

Taroborah Coal Project

Environmental Impact Statement

Section 4.7 – Environmental Values and Management of Impacts – Noise and Vibration

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arc
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4.7 NOISE AND VIBRATION

An assessment of the potential impacts of noise and blasting vibration from the Project was undertaken by ASK Consulting Engineers Pty Ltd (ASK).

This section describes the existing environmental values that may be affected by noise and vibration from the Project and the practical measures used to protect and / or enhance environmental values. The Noise Impact Assessment (2013) is provided in Appendix 17.

4.7.1 Description of environmental values

Section 7, Part 3 of the *Environmental Protection (Noise) Policy 2008* (EPP (Noise)) defines the following environmental values relevant to the acoustic environment potentially affected by the Project that shall be enhanced or protected:

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

(b) Qualities of the acoustic environment that are conducive to human health and wellbeing, including by ensuring a suitable acoustic environment for individuals to do any of the following:

(i) Sleep;
(ii) Study or learn
(iii) Be involved in recreation, including relaxation and conversation; and

(c) Qualities of the acoustic environment that are conducive to protecting the amenity of the community.

In addition, the EPP (Noise) states acoustic quality objectives in the form of noise levels and provides a framework for making decisions regarding the affected acoustic environment.

4.7.1.1 Sensitive Receptors

Sensitive receptors are locations which are likely to experience adverse effects due to the activities associated with the Project. Sensitive receptors can be defined as human residences and places of work or recreation such as kindergartens, schools, hospitals, aged care facilities, office buildings, factories and workshops.

The majority of sensitive receptors relevant to the Project were found to be residences and no kindergartens, schools, hospitals, aged care facilities, office buildings, factories and workshops are known to exist in local proximity to the Project.

There are 14 potentially affected noise sensitive receptors within and surrounding the Project site. The nearest sensitive locations are summarised in Table 4.98 and illustrated in Figure 4.112.

Table 4.98 Sensitive Noise Receptors Associated with the Project

Receptor	Homestead	Direction From Mine	Distance (km)		Coordinates	
			From Pit	From CPP	Easting	Northing
1	Airlie	South	6.8	8.2	596588	7387748
2	Donnelly	North	0.2	2.6	596450	7396228
3	Dunloe	West	6.0	5.1	589085	7396597
4	Fairways	West	5.3	4.3	589734	7395104
5	Fork Lagoons	North	14.3	14.9	595365	7410405
6	Glendarriwell	South-West	12.1	11.2	584109	7390151
7	Iona Downs	North	0.7	3.0	596686	7396790
8	Jabiru	North	7.1	8.5	597530	7403116
9	Kingower	North-East	14.2	17.0	606399	7407103
10	Selma	East	8.0	11.5	605237	7398595
11	St Helens	South	2.4	2.4	594379	7393033
12	Sypher	North-East	6.6	10.0	602818	7400147
13	Walther	North-East	2.5	6.0	599728	7397238
14	Wilga downs	South	5.2	7.9	598993	7389546

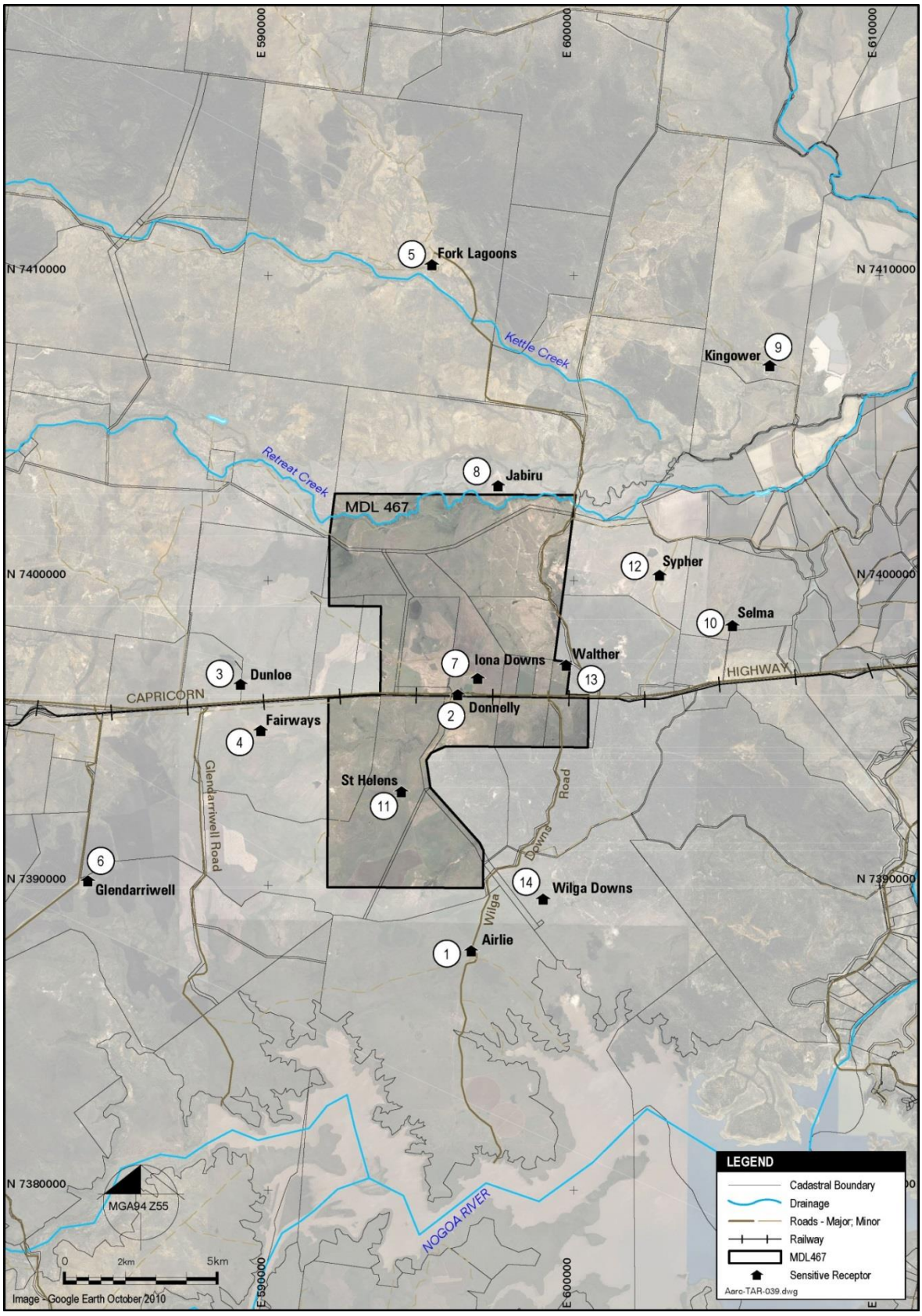

Figure 4.112 Noise Sensitive Receptor Locations Surrounding the Project Site (MDL 467)

4.7.1.2 Existing Noise Environment

The noise and vibration assessment included both attended and unattended environmental noise logging to characterise the existing noise environment surrounding the Project, in accordance with the methodology outlined in the Department of Environment and Heritage Protection (EHP) *Noise Measurement Manual* (2000).

Unattended environmental noise logging was conducted using four Larson Davis LD831 Environmental Noise Loggers while attended logging was undertaken using a Rion NA-27 sound level meter.

Noise monitoring was conducted between 19th - 27th April 2012 at the following four sensitive receiver locations:

- Location A - Iona Downs Property (Receptor 7);
- Location B - St Helens Property (Receptor 11);
- Location C – Walther Property (Receptor 13); and
- Location D – Jabiru Property (Receptor 8).

Noise levels are expressed in terms of the L_{eq}, L_{10}, and L_{90}. The L_{10} and L_{90} are respectively the A-weighted noise levels exceeded 10%, and 90% of the time. The L_{eq} is the A-weighted energy average noise level containing the same acoustic energy as the actual fluctuating noise level.

The ambient L_{eq}, average L_{10}, and min L_{90} noise levels for each complete measured period (day, evening and night) are listed in Table 4.99. The noise levels are expressed in terms of the maximum, minimum and average levels, in addition to the highest (top) 10% of noise levels, and the lowest (low) 10% of noise levels.

Table 4.99 Summary of Measured Noise Levels

Location	Statistic	L_{10}, dB(A)			L_{90}, dB(A)			L_{eq}, dB(A)		
		Day	Even	Night	Day	Even	Night	Day	Even	Night
A	Max	70	61	88	70	58	70	70	58	80
	Min	31	35	20	26	24	17	28	30	18
	Top 10%	54	52	51	44	48	44	49	49	46
	Low 10%	34	42	28	29	36	19	30	38	24
	Average	45	47	41	37	43	32	41	44	36
B	Max	65	59	52	47	42	36	63	59	45
	Min	34	23	18	27	20	17	30	21	18
	Top 10%	48	46	41	43	34	27	45	40	34
	Low 10%	39	26	19	31	23	18	34	25	19
	Average	44	37	29	38	29	21	40	34	26
C	Max	60	58	85	47	52	74	53	54	91
	Min	36	33	27	29	25	20	31	28	23
	Top 10%	51	54	50	46	50	45	47	50	46
	Low 10%	41	43	35	33	37	27	37	39	30
	Average	46	50	43	39	45	37	42	46	39
D	Max	67	62	52	55	61	43	63	59	55
	Min	29	38	19	23	29	18	26	33	19
	Top 10%	50	56	44	36	46	38	45	48	40
	Low 10%	32	40	21	25	34	19	28	37	21
	Average	41	46	33	29	41	27	36	43	31

*incomplete measurement periods have not been included within the analysis

The background noise levels (minL_{90}) were calculated using the 'lowest 10th percentile' of the minL_{90} noise levels in each period (day, evening and night) and are outlined in Table 4.100. The 'lowest 10th percentile' determines the lowest 10th percentile for each day and then reports the value corresponding to the median.

Table 4.100 Measured Background Noise Levels

Location	Background Noise Level, minL_{90}, dB(A)		
	Day	Evening	Night
A	31	36	20
B	31	24	18
C	33	43	27
D	25	35	19

Results indicate background noise levels are lowest during the night at Location B (St Helens Property – Receptor 11) and highest at Location D (Walther Property - Receptor 13). Further attended noise measurements were undertaken at locations A to D to gain a better understanding of the current background noise environment and assist with interpreting the noise logger results.

This assessment provided insight to the current activities in proximity to the Project area that may attribute to the background noise levels. During the assessment, the following occurrences likely to attribute to background noise levels were recorded:

- Trains;
- Traffic from the Capricorn Highway;
- Cows, dogs, horses and insects;
- Mechanical plant; and
- Banging and grinding from homestead shed.

Complete results from attended noise measurements together with associated field notes are provided in Appendix 17.

4.7.1.3 Noise Evaluation

Noise and vibration criteria for the Project have been developed to address a number of potential noise impacts on existing and future sensitive receptors. The acoustic objectives used to define proposed noise quality criteria have been acquired from the following sources and are discussed throughout this section:

- The EPP (Noise) – Contains criteria for controlling background creep and railway noise, in addition to acoustic quality objectives for sensitive receivers;
- EcoAccess Guideline *Planning For Noise Control* – Provides a procedure for the control and prevention of background creep and refers to the World Health Organisation (WHO) guideline *Guidelines for Community Noise* (1999) to determine sleep disturbance criteria;
- EcoAccess Guideline *Assessment of Low Frequency Noise* – Contains methods and

procedures that are applicable to low frequency noise emitted from mining operations for planning purposes; and

- EcoAccess Guideline *Noise and Vibration from Blasting* – Contains criteria and procedures that are applicable to noise and vibration emitted from blasting.

Environmental Protection (Noise) Policy 2008

Background Creep

Background Creep refers to background noise levels progressively creeping higher over time with the establishment of new developments in an area. The EPP(Noise) criteria are as follows:

To the extent that it is reasonable to do so, noise from an activity must not be—

a) for noise that is continuous noise measured by LA90,T—more than nil dB(A) greater than the existing acoustic environment measured by LA90,T; or

b) for noise that varies over time measured by LAeq,adj,T—more than 5dB(A) greater than the existing acoustic environment measured by LA90,T.

The EPP(Noise) does not define "continuous noise", but by definition, the "continuous noise" would be required to occur for at least 90% of a measurement period (typically 15 minutes or 60 minutes). Thus this criterion could apply for equipment such as mechanical plant.

The criterion for "noise that varies over time" is appropriate for noise sources operating for less than 90% of a measurement period, and could apply to intermittent events (e.g. vehicles) or mechanical plant that does not run continuously (e.g. air-conditioning).

Railway Noise

The EPP (Noise) defines planning or target levels for rail noise. Schedule 1, paragraph 3 of the EPP (Noise) contains the following planning levels for railways;

a) 65 dB(A), assessed as the 24 hour equivalent continuous (i.e. average energy) A-weighted sound pressure level (L_{eq}(24 hour)); and

b) 87 dB(A), assessed as a single event maximum sound pressure level (L_{max}).

These planning or target levels are to be assessed 1 metre in front of the most exposed part of an affected noise sensitive place.

EHP and QR have reached agreement on the definition of single event maximum level as being the "arithmetic average of the highest 15 maximum noise levels per 24 hour period."

Acoustic Quality Objectives

Schedule 1 of the EPP (Noise) includes the following acoustic quality objectives to be met at residential dwellings:

- Outdoors
  - Daytime and Evening: 50 dB(A) $LA_{eq,adj,1hr}$, 55 dB(A) $LA_{10,adj,1hr}$ and 65 dB(A) $LA_{1,adj,1hr}$;
- Indoors
  - Daytime and Evening: 35 dB(A) $LA_{eq,adj,1hr}$, 40 dB(A) $LA_{10,adj,1hr}$ and 45 dB(A) $LA_{1,adj,1hr}$; and
  - Night: 30 dB(A) $LA_{eq,adj,1hr}$, 35 dB(A) $LA_{10,adj,1hr}$ and 40 dB(A) $LA_{1,adj,1hr}$.

In the EHP EcoAccess Guideline *Planning For Noise Control* it is proposed that the noise reduction provided by a typical residential building façade is 5 to 7 dB(A) assuming open windows. That is, with an external noise source, a 5 to 7 dB(A) reduction in noise levels from outside a house to inside a house is expected when windows are fully open. Thus the indoor noise objectives noted above could be considered as the following external objectives (with windows open):

- Daytime and Evening: 40 to 42 dB(A) $LA_{eq,adj,1hr}$, 45 to 47 dB(A) $LA_{10,adj,1hr}$ and 50 to 52 dB(A) $LA_{1,adj,1hr}$; and
- Night: 35 to 37 dB(A) $LA_{eq,adj,1hr}$, 40 to 42 dB(A) $LA_{10,adj,1hr}$ and 45 to 47 dB(A) $LA_{1,adj,1hr}$.

EcoAccess Guideline *Planning For Noise Control*

Sleep Disturbance Criteria

The WHO *Guidelines for Community Noise* (2009) outlines criteria in regard to annoyance response and sleep disturbance *"where the noise is continuous".* The EHP EcoAccess Guideline *Planning for Noise Control* refers to the WHO guidelines and makes the general recommendations regarding short term transient noise events. The criteria derived from the WHO guidelines are summarised in Table 4.101.

Table 4.101 Summary of WHO Sleep Disturbance and Annoyance Criteria

Descriptor	Number of Noise Events	Indoor Criterion in dB(A)	Outdoor Criterion, dB(A)*
Sleep Disturbance (Short Duration Events)	Not Specified	L_{max} 42	L_{max} 47 to 49
Sleep Disturbance (Continuous Noise)	Continuous	L_{eq} 30	L_{eq} 35 to 37
Annoyance (Night Time)	Continuous	L_{eq} 35	L_{eq} 40 to 42

* The outdoor criteria are based on the EHP EcoAccess Guideline *Planning For Noise Control* nominated outdoor-to-indoor noise reduction of 5 to 7 dBA for open windows

EcoAccess Guideline *Assessment of Low Frequency Noise*

Items such as boilers, pumps, transformers, cooling fans, compressors, oil and gas burners, foundries,

wind farms, electrical installations, diesel engines, ventilation and air-conditioning equipment, wind turbulence and large chimney resonance are sources of high level noise having frequency content less than 200 Hz.

These sources exhibit a spectrum that characteristically shows a general increase in sound pressure level with decrease in frequency. Annoyance due to low frequency noise can be high even though the dB(A) level measured is relatively low. Where a noise emission occurs exhibiting an unbalanced frequency spectrum, the overall sound pressure level inside residences should not exceed 50 dB(Linear) to avoid complaints of low frequency noise annoyance.

EcoAccess Guideline *Noise and Vibration from Blasting*

The following criteria address human comfort and are below typical limits for prevention of structural damage. The criteria apply at residential and commercial receivers and are presented in Table 4.102.

Table 4.102 Blasting Vibration and Airblast Criteria

Issue	Criteria
Airblast	Air blast overpressure of 115 dB (linear peak) for nine (9) out of ten (10) consecutive blasts initiated and not greater than 120 dB (linear peak) at any time.
Vibration	5 mm/s peak particle velocity (PPV) for nine (9) out of ten (10) consecutive blasts and not greater than 10 mm/s PPV at any time.

4.7.1.4 Proposed Noise Criteria

Suitable indicators for measuring noise have been developed with consideration to existing guidelines and policy as described throughout Section 4.7.1.3 in addition to measured background noise levels in order to determine noise quality criteria for the Project.

It is proposed that an external night-time noise limit of 35 dBA $L_{eq,adj,T}$ is applied to the Project for operations (7 days per week and 365 days per year). This limit is based on achieving an internal sleep disturbance criterion of 30 dBA L_{eq} and an acoustic quality objective of 30 dBA L_{eq}, assuming a minimal 5 dBA reduction through a lightweight building façade with open windows.

A limit of 40 dBA $L_{eq,adj,T}$ is recommended for the daytime and evening, as this would be expected to achieve an acoustic quality objective of 35 dBA $L_{eq,adj,T}$ inside a dwelling, consistent with EHP guideline *Planning For Noise Control.*

An external limit of 47 dBA L_{max} is also recommended for the night-time for sleep disturbance, based on the WHO guideline as discussed in Section 4.7.1.3.

The proposed noise criteria developed for the Project are shown in Table 4.103.

Table 4.103 Proposed Noise Limits

Recommended Noise Limits	Time Period		
	Daytime	Evening	Night-time
$L_{eq,adj,T}$ (T= 15 minutes to 1 hour), dBA*	40	40	35
L_{max} dBA*	N/A	N/A	47

Notes: * To be achieved under the majority of adverse meteorological conditions.
Daytime = (7am to 6pm), Evening = (6pm to 10pm), Nighttime = (10pm to 7am).

The difference between the average L_{max} noise events and the L_{eq} due to the variable noise from equipment is typically 5 dB(A) to 8 dB(A). Therefore, in complying with the 35 dB(A) L_{eq} criteria, it is predicted that the 47 dB(A) L_{max} sleep disturbance limit will be met.

4.7.2 Potential Impacts and Mitigation Measures

The enHealth Council (2004) outlined within their report, "*The health effects of environmental noise – other than hearing loss",* the significance of noise pollution and its effects on the health of the general public.

The WHO, European Community members and numerous other countries have determined there is 'sufficient evidence' linking noise with annoyance, school children's performance, sleep disturbance, ischaemic heart disease and hypertension. Currently, there appears sufficient information to merit public health action in Australia to reduce health effects such as those linked to cardiovascular health and mental health.

Potential noise and vibration sources from the Project activities include:

- Light and heavy vehicles accessing the Project;
- Blasting activities during opencut mining;
- Underground vent fan and motors;
- Opencut mining activities (excavation, hauling, drilling, etc.);
- Crushing coal;
- Conveying and stacking coal; and
- Loading of coal trains.

Noise associated with the Project has the potential to adversely affect sensitive receptors that surround the Project site. The potential impacts on native fauna have not been assessed quantitatively as noise impacts are species specific. However, it is anticipated that above certain noise levels some species will be impacted and will migrate away from the sources of such noise.

In order to quantify potential noise impacts from the Project, noise modelling was carried out using the SoundPLAN computer program and using the CONCAWE algorithms. The SoundPLAN model was

configured to run with a meteorological file containing neutral and adverse (temperature inversion) conditions and included terrain data for the Project site plus the opencut pit and out-of-pit spoil dumps.

Further information of the model configuration including the predicted sound power levels used to predict the noise impact from plant and mobile equipment are provided in Appendix 17.

4.7.2.1 Predicted Noise Emissions

Modelling Scenarios

To predict noise level emissions, Year 3 of the Project was selected for integration into the model as this mining scenario is generally considered to be worst-case as the operations include out-of-pit dumping, the majority of mobile equipment are in use, and mining operations generally occur across the extent of the pits. The CPP is included in the day and evening noise level predictions, but is not included in night-time noise level predictions as it is not required or planned to operate at night.

The noise emissions will differ during other mining years, with variances due to pit dumping and mining locations. In later years mining will be underground, and therefore above ground vehicle movements will be reduced and overall noise emissions reduced.

The predicted noise levels from Year 3 mining operations include the underground vent fan and motor though this is not in operation until Year 5. Its contribution to the overall noise levels is generally minor given its sound power level, except at close proximity, and its contribution does not result in additional noise limit exceedances.

Details of modelling inputs and assumptions are provided in Appendix 17.

Predicted Noise Levels

Noise levels have been calculated for Year 3 of mining operations under each of the proposed meteorological conditions (neutral and adverse). The predicted noise levels at the nearby sensitive receptors due to the modelled opencut and underground mining operations during Year 3 are shown in Table 4.104. Results which exceed the nominated criteria are highlighted red.

Table 4.104 Predicted Noise levels at Nearby Sensitive Receptors during Year 3 Modelled Scenario

Location	Predicted Noise Level $L_{eq,1hr}$, dBA		
	Day and Evening (Limit 40 dBA)	Night (Limit 35 dBA)	
	Neutral Conditions	Neutral Conditions	Adverse Conditions
Airlie	22	22	28
Donnelly	47	47	53
Dunloe	24	23	30
Fairways	27	26	33
Fork Lagoons	15	15	18
Glendarriwell	16	15	19
Iona Downs	44	44	51
Jabiru	22	22	28
Kingower	14	14	17
Selma	20	20	24
St Helens	37	37	44
Sypher	21	21	27
Walther	31	31	39
Wilga downs	25	25	31

The noise contours for Year 3 of mine operations under neutral and adverse meteorological conditions are shown in Figure 4.113 to Figure 4.115.

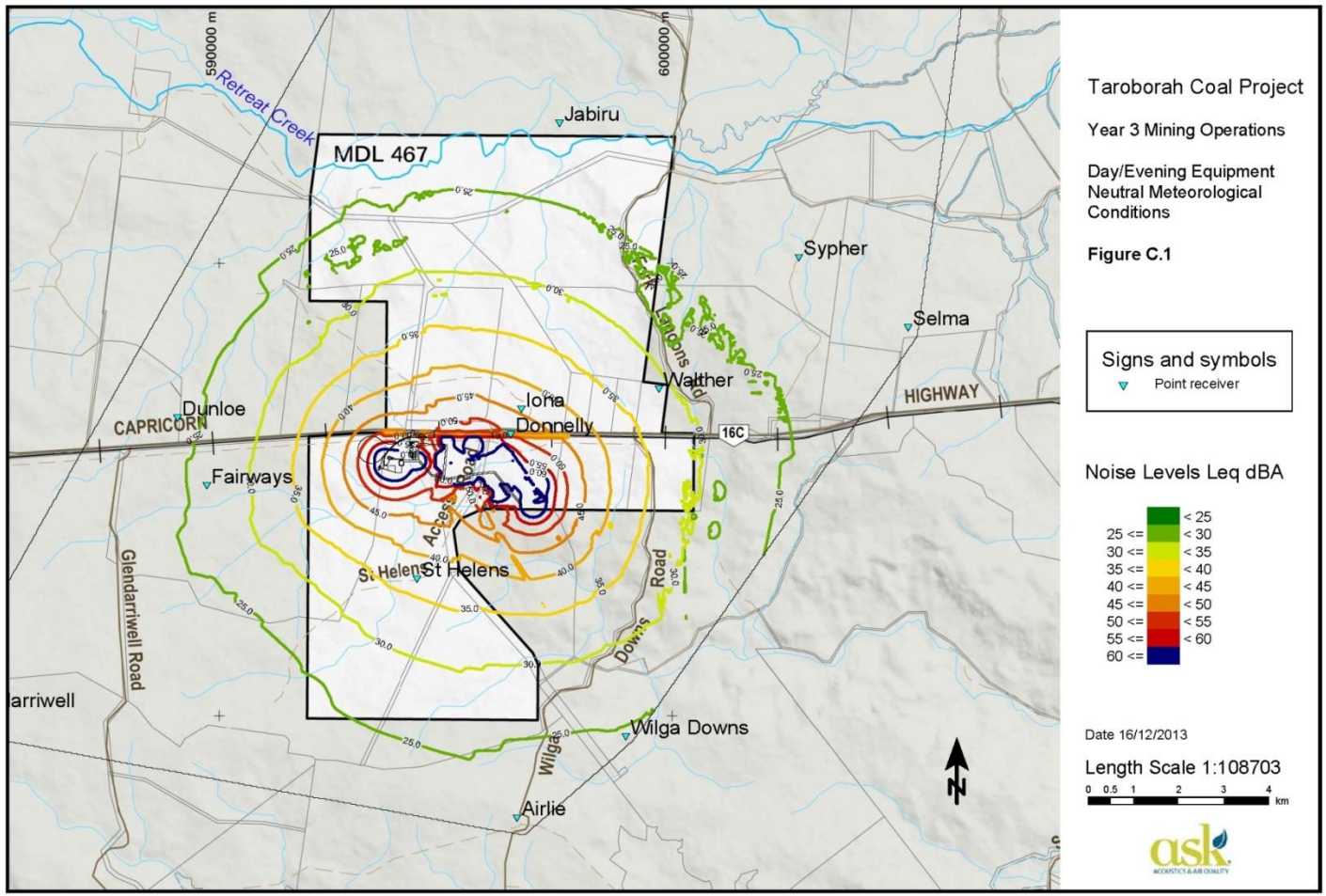

Figure 4.113 Noise Contours for Year 3 – Day / Evening Neutral Meteorological Conditions

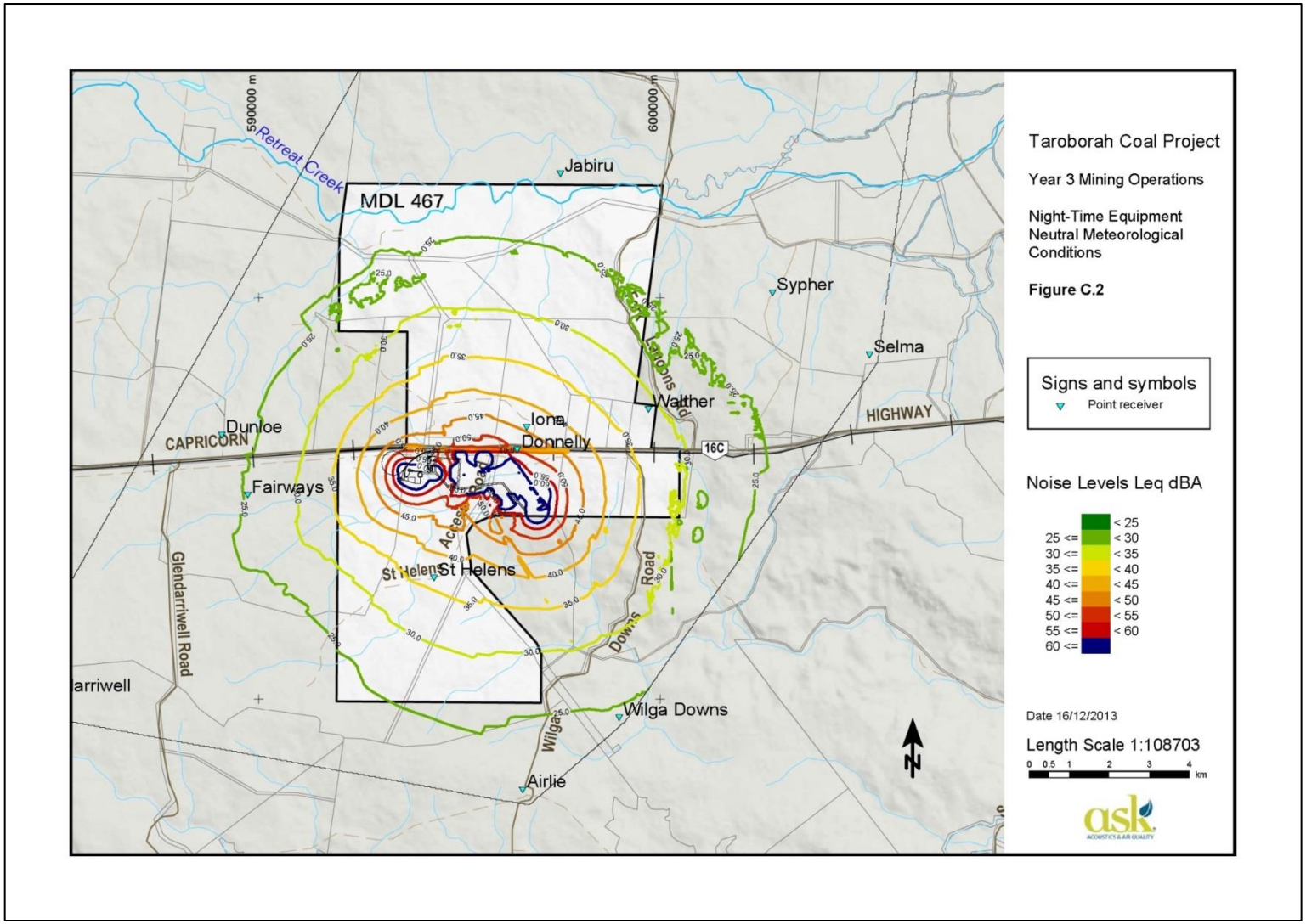

Figure 4.114 Noise Contours for Year 3 – Night-Time Neutral Meteorological Conditions

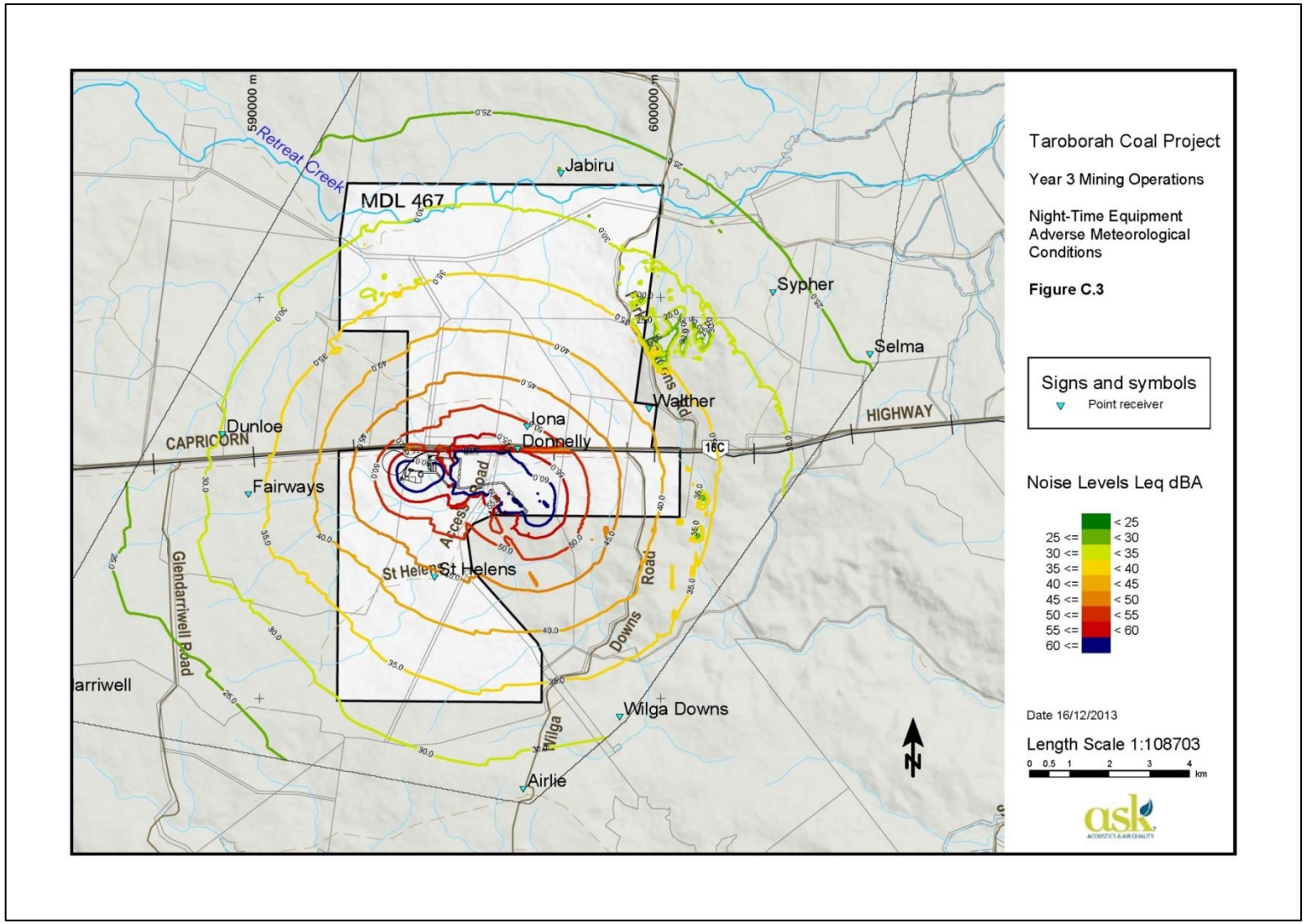

Figure 4.115 Noise Contours for Year 3 – Night-Time Adverse Meteorological Conditions

In total, four sensitive receptors are predicted to exceed either the day and evening (40 dBA) or night–time (35 dBA) noise criteria. A summary of the predicted exceedances of the proposed day and evening and night-time criteria for the Year 3 modelled scenario outlined in Table 4.104 are:

- Under neutral meteorological conditions, it is predicted that the day and evening noise limit (40 dBA) will be exceeded at two locations; Donnelly and Iona Downs by 7 dBA and 4 dBA respectively;

- Under neutral meteorological conditions, it is predicted that the night-time noise limit (35dBA) will be exceeded at three locations; Donnelly, Iona Downs and St Helens by 12 dBA, 9 dBA and 2 dBA respectively; and

- Under adverse meteorological conditions, it is predicted that the night-time noise limit (35 dBA) will be exceeded at four locations; Donnelly, Iona Downs, St Helens, and Walther by 18 dBA, 16 dBA, 9 dBA and 4 dBA respectively.

The predictions are based on a typical worst-case operating scenario and the assessment determined the major noise items associated with noise criteria exceedances are generally the mobile equipment (trucks and dozers).

Low Frequency Noise

Low frequency noise emitted from mining operations may be sourced from pumps, transformers, cooling fans, compressors, oil and gas burners, electrical installations, diesel engines and air-conditioning equipment. Such equipment may comprise sources of high level noise having frequency content less than 200 Hertz (Hz).

Sources of low frequency noise may exhibit a spectrum that characteristically shows a general increase in sound pressure level with decrease in frequency. Typically, annoyance may be experienced in the otherwise quiet environments such as residences adjacent to or near low frequency noise sources.

The un-weighted noise levels have been predicted under adverse meteorological conditions for the Year 3 mining scenario. The unweighted (linear) noise levels are used to assess the low frequency component of the noise emissions. The results are shown in Table 4.105 together with the differences between the un-weighted and A-weighted levels. Noise limit exceedances for individual levels are highlighted in red.

Table 4.105 Predicted Noise Levels for Assessment of Low Frequency Noise (Year 3)

Location	Predicted Noise Levels under Night-Time Adverse Meteorological Conditions			
	Unweighted Noise Level $L_{eq,1hr}$, dB	A-Weighted Noise Level $L_{eq,\ 1hr}$, dB	Difference Between Unweighted and A-Weighted Level	Exceedance of Criteria
Airlie	41	28	13	-
Donnelly	61	53	8	-
Dunloe	41	30	11	-
Fairways	44	33	11	-
Fork Lagoons	34	18	16	-
Glendarriwell	34	19	15	-
Iona Downs	59	51	8	-
Jabiru	41	28	13	-
Kingower	33	17	16	-
Selma	39	24	15	-
St Helens	53	44	9	-
Sypher	40	27	13	-
Walther	49	39	10	-
Wilga downs	44	31	13	-

* Limit is both an external level of 55 dB and a spectral difference (between the unweighted and A-weighted levels) of greater than 15 dB occurring at the same location, as per EHP EcoAccess Guideline *Assessment of Low Frequency Noise*.

Table 4.105 indicates that no receivers are predicted to experience both noise levels exceeding the proposed external low frequency noise limit of 55 dB and have a spectral difference (between the unweighted and A-weighted levels) of greater than 15 dB (note that both criteria have to apply to each location). Therefore, since both noise criteria have not been surpassed at any single location, the low frequency noise criteria is not exceeded for any of the locations presented in this table.

Train Noise

The rail noise contribution has been considered for trains associated with the Project both within the Project boundary and as they travel along the existing Queensland Rail (QR) line to Emerald and along the Aurizon Blackwater rail system to the Wiggins Island Coal Export Terminal (WICET) near Gladstone. The assessment has considered the total train noise levels, including existing train activity.

It is proposed to utilise the following locomotive / wagon configuration to haul coal from the mine to the WICET:

- 3 x 120t (4000 Class) Locomotives; and
- 90 x 80t wagons.

This train configuration would result in a total train length of approximately 1425m. Future speed has not been finally determined as it will depend on the track condition following the planned upgrades. However, future speeds would likely vary from 70-80 km/h between the mine site and Emerald and 40-60 km/h in Emerald. The train configuration and train speeds are not likely to change during the Project life.

Based on the above configuration and train speeds, approximately 1 train per day will be required to take coal from the mine to the port in Years 1 to 7 and this will increase to approximately 3 trains per day from Year 8 onwards.

As expected future non-Project train activity was unable to be provided by QR, it has been assumed that future rail activity remains at the current level. This, with the addition of Project rail activity, it is predicted that the QR 24 hour L_{eq} noise limit of 65 dBA would be exceeded within 5m of the QR rail line for Years 1 to 5 and Years 6 to 7, and within 10m of the rail line for Years 8 – 20. For comparison, the QR 24 hour L_{eq} noise limit of 65 dBA is currently exceeded within 5m of the rail line, based on the average of two rail pass-bys events per day. Meteorological effects have not been considered for the prediction of the 24 hour L_{eq} noise level as meteorological conditions will vary through-out a 24 hour period, and differ through seasons.

From previous data, it is predicted that the train movements would exceed the QR L_{max} noise criteria of 87 dBA at a distance of approximately 40 m or less from the railway under neutral meteorological conditions, or approximately 60 m or less under adverse meteorological conditions (e.g. downwind).

In summary, QR noise criteria are predicted to be met at approximately 60m or more from the railway lines along the route from the mine to the export terminal, under all meteorological conditions.

Blast Vibration and Airblast Overpressure

Ground vibration and airblast levels caused by blasting activities have been predicted based on the formulas and methodology of Australian Standard *AS2187.2 Explosives - Storage Transport and Use - Use of Explosives*, which predicts the peak particle velocity (PPV) in mm/s and the airblast over pressure (peak pressure) in dB.

Vibration

In accordance with the criteria outlined in the EcoAccess Guideline *Noise and Vibration from Blasting* (refer to Section 4.7.1.3), ground vibration levels are not to exceed 5 millimetres per second (mm/s) peak particle velocity (PPV) for nine out of ten blasts and are not to exceed 10 mm/s (PPV) at any

time.

Table 4.106 presents the separation distances from the blast beyond which the nominated ground vibration level (PPV in mm/s) limits will be achieved.

Table 4.106 Separation Distances Required to Achieve Nominated Ground Vibration Level Limits

PPV (mm/s)	Separation Distance from Mine (km)	
	K = 800	K = 1600
10.0	0.2	0.4
5.0	0.4	0.6
2.0	0.7	1.1
1.0	1.1	1.6
0.5	1.6	2.5

*the site constant (K) was assumed to be in the range 800 to 1600

Table 4.106 shows that the 5 mm/s peak particle velocity criterion could be exceeded at distances less than 600m from the blast assuming the higher site constant (K) of 1600. The only sensitive receiver within 600m of the proposed opencut pit is Donnelly at approximately 200m north of the pit limit. The vibration levels are predicted to be compliant with the nominated blast parameters throughout the mine life for all other sensitive receivers.

Airblasts

In accordance with the criteria outlined in the EcoAccess Guideline *Noise and Vibration from Blasting* (refer to Section 4.7.1.3), airblast pressure levels are not to exceed 115 dB for four out of five blasts and are not to exceed 120 dB at any time.

The distance to the 120 dB(Lin) Lpeak contour line from the blast was calculated using formula provided in Australian Standard *AS2187.2 Explosives - Storage Transport and Use - Use of Explosives* and data based on similar opencut and underground coal mines outlined in Appendix 17.

The distance to the 120 dB contour line is calculated to be 0.7 km. The distance to the 115 dB contour line can be calculated using the attenuation rate of 9 dB per doubling of distance. Therefore, the 115 dB airblast criteria would be exceeded at a distance of approximately 1 km or less. The nearest sensitive receptor to the proposed opencut operations is approximately 200 m north of the pit limit, within the airblast impact zone.

In addition, Iona Downs will also be potentially affected from airblast in Years 4 to 7 as it is located 1 km to the north of the pit limit. Blast parameters will need to be designed to ensure that airblast criteria are met at this location.

Construction Noise

The sound power level of the construction fleet was estimated by interpolating the operational equipment mobile fleet from the range of 123 to 131 dBA. A construction sound power level of 127 dBA was estimated as the proposed fleet of equipment utilised during construction was determined to

be generally lower.

Although given the operational sound power level was calculated to be 129 dBA and the construction noise levels would be marginally lower than that predicted for operational noise, and thus have potential for marginally lower noise criteria exceedances, it is recommended that the proposed noise criteria be adopted during construction.

4.7.2.2 Noise Mitigation

Construction of the mine will be staged, with opencut mining operations beginning 9 months into the construction phase and being conducted concurrently with construction of the underground mine during Year 5. The opencut mine and associated operational infrastructure is proposed to be established by 2018, with underground mining not expected to commence until 2022. This approach, integrating construction and operations where appropriate, will reduce potential environmental nuisance from noise and vibration by reducing the overall mine life, whilst maintaining productivity.

To reduce the predicted worst case noise impacts of 4 - 18 dBA at sensitive receptors, the following noise mitigation measures will be implemented where appropriate:

- Alternative arrangements with property holders (e.g. property purchases);
- Attenuation of equipment (fixed and mobile plant);
- Noise barriers at source i.e. around crushers, pumps and other noise sources;
- Alternative (quieter) operating methods;
- Limit the power applied to diesel locos as they pull away from the mine; and
- Implementation of a noise monitoring program.

Property Purchase or Lease

There are four sensitive receptors - Iona Downs, Donnelly, St Helens and Walther - that are predicted to experience possible exceedances of daytime, evening and/or night time noise criteria (Table 4.104). These receptors are in closest proximity to the Project, and all are located within the proposed Project boundary.

Due to the potential for noise, and other nuisance and disturbance at these sensitive receivers, it is expected that negotiations with landholders will include offers to purchase these properties or otherwise enter into lease arrangements during the mine life.

While all options for noise mitigation may be considered, purchase or lease arrangements are considered to be the most likely to address specific impacts of the operation on these sensitive receivers, and is therefore the preferred strategy.

Attenuation of Equipment

Reductions of 16 dBA to 18 dBA at night time through attenuation of fixed and mobile plant was determined unlikely to be feasible. However, addressing the modelled exceedance of 9 dBA at St Helens may be possible if conducted in combination with other methods of noise reduction such as

sound barriers for fixed plant to collectively reduce the Project's overall noise impacts.

Attenuation of equipment may prove to be an effective strategy in the mitigation of minor exceedances such as those experienced at Walther (4 dBA).

It is recommended that the proposed supplier of each piece of equipment is consulted in detail as to the attenuation options that are available or have been used elsewhere. Suggested techniques for equipment attenuation can be found in *Noise Reduction In New Open-Cut Coal Mines, Coal Handling and Preparation Plants* (Mils et al, 2000).

Mining Methods

Alternative mining methodology in the form of re-routing of haul roads, re-allocation of mobile plant, restrictions of dumping, particularly during the night period, and significant bunding in close proximity to haul routes will be employed where feasible to further reduce noise nuisance at sensitive receptors.

Noise Monitoring

Noise monitoring will be conducted to ensure that mining operations are undertaken in accordance with the prescribed noise criteria. Monitoring will be conducted at the worst affected sensitive receptors to validate the noise model and improve its accuracy as required.

Noise monitoring sites and equipment will be selected in consultation with an acoustic consultant. As recommended, the monitoring equipment will record one-third octave band noise levels using the A-weighted L_{eq} parameter of duration 15 to 60 minutes. Measurement results will be recorded in conjunction with weather data and compared with the nominated noise criteria. Recording operational equipment will enable the noise model to be tailored to suit the as-measured mine conditions, and confirm model accuracy. Occasional attended monitoring will also be undertaken to ensure that interpretation of unattended noise monitoring data is accurate.

Measurement results will be reported in conjunction with weather data and stored on-site.

Noise Complaints

If legitimate noise complaints are received from nearby residents as a result of mining activities, then additional attended noise monitoring will be undertaken, with results from this and the periodic monitoring compared against the noise limits.

If noise limits are exceeded, noise mitigation measures will be investigated in consultation with affected residents. Noise mitigation measures will be selected in order to address the specific complaint i.e. addressing the equipment of concern and the locality of concern.

Vibration and Airblast Monitoring

Vibration and airblast monitoring will also be undertaken to ensure that blast parameters are compliant with vibration and airblast objectives. Where an exceedance is recorded, blast parameters will be revised.

In addition, a mandatory exclusion zone, in accordance with Australian Standard AS 2187.2 *Explosives – Storage and use Part 2: Use of explosives* will be employed during detonation, to mitigate fly rock exposure.