 1080, which includes both open cut and underground mining, on mine infrastructure and associated mine processing facilities (the Mine) and the Mine (offsite) infrastructure including a workers accommodation village and associated facilities, a permanent airport site, an industrial area and water supply infrastructure
- The Project (Rail): a greenfield rail line connecting to mine to the existing Goonyella and Newlands rail systems to provide for the export of coal via the Port of Hay Point (Dudgeon Point expansion) and the Port of Abbot Point, respectively including:
  - Rail (west): a 120 km dual gauge portion running west, from the Mine site east to Diamond Creek
  - Rail (east): a 69 km narrow gauge portion running east from Diamond Creek connecting to the Goonyella rail system south of Moranbah.
  - Quarries: five local quarries to extract quarry materials for construction and operational purposes

The Project (Mine) has an expected operational life of 60 years during which a mixture of underground and open-pit mining operations will occur and significant dust generating potential exists.

The aim of the assessment was to determine potential noise and vibration impacts associated with the construction and operation of the open cut and underground mining areas, on mine infrastructure and associated mine processing facilities (the Mine) and the Mine (offsite) infrastructure including a workers accommodation village and associated facilities, a permanent airport site, an industrial area and water supply infrastructure

Acoustic modelling was undertaken using CadnaA Version 4.2 and implementing the CONCAWE algorithm to predict the effects of construction and operational related noise from the Project (Mine). The revised noise modelling was conducted for mining operation scenarios Year 2015, Year 2026, Year 2049 and Year 2071. Operational industrial noise from the Project (Mine) also includes noise generated from the proposed industrial precinct.

Noise model results indicate construction noise is not expected to cause any significant impacts at noise sensitive receptors. Results indicate that predicted construction noise levels outside of normal hours are expected to be well under the 55 dB(A) World Health Organisation criteria for sleep at all sensitive receptors. Vibration levels produced by construction activities within the mining boundary are expected to be well below the most stringent structural damage criteria of 3 mm/s at receptors located at distances greater than 50 metres.

Since the construction of the workers accommodation village will be staged, there is potential for dwellings that are already completed and habitable to be impacted by construction noise occurring in other uncompleted stages in the workers accommodation village. As such, there is potential for workers accommodation village building construction related noise impacts to occur during daytime hours when workers are sleeping. General in-principle mitigation measures are provided in Section 3.2.4 to assist with minimising noise impacts on residents located in the workers accommodation village.

Operational noise modelling results including low frequency noise and traffic noise indicate that received noise levels are expected to comply with the project specific criteria at all assessed sensitive receptors under assessed neutral and adverse weather conditions.

Predicted results indicate the estimated construction and operational noise level at the nearest potentially affected receptor due to vehicle movements along Elgin Moray Road is expected to be well under the Department of Transport and Main Roads (DTMR) 68 dB(A)$L_{10,18hr}$ criteria. Based on the provided traffic volumes, the buffer distance to comply with the criteria is approximately 45 m from the nearest edge of the road.

Vibration levels from blasting during removal of overburden and coal have been predicted to comply with the adopted blasting criteria. Air blast overpressure levels are also expected to comply with the criteria, however air blast overpressure levels are expected to approach the criteria at sensitive receptors 4 (Lignum) and 6 (Doongmabulla). It is recommended that blast monitoring be conducted during the initial blasts to assist with the optimisation of the blast parameters and confirmation of predictions.

Aircraft noise was assessed with reference to *AS2021 Acoustics Aircraft noise intrusion-Building siting and construction (2000)*. Aircraft noise levels at sensitive receptors fall below the indoor design sound levels (50 dB(A) to 60 dB(A)) for existing buildings and below <80 dB(A) to <85 dB(A) for new building sites. Hence, noise mitigation measures are not specifically required against aircraft noise at the sensitive receivers.

Based on available literature it is unlikely that any adverse impacts on livestock and native fauna would be associated with the Project (Mine) (see SEIS Volume 4 Appendix J1 Mine Terrestrial Ecology Report). As such, mitigation measures are not recommended.

Although adverse noise impacts are not predicted, a range of management measures are provided in this report as corrective actions if noise impacts do occur and/or valid noise-related complaints are received.

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Abbreviations and glossary

Project Specific Terminology	
Abbreviation	Term
the SEIS	Carmichael Coal Mine and Rail Project Supplementary Environmental Impact Statement
the Project	Carmichael Coal Mine and Rail Project
the Proponent	Adani Mining Pty Ltd

Generic Terminology	
Abbreviation	Term
Air blast overpressure	The energy transmitted from the blast site within the atmosphere in the form of pressure waves. The maximum excess pressure in this wave is known as the peak air overpressure, generally measured in decibels using linear frequency weighting.
Blasting	The use of explosives to fracture rock, coal or other materials for later recovery
CHPP	Coal handling process plant
dB	Decibel is the unit used for expressing the sound pressure level (SPL) or power level (SWL) in acoustics.
dB(A)	Frequency weighting filter used to measure ‘A-weighted’ sound pressure levels, which conforms approximately to the human ear response, as our hearing is less sensitive at very low and very high frequencies.
DERM	Former Queensland Department of Environment and Resource Management
LA10	The sound pressure level that is exceeded for 10 percent of the measurement period.
LA90	The sound pressure level that is exceeded for 90 percent of the measurement period.
LAeq	Equivalent sound pressure level: the steady sound level that, over a specified period of time, would produce the same energy equivalence as the fluctuating sound level actually occurring.
LAmax	The maximum sound level recorded during the measurement period.
LAmin	The minimum sound level recorded during the measurement period.
LFN	Low frequency noise, sound in the frequency range 10 Hz to 200 Hz.
MIA	Mine infrastructure area
Mtpa	Million Tonnes Per Annum
PPV	Peak particle velocity, a measure of the ground vibration magnitude and is the maximum instantaneous particle velocity at a point during a given time interval in mm/s.
RBL	Rating background level, the overall single-figure background level representing each assessment period (day/evening/night) over the whole monitoring period (as opposed to over each 24-hour period used for the assessment background level). This is the level used for assessment purposes. It is defined as the median value of: All the day assessment background levels over the monitoring period for the day (7:00 am to 6:00 pm) All the evening assessment background levels over the monitoring period for the evening (6:00 pm to 10:00 pm)

Generic Terminology	
	All the night assessment background levels over the monitoring period for the night (10:00 pm to 7:00 am)
SLM	Sound level meter, capable of measuring continuous sound pressure levels and able to record LAmin, LA90, LA10, LAmax and LAeq noise descriptors
SWL	Sound power level
ROM	Run of mine stockpile
TOR	Terms of Reference
VDV	Vibration Dose Value - As defined in BS6472 – 2008, VDV is given by the fourth root of the integral of the fourth power of the frequency weighted acceleration.
Vibration	The variation of the magnitude of a quantity which is descriptive of the motion or position of a mechanical system, when the magnitude is alternately greater and smaller than some average value or reference. Vibration can be measured in terms of its displacement, velocity or acceleration. The common units for velocity are millimetres per second (mm/s).
WHO	World Health Organisation

1. Introduction

1.1 Project overview

Adani Mining Pty Ltd (Adani, the Proponent), commenced an Environmental Impact Statement (EIS) process for the Carmichael Coal Mine and Rail Project (the Project) in 2010. On 26 November 2010, the Queensland (Qld) Office of the Coordinator General declared the Project a ‘significant project’ and the Project was referred to the Commonwealth Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) (referral No. 2010/5736). The Project was assessed to be a controlled action on the 6 January 2011 under section 75 and section 87 of the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The controlling provisions for the Project include:

- World Heritage properties (sections 12 & 15A)
- National Heritage places (sections 15B & 15C)
- Wetlands (Ramsar) (sections 16 & 17B)
- Listed threatened species and communities (sections 18 & 18A)
- Listed migratory species (sections 20 & 20A)
- The Great Barrier Reef Marine Park (GBRMP) (sections 24B & 24C)
- Protection of water resources (sections 24D & 24E)

The Qld Government’s EIS process has been accredited for the assessment under Part 8 of the EPBC Act (1999) in accordance with the bilateral agreement between the Commonwealth of Australia and the State of Queensland.

The Proponent prepared an EIS in accordance with the Terms of Reference (ToR) issued by the Qld Coordinator-General in May 2011 (Qld Government, 2011). The EIS process is managed under section 26(1) (a) of the *State Development and Public Works Act 1971* (SDPWO Act), which is administered by the Qld Government’s Department of State Development, Infrastructure and Planning (DSDIP).

The EIS, submitted in December 2012, assessed the environmental, social and economic impacts associated with developing a 60 million tonne (product) per annum (Mtpa) thermal coal mine in the northern Galilee Basin, approximately 160 kilometres (km) north-west of Clermont, Central Queensland, Australia. Coal from the Project will be transported by rail to the existing Goonyella and Newlands rail systems, operated by Aurizon Operations Limited (Aurizon). The coal will be exported via the Port of Hay Point and the Point of Abbot Point over the 60 year (90 years in the EIS) mine life.

Project components are as follows:

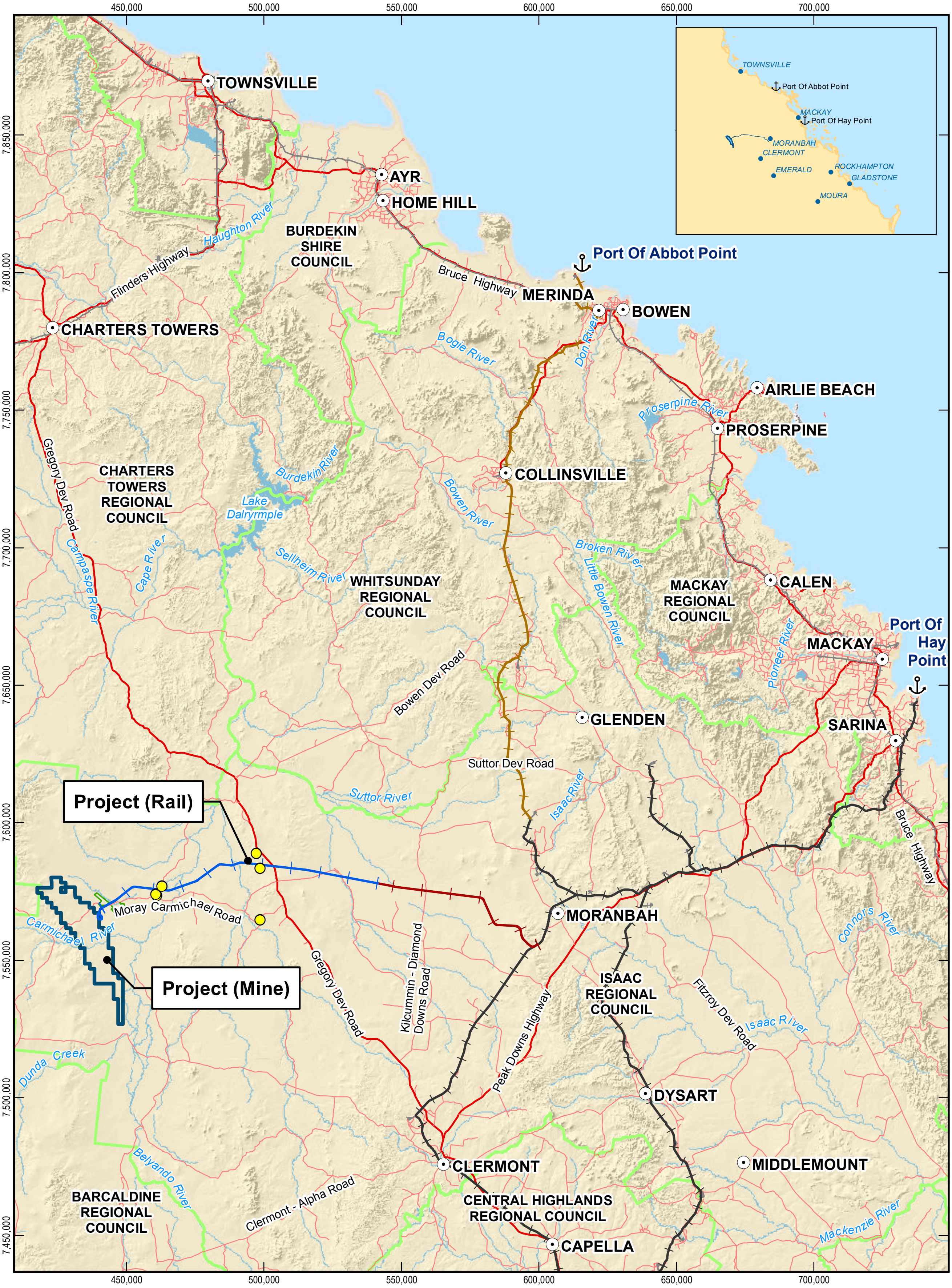
- The Project (Mine): a greenfield coal mine over EPC 1690 and the eastern portion of EPC 1080, which includes both open cut and underground mining, on mine infrastructure and associated mine processing facilities (the Mine) and the Mine (offsite) infrastructure including a workers accommodation village and associated facilities, a permanent airport site, an industrial area and water supply infrastructure

- The Project (Rail): a greenfield rail line connecting to mine to the existing Goonyella and Newlands rail systems to provide for the export of coal via the Port of Hay Point (Dudgeon Point expansion) and the Port of Abbot Point, respectively including:
  – Rail (west): a 120 km dual gauge portion running west, from the Mine site east to Diamond Creek
  – Rail (east): a 69 km narrow gauge portion running east, from Diamond Creek connecting to the Goonyella rail system south of Moranbah
  – Quarries: five local quarries to extract quarry materials for construction and operational purposes

The location of the Project is illustrated in Figure 1.

1.2 Scope of reporting

This report addresses those elements of noise and vibration relevant to the Project (Mine) during construction and operation. The report presents updated findings based on the revised Project Description provided in SEIS Volume 4, Appendix B. The report also addresses aircraft noise generated by off-site infrastructure including the airport and issues raised in submissions received during the Project EIS public notification period.



LEGEND

- Town
- Major Port
- Other Rail Network
- Goonyella System
- Newlands System
- Local Road
- Watercourse
- Local Government Area
- Project (Rail)
  - Rail (West)
  - Rail (East)
- Project (Mine)
- Mine (Offsite)
- Quarry

Based on or contains data provided by the State of QLD (DNRM) [2013]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:2,000,000 (at A4)

0 10 20 30 40 50

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

GHD adani

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS

Job Number	41-26422
Revision	2
Date	14-10-2013

Project Location

Figure 1

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Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: © Commonwealth of Australia (Geoscience Australia): Town, Railways, Watercourses (2007); DNRM: LGA, (2011), Hillshade (2009); DMR: State Roads (2008); Adani: Project Rail 1 (Opt11 Rev2) & 2 (Opt9 Rev3), Offsite, Quarry (2013). Created by: MS

1.3 Legislation, policies and guidelines

1.3.1 Legislative basis

The *Environmental Protection Act 1994* (EP Act) provides for the protection of environmental values, including environmental values relating to maintenance of public amenity. The EP Act establishes a number of environmental protection policies. In relation to noise, the EP Act is supported by the Environmental Protection (Noise) Policy 2008 (EPP (Noise)). The EPP Noise Section 7 outlines the key environmental values for the acoustic environment, as set out below:

The environmental values to be enhanced or protected under this policy are-

a) *The qualities of the acoustic environment that are conducive to protecting the health and biodiversity of ecosystems; and*

b) *The qualities of the acoustic environment that are conducive to human health and wellbeing, including by ensuring a suitable acoustic environment for individuals to do any of the following –*

   (i) *Sleep;*

   (ii) *Study or learn;*

   (iii) *Be involved in recreation, including relaxation and conversation; and*

   (iv) *The qualities of the acoustic environment that are conducive to protecting the amenity of the community.*

To further assist in determining noise levels consistent with the identified environmental values, the EPP Noise also sets out acoustic quality objectives as shown in Table 1. Based on a typical dwelling façade noise reduction of 10 dB(A) through a partially open window, an external criterion of 40 dB(A) $L_{Aeq,adj,1hr}$ is recommended for health and well-being in relation to the ability to sleep. Measurement of this acoustic quality objective is at the receptor.

Table 1 Acoustic quality objectives for dwellings

Sensitive Receptor	Time of Day	Acoustic Quality Objectives (measured at receptor) dB(A)			Environmental Value
		$LA_{eq,adj,1hr}$	$LA10_{adj,1hr}$	$LA1_{adj,1hr}$	
Dwelling (for outdoors)	Daytime and evening	50	55	65	Health and wellbeing
Dwelling (for indoors)	Daytime and evening	35	40	45	Health and wellbeing
	Night-time	30	35	40	Health and wellbeing, in relation to the ability to sleep

1.3.2 Construction noise criteria

The construction phase for the Project (Mine) will include works such as construction of the open cut and underground mining operations, coal handling process plant (CHPP), workshops, equipment storage, administration building, and other components within the Mine infrastructure areas (MIA), and associated roads and offsite infrastructure. The majority of construction will occur over a period of 36 to 48 months however, will continue until the mine reaches full production in 2022. Construction activities will occur 24 hours per day, 7 days per week.

For construction work occurring during normal daytime hours, provided all mechanical powered plant is fitted with appropriate mufflers, specific noise limits are not prescribed in Queensland. In this regard, it is noted that the EPP Noise does not include construction noise limits.

In Queensland, it is generally accepted that construction activities should be in accordance with general building work hours as described under section 440R – "Building Work" of the EP Act. Under the EP Act, no audible noise is permitted:

- Between 6:30 pm and 6:30 am – Monday to Saturday
- On Sundays and public holidays

The time restrictions are designed to strike a balance between protecting noise amenity and the need to start construction activities early in the morning and also recognise the difficulties of controlling some types of construction noise.

Noise impacts during construction are therefore usually minimised by limiting the hours of operation and, in particular circumstances, scheduling the noisiest activities to occur at times when they would generate least disruption. Particular noise limits should be applied to construction works extending outside normal working hours. As such, the World Health Organisation (WHO) recommend for quality of sleep, maximum noise levels should not exceed 45 dB(A). This guideline is recommended for construction work occurring inside the hours listed above. Based on a typical building façade noise reduction of 10 dB(A) through a partially open window, an external criterion of 55 dB(A)L_{max} is recommended for sleep disturbance, assessable at 4 metres (m) from the building façade. Residential receptors - operational noise criteria

Planning for Noise Control (The PNC Guideline; EPA 2004) provides guidance on the assessment of operational noise impacts. The guideline includes noise criteria designed to protect sensitive receptors from noise significantly louder than the background level, and to limit the total noise level from all sources near a receptor, hence protecting the amenity.

In line with the PNC Guideline, noise from continuous sources should be limited to 3 dB(A) above the rating background noise level for each period, unless the combined (ambient plus site contribution) noise level would exceed the recommended ambient noise level for the receptor zone. In that case, the noise limit for the site is set so that the combined noise level for the receptor zone does not exceed the recommended level. Table 2 shows the derivations of the $L_{A90,\ 1hr}$ and $L_{Aeq,\ 1hr}$ noise criteria with consideration to PNC Guideline for each monitoring location.

A rural residential area has been selected for setting the recommended outdoor background planning noise level. A Z1 noise area category (very rural, purely residential, less than 40 vehicles an hour) has been selected for determining the Planning Noise Level (PNL) at the assessed receptor locations.

Table 2 shows the Project (Mine) specific noise criteria adopted for this assessment. Refer to Section 1.4.2 (Figure 2) for noise monitoring locations. Comparison between the criteria shown in Table 2 and the EPP Noise external night-time criterion of 40 dB(A) $L_{Aeq,adj,1hr}$ indicates the PNC criteria are more stringent. The PNC criteria are therefore used in this assessment. By

default, adoption of the PNC criteria for the Project (Mine) will ensure compliance with the EPP Noise 40 dB(A) $L_{Aeq,adj,1hr}$ criteria.

Table 2 Project (Mine) specific noise levels

Criterion	Logger 1			Logger 2		
	Day dB(A)	Evening dB(A)	Night dB(A)	Day dB(A)	Evening dB(A)	Night dB(A)
Measured Background, LA90	31	31	27	25	25	22
Acceptable Measured Background LA90	31	31	27	25	25	25
Recommended Background, $minL_{A90}$ (PNC Table 1)	35	30	25	35	30	25
Adjusted Background, $minL_{A90}$ (PNC Table 2)	33	25	25	30	28	25
Measured Ambient LAeq	48	41	43	44	41	39
Recommended PNL $_{LAeq,1hr}$ (PNC, Table 3, Category Z1)	40	35	30	40	35	30
Planning Noise Level (PNC Table 4 adjusted) [2]	38	31	33	34	31	29
Specific/Component Noise Level 1	36	28	28	33	31	28
Project (Mine) Specific Level, $LA_{eq,1hr}$ [3],	36	28	28	33	31	28

1 Project (Mine) Specific/Component Level, $LA_{,eq,\ 1\ Hr}$ = min $LA_{90,\ 1\ Hr\ +\ 3}$

2 There is no significant contribution from existing industrial noise sources, therefore PNC Table 4 adjustments have been applied but not considered in the setting of the project specific noise criteria.

3 Project specific level is taken as the lower of the Specific/Component level and the adjusted PNL

4 As outlined in the PNC, where the measured background noise level is less than 25 dB (A), the minimum background noise level is set to 25 dB (A).

1.3.3 Low frequency noise

The Queensland Government *Assessment of Low Frequency Noise Guideline* (Ecoaccess, 2006) is considered to address noise sources with inherent dominant infrasound or (very) low frequency noise (LFN) characteristics. CHPPs have the potential to generate LFN components below 200 Hz. The procedure for the initial screening to determine if a more detailed assessment is required is as follows:

- The overall sound pressure level inside residences should not exceed 50 dB(Linear) to minimise risk of complaints of LFN annoyance.
- If the dB(Linear) measurement exceeds the dB(A) measurement by more than 15 dB, a one-third octave band measurement in the frequency range 20 to 200 Hz should be carried out.

1.3.4 Sleep disturbance criteria

The EPP Noise recommends that for the health and well-being of residents, in relation to the ability to sleep, the following acoustic quality objectives apply, when measured indoors:

- 30 $dBL_{Aeq,\ adj,\ 1hour}$

- 35 dB$L_{A10, adj, 1hour}$
- 40 dB$L_{A1, adj, 1hour}$

For these criteria, noise levels are measured over a one-hour period and are adjusted for tonal character or impulsiveness. Additionally, the purpose of the PNC Guideline is to limit the external maximum noise impact level, according to the likely number of occurrences and the potential noise reduction from outside to inside. Maximum noise levels over the night-time period should be restricted to prevent sleep disturbance.

The guideline recommends that instantaneous internal sound pressure levels do not exceed a maximum sound pressure level in the order of 45 dB(A)L_{max} more than 10 – 15 times per night as a rule in planning for short-term or transient events. On this basis, a “mid-range” external noise level of 55 dB(A)L_{max} more than 10 – 15 times per night is considered appropriate for assessment purposes, as the Guideline states a 10 dB outside to inside reduction in noise level through a partially open window is typical.

1.3.5 World Health Organisation Guidelines for Community Noise, 1999

The WHO discusses the effects of environmental noise in non-industrial environments in its Guideline for Community Noise (1999). This guideline examines aspects such as sleep disturbance, annoyance, and speech intelligibility and provides guidance for protecting people from adverse effects induced by excessive noise. The guideline is also referred to in the PNC Guideline’s section on sleep disturbance criteria. While the WHO Night Noise Guidelines For Europe (2009) detailed in Section 1.3.6 provides a revised approach, the WHO 1999 Guideline is considered relevant and complementary.

Most people are likely to experience a high level of annoyance should daytime sound pressure levels at outdoor living areas exceed 55 dB(A)L_{eq} for a steady, continuous noise. Moderate annoyance may be felt should daytime outdoor sound pressure level exceed 50 dB(A)L_{eq}. Sound pressure levels during the evening and night should be 5 to 10 dB lower than the level during the day.

When the noise comprises of a large low frequency component, lower guideline values are recommended as LFN can disturb sleep at lower sound pressure levels. The recommendation of lower noise levels for LFN also applies for outdoor living areas. For intermittent noise, it is necessary to take into account the maximum sound pressure level as well as the number of noise events. Interference to speech intelligibility may be prevented by maintaining background noise to levels of about 35 dB(A) to 45 dB(A). Table 3 summarises the WHO 1999 Guideline values.

Table 3 Summary of WHO guidelines for community noise, 1999

Descriptor	Indoor Guideline Value	Outdoor Guideline Value
Speech intelligibility (dwellings indoors)	35 dB(A) Leq (steady noise)	Not applicable.
Sleep disturbance (Bedrooms)	30 dB(A) Leq (steady noise) 45 dB(A) Lmax (intermittent noise)	45 dB(A) Leq (steady noise) 60 dB(A) Lmax (intermittent noise)
Annoyance (daytime and evening)	35 dB(A) Leq	50 dB(A) Leq

While the WHO 1999 Guidelines provide values for sleep disturbance, external amenity and speech intelligibility, these values are less stringent than the PNC Guideline goals outlined previously. The above 30 dB(A) L_{eq} guideline value shown in Table 3 equates to 40 dB(A) L_{eq} external (based on typical 10 dB(A) façade reduction – as per Australian Standard AS3671 and indeed WHO recommends 15 dB(A) façade reduction). Given the PNC Guideline criterion is 28 dB(A) $L_{eq,\ 1hour}$ outdoor at night-time, it is considered that the adoption of the PNC Guideline criteria for this Project (Mine) will also ensure compliance with the WHO 1999 guidelines.

1.3.6 World Health Organisation Night Noise Guidelines for Europe, 2009

The WHO Night Noise Guidelines For Europe (2009) provide detailed discussion of night time noise levels and the effects on sleep and health for residential noise receivers and is based on noise studies undertaken since the implementation of the WHO 1999 Guideline, which is considered relevant and complementary to the WHO 2009 Guideline.

The target levels recommended by the WHO 2009 Guideline are based on the concept of lowest observed adverse effect level (LOAEL) for night noise with consideration to biological effects, sleep quality, well-being, and night noise related medical conditions. These targets were derived with consideration to typical European building construction and proportion of time that dwelling windows are open and closed, resulting in a 21 dB attenuation outside to inside. The targets have therefore been adjusted for Australian typical construction with windows open to reflect Queensland conditions, a 10 dB attenuation.

The WHO 2009 Guideline recommended night noise targets are presented in Table 4 including adjusted targets for Australian conditions. The NNG level is recommended except where achievement is not feasible in the short term, in this case the IT level would be applicable. With regards to the guideline and the Project, the NNG for Australian conditions is the applicable night noise target, however as the PNC Project (Mine) Specific Noise criteria for night time are more stringent at 28dB(A) $L_{eq,1hr}$, the PNC levels become the controlling criteria for assessment of operational night noise impacts from the Project.

Table 4 Summary of WHO night noise guidelines for Europe, 2009

Descriptor	Outdoor Guideline Value for Europe	Outdoor Guideline Value for Australian Conditions[1]
Night Noise Guideline (NNG)	40 dB(A) Lnight, outside[2]	29 dB(A) Lnight, outside
Interim Target (IT)	55 dB(A) Lnight, outside	-

1 Based on an assumed standard façade attenuation of 10 dB for typical Australian building construction.

2 Lnight, outside is the night time noise indicator defined by EU Directive 2002/49/EC and is the long-term averaged night noise level determined over a year, where night is the eight hour night period (23:00 – 07:00).

1.3.7 Industrial and commercial receptor noise criterion

The Industrial precinct and airport, when developed, will be exposed to a certain degree of noise from mining operations. These areas are, however, less sensitive than residential receptors. The PNC Guideline recommends background noise planning levels for industrial and commercial noise receptors. The following noise targets have been adopted for commercial and industrial areas:

- Shop or commercial office: 55 dB(A) $L_{¬Aeq,\ 1hour}$
- Industrial area or factory: 60 dB(A) $L_{¬Aeq,\ 1hour}$

1.3.8 Blasting overpressure and vibration

Section 440 ZB of the EP Act provides criteria for the assessment of blasting impacts and states that blasting must not be conducted if:

(a) the airblast overpressure is more than 115dB Z Peak for 4 out of any 5 consecutive blasts;

(b) the airblast overpressure is more than 120dB Z Peak for any blast; or

(c) the ground vibration is —

> *(i) for vibrations of more than 35Hz--more than 25 mm a second ground vibration, peak particle velocity.*
>
> *(ii) for vibrations of no more than 35Hz--more than 10 mm a second ground vibration, peak particle velocity.*

Additional blasting criteria are referred to in the *Noise and Vibration from Blasting Guideline* (EPA 2006).

The guideline recommends that blasting should generally only be permitted during the hours of 9:00 am to 3:00 pm, Monday to Friday, and from 9:00 am to 1:00 pm on Saturdays and that blasting should not generally take place on Sundays or public holidays where there are sensitive receptors in proximity to the blast location. Blasting outside these recommended times should be undertaken only where:

- Blasting during the preferred times is clearly impracticable (in such situations blasts should be limited in number and stricter air blast overpressure and ground vibration limits should apply); or
- There is no likelihood of persons in a noise-sensitive place being affected because of the remote location of the blast site.

The guideline provides assessment criteria for blasting noise and vibration limits as shown in Table 5. The guideline values have been adopted for this assessment.

Table 5 Guideline blasting limits

Air blast Overpressure	Ground Vibration
115 dB(lin) peak	5 mm/s Peak Particle Velocity (PPV)
Must not be more than 115 dB(lin) peak for nine out of any ten consecutive blasts initiated, regardless of the interval between blasts, but never over 120 dB(lin) peak for any blast.	Must not exceed a PPV of 5 mm/s for nine out of any ten consecutive blasts initiated, regardless of the interval between blasts, but never over 10 mm/s for any blast.

1.3.9 Human comfort vibration criteria

In the absence of any Queensland or Australian guidelines relating to human comfort criteria for vibration, criteria have been adopted with consideration to the British Standard BS 6472 – 2008, Guide to evaluation of human exposure to vibration in buildings Part 1: Vibration sources other than blasting, which is recognised as the preferred standard for assessing the “human comfort criteria” for residential buildings.

Typically, mine activities generate ground vibration of an intermittent nature. Under BS 6472:2008, intermittent vibration is assessed using the vibration dose value (VDV). Table 6 includes acceptable values of VDVs for residential receptors for daytime and night-time periods.

Table 6 Vibration dose value ranges and probabilities for adverse comment to intermittent vibration ($m/s^{1.75}$)

Location	Low probability of adverse comment[1]	Adverse comment possible	Adverse comment probable[2]
Residential buildings 16 hour day (0700 – 2300 hrs)	0.2 to 0.4	0.4 to 0.8	0.8 to 1.6
Residential buildings 8 hour night (2300 to 0700 hrs)	0.1 to 0.2	0.2 to 0.4	0.4 to 0.8

1 Below these ranges adverse comment is not expected.
2 Above these ranges adverse comment is very likely.

These values represent the best judgement available at the time the standard was published and may be used for both vertical and horizontal vibration, providing that these components are correctly weighted. Because there is a range of values for each category, judgement can never be precise.

Whilst the assessment of response to vibration in BS 6472-1:2008 is based on VDV and weighted acceleration, for construction related vibration, it is considered more appropriate to provide guidance in terms of PPV, since this parameter is more likely to be routinely measured based on the more usual concern over potential building damage.

Humans are capable of detecting vibration at levels well below those that risk damage to a building. The degrees of perception for humans are suggested by the vibration level categories given in British Standard BS 5228-2:2009 Code of practice for noise and vibration on construction and open sites – Part 2: Vibration as shown in Table 7.

Table 7 Guidance on the effects of vibration levels

Approximate Vibration Level	Degree of Perception
0.14 mm/s	Vibration might be just perceptible in the most sensitive situations for most vibration frequencies associated with construction. At lower frequencies, people are less sensitive to vibration.
0.30 mm/s	Vibration might be just perceptible in residential environments.
1.00 mm/s	It is likely that vibration of this level in residential environments will cause complaint, but can be tolerated if prior warning and explanation has been given to residents.
10.00 mm/s	Vibration is likely to be intolerable for any more than a very brief exposure to this level.

1.3.10 Structural vibration criteria

Currently, there is no Australian Standard that sets the criteria for the assessment of building damage caused by vibration. Guidance for limiting vibration values is attained from reference to German Standard DIN 4150-3: 1999 Structural Vibration – Part 3: Effects of vibration on structures.

Table 8 presents the short-term vibration guideline values. The vibration criteria presented in this standard exceed the human comfort criteria presented above. Therefore, as indicated above, the human comfort criteria should be the over-riding criteria for the assessment of vibration impacts.

Table 8 Guideline values for vibration velocity to be used when evaluating the effects of short-term vibration on structures

Guideline Values for Velocity, vi(t)[1] [mm/s]				
Line	Type of Structure	Vibration at the Foundation at a Frequency of		
		1Hz to 10 Hz	10Hz to 50Hz	50Hz to 100Hz2
1	Buildings used for commercial purposes, industrial buildings, and buildings of similar design.	20	20 to 40	40 to 50
2	Dwellings and buildings of similar design and/or occupancy	5	5 to 15	15 to 20
3	Structures that, because of their particular sensitivity to vibration, cannot be classified under lines 1 and 2 and are of great intrinsic value (e.g. listed buildings under preservation order)	3	3 to 8	8 to 10

1 The term vi refers to vibration levels in any of the x, y or z axes.
2 At frequencies above 100Hz the values given in this column may be used as minimum values.

1.3.11 Road traffic noise

The Project (Mine) has the potential to generate traffic on public roads near sensitive receptors during construction and operation. Traffic volumes generated by the construction of the Mine will vary and will depend on the construction timetable.

The Department of Transport and Main Roads (DTMR) *Road Traffic Noise Management: Code of Practice* (DTMR, 2007) provides guidance for the assessment of road traffic noise. The traffic noise level of an existing state controlled road should not exceed $L_{A10(18hr)}$ 68 dB(A) assessed one metre in front of the most exposed part of an affected noise sensitive place.

1.3.12 Aircraft Noise criteria

Aircraft taking-off and landing at the proposed airport have the potential to generate noise impacts at surrounding sensitive receptors.

For airstrips without Australian Noise Exposure Forecast (ANEF) charts, the standard provides acceptability criteria for building sites in terms of calculated aircraft noise levels. Based on the noise levels, the standard classifies the site as ‘acceptable’, ‘conditionally acceptable’ or ‘unacceptable’. If the receiver site is classified as ‘conditionally acceptable’ or ‘unacceptable’, further noise attenuation measures may be required. This criterion applies to the sensitive receptors located at the workers accommodation village. Table 9 draws upon Table D1 of *AS2021* and presents the noise criteria for residential building sites. As the standard does not prescribe noise level criteria for less than five flights per day, conservatively, the noise level criteria for ’20 or less flights per day’ have been used for the purposes of this assessment.

Table 9 Building acceptability criteria (building sites)

Building site	Aircraft noise level expected at building site, dB(A)					
	20 or less flights per day			Greater than 20 flights per day		
	Acceptable	Conditionally acceptable	Unacceptable	Acceptable	Conditionally acceptable	Unacceptable
Residence	<80	80 to 90	>90	<75	75 to 85	>85
Hotel	<85	85 to 95	>95	<80	80 to 90	>90
School	<80	80 to 90	>90	<75	75 to 85	>85
Hospital	<80	80 to 90	>90	<75	75 to 85	>85

For existing buildings (and the workers accommodation village post-construction), Table 3.3 of the standard provides indoor design sound levels. As receivers R2 and R3 are existing homesteads, Table 10 provides the indoor noise criteria for these. AS2021 states that these indoor design sound levels represent "a maximum level from an aircraft flyover which, when heard inside a building by the average listener, will be judged as non-intrusive or annoying by that listener while carrying out the specified activity".

Table 10 Building indoor design sound level (existing buildings)

Building type and activity	Indoor design sound level
Residence-Sleeping areas	50
Residence-Other habitable spaces	55
Bathrooms, toilets, laundries	60

1.4 Approach and methodology

1.4.1 Overview

This report provides an assessment of potential impacts associated with noise and vibration generated during the construction and operation of the Project (Mine) including off-site infrastructure and operation of the airport, by:

- Reviewing the existing noise and vibration environment
- Addressing the acoustic requirements detailed in the ToR in relation to the construction and operational phases of the Project (Mine) including off-site infrastructure
- Evaluating the potential construction and operational noise and vibration impacts at sensitive locations in terms of planning levels identified in the PNC Guideline, and other standards and guidelines as applicable
- Evaluating the potential noise from aircraft landing and taking off at the proposed airport with consideration to AS2021 Acoustics Aircraft noise intrusion-Building siting and construction (2000)
- Defining noise and vibration goals by which potential construction and operational noise and vibration impacts at sensitive locations may be evaluated and assessed
- Evaluating and assessing the extent of resulting impacts and the scope for the reduction of these impacts through reasonable and feasible mitigation strategies

- Recommending appropriate impact mitigation measures

It should be noted that this assessment is based on ambient noise levels and disturbance to sensitive receptors in the community and environment, and does not consider occupational noise issues. Occupational noise is managed through the *Coal Mining Safety and Health Act 1999* (on-lease) and *Work Health and Safety Act 2011* (off-lease).

1.4.2 Noise monitoring methodology

Background and ambient noise monitoring was conducted as part of this assessment. Background noise levels were assessed using a combination of unattended and attended noise monitoring. Monitoring was conducted at two locations in the vicinity of the Project (Mine). Noise monitoring site locations are provided in Figure 2, together with the locations of potential sensitive receptors. A brief description of each monitoring site is provided in Table 11. Photographs of the monitoring sites are provided in Plate 1 and Plate 2.

Unattended noise logging was conducted to establish typical noise levels in the area of the potentially most affected receptors. Attended monitoring was also completed at these locations to better understand the noise sources contributing to overall existing noise levels. Locations selected are considered representative of the acoustic environment for the nearest potential sensitive receptors located in the vicinity to the Project (Mine). The monitoring locations were also chosen as being a safe and secure place for staff and unattended equipment, minimising the risk of theft, vandalism, or damage by natural causes. Land access permission was also a factor that contributed to the final selection of the locations.

Table 11 Noise survey location details

Location	GPS coordinates	Description of noise survey location	Monitoring period
A	22° 04.217' S 146° 14.664' E	Doongmabulla Homestead	26 Aug 2011 – 7 Sept 2011
B	22° 00.660' S 146° 21.593' E	Labona Homestead [1]	26 Aug 2011 – 6 Sept 2011
1 Labona Homestead has been acquired and will be demolished and therefore is not classified as a sensitive receptor. However, this location was selected as a monitoring location because it is considered representative of the acoustic climate for the workers accommodation village, being an area of low background noise level.			

Plate 1 Monitoring location A Doongmabulla homestead

Plate 2 Monitoring location B Labona homestead

Unattended noise monitoring was undertaken using two Rion NL-21 environmental noise loggers from 26 August to 6 – 7 September 2011 at two locations within the vicinity of the Project (Mine). These loggers are capable of measuring continuous sound pressure levels and are able to record L_{A90}, L_{A10} and L_{Aeq} noise descriptors. The instruments were programmed to accumulate environmental noise data continuously over sampling periods of 15 minutes for the entire monitoring period. Prior to deployment, the loggers were calibrated with a sound pressure level of 94 dB at 1kHz using a RION NC-73 calibrator. At completion of the monitoring period, the loggers were retrieved and calibration was rechecked. The difference was less than +/- 0.5 dB.

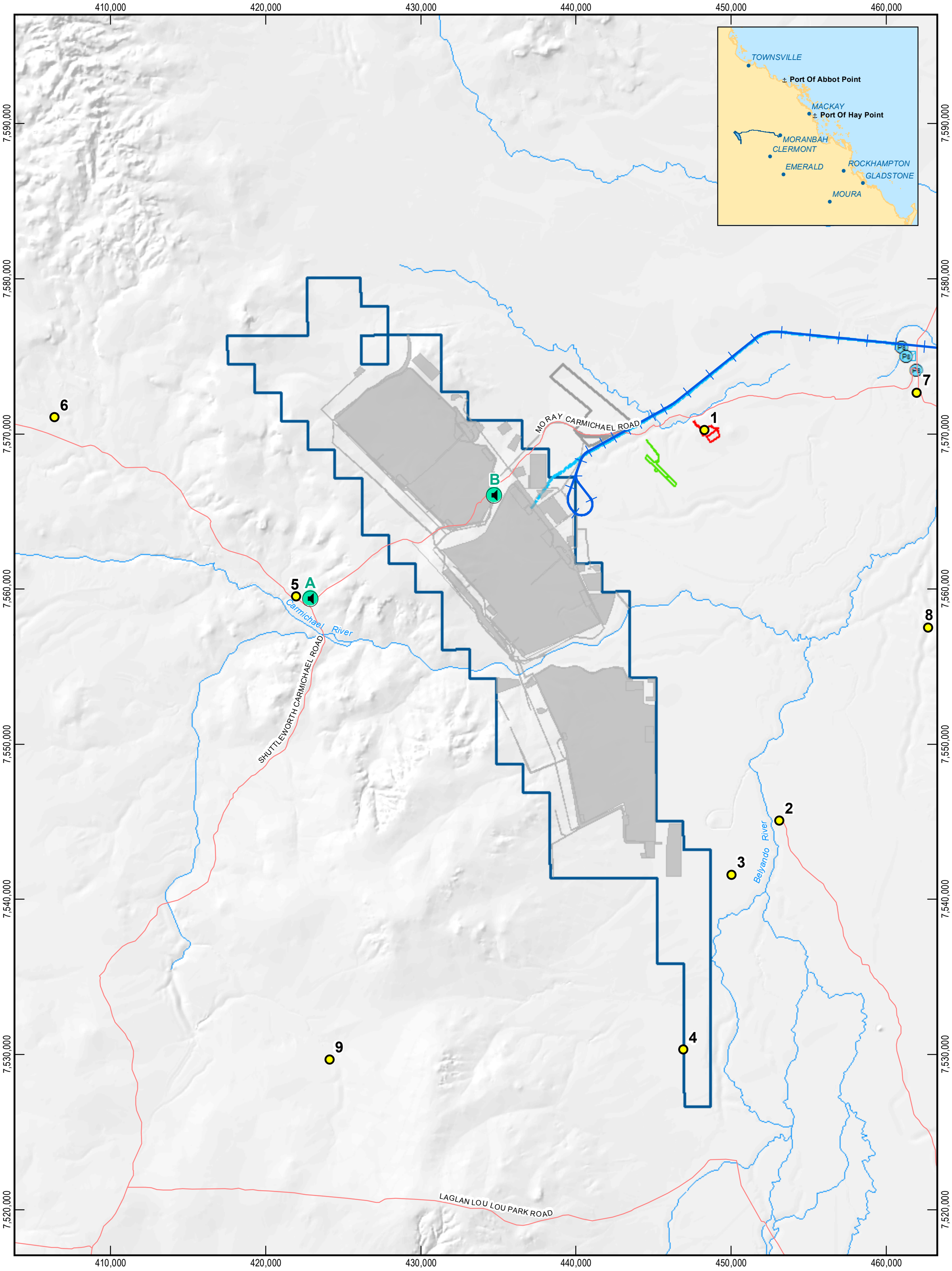
The data collected by the loggers was downloaded and analysed and any invalid data removed. Invalid data generally refers to periods where average wind speeds were greater than 5 m/s, or when rainfall occurred. Weather data over the monitoring period was collected from the Bureau of Meteorology Emerald Airport Automatic Weather Station. Table 12 provides details of the noise loggers at each monitoring location.

Table 12 Unattended noise logger details

Monitoring location	Logger serial No.	Measurement started	Measurement ceased	Pre Cal	Post Cal	Frequency weighting	Time response
Location A Doongmabulla Homestead	1277353	26/08/11	07/09/11	93.6	93.9	A	Fast
Location B Labona Homestead	1043718	26/08/11	06/09/11	94.1	94.0	A	Fast

Attended measurements were taken at unattended monitoring locations to supplement logger data. Attended noise measurements were conducted on 26 August 2011 using a Rion NL-21 Sound Level Meter (SLM). This SLM is capable of measuring continuous sound pressure levels and is able to record L_{Amin}, L_{A90}, L_{A10}, L_{Amax} and L_{Aeq} noise descriptors. Prior to deployment, the meter was calibrated using a Rion NC-73 calibrator with a sound pressure level of 94 dB at 1 kHz. Calibration was checked prior to the commencement of measurements and at completion of the measurements. The difference was less than +/- 0.5 dB.

All sampling activities were undertaken with due consideration to the specifications outlined in AS 1055 (1997) Description and Measurement of Environmental Noise and the Queensland Government Noise Measurement Manual (EPA, 2000).



LEGEND

- Sensititve Receptors
- Noise Logger
- Local Road
- Watercourse
- Rail (West)
- Mine (Onsite)
- Mine Footprint
- Mine (Offsite)
- Pump Station
- Storage Facility (Offstream)
- Airport
- Industrial Area
- Accommodation Village

1:350,000 (at A4)

0 2 4 6 8 10 12

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS

Job Number	41-26422
Revision	B
Date	24-10-2013

Potential Sensitive Receptors and Noise and Vibration Monitoring Locations

Figure 2

G:\41\26422\GIS\Maps\MXD\0200_Noise\41-26422_0213_rev_b.mxd

Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: DME: EPC 1690 (2010)/EPC 1080 (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007); Adani: Alignment, Offsite (SP1 & 2), Footprint (2013); GHD: Sensitive Receptor, Noise Logger (2012). Created by: MS

1.4.3 Vibration monitoring methodology

Vibration monitoring was undertaken on 26 August 2011 at the monitoring locations displayed in Figure 2. Vibration measurements were conducted using an Instantel Minimate Plus vibration logger with a tri-axial geophone to monitor ground vibration PPV in each axial direction. The Minimate unit has an inbuilt data logger, downloadable to PC where analysis can be performed using Blastware software.

The geophone was adhered to a granite paver and positioned on relatively flat ground. Vibration monitoring was undertaken utilising a Minimate Plus (serial: BE12721), calibration expiry August 2012 recording in histogram mode. Histograms at one minute intervals were recorded with concurrent site observations. The Minimate Plus was configured with a range of 31.7 mm/s and a sampling rate of 2,048 /s.

1.4.4 Construction noise assessment methodology

Construction methods and equipment

The Project (Mine) will use standard construction equipment, general trade equipment and specialised equipment as required. Table 13 shows the indicative number and type of construction equipment required, with the corresponding noise levels, based on GHD's noise source database. Typical construction equipment noise levels have been obtained from AS 2436 – 2010, Guide to noise and vibration control on construction, demolition and maintenance sites and GHD's noise database.

Note that final equipment types and numbers will not be known until shortly before commencement of construction, however given the noise predictions are based on worst-case scenario based on equipment location and operating at maximum power for the entire period, the received noise levels are not expected to change significantly.

For the purposes of noise level predictions, it has been assumed that all construction equipment in each phase listed in Table 13 will be operating at maximum levels. Noise levels have been predicted for worst-case scenario where all phases operate simultaneously under adverse weather conditions. Equipment locations are based on the proposed Mine Plan (SEIS Volume 4 Appendix B).

In fact, construction machinery will likely move about the study area altering noise impacts with respect to individual receptors. During any given period, the machinery items to be used in the study area will operate at maximum sound power levels for only brief stages. At other times, the machinery may produce lower sound levels while carrying out activities not requiring full power. It is highly unlikely that all construction equipment would be operating at maximum sound power levels at any one time and certain types of construction machinery will be present in the study area only for brief periods during construction. The predicted noise levels should therefore be considered as conservative estimates.

Note, the workers accommodation village and the industrial precinct are not assessed as sensitive receptors whilst the areas themselves are being constructed.

Table 13 Indicative construction equipment and sound power levels (SWL)

Construction Phase	Indicative Number of Plant	SWL, dB(A) Lmax Per Machine
Phase 1 Prepare works for MIA and mine camp construction. Access road construction to Gregory Developmental Road	Dozer x 1	116
	Truck x 2	108
	Excavator x 1	112
	Grader x 2	112
	Roller x 2	110
Phase 2 Construction of power, water supply and other external services	Excavator x 1	112
	Truck x 1	108
	Backhoe x 1	108
Phase 3 Permanent access road and rail spur	Scraper x 4	119
	Dozer x 3	116
	Truck x 4	108
	Excavator x 3	112
	Grader x 2	112
	Roller x 2	110
Phase 4 Dams construction	Scraper x 2	119
	Dozer x 1	116
	Truck x 2	108
	Excavator x 1	112
Phase 5 Project power supply	Mobile crane x 1	112
	Welder x 2	104
	Truck x 3	108
	Various hand tools including grinders and impact wrenches	119
Phase 6 MIA and CHPP	Impact Piling Rig x 1	133
	Truck x 2	108
	Excavator x 1	112
	Grader x 1	112
	Roller x 1	110
	Backhoe/bobcat x 1	108
	Mobile crane x 1	112
	Various hand tools including grinders and impact wrenches	119
Phase 7 ROMS and Vegetation Stripping	Impact Piling Rig x 1	133
	Truck x 4	108
	Excavator x 1	112
	Grader x 1	112
	Roller x 1	110
	Backhoe/bobcat x 1	108
	Mobile crane x 1	112
	Various hand tools including grinders and impact wrenches	119
	Scraper x 4	119

Construction Phase	Indicative Number of Plant	SWL, dB(A) Lmax Per Machine
Phase 8 Commercial/Industrial Precinct	Impact Piling Rig x 1	133
	Truck x 4	108
	Excavator x 1	112
	Grader x 1	112
	Roller x 1	110
	Backhoe/bobcat x 1	108
	Mobile crane x 1	112
	Various hand tools including grinders and impact wrenches	119
	Scraper x 4	119

Construction noise prediction

Acoustic modelling was undertaken using Computer Aided Noise Abatement (CadnaA) Version 4.2 to predict the effects of construction related noise from the Project (Mine). CadnaA is a computer program for the calculation, assessment and prognosis of noise propagation. CadnaA calculates environmental noise propagation according to the CONCAWE[1] algorithm. Ground absorption, reflection and relevant shielding objects are taken into account in the calculations.

Atmospheric effects due to wind and temperature inversion are calculated using the CONCAWE algorithm. The Project (Mine) has been modelled based on available data at the time of assessment and is considered indicative for the Project (Mine) as currently proposed.

Continuous traffic flow related noise is typically calculated using the United Kingdom Calculation of Road Traffic Noise (CoRTN) algorithm, however due to the non-continuous nature of the heavy vehicle movements to and from the site, the United States EPA's Intermittent Traffic Noise guidelines has been utilised to determine potential impacts. The following equation outlines the mathematical formula used in calculating the $L_{eq,T}$ noise level for intermittent traffic noise.

$$L_{eq},T = L_b + 10\log\left[1 + \frac{ND}{T}\left(\frac{10^{(L_{max} - L_b)/10} - 1}{2.3} - \frac{(L_{max} - L_b)}{10}\right)\right]$$

Where:

L_b is background noise level, dB(A)

L_{max} is vehicle maximum noise level, dB(A)

T is the time for each group of vehicles (min)

N is number of vehicle trips

D is duration of noise of each vehicle (min)

The parameters above were determined as follows:

[1] The CONCAWE method is a research paper especially designed for the requirements of large facilities. It was published in 1981 under the title, "The propagation of noise from petroleum and petrochemical complexes to neighbouring communities." This method is the only one dealing explicitly with the influence of wind and the stability of the atmosphere. Source: SoundPlan

- Background noise levels are based on the unattended noise monitoring conducted at Location B (Labona Homestead) i.e. 25 dB(A)
- The heavy vehicle maximum noise level was sourced from AS 2436 – 2010
- The duration of each vehicle passby was 30 seconds
- The time for each group of vehicles was 60 minutes

As the Intermittent Traffic Noise calculation outputs are $L_{Aeq(T)}$ values, these need to be converted to $L_{A10(18hr)}$ to suit the DTMR criteria.

Table 2 of Austroads document titled "Modelling, Measuring and Mitigating Road Traffic Noise" (Austroads 2005) AP-R277/05 outlines factors for simple conversion between road traffic noise descriptors. The document indicates $L_{Aeq(1hr)}$ and $L_{A10(18h)}$ are equivalent with a zero correction factor.

A façade correction factor of 2.5 dB(A) has been applied to the predicted noise levels to account for reflection.

1.4.5 Blasting impacts assessment methodology

Blasting will be required to prepare both overburden and coal for removal. Air blast overpressure levels are dependent on a number of factors such as:

- Maximum Instantaneous Charge (MIC) per delay
- distance from blast to receptor
- burden depth
- stemming height
- meteorology.

Ground vibration due to blasting is a function of numerous factors such as:

- ground conditions including rock structure and strata type
- MIC per delay
- distance from blast to receptor.

Ground vibration levels depend on the maximum instantaneous charge (effective charge weight per delay), and not the total charge weight, provided the effective delay interval is appropriate.

Blast effects have been predicted having consideration to the equations given in AS 2187:2006 *Part 2 Explosives - Storage and Use - Use of Explosives*., It is very likely that ground conditions including rock structure and strata type can vary significantly in and surrounding a mine site. As such, typical site constants have been used in the blasting assessment.

Ground vibration has been estimated using the following equation:

$$V = k_g \left(\frac{R}{Q^{1/2}} \right)^{-1.6}$$

Where:

V is the ground vibration PPV (mm/s)

R is the distance from charge (m)

Q is the MIC (kg)

k_g is the site constant

The ground vibration estimations are based on free face field conditions with site constants (K_g) of between 800 and 1600.

Air blast overpressure has been estimated using the following equation:

$$P = K_a \left(\frac{R}{Q^{1/3}} \right)^{-1.45}$$

Where:

P is the pressure (kPa)

R is the distance (m)

Q is the MIC (kg)

K_a is the site constant

The air blast overpressure estimations are based on site constants (K_a) of between 10 and 100 which are typical of confined charges. A typical blast includes a number of charged holes which are detonated in a specific pattern to maximise the effectiveness of the blast. Calculations of air blast overpressure and ground vibration in this assessment are based on a MIC of 1,000 kg per hole.

1.4.6 Offsite infrastructure noise assessment methodology

Offsite infrastructure is expected to comprise of the following:

- an industrial precinct comprising of general industrial uses such as freight unloading terminals, fuel storage, vehicle and equipment maintenance, concrete batching plant
- a rail siding located adjacent to the Project (Rail)
- an airstrip
- workers accommodation village
- water supply infrastructure, including pump stations for off-stream water storage

Project (Mine) offsite infrastructure locations are shown in Figure 2. A review of potential sensitive receptors surrounding the offsite infrastructure identified that the nearest receptors were over 5 km from the proposed industrial precinct and rail siding, and over 1 km from any of the proposed pump stations. The potential for noise impacts from pump stations at a separation distance of at least 1 km was considered to be very low and was not further assessed. The parameters of noise modelling were based on noise levels measured by GHD at similar facilities, or typical noise levels for industrial areas.

Industrial precinct noise

Whilst details of the exact nature and type of industry within the proposed industrial precinct are yet to be finalised, the noise impact assessment has been conducted based on typical sound

emission levels for general types of industry sourced from available literature. Typical area-related sound power levels (SWL) are provided in Table 14 below for a variety of industrial areas.

Based on the Project (Mine) information, it was considered that a mix of Area Type 4 and Type 5 would conservatively represent the type of activities expected within the industrial precinct. It was also assumed that 50 percent of the area proposed for development within Industrial Precinct would have industrial noise sources operating at any one time, as a maximum case for impact assessment. This takes into account areas such as stockpiles areas, and warehouse storage facilities that will generate minimal noise emissions. The industrial precinct was included in the noise model as part of the Project (Mine) operational noise assessment.

Table 14 Type of industry and area-related sound power levels – industrial precinct dB(A)

Area Type	Area-Related LW dB(A)[1]	Type of Industry
1	70 – 75	Open air plants with few noise protection measures such as shipyards and refineries
2	65 – 70	Open air plants using state-of-the-art noise protection
3	60 – 65	Container terminal, louder equipment, steel mills, waste processing production mainly in buildings
4	55 – 60	Production mainly in buildings
5	50 – 55	All production in building, some transport noise, cooling towers
6	45 – 50	Indoor production without noticeable outdoor activities
7	35 – 45	No production. Warehouse with cooling..

[1] The highest sound power value in the range was used in noise modelling.

Rail siding noise level

Predicted noise impacts due to the operation of the rail siding at the industrial precinct were determined based on sound power levels measured by GHD for a similar facility (Nebo Maintenance and Provisioning Facility, GHD, 2009). The sound power levels are shown in Table 15.

Table 15 Rail siding sound power levels dB(A)

Noise source	Octave centre frequency (Hz) (A-weighted)									LW dB(A)
	31.5	63	125	250	500	1k	2k	4k	8k	
Diesel Locomotive (idling)	-	77	82	91	94	97	98	90	78	103
Coal wagon (braking)	72	93	99	107	107	106	107	110	106	115[1]
Shunting vehicle	53	68	75	75	86	75	89	88	81	94[2]

1 Empty coal wagon includes a 2 dB(A) adjustment to account for impulsive noise and is estimated to be operating for 10% of the time during the day-time period

2 Shunting vehicle includes a 2 dB(A) adjustment to account for impulsive noise

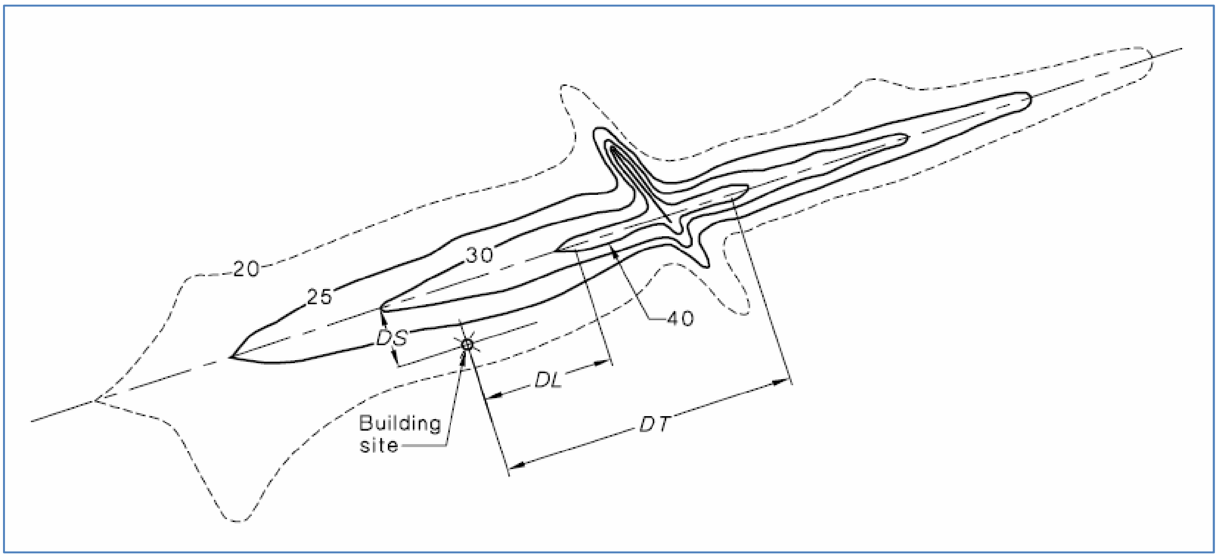
Airstrip noise level

Aircraft noise has been assessed with consideration to *AS2021 Acoustics Aircraft noise intrusion-Building siting and construction (2000)*. This standard is used to calculate aircraft take-off and landing noise levels at civil aerodromes and military airfields. Australian Noise Exposure Forecast Charts (ANEF) are generally used to determine aircraft noise exposure for major city airports, military aerodromes and for many country aerodromes. AS2021 indicates that ANEF charts are preferable to predict aircraft noise exposure at a site, however in the absence of ANEF charts for the proposed airport, the following methodology is provided in the standard to determine building siting suitability.

The standard calculates aircraft noise levels based on three coordinate distances from the airport runway to the sensitive receiver location. These three distance coordinates are shown in Figure 3 and defined as:

- DS: The distance between the sensitive receiver to the extended runway centre-line, measured in meters. This represents the sideline projection distance of the sensitive receiver with respect to the airport runway.
- DL: The distance from the closer end of the runway to the intersection of the extended runway centre-line and the location of the sensitive receiver, measured in meters. This represents the landing or arrival distance between the aircraft and the receiver.
- DT: The distance from the farther end of the runway to the intersection of the extended runway centre-line and the location of the sensitive receiver, measured in meters. This represents the take-off or departure distance between the aircraft and the receiver.

Figure 3 AS2021 Distance coordinates



Source: AS2021

Additionally, the standard provides correction factors for the above distances under the following conditions:

- The aircraft departure and arrival paths are curved, rather than straight.
- The receiver site elevation differs from that of the aerodrome by more than 10 m.

Workers accommodation village

Construction of the workers accommodation village is expected to occur in stages 24 hours per day. Since the construction will be staged, there is potential for dwellings that are already completed and habitable to be impacted by construction noise occurring in other uncompleted stages in the workers accommodation village. Furthermore, since workers operate under a day/night shift based system, approximately 50 percent of the workers could be sleeping during the daytime hours. As such, there is potential for workers accommodation village building construction related noise impacts to occur during daytime hours when they are sleeping. Since the exact construction schedule and staging information is not known, general in-principle noise and vibration mitigation measures are provided in Section 3.2 to assist with minimising potential noise and vibration impacts on workers located in the workers accommodation village.

Water supply infrastructure noise level

Noise emitting components of water supply infrastructure will primarily comprise of water pumps to pump water to off-stream storage areas and then to the site for use. Typical sound power data for a water pump has been sourced from measurements taken by GHD and is shown below in Table 16. Based on a minimum separation distance of 1 km to the nearest sensitive receptor, adverse noise impacts from water pumps are unlikely. As such, water supply infrastructure has been excluded from the operational noise impact assessment of the Project (Mine).

Table 16 Pump sound power levels dB(A)

Noise source	Octave centre frequency (Hz) (A-weighted)									LW dB(A)
	31.5	63	125	250	500	1000	2000	4000	8000	
Diesel surface water pump	-	72	87	80	83	93	95	88	89	99

1.4.7 Operational noise assessment methodology

Acoustic modelling was undertaken using CadnaA Version 4.2 and implementing the CONCAWE algorithm to predict the effects of operational related noise from the Project (Mine). Ground absorption, ground terrain, reflection and relevant shielding objects are taken into account in the calculations. The proposed development has been modelled based on available data at the time of assessment and, as such, should be used for guidance purposes only.

Model configuration

The following assumptions were made with regard to the model configuration:

- Terrain topography at 10 m resolution has been included in the calculations
- A general ground absorption coefficient of 0.5 was used throughout the model
- Modelling is based on atmospheric conditions of 10°C and 70 percent humidity

Project (Mine) operational equipment

For the proposed underground operations, exposed noise sources at the surface such as ventilation fans and overland conveyors have been included in the noise model. The proposed open cut mining method primarily involves truck and excavator operation with truck haulage to run of mine stockpiles (ROM). Coal will be hauled from the pit by truck and will be hauled directly to the ROM located adjacent to the CHPP or where mining is occurring distant from the CHPP, to a remote ROM for transport via overland conveyor to the CHPP. The CHPP facilities will be located adjacent to the rail loop.

Table 17 shows the proposed equipment for the scheduled mining, necessary to provide sufficient capacity to supply coal to meet planned output levels, based on the equipment list from the updated fleet details and mine plans (Appendix D). Table 18 and Table 19 respectively show the equipment L_{eq} and L_{max} sound power levels (SWL). Typical mining equipment noise levels have been obtained from GHD's noise source database and noise assessments conducted for similar projects, including Olympic Dam Expansion Draft EIS (2009), Clermont Coal Project EIS (2004), Cloncurry Copper Project (ASK 2009), Wandoan Coal Project EIS (2008), Maules Creek Coal Project EA (2011), Bengalla Coal Mine Development Consent Modification EA (2010) and Grosvenor Coal Project EIS (2010). L_{max} SWLs have not been listed for equipment which typically operate with continuous steady-state emissions. The model configuration for the noise sources was as follows:

- The sound power levels for the all equipment except for the conveyors were modelled as point sources. Conveyors were modelled as line sources.
- Equipment height above ground level was sourced from similar projects and GHD's noise source database.
- Equipment assumed to be running at full power and, whilst operating continuously.

Noise sources were modelled based on the mine staging plans shown in Appendix D. The mine stages were selected on the basis of worst case scenarios in relation to equipment type, numbers and proximity of mining operations to sensitive receptors. It should be noted that final equipment and plant types and numbers will not be known until closer to commencement of the proposed mining activity.

Table 17 Proposed schedule of mining equipment

Mine Activity	Indicative Mine Equipment and Mine Year (Number of Plant)				
	Item	Year 2015	Year 2026	Year 2049	Year 2071
Major Mobile Equipment	P&H4100XPC Shovel	0	5	7	0
	Cat 6060 Excavator	3	5	4	2
	Hitachi EX5600 Excavator	4	5	6	2
	Liebherr R9800 Excavator	0	4	4	0
	Liebherr R9400 Excavator	0	8	7	2
	CAT 797F Truck	0	70	77	0
	CAT 793F Truck	32	67	71	22
	CAT 789D Truck	0	47	49	10
	CAT 785D Truck	0	22	26	4
	Atlas Copco PV275 Drill	4	17	18	2
	CAT 24M Grader	4	17	18	2
	CAT D10T Track Dozer	4	19	21	2
	CAT D11T Track Dozer	4	23	21	2
	CAT 854 Wheel Dozer	3	12	12	2
	CAT 992K Loader	0	0	2	2
Major Fixed	ROM	0	3	3	3

Mine Activity	Indicative Mine Equipment and Mine Year (Number of Plant)				
	Item	Year 2015	Year 2026	Year 2049	Year 2071
Equipment	Secondary Crusher	0	3	3	3
	Tertiary Crusher	0	3	3	3
	CHPP	0	1	1	1
	Coal Wash Plant	0	1	1	1
	Train Loadout	0	1	1	1
	Train on rail spur	0	2	2	2
	Overland Conveyor	0	12	12	12
	Stacker	0	6	6	6
	Transfer Station	0	24	24	24
	Ventilation Fans	0	5	5	5

Table 18 Proposed site noise source sound power levels SWL (L_{eq}, re: 20µPa)

Noise Source	Source Height (m)	Octave Centre Frequency (Hz) / dB (linear)									SWL dB(A) Leq
		31.51	63	125	250	500	1k	2k	4k	8k	
P&H4100XPC Shovel	4	110	110	111	110	107	106	103	98	88	111
CAT 6060 Excavator	4	102	117	111	107	107	106	102	92	82	110
Hitachi EX5600 Excavator	4	110	110	115	119	116	114	109	103	92	118
Liebherr R9800 Excavator	4	102	117	111	107	107	106	102	92	82	110
Liebherr R9400 Excavator	4	102	117	111	107	107	106	102	92	82	110
CAT 797F Truck	4	112	112	111	112	114	112	112	106	101	118
CAT 793F Truck	4	114	114	120	115	116	114	113	109	97	119
CAT 789D Truck	4	107	107	113	114	110	108	109	102	97	115
CAT 785D Truck	4	116	116	120	108	111	109	107	99	99	114
Atlas Copco PV275 Drill	4	115	115	116	113	113	111	110	104	99	116
CAT 24M Grader	4	106	106	104	105	103	104	99	94	87	107
CAT D10T Track Dozer	3	106	106	106	106	111	109	110	102	92	115
CAT D11T Track Dozer	3	106	106	106	106	111	109	110	102	92	115
CAT 854 Wheel Dozer	3	106	106	106	106	111	109	110	102	92	115
CAT 992K Loader	3	107	107	117	104	109	107	106	100	95	112
ROM	5	109	109	107	107	108	105	100	93	83	109
Secondary Crusher	5	115	115	116	111	111	107	102	95	88	112
Tertiary Crusher	5	115	115	116	111	111	107	102	95	88	112
CHPP	10	122	122	122	117	114	111	108	102	95	117

Noise Source	Source Height (m)	Octave Centre Frequency (Hz) / dB (linear)									SWL dB(A) Leq
		31.51	63	125	250	500	1k	2k	4k	8k	
Coal Wash Plant	10	115	115	110	110	109	109	106	101	94	113
Train Loadout	3.5	107	107	109	103	99	97	94	92	82	103
Train on rail spur	3.5	108	108	105	101	100	101	103	100	97	108
Overland Conveyor	2	80	80	81	81	83	77	72	63	55	83
Stacker	5	98	98	103	100	97	94	92	89	81	100
Transfer Station	4	103	103	108	105	102	99	97	94	86	105
Ventilation Fans	5	116	109	107	102	94	99	92	88	74	102

[1] No data available, therefore conservatively estimated as equal to 63 Hz values.

Table 19 Proposed site noise source sound power levels SWL (L_{max}, re: 20μPa)

Noise Source	Source Height (m)	Octave Centre Frequency (Hz) / dB (linear)									SWL dB(A) Lmax
		31.5[1]	63	125	250	500	1k	2k	4k	8k	
P&H4100XPC Shovel	4	111	111	112	114	118	112	108	103	96	118
CAT 6060 Excavator	4	115	115	126	122	121	119	114	108	103	123
Hitachi EX5600 Excavator	4	116	120	121	123	122	115	112	107	99	122
Liebherr R9800 Excavator	4	115	115	126	122	121	119	114	108	103	123
Liebherr R9400 Excavator	4	111	111	122	118	117	115	110	104	99	119
CAT 797F Truck	4	122	128	128	123	119	114	111	105	100	121
CAT 793F Truck	4	122	128	128	123	119	114	111	105	100	121
CAT 789D Truck	4	120	120	116	113	114	114	110	106	98	118
CAT 785D Truck	4	125	125	122	118	121	116	115	109	100	122
Atlas Copco PV275 Drill	4	110	110	123	114	119	111	109	103	98	119
CAT 24M Grader	4	106	106	119	115	113	114	108	103	98	117
CAT D10T Track Dozer	3	122	122	112	114	122	115	116	106	94	122
CAT D11T Track Dozer	3	122	122	112	114	122	115	116	106	94	122
CAT 854 Wheel Dozer	3	122	122	112	114	122	115	116	106	94	122
CAT 992K Loader	3	112	112	111	112	114	112	112	106	111	118
ROM	5	141	141	129	129	111	103	100	96	89	122
Secondary Crusher	5	147	147	130	123	118	111	106	99	94	124
Tertiary Crusher	5	146	146	129	116	112	108	102	95	89	122

[1] No data available, therefore conservatively estimated as equal to 63 Hz values.

2. Existing environment

2.1 Potential sensitive receptors

The land use surrounding the mine area is rural in nature with a limited number of potential sensitive receptors. Table 20 lists potential sensitive receptors identified within approximately 22 km of the Project (Mine). Figure 2 (refer to Section 1.4.2) provides a map of the sensitive receptor locations.

The nearest identified sensitive receptor in relation to the proposed nearest mine operational noise sources is sensitive receptor 1 (workers accommodation village) which is approximately 8.5 km away. The distance to the nearest operational noise source is the minimum distance of the assessed mining year scenarios. The nearest identified offsite infrastructure relative to the receptor 1 (workers accommodation village) is the airport and industrial precinct, however it should be noted that airport noise and industrial noise are assessed separately in line with the relevant guidelines and standards.

Receptors 3, 4 and 5 are located on the southern side of the Carmichael River and will not be subject to noise from mining activities until after year 2035 when mining is expected to commence in this area.

Table 20 Potential sensitive receptors

Potential Sensitive Receptor	Easting	Northing	Approximate Distance from Nearest Operational Noise Source within the Mine Lease Boundary(m)	Description/Comment
1	448328	7570180	8,500	Workers accommodation village
2	453157	7544999	9,000	Bygana Homestead
3	450080	7541530	7,500	Lignum Homestead
4	446973	7530251	15,200	Mellaluka Homestead
5	422016	7559462	9,000	Doongmabulla Homestead
6	406412	7571007	16,500	Carmichael Homestead
7	462027	7572602	22,200	Moray Downs Homestead
8	462767	7557458	21,100	Albinia Homestead
9	424165	7529616	21,400	Bimbah East Homestead

2.2 Background noise

Section 1.4.2 provides a brief description of the noise monitoring sites, including their locations (see Figure 2). Unattended monitoring results are summarised in Table 21, Table 22 and Table 23 and are presented in graphical format in Appendices A and B. Data was removed from the tabulated data during periods in which wind speeds were over 5 m/s or rainfall occurred, as described in the method included in Section 1.4.2.

Noise monitoring results at both locations are typical of a rural environment with low background noise levels, during day (7:00 am to 6:00 pm), evening (6:00 pm to 10:00 pm) and night (10:00 pm to 7:00 am) periods. The rating background level (RBL) for each period at monitoring

Location A Doongmabulla is 31 dB(A), 31 dB(A) and 27 dB(A), respectively. At monitoring Location B Labona the RBL for each period, respectively, is 25 dB(A), 25 dB(A) and 22 dB(A).

The ambient noise level (L_{Aeq}) for each period, respectively, at monitoring Location A Doongmabulla was recorded as 48 dB(A), 41 dB(A) and 43 dB(A). At monitoring Location B Labona the ambient noise level for each period, respectively, was recorded as 44 dB(A), 41 dB(A) and 39 dB(A). The noise level graphs shown in Appendix B and Appendix C indicate background noise levels during night-time periods typically fall to below 25 dB(A) at monitoring Location B Labona and to a lesser extent at monitoring Location A Doongmabulla.

Noise levels at monitoring Location A Doongmabulla are generally higher due to the influence of birdlife and cattle. Notwithstanding this, both locations are dominated by natural noise sources including insects and birds. Attended noise monitoring results are summarised in Table 24.

Table 21 Summary of noise monitoring results – monitoring location A Doongmabulla

Date	Background LA90 dB(A)			Ambient LAeq dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
26-Aug-11	27	27	25	44	40	41
27-Aug-11	27	26	28	42	37	44
28-Aug-11	27	26	31	46	41	44
29-Aug-11	28	30	33	48	42	47
30-Aug-11	29	31	32	46	42	41
31-Aug-11	31	33	31	52	40	45
01-Sep-11	30	32	25	47	40	42
02-Sep-11	33	32	28	47	44	42
03-Sep-11	39	32	25	51	45	43
04-Sep-11	34	31	22	50	42	42
05-Sep-11	33	30	24	49	38	44
06-Sep-11	33	30	21	48	40	42
RBL and Leq Overall	31	31	27	48	41	43

Table 22 Summary of noise monitoring results – monitoring location B Labona

Date	Background LA90 dB(A)			Ambient LAeq dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
26-Aug-11	28	28	28	40	36	36
27-Aug-11	21	26	19	40	39	40
28-Aug-11	22	22	21	44	35	39
29-Aug-11	22	23	22	44	43	37
30-Aug-11	22	30	26	45	41	39
31-Aug-11	23	27	28	43	41	38
01-Sep-11	25	25	23	42	44	41

Date	Background LA90 dB(A)			Ambient LAeq dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
02-Sep-11	27	25	21	46	41	40
03-Sep-11	31	28	22	47	39	39
04-Sep-11	27	23	21	48	40	39
05-Sep-11	26	21	20	42	40	40
06-Sep-11	-	-	-	-	-	-
RBL and Leq Overall	25	25	22	44	41	39
Note: (-) denotes data not available						

Table 23 Summary of noise monitoring results

Location	Background LA90 dB(A)			Ambient LAeq dB(A)		
	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)	Day (7 am to 6 pm)	Evening (6 pm to 10 pm)	Night (10 pm to 7 am)
Location A Doongmabulla	31	31	27	48	41	43
Location B Labona	25	25	22	44	41	39
Note: Rounded to nearest integer						

Table 24 Attended noise survey summary

Location	Period Date	Duration (mins)	Time	dB(A) L90	dB(A) Leq	Comments (instantaneous Noise Levels dB(A))
Location A Doongmabulla	26/08/11	15	09:00	34.0	47.7	Air conditioning unit barely audible (< 30) Birds (32-60) Insects (32-35) Cattle (35-42)
Location B Labona	26/08/11	15	12:00	27.6	38.2	Birds (<30-46) Insects (<30-32) Truck pass by (40-44) Water tower (28-30)
Note: While attended monitoring was only undertaken during the daytime assessment period, the most stringent night time criteria possible under the Ecoaccess PNC Guideline has been used in this assessment which is based on the minimum background noise level. Therefore, attended monitoring during night-time would not change the assessment outcomes.						

2.3 Background vibration

Measured ground vibration results indicate very low ground vibration levels (in the order of 0.1 mm/s) at all locations which confirms the lack of perceptible vibration at all sites. Table 25 details the baseline vibration results.

Table 25 Vibration measurement results – peak particle velocity (mm/s)

Measurement Location	Date/ Time	Direction			Sum	Observations
		Trans	Vert	Long		
Location A Doongmabulla	07/09/2011 13:04	0.0794	0.0635	0.0794	0.0926	No perceptible ground vibration
Location B Labona	06/09/2011 17:24	0.0794	0.0635	0.0635	0.0870	No perceptible ground vibration

2.4 Local meteorology

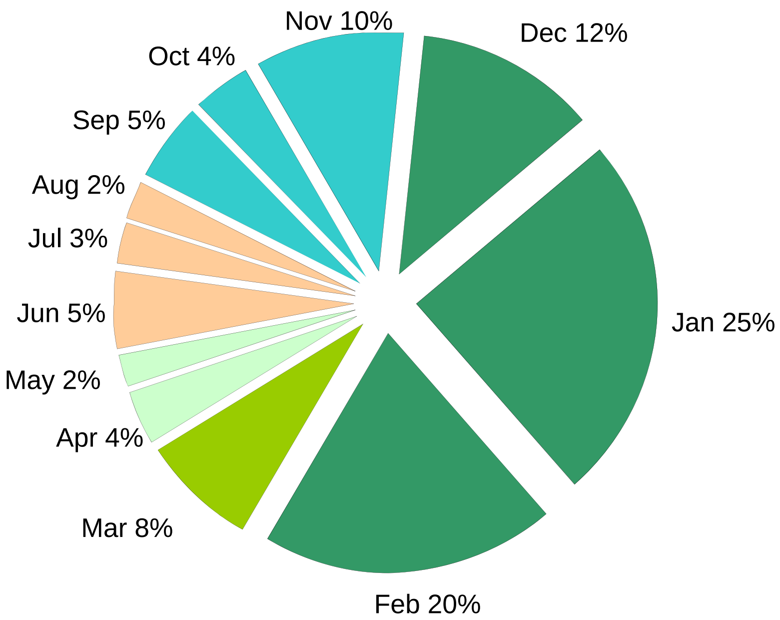
Noise propagation over long distances can be significantly affected by weather conditions. In particular, source to receptor winds and the presence of temperature inversions can enhance received noise levels. To account for these atmospheric phenomena, the PNC Guideline specifies procedures to determine the prevalent weather conditions and identify whether these conditions are a feature of the Project area.

Meteorological data was obtained from the Air Quality Assessment (refer to Volume 4 Appendix S Mine Air Quality Report) and used for determining the prevalent weather conditions. The wind rose charts for each season in each time period (day, evening and night) and the Pasquill / Gifford scale of atmospheric stability for the winter season in the night-time period are presented in Appendix C of this report.

The annual mean rainfall at Carmichael meteorological station, approximately 12 km west of the Project (Mine), is 524 mm and is dominated by the warm months producing convectively driven rainfall. Figure 4 provides a graphical representation of the annual mean rainfall at the Carmichael meteorological station. December through March, inclusive, account for 65 percent of the annual mean rainfall. The wettest month is January with a mean of 129.1 mm and the driest month is May with a mean of 11.2 mm.

Given the annual mean rainfall is over 500 mm per year, the site is considered non-arid (as per the PNC Guideline).

Figure 4 Monthly mean rainfall (mm) proportions at Carmichael site number 036122 (January 2003 to December 2010)



2.5 Temperature inversions and wind

Records of the Pasquill Stability Class, a parameter representing the degree of mixing in the atmosphere, can gauge the prevalence and magnitude of temperature inversions. Stability classes are categorised as A to G where Class A applies under sunny conditions with light winds when dispersion is most rapid. Stability Class D applies under windy and/or overcast conditions when dispersion is moderately rapid and Stability Classes F and G can occur at night when winds are light and the sky is clear. Stability Classes B, C and E are intermediate conditions between those described above. Temperature inversions may occur during stability classes E, F and G. In particular, stability class F generally represents a range of temperature gradients from 1.5 ºC/100 m to less than 4 ºC/100 m.

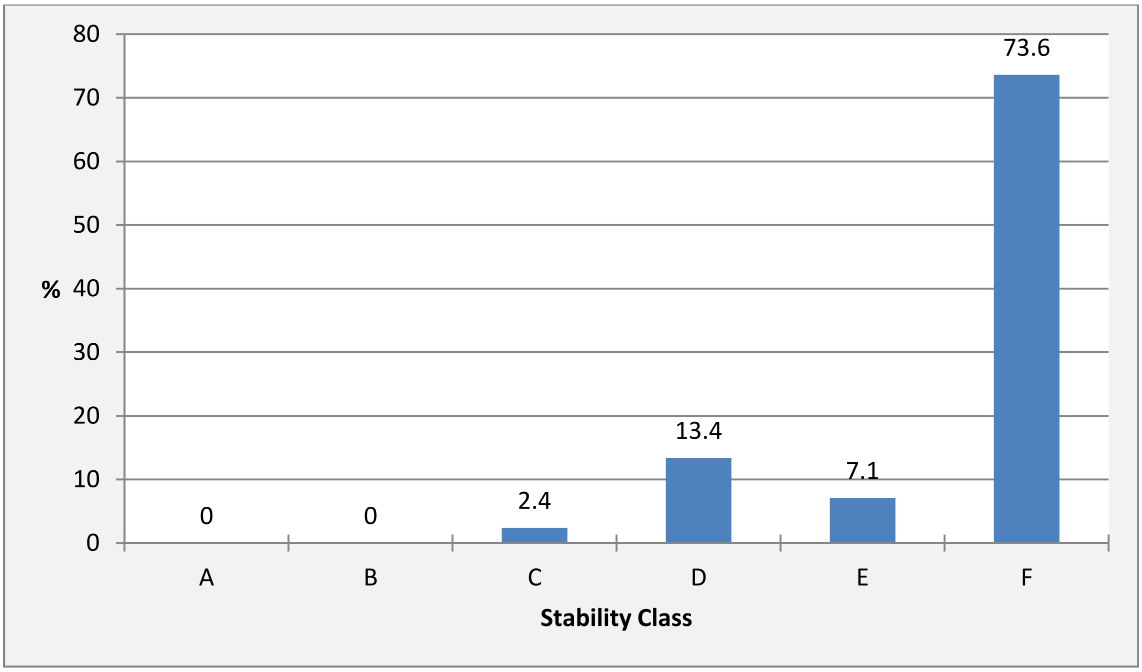
The Project (Mine) would operate 24 hours per day including the night-time period when temperature inversions are likely to occur. Analysis of the meteorological data (refer to Figure 5) indicates that class F temperature inversions occur more than 30 percent of the time during night-time in the winter season. As a result of this analysis and given the average annual rainfall is representative of a non-arid environment, moderate temperature inversion will be considered in this assessment (as per the requirements of the PNC Guideline).

Noise propagation can be increased by wind conditions. The PNC Guideline states that when there is greater than 30 percent occurrence of wind of up to 3 m/s, in any period (day, evening, night) in any season, from source to receptor, wind should be considered in noise prediction calculations.

Analysis of the seasonal wind rose data (refer to Appendix C of this report) indicates that easterly winds up to 3 m/s occur more than 30 percent of the time in autumn season during evening time. Therefore, wind is considered a feature of the area and the noise model will include a 3 m/s easterly wind (as per the requirements of the PNC Guideline).

The actual percentage occurrence of wind (up to 3 m/s source to receptor) was also verified using the NSW Office of Environment and Heritage *Noise Enhancement Wind Analysis* software (Review Version).

Figure 5 Stability class frequency distribution (winter night-time)



3. Potential impacts and mitigation

3.1 Introduction

The construction and operation of the Project (Mine) both have the potential to cause noise and vibration impacts on the surrounding environment. Potential construction and operational impacts have been identified and analysed on the basis of a desktop analysis combined with acoustic modelling considering the construction and operational methods, equipment proposed to be used and mine stage plans.

3.2 Mine construction

3.2.1 Overview

With regard to the Project (Mine) construction phase, mining (fixed and mobile) equipment and blasting associated with the civil works and construction of the MIA are the primary aspects influencing noise and vibration.

3.2.2 Noise from civil works

Potential noise impact

Construction activities, such as civil works including: earthworks, drainage construction, pile driving and equipment use, and mine construction have the potential to adversely impact on noise sensitive receptors through:

- disturbance to sleep, social activities and/or work or study activities
- disturbance of livestock and native fauna (see Section 3.3.5)

Table 26 shows the predicted construction noise level at each of the surrounding sensitive receptors for adverse meteorology (ISO 9613 algorithm of moderate downwind or inversion conditions). Worst case construction noise levels are predicted to be less than 10 dB(A) at all receptors except at sensitive receptor 2 (workers accommodation village) where the noise levels are expected to be up to 19 dB(A). The predicted impact is conservative as it assumes that all construction phases are taking place simultaneously based on maximum sound power levels.

While most construction work would be completed during daytime hours, some construction activity will occur during evening and night periods to meet the proposed construction schedule. Any construction work outside of normal hours should be conducted with consideration to the WHO guideline recommended external noise criteria of 55 dB(A), as discussed in Section 1.3.5 and 1.3.6. This criteria addresses sleep disturbance, assessable at 4 m from the building façade.

In any case, it is clear from the results given in Table 26 that predicted construction noise levels are expected to be well under the 55 dB(A) WHO criteria at all sensitive receptors.

Table 26 Predicted construction noise level at sensitive receptors

Sensitive Receptor	Predicted Construction Noise Level, dB(A) (Adverse Meteorology)
1 Commercial/Industrial precinct	Not in use during construction of the Project (Mine)
2 Workers accommodation village*	19
3 Bygana Homestead	<10
4 Lignum Homestead	<10
5 Mellaluka Homestead	<10
6 Doongmabulla Homestead	<10
7 Carmichael Homestead	<10
* Note: workers accommodation village does not include noise from construction of the workers accommodation village itself, as there are no sensitive receptors at the workers accommodation village until it is constructed. Construction noise from the workers accommodation village to sensitive receptors within the village is covered in Section 3.2.4.	

Heavy vehicle movements associated with the earthworks and supply of plant and material have been estimated based on vehicle movement volumes in the Logistics Study (November, 2012). It has been assumed that all vehicle movements would occur along the Gregory Developmental Road, Elgin Moray Road and Moray Carmichael Road. The following assumptions were made:

- Construction vehicle movements were assumed to occur 365 days per year.
- Peak hour vehicle movements were assumed to be 20 percent of daily movements.

Table 27 provides the estimated worst-case daily construction vehicle movements that have been generated in the Logistics Study. It should be noted that the figures provided in Table 27 represent trips to and from site and are estimated on the basis of two truck movements per delivery.

Table 27 Estimated total construction vehicle movements (worst case scenario)

Access Roads	Maximum movements per year	Vehicles per day	Estimated Peak Hour movements
Gregory Developmental Road, Elign Moray Road, Moray Carmichael Road	27,011	74	15

The nearest identified sensitive receptor relative to the haulage route is the Moray Downs Homestead which is located approximately 130 metres from the Elgin Moray Road which joins into Gregory Developmental Road, as shown in Figure 2. Noise levels due to construction vehicle movements at this receptor have been predicted based on the Intermittent Traffic Noise calculation method shown in Section 1.4. Table 28 provides the estimated traffic noise level with consideration having regard to the DTMR noise criteria.

Based on the results, the estimated construction noise level at the nearest potentially affected receptor due to vehicle movements along Elgin Moray Road is expected to be well under the DTMR 68 dB(A)$L_{10,18hr}$ criterion.

Table 28 Estimated traffic noise levels at potentially most affected sensitive receptor (Moray Downs Homestead)

Noise Source	Criterion dB(A)L10,18hr	Estimated Peak-Hour Traffic Noise Level dB(A)L10,18hr
Construction vehicle movements on local roads	68	57
* Includes 2.5 dB(A) façade reflection.		

Management measures

Noise model results indicate construction noise levels are unlikely to cause adverse impacts, and therefore direct mitigation measures are not necessary.

Mitigation measures would only be required upon receipt of a valid complaint. Adani will maintain a stakeholder engagement program throughout construction including:

- Provision of information to nearby residents regarding construction activities and how to contact Adani if noise issues arise
- A continuously monitored community liaison phone number and email address that allows noise complaints to be received and addressed in a timely manner.

If noise complaints are received, these will be entered into Adani's Consultation Manager database and responsibilities assigned for contacting the complainant and investigating the complaint in a timely manner.

In the event that complaint investigations indicate that construction noise levels are unreasonable, there are a range of management measures that may be able to be implemented.

Table 29 presents noise control methods and expected noise reductions according to Australian Standard *AS 2436 – 2010 Guide to Noise and Vibration Control on Construction, Demolition and Maintenance Sites*.

Table 29 Relative effectiveness of various forms of noise control dB(A)

Noise Control Method	Typical noise reduction dB(A)	Maximum noise reduction dB(A)
Distance	Approximately 6 per doubling of distance	
Screening	5 to 10	15
Acoustic Enclosures	15 to 25	50
Engine Silencing	5 to 10	20

3.2.3 Vibration from pile driving and heavy equipment

Potential vibration impact

Construction activities and equipment such as pile driving can lead to high vibration levels potentially resulting in adverse impacts to structural integrity and personal comfort. Assessment of potential vibration impacts is necessary to minimise potential adverse impacts on the surrounding sensitive receptors. Pile driving is, as a minimum, expected to be required as part of the construction of the MIA. Ground vibration caused by blasting is covered in Section 3.3.5.

Table 30 provides details for the predicted ground vibrations levels at various distances for typical construction equipment. Table 30 indicates vibration levels of 0.1 mm/s or less at a distance of approximately 300 m for all equipment identified. This is well below the adopted vibration criteria for all nominated plant items set out in Sections 1.3.9 and 1.3.10. Therefore, it is unlikely that ground vibration as a result of construction activities and equipment (excluding blasting) will adversely impact potentially sensitive receptors. Vibration levels produced by construction activities are expected to be well below the most stringent structural damage criteria of 3 mm/s at receptors located at distances greater than 50 m.

Table 30 Predicted construction equipment vibration levels

Plant Item [1]	Human Perception Preferred Criteria Peak Velocity mm/s (Maximum Criteria)		Predicted Ground Vibration Levels (mm/s PPV)				
	Day	Night	10 m	30 m	50 m	100 m	300 m
Pile Drivers (Impulsive)	8.6 (17.0)	2.8 (5.6)	21.0	4.0	1.9	0.7	0.1
15t Roller	0.28 (0.56)	0.2 (0.4)	7.5	1.4	0.7	0.2	<0.1
Dozer	0.28 (0.56)	0.2 (0.4)	3.3	0.6	0.3	0.1	<0.1
7t compactor	0.28 (0.56)	0.2 (0.4)	6.0	1.2	0.5	0.2	<0.1
Rock Breaking	0.28 (0.56)	0.2 (0.4)	7.0	1.3	0.6	0.2	<0.1
Backhoe	0.28 (0.56)	0.2 (0.4)	1.0	0.2	0.1	<0.1	<0.1

[1] NSW RTA Environment noise management manual

Management measures

As construction vibration levels are unlikely to cause adverse impacts, no direct mitigation and management measures are required.

3.2.4 Noise from workers accommodation village construction

Since the construction of the workers accommodation village will be staged, there is potential for dwellings that are already completed and habitable to be impacted by construction noise occurring in other uncompleted stages in the workers accommodation village. As such, there is potential for workers accommodation village building construction related noise impacts to occur during daytime hours when workers are sleeping. General in-principle mitigation measures are provided in the next section to assist with minimising noise impacts on mine residents located in the workers accommodation village.

Management measures

The site configuration and construction staging should be designed to minimise noise impacts to the surrounding workers accommodation village community. The following is recommended for consideration during construction of the workers accommodation village:

- The construction site would be laid out in such a way that the primary noise sources are at a maximum distance from existing workers accommodation village residences, with solid structures (sheds, containers, etc.) placed between residences and noise sources (and as close to the noise sources as is practical).

- Compressors, generators, pumps and any other fixed plant located as far away from residences as possible and behind site structures.
- Temporary noise barrier (boarding) installed around the site boundary where effective in reducing noise impacts to adjacent residences. Noise barriers would not be effective in reducing noise impacts if the line of sight from the noise source to the residence is not reduced. Therefore, it may not be practical to install a temporary noise barrier around the full perimeter of each building site.
- All equipment selected to minimise noise emissions. Equipment would be fitted with appropriate silencers and be in good working order. Machines found to produce excessive noise compared to normal industry expectations would be removed from the site or stood down until repairs or modifications can be made.
- To reduce the annoyance associated with reversing alarms, broadband reversing alarms (audible movement alarms) would be used for all site equipment.
- As far as possible, materials dropped from heights would be minimised.
- Machines would be operated at low speed or power and would be switched off when not being used rather than left idling for prolonged periods.
- All site workers would be made aware of the potential for noise and vibration impacts on local residents and encouraged to take practical and reasonable measures to minimise the impact during the course of their activities e.g. minimising use of loud radios, use of silenced nail guns, minimise metal on metal impacts such as dropping material into an empty skip.
- Liaise with the potentially effected residences prior to the start of construction so that they are aware of the mechanism to lodge a complaint or feedback. All complaints lodged by nearby residents are to be logged on a complaints register, which would also document the investigation into the source of the emission giving rise to the complaint and any corrective actions taken to rectify the cause of complaint.
- Where work is required within the proposed buffer distances, potentially impacted residents would be informed of the nature of the works, duration and contact details. The contractor would undertake a dilapidation survey for buildings within 20 metres of construction works. A copy of the report would be sent to the landholder.
- Attended compliance noise and vibration monitoring would be undertaken upon receipt of a noise and / or vibration complaint. Monitoring should be undertaken at the earliest convenience and reported as soon as possible. In the case that exceedances are detected, the situation should be reviewed in order to identify means to reduce the impact to acceptable levels.
- Noise and vibration monitoring would be undertaken by a qualified professional with consideration to the relevant standards and guidelines.

3.3 Mine operation

3.3.1 Overview

With regard to the Project (Mine) operational phase, mining (fixed and mobile) equipment and blasting are the primary aspects influencing noise and vibration.

3.3.2 Mine operations

Potential noise impact

Mine operation has the potential to adversely impact on noise sensitive places through:

- Disturbance to sleep, social activities and/or work and study activities
- Disturbance of native fauna and livestock (see Section 3.3.5)

Predicted noise levels during neutral and adverse weather conditions considered the following mine operation scenarios:

- Scenario 1 – Mining operation (Year 2015)
- Scenario 2 – Mining operation (Year 2026)
- Scenario 3 – Mining operation (Year 2049)
- Scenario 4 – Mining operation (Year 2071)

Table 31 and Table 32 show the predicted operational noise levels at the surrounding sensitive receptors for neutral and adverse weather conditions respectively. The most stringent night-time noise criterion has been provided for comparative purposes as mining will take place 24 hours per day. Predicted noise results are also provided in graphical format in Appendix E.

Noise model results indicate the predicted noise levels for all assessed mine operational years are expected to be compliant with the most stringent night-time noise criteria at all assessed surrounding sensitive receptors under neutral and adverse weather conditions. The highest predicted mine operational noise level is expected to occur at sensitive receptor 3 and 4 with 20 dB(A) during year 2049, compliant with the most stringent night-time criteria of 28 dB(A).

Noise modelling indicates the noise contribution from the mine operation including the industrial precinct is expected to be 20 dB(A), well under the night-time criteria of 28 dB(A). However, the contribution of noise generated by the power generation area located adjacent to the workers accommodation village is expected to exceed the night-time noise criteria at the workers accommodation village by up to 4 dB.

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Table 31 Predicted operational noise level at receptors – neutral conditions

Receptor	Night-time criteria Leq dB(A)	Predicted operational noise level, dB(A) Neutral meteorology			
		Year 2015	Year 2026	Year 2049	Year 2071
1 Workers accommodation village	28	32	32	32	32
2 Bygana Homestead		13	19	20	15
3 Lignum Homestead		14	19	20	15
4 Mellaluka Homestead		6	12	13	8
5 Doongmabulla Homestead		5	12	12	7
6 Carmichael Homestead		3	9	9	5
7 Moray Downs Homestead		9	16	16	11
8 Albinia Homestead		11	17	17	12
9 Bimbah East Homestead		0	6	7	2

Table 32 Predicted operational noise level at receptors – adverse conditions

Receptor	Night-time criteria Leq dB(A)	Predicted operational noise level, dB(A) Adverse meteorology (F Class inversion + 2 m/s easterly wind)			
		Year 2015	Year 2026	Year 2049	Year 2071
1 Workers accommodation village	28	32	32	32	32
2 Bygana Homestead		13	19	20	15
3 Lignum Homestead		14	19	20	15
4 Mellaluka Homestead		8	14	15	11
5 Doongmabulla Homestead		8	15	16	11
6 Carmichael Homestead		6	12	13	8
7 Moray Downs Homestead		9	16	16	11
8 Albinia Homestead		11	17	17	12
9 Bimbah East Homestead		6	12	13	9

Table 33 Predicted Operational Noise Level at Receptors – Lmax (Adverse Conditions)

Receptor	Night-time sleep disturbance criteria Lmax dB(A)	Predicted operational noise level, dB(A) Adverse meteorology (F Class inversion + 2 m/s easterly wind)			
		Year 2015	Year 2026	Year 2049	Year 2071
1 Workers accommodation village	55 (external)	32	33	34	32
2 Bygana Homestead		21	28	29	22
3 Lignum Homestead		22	28	29	23
4 Mellaluka Homestead		16	24	24	19
5 Doongmabulla Homestead		17	24	25	19
6 Carmichael Homestead		14	21	22	16
7 Moray Downs Homestead		18	25	25	20
9 Albinia Homestead		19	26	26	20
10 Bimbah East Homestead		15	21	22	16

Management measures

Based on information available on equipment and plant types and numbers, operation noise levels are unlikely to cause adverse impacts, and therefore direct mitigation measures are not necessary.

Noise level predictions should be revisited once final equipment and plant lists are available and to reflect any changes in the mine plan that occur as more detailed design and mine planning progresses. However, it is unlikely that any significant changes in noise levels will occur that cannot be addressed through noise mitigation and attenuation measures.

Adani will also maintain a stakeholder engagement program throughout operation including:

- Provision of information to nearby residents regarding mining activities and how to contact Adani if noise issues arise
- A continuously monitored community liaison phone number and email address that allows noise complaints to be received and addressed in a timely manner.

If noise complaints are received, these will be entered into Adani's Consultation Manager database and responsibilities assigned for contacting the complainant and investigating the complaint in a timely manner. Similarly, if noise monitoring indicates that noise levels are exceeded, this will be treated as an incident. In either case, an investigation will follow the incident investigation procedure established for the mine site and corrective actions arising will be entered into the corrective action register. The stakeholder engagement program will ensure prompt and ongoing communications with the complainant or any other potentially affected parties in relation to the complaint and investigation.

In the event that routine monitoring or complaint investigations indicate that operational noise levels exceed environmental authority criteria, there are a range of management measures that can be implemented. These may include:

- Selection of quieter equipment or maintenance and modification of equipment to reduce noise emissions when operating in proximity to noise sensitive receptors
- Grading haul roads to remove potholes and bumps
- Use of broadband reversing alarms (audible movement alarms) rather than standard tonal reversing alarms
- Partial or full enclosure of noisy stationary plant items
- Use of earth mounds to block noise
- Noise mitigation at sensitive receptors

3.3.3 Low frequency noise

Potential noise impact

LFN due to operation of the Project (Mine), in particular the coal handling and processing CHPP, has the potential to adversely impact on noise sensitive places through annoyance and discomfort to humans located in dwellings. The predicted operational LFN levels at the nearest surrounding sensitive receptors are shown in Table 34. Noise model results indicate the predicted LFN levels are expected to be under the LFN criteria of 50 dB(linear) at all assessed surrounding sensitive receptors.

Table 34 Predicted operational low frequency noise level at receptors – adverse conditions

Receptor	LFN criteria dB(linear)	Predicted operational LFN level, dB(linear)			
		Adverse meteorology (F Class inversion + 2 m/s easterly wind)			
		Year 2015	Year 2026	Year 2049	Year 2071
1 Workers accommodation village	50	29	36	36	32
2 Bygana Homestead		29	35	36	31
3 Lignum Homestead		30	35	36	31
4 Mellaluka Homestead		24	31	31	27
5 Doongmabulla Homestead		25	32	32	27
6 Carmichael Homestead		22	28	29	24
7 Moray Downs Homestead		26	32	32	27
8 Albinia Homestead		27	33	33	28
9 Bimbah East Homestead		23	28	29	25

Management measures

Noise model results indicate the predicted LFN levels are expected to be under the LFN criteria of 50 dB(linear) at all assessed surrounding sensitive receptors and mitigation measures are not required.

3.3.4 Operational traffic

Potential operational traffic impact

Operational traffic generation due to vehicles travelling to the mine site has the potential to adversely impact on noise sensitive places in close proximity to travel routes.

Vehicle movements will comprise of the following:

- Operations equipment – Delivery of equipment required for the operations at the site.
- Operations workforce – Light vehicle movements due to local travel of operations workforce.
- Consumable for workforce – Consumables such as food and miscellaneous items required to sustain the workforce.

Vehicle movements associated with operation of the Mine have been estimated based on vehicle movements provided in the Logistics Study for the Mine.

It has been assumed that all vehicle movements would occur along the Gregory Developmental Road, Elgin Moray Road and Moray Carmichael Road. The following assumptions were made:

- Operations vehicle movements were assumed to occur 365 days per year.
- Peak hour vehicle movements were assumed to be 20 percent of daily movements.

Table 35 provides the estimated worst-case daily vehicle movements during Mine operations that have been generated in the Logistics Study.

Table 35 Estimated operational vehicle movements (worst-case scenario)

Access Roads	Maximum movements per year	Vehicles per day	Estimated Peak Hour movements
Gregory Developmental Road, Elign Moray Road, Moray Carmichael Road	52,158	143	29

It should be noted that the figures provided in Table 35 represent trips to and from site and are estimated on the basis of two vehicle movements per delivery.

The nearest identified sensitive receptor relative to the off-site haulage route is the Moray Downs Homestead which is located approximately 130 m from the Elgin Moray Road which joins into Gregory Developmental Road. Noise levels due to operational vehicle movements at this receptor have been predicted based on the Intermittent Traffic Noise calculation method shown in Section 1.4. Table 36 provides the estimated traffic noise level with having consideration to the DTMR noise criteria. Based on the results, the estimated operational noise level at the nearest potentially affected receptor due to heavy vehicle movements along Elgin Moray Road is expected to be well under the DTMR 68 dB(A)$L_{10,18hr}$ criterion. Furthermore,

calculations show that based on the above traffic volumes, the buffer distance required to meet the 68 dB(A)$L_{10,18hr}$ is approximately 45 m from the edge of the road.

Table 36 Estimated operational traffic noise levels at potentially most affected sensitive receptor (Moray Downs homestead)

Noise Source	Criterion dB(A)L10,18hr	Estimated Peak-Hour Traffic Noise Level dB(A)L10,18hr
Operational vehicle movements on local roads	68	59
* Includes 2.5 dB(A) façade reflection.		

3.3.5 Blasting

Potential blasting impact

Potential adverse impacts to sensitive receptors associated with blasting may include:

- Disturbance of native fauna and livestock (see Section 3.5)
- Annoyance and discomfort to sensitive receptors as a result of air blast overpressure and ground vibration
- Damage to property and infrastructure as a result of ground vibration.

Ground vibration and air blast overpressure estimations have been undertaken with consideration to AS2187-2006 and have been based on available information. Typical site constants have been used in the blasting assessment to reflect geological conditions, however ground conditions, including rock structure and strata type, can vary significantly within and surrounding a mine site and this can affect the propagation of vibration and air blast overpressure.

Calculations are based on the distance from the nearest open cut or underground mining boundary, to the sensitive receptors.

Table 37 identifies predicted ground vibration and air blast overpressure levels at sensitive receptors based on expected lower and upper site constants. Based on the predicted blast impacts, the predicted air blast overpressure and ground vibration levels at the surrounding sensitive receptors are expected to be below the blasting criteria under all assessed conditions.

Table 37 Predicted blast impacts

Receptor	Distance from nearest open cut or underground mining boundary (m)	Estimated Air blast Overpressure, dB(Linear) Peak		Estimated Ground Vibration, PPV (mm/s)	
		ka = 10	ka = 100	Kg = 800	Kg = 1600
1 Commercial/ Industrial precinct	7,700	90.3	110.3	0.1	0.2
2 Workers accommodation village	14,100	82.7	102.7	<0.1	0.1
3 Bygana Homestead	9,900	87.1	107.1	0.1	0.2
4 Lignum_Homestead	6,900	91.7	111.7	0.1	0.3
5 Mellaluka Homestead	12,300	84.4	104.4	0.1	0.1
6 Doongmabulla Homestead	6,300	92.8	112.8	0.2	0.3
7 Carmichael Homestead	13,500	83.2	103.2	<0.1	0.1
Acceptable limits		115 dB(L)		5 mm/s PPV	

Management measures

Although predicted air blast overpressure and ground vibration levels are expected to be under the criteria, overpressure levels at sensitive receptors 4 (Lignum) and 6 (Doongmabulla) are predicted to be within 2 to 3 dB of the 115 dB(L) criteria.

It should be noted that the calculations are based on typical site constants which should be verified with the blasting contractor prior to blasting. If predictions indicate that the acceptable limit of 115 dB(L) is likely to be approached or exceeded, and this cannot be confidently addressed by changing blasting parameters, receptors will be notified and consideration will be given to whether receptors at potentially affected homesteads should be relocated away from the blast location during the blasting activity. As this is only likely to affect a small number of individuals at the potentially affected homesteads, this should not cause unnecessary disruption. Engagement with potentially affected landholders and workers on adjacent properties will occur through the stakeholder engagement program and details of engagement will be recorded in the Consultation Manager database.

If air blast levels are likely to exceed the acceptable limits, monitoring will also be undertaken to check the accuracy of predictions and indicate whether further optimisation of the blast parameters is required.

Where monitoring or complaints indicate air blast overpressure or ground vibration levels exceed the environmental protection objectives, modification to blast parameters will be considered. Blast parameters that may be altered to address excessive air blast overpressure include:

- Maximum instantaneous charge
- Stemming height
- Reducing the maximum instantaneous charge by using delays, reduced hole diameter and/or deck loading

- Changing the burden and spacing by altering the drilling pattern and/or delay layout, or altering the hole inclination
- Ensuring stemming depth and type is adequate
- Restricting blasts to favourable weather conditions.

It is not proposed to introduce time restrictions to blasting activities given the small number of potentially affected receptors, and that these receptors will be notified ahead of time of proposed blasting activities. Blasting is not expected to take place at night except in extraordinary circumstances.

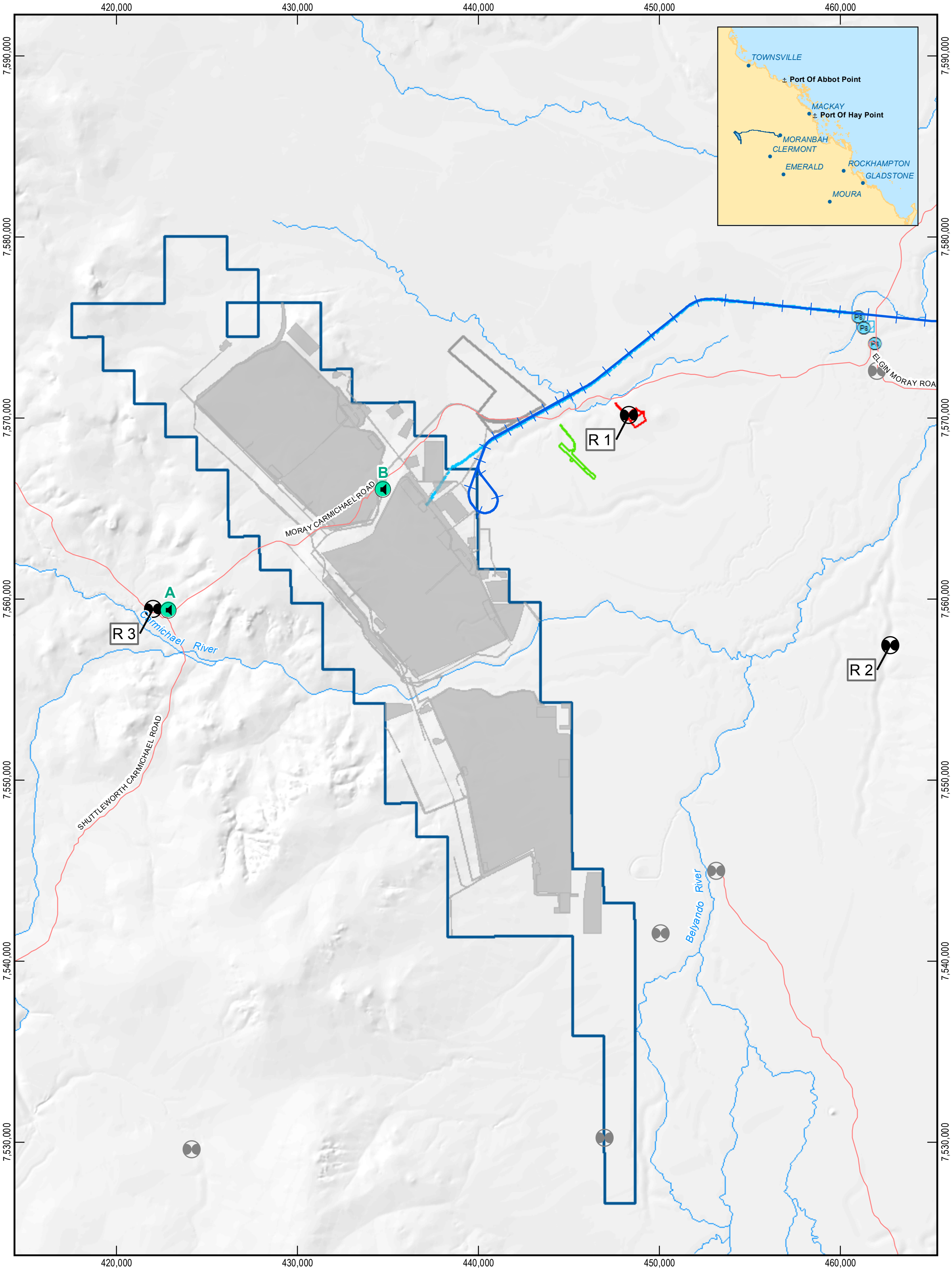
3.4 Aircraft noise

3.4.1 Sensitive receivers

Sensitive receivers identified in the vicinity of the airport are shown in Figure 6 and details of these receivers are provided in Table 38. The nearest sensitive receiver (R1) is the workers accommodation village site 3.8 km away from the airport. The next nearest sensitive receiver (R2) is a homestead approximately 17 km away. Noise levels have been calculated at the three receiver locations (R1, R2 and R3). The noise levels identified at these receivers represent a limiting value for other receivers located at a similar distance and/or farther away.

Table 38 Aircraft sensitive receivers

Receiver	Type	Distance from airport (km)	Elevation difference from airport (m)
R1	Workers accommodation village s	3.8	0
R2	Albinia Homestead	17	0
R3	Doongmabulla Homestead	25	+30



LEGEND

Sensitive Receptor

Assessed Receptor

Not Assessed
(due to distance from runway)

Local Road

Watercourse

Rail (West)

Mine (Onsite)

Mine Footprint

Mine (Offsite)

Pump Station

Storage Facility (Offstream)

Airport

Industrial Area

Accommodation Village

Based on or contains data provided by the State of QLD (DERM) [2010]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:300,000 (at A4)

0 2 4 6 8 10

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS

Job Number	41-26422
Revision	B
Date	24-10-2013

Aircraft noise sensitive receptors

Figure 6

G:\41\26422\GIS\Maps\MXD\0200_Noise\41-26422_0214_rev_b.mxd

Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: DME: EPC 1690 (2010)/EPC 1080 (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007); Adani: Alignment, Offsite (SP1 & 2), Footprint (2013); GHD: Sensitive Receptor, Noise Logger (2012). Created by: MS

3.4.2 Aircraft noise levels

Boeing 737's and other light aircraft are expected to carry construction and operational workforce to and from the airport (R1 in Figure 6). Aircraft movements are shown in Table 39. Less than five aircraft fly to and from the airport four days a week.

Table 39 Expected aircraft movements

Flights	2015-2016	2017-2018	2019-2028
Tuesday	4	3	4
Wednesday	4	3	4
Sunday	4	3	4
Monday	0	0	0

DS, DT and DL coordinates for these aircraft have been calculated at the identified sensitive receivers and are presented in Table 40. It has been assumed in these calculations that the aircraft fly-in and depart using straight flight paths. Distance coordinates for receiver R3 have been corrected to account for elevation differences from the airport. Due to different correction factors for different aircraft types, two DT distances result for receiver R3.

Table 40 Receiver distance coordinates

Receiver	DS (m)	DT (m)	DL (m)
R1	3,850	920	1,340
R2	4,685	18,332	20,457
R3	22,232	9,791 (domestic jet) 9,941 (light aircraft)	12,413

3.4.3 Noise impact assessment

Aircraft noise levels for Boeing 737s and general light aircraft are provided in Table 41 based upon the coordinate distances calculated in Table 40. A conservative 5 dBA correction has been applied to the external noise levels for receivers R2 and R3 to calculate the indoor noise levels. It should be noted that the DS values provided by the standard for calculation purposes are 2,600 m (take-offs) and 1,400 m (arrivals). As the sideline distances for all identified sensitive receivers are greater than these values, the noise levels in reality will range from lower to significantly lower than the noise levels calculated in Table 41.

Table 41 Aircraft noise levels

Receiver	Boeing 737 Take-off (dBA)	Boeing 737 Landing (dBA)	Light Aircraft Take-off (dBA)	Light Aircraft Landing (dBA)
R1	<51	<49	<47	<44
R2	<50	<48	<46	<44
R3	<51	<49	<44	<45

Aircraft noise levels at sensitive receiver R1 range from <44 dBA to <51 dBA. These values are significantly lower than those stipulated by the standard (<80 dBA to <85 dBA for 20 or less flights per day) and hence, the building site is deemed to be 'acceptable'. Once the construction of the accommodation village is complete, the site will become a residential receiver and the indoor noise criteria will apply. As aircraft noise levels range from <44 dBA to <51 dBA, the receiver is expected to comply with the indoor design sound levels for all residential activities.

Similarly, for receiver R2 indoor noise levels will range from <44 dBA to <50 dBA and for receiver R3, <44 dBA to <52 dBA. These fall below the indoor design sound levels (50 dBA to 60 dBA) for existing buildings. Hence, no further noise protection is specifically required against aircraft noise at these and other nearby receivers.

3.5 Noise impacts on native fauna and livestock

Refer to the SEIS Volume 4 Appendix J1 Mine Terrestrial Ecology Report for detail regarding noise impacts on native fauna.

4. Conclusion

4.1 Baseline monitoring and noise and vibration criteria

Baseline noise monitoring was conducted at two locations in the vicinity of the proposed Project (Mine). Locations selected were considered representative of the acoustic environment for the nearest sensitive receptors located in the vicinity of the mine. Noise levels at monitoring Location A were generally higher due to the influence of birdlife and cattle. Both monitoring locations were dominated by natural noise sources including insects and birds and noise levels were consistent with a quiet rural location.

Based on the background noise monitoring results, construction and operational noise criteria have been determined and are given in Section 1.3.2. Human comfort, vibration and structural vibration criteria are also discussed in Section 1.3.9 and 1.3.10. Blasting vibration and overpressure criteria are given in Section 1.3.8.

4.2 Construction noise

Noise predictions indicate that construction noise relating to mine infrastructure is not expected to cause adverse impacts at noise sensitive receptors.

Predicted results indicate the estimated construction noise level at the nearest potentially affected receptor due to vehicle movements along Elgin Moray Road is expected to be well under the DTMR 68 dB(A)$L_{10,18hr}$ criteria.

Results indicate that predicted construction noise levels outside of normal hours are expected to be well under the 55 dB(A) WHO criteria at all sensitive receptors.

Since the construction of the workers accommodation village will be staged, there is potential for dwellings that are already completed and habitable to be impacted by construction noise occurring in other uncompleted stages. As such, there is potential for construction related noise impacts to occur during daytime hours when workers are sleeping. General in-principle mitigation measures are provided in Section 3.2.4 to assist with minimising noise impacts on residents located in the workers accommodation village.

4.3 Operational noise and vibration

Operational noise modelling results indicate the predicted noise levels for all assessed mine operational years are expected to be compliant with the most stringent night-time noise criteria at all assessed surrounding sensitive receptors under neutral and adverse weather conditions. The highest predicted mine operational noise level is expected to occur at sensitive receptor 3 and 4 with 20 dB(A) during peak mine year 2049, compliant with the most stringent night-time criteria of 28dB(A).

Noise modelling indicates the noise contribution from the mine operation including the industrial precinct is expected to be 20 dB(A), well under the night-time criteria of 28 dB(A). However, the contribution of noise generated by the power generation area located adjacent to the workers accommodation village is expected to exceed the night-time noise criteria at the workers accommodation village by up to 4 dB.

Noise from the proposed offsite infrastructure has been conservatively assessed and included in the operational noise models. Noise impacts associated with the proposed industrial precinct, rail siding and water pumping stations are not expected to cause adverse noise impacts at sensitive receptors.

Although Project (Mine) operations are generally not expected to cause adverse noise impacts, mitigation measures have been identified in the event that exceedance of the noise criteria occurs, or a complaint is received and validated.

Noise model results indicate the predicted LFN levels are expected to be under the LFN criteria of 50 dB(linear) at all assessed surrounding sensitive receptors and mitigation measures are not required.

Given the relatively low volume of project related traffic volumes projected on the Moray Carmichael Road and the large distances involved from the road to sensitive receptors, traffic noise levels during Mine operations are expected to be well under the DTMR 68 dB(A)$L_{10,18hr}$ criteria.

Based on typical site constants, predicted air blast overpressure and ground vibration levels are expected to be under the criteria. However, overpressure levels at sensitive receptors 4 (Lignum) and 6 (Doongmabulla) are predicted to be within 2 to 3 dB of the 115 dB(L) criteria.

Once site constants are verified with the blasting contractor, it is recommended that air blast overpressure be recalculated prior to blasting and mitigation measures identified if required. Monitoring should also be conducted during the initial blasts to assist with the optimisation of the blast parameters and confirmation of predictions. Maximum instantaneous charge and stemming height together with other blast parameters should be designed to ensure the air blast criterion is not exceeded.

4.4 Aircraft noise

Noise predictions indicate that aircraft noise is not expected to cause adverse impacts at noise sensitive receptors. Predicted results indicate that estimated aircraft noise levels at the nearest potentially affected receptor range from <44 dB(A) to <51 dB(A). These values are significantly lower than those stipulated by the standard (<80 dB(A) to <85 dB(A) for 20 or less flights per day) for new building sites and hence, no further noise mitigation measures are required.

Similarly, aircraft noise predictions at the homestead receptors fall below the indoor design sound levels (50 dB(A) to 60 dB(A)) for existing buildings. Hence, no further noise protection is specifically required against aircraft noise at these and other nearby receptors.

5. References

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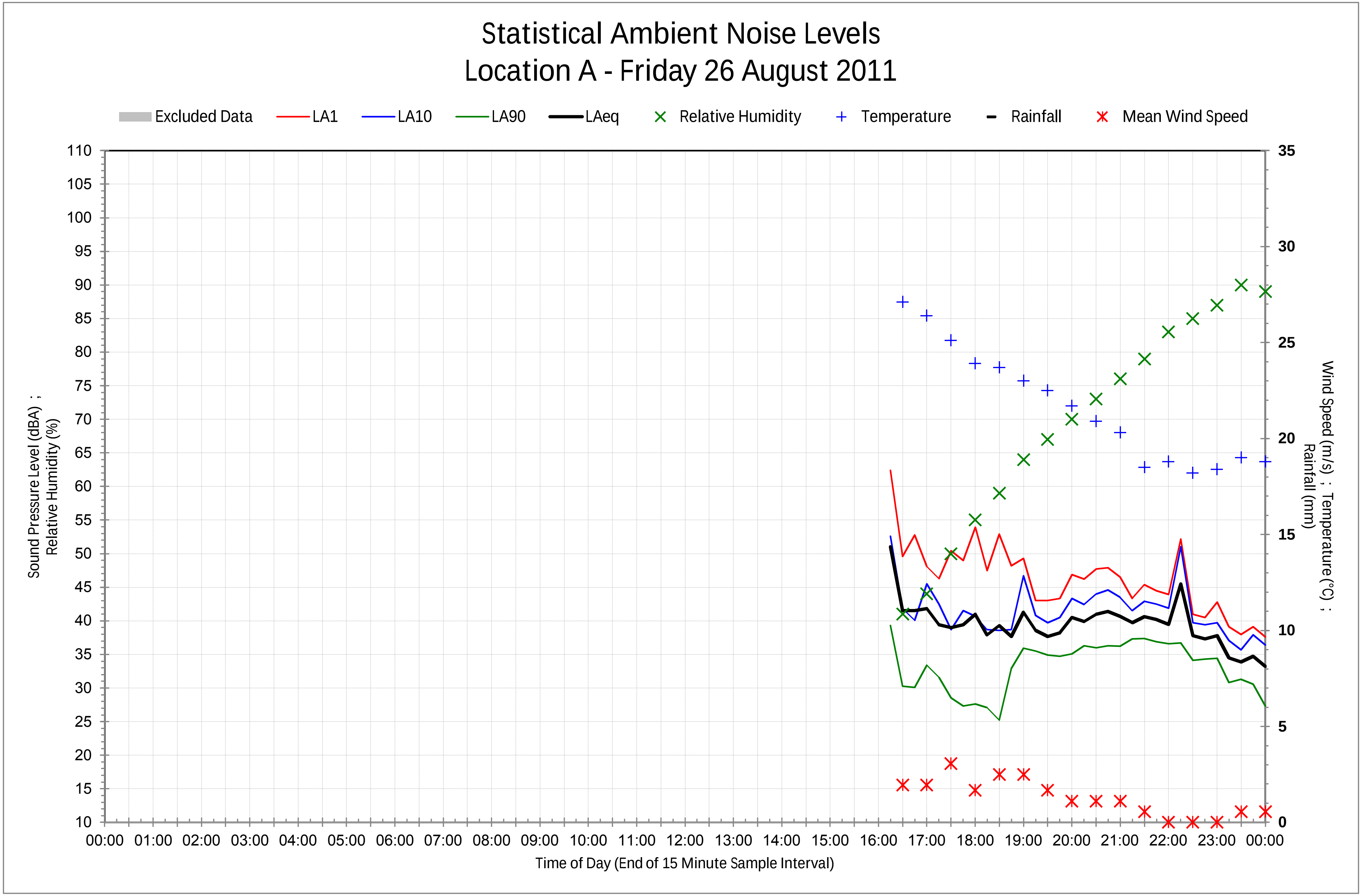
Appendix A – Noise monitoring data – Location A


Statistical Ambient Noise Levels
Location A - Friday 26 August 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
35
30
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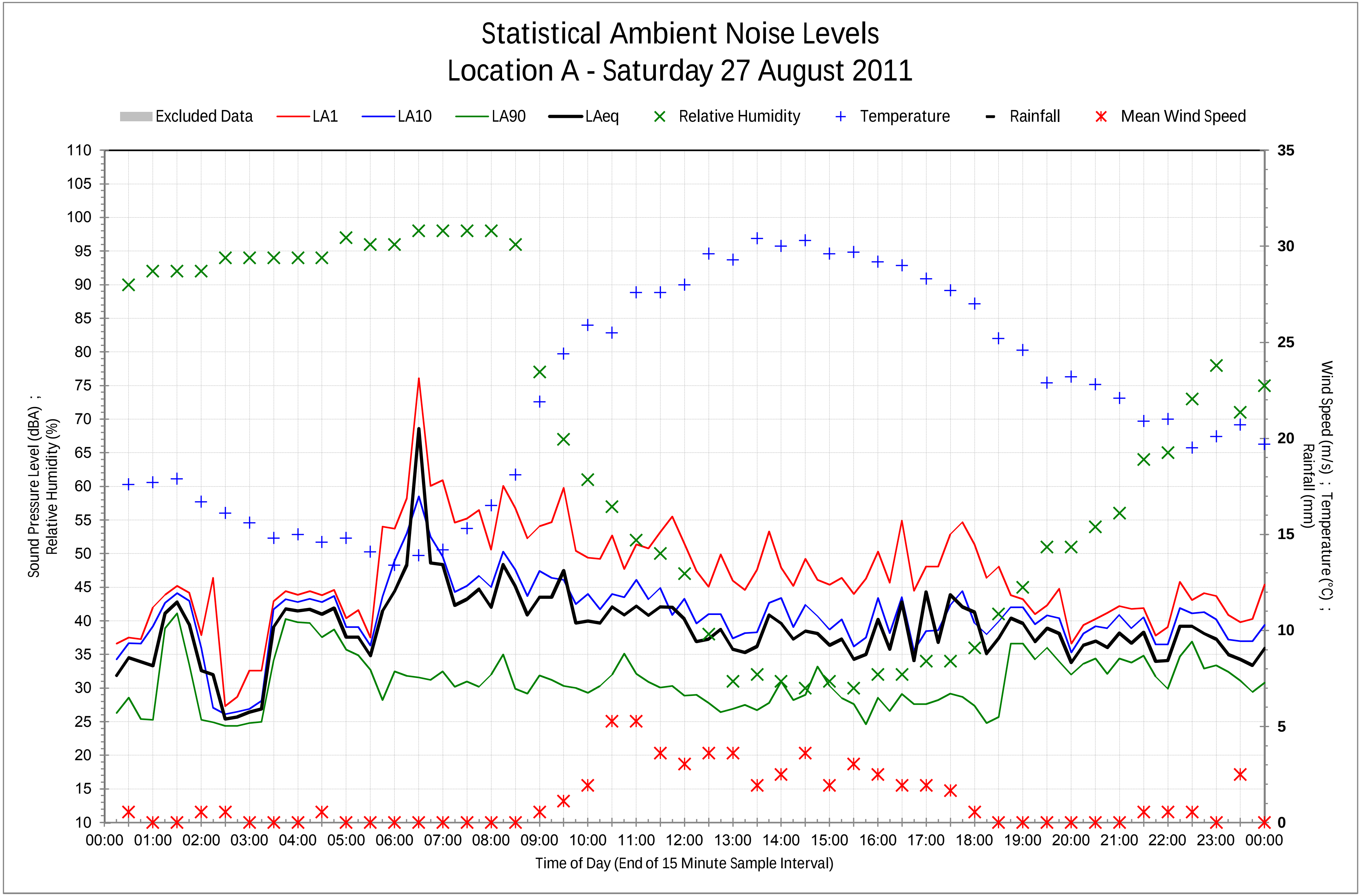
0
00:00 01:00 02:00 03:00 04:00 05:00 06:00 07:00 08:00 09:00 10:00 11:00 12:00 13:00 14:00 15:00 16:00 17:00 18:00 19:00 20:00 21:00 22:00 23:00 00:00
Time of Day (End of 15 Minute Sample Interval)



Statistical Ambient Noise Levels
Location A - Saturday 27 August 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
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30
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20
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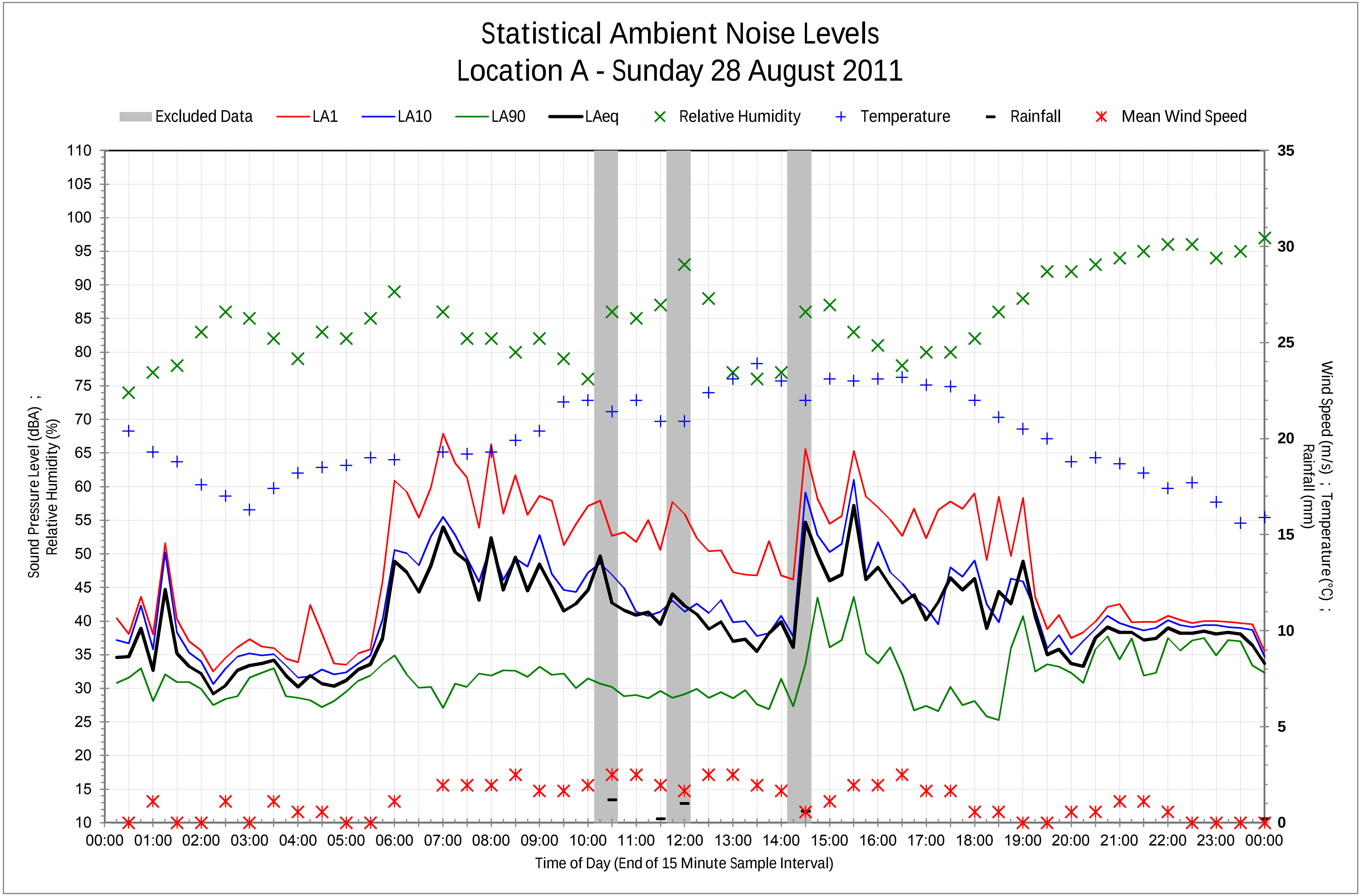
Time of Day (End of 15 Minute Sample Interval)



Statistical Ambient Noise Levels
Location A - Sunday 28 August 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)
110
105
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
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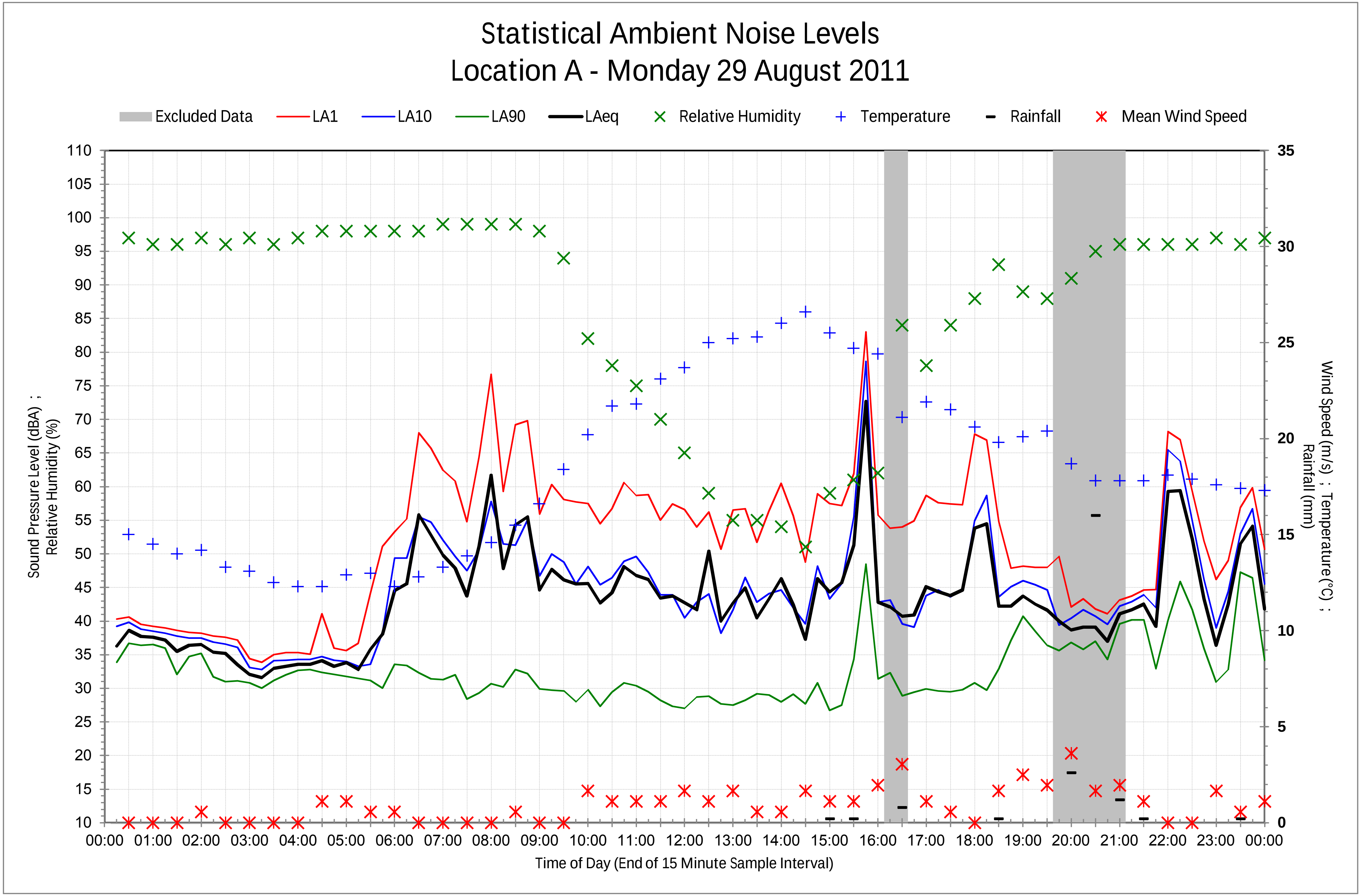

Statistical Ambient Noise Levels
Location A - Monday 29 August 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)
110
105
100
95
90
85
80
75
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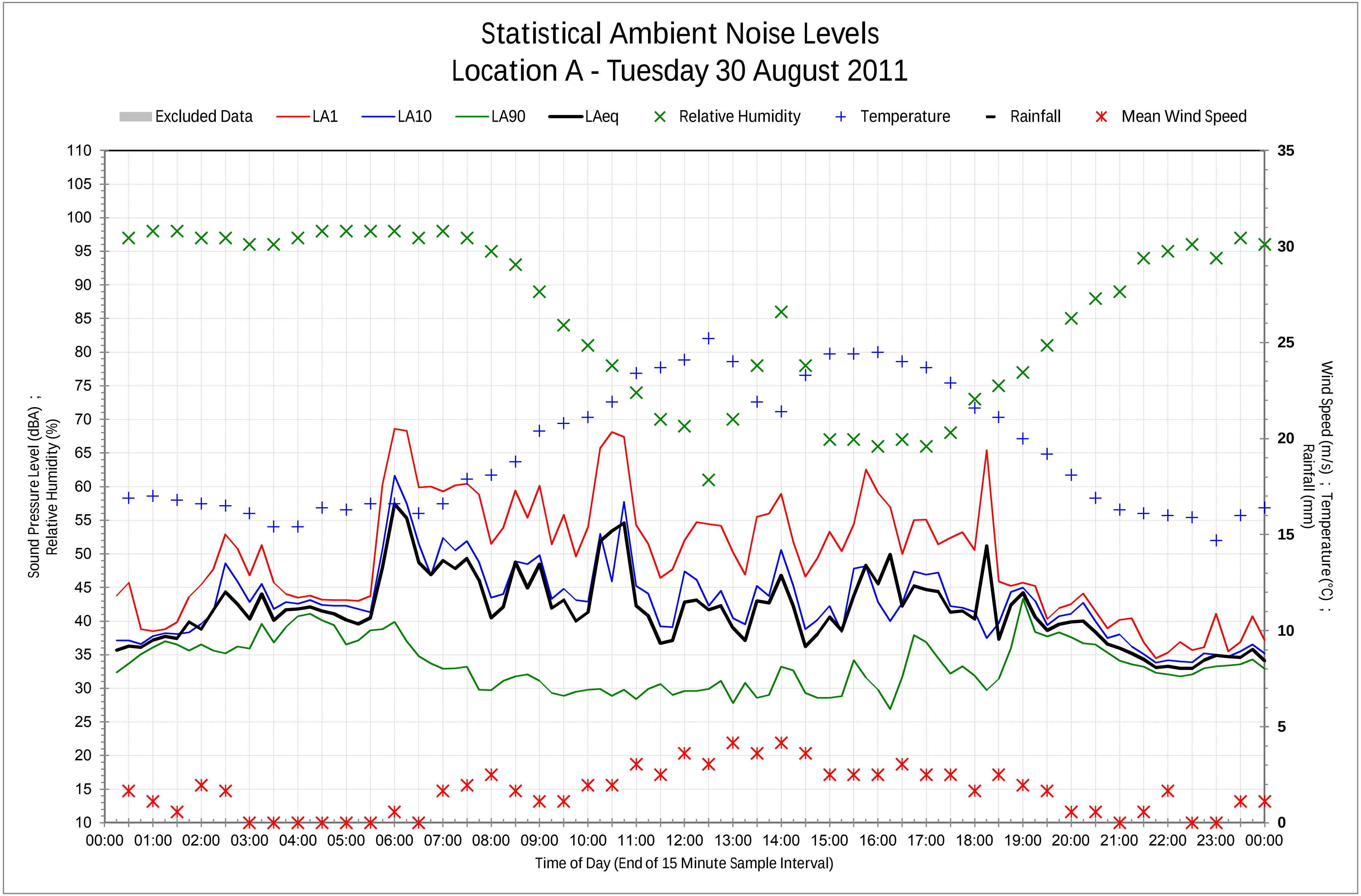

Statistical Ambient Noise Levels
Location A - Tuesday 30 August 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
110
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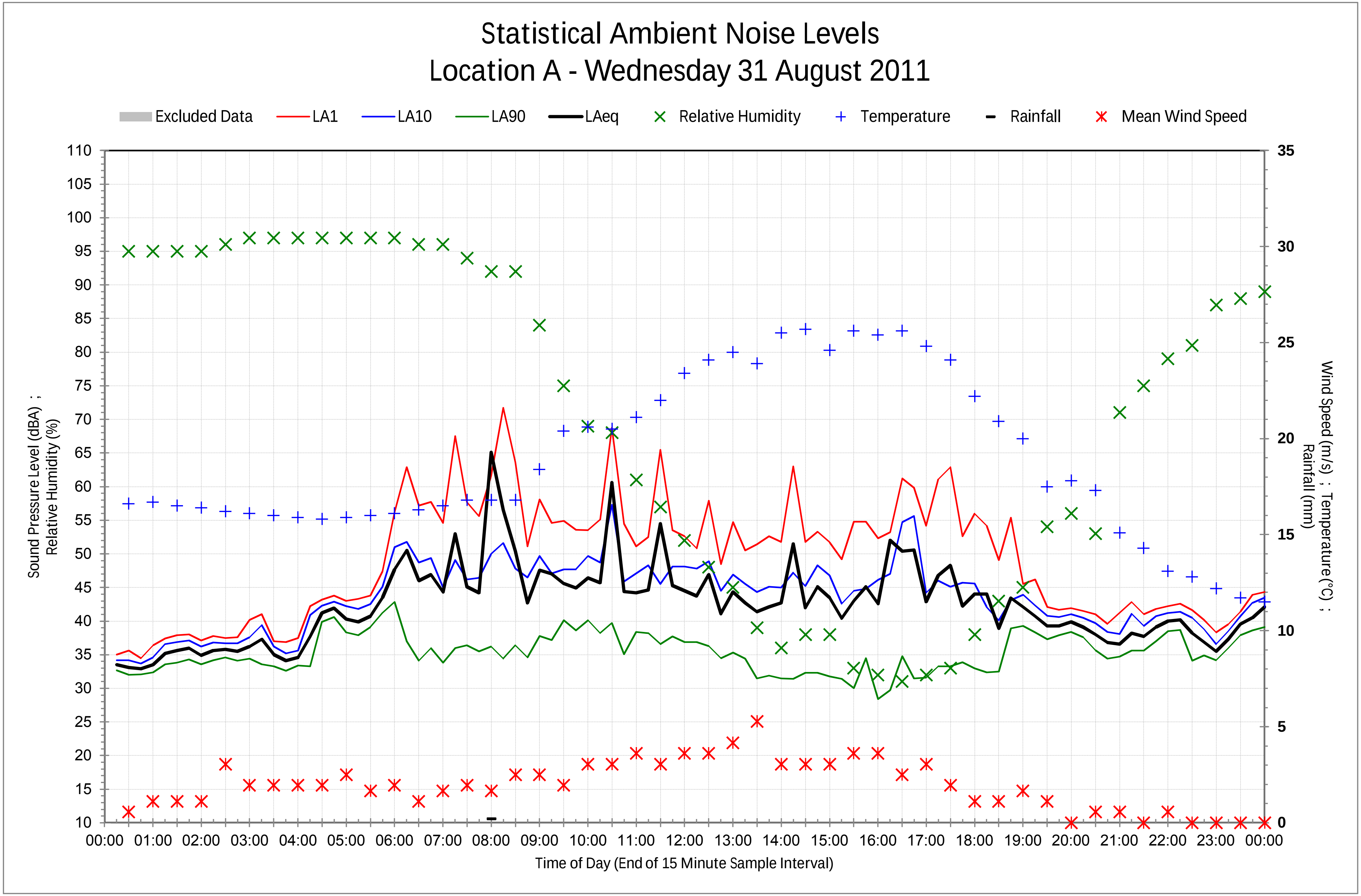
Time of Day (End of 15 Minute Sample Interval)



Statistical Ambient Noise Levels
Location A - Wednesday 31 August 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)
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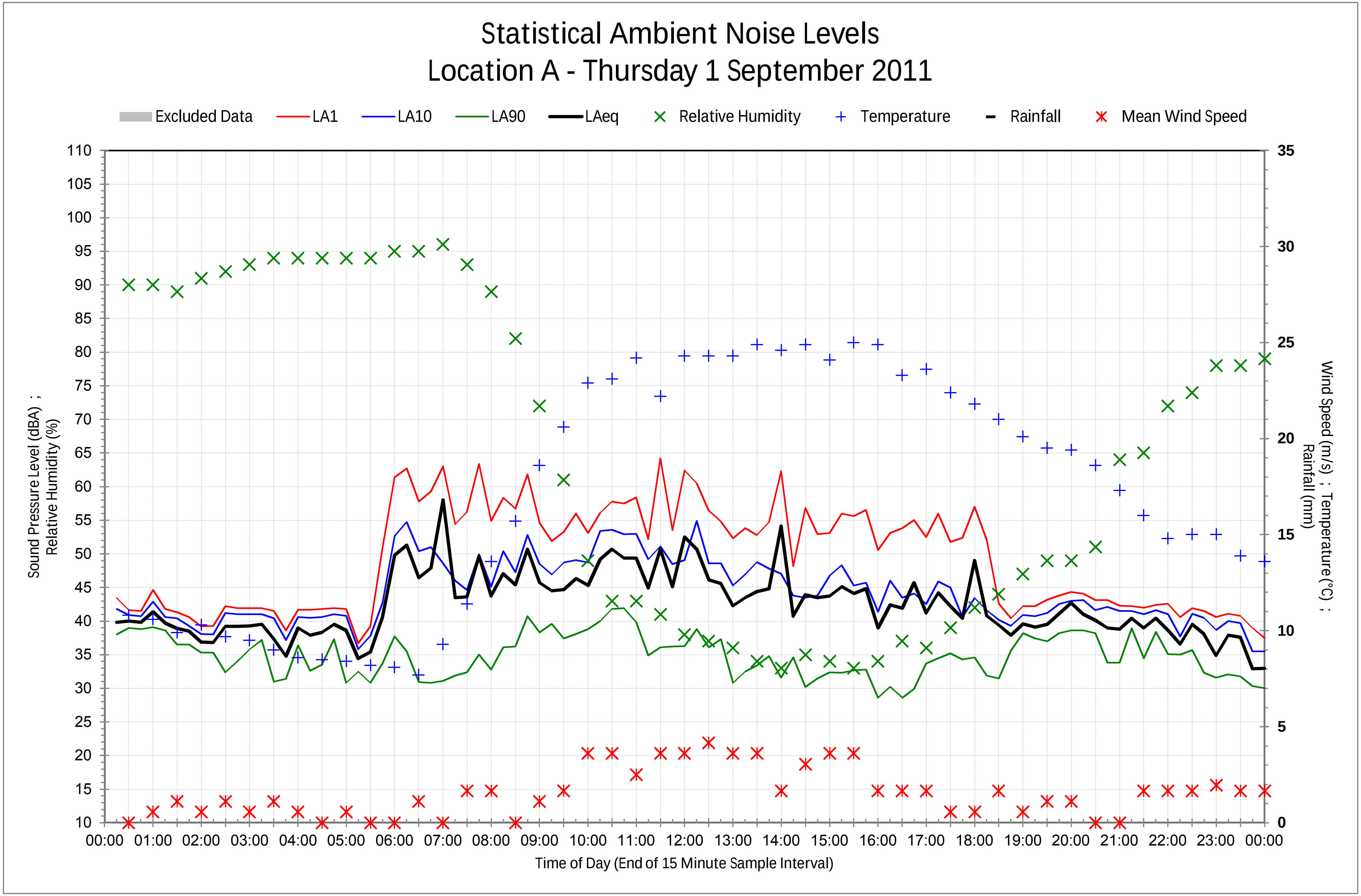

Statistical Ambient Noise Levels
Location A - Thursday 1 September 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
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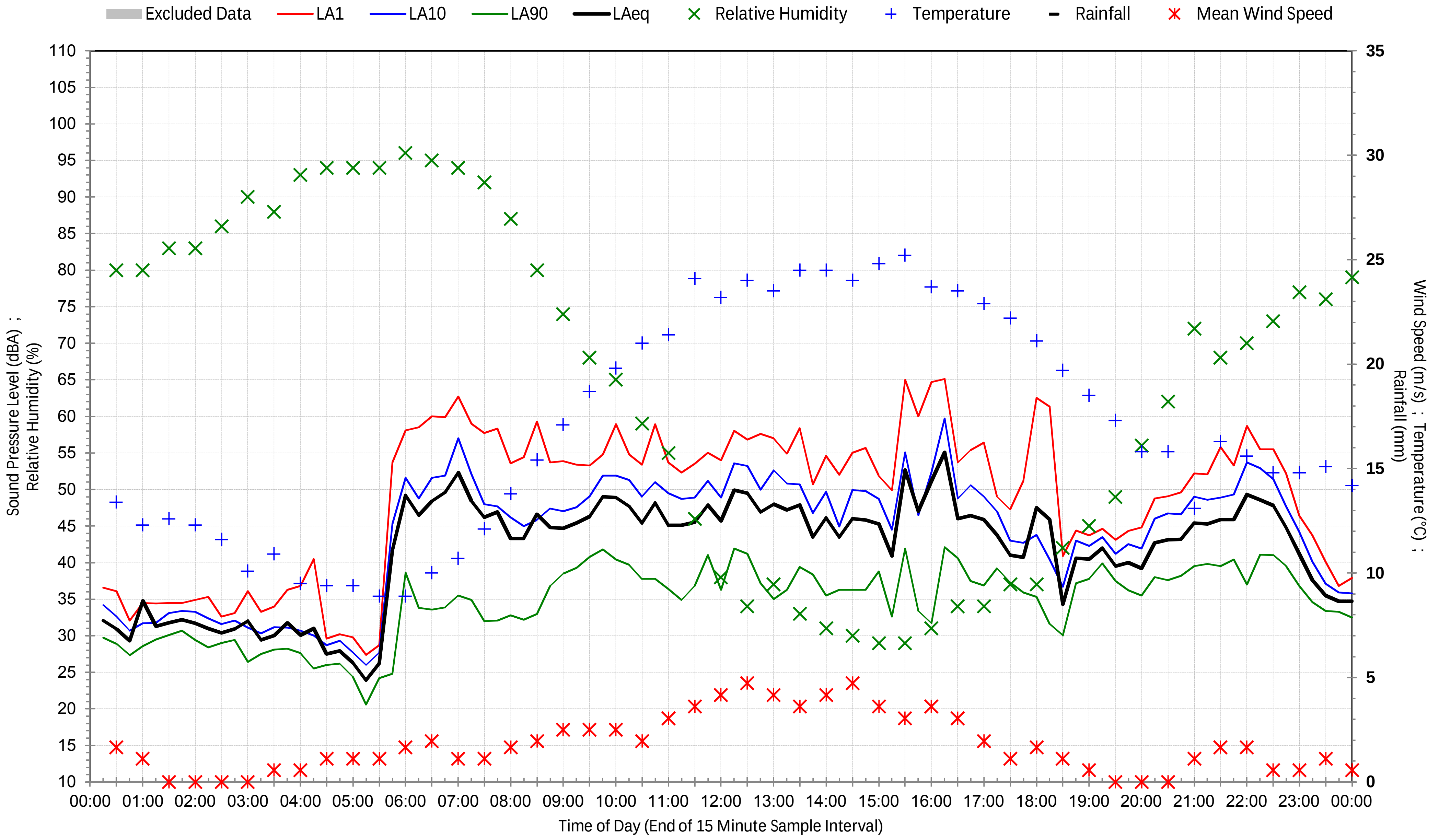
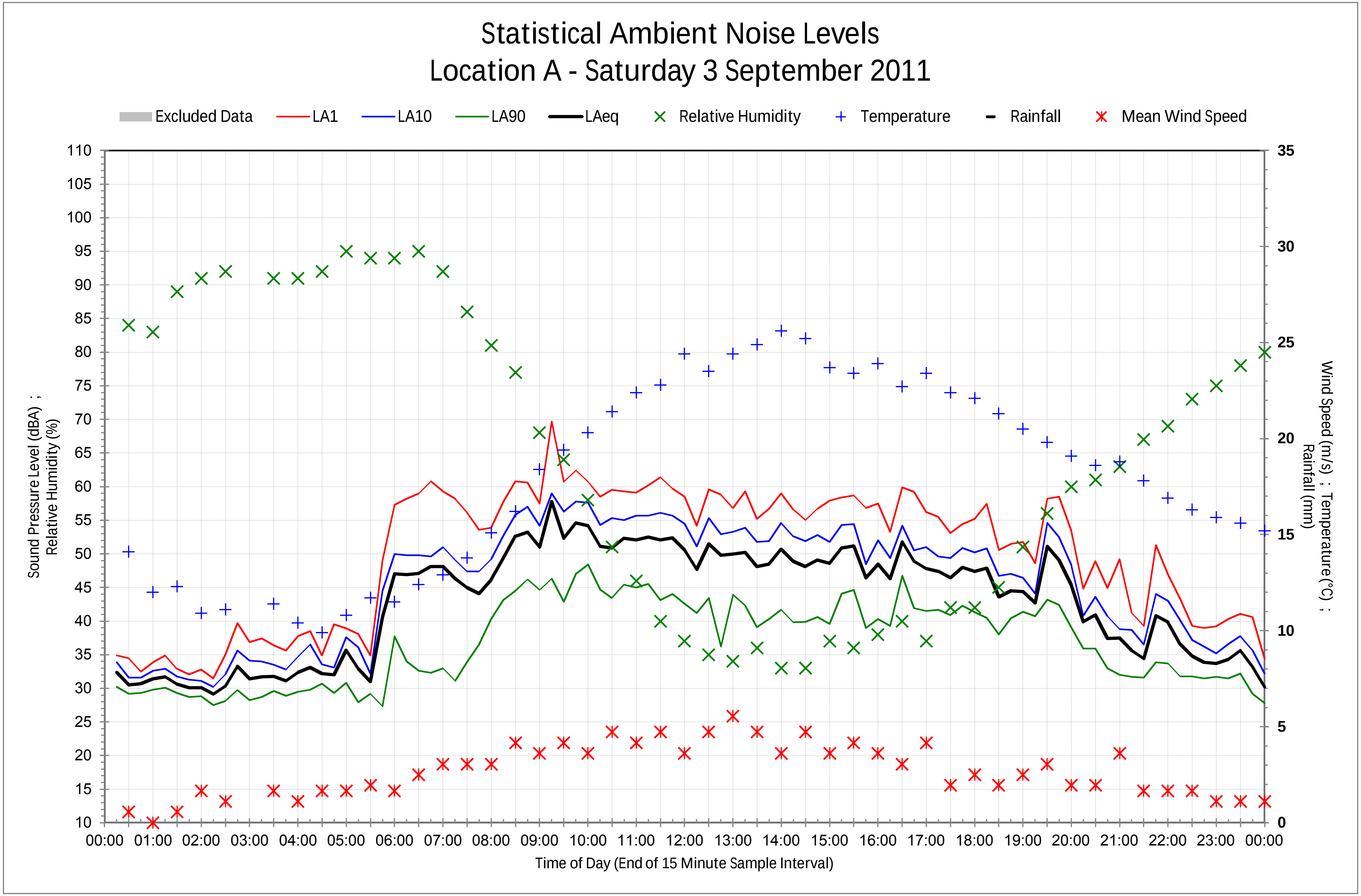
Time of Day (End of 15 Minute Sample Interval)

Statistical Ambient Noise Levels
Location A - Friday 2 September 2011





Statistical Ambient Noise Levels
Location A - Saturday 3 September 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)
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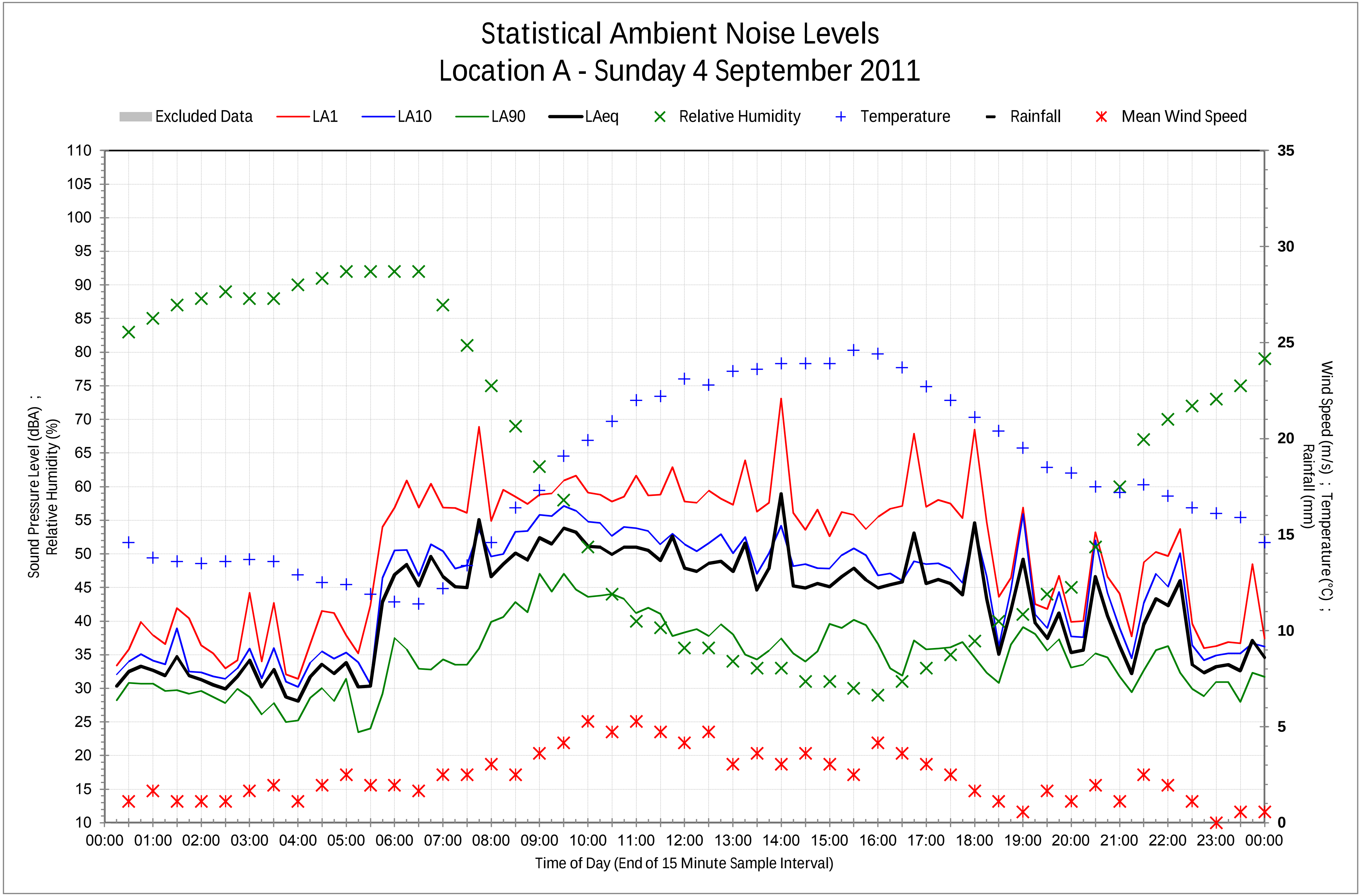

Statistical Ambient Noise Levels
Location A - Sunday 4 September 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)
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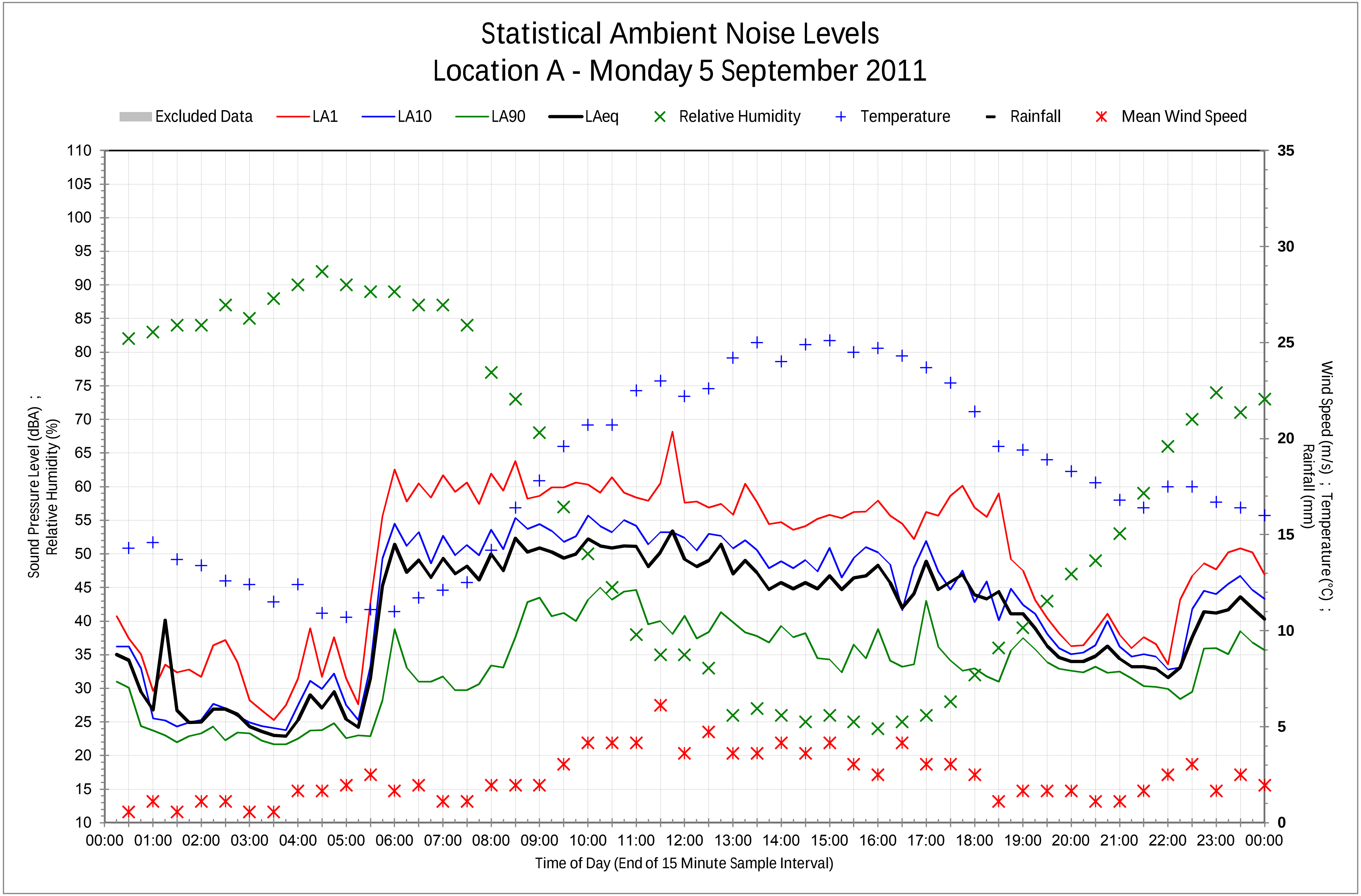

Statistical Ambient Noise Levels
Location A - Monday 5 September 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)
110
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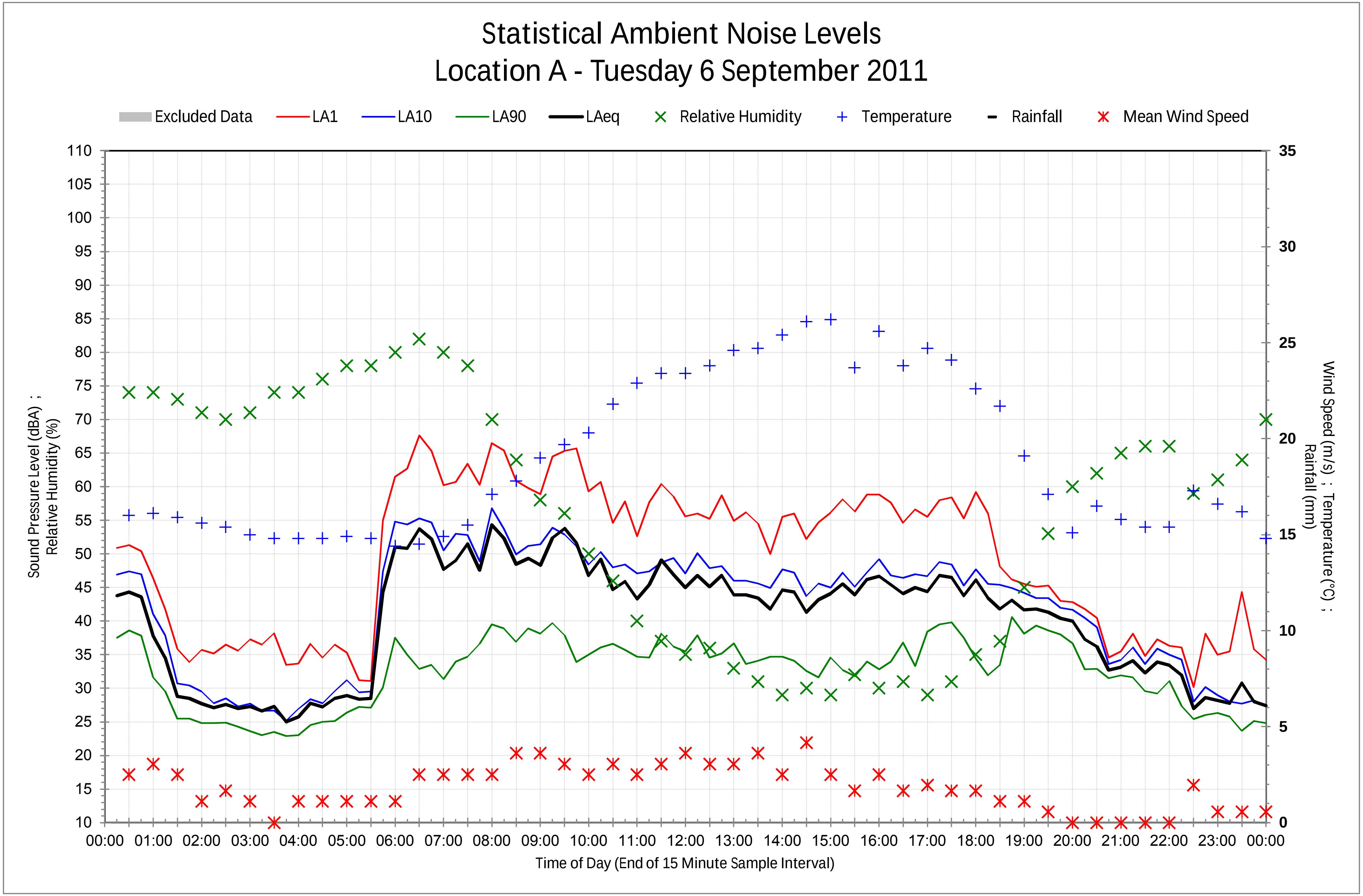

Statistical Ambient Noise Levels
Location A - Tuesday 6 September 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)
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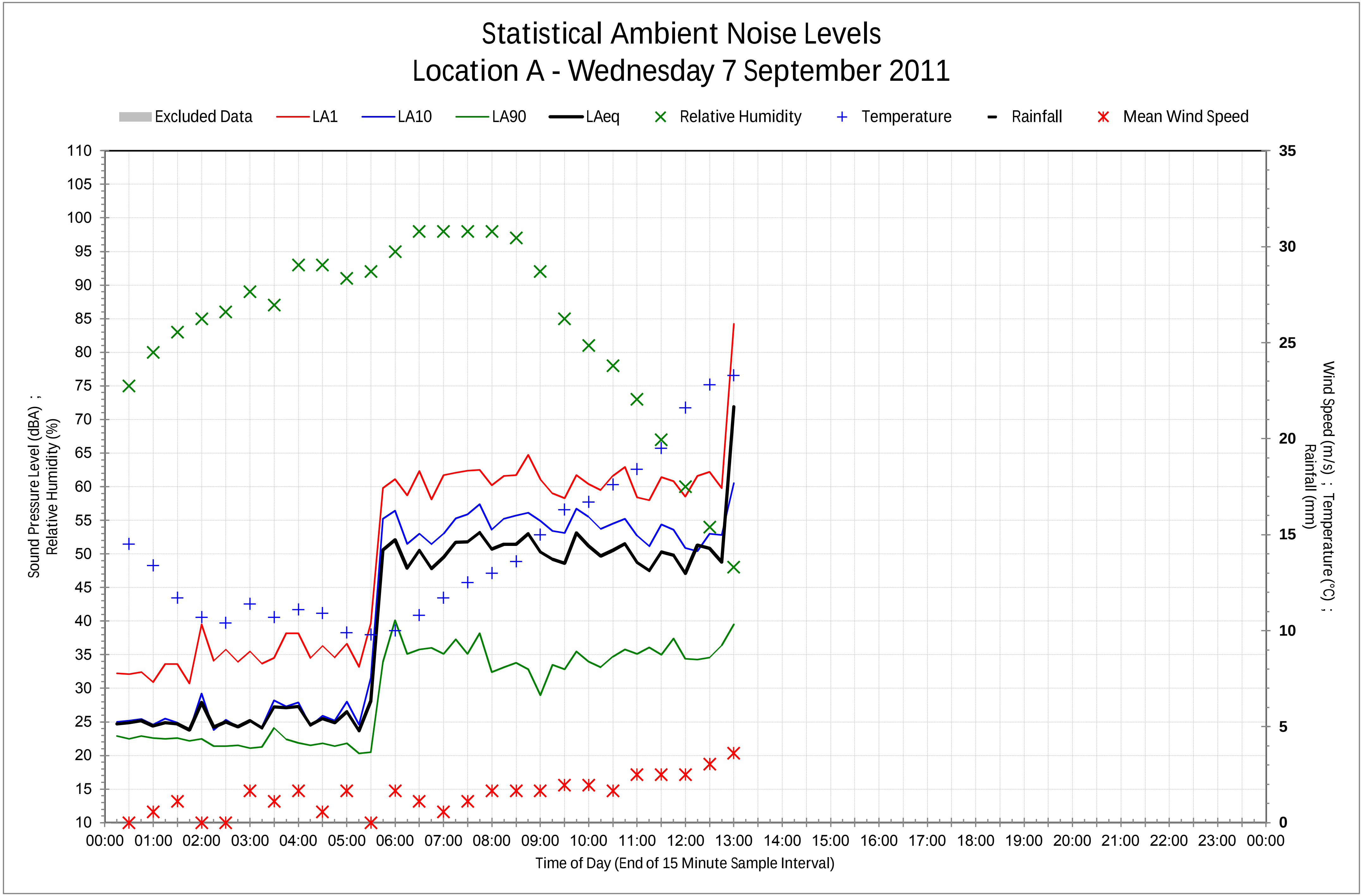
Statistical Ambient Noise Levels
Location A - Wednesday 7 September 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)
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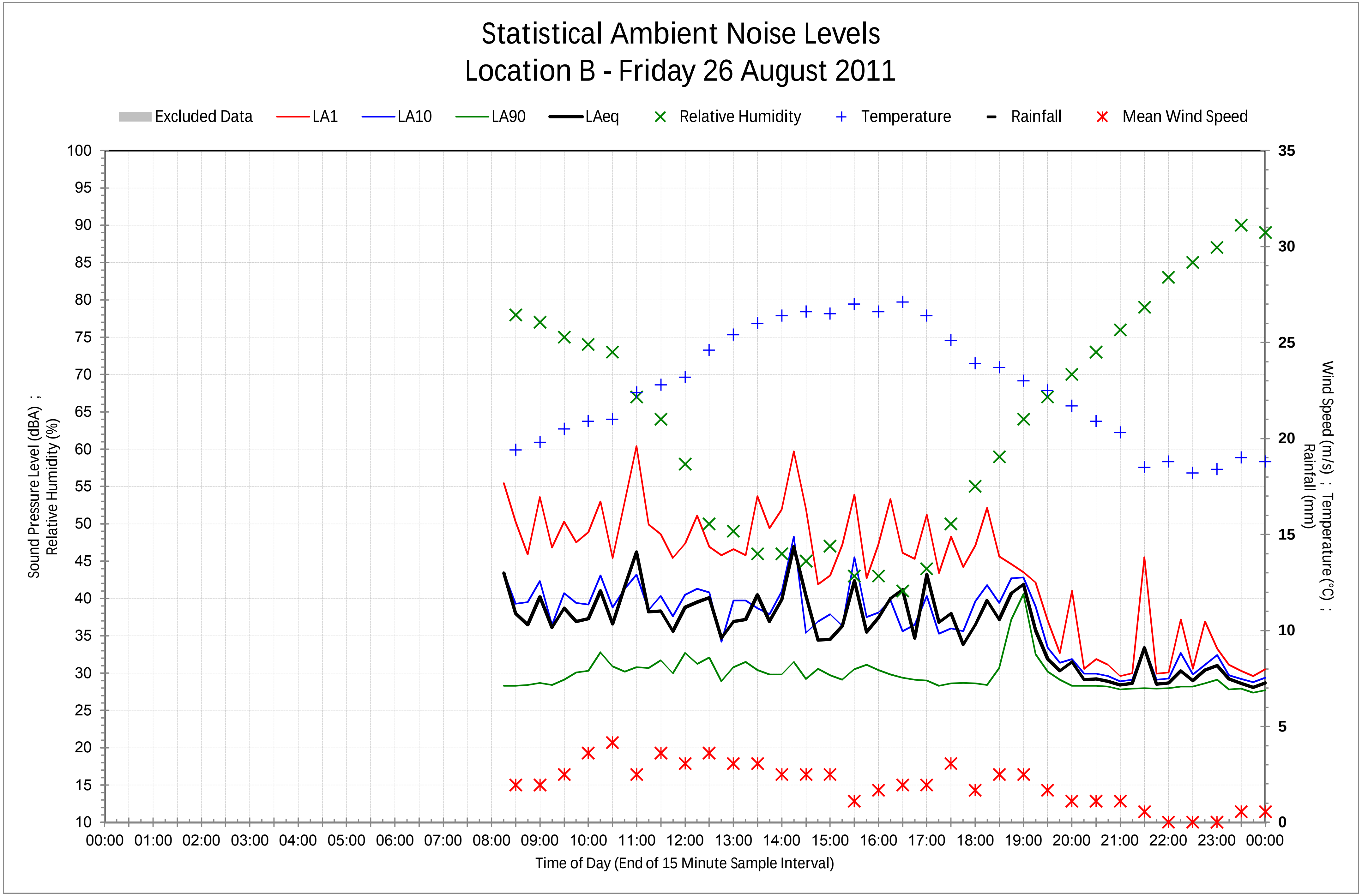
Appendix B – Noise monitoring data – Location B


Statistical Ambient Noise Levels
Location B - Friday 26 August 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)
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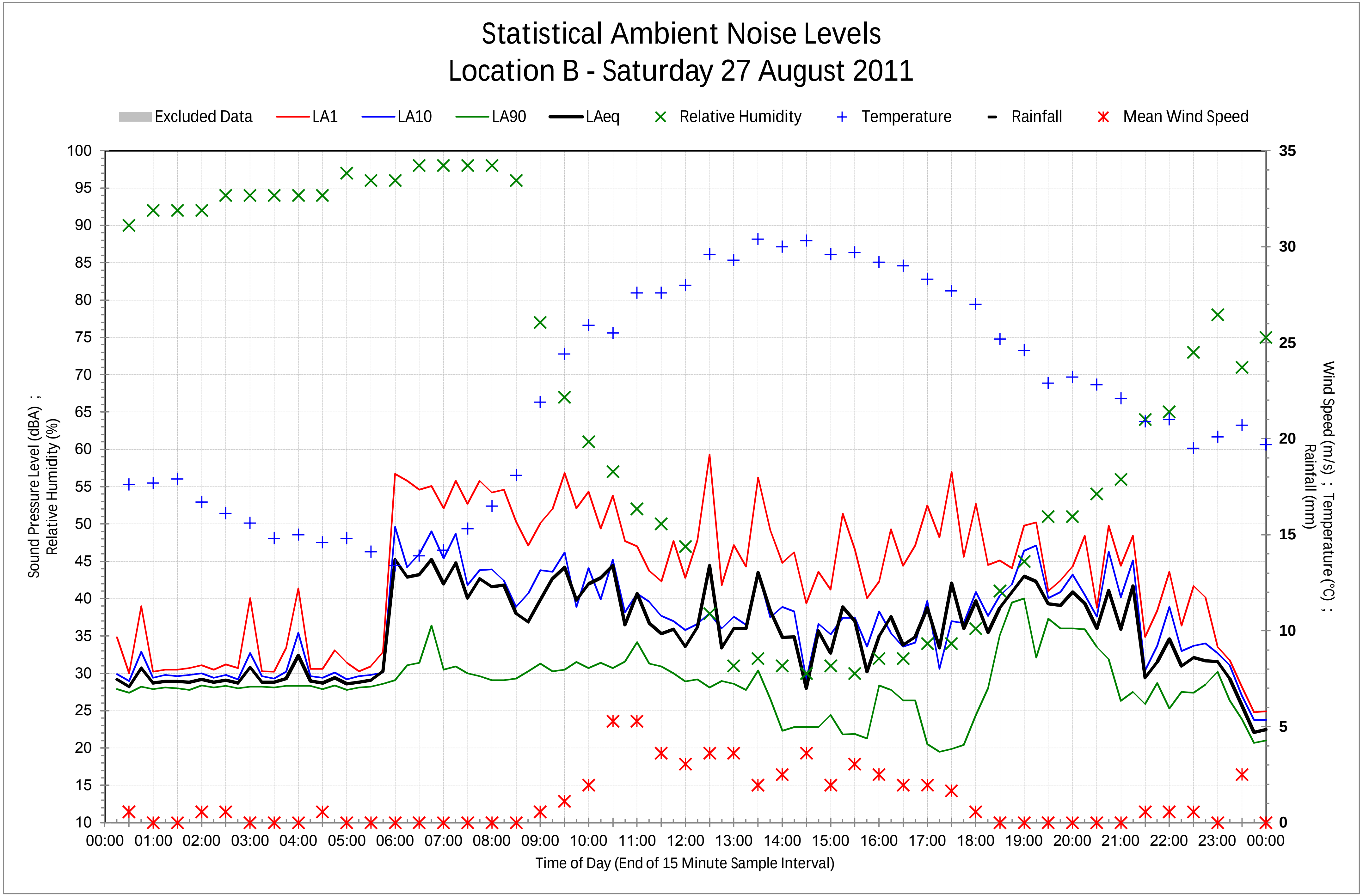

Statistical Ambient Noise Levels
Location B - Saturday 27 August 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
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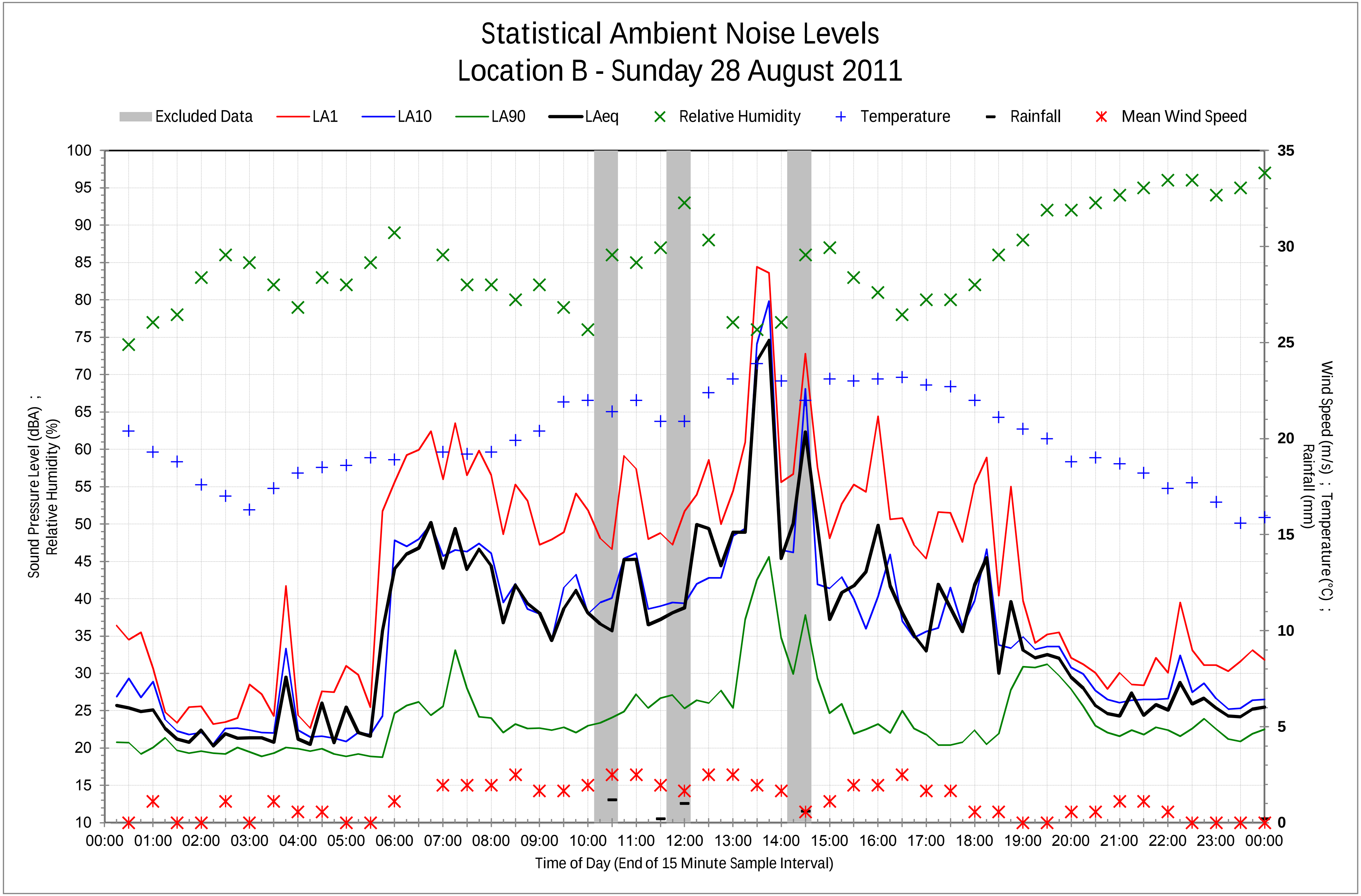
Time of Day (End of 15 Minute Sample Interval)



Statistical Ambient Noise Levels
Location B - Sunday 28 August 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
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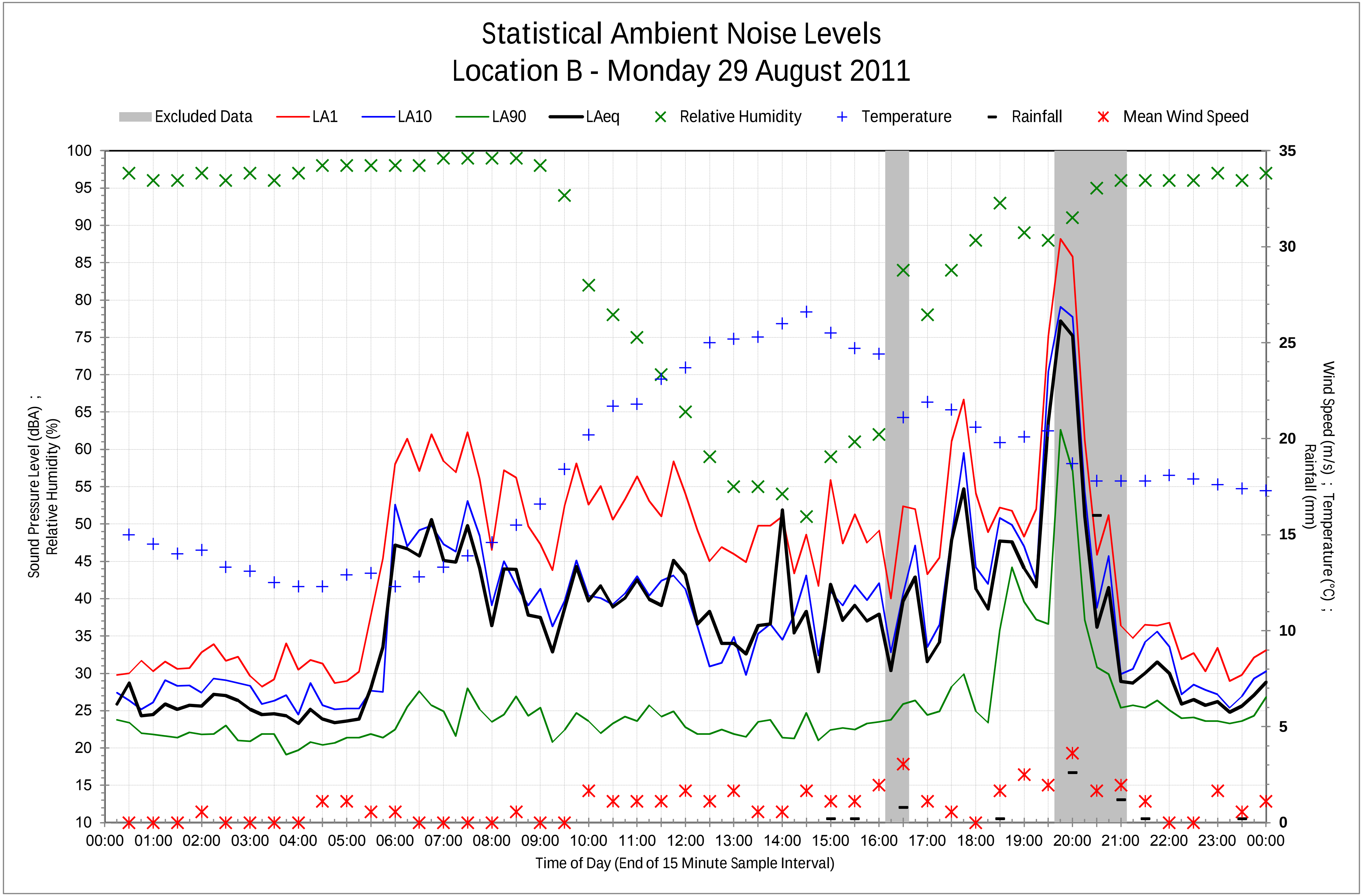
Time of Day (End of 15 Minute Sample Interval)


Statistical Ambient Noise Levels
Location B - Monday 29 August 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)
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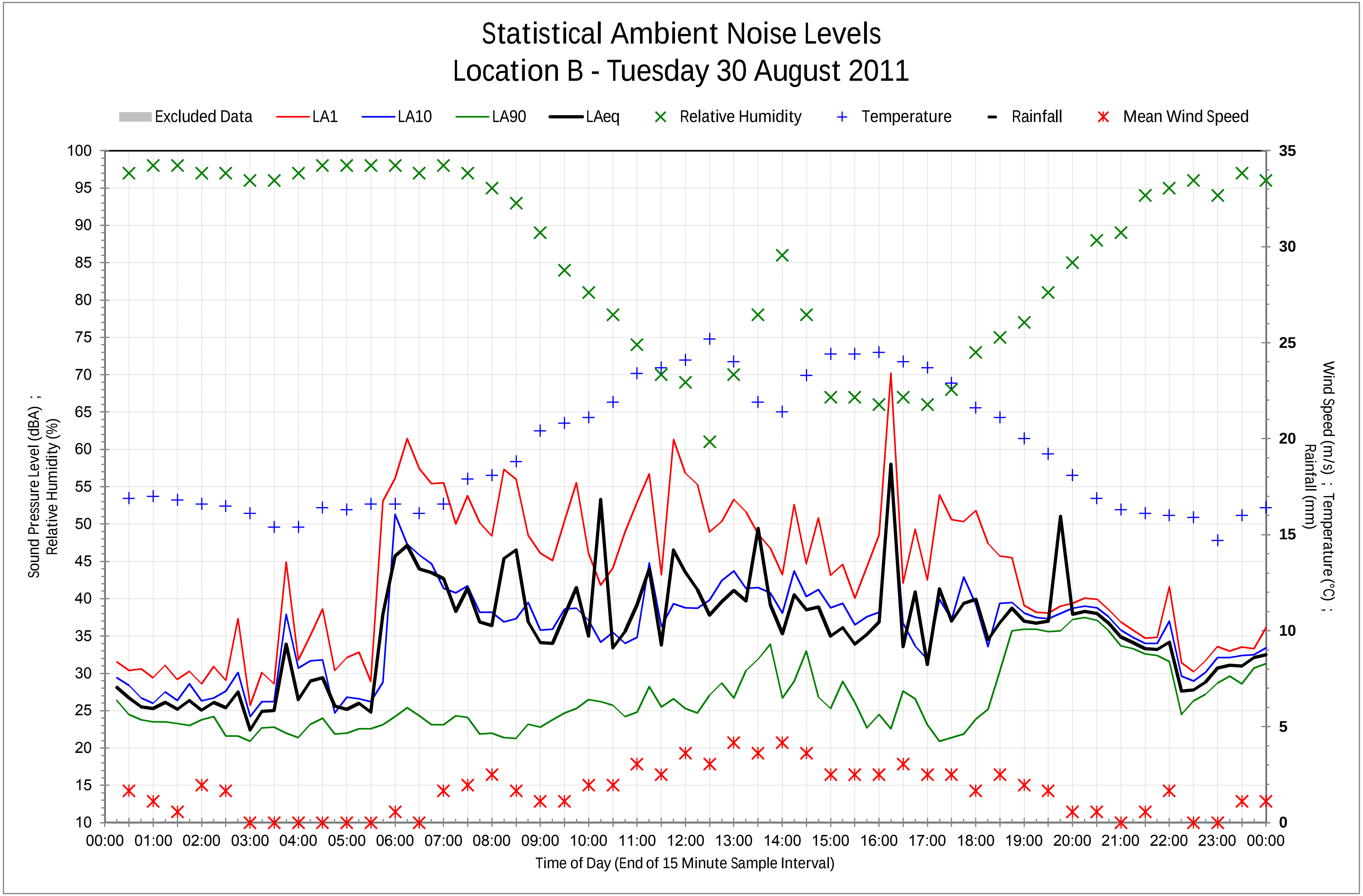

Statistical Ambient Noise Levels
Location B - Tuesday 30 August 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
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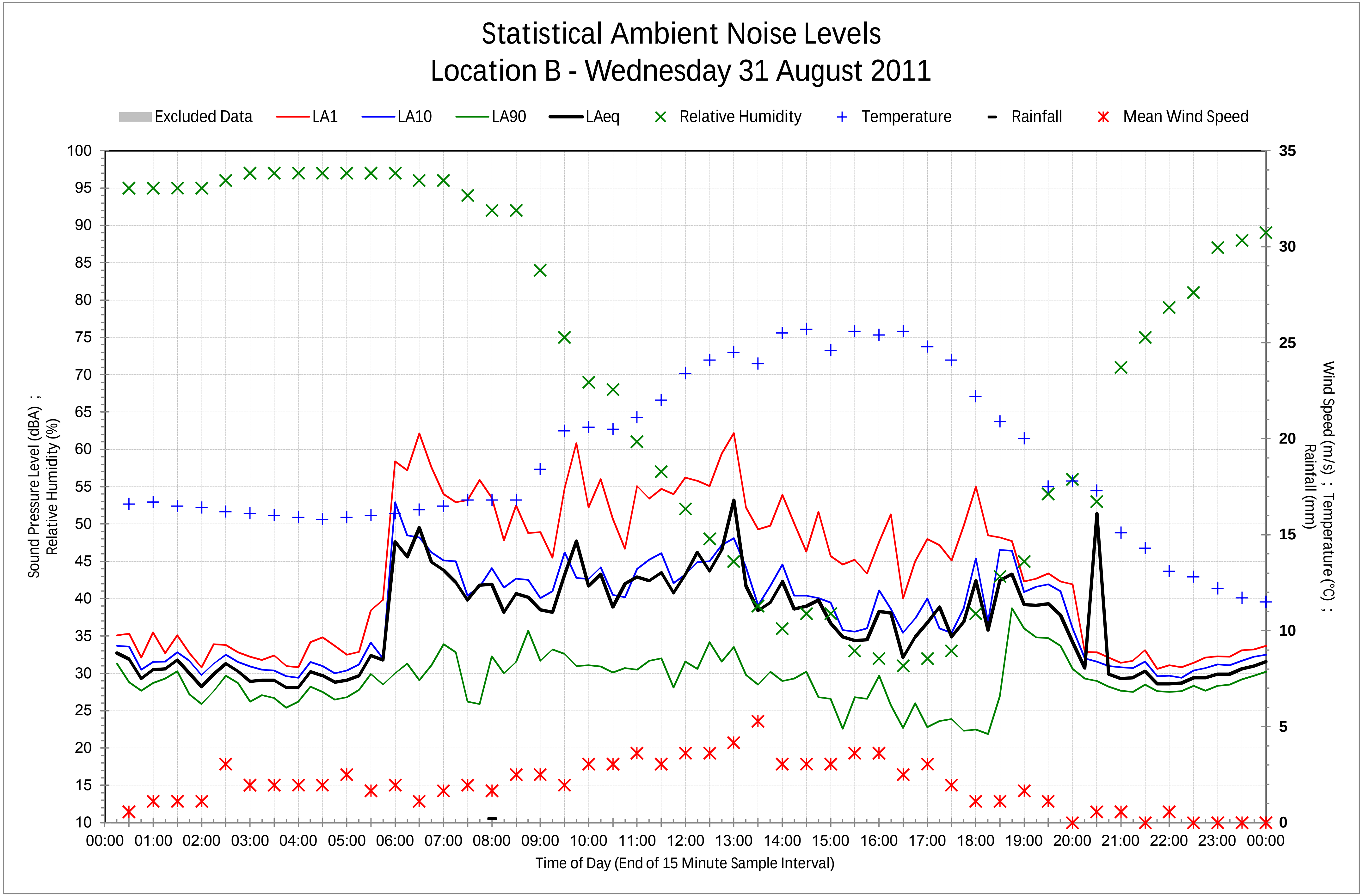
Time of Day (End of 15 Minute Sample Interval)



Statistical Ambient Noise Levels
Location B - Wednesday 31 August 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
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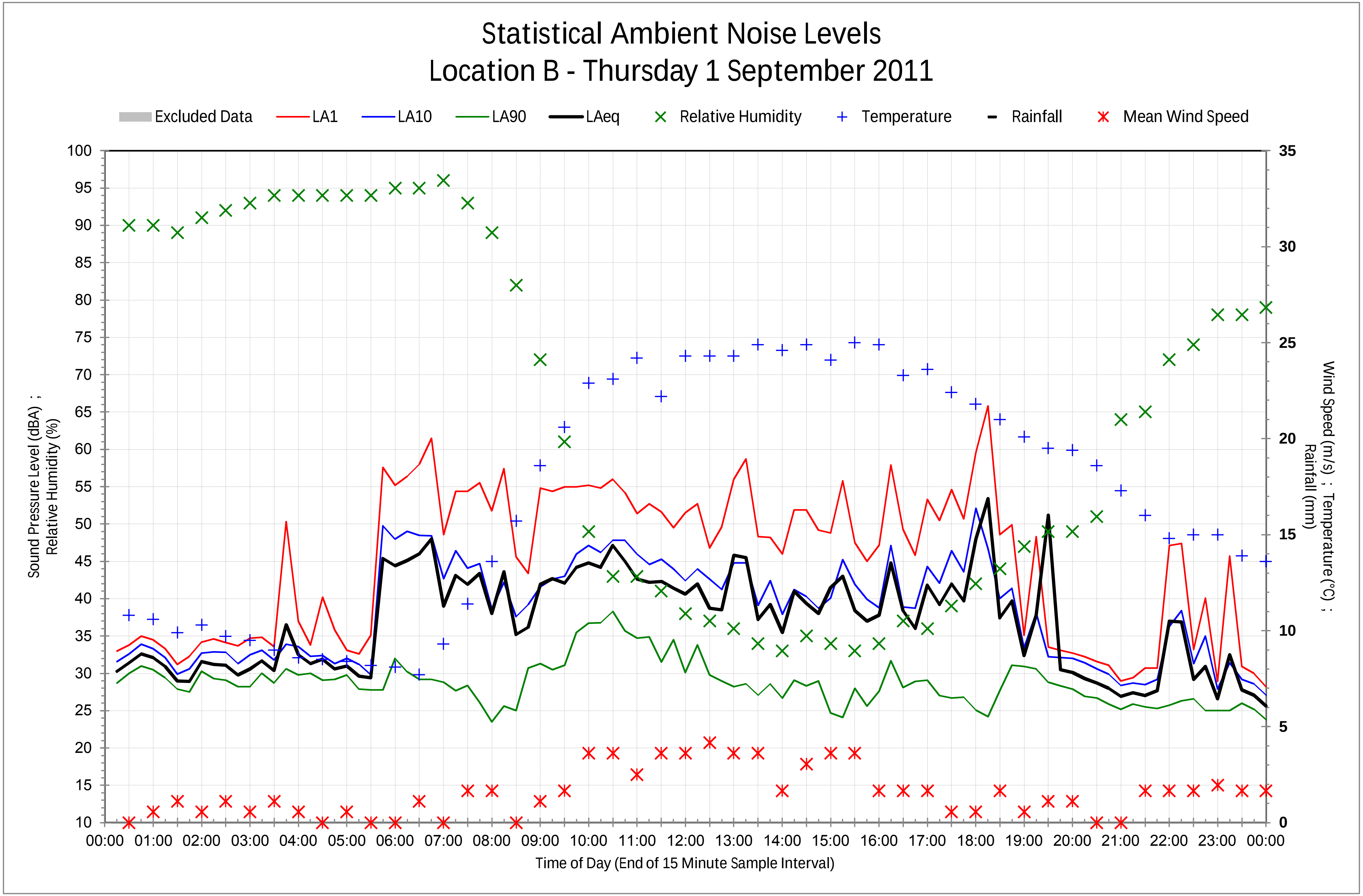
Time of Day (End of 15 Minute Sample Interval)



Statistical Ambient Noise Levels
Location B - Thursday 1 September 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)
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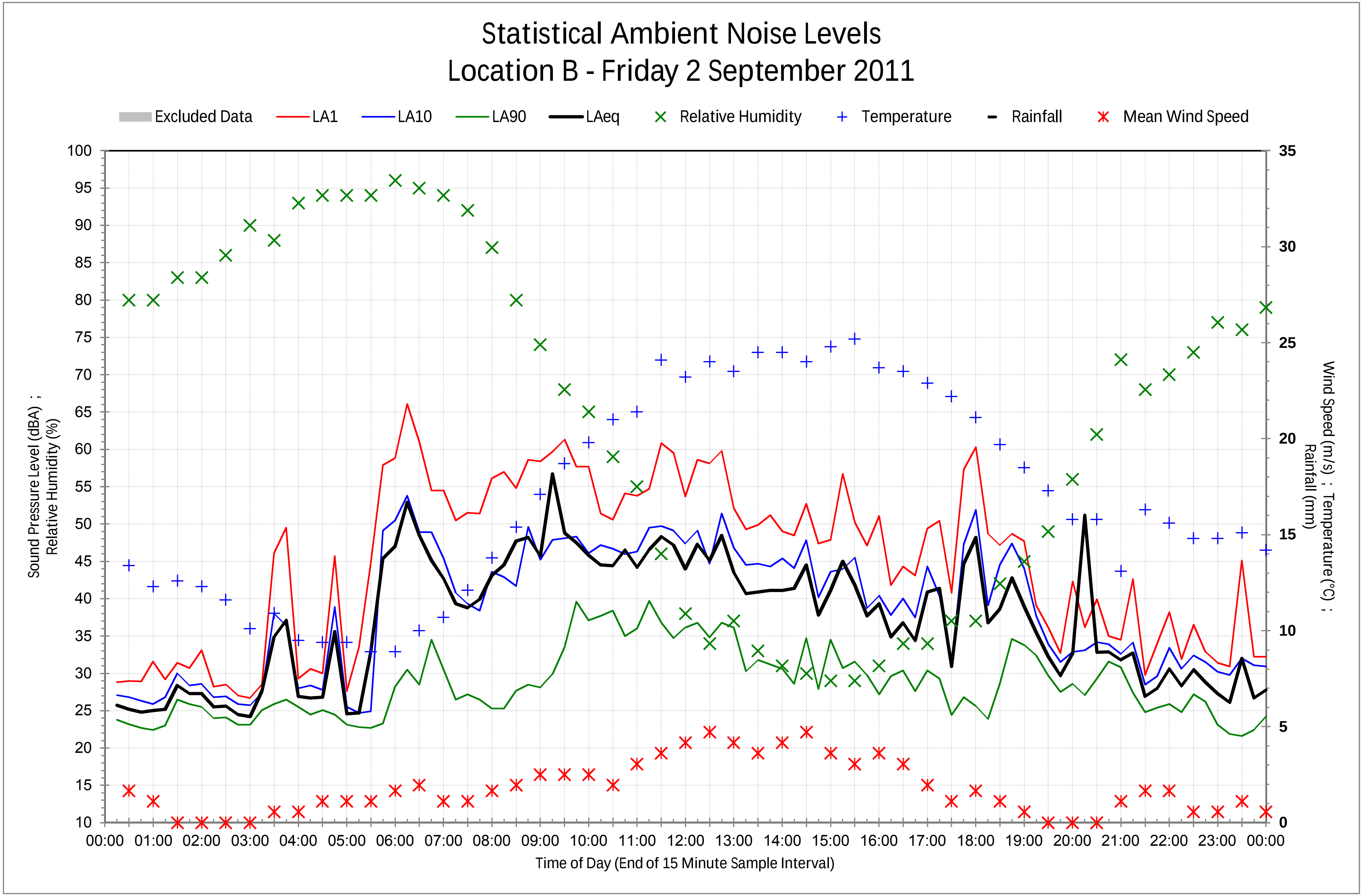
Statistical Ambient Noise Levels
Location B - Friday 2 September 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
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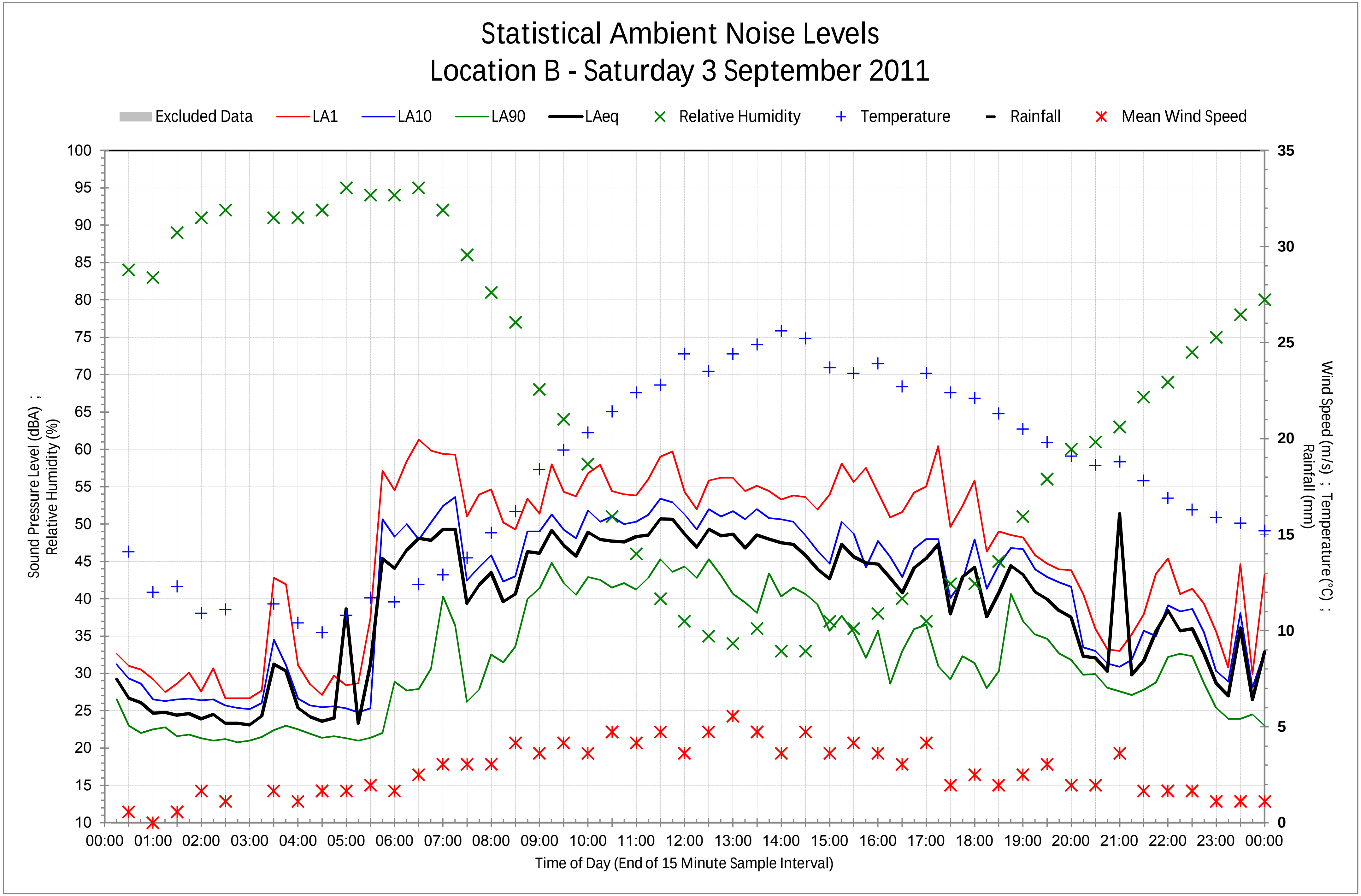
Time of Day (End of 15 Minute Sample Interval)



Statistical Ambient Noise Levels
Location B - Saturday 3 September 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)
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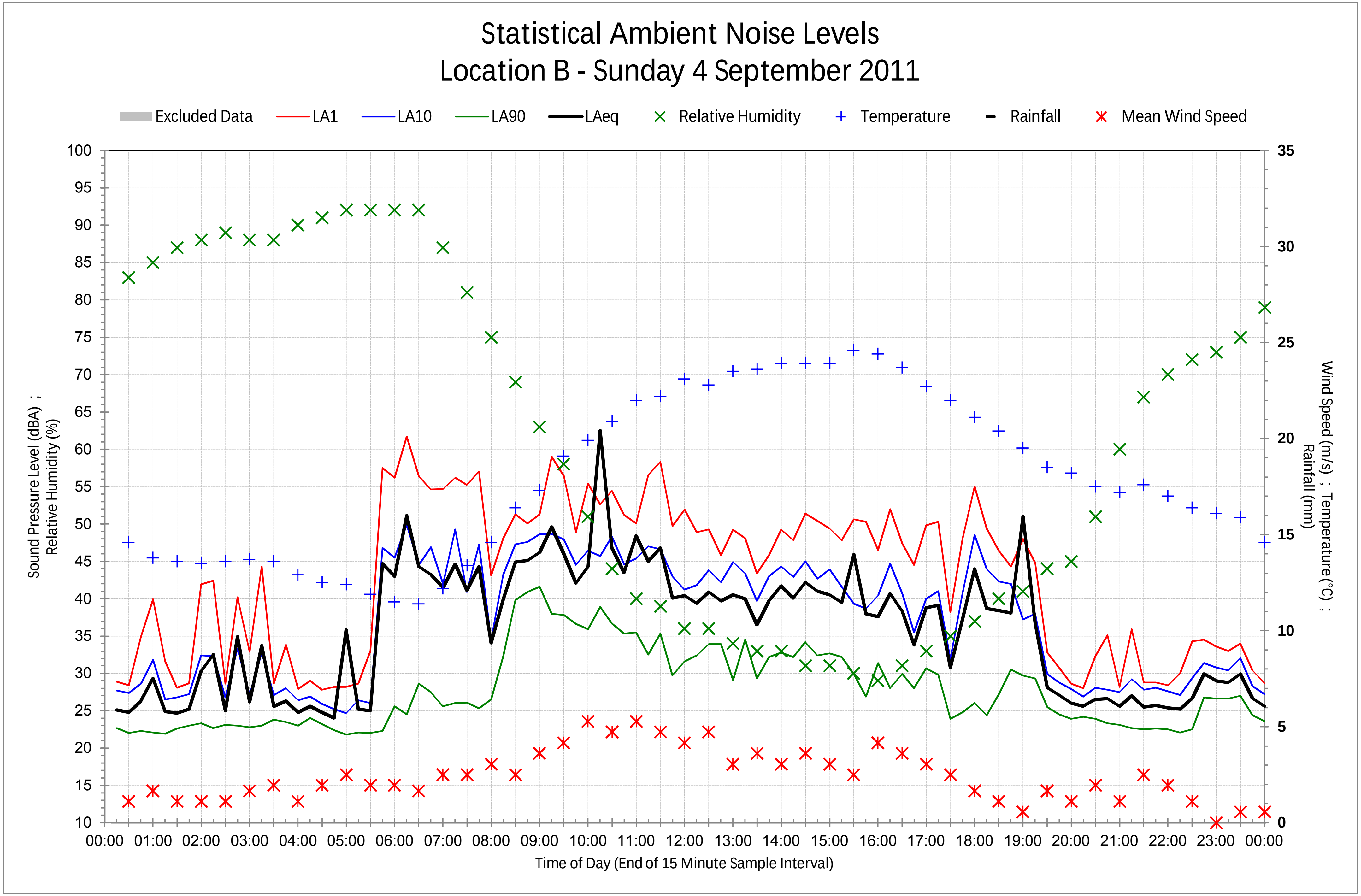
Statistical Ambient Noise Levels
Location B - Sunday 4 September 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)
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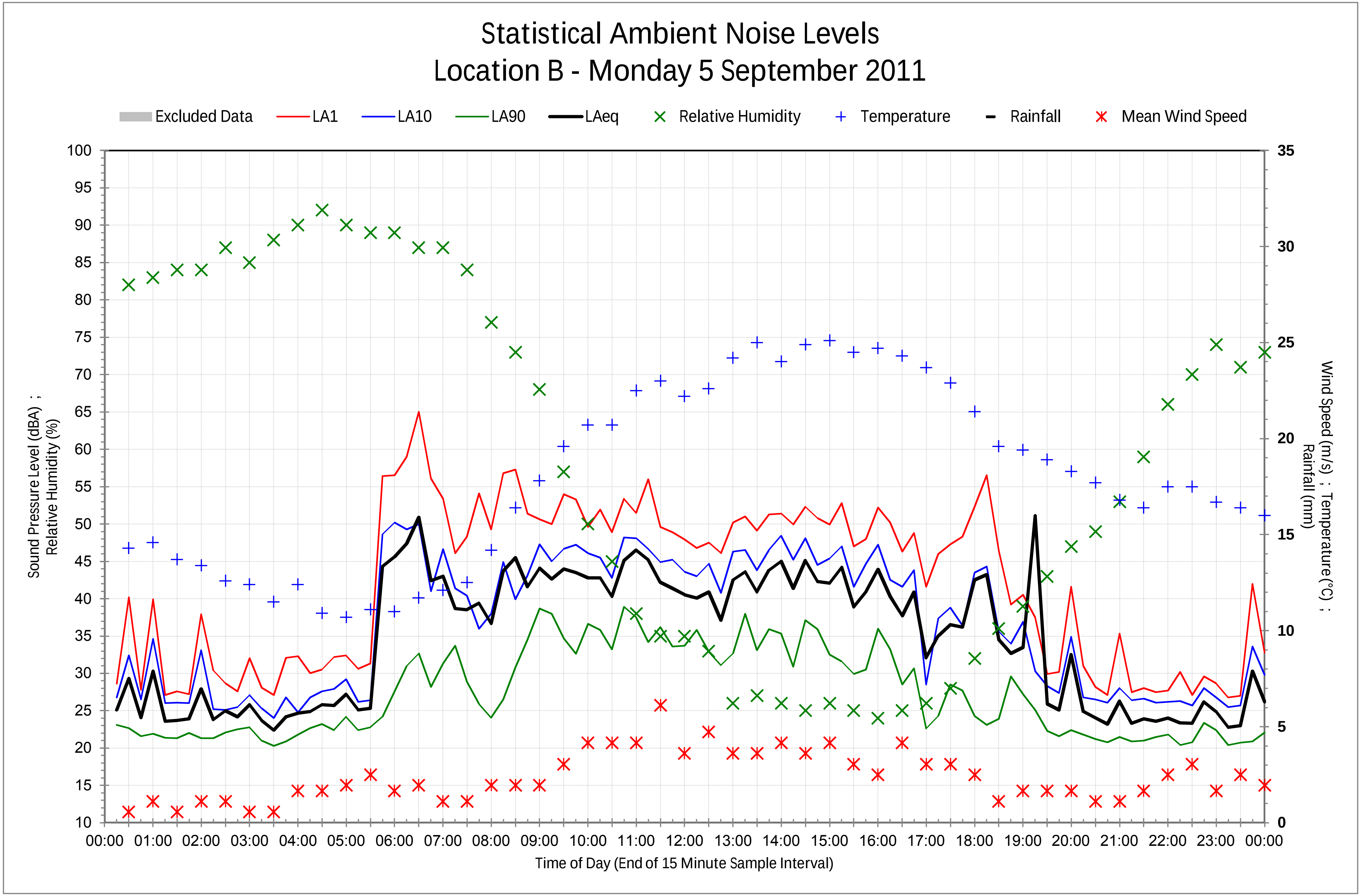

Statistical Ambient Noise Levels
Location B - Monday 5 September 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
Time of Day (End of 15 Minute Sample Interval)
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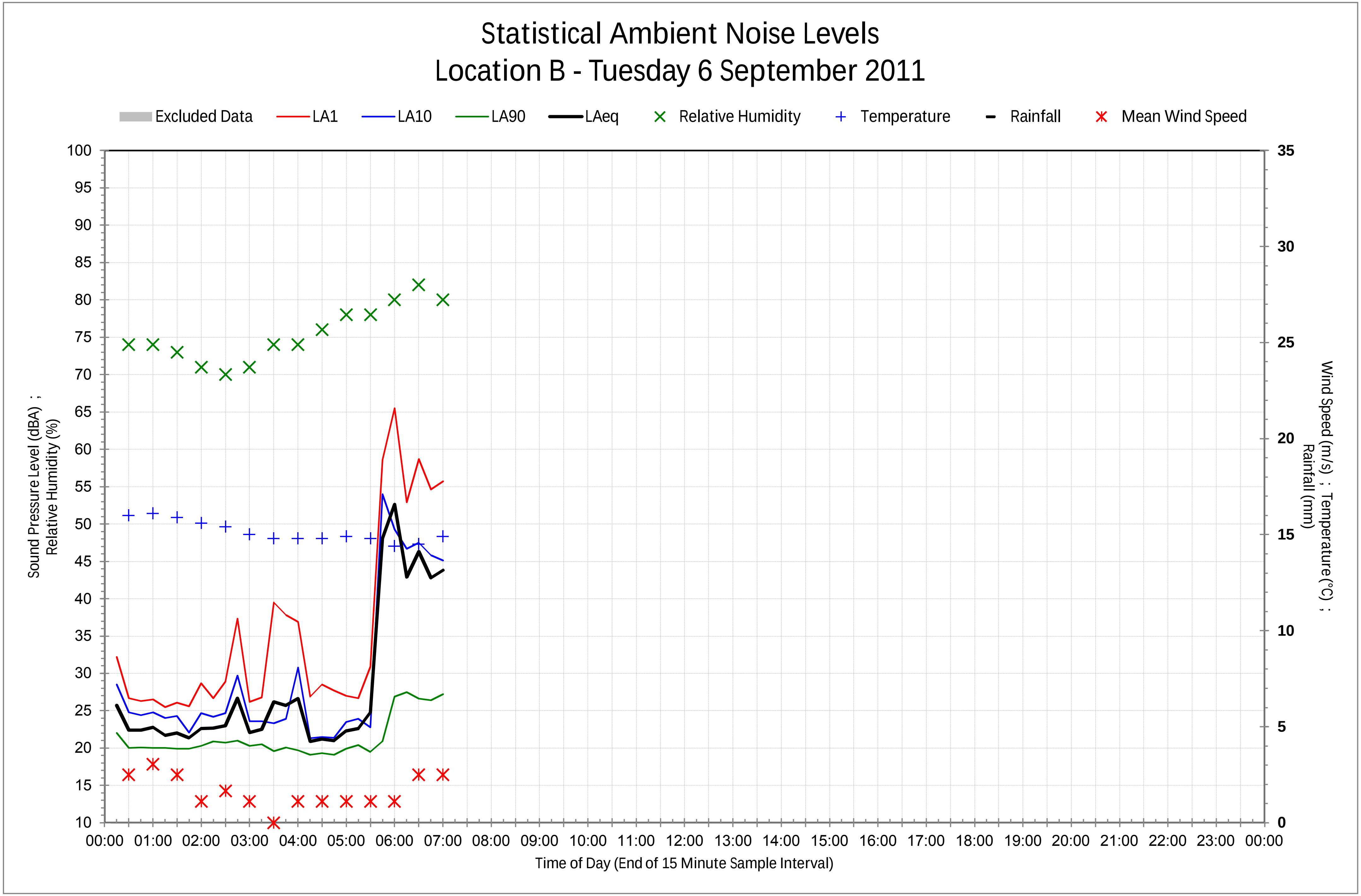
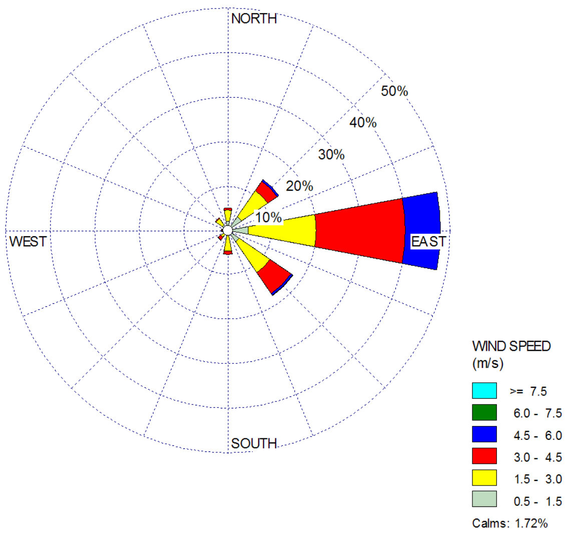


Statistical Ambient Noise Levels
Location B - Tuesday 6 September 2011
Excluded Data
LA1
LA10
LA90
LAeq
Relative Humidity
Temperature
Rainfall
Mean Wind Speed
Sound Pressure Level (dBA) ; Relative Humidity (%)
Wind Speed (m/s) ; Temperature (°C) ; Rainfall (mm)
100
95
90
85
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
35
30
25
20
15
10
5
0
00:00
01:00
02:00
03:00
04:00
05:00
06:00
07:00
08:00
09:00
10:00
11:00
12:00
13:00
14:00
15:00
16:00
17:00
18:00
19:00
20:00
21:00
22:00
23:00
00:00
Time of Day (End of 15 Minute Sample Interval)

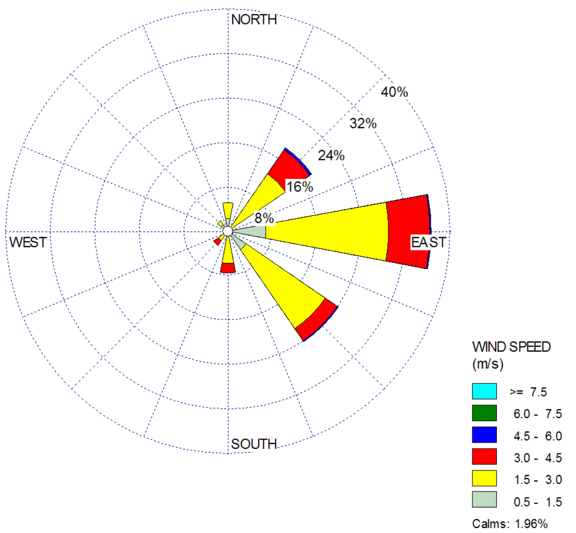
Appendix C – Meteorological data

Wind roses

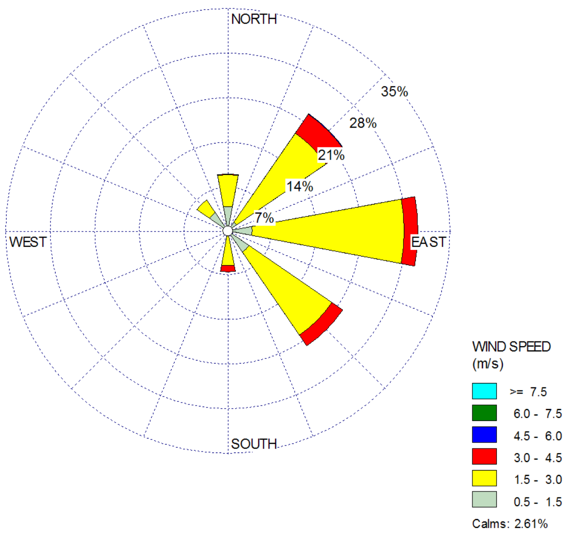
AUTUMN



0700 – 1800 hrs

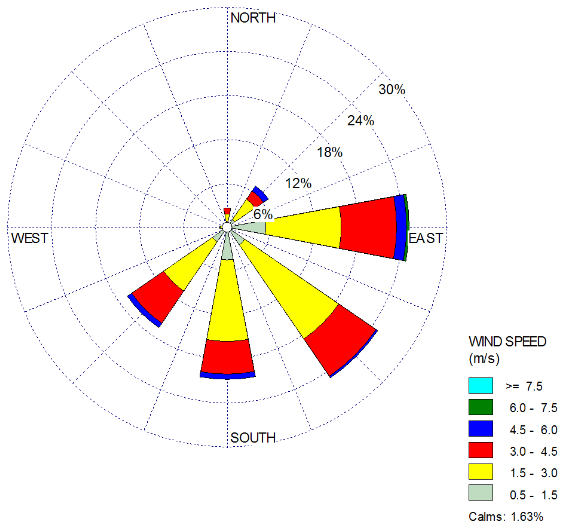


1800 – 2200 hrs

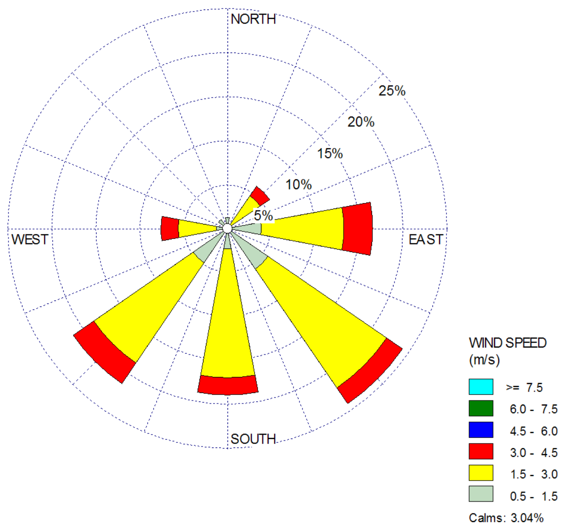


2200 – 0700 hrs

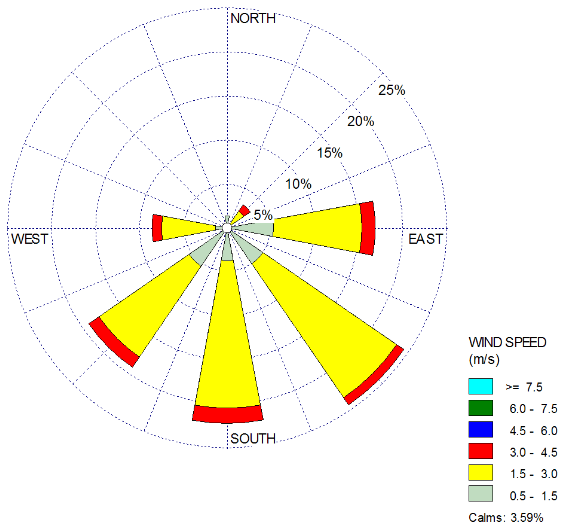
WINTER



0700 – 1800 hrs

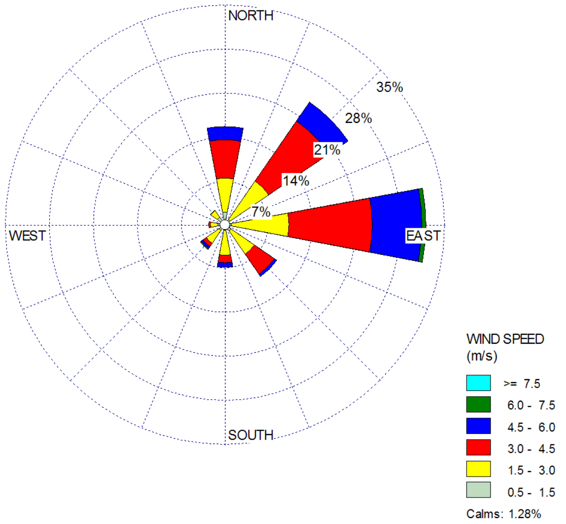


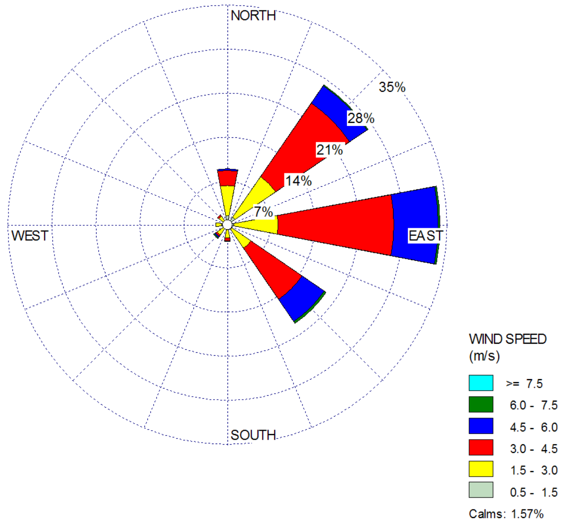
1800 – 2200 hrs



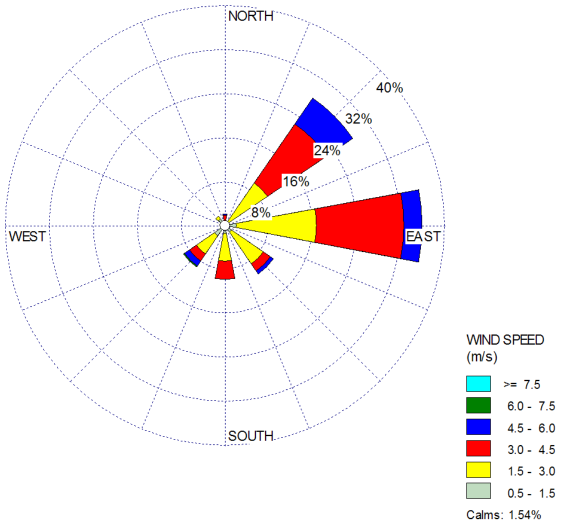
2200 – 0700 hrs

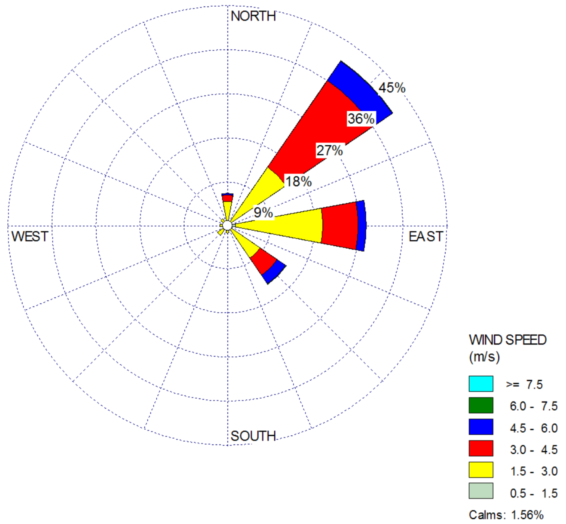
SPRING | SUMMER



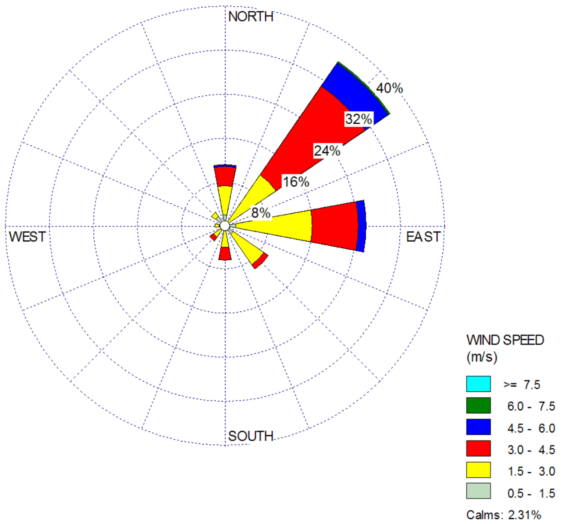


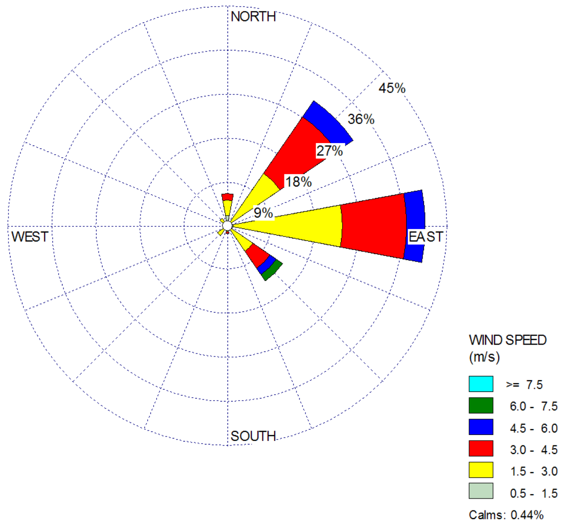
0700 – 1800 hrs | 0700 – 1800 hrs





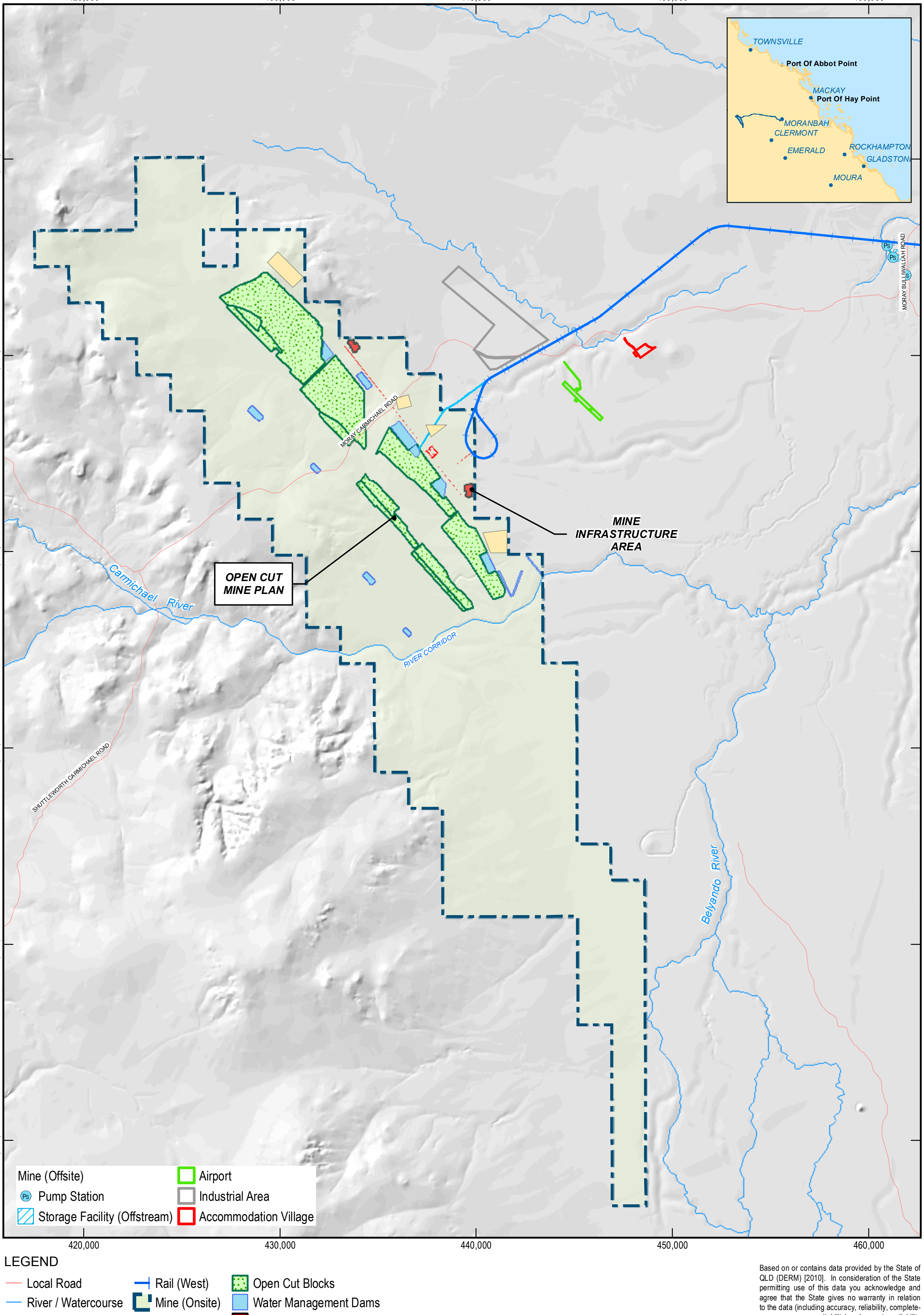
1800 – 2200 hrs | 1800 – 2200 hrs





2200 – 0700 hrs | 2200 – 0700 hrs

Appendix D – Mine operational stage plans



Based on or contains data provided by the State of QLD (DERM) [2010]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:275,000 (at A4)

0 2 4 6 8 10

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS

Job Number	41-26422
Revision	B
Date	24-10-2013

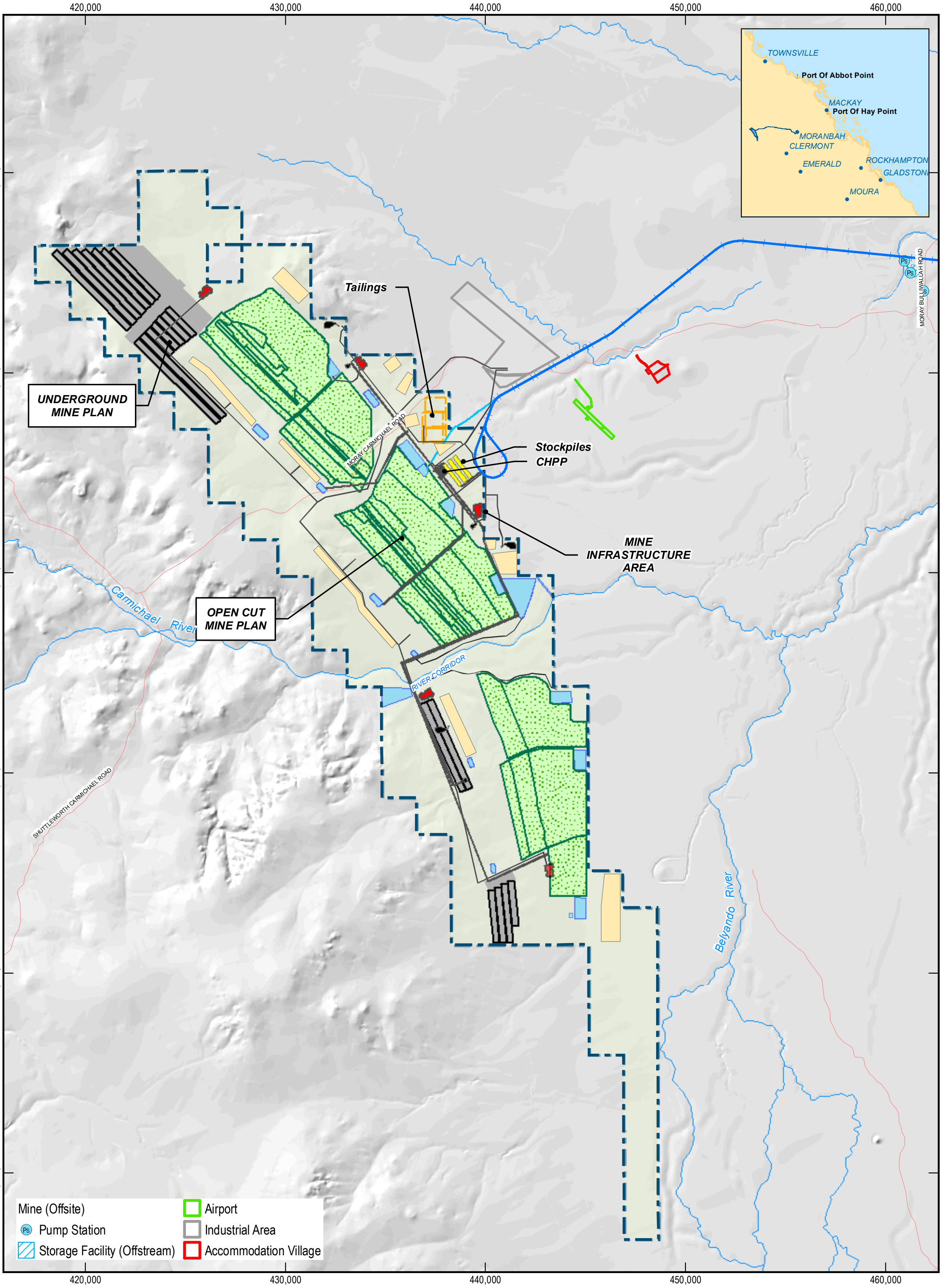
Mine Stage - Year 2015

Figure D1

G:\41\26422\GIS\Maps\MXD\01000_Project_Description\41_26422_01013_rev_b.mxd

Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Alignment, Offsite(2013), Mine Layout / Infrastructure (2013); Created by: MS



LEGEND

- Local Road
- River / Watercourse
- Overland Conveyors
- Rail (West)
- Mine (Onsite)
- Open Cut Blocks
- Water Management Dams
- Mine Infrastructure Area
- Mine Infrastructure
- Stockpiles
- Tailings Cell
- Top Soil Storage

Based on or contains data provided by the State of QLD (DERM) [2010]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:275,000 (at A4)

0 2 4 6 8 10

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS

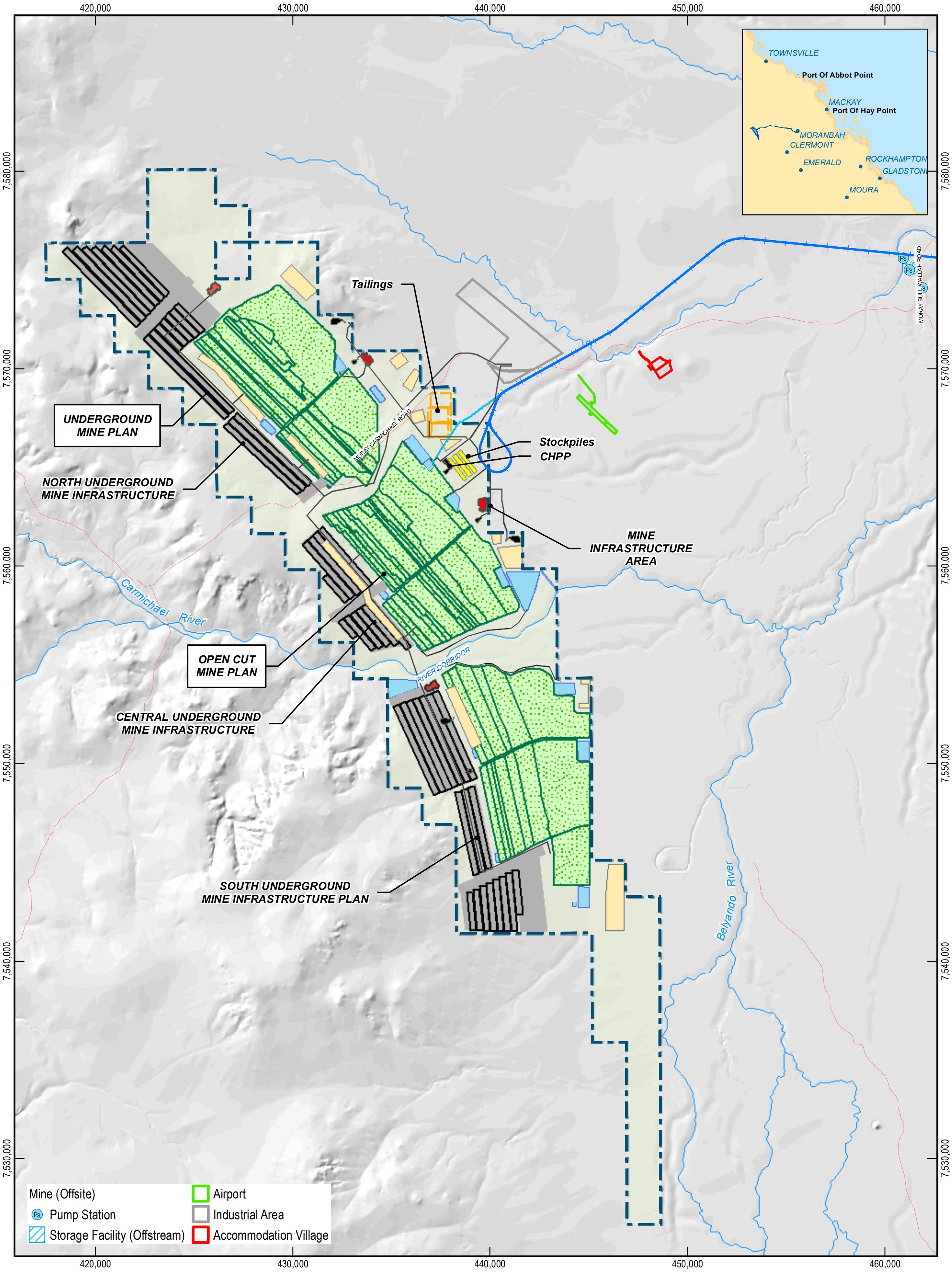
Job Number	41-26422
Revision	C
Date	24-10-2013

Mine Layout Progress Plot
Year 2025 - 2029

Figure D2

G:\41\26422\GIS\Maps\MXD\01000_Project_Description\41_26422_01007_rev_c.mxd Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Alignment, Offsite(2013), Mine Layout / Infrastructure (2013); Created by: MS



LEGEND

- Local Road
- River / Watercourse
- Overland Conveyors
- Rail (West)
- Mine (Onsite)
- Open Cut Blocks
- Water Management Dams
- Mine Infrastructure Area
- Mine Infrastructure
- Stockpiles
- Tailings Cell
- Top Soil Storage

Based on or contains data provided by the State of QLD (DERM) [2010]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:275,000 (at A4)

0 2 4 6 8 10

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

GHD adani

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS

Job Number	41-26422
Revision	B
Date	24-10-2013

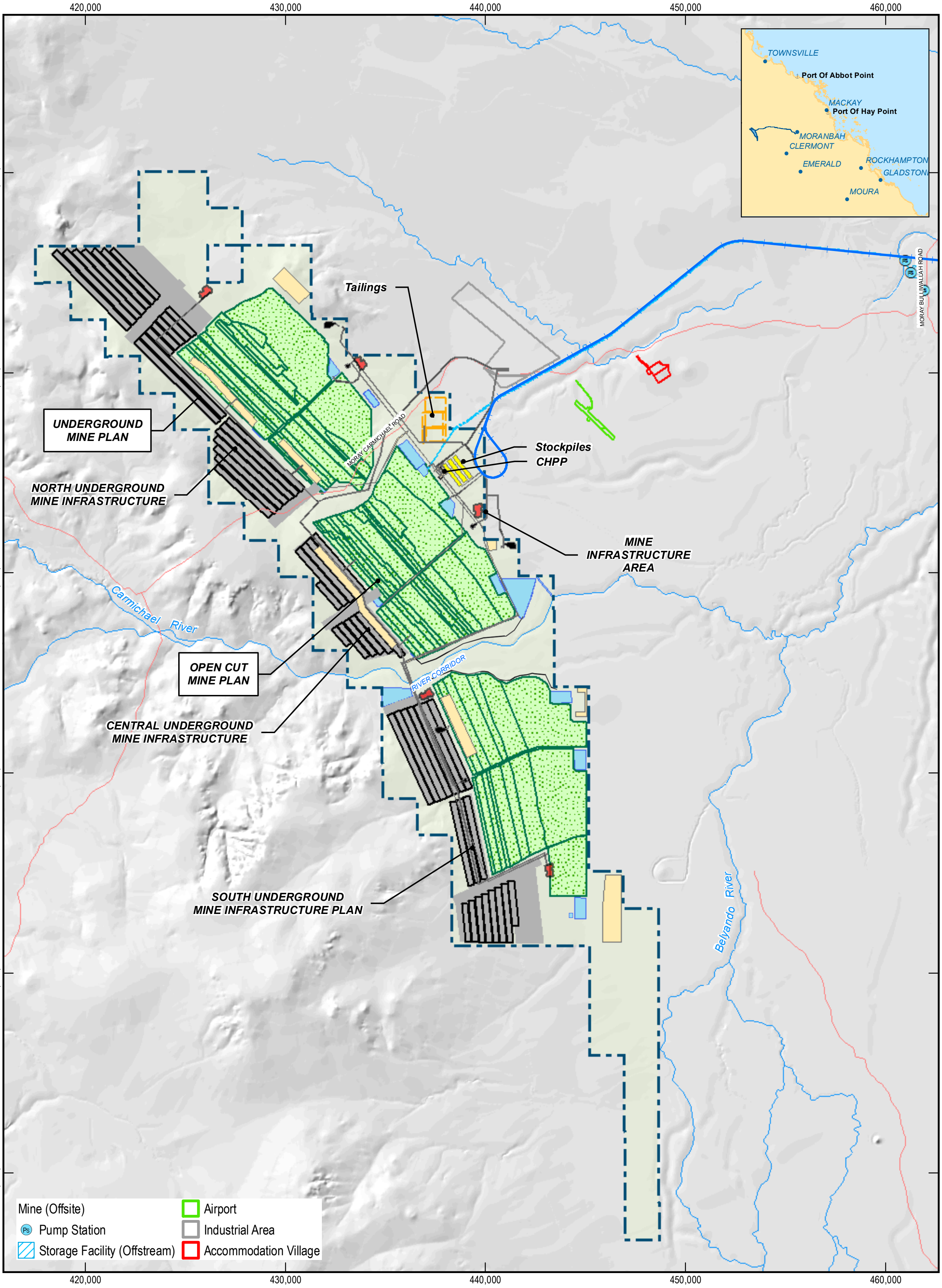
Mine Stage - Year 2045 - 2049

Figure D3

G:\41\26422\GIS\Maps\MXD\01000_Project_Description\41_26422_01003_rev_b.mxd

Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Alignment, Offsite(2013), Mine Layout / Infrastructure (2013); Created by: MS



LEGEND

- Local Road
- River / Watercourse
- Overland Conveyors
- Rail (West)
- Mine (Onsite)
- Open Cut Blocks
- Water Management Dams
- Mine Infrastructure Area
- Mine Infrastructure
- Stockpiles
- Tailings Cell
- Top Soil Storage

1:275,000 (at A4)

0 2 4 6 8 10

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS

Job Number	41-26422
Revision	B
Date	24-10-2013

Mine Stage - Year 2061 - 2072

Figure D4

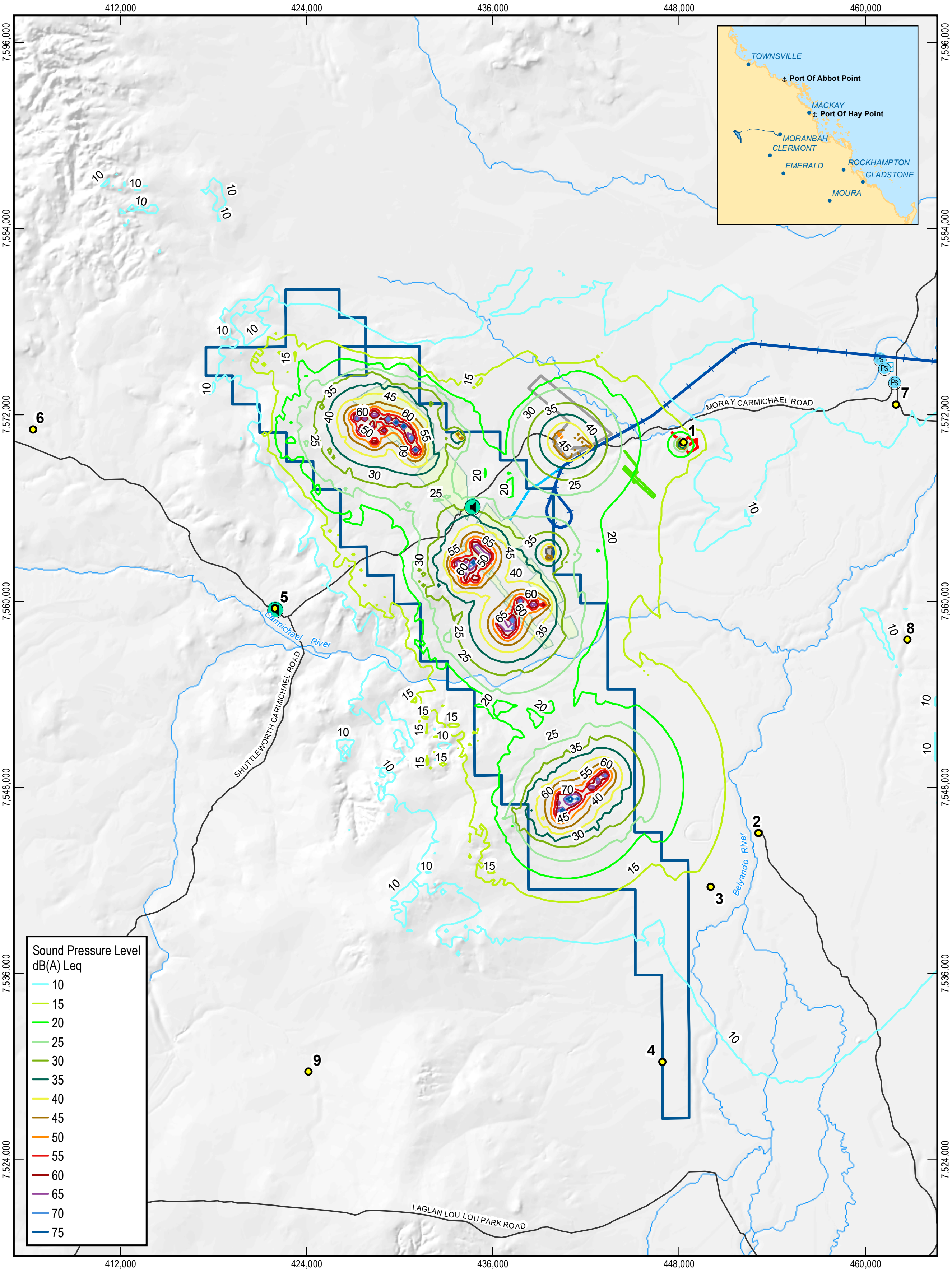
G:\41\26422\GIS\Maps\MXD\01000_Project_Description\41_26422_01001_rev_b.mxd

Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: GA: Road, River / Watercourse (2007); DME:EPC1690 (2010), EPC1080 (2011); Adani: Alignment, Offsite(2013), Mine Layout / Infrastructure (2013); Created by: MS

Appendix E – Mine operational noise contours

Year 2015, 2026, 2049 and 2071



LEGEND

- Sensitive Receptor
- Noise Logger
- Watercourse
- Local Road
- Rail (West)
- Mine Site
- Mine Infrastructure Area
- Open Cut Blocks
- Mine (Offsite)
- Pump Station
- Storage Facility (Offstream)
- Airport
- Industrial Area
- Accommodation Village

Based on or contains data provided by the State of QLD (DNRM) [2013]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:350,000 (at A4)

0 2 4 6 8 10 12

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

GHD adani

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS
Mine Operational Noise Contours
Mine Year 2015
L_{Aeq} Neutral Weather Conditions

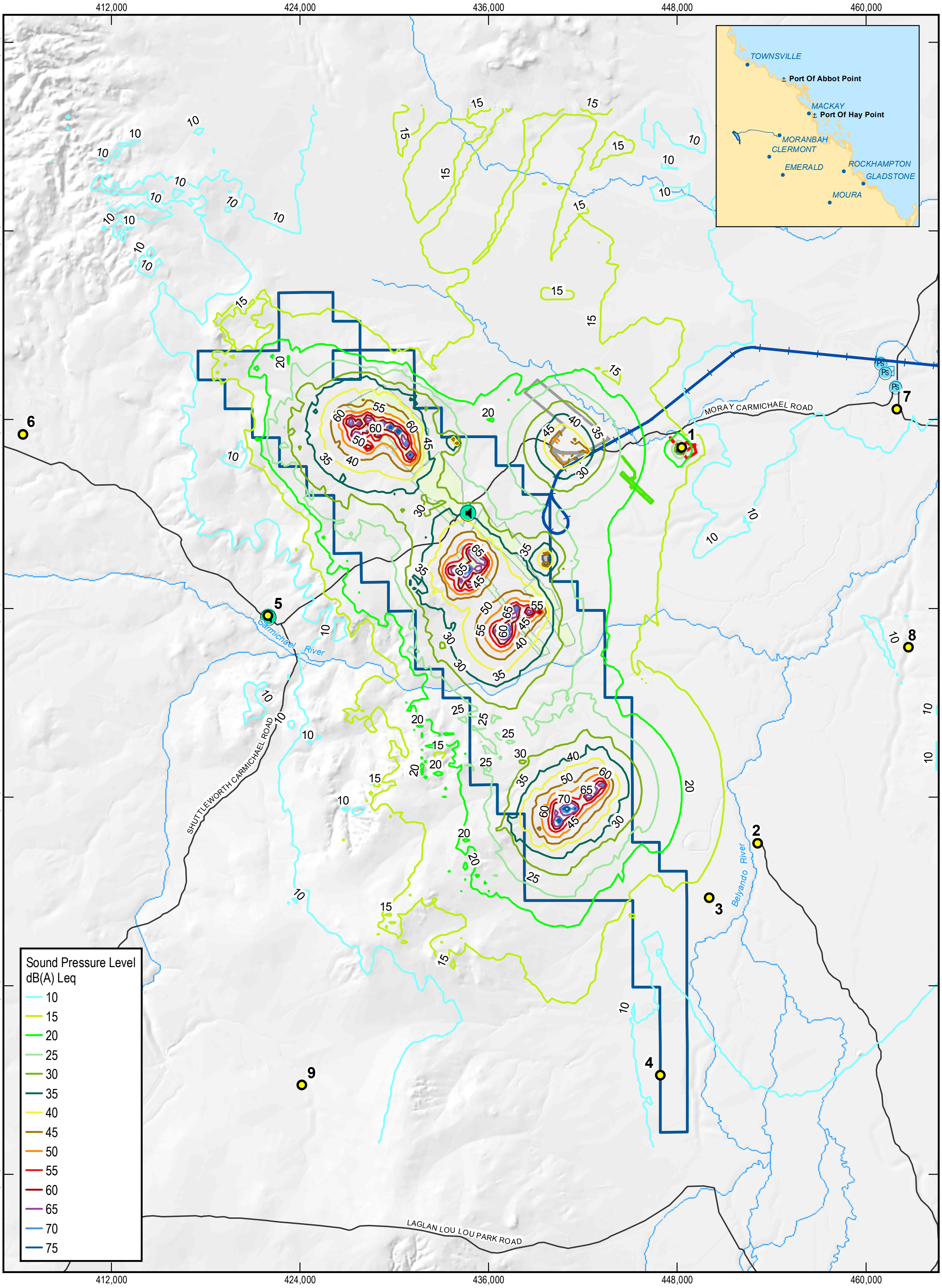
Job Number	41-26422
Revision	B
Date	23-10-2013

Figure E-1

G:\41\26422\GIS\Maps\MXD\0200_Noise\41-26422_0201_rev_b.mxd

Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: DME: EPC 1690 (2010)/EPC 1080 (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007);
Adani: Project Rail 1 (Opt11 Rev2) & 2 (Opt9 Rev3), Facilities (2013), Mine Layout / Infrastructure (2013); GHD: Sensitive Receptor (2012), Noise Contours (2013). Created by: JVC



LEGEND

- Sensitive Receptor
- Noise Logger
- Watercourse
- Local Road
- Rail (West)
- Mine Site
- Mine Infrastructure Area
- Open Cut Blocks
- Mine (Offsite)
- Pump Station
- Storage Facility (Offstream)
- Airport
- Industrial Area
- Accommodation Village

Based on or contains data provided by the State of QLD (DNRM) [2013]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:350,000 (at A4)

0 2 4 6 8 10 12

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

GHD adani

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS
Mine Operational Noise Contours
Mine Year 2015
L_{Aeq} Adverse Weather Conditions

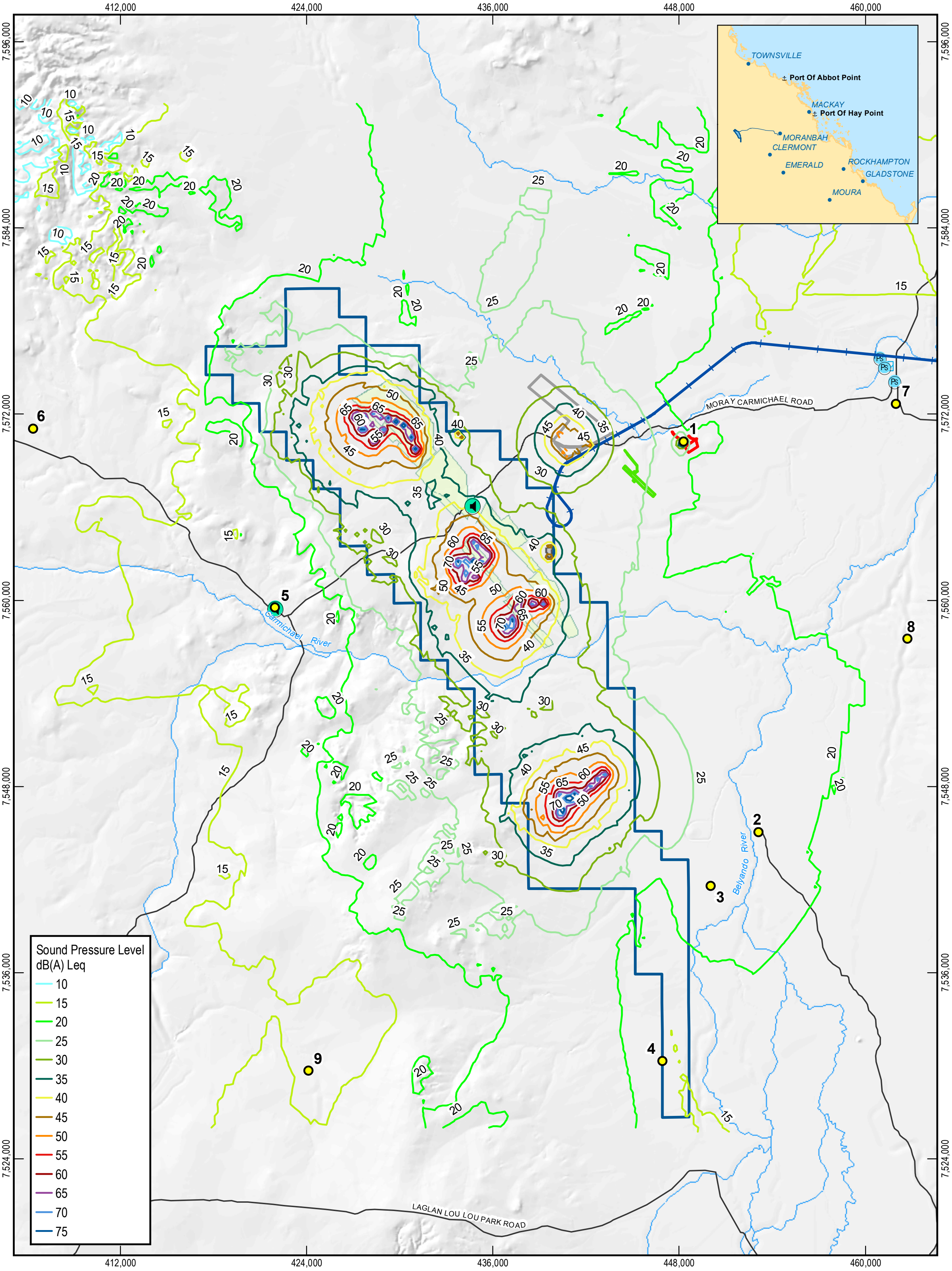
Job Number 41-26422
Revision B
Date 24-10-2013

Figure E-2

G:\41\26422\GIS\Maps\MXD\0200_Noise\41-26422_0202_rev_b.mxd

Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: DME: EPC 1690 (2010)/EPC 1080 (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007);
Adani: Adani: Project Rail 1 (Opt11 Rev2) & 2 (Opt9 Rev3), Facilities (2013), Mien Layout / Infrastructure (2013); GHD: Sensitive Receptor (2012), Noise Contours (2013). Created by: JVC



LEGEND

- Sensitive Receptor
- Noise Logger
- Watercourse
- Local Road
- Rail (West)
- Mine Site
- Mine Infrastructure Area
- Open Cut Blocks
- Mine (Offsite)
- Pump Station
- Storage Facility (Offstream)
- Airport
- Industrial Area
- Accommodation Village

1:350,000 (at A4)

0 2 4 6 8 10 12

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

GHD adani

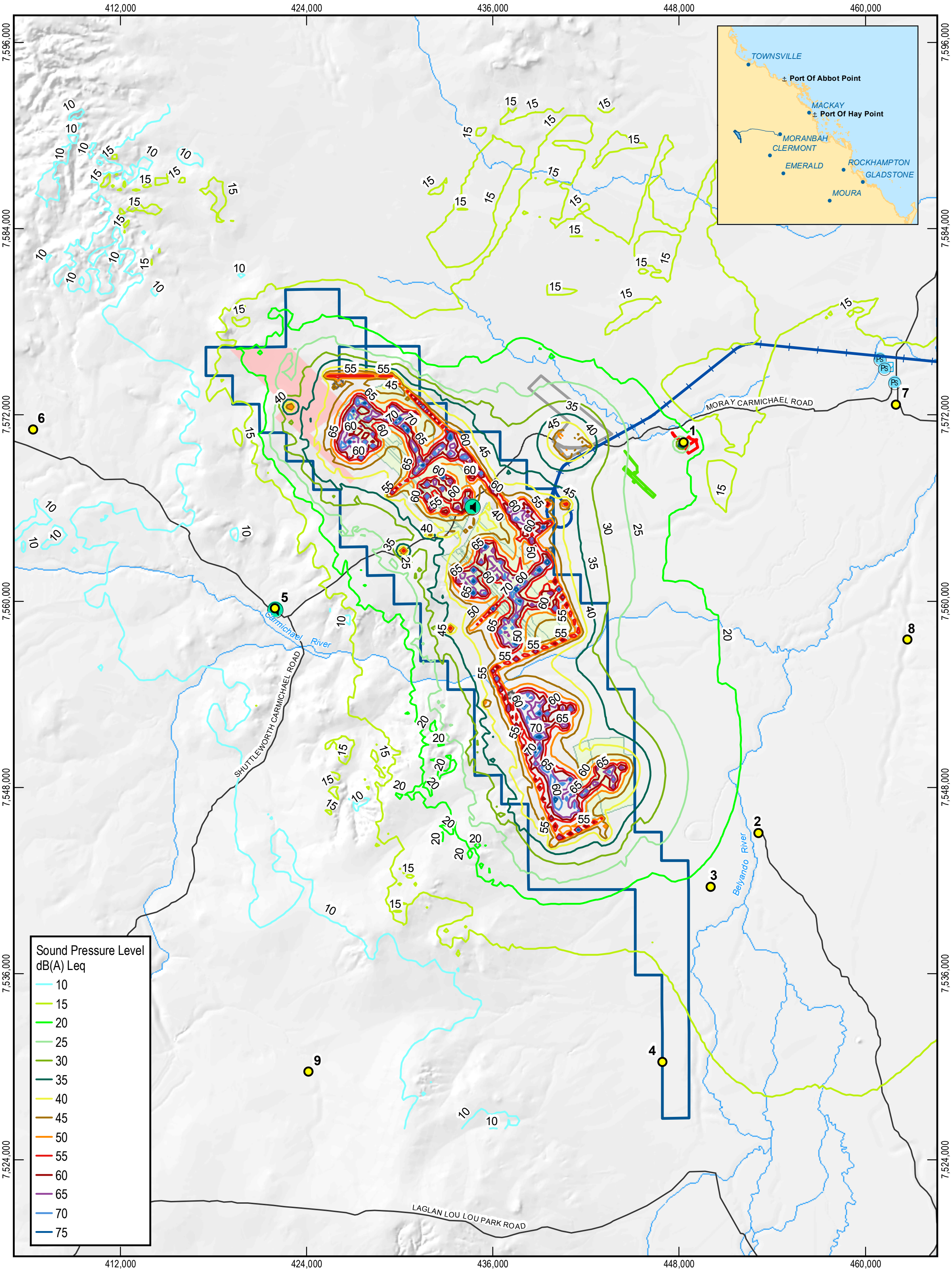
Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS
Mine Operational Noise Contours
Mine Year 2015
L_{AMax} Adverse Weather Conditions

Job Number 41-26422
Revision B
Date 24-10-2013

Figure E-3

Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: DME: EPC 1690 (2010)/EPC 1080 (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007);
Adani: Adani: Project Rail 1 (Opt11 Rev2) & 2 (Opt9 Rev3), Facilities (2013), Mien Layout / Infrastructure (2013); GHD: Sensitive Receptor (2012), Noise Contours (2013). Created by: JVC



LEGEND

- Sensitive Receptor
- Noise Logger
- Watercourse
- Local Road
- Rail (West)
- Mine Site
- Mine Infrastructure Area
- Open Cut Blocks
- Underground Mine Plan
- Mine (Offsite)
- Pump Station
- Storage Facility (Offstream)
- Airport
- Industrial Area
- Accommodation Village

Based on or contains data provided by the State of QLD (DNRM) [2013]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:350,000 (at A4)

0 2 4 6 8 10 12

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

GHD adani

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS
Mine Operational Noise Contours
Mine Year 2026
L_{Aeq} Neutral Weather Conditions

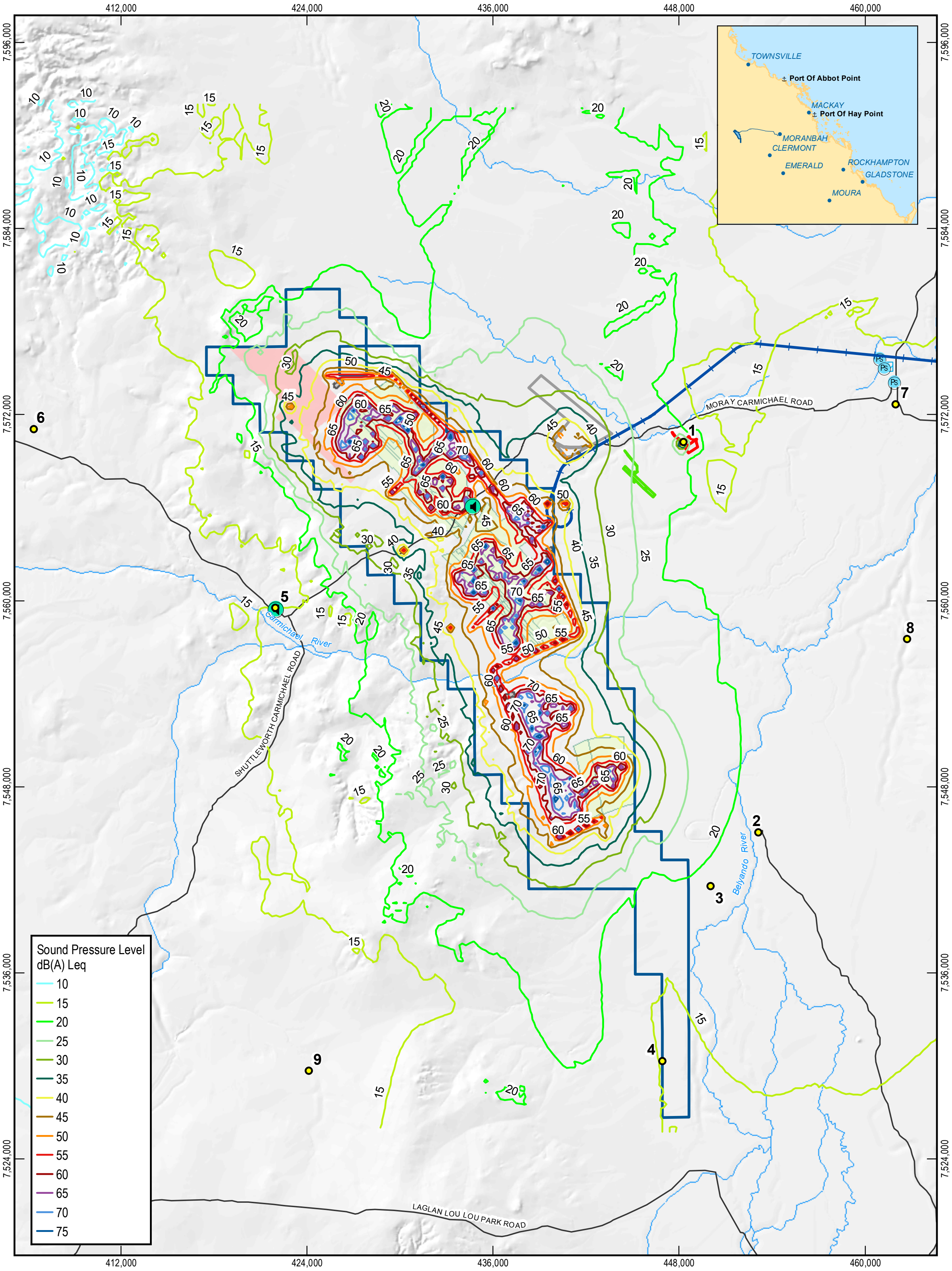
Job Number	41-26422
Revision	B
Date	24-10-2013

Figure E-4

G:\41\26422\GIS\Maps\MXD\0200_Noise\41-26422_0204_rev_b.mxd

Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: DME: EPC 1690 (2010)/EPC 1080 (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007);
Adani: Adani: Project Rail 1 (Opt11 Rev2) & 2 (Opt9 Rev3), Facilities (2013), Mien Layout / Infrastructure (2013); GHD: Sensitive Receptor (2012), Noise Contours (2013). Created by: JVC



LEGEND

- Sensitive Receptor
- Noise Logger
- Watercourse
- Local Road
- Rail (West)
- Mine Site
- Mine Infrastructure Area
- Open Cut Blocks
- Underground Mine Plan
- Mine (Offsite)
- Pump Station
- Storage Facility (Offstream)
- Airport
- Industrial Area
- Accommodation Village

1:350,000 (at A4)

0 2 4 6 8 10 12

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS
Mine Operational Noise Contours
Mine Year 2026
L_{Aeq} Adverse Weather Conditions

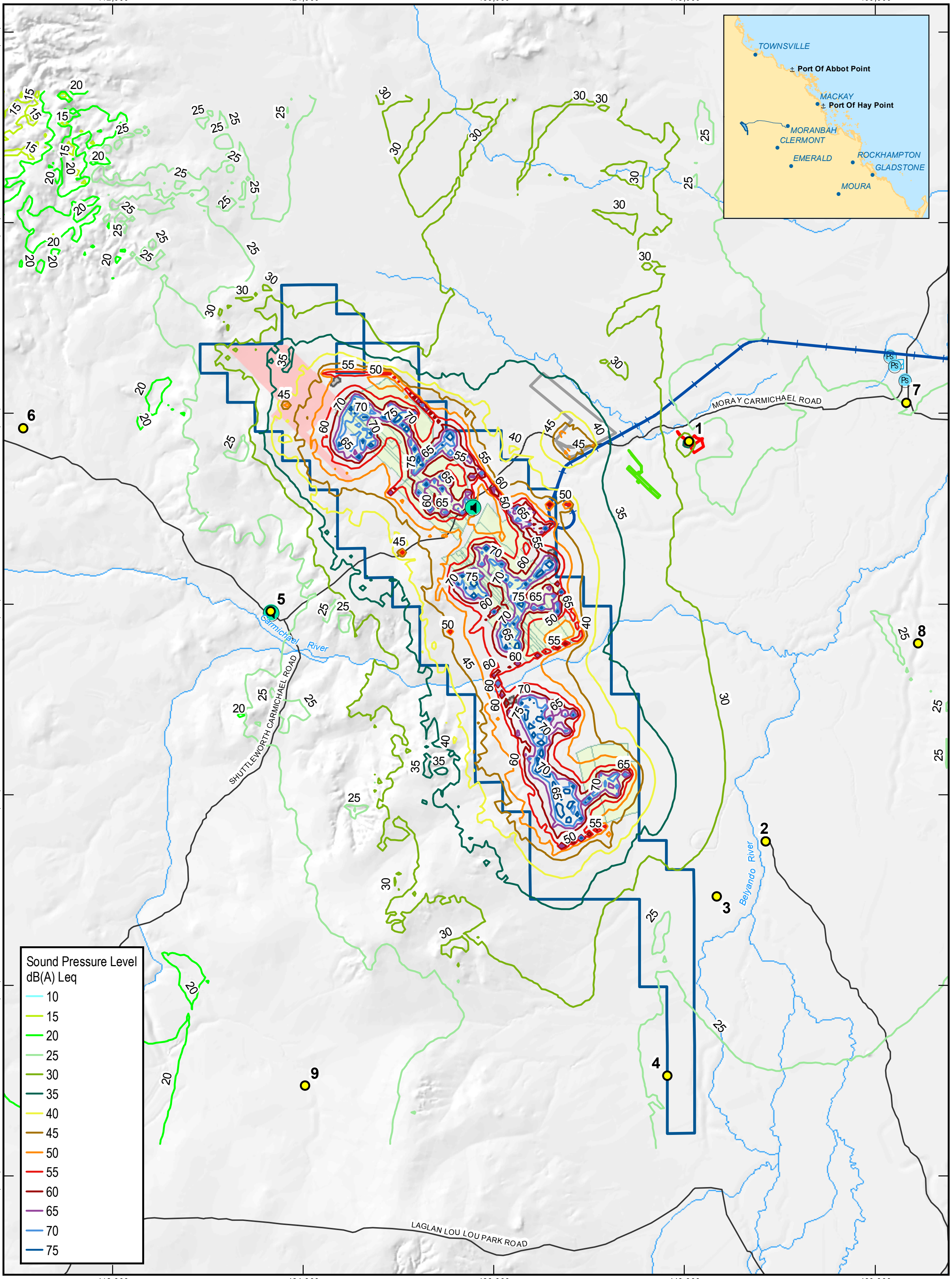
Job Number	41-26422
Revision	B
Date	24-10-2013

Figure E-5

G:\41\26422\GIS\Maps\MXD\0200_Noise\41-26422_0205_rev_b.mxd

Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: DME: EPC 1690 (2010)/EPC 1080 (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007);
Adani: Adani: Project Rail 1 (Opt11 Rev2) & 2 (Opt9 Rev3), Facilities (2013), Mien Layout / Infrastructure (2013); GHD: Sensitive Receptor (2012), Noise Contours (2013). Created by: JVC



LEGEND

- Sensitive Receptor
- Noise Logger
- Watercourse
- Local Road
- Rail (West)
- Mine Site
- Mine Infrastructure Area
- Open Cut Blocks
- Underground Mine Plan
- Mine (Offsite)
- Pump Station
- Storage Facility (Offstream)
- Airport
- Industrial Area
- Accommodation Village

Based on or contains data provided by the State of QLD (DNRM) [2013]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:350,000 (at A4)

0 2 4 6 8 10 12

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

GHD adani

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS
Mine Operational Noise Contours
Mine Year 2026
L_{AMax} Adverse Weather Conditions

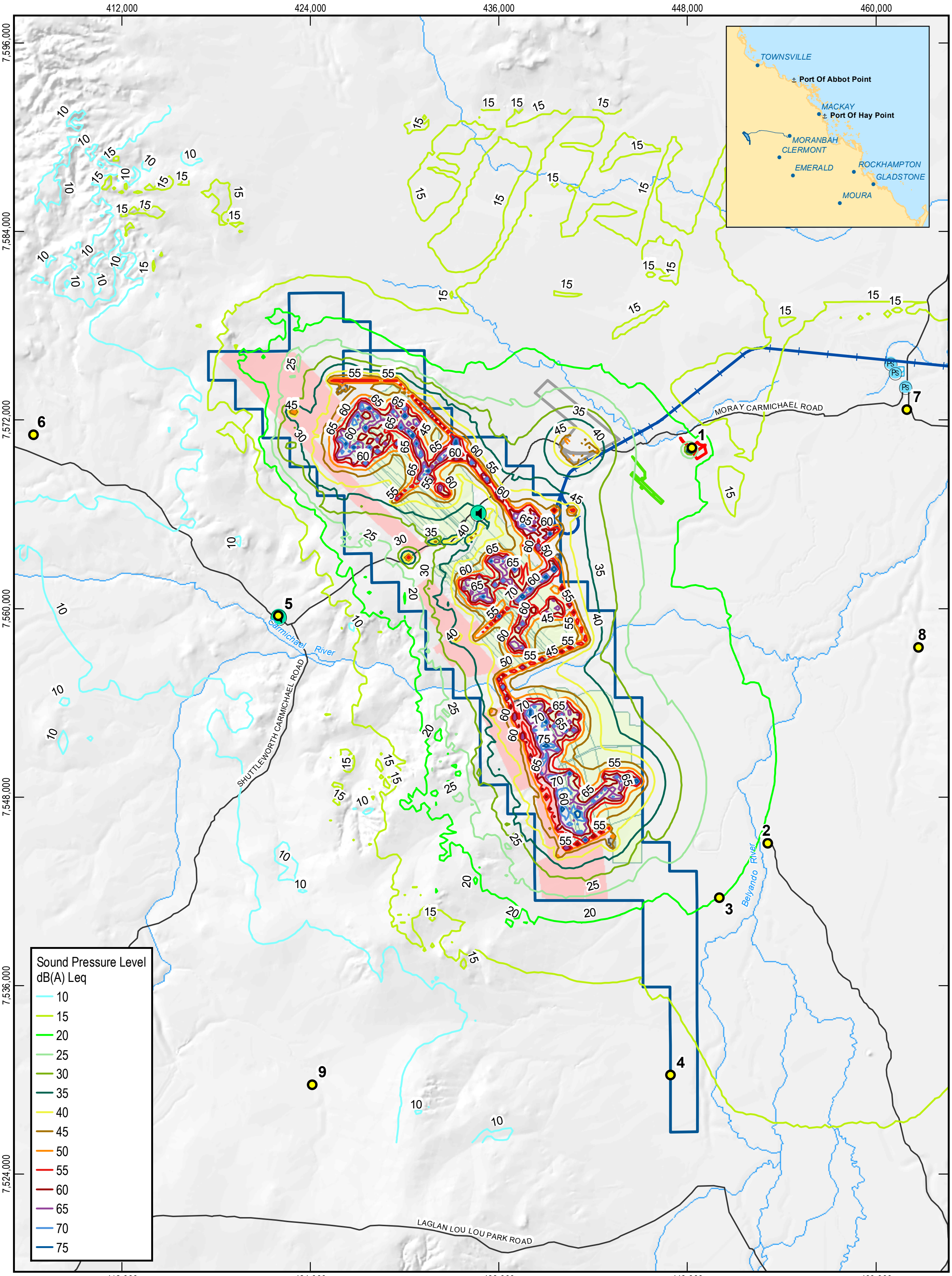
Job Number	41-26422
Revision	B
Date	24-10-2013

Figure E-6

G:\41\26422\GIS\Maps\MXD\0200_Noise\41-26422_0206_rev_b.mxd

Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: DME: EPC 1690 (2010)/EPC 1080 (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007);
Adani: Adani: Project Rail 1 (Opt11 Rev2) & 2 (Opt9 Rev3), Facilities (2013), Mien Layout / Infrastructure (2013); GHD: Sensitive Receptor (2012), Noise Contours (2013). Created by: JVC



LEGEND

- Sensitive Receptor
- Noise Logger
- Watercourse
- Local Road
- Rail (West)
- Mine Site
- Mine Infrastructure Area
- Open Cut Blocks
- Underground Mine Plan
- Mine (Offsite)
- Pump Station
- Storage Facility (Offstream)
- Airport
- Industrial Area
- Accommodation Village

Based on or contains data provided by the State of QLD (DNRM) [2013]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:350,000 (at A4)

0 2 4 6 8 10 12

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

GHD

adani

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS
Mine Operational Noise Contours
Mine Year 2049
L_{Aeq} Neutral Weather Conditions

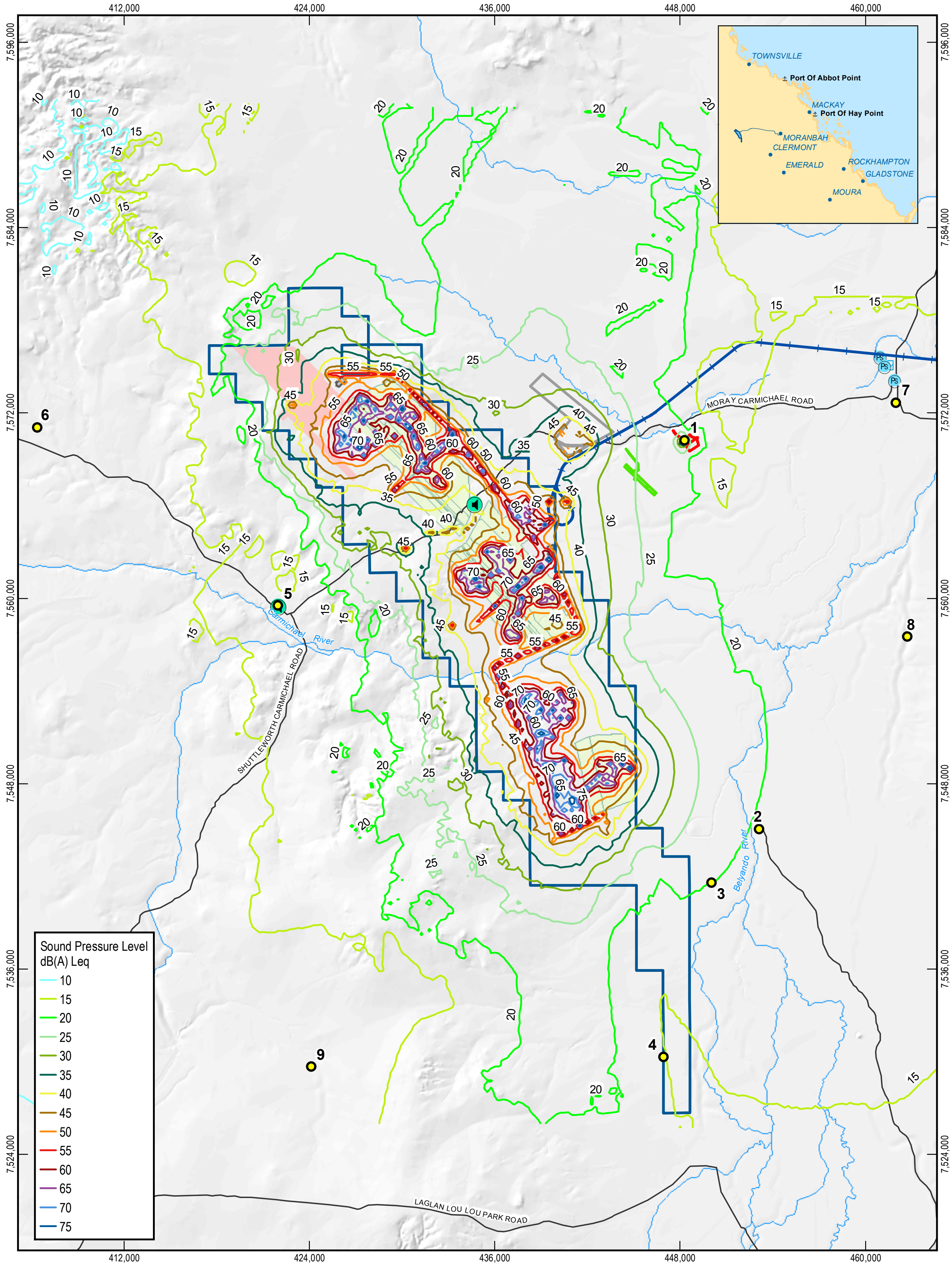
Job Number	41-26422
Revision	B
Date	24-10-2013

Figure E-7

G:\41\26422\GIS\Maps\MXD\0200_Noise\41-26422_0207_rev_b.mxd

Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: DME: EPC 1690 (2010)/EPC 1080 (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007);
Adani: Adani: Project Rail 1 (Opt11 Rev2) & 2 (Opt9 Rev3), Facilities (2013), Mien Layout / Infrastructure (2013); GHD: Sensitive Receptor (2012), Noise Contours (2013). Created by: JVC



LEGEND

- Sensitive Receptor
- Noise Logger
- Watercourse
- Local Road
- Rail (West)
- Mine Site
- Mine Infrastructure Area
- Open Cut Blocks
- Underground Mine Plan
- Mine (Offsite)
- Pump Station
- Storage Facility (Offstream)
- Airport
- Industrial Area
- Accommodation Village

1:350,000 (at A4)

0 2 4 6 8 10 12

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

GHD adani

Adani Mining Pty Ltd

Carmichael Coal Mine and Rail Project SEIS

Mine Operational Noise Contours
Mine Year 2049
L_{Aeq} Adverse Weather Conditions

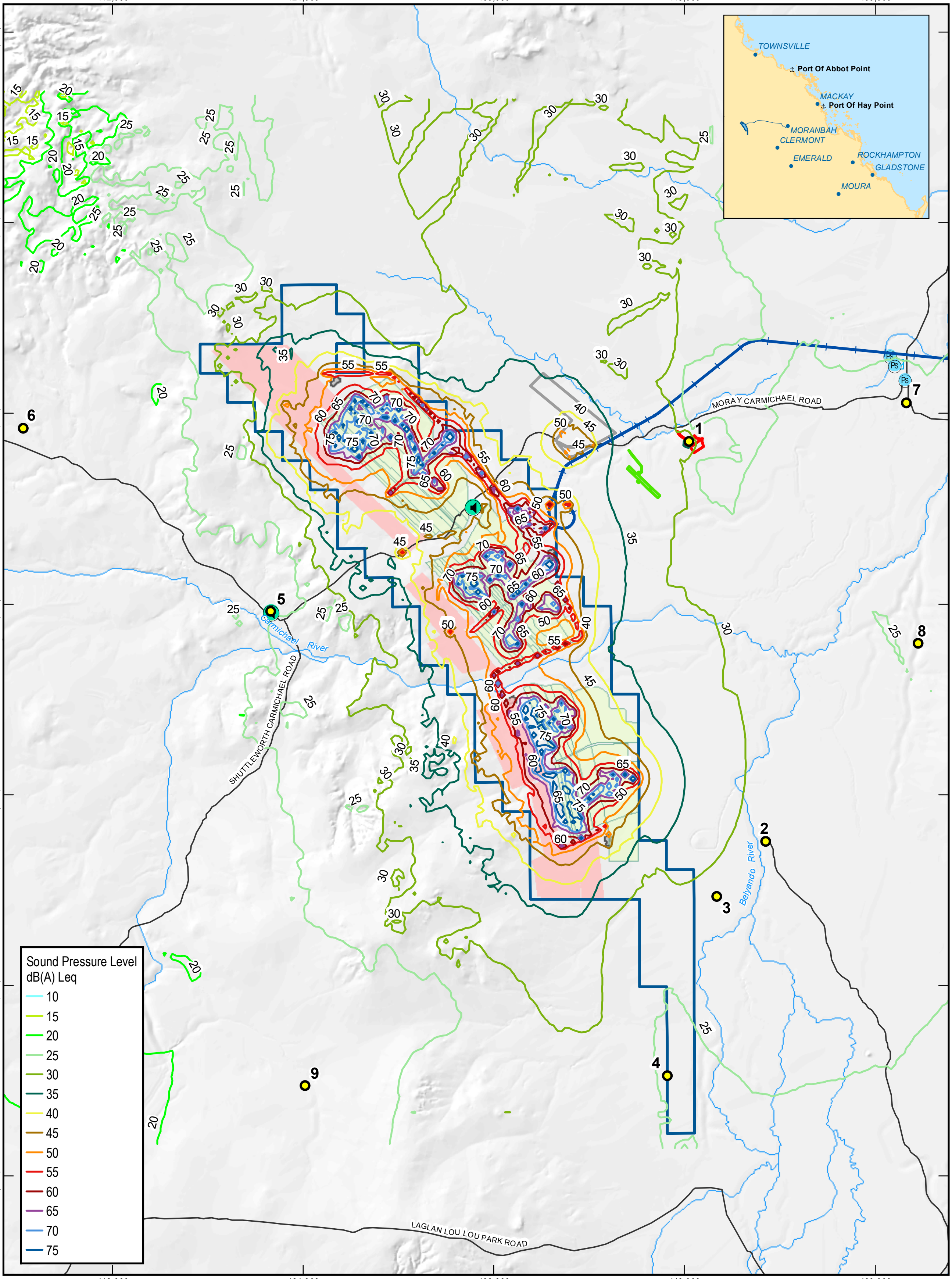
Job Number	41-26422
Revision	B
Date	24-10-2013

Figure E-8

G:\41\26422\GIS\Maps\MXD\0200_Noise\41-26422_0208_rev_b.mxd

Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: DME: EPC 1690 (2010)/EPC 1080 (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007);
Adani: Adani: Project Rail 1 (Opt11 Rev2) & 2 (Opt9 Rev3), Facilities (2013), Mien Layout / Infrastructure (2013); GHD: Sensitive Receptor (2012), Noise Contours (2013). Created by: JVC



LEGEND

- Sensitive Receptor
- Noise Logger
- Watercourse
- Local Road
- Rail (West)
- Mine Site
- Mine Infrastructure Area
- Open Cut Blocks
- Underground Mine Plan
- Mine (Offsite)
- Pump Station
- Storage Facility (Offstream)
- Airport
- Industrial Area
- Accommodation Village

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1:350,000 (at A4)

0 2 4 6 8 10 12

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

GHD adani

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS
Mine Operational Noise Contours
Mine Year 2049
L_{AMax} Adverse Weather Conditions

Job Number	41-26422
Revision	B
Date	24-10-2013

Figure E-9

G:\41\26422\GIS\Maps\MXD\0200_Noise\41-26422_0209_rev_b.mxd

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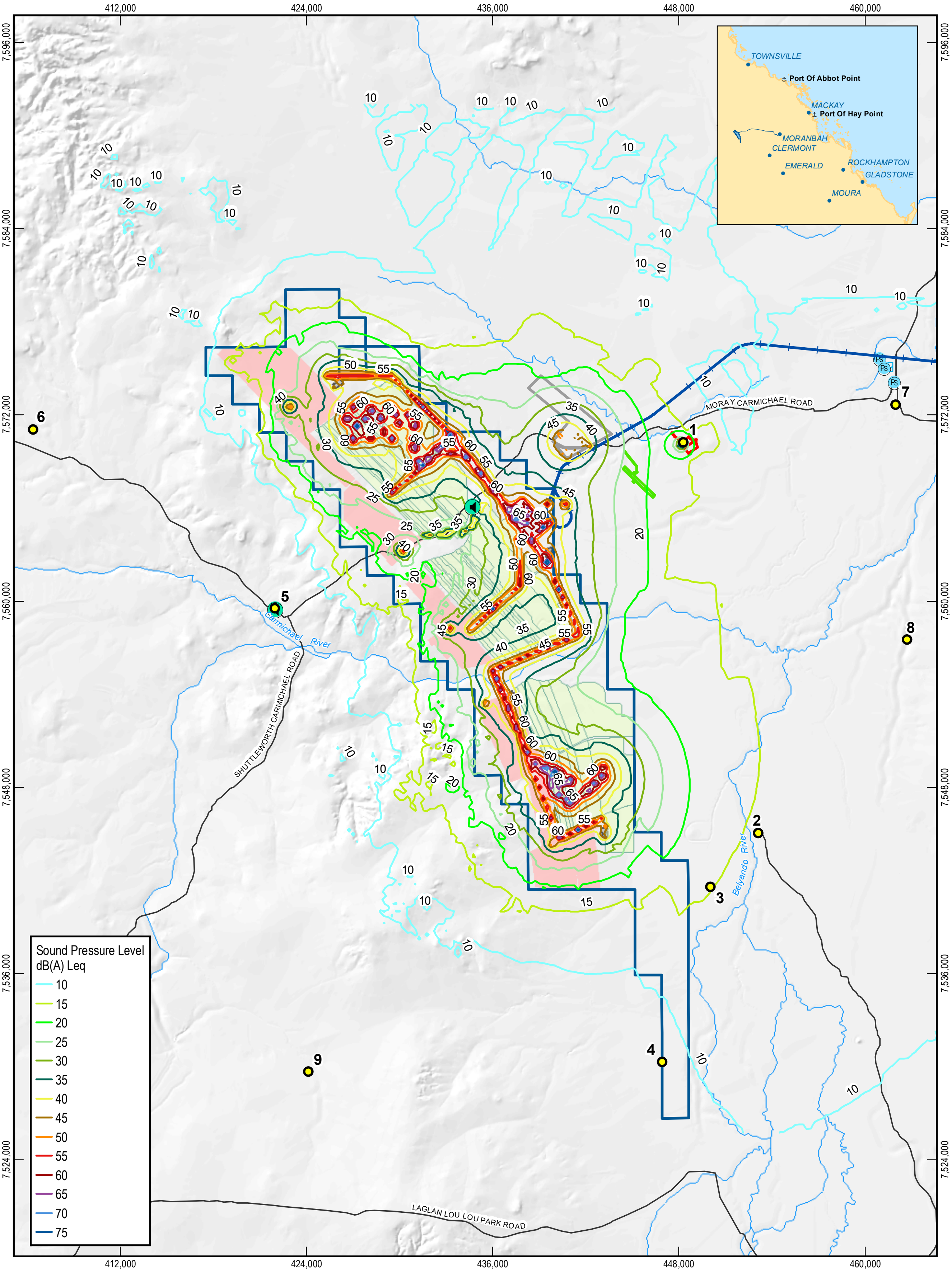
Adani: Adani: Project Rail 1 (Opt11 Rev2) & 2 (Opt9 Rev3), Facilities (2013), Mien Layout / Infrastructure (2013); GHD: Sensitive Receptor (2012), Noise Contours (2013). Created by: JVC



LEGEND

- Sensitive Receptor
- Noise Logger
- Watercourse
- Local Road
- Rail (West)
- Mine Site
- Mine Infrastructure Area
- Open Cut Blocks
- Underground Mine Plan
- Mine (Offsite)
- Pump Station
- Storage Facility (Offstream)
- Airport
- Industrial Area
- Accommodation Village

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1:350,000 (at A4)

0 2 4 6 8 10 12

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

GHD

adani

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS
Mine Operational Noise Contours
Mine Year 2071
L_{Aeq} Neutral Weather Conditions

Job Number	41-26422
Revision	B
Date	24-10-2013

Figure E-10

G:\41\26422\GIS\Maps\MXD\0200_Noise\41-26422_0210_rev_b.mxd

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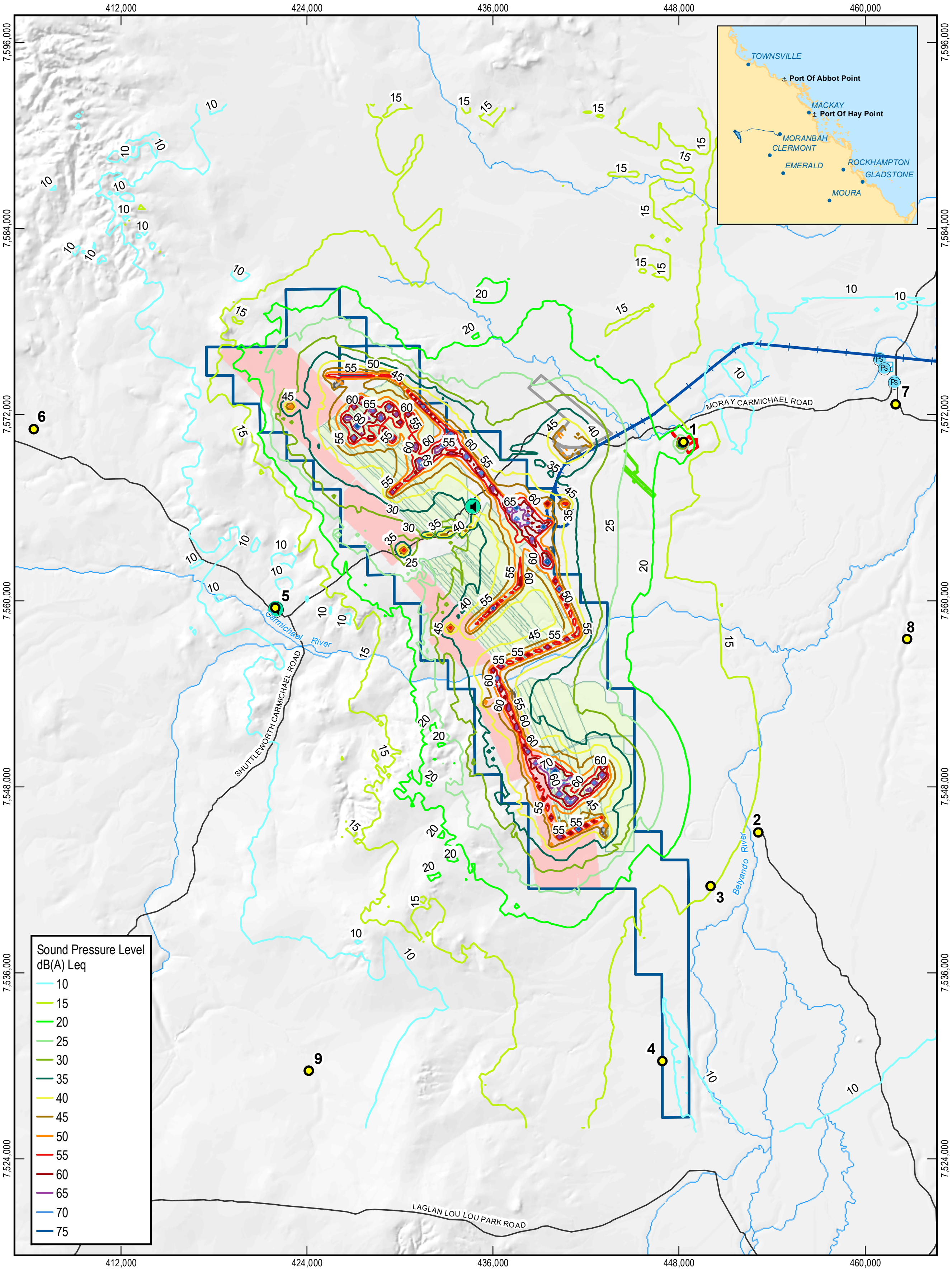
Data Source: DME: EPC 1690 (2010)/EPC 1080 (2011); © Copyright Commonwealth of Australia - Geoscience Australia: Mainland, Homestead, Locality, Road, Watercourse (2007);
Adani: Adani: Project Rail 1 (Opt11 Rev2) & 2 (Opt9 Rev3), Facilities (2013), Mien Layout / Infrastructure (2013); GHD: Sensitive Receptor (2012), Noise Contours (2013). Created by: JVC



LEGEND

- Sensitive Receptor
- Noise Logger
- Watercourse
- Local Road
- Rail (West)
- Mine Site
- Mine Infrastructure Area
- Open Cut Blocks
- Underground Mine Plan
- Mine (Offsite)
- Pump Station
- Storage Facility (Offstream)
- Airport
- Industrial Area
- Accommodation Village

Based on or contains data provided by the State of QLD (DNRM) [2013]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:350,000 (at A4)

0 2 4 6 8 10 12

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

GHD adani

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS
Mine Operational Noise Contours
Mine Year 2071
L_{Aeq} Adverse Weather Conditions

Job Number	41-26422
Revision	B
Date	24-10-2013

Figure E-11

G:\41\26422\GIS\Maps\MXD\0200_Noise\41-26422_0211_rev_b.mxd

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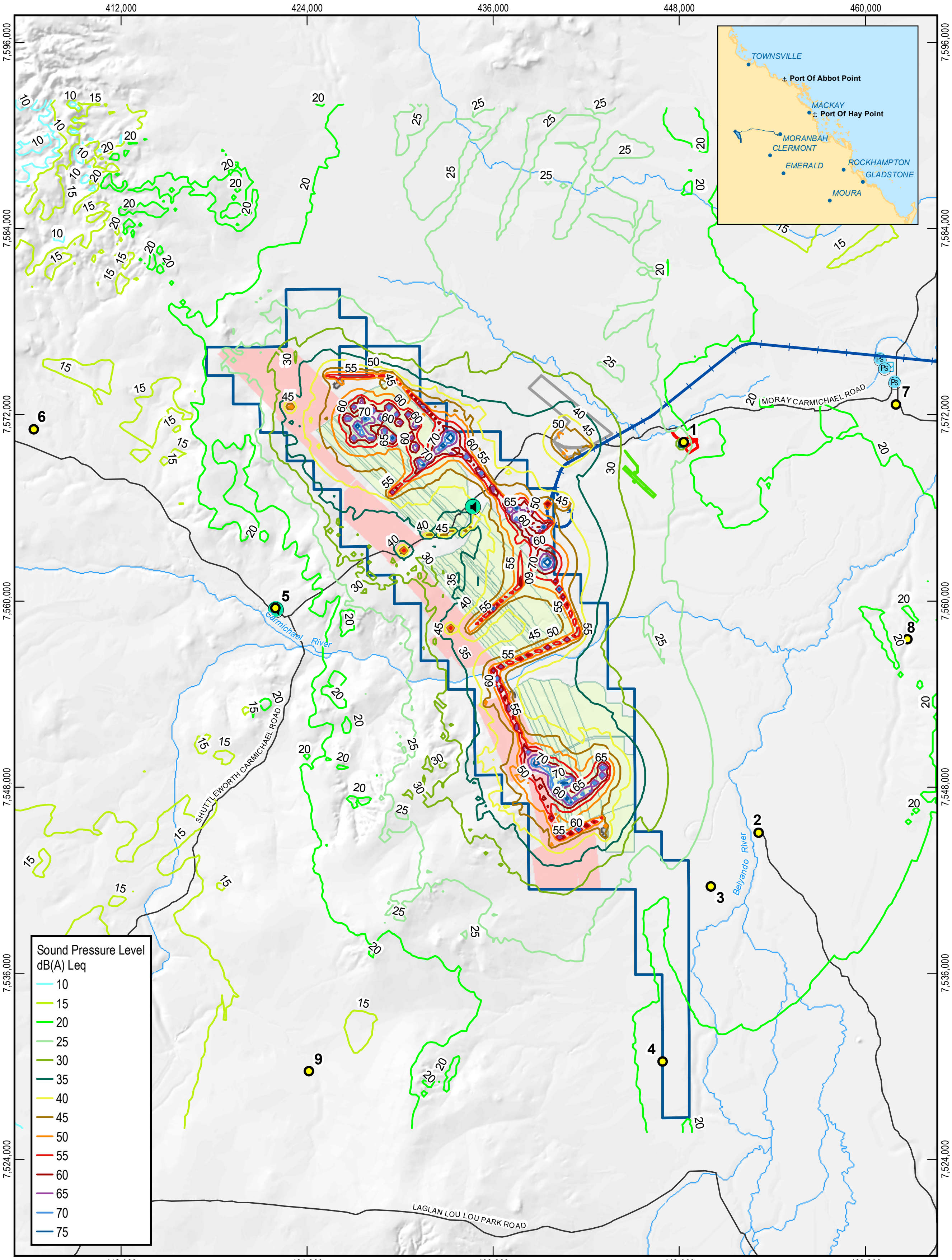
Adani: Adani: Project Rail 1 (Opt11 Rev2) & 2 (Opt9 Rev3), Facilities (2013), Mien Layout / Infrastructure (2013); GHD: Sensitive Receptor (2012), Noise Contours (2013). Created by: JVC



LEGEND

- Sensitive Receptor
- Noise Logger
- Watercourse
- Local Road
- Rail (West)
- Mine Site
- Mine Infrastructure Area
- Open Cut Blocks
- Underground Mine Plan

Mine (Offsite)

- Pump Station
- Storage Facility (Offstream)
- Airport
- Industrial Area
- Accommodation Village

1:350,000 (at A4)

0 2 4 6 8 10 12

Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

GHD adani

Adani Mining Pty Ltd
Carmichael Coal Mine and Rail Project SEIS
Mine Operational Noise Contours
Mine Year 2071
L_{AMax} Adverse Weather Conditions

Job Number	41-26422
Revision	B
Date	24-10-2013

Figure E-12

G:\41\26422\GIS\Maps\MXD\0200_Noise\41-26422_0212_rev_b.mxd

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Adani: Adani: Project Rail 1 (Opt11 Rev2) & 2 (Opt9 Rev3), Facilities (2013), Mien Layout / Infrastructure (2013); GHD: Sensitive Receptor (2012), Noise Contours (2013). Created by: JVC

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B	C Evenden	J Keane	DRAFT	J Keane	DRAFT	25/07/2013
0	C Evenden	J Keane	On file	J Keane	On file	30/07/2013
1	M Goodall	J Keane		J Keane		18/10/2013

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