NOISE AND VIBRATION 14

14.1 INTRODUCTION

The Roxby Downs township is located in remote South Australia, about 14 km from the Olympic Dam operation, and has a naturally low background noise level. The principal sources of noise in the region are industrial, and noise generated by vehicles and aircraft movement that result from activities associated with the existing Olympic Dam operation. Local noise sources such as residential air-conditioners and local traffic currently mask the noise from the existing operation, which is rarely audible at Roxby Downs.

The proposed expansion introduces several additional noise and vibration sources to Olympic Dam, including open pit mining, placement of mine rock, an expanded metallurgical plant and the potential construction of a gas-fired power station. The expansion also introduces noise sources further afield of Olympic Dam, including a landing facility and associated access corridor south of Port Augusta, a coastal desalination plant at Point Lowly, the construction of a new rail spur from Pimba to Olympic Dam, a relocated and expanded airport and the construction of Hiltaba Village for workforce accommodation about halfway between Roxby Downs and Andamooka. The transport and handling of materials between Olympic Dam and the Port of Darwin and Outer Harbor would also increase noise levels above current backgrounds.

This chapter explains how these additional project components would affect existing noise and vibration levels and compares the predicted levels to applicable limits. Design modifications and management measures that would reduce predicted levels to within applicable limits are identified if necessary.

The potential effects of noise and vibration levels from the proposed expansion on wildlife and on human health and safety are addressed in Chapters 15, Terrestrial Ecology, and 22, Health and Safety, respectively.

14.2 ASSESSMENT METHODS

Arup Acoustics conducted the assessment of noise and vibration. The following sections provide an overview of the methods used; details are provided in Appendix M. The assessment approach involved:

- identifying sensitive noise and vibration receivers for each project component
- identifying relevant regulations, guidelines and criteria for each sensitive receiver
- establishing background noise levels at these receivers
- identifying sources of noise and vibration for the existing and expanded operation and modelling, where relevant, the total noise and vibration levels for the expanded project
- estimating the noise and vibration levels and, if required, identifying design modifications and management measures that would reduce predicted levels to below applicable limits.

14.2.1 SENSITIVE RECEIVERS

The sensitive receivers referred to in this assessment are based on the human population centres outside the mine lease that are most exposed to potential noise and vibration sources. In general, these are linked to the construction and operation of specific infrastructure associated with the proposed expansion as described in Table 14.1, and were previously shown in Chapter 13, Greenhouse Gas and Air Quality, Figures 13.9 a to 13.9 d.

Receivers within the mine lease are discussed further in Chapter 22, Health and Safety, as they have higher noise limits related to occupational health, in comparison to residential (public) noise limits which are based primarily on impacts to amenity. Residences in the vicinity of existing and proposed traffic and rail routes are referred to in general terms rather than identifying each individual property as a sensitive receiver.

Table 14.1 Sensitive receivers near proposed infrastructure

Proposed infrastructure component	Sensitive receivers
New open pit mine and metallurgical plant	Roxby Downs and Hiltaba Village residences
Coastal desalination plant and intake structures	Point Lowly residences
Water supply pipeline and associated pumping stations	Pastoral properties
Transmission line	Pastoral properties
Gas supply pipeline	Pastoral properties
Rail line and additional rail traffic	Roxby Downs, Hiltaba Village, Woomera and population centres adjacent to the existing rail line between Adelaide and Darwin
Pimba intermodal road/rail facility	Pimba residences
Road infrastructure and additional traffic	Roxby Downs and population centres adjacent to the roads between Olympic Dam and Outer Harbor
Port of Darwin	Darwin residences
Outer Harbor	Outer Harbor residences
Landing facility	Shack Road residences
Airport	Hiltaba Village residences

14.2.2 MODELLING OF BACKGROUND AND PREDICTED LEVELS

Acoustic modelling was undertaken by Arup Acoustics to predict noise levels associated with the expanded mining and metallurgical activities, including activities associated with the coastal desalination plant, the landing facility, and rail-generated noise near the townships of Roxby Downs and Woomera. This model was calibrated against background noise measurements taken during field surveys as part of the Draft EIS assessment.

Noise modelling

Noise level predictions have been prepared using SoundPLAN environmental modelling software and the CONCAWE noise propagation model. This software allows local meteorology to be incorporated into the acoustic model, and considers noise attenuation by:

- geometrical spreading
- atmospheric absorption
- ground effects
- meteorological conditions
- existing or proposed noise barriers.

Field measurements were taken at the existing Olympic Dam operation over two weeks in February 2006 to establish background levels and to calibrate the acoustic model (see Plates 14.1 and 14.2). Attended noise measurement (15-minute 'snapshots' taken during the day, evening and night at each location) were taken in a variety of locations. A noise data logger was used to record daily variation of noise levels at some of these locations. Calibration of the model was carried out by establishing the existing noise levels of defined noise sources as described in Appendix M, running the model to predict the noise levels from these sources, and comparing these predictions to the actual levels.

Plate 14.1 Attended noise measurement at Olympic Dam Village

Plate 14.2 Noise data logger at Roxby Downs

The acoustic model was then used to predict the noise level at sensitive receivers for future operational scenarios under various weather conditions. The model used topography, building structures, meteorological conditions, and ground and air absorption factors as inputs.

For the purpose of including mobile noise sources in the model, such as haul trucks, the sources were placed in realistic locations and treated as stationary noise sources.

Topography and building structures

Local topographic data were used as an input to the acoustic model, although their effect is likely to be minimal because of the relatively flat terrain of the Olympic Dam region (see Chapter 10, Topography and Soils, for details).

Topographic changes associated with developing the RSF and the TSF were entered into the model for the various modelled scenarios (see Chapter 5, Description of the Proposed Expansion, and Figures 5.6a and 5.6b for the RSF and TSF growth over time).

The size and location of existing and proposed building structures, approximated from design drawings, were added to the model because large buildings can shield or otherwise attenuate noise.

Meteorology

The meteorology of the Olympic Dam region is discussed in Chapter 8, Meteorological Environment and Climate. Meteorological conditions can greatly affect noise levels at sensitive receivers by creating conditions that drown out, reflect and/or refract sound. For the purpose of the acoustic modelling, some worst-case meteorological conditions were developed. These usually involved the simulation of temperature inversions and wind-speed events in which the wind originating from the noise source travelled towards the sensitive receivers. Temperature inversions typically occur on still nights when the wind is not mixing the air and the warmer air rising from the Earth's surface is trapped by a layer of cooler air in the atmosphere. This natural weather condition is relevant to noise because the inversion refracts sound waves back towards the ground that might otherwise disperse.

Ground and air absorption factors

Default factors for ground and air absorption were entered into the model, based on the noise modelling consultant's experience (for ground absorption) and temperature and humidity data at Olympic Dam (for air absorption).

Vibration modelling

Vibration levels for the proposed operation were assessed in accordance with the procedures outlined in AS 2187.2 (Explosives – Storage and Use Part 2: Use of Explosives).

14.2.3 APPLICABLE NOISE AND VIBRATION CRITERIA

The South Australian regulatory framework for noise and vibration sources and receivers was reviewed. If applicable limits for the identified sources were undefined, alternative criteria from the South Australian Environment Protection Authority (EPA) or derived from Australian Standards were used. Further detail regarding noise and vibration limits is provided in Appendix M.

Noise limits

Relevant noise limits are presented in accordance with the type of source to allow reference to applicable legislative criteria:

- industrial noise (including blasting)
- road traffic noise
- rail noise
- aircraft noise
- construction noise.

Industrial noise and blasting

The current legislative criteria governing industrial noise in South Australia is the Environment Protection (Noise) Policy 2007 (SA EPA 2007). The policy establishes industrial noise limits for the sensitive receivers likely to be affected by an industrial noise source. If the Noise Policy specified no criteria, the World Health Organisation (WHO) Guidelines for Community Noise were applied. The adopted criteria for the receivers that could be affected by industrial noise are shown in Table 14.2; their derivation is described in Appendix M.

Blasting activities were assessed in accordance with criteria described in Australian Standard AS 2187.2 and are summarised in Table 14.3.

Road traffic noise

Road traffic noise can be divided generally into two types:

- increasing volume of traffic along roads adjacent to existing residences
- increased traffic flow to and from future housing which will be constructed adjacent to existing roads.

Road traffic noise for existing residences was assessed using the Department for Transport, Energy and Infrastructure – Road Traffic Noise Guidelines (DTEI 2002). The results are summarised in Table 14.4. The SA EPA has advised that new residences constructed adjacent to existing roads should meet different criteria, also shown in Table 14.4, to be measured at the building window (see Appendix M for more details).

Rail noise

Because no criteria are specified for rail noise in South Australia, the SA EPA has advised that rail noise from the new rail spur should not exceed:

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

Table 14.2 Summary of industrial noise criteria

Receiver location	Relevant document	Expanded operation criteria[1,2]	
		Day (7 am to 10 pm)	Night (10 pm to 7 am)
Roxby Downs	Environment Protection (Noise) Policy, 2007	47 dBL_{Aeq}	40 dBL_{Aeq} 60 dBL_{Amax}
Hiltaba Village	WHO Guidelines for Community Noise, 1999	50 dBL_{Aeq}[3]	45 dBL_{Aeq} 60 dBL_{Amax}
Point Lowly	Environment Protection (Noise) Policy, 2007	51 dBL_{Aeq}	43 dBL_{Aeq} 60 dBL_{Amax}
Pimba	Environment Protection (Noise) Policy, 2007	51 dBL_{Aeq}	43 dBL_{Aeq} 60 dBL_{Amax}
Shack Road	Environment Protection (Noise) Policy, 2007	51 dBL_{Aeq}	43 dBL_{Aeq} 60 dBL_{Amax}
Rural residences	Environment Protection (Noise) Policy, 2007	42 dBL_{Aeq}	35 dBL_{Aeq} 60 dBL_{Amax}
Outer Harbor	Environment Protection (Noise) Policy, 2007	54 dBL_{Aeq}	45 dBL_{Aeq}

Note: Criteria refer to industrially-contributed noise, and do not take into account existing background noise levels.
[1] dBL_{Aeq} is the noise level weighting based on the frequency response of the human ear, averaged over the defined time period.
[2] dBL_{Amax} is the maximum A-weighted noise level during the defined time period.
[3] The night-time criteria would be adopted during the day in recognition of shift workers.

Table 14.3 Summary of blasting noise and vibration criteria

Acoustic criteria	Type of operations	Expanded operation criteria
Ground vibration	Operations lasting longer than 12 months or more than 20 blasts	5 mm/s for 95% of blasts per year
		10 mm/s maximum
Air blast	Operations lasting longer than 12 months or more than 20 blasts	115 dBL for 95% of blasts per year
		120 dBL maximum

Table 14.4 Summary of road traffic noise criteria

Type of operation	Expanded operation criteria	
	Day (7 am to 10 pm)	Night (10 pm to 7 am)
Existing residences	55 to 65 dBL_{Aeq}[1]	50 to 60 dB_{LAeq}[1]
New residences	50 dBL_{Aeq}	45 dBL_{Aeq}
		60 dBL_{Amax}

[1] The range takes into account existing traffic volumes. Roads with little existing traffic should target the lower end of the range, and areas with higher traffic should target the upper end of the range.

The same criteria have also been applied at residences adjacent to the existing rail line.

Aircraft noise

There are no legislative criteria for aircraft noise in South Australia. However, the requirements of Australian Standard AS 2021:2000 (Acoustics – Aircraft Noise Intrusion – Building, Siting and Construction) should apply (see Table 14.5).

Construction noise

Construction noise associated with the Olympic Dam expansion is to meet the requirements of the South Australian Environment Protection (Noise) Policy 2007. Details of the relevant section of this document can be found in Appendix M and 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 background continuous noise level, whichever is higher; or
- the maximum noise source level exceeds 60 dB(A) or the background maximum noise level (that is reached consistently), whichever is higher.

Construction 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 (7 pm to 7 am).

Table 14.5 Summary of aircraft noise criteria

Criteria	Maximum
Indoor	50 dBL_{Amax}
External	65 dBL_{Amax} [1]

[1] The external criteria are derived from the indoor criteria, assuming 15 dBLA attenuation from the building structure.

The exceptions to this are if construction is to occur to:

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

If construction noise is considered to have an adverse impact on amenity, all reasonable and practicable measures are to be taken to minimise it and its impact.

Vibration criteria

Australian Standard AS 2670.2 (Evaluation of human exposure to whole body vibration, Part 1: General Requirements and Part 2: Continuous and shock induced vibration in buildings (1–80 Hz)) provides a guide for vibration limits for human exposure, which is summarised in Table 14.6.

Table 14.6 Summary of vibration criteria

Sensitive receiver	Condition	Limit (mm/s)
Residences	Day	0.3–0.6
	Night	0.2
Offices and retail		0.6

14.2.4 RISK AND IMPACT ASSESSMENT

The assessment of impacts and risks for the proposed expansion has been undertaken as two separate, but related, processes (see Section 1.6.2 of Chapter 1, Introduction, and Figure 1.11).

Impacts and benefits are the consequence of a known event. They are described in this chapter and categorised as high, moderate, low or negligible, in accordance with the criteria presented in Table 1.3 (Chapter 1, Introduction).

A risk assessment describes and categorises the likelihood and consequence of an unplanned event. These are presented in Chapter 26, Hazard and Risk Reduction.

14.3 EXISTING ENVIRONMENT

This section describes the current noise and vibration environment at the sensitive receivers. The results of the attended noise measurements are summarised in Table 14.7 and daily variation of noise levels is discussed in greater detail in Appendix M.

14.3.1 ROXBY DOWNS

Although the current Olympic Dam mining and metallurgical operation, the Opal Road quarry, the municipal landfill west of Roxby Downs, and the minor industrial activities north of Roxby Downs are all potential noise sources, none were found to be audible in Roxby Downs during the baseline survey. Noise levels in Roxby Downs were dominated by the use of air-conditioners and by local traffic noise, with noise levels varying between 35 dBL_{Aeq} and 52 dBL_{Aeq}.

14.3.2 HILTABA VILLAGE

The existing mining and metallurgical operation and the existing airport are the only potential sources of noise in the vicinity of the proposed Hiltaba Village. The existing operation was audible at this location, but recorded background noise levels were low with noise levels varying between 31 dBL_{Aeq} and 42 dBL_{Aeq}.

14.3.3 POINT LOWLY

The Santos Port Bonython oil storage and processing plant, including port and terminal facilities, and the Kingfish processing facility operated by Clean Seas Aquaculture Pty Ltd are the only industrial noise sources in the area. Noise measurements undertaken at residential receivers at Point Lowly were affected by high winds. The existing plants were not audible at the receivers on the day of the acoustic survey (see Plate 14.3) and background noise levels were found to be low with noise levels varying between 41 dBL_{Aeq} and 42 dBL_{Aeq}.

14.3.4 SHACK ROAD – LANDING FACILITY

The Flinders Power Playford and Northern coal-fired power stations are the only significant continuous noise source in the Shack Road region. Although the Australian Army occasionally

Table 14.7 Attended noise measurements of existing noise levels

Receiver location	Measured ambient noise level (dBL_{Aeq})	
	Day (7 am to 10 pm)	Night (10 pm to 7 am)
Roxby Downs	52	35
Hiltaba Village	42	31
Point Lowly	41	42
Shack Road	46	41
Rural residences (measured at Woomera)	35	33[1]

[1] Night-time noise level recorded from a data logger rather than attended.

uses the Cultana Training Area for training and wheeled and tracked vehicle manoeuvres, at the time the noise levels were being measured no activities were under way. Day-time noise levels at the residences on Shack Road were dominated by the sound of waves on the shoreline and occasional light vehicle traffic. At night, noise from the power station was clearly audible, particularly during coal bin filling or dumping activities. Background noise levels were, however, relatively low (i.e. 41–46 dBL_{Aeq}).

Plate 14.3 Noise monitoring at Point Lowly residences

14.3.5 RURAL RESIDENCES

The noise levels measured at Woomera were assumed to be relevant to all rural residences that could be affected by the proposed expansion (see Plate 14.4) including those at Pimba and Purple Downs. There are no significant continuous industrial noise sources at Woomera or near the other rural residences. Although activities such as weapons testing and aircraft movements at the Woomera Prohibited Area nearby are likely to cause short-term noise and vibration, such events occur rarely. Minor traffic noise was found to be audible at night, but generally, background noise levels are very low (33–35 dBL_{Aeq}).

Plate 14.4 Woomera town centre

14.3.6 PORT OF DARWIN

Baseline noise monitoring has been undertaken for the Darwin LNG Project (URS 2004 and URS 2005) and for the Quarantine Waste Treatment Facility (GHD 2006). The nearest sensitive receivers to East Arm have been identified as:

- Government House, approximately 4 km west of East Arm and adjacent to the Darwin CBD
- Berrimah, approximately 6 km to the north-east of East Arm
- Marlow Lagoon in Palmerston, approximately 7.2 km east of East Arm.

Results of previous baseline noise modelling at these locations and East Arm is summarised in Table 14.8.

Table 14.8 Baseline noise levels (2005–2006)

Location	Noise level (dB(A) LA_{90})	
	Minimum	Maximum
East Arm wharf	30.9	32.3
East Arm boat ramp	33	60
Government House	38	42.6
Berrimah	39.4	45.8
Marlow Lagoon	25	47

Existing industrial activities that contribute to current noise levels at East Arm include the loading and unloading of bulk materials, livestock and containers. Up to 700,000 t of bulk manganese is exported from the East Arm wharf annually (Darwin Port Corporation 2008), while up to 170,000 t of sulphuric acid is currently imported, expected to increase to around 300,000 tpa in the short term. Territory Resources Limited are targeting 2.5 Mtpa of iron ore exports from the port by the end of 2009, an increase from the current 2 Mtpa (Territory Resources 2008). OZ Minerals Prominent Hill project has selected East Arm as the preferred location for its bulk handling facilities, expected to have a capacity of up to 250,000 tpa of copper concentrate (Darwin Port Corporation 2008).

14.3.7 OTHER RECEIVERS

Attended noise measurements were not recorded for sensitive receivers in Outer Harbor and along the road and rail corridors. Instead, a general assessment of the probable relative increase in existing noise levels was carried out (see Section 14.5).

14.4 DESIGN MODIFICATIONS TO PROTECT ENVIRONMENTAL VALUES

14.4.1 ENVIRONMENTAL VALUES

The environmental values of relevance to noise and vibration are the existing background levels at sensitive receivers as described in Section 14.3.

14.4.2 MAJOR ELEMENTS OF THE PROJECT DESIGN

The large scale of the expanded mining and metallurgical operation, and its proximity to Roxby Downs, suggested that compliance with the noise criteria may be a challenge. As a result, some mitigation measures were identified and included in the project design and in the acoustic model that resulted in reduced noise levels at Roxby Downs and Hiltaba Village. Other management decisions were made regarding the location of project infrastructure to reduce the potential impacts on sensitive receivers. These mitigation and management measures were:

- restrict the use of haul truck air horns while trucks are operating on the RSF
- relocate Olympic Village and the existing heavy industrial estate to reduce potential workforce and residential exposure to high noise levels
- position Hiltaba Village approximately half way between Roxby Downs and Andamooka to maximise the distance between the noise sources and the residents (in addition to, and considering, the social and economic impacts associated with the construction and operation of an accommodation camp for up to 10,000 people)
- design the location and orientation of the proposed airport to broadly align with the prevailing wind direction while avoiding overflying Hiltaba Village and Roxby Downs.

For noise and vibration associated with off-site infrastructure, the following mitigation and management measures were incorporated:

- enclose the reverse osmosis section of the coastal desalination plant and the seawater intake pumping station
- locate the proposed landing facility to minimise the number of properties that could be affected, and limit operations at the proposed landing facility to between 7 am and 7 pm to minimise noise nuisance to nearby residents.

These management and mitigation measures were incorporated into the noise and vibration impact assessment. Further details of management, monitoring and auditing requirements are discussed in Chapter 24, Environmental Management Framework.

14.5 IMPACT ASSESSMENT AND MANAGEMENT

14.5.1 NOISE AND VIBRATION SOURCES

Noise and vibration sources around the Special Mining Lease

Some parts of the expanded and modified mining and metallurgical operation could create significant industrial noise, as summarised below and described in greater detail in Appendix M.

Open pit mining activities

The new open pit mining operation would introduce a large number of potential noise sources including:

- haul trucks (particularly the use of air horns and reversing alarms)
- primary crushers for the crushing of ore
- blasting activities
- electric shovels.

The noise from blasting and crushing would be somewhat attenuated by the walls of the open pit and the RSF. The noise associated with the movement of haul trucks, however, including dumping, air horns and reversing alarms, would become more significant as the distance between the sources and the receivers on the southern and eastern sections of the RSF decreased.

Plate 14.5 shows an electric shovel and diesel haul truck of the size likely to be used at the expanded Olympic Dam.

New and expanded metallurgical plant

The construction of a new metallurgical plant would result in a greater number of noise sources associated with various items of plant and equipment. The most significant of these are:

- up to nine additional grinding mills
- four additional sulphur-burning acid plants
- additional smelter gas treatment facilities
- miscellaneous additional pumps and fans.

CCGT power station

A CCGT power station may be constructed to satisfy the expanded operation's electrical demand. The most significant noise-generating aspects of the proposed power station are:

- cooling water and steam pumps
- cooling towers
- turbine assemblies
- condensers.

Plate 14.5 Mine rock loading operations at Escondida, Chile

Off-site infrastructure

Desalination plant

The construction and operation of the desalination plant would be an additional source of noise at Point Lowly, with electric pumps and energy recovery systems operating continuously. The nearest sensitive receivers are residential properties located between 500 m and 2.5 km from the proposed plant. Plate 14.6 shows the construction of Perth's Kwinana desalination plant, to which the proposed Point Lowly plant is likely to be similar.

Water supply pipeline

Some noise may be associated with the construction of the water supply pipeline. When it is operating, however, noise would be confined to that generated by the three pumping stations located along the pipeline corridor. The distance between the pump stations and the nearest rural residence is approximately 2.4 km.

Electricity transmission line

The electricity transmission line would not be a source of noise during operation except for strumming from lines (Aeolian noise) and annual helicopter inspections of the line. During construction, however, some temporary and localised noise would be generated during the installation of towers. The nearest sensitive receiver is Purple Downs homestead, which is located approximately one kilometre away.

Plate 14.6 Construction of desalination plant at Cockburn Sound, Perth

Plate 14.7 Typical rail traffic between Pimba and Outer Harbor

Gas supply pipeline

During construction of the gas supply pipeline, some temporary and localised noise would be generated. The closest sensitive receiver is the Muloorina homestead, which is located approximately 1.3 km away from the proposed pipeline. During operation, the compression station (needed for pipeline options 2 and 3 – see Chapter 5, Description of the Proposed Expansion) would be a source of noise. The nearest sensitive receiver to the compressor station would be Mount Hopeless homestead, located approximately 20 km away.

Rail

Noise sources from rail are also relevant to the project in two areas. Firstly, the noise associated with the construction and operation of the new 105 km rail link from near Pimba to Olympic Dam. The proposed new rail line would pass about 6 km east of Woomera, 5 km west of Roxby Downs and about 1.2 km west of the Purple Downs homestead. Purple Downs homestead was assessed as the nearest sensitive receiver.

The effect of additional rail traffic on residents adjacent to the existing rail line between Pimba and Outer Harbor (see Plate 14.7) and between Pimba and Darwin was assessed. The expected rail traffic between Olympic Dam and Outer Harbor would increase by about 28 trains per week in addition to the 52 to 79 rail movements that presently occur each week. Rail traffic from Olympic Dam to the Port of Darwin would increase by around 14 trains per week in addition to the current weekly average of 10 to 34 rail movements.

Pimba intermodal road/rail facility

Prior to the construction of the rail spur from Pimba to Olympic Dam, an intermodal road/rail facility would be established to transfer railed materials from rail wagons to trucks for final delivery to Olympic Dam. This would reduce the volume of traffic required on the Stuart Highway and Olympic Way. The noise sources at the intermodal facility would include railway shunting and container loading and unloading activities, including the use of reversing alarms.

The intermodal facility is located about 1.1 km north of Pimba.

Road traffic

Traffic in and around Roxby Downs would increase as a result of the increase in population associated with the proposed expansion. It is predicted that traffic volume along existing major corridors (such as between Roxby Downs and Olympic Dam) would increase approximately fourfold, and on lesser roads, traffic volume would double.

Heavy vehicle traffic associated with the proposed expansion is likely to increase on the roads between Outer Harbor and Olympic Dam, although it is predicted that this would be limited to an increase of between 5% and 30% on existing heavy traffic volumes.

Concentrate handling facility

The proposed handling facility for concentrate in the Port of Darwin would produce noise associated with railway shunting and general conveying and materials handling and loading activities.

Sulphur handling facility

Similarly, the proposed sulphur handling facility at Outer Harbor would be a noise source due to the use of materials handling equipment and railway shunting and loading activities.

Landing facility

Approximately 280 vessels would be offloaded at the landing facility over a seven-year period. The offloaded cargo would be transported to the Port Augusta pre-assembly yard (via a dedicated access corridor) and then to Olympic Dam via the Stuart Highway. Construction activities would involve the building of a jetty and the establishment of a quarantine laydown area adjacent to the landing facility.

Airport

The proposed airport would be located 17 km from Roxby Downs and Andamooka, and about 1 km from Hiltaba Village. The airport would accommodate class 4C aircraft, such as Boeing 737 and Airbus A320 class jet aircraft. It is estimated that about five class 4C flights would occur each day. Additional scheduled flights, including night flights, would also be likely, particularly during the construction phase.

The existing airport located adjacent to the existing Olympic Village, approximately 10 km north of Roxby Downs, would be decommissioned after the proposed airport was commissioned.

14.5.2 PREDICTED NOISE LEVELS

Predicted noise and vibration levels at sensitive receivers are described below (see Appendix M for details).

Predicted noise levels around the SML

Three meteorological conditions were modelled to represent neutral, adverse and inversion (being the likely worst-case conditions for transmitting noise from the operation to sensitive receivers). These adverse and worst-case conditions were significant winds from noise sources to the sensitive receivers and winter inversion conditions, respectively. Although detailed inversion information is not collected at Roxby Downs, data indicates that atmospheric stability is only conducive to the formation of inversions during the night and for about 26% of nights (or around 95 nights per year). The inversions would generally last only a few hours, typically forming in the early morning and breaking down as the sun rises.

Table 14.9 identifies the meteorological conditions modelled for the expanded operation.

Table 14.10 lists the results of the noise modelling under the various meteorological conditions at Roxby Downs and Hiltaba Village.

The noise contours for the expanded operation are shown in Figure 14.1. The results indicate compliance with the noise criteria with the exception of Roxby Downs during inversion conditions, when the night criterion is predicted to be exceeded by 3 dB. Such conditions are predicted to occur, on average, about 95 nights a year for a few hours each time (corresponding with the predicted frequency and duration of temperature inversions). For the expanded operation, the use of haul trucks (including the use of air horns and reversing alarms) surrounding the pit and on the southern and south-eastern sections of the RSF would be the primary source of noise at the sensitive receivers.

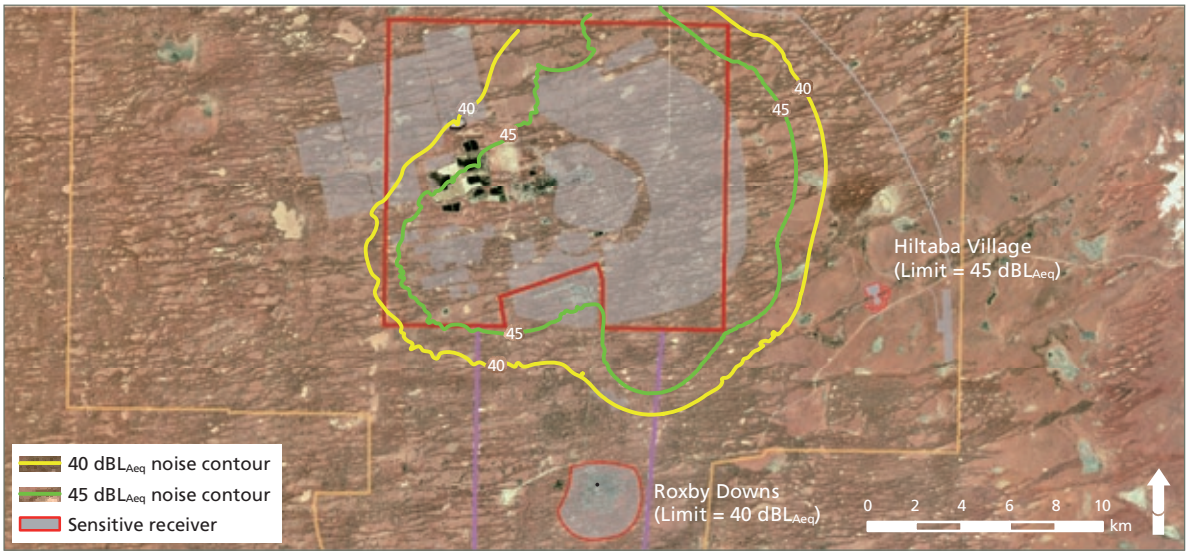
Table 14.9 Meteorological conditions modelled

Meteorological condition	Wind speed (m/s)	Temperature (°C)	Humidity (%)	Pasquil stability category[1]
Neutral	0	20	50	Neutral (D)
Adverse[2]	8	7	77	Unstable (B)
Inversion	0	7	77	Stable (F)

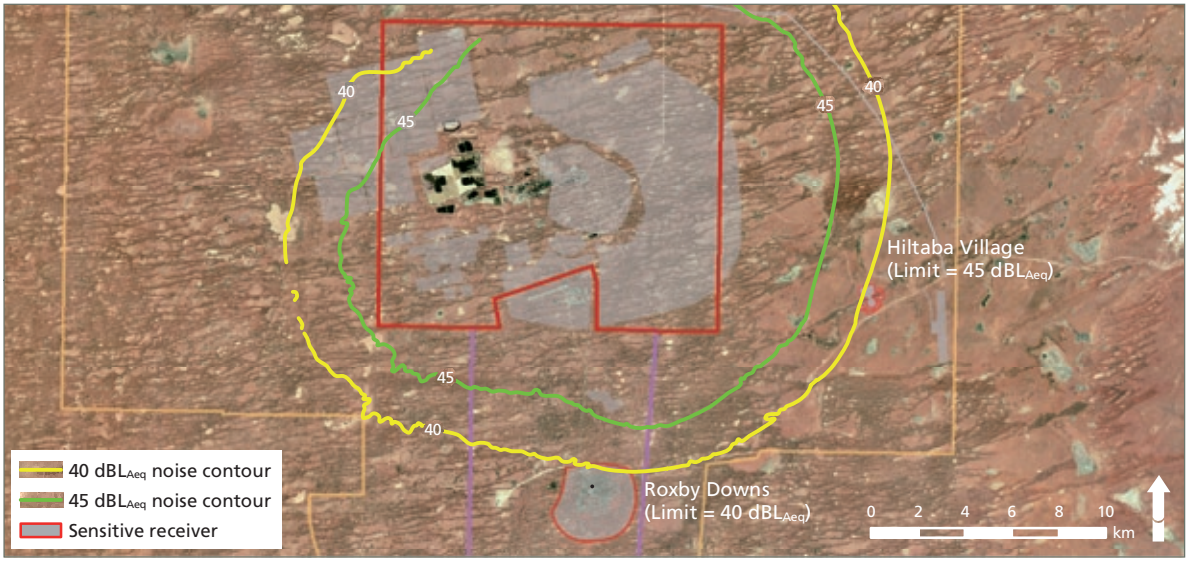
[1] This category relates to atmospheric stability (see Chapter 8, Meteorological Environment and Climate).
[2] The wind direction resulting in the highest noise level at receivers was used.

Table 14.10 Predicted industrial noise levels

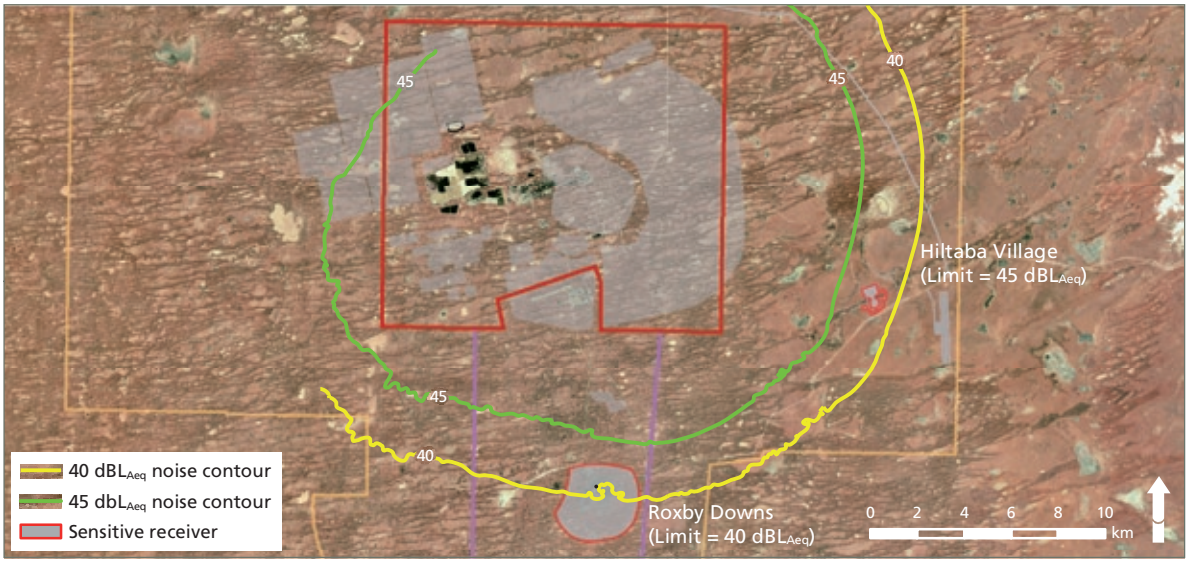
Location	Predicted noise level (dBL_{Aeq})			Criteria (dBL_{Aeq})	
	Neutral meteorological conditions	Adverse meteorological conditions	Temperature inversion (night only)	Day	Night
Roxby Downs	33	40	43	47	40
Hiltaba Village	32	39	42	45	45



Neutral conditions



Adverse conditions



Temperature inversion

Figure 14.1 Predicted noise contours for the expanded operation under various meteorological conditions (dBL_{Aeq})

A number of potential mitigation strategies are available to further reduce noise levels to within external noise limits during temperature inversions. One or more of the following strategies would be implemented to achieve compliance at sensitive receivers:

- modify the design and use of surface equipment air horns and reversing alarms (e.g. restricted use, use of horns and alarms of different frequencies and use of ambient noise sensor horns and alarms)
- relocate mobile noise sources (e.g. haul trucks) to areas further away from sensitive receivers
- attenuate sound on mobile equipment by fitting acoustic shielding.

The Environmental Management Program (EM Program) would be updated to include monitoring aimed at confirming the findings of the noise modelling, assessing the adequacy of the proposed mitigation mechanisms, and providing real-time weather data to inform operational control. The revised plan would include:

- development of a refined and validated acoustic model based on the as-built mining and metallurgical operations
- installation of a meteorological system that incorporates climatic conditions such as wind speed and direction (which may also record temperature inversions) into the acoustic model so that noise levels contributed during operations at Roxby Downs and Hiltaba Village could be predicted
- monitor sound at key receptor locations to assess compliance with the adopted criteria, and to ensure the reliability of the acoustic model
- implement an operating response plan for situations where noise levels were predicted to exceed the compliance criteria. This may include the relocation of mine rock haulage activities to locations further away from the receiver, or other measures as required.

The exceedance by 3 dB at Roxby Downs during the night-time inversions would be difficult to distinguish from local noise sources, including air-conditioners, heaters and local traffic.

Furthermore, the World Health Organisation (WHO) Guidelines for Community Noise suggest that an indoor noise level of 30 dB is required to avoid nuisance. It also notes that buildings typically attenuate external noise levels by about 15 dB. This would mean that the modelled external noise at Roxby Downs of 43 dB may be attenuated by around 15 dB, resulting in an interior noise level during temperature inversions of around 28 dB (lower during neutral and adverse meteorological conditions) and therefore below the WHO guideline level at all times. As a result, the residual impact is considered low.

Predicted vibration levels around the SML

Blasting activities associated with the existing underground workings would continue until the underground mine was decommissioned. Additional blasting would occur in the proposed open pit mine.

To achieve the proposed increase in the rate of mining, the total volume of material blasted is predicted to increase from approximately 12 million tonnes per annum (Mtpa) to approximately 410 Mtpa. This would require the equivalent of approximately 335 blasted holes per day, with a TNT equivalent of some 800 kg per hole.

The predictions for blasting overpressure (i.e. the 'shockwave' caused by blasting) and vibration are shown in Figure 14.2. The predicted overpressure and vibration levels at Roxby Downs and at the proposed Hiltaba Village are provided in Table 14.11.

The modelling of ground vibration and air blast associated with blasting activities demonstrates that the vibration criteria at Roxby Downs and Hiltaba Village are complied with under all conditions. The off-site residual impact from blast vibration, therefore, is categorised as negligible, based on the low levels predicted by the modelling.

Predicted noise levels from the proposed desalination plant

Noise contours for the Point Lowly desalination plant were generated for the construction and operation phases and are shown with the applicable noise limit in Figure 14.3. Table 14.12

Table 14.11 Predicted vibration levels

Receiver	Ground vibration (mm/s)	Applicable criteria (mm/s)	Overpressure (dBL)	Applicable criteria (dBL)
Roxby Downs	0.5	5	109	115
Hiltaba Village	0.5	5	109	115

Table 14.12 Predicted noise levels at Point Lowly receivers

Phase	Predicted noise level (dBL_{Aeq})		Criteria (dBL_{Aeq})	
	Neutral meteorological conditions	Adverse meteorological conditions	Day	Night[1]
Construction phase	31	36	n.a.	45
Operation phase	20	25	51	43

[1] The night-time period for the construction phase is 7 pm to 7 am. The night-time period for the operation phase is 10 pm to 7 am.

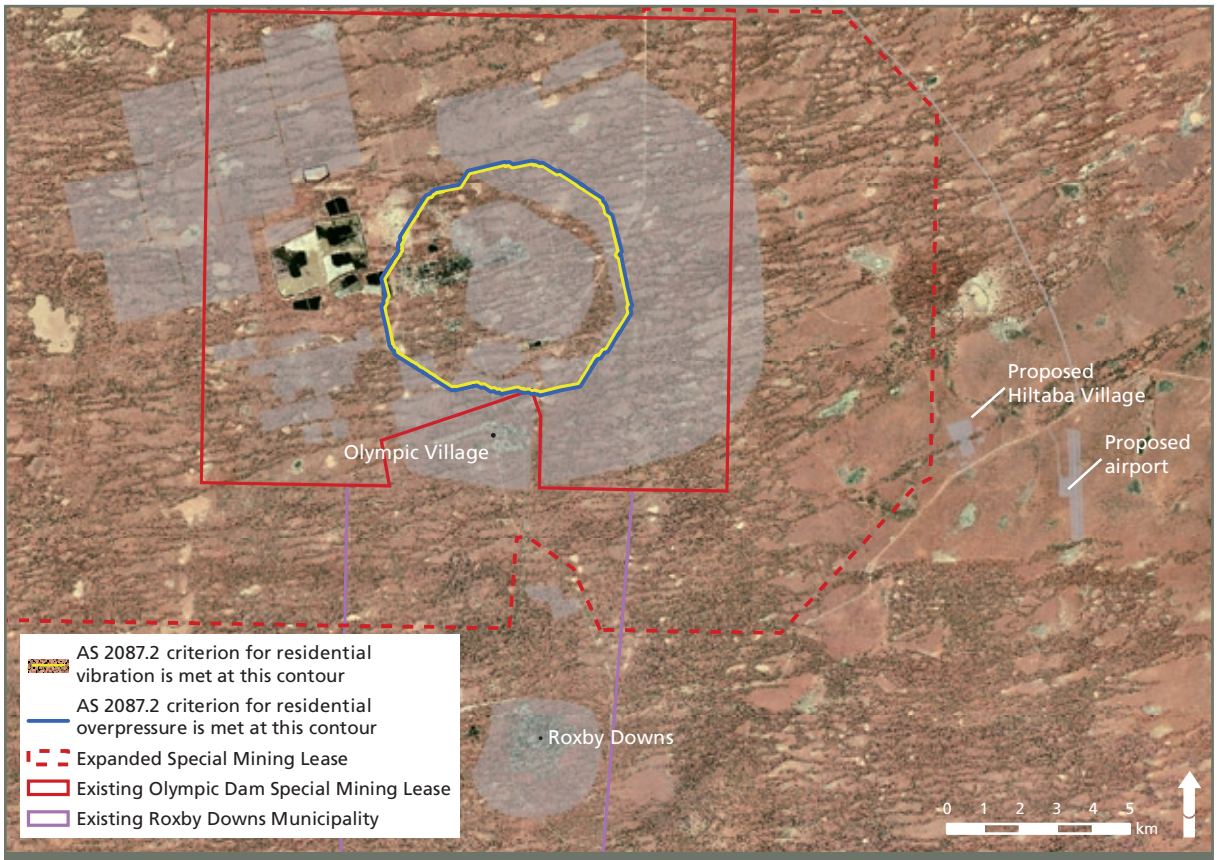


Figure 14.2 Predicted maximum blast vibration contours and applicable residential limits

shows the noise levels for each phase and the neutral and adverse weather conditions modelled. Inversion conditions were not modelled because the stability conditions necessary for inversions to form are not considered likely in an area with unstable atmospheric conditions, such as a near-sea location under the influence of off-shore and on-shore winds.

The results of the modelling show that the proposed desalination plant would generate noise levels that are well below applicable limits. The modelling includes attenuation resulting from enclosing the desalination plant in a standard warehouse-type shed, and fully enclosing the seawater pumps associated with the intake pipe. Both measures are standard engineering practice.

Noise generated during the construction of the desalination plant and associated pipelines is expected to be general construction noise and the local community would be informed prior to significant noise generating activities. Geotechnical investigations into potential construction methods for the intake and outfall pipelines will be carried out during the detailed design stage. The installation of temporary noise attenuation barriers, if required, would be detailed in environmental management specifications (see Chapter 24, Environmental Management Framework, for details).

The impacts of noise and vibration that occur during construction and operation of the desalination plant are categorised as low because of the relatively remote location of the desalination plant, the enclosure of the seawater pumps, and adherence to the SA EPA Environment Protection (Noise) Policy construction noise requirements.

Predicted noise levels from the proposed water supply pipeline

General construction noise would be generated during installation of the water supply pipeline. This is unlikely to disturb regional residents due to the distance between the pipeline and the nearest receivers.

The ongoing noise levels associated with the operation of the water supply pipeline would be limited to the three pump stations. The nearest sensitive receiver to a pump station is approximately 2.4 km and therefore the noise impact would be negligible.

Predicted noise levels from the proposed electricity transmission line

General construction noise would be generated during installation of the electricity transmission line. This is unlikely to disturb regional residents due to the distance between the line and the nearest receivers (approximately 1.1 km).

The Aeolian noise (i.e. strumming) from the transmission line during windy days was assessed at a distance of 1.1 km. The results are shown in Table 14.13.

Construction phase – neutral conditions

Construction phase – adverse conditions

Operational phase – neutral conditions

Operational phase – adverse conditions

Figure 14.3 Predicted noise contours at the desalination plant

Table 14.13 Summary of Aeolian tones from transmission lines[1]

Number of cables	Wind speed (m/s)				
	1	3	5	8	10
1	0	0	0	15	21
2	0	0	3	18	24
4	0	0	6	21	27

[1] All values in dB(A) referenced to 20 x 10^{-6} Pa, relating to the sound pressure threshold of human hearing.

In addition to the significant distance between the transmission line and the nearest receivers (1.1 km as stated above), the noise associated with the wind itself would mask the Aeolian tones, resulting in a negligible residual impact to receivers.

Predicted noise levels from the proposed gas supply pipeline

The nearest sensitive receiver to the proposed gas supply pipeline is approximately 1.3 km from route options 2 and 3 (see Chapter 5, Description of the Proposed Expansion). No sensitive receivers exist within the EIS Study Area for route option 1. Therefore construction noise would have a negligible impact on the nearest receiver. During operation the pipeline would not generate significant noise except for that generated by the compressor station in options 2 and 3. If required, the existing (unused) compressor station on the Moomba-Adelaide pipeline would be recommissioned, or a new compressor station built. Either would be far enough away from the nearest sensitive receiver (approximately 20 km from the compressor station location) that the residual impact is categorised as negligible.

Predicted noise levels from the proposed rail line

Noise contours generated from the operation of the rail line near Roxby Downs and Woomera are shown in Figure 14.4. Table 14.14 presents the predicted noise levels for the nearest noise sensitive receivers at Roxby Downs, Woomera and the nearest pastoral station to the rail line, Purple Downs homestead (located 1.2 km from the proposed line), compared to the criteria described in Section 14.2.3.

The results of the modelling indicate that the proposed rail line would generate noise levels well below applicable limits and would have a negligible residual impact. Ground level vibration from operation of the rail line would not be detectable beyond a few hundred metres from the line, and would have no impact on Roxby Downs, Woomera or Purple Downs homestead.

The overall increase in noise and vibration levels as a result of the increase in rail traffic on the existing rail line between Pimba and Darwin, and Pimba and Outer Harbor, would be approximately 2 dB(A)$L_{Aeq\ (24\text{-}hour)}$, which would be unnoticeable. Maximum noise levels would be unchanged as a result of the additional trains. Therefore, the impact to receivers adjacent to the rail line is categorised as negligible.

Predicted noise levels from the proposed Pimba intermodal road/rail facility

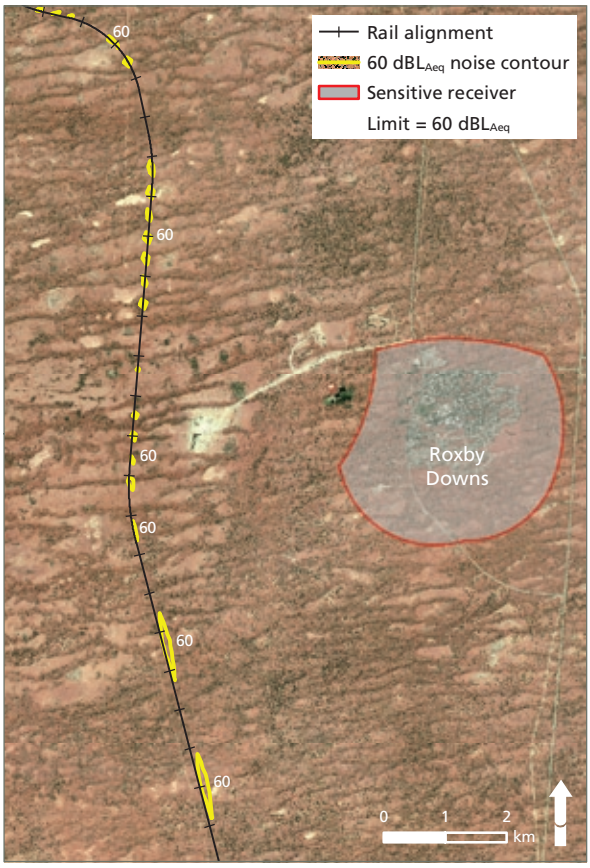
The operation of the Pimba intermodal road/rail facility would generate noise associated with rail shunting and materials handling, including reversing alarms. The distance between the facility and the nearest receiver in Pimba is approximately 1.1 km. Modelling of the proposed facility indicates that the noise criteria would be met at Pimba and it is unlikely, therefore, that noise from the intermodal facility would have a significant impact on residents of Pimba. In addition, the current rail and road transport activities at Pimba would create similar noise levels at closer distances to the sensitive receivers than those arising from the intermodal facility. For these reasons, the predicted impact to receivers at Pimba is categorised as negligible.

Predicted noise levels from road traffic

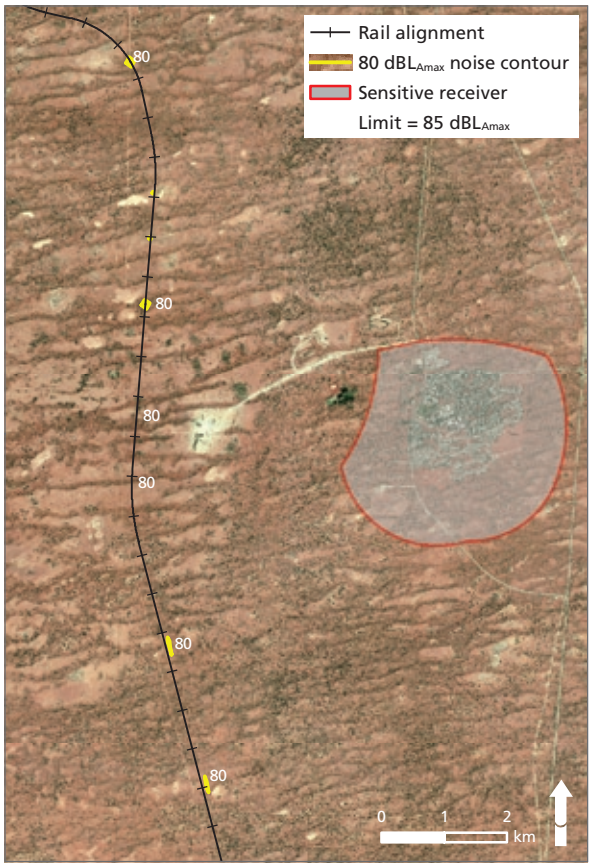
During peak hours, the volume of traffic on major roads around Roxby Downs (such as the road between Roxby Downs and Olympic Dam) may increase by up to four times during the construction phase of the proposed expansion. This would decrease when construction ceased. The larger feeder roads within Roxby Downs (such as Pioneer Drive and Stuart Road) are expected to have twice the volume of traffic as they do now, while road traffic on the residential streets is not expected to change significantly. The effects of change in traffic volume and the associated noise increases are described in Table 14.15.

Table 14.14 Predicted noise levels from proposed rail line

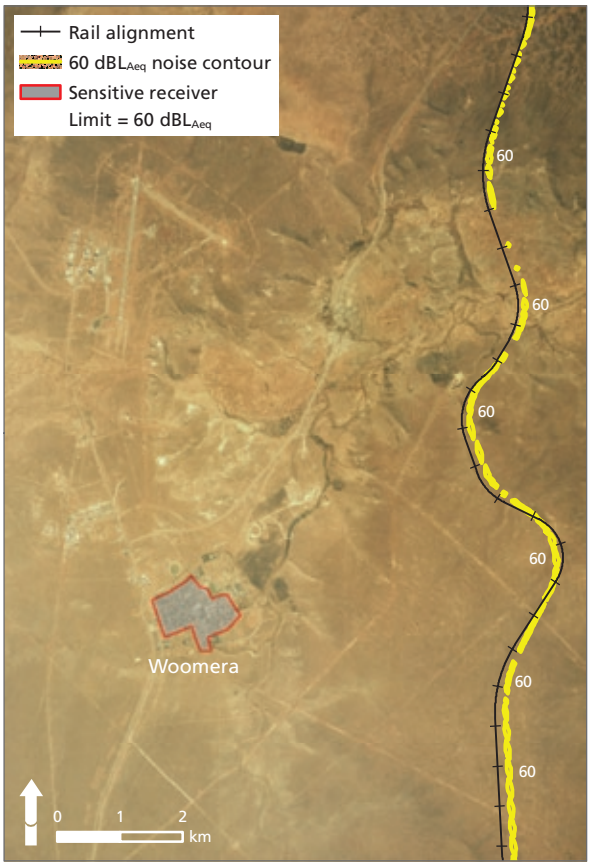
Receiver	Predicted noise level (dB re 20x10^{-6} Pa)		Criteria	
	$dBL_{Aeq\ (24\ hour)}$	dBL_{Amax}	$dBL_{Aeq\ (24\text{-}hour)}$	dBL_{Amax}
Roxby Downs	35	40	60	85
Woomera	36	45	60	85
Purple Downs homestead	34	40	60	85



Rail noise contours for Roxby Downs (average)



Rail noise contours for Roxby Downs (maximum)



Rail noise contours for Woomera (average)

Rail noise contours for Woomera (maximum)

Figure 14.4 Predicted noise contours as a result of the proposed rail line at Roxby Downs and Woomera

Table 14.15 Predicted noise increases as a result of increased road traffic

Scenario	Noise increase (dBL_{Aeq})
Fourfold increase in traffic volumes (major roads outside of Roxby Downs)	6
Twofold increase in traffic volumes (feeder roads within Roxby Downs)	3
Little increase in traffic volumes (residential streets)	Negligible

Some residences, particularly those along Olympic Way between Roxby Downs and Olympic Dam, would be affected by additional noise (up to 6 dB) associated with increases in road traffic volumes. The overall noise levels as a result of road traffic (existing and additional volumes) are predicted to remain within the acceptable criteria outlined in Section 14.2.3. Acoustic mitigation may be required at residences on Olympic Way, in the form of noise barriers or other suitable technologies to maintain existing amenity. As periodic and short-term exceedances of applicable limits may occur at the closest of residences, the residual impact has been categorised as moderate, therefore requiring ongoing management attention during the detailed design phase. New residences would be constructed with a buffer between the nearest residence and Olympic Way to reduce adverse impacts.

Three noise loggers were placed along Pioneer Drive, a feeder road on which traffic volume is expected to double as a result of the proposed expansion. Noise levels along this road were 55 dB during peak traffic times. A predicted increase of 3 dB would result in expected noise levels being around 58 dB, at the lower end of the criteria discussed in Section 14.2.3. Therefore, impacts to residents along these roads have been categorised as low (reflecting an effect but within compliance limits).

Predicted noise levels from the proposed concentrate handling facility

The construction and operation of the concentrate handling facility at the Port of Darwin would not result in increased noise levels at sensitive receivers. The nearest residences are some five kilometres from the location, with the port being relocated to avoid such social issues commonly associated with urban encroachment of Australian ports.

Predicted noise levels from the proposed sulphur handling facility

Modelling of the noise associated with the operation of the sulphur handling facility at Outer Harbor indicates that the daytime noise criteria would be met. However, the night-time criteria may be slightly exceeded at the nearest sensitive receivers as a result of noise from the conveyor. Investigations into the exact design of the conveyor would be undertaken during the detailed design phase, and may include the addition of sound insulation around conveyor motors to mitigate potential noise impacts. The nearest residences are approximately 1 km from the proposed location, which is already dominated by heavy industry, including container handling and bulk materials loading and unloading. As a result of the high level modelling outcomes and the existing industrial activities in the vicinity of the sulphur handling facility, the residual impact has been categorised as low.

Predicted noise levels from the proposed landing facility

An acoustic model was used to assess noise generated at the landing facility. The results are presented in Table 14.16 and the noise contours are shown in Figure 14.5.

The assessment indicates that noise criteria are expected to be exceeded at residences up to 450 m away during neutral meteorological conditions and at residences up to 750 m away during times when the wind is blowing from the landing facility to the receivers. Winds with a northerly component are expected to occur up to 35% of the time. It is therefore expected that up to 13 residences nearby would experience noise levels above the criteria during the day-time unloading activities (predicted to occur, on average, every 11 days). As this represents a periodic and short-term non-compliance with applicable limits, the residual impact is categorised as moderate, therefore requiring additional management attention during the detailed design phase. Management options are currently being discussed with potentially affected landholders.

Predicted noise levels from the proposed relocated airport

The 65 dBL_{Amax} noise contour, which represents the applicable limit for airport operational noise, is shown in Figure 14.6. This shows that all sensitive receivers, including Hiltaba Village and Roxby Downs, are located outside the contour for the applicable noise limit. It is considered that the impact on Roxby Downs of noise from the relocated airport would be less than that from the existing airport. This is because the relocated airport would be further away, and aircraft flight paths would be realigned to avoid flying over the town. The overall residual impact of the relocated airport is categorised as low, reflecting an effect, but within compliance limits.

Table 14.16 Predicted noise levels at the nearest sensitive receiver to the proposed landing facility

Operation	Meteorological conditions		Criteria
	Neutral	Adverse	
Day (7 am to 10 pm)	54	58	51 dBL_{Aeq}
Night (10 pm to 7 am)	37	42	43 dBL_{Aeq}
	n.a.	n.a.	60 dBL_{Amax}

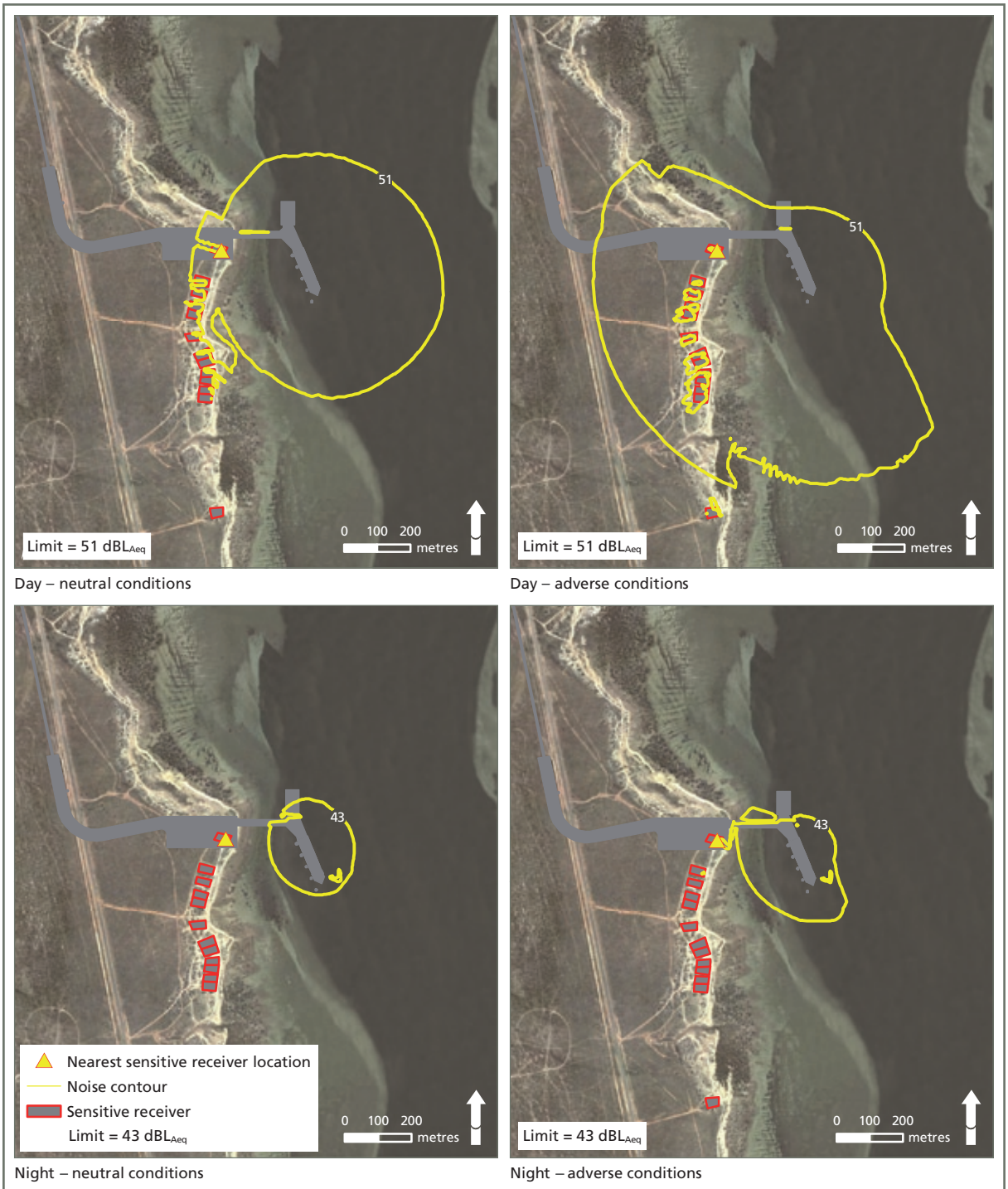


Figure 14.5 Predicted noise levels from the proposed landing facility

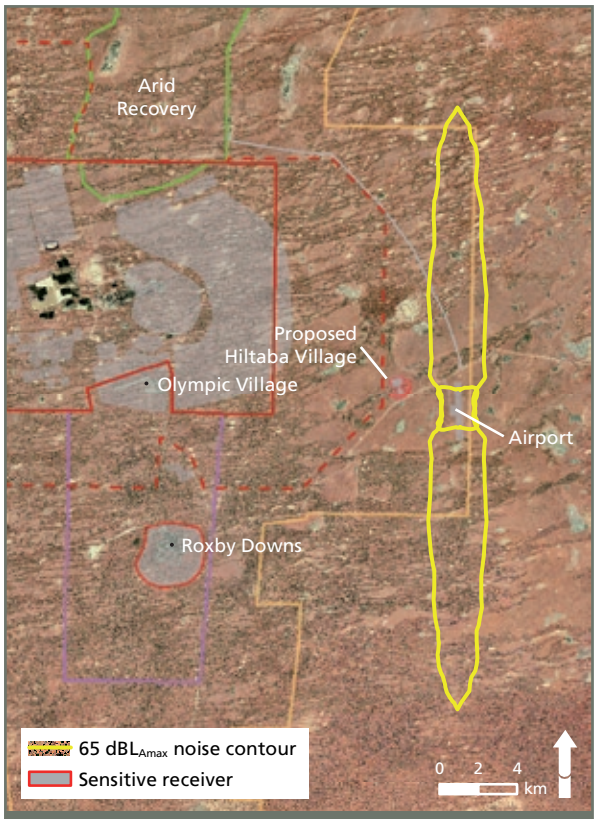


Figure 14.6 Predicted noise level contour for the relocated airport

14.6 FINDINGS AND CONCLUSIONS

The assessment of the impact of noise and vibration caused by the proposed expansion has identified potential additional noise and vibration sources, and considered them against state, territory and federal legislation, standards and guidelines.

In general, noise and vibration criteria are met for the proposed expansion and associated off-site infrastructure, which includes the coastal desalination plant, water supply pipeline, electricity transmission line, gas supply pipeline, rail line and associated traffic volume increase, concentrate and sulphur handling facilities, and the relocated airport.

For the expanded mining and metallurgical operation, the modelled noise and vibration meet the criteria for all indicators except under inversion conditions at Roxby Downs township. Several mitigation options are available to reduce noise levels at the source. These would be investigated during the detailed design phase of the project. An operational response plan would be developed that would aim to reduce noise levels at the receivers during the few hours on the nights when temperature inversions are likely to occur. This could be achieved by moving haul truck operations further away from the receivers, or by reducing the quantity of material moved. Also, local noise sources such as traffic, air-conditioners and heaters would mask the noise from the mining operations, resulting in a low residual impact.

An increase in road traffic volume is likely to increase noise levels, particularly at those properties adjacent to major roads such as Olympic Way between Roxby Downs and Olympic Dam. Although the predicted noise levels would be within the upper end of the specified criteria, some acoustic mitigation such as noise attenuating fencing or earthen mounds may be required to maintain existing amenity. Nevertheless, and in the current absence of such measures, the residual impact has been categorised as moderate, therefore requiring additional management attention during the detailed design phase.

Up to 13 residences adjacent to the proposed landing facility on Shack Road may be affected by increased noise levels. During neutral meteorological conditions, noise levels could exceed the criteria at properties up to 450 m from the facility. During adverse conditions, noise levels could exceed the criteria at properties up to 750 m from the facility, resulting in a residual impact categorised as moderate and also requiring further management attention. BHP Billiton is currently discussing these issues with affected landholders.

The noise and vibration levels would meet the criteria at all other investigated receivers, resulting in a low to negligible residual impact.