OLYMPIC DAM EXPANSION

DRAFT ENVIRONMENTAL IMPACT STATEMENT 2009

APPENDIX M
NOISE AND VIBRATION

bhpbilliton
resourcing the future

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APPENDIX M

NOISE AND VIBRATION

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11 November 2008

Olympic Dam Letter of Testimony Technical Review of Arups Olympic Dam Expansion Report Revision A july 2008.doc
VE22162

Dear David

RE: Peer Review of Arup Report re Acoustic Impact Olympic Dam

TECHNICAL REVIEW OF OLYMPIC DAM EXPANSION REPORT

ISSUE JULY 2008

Doc Ref AAc/85204-00/R004 REVISION A

And Review of Proposed Chapter 14 Noise and Vibration

Dear David,

Following your request, we have reviewed the Draft Environmental Impact Assessment - Noise and Vibration for the Olympic Dam Expansion as prepared by Arup Acoustics. We have also reviewed the proposed Chapter 14 Noise and Vibration.

It is our opinion that the Revision A report has been prepared to an appropriate technical standard for the Olympic Dam EIS. The scope of work has been appropriate and is in line with standard industry practice and is therefore acceptable for the intended purpose.

Chapter 14 as written correctly reflects the results of the investigation described in the Appendix.

Should you have any queries regarding the above, please advise.

Yours sincerely

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ArupAcoustics

BHP Billiton

Olympic Dam Expansion

Environmental Impact Assessment - Noise and Vibration

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Environmental Impact Assessment - Noise and Vibration

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Aims

The aims of this investigation were to:

- Determine appropriate acoustic criteria
- Identify existing noise and vibration sources
- Provide results of acoustic measurements
- Create an acoustic model for the existing Olympic Dam operation site
- Provide results of predictions for the existing operation
- Identify noise and vibration sources associated with the proposed Olympic Dam expansion
- Obtain noise levels for the noise sources identified
- Update the acoustic model to represent the proposed Olympic Dam expansion
- Predict noise levels due to the full scale operation
- Predict noise levels for the desalination plant, landing facility, intermodal facility, sulphur handling facility, transmission corridors, railway, road traffic and airstrip associated with the proposed Olympic Dam expansion
- Assess predicted noise and vibration levels with respect to the acoustic criteria
- Provide ‘in-principle’ options for noise and vibration mitigation where required to meet acoustic criteria

Executive Summary

Noise and Vibration measurements have been conducted at locations relevant to the Olympic Dam expansion, including long-term noise monitoring, attended measurements and measurement of specific noise and vibration sources. The results of these measurements are presented in this report.

An acoustic model of the existing Olympic Dam operation site and surrounding areas has been created and used to predict noise levels for specific scenarios of plant operation and meteorological conditions that occurred during the noise monitoring period within the Olympic Dam operation site and at surrounding boundaries. The scenarios considered indicate that the predicted noise levels generated from the acoustic model agree with the noise monitoring results to within 0 to 5 dB. A 5 dB variation with respect to measurements is considered reasonable for environmental noise. In most cases the model predicts noise levels higher than the measured values. The implication of this is that the predicted results are typically conservative.

Industrial Noise

The existing acoustic model was updated to reflect the Olympic Dam expansion and additional acoustic models have been created for Point Lowly and Port Augusta.

Industrial noise from the Olympic Dam operation site is predicted to comply with criteria for all scenarios considered except for the meteorological case of a temperature inversion for noise sensitive receivers at Roxby Downs. In this case it is predicted that the night-time criterion will be exceeded by 3 dB. Mitigation options to achieve the night-time noise criterion at Roxby Downs with respect to industrial noise have been considered and have been provided in this report.

Vibration associated with the industrial activities at the Olympic Dam operation site, including blasting, is predicted to meet the vibration criteria.

Industrial noise from the Point Lowly desalination plant, the Pimba intermodal facility, the Port of Darwin copper concentrate handling facility and transmission corridors (including potential pump stations) are predicted to meet noise criteria for the scenarios considered.

Industrial noise from the Port Augusta landing facility is predicted to exceed the day time criterion at residences within 750 m of the facility. Recommendations for operation of the landing facility to achieve the noise limits have been considered and have been provided in this report.

Industrial noise from the Outer Harbour sulphur handling facility is predicted to exceed the night-time criterion due to noise from the conveyer. Mitigation methods have been considered and recommendations for further investigation are provided in this report.

Road Traffic Noise

Initial road traffic noise predictions indicate that existing traffic noise may increase locally by up to 6 dB.

In locations where road traffic noise has increased by 4 dB or more and is also exceeding the upper target noise levels provided in the Road Traffic Noise Guidelines, all reasonable and practicable measures should be undertaken to mitigate the road traffic noise.

A detailed study is required to determine overall noise levels and the impact on specific noise sensitive receivers, however general ‘in principle’ mitigation options have been provided.

Rail

Rail noise has been predicted to meet the criteria set by the SA EPA at noise sensitive receivers at Roxby Downs, Hiltaba Village, Woomera and The Purple Downs Homestead and is expected to have an insignificant affect on the noise levels due to additional rail traffic.

Vibration associated with the proposed rail is not expected to be an issue due to the significant distance between the location of the rail and the noise sensitive receivers.

Aircraft

Aircraft noise at residences at Roxby Downs and Hiltaba Village is considered to be 'acceptable' when assessed in accordance with *Australian Standard 2021*[1] and therefore will not require additional acoustic treatment. In addition to this the residences are located outside the 65 dB(A) single event contour for the proposed airstrip. The acoustic criterion for aircraft noise is therefore met.

OH&S (Noise)

The cabins or control rooms for all mobile machinery proposed for the Olympic Dam expansion are designed to achieve compliance with OH&S (noise) criteria for a 12 hour shift.

For other operators opportunities to plan the expanded operation to minimise noise exposure exist. As workers will operate in a number of areas for various durations of time, these details will need to be considered in the design of the expanded operation.

Blasting

Noise and vibration associated with blasting have been predicted to meet the criteria.

[1] AS2021:2000 Australian Standard Acoustics – Aircraft noise intrusion – Building siting and construction

1 Introduction

The Olympic Dam operation site is located in remote South Australia approximately 16 km north of the Roxby Downs Township. It currently has industrial, vehicular traffic and aircraft noise sources and industrial vibration sources associated with its operation. The mine operates continuously with occasional shutdown periods for maintenance.

Noise and vibration from a future expansion of the site, including the addition of a rail system and intermodal facility, landing facility, desalination plant, sulphur handling facility, the relocation of the airport, and introduction of a fleet of mobile machinery associated with the conversion from underground to open-pit mining has the potential to adversely affect noise sensitive receivers at:

- The expanded Roxby Downs Township
- Proposed Contractor Accommodation (Hiltaba Village)
- Point Lowly
- Woomera Township
- Shacks Road, Port Augusta
- Outer Harbour
- Pimba
- Townships and noise sensitive receivers adjacent to the proposed railway and transmission corridors between Pimba and Port Adelaide

The expansion at the Olympic Dam operation site includes significant noise and vibration sources that will be located in the order of 5 km from the expanded Roxby Downs Township and in the order of 6 km from the proposed Hiltaba Village. The existing Olympic Dam Village is expected to be abandoned at a stage during the expansion due to the encroaching operations and is therefore not included in the assessment.

This report presents the following information:

- Details of the relevant acoustic regulations with which noise and vibration from the Olympic Dam operation site is to comply and acoustic guidelines where compliance is recommended
- Details of the existing noise and vibration sources
- The results of noise and vibration measurements conducted at Roxby Downs, Olympic Dam Village, Woomera, Point Lowly, Port Augusta and locations adjacent to Andamooka Road (including proposed sites for Hiltaba Village)
- Details of the acoustic model for the existing Olympic Dam operation site
- Changes to the Olympic Dam operation site associated with the expanded operation, including:
    - Additional processing plant
    - Addition of a Combined Cycle Gas Turbine (CCGT) plant
    - Additional mobile machinery
    - An open-pit mine and associated Rock Storage Facility (RSF)
    - The expansion of the Roxby Downs Township
    - Additional contractor accommodation (Hiltaba Village)
    - Closure of the existing contractor accommodation (Olympic Dam Village)
    - Upgrade of the existing road network
    - Relocation of the existing airstrip

- Offsite changes associated with the expanded operation, including:
    - A desalination plant at Point Lowly
    - A landing facility at Shacks Road, Port Augusta
    - Copper Concentrate Handling Facility at Port of Darwin.
    - Sulphur Handling Facility at Outer Harbour
    - Introduction of a rail connection from Pimba to Roxby Downs
    - An intermodal facility at Pimba
    - Introduction of a haul road from Point Lowly, past Port Augusta to the Olympic Dam operation site
    - Transmission corridors from Port Augusta and Point Lowly to the Olympic Dam operation site
    - Potential pump and compressor stations along the transmission corridors
- Prediction of the noise levels associated with the expansion at noise sensitive receivers and assessment of the vibration impact
- Implications regarding occupational health and safety (noise) for staff working at the Olympic Dam operation

The assessment presented in this report includes:

- Identification of noise and vibration sources associated with the proposed Olympic Dam expansion
- Determination of noise levels for the sources identified
- Creation of acoustic models for the proposed expansion
- Prediction of noise levels due to industrial noise sources for various meteorological conditions
- Assessment of noise and vibration associated with blasting
- Prediction of noise levels associated with:
    - Road
    - Rail
    - Aircraft
    - Transmission corridors
- Assessment of predicted noise and vibration levels with respect to the acoustic criteria and guidelines to determine the impact
- Identification of the implications of the predicted noise levels at the Olympic Dam operation with respect to the Occupational Health and Safety (Noise) Regulations[2]

Options for 'in-principle' noise mitigation are provided where required to meet the acoustic criteria.

The location of the existing mine and transportation corridors relative to Roxby Downs and Olympic Dam Village as well the expanded operation is shown on Figure 1 and the extent of works for the Olympic Dam expansion (including the offsite locations) is shown on Figure 2 in the Figures Section of this report.

Acoustic Terminology is explained in Appendix A.

This work is part of a pre-feasibility study and the information and assumptions in this report were the most accurate at the time of preparation. Any changes to the information or the

[2] South Australia, *Occupational Health, Safety and Welfare Regulations*, 1995

assumptions detailed in this report may affect the results and outcomes that have been presented.

2 Approach

The approach to the assessment is detailed below:

1. Identify existing noise and vibration sources with regard to the existing Olympic Dam operation.
2. Identify relevant regulations, guidelines and criteria with respect to noise and vibration sources.
3. Conduct 'baseline' noise and vibration measurements at noise sensitive locations and at other strategic locations.
4. Conduct source noise and vibration measurements at the Olympic Dam operation site.
5. Determine the sound power level of specific noise sources.
6. Develop an acoustic model of the existing mining operation and surrounding areas.
7. Predict noise levels at strategic locations and determine the accuracy of the existing acoustic model.
8. Identify noise and vibration sources associated with the proposed Olympic Dam expansion.
9. Determine source noise levels associated with specific equipment for the expansion
10. Update the existing acoustic model to include the noise sources and changes to the mine layout associated with the Olympic Dam expansion.
11. Create acoustic models for off-site noise sources associated with the Olympic Dam expansion.
12. Predict noise and vibration levels for various scenarios and assess these with respect to criteria.
13. Provide 'in principle' options for noise control where required.
14. Identify the implications with respect to Occupational Health and Safety (OH&S) (Noise) Regulations[3].

[3] Ibid

3 Acoustic Criteria

The current legislative requirements and guideline documents relevant in South Australia are identified below. Further details of these documents are provided in Appendix B. The acoustic criteria provided in this section have been used for the assessment of the impact of noise and vibration.

3.1 Industrial Noise

The regulation in which limits are prescribed for industrial noise in South Australia is *The Environment Protection (Noise) Policy 2007*[4] (SA EPA Policy 2007). Details of the relevant sections of this document are provided in Section B1.1 of Appendix B.

It should be noted that Hiltaba Village is defined as 'on site accommodation' and therefore at this location the noise criteria defined in the SA EPA Policy 2007 are not mandatory. The noise levels at Hiltaba Village will, however, will be subject to the requirements of the South Australia Environmental Protection Act 1993 for which there is a requirement to 'prevent unreasonable interference'. It is noted by the South Australian EPA (SA EPA) that compliance with the *World Health Organisation (WHO) Guidelines for Community Noise*[5] (WHO Guidelines) is expected to prevent 'unreasonable interference'[6].

A summary of the industrial noise criteria for noise sensitive receivers in the vicinity of the Olympic Dam operation site have been determined and are presented in Table 1 below.

Receiver Location	Relevant Document	External Noise Limit at Noise Sensitive Receiver	
		Day (7am to 10pm)	Night (10pm to 7am)
Roxby Downs	SA EPA Policy 2007	47 dBL_{Aeq}	40 dBL_{Aeq} 60 dBL_{Amax}
Hiltaba Village	WHO *	50 dBL_{Aeq}	45 dBL_{Aeq} 60 dBL_{Amax}
Point Lowly	SA EPA Policy 2007	51 dBL_{Aeq}	43 dBL_{Aeq} 60 dBL_{Amax}
Shack Road, Port Augusta	SA EPA Policy 2007	51 dBL_{Aeq}	43 dBL_{Aeq} 60 dBL_{Amax}
Pimba	SA EPA Policy 2007	51 dBL_{Aeq}	43 dBL_{Aeq} 60 dBL_{Amax}
Outer Harbour	SA EPA Policy 2007	54 dBL_{Aeq}	45 dBL_{Aeq} 60 dBL_{Amax}
Rural Residences	SA EPA Policy 2007	42 dBL_{Aeq}	35 dBL_{Aeq} 60 dBL_{Amax}

* The WHO Guidelines also allow internal noise levels to be considered and assumes a 15 dB reduction from outside to inside a residence with an open window.

Table 1: Summary of Industrial Noise Criteria for the Olympic Dam Expansion

An adjustment for tonality or low frequency content of noise due to the mining operations at Olympic Dam operation site is not expected to be required at Roxby Downs or Hiltaba Village due to the level of ambient noise at these locations[7]. It is also not expected that noise will be impulsive or have a modulating characteristic due to the ambient noise level and the extent of the operation.

[4] Environment Protection Authority, *South Australia Environment Protection (Noise) Policy 2007*, December 2007
[5] World Health Organisation Geneva, *Guidelines for Community Noise*, April 1999
[6] Confirmed via email from SA EPA, 19 May 2006
[7] Confirmed approach via phone conversation with SA EPA, 24 June 2006

3.2 Blasting

Due to the transient nature of the noise and vibration associated with blasting activities and as legislative criteria for blasting does not exist in SA, assessment has been in accordance with *Australian Standard 2187.2*[8]. This document gives recommendations for airblast and vibration levels at sensitive receivers for blasting activities lasting longer than 12 months. Recommended criteria for air blast and ground vibration that are in compliance with AS2187.2 are presented in Table 2 below.

Category	Type of blasting operations	Recommendations for human comfort
Ground Vibration	Operations lasting longer than 12 months or more than 20 blasts (as expected for Olympic Dam operations)	5 mm/s for 95% of blasts per year 10mm/s maximum unless agreement is reached with the occupier that a higher limit may apply
Airblast		115 dBL for 95% blasts per year 120 dBL maximum unless agreement is reached with occupier that a higher limit may apply

Table 2: Summary of Blasting Noise and Vibration Criteria

3.3 Road Traffic Noise

Legislation for road traffic noise limits do not exist in South Australia. The document relevant to road traffic noise is *The Department for Transport, Energy and Infrastructure – Road Traffic Noise Guidelines*[9]*.* Details of this document are provided in Section B2 of Appendix B. The SA EPA has advised that these guidelines should be used to assess noise sensitive receivers at Roxby Downs where the noise level at noise sensitive receivers adjacent to existing roads is predicted to increase by 4 dB or more[10]. The outdoor target noise level range provided in the guidelines is:

Time Period	Target Noise Level Range[Note 1] (dBL_{Aeq})	
Daytime (7am to 10pm)	55	65
Night-time (10pm to 7am)	50	60

Table 3: Outdoor Target Noise Levels for Road Traffic Noise

Note 1: Generally, where a receiver or group of receivers are not currently exposed to traffic noise, then the lower end of the range is used. For noise sensitive land uses with some exposure to existing traffic noise, an outdoor target is selected according to the level of current exposure. For the situation of noise sensitive land uses already exposed to high levels of traffic noise (above the target range), then the higher end of the range is used.

The SA EPA has also advised that if it is proposed to develop new houses near an existing road, then measures (e.g. separation distance, barriers) should be employed so that the road traffic noise level does not exceed:

- 50 $dBL_{Aeq(15hr)\ 7am\ -\ 10pm}$
- 45 $dBL_{Aeq(9hr)\ 10pm\ -7am}$
- 60 $dBL_{Amax\ 10pm\ -\ 7am}$

These levels are to be measured at the building envelope on allotments, one meter from the most exposed window at a height of 1.5 m. The criteria should also be met outside upper stories on allotments with the potential for multi-storey buildings.

[8] Australian Standard AS 2187.2, *Explosives – Storage and Use Part 2: Use of Explosives*, 2006
[9] Department for Transport, Energy and Infrastructure*, Road Traffic Noise Guidelines Version 3*, March 2007
[10] Received via email from SA EPA, 11 April 2008

3.4 Rail Noise

Legislative requirements or standards in South Australia with respect to rail noise do not exist. The SA EPA has advised that, for a new rail line, the following noise limits should be met at noise sensitive receivers[11]:

- 60 $dBL_{Aeq(24hr)}$
- 85 dBL_{Amax}

Where an existing rail line is located near existing houses the above noise levels should not be seen as levels where an exceedance means an offence is committed but rather as a level that, where exceeded, an environment improvement plan should be implemented to achieve the levels (or better) at noise sensitive receivers. In addition to this, all reasonable and practicable measures should be taken (e.g. separation) to avoid residents from receiving this level of noise.

3.5 Aircraft Noise

Australian Standard 2021-2000[12] is used to assess building site acceptability in Australia with respect to aircraft noise due to take off and landing and provides information with respect to the type of building construction necessary to achieve a given noise reduction. Application of this standard should be considered for buildings located within 10 km of the Olympic Dam airstrip. Details of this document are presented in Section B3.1 of Appendix B. It should be noted, however, that the use of ANEF curves has been discussed in the *Roxby Downs Proposed Airport Preliminary Noise Study*[13] and an alternative criterion is proposed to take into consideration the small number of flights to and from the airport. This is further discussed in Section B3.2 of Appendix B. The criterion proposed and used for this project is:

- 50 dBL_{Amax} (indoors)

This level is described as the acceptable standard for sleeping areas and lounges of domestic dwellings in *Australian Standard 2021-2000*. Allowing for a 15 dB attenuation by a building with closed windows, then a 65 dB(A) noise contour is appropriate for Hiltaba Village and the Roxby Downs Township.

3.6 Occupational Health and Safety (Noise)

The relevant regulation for occupational noise is the *South Australian Occupational Health, Safety and Welfare Regulations*[14] along with the *Occupational Health and Safety Welfare Variation Regulations*[15]. Details of these documents are provided in Section B4 of Appendix B.

The exposure standard is

- an eight hour equivalent continuous A-weighted sound pressure level, $L_{Aeq,\ 8\ hour}$ of 85 dB referenced to 20 micropascals and
- a C-weighted peak sound pressure level, $L_{C,peak}$ of 140 dB referenced to 20 micropascals

Note: Shifts longer than 8 hours have a lower exposure standard. It has been advised that the shifts at the Olympic Dam operation are usually 12 hours. The equivalent criteria for a 12 hour shift are provided below.

- a twelve hour equivalent continuous A-weighted sound pressure level, $L_{Aeq\ 12\ hour}$ of 83 dB referenced to 20 micropascals and

[11] Received via email from SA EPA, 11 April 2008
[12] Australian Standard, *2021-2000 Acoustics – Aircraft Noise Intrusion – Building Siting and Construction*, July 2000
[13] Airport technical Services Pty Ltd, *Roxby Downs Proposed Airport – Preliminary Noise Study*, November 2005
[14] Ibid
[15] ibid

- a C-weighted peak sound pressure level, $L_{C,peak}$ of 140 dB referenced to 20 micropascals

3.7 Construction Noise

Construction noise associated with the Olympic Dam expansion is to meet the requirements of the SA EPA Policy 2007, *Part 6 – Special noise control provisions, Division 1 – Construction noise*. Details of the relevant section of this document can be found in Section B5 of Appendix B. The provisions are summarised below:

Construction noise is considered to have an adverse impact on amenity at noise sensitive receivers when:

- the continuous noise source level exceeds 45 dB(A) or the ambient continuous noise level, whichever is higher; or
- the maximum noise source level exceeds 60 dB(A) or the ambient maximum noise level (that is reached consistently), whichever is higher

Noise that is considered to have an adverse impact on amenity should:

- not occur on a Sunday or public holiday
- not occur during the night-time or evening period (7pm to 7am)

Unless construction must occur to:

- Avoid unreasonable interruption of vehicle or pedestrian traffic movement; or
- If other grounds exist that the administering agency determines to be sufficient

Where construction noise is considered to have an adverse impact on amenity all reasonable and practicable measures must be taken to minimise construction noise and its impact.

3.8 Vibration (Rail and Industrial)

Legislative requirements with respect to vibration do not exist in Australia, however, guidance for vibration limits for human exposure is provided in *Australian Standard 2670.2*[16]. A summary of the requirements of this standard is provided below and further details can be found in Section B6 of Appendix B.

Maximum vibration levels due to continuous or intermittent vibration sources, such as trains or industrial sources are provided below to maintain human comfort in residences and offices, for each one-third octave centre frequency band between 8 Hz and 8 kHz.

Receiver	Limit
Residences (night)	0.2 mm/s (Curve 1.4)
Residences (day)	0.3 mm/s to 0.6 mm/s (Curve 2 to Curve 4), depending on the sensitivity of the occupants, and
Offices and retail	0.6 mm/s (Curve 4)

Note: Curves can be found in Section B6 of Appendix B.

Table 4: Summary of Vibration Criteria

While groundborne vibration from train movements and industry are not to exceed the levels provided above, they may be occasionally perceptible in some areas, however, are unlikely to give rise to complaint in continuously occupied spaces.

[16] Australian Standard, *2670.2-1990 Part 2: Continuous and shock induced vibration in buildings (1 to 80 Hz)*, 1990

4 Baseline

4.1 Noise and Vibration Sources

The noise sources associated with the existing Olympic Dam operation site are:

- Industrial
- Road (vehicular) traffic
- Aircraft

Currently an above ground rail system for the Olympic Dam operation does not exist.

Vibration associated with industrial sources is present; however, vibration from road traffic and aircraft is not considered to be significant and therefore has not been investigated.

4.1.1 Industrial Noise and Vibration Sources

Significant industrial noise sources at the Olympic Dam operation are identified below. Calculated sound power levels and further comments with respect to the equipment considered are provided in Section C1 of Appendix C.

Outdoor

- Mills 2 and 3
- Vibrating screens for Mills 2 and 3
- ANI (Slag) Mill
- Regrind Mills 1 and 2
- Steam traps and steam pressure relief exhausts+
- Oxygen Plants
- Smelter 1 Shaft Furnace

Indoor

- Flash Furnace
- Electric Furnace
- Launder systems gas burners
- Cathode Stripping Machine (CSM)

Industrial sources of vibration at the Olympic Dam operation include:

- Development, stope and quarry blasting
- Grinding mills

4.1.2 Road Traffic

A traffic survey has been conducted for feeder and distributor roads in the Roxby Downs Township and for main roads in the surrounding areas. This information is provided in Section C2 of Appendix C.

The largest existing traffic flows in the vicinity of the Roxby Downs Township occur along Olympic Way. Existing traffic tends to use Olympic Way between the Roxby Downs Township and the mine (as opposed to the Pimba Highway)[17].

The posted speed limits are currently 50 km/h within the Roxby Downs Township and between 60 to 110 km/h on Olympic Dam Way and Pimba Highway.

[17] Arup, *BHPB Global Concept Traffic Management Plan*, October 2007

4.1.3 Aircraft

The airstrip is currently located in the vicinity of the Olympic Dam Village, approximately 4 km south of the Olympic Dam operation.

The aircraft types that are currently used to fly to and from the airstrip are the:

- Saab SF340 (with a capacity of 30 or 34 seats) and
- Fairchild Metro 23 (with a capacity of 19 seats)

Regular Regional Express (REX) flights are currently scheduled for Olympic Dam airstrip. This information is provided in Section C3 of Appendix C. Note that charter aircraft, and light aircraft flight training operations also occur, however, times for these activities vary.

4.2 Site Acoustic Measurements

Noise measurements have been conducted. These include ambient noise measurements at locations that are currently affected or will potentially be affected by noise due to the Olympic Dam expansion and measurements at locations that are not currently affected by industrial noise. Source noise measurements have also been conducted at the Olympic Dam operation site.

Results of these measurements are provided in Appendix D. Details of the equipment used for these measurements are provided in Section D1 of Appendix D.

The location of these measurements is provided in Section D2 of Appendix D.

4.2.1 Attended Ambient Noise Measurements

The results of the attended ambient noise measurements are provided in Section D3 of Appendix D. Attended ambient noise measurements were conducted at the following locations:

- Roxby Downs Township (see Section D3.1 of Appendix D)
- Adjacent to Andamooka Road (see Section D3.2 of Appendix D.)
- Mining Lease Boundary and Site Boundary (see Section D3.3 of Appendix D.)
- Woomera Township (see Section D3.4 of Appendix D.)
- Point Lowly (see Section D3.5 of Appendix D.)
- Port Augusta (see Section D3.6 of Appendix D.

4.2.2 Unattended Ambient Noise Monitoring

The results of the unattended ambient noise monitoring are presented in Section D4 of Appendix D. Ambient noise monitoring was conducted in the following locations:

- Roxby Downs Township (see Section D4.1 of Appendix D)
- Olympic Dam Village (see Section D4.2 of Appendix D)
- Mining Lease Boundary and Site Boundary (see Section D4.3 of Appendix D)
- Woomera Township (see Section D4.4 of Appendix D)
- Point Lowly (see Section D4.5 of Appendix D)

4.2.3 Source Noise Measurements

Source noise measurements have been conducted at the Olympic Dam operation site and the results are provided in Section D5 of Appendix D. The results of attended noise measurements of specific noise sources can be found in Section D5.1 of Appendix D along with comments on the location, size and nature of the equipment.

Noise monitoring at locations within the Olympic Dam operations site are presented in Section D5.2 of Appendix D.

4.2.4 Vibration Measurements

Vibration measurements have been conducted at the Olympic Dam mining lease boundary, north of the Olympic Dam Village. Details of the vibration measurements are provided in Section D6 of Appendix D.

4.3 Baseline Acoustic Model

Noise level predictions have been undertaken using SoundPLAN version 6.4 environmental modelling software which has implemented the CONCAWE[18] noise propagation model. This methodology considers noise attenuation by mechanism of:

- Geometrical spreading
- Atmospheric absorption
- Ground effects
- Meteorological conditions
- Barriers

The CONCAWE methodology has the advantage over other methodologies in that it allows consideration of meteorological conditions.

The model in SoundPLAN includes:

- Topography
- Building Structures
- Sources
- Receivers
- Meteorological Conditions
- Ground Absorption
- Air Absorption

The octave band sound power levels of significant sources within the Olympic Dam operation site have been calculated from measurements using standard acoustic calculations (see Section 4.1.1) and these are used in the model.

The acoustic model of the Olympic Dam operation site is, in the first instance, used to predict the noise from the operation to various locations where noise measurements have been conducted. A comparison between measured and predicted values is then used to check the validity of the acoustic model.

[18] CONCAWE, *The Propagation of Noise from Petroleum and Petrochemical Complexes to Neighbouring Communities*, C.J Manning 1981

4.3.1 Results of Baseline Acoustic Modelling

The acoustic model was used to predict noise levels associated with various scenarios of plant operation and meteorological conditions that occurred during noise monitoring period within the Olympic Dam operation site and surrounding boundaries. Comparisons have been made between the predicted noise levels and the measured noise levels for 3 scenarios which are described below. The ground was modelled as 'hard' for all scenarios.

The following scenarios were considered and provide a good representation of the existing Olympic Dam operation for various weather conditions and major noise source operation:

Scenario 1 represents the Olympic Dam operation during a strong southerly wind at a time when the process control information[19] indicated that all major noise sources are active.

Scenario 2 represents the Olympic Dam operation during a northerly wind (3.6 m/s) at a time when the process control information indicates that Mill 3 is not operating.

Scenario 3 represents the Olympic Dam operation during a still night at a time when the process control information indicates that all major noise sources are active.

Results are presented in Appendix E in tables and as colour noise contours. A summary of the differences between the measured $L_{eq\ ,15\ minute}$ range (over one hour, ie four measurements) and the predicted Sound Pressure Level (SPL) at each location for the scenarios considered is provided in Table 5 below.

Location (Figure D1)	Scenario		
	1	2	3
J	1 to 5 dB	-3 to 2 dB	-5 to -3 dB
K	-2 to 0 dB	-3 to -1 dB	-2 to 0 dB
Q	- 3 dB	-4 to -2 dB	-1 to 0 dB
R	-3 to 0 dB	1 to 4 dB	0 to 1 dB
S	-3 to -5 dB	0 to 1 dB	-4 to -2 dB
T	-1 dB	-2 to -1 dB	-2 dB

Table 5: Difference between Measured Range and Predicted Noise Level

The scenarios considered show that the predicted noise levels generated from the acoustic model agree with the noise monitoring results to within 5 dB. In most cases the model predicts noise levels higher than the measured values. The implication of this is that the risk of noise emissions from the Olympic Dam operation site exceeding criteria is reduced.

A 5 dB variation with respect to noise measurements is considered reasonable when taking into account the number of measurements that were assessed as part of the model validation. Variation of this order is expected with environmental noise assessment[20].

Noise logging, unlike attended noise measurements, has a risk that noise sources that have not been taken into account in the acoustic prediction (eg local vehicle movements or workers) are measured. This risk was reduced by assessment of the noise logger site before and after each measurement.

It was observed that for Scenario 2, the location that is in the vicinity of Mill 3 (ie a position that is affected by the shutdown), was both measured and predicted to be lower than for the other two scenarios.

4.4 OH&S (Noise)

BHP Billiton has advised that staff are generally concentrated in the Refinery, the Smelter and the Hydromet areas. While Arup Acoustics staff were on site conducting noise

[19] Received via email from senior HSEC Advisor , 5 March 2006
[20] Ibid, CONCAWE Section 5.2, 95% Confidence Limits

measurements, the Refinery was undergoing planned maintenance and therefore was not assessed. Furthermore, the Solvent Extraction section of the concentrator / Hydromet facility was not assessed as it was not permissible to enter this area with non-intrinsically safe electrical equipment. However, noise levels were measured within the Smelter 2 facility and the results of these, along with the length of time that can be spent in this area for either an 8-hour shift or a 12-hour shift to comply with the OH&S noise regulations is provided in the Table 6 below. It should be noted that the noise levels measured represent a "snapshot" in time and may vary under different operational situations. Measurements were conducted at each location for a minimum of 10 minutes. It should also be noted that hearing protection requirements are established for the Smelter 2 facility, requiring the mandatory use of hearing protection at all times.

Location	**Measured Noise Level** dBL_{Aeq}	**Maximum exposure time for 8-hour shift** Note 1, Note 2, Note 3 **(hours)**	**Maximum exposure time for 12-hour shift** Note 1, Note 2, Note 3 **(hours)**
Anode Casting	75	Full shift	Full shift
Level 2, Smelter (launder system)	90	2.5	1.7
Level 2, Electric Furnace (at 2 m)	89	3.1	2.1
Level 3, Smelter	91	2	1.3
Level 4, Smelter	91	2	1.3
Level 5 Smelter	86	6.3	4.1

Table 6: Maximum exposure times for OHS regulations

Notes:

1: On the basis that for the rest of the shift the staff member is only subjected to noise levels less than 75 dB(A) for an 8 hour shift and 73 dB(A) for a 12 hour shift.

2: Times of exposure will be less for shifts that are longer than the exposure time indicated.

3: Values have been rounded down to one decimal place in order to be conservative.

4: The information provided above assumes that hearing protection is not used.

5: L_{Cpeak} measurements all complied with the maximum value of 140 dB.

As workers operate in a number of areas for various durations of time on any single day it is recommended that dosimetry be used to determine individual noise exposure levels. Based on the results of the dosimetry, appropriate courses of action can be determined if required. This will be in terms of engineering noise control, administrative noise control or hearing protection. BHP Billiton has advised that site dosimetry is undertaken on a regular basis.

5 Expansion

The noise and vibration assessment for the proposed Olympic Dam expanded operation includes:

- Industrial sources of noise and vibration (including blasting)
- Road traffic noise
- Railway noise
- Aircraft noise

The only industrial source of vibration investigated in this study is blasting. Vibration associated with other industrial sources is not expected to be significant at the sensitive receivers due to the significant distance between them and the expanded mine operation (i.e. greater than 5 km).

Vibration from aircraft and road traffic is not expected to result in an impact and therefore is not assessed. Vibration from railway sources can cause an impact, however, due to the significant distances between the railway lines and sensitive receivers (ie greater than 3.5 km from sensitive receivers at Roxby Downs and greater than 2.5 km from sensitive receivers at Woomera), vibration due to the railway is not expected to result in an impact and therefore has not been assessed.

Construction noise has been addressed in general and it is expected that a detailed investigation will be undertaken for some specific construction operations, when further details are available.

5.1 Industrial Noise Sources

The following sections outline the specific equipment that is expected to be used as part of the Olympic Dam expanded operation[21]. Where applicable, the items of equipment in each of the groups below are provided in Section F1 of Appendix F.

Industrial noise and vibration sources can be grouped as follows:

- Mobile Machinery (see Section F1.1 of Appendix F)
- Expanded Processing Plant (see Section F1.2 of Appendix F)
- Onsite CCGT Plant (see Section F1.3 of Appendix F)
- Point Lowly Desalination Plant (see Section F1.4 of Appendix F)
- Port Augusta Landing Facility (see Section F1.5 of Appendix F)
- Pimba Intermodal Facility (See Section 5.1.4 below)
- Port of Darwin Copper Concentrate Handling Facility (See Section 5.1.5 below)
- Outer Harbour Sulphur Handling Facility (See Section 5.1.6 below)
- Blasting (see Section 5.1.1.1 below)
- Transmission Corridors (see Section 5.1.4 below)

Further details of the equipment and source noise levels are presented in Section F2 and F3 of Appendix F. General locations for items of equipment are presented in Section F4 of Appendix F.

[21] Communication with Senior HSEC Advisor, 5 April 2006

5.1.1 Olympic Dam Operation Site

A 'full scale operation' scenario has been investigated as the expected 'worst case' configuration for the Olympic Dam operation site. Details of the significant industrial noise and vibration sources for this scenario are identified below and the locations are shown in Figure F 1 in Section F4 of Appendix F.

BHP Billiton has advised that the following noise sources are anticipated for the full scale operation.

- Mobile Machinery
- Expanded Plant Operations
- CCGT Power Station Plant
- Blasting

The 'worst case' full scale operation scenario is modelled as follows:

- A pit depth of up to 700 m and a minimum RSF height of 35 m and up to 110 m with 14 active dumping locations spread across the RSF, including locations at the RSF extents closest to the Roxby Downs and Hiltaba Village receivers.
- All drill rigs, shovels, large excavators and approximately 70% of the CAT 797B haul trucks at various depths in the pit. The remainder of CAT 797B haul trucks are located along the haul roads and on the RSF, including the 11 active dumping locations.
- Active dumping locations include a CAT 797B haul truck with reversing alarm operating and noise associated with the dumping of material from the CAT 797B dump box. A CAT D11 bulldozer has been modelled in the vicinity of each of the active dump locations.
- Five of the CAT 797B haul trucks are operating air horns inside the pit at any one time.
- All remaining mobile equipment is on ground level haul roads (ie not in the pit) or between the maintenance workshop and pit.
- Five reversing alarms operating on ancillary vehicles in the area between the maintenance workshop and pit.
- Existing plant operations remain active along side the expanded processing plant, including the CCGT power station.

5.1.1.1 Blasting

Blasting is anticipated to occur daily during the lifetime of the mine. The 'worst case' blast site is modelled to occur at the extent of the open pit footprint closest to noise sensitive receivers. The minimum distance between blasting and noise sensitive receivers is 9 km, and this value has been used for the assessment. Predictions of noise and vibration associated with worst case blasting activity inside the pit are based on the following data and assessed in accordance with *Australian Standard 2187.2*[22] :

- Maximum Instantaneous Charge (MIC) per blast hole of 1500 kg[23]
- Distance between blasting activity and Roxby Downs receivers of 9 km
- Environmental conditions for the site as detailed in *Australian Standard* 2187.2 and provided below:
    - Overpressure Site Constant, 'K(a)', of 100
    - Overpressure Site Exponent, 'a', of -1.45

[22] ibid
[23] Via phone conversation with ORICA explosives manager at Olympic Dam, 17 October and 8 November 2006

- 20 dBL increase added to overpressure calculation for possible inversion and wind effects
- Ground Vibration Site Constant, 'K(g)' of 1140
- Ground Vibration Rock Constant, 'B' of 1.6

5.1.2 Point Lowly Desalination Plant

The significant industrial noise sources at Point Lowly are provided in Section F1.4 of Appendix F and the desalination plant location is shown in Figure F3 in Appendix F. Two scenarios are considered:

- Scenario 1 – Construction
- Scenario 2 - Operation

The 'worst case' configurations for both options during operation and construction, including details of the significant industrial noise sources are identified below.

Scenario 1 - Construction

Standard construction equipment (see Section F1.4.1 of Appendix F) will be used during this phase of the desalination plant. Construction includes the installation of a pipeline that will run north from the desalination plant, and be located west of the nearest residential property. Two 40T excavators will be used during the installation of the pipeline. The 'worst case' modelled is as follows:

- Two standard excavators modelled at the location along the pipeline that is adjacent to the nearest receiver.
- Standard construction equipment modelled in the vicinity of the excavators.
- Standard construction equipment modelled in the vicinity of the desalination plant.

Scenario 2 – Operation

The worst case modelled for this scenario is detailed below:

- 16 Reverse Osmosis pumps and an energy recovery device located inside the 1st pass reverse osmosis station
- 10 pumps located inside the product pump station
- The construction of buildings containing noise sources will be standard metal cladding and any doors or other openings will be closed during normal operation
- 4 sea water pump motors located at the pipeline, approximately 6 m inland from the shoreline. Motors are located in an open pit of approximately 2 m depth

5.1.3 Port Augusta Landing Facility

Details of the significant industrial noise sources expected at Port Augusta are provided in Section F1.5 of Appendix F. There are two scenarios of operation considered for the Port Augusta landing facility:

- Scenario 1 – Daytime (normal) Operation
- Scenario 2 – Night-time Operation

The 'worst case' configuration for both scenarios is identified below.

Scenario 1 – Daytime (normal) Operation (7am to 10pm)

All sources have been modelled as operating on the barge and at the loading area, approximately 300 m from the nearest noise sensitive receiver.

Impact noise levels associated with heavy equipment being loading onto a truck has been modelled at the loading area.

Scenario 2 – Night-time Operation (10pm to 7am)

It has been advised that the landing facility will not be fully operational during the night-time period; however a barge may be docked at the wharf with generators running. Generators have, therefore, been modelled at the barge docking location.

5.1.4 Pimba Intermodal Facility

Noise levels used for the assessment of the Pimba Intermodal Facility are provided in Section F3.5 of Appendix F. A high level assessment of this facility has been undertaken based on an idling freight train located 1.1 km from a noise sensitive receiver.

5.1.5 Port of Darwin Copper Concentrate Handling Facility

The Copper Concentrate Handling Facility is to be located in an industrial zone at the Port of Darwin approximately 5 km from the nearest noise sensitive receiver.

5.1.6 Outer Harbour Sulphur Handling Facility

Noise levels used for the assessment of the Outer Harbour Sulphur Facility are provided in Section F3.6 in Appendix F. A high level assessment of this facility has been undertaken based on the following equipment:

- 800 m materials conveyor (from western shipping port to handling facility)
- Conveyor drive motor at handling facility
- Two standard dump trucks

Any noisy activities inside the free span shed are assumed to be negligible with respect to noise from trucks outside or the conveyor.

5.1.7 Transmission Corridors

Transmission corridors have the potential to create noise in the form of:

- Aeolian (wind induced) noise from powerlines
- Pump stations noise at locations along the pipeline

BHP Billiton has advised the following ‘worst case’ assumptions for the prediction of Aeolian noise:

- A noise sensitive receiver at a distance of 1.1 km
- 400 m distance between pylons
- Cable diameter of 70 mm
- Aluminium Alloy Cables (density 2700 kg/m^3)
- Pretension 40 kN
- Wind direction perpendicular to the length of cable

Pump stations along transmission corridors have been addressed generally and it is expected that a specific investigation will be conducted for each location when they have been determined. Details of a typical pump station expected along the proposed pipeline are provided in Section F2.13 of Appendix F.

5.2 Road Traffic Noise

Road traffic noise has been assessed generally with respect to predicted increases in local light vehicle traffic and heavy vehicle traffic associated with the expansion. Local light vehicle traffic volumes at Roxby Downs and Hiltaba village are expected to peak in year

2012, at which time there will also be a bus network operating. It is predicted that a 'worst case' increase in heavy vehicle traffic will occur in 2009 with approximately 25 trucks per day (or an increase of approximately 1 truck per hour) with respect to the existing heavy vehicle traffic. After this 'worst case' period, traffic volumes for heavy vehicles on Olympic Dam Road and Roxby Downs Bypass are expected to decrease with respect to existing traffic volumes due to the introduction of the proposed Olympic Dam rail system.

5.3 Rail Noise

The proposed rail system for the Olympic Dam expansion will link the existing rail at Pimba to the Olympic Dam operation site. The proposed rail is planned to be a minimum distance of approximately 4 km west of Roxby Downs Township and a minimum distance of approximately 2.5 km east of Woomera Township. Hiltaba Village is located at a distance further from the railway than Roxby Downs.

The proposed rail link has 4 scheduled freight train movements per day. These trains are expected to be in the order of 1800 m in length travelling at a maximum speed of 110 km/h.

Rail traffic will also use the existing railway between Port Adelaide and Pimba. It is expected that the existing rail traffic of approximately 20 rail movements per day in this area would increase by 3 to 6 movements per day.

A map showing the proposed rail link is provided in Section F4 of Appendix F.

5.4 Aircraft Noise

The proposed Roxby Downs Airstrip is to be located to the south east of Hiltaba Village (north east of the Roxby Downs Township).

Assumptions for the proposed airstrip are as detailed in the *Roxby Downs Proposed Airport Preliminary Noise Study*[24] and include:

- Aircraft movements in the order of 5 scheduled flights per day
- Aircraft operating at the airstrip being Boeing B737 or A320
- Scheduled aircraft operating during daytime hours
- Landing approach being a straight line

Note that the Royal Flying Doctor Service and ad-hoc charter flights may operate at the airstrip; however, they are limited in number and therefore are not expected to significantly affect the noise assessment.

The proposed airstrip location at Roxby Downs is presented in Section F4 of Appendix F.

[24] Airport Technical Services Pty Ltd, *Draft Roxby Downs Proposed Airport Preliminary Noise Study*, September 2005

6 Impact of Olympic Dam Expansion

6.1 Industrial Noise at the Olympic Dam Operation Site

6.1.1 Prediction

The existing acoustic model of the Olympic Dam operation site, as described in Section 4.3 of this report, has been adjusted to include additional noise sources, revised topography and noise sensitive receivers that are representative of the expected 'worst case' scenario for the full scale Olympic Dam operation as described in Section 5.1.1 of this report.

SoundPLAN version 6.4 has been used to implement the CONCAWE[25] noise propagation model and predict noise levels for the three meteorological conditions described in Table 7 below.[26,27]

Meteorological Condition	Wind Speed (m/s)	Temperature (°C)	Humidity (%)	Pasquil Stability Category[28]
Neutral	0	20	50	Neutral (D)
Adverse*	8	7	77	Unstable (B)
Inversion	0	7	77	Stable (F)

*The wind direction resulting in the highest noise level at the noise sensitive receivers was used.

Table 7: Considered Meteorological Conditions

It should be noted that temperature inversions are only expected to occur on occasion during the night time period and during the winter months.

Blasting has not been included in the acoustic model due to its transient nature. Overpressure and vibration due to blasting activities in the pit have been assessed using the methods described in *Australian Standard 2187.2*[29] (see Section 6.8 below).

6.1.2 Results

Predicted noise levels at the most affected noise sensitive receivers in the Roxby Downs Township and at Hiltaba Village for the meteorological conditions considered are provided in Table 8 below. Noise contours for industrial noise from the Olympic Dam operation site to Roxby Downs and Hiltaba Village, for each of the meteorological conditions considered, are provided in Figure G1 to
Figure G3 in Appendix G.

Location	Sound Pressure Level, dB(A) re 20 X 10^{-6}Pa		
	Meteorological Conditions		
	Neutral	Adverse	Temperature Inversion
Roxby Downs	33	40	43
Hiltaba Village	32	39	42

Table 8: Predicted Sound Pressure Level at the Most Affected Noise Sensitive Receiver

6.1.3 Impact Assessment

The noise limits for industrial noise sources are detailed in the Section 3.1 of this report and are provided in Table 9 below for the noise sensitive receivers in the vicinity of the expanded Olympic Dam operation site.

[25] Ibid
[26] The Bureau of Meteorology, *Meteorology Data Summary for Olympic Dam,* 1997 to 2005
[27] Confirmed in meeting with Senior HSEC advisor, 9 February 2007
[28] Pasquil, F, *The Estimation of the Dispersion of Windborne Material*, The Meteorological Magazine 1961
[29] Ibid

Location	External Noise Criteria	
	Day (7am to 10pm)	Night (10pm to 7am)
Roxby Downs	47 dBL_{Aeq}	40 dBL_{Aeq} 60 dBL_{Amax}
Hiltaba Village	50 dBL_{Aeq}	45 dBL_{Aeq} 60 dBL_{Amax}

* Note that the WHO Guidelines for Community Noise also allow internal noise levels to be considered. A 15 dB reduction is assumed from outside to inside a residence with an open window.

Table 9: Noise Limits for Industrial Noise for Expanded Operation

Note: L_{Amax} noise limits cannot be directly assessed as source L_{Amax} values are not available. However, for the acoustic predictions, the maximum event sound pressure levels have been used where this information is available and it is therefore not expected that the L_{Amax} (instantaneous) levels will be significantly higher than these. Consequently, if the L_{Aeq} noise limit is met then on this basis it is expected that the L_{Amax} noise limit will also be met as it is significantly higher (ie 20 dB higher at Roxby Downs and 15 dB higher at the proposed Hiltaba Village).

Predicted noise levels for noise sensitive receivers at Roxby Downs and Hiltaba Village for the three meteorological conditions detailed in Table 7 are assessed with respect to the criteria in Table 10 below.

Receiver	Sound Pressure Level dB(A) re 20 X 10^{-6} Pa	Excess	Comments
Neutral Meteorological Conditions:			
Roxby Downs	33	0	Daytime and night-time noise criteria met
Hiltaba Village	32	0	Daytime and night-time noise criteria met
Adverse Meteorological Conditions:			
Roxby Downs	40	0	Daytime and night-time noise criteria met
Hiltaba Village	39	0	Daytime and night-time noise criteria met
Temperature Inversion:			
Roxby Downs	43	3	Daytime noise criterion is met and night-time noise criterion is marginally exceeded
Hiltaba Village	42	0	Daytime and night-time noise criteria met

Table 10: Assessment of Predicted Sound Pressure Level at Roxby Downs

6.1.4 Discussion

At Roxby Downs and Hiltaba Village, the predicted noise levels are higher for the adverse meteorological conditions than the neutral meteorological conditions and higher again for the temperature inversion.

The night-time criterion is predicted to be exceeded at Roxby Downs during temperature inversions while the daytime and night-time criteria for the other meteorological conditions considered are predicted to be met.

For this prediction mobile machinery operating in the open pit is shielded by the pit and the RSF. The significant noise sources contributing to the excess to the night-time criterion at Hiltaba Village are:

- CAT 797B reverse alarms at the RSF extents
- CAT 797B dumping noise at the RSF extents
- CAT 797B engine/operating noise at the RSF extents

6.2 Industrial Noise at Point Lowly Desalination Plant

6.2.1 Prediction

An acoustic model of the Point Lowly desalination plant and surrounding area has been created. A 'worst case' model was created for the scenarios described in Section 5.1.2 of this report. SoundPLAN version 6.4 has been used to implement the CONCAWE[30] noise propagation model to predict noise levels for the two meteorological conditions provided in Table 11 below. It should be noted that temperature inversions are not expected at Point Lowly due to its coastal location.

Meteorological Condition	Wind Speed (m/s)	Temperature (°C)	Humidity (%)	Pasquil Stability Category[31]
Neutral	0	20	50	Neutral (D)
Adverse*	8	7	77	Unstable (B)

*The wind direction resulting in the highest noise level at the noise sensitive receivers was used.

Table 11: Considered Meteorological Conditions

6.2.2 Results

The predicted noise levels at the most affected noise sensitive receivers at Point Lowly for each scenario and for the meteorological conditions considered are provided in Table 12 below. Noise contours are provided in Figure G4 to Figure G11 in Appendix G.

	Sound Pressure Level, dB(A) re 20 X 10^{-6} Pa	
	Meteorological Conditions	
	Neutral	Adverse
Scenario 1 – Construction Phase	31	36
Scenario 2 – Operation Phase	20	25

Table 12: Predicted Noise Levels at Most Affected Noise Sensitive Receivers in Point Lowly

[30] ibid
[31] Pasquil, F, The Estimation of the Dispersion of Windborne Material, The Meteorological Magazine 1961

6.2.3 Impact Assessment

The noise limits for industrial noise are detailed in Table 1 in Section 3.1 of this report and are provided in Table 13 below for the noise sensitive receivers at Point Lowly.

Criteria	External Noise Criteria	
	Day (7am to 10pm)	Night (10pm to 7am)
Scenario 1 - Operational Phase	51 dBL_{Aeq}	43 dBL_{Aeq} 60 dBL_{Amax}

Table 13: Industrial Noise Criteria for Point Lowly

The noise limits for construction noise to be considered as an "adverse impact" are detailed in Table 1 in Section 3.7 of this report and are provided in Table 14 below for the noise sensitive receivers at Point Lowly.

BHP Billiton has advised that construction activity will only occur during the daytime hours and therefore construction noise has been assessed against the daytime noise criterion only.

Criteria	External Noise Criteria	
	Day (7am to 7pm)	Night/Evening (7pm to 7am)
Scenario 2 - Construction Phase	45 dBL_{Aeq}	NA

Table 14: Construction Noise Criteria for Point Lowly

Predicted noise levels for the most affected noise sensitive receivers at Point Lowly for the two meteorological conditions detailed in Table 11 are presented in Table 15 below.

Scenario	Predicted SPL dB(A) re 20 X 10^{-6} Pa	Excess	Comments
Neutral Meteorological Conditions:			
Construction	31	0	Daytime and night-time criteria are met
Operation	20	0	Daytime and night-time criteria are met
Adverse Meteorological Conditions:			
Construction	36	0	Daytime and night-time criteria are met
Operation	25	0	Daytime and night-time criteria are met

Table 15: Assessment of Predicted Noise Levels at Point Lowly

6.2.4 Discussion

It is predicted that the criteria will be met for Scenario 1 – Operational Phase for the meteorological conditions considered.

It is predicted that construction noise will meet the criterion and therefore will not have an adverse impact on amenity for the meteorological conditions considered.

6.3 Industrial Noise at Port Augusta Landing Facility

6.3.1 Prediction

An acoustic model of the Port Augusta landing facility and surrounding area has been created. A 'worst case' model was created for the scenario described in Section 5.1.3 of this report. SoundPLAN version 6.4 has been used to implement the CONCAWE[32] noise propagation model to predict noise levels for the two meteorological conditions provided in Table 16 below. It should be noted that temperature inversions are not expected at the Port Augusta landing facility due to its coastal location.

Meteorological Condition	Wind Speed (m/s)	Temperature (°C)	Humidity (%)	Pasquil Stability Category[33]
Neutral	0	20	50	Neutral (D)
Adverse*	8	7	77	Unstable (B)

*The wind direction resulting in the highest noise level at the noise sensitive receivers was used.

Table 16: Considered Meteorological Conditions

6.3.2 Results

Predicted noise levels at the most affected noise sensitive receivers at Port Augusta for the scenarios and meteorological conditions considered are provided in Table 17 below. Noise contours are provided Figure G12 to Figure G15 in Appendix G.

	Sound Pressure Level, dB(A) re 20 X 10^{-6} Pa	
	Neutral Meteorological Conditions	Adverse Meteorological Conditions
Scenario 1 – Day (7am to 10pm)	54	58
Scenario 2 – Night (10pm to 7am)	37	42

Table 17: Predicted Noise Levels at Most Affected Noise Sensitive Receiver in Port Augusta

[32] Ibid
[33] Ibid

6.3.3 Impact Assessment

The noise limits for industrial noise are detailed in the Table 1 in Section 3.1of this report and are provided in Table 13 below for the noise sensitive receivers at Port Augusta.

Relevant Document	External Noise Criteria	
	Day (7am to 10pm)	Night (10pm to 7am)
SA EPA Policy 2007	51 dBL_{Aeq}	43 dBL_{Aeq} 60 dBL_{Amax}

Table 18: Industrial Noise Criteria for Point Lowly

Predicted noise levels at the most affected noise sensitive receivers at the Port Augusta landing site for the two scenarios and the meteorological conditions detailed in Table 16 are presented in Table 19 below.

	Sound Pressure Level dB(A) re 20 X 10^{-6} Pa	Excess (dB)	Comments
Neutral Meteorological Conditions:			
Scenario 1 – Day	54	3	Daytime noise criterion is exceeded
Scenario 2 - Night	37	0	Night-time noise criterion is met
Adverse Meteorological Conditions:			
Scenario 1 – Day	58	7	Daytime noise criterion is exceeded
Scenario 2 - Night	42	0	Night-time noise criterion is met

Table 19: Assessment of Predicted Noise Levels at Port Augusta

Discussion

The night-time scenario is predicted to meet the night time noise criterion. The daytime operation of the landing facility at Port Augusta has the potential to exceed industrial noise limits. It is predicted that the day time noise criterion will be exceeded at properties within 450 m and 750 m of the port for neutral and adverse meteorological conditions respectively.

Mitigation options are provided in Section 7.1 of this report.

6.4 Industrial Noise at the Pimba Intermodal Facility

A high level prediction has been undertaken for the Pimba Intermodal Facility at Pimba. The prediction is based on a freight train idling at a distance of 1.1 km from the nearest noise sensitive receiver. The prediction has been conducted in general accordance with the CONCAWE noise propagation model.

The criteria at the noise sensitive receivers in the vicinity of the facility are:

Daytime: 51 $dBL_{Aeq,\ 15\ minute}$

Night-time: 43 $dBL_{Aeq,\ 15\ minute}$

It is predicted that both the daytime and night-time criteria at the noise sensitive receivers will be met for the scenario considered.

If further noisy equipment or activities are expected during times when trains are shunting, then there is the risk that the criteria could be exceeded at the nearest noise sensitive receiver for some weather conditions, particularly during the night-time period.

6.5 Industrial Noise at the Port of Darwin Copper Handling Facility

At this stage predictions have not been conducted for this facility. However, as the nearest noise sensitive receivers are located at a minimum distance of 5 km, it is expected that noise associated with materials handling from the Copper Concentrate Handling Facility will be inaudible and that the criteria at the noise sensitive receivers will be met.

6.6 Industrial Noise at the Outer Harbour Sulphur Handling Facility

A high level prediction has been undertaken for the Outer Harbour Sulphur Handling Facility. The prediction is based on an 800 m conveyer to a handling facility running parallel to noise sensitive receivers and a distance of 1 km to the nearest noise sensitive receiver.

The criteria at the noise sensitive receivers in the vicinity of the facility are:

Daytime: 54 $dBL_{Aeq,\ 15\ minute}$

Night-time: 45 $dBL_{Aeq,\ 15\ minute}$

While it is predicted that the daytime criterion will be met for the scenario considered, the night-time criterion may be marginally exceeded at the most exposed noise sensitive receivers due to noise from the conveyer.

Further predictions are recommended once details of the conveyer manufacturer and location are available.

6.7 Industrial Noise from Transmission Corridors

6.7.1 Prediction of Aeolian Noise

There is the potential for winds passing across power lines (cables or wires) to produce Aeolian tones by means of vortex shedding. This noise can be highly tonal in character.

The sound level due to vortex shedding has been predicted for a range of wind speeds and number of cables. BHBP has advised that the following assumptions are to be used for the predictions:

- The closest noise sensitive receiver is at a distance of 1.1 km
- 400 m between pylons
- Cable diameter of 70 mm
- Aluminium Alloy Cables (density 2700 kg/m^3)
- Pretension 40 kN
- Wind direction is perpendicular to the length of cable

The sound level is predicted only for the vortex shedding frequency and an estimate of the typical spectrum for Aeolian tones is used, based on a 3 dB decrease for each increase in octave band. The resulting A-weighted sound pressure levels are provided in Table 20 below.

The natural frequencies of the wires are well removed for the vortex shedding frequencies, therefore resonances are not expected.

6.7.2 Results

The predicted noise levels due to vortex shedding on overhead powerlines are presented in Table 20 below.

	Predicted Sound Pressure Level, dB(A) re 20 X 10^{-6} Pa				
	Wind Speed (m/s)				
Number of Cables	**1**	**3**	**5**	**8**	**10**
1	0	0	0	15	21
2	0	0	3	18	24
4	0	0	6	21	27

Table 20: Predicted Sound Pressure Level at 1.1 km due to Powerlines

6.7.3 Impact

The night-time industrial noise criterion of 35 $dBL_{Aeq,10min}$ for rural areas, as presented in Table 1 of this report, requires a 5 dB adjustment for the tonality associated with the noise source, ie reducing the criterion to 30 dBL_{Aeq}. Based on the predicted noise levels above, the noise criterion at the nearest noise sensitive receiver (ie at 1.1 km) is achieved.

Discussion

Noise from the overhead powerlines is predicted to meet criterion at the nearest noise sensitive receiver for wind speeds up to 10 m/s (assuming up to 4 cables). At higher wind speeds, the ambient noise (due to wind) will usually mask the noise due to vortex shedding. Consequently therefore if wind speeds are greater than 10 m/s at the noise sensitive receivers the Aeolian tones are not likely to be audible over the ambient noise.

6.7.4 Pump Stations

It is predicted that industrial noise from pump stations and in particular from pump station exhaust outlets will meet the night-time (and daytime) noise criteria for rural residences if a minimum distance of 20 m is maintained between a housed pump station and noise sensitive receivers.

6.8 Blasting and Overpressure at the Olympic Dam Operation Site

Blasting overpressure and vibration predictions in accordance with *Australian Standard 2187.2*[34] are presented in Figure G16 in Appendix G.

Predicted overpressure and vibration levels at the most affected sensitive receivers in the Roxby Downs Township and at Hiltaba Village are provided in Table 21 below.

	Ground Vibration (mm/s)	Overpressure (dBL re 20 X 10^{-6} Pa)
Roxby Downs	0.5	109
Hiltaba Village	0.5	109

Table 21: Predicted Overpressure and Vibration Levels due to Blasting

Discussion

It is predicted that the blasting criteria set out in Table 2 of Section 3.1 of this report will be met at Roxby Downs and Hiltaba Village for the worst case blasting conditions as detailed in Section 5.1.1of this report[35].

[34] Ibid

[35] Note that while it is possible that the worst case predictions may occur, most blast events are expected to create lower levels of overpressure and vibration due to a lower MIC per blast hole and neutral environmental conditions.

6.9 Road Traffic Noise Impact

6.9.1 Prediction of Road Traffic Noise

Traffic counts have been conducted for feeder and distribution roads in the existing Roxby Downs Township and peak hour traffic volume predictions have been made for the most affected roads in Roxby Downs Township, following the expansion. Peak traffic conditions based on Olympic Dam activity are likely to occur in the year 2012. During this period, traffic generated will be associated with an accumulation of short term facility development contractors and long term mine workers. Predictions of the heavy vehicle traffic increase have been provided for the construction phase[36].

6.9.2 Results

Based on peak hour traffic predictions, a change in light vehicle traffic volume of up to the order of 4 times the existing traffic volumes is expected for some roads[37] during peak hours. The largest increases occur along the highway links to the north of Roxby Downs to Olympic Dam. On other distributor roads within the Roxby Downs Township, the increase is only predicted to be of the order of 2 times the existing traffic volumes.

An increase in traffic volume of in the order 4 times the existing traffic equates to an increase of up to 6 dB, such an increase in noise is predicted during peak hours on the most affected roads. An increase in the order of 2 times the existing traffic equates to an increase of approximately 3 dB.

The worst case increase in heavy vehicles is approximately 25 per day or approximately 1 truck per hour above existing heavy vehicle traffic.

6.9.3 Impact Assessment

It is expected that there will be locations north of the Roxby Downs Township where the increase in traffic may result in an increase in noise level of the order of 4 dB over the daytime period, and may also exceed the target range given in the *Road Traffic Noise Guidelines*. These locations would be considered to have exceeded criteria.

Where the traffic has doubled within the Roxby Downs Township, the increase in noise level due to traffic will be of the order of 3 dB, this is generally considered to be “just barely perceptible[38] and complies with the SA EPA requirements.

It should be noted that the increases in noise level described above are indicative and the location of the noise sensitive receivers relative to the traffic increases on particular roads will be of importance in determining specific impacts.

The change in heavy vehicle traffic due to the construction period and introduction of the rail system is expected to have an insignificant affect on the overall daytime and night-time noise levels.

6.9.4 Discussion

In locations where road traffic noise has increased by 4 dB or more at noise sensitive receivers and is also exceeding the upper target noise levels provided in the *Road Traffic Noise Guidelines*, then all reasonable and practicable measures should be undertaken to mitigate the road traffic noise. Mitigation options are provided in Section 7.8. The area where it is expected that this may occur is along the highway links to the north of Roxby Downs to Olympic Dam.

At this stage specific predicted road traffic volumes are not available. Once this information becomes available a detailed noise assessment can be conducted and specific mitigation options determined.

If traffic noise levels have significantly increased but are still considered to be typical for the environment, then acoustic treatment may not be required.

[36] Via email from Senior HSEC Advisor, dated 7 February 2007
[37] Communication with Arup Transport
[38] M D Egan, Architectural Acoustics, 1998 McGraw Hill

It should be noted that traffic volumes on small residential streets (ie roads that are not distributor or feeder roads) are not expected to significantly increase and therefore noise levels are likely to remain at a similar level as existing.

6.10 Rail Noise Impact

6.10.1 Prediction of Rail Noise

Airborne rail noise predictions have been undertaken for the proposed rail alignment using the maximum predicted rail traffic flows for the expanded operation. These predictions have been made using the acoustic software package SoundPLAN version 6.4 which implements the Nordic Rail Traffic Noise Prediction Methodology[39]. This methodology predicts both the sound pressure level and L_{Amax} noise levels for railways and takes into account:

- Topography
- Ground Absorption
- Barriers/Screening

Inputs to the acoustic model for the prediction of airborne noise from the railway have been provided by Arup Rail[40] and are as follows:

- Trains are expected to travel at a maximum speed of 110 km/h
- Maximum consist length of 1800 m
- 4 scheduled train movements per day (24hr operation)
- It is expected that a 4400 hp locomotive will run on the railway
- There will be up to 3 locomotives for each 1800 m train

Noise levels for a 4400 hp locomotive at a distance of 10 m have been estimated using the predictive model detailed in the Rail Noise Database[41] prepared for Rail Access Corporation[42] and are presented in Table 22 below.

Description	dB(A)	Octave Band Sound Pressure Level at 10 m (dB re 20X 10^{-6} Pa)							
		63	125	250	500	1k	2k	4k	8k
4400 hp Diesel Locomotive L_{Amax}	87	86	81	81	80	85	80	75	75
4400 hp Diesel Locomotive $L_{Aeq, 9\ hour}$	65	64	63	63	60	59	59	52	52

Table 22: 4400 hp Diesel Locomotive Sound Pressure Levels at 10 m

6.10.2 Results

Contours for rail noise in the vicinity of Roxby Downs and Woomera are presented in Figure G18 to Figure G21 in Appendix G. Hiltaba Village is 15 km further from the railway than Roxby Downs and therefore noise levels at this location will be lower than the noise levels predicted for Roxby Downs.

The predicted noise levels for the most affected receivers adjacent to the additional railway are presented in Table 23 below.

Receiver Location	Sound Pressure Level (dB re 20 X 10^{-6} Pa)	
	$L_{Aeq,24\ hour}$	L_{Amax}

[39] Kilde, *Nordic Rail Traffic Noise Prediction Method*, Nordic Council of Ministers 1984
[40] Communication with Arup Rail, dated to 13 November 2006
[41] Wilkinson Murry Ptd Ltd, *Rail Noise Database: Stage 2 Noise Measurement and Analysis*, 2001
[42] Rail Access Corporation (now Railcorp) is one of four rail entities in NSW, Australia

Roxby Downs	35	40
Purple Downs Homestead	34	40
Woomera	36	45

Table 23: Predicted Rail Noise Levels at Receivers at Roxby Downs and Woomera

In addition to the proposed railway from Pimba to Roxby Downs, a worst case increase from 20 trains per day to 23 - 26 trains per day is predicted for the existing rail system connecting Port Adelaide to Pimba which is predicted to increase overall $L_{Aeq,\ 24\ hour}$ noise level at noise sensitive receivers by the order of 2 dB. The L_{Amax} at noise sensitive receivers is unaffected by additional trains.

6.10.3 Impact Assessment

The noise criteria for rail noise are detailed in Section 3.4 of this report and are also provided below.

- 60 $dBL_{Aeq(24hr)}$
- 85 dBL_{Amax}

It is predicted that the rail noise criteria will be met at the noise sensitive receivers at Roxby Downs, Hiltaba Village, Purple Downs and Woomera for the proposed rail system from Pimba to Roxby Downs, as detailed in Section 5.3 of this report.

Vibration and groundborne noise from the proposed rail alignment is not expected to be perceptible at noise sensitive receivers at Roxby Downs, Hiltaba Village, and The Purple Downs Homestead due to the large distances between the rail and the closest receivers.

The increase in overall $L_{Aeq,\ 24\ hour}$ noise level due an increase in rail traffic of 3 to 6 trains with respect to the existing 20 trains using the existing rail system connecting Pimba to Port Adelaide is considered to be insignificant.

Discussion

The predicted rail noise levels meet the noise limits at the noise sensitive receivers at Roxby Downs, Hiltaba Village, The Purple Downs Homestead and Woomera.

Receivers adjacent to existing railway are not likely to notice adverse affects due to the increase in rail traffic.

6.11 Aircraft Noise

6.11.1 Prediction

Predictions of aircraft noise have been undertaken for the proposed airstrip in accordance with *Australian Standard 2021*[43] and the methodology recommended in the *Roxby Downs Proposed Airport Preliminary Noise Study*[44]. The assumptions used are provided in the *Roxby Downs Proposed Airport Preliminary Noise Study* dated September 2005. These assumptions are:

- Boeing 737 or A300 series aircraft type
- Three scheduled flights on weekdays
- No scheduled flights between 10 pm and 7 am

6.11.2 Results

Aircraft noise from the proposed airstrip has been assessed in accordance with *Australian Standard 2021* for airports without ANEF curves. The result is that the take-off and landing noise levels at noise sensitive receivers at Roxby Downs and Hiltaba Village are considered to 'acceptable' and therefore do not require additional acoustic attenuation.

[43] libid
[44] Airport technical Services Pty Ltd, *Roxby Downs Proposed Airport – Preliminary Noise Study*. November 2005

The 65 dB(A) single event contour shown in the *Roxby Downs Proposed Airport Preliminary Noise Strategy* report has been relocated to the proposed airstrip and is presented in Figure G1 in Appendix G. The location of residences associated with Roxby Downs and Hiltaba Village are outside this contour and therefore, according to the methodology in the *Roxby Downs Proposed Airport Preliminary Noise Strategy*, do not require additional acoustic treatment.

6.11.3 Impact Assessment

Aircraft noise is predicted to be 'acceptable' at noise sensitive receivers at Roxby Downs and Hiltaba Village based on the methodology in *Australian Standard 2021*[45]. In addition to this, noise sensitive receivers are located outside the 65 dB(A) noise contour as per the methodology in *the Roxby Downs Proposed Airport Preliminary Noise Strategy*.

Discussion

Both of the criteria proposed are predicted to be met by the aircraft types expected to use the proposed airstrip. As the acoustic criteria are predicted to be met, additional acoustic treatment will not be required.

6.12 Implications with Respect to OH&S (Noise) Regulations

The OH&S (Noise) Regulations are detailed in Section 3.6 of this report and presented below.

The exposure standard is

a) an eight hour equivalent continuous A-weighted sound pressure level $L_{Aeq,8h}$ of 85 dB referenced to 20 micropascals and

b) a C-weighted peak sound pressure level $L_{C,peak}$ of 140 dB referenced to 20 micropascals

Note: Shifts longer than 8 hours have a lower exposure standard. It has been advised that the shifts at the Olympic Dam operation site are usually 12 hours. The equivalent criteria are provided below.

a) a twelve hour equivalent continuous A-weighted sound pressure level $L_{Aeq,12h}$ of 83 dB referenced to 20 micropascals and

b) a C-weighted peak sound pressure level LC,peak of 140 dB referenced to 20 micropascals

To determine the implication of noise with respect to the OH&S (Noise) Regulations the noise levels measured at the existing Olympic Dam operation site and the predicted noise levels for the expanded operation have been considered.

In the existing operation that will continue to be used BHP Billiton staff are generally concentrated in the Refinery, the Smelter and the Hydromet areas of the existing processing plant and it is expected that this will be the same for the additional processing plant. It is also expected that staff operating mobile machinery will be in cabins. Other staff locations have not been identified at this time. Based on measurements conducted previously (see section 4.4), the amount of time that can be spent in certain areas for either an 8-hour shift or a 12-hour shift and comply with the OH&S noise regulations is provided in the Table 19 below. It should be noted that there will be additional areas in the expanded operation to be assessed.

Location	Maximum exposure time for 8-hour shift.[Note 1, Note 2, Note 3] (hours)	Maximum exposure time for 12-hour shift.[Note 1, Note 2, Note 3] (hours)
Anode Casting	Full shift	Full shift
Level 2, Smelter (launder system)	2.5	1.7

[45] Ibid

Level 2, Electric Furnace (@2 m)	3.1	2.1
Level 3, Smelter	2	1.3
Level 4, Smelter	2	1.3
Level 5 Smelter	6.3	4.1
Mobile machinery cabins	Full shift	Full shift

Table 24: Maximum Exposure times for OH&S (Noise) Regulations

Note 1: On the basis that for the rest of the shift the staff member is only exposed to noise levels less than 75 dB (A) for an 8 hour shift and 73 dB(A) for a 12 hour shift.

Note 2: Times of exposure will be less for shifts longer than the exposure time indicated.

Note 3: Values have been rounded down to one decimal place in order to be conservative.

Note 4: The information provided above assumes that hearing protection is not used.

Note 5: L_{Cpeak} measurements all complied with the maximum value of 140 dB.

Note 6: The noise levels measured represent a “snapshot” in time and may vary under different operational situations. It should also be noted that hearing protection requirements are established for the Smelter 2 facility, requiring the mandatory use of hearing protection at all times.

Note 7: Manufacturer’s noise levels for inside cabins of mobile machinery comply with OHS requirements for a 12 hour shift. This assumes truck drivers are not in noisy areas for the rest of the shift.

By careful planning during the design process of the expanded operation, exceedance of the exposure standard should be avoided. However, where the predicted noise levels result in the exposure standard being exceeded courses of action will need to be employed. These are detailed in Section B4 of Appendix B.

7 In Principle Noise Controls

7.1 Industrial Noise at Olympic Dam Operation Site

7.1.1 Olympic Dam Operation

The predicted noise levels exceed the night time noise limit for the temperature inversion scenario by the order of 3 dB at Roxby Downs. The significant noise sources contributing to the excesses are:

- CAT 797B reverse alarms at the RSF extents
- CAT 797B dumping noise at the RSF extents
- CAT 797B engine/operating noise at the RSF extents

Options for noise controls include:

(i) Reversing Alarms

Timing – the excesses only occur during the night time periods temperature inversion meteorological conditions. Avoiding operation during these times would eliminate this noise source.

Location – the reversing alarms, operating at the southern extents of the RSF, contribute to the excesses at noise sensitive receivers. If it were possible to relocate operations to the north extents of the RSF during night time for temperature inversion meteorological conditions, then the noise impact at noise sensitive receivers due to this noise source will be reduced.

Quieter Alarms – The noise level used in the acoustic model for the CAT 797B is based on a sound pressure level of 116 dB at 1.2 m at 1000 Hz which is at the high end of the range for reverse alarms. If these alarms had a lower setting that was used during times of temperature inversion meteorological conditions, it would reduce the impact of this noise source.

Frequency Content – altering the frequency content from 1000 Hz to 2000 Hz would reduce the noise level due to reversing alarms at the noise sensitive receivers due to an increase in air absorption.

(ii) Dumping

Location – dumping of mine rock at the southern extents of the RSF, contribute to excesses to the noise limit at the most exposed noise sensitive receivers. If it were possible to relocate this operation to the north extents of the RSF during the night time period for meteorological conditions for which an excess is predicted, then the noise impact at noise sensitive receivers due to this noise source will be reduced.

(iii) Mobile Machinery

Noise levels used in the acoustic model for the CAT 797 B, have been provided by the manufacturers. At particular locations these items contribute significantly to the noise levels at the noise sensitive receivers. Attenuating the noise sources associated with this machinery would reduce the noise impact at noise sensitive receivers due to these noise sources. It is expected that noise reductions associated with this machinery of up to the order of 10 dB may be achievable. This would require a study to determine the specific noise sources associated with the machinery and appropriate attenuation which would not adversely affect the operation of the machinery. Prototypes would need to be constructed and tested. Mitigation measures applied to the CAT 789C haul trucks at Mt Arthur have been shown to reduce the noise level of the CAT 789 C by the order of 13 dB lower than the un-attenuated A-weighted levels[46]. It is noted that this was achieved 'with no impediment to the truck's cooling system.

[46] GHD, Worlds Quietest Truck, www.ghd.com.au/aptrixpublishing.nsf/AttachmentsByTitle/CS+QuietTruck+PDF/$FILE/quietest_truck_A4.pdf

Approach for Implementing Noise Control

Excesses are only predicted to occur during temperature inversions which are not common. Therefore, to avoid unnecessarily relocating equipment or implementing attenuation to reduce noise levels, it is recommended that permanent noise monitors be set up in the vicinity of the most exposed noise sensitive receivers. Data from these monitors can be fed to mine management controls where the noise levels could be monitored. Should the noise levels exceed the noise limits then the appropriate personnel would be alerted and preventative actions could be taken as described above.

Scenario of Noise Attenuation to Meet Noise Criteria

There are many scenarios of noise attenuation to meet the noise criteria for all of the meteorological conditions considered. Workable solutions at the Olympic Dam expansion need to be determined. One option that will meet all limits is presented below:

- Reversing alarms adjusted to be 5 dB above the overall truck noise (alarm operating at 1000 Hz).
- A minimum of 10 dB attenuation for CAT 797, CAT 793 or CAT 785 trucks that are operating on the southern RSF (or within 8.5 km of the Roxby Downs Township extents).

This scenario of noise attenuation is predicted to achieve a noise level reduction of the order of 3 dB at Roxby Downs. The predicted noise level is 40 dB at Roxby Downs during a temperature inversion.

It is predicted that this mitigation scenario would only be required during a temperature inversion (which are only expected during the night-time period). Noise monitoring should be conducted during temperature inversions to confirm that mitigation is required.

7.2 Industrial Noise at Point Lowly

The noise levels predicted for the desalination plant at Point Lowly comply with the limits at the most exposed noise sensitive receivers. Consequently no additional acoustic treatment will be required.

7.3 Industrial Noise at Port Augusta Landing Facility

Noise barriers are unlikely to be acceptable or effective for the Landing Facility. Therefore it is recommended that timing of operation should be considered carefully and should include consultation to the affected properties.

It would be possible to achieve suitable indoor noise levels by treating the most affected houses. It may be possible to explore this approach with the SA EPA and residents.

7.4 Industrial Noise at Pimba Intermodal Facility

High level calculations, based on the information currently available, predict that the noise levels for the Intermodal Facility at Pimba comply with the noise limits at the most exposed noise sensitive receivers.

7.5 Industrial Noise at the Port of Darwin Copper Handling Facility

It is expected that noise levels for the Copper Concentrate Handling Facility at the Port of Darwin will comply with the noise limits at the most exposed noise sensitive receivers. Consequently no acoustic treatment will be required.

7.6 Industrial Noise at the Outer Harbour Sulphur Handling Facility

High level calculations predict that the conveyer at Outer Harbour could exceed the night-time criterion for noise sensitive receivers. Therefore it is recommended that mitigation should be investigated for the design of the conveyer. Methods of mitigation for conveyers include:

- Low-noise idlers;
- Cladding;
- Sound absorptive surface lining;
- Vibration isolation;
- Panel dampening coatings; or
- Noise barriers.

A combination of the above noise mitigation techniques may be the most efficient way to achieve criterion.

7.7 Industrial Noise from Powerlines

The predicted noise levels due to aeleon tones meet the night-time noise limit for wind speeds up to 10 m/s (assuming 4 cables). At higher wind speeds, the ambient noise (due to wind) will usually mask the noise due to vortex shedding. Consequently therefore if wind speeds are greater than 10 m/s at the noise sensitive receivers the Aeolian tones are not likely to be audible over the ambient noise.

7.8 Road Traffic Noise

At this stage, specific predicted noise level due to traffic noise has not been determined. While a detailed study of road traffic noise is required, options for noise control include:

- Low noise road surface finishes
- Reduced speed limits
- Noise attenuation barriers/noise mounds
- Acoustic treatment to houses adjacent to roads
- Increasing the distance between houses and roads (during design)

7.9 Rail

The noise and vibration levels predicted for Rail comply with the limits at noise sensitive receivers at Roxby Downs, Hiltaba Village, Woomera and The Purple Downs Homestead. Consequently no additional acoustic treatment will be required.

7.10 Aircraft Noise

The noise levels predicted for aircraft taking off from and landing at the air strip adjacent to the Andamooka Road will comply with the noise criteria for aircraft noise at noise sensitive receivers. Consequently no additional acoustic treatment will be required.

7.11 OH&S (Noise)

Refer to Section 6.12.

8 Summary

The following information has been provided in this report:

- Identification of existing and proposed noise and vibration sources
- Relevant acoustic criteria
- Results of acoustic measurements
- An acoustic model of the existing Olympic Dam operation site
- Acoustic models of the proposed Olympic Dam expansion
- Impact Assessment
- 'In Principle' options for noise control

Relevant acoustic criteria for the site have been determined. In some cases these are regulatory and in other cases they are guidelines. Arup Acoustics staff has had significant interaction with the SA EPA in confirming the criteria presented in this report.

For industrial noise, more onerous criteria (noise limit less 5 dB) is required for new developments such as the expanded operation at Olympic Dam. The SA EPA has advised that the reasons for this are:

- It reflects the increased sensitivity of people to newly introduced noise sources
- Noise policy levels represent a compromised level of amenity and therefore it is not an ideal planning approach. The 'minus 5 approach' addresses this.

It should be noted that noise from the existing operations is expected to be insignificant with respect to the expanded operations.

Arup Acoustics staff spent 14 days onsite with BHP Billiton staff identifying noise and vibration sources and conducting acoustic and vibration measurements for existing operations. The results from these measurements form the basis for an acoustic model of the area. The acoustic model has predicted to within 5 dB of the measured noise levels.

This section of the EIS report is part of a pre-feasibility study and the information and assumptions in this report were the most accurate at the time of preparation. Any changes to the information or the assumptions detailed in this report may affect the results and outcomes that have been presented.

8.1 Industrial

Industrial noise from the Olympic Dam operation site is predicted to:

- Exceed the night-time criterion at Roxby Downs during temperature inversions
- Comply with all other daytime and night-time noise criteria at Roxby Downs and Hiltaba Village

Industrial noise from the Sulphur Handling Facility at Outer Harbour is predicted to:

- Exceed the night-time criterion at the nearest noise sensitive receiver.
- Meet the daytime criterion at the nearest noise sensitive receiver.

Industrial noise from the Desalination Plant at Point Lowly, the Copper Concentrate Handling Facility at Port of Darwin and the Intermodal Facility at Pimba is predicted to:

- Comply with the daytime and night-time noise limits for the scenarios and meteorological conditions considered.

Mitigation options considered to achieve the industrial noise criteria include:

- Management of use of reversing alarm noise (including location of equipment), the noise level of alarm and the frequency content of the alarm

- Management of use of the air horn noise, reduction of the noise level, frequency content, use of alternative alarm systems, use of active noise levels
- Scheduling of active dump points and other activity on the RSF at the Olympic Dam operation site
- Attenuation of the mobile machinery
- Possible mitigation of the conveyer at Outer Harbour

Permanent noise monitoring is recommended at the Olympic Dam operation site to identify when noise limits are being exceeded and action to reduce the noise levels are required.

Vibration associated with industrial activities including blasting is predicted to meet the vibration criteria.

8.2 Road Traffic Noise

In locations where the increase in traffic causes an increase in noise level of the order of 4 dB over the daytime period, and also exceeds the target range given in the *Road Traffic Noise Guidelines*, the following options for noise control can be considered:

- Road surface finishes
- Speed Limits
- Noise attenuation barriers/noise mounds
- Acoustic treatment to houses adjacent to roads
- Increasing the distance between houses and roads

8.3 Rail

Rail noise has been predicted to achieve the criteria set by the SA EPA at noise sensitive receivers at Roxby Downs, Hiltaba Village, Woomera and The Purple Downs Homestead and is expected to have an insignificant affect on noise levels due to additional rail traffic experienced by receivers adjacent to the existing rail system.

Vibration associated with the proposed rail is not expected to exceed criteria due to the significant distance between the location of the rail and the noise sensitive receivers.

8.4 Aircraft

Residences at Roxby Downs and Hiltaba Village, are considered to be 'acceptable' according to *Australian Standard 2021 Acoustics – Aircraft noise intrusion – Building siting and construction* and therefore will not require additional acoustic treatment.

Noise sensitive receivers are located outside the 65 dB(A) single event contour for the proposed airstrip. They therefore comply with the acoustic criteria for aircraft noise.

8.5 OH&S (Noise)

The cabins or control rooms for all mobile machinery proposed for the Olympic Dam expansion comply with OH&S noise criteria for a 12 hour shift. This assumes that operators are not in noisy areas for the rest of the shift.

Opportunities to plan the expanded operation to meet the required exposure standard exist. As workers will operate in a number of areas for various durations of time, these details will need to be considered in the design of the expanded operation.

FIGURES

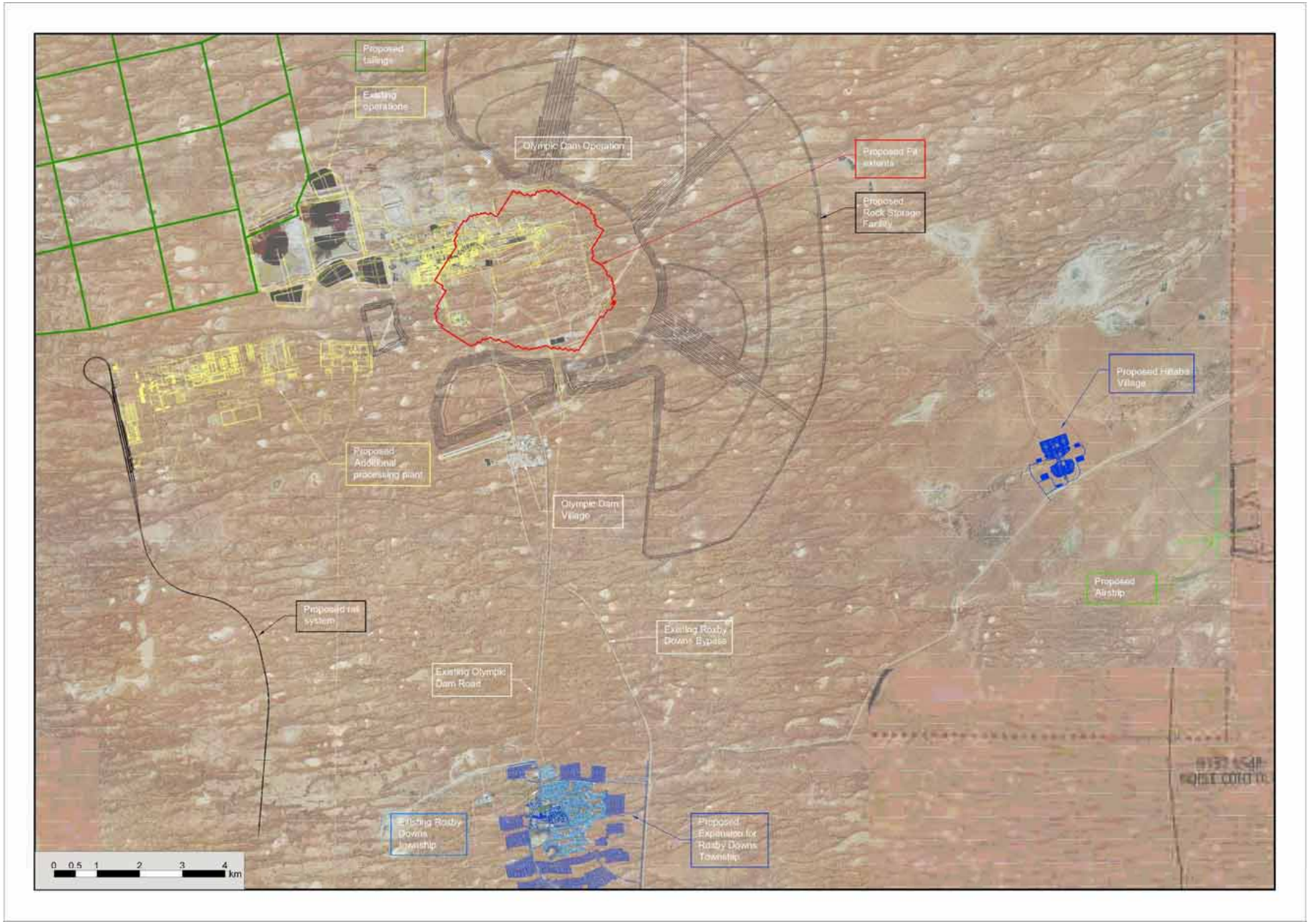

Figure 1: Olympic Dam Operation and Surrounding Area

Figure 2: Olympic Dam Expansion, South Australia

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Appendix A

Acoustic Terminology

DECIBEL

The ratio of sound pressures which we can hear is a ratio of 10^6 (one million:one). For convenience, therefore, a logarithmic measurement scale is used. The resulting parameter is called the 'sound pressure level' (L_p) and the associated measurement unit is the decibel (dB). As the decibel is a logarithmic ratio, the laws of logarithmic addition and subtraction apply.

dB(A)

The unit generally used for measuring environmental, traffic or industrial noise is the A-weighted sound pressure level in decibels, denoted dB(A). An A-weighting network can be built into a sound level measuring instrument such that sound levels in dB(A) can be read directly from a meter. The weighting is based on the frequency response of the human ear and has been found to correlate well with human subjective reactions to various sounds. It is worth noting that an increase or decrease of approximately 10 dB corresponds to a subjective doubling or halving of the loudness of a noise, and a change of 2 to 3 dB is subjectively barely perceptible.

dB(C)

The unit used for measuring occupational health and safety maximum industrial noise levels in Australia is the C-weighted sound pressure level in decibels, denoted dB(C). C-weighting has a relatively flat response when compared to an A-weighting network.

EQUIVALENT CONTINUOUS SOUND LEVEL

The equivalent continuous sound level, L_{eq} is a notional steady level which would, over a given period of time, deliver the same sound energy as the actual time-varying sound over the same period. Hence fluctuating levels can be described in terms of a single figure.

FREQUENCY

The rate of repetition of a sound wave. The subjective equivalent in music is pitch. The unit of frequency is the Hertz (Hz), which is identical to cycles per second. One thousand hertz is often denoted kHz, eg 1 kHz = 1000 Hz. Human hearing can range approximately from 20 Hz to 20 kHz. For design purposes, the octave bands between 63Hz to 8kHz are generally used. The most commonly used frequency bands for environmental noise are octave bands, in which the mid frequency of each band is twice that of the band below it. For more detailed analysis, each octave band may be split into three one-third octave bands or in some cases, narrow frequency bands.

GROUNDBORNE NOISE

The transmission of noise energy as vibration of the ground. The energy may then enter building elements and become structureborne noise.

SOUND POWER

The sound power level (L_w) of a source is a measure of the total acoustic power radiated by a source, unlike the sound pressure level which varies as a function of distance from a source. The sound power level is an intrinsic characteristic of a source (analogous to its volume or mass), which is not affected by the environment within which the source is located.

STATISTICAL NOISE LEVELS

For sound levels of noise that vary widely with time, such as road traffic noise, it is necessary to employ an index which allows for this variation. The L_{10} is the sound pressure level exceeded for ten percent of the time period under consideration and has been adopted in Australia for the assessment of road traffic noise. The L_{90} is the sound pressure level exceeded for ninety percent of the time is generally adopted to represent the background noise level. The L_1, the sound pressure level exceeded for one percent of the time, is representative of the maximum levels recorded during the sample period. A-weighted statistical noise levels are denoted L_{A10}, dBL_{A90} etc. The reference time period (T) is normally included, eg $dBL_{A10,\ 5min}$ or $dBL_{A90,\ 8hr}$.

STRUCTUREBORNE NOISE

The transmission of noise energy as vibration of building elements. The energy may then be re-radiated as airborne noise. Structureborne noise my be reduced by structural discontinuities, ie expansion joints and floating floors.

VIBRATION

Vibration may be expressed in terms of displacement, velocity and acceleration. Velocity and acceleration are most commonly used when assessing structureborne noise or human comfort respectively. Vibration amplitude may be quantified as a peak value, or as a root mean squared (rms) value.

Vibration amplitude can be expressed as an engineering unit value eg $1mms^{-1}$ or as a ratio on a logarithmic scale in decibels:

$$\text{vibration velocity level} = 20 \log (V/V_{ref}) \text{ (dB)}.$$

where the preferred reference level, V_{ref}, for vibration velocity = 10^{-9} m/s.

The decibel approach has advantages for manipulation and comparison of data.

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Appendix B

Legislation and Guidelines

B1 Industrial Noise

B1.1 South Australia Environment Protection (Noise) Policy 2007

Noise criteria for a new development are provided in Part 5, Development authorisation applications, Clause (3) of the SA EPP. The criteria are detailed below.

A predicted source noise level (continuous) for a new development should not exceed the relevant indicative noise level less 5 dB.

The indicative noise level can be following method:

(i) For cases where the proposed noise source falls into one of the categories in the Table B1 and the noise sensitive receiver falls within this same category, then the indicative noise level is equal to the indicative noise factor in Table B1.

(ii) For all other cases, the indicative noise level is equal to the indicative noise factor in Table B2.

Land use category	Indicative noise factor (dB(A))	
	Day (7am – 10pm)	Night (10pm – 7am)
General Industry	65	65
Special Industry	70	70

Table B 1: Indicative Noise Factor with respect to point (i) above

Land use category	Indicative noise factor (dB(A))	
	Day (7am – 10pm)	Night (10pm – 7am)
Rural Living	47	40
Residential	52	45
Rural Industry	57	50
Light Industry	57	50
Commercial	62	55
General Industry	65	55
Special Industry	70	60

Table B 2: Indicative Noise Factor with respect to point (ii) above

Notes:

1. If the land uses for the noise source and the noise sensitive receiver fall within a single land use category, the indicative noise level for the noise source is the indicative noise factor for that land use category.
2. If the land uses noise source and the noise sensitive receiver do not all fall within a single land use category, the indicative noise level for the noise source is the average of the indicative noise factors for the land use categories within which those land uses fall.
3. If the noise from the noise source contains characteristics, the source noise level (continuous) must be adjusted in the following way:

- addition of 5 dB for one characteristic
- addition of 8 dB for two characteristics
- addition of 10 dB for 3 or 4 characteristics

It should be noted that the indicative noise levels for Point Lowly, Port Augusta and Pimba have been determined using the method detailed in Note 2. The indicative noise level is the rounded average of *General Industry* and *Rural Living*, less 5 for a new development. The indicative noise level for Outer Harbour is the rounded average of *General Industry* and *Residential*, less 5 dB for a new development.

The predicted source noise level should be assessed with respect to the indicative noise level, assuming that measurement is to be taken in accordance with this policy, as generally detailed below:

- A microphone height of 1.2 m to 1.5 m above ground level
- A distance of at least 3.5 m from any vertical acoustically reflective surface
- A wind shield installed
- Wind velocity not to exceed 5 m/s

B1.2 World Health Organization Guidelines

The World Health Guidelines provide a table of guidelines values for community noise in specific environments. Environments including in this table that may be relevant to the Olympic Dam expansion are provided in Table B3 below.

Specific Environment	Critical Health Effect(s)	L_{Aeq} (dB(A))	Time Base (hours)	L_{Amax} fast (dB)
Outdoor living area	Serious Annoyance, daytime and evening	55	16	-
	Moderate annoyance, daytime and evening	50	16	-
Dwelling, indoors	Speech intelligibility and moderate annoyance, daytime and evening	35	16	
Inside bedrooms	Sleep disturbance, night-time	30	8	45
Outside bedrooms	Sleep disturbance, window open (outdoor values)	45	8	45
Industrial commercial shopping and traffic areas, indoors and outdoors	Hearing impairment	70	21	110

Table B 3:WHO Guideline Values for Community Noise in Specific Environments

B2 Road Traffic Noise

Legislation for road traffic noise limits do not exist in South Australia. The document relevant to road traffic noise is *The Department for Transport, Energy and Infrastructure – Road Traffic Noise Guideline*

The outdoor target noise levels in the guidelines are:

Time Period	Target Noise Level Range (dBL_{Aeq})	
L_{eq} daytime (7am to 10pm)	55	65
L_{eq} night-time (10pm to 7am)	50	60

Table B 4: Outdoor Target Noise Levels for Road Traffic Noise

Generally, where a receiver or group of receivers are not currently exposed to traffic noise, then the lower end of the range is used. For noise sensitive land uses with some exposure to existing traffic noise, and outdoor target is selected according to the level of current exposure. For the situation of noise sensitive land uses already exposed to high levels of traffic noise (above the target range), then the higher end of the range is used.

Generally, target noise levels can be determined as follows:

- If existing noise levels are less than 53 dBL_{Aeq} day and 48 dBL_{Aeq} night, then the targets are 55 dBL_{Aeq} day and 50 dBL_{Aeq} night.
- If existing noise levels are less than 63 dBL_{Aeq} day and 58 dBL_{Aeq} night, then the targets are the existing noise level plus 2 dB.
- If existing noise levels are greater than 63 dBL_{Aeq} day and 58 dBL_{Aeq} night, then the targets are 65 dBL_{Aeq} day and 60 dBL_{Aeq} night.

Noise levels are to be predicted or measured outside a position 1 metre from the most exposed window at a height of 1.5 metres above floor level for each noise sensitive receiver. Predicted noise levels at this location are to include a façade reflection factor of +2.5 dB.

Each level of a multi-storey dwelling or building should be considered separately when predicting noise levels for comparison against target noise criteria.

All reasonable and practicable measures should be considered to achieve the target noise levels.

The target noise levels and the predicted noise levels are generally to be taken to be at 10 years after the opening with the proposed changes to the road network implemented, although a longer planning horizon such as 15 years should be used if there will be a significant change to noise levels in the future. It is, however, noted that this approach is not appropriate for the Olympic Dam expansion where traffic volumes are predicted to be at a maximum shortly after and during the expansion (ie during a construction phase) after which, traffic volumes are predicted to decrease[47].

[47] Arup, *BHPB Olympic Dam Global Concept Traffic Management Plan*, October 2007

B3 Aircraft Noise

B3.1 Australian Standard 2021-2000

Australian Standard AS2021*Acoustics – Aircraft Noise Intrusion – Building Siting and Construction*[48] is used to assess building site acceptability for aircraft takeoff and landing in Australia and provides information with respect to the type of building construction necessary to achieve a given noise reduction. Application of this standard should be considered for buildings located within 10 km of the Olympic Dam airstrip. Details of this document are presented below:

- Residential buildings area acceptable without construction to provide protection specifically against aircraft noise when located in areas outside the 20 ANEF noise contour.
- Residential buildings are conditionally acceptable when located in areas 20 to 25 ANEF (constructions will need to provide protection against aircraft noise)
- Residential buildings are unacceptable when located in areas > 25 ANEF (construction of residential buildings should not normally be considered).

B3.2 Preliminary Airport Noise Study

It should be noted that the use of ANEF curves has been discussed in the *Roxby Downs Proposed Airport Preliminary Noise Study*[49] and an alternative criterion is proposed to take into consideration the small number of flights to and from the airport. The relevant discussion in this report is summarised below:

Because the ANEF is a summation of the total noise over an average day, when applied at airstrips with only small numbers of aircraft movements, the results are less than satisfactory, in that the ANEF contours barely go beyond the extent of the airport, whereas it is known aircraft noise will be heard over a far greater area and will, in some situations, be considered intrusive.

Initial information suggests the new Roxby Downs airport will receive in the order of 3 flights per day by Regular Public Transport (RPT) aircraft service. The 3 landings and 3 takeoffs per day (a total of 6 movements) by the critical aircraft will not be enough to expand the area covered by the ANEF contours to effectively describe the areas subject to potential adverse noise. This would still be that case even if the number of predicted movements were increased well above the likely growth rate.

An alternative is to plot the aircraft noise as a single noise level event contour, superimposed on the aircraft flight paths. Typically the 70 dB(A) contour has been used in studies undertaken by Department of Transport and Regional Services, as it is equivalent to a single event level of 60dB(A) specified in the Australian Standard 2021, as the accepted indoor design sound level for normal domestic dwellings. (An external single noise event will be attenuated by approximately 10 dB(A) by the fabric of a house with open windows) An internal noise level above 60 dB(A) is likely to interfere with conversation or listening to the television.

Roxby Downs presents a unique situation, where the nearby residents are likely to receive lower ambient noise levels than their city counterparts. They would also be clear of noise emanating from the existing airport. Some experience has shown that communities which are newly-exposed to aircraft noise (e.g. as a result of the construction of new runways, or the redesign of flight paths near an airport) tend to be more sensitive to such noise than communities which are accustomed to it. Source Australian Standard 2021

[48] Ibid
[49] Ibid

In the discussion paper "Expanding Ways to Describe and Access Aircraft Noise" AirServices Australia generally considered areas likely to be affected by aircraft noise commencing at 10 noise events per day of greater than 70 dB(A). For the purpose of this study, a lower threshold of 65 dB(A) has been adopted, given the absence of existing noise, the low ambient levels and the likely high number of residents working night shifts.

Australian Standard 2021-2000 also states that 50 dB(A) is the accepted standard for sleeping areas and lounges of domestic dwellings. Allowing for a 15 dB(A) attenuation by a building with closed windows, suggests that a 65 dB(A) noise contour is appropriate for the Roxby Downs Township.

B4 Occupational Health and Safety (Noise)

The relevant regulation for occupational noise exposure is the *South Australian Occupational Health, Safety and Welfare Regulations 1995* along with the *Occupational Health and Safety Welfare Variation Regulations 2004* which comes under the *Occupational Health, Safety and Welfare Act 1986*.

The exposure standard described in the documents above is:

(a) an eight hour equivalent continuous A-weighted sound pressure level L_{Aeq8h} of 85 dB referenced to 20 micropascals and

(b) a C-weighted peak sound pressure level $L_{C,peak}$ of 140 dB referenced to 20 micropascals

An employer must ensure that no employee at the workplace is exposed to noise that exceeds the exposure standard by implementing the following control measures

(c) if practicable, the employer must eliminate the source of noise to which an employee is exposed

(d) if it is not practicable to eliminate the source of the noise, the employer must reduce the exposure of the employee to noise, so far as is practicable, by:

(i) substituting quieter plant or processes or

(ii) using engineering controls

(e) If an employee is still exposed to noise that exceeds the exposure standard after the employer has complied with paragraph (b) the employer must reduce the exposure of the employee to noise, so far as is practicable, by the use of administrative controls.

(f) if an employee is still exposed to noise that exceeds the exposure standard after the employer has complied with paragraphs (b) and (c), the employer must provide hearing protectors to reduce the exposure of the employee to noise, so that it does not exceed the exposure standard.

"**engineering controls**" means:

- isolating plant by enclosures or barriers or the use of vibration isolation mountings;
- any other physical control designed to reduce the generation or transmission of noise

but does not include any administrative control or the use of hearing protectors.

"**administrative control**" means:

- increasing the distance of employees from sources of noise
- limiting the entry of employees into areas in which their exposure to noise may exceed the exposure standard
- reducing the duration of employees' exposure to noise
- any other system of work designed to reduce exposure to noise

but does not include any engineering control or the use of hearing protectors.

"**hearing protector**" means:

a device that is designed to protect a person's hearing and that

- is inserted into the ear canal; or
- covers the ear canal entrance; or
- covers the entire ear.

B5 Construction Noise

The *SA EPA* Policy *2007, Part 6 – Special noise control provisions, Division 1 – Construction noise* states that:

1) The following provisions apply to construction activity resulting in noise with an adverse impact on amenity:

(a) subject to paragraph (b), the activity

(i) must not occur on a Sunday or other public holiday

(ii) must not occur on any other day except between 700 and 1900 hours

(b) a particular operation may occur during these times:

(i) to avoid an unreasonable interruption of vehicle or pedestrian traffic movement; or

(ii) if other grounds exist that the Authority or another administering agency determines to be sufficient.

(c) all reasonable and practicable measures must be taken to minimise noise resulting from the activity and to minimise its impact including (without limitation)

(i) commencing any particularly noisy part of the activity (such as masonry sawing or jack hammering) after 9:00 hours and

(ii) locating noisy equipment (such as masonry saws or cement mixers) or processes so that their impact on neighbouring premises is minimised (whether by maximising the distance to the premises, using structures or elevations to create barriers or otherwise); and

(iii) shutting or throttling equipment down whenever it is not in actual use and;

(iv) ensuring that noise reduction devices such as mufflers are fitted and operating effectively; and

(v) ensuring that equipment is not operated if maintenance or repairs would eliminate or significantly reduce a characteristic of noise resulting from its operation that is audible at noise-affected premises; and

(vi) operating equipment and handling of materials so as to minimise impact noise; and

(vii) using off-site or other alternative processes that eliminate or lessen resulting noise

(2) the responsible person for construction activity must ensure that if the construction activity results in noise with an adverse impact on amenity, the construction activity does not occur or commence except as permitted by 1(a) and 1(b).

(3) For the purpose of this clause, construction activity results in noise with an adverse impact on amenity if measurements taken in relation to the noise source and noise-affected premises show:

(a) that the source noise level (continuous) exceeds 45 dB(A); or

(b) that the source noise level (maximum) exceeds 60 dB(A)

(4) However

(a) if measurements of ambient noise at the noise-affected premises show that the ambient noise level (continuous) exceeds 45 dB(A), the construction activity does not result in noise with an adverse impact on amenity unless the source noise level (continuous) exceeds the ambient noise level (continuous).

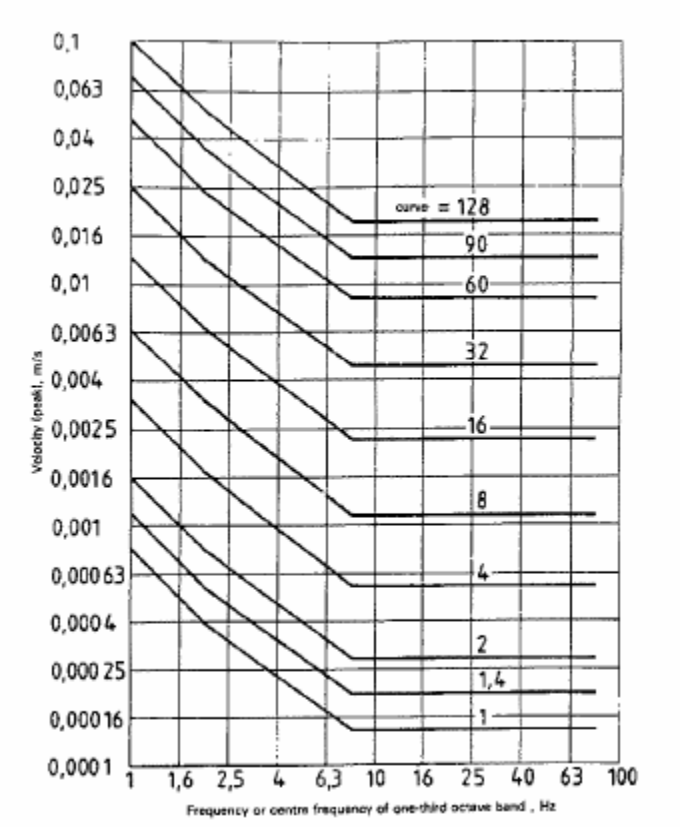
(b) if measurements of ambient noise at the noise-affected premises show that the ambient noise level (maximum) exceeds 60 dB(A), the construction activity does not result in noise with an adverse impact on amenity unless the source noise level (maximum) exceeds the ambient noise level (maximum) or the frequency of the occurrence of the ambient noise level (maximum).

B6 Vibration

Australian Standard 2670.2 recommends maximum vibration levels due to continuous or intermittent vibration sources, such as trains. To maintain human comfort in residences and offices, *Australian Standard 2670.2* recommends the following vibration limits for each one-third octave centre frequency band between 8 Hz and 80 Hz:

- Residences (night) 0.2 mm/s (Curve 1.4)
- Residences (day) 0.3 mm/s to 0.6 mm/s (Curve 2 to Curve 4)
- Offices and retail 0.6 mm/s (Curve 4).

Groundborne vibration from train movements will be limited to the levels provided above which, although they may be occasionally perceptible in some areas, are unlikely to give rise to complaint in continuously occupied spaces.



Note: The above figure shows peak particle velocity in m/s while criteria is in mm/s

Figure B1: Vibration in buildings, AS2670.2 – Combined direction peak velocity curves

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Appendix C

Existing Noise and Vibration Source Data

C1 Industrial

The sound power levels of existing equipment at the Olympic Dam operation site have been calculated from source noise measurements (See Section D5.1 in Appendix D using standard acoustic calculation methods. The calculated sound power levels are provided in Table C1 below.

Item/Source	dB(A)	Calculated Sound Power Level (dB) re 10^{-12} W								Comments/Location
		63	125	250	500	1k	2k	4k	8k	
Acid Plant exhaust	98	99	100	97	95	93	91	84	75	Two exhaust outlets in Acid Plant facade each at equal distance of approximately 5 m from the measurement (2 m in elevation). Acid Plant Steam Offtake only just barely audible during measurement. Location 17 on Figure D5 in Appendix D.
Acid Plant compressor shed	102	101	101	100	100	98	94	87	76	Measurement taken at approximately 2 m from the Acid Plant main compressor façade. Location 11 on Figure D5 in Appendix D.
Acid Plant steam offtake	108	95	94	94	100	102	104	99	92	Steam outlet at approximately 5 m elevation and measured at approximately 5 m away from the base. Location 9 on Figure D5 in Appendix D.
ANI Mill	107	113	110	107	103	101	97	96	93	Measurement taken at approximately 1 m from the ANI mill grinding wheel. Grinding wheel is approximately 6 m wide with a 6 m diameter. Location 7 on Figure D5 in Appendix D.
Cooling Tower pumps	99	96	98	99	94	93	91	89	86	Two pumps at an equal distance of approximately 6 m were audible at the measurement location. Location 16 on Figure D5 in Appendix D.
Desalination Plant Cooling Towers	89	98	93	92	88	82	75	66	61	Measurement taken at approximately 2 m from the cooling tower set.
Desalination Plant pump	89	83	84	80	82	87	82	70	61	Measurement taken 1 m from pump. Other pumps not audible at this location.
Desalination Plant Radiator	92	88	89	97	91	84	81	73	67	Measurement taken 1 m from pump. Other pumps not audible at this location.
Feed Prep Water cooling fans	110	107	103	103	101	93	93	108	101	Measurement taken at approximately 5 m from fan. Other fans not audible at this location. Location 18 on Figure D5 in Appendix D.
Feed Prep exhaust	97	100	101	99	96	90	85	81	75	Two exhaust outlets on the Feed Prep building at an equal distance of approximately 20 m were audible at the location. Location 19 on Figure D5 in Appendix D.
Feed Prep Hydrolic Pump shed	94	85	85	87	93	90	86	82	77	Measurement taken at approximately 1.5 m from the Feed Prep Hydrolic Pump shed façade. Location 21on Figure D5 in Appendix D.
Floatation Circuit Air pumps	99	98	101	97	92	95	92	85	79	Measurement taken at approximately 1 m from the Floatation Circuit air pumps shed façade. Location 15 on Figure D5 in Appendix D.

Item/Source	dB(A)	Calculated Sound Power Level (dB) re 10^{-12} W								Comments/Location
		63	125	250	500	1k	2k	4k	8k	
Gold Room NOX scrubbing system	85	86	88	85	82	78	79	75	69	Measurement taken approximately 2 m from source. Location 24 on Figure D5 in Appendix D.
Gold Room Roaster Off-Gas srubbing system	102	91	86	88	88	86	90	97	99	Measurement taken approximately 2 m from source. Location 13 on Figure D5 in Appendix D.
Mill 2	116	123	118	119	113	110	105	101	95	Measurement taken at approximately 1 m from the mill grinding wheel. Grinding wheel is approximately 5 m wide with a 11 m diameter. Location 2 on Figure D5 in Appendix D.
Mill 2 Vibrating Screen	100	100	98	98	94	94	92	92	91	Measurement taken at approximately 1 m from an opening in the vibrating screen. Opening was approximately 5 m X 2 m. Location 12 on Figure D5 in Appendix D.
Mill 3	115	115	117	118	113	109	104	100	96	Measurement taken at approximately 1 m from the mill grinding wheel. Grinding wheel is approximately 6 m wide with a 11 m diameter. Location 3 on Figure D5 in Appendix D.
Mill 3 Vibrating Screen	103	94	98	95	93	92	93	98	98	Measurement taken at approximately 1 m from an opening in the vibrating screen. Opening was approximately 5 m X 2 m. Location 10 on Figure D5 in Appendix D.
AF and EF Off-Gas Fans	104	103	103	104	105	97	91	89	88	Measurement taken at approximately 3 m from the Off-Gas Fan. Other fans and motors not audible at this location. Location 8 on Figure D5 in Appendix D.
AF and EF Off-Gas Motors	90	94	93	94	87	85	78	73	67	Measurement taken at approximately 3 m from a set of 3 audible motors. Off-Gas fans not audible at this location. Location 23 on Figure D5 in Appendix D.
Oxygen Plant Compressor	101	86	86	91	84	89	94	98	86	Measurement taken at 3 m from the Oxygen Plant Compressor. Location 14 on Figure D5 in Appendix D.
PLS Pumpset	69	67	64	62	69	63	60	54	46	Measurement taken at 5 m from the PLS pumpset (7 pumps audible: 3 PLS pumps and 4 Fire Water Pumps. Location 25 on Figure D5 in Appendix D.
Refinery Electrical Substation	91	87	88	85	89	88	83	77	71	Measurement taken at approximately 1 m from the substation façade. Location 22 on Figure D5 in Appendix D.
Regrind Mill	114	107	110	114	114	109	100	97	89	Measurement taken at approximately 1 m from the mill grinding wheel. Grinding wheel is approximately 5 m wide with a 6 m diameter. Location 5 on Figure D5 in Appendix D.
Shaft Furnace Stack	112	114	110	111	107	104	105	104	98	Measurement taken at 15 m from the Shaft Furnace Stack outlet. Location 6 on Figure D5 in Appendix D.

Item/Source	dB(A)	Calculated Sound Power Level (dB) re 10^{-12} W								Comments/Location
		63	125	250	500	1k	2k	4k	8k	
Smelter Ventilation System Exhaust	112	115	117	114	111	106	102	98	90	Two exhaust outlets on the Smelter building at an equal distance of approximately 10 m were audible at the location. Location 1 on Figure D5 in Appendix D.
Steam Release (ground level)	96	89	87	84	82	81	83	88	95	Measurement taken at approximately 1 m steam outlet. Near Location 20 on Figure D5 in Appendix D. Various steam outlets exist throughout the Olympic Dam operation site.
Steam Trap (at 2 m)	114	98	98	97	104	110	108	107	103	Steam outlet at approximately 10 m elevation. Measurement taken at approximately 2 m from outlet. Location 4 on Figure D5 in Appendix D.
Tailings Disposal Pumps	97	91	87	86	88	94	88	88	84	7 pumps in set, measurement taken at approximately 3 m from southern most pump where only 1 pump was audible. Location 20 on Figure D5 in Appendix D.
Raise Bore Exhaust	115	116	117	119	111	108	106	103	96	Measurement taken at approximately 10 m from the exhaust outlet with a 3.5 m metal barrier between outlet and measurement location. Location 26 on Figure D5 in Appendix D.
Raise Bore Fan/Motor	93	103	102	96	88	86	84	78	70	Two motors at an equal distance of approximately 5 m were audible at the location. Motors at an elevation of approximately 4 m. Location 26 on Figure D5 in Appendix D.

Table C1: Calculated Sound Power Levels for Plant at the Existing Olympic Dam Operation Site

C2 Road Traffic

The 2-way 24 hour average weekday traffic volume along with the percentage of heavy vehicles and posted speed limit for year 2006 are provided in Table C2 below. Locations of these roads are shown on Figure C1 below.

Site (Figure C1)	Name	2-Way 24 Hour Traffic Volume	Percentage of Heavy Vehicles (%)	Posted Speed Limit (km/h)
1	Blindman Road (west of Olympic Way)	1545	11.4	50
2	Olympic Way (south of Blindman Rd)	4550	11.1	50
3	Charlton Road (west of Olympic Way)	2207	16.4	50
4	Olympic Way (north of Opal Road)	3968	5.3	60
5	Opal Road (west of Olympic Way)	167	35.9	50
6	Axehead Road (east of Olympic Way)	1196	3.8	50
7	Axehead Road (east of Pioneer Drive)	393	11.3	50
8	Pimba-Olympic Dam Road (north of Axehead Road)	562	19.9	110
9	Andamooka Road (east fo Pimba-Olympic Dam Road)	546	5.5	110
10	Pioneer Drive (south of Axehead Road)	551	3.6	50
11	Pioneer Drive (east of Olympic Way)	2311	3.4	50
12	Arcoona Street (south of Peoneer Drive)	3494	1.6	50
13	Richardson Place (west of Arcoona Street)	2733	3.5	50
14	Arcoona Street (north of Stuart Road)	2280	2	50
15	Stuart Road (east of Arcoona Street)	910	1.2	50
16	Arcoona Street (south of Stuart Road)	1779	2.1	50
17	Stuart Road (west of Arcoona Street)	545	2.6	50
18	Burgoyne Street (south of Richardson Street)	1748	3.8	50
19	Burgoyne Street (east of Olympic Way Oval)	2371	6.1	50
20	Burgoyne Street (east of Olympic Way Caravan Park	909	4.9	50
21	Olympic Way (south of Burgyne Street)	381	9.7	50

Table C2: 2-way Average Weekday Traffic Data for Roxby Downs

Figure C1: Current Traffic Survey Locations (See Table C1)

C3 Aircraft

The regional express aircraft schedule is provided in Table C3 below.

Day	Landing Time	Takeoff Time
Monday	8:00	8:30
	11:55	12:25
	12:50	13:20
	16:25	16:55
Tuesday	8:00	8:30
	11:55	12:25
	12:50	13:20
	16:25	16:55
Wednesday	8:00	8:30
	11:55	12:25
	12:50	13:20
	16:25	16:55
Thursday	8:00	8:30
	11:55	12:25
	12:50	13:20
	16:25	16:55
Friday	8:00	8:30
	11:55	12:25
	12:50	13:20
	16:25	16:55
Saturday	12:50	13:20
Sunday	16:25	16:55

Table C3: Regional Express (REX) flight timetable for Olympic Dam Airstrip

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Appendix D

Noise and Vibration Measurements

D1 Noise Measurement Equipment

Acoustic measurements were conducted using the following equipment.

Manufacturer	Type Number	Name of Instrument	Serial Number
Brüel & Kjær	2260	Investigator Sound Level Analyser	2124638
Brüel & Kjær	4231	Sound Level Calibrator	2136569
Brüel & Kjær	2635	Charge Amplifier	1473803
RTA Technology	ENL	Environmental Noise Logger	RTA009, RTA016, RTA83, RTA83, RTA29, RTA31
Brüel & Kjær	4294	Calibration Exciter	1870580
Brüel & Kjær	4370	Piezoelectric Accelerometer	1737185
Larson·Davis	2900	Dual Channel Real Time Analyser	2900A0526
RTA Technology	RTA02	Environmental Wind/Noise Logger	RTA015

Table D1: Acoustic Equipment
Note: Equipment was checked for calibration before and after each set of measurements.

D2 Measurement Locations

Acoustic measurements have been conducted at:

- Roxby Downs Township
- Proposed Contractor Village
- Olympic Dam Village
- Mining Lease and Site Boundary
- Woomera
- Point Lowly
- Port Augusta
- Olympic Dam Operation Site

Locations of these measurements can be found in Figure D1 to Figure D5 below.

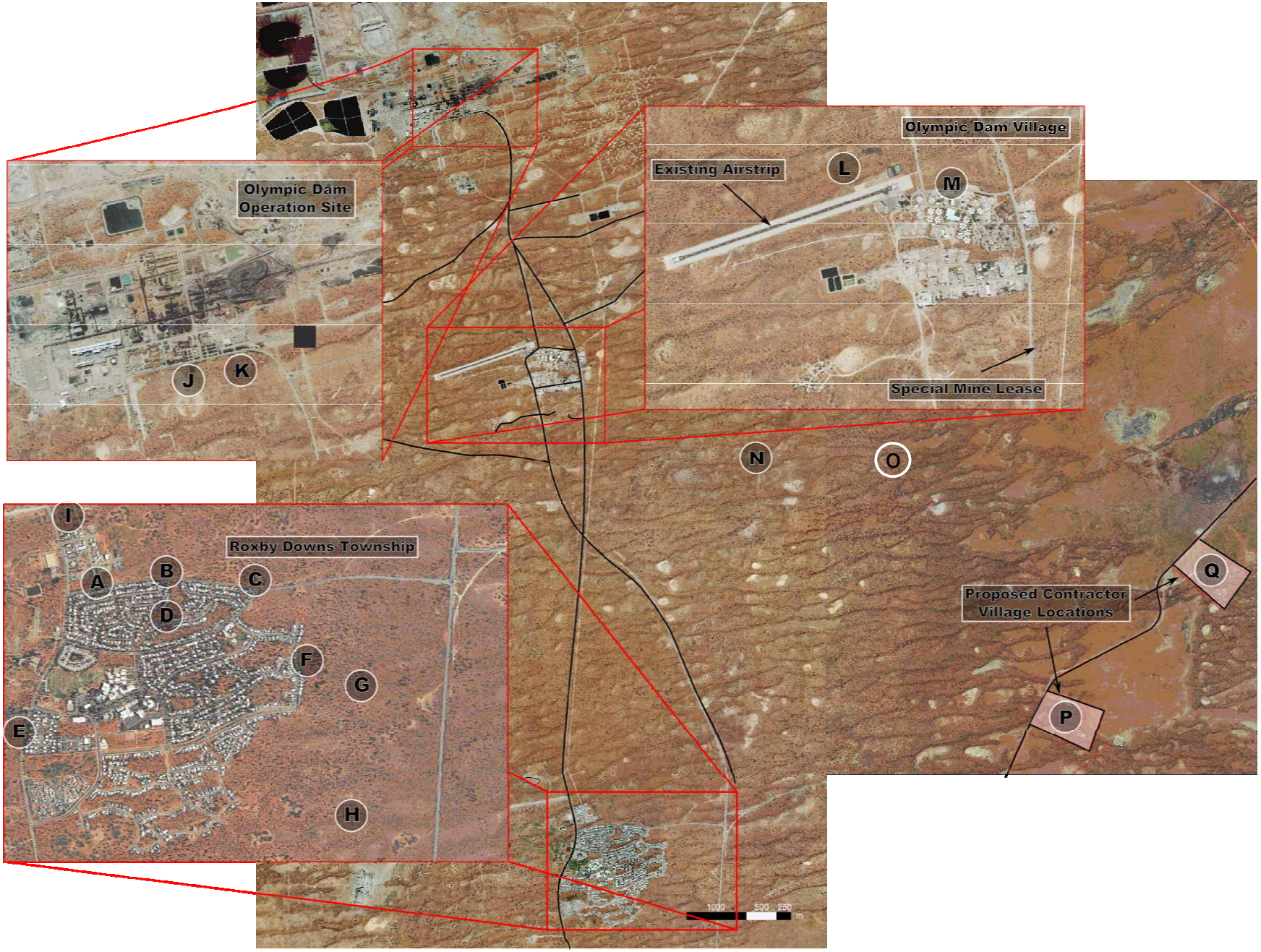


Figure D1: Measurement Locations at the Olympic Dam Operation Site and Surrounding Areas

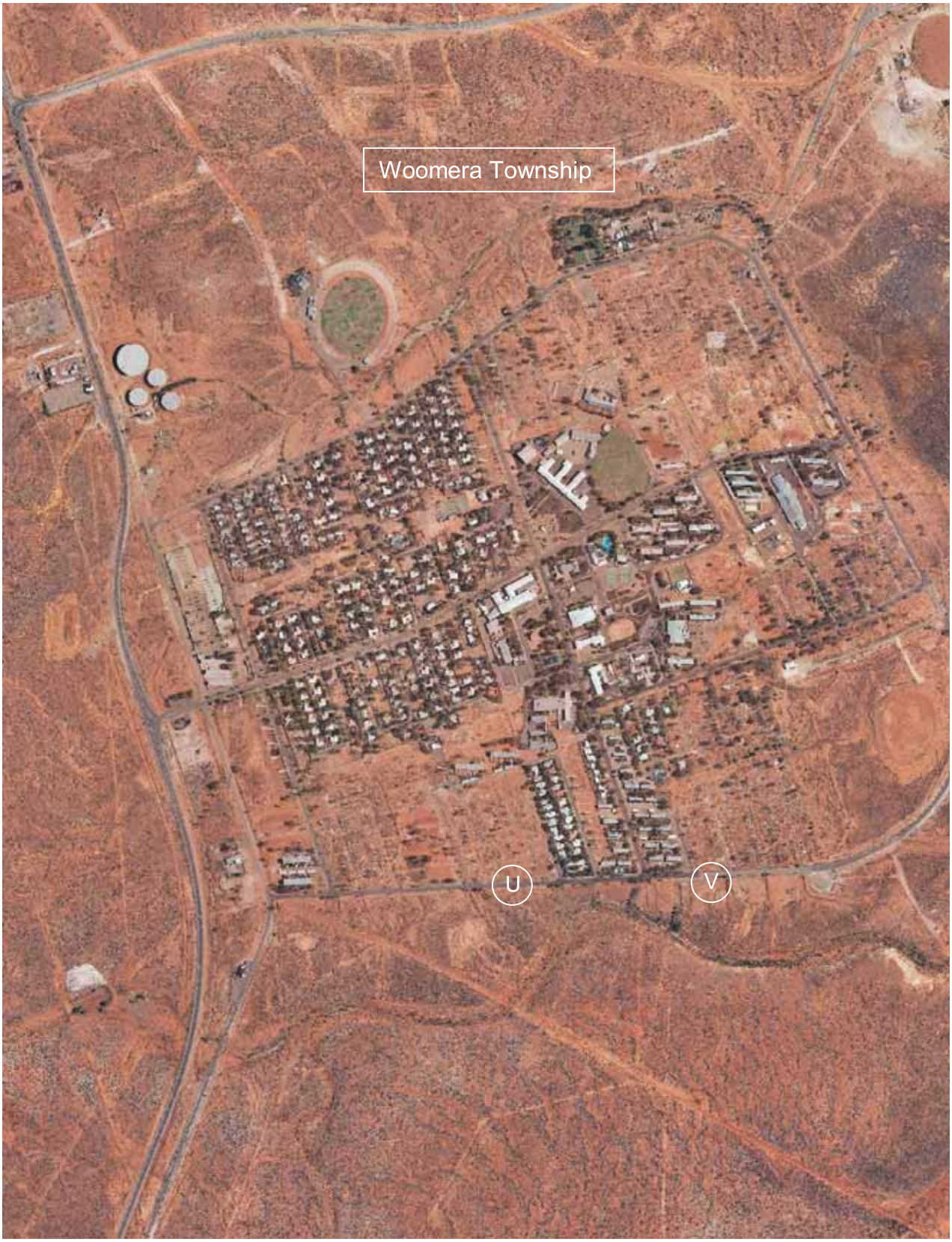


Figure D2: Noise Measurement Locations at the Woomera Township

Figure D3: Noise Measurement Locations at Point Lowly

Figure D4: Noise Measurement Locations at Port Augusta

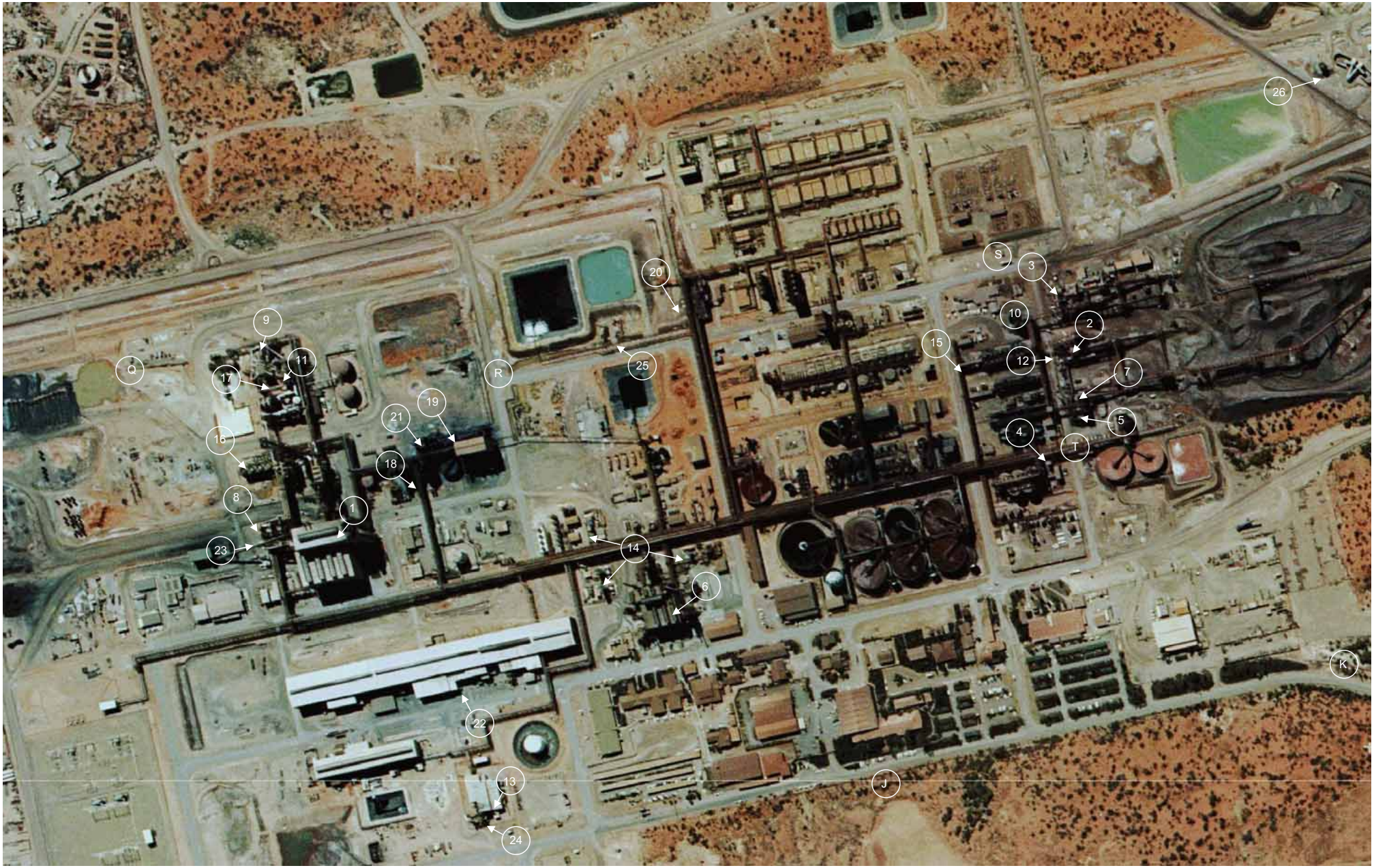


Figure D5: Noise Measurement Locations in the Olympic Dam Operation Site

D3 Attended Ambient Noise Measurements

Attended noise measurements have been conducted at strategic locations associated with the Olympic Dam operation and the proposed Olympic Dam expansion. Results of these measurements are presented in Table D3 to Table D8 below.

D3.1 Roxby Downs Township

The results of attended noise measurements at locations around the Roxby Downs Township are presented in Table D3 and Table 4 below. Measurements were for a period of at least 15 minutes.

Location (Figure D1)	Time (hours)	Date	L_{Aeq} (dB)	L_{A10} (dB)	L_{A90} (dB)	L_{A95} (dB)	Comments
A	10:20	21/02/06	50	47	37	36	Traffic and AC noise was audible at the time of measurement. Noise from Olympic Dam operations not audible.
	19:05	21/02/06	53	50	40	40	Traffic and AC noise was audible at the time of measurement. Noise from Olympic Dam operations not audible.
	23:20	23/02/06	42	42	41	40	Insects and AC noise was audible at time of measurement. Noise from Olympic Dam operations not audible.
B	10:45	21/02/06	52	52	32	32	Distant traffic and AC noise was audible at the time of measurement. Noise from Olympic Dam operations not audible.
	19:25	21/02/06	56	54	36	36	Traffic and AC noise was audible at the time of measurement. Noise from Olympic Dam operations not audible.
	23:25	23/02/06	35	35	34	34	Insects and AC noise was audible at the time of measurement. Noise from Olympic Dam operations not audible.
C	11:05	21/02/06	52	52	33	32	Insects and birds, distant AC noise and traffic were audible at the time of measurement. Noise from Olympic Dam operations not audible.
	19:45	21/02/06	48	47	32	32	Birds and Insects, distant people talking, AC noise and traffic was audible at the time of measurement. Noise from Olympic Dam operations not audible.
	23:35	21/02/06	33	35	30	30	Insects and distant AC noise was audible at the time of measurement. Noise from Olympic Dam operations not audible.
D	11:35	21/02/06	46	42	32	32	AC noise was audible at the time of measurement. Noise from Olympic Dam operations not audible.
	20:05	21/02/06	41	44	37	37	Distant people talking and AC noise was audible at the time of measurement. Noise from Olympic Dam operations not audible.
	23:45	23/02/06	38	39	35	35	Distant traffic on the Roxby Bypass and AC noise was audible at the time of measurement. Noise from Olympic Dam operations not audible.

Table D2: Attended Noise Measurements Conducted in the Roxby Downs Township - continued on next page

Location (Figure D1)	Time (hours)	Date	LAeq (dB)	LA10 (dB)	LA90 (dB)	LA95 (dB)	Comments
E	12:30	21/02/06	53	50	40	40	Traffic and AC noise was audible at the time of measurement. Noise from Olympic Dam operations not audible.
	20:55	21/02/06	54	43	38	38	Traffic, birds and AC noise was audible at the time of measurement. Noise from Olympic Dam operations noise not audible.
	23:10	23/02/06	38	39	35	35	Distant traffic and AC noise was audible at the time of measurement. Noise from Olympic Dam operations not audible.
F	11:55	21/02/06	33	36	24	23	Distant traffic was audible at the time of measurement. Noise from Olympic Dam operations not audible.
	20:30	21/02/06	39	41	34	33	Distant traffic and domestic noise was audible at the time of measurement. Noise from Olympic Dam operations not audible.
	23:55	23/02/06	33	35	29	27	Insects were audible at the time of measurement. Noise from Olympic Dam operations not audible.
G	07:30	02/03/06	27	29	23	23	Insect and bird noise was audible at the time of measurement. Noise from Olympic Dam operations not audible.
H	07:00	02/03/06	34	35	30	30	Insects, bird and very distant traffic noise was audible at the time of measurement. Noise from Olympic Dam operations not audible.
I	08:30	22/02/06	49	52	40	39	Traffic noise (wet road) audible at the time of measurement. Noise from Olympic Dam operations not audible.
	19:15	22/02/06	45	49	39	38	Traffic and trail motor bike noise was audible at the time of measurement. Noise from Olympic Dam operations not audible.
	01:15	22/02/06	50	42	28	28	Intermittent noise from commercial buildings to the south and distant traffic was audible at the time of measurement. Noise from Olympic Dam operations not audible.

Table D3: Attended Noise Measurements Conducted in the Roxby Downs Township

D3.2 Adjacent to Andamooka Road

The results of attended noise measurements at locations adjacent to Andamooka Road (ie the proposed contractor village locations) are presented in Table D4 below. Measurements were for a period of at least 15 minutes.

Location (Figure D1)	Time (hours)	Date	L_{Aeq} (dB)	L_{A10} (dB)	L_{A90} (dB)	L_{A95} (dB)	Comments
P	9.10	23/02/06	36	38	32	31	Wind noise in shrubs was audible at the time of measurement. Noise from Olympic Dam operations not audible.
	20.10	23/02/06	48	40	29	29	One car passed while conducting the measurement. Noise from Olympic Dam operations not audible.
	0.25	24/02/06	34	34	28	28	Very distant rumble from the mine was audible.
Q	9.30	23/02/06	42	40	31	30	A distant rumble from the mine was audible.
	19.50	23/02/06	54	45	35	34	One car passed while conducting the measurement. Distant thunder was audible at the time of measurement. Noise from Olympic Dam operations not audible.
	0.45	24/02/06	31	34	26	26	Very distant rumble from the mine was audible at times (dependant on wind direction),

Table D4: Attended Noise Measurements Conducted Adjacent to Andamooka Road

D3.3 Mining Lease Boundary and Site Boundary

The results of attended noise measurements at locations on the mining lease and site boundary are presented in Table D5 below. Measurements were for a period of at least 15 minutes.

Location (Figure D1)	Time (hours)	Date	L_{Aeq} (dB)	L_{A10} (dB)	L_{A90} (dB)	L_{A95} (dB)	Comments
M	10.10	27/03/06	36	39	30	30	Traffic from Olympic Dam way and noise from Olympic Dam Village is audible. Noise from Olympic Dam mine not audible.
	19.00	2/03/06	-	-	-	-	Measurement affected by wind on microphone. Noise from Olympic Dam mine not audible.
	23.00	01/03/06	36	39	31	31	Mine is clearly audible as distant hum. Insects are constantly audible and intermittent noise from the Olympic Dam Village is audible from the south.
0	11.15	27/03/06	34	38	26	24	Noise from wind in vegetation slightly audible. Noise from Olympic Dam mine not audible.
	19.10	02/03/06	-	-	-	-	Wind is shielded by car, however the measurement is still affected by wind on microphone. Noise from Olympic Dam mine not audible.
L	8.30	25/02/06	50	51	47	47	Rockfall and the stacker, mills, fans and traffic noise was audible at the time of measurement.
K	8.10	25/02/06	48	48	46	46	Mills and fans were audible as a hum and cutting or grinding was audible at the time of measurement.

Table D5: Attended Noise Measurements at Olympic Dam Boundaries

D3.4 Woomera

The results of attended noise measurements at locations in the Woomera Township are presented in Table D6 below. Measurements were for a period of at least 15 minutes.

Location (Figure D2)	Time (hours)	Date	L_{Aeq} (dB)	L_{A10} (dB)	L_{A90} (dB)	L_{A95} (dB)	Comments
U	16.30	23/07/07	35	37	27	27	Distant local road traffic noise, aircraft and dogs were audible at the time of measurement.

Table D6: Attended Noise Measurements at the Woomera Township

D3.5 Point Lowly

The results of attended noise measurements at locations at Point Lowly are presented in Table D7 below. Measurements were for a period of at least 15 minutes.

Location (Figure D3)	Time (hours)	Date	L_{Aeq} (dB)	L_{A10} (dB)	L_{A90} (dB)	L_{A95} (dB)	Comments
W	09:00	24/07/07	41	42	39	38	Distant vehicles, aircraft, wind noise and waves audible at the time of measurement. Refinery not audible at time of measurement
	01:00	25/07/07	42	43	40	40	Wind noise and waves audible at the time of measurement. Refinery not audible at time of measurement.
X	09:20	24/07/07	42	44	38	38	Distant vehicles, aircraft, wind noise and waves audible at the time of measurement. Refinery is just audible as a soft rumble at time of measurement
Y	10.00	24/07/07	49	50	47	46	At residence closet to refinery. Refinery is clearly audible. There is high wind; at the time of measurement however the measurement location is shielded by a large shed.

Table D7: Attended Noise Measurements at Point Lowly

D3.6 Port Augusta

The results of attended noise measurements at locations along Shacks Road, Port Augusta are presented in Table D8 below. Measurements were for a period of at least 15 minutes.

Location (Figure D4)	Time (hours)	Date	L_{Aeq} (dB)	L_{A10} (dB)	L_{A90} (dB)	L_{A95} (dB)	Comments
Z1	11:15	24/07/07	46	46	40	40	Wind and wave noise audible at time of measurement. Distant road traffic and aircraft noise are just audible at time of measurement.
	02:30	25/07/07	41	43	35	35	Wind and wave noise audible at time of measurement.
Z2	11.45	24/07/07	41	42	37	36	Wind and wave noise audible at time of measurement.
Z3	12.10	24/07/07	40	41	37	36	Wind and wave noise audible at time of measurement.
Z4	12.30	24/07/07	42	43	39	39	Wind and wave noise audible at time of measurement.

Table D8: Attended Noise Measurements at Port Augusta

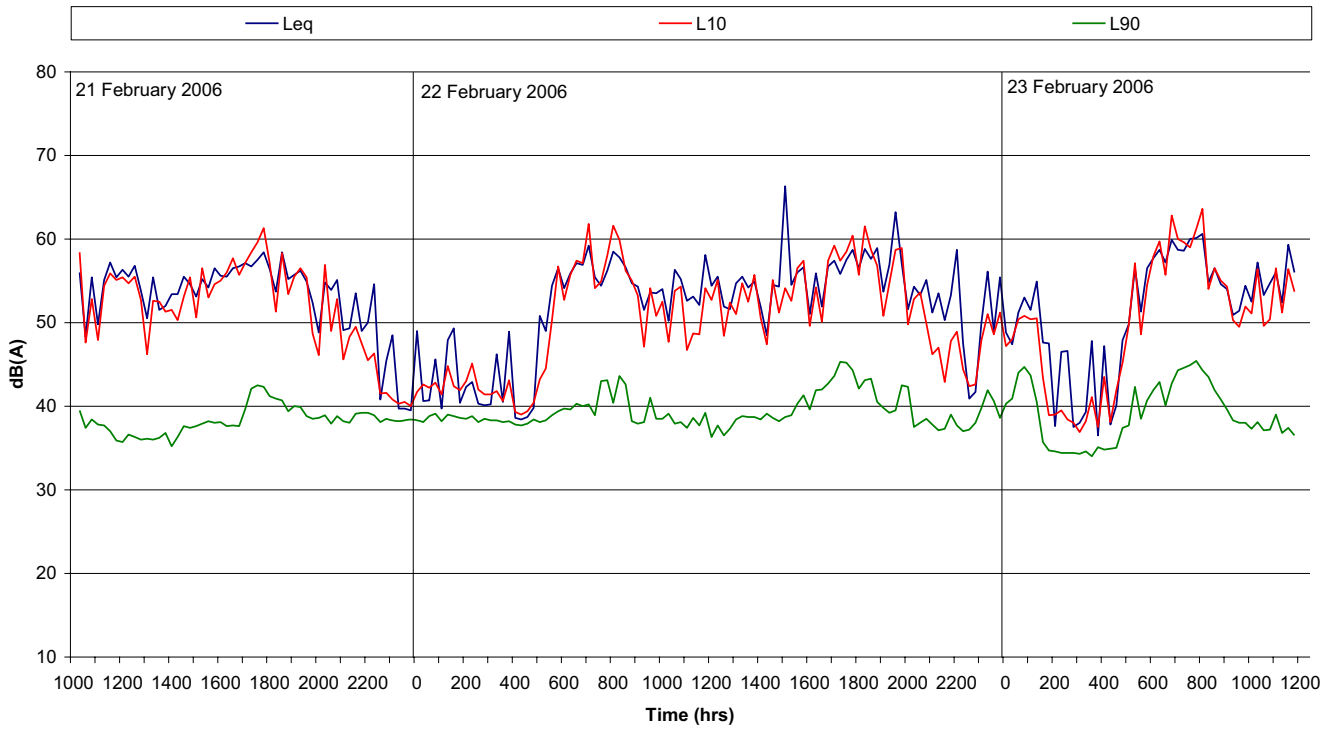
D4 Ambient Noise Monitoring

D4.1 Roxby Downs Township

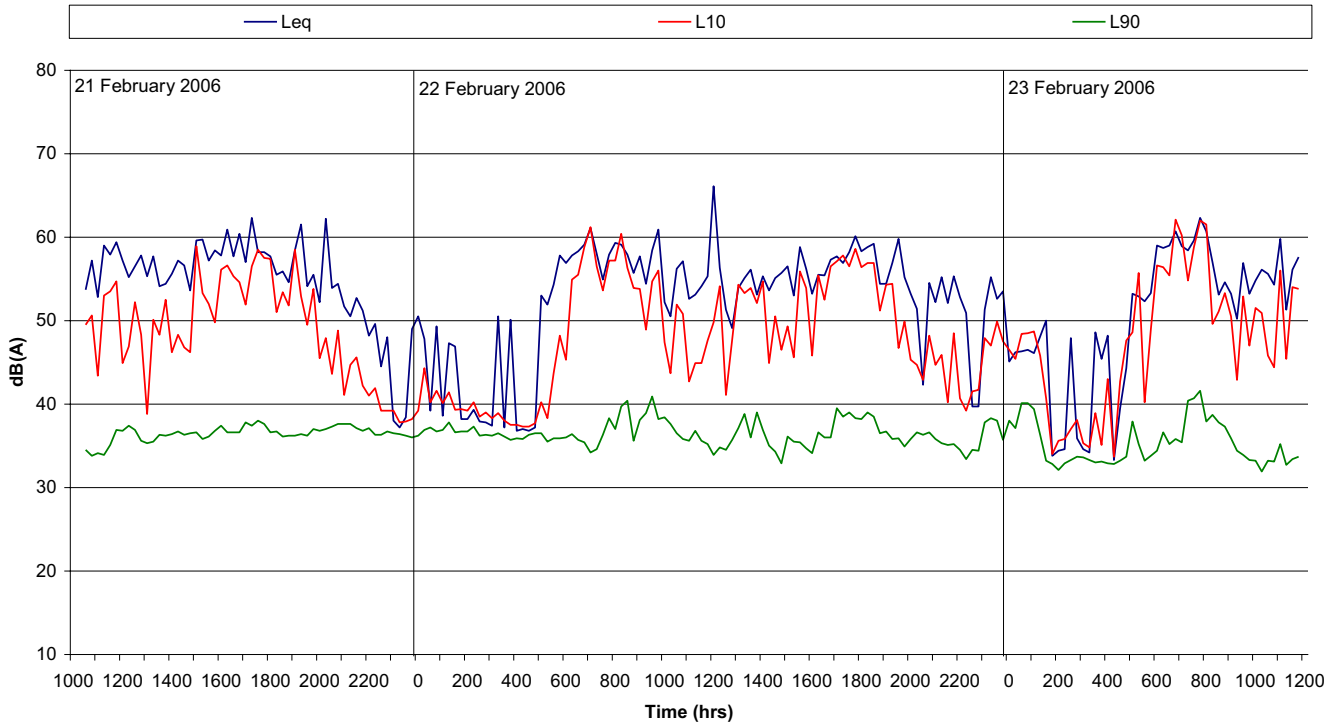
The results of noise monitoring at locations around the Roxby Downs Township are presented in Table D9 below. Measurements were for a period of at least 15 minutes.

Location (Figure D1)	Date	Time	L_{Aeq} (dB)	L_{A10} (dB)	L_{A90} (dB)	L_{A95} (dB)	Comments
A	23/02/06	03.30	48	41	34	34	Noise monitoring was conducted between 21 and 23 February 2006; results are presented in Graph D1. Logger located across the road from the residence to reduce noise recorded from air-conditioner units, 5 m from roadside. Air conditioner units are audible at this position. Sand dunes block line of sight to the commercial precinct and mine operation to the north. Noise from Olympic Dam operations is not audible.
B	23/02/06	10.15	56	51	32	-	Noise monitoring was conducted between 21 and 23 February 2006; results are presented in Graph D2. Logger located 1 m from Axehead Road on the same side as the Roxby Downs residences. An empty block of land is located to the south and sand dunes block line of sight to the mine to the north. Audible air conditioning units located 30 m away at nearest residence. Noise from Olympic Dam operation not audible.
C	23/02/06	04.00	33	24	17	17	Noise monitoring was conducted between 21 and 23 February 2006; results are presented in Graph D3. Logger located approximately 5 m from Axehead Road on the opposite side to the residence. Sand dunes block line of sight to the mine to the north. Audible air conditioning units are only just audible. Noise from Olympic Dam operation not audible.
D	23/02/06	04.15	33	33	31	-	Noise monitoring was conducted between 21 and 23 February 2006; results are presented in Graph D4. Logger located approximately 2 m from residence back fence and approximately 6 m from a walking path. Direct line of sight to the operation. Air conditioning units audible. Noise from Olympic Dam operation not audible.
E	21/02/06	12.00	50	41	37	36	Noise monitoring was conducted between 21 and 23 February 2006; results are presented in Graph D5. Logger located approximately 5 m from Olympic Dam Road and 30 m from carpark. Air conditioning units clearly audible from campsite residence approximately 5 m away. Noise from Olympic Dam operation not audible.
F	21/02/06	12.00	37	40	29	-	Noise monitoring was conducted between 21 and 23 February 2006; results are presented in Graph D6. Logger located 10 m from residence back fence. Trucks on the Roxby Downs Bypass audible. Noise from Olympic Dam mine not audible.
G	02/03/06	04.00	26	26	26	-	Noise monitoring was conducted between 28 February and 2 March 2006; results are presented in Graph D7. Logger located approximately 300 m from the Olympic Dam Bypass at the proposed Roxby Downs Expansion boundary. Birds and insects audible. Traffic from Roxby Downs is only just audible. Noise from Olympic Dam mine not audible.
H	02/03/06	00.00	24	24	23	23	Noise monitoring was conducted between 28 February and 2 March 2006; results are presented in Graph D8. Logger located approximately 300 m from the Olympic Dam Bypass at the proposed Roxby Downs Expansion boundary. Birds and insects audible. Noise from Olympic Dam mine not audible.

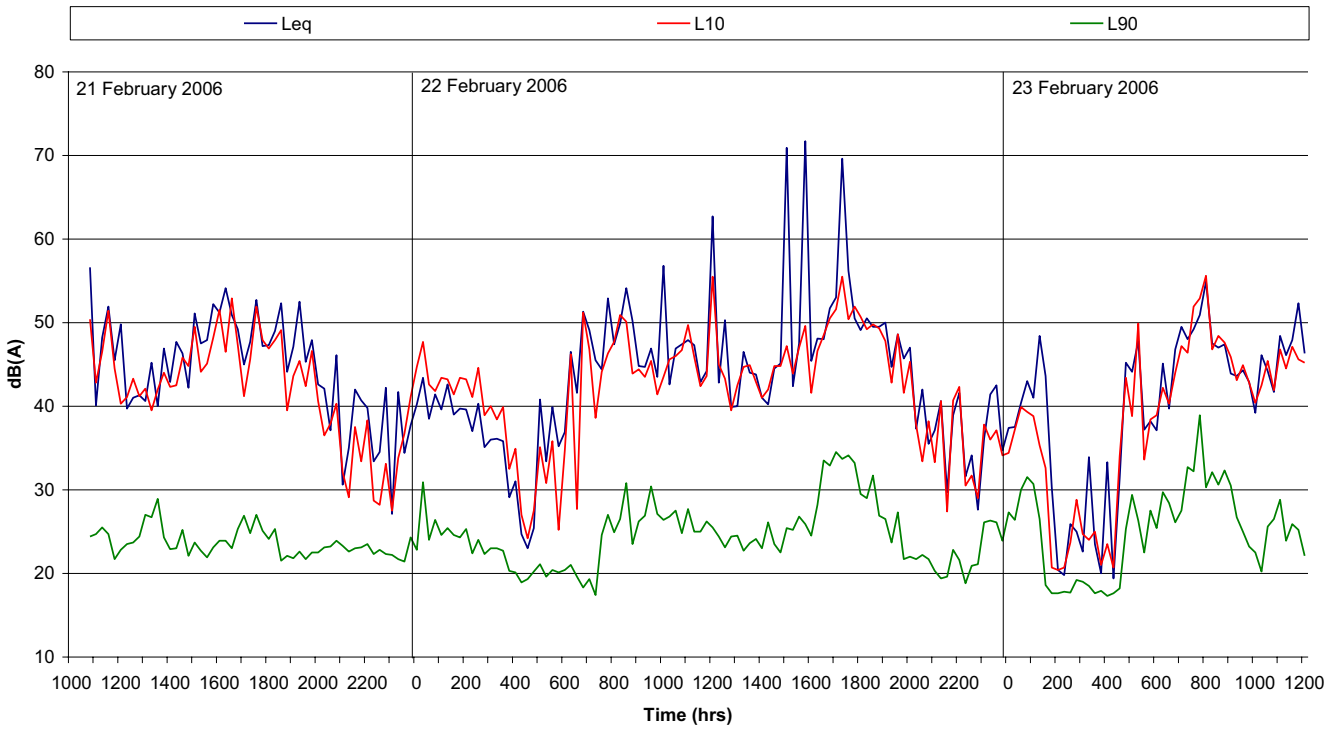
Table D9: Noise Monitoring at Locations in the Roxby Downs Township



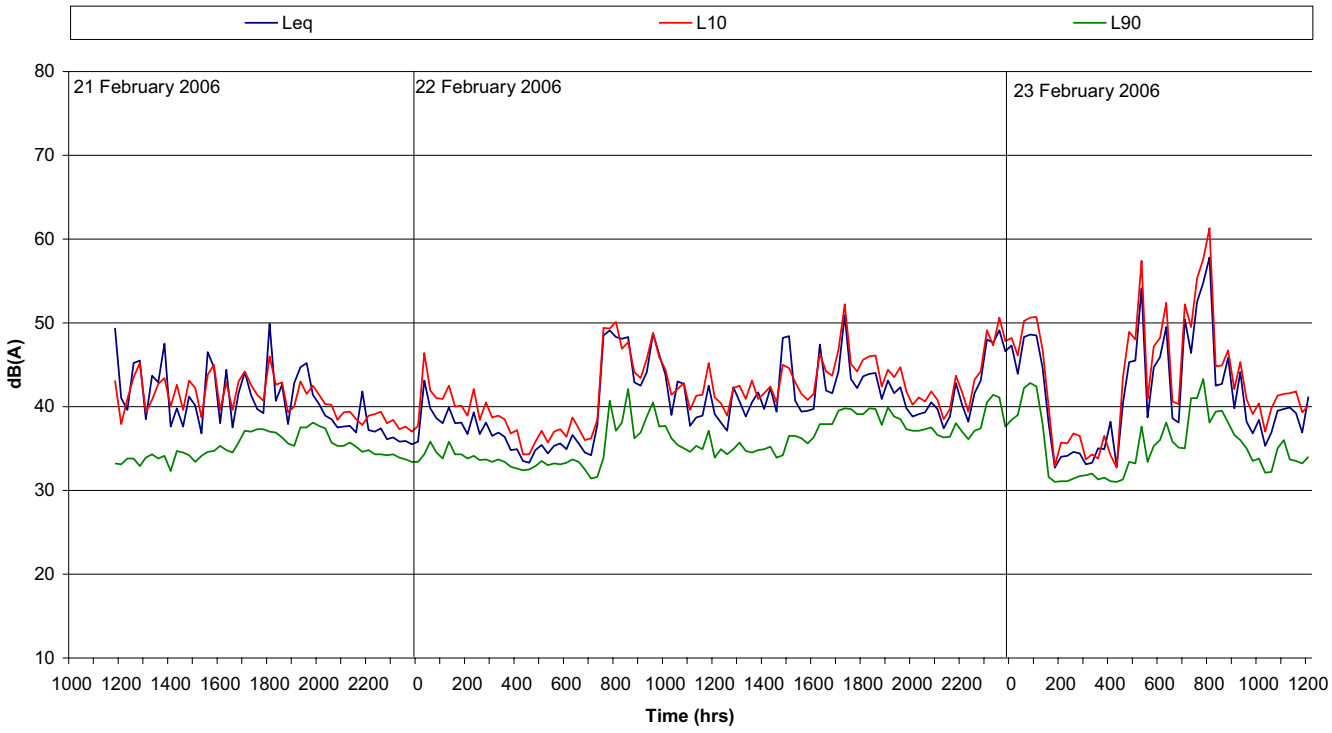
Graph D1: 15 Minute Duration Noise Monitoring at Position A (See Figure D1))



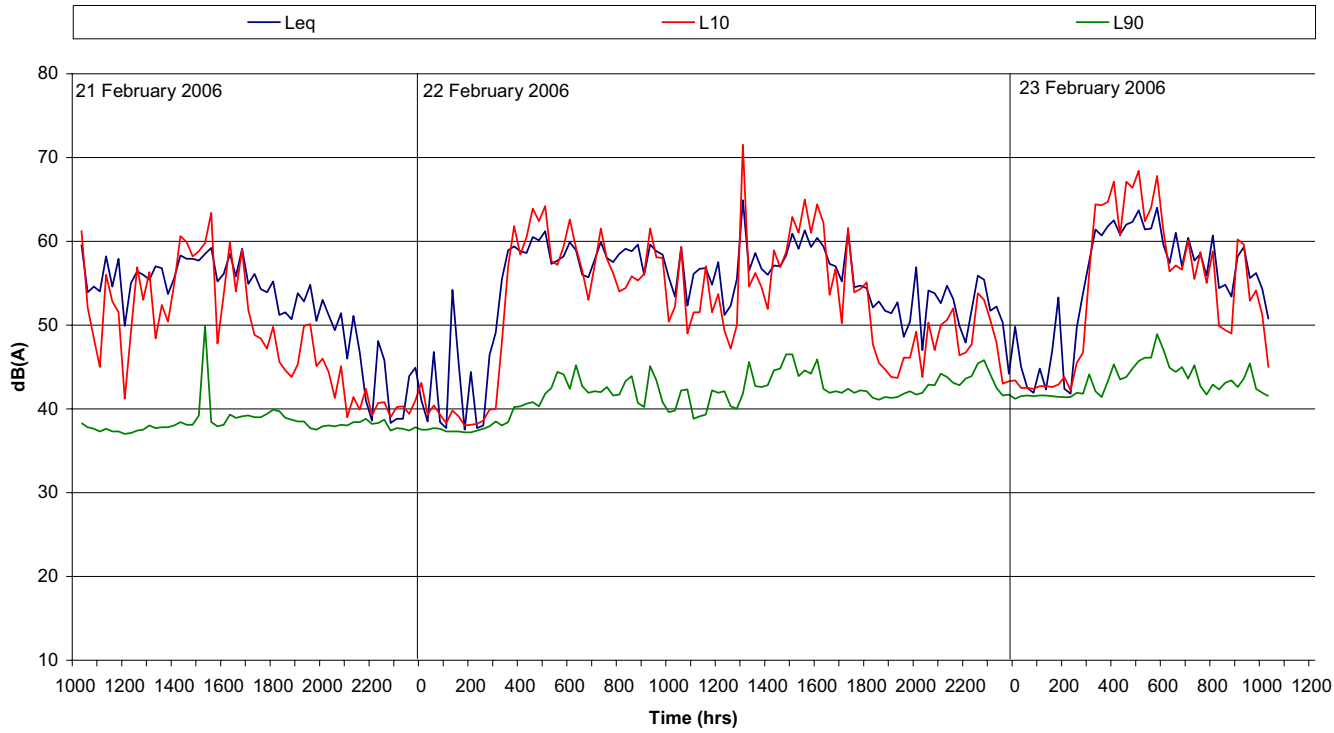
Graph D2: 15 Minute Duration Noise Monitoring at Position B (See Figure D1)



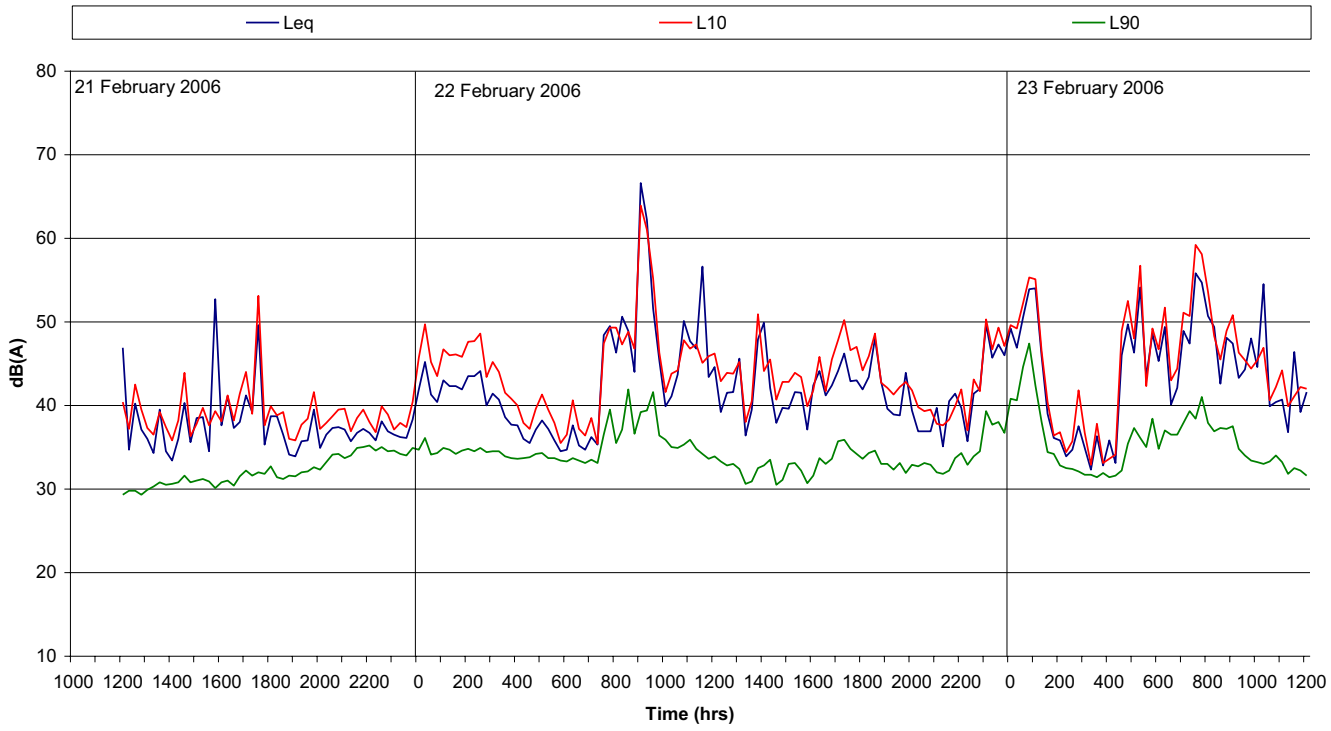
Graph D3: 15 Minute Duration Noise Monitoring at Position C (See Figure D1)



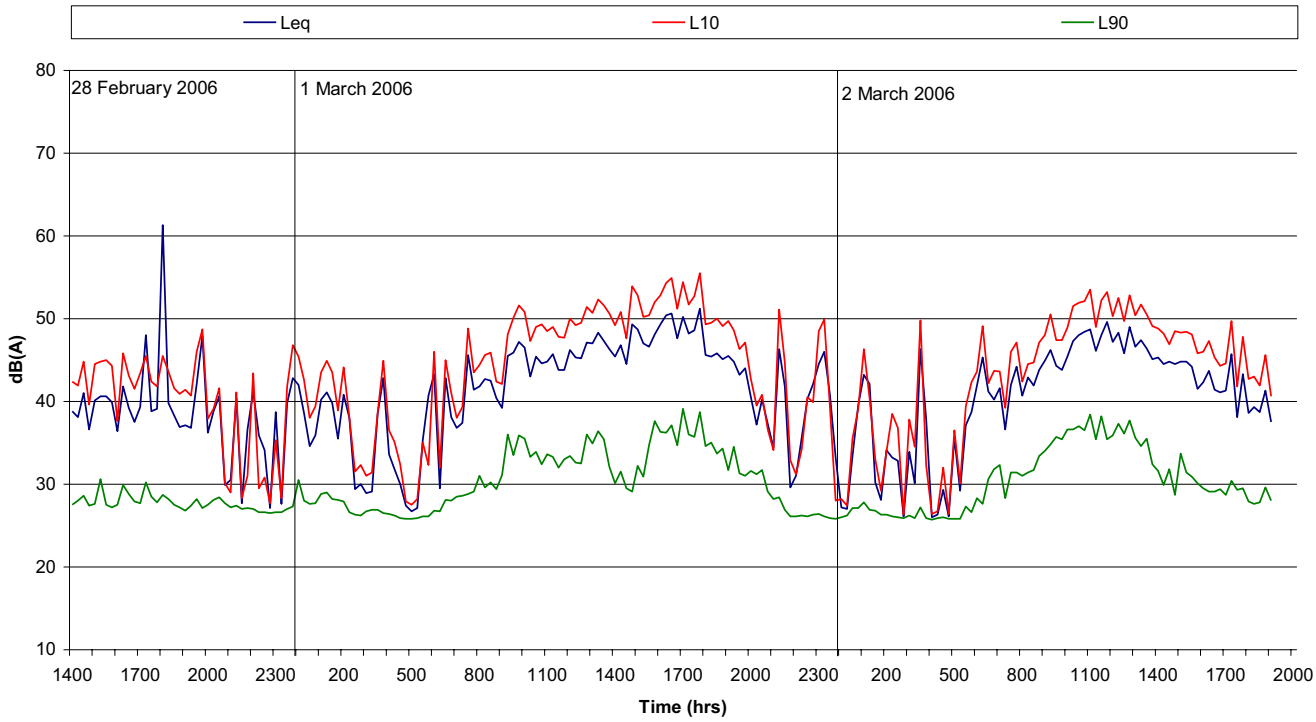
Graph D4: 15 Minute Duration Noise Monitoring at Position D (See Figure D1)



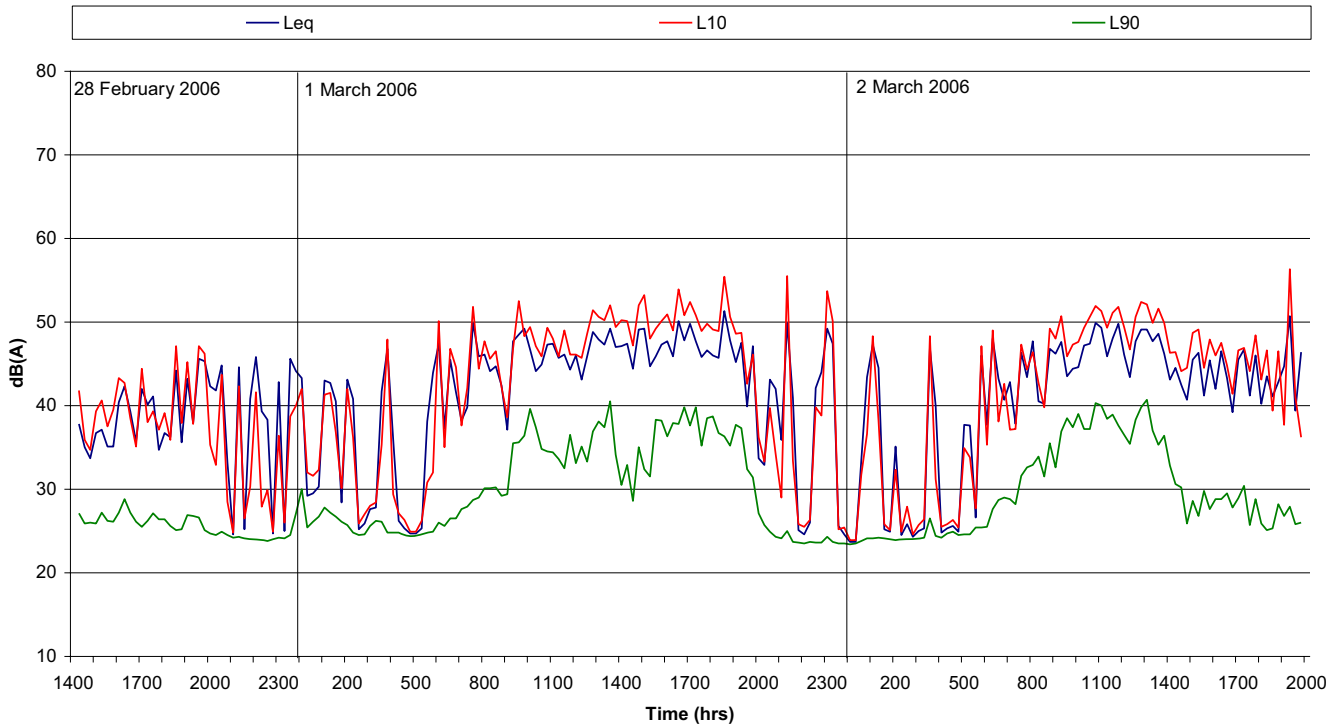
Graph D5: 15 Minute Duration Noise Monitoring at Position E (See Figure D1)



Graph D6: 15 Minute Duration Noise Monitoring at Position F (See Figure D1)



Graph D7: 15 Minute Duration Noise Monitoring at Position G (See Figure D1)



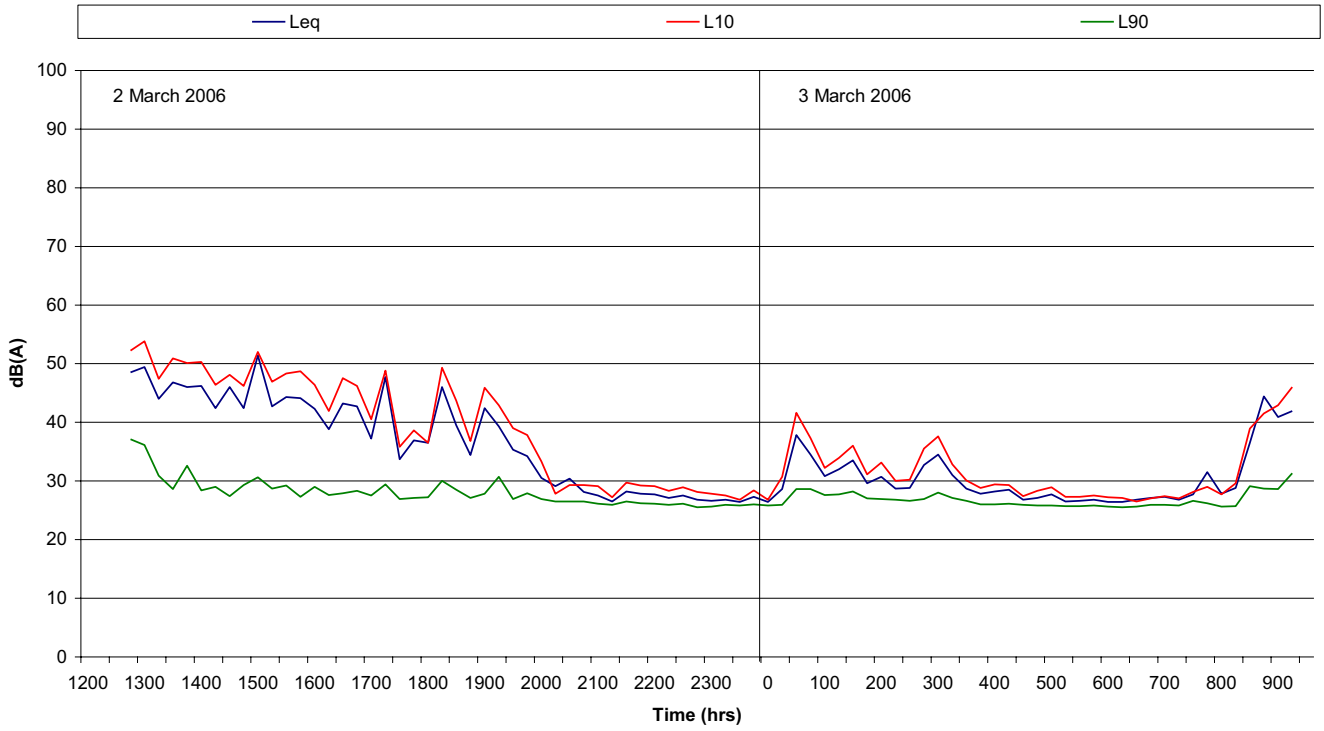
Graph D8: 15 Minute Duration Noise Monitoring at Position H (See Figure D1)

D4.2 Olympic Dam Village

The results of noise monitoring at the Olympic Dam village are presented in Table D10 below

Location (Figure D1)	Time	Date	L_{Aeq} (dB)	L_{A10} (dB)	L_{A90} (dB)	L_{A95} (dB)	Comments
M	04:00	02/03/06	37	41	23	22	Noise monitoring was conducted over 3 days between 28 February and 2 March 2006; results are presented in Graph D9. Logger was located approximately 5 m from the Airstrip Road on the opposite side to the Olympic Dam Village. Air condenser and traffic noise audible. Noise from Olympic Dam operations not audible.

Table D10: Noise Monitoring at Locations in the Olympic Dam Village



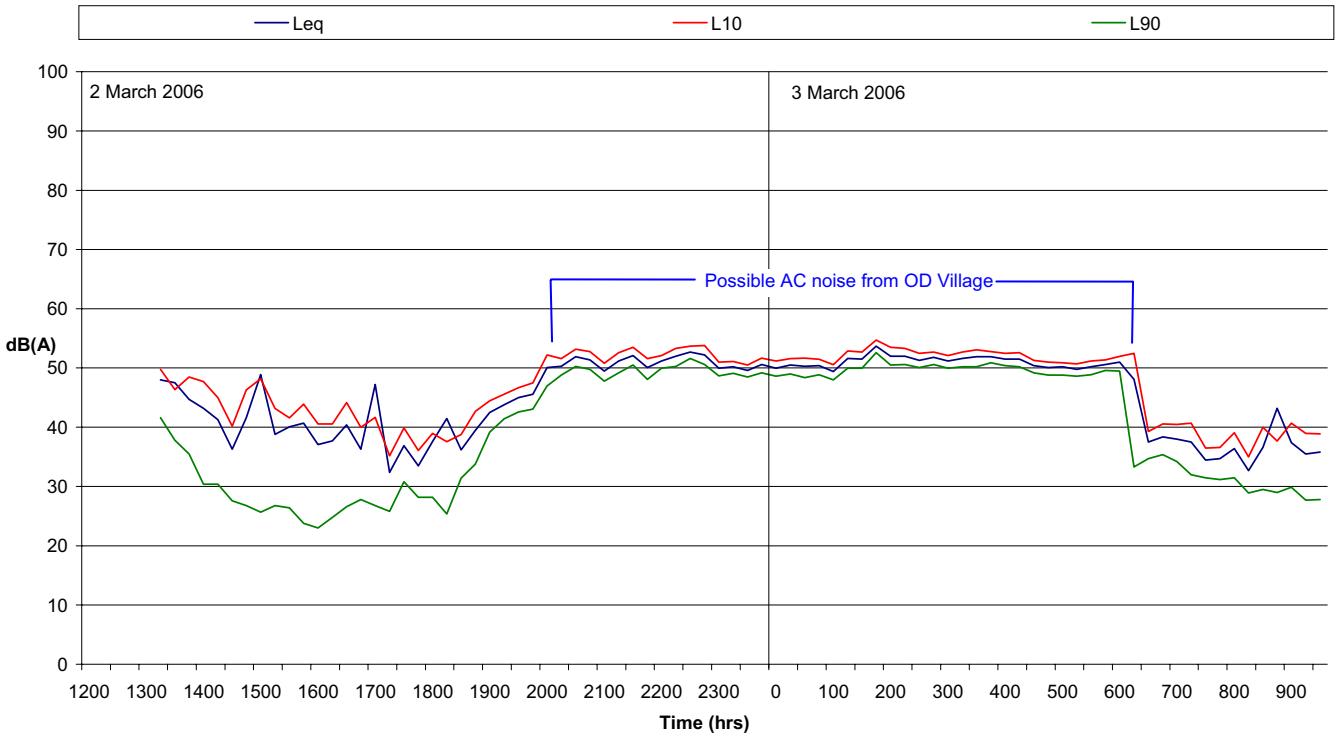
Graph D9: 15 Minute Duration Noise Monitoring at Position M (See Figure D1)

D4.3 Mining Lease Boundary and Site Boundary

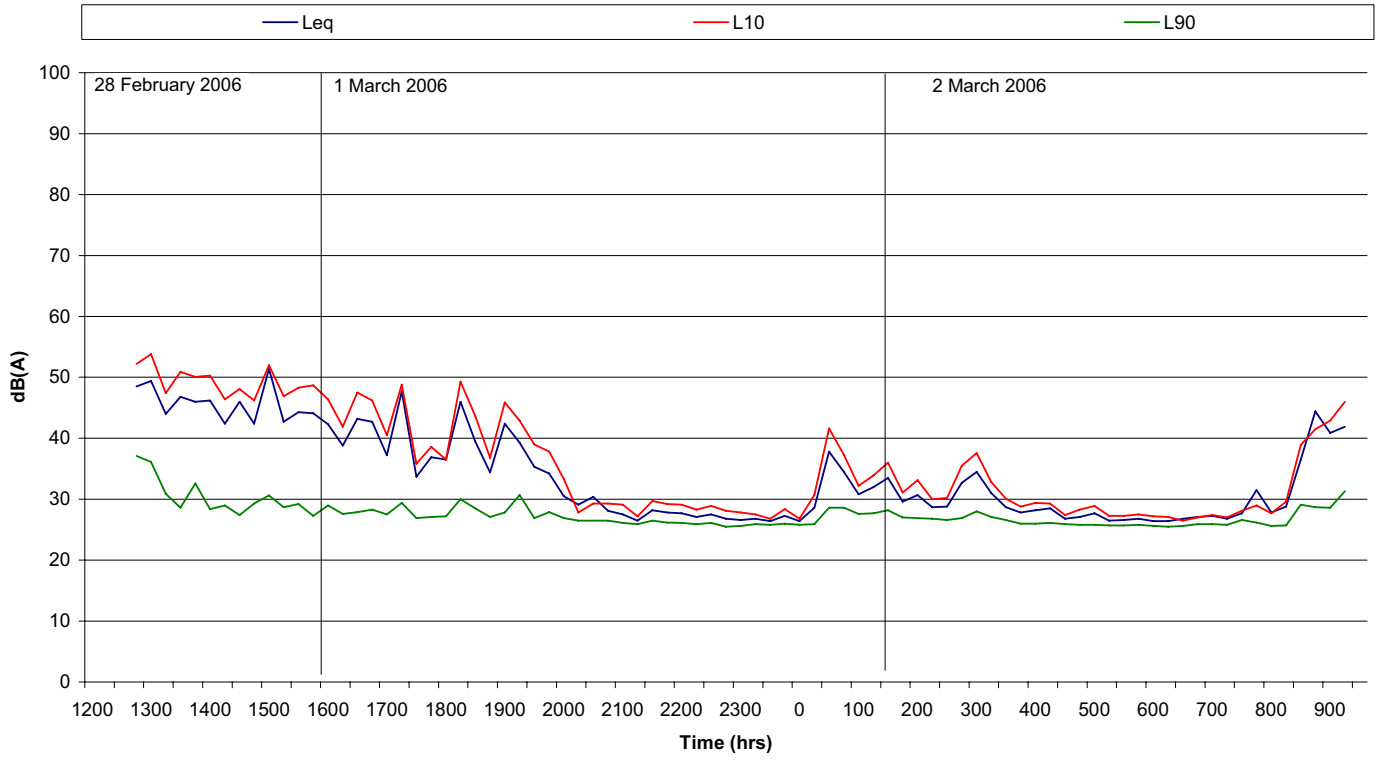
The results of noise monitoring at locations in Point Lowly are presented in Table D11 below. Measurements were for a period of at least 15 minutes.

Location (Figure D1)	Time	Date	L_{Aeq} (dB)	L_{A10} (dB)	L_{A90} (dB)	L_{A95} (dB)	Comments
L	06:15	03/03/06	26	27	26	25	Noise Monitoring was conducted over 2 days between 2 and 3 March 2006, results are presented in Graph D10. Located at the Olympic Dam mining lease boundary. Direct line of sight to the mine located to the north and sand dunes blocking line of sight to the Airstrip and Olymic Village to the south. Road traffic noise and Olympic Dam operations audible.
N	19:45	02/03/06	52	49	39	39	Noise monitoring was conducted over 2 days between 2 and 3 March 2006, results are presented in Graph D11. Located at the Olympic Dam mining lease boundary. Direct line of sight to the mine is blocked by terrain. Olympic Dam operations only just audible.

Table D11: Noise Monitoring at the Mining Lease and Site Boundary



Graph D10: 15 Minute Duration Noise Monitoring at Position L (see Figure D1)



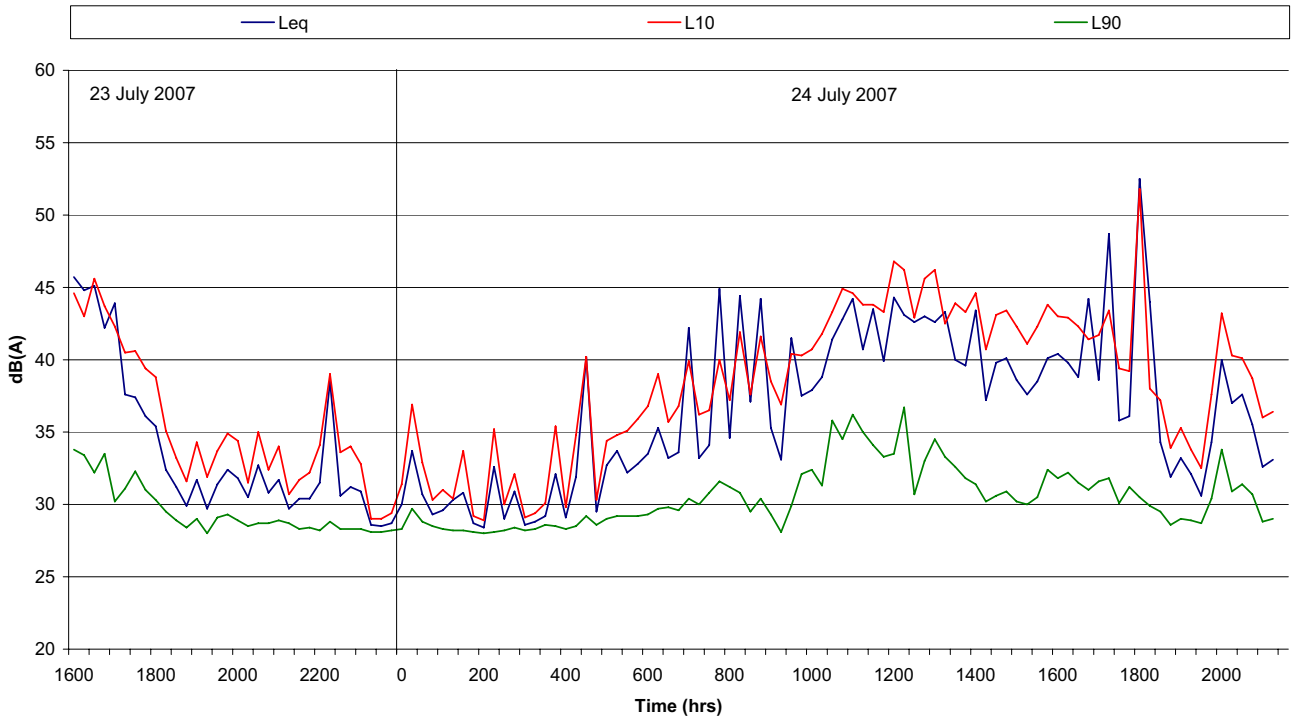
Graph D11: 15 Minute Duration Noise Monitoring at Position N (see Figure D1)

D4.4 Woomera

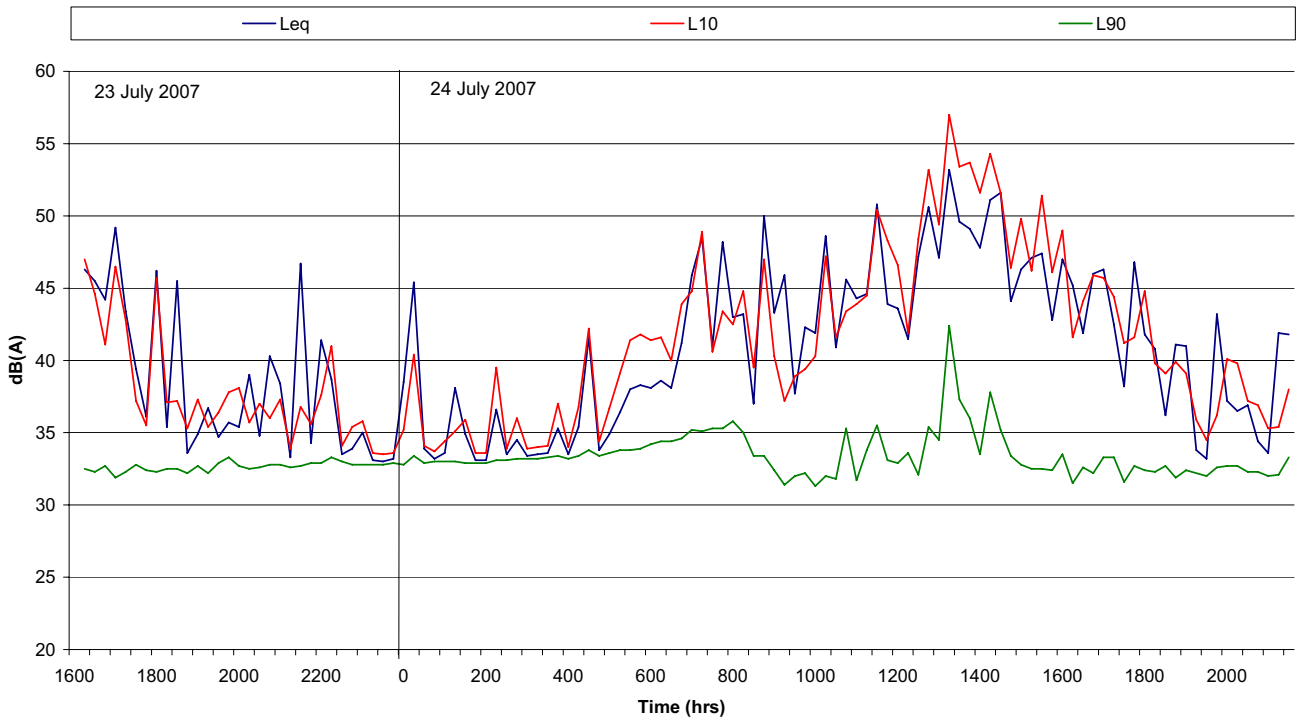
The results of noise monitoring at locations in the Woomera Township are presented in Table D12 below. Measurements were for a period of at least 15 minutes.

Location (Figure D2)	Time	Date	L_{Aeq} (dB)	L_{A10} (dB)	L_{A90} (dB)	L_{A95} (dB)	Comments
V	02:00	24/07/07	28	29	28	28	Noise monitoring was conducted over 2 days between 23 and 24 July 2007, results are presented in Graph D12. Located at the south east extent of the Woomera Township, across the road from residential property. No noise sources audible.
U	23:30	23/07/07	33	34	33	33	Noise monitoring was conducted over 2 days between 23 and 24 July 2007, results are presented in Graph D13. Located at the south west extent of the Woomera Township, across the road from residential property. Distant traffic can be heard on Roxby Downs Road an in the Township. No other noise source is audible.

Table D12: Noise Monitoring at Locations in the Woomera Township



Graph D12: 15 Minute Duration Noise Monitoring at Position V (See Figure D2)



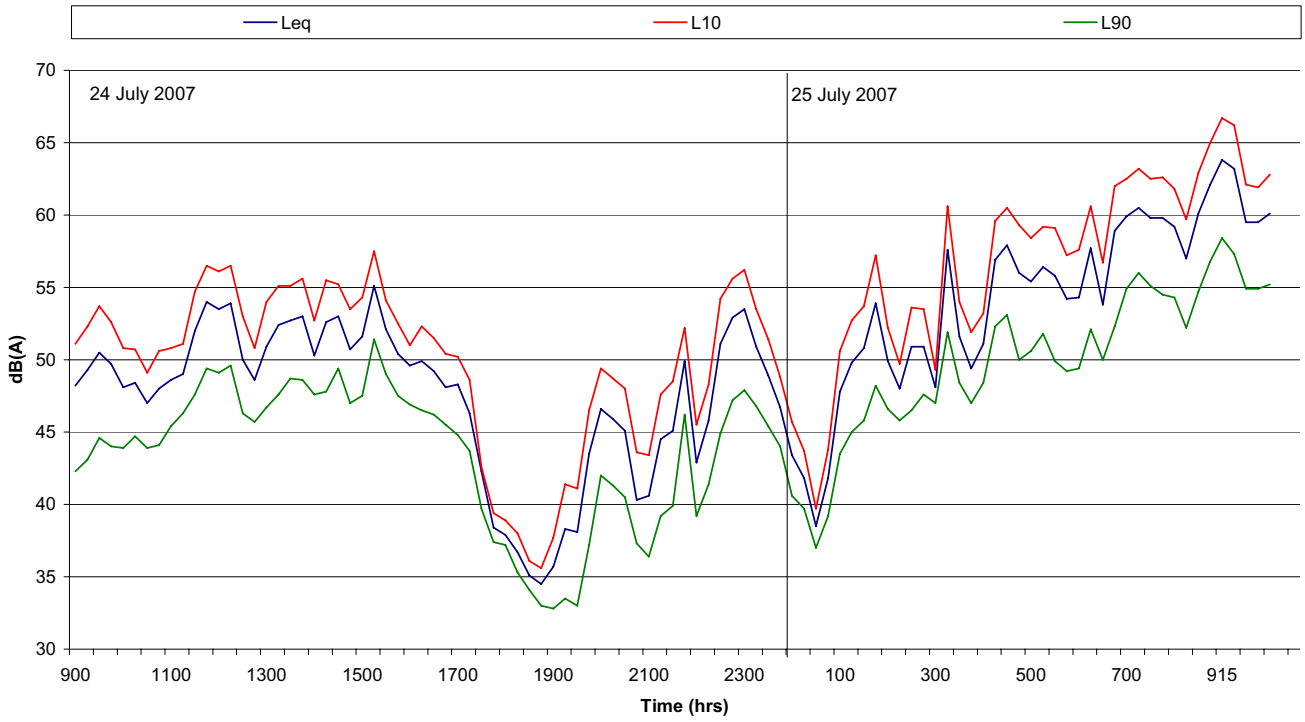
Graph D13: 15 Minute Duration Noise Monitoring at Position U (See Figure D2)

D4.5 Point Lowly

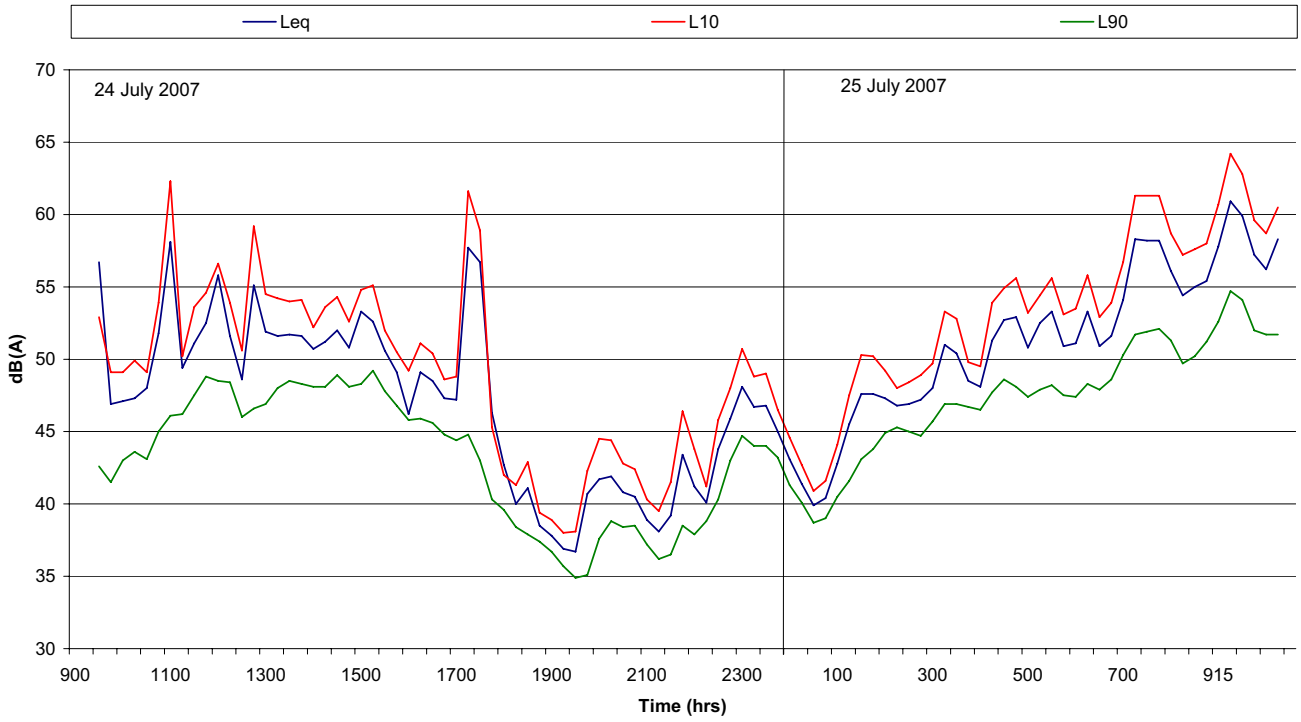
The results of noise monitoring at locations in Point Lowly are presented in Table D13 below. Measurements were for a period of at least 15 minutes.

Location (Figure D3)	Time	Date	L_{Aeq} (dB)	L_{A10} (dB)	L_{A90} (dB)	L_{A95} (dB)	Comments
W	18.45	24/07/07	35	36	33	33	Noise monitoring was conducted over 2 days between **24 and 25 July 2007**, results are presented in Graph D14. Located at across the road from the residential property closest to the proposed desalination plant. Wind and wave noise audible and noise from the refinery occasionally audible.
X	23:30	23/07/07	33	34	33	33	Noise monitoring was conducted over 2 days between 24 and 25 July 2007, results are presented in Graph D15. Located at across the road from the residential property in vicinity of the proposed desalination plant. Wind and wave noise audible and noise from the refinery occasionally audible.

Table D13: Noise Monitoring at Locations in the Point Lowly



Graph D14: 15 Minute Duration Noise Monitoring at Position W (See Figure D3)



Graph D15: 15 Minute Duration Noise Monitoring at Position X (See Figure D3)

D5 Source Noise Measurements

Details of noise measurements conducted at the Olympic Dam operation site are provided below. Both attended noise measurements and noise monitoring were conducted.

D5.1 Attended Noise Measurements

Attended noise measurements were conducted for all major noise sources associated with the Olympic Dam operation. Details and results for these measurements are provided in Table D14 below.

Meteorological conditions during the attended noise measurements at the Olympic Dam operation site were mostly overcast with northerly wind with a wind speed of up to 4.6 m/s, relative humidity up to 32% and a temperature up to 30°C.

Item/Source	dB(A)	Measured Sound Pressure Level (dB re 20 X 10^{-6} Pa)								Comments
		63	125	250	500	1k	2k	4k	8k	
Acid Plant exhaust	79	80	81	78	76	74	72	65	56	Two exhaust outlets in Acid Plant facade each at equal distance of approximately 5 m from the measurement (2 m in elevation). Acid Plant Steam Offtake only just barely audible during measurement. Location 17 on Figure D5.
Acid Plant compressor shed	78	77	77	75	75	73	70	63	52	Measurement taken at approximately 2 m from the Acid Plant main compressor façade. Location 11 on Figure D5.
Acid Plant steam offtake	83	70	68	69	75	77	79	74	66	Steam outlet at approximately 5 m elevation and measured at approximately 5 m away from the base. **Location 9 on** Figure D5.
ANI Mill	86	93	90	87	83	80	77	75	72	Measurement taken at approximately 1 m from the ANI mill grinding wheel. Grinding wheel is approximately 6 m wide with a 6 m diameter. Location 7 on Figure D5.
Cooling Tower pumps	81	78	81	81	76	75	73	71	68	Two pumps at an equal distance of approximately 6 m were audible at the measurement location. Location 16 on Figure D5.
Desalination Plant Cooling Towers	79	88	83	82	78	72	65	56	51	Measurement taken at approximately 2 m from the cooling tower set.
Desalination Plant Pumpshed	89	84	85	89	89	84	78	71	65	Measurement taken 1 m from northern most pump. Reverberant noise build-up in shed is audible.
Desalination Plant pump	81	75	76	72	74	79	74	62	53	Measurement taken 1 m from pump. Other pumps not audible at this location.
Desalination Plant Storage Tank pump	78	74	75	83	77	70	67	59	53	Measurement taken 1 m from pump. Other pumps not audible at this location.
Feed Prep Water cooling fans	91	88	84	84	82	74	74	89	82	Measurement taken at approximately 5 m from fan. Other fans not audible at this location. Location 18 on Figure D5.
Feed Prep exhaust	69	72	73	71	68	62	57	53	47	Two exhaust outlets on the Feed Prep building at an equal distance of approximately 20 m were audible at the location. Location

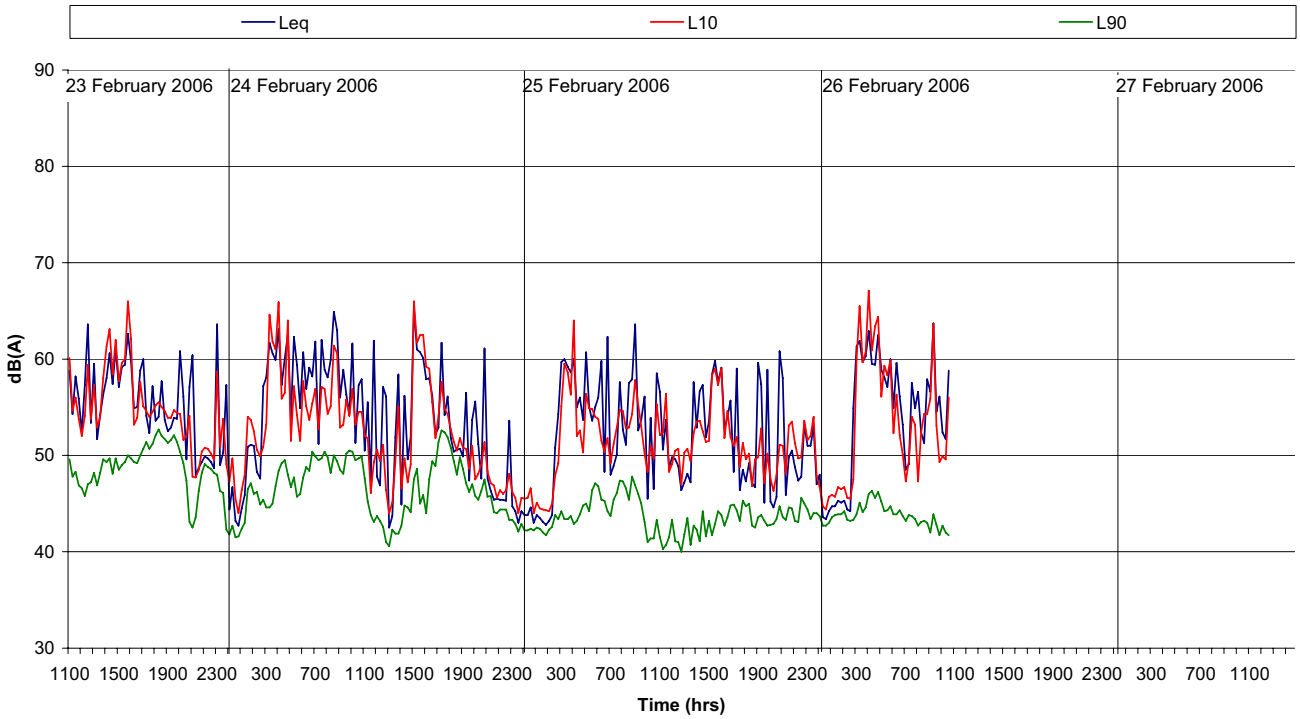
Item/Source	dB(A)	Measured Sound Pressure Level (dB re 20 X 10^{-6} Pa)								Comments
		63	125	250	500	1k	2k	4k	8k	
										19 on Figure D5.
Feed Prep Hydraulic Pump shed	83	73	73	76	82	78	75	70	65	Measurement taken at approximately 1.5 m from the Feed Prep Hydraulic Pump shed façade. Location 21 on Figure D5.
Floatation Circuit Air pumps	79	79	82	78	73	76	73	65	60	Measurement taken at approximately 1 m from the Floatation Circuit air pumps shed façade. Location 15 on Figure D5.
Gold Room NOX scrubbing system	71	72	74	71	68	64	65	61	55	Measurement taken approximately 2 m from source. Location 24 on Figure D5.
Gold Room Roaster Off-Gas scrubbing system	88	77	72	74	74	72	76	83	85	Measurement taken approximately 2 m from source. Location 13 on Figure D5.
Mill 2	92	99	95	95	90	86	82	77	71	Measurement taken at approximately 1 m from the mill grinding wheel. Grinding wheel is approximately 5 m wide with a 11 m diameter. Location 2 on Figure D5.
Mill 2 Vibrating Screen	93	93	91	91	87	87	85	85	84	Measurement taken at approximately 1 m from an opening in the vibrating screen. Opening was approximately 5 m X 2 m. Location 12 on Figure D5.
Mill 3	90	90	93	93	88	85	79	76	71	Measurement taken at approximately 1 m from the mill grinding wheel. Grinding wheel is approximately 6 m wide with a 11 m diameter. Location 3 on Figure D5.
Mill 3	79	80	80	83	76	72	68	65	61	Measurement taken at approximately 10 m from the base of Mill 3. Mill 3 the only audible source at this location
Mill 3 Vibrating Screen	96	87	91	88	86	85	86	91	91	Measurement taken at approximately 1 m from an opening in the vibrating screen. Opening was approximately 5 m X 2 m. Location 10 on Figure D5.
AF and EF Off-Gas Fans	90	89	89	89	90	82	76	74	73	Measurement taken at approximately 3 m from the Off-Gas Fan. Other fans and motors not audible at this location. Location 8 on Figure D5.
AF and EF Off-Gas Motors	79	82	81	82	76	74	66	61	56	Measurement taken at approximately 3 m from a set of 3 audible motors. Off-Gas fans not audible at this location. Location 23 on Figure D5.
Oxygen Plant Compressor	93	78	78	83	76	81	86	90	78	Measurement taken at 3 m from the Oxygen Plant Compressor. Location 14 on Figure D5.
PLS Pumpset	69	67	64	62	69	63	60	54	46	Measurement taken at 5 m from the PLS pumpset (7 pumps audible: 3 PLS pumps and 4 Fire Water Pumps. Location 25 on Figure D5.
Refinery Electrical Substation	77	73	75	71	75	74	69	63	57	Measurement taken at approximately 1 m from the

Item/Source	dB(A)	Measured Sound Pressure Level (dB re 20 X 10^{-6} Pa)								Comments
		63	125	250	500	1k	2k	4k	8k	
										substation façade. Location 22 on Figure D5.
Regrind Mill	105	89	91	96	108	90	82	79	71	Measurement taken at approximately 1 m from the mill grinding wheel. Grinding wheel is approximately 5 m wide with a 6 m diameter. Location 5 on Figure D5.
Shaft Furnace Stack	80	82	79	79	75	72	73	72	67	Measurement taken at 15 m from the Shaft Furnace Stack outlet. Location 6 on Figure D5.
Smelter Ventilation System Exhaust	87	90	92	89	86	81	77	73	65	Two exhaust outlets on the Smelter building at an equal distance of approximately 10 m were audible at the location. Location 1 on Figure D5.
Steam Release (ground level)	87	81	79	76	74	73	75	80	87	Measurement taken at approximately 1 m steam outlet.
Steam Trap	100	84	84	83	90	96	94	93	89	Steam outlet at approximately 10 m elevation. Measurement taken at approximately 2 m from outlet. Location 4 on Figure D5.
Tailings Disposal Pumps	79	73	69	69	71	77	70	70	66	7 pumps in set, measurement taken at approximately 3 m from southern most pump where only 1 pump was audible. Location 20 on Figure D5.
Tailings Disposal Pumps	82	70	66	67	73	71	72	76	78	Measurement taken approximately 5 m to the west of the pump set, with all pumps audible during the measurement.
Raise Bore Exhaust	73	79	79	79	68	62	58	55	48	Measurement taken at approximately 10 m from the exhaust outlet with a 3.5 m metal barrier between outlet and measurement location. Location 26 on Figure D5.
Raise Bore Fan/Motor	75	85	84	78	70	68	65	60	52	Two motors at an equal distance of approximately 5 m were audible at the location. Motors at an elevation of approximately 4 m. Location 26 on Figure D5.

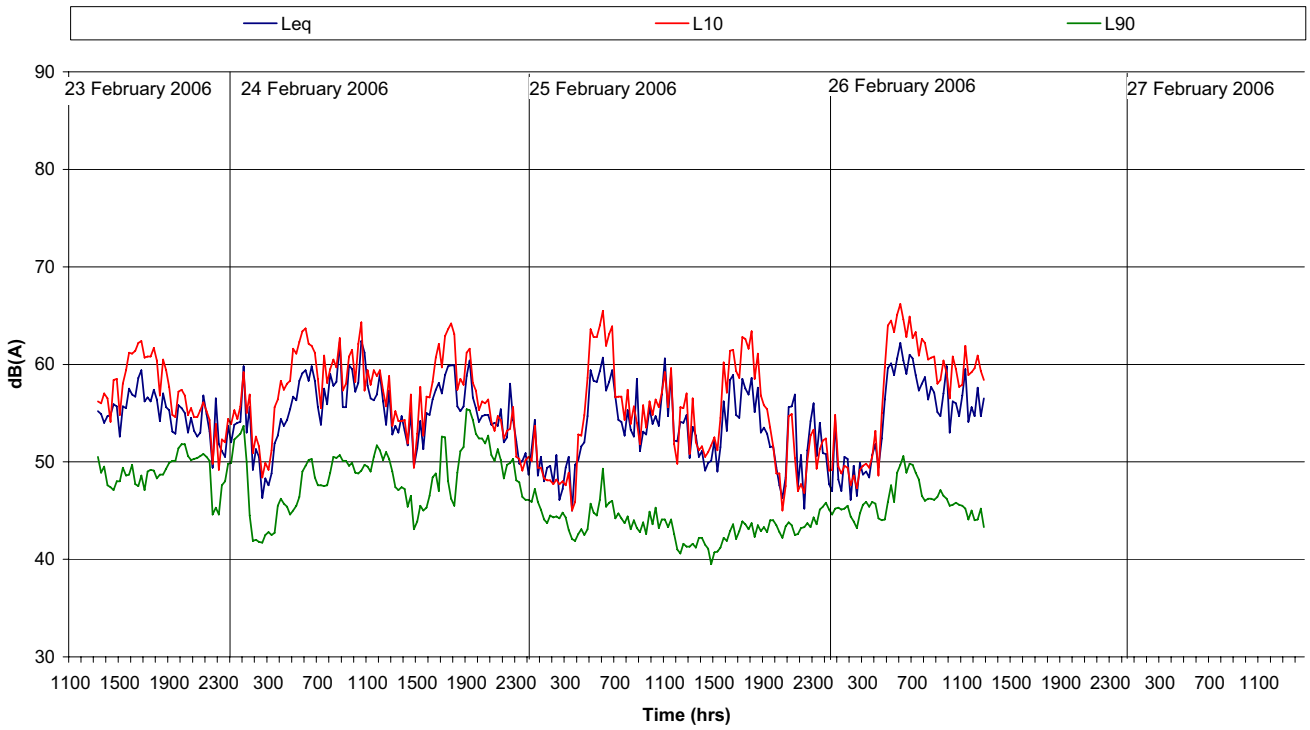
Table D14: Attended Noise Measurements at the Olympic Dam Operation Site

D5.2 Noise Monitoring

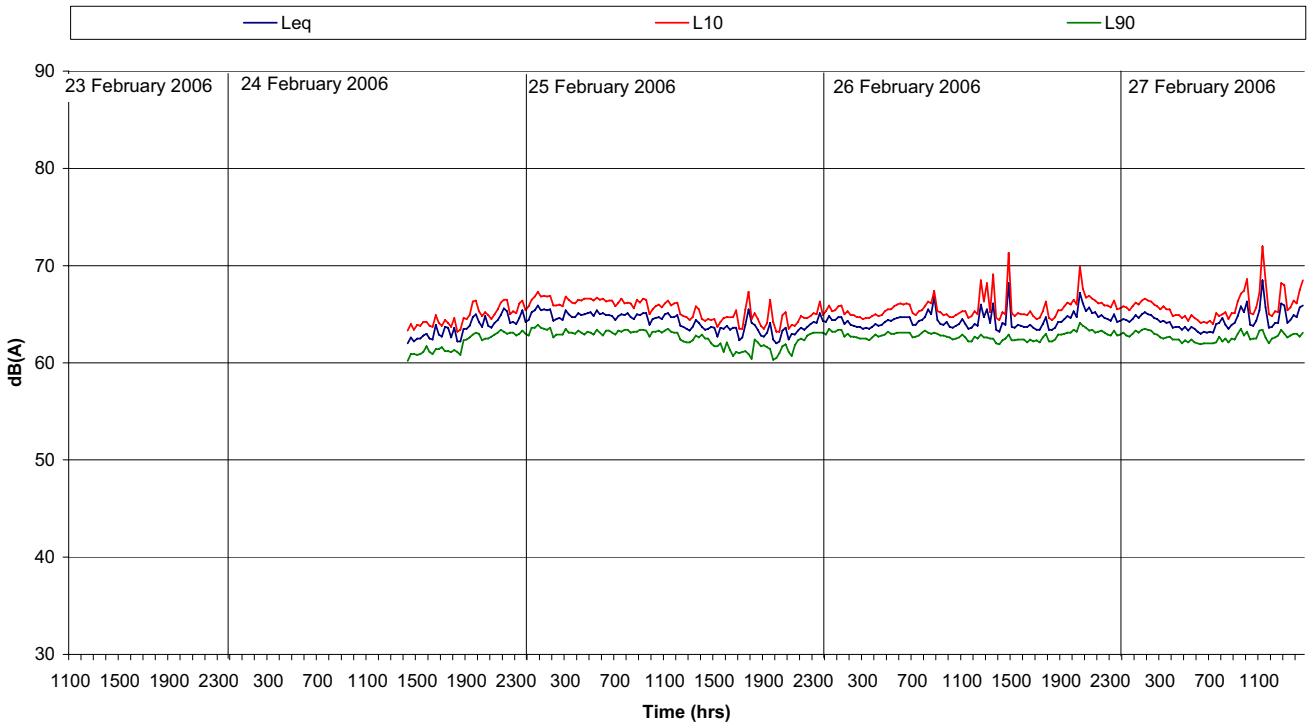
Noise loggers were setup at strategic locations within the Olympic Dam operation site to determine existing noise levels. The locations of the measurements have been provided in Figure D5 in Appendix D. The results of these measurements are provided in Graph D15 to Graph D21 below.



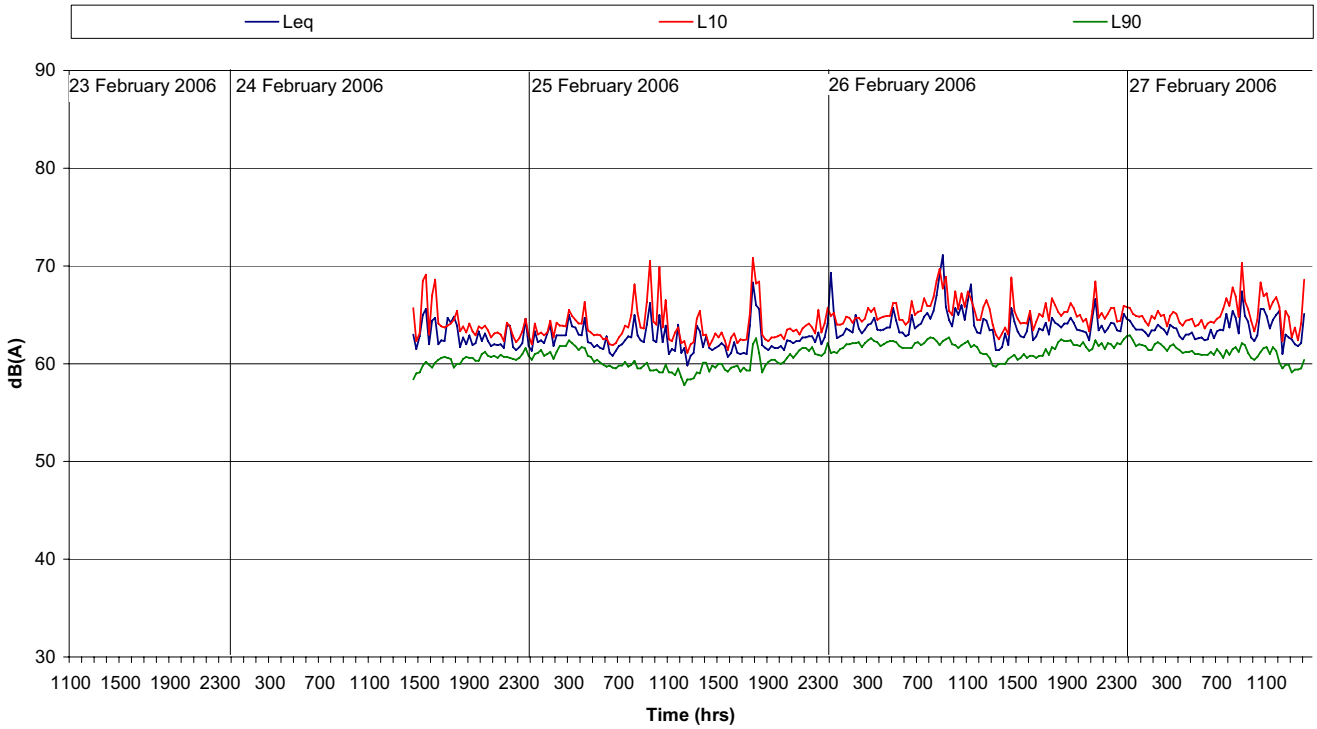
Graph D16: 15 Minute Duration Noise Monitoring at Position J (See Figure D5)



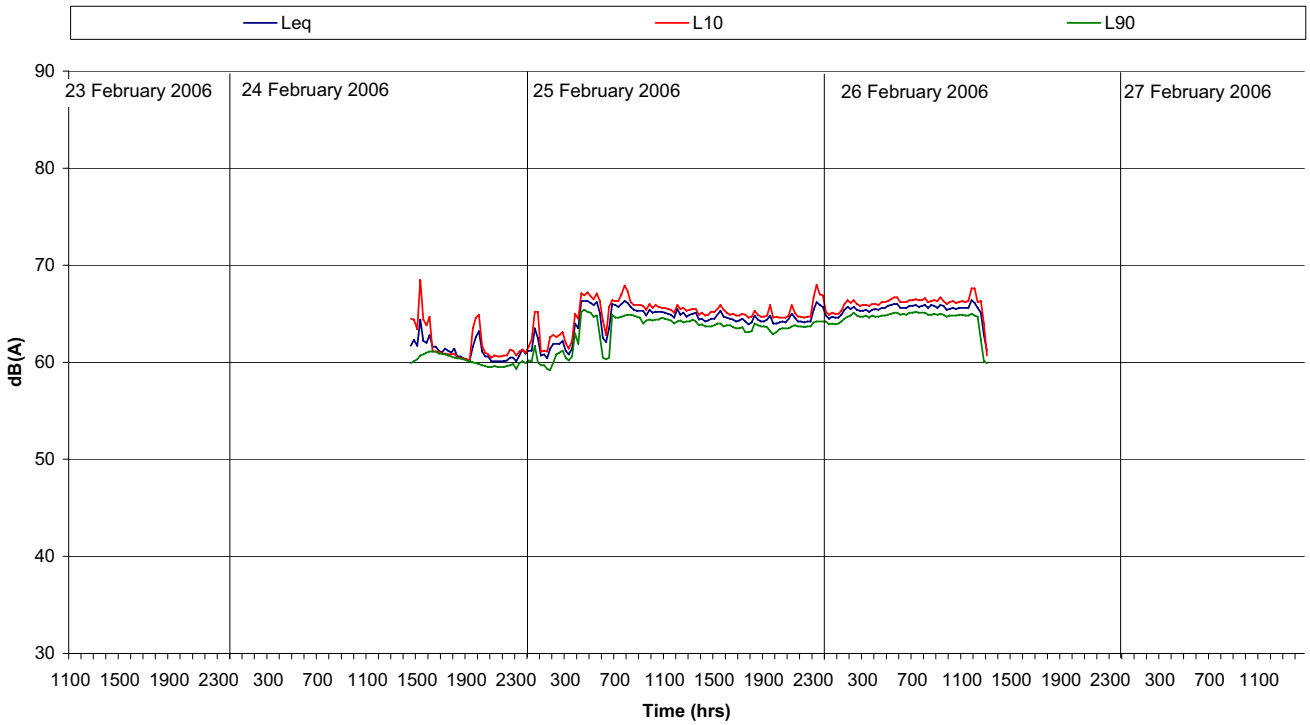
Graph D17: 15 Minute Duration Noise Monitoring at Position K (See Figure D5)



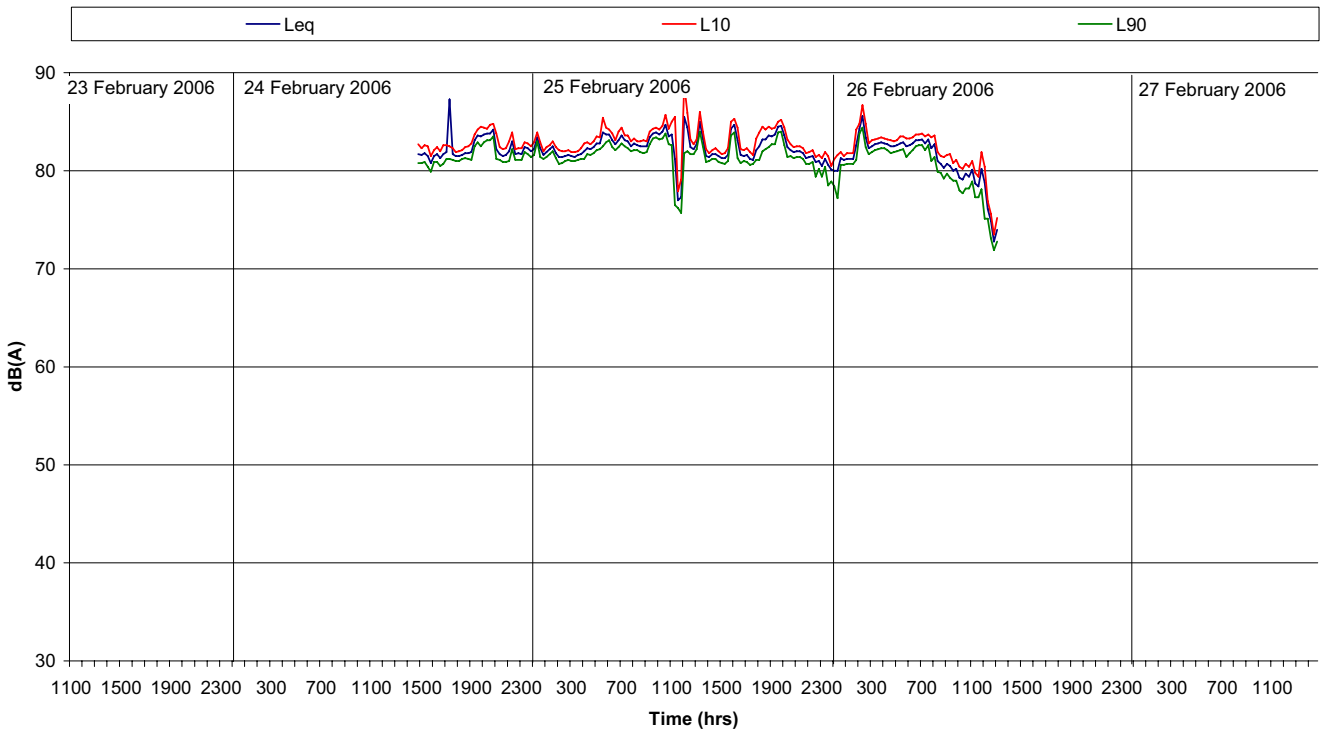
Graph D18: 15 Minute Duration Noise Monitoring at Position Q (See Figure D5)



Graph D19: 15 Minute Duration Noise Monitoring at Position R (See Figure D5)



Graph D20: 15 Minute Duration Noise Monitoring at Position S (See Figure D5)



Graph D21: 15 Minute Duration Noise Monitoring at Position T (See Figure D5)

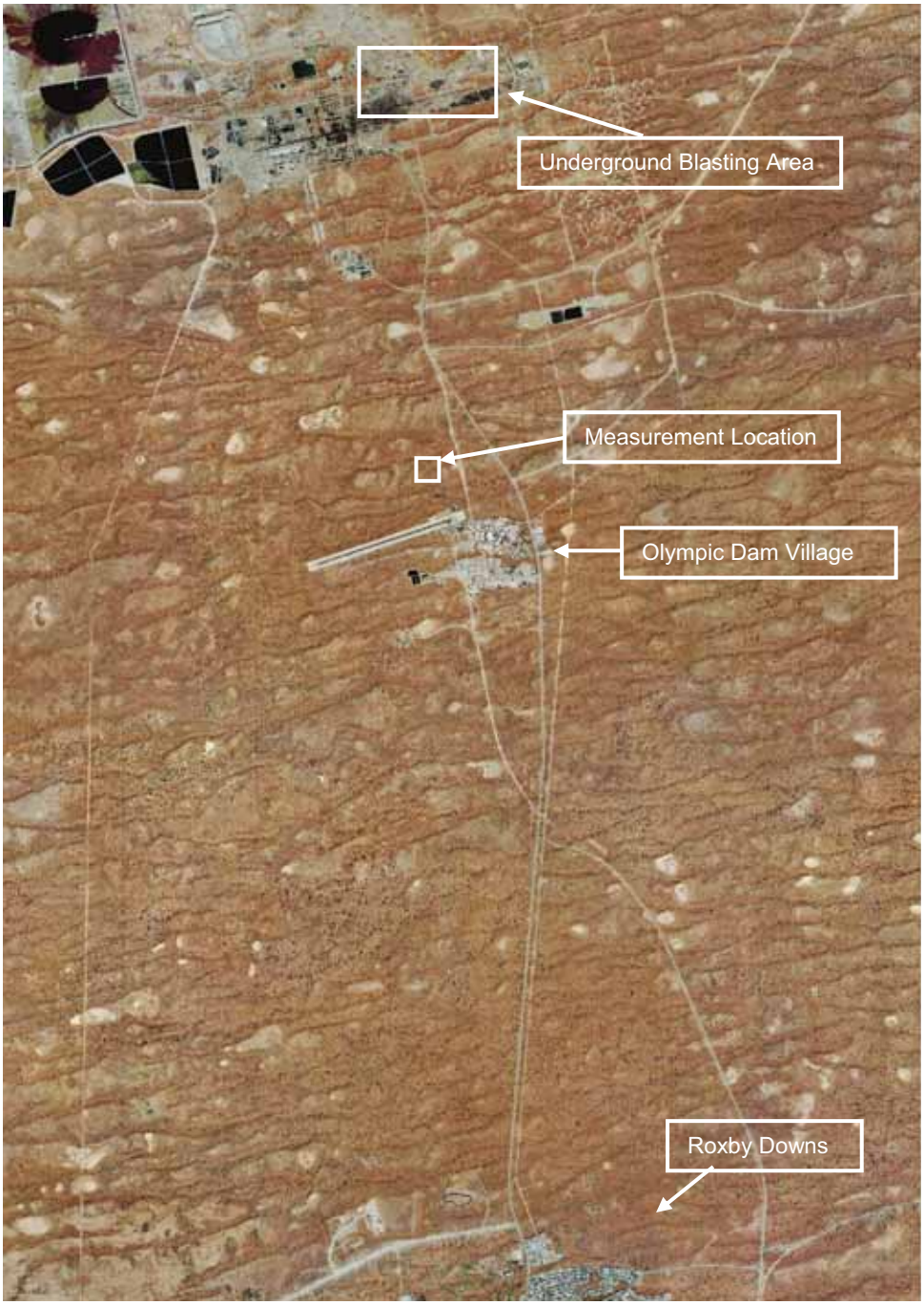
D6 Vibration Measurements

Vibration measurements were conducted at the location shown in Figure D 8 below (located on the mining lease boundary). The measurements were conducted on 28 February 2006 from 7.00am to 8.00am. During this time it was advised that underground development blasting was being carried out[50] . See the figure below for the location of blasting activity with respect to the measurement location and sensitive receivers.

No vibration was detected underfoot and the measurements conducted do not display any readings above the ambient measurements conducted at the same location.

Continuous vibration from industrial sources such as the grinding mills was not detected in this measurement.

[50] Email from Kate Frost, Senior Engineer Mine Projects Macmahon Mine Development Superintendent, dated 28 February 2006


Underground Blasting Area
Measurement Location
Olympic Dam Village
Roxby Downs

ArupAcoustics

Appendix E

Results of Baseline Acoustic Predictions

E1 Results of Baseline Acoustic Predictions

E1.1 Scenario 1

Scenario 1 occurred between 03:30 and 04:30 hours on 25 February 2006 with no major equipment shutdown. Meteorological conditions at this time consisted of; a temperature of 25°C, relative humidity of 57% and a southerly (140°) wind at 8.2 m/s.

The predicted noise levels and the measured range of noise levels between 03:30 and 04:30 hours are provided in Table E1 below. Noise contours for the Olympic Dam operation site and the Roxby Downs Township for Scenario 1 follow.

Location (Figure D5)	Predicted Value SPL, dB(A)	Measured Range ($dBL_{Aeq,\ 15\ minute}$)	Difference (dB)	Comments
J	54	55-59	1-5	This location is adjacent to a car park, however, it is not considered that traffic noise affected this measurement. An overall hum from the operation was audible at this location. It is predicted that the smelter ventilation exhaust outlets and shaft furnace are the most significant noise contributors at this location.
K	52	50-52	0-2	This location is at the operation fence line and has direct line of sight to the grinding mills. It is predicted that the steam trap and mills are the most significant noise contributors at this location.
Q	68	65	3	This location is to the north west of the Acid Plant. It is predicted the Off Gas fans and motors and Acid Plant steam relief exhausts are the most significant noise contributors at this location.
R	65	62-65	0-3	This location is north east of smelter 2, adjacent to the PLS pond. It is predicted that the oxygen plants and smelter exhaust outlets are the most significant noise contributors at this location.
S	69	64-66	3-5	This location is to the north of the grinding mills and south of the electrical substation. Mill 3 is the most significant noise contributor at this location.
T	83	82	1	This location is underneath the broadway piper rack to the south of the Mill area. It is predicted that the Regrind mills, ANI mill and the steam trap are the most significant noise contributors at this location.

Table E1: Acoustic Model Results for Scenario 1

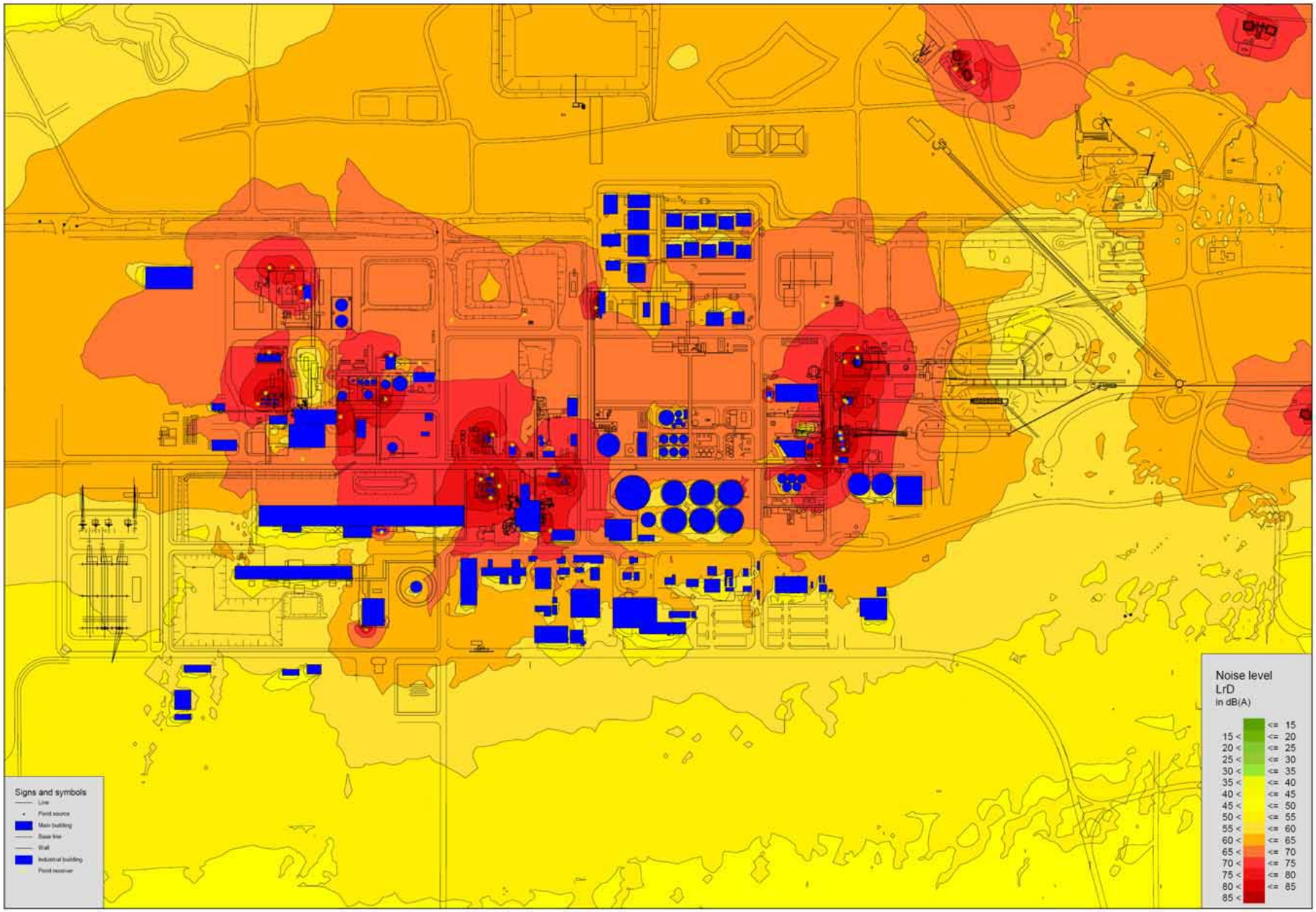


Figure E1: Noise Contours for the Olympic Dam Operation, Scenario 1 (Sound Pressure Level, dB(A))

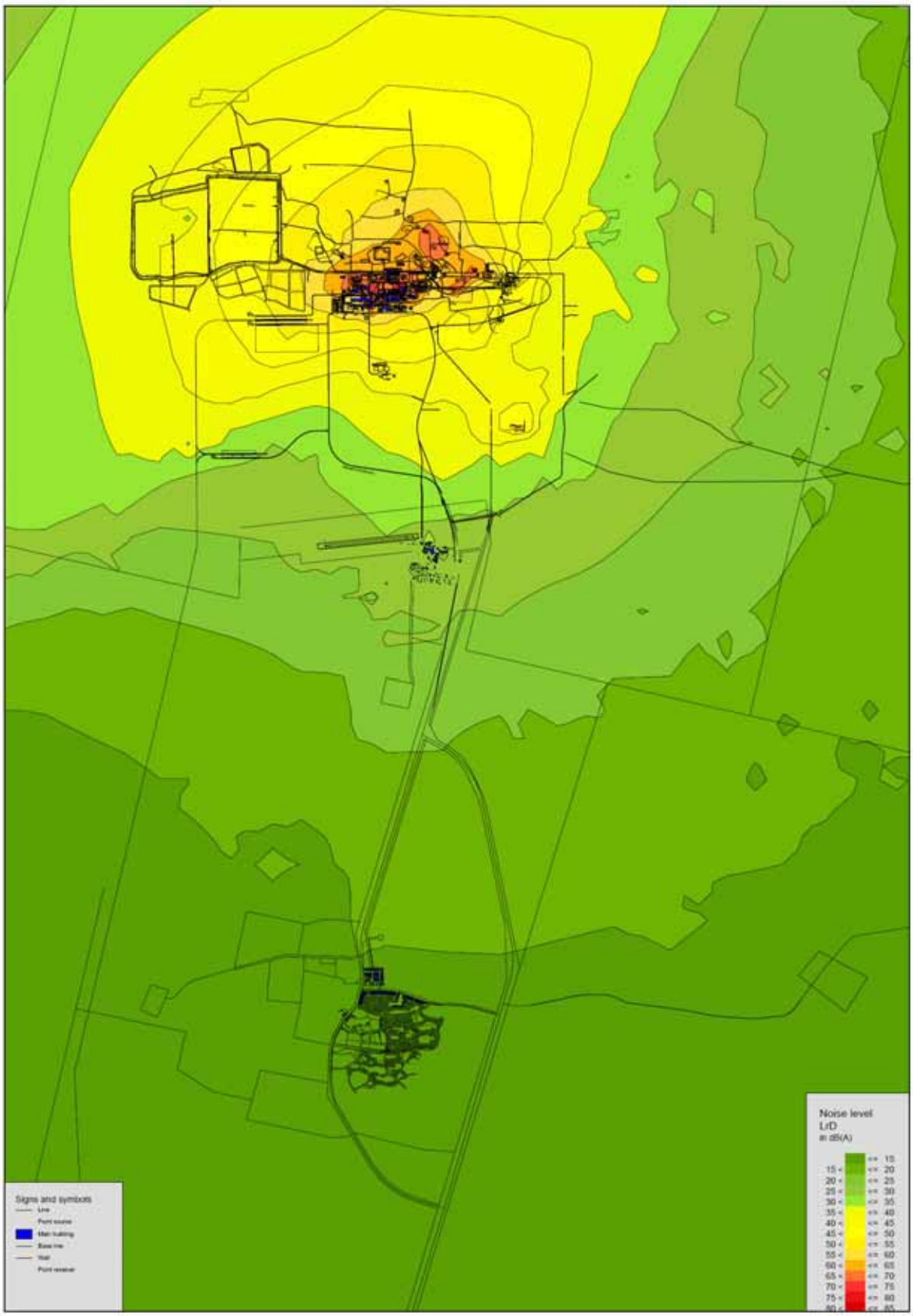


Figure E2: Noise Contours for the Roxby Downs Township, Scenario 1 (Sound Pressure Level, dB(A))

E1.2 Scenario 2

Scenario 2 occurred between 15:30 and 16:30 hours on 24 February, 2006. During this time, Mill 3 was not in operation and therefore noise associated with it was not included in the acoustic model. Meteorological conditions at this time consisted of; a temperature of 35°C, relative humidity of 26% and a northerly (30°) wind of 3.6 m/s.

The predicted values and the measured range between 15:30 and 16.30 hours are provided in Table E2 below and noise contours for the Olympic Dam operation site and the Roxby Downs Township for Scenario 2 follow.

Location (Figure D5)	Predicted SPL dB(A)	Measured Range (dBL_{Aeq})	Difference	Comments
J	58	56-60	0-2	This location is adjacent to a car park, however, it is not considered that traffic noise affected this measurement. An overall hum from the operation was audible at this location. It is predicted that the smelter ventilation exhaust outlets and shaft furnace are the most significant noise contributors at this location.
K	58	55-57	1-3	This location is at the operation fence line and has direct line of sight to the grinding mills. The steam trap and mills are the most significant noise contributors at this location. Note that Mill 3 is not operating for this scenario.
Q	66	62-64	2-4	This location is to the north west of the Acid Plant. The Off gas fans and motors and acid plant steam relief exhausts are the most significant noise contributors at this location.
R	61	62-65	1-4	This location is north east of smelter 2, adjacent to the PLS pond. Oxygen plants and smelter exhaust outlets are the most significant noise contributors at this location.
S	62	62-63	0-1	This location s to the north of the grinding mills and south of the electrical substation. Mill 2, Regrind Mills and ANI mill are the most significant noise contributors at this location, as Mill 3 is not operating for this scenario.
T	83	81-82	1-2	This location is underneath the broadway piper rack to the south of the Mill area. Regrind mills, ANI mill and the steam trap are the most significant noise contributors at this location.

Table E2: Acoustic Model Results for Scenario 2

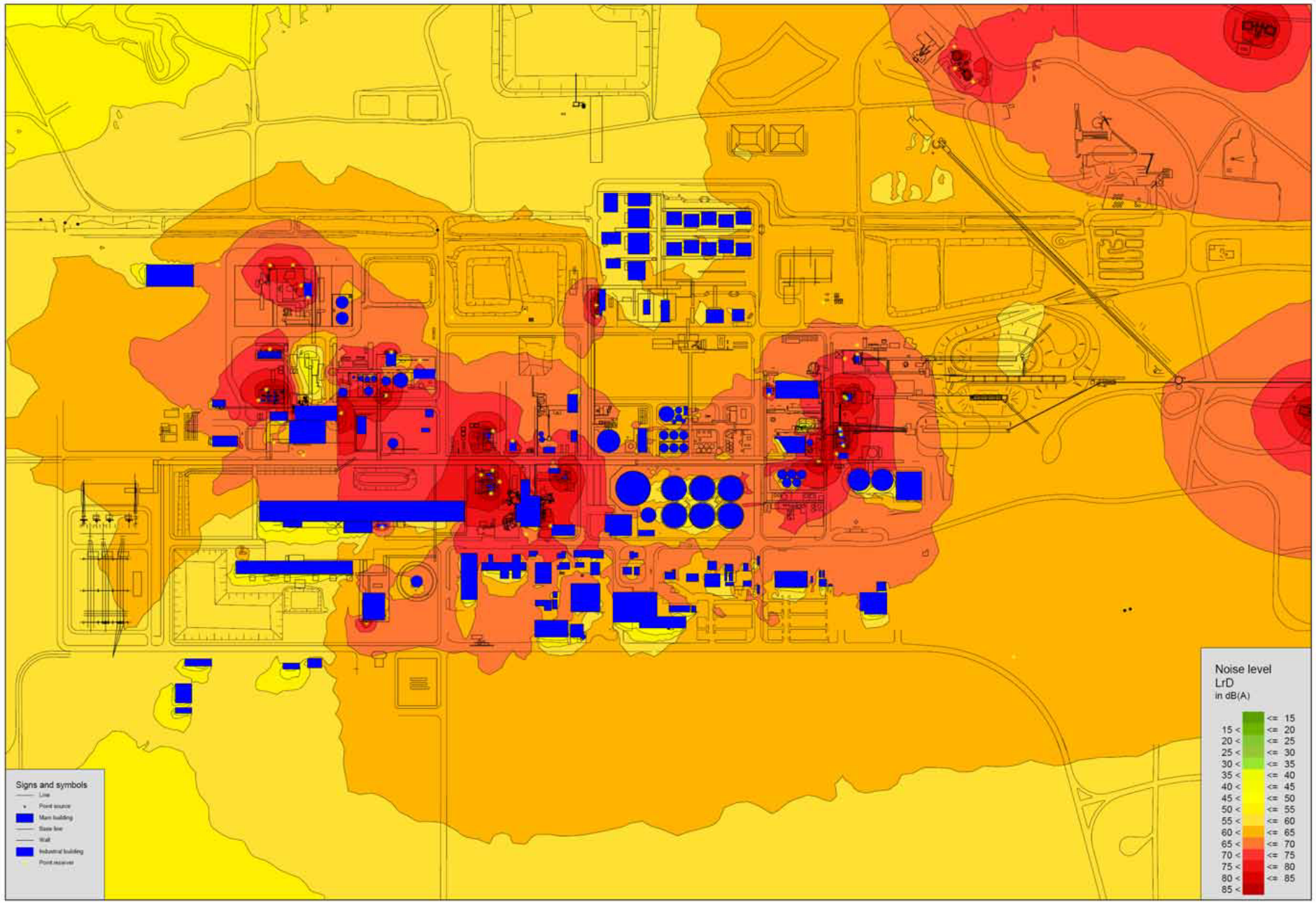


Figure E3: Noise Contours for the Olympic Dam Operation, Scenario 2 (Sound Pressure Level, dB(A))

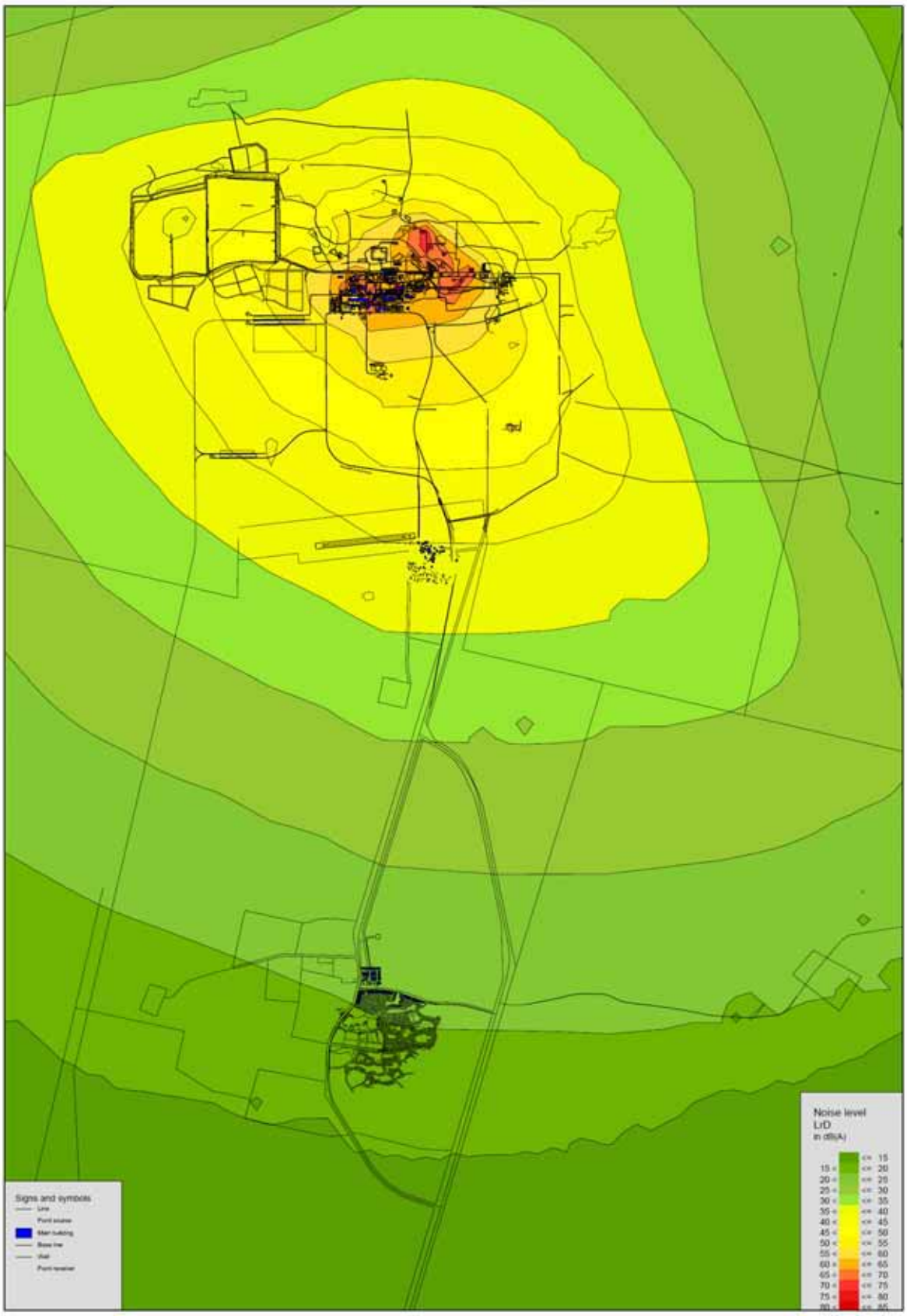


Figure E4: Contours for the Roxby Downs Township, Scenario 2 (Sound Pressure Level, dB(A))

E1.3 Scenario 3

Scenario 3 occurred between 22:30 and 23:30 hours on 25 February, 2006 with no major equipment shutdown. Meteorological conditions at this time consisted of; a temperature of 27°C, Relative Humidity of 55% and no measured wind.

The predicted values and the measured range between 22:30 and 23.30 hours are provided in Table E3 and noise contours for the Olympic Dam operation site and the Roxby Downs Township for Scenario 3 follow.

Location (Figure D5)	Predicted SPL (dB)	Measured Range (dBL_{Aeq})	Difference	Comments
J	56	51-53	3-5	This location is adjacent to a car park, however, it is not considered that traffic noise affected this measurement. An overall hum from the operation was audible at this location. It is predicted that the smelter ventilation exhaust outlets and shaft furnace are the most significant noise contributors at this location.
K	56	54-56	0-2	This location is at the operation fence line and has direct line of sight to the grinding mills. The steam trap and mills are the most significant noise contributors at this location.
Q	65	64-65	0-1	This location is to the north west of the Acid Plant. The Off gas fans and motors and acid plant steam relief exhausts are the most significant noise contributors at this location.
R	62	62-63	0-1	This location is north east of smelter 2, adjacent to the PLS pond. Oxygen plants and smelter ventilation exhaust outlets are the most significant noise contributors at this location.
S	68	64-66	2-4	This location s to the north of the grinding mills and south of the electrical substation. Mill 3 is the most significant noise contributor at this location.
T	83	81	2	This location is underneath the broadway piper rack to the south of the Mill area. Regrind mills, ANI mill and the steam trap are the most significant noise contributors at this location.

Table E3 Acoustic Model Results for Scenario 3

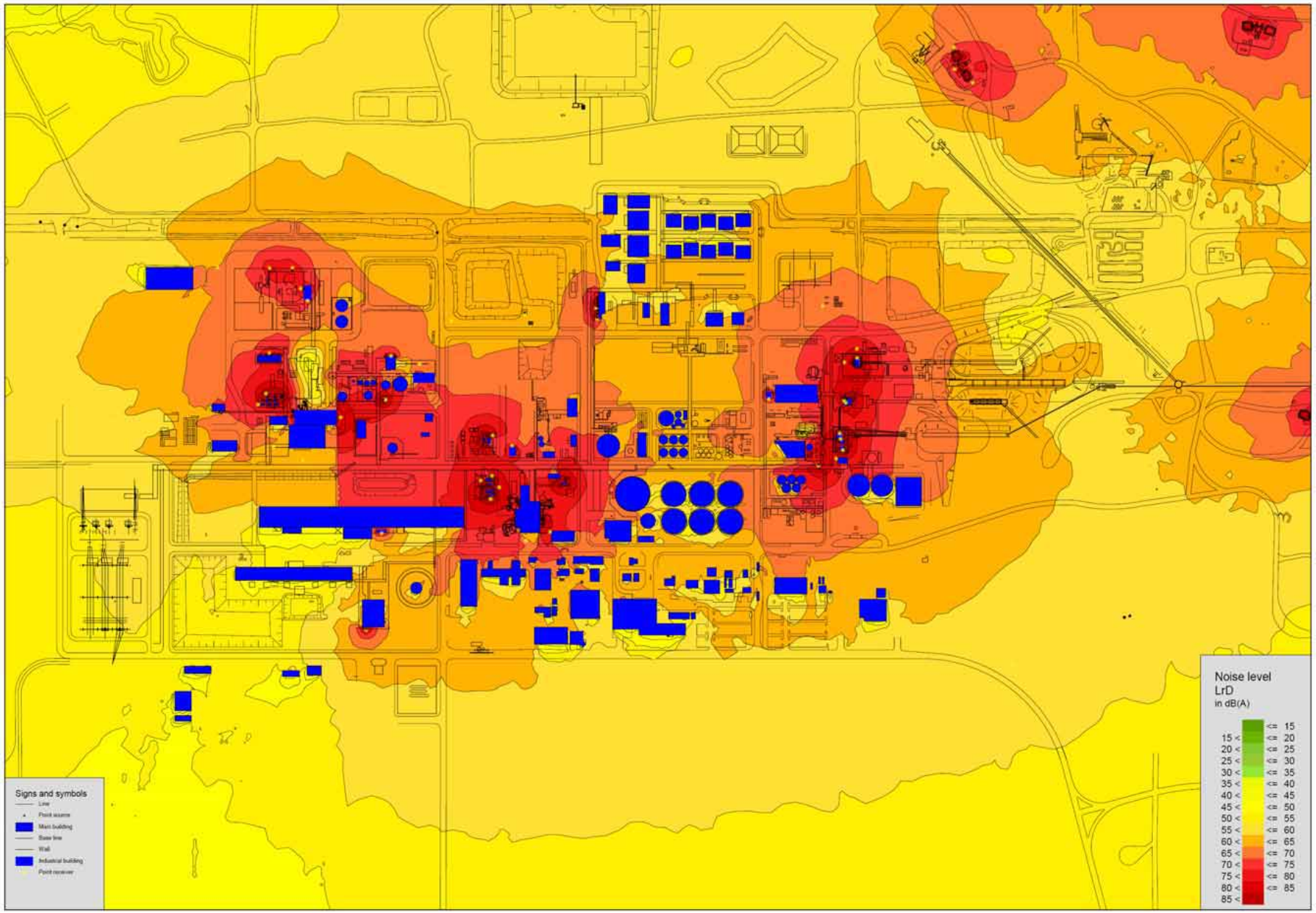


Table E4: Noise Contours for the Olympic Dam Operation, Scenario 3 (Sound Pressure Level, dB(A))

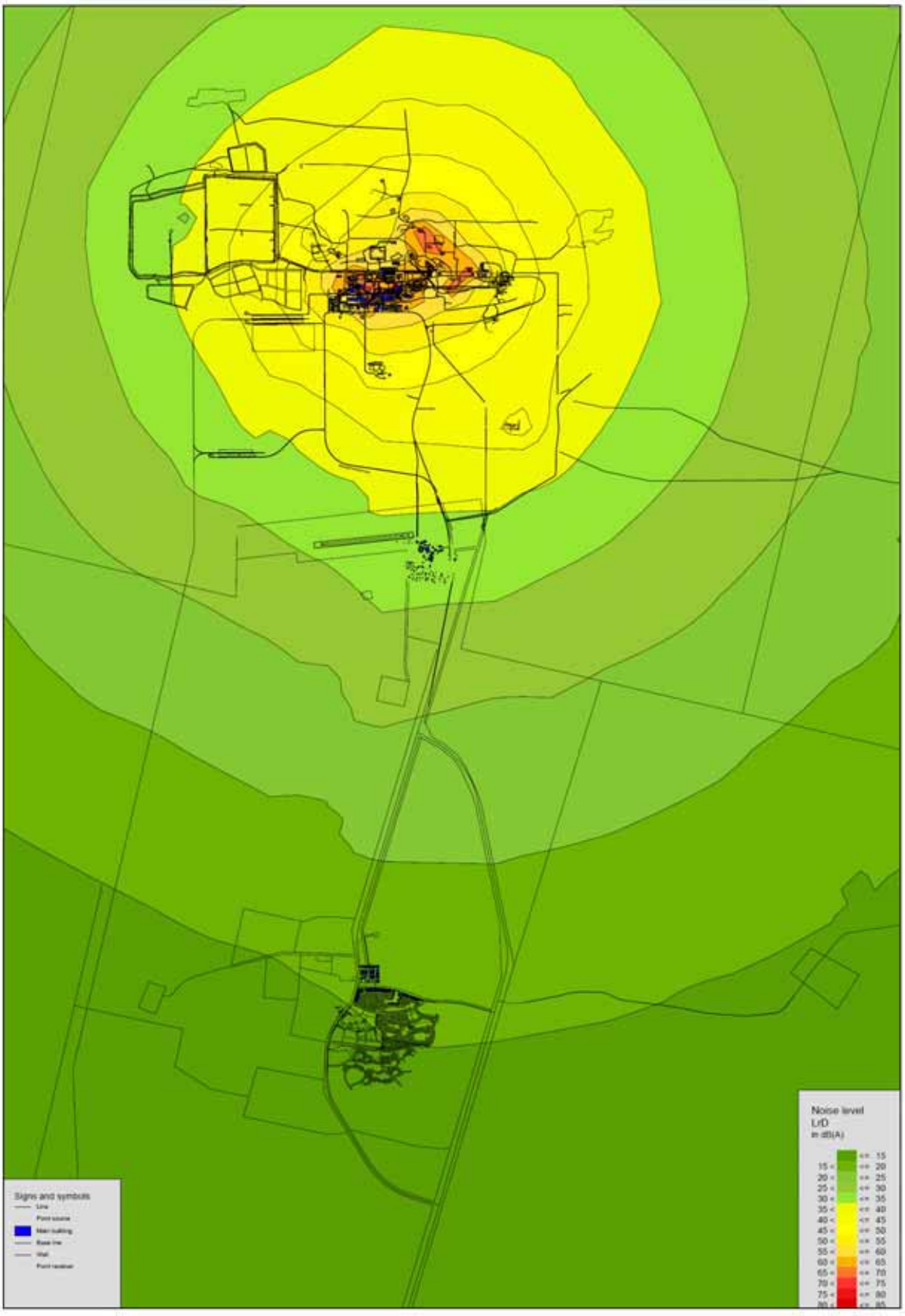


Figure E5: Noise Contours for Roxby Downs Township, Scenario 3 (Sound Pressure Level, dB(A))

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Appendix F

Expanded Operation Equipment

F1 Equipment Modelled for the Expanded Operation

F1.1 Mobile Machinery

- 148 X CAT 797 Haul Trucks
- 5 X CAT 793 Haul Trucks
- 3 X CAT 777 Haul Trucks
- 6 X CAT D11 Tracked Bulldozers
- 4 X CAT D10 Tracked Bulldozers
- 9 X CAT 854 Wheeled Bulldozers
- 9 X P&H 4100 XPB Rope Shovels
- 2 X Komatsu PC 8000 Hydraulic Shovels
- 2 X Komatsu PC 300 Hydraulic Excavators
- 9 X CAT 854 Wheeled Bulldozers
- 9 X P&H 4100 XPB Rope Shovels
- 2 X Komatsu PC 8000 Hydraulic Shovels
- 2 X Komatsu PC 300 Hydraulic Excavators
- 2 X Hitachi EX 2500 Hydraulic Excavators
- 3 X CAT 994 Loaders
- 1 X CAT 980 Loader
- 6 X CAT 785 Water Trucks
- 4 X CAT 24H Graders
- 2 X CAT 16G Graders
- 8 X Bucyrus 49 HR Drill Rigs
- 2 X P&H 2500 XP Drill Rigs
- 4 X IR DM45 Drill Rigs
- 5 X CAT 988 Cable Handlers
- 2 X CAT 988 Tyre Handlers
- 4 X CAT 773 Lube Trucks
- 2 X CAT 793 Tow Trucks

F1.2 Processing Plant

The proposed processing equipment for the expanded operation, in addition to the existing processing plant is listed below.

- 4 X Acid Plant
- 4 X Cooling Towers
- 4 X Flotation Pumps
- 10 X Grinding Mills
- 4 X Off Gas System
- 4 X Oxygen Plants
- 1 X Steam Trap

- 10 X Vibrating Screen

F1.3 CCGT

The plant associated with the CCGT power station is listed below:

- Turbine Assembly
- Exciter
- Condensers
- Transformers
- Electric Motors
- Large Pumps
- Auxiliary Boiler
- Heat Recovery Device
- Cooling Towers

F1.4 Desalination Plant

F1.4.1 Scenario 1 – Construction

Standard construction activities are expected to take place at Point Lowly during the construction of the desalination plant. Items of equipment that have been included in the acoustic model are:

- Concrete Pumps
- Dump Trucks
- Wheeled Mobile Crane
- Welders (hand held)
- Standard Dump Trucks
- Gas Cutters
- Cement Mixers
- Scissor Lifts
- Circular Saws
- Diesel Generators
- Water Pumps
- Dust Suppression Unit Trailers
- Angle Grinders
- Diesel Bowser
- Water Bowser

F1.4.2 Scenario 2 - Operation

Major noise sources that are expected to be part of the desalination plant operation are listed below.

- Desalination Plant Reverse Osmosis Pump Motors
- Desalination Sea Water Pumps
- Desalination Plant Energy Recovery Device

It is assumed that plant is housed in standard metal clad building structures with no major openings. The transmission loss for standard metal cladding is presented in Table F1 below:

		Transmission Loss, dB							
Description	**Rw**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Metal Cladding (0.6mm)	35	10	11	27	41	44	48	54	50

Table F1: Transmission Loss for Standard Metal Cladding

F1.5 Landing Facility

BHP Billiton has advised that the following noise sources are anticipated for the operation of the Port Augusta landing facility:

- Barge Engine Noise (Idle)
- Truck Engine Noise (Idle)
- Crane Operational Noise

F1.6 Typical Pump Station

Pump stations (or 'booster' stations) are expected to be located alone the pipeline, however, specific locations are yet to be determined. A pump station is expected to be housed in a typical metal cladding structure and a 'worst case' scenario is taken to be with an exhaust outlet facing a noise sensitive receiver. It is assumed that noise through the metal cladding will be insignificant with respect to noise from the exhaust. The sound power level used for the typical pump station is based on measured noise levels for a typical pump station and is presented in below:

		Octave Band Sound Power Level (dB re 10^{-12} W)							
Description	**dB(A)**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Pump station Exhaust	69	66	64	60	64	63	60	60	65

Table F 2: Noise Levels for a Typical Pump Station

F2 Equipment Details for the Expanded Operation

F2.1 CAT 797B Haul Truck

BHP Billiton has advised that a fleet of one hundred and forty eight CAT 797B haul trucks are to be used for the expanded Olympic Dam operations[51]. Noise sources associated with the trucks include:

i. truck engine noise

ii. the backup alarm

iii. the air horn

iv. dumping of payload

(i) Truck Engine Noise.

The haul truck noise level used in the acoustic model is based on the manufacturer's specification for the exterior sound rating of the CAT 797B mining truck in terms of overall A-weighted sound pressure level (SPL). This is an SPL of 92 dB(A) measured at 15 m when the truck is operated as per the prescribed modes in ANSI/SAE J88 JUN 86 for the mode that gives the highest noise level. This is calculated to a Sound Power Level of 121 dB(A), when taking into account an engine of approximately 4 m by 4 m as the source. As the manufacturer has not been able to provide spectral information, the spectrum used is based on the measured spectrum for the CAT 789C trucks measured at the Mt Arthur Mine by GHD[52]. This is shown in Table F3 below.

		Octave Band Sound Power Level (dB re 10^{-12} W)							
Description	**dB(A)**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
CAT 789C (measured)	123	119	123	120	121	118	116	109	103
CAT 797B*	121	117	121	118	119	116	114	107	101

*based on the CAT 789C Spectrum

Table F3: Noise Levels for the CAT 789C and 797B Haul Trucks

(ii) Backup Alarm Noise

It has been advised that the back-up alarms will operate at 5 dB above the ambient noise level of the haul truck, as shown in part (i) above. Therefore a SWL of 121 dB at 1000 Hz has been used in the acoustic model for all reversing 797B haul trucks.

(iii) Air horn

The sound pressure level associated with the air-horn has been provided by BHP Billiton[53] and is 129 dB (A) at 0.75 m. The current practice of operation of the air horn is:

Starting: 1 blast of air horn

Forward: 2 blasts of horn

Reverse: 3 blasts of horn

The spectrum for noise associated with the air horn has been based upon information in Arup Acoustics sound level database - a measurement of an air horn on freight train. The spectrum for the air horn for the trucks in the acoustic model is provided in Table F4 below

[51] Memo to Arup Acoustics from BHPB senior HSEC advisor, dated 17 October 2006.
[52] Provided via email from BHPB senior HSEC advisor, dated 5 October 2006
[53] Email to Arup Acoustics from Dave Winterburn dated 26 October 2006 and quoting information from Joe Tanner (BHPB)

and has been adjusted to the Sound Pressure Level provided by BHP. It is proposed that the air horn will only be used during Starting/Forward and /Reverse operation in the pit an adjustment to the truck noise level to account for noise associated with the air horn is applied to approximately 40% of trucks in the pit (and one truck at the ROM stockpile).

		Octave Band Sound Power Level (dB re 10^{-12} W)							
Description	**dB(A)**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Air-horn	135	131	134	130	135	131	120	121	112

Table F4: Air Horn Sound Power Level

(iv) Dumping of Payload

Noise associated with dumping of rock from the CAT 797B has not been measured or provided and therefore the values used for dumping noise are based on available acoustic data. The noise level for a 50 Tonne dump is provided in BS5338[54] and the spectrum for a 28 Tonne dump has been measured by DEFRA[55]. Using this data and adding a factor to account for the difference in payload size (ie the CAT 797B has a 350 Tonne payload compared to the 50 Tonne payload detailed in the BS5338), a spectrum for dumping noise associated with the CAT 797B has been determined Details of the noise levels are provided in Table F5 below.

		Octave Band Sound Power Level (dB re 10^{-12} W)							
Description	**dB(A)**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
28 Tonne dump (DEFRA)	108	122	104	105	103	104	101	96	91
50 Tonne dump*	110	124	106	107	105	106	103	98	93
Factor to account for dump size (10 log $^{350}/_{50}$)		8.5	8.5	8.5	8.5	8.5	8.5	8.5	8.5
Derived 350 Tonne dump	**119**	**132**	**114**	**115**	**113**	**114**	**111**	**106**	**101**

*spectrum based on 28 T dump

Table F5: Dumping Noise Level Assessment

[54] BS 5338 Part 1, Noise and vibration control on construction and open sites, 1997
[55] Ibid

F2.2 Additional Mining Trucks

In addition to the fleet of 797B haul trucks, other mining trucks include:

- CAT 793 Dump Trucks
- CAT 777 Dump Trucks
- CAT 785 Water Trucks
- CAT 773 Lube Trucks
- CAT 793 Tow Trucks

The engine noise level used in the acoustic model for each truck is based on the manufacturer's specification for the exterior sound rating in terms of overall A-weighted sound pressure level measured in accordance with ANSI/SAE J88 86. This is calculated to be an overall A-weighted Sound Power Level. The spectrum used is based on the measured spectrum for the CAT 789C trucks measured at the Mt Arthur Mine by GHD. The noise levels used are provided in Table F8 of this Appendix.

F2.3 Bulldozers

BHP Billiton has advised that the following bulldozers will operate at Olympic Dam:

- CAT D10 track dozers
- CAT D11 track dozers
- CAT 854 wheel dozers

The noise levels used in the acoustic model for bulldozers are based on noise measurements of the CAT D11 bulldozers conducted by Centennial Coal at Lamberts Gully Mine for an environmental assessment[5657]. Noise levels are provided in Table F8 of this Appendix.

F2.4 Shovels

BHP Billiton has advised that the following shovels will operate at Olympic Dam:

- P&H XPB 4100 Rope Shovels
- Komatsu PC 8000 Hydraulic Shovels

The noise levels used in the acoustic model for the P&H 4100 XPB Rope Shovel are based on the manufacturer's specification for the overall A-weighted SPL. The spectrum used is based on the measured spectrum for the P&H 4100 XPB Rope Shovel measured at Genesee Generating Station by Faszer Farquharson and Associates.[58]

The noise levels used in the acoustic model for the Komatsu PC 8000 Hydraulic Shovel are based on the manufacturer's specification for overall A-weighted SPL. The spectrum used in based on the measured spectrum for a standard 71 000 kg shovel as detailed in DEFRA[59] construction noise. Noise levels are provided in Table F8 of this Appendix.

[56] Centennial Coal, Lamberts Gully Mine Extension of Mining Operations Within Existing Mining Leases, Jan 2006
[57] CAT specifications show that the CAT 854 and CAT D11 share the same engine model and it is assumed that noise levels will be similar. The CAT 10 is expected to have a slightly lower noise level, however no measured or manufacturer's noise levels are available
[58] Faszer Farquharson and Associates, Genesee Generating Station Phase 3, June 2001
[59] Department for environment Food and Rural Affairs, *Update of noise database for prediction of noise on construction and open sites*, 2005

F2.5 Excavators

BHP Billiton has advised that the following excavators will operate at Olympic Dam:

- Komatsu PC 300 Hydraulic Excavators
- Hitachi EX 2500 Hydraulic Excavators

The Sound Power Level used in the acoustic model for the PC 300 Hydraulic Excavators have been supplied by Komatsu. The noise levels used in the acoustic model for the Hitachi EX 2500 Hydraulic Excavator are for a standard 240 000 kg excavator as detailed in DEFRA construction noise measurements. Noise levels are provided in Table F8 of this Appendix.

F2.6 Loaders

BHP Billiton has advised that the following loaders will operate at Olympic Dam:

- CAT 994 Loaders
- CAT 980 Loaders

The noise level used in the acoustic model for the CAT 994 Loader have been measured at the Genesee Generating Station[60].

The noise level used in the acoustic model for the CAT 980 loader is based on the measured SPL of a CA 980 loader at Channel Road Resource Extraction[61] for the overall A-weighted level. The spectrum used is the measured spectrum for the CAT 994 as detailed above.

These noise levels are provided in Table F6 below:

		Octave Band Sound Power Level dB re 10^{-12} W							
Description	**dB(A)**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
CAT 994	113	104	118	116	107	106	105	98	90
CAT 980	108	99	113	111	102	101	100	93	85

Table F6: Loader Noise Levels

[60] Faszer Farquharson and Associates, *Genesee Generating Station Phase 3*, June 2001
[61] Kimley-Horn and Associates, Channel Road Resource Extraction Major Use Permit and Reclamation Plan, July 2005

F2.7 Graders

BHP Billiton has advised that the following graders will operate at Olympic Dam:

- 4 CAT 24H Graders
- 2 CAT 16G Graders

The noise levels used in the acoustic model for the CAT graders have been measured at the Joslyn North Mine[62]. Noise levels are provided in Table F8 of this Appendix.

F2.8 Drill Rigs

BHP Billiton has advised that the following graders will operate at Olympic Dam:

- 8 BE HR Drill Rigs
- 2 XP 2500 Drill Rigs
- 4 IR DM 45 Drill Rigs

The noise levels used in the acoustic model for the drill rigs are based on measurements of the Ingersoll-Rand DM 45 Drill Rig at Golden Pike taken by Herring Storer Acoustics[63] for an overall A-weighted sound power level. The spectrum is based on a standard 100 mm bore drill rig as shown in the DEFRA[64] construction noise measurements. Noise levels are provided in Table F8 of this Appendix.

F2.9 Other Mobile Machinery

BHP Billiton has advised that other mobile machinery operating at Olympic Dam includes:

- 5 CAT 988 Cable Handlers
- 2 CAT 988 Tyre Handlers

The noise levels used in the acoustic model for Cable Handler and Tyre Handler are the same as used for the CAT 994 loader and are provided in Table F8 of this Appendix.

F2.10 CCGT Plant

Noise levels associated with items of the CCGT plant are detailed in the table below. Noise levels were determined using the Electric Power Plant Environmental Noise Guide[65].

		Octave Band Sound Power Level dB re 10^{-12} W							
Description	**dB(A)**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Turbine Assembly	112	120	118	113	109	105	102	94	88
Exciter	104	85	104	101	100	99	97	90	85
Condensers	114	116	115	113	114	108	103	98	94
Transformers	104	106	108	103	103	97	92	87	80
Electric Motors	104	96	98	98	98	98	98	95	88
Large Pumps	115	110	108	107	106	105	104	103	99
Heat Recovery Device	93	83	93	98	93	83	78	73	68
Cooling Towers	117	105	105	104	106	108	110	112	110

[62] Faszer Farquharson & Associates, *Noise Impact Assessment Deer Creek Energy Limited Joslyn North Mine*, December 2005
[63] Herring Storer Acoustics, *Acoustic Assessment Golden Pike Development Including Noise Bund Construction for Kalgoorie Consolidated Gold Mines*, June 2005
[64] Ibid
[65] Edison Electric Institute, *Electric Power Plant Noise Guide*, Volume 1 2nd Edition, February 1989

F2.11 Landing Facility

Noise levels associated with items of the landing facility are detailed in the table below. Noise levels were determined using the measurements from Arup Acoustics database.

		Octave Band Sound Power Level dB re 10^{-12} W							
Description	**dB(A)**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Barge	112	85	104	101	100	99	97	90	85
Truck Idle	81	116	115	113	114	108	103	98	94
Operational Crane	99	106	108	103	103	97	92	87	80

F2.12 Desalination Plant

Arup Water has advised that the following equipment is likely to be located at the Point Lowly desalination plant:

- 4 Sea Water Pumps
- 15 High Pressure Reverse Osmosis Pumps
- Positive Displacement Energy Recovery Device

The noise levels used in the acoustic model for the Sea Water Pumps are based on manufacturer's specifications in terms of an overall A-weighted sound power level for the sea water pump monitor[66]. The spectrum is based on a standard pump motor from the Arup Acoustics noise level database.

The noise levels used in the acoustic model for the Reverse Osmosis Pumps have been provided by the manufacturer.

The noise levels used in the acoustic model for the energy recovery device are based on the manufacturer's specification in terms of an overall A-weighted sound power level. The spectrum has been assumed to have a peak at 250 Hz[67]. Noise levels are provided in Table F12 of this Appendix.

F2.13 Typical Pump Station

Pump stations (or 'booster' stations) are expected to be located alone the pipeline and specific locations are yet to be determined. A pump station is expected to be housed in a typical metal cladding structure and a 'worst case' scenario is taken to be with an exhaust outlet facing a noise sensitive receiver. The sound power levels used for the exhaust outlet is based on pipeline booster station measurements in Arup Acoustics noise level database and are provided in Table F 7 below.

		Octave Band Sound Power Level dB re 10^{-12} W							
Description	**dB(A)**	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**
Booster Station Exhaust	64	67	65	61	65	64	61	61	66

Table F 7: Pump Station Exhaust Outlet

[66] The pump will be submerged while the above ground motor is main noise source as noted in phone conversation with Liam Bonham of Flowserve Pump Division dated 30 November
[67] Via email from Energy Recovery Inc, 12 December 2006

F3 Source Noise Levels for the Expanded Operation

F3.1 Mobile Machinery

Details of the source of the individual items of equipment noise levels and a description of the equipment is provided in Section F2 of this Appendix. The source sound power levels used for the acoustic prediction are provided in Table F8 and Table F9 below.

Item	Description	Octave Band Sound Power Level (dB re 10^{-12} W)								
		dB(A)	63	125	125	500	1k	2k	4k	8k
CAT 797B	350T Haul Truck	121	117	121	118	119	116	114	107	101
CAT 793	218T Haul Truck	121	117	121	118	119	116	114	107	101
CAT 777	100T Haul Truck	116	112	116	113	114	111	109	102	96
CAT D10	580 hp Bulldozer	115	106	106	106	111	109	110	102	92
CAT D11	850 hp Bulldozer	115	106	106	106	111	109	110	102	92
CAT 854G	Wheeled Bulldozer	115	106	106	106	111	109	110	102	92
P&H 4100 XPB	Rope Shovel	110	110	111	110	107	106	103	68	88
Komatsu PC 8000	Hydraulic Shovel	127	125	134	128	124	120	118	114	111
Komatsu PC 300	Hydraulic Excavator	102	81	90	96	99	99	95	89	83
Hitachi EX 2500	Hydraulic Excavator	118	116	119	115	114	111	109	104	114
CAT 994	Loader	113	104	118	116	107	106	105	98	90
CAT 980	Loader	108	99	113	111	102	101	100	93	85
CAT 785	Water Truck	121	117	121	118	119	116	114	107	101
CAT 24H	Grader	117	106	119	115	113	114	108	103	98
CAT 16G	Grader	114	103	116	112	110	111	105	100	95
Bucyrus 49 HR	Drill Rig	117	116	124	109	110	111	110	107	105
XP 2500	Drill Rig	117	116	124	109	110	111	110	107	105
IR DM45	Drill Rig	117	116	124	109	110	111	110	107	105
CAT 998	Cable Handler	113	104	118	116	107	106	105	98	90
CAT 988	Tyre Handler	113	104	118	116	107	106	105	98	90
CAT 773	Lube Truck	116	112	116	113	114	111	109	102	96
CAT 793	Tow Truck	116	112	116	113	114	111	109	102	96

Table F8: Mobile Machinery Sound Power Levels

Description	Octave Band Sound Power Level (dB re 10^{-12} W)								
	dB(A)	63	125	125	500	1k	2k	4k	8k
Reverse Alarm for CAT 797 B	121					121			
Air-horn for CAT 797 B	135	131	134	130	135	131	120	121	112
350 Tonne dump for CAT 797 B	119	132	114	115	113	114	111	106	101

Table F9: Sound Power Levels for Additional Noise Sources

F3.2 Processing Plant

The noise levels used in the acoustic model for the additional processing plant are based on noise measurements taken onsite for the existing processing plant at the existing Olympic Dam operation site. These noise levels are presented in Table F10 below.

Note that noise levels used for the existing processing plant are detailed in Section C1 of Appendix C.

Item	Octave Band Sound Power Level (dB re 10^{-12} W)								
	dB(A)	63	125	125	500	1k	2k	4k	8k
Acid Plant Exhaust	98	99	97	97	95	93	91	84	75
Acid Plant Generator	102	101	101	100	100	98	94	87	76
Acid Plant Steam Off-take	108	95	93	94	100	102	103	99	91
Cooling Tower Pumps	99	96	98	99	94	93	91	89	86
Feed Prep Exhaust	69	72	73	71	68	62	57	53	47
Floatation Pumps	99	98	101	97	92	95	92	85	79
Grinding Mill	115	115	117	118	113	109	104	100	96
Off Gas Fans	103	103	104	105	97	91	89	88	103
Off Gas Motors	90	94	93	94	87	85	78	73	67
Oxygen Plant	93	78	78	83	76	81	86	90	78
PLS Pool Pumps	69	67	64	62	69	63	60	54	46
Refinery Substation	91	87	88	85	89	88	83	77	71
Scrubbers	88	77	72	74	74	72	76	83	85
Shaft Furnace	112	114	110	111	107	104	105	104	98
Smelter Exhaust	112	115	117	114	111	106	102	98	90
Steam Release	95	89	87	84	82	81	83	88	95
Steam Trap	114	98	98	97	104	110	108	107	103
Tailings Disposal Pump	79	73	69	69	71	77	70	70	66
Vibrating Screen	103	94	98	95	93	92	93	98	98

Table F10: Additional Processing Plant Sound Power Levels

F3.3 Construction Activities

Noise levels that are used in the acoustic model for standard construction equipment are presented in Table F11 below. These noise levels are based on the DEFRA[68] construction noise measurements.

BHP Billiton has advised that 'standard' construction equipment will be located at the lay-down and prefabrication areas.

Item	Description	Octave Band Sound Power Level (dB re 10^{-12} W)								
		dB(A)	63	125	125	500	1k	2k	4k	8k
Concrete Pump	2.8t/180mm/ 59bar	78	84	76	70	71	73	73	66	58
Wheeled Mobile Crane	70 T	70	80	72	71	67	65	62	57	49
Welder (hand held)	-	73	67	68	69	68	69	66	61	56
Generator (for welder)	-	73	75	72	67	68	70	66	62	60
Gas Cutter	230 bar	68	74	74	72	61	60	58	56	56
Standard Dump Truck	25 t	81	90	87	77	79	75	73	67	63
Cement Mixer	Discharging	75	80	69	66	70	71	69	64	58
Scissor Lift	Diesel / 6 t	79	80	77	76	76	76	71	65	63
Circular Saw	Bench/Petrol	85	85	74	72	70	72	76	82	77
Diesel Generator	3kW/210 kg	65	57	71	65	61	60	56	52	44
Water Pump	Diesel	65	77	72	64	60	59	57	54	42
Dust Suppression Unit Trailer	-	79	78	73	74	80	70	68	60	56
Angle Grinder	On Steel	81	57	51	52	60	70	77	73	73
Diesel Bowser	-	89	80	81	84	81	84	85	76	66
Water Bowser	-	81	80	81	75	79	73	74	70	65
Standard 40T Excavator	Tracked	104	112	108	103	102	98	95	92	84

Table F11: Sound Power Levels for Construction Equipment

[68] Ibid

F3.4 Desalination Plant

The noise levels that are used in the acoustic model for the desalination plant are presented in Table F12 below.

Details of these noise sources are provided F2.12 in this Appendix.

Description	Octave Band Sound Power Level (dB re 10^{-12} W)								
	dB(A)	63	125	125	500	1k	2k	4k	8k
Sea Water Pump (Motor)	93	73	77	83	86	89	88	83	73
Reverse Osmosis Pumps	105	94	96	98	100	100	100	96	91
Energy Recovery Device	93	83	93	98	93	83	78	73	68

Table F12: Sound Power Levels for the Desalination Plant

F3.5 Pimba Intermodal Facility

The noise levels that are used in the acoustic predictions for the Intermodal Facility are presented in Table F13 below.

Description	Octave Band Sound Power Level (dB re 10^{-12} W)								
	dB(A)	63	125	125	500	1k	2k	4k	8k
Slow Moving Freight Train	112	129	117	110	109	105	101	97	92
Freight Maximum Impact Noise	133	132	122	118	117	119	112	111	106

Table F13 Sound Power Levels for the Intermodal Facility

F3.6 Outer Harbour Sulphur Handling Facility

The noise levels that are used in the acoustic predictions for the Sulphur Handling Facility are presented in below.

Description	Octave Band Sound Power Level (dB re 10^{-12} W)								
	dB(A)	63	125	125	500	1k	2k	4k	8k
Conveyer (per meter)	83	87	88	85	81	78	72	67	58
Conveyer Drive Motor	96	86	92	93	93	93	86	80	75
Dump Truck Idling	91	101	92	83	83	88	84	78	71

Table F14: Sound Power Levels for the Sulphur Handling Facility

F4 Noise Source Locations for the Expanded Operation

Locations for the noise sources for the Olympic Dam expansion are shown on Figure F 1 to Figure F below.

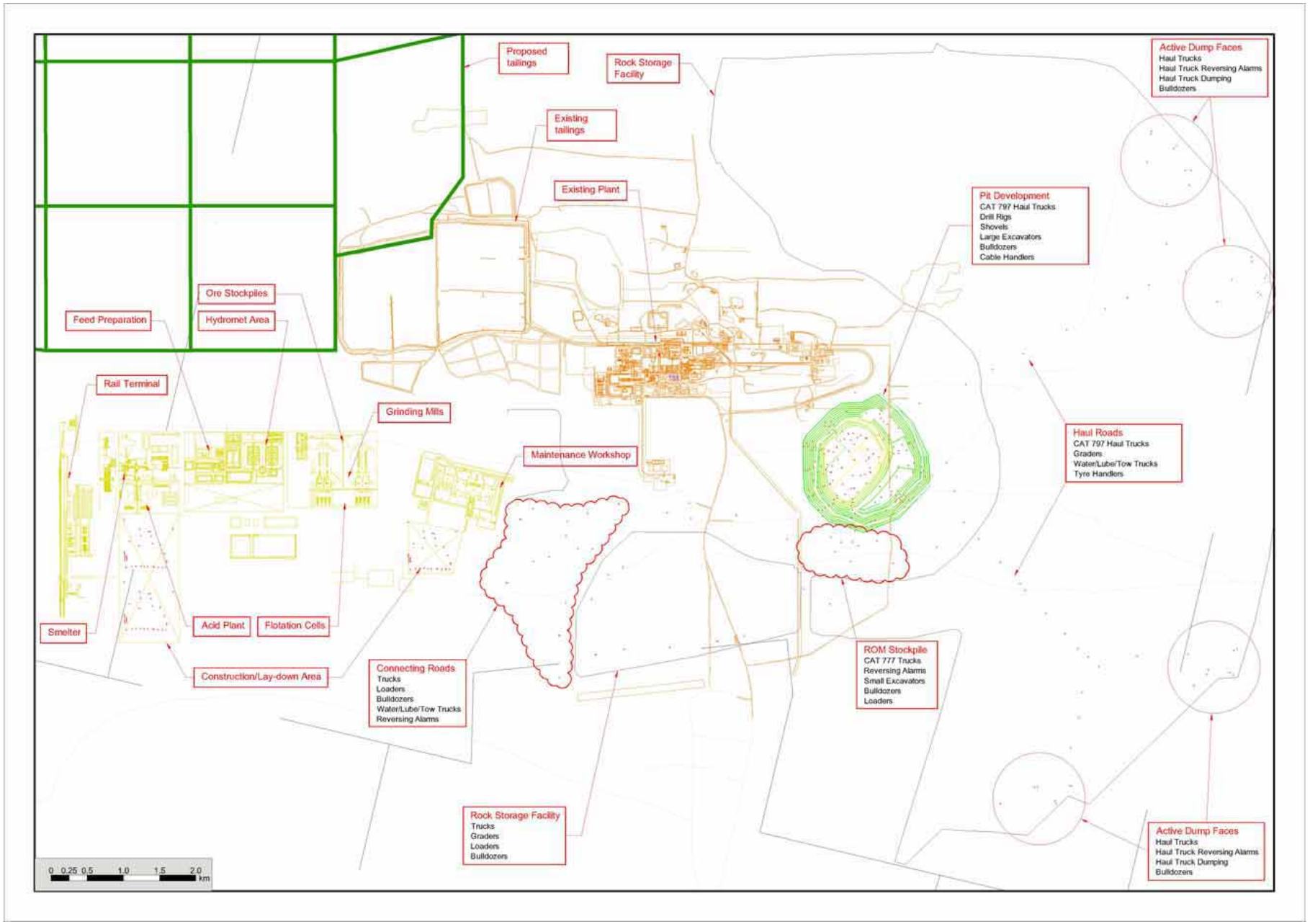

Figure F 1 General Plant Locations for the Expanded Olympic Dam Operation

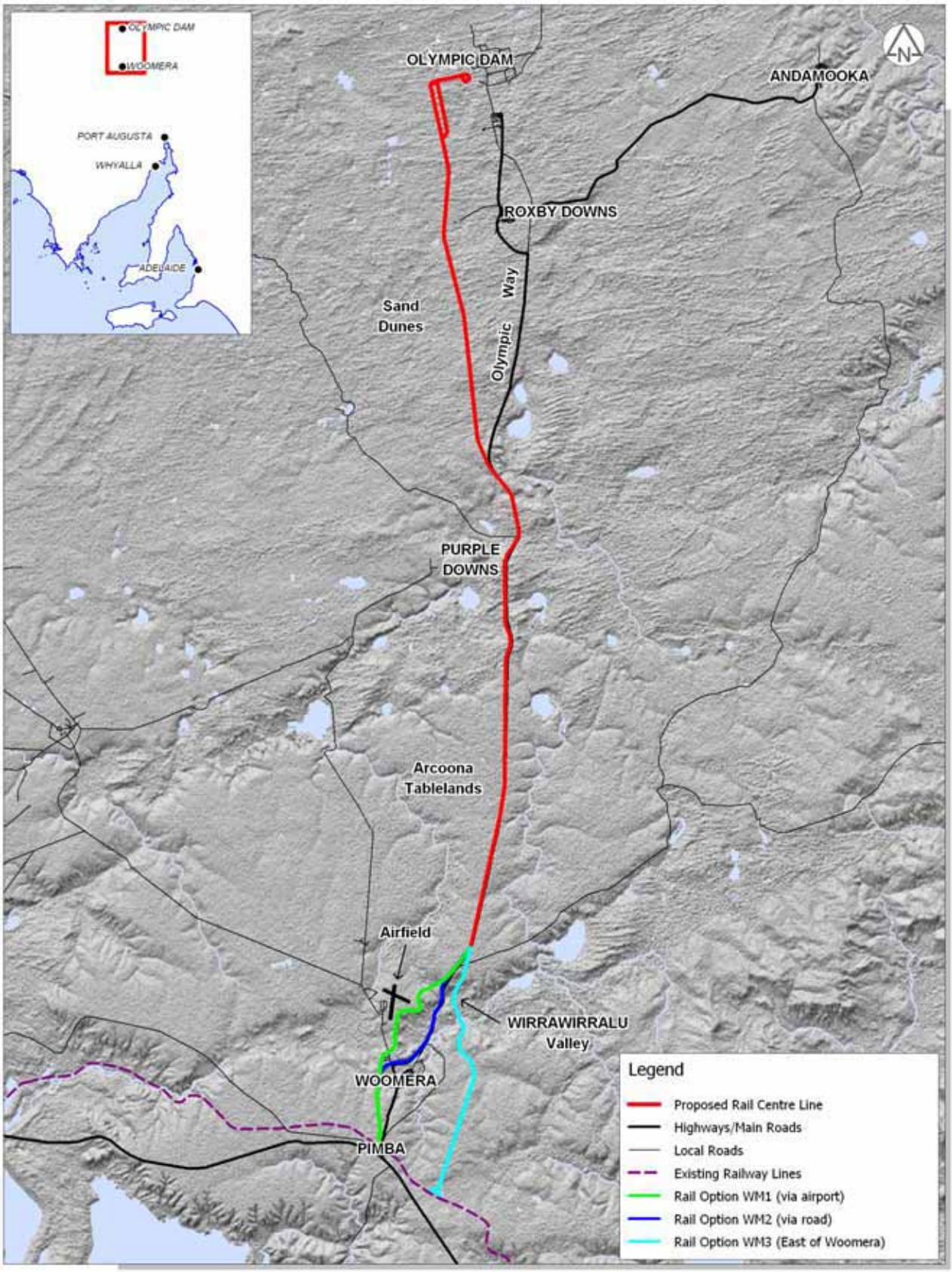

Figure F2: Extents of Pimba to Olympic Dam Rail Connection (Option WM3)

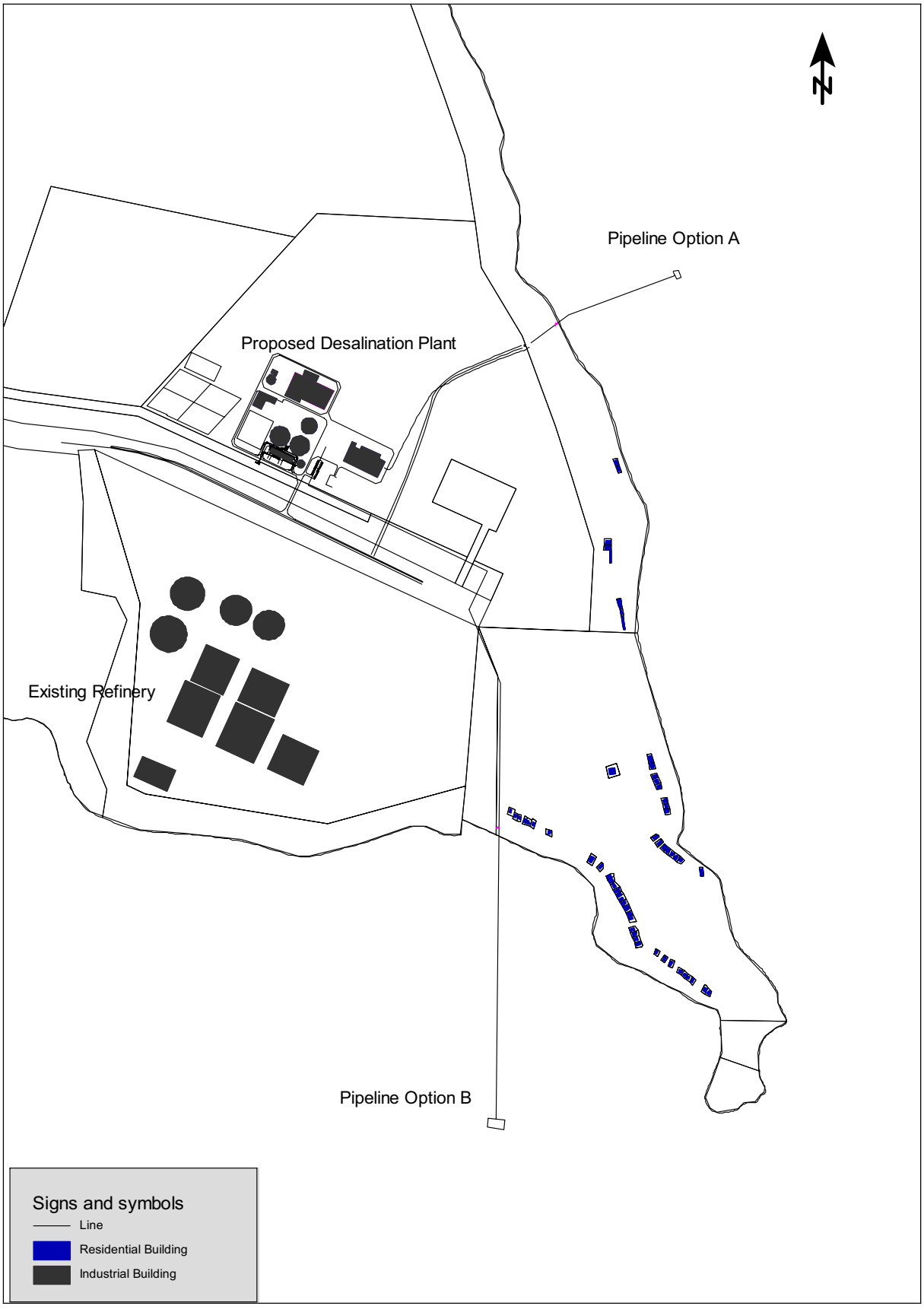

Figure F3: Location of the Point Lowly Desalination Plant (Pipeline Option A and B)

Figure F4: Location of the Proposed Airstrip with Respect to Hiltaba Village

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Appendix G

Results of Acoustic Predictions for the Expanded Operation

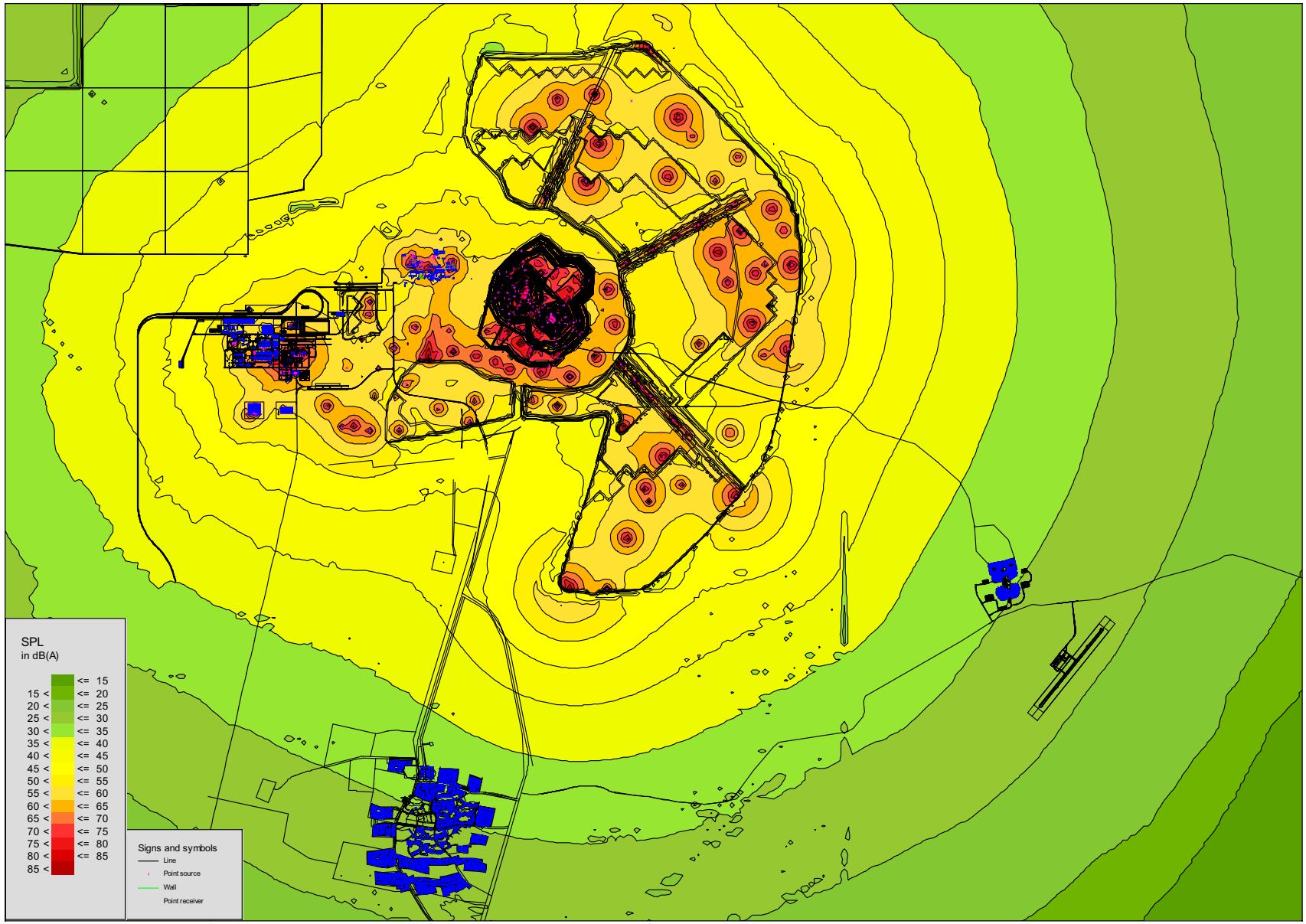

Figure G1: Industrial Noise Prediction Olympic Dam Expanded Operation – Meteorological Conditions Neutral, Sound Pressure Level, dB(A)

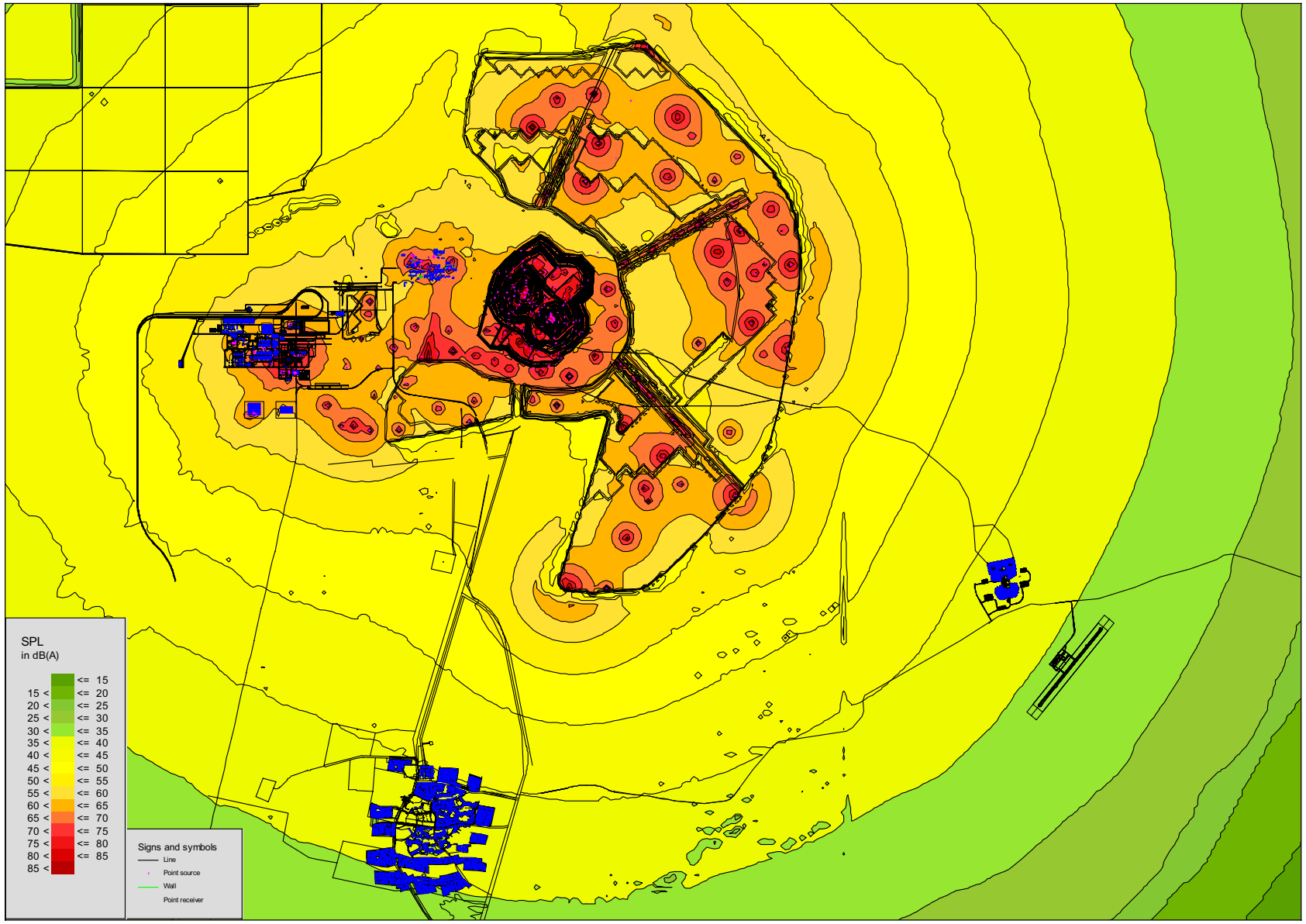

Figure G2: Industrial Noise Prediction Olympic Dam Expanded Operation – Meteorological Conditions Adverse, Sound Pressure Level, dB(A)

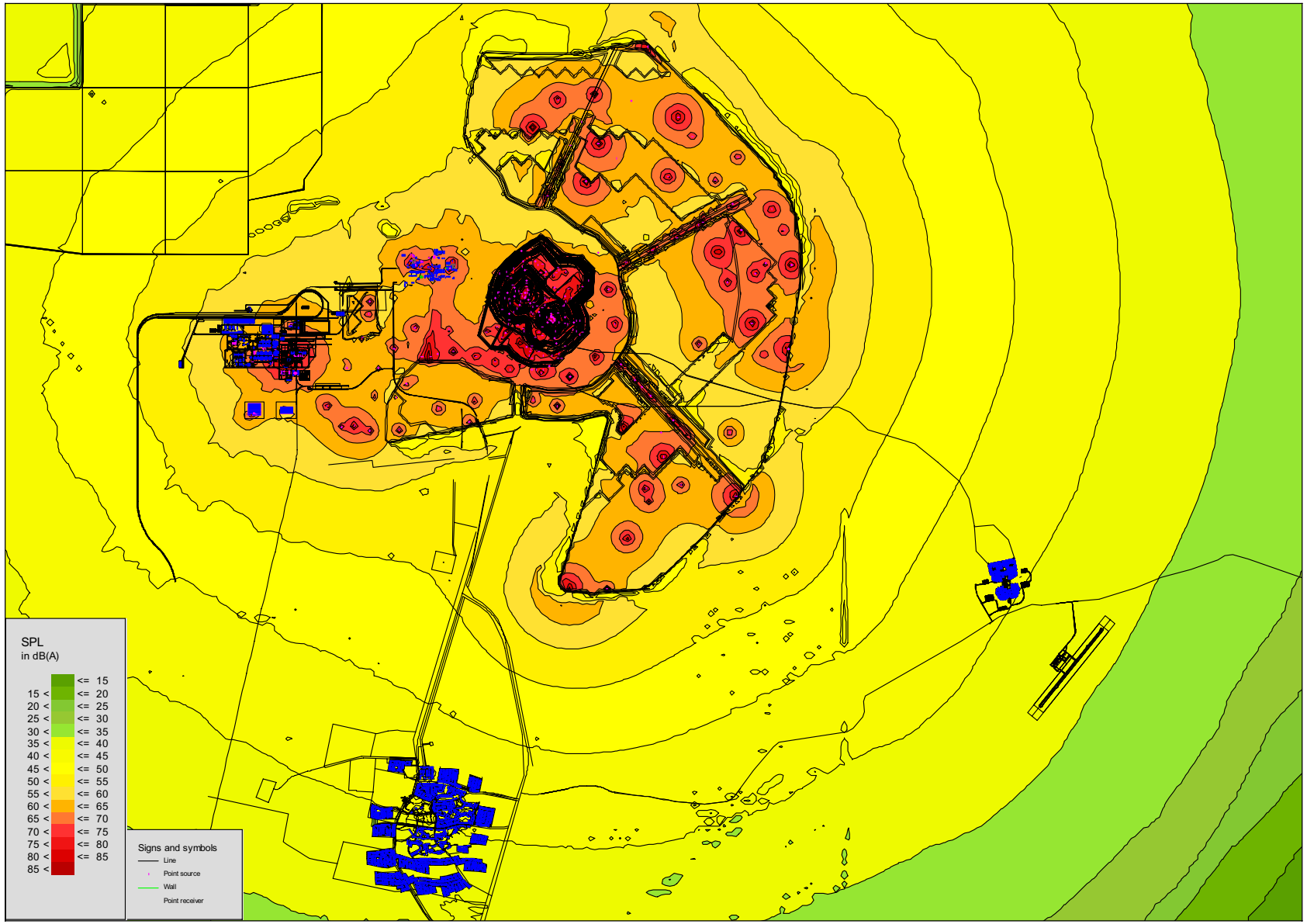

Figure G3: Industrial Noise Prediction Olympic Dam Expanded Operation – Meteorological Conditions Temp. Inversion, Sound Pressure Level, dB(A)

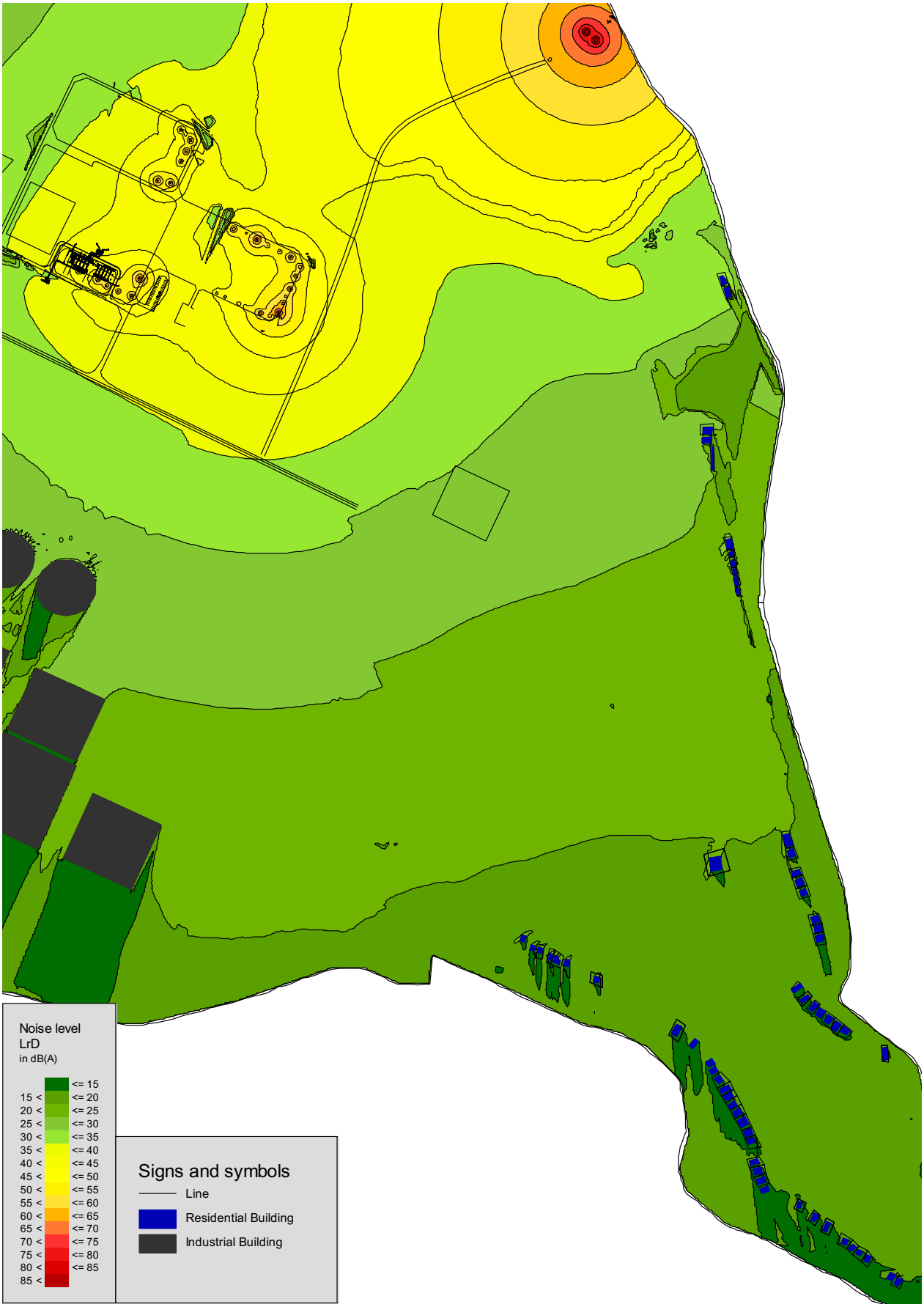

Figure G4: Industrial Noise Prediction Point Lowly Option A, Scenario 1 – Meteorological Conditions Neutral, Sound Pressure Level, dB(A)

Figure G5: Industrial Noise Prediction Point Lowly Option A, Scenario 1 – Meteorological Conditions Adverse, Sound Pressure Level, dB(A)

Figure G6: Industrial Noise Prediction Point Lowly Option A, Scenario 2 – Meteorological Conditions Neutral, Sound Pressure Level, dB(A)

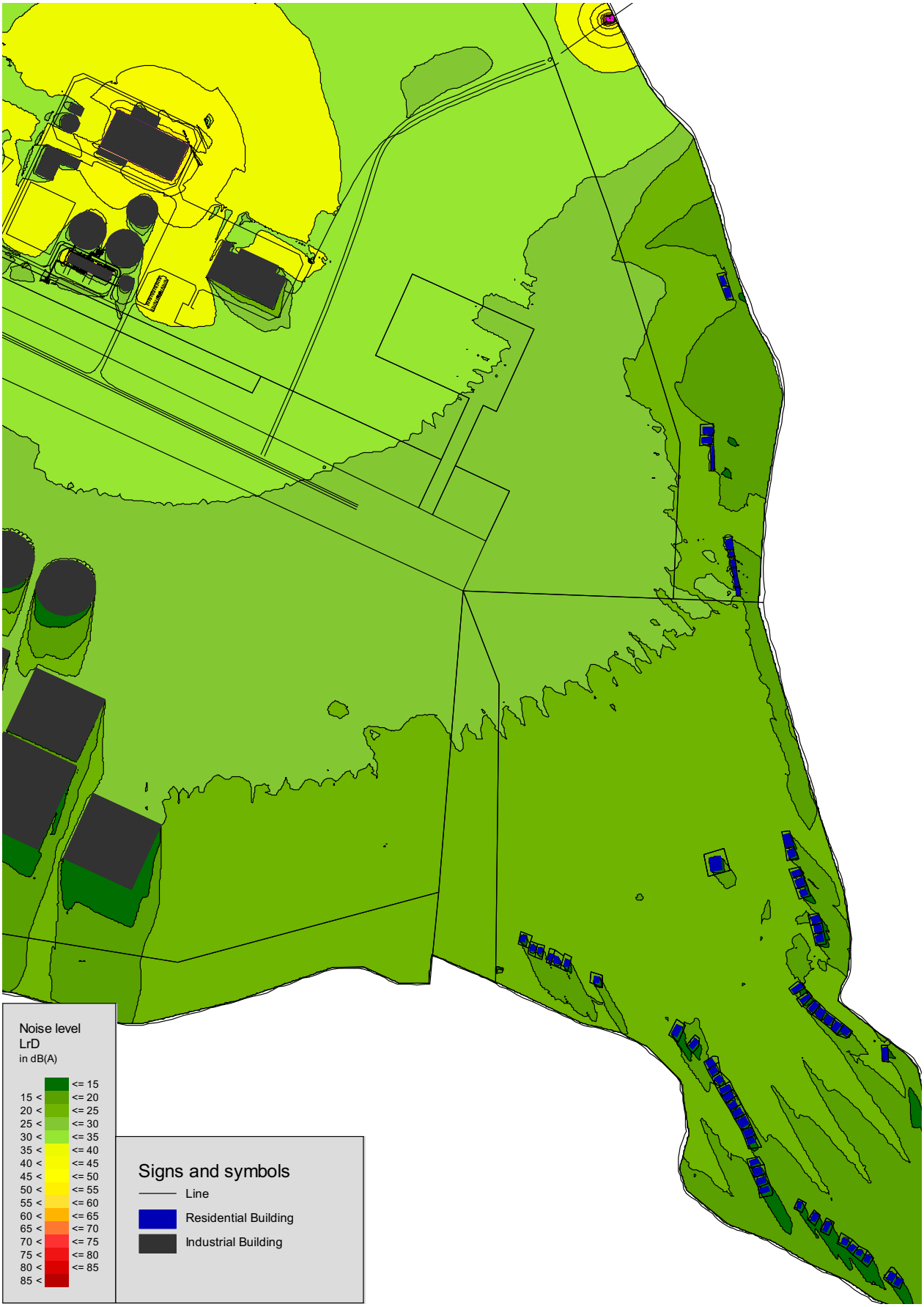

Figure G7 Industrial Noise Prediction Point Lowly Option A, Scenario 2 – Meteorological Conditions Adverse, Sound Pressure Level, dB(A)

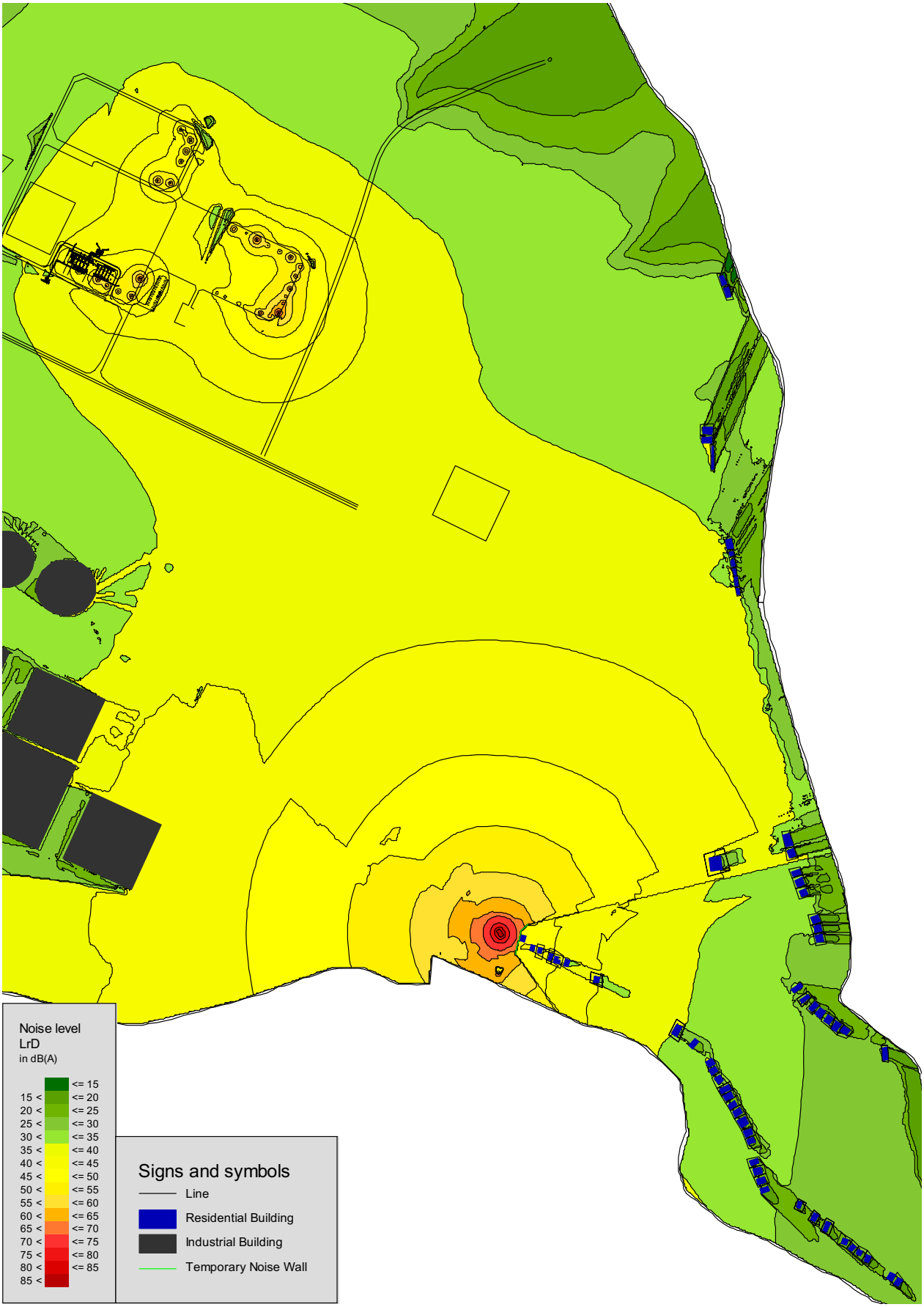

Figure G8: Industrial Noise Prediction Point Lowly Option B, Scenario 1 – Meteorological Conditions Neutral, Sound Pressure Level, dB(A)

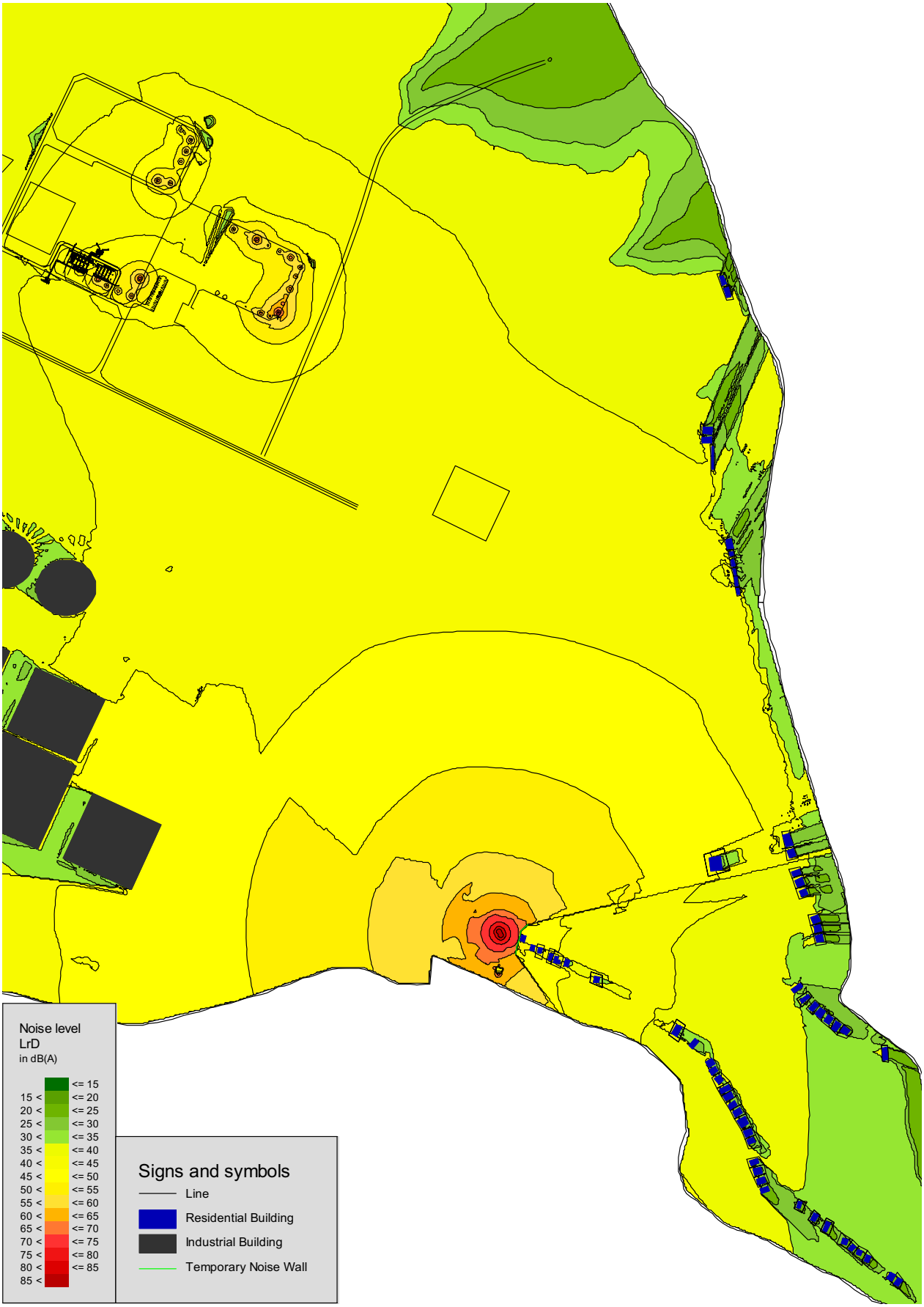

Figure G9: Industrial Noise Prediction Point Lowly Option B, Scenario 1 – Meteorological Conditions Adverse, Sound Pressure Level, dB(A)

Figure G10: Industrial Noise Prediction Point Lowly Option B, Scenario 2 – Meteorological Conditions Neutral, Sound Pressure Level, dB(A)

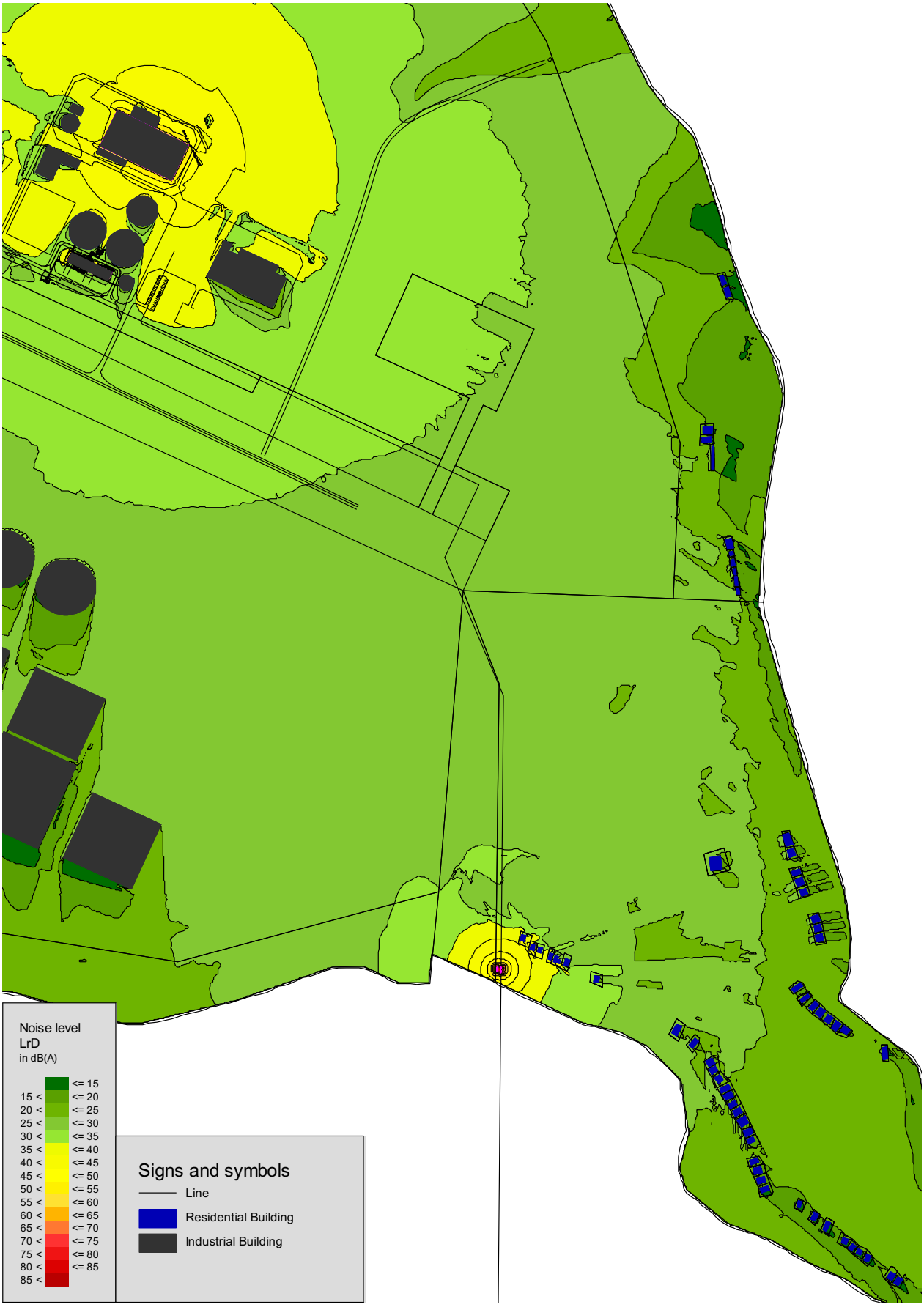

Figure G11: Industrial Noise Prediction Point Lowly Option B, Scenario 2 – Meteorological Conditions Adverse, Sound Pressure Level, dB(A)

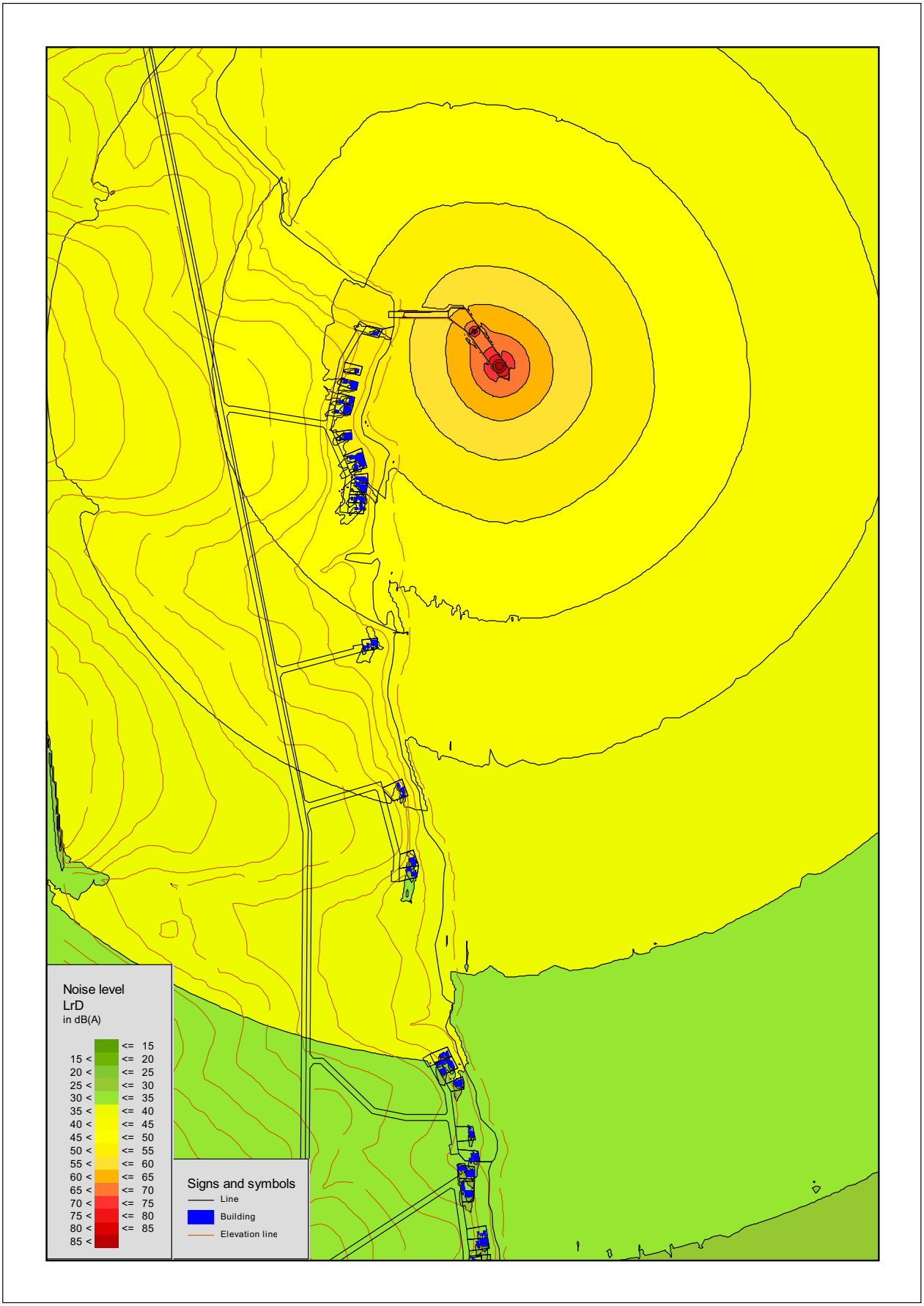

Figure G12: Industrial Noise Prediction Port Augusta, Daytime – Meteorological Conditions Neutral, Sound Pressure Level, dB(A)

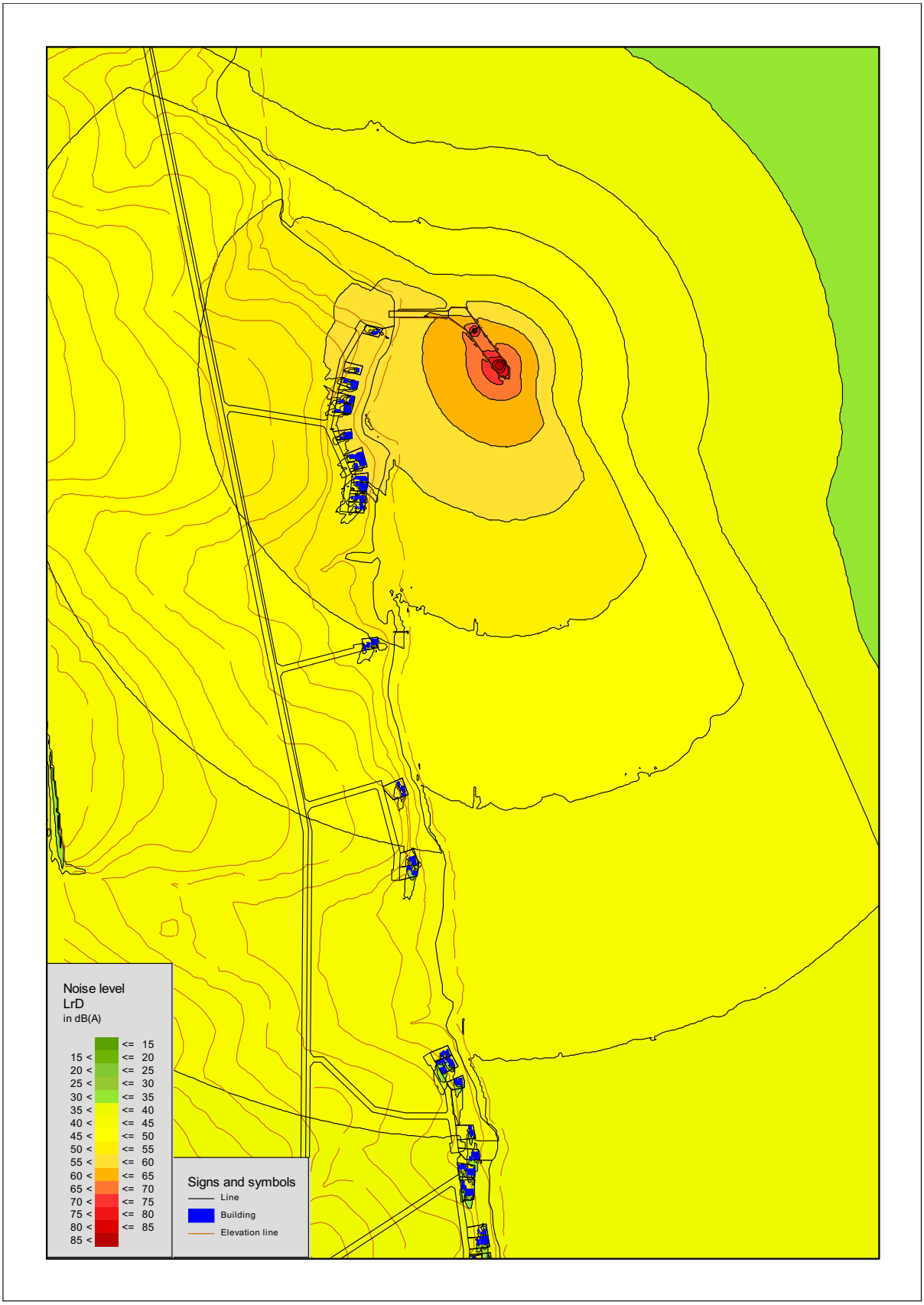

Figure G13: Industrial Noise Prediction Port Augusta, Daytime – Meteorological Conditions Adverse, Sound Pressure Level, dB(A)

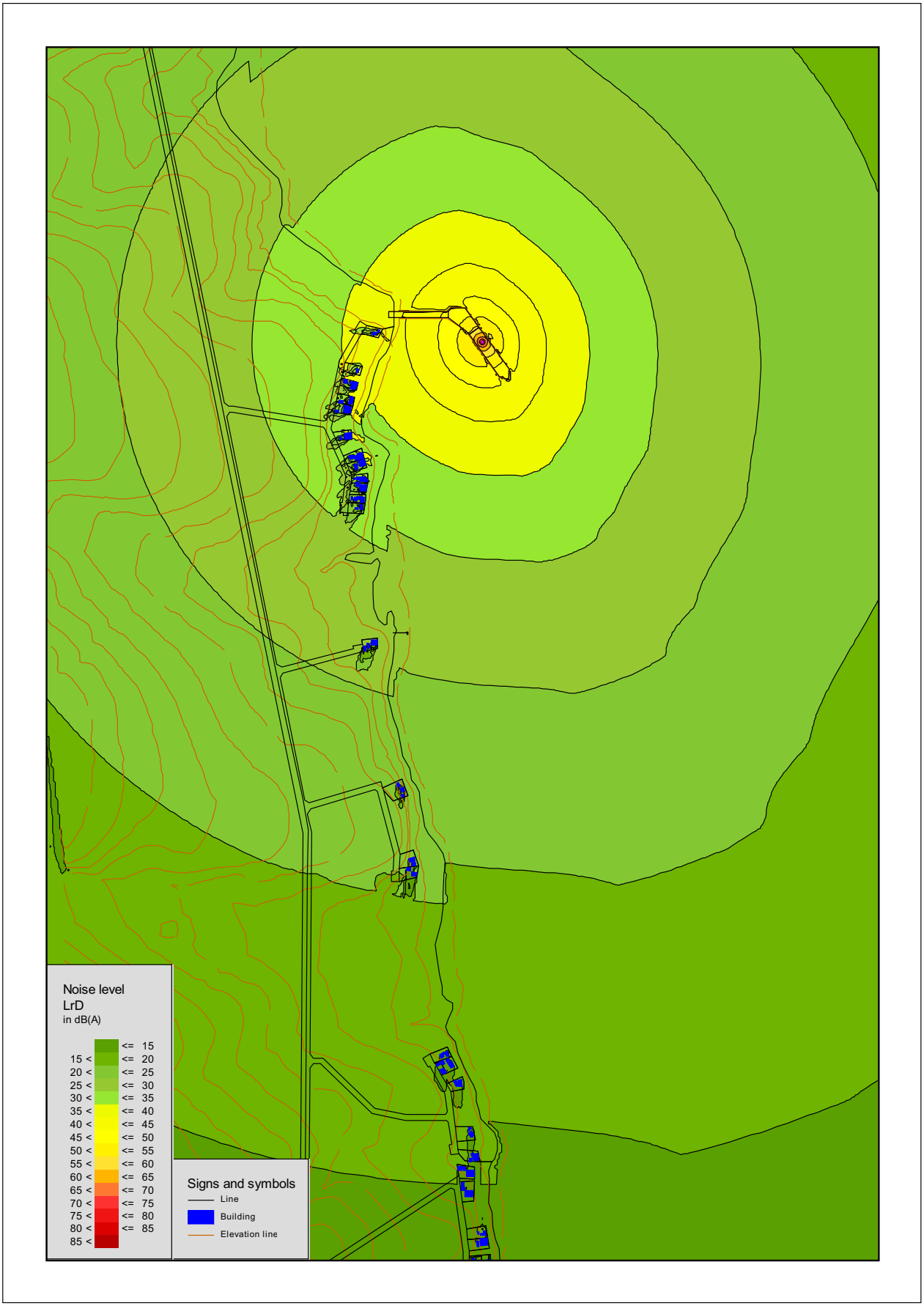

Figure G14: Industrial Noise Prediction Port Augusta, Night-time – Meteorological Conditions Neutral, Sound Pressure Level, dB(A)

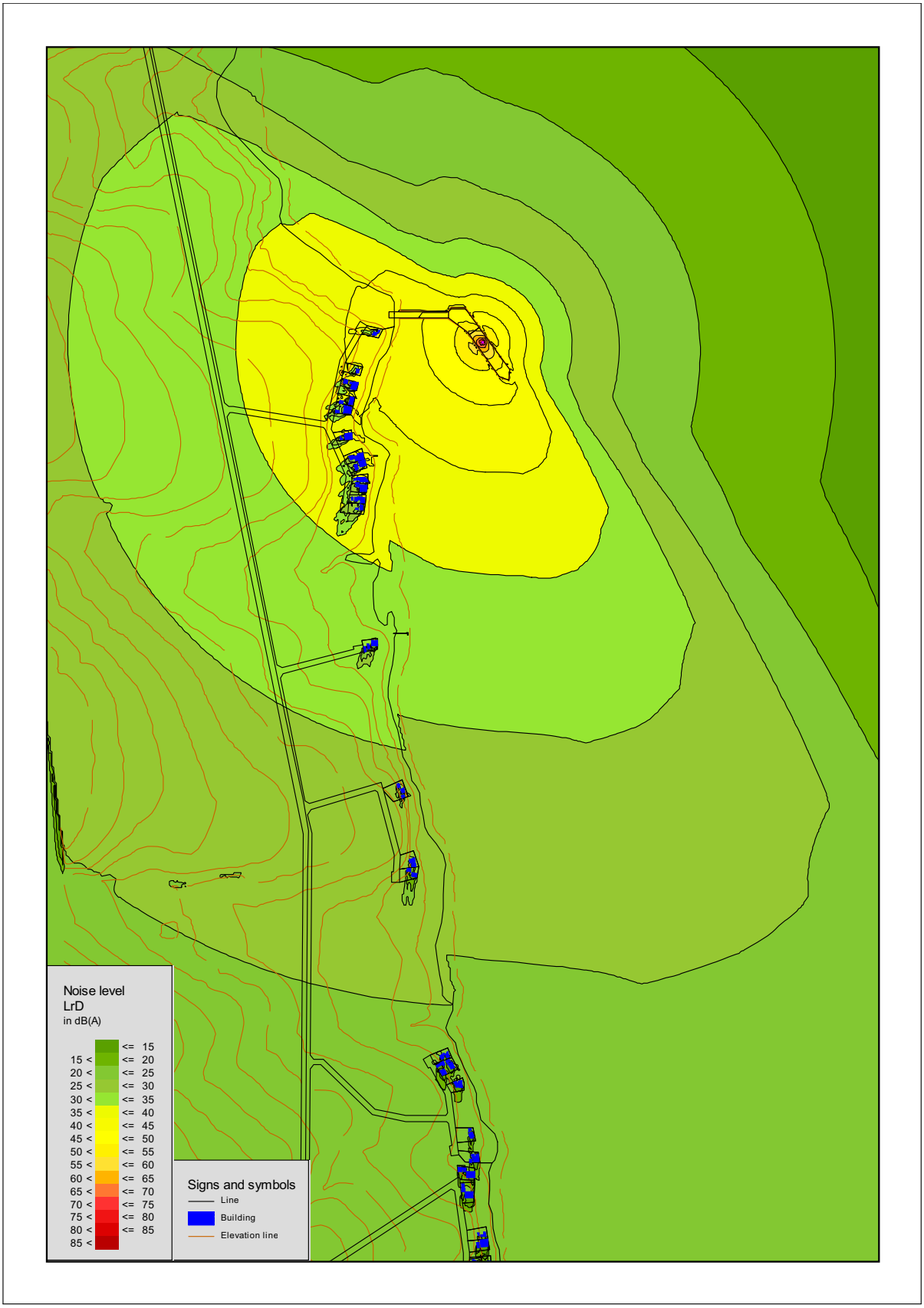

Figure G15: Industrial Noise Prediction Port Augusta, Night-time – Meteorological Conditions Adverse, Sound Pressure Level, dB(A)

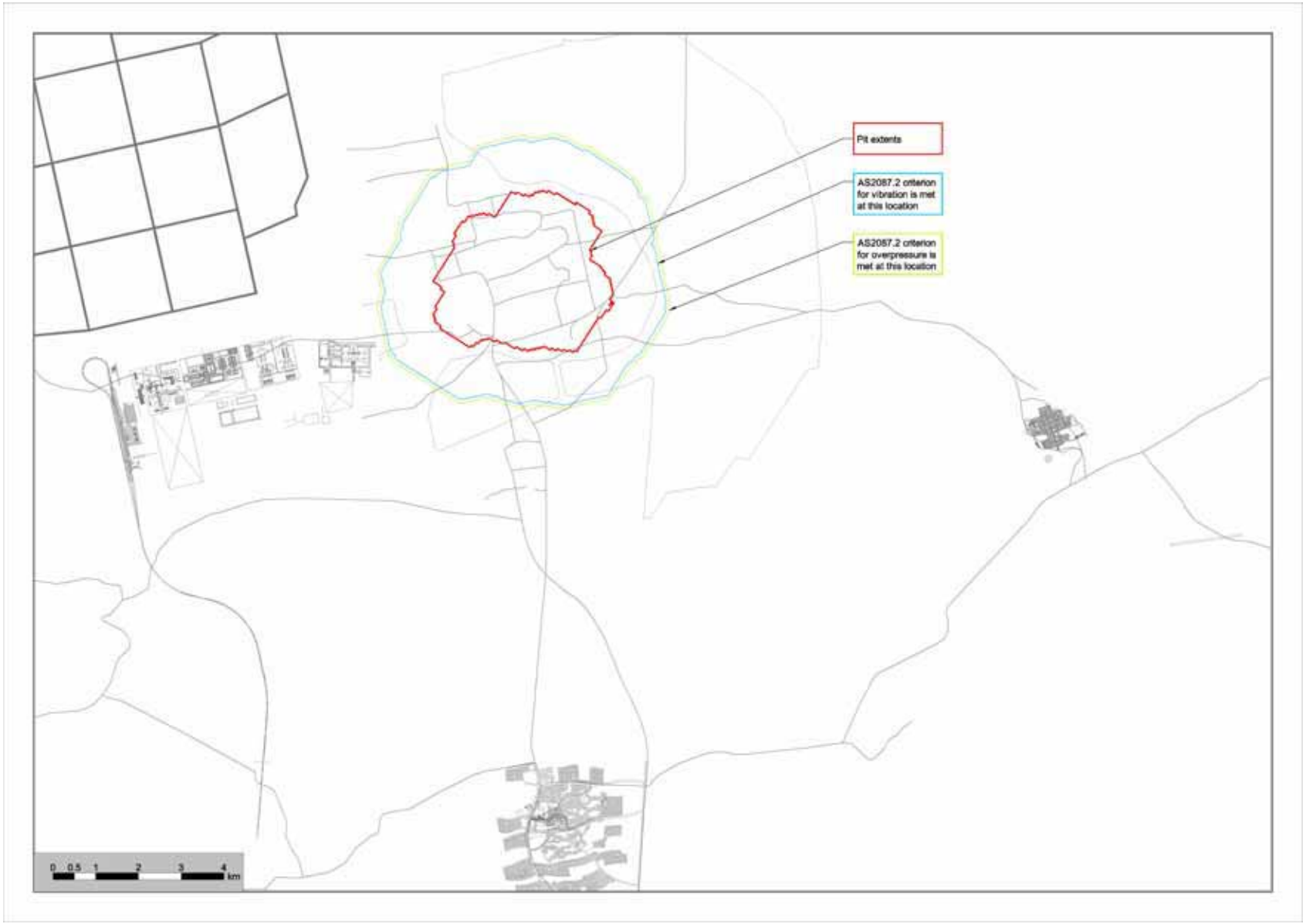

Figure G16: Location of Blasting Limits in Accordance with Australian Standard 2187.2

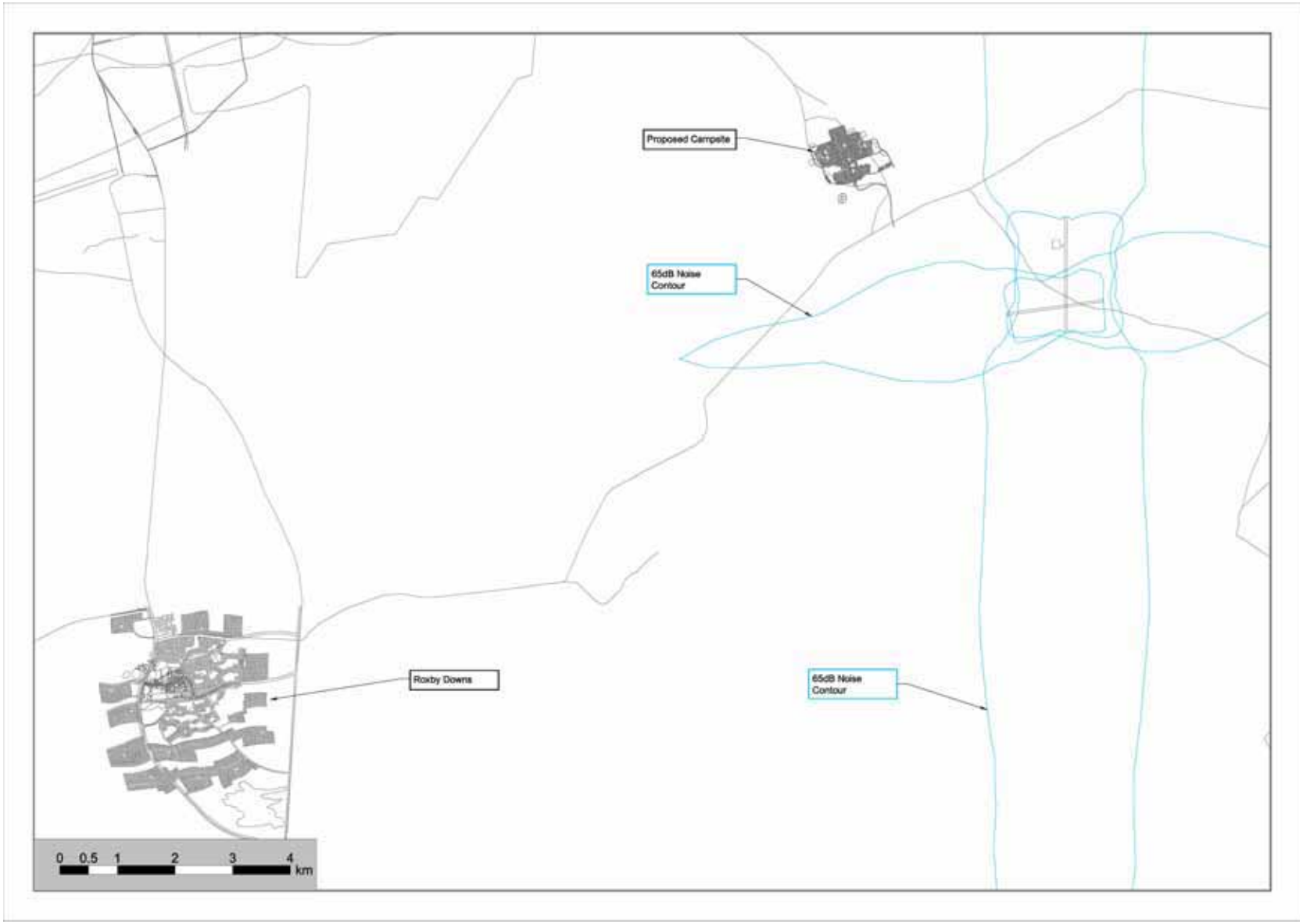

Figure G17: 65 dB single Event Noise Contour for the Proposed Airstrip at Roxby Downs:

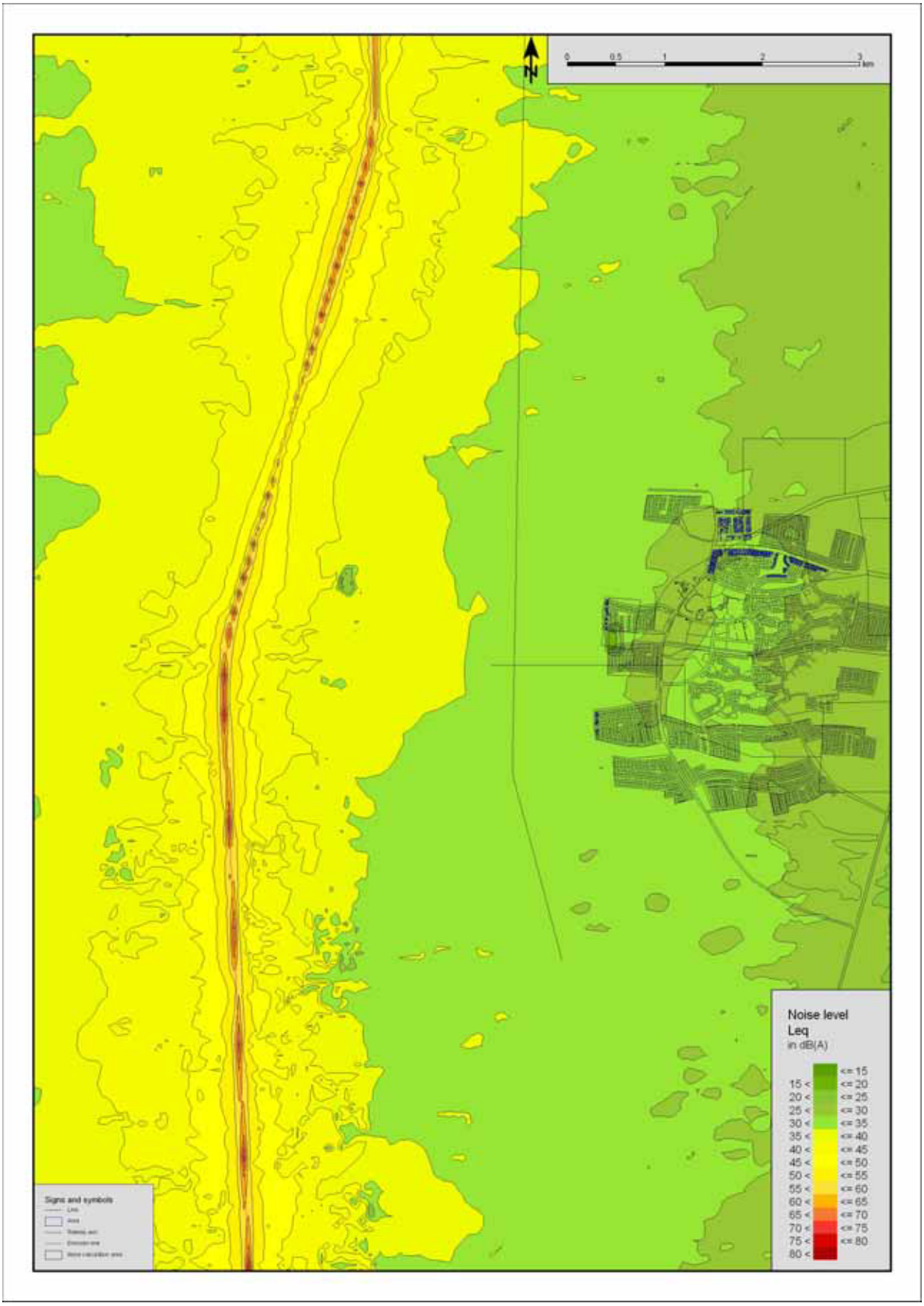

Figure G18: Rail Noise Contours for Roxby Downs, $dBL_{Aeq,}$ 9hr (Night)

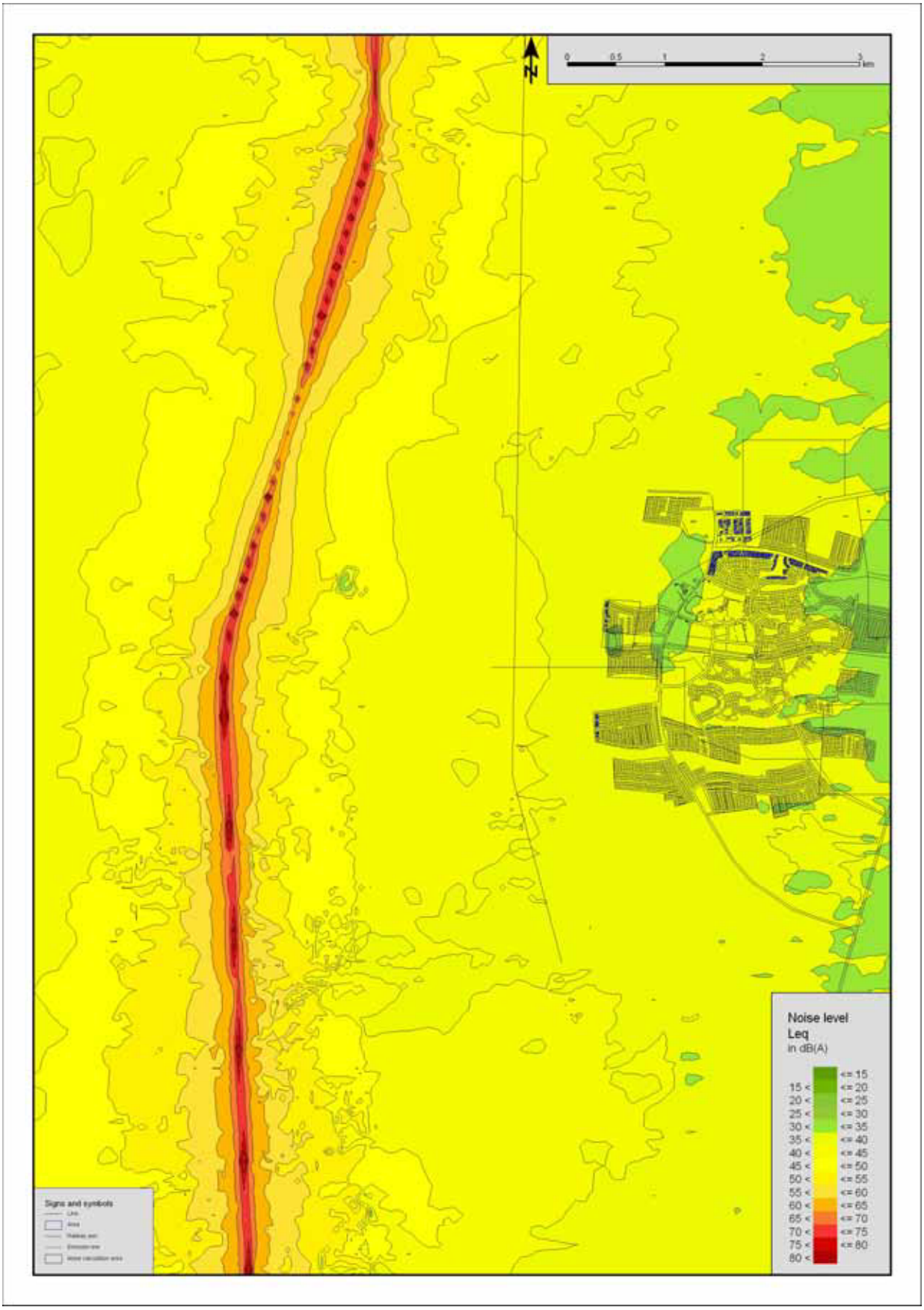

Figure G19: Rail Noise Contours for Roxby Downs, Maximum Sound Pressure Level, dB(A)

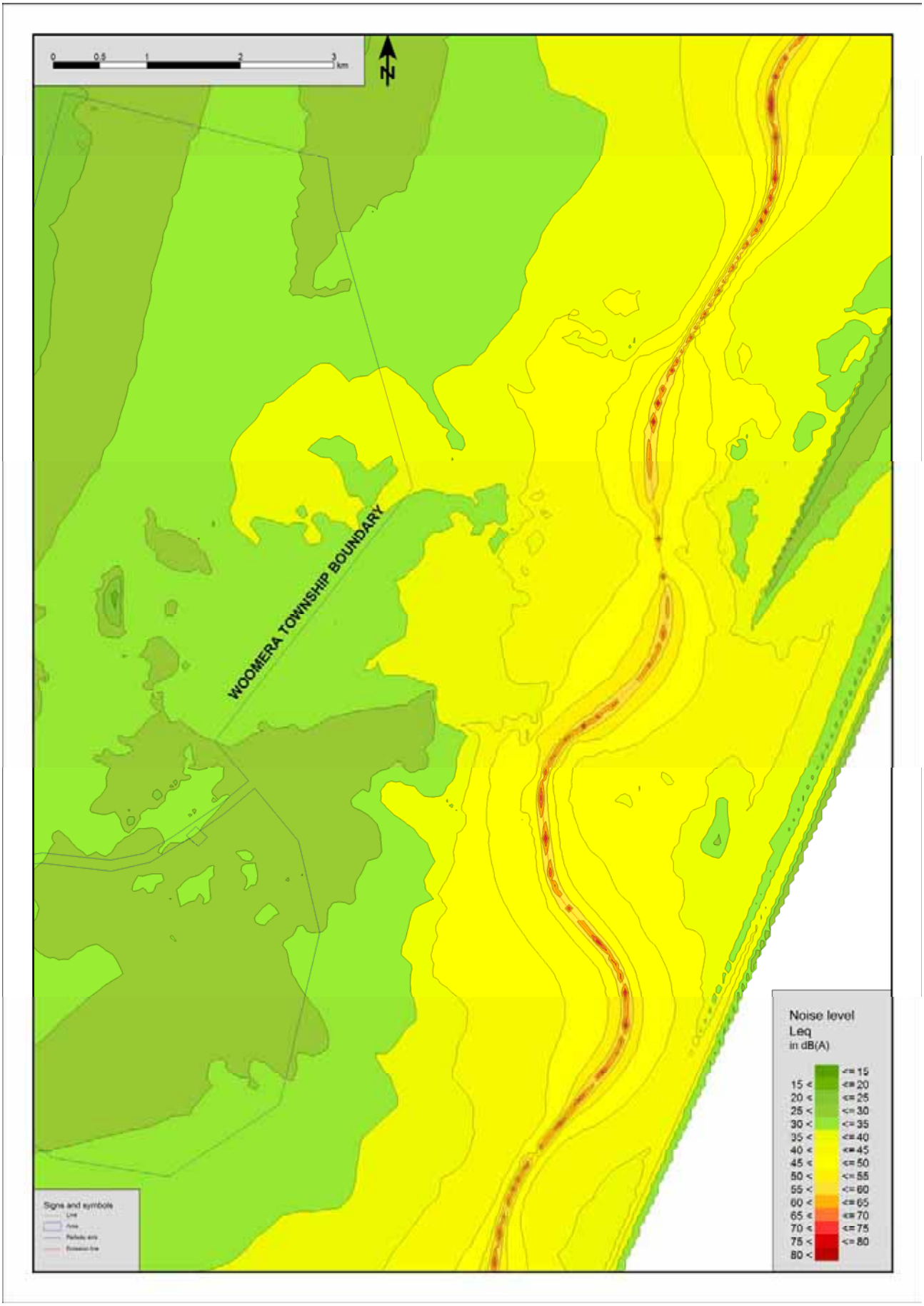

Figure G20: Rail Noise Contours for Woomera, $dBL_{Aeq,}$ 9hr (Night)

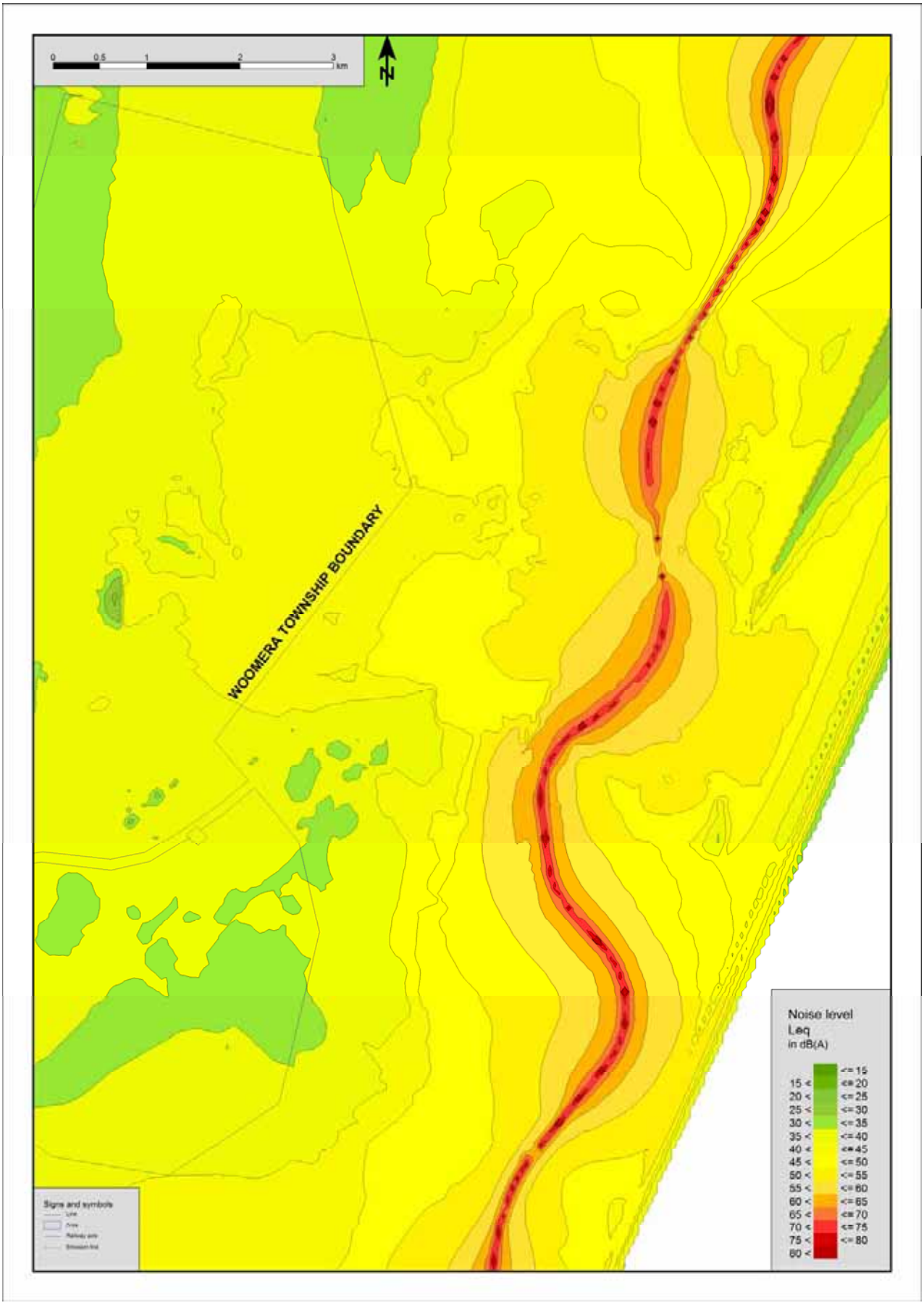

Figure G21: Rail Noise Contours for Woomera, Maximum Sound Pressure Level, dB(A)