APPENDIX

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Acoustics Impact Assessment

BRIDGES ACOUSTICS
ABN: 73 254 053 305

78 Woodglen Close
P.O. Box 61
PATERSON NSW 2421
Phone: (02) 4938 5866
E-mail: bridgesacoustics@bigpond.com

ASTON RESOURCES PTY LIMITED

ACOUSTICS IMPACT ASSESSMENT

MAULES CREEK COAL PROJECT
ENVIRONMENTAL ASSESSMENT

REPORT J0130-41-R3
4 JULY 2011

Prepared for:
Hansen Bailey Pty Ltd
P.O. Box 473
SINGLETON NSW 2330

Prepared by:
Mark Bridges BE Mech (Hons) MAAS
Principal Consultant

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1 INTRODUCTION

Bridges Acoustics was commissioned by Hansen Bailey on behalf of Aston Resources Pty Limited (Aston Resources) to undertake a noise and vibration impact assessment for the Maules Creek Coal Project (the Project). The purpose of this assessment is to form part of an Environmental Assessment (EA) being prepared by Hansen Bailey to support an application for a contemporary Project Approval under Part 3A of the *Environmental Planning and Assessment Act 1979* (EP&A Act) to facilitate the development of a 21 year open cut coal mining operation and associated infrastructure.

Specifically, the Project would consist of:

- Construction and operation of an open cut mine extracting up to 13 Million tonnes per annum (Mtpa) Run of Mine (ROM) coal to the Templemore Seam;
- Open cut mining fleet including excavator / shovels and fleet of haul trucks, dozers, graders and water carts with up to 470 permanent employees;
- Construction and operation of a Coal Handling and Preparation Plant (CHPP) with a throughput capacity of 13 Mtpa ROM coal;
- Construction and operation of Tailings Drying Area;
- Construction and operation of a rail spur, rail loop, associated load out facility and connection to the Werris Creek to Mungindi Railway Line;
- Construction and operation of a Mine Access Road;
- Construction and operation of administration, workshop and related facilities;
- Construction and operation of water management infrastructure including a water pipeline, pumping station and associated infrastructure for access to water from the Namoi River;
- Installation of supporting power and communications infrastructure; and
- Construction and operation of explosive magazines and explosives storage areas.

This report includes an assessment of noise and blasting impacts associated with the Project in accordance with the Director-General's Environmental Assessment Requirements (EARs) dated 2 November 2010 and in accordance with current NSW Department of Environment Climate Change and Water (DECCW) guidelines and policies as described below.

1.1 Environmental Noise Policies

DECCW has developed or adopted policies and recommended procedures to assess environmental noise levels from various noise source categories. The following policy documents are relevant to this assessment:

- The *NSW Industrial Noise Policy* (INP) (EPA, 2000) is intended to guide noise investigations from existing or proposed industrial developments including coal mines. The INP recommends procedures to determine:
  - background noise levels at receiver properties;
  - existing noise levels from an industrial site;
  - recommended, not mandatory, noise criteria for existing and proposed operations;
  - predicted noise levels from proposed developments; and
  - negotiation options if recommended noise criteria are not or may not be met.

- The *Environmental Noise Control Manual* (ENCM) (EPA, 1985) predates the INP. While much of the ENCM is no longer applicable, some sections remain relevant including chapter 19 related to sleep disturbance from industrial sources operating at night;
- The *Environmental Criteria for Road Traffic Noise* (ECRTN) (EPA, 1999) provides recommended noise criteria and assessment procedures for road traffic noise, including Project-related traffic, from public roads but excludes noise produced by vehicle movements on the Project site;
- The *Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration* (Australian and New Zealand Environment Council (ANZEC), 1990) recommends residential ground vibration and overpressure limits and time restrictions for blasting;
- *Assessing Vibration – a Technical Guide* (DEC, 2006) provides recommended criteria and methods for assessing vibration, primarily from construction activities such as pile driving;
- *DIN 4150 Part 3 – Structural Vibration: effects of vibration on structures* (ISO, 1999);
- *Interim Guideline for the Assessment of Noise from Rail Infrastructure Projects* (Interim Rail Noise Guideline) (DECC, 2007) provides criteria and methods to assess noise from train movements on publicly owned rail lines; and
- *Interim Construction Noise Guideline* (DECC, 2009) provides criteria, recommended hours and methods for assessing noise from construction work.

1.2 Receivers

The Project is located on land owned by Aston Resources, within part of the Leard State Forest and extends over two rural properties to the north. Rural and residential receivers and the Leard State Conservation Area adjoin the Project's northern and western boundaries while the remainder of the Leard State Forest adjoins the Project to the south and west. Boggabri Coal Mine which is owned and operated by Boggabri Coal Pty Ltd (Boggabri Coal) is located directly south of the Project and Tarrawonga Mine which is owned and operated by Whitehaven Coal Mining Limited is located south east of the Boggabri Coal Mine.

A land ownership plan showing land owned by Aston Resources, other mining companies and private individuals or companies is included in each noise contour figure in Appendix A.

1.3 Glossary

The following acoustical terms are used in this report:

Sound Pressure	Small air pressure variations above and below normal atmospheric pressure that are perceived by human ears as sound;
Frequency	The rate of sound pressure fluctuations per second, expressed as cycles per second or hertz (Hz). Human ears in good condition can typically detect sound in the frequency range 20 Hz to 20,000 Hz (20 kHz), depending on sound level;
Decibels, dB	A noise level unit based on a logarithmic scale of Pascals of sound pressure above and below atmospheric pressure. Expressing a sound pressure level in decibels implies root-mean-squared (RMS) sound pressure unless explicitly stated otherwise. Human ears in good condition can typically detect sound pressures from the threshold of perception at 0 dB (20 uPa) to the threshold of pain at 140 dB (200 Pa). An increase of 10 dB is perceived as an approximate doubling of sound level by an average human ear;

dBL	Linear decibels, the same as dB but used to explicitly define a decibel scale in the absence of any frequency weighting;
dBA	A-weighted decibels, where the A weighting means frequencies below 500Hz and above 10kHz are artificially reduced to approximate the frequency response of an average human ear. Most sound monitoring instruments include an A-weighting option, enabling direct measurement of noise levels in dBA;
LA90	The A-weighted noise level exceeded 90% of the time (which can be thought of as the quietest 10% of the time) over a defined measurement period, usually 15 minutes or one hour, and widely accepted as the background noise level;
LAeq	The A-weighted equivalent continuous, or logarithmic average, noise level over a defined time period either measured or predicted at a specific location; and
Sound Power	Sound energy emitted by a source, measured in watts (W) or expressed on a decibel scale with 0 dB representing 1 picowatt (1 pW) of sound power. While both sound pressure and sound power can be expressed on a decibel scale, they are not interchangeable or directly comparable. Sound power levels are most commonly expressed as unweighted decibels (dBL) but can be expressed as A-weighted decibels (dBA).

2 EXISTING ENVIRONMENT

2.1 EIS

The *Maules Creek Coal Project Environmental Impact Statement* (Kembla Coal and Coke, 1989) included *Proposed Coal Mining Operations at Maules Creek, Boggabri, Assessment of Existing Acoustical Environment* (Challis Report) (Louis A Challis and Associates, 1986). The Challis Report includes results from a series of background noise measurements at four representative receiver locations in the area in February 1986, as shown in Table 1.

Section 4.1 of the Challis Report includes a comment that background noise levels at Tralee would have been closer to 20 dBA during the night, rather than 28 dBA as reported by the noise measurement system. Results in Table 1 indicate background noise levels are typically close to 30 dBA during the day and, in the absence of insect noise, below 30 dBA during the night.

Table 1: Measured Background Noise Levels, Challis Report, February 1986.

Property Reference [1], Receiver Location	Measured Background Level, LA90,20min		
	Day	Evening	Night
Near 'The Rock' [2]	29	N/A	40 (insects)
256 Cooboobindi	30	N/A	32 (insects)
Teston [3]	31	N/A	< 31 [4]
126 Tralee	33	N/A	< 28 [4]

1 Property Reference number as listed in the EA and shown on the noise contour figures in Appendix A.

2 Property owned by Boggabri Coal.

3 Property owned by Aston Resources.

4 The lower limit of the noise measurement equipment was reported. Actual levels would be lower.

2.2 Noise Monitoring Program

Existing environmental noise levels were monitored during the period 8 September to 20 September 2010 at the following five representative receiver locations as shown on the noise contour figures in Appendix A:

M1 – on the eastern side of Therribri Road approximately 300m south of Receiver 259;

M2 – on the road reserve approximately 300m south of Receiver 120;

M3 – on the western side of Therribri Road approximately 300m west of Receiver 105;

M4 – on the southern side of Harparary Road approximately 50m east of the Maules Creek Hall; and

M5 – on the western side of Leard Forest Road approximately 900m south of Harparary Road.

Noise monitors consisted of either ARL EL215, Svan 949 or 01dB SIP95S Type 1 or 2 sound level meters fitted in weatherproof cases, with the microphones attached via extension cables and mounted approximately 1.2m above the ground. The EL215 monitors were programmed to measure and store 15 minute A-weighted percentile statistics directly. The Svan and 01dB monitors were programmed to measure and store 1 second LAeq readings for the entire monitoring period, with software supplied by 01dB able to subsequently convert the data to 15 minute percentile statistics. Monitor calibration levels were checked before and after the survey using an 01dB Cal-01Type 1 acoustic calibrator producing 94 dB at 1 kHz. A summary of results from each monitor are attached as tables in Appendix D and in chart form in Appendix E.

Short term operator attended noise measurements of 15 minutes duration were also taken at the five locations in order to determine dominant sources of background noise and existing ambient noise levels from various sources in the area, as the long term measurements returned by the noise loggers cannot be used to reliably identify various sources of noise. Operator attended noise measurements were taken at each of the long term monitoring locations during the evening and night of 8 September, during the day on 9 September and during the evening and night of 20 September 2010.

Short term attended noise surveys were completed using a Svan 912AE Type 1 sound level analyser fitted with a 12.7mm polarised condenser microphone and a windshield. This instrument was mounted on a tripod with the microphone approximately 1.2m above the ground. Analyser calibration levels were checked at the beginning and end of the survey using an 01dB Cal-01 Type 1 calibrator producing 94 dB at 1 kHz.

2.3 Measured Noise Levels

Background noise levels at monitoring locations M1 to M5 were determined according to the INP which requires ‘assessment background noise levels’ (ABLs) to be determined for each day, evening or night period by taking the lowest 10% of the individual measured background levels. Calculated ABLs for each time period are included in tables in Appendix D and are shown on the results charts in Appendix E while Table 2 shows the single ‘rating background level’ (RBL) during each time period at each of the five monitoring locations.

Measured background noise levels at some locations were within 5 dBA of each monitor’s noise floor and have been corrected before presentation in this report where required. Such corrections were applied to results obtained from locations M1 to M4 and measured noise levels less than 30 dBA at these locations may therefore not be accurate. Results from the monitor installed at location M5 did not require such corrections. According to the INP, background noise levels below 30 LA90,15min should be considered to be 30 LA90,15min for the purposes of determining noise criteria. Accordingly, a background level of 30 LA90,15min has been adopted for all receiver locations.

Table 2: Measured Background and Ambient Noise Levels, dBA

Date (September 2010)	Background Levels, LA90			Ambient Levels, LAeq		
	Day	Evening	Night	Day	Evening	Night
M1 South West [1]	28.1	30.8	28.7	56.3	49.9	48.4
M2 West [1]	30.4	29.0	28.3	51.1	37.8	44.9
M3 North West [1]	26.6	30.7	30.4	53.8	44.9	42.4
M4 North [1]	26.9	39.8	31.7	63.6	53.2	48.8
M5 North East	21.5	23.3	20.1	48.3	43.0	45.8

1 Measured noise levels were corrected for the monitors' noise floor.

2.3.1 M1 South West

Measured background noise levels at this location were dominated by insects and frogs in all time periods, with some contribution from Kamilaroi Highway traffic depending on weather and traffic conditions. Ambient noise levels were primarily influenced by passing traffic with some contribution from insects, frogs, birds and wind noise. Background noise levels below 30 LA90,15min were measured at this location, resulting in an adopted background noise level of 30 LA90,15min during all time periods as recommended in the INP.

Noise from coal trucks operating on Boggabri Coal's private haul road was audible at times, with noise levels up to 35 LAmax as the trucks accelerated from the Therribri Road intersection. Up to two truck movements were noted in one 15 minute period which resulted in a truck noise contribution of approximately 25 LAeq,15min during that period. No other industrial noise sources were audible at this location.

2.3.2 M2 West

Measured background noise levels at this location were influenced by insects, frogs, birds, Kamilaroi Highway traffic and agricultural work in nearby fields. Ambient noise levels were influenced by occasional vehicle movements past the monitoring location, Kamilaroi Highway and Therribri Road traffic, insects, frogs and birds. Operator attended noise measurements during the evening and night were taken approximately 400m south of the long term monitor to avoid disturbance to residents during these time periods.

Background noise levels below 30 LA90,15min were measured at this location, resulting in an adopted background noise level of 30 LA90,15min during all time periods as recommended in the INP.

Noise from coal trucks operating on Boggabri Coal's private haul road was just audible at times, with an estimated noise contribution of 25 LAmax and less than 20 LAeq,15min from this source. No other industrial noise sources were audible at this location.

2.3.3 M3 North West

Measured background noise levels at this location were influenced by insects, frogs, birds and Kamilaroi Highway traffic. Ambient noise levels were influenced by Kamilaroi Highway and Therribri Road traffic, insects, frogs and birds. Background noise levels below 30 LA90,15min were measured at this location, resulting in an adopted background noise level of 30 LA90,15min during all time periods as recommended in the INP. No existing industrial noise sources were audible at this location.

2.3.4 M4 North

Measured background noise levels at this location were influenced by insects, frogs and birds, with no other sources of background noise in the area. Ambient noise levels were influenced by occasional Harparary Road traffic, insects, frogs and birds. Background noise levels below 30 LA90,15min were measured at this location at times, resulting in an adopted background noise level of 30 LA90,15min during all time periods as recommended in the INP. No existing industrial noise sources were audible at this location.

2.3.5 M5 North East

Measured background noise levels at this location were influenced by insects, frogs and birds, with some contribution from agricultural activities on nearby properties. Ambient noise levels were influenced by occasional Harparary Road traffic, insects, frogs, birds. Background noise levels below 30 LA90,15min were measured at this location, resulting in an adopted background noise level of 30 LA90,15min during all time periods as recommended in the INP. No existing industrial noise sources were audible at this location.

2.4 Adopted Background Noise Levels

The data above indicate existing background noise levels are close to or below 30 LA90,15min at all locations and during all time periods. The INP recommends background noise levels below 30 LA90,15min should be considered 30 LA90,15min for the purposes of noise assessment. Accordingly, a background level of 30 LA90,15min has been adopted for all receivers and time periods.

3 CRITERIA

3.1 Mining Noise

The INP contains two sets of noise criteria for residential receivers. Intrusive criteria are set 5 dBA above the adopted Rating Background Level (RBL) in each time period and are designed to limit the relative audibility of mining or industrial operations. These criteria can be adjusted by one or more ‘modifying factors’ such as tonality or impulsiveness described in Section 4 of the INP, or alternatively the source noise levels can be adjusted to consider any modifying factors applicable to those sources. As any relevant adjustments have been applied to source noise levels, an intrusive criterion of 35 LAeq,15min is adopted for this assessment for all receivers and time periods.

Amenity limits recommended in the INP depend on existing industrial noise levels and the nature of the receiver area. The amenity limits are designed to control the total or cumulative level of industrial noise at a sensitive receiver such as a residence. Amenity criteria are set to the amenity limits in cases where limited industrial noise is currently received, or to lower levels to ensure the cumulative impact of existing and proposed noise sources does not exceed the amenity limit for each time period.

As noise survey results indicate existing industrial noise levels are below 30 LAeq,15min at all locations, no corrections for existing industrial noise are required and the amenity limits have been adopted. For the purposes of determining appropriate noise amenity criteria, all assessed receivers have conservatively been assigned the ‘rural’ amenity category. Table 3 shows the intrusive and amenity criteria adopted for this assessment and the method used to determine these criteria.

Table 3: Adopted Maules Creek Project Operational Noise Criteria.

Time Period	Day 7am – 6pm [1]	Evening 6pm – 10pm	Night 10pm – 7am
Adopted background noise level LA90,15min (Section 2.3)	30	30	30
Intrusive Criteria LAeq,15min (Background + 5 dBA)	35	35	35
Amenity limit LAeq,period (INP, rural category)	50	45	40
Existing industrial noise level LAeq,period	<30	<30	<30
Amenity Criteria LAeq,period (Table 2.2 of INP) [2]	50 [2]	45 [2]	40 [2]
Adopted Intrusive Noise Criteria LAeq,15min	35	35	35

1 Night ends, and Day begins, at 8am on Sundays and public holidays.

2 The amenity criteria are used to assess potential cumulative noise impacts.

Noise criteria in Table 3 apply to all proposed noise sources including mining and coal processing equipment, train loading equipment and train movements on the private rail spur and loop. According to the INP, the criteria apply within 30m of a residence or at the receiver property boundary where the boundary is closer than 30m from the residence.

Car and truck traffic on public roads and train movements on public rail lines are subject to alternative noise criteria as described in Section 3.6 below.

Additional noise criteria normally apply to other land uses such as passive recreation areas, commercial and industrial receivers. Occupied areas of the Leard State Forest and the Leard State Conservation Area would be considered passive recreation areas, however these properties are not normally occupied as they do not contain tourist or visitor facilities such as camping or picnic areas. Noise criteria are therefore not required for these areas at present. Should visitor facilities be provided in these areas in the future, such areas would be subject to a criterion of 50 LAeq,15min during the day (ie when the area is occupied).

3.2 Where Criteria May be Exceeded

Noise criteria listed in Table 3 should be considered the levels above which some acoustic impact may be noticed by residents. Louder noise levels at a residence do not necessarily imply the noise is unacceptable at that residence. The INP describes strategies to deal with potential exceedances of the criteria such as:

- best practice noise mitigation measures applied to individual plant items and mine operating procedures;
- adoption of alternative noise criteria based on achievable noise levels and considering other factors such as social worth attached to the development and historical noise levels from existing developments;
- negotiation of offset arrangements with regulators and/or the affected community; and
- acquisition of properties where the predicted or measured noise impacts are unacceptable.

Recent noise assessment practice for coal mine developments considers an exceedance of up to 5 dBA above the intrusive or amenity criteria is generally acceptable provided the proponent can show all reasonable and feasible noise control measures and best practice operational noise management measures have been incorporated into the design and operational planning for the development. These residences are typically considered to fall within a ‘management zone’ and the proponent is expected to implement ongoing management practices and engineering noise control measures to achieve the lowest practical levels at these properties.

Residences expected to receive more than 5 dBA above the intrusive criteria are typically considered to lie within an area of affectation and are often subject to acquisition by the mine upon request by residents or are offered other negotiated noise mitigation options if desired by residents.

3.3 Cumulative Noise Levels

The INP recommends two sets of criteria, including the intrusive criteria which would apply to the Project operating alone and the amenity criteria which are intended to control the total noise level at a receiver location from all industrial or mining developments. Cumulative noise levels are therefore assessed to the amenity criteria shown in Table 3 which are:

- 50 LAeq,11hr during the day;
- 45 LAeq,4 hr during the evening; and
- 40 LAeq,9hr during the night.

3.4 Construction Noise

Construction work has historically been assessed under the ENCM, although the DECCW has recently published the Interim Construction Noise Guideline (ICNG) (DECC, 2009) which, when finalised, would replace the relevant chapter in the ENCM.

Section 1.2 of the ICNG states it does not apply to industrial sources, including construction associated with quarrying and mining, and suggests this activity be assessed under the INP. In that case, noise criteria applied to proposed construction work are identical to mine operational criteria as shown in Table 3.

3.5 Sleep Disturbance

Sleep disturbance can be caused by a short, sharp sound that is noticeably louder than the typical or usual noise level within a bedroom. The ENCM recommends a conservative sleep disturbance criterion of 15 dBA above the night background noise level and, in the absence of more recent research or recommendations, this conservative criterion has been adopted.

All residential properties are therefore subject to a sleep disturbance criterion of 45 LA1,1min. The criterion applies 1m outside the potentially most affected bedroom window of a residence during the hours 10pm to 7am, or to 8am on Sundays and public holidays.

3.6 Traffic Noise

Relevant road traffic noise criteria are listed in Table 1 in the ECRTN. Noise criteria for Situation 13 “Land use developments with the potential to create additional traffic on local roads” are 55 LAeq,1hr during the day and 50 LAeq,1hr during the night for residential receivers.

Situation 7 “Land use developments with the potential to create additional traffic on existing freeways/arterials” are 60 LAeq,15hr during the day and 55 LAeq,9hr during the night for residential receivers near the Kamilaroi Highway.

The recommended criterion for proposed school classrooms, and for existing classrooms that are not significantly affected by traffic noise, is 40 LAeq,1hr near the centre of the room. For the purposes of this assessment an equivalent criterion of 50 LAeq,1hr outside the room has been adopted, on the assumption that the classroom windows would remain fully open.

Recommended criteria apply to all traffic, including vehicles associated with the Project. The LAeq,1hr parameter refers to the average traffic noise level in the loudest 10% of the hours in a day or night. As it can be difficult to determine the loudest 10% hour during the day and night, this assessment conservatively considers the loudest hour during a 24 hour period.

Rail noise criteria are sourced from the *Interim Rail Noise Guideline* which recommends trigger levels of 65 LAeq,15hr during the day, 60 LAeq,9h during the night and 85 LAmax from existing rail lines such as the Werris Creek to Mungindi Railway (WCMR). Similarly, condition L6.1 of Environment Protection License EPL 3142 issued to the Australian Rail Track Corporation (ARTC), covering train movements on all railways controlled by ARTC, specifies noise level objectives of 65 LAeq,15hr day, 60 LAeq,9hr night and 85 LAmax at one metre from the façade of affected residential premises.

3.7 Low Frequency Noise

Section 4 of the INP recommends low frequency noise levels be considered in the normal operational noise criteria by the addition of a 'modifying factor' to either a source sound power level or a received noise level. Any modifying factors that are relevant to the assessment, including low frequency penalties, have been applied to the adopted sound power levels for mining and transportation equipment and no separate assessment of low frequency noise levels is required.

3.8 Blast Overpressure and Vibration

Current noise and vibration criteria are recommended in the ANZEC publication *"Technical basis for guidelines to minimise annoyance due to blasting overpressure and ground vibration"*. Recommended noise and vibration limits in the Guideline are:

Overpressure	115 dBL; and
Ground vibration	5mm/s Peak Particle Velocity (PPV).

The Guideline recognises blast effects cannot always be controlled accurately and allows higher limits of 120 dBL and 10mm/s PPV for up to 5% of the total number of blasts on a site in a 12 month period. Recommended blasting criteria apply during the hours 9am to 5pm Monday to Saturday, excluding public holidays.

4 ASSESSMENT

4.1 Noise Assessment Method

Noise levels from operation of the Project including the rail loading facility, private rail spur and mine access road, have all been assessed using a comprehensive model of the site based on RTA Technology's Environmental Noise Model (ENM) software. ENM is a general purpose noise modelling package that combines terrain and noise source information with other input parameters such as weather conditions to predict noise levels at specific receiver locations or as contours over a specified receiver area. It is recognised in NSW as the most appropriate choice for situations involving complex topography and a large number of individual noise sources and where a detailed assessment of the effects of atmospheric conditions on noise propagation is required.

The standard ENM package includes data input modules to allow terrain and noise source information to be entered and amended, plus an initial setup page containing terrain and source lists and modelled weather conditions for each scenario. All terrain and source files were prepared for this assessment using a combination of AutoCad and Excel based data then automatically converted to ENM format terrain and source files using specially prepared software. All outputs were obtained using ENM's standard sectioning and contouring algorithms and are presented on a base plan. Tabulated noise levels at residences, and noise levels over 25% of contiguous property areas, have been produced by specially prepared software based on ENM's intermediate calculation files used to produce the noise contours. Noise contour figures are presented in Appendix A.

4.2 Weather Conditions

Atmospheric conditions including temperature, relative humidity, wind speed, wind direction and vertical temperature gradient can all affect noise propagation and received noise levels at some distance from a source. The INP recommends noise enhancing winds or temperature inversions that occur for at least 30% of the time in any season or time period should be considered when predicting noise levels.

A weather dataset was compiled by PAE Holmes using the California Meteorological (CALMET) Model and checked against available data from an on-site weather station operated by Aston Resources. Data analysis was completed using the DECCW's Noise Enhancement Wind Analysis (NEWA) program in each of 16 compass directions. Further analysis of the dataset indicates mild F class temperature inversions occur 69% of the time during winter evenings and nights, which would be expected for this area. Noise enhancement due to temperature inversions therefore occurs for more than 30% of the time and must be included in the assessment. The dataset included stability classes A to F with no occurrence of G class inversions, indicating strong temperature inversions do not occur in this area despite expectations to the contrary. Further discussion of this issue, including adopted noise model parameters that simulate the effects of stronger inversions, is included in Section 4.2.5 below.

4.2.1 Gradient Winds

Results from the NEWA program are shown in Table 4, with entries in bold font highlighting significant winds that occur over 30% of the time in any season or time period.

Table 4: Noise Enhancing Winds, Calmet 2010 Data.

Wind Direction	Occurrence of Noise Enhancing Winds, % of Season and Time Period											
	Summer			Autumn			Winter			Spring		
	Day	Even.	Night	Day	Even.	Night	Day	Even.	Night	Day	Even.	Night
N	4.2	11.1	9.4	3.6	5.2	5.2	1.1	4.9	2.2	6.0	1.6	3.3
NNE	6.6	12.2	14.7	4.9	7.1	6.5	2.2	6.0	3.0	9.9	5.5	8.3
NE	10.2	18.1	16.0	7.4	9.5	9.2	4.3	10.6	4.6	13.5	10.7	12.1
ENE	13.3	21.4	18.1	10.9	9.2	9.3	6.4	14.4	7.2	16.5	17.6	17.3
E	20.8	25.3	20.3	17.4	15.8	17.4	12.8	18.8	14.0	20.2	26.6	24.3
ESE	23.3	**30.0**	21.0	21.4	26.4	27.7	23.6	28.8	26.9	23.5	**34.6**	**32.0**
SE	22.1	26.9	22.4	22.3	28.8	**30.6**	27.8	27.4	**30.0**	21.2	**34.6**	**32.2**
SSE	26.0	24.2	21.5	22.0	28.0	**30.2**	**34.2**	25.8	**30.0**	22.7	**30.5**	28.2
S	24.5	18.1	16.6	19.4	22.6	21.6	**35.7**	23.6	24.9	26.1	25.5	22.3
SSW	24.5	15.8	13.9	19.0	16.0	13.6	25.7	16.8	12.6	23.5	16.5	9.4
SW	23.5	14.4	13.1	14.9	9.0	8.1	22.2	19.3	14.0	22.0	12.1	5.3
WSW	20.2	14.4	11.6	13.2	7.3	8.3	25.9	18.2	15.7	25.8	11.0	4.8
W	15.5	12.8	11.5	10.8	6.3	7.7	23.4	12.5	13.6	23.4	9.9	4.9
WNW	9.6	7.2	8.3	8.4	3.5	5.9	19.7	10.1	12.7	19.7	6.9	4.5
NW	7.9	6.9	6.4	7.5	3.5	5.3	16.7	3.5	5.3	17.6	3.3	4.6
NNW	4.8	6.4	5.6	5.0	2.2	2.4	7.7	0.8	0.7	10.1	1.6	3.4

Table 4 shows dominant winds can occur from various directions ranging from ESE to south, during all time periods, which is consistent with previous results obtained at other locations near the Project. Evening and night time periods have been combined in this assessment given the similarities between evening and night weather conditions shown in Table 4.

4.2.2 Drainage Flows

Cold air drainage flows tend to run downhill and would therefore flow in different directions depending on the specific location of interest. A detailed inspection of topography in the area indicates the Project is located on land that generally slopes down towards the north-west which would tend to cause a south easterly drainage flow during the evening and night. This drainage flow is included in the assessment.

4.2.3 Temperature Inversions

Temperature inversions can occur at night as air at low elevation is cooled by the ground. Cold air is denser than warm air and therefore tends to stay near the ground or to flow downhill and pool in valleys. Inversions commonly occur in areas away from large bodies of water and are often stronger in arid or semi-arid areas.

Aston Resources' weather station includes temperature sensors at heights of 2 m and 10 m above the ground. While these sensors can indicate the presence of a temperature inversion, an 8 m vertical range between the sensors is insufficient to accurately determine the inversion strength up to 100 m above the ground which is approximately the height required to determine the effect of inversions on noise propagation.

Inspection of the weather station data indicate the measured temperature at 10 m above the ground is often 2 to 3 °C higher than the temperature at 2 m above the ground during the night, which indicates temperature inversions occur regularly in this area. In the absence of detailed data to indicate an appropriate inversion strength over a representative height of 100 m above the ground, the INP default of 3 °C/100m is adopted. Stronger inversions, as expected to occur in the area at times, have also been considered as discussed in Section 4.2.5.

4.2.4 Adopted Weather Conditions

Table 5 shows adopted atmospheric parameters for this assessment. The adopted weather conditions represent prevailing conditions for receivers in all directions from the site, including those which do not receive a significant occurrence of winds towards them from the site and are therefore assessed under calm wind conditions during the day and temperature inversion conditions during the night.

Table 5: Modelled Weather Conditions.

Atmospheric Parameter	Day		Evening and Night		
	Neutral	Prevailing	Inversion No wind	Inversion ESE Wind	Inversion SSE Wind
Temperature, °C	20	20	10	10	10
Relative Humidity, %	70	70	90	90	90
Wind Speed, m/s	0	3	0	2	2
Wind Direction	-	South	-	ESE	SSE
Temp Gradient, °C/100m	-1	-1	3	3	3

Noise contour figures for prevailing weather conditions have been prepared by taking the outer envelope, or maximum noise level, of each set of weather conditions for the relevant time period. For example, the evening and night noise contours represent the maximum of the three sets of evening and night weather conditions listed in Table 5.

4.2.5 Strong Temperature Inversions

In the absence of data indicating the typical strength of temperature inversions that occur in this area, it is possible that inversions stronger than 3 °C/100m may occur in the area from time to time.

Temperature inversions tend to cause increased received noise levels because they refract sound 'rays' down towards the ground. Winds also cause increased noise levels, for receivers down wind, for the same reason. Research indicates the effects of inversions and winds are approximately cumulative and the noise model software adopts this approach by combining inversions and winds into an equivalent inversion strength. For the 'rural' terrain category in ENM software as used for this assessment, the equivalent inversion strength used for determining received noise levels is calculated by:

Equivalent Inversion °/100m = Inversion °/100m + 2.5 x Wind speed m/s. *Equation 1.*

Table 5 indicates the night scenarios include a combined 3 °/100m inversion plus a 2m/s wind from the ESE or SSE. According to Equation 1, a 2m/s wind is equivalent to a 5 °/100m inversion for receivers downwind of the source. The night scenarios, with a combined wind and inversion, include an equivalent inversion of 8 °/100m. This equivalent inversion is significantly stronger, and causes greater noise enhancement, than the INP default 3 °/100m inversion strength.

The combined wind and inversion approach adopted in this assessment satisfies the recommendations in the INP while simultaneously assessing the effects of strong noise enhancement for potentially affected receivers. Noise levels at receivers generally east and south of the mine are calculated using a 3 °/100m inversion, which is appropriate given the topography in these directions which would prevent a strong inversion from forming.

4.3 Noise Control Measures

The following noise control and mitigation measures have been incorporated into the Project to minimise noise impacts on receivers and to reduce the Project's area of affectation.

- All mining trucks and water carts would be fitted with best practice exhaust silencers to reduce their noise emissions;
- The overburden fleet would be directed to higher, exposed emplacement areas during favourable weather conditions (generally during the day) and to lower, more shielded emplacement areas where possible during noise enhancing weather conditions (generally during the evening and night);
- Tracked dozers would be operated at slow speed, particularly in reverse, in exposed areas of the site during noise enhancing weather conditions to minimise audible track noise;
- Vehicle reverse alarms and horns, equipment start alarms and other audible warning devices would be selected, installed and adjusted to produce the lowest possible noise level consistent with safe operation;
- Mobile and coal handling equipment would be maintained in good condition to maximise productivity and, at the same time, minimise any additional or unnecessary noise;
- A slewing, luffing bucketwheel reclaimer would be used on the product coal stockpile instead of a reclaim tunnel and three or four tracked dozers; and

- The proposed rail spur would include noise control measures such as large radius curves to minimise wheel squeal, concrete instead of steel bridges or vibration isolation material between the rails and steel bridges, and continuously welded rails to minimise wheel noise over joints.

Preliminary noise modelling in the absence of the proposed noise control measures has indicated the proposed measures would achieve a significant noise reduction at all receiver locations, as further described in Section 4.6 below.

4.4 Operational Noise Sources

4.4.1 Mining and Coal Processing

Proposed mining operations would require a number of items of fixed and mobile equipment to uncover, extract, process and transport coal. Sound power levels for mining and coal processing equipment have been derived from manufacturer's data where available, or from noise measurements on existing mine sites, and include the noise mitigation measures listed in Section 4.3.

Sound power levels for locomotives travelling at slow speed on a loading loop were measured on a loop at another mine, while noise from coal trains travelling at higher speeds was measured in late 2009 in the East Maitland area near Newcastle. Sound power levels for proposed operational equipment included in the noise model are listed in Table 6.

Table 6: Modelled Noise Sources and Sound Power Levels.

Code, Source	Octave Band Centre Frequency, dBL [1]								dBL Total	dBA Total
	63	125	250	500	1k	2k	4k	8k		
Mining Sources										
E1, Shovel 1000t	121	120	118	120	118	117	109	100	127.8	122.9
E2, Excavator 600t	121	120	118	120	118	117	109	100	127.8	122.9
E3, Excavator 350t	129	125	119	115	114	112	105	96	131.3	119.2
E4, Excavator 250t	129	125	119	115	114	112	105	96	131.3	119.2
T1, Truck 330t	117	119	115	112	114	109	100	92	124.0	117.1
T2, Truck 230t	117	119	115	112	114	109	100	92	124.0	117.1
T3, Truck 185t	117	119	115	112	114	109	100	92	124.0	117.1
Dz, Dozer, no track noise [2]	115	115	112	113	111	106	99	90	122.2	115.0
Dzt, Dozer with track noise	117	118	121	124	123	119	112	100	129.1	126.7
Dr, Drill	108	113	116	118	109	109	99	95	121.8	117.5
G, Grader 16H	107	115	111	107	108	104	98	90	118.3	111.9
W, Water cart 777	115	117	113	110	112	107	98	90	122.0	115.1
L, Loader 992	115	115	112	113	111	106	99	90	122.2	115.0
CHPP and Transportation Sources										
PP, Prep plant	122	122	117	114	111	108	102	95	133.0	116.7
C2, Conveyor 200m	103	102	102	105	105	101	91	81	112.8	108.3
C5, Conveyor 500m	107	106	106	109	109	105	95	85	116.8	112.3
Pri, Primary sizers	109	107	107	108	105	100	93	83	116.5	109.3
Sec, Secondary sizers	115	116	111	111	107	102	95	88	120.5	112.1
Sk, Stacker	105	106	102	102	98	97	90	84	111.2	104.0
Rec, Reclaimer	114	117	112	110	111	108	106	100	121.9	115.4
Tr, Transfer station	111	110	101	101	98	95	87	76	117.1	103.4
Lo, Locomotive	100	101	97	93	90	89	80	75	106.2	96.2

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Code, Source	Octave Band Centre Frequency, dBL [1]								dBL	dBA
	63	125	250	500	1k	2k	4k	8k	Total	Total
TB, Train loadout	107	109	103	99	97	94	92	82	113.9	102.8
X, Train on rail spur [3]	108	105	101	100	101	103	100	97	112.4	107.9
R, Access road [4]	100	94	91	92	92	86	79	73	103.2	94.9

1. dBL means unweighted, as opposed to A-weighted, noise levels.
2. Includes tracked dozers (operating slowly to avoid track noise) and rubber tyred dozers.
3. A train includes three locomotives and 90 wagons travelling at an average speed of 50 – 60 km/hr on the rail spur. The listed sound power level applies to each 200m length of rail spur.
4. The listed sound power level applies to each 200m length of access road.

Minor items of equipment that are unlikely to be audible at any receiver under any weather conditions, such as pumps located in the pit or conveyor drives within the coal handling area, have been shown by preliminary noise modelling to have no appreciable effect on received noise levels and have been omitted from the assessment.

Figures showing noise source locations for the mine, rail loading facility, rail spur and mine access road are included in Appendix B. The figures show the modelled location of each source, where the actual location is the lower left corner of each text entity. Source heights above local ground level have been determined based on the estimated height of the acoustic centre for each source type.

4.4.2 Mine Access Road

A permanent mine access road is proposed from Therribri Road to the Project, generally following the proposed rail spur alignment. Vehicles travelling along a private road such as the proposed mine access road are considered industrial sources and have been included in the operational noise model in all scenarios.

The number and type of vehicles travelling on the mine access road would vary from time to time. Vehicle movements are expected to be concentrated either side of the shift changeover times, as staff travel to or from the site. Given that many staff would travel from Boggabri in three buses rather than by private car, the following vehicle movements in a 15 minute period and associated sound power levels have been included in the model to present a reasonable worst case situation:

- Three large trucks or buses (108 dBA); and
- Twenty cars (85 dBA each).

A total sound power level of 113 LAeq has been divided into 63 source points at 200m intervals, with each source modelled with a sound power level of 95 LAeq,15min as shown in Table 6. Noise source locations for the access road are shown in Figure B11 in Appendix B.

4.4.3 Rail Spur

A private rail spur is proposed from the WCMR to the Project. Coal trains on a private rail spur are normally considered industrial sources and have been included in the operational noise model.

Boggabri Coal has also proposed to construct a rail spur from Boggabri Coal Mine to the WCMR, although the timing of this project is uncertain and approval for the proposed rail spur has not yet been obtained. As it is possible that either Boggabri Coal does not receive approval for the rail spur or does not commit to construction of the rail spur within a ‘suitable’ timeframe, Aston has also proposed a standalone rail spur option following a similar alignment to part of Boggabri Coal’s proposed rail spur. Two rail spur options have therefore been investigated:

- Option 1 - A preferred rail spur from the Project to meet Boggabri Coal's proposed rail spur, then a shared rail spur over the Namoi River floodplain to the WCMR. For the purposes of this assessment the shared portion of the rail spur follows Boggabri Coal's proposed alignment although that may not be the agreed outcome; and
- Option 2 - A standalone rail spur from the WCMR to the Project, following Aston's proposed alignment assuming this alignment is agreed with Boggabri Coal or Boggabri Coal does not commit to a rail spur.

Rather than assess noise levels from each rail spur option for each year and time period, the Option 1 rail spur alignment has been primarily considered and noise levels from this option are included in Figures A4, A8, A12, A16, A20 and A22 for each assessed year and for all years combined. Noise levels from the Option 2 rail spur alignment are shown in Figure A25 and are similar to Option 1 noise levels for most receivers.

The number of train movements per day would vary from one day to the next depending on the shipping schedule with no trains visiting the site in some days, an average of 6 trains per day and up to 12 trains (24 train movements) per day during busy times. Each train movement along the rail spur is assumed to take approximately 15 minutes and, given the proposed rail spur would be constructed with a single track, two or more train movements cannot reasonably occur in a 15 minute period.

Based on previous noise measurements taken in the Hunter Valley, a typical coal train with 3 locomotives and 90 wagons would produce a sound power level of up to 126 dBA when travelling at 50 to 60 km/hr, due primarily to wheel noise including some wheel and brake squeal. A train travelling at a higher speed such as 80 km/hr tends to produce a higher sound power level for a shorter time period, which results in a similar average received noise level over a typical 15 minute period. This assumption presents a worst case assessment as it considers a longer and therefore louder train than assumed in the EA traffic assessment report. This sound power has been distributed over 74 source points at 200 m intervals from the MWCR to the base of the loop. Noise from the rail spur has been modelled separately for the worst case night period, under prevailing weather conditions, and has been added to mining and mine access road noise levels for each assessed year. Figures A4, A8, A12, A16 and A20 in Appendix A include noise from the rail spur for each assessed year while Figure A22 show the total area of affectation including the rail spur for all years. Rail spur noise source locations, for both options, are shown in Figure B11 in Appendix B.

Train noise from the loop has been included in all noise model scenarios by distributing three locomotive sources on the loop. Wagon noise on the loop would be insignificant at the slow speed the train would move while being loaded and has not been included in these scenarios.

4.5 Predicted Mining Noise Levels

Noise levels from the Project have been modelled for representative operating scenarios, time periods and weather conditions. Noise contour figures showing predicted noise levels for years 1, 5, 10, 15 and 21 under neutral and prevailing weather conditions are included in Appendix A while detailed tables of noise levels at potentially affected receiver locations and over 25% of contiguous property and lot areas are presented in Appendix C. A summary of results is presented in Table 7, excluding residences and properties that are owned by a mining company.

Predicted noise levels include normal mining activity, coal handling and processing, operation of the rail loading facility, three locomotives operating at low speed on the loading loop and, in some of the noise contour figures as marked, a train movement on the rail spur assuming the Option 1 shared rail spur alignment. All noise control and mitigation measures listed in Section 4.3 have been considered in the calculations.

Table 7: Summary of Predicted Noise Levels, LAeq,15min.

Owner	Residence					25% of Property Area				
ID	ID	Day Neutral	Day/ Evening	Night	Night +Rail	ID	Day Neutral	Day/ Evening	Night	Night +Rail
2	126	32.7	45.2	48.4	48.4	125-131	35.5	47.4	50.0	50.0
3	-	-	-	-	-	123-124	30.3	40.1	42.9	42.9
5	134	21.1	34.4	35.8	35.8	132-140	28.6	42.9	45.0	45.0
6	-	-	-	-	-	141-148	26.3	38.4	40.7	40.7
7	-	-	-	-	-	149-155	28.2	41.5	44.4	44.4
8	118	29.0	40.0	44.0	44.0	117-119	33.0	43.2	47.9	47.9
	120	18.8	23.4	36.2	39.1	120	25.5	29.7	36.6	42.8
10	-	-	-	-	-	110-114	26.8	37.1	41.9	41.9
14	-	-	-	-	-	240	23.3	28.8	35.4	44.2
16	61	30.1	30.1	35.1	43.1	61-66	27.0	27.0	33.4	40.9
						58-60	20.2	32.9	34.5	34.6
17	256	21.2	21.2	31.5	40.1	256-263	23.3	23.3	30.9	41.5
	259	19.0	19.0	29.5	39.1					
46	-	-	-	-	-	254-255	15.2	15.2	27.7	40.2
41	-	-	-	-	-	246-247	19.4	24.8	31.2	39.7
4	-	-	-	-	-	121-122	27.8	37.0	39.8	39.8
12	108	24.3	35.4	39.1	38.6	108-109	24.7	34.8	39.5	39.5
35	-	-	-	-	-	168-170	24.4	35.5	38.3	38.3
48	-	-	-	-	-	227	17.8	21.7	35.7	38.1
						228	15.7	18.7	33.1	35.2
91	-	-	-	-	-	250-251	7.4	7.4	22.4	37.1
9	-	-	-	-	-	106-107	22.6	33.0	36.0	36.1
11	-	-	-	-	-	115-116	22.3	33.2	36.1	36.1
36	-	-	-	-	-	173-174	24.0	34.1	36.8	36.8
37	-	-	-	-	-	175	23.8	33.8	36.5	36.5
38	-	-	-	-	-	156-165	23.1	34.7	36.5	36.5
42	-	-	-	-	-	237-239	14.9	17.6	30.1	35.2
43	-	-	-	-	-	244-245	13.7	15.6	28.3	35.7
47	236	16.1	19.4	34.0	35.9	236	17.2	20.5	34.4	37.0
62	77	19.8	33.4	35.0	35.0	70-77	20.1	33.7	35.3	35.3
Relevant Noise Contour Figures		A1, A5, A9, A13, A17	A2, A6, A10, A14, A18	A21	A22	-	A1, A5, A9, A13, A17	A2, A6, A10, A14, A18	A21	A22

Red – Significant noise impact of more than 5 dBA over the criterion
Blue – Moderate noise impact up to 5 dBA above the criterion
Green – Mild noise impact up to 2 dBA above the criterion
Purple – Property subject to an agreement with Aston Resources

Table 7 shows, including noise from a train on the rail spur:

- Four residences (126, 118, 61 and 256) and eight additional properties (Lots 123-124, 132-140, 141-148, 149-155, 120, 110-114, 240 and 254-255) would be significantly affected by noise. Of these, two residences and two properties (126, 118, 132-140 and 120) are subject to agreement with Aston Resources. Significantly affected landowners also own two moderately affected residences (120 and 259) and one mildly affected residence (134);

- One residence (108) and five additional unoccupied properties (246-247, 121-122, 168-170, 227 and 250-251) would be moderately affected by noise. One moderately affected landowner also owns one mildly affected property (228); and
- One residence (236) and eight additional properties (106-107, 115-116, 173-174, 175, 156-165, 237-239, 244-245 and 70-77) would be mildly affected by noise. Of these, one residence (236) is subject to agreement with Aston Resources.

Should visitor facilities such as picnic areas be constructed within either the Leard State Forest or the Leard State Conservation Area in the future, such facilities would become noise sensitive areas and would be subject to a criterion of 50 LAeq,15min. Predicted noise levels from the Project would exceed the 50 LAeq,15min criterion over approximately 7.5% of the Leard State Forest area, excluding part of the Forest within the proposed mine footprint, which is considered an insignificant noise impact. The Leard State Conservation Area would be outside the 50 LAeq,15min contour so would remain unaffected by noise from the Project.

4.6 Effect of Noise Control Measures

The predicted noise levels described in Section 4.5 and Table 7 include all proposed noise control measures listed in Section 4.3. The proposed noise control measures were adopted based on the results of an investigation into the effectiveness of various noise control options, and represent all available ‘feasible and reasonable’ options. While it is technically possible to adopt additional noise control measures, an economic analysis completed by Aston Resources and further described in the EA shows such measures are not considered economically achievable or cost effective. Results from the noise control investigation can be summarised into four distinct cases:

Case 1 – No Noise Control

Case 2 – Proposed Noise Control – as described in Section 4.3 including mine plan modifications, quieter equipment options and engineering noise control measures;

Case 3 – Case 2 (proposed) plus full engineering controls on all excavators and shovels; and

Case 4 – Case 3 plus full engineering controls on all trucks and water carts and slow speed operation of all dozers, not just those in exposed areas of the site, to avoid track noise.

Table 8 shows the modelled mobile equipment sound power levels for each noise control case. No other sound power level differences exist between the four cases.

Noise contours for all 4 cases are shown in Figure A26 in Appendix A. Received noise levels for each case to potentially affected residences and properties are shown in Table 9, including noise from a train on the Option 1 rail spur alignment under noise enhancing weather conditions during the night which represents the worst case. Noise levels in *italics* are primarily affected by noise from the rail spur and are therefore relatively unaffected by the various noise control cases. Results for the adopted Case 2 include minor adjustments to the rail noise model, to be more consistent with Boggabri Coal’s proposed rail spur alignment, that were made since the other three cases were calculated. Noise levels at receivers near the rail spur have generally changed by less than 0.5 dB as a result of these adjustments.

Table 8: Modelled Sound Power Levels, Four Noise Control Cases, LAeq,15min.

Source		Assessed Noise Control Case				Sound Power Differences		
		1	2 Proposed	3	4	Case 1 to Case 2	Case 2 to Case 3	Case 2 to Case 4
Shovel 1000t	dBL	128	128	124	124	-	-4	-4
	dBA	123	123	115	115	-	-8	-8

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Source		Assessed Noise Control Case				Sound Power Differences		
		1	2 Proposed	3	4	Case 1 to Case 2	Case 2 to Case 3	Case 2 to Case 4
Excavator 600t	dBL	128	128	124	124	-	-4	-4
	dBA	123	123	115	115	-	-8	-8
Excavator 350t	dBL	131	131	123	123	-	-8	-8
	dBA	119	119	114	114	-	-5	-5
Excavator 250t	dBL	131	131	123	123	-	-8	-8
	dBA	119	119	114	114	-	-5	-5
Truck 330t	dBL	126	124	124	124	-2	-	0
	dBA	122	117	117	114	-4	-	-3
Truck 230t	dBL	128	124	124	124	-4	-	0
	dBA	121	117	117	114	-4	-	-3
Truck 185t	dBL	127	124	124	123	-3	-	-1
	dBA	120	117	117	113	-3	-	-4
Dozer no tracks	dBL	122	122	122	122	-	-	-
	dBA	115	115	115	115	-	-	-
Dozer + tracks	dBL	132	129	129	122[1]	-3	-	-7
	dBA	130	127	127	115[1]	-3	-	-12
Water cart	dBL	125	122	122	122	-3	-	0
	dBA	118	115	115	114	-3	-	-1

1 Track noise has been eliminated from all dozers, not just those in exposed areas of the site, for Case 4.

Table 9: Summary of Predicted Noise Levels for Four Noise Control Cases, LAeq,15min.

Owner	Residence					25% of Property Area				
ID	ID	Case 1	Case 2	Case 3	Case 4	ID	Case 1	Case 2	Case 3	Case 4
2	126	49.4	48.4	47.9	47.0	125-131	50.6	50.2	49.5	48.4
3	123	38.6	34.6	34.0	33.6	123-124	46.2	42.9	42.5	41.7
4	122	39.7	34.5	33.9	33.4	121-122	45.2	39.8	39.2	38.8
5	134	38.4	35.8	34.9	34.2	132-140	46.1	45.0	44.8	43.9
6	147	36.1	34.1	33.3	32.4	141-148	41.4	40.7	39.2	38.1
7	-	-	-	-	-	149-155	48.0	44.4	43.4	42.5
8	118	49.6	44.0	43.3	42.7	118-119	53.8	47.9	47.3	46.6
	120	*40.9*	*39.1*	*38.7*	*38.3*	*120*	*42.5*	*42.8*	*41.7*	*41.7*
9	106	36.8	30.8	30.1	29.6	106-107	42.4	36.1	35.5	35.0
10	111	37.4	32.0	31.3	30.8	110-114	48.8	41.9	41.1	40.7
11	116	39.1	33.7	32.7	32.2	115-116	40.4	36.1	35.3	34.9
12	108E	45.9	39.1	38.2	37.8	108-109	46.2	39.5	38.8	38.4
12	108W	45.3	38.6	37.7	37.3					
14	-	-	-	-	-	*240*	*44.6*	*44.5*	*42.3*	*42.2*
16	-	-	-	-	-	58-60	39.1	34.6	33.9	33.3
	61	*43.0*	*43.6*	*42.8*	*42.8*	*61-66*	*41.2*	*40.9*	*40.9*	*40.9*
17	*256*	*39.2*	*40.1*	*39.2*	*39.1*	*256-263*	*41.5*	*41.5*	*41.4*	*41.4*
	259	*38.9*	*39.1*	*38.9*	*38.8*					
18	-	-	-	-	-	266-268	35.7	34.5	35.2	34.9
34	-	-	-	-	-	176-195, 283-284	37.5	32.0	31.7	30.7
35	-	-	-	-	-	168-170	40.9	38.3	37.5	36.7
36	-	-	-	-	-	173-174	39.6	36.8	36.2	35.4

Owner	Residence					25% of Property Area				
ID	ID	Case 1	Case 2	Case 3	Case 4	ID	Case 1	Case 2	Case 3	Case 4
37	-	-	-	-	-	175	39.2	36.5	35.9	35.0
38	-	-	-	-	-	156-167	40.1	36.5	35.6	34.4
41	-	-	-	-	-	*246-247*	*39.7*	*39.7*	*38.7*	*38.6*
42	-	-	-	-	-	237-239	35.5	35.2	34.1	33.8
43	-	-	-	-	-	*244-245*	*35.3*	*35.7*	*34.9*	*34.8*
46	-	-	-	-	-	*254-255*	*40.2*	*40.2*	*40.1*	*40.0*
47	236	38.1	35.9	35.3	34.8	236	38.7	37.0	36.3	35.8
48	-	-	-	-	-	227	40.5	38.1	37.7	37.3
						228	37.2	35.2	34.4	33.8
49	225	36.9	34.4	33.7	33.0	222-225	36.7	34.3	33.9	33.4
52	104	37.2	32.0	31.0	30.6	104	40.9	35.0	34.2	33.8
53	105	37.3	31.6	31.0	30.4	105	39.1	33.2	32.6	32.1
55	-	-	-	-	-	37	35.3	30.1	29.1	28.5
56	-	-	-	-	-	38	35.5	30.3	29.3	28.7
57	42	35.7	30.4	29.5	29.0	42	35.6	30.6	29.8	29.2
58	-	-	-	-	-	43	35.4	31.5	30.6	29.8
59	-	-	-	-	-	44	35.5	31.6	30.7	29.9
60	54	36.9	32.7	32.2	31.4	52-56	36.9	33.3	32.8	32.0
62	77	38.1	35.0	34.4	33.7	70-77	38.3	35.3	34.6	34.0
63	-	-	-	-	-	80-81	37.1	34.6	33.8	33.0
65	-	-	-	-	-	67	37.9	34.8	34.2	33.5
66	68	37.8	34.8	34.1	33.4	68	37.8	34.8	34.1	33.4
67	-	-	-	-	-	33	35.9	30.7	30.1	29.4
68	-	-	-	-	-	35-36	35.9	30.3	29.7	29.1
77	-	-	-	-	-	48-51	35.5	32.4	31.8	30.9
79	-	-	-	-	-	68	35.9	33.1	32.5	31.6
91	-	-	-	-	-	250-251	37.1	37.1	37.1	37.1
Number of Residences/ Properties		6	4	3	3	Significant	20	12	11	10
		13	4	5	5	Moderate	13	7	7	7
		4	2	1	0	Mild	14	9	7	3

Red – Significant noise impact of more than 5 dBA over the criterion

Blue – Moderate noise impact up to 5 dBA above the criterion

Green – Mild noise impact up to 2 dBA above the criterion

Purple – Property subject to an agreement with Aston Resources

Comparison of the noise contours on Figure A26 and the results in Table 9 for each case indicates:

- Proposed noise control measures would generally achieve a reduction of 3 to 6 dBA (Case 1 to Case 2) at most receiver locations;
- Additional noise control measures applied to the excavators and shovels (Case 2 to Case 3) would achieve an additional 0.5 dBA average reduction at potentially affected receivers; and
- Additional noise control measures applied to trucks and water carts and avoiding dozer track noise (Case 3 to Case 4) would achieve a further 0.5 dBA average reduction at potentially affected receivers, for a total average reduction of 1 dBA (Case 2 to Case 4).

Results indicate the adopted noise control measures for Case 2, as proposed, have achieved a large percentage of the available or technically achievable noise reduction at a significant but acceptable cost to Aston Resources. The proposed noise control measures would also achieve a significant reduction in the number of affected properties as shown in Table 9, while further noise control measures assumed in Case 3 and Case 4 would achieve only modest further reductions in the number of affected properties at a substantial additional cost.

Further noise control measures in Case 3 and 4 would therefore be significantly less cost effective than the proposed noise control measures adopted for Case 2. A more detailed assessment of the economic feasibility and efficiency of each case is beyond the scope of this acoustic assessment but is included in Volume 1 of the EA.

4.7 Construction Noise

4.7.1 Construction Activities

Construction work would be required to implement the following works.

- Site establishment including construction of the temporary access road;
- Water pump station, power supply and pipeline;
- Therribri Road upgrade;
- Permanent mine access road and rail spur;
- Water management structures including dams;
- Power supply to the Project;
- Mining Infrastructure Area (MIA) including offices, workshop, fuel storage and bathhouse; and
- CHPP.

The earthmoving phase for each construction project typically produces the highest sound power level and is therefore considered in this assessment. Proposed construction work would occur within ‘daytime’ hours as defined in the INP which are 7am to 6pm Monday to Saturday and 8am to 6pm Sunday and public holidays.

4.7.2 Construction Noise Sources

Table 10 shows typical construction noise sources required to complete the proposed works, assuming all machines operate continuously at full power to present a worst case assessment. The Table shows the loudest proposed construction activity would be the permanent mine access road and rail spur earthmoving phase, primarily due to a number of diesel powered machines required on the site, followed by dam construction and the proposed MIA and CHPP works.

Table 10: Typical Earthmoving Phase Construction Sources and Sound Power Levels.

Project	Typical Construction Machines	Sound Power Level, LAmax	
		Per Machine	Total
Site establishment, temporary access road	Dozer x1	116	121
	Truck x2	108	
	Excavator x1	112	
	Grader x2	112	
	Roller x2	110	
Water pump station, power supply, pipeline	Excavator x1	112	115
	Truck x1	108	
	Backhoe x1	108	
Therribri Road upgrade	Dozer x1	116	122
	Truck x3	108	
	Excavator x2	112	
	Grader x2	112	
	Roller x2	110	
	Backhoe/bobcat x1	108	
Permanent access road and rail spur	Scraper x4	119	127
	Dozer x3	116	
	Truck x4	108	
	Excavator x3	112	
	Grader x2	112	
	Roller x2	110	
Water management dams	Scraper x2	119	124
	Dozer x1	116	
	Truck x2	108	
	Excavator x1	112	
Project power supply	Mobile crane x1	112	121
	Welder x2	104	
	Truck x3	108	
	Various hand tools including grinders	119	
MIA and CHPP	Truck x2	108	122
	Excavator x1	112	
	Grader x1	112	
	Roller x1	110	
	Backhoe/bobcat x1	108	
	Mobile crane x1	112	
	Various hand tools including grinders	119	

4.7.3 Construction Noise Assessment

Environmental noise levels produced during the construction phase would depend on the activities occurring at the time, the location of construction work compared to receiver properties and weather conditions. Given the relatively wide spread of construction sources within the Project Boundary and the potential for daytime noise enhancing winds, daytime construction noise levels have been determined using ENM.

The construction noise model includes the following components which, apart from the Therribri Road upgrade, would most likely occur simultaneously within Year 1 and would therefore represent a worst case assessment:

- Water pump station, power supply and pipeline;
- Therribri Road upgrade;
- Permanent mine access road and rail spur;
- Water management structures including dams;
- Power supply to the Project;
- MIA including offices, workshop, fuel storage and bathhouse; and
- CHPP.

Construction machines associated with the pipeline, Therribri Road upgrade and the mine access road and rail spur would tend to progress along each route, while construction machines associated with the other listed works would tend to remain within a smaller area for a longer period of time. Construction machines associated with works that cover a large area have been modelled by placing all sources at regular intervals along the pipeline, road or rail spur routes and taking the maximum noise level from all modelled locations at each receiver.

Construction noise associated with the other works has been modelled separately to determine cumulative noise levels from those works. Maximum noise levels from the three extended construction works were then added to the cumulative levels from the other works to determine overall construction noise levels at each receiver. Noise contours for the worst case construction period, under prevailing weather conditions during the day, are shown in Figure A23 in Appendix A.

Figure A23 indicates the conservative 35 LAeq,15min construction noise criterion would potentially be exceeded at times at the following residential receivers, excluding receivers that are already shown in red shaded areas of Table 7 above:

- Receiver 264 Almost entirely from Therribri Road upgrade work;
- Receiver 236 Primarily from water pipeline construction work with a minor contribution from rail spur construction work; and
- Receiver 225 From water pipeline and rail spur construction work.

All other receivers are either expected to be affected by noise from operation of the Project or would remain unaffected by the proposed construction works. Construction noise levels at the three potentially affected receivers listed above are expected to be acceptable for the following reasons:

- Receiver 264 would primarily receive noise from the Therribri Road upgrade works. This receiver would currently be exposed to occasional noise from road maintenance activities such as grading and rolling and would directly benefit from the upgraded road by a reduction in travel time, improved safety and reliability in wet weather, reduced vehicle maintenance costs due to the improved road and a reduction in future maintenance activity; and
- Receiver 236 would primarily receive noise from the pipeline construction works which would progress reasonably quickly along the pipeline route. Noise levels from the construction works would be similar to, or perhaps quieter than, typical rural activities such as ploughing, planting and harvesting crops which currently occurs intermittently in the area; and
- Receiver 225 would receive mild noise impacts of less than 2 dBA, and only during noise enhancing wind conditions, from the pipeline and rail spur construction work.

Despite these comments, a construction noise management plan would be developed and implemented to achieve the lowest construction noise levels consistent with safe and efficient working practices.

4.7.4 Extended Construction Hours

While most construction work would be completed during the day, some construction activity during the evening and night may be required to meet the proposed construction schedule. Any extended hours work would be subjected to the operational noise criterion of 35 LAeq,15min at all noise sensitive receivers. Proposed construction work during extended hours would specifically exclude the following activities:

- Pile driving or rock hammering;
- Drilling footings;
- Blasting;
- Rail ballast placing or shaping; and
- Rail laying.

The following evening and night construction activities within the mine site, MIA or CHPP areas or along the proposed rail spur alignment may be required:

- Planning, marking and setting out;
- Limited excavation or earthmoving;
- Concrete pour preparation and finishing;
- Mechanical and electrical work such as installation of equipment;
- Welding, threading and light pre-assembly; and
- Checking, testing and commissioning.

The potentially loudest noise sources likely to occur as part of night construction work would include a backhoe or small loader, a forklift, concrete trucks and welders. Sound power levels produced by such equipment are unlikely to exceed 108 dBA per item. A total sound power level of 118 dBA assumes a worst case situation with ten noise sources operating simultaneously.

Night construction work within the CHPP area would therefore be quieter than normal CHPP operation, based on the modelled CHPP sound power levels listed in Table 6. Worst case night construction work within the MIA would be similar to or quieter than a haul truck approaching or leaving the workshop, while work associated with the rail spur would be significantly quieter than a train passby.

As CHPP operation, truck movements and train movements are all included in the operational noise assessment during all time periods, it is clear that proposed construction work during extended hours would result in received noise levels below the operational noise levels predicted in this assessment and no further analysis of noise levels during extended construction hours is required.

4.8 Sleep Disturbance

4.8.1 Mining

Coal mining primarily involves a number of diesel powered machines operating to remove overburden and extract coal. Most machines, such as trucks, have very little potential to produce a noise character that is likely to disturb sleep. Other machines, such as shovels and dozers, can produce intermittent louder noise depending on working conditions, machine condition and operator actions.

Shovels handle overburden by collecting the material into a bucket, swinging the bucket over a truck and allowing the rear section of the bucket to swing open to release the material into the truck. The rear of the bucket, known as the gate, is then swung closed and latched ready for the next load of material and can produce a moderately loud impact noise as it closes. Noise measurements on other mine sites indicate a shovel gate can produce a wide range of noise levels, with a sound power level in the range 125 to 128 dBA representing a typical maximum for this source.

Tracked dozers generally work in the forward direction, either pushing material with the blade or ripping hard ground with the rear-mounted ripping tines. Forward operation, particularly under load, tends to produce noise from the engine and exhaust but very little noise from the tracks. As a dozer reverses, however, lack of tension in the tracks tends to cause them to droop between the drive sprocket and the rear idler and this lack of tension can cause a regular impact noise. The level of noise a dozer can produce in reverse depends on a number of factors including machine type, condition, speed and ground conditions, with a sound power level in the range 125 to 130 dBA representing a typical maximum for this source.

Other sources of potential sleep disturbance include raw coal being dumped from a truck or loader into a steel ROM hopper, vehicle horns and equipment alarms. Noise measurements on other mine sites indicates these sources tend to produce a sound power level in the range 115 to 120 dBA, although the proposed vehicle horns and alarms would be significantly quieter.

This discussion indicates dozer tracks are generally the loudest sources of potential sleep disturbance within the mine, followed by shovel gates.

4.8.2 Trains

Train movements on the proposed private rail spur also have the potential to cause sleep disturbance. A long coal train travelling at 50 – 60 km/hr tends to produce a sound power level of approximately 126 dBA as shown in Table 6, with some of this noise attributed to wheel squeal and other rail-related sources. While the proposed rail spur would include the noise control measures listed in Section 4.3 of this report, it is difficult to completely eliminate wheel squeal.

Train movements on the loading loop are unlikely to cause significant impact noise due to the slow travel speed required while loading, although noise from wagon bunching and stretching may occur at times. Train movements on the private rail spur have the potential to cause increased noise levels due to the higher anticipated speeds and possible wheel squeal that may occur on the bends, despite the proposed track design to minimise this source. Stretching, bunching, wheel squeal and similar maximum noise level sources would be adequately covered by the 126 dBA modelled noise sources used for the sleep disturbance assessment, as higher train speeds do not tend to increase noise levels from these sources.

4.8.3 Calculated Noise Levels

Figure 4 shows the 45 dBA maximum contour, which is approximately equivalent to the 45 LA1,1min sleep disturbance criterion, produced by the following sources:

- Dozer track noise up to 127 dBA sound power within the mining and overburden emplacement areas for all years; and
- Train noise at 126 dBA sound power including wheel squeal at any point on the private rail spur.

Figure A24 in Appendix A shows the 45 LAmax contour, which is approximately equivalent to the 45 LA1,1min sleep disturbance contour, produced by taking the maximum noise level from the loudest potential sources of sleep disturbance listed above. Figure A24 indicates Receiver 126 would be subject to potential sleep disturbance assuming occasional dozer track noise occurs at night within the mining area or on the Overburden Emplacement Area (OEA). Receiver 126 is also expected to receive 40 LAeq,15min or more from the Project as shown in Table 7.

Figure A24 also shows Receivers 61, 256 and 259 would be subject to occasional sleep disturbance when a train travels along the proposed rail spur to or from the Project. Receiver 61 is also expected to receive train noise levels over 40 LAeq,15min while combined rail spur and access road noise levels would just exceed 40 LAeq,15min at Receiver 256 and remain just under 40 LAeq,15min at Receiver 259. These three receivers would remain unaffected by other noise sources associated with the Project.

4.9 Road Traffic Noise

Noise levels from vehicles travelling on the private road component of the permanent mine access road have been included in the operational noise model, while vehicle movements on the public road network are assessed in this section.

Traffic noise calculations are based on the United States EPA Intermittent Traffic Noise calculation method which is the most appropriate method for occasional or intermittent vehicle movements along a route. The usual Calculation of Road Traffic Noise (CORTN) method has not been used in this assessment as it is more appropriate for semi-continuous traffic flows on arterial roads.

The calculation method assumes a trapezoidal time trace as occurs when a vehicle approaches, passes the observer then recedes. Adopted sound power levels are 95 dBA for cars and 108 dBA for trucks and large buses.

4.9.1 Construction Traffic Flows

The construction program developed by Aston Resources indicates up to 221 heavy vehicles per week would be required during the construction period and, to present a worst case assessment, all of these vehicles are assumed to travel on each assessed route. An average of 221 trucks (or 442 truck movements) per week is equivalent to 6.3 truck movements per hour assuming a 7 day working week and 10 working hours per day. A reasonable worst case hour is assumed to include up to 30 truck movements on each route to allow for significant truck bunching, which is almost five times the proposed average hourly truck movements.

The construction program also indicates a maximum of 340 construction staff would be required for the Project. This assessment assumes up to 200 construction staff would travel to or from the Project during the busiest hour, with 150 staff travelling from Boggabri in three 50-seat buses and the remaining 50 staff travelling in 40 cars. The following worst case hourly construction traffic flows have therefore been adopted for all access routes;

- 30 trucks;
- 3 buses; and
- 40 cars.

4.9.2 Operational Traffic Flows

Up to 470 operational staff would be employed by the mine, including contract staff. This assessment assumes up to 250 staff would travel to or from the Project during the busiest hour, with 200 staff travelling from Boggabri in four 50-seat buses and the remaining 50 staff travelling in 40 cars. The assumed situation is most likely to occur at shift changeover times, which would occur two or three times per 24 hour period, during the day and night.

Additional vehicle movements related to material and fuel deliveries, waste removal, couriers and other visitors would occur intermittently during the day. Two heavy vehicle movements per hour have been included in the assessment to account for these vehicles.

The following worst case hourly operational traffic flows have therefore been adopted;

- 2 trucks;
- 4 buses; and
- 40 cars.

4.9.3 Temporary Eastern Mine Access Road

A temporary eastern access route from the Kamilaroi Highway via Manilla Road and Leard Forest Road, then via a temporary road approaching the Project from the east, would be the primary access route during the initial construction stages and would also be used intermittently during later construction stages as required.

The construction program shows a number of works would begin during the first 4 months when this route would primarily be used, with only some components requiring traffic movements on this route. Exceptions include works related to the Therribri Road upgrade, pump station construction and bridge construction over the Namoi River floodplain.

Closest residences to this route are Receiver 269 approximately 420m north of Manilla Road, an unnumbered receiver approximately 420m south of Manilla Road and Receiver 277 approximately 390m east of Leard Forest Road.

4.9.4 Temporary Western Mine Access Road

A temporary western access route from Therribri Road, approximately following the proposed alignment of the permanent mine access road, is proposed to be constructed during the first four months and used for most of the construction period. The temporary western access road would be replaced by the permanent access road when it is completed.

Construction works for the rail spur and permanent mine access road would occasionally require the temporary western mine access road to be closed for a brief period and would result in the temporary eastern mine access road being used for these periods.

Closest residences to the public road part of the route are Receiver 264 approximately 37m west of Therribri Road and Receiver 259 approximately 45m east of Therribri Road.

4.9.5 Permanent Mine Access Road

The permanent mine access road from Therribri Road would be constructed in conjunction with the rail spur and, given the significant bulk earthworks required for these components, is programmed to be completed towards the end of the construction period. Ongoing construction works at the time that the permanent mine access road is completed would include the final months of the rail spur, MIA and CHPP construction works. The temporary western access road would be replaced by the permanent access road when it is completed.

Construction works for the rail spur and permanent mine access road would occasionally require the temporary western mine access road to be closed for a brief period and would result in the temporary eastern mine access road being used for these periods.

Closest residences to the public road part of the route are Receiver 264 approximately 37m west of Therribri Road and Receiver 259 approximately 45m east of Therribri Road.

4.9.6 Construction Traffic Noise Levels

Based on a reasonable worst case construction scenario including 30 truck, 3 bus and 40 car movements per hour, the following traffic noise levels have been calculated for the construction period.

- Temporary eastern route to Receiver 269 44 LAeq,1hr;
- Temporary eastern route to unnumbered receiver 44 LAeq,1hr; and
- Temporary eastern route to Receiver 277 45 LAeq,1hr.
- Temporary western and permanent route to Receiver 259 55 LAeq,1hr.
- Temporary western and permanent route to Receiver 264 54 LAeq,1hr;

As worst case Project-related construction traffic flows would represent the majority of traffic on all routes, non-project traffic flows would have an insignificant effect on predicted traffic noise levels and do not require inclusion in the assessment. Predicted worst case construction traffic noise levels would be acceptable compared to the 55 LAeq,1hr day criterion at all receivers.

4.9.7 Operational Traffic Noise Levels

Based on a reasonable worst case operational traffic scenario including 2 truck, 4 bus and 40 car movements per hour, the following worst case hourly traffic noise levels have been calculated for the operational period.

- Permanent mine access route to Receiver 259 48 LAeq,1hr.
- Permanent mine access route to Receiver 264 48 LAeq,1hr;

As worst case Project-related construction traffic flows would represent the majority of traffic on all routes, non-project traffic flows would have an insignificant effect on predicted traffic noise levels and do not require inclusion in the assessment. Predicted worst case operational traffic noise levels would remain well below the 55 LAeq,1hr day criterion and within the 50 LAeq,1hr night criterion at all receivers.

Vehicle movements associated with the Project would not regularly occur on Harparary Road but may occasionally be required to access environmental monitoring locations in the receiver area north of the Project Boundary. A reasonable worst case assessment would include two Project related vehicle movements per hour on Harparary Road past the Maules Creek School, which is expected to represent less than 10% of existing traffic flows and a potential traffic noise level increase of up to 0.4 LAeq,1hr at the School. Occasional vehicle movements on Harparary Road past the School are therefore expected to produce insignificant traffic noise levels and no mitigation measures are required or recommended.

4.10 Rail Traffic Noise

Noise from train movements on the WCMR is subject to the criteria described in Section 3.6 and is assessed separate to noise from train movements on the private rail spur.

A detailed assessment of noise from train movements on the WCMR requires data regarding the average and maximum number of train movements per day that currently occur on the railway and the location of all potentially affected residences along the route. In the absence of such data, a detailed assessment of train noise to all residences near the WCMR is beyond the scope of this report.

The *2009-2018 Hunter Valley Corridor Capacity Strategy – Consultation Document* (ARTC, 2009) includes the following data regarding train movements on the WCMR:

- 12 train movements per day from Narrabri to Boggabri;
- 14 train movements per day from Boggabri to Gunnedah; and
- 20 train movements per day from Gunnedah to Curlewis;

The more recent publication *2011-2020 Hunter Valley Corridor Capacity Strategy – Consultation Document* (ARTC, 2011) contains information that is consistent with the data above.

Approved or recently proposed coal mine developments that are likely to generate additional train movements are:

- Continuation of Boggabri Coal Project – 1 to 2 additional train trips, or an average of 3 additional train movements, would be required per day. Existing train movements associated with Boggabri Coal are included in the ARTC data above; and
- Narrabri Coal Mine Stage 2 Longwall Project – 5 additional train trips or 10 additional train movements would be required per day. Any existing train movements associated with Narrabri Coal Mine Stage 1 would be included in the ARTC data above.

The Project would require approximately 5 trains, or an average of 10 train movements per day, to transport up to 10 Mtpa of product coal assuming a limit of 72 wagons per train and the current axle load limit of 25 tonnes. An increase to 96 wagons per train, which is expected to be achieved after completion of ARTC's proposed rail realignment at Ardglen, would result in an average of 4 trains (8 movements) per day. An average of 10 train movements per day and a reasonable maximum of 20 movements per day has been adopted in this assessment.

There are a number of residences between Boggabri and Curlewis located at various distances from the WCMR. Specific analysis of noise levels at each residence is beyond the scope of this report. A representative receiver distance of 30m from the WCMR has therefore been adopted for this assessment. Results are presented in Table 11.

Table 11: Predicted Average Train Movements and Noise Levels at 30m Distance

Section of WCMR	Train movements per day		Predicted Noise Level LAeq,24hr [2]		Difference, LAeq,24hr
	Existing [1]	Proposed	Existing [1]	Proposed	
Narrabri to Boggabri	25	25	58.5	58.5	0
Boggabri to Gunnedah	27	37	58.9	60.2	+1.3
Gunnedah to Curlewis	33	43	59.7	60.9	+1.2

1 Includes additional proposed Narrabri Coal and Boggabri Coal train movements

2 No data are available regarding existing train movements during the day and night so average noise levels over a 24 hour period have been calculated.

Predicted noise levels in Table 11 are acceptable compared to the 65 LAeq,15hr day and slightly over the 60 LAeq,9hr night criteria for a nominal receiver at a distance of 30m from the rail line. Receivers closer than 30m from the railway would receive higher average noise levels, while receivers further from the rail line or effectively shielded by topography or other barriers would receive lower noise levels than predicted in Table 11.

Table 11 also shows Project related average daily train movements would result in an increase of 1.2 to 1.3 LAeq,24hr at all receivers near each section of the rail line. A busy day with a reasonable maximum of 20 Project related train movements would cause a further noise level increase of 1.0 LAeq,24hr at all receivers near the WCMR.

As various trains including coal, general freight and passenger services already use the WCMR and the proposed coal train movements would produce a similar maximum noise level as current train movements, no increase in maximum noise levels is anticipated. As few receivers would be located closer than 30m from the rail line, and those receivers would currently experience maximum noise levels close to or over the 85 LAmax criterion, proposed train noise levels are considered acceptable.

4.11 Blast Overpressure and Vibration

Explosive blasting would be required to prepare overburden for removal and may be required for coal extraction. Up to 160 blast events per year, or an average of just over three blasts per week, are expected to be required for the Project. Blast effects including ground vibration and overpressure depend on the following factors:

- Ground conditions including rock types and layers;
- Groundwater conditions including extent and depth;
- Distance from the blast site to a receiver;
- How well the explosive charges are confined with stemming material;
- Maximum Instantaneous Charge (MIC) for the blast event;
- Topography between the blast site and receivers; and
- Atmospheric conditions including wind speed, wind direction and vertical temperature gradient.

Blast effects have been calculated using the equations in Appendix J of AS2187.2. Ground and groundwater conditions, and their effect on vibration propagation through the ground, are difficult to quantify and would tend to vary from one area to the next within the Project Boundary and surrounding area. In lieu of detailed information and analysis of these factors, typical ground vibration coefficients have been adopted based on experience with other coal mines.

A typical blast includes a number of separate charged holes which are detonated in a specific pattern to maximise the effectiveness of the blast. The MIC is determined by the weight of explosive material per hole multiplied by the maximum number of holes detonated simultaneously within the firing pattern and is typically in the range 3000 to 6000 kg for a large open cut mine. With approximately 1500 kg of explosive material per hole for a 30m deep bench, a 6000 kg MIC represents 4 holes detonating simultaneously.

Table 12 shows calculated ground vibration and overpressure levels for closest blast events to each receiver location for comparison with the 5 mm/s and 115 dB criteria, assuming no topographical or other shielding between the blast site and the receiver. Calculated overpressure levels assume a typical well confined bench blast, with throw blasting expected to produce overpressure levels approximately 10 to 12 dB higher than shown in the Table.

Table 11: Predicted Blast Effects

Receiver (closest distance)	Ground Vibration, mm/s		Overpressure, dB	
	MIC 3000kg	MIC 6000kg	MIC 3000kg	MIC 6000kg
R126 (3350m)	1.6	2.8	105	108
R118 (3850m)	1.3	2.2	104	106
R112 (4850m)	0.9	1.5	102	104
R152 (5500m)	0.7	1.2	100	102
R123 (5600m)	0.7	1.2	100	102

Table 12 shows predicted blast effects would remain well below the criteria at closest receiver locations, in the absence of noise enhancing weather conditions. Prevailing southerly winds would tend to enhance overpressure levels at receiver locations generally north of the Project Boundary, including all closest receivers. The closest receiver locations listed in Table 12 are all expected to receive significant noise impacts from mining operations and are therefore likely to be acquired by Aston Resources or subject to negotiated agreements regarding noise levels. Receiver locations that are unlikely to be acquired by Aston Resources or subject to private agreements are at least 5600m from closest blast events and would therefore receive blast effects below 1.2 mm/s and 102 dB.

4.11.1 Buildings

Recommended blast noise and vibration criteria are designed to provide an acceptable level of personal comfort for residents. Building damage vibration criteria from *DIN 4150 Part 3* are intended to minimise the chance of building or structure damage and are an order of magnitude higher than the personal comfort criteria referred to in this assessment. The proposed blasting program therefore offers an extremely low chance of even superficial or cosmetic damage to privately owned residences or other structures such as outbuildings or buried pipelines. This means structural members within each residence or building absorb the vibration in an elastic manner, without yielding or suffering permanent damage or change, which in turn means the vibration could theoretically continue indefinitely with no noticeable change to the building or structure.

4.11.2 Heritage Structures

A number of buildings or other structures with potential heritage value have been identified in the vicinity of the Project, although all such sites are outside the Project Boundary:

- Velyama Shearing Shed – located approximately 280m south-east of the proposed rail spur and approximately 1000m north of Boggabri Coal's proposed rail spur;
- Velyama Burial Ground – located approximately 440m north-west of the proposed rail spur and approximately 200m south of the Project Boundary enclosing the proposed water pipeline route;
- Velyama Homestead site – located approximately 300m north-west of the proposed rail spur and approximately 40m south of the Project Boundary enclosing the proposed water pipeline route;
- Therribri Homestead – located approximately 280m north-west of the Project Boundary and approximately 200m north-west of Residence 2E; and
- Warriahdool Hut – located on Property 5 approximately 190m north of the Project Boundary and approximately 2180m east of Residence 2E.

The closest heritage structure to a potential blast site is Warriahdool Hut which is approximately 2500m north of the proposed mining area. A reasonable maximum blast event with up to 6000kg MIC would result in a vibration level of up to 4.4mm/s and an overpressure level of 111 dB which would comply with residential vibration and overpressure criteria. With building damage criteria significantly above the residential or personal comfort criteria, blast effects are considered highly unlikely to affect the Warriahdool Hut and, by extension, the other identified heritage items which are located at greater distances from proposed blast sites.

The closest heritage item to the proposed rail spur and mine access road alignment would be the Velyama Shearing Shed at an approximate distance of 280m from the rail spur. Previous investigations into ground vibration levels from train movements indicates vibration levels would comply with personal comfort criteria for the conservative night period at a distance of less than 100m from a rail line. With all heritage sites at least 280m from the rail line and significantly higher criteria applied to structures than to occupied residences, vibration from train movements along the proposed rail spur would be clearly acceptable.

4.11.3 Cumulative Blast Impacts

Potential cumulative impacts from blasting would normally be limited to an increase in the average number of blasts per day noticed by residents, with a very low chance of blast events at two or more mines occurring simultaneously. Nevertheless, Aston Resources would endeavour to coordinate blasting schedules with other mines within a 10km radius to avoid any potential for simultaneous blast events. All blast events associated with the Project would be designed to meet relevant overpressure and ground vibration criteria. Potential cumulative impacts, in the form of additional blast events per day from two or more nearby mine sites, would not increase maximum overpressure or ground vibration levels so would not result in exceedances of relevant criteria.

4.12 Cumulative Noise Levels

Cumulative noise impacts would potentially be caused by simultaneous operation of the Project and other nearby industrial developments such as the existing Boggabri Coal Mine to the south. Existing noise levels from Boggabri Coal Mine have been considered in Section 3.1 when determining Project noise criteria and no further cumulative assessment of existing Boggabri Coal Mine noise levels is required.

The proposed expansion of Boggabri Coal Mine, including an increase in annual production, would require additional mining machines to achieve the anticipated production increase and would therefore result in an increase in environmental noise levels compared to the current situation. Boggabri Coal has recently submitted a Project Application to the NSW Department of Planning, including an Environmental Assessment prepared by Hansen Bailey (Boggabri EA).

Noise contour figures in Appendix A, and the equivalent noise contour figures in the Boggabri EA, show LAeq,15min noise levels for direct comparison with the intrusive noise criteria. The intrusive criteria only apply to one industrial source such as a coal mine operating alone, while potential cumulative noise impacts from two or more industrial developments are assessed to the amenity criteria listed in Table 3. The amenity criteria, for the most critical night period, are expressed as LAeq,9hr which is the average noise level over an entire 9 hour night. The LAeq,9hr level from a typical mining operation, considering variations in operating conditions and weather conditions over a typical night, would be approximately 3 to 5 dBA lower than the LAeq,15min level.

For the purposes of this assessment the cumulative or total noise level from two or more industrial developments is therefore the sum of the separate noise levels from each development, expressed as Leq,15min levels, minus 3 dBA. An assessment of cumulative noise levels to representative properties near the Project is shown in Table 13, considering only the most sensitive night period.

Table 13: Cumulative Noise Levels with Boggabri Coal Mine, LAeq,9hr Night.

Representative Receiver	Predicted Maules Creek Noise Level		Predicted Boggabri Coal Noise Level		Cumulative Noise Level
	Intrusive LAeq,15min	Amenity LAeq,9hr	Intrusive LAeq,15min	Amenity LAeq,9hr	LAeq,9hr
186 (vacant lot)	35.7	32.7	39.0	36.0	37.7
168 (vacant lot)	38.3	35.3	35.4	32.4	37.1
120 (occupied property)	43.2	40.2	31.9	28.9	40.5
61 (residence)	35.1(mine) 44.5(train)	32.1(mine) 41.5(train)	40.6(haul rd)	37.6(haul rd)	38.7 (mine) 42.9 (train)
61 (property)	36.7(mine) 46.5(train)	33.7(mine) 43.5(train)	44.5(haul rd)	41.5(haul rd)	42.2 (mine) 45.6 (train)

Table 13 leads to the following comments:

Receiver 186	The cumulative noise level of 37.7 LAeq,9hr is numerically lower than the individual noise contribution of 39 LAeq,15min from the Boggabri Project but would of course remain above Boggabri Coal's predicted 36 LAeq,9hr amenity level and would comply with the noise amenity criterion;
Receiver 168	The cumulative noise level of 37.0 LAeq,9hr is numerically lower than the individual noise contribution of 38.2 LAeq,15min from the Maules Creek Coal Project but would remain above Maules Creek's predicted 35.2 LAeq,9hr amenity level and would comply with the noise amenity criterion;
Receiver 120	The cumulative noise level of 40.5 LAeq,9hr exceeds the noise amenity criterion, however the predicted 43.2 LAeq,15min noise contribution from the Maules Creek Coal Project would also significantly exceed the 35 LAeq,15min intrusive criterion. In this case, a cumulative noise impact is accompanied by a corresponding noise impact from one of the contributing coal mine developments;
Receiver 61	The Boggabri Project's proposed truck movements on the haul road would exceed the 35 LAeq,15min intrusive criterion and, with intermittent train movements from both mines, is the dominant contributor to cumulative noise levels over the noise amenity criterion at this receiver.
All receivers	Any exceedances of the amenity noise criterion, against which cumulative noise impacts are assessed, must be accompanied by a corresponding exceedance of 5 dBA or more above the intrusive noise criterion for the development that contributes the highest noise level. With only one other development in the area with the potential to produce significant environmental noise and cumulative noise impacts with the Project, cumulative noise impacts cannot occur unless the receiver is also affected by one or both of the Maules Creek or Boggabri Coal Projects.

Based on the analysis shown in Table 13 and the discussion above, it is clear that cumulative noise impacts cannot occur at any receiver that remains unaffected by noise from each Project considered separately. No further analysis of cumulative noise impacts is therefore required.

5 CONCLUSION

This assessment shows the area of affectation from the Project is expected to include a number of privately owned receiver properties, as shown in the red shaded areas of Table 7, while some additional properties listed in the Table would receive moderate or mild noise impacts under specific operating and weather conditions. All privately owned properties not listed in Table 7 are expected to receive acceptable noise levels compared to relevant criteria under all assessed weather conditions.

Proposed noise control measures would result in a reduction of 3 to 6 dBA at most receivers. Additional noise control measures are technically possible, as discussed in Section 4.6, which if proposed would result in a further average noise level reduction of 1 dBA. Given the substantial additional costs for further noise control measures and the modest noise reduction such measures would offer, Aston Resources does not consider such measures to be reasonable and feasible and such measures have not been adopted.

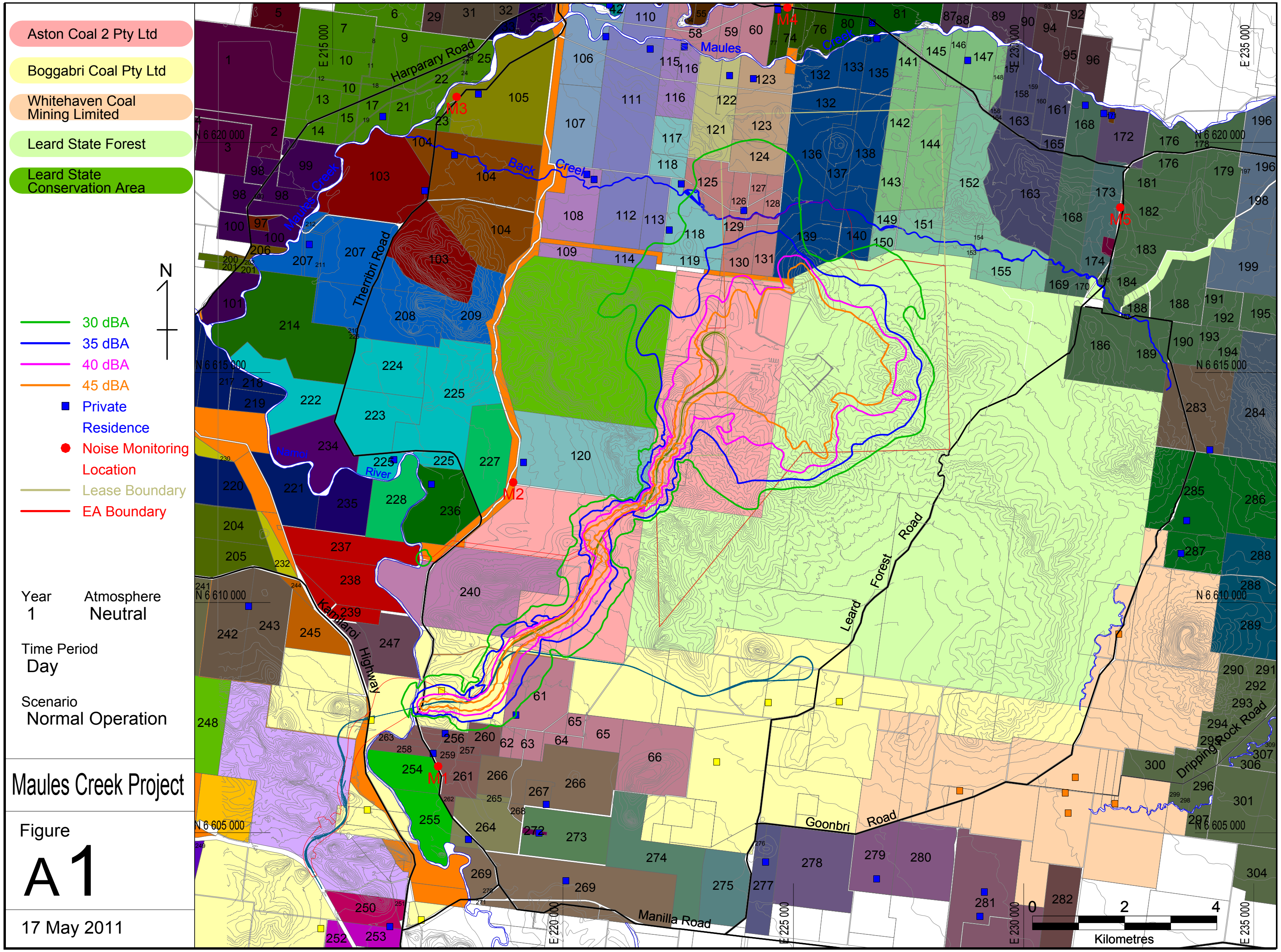
Construction noise levels are expected to be generally acceptable at all potentially affected residences despite predicted exceedances of the conservative construction noise criterion during the busiest construction periods. A construction noise management plan is recommended to ensure all feasible and reasonable noise mitigation measures are implemented during pipeline, rail spur and road construction and Therribri Road upgrade works.

Sleep disturbance from impact sources within the mine such as dozer tracks is unlikely to occur at any privately owned property considering the large distance from the mine to closest receivers. Any potential sleep disturbance impacts would only occur at receivers that are also subject to significant exceedances of relevant intrusive criteria. Discussions between Aston Resources and potentially affected receivers are therefore recommended to resolve any issues.

Train movements on the proposed rail spur have the potential to disturb sleep for closest residents, depending on the occurrence of wheel squeal and other sources as a train travels along the rail spur. Noise monitoring of train movements is recommended after the rail spur is commissioned to identify any noise issues and required mitigation measures. Noise from road traffic associated with construction activities and ongoing operation of the Project should be acceptable at all residences.

Low frequency noise levels from the Project are implicitly controlled by the intrusive noise criteria, as intended by the INP, so low frequency noise impacts are unlikely to occur at any privately owned receiver. Blasting associated with the Project is expected to produce ground vibration and overpressure levels below relevant amenity criteria at all privately owned residences. Blast monitoring at two or three closest residences, or at other representative locations, is proposed to confirm ongoing compliance with relevant blast criteria.

APPENDIX A – NOISE CONTOUR FIGURES

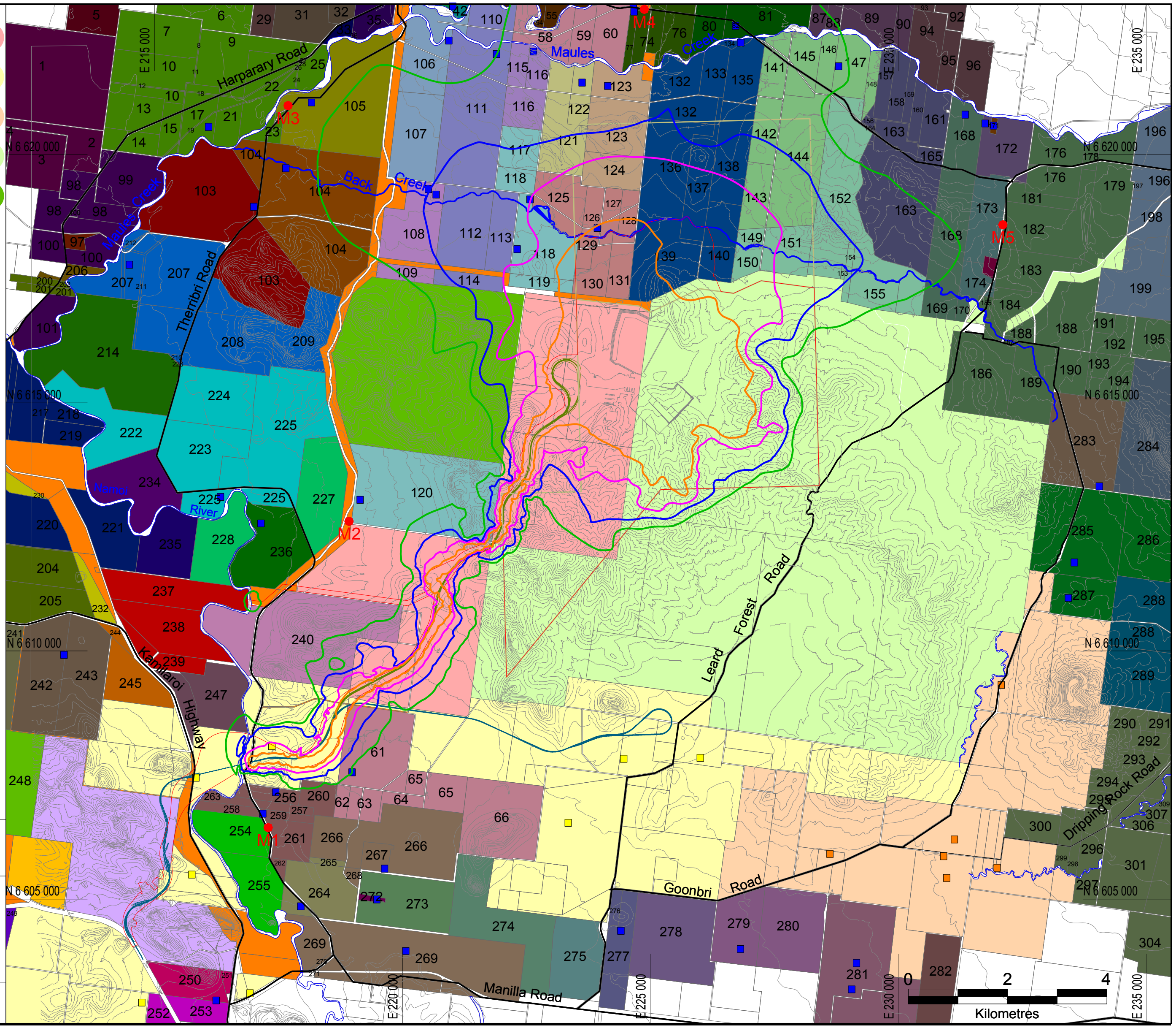


Maules Creek Project

Figure A1

17 May 2011

Aston Coal 2 Pty Ltd
Boggabri Coal Pty Ltd
Whitehaven Coal Mining Limited
Leard State Forest
Leard State Conservation Area



30 dBA
35 dBA
40 dBA
45 dBA
Private Residence
Noise Monitoring Location
Lease Boundary
EA Boundary

Year 1
Atmosphere Prevailing

Time Period Day

Scenario Normal Operation

Maules Creek Project

Figure A2

17 May 2011

Aston Coal 2 Pty Ltd

Boggabri Coal Pty Ltd

Whitehaven Coal Mining Limited

Leard State Forest

Leard State Conservation Area

N

30 dBA
35 dBA
40 dBA
45 dBA
Private Residence
Noise Monitoring Location
Lease Boundary
EA Boundary

Year 1

Atmosphere Prevailing

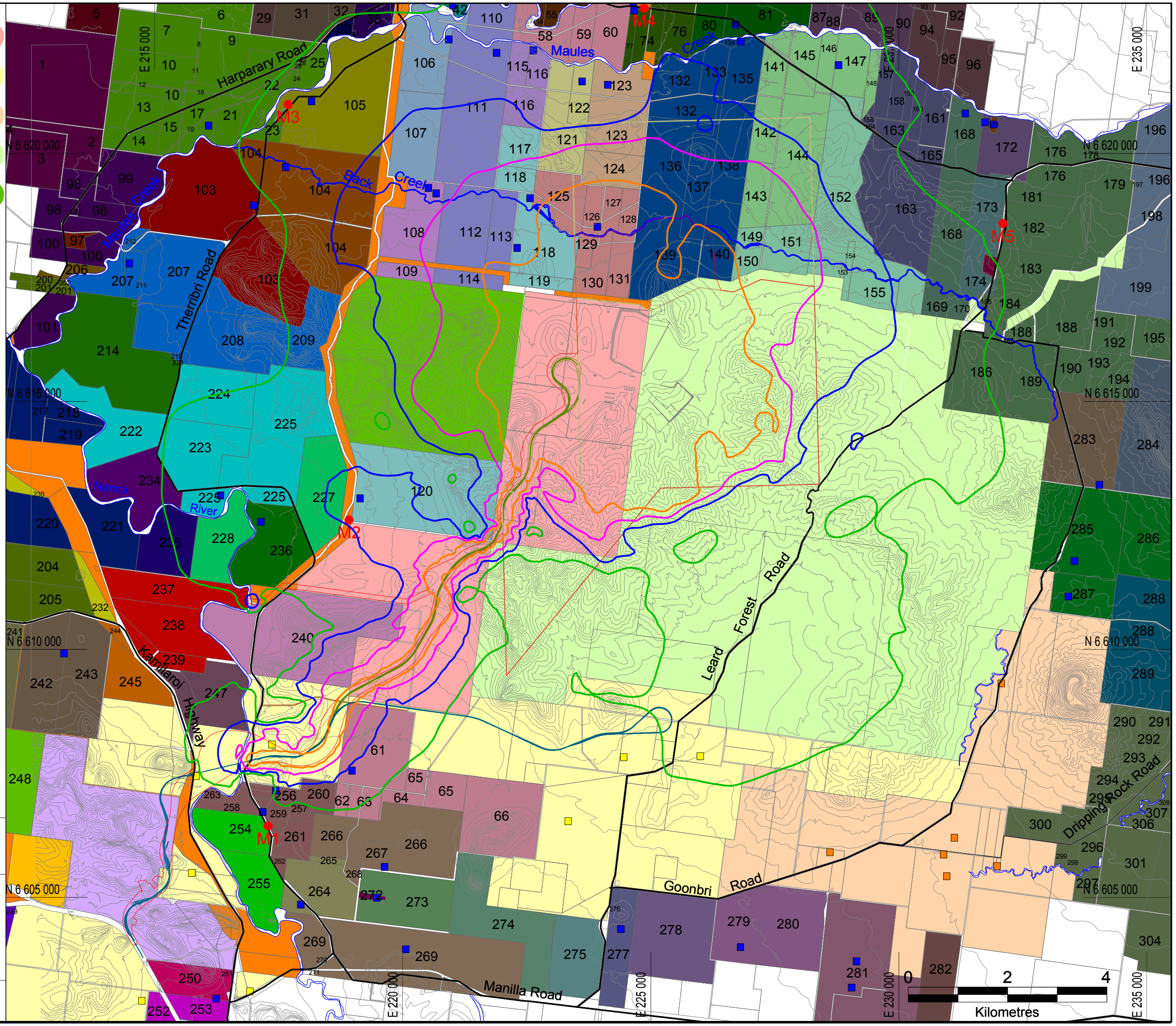
Time Period Evening / night

Scenario Normal Operation

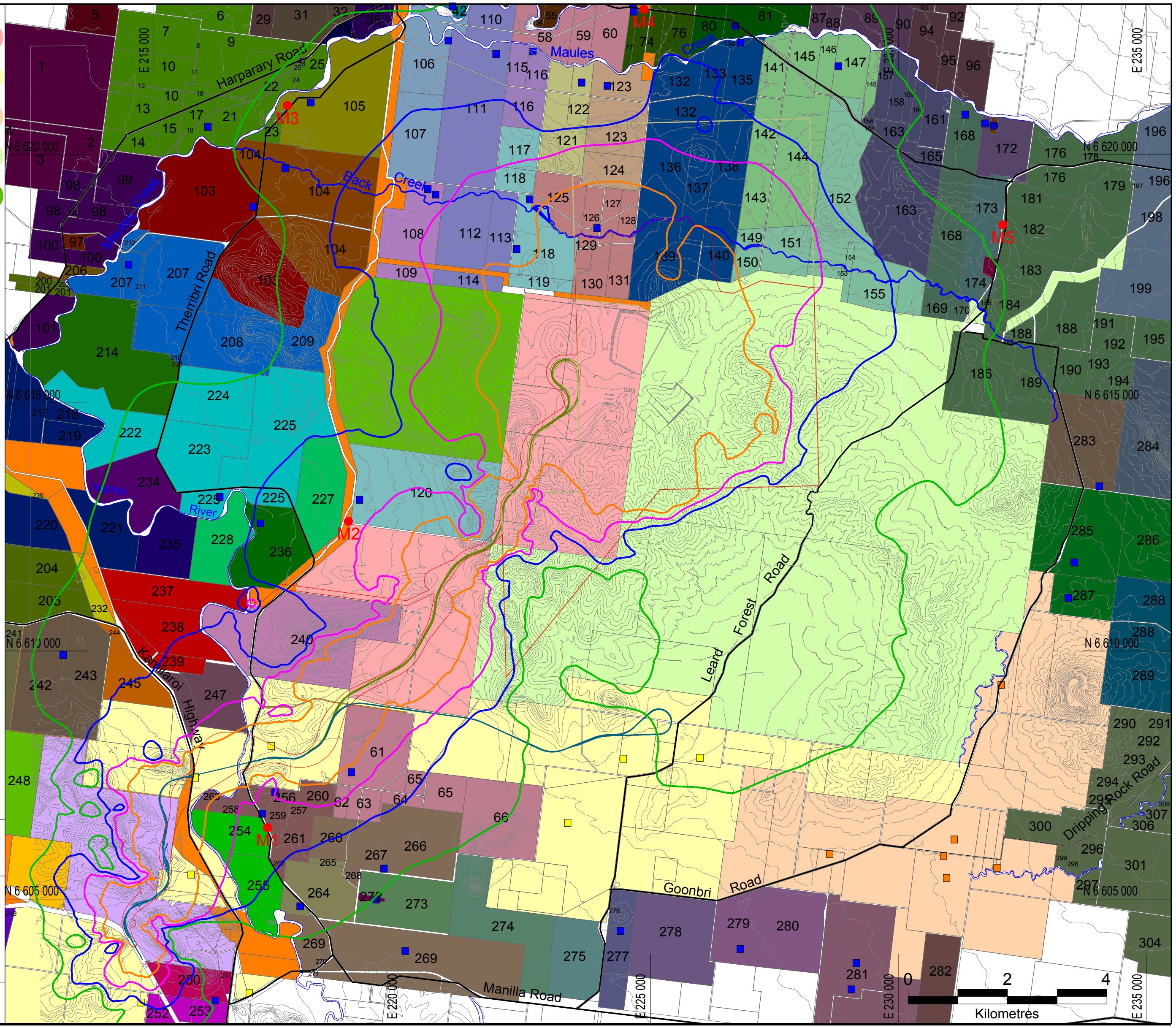
Maules Creek Project

Figure A3

17 May 2011



Aston Coal 2 Pty Ltd
Boggabri Coal Pty Ltd
Whitehaven Coal Mining Limited
Leard State Forest
Leard State Conservation Area



N

30 dBA
35 dBA
40 dBA
45 dBA
Private Residence
Noise Monitoring Location
Lease Boundary
EA Boundary

Year 1
Atmosphere Prevailing

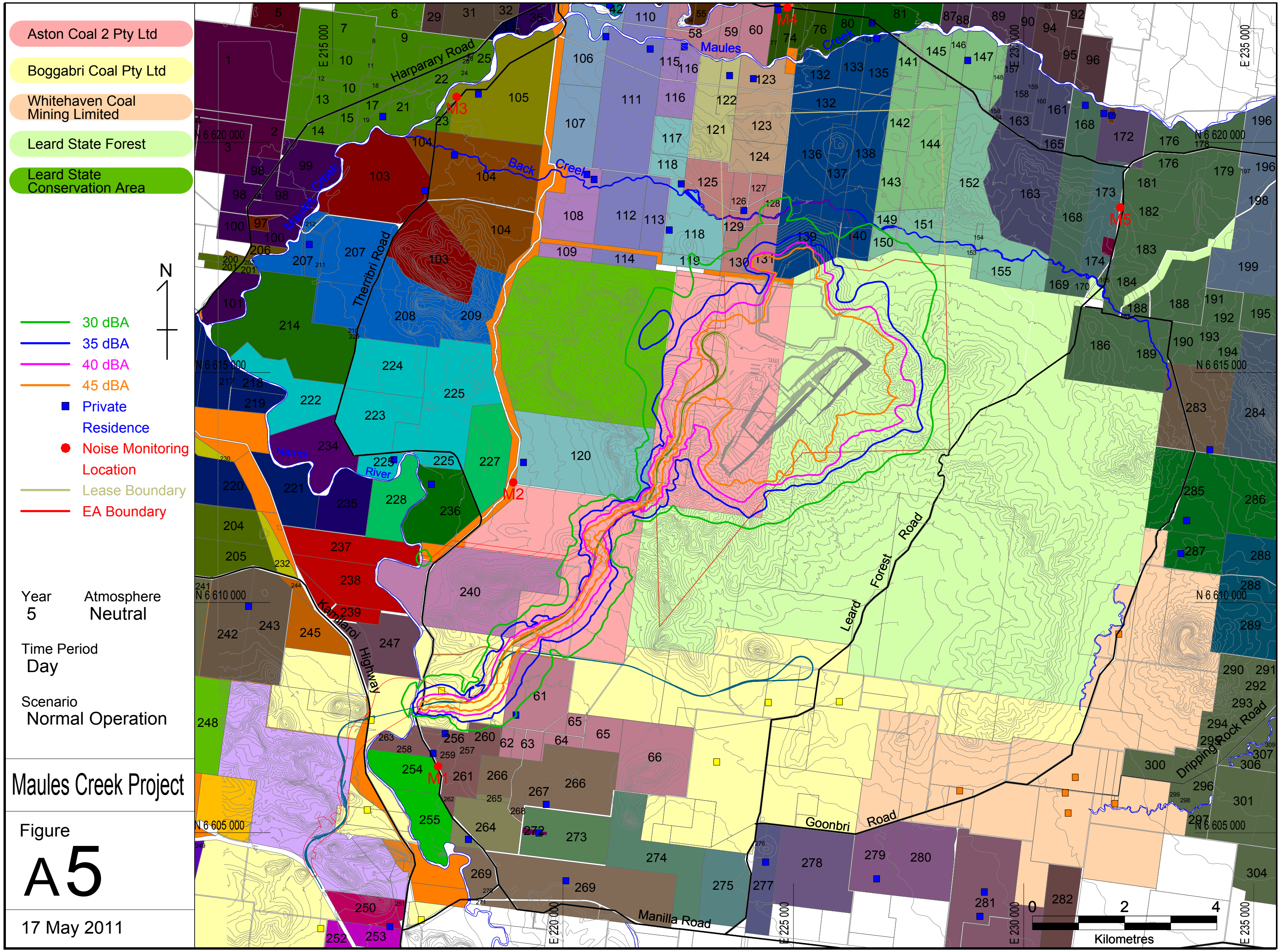
Time Period
Evening / Night

Scenario
Normal Operation Including Rail Spur

Maules Creek Project

Figure A4

6 June 2011



Maules Creek Project

Figure A5

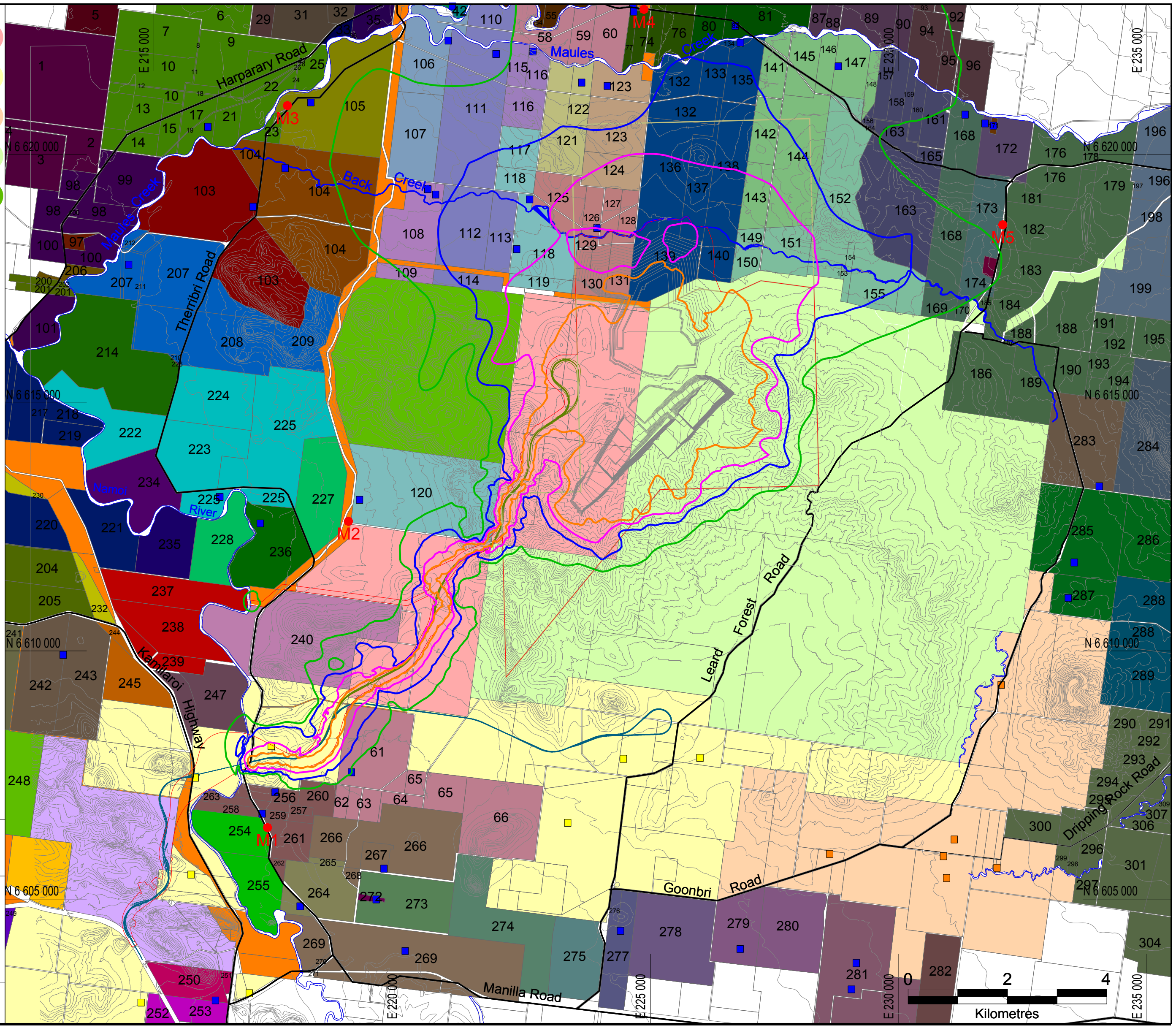
17 May 2011

Aston Coal 2 Pty Ltd
Boggabri Coal Pty Ltd
Whitehaven Coal Mining Limited
Leard State Forest
Leard State Conservation Area

N

30 dBA
35 dBA
40 dBA
45 dBA
Private Residence
Noise Monitoring Location
Lease Boundary
EA Boundary

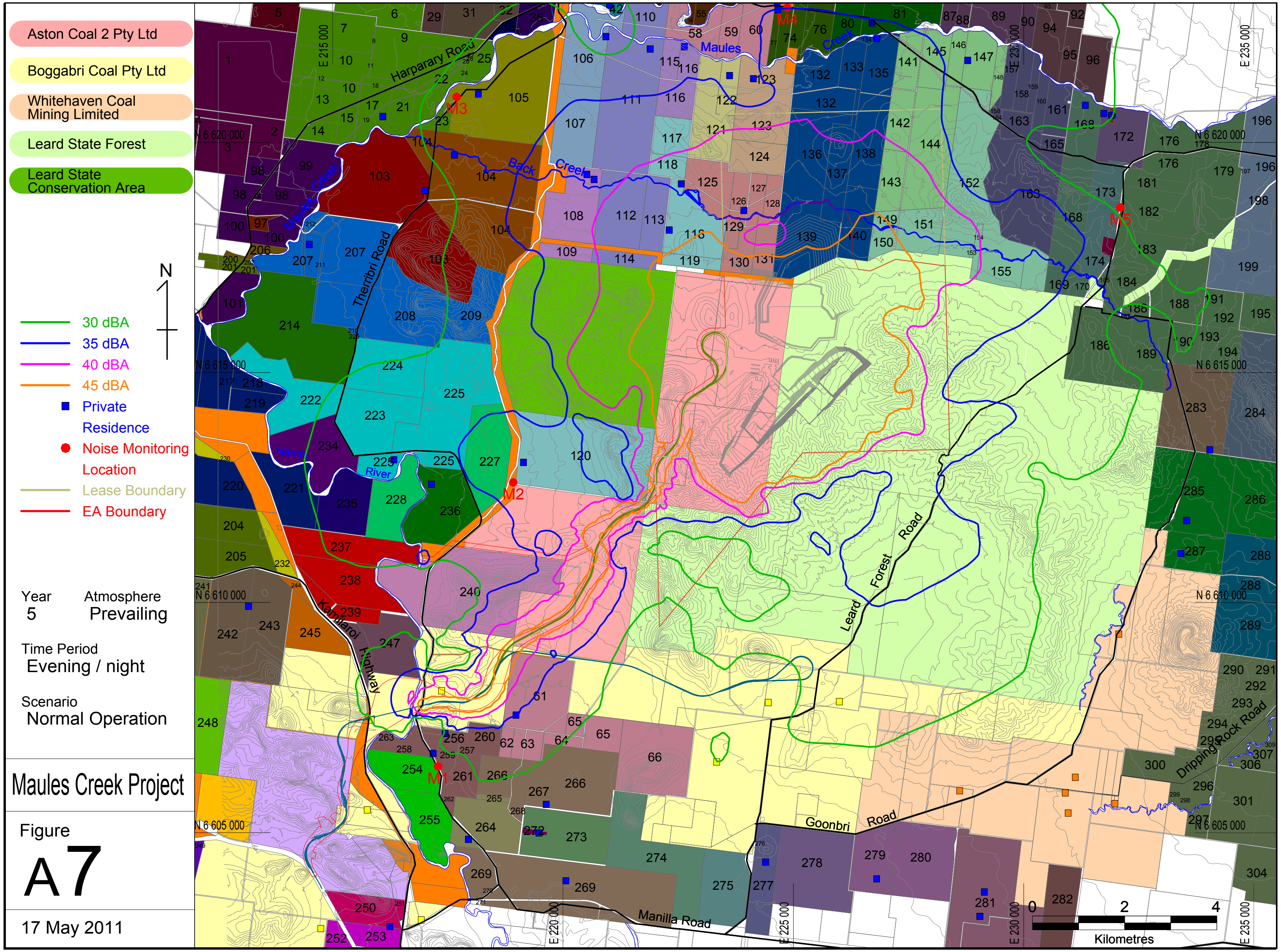
Year 5
Atmosphere Prevailing
Time Period Day
Scenario Normal Operation

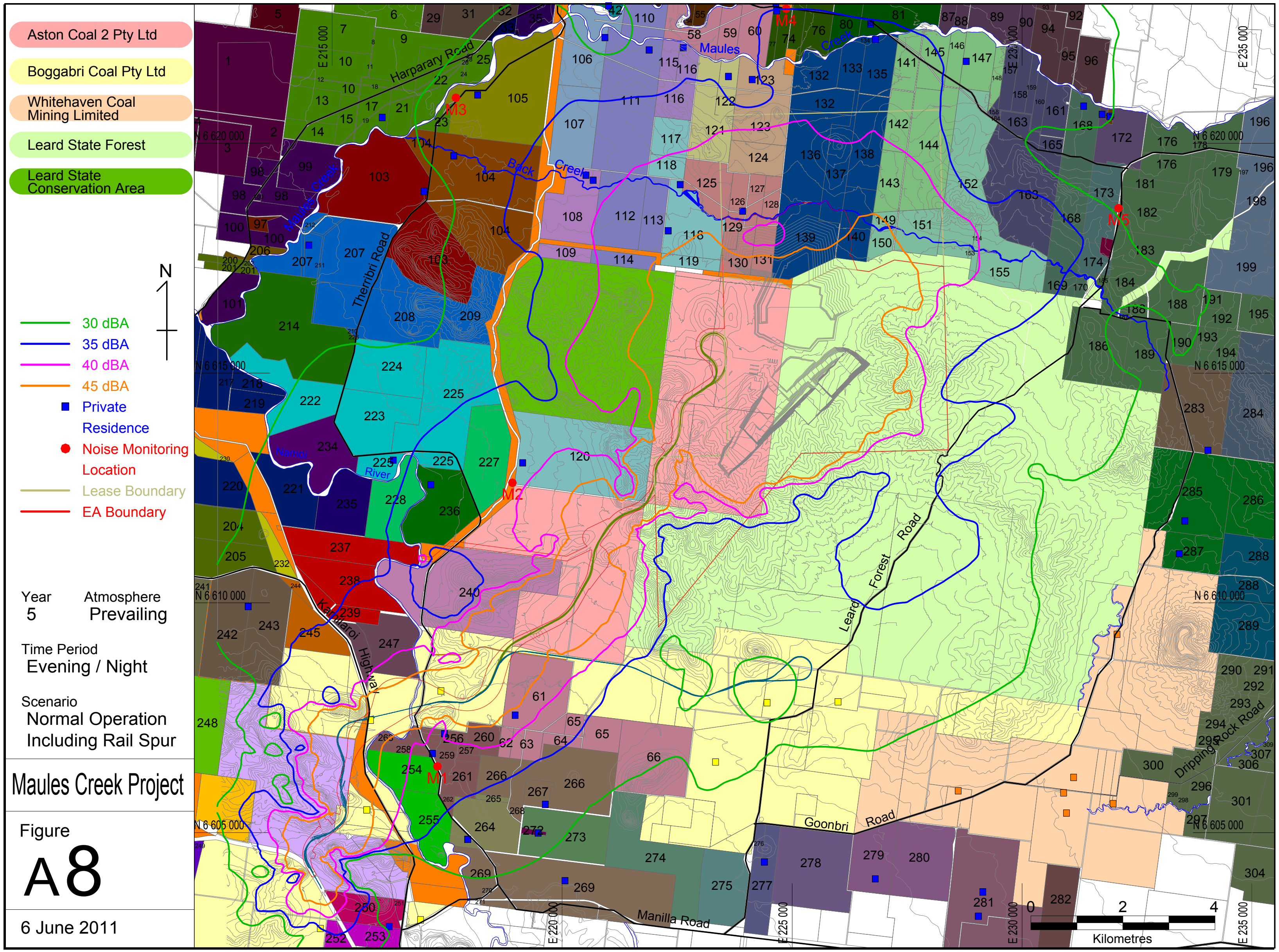


Maules Creek Project

Figure
A6

17 May 2011

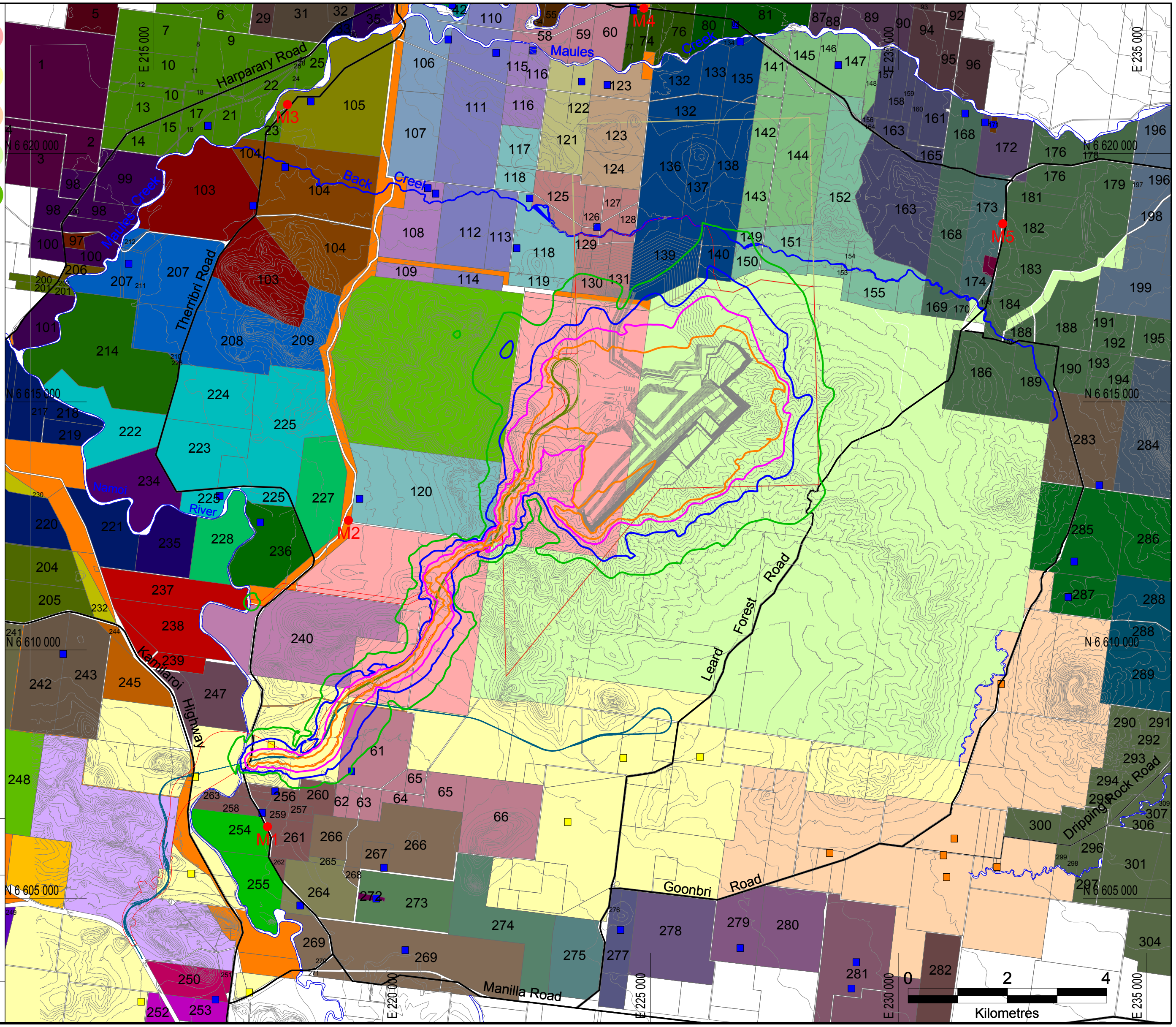

Aston Coal 2 Pty Ltd
Boggabri Coal Pty Ltd
Whitehaven Coal Mining Limited
Leard State Forest
Leard State Conservation Area
N
30 dBA
35 dBA
40 dBA
45 dBA
Private Residence
Noise Monitoring Location
Lease Boundary
EA Boundary
Year
5
Atmosphere
Prevailing
Time Period
Evening / night
Scenario
Normal Operation
Maules Creek Project
Figure
A7
17 May 2011
Harparary Road
Therribri Road
Maules Creek
Back Creek
Namoi River
Kamilaroi Highway
Leard Forest Road
Goonbri Road
Manilla Road
Dripping Rock Road
M1
M2
M3
M4
M5
E 215 000
E 220 000
E 225 000
E 230 000
E 235 000
N 6 605 000
N 6 610 000
N 6 615 000
N 6 620 000
0
2
4
Kilometres



Maules Creek Project

Figure A8

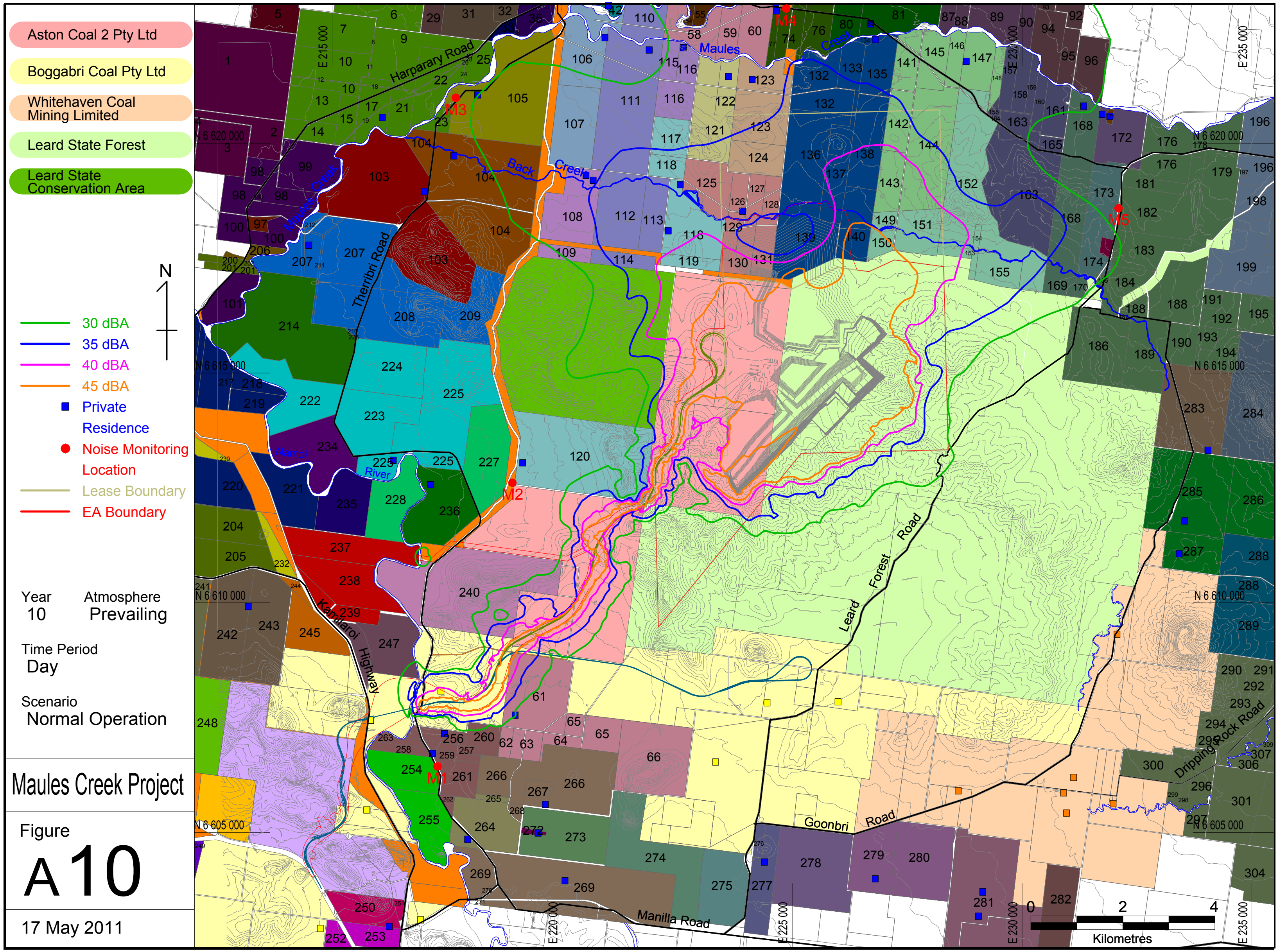
6 June 2011



Maules Creek Project

Figure A9

17 May 2011


Aston Coal 2 Pty Ltd
Boggabri Coal Pty Ltd
Whitehaven Coal Mining Limited
Leard State Forest
Leard State Conservation Area
N
30 dBA
35 dBA
40 dBA
45 dBA
Private Residence
Noise Monitoring Location
Lease Boundary
EA Boundary
Year
10
Atmosphere
Prevailing
Time Period
Day
Scenario
Normal Operation
Maules Creek Project
Figure
A10
17 May 2011
Harparary Road
Therribri Road
Back Creek
Maules Creek
Namoi River
Kamilaroi Highway
Leard Forest Road
Goonbri Road
Manilla Road
Dripping Rock Road
M1
M2
M3
M4
M5
N 6 620 000
N 6 615 000
N 6 610 000
N 6 605 000
E 215 000
E 220 000
E 225 000
E 230 000
E 235 000
0
2
4
Kilometres