Chapter 24

Noise and Vibration

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24. NOISE AND VIBRATION

24.1 Introduction

This chapter provides a description of existing noise and vibration conditions in the project area and identifies any likely change following commencement of mining. The noise and vibration levels at sensitive receptors are modelled and compared to noise and vibration limits developed for the project.

Information in this chapter is based on the report 'Noise and Vibration Assessment', provided in **Appendix 24**.

24.2 Baseline Conditions

24.2.1 Overview

The project is situated in a relatively flat, well established grazing and mining region comprising open farmlands and native scrublands.

There are several existing coal mines within 15 km of the project boundary, including:

- Newlands Mine ML4748 (immediately adjacent to the project area), Newlands East ML4774, Northern Underground Mines ML10317, ML10322 and ML10362, Eastern Creek ML4754, Eastern Creek South ML4755 (all Xstrata Coal), all to the east of the project.
- Suttor Creek Mine ML4761 (Xstrata Coal), immediately adjacent to the south of the project (includes Suttor Creek and Wollombi Pits).

24.2.2 Climate

The project is situated between Moranbah and Collinsville. Both of these locations maintain a Bureau of Meteorology (BOM) weather monitoring station. Refer to **Appendix 24** for a summary of the main statistics collected at these sites. **Chapter 12** of the EIS describes the climate of the project area and region in additional detail.

24.2.3 Noise Sources

The regional warm wet season encourages crickets, cicadas and other wildlife, which contribute to ambient noise levels. During the dry winter season the ambient noise levels are lower since the cooler conditions and lack of water reduces insect activity. The greatest noise impact from mining usually occurs during the cool dry season as cooler conditions are more favourable to the propagation of noise at large distances (particularly at night) and the cooler conditions also result in lower ambient noise levels. Daytime conditions throughout the year are always warm to hot since the area is subject to high solar loads. The environmental noise levels from mines are often lower during the day than at night since daytime has less favourable propagation characteristics than night.

Sources of noise from the surrounding environment primarily comprise:

- farming and grazing activities
- residential activity noise
- existing mining
- existing commercial activities

- road-based traffic
- existing rail.

24.2.4 Existing Noise Environment

A survey of the existing noise levels was undertaken at the four locations identified below during July and August 2011 (see **Figure 24-1**):

- R4 Wollombi Station Homestead is the closest off lease dwelling, situated to the west of the workings in the south of the project area. However it is not considered a sensitive receptor as the dwelling will not be occupied for the duration of the project. As such this location is included for comparative purposes as part of this assessment;
- R5 - Cerito Station Homestead was selected as the closest sensitive receptor situated to the east of the lease between the northern and southern works.
- R6 - Byerwen Station homestead was selected due to proximity to the northern operations and it is also situated to the east of the site.
- Subject site (near R1) (close to the southern MIA) was selected to determine the lowest noise levels in the surrounding area, essentially free of household, traffic and mining noise. It is a noise level representative of rural areas.

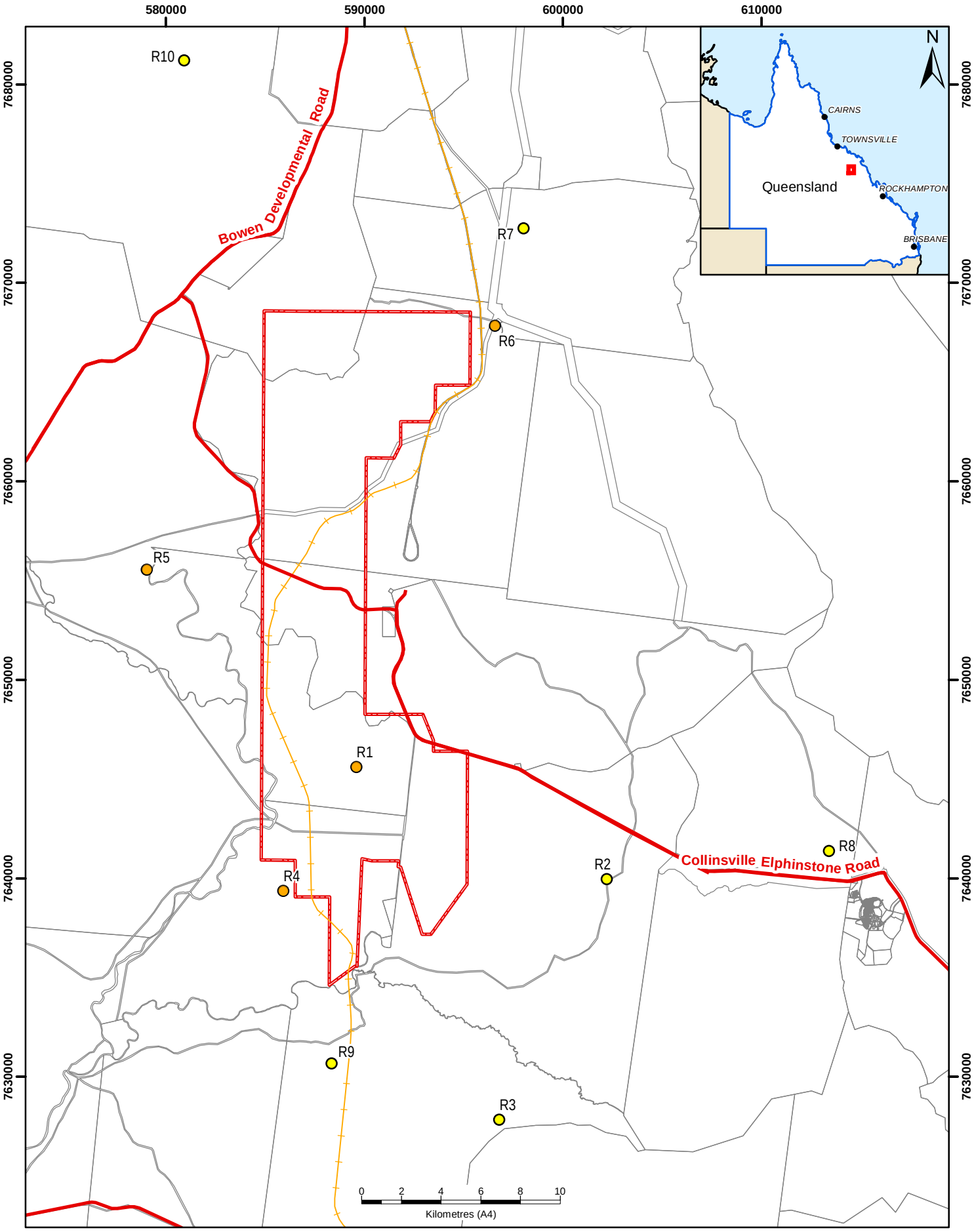
Existing noise levels were obtained in compliance with the Queensland Government Noise Measurement Manual 2000 and AS 1055: Acoustics—Description and Measurement of Environmental Noise. The Rating Background Level (RBL) for survey locations is shown in **Table 24-1**. RBL is the median of the Assessment Background Levels (ABL) which were measured during the site surveys. Detailed information on the noise survey terminology, methodology and all recorded ABL results is included in **Appendix 24**. A glossary of noise related terms is included in **Appendix 5** of the EIS.

Table 24-1 Rating Background Levels for Measured Existing Noise Levels [dB(A)]

RBL / median	Background noise level $L_{A90(10\ minute)}$			Noise level $L_{Aeq\ (10\ minute)}$				Noise level $L_{A10(10\ minute)}$		
	Day	Evening	Night	24 hour	Day	Evening	Night	Day	Evening	Night
R4-Wollombi	27.8	28.6	24.4	39.6	42.0	37.3	32.5	42.3	38.8	34.5
R5-Cerito	30.9	21.5	18.9	44.5	47.8	36.6	25.0	48.9	36.1	23.8
R6-Byerwen	18.0	17.6	16.7	31.6	33.1	31.5	21.9	34.4	33.4	22.5
Subject site (near R1)	25.5	26.0	26.7	32.0	33.6	28.4	29.4	34.4	28.8	30.7

Results were recorded with calibrated noise logger at ten minute intervals. The results were verified and confirmed as a representative dataset through series of attended measurements which were obtained during the day, evening and night at all four monitoring sites. Attended measurements were taken between 14 and 16 September 2011, (see **Appendix 24**).

At many of the noise monitoring locations there is bird noise at dawn and dusk and insect noise at night. This noise has a repeating diurnal cycle which was evident in the background noise levels recorded at most of the noise monitoring sites. The RBL, obtained during dry period of the year, is considered to be representative of the quieter periods of the year. It is noted that the noise levels measured at R6 were extremely low and demonstrate a relative absence of significant noise producing activities.



Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors/Survey Locations
- Potentially Sensitive Receptors
- GAP Rail Line
- Main Road

Survey Locations and Potentially Sensitive Receptors Locations		QCOAL GROUP
Figure 24-1	**Byerwen Coal Project**	elp environmental and licensing professionals pty ltd
Date: *5/02/2013*	**Author:** Shahram.Nasiri	
	Map Scale: 1:250,000	
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55	
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24.3 Sensitive Receptors

The potentially sensitive locations in the vicinity of the project comprise the homesteads of grazing properties and Glenden township, (see **Figure 24-1).** The locations and separation distances to the project area boundary, project footprint and train loading facilities (TLF) are contained in **Table 24-2**. Several sensitive receptors are not occupied for the duration of the project. These sites have been identified for completeness but will not be considered in the assessment stages of this report. As described in **Chapter 3**, the scope of this EIS does not include worker accommodation within the project area.

Table 24-2 Sensitive Receptors Adjacent to MLA Tenement and Railway Corridor

Sensitive receptor	Considered as a receptor	Separation distance [km] and direction to sensitive receptor			
		Receptor ID	Project area	Project footprint	TLFs
Glenden Township	Yes	-	19.4 km E	20.0 km E	25.7 km NE
Suttor North Station Homestead (property will be unoccupied for the duration of the project)	No	R1	(on lease)	-	-
Suttor Creek Station Homestead	Yes	R2	6.8 km E	7.3 km NW	14.2 km NW
Lancewood Station Homestead	Yes	R3	9.7 km SE	13.3 km NW	19.5 km NW
Wollombi Homestead (property will be unoccupied for the duration of the project)	No	R4	0.5 km E	0.6 km E	1.4 km E
Cerito Station Homestead (occasional occupancy)	Yes	R5	5.8 km W	7.0 km SE	12.7 km SE
Byerwen Station Homestead	Yes	R6	1.5 km E	7.9 km SW	5.5 km SW
Weetalaba Station Homestead	Yes	R7	4.9 km NE	12.4 km SW	10.7 km SW
Glenden Station Homestead	Yes	R8	18.2 km E	18.5 km E	24.0 km NE
Talwood Station Homestead (Identified as two sheds)	No	R9	3.7 km N	8.3 km N	14.6 km N
Fig Tree Station Homestead	Yes	R10	13.2 km SE	17.2 km SE	20.8 km SE

Noise sensitive ecological receptors are described in **Chapter 18**.

24.4 Noise and Vibration Criteria

The noise and vibration criteria developed in this section apply equally to construction, decommissioning as well as the operational phase of the mine. The study has focussed on operational phase rather than construction or decommissioning phases, since the operational phase has the potential to be significantly noisier than either the construction or decommissioning phases.

The following legislation, policy and guidelines were of key consideration in the establishment of acoustic quality objectives and the control of background creep:

- *Environmental Protection Act 1994 (EP Act)*
- *Environmental Protection (Noise) Policy 2008 (EPP (Noise)) 2008*
- DERM (now EHP) Ecoaccess Guideline "Planning for Noise Control" (EPA, 2004)
- Ecoaccess Guideline "Noise and Vibration from Blasting" (EPA, 2006)
- Ecoaccess Guideline "Assessment of Low Frequency Noise"
- British Standard 7385:Part 2-1993 *Evaluation and Measurement for Vibration in Buildings*
- The German Standard DIN 4150.3-1999 Structural Vibration – Part 3: *Effects of vibration on structures*
- The World Health Organisation *Night Noise Guidelines for Europe* (2009).

A summary is provided below of the noise and vibration objectives for the project. Details on the process of how these have been determined are included in **Appendix 24**.

24.4.1 Acoustic Quality Objectives

The EPP (Noise) identifies acoustic quality objectives as - maintenance of noise levels at or below those that are conducive to human health and wellbeing, enabling individuals to sleep, study, learn, relax, converse and partake in recreation activities. The indoor night-time objectives effectively address sleep disturbance and sleep awakenings, while during the day it protects conversation. The EPP (Noise) also includes acoustic quality objectives for ecological critical habitats.

The noise level objectives are based on the acoustic quality objectives expressed as outdoor noise level objectives, at 4 m from residences. It is conservatively assumed that the residences have their windows open and the reduction through the building facade is 5 dB.

The noise objectives for the project are provided in **Table 24-3**.

Table 24-3 Summary of Noise Acoustic Objectives

Location	Time period	Acoustic quality objectives dB(A)		
		$L_{Aeq, adj, 1 hr}$	$L_{A10, adj, 1 hr}$	$L_{A1, adj, 1 hr}$
All residential receptors	Day (7am to 6pm)	40	45	50
	Evening (6pm to 10pm)	40	45	50
	Night (10pm to 7am)	35	40	45

24.4.2 Controlling Background Creep

The background creep (i.e. noise levels that slowly increase with each successive development introduced into an area) controlling objective seeks to prevent deterioration of the acoustic

environment through limiting both continuous and variable noise sources including sources that are individual or collective in nature.

DERM (now DEHP) Ecoaccess Guideline "Planning for Noise Control" (EPA, 2004) provides methods and procedures that are applicable for setting conditions relating to noise emitted from industrial premises, commercial premises and mining operations, and are intended for planning purposes.

To prevent background creep over time, Recommended Outdoor Background Noise Planning Levels ($minL_{A90,1hour}$) for 'Very Rural' receiver areas have been used as the basis for setting the maximum planning noise objective levels. The Recommended Outdoor Background Noise Planning Levels were moderated using the guideline Recommended Noise Emission Planning Levels for Developments ($minL_{A90,1hour}$) guidelines table where the RBL values are higher or lower than the Outdoor Background Noise Planning Levels.

The resulting Maximum Planning Background Noise Levels are shown in **Table 24-4** (see **Appendix 24** for a detailed methodology description).

Table 24-4 Planning Background Noise Levels

Location	Rating Background Noise Level [dB(A)]			Maximum Planning Level L_{A90}		
	Day	Evening	Night	Day	Evening	Night
R4-Wollombi	28	29	24	33	25[#1]	25[#1]
R5-Cerito	31	22	19	**33**	**27**	**25[#1]**
R6-Byerwen	18	18	17	**25[#1]**	**25[#1]**	**25[#1]**
Subject Site (near R1)	25	26	26	30	28	25[#1]

#1: The background L_{A90} noise level of 25 dB(A) has been adopted for locations with RBL noise levels below 25 dB(A).

The noise level objectives have been calculated and are equal to $L_{Aeq,adj,T} = L_{A90,T} + 3$ dB(A). The $L_{A90,T}$ is the Maximum Planning background noise level calculated in **Table 24-4.**

The noise levels measured at R5 Cerito Station Homestead are considered acceptable for that site. The noise levels measured at R6 Byerwen Homestead are considered to be representative of the quietest noise levels likely in the study area. As a highly conservative measure, the noise level goals developed for R6 have been applied at all locations, including Glenden township. Adoption of these goals provides the lowest noise level goals possible under the approach described in the EcoAccess guideline.

Table 24-5 Summary of Noise Level Objectives to Avoid Background Creep

Location	Modelled noise objectives to avoid background creep LAeq, adj, 1 hr [dB(A)]		
	Daytime	Evening	Night
R-5 Cerito Station Homestead	36	30	28
R-6 Byerwen Station Homestead and all other sensitive receptors	28	28	28

It is noted that the noise level objectives to avoid background creep (**Table 24-5**) are lower than the acoustic quality objectives in **Table 24-3** during all time periods. This indicates the existing noise levels are relatively low and generally unaffected by industrial or traffic noise.

24.4.3 Low Frequency Noise

Ecoaccess Guideline “Assessment of Low Frequency Noise” identifies a number of industrial sources and processes having high noise levels and frequency content less than 200 Hz.

Where a noise emission occurs exhibiting an unbalanced frequency spectra, the overall sound pressure level inside residences should not exceed 50 dB(Linear) to avoid complaints of low frequency noise annoyance.

24.4.4 Blasting Criteria – Sensitive Receptors

Open-cut coal mining procedures often include drilling and blasting of overburden material to make removal of that material easier.

24.4.4.1 Environmental Protection Act 1994

Section 440ZB(c) of the *Environmental Protection Act 1994* states that:

"A person must not conduct blasting if the ground vibration is-

i. *for vibration of more than 35 Hz - not more than 25 millimetres per second ground vibration, peak particle velocity; or*
ii. *for vibration of not more than 35 Hz - not more than 10 millimetres per second ground vibration, peak particle velocity."*

24.4.4.2 Ecoaccess Guideline "Noise and Vibration from Blasting"

The Ecoaccess Guideline "Noise and Vibration from Blasting" indicates that blasting should be limited to the hours of 09:00 to 15:00, Monday to Friday, and from 09:00 to 13:00 on Saturdays. Blasting should not generally take place on Sundays or public holidays.

Blasting outside these recommended times should be approved only where:

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

Blasting activities must be carried out in such a manner that if blasting noise should propagate to a noise-sensitive place, then:

a) the airblast overpressure must be not more than 115 dB(linear) peak for 9 out of any 10 consecutive blasts initiated, regardless of the interval between blasts; and
b) the airblast overpressure must not exceed 120 dB(linear) peak for any blast.

Blasting operations must be carried out in such a manner that if ground vibration should propagate to a vibration-sensitive place:

a) the ground-borne vibration must not exceed a peak particle velocity of 5 mm per second for nine out of any 10 consecutive blasts initiated, regardless of the interval between blasts; and
b) the ground-borne vibration must not exceed a peak particle velocity of 10 mm per second for any blast.

24.4.5 Blasting Criteria – Buildings and Infrastructure

Most commonly specified “safe” structural vibration levels are designed to minimise the risk of threshold or cosmetic surface cracks, and are set well below the levels that have the potential to cause

damage to the main structure. Examples of threshold or cosmetic cracking include minor non-structural effects such as superficial cracking in cement render or plaster.

Reinforced and heavy framed commercial structures and less likely to be the subject of cosmetic damage from vibration and as a consequence have higher vibration limits than unreinforced or light frames buildings. Thus the goals presented in this section are for the light-frames dwellings typical of central Queensland.

24.4.5.1 BS 7385:Part 2-1993 Vibration in Buildings

British Standard (BS) 7385: Part 2-1993 Evaluation and Measurement for Vibration in Buildings provides limits to avoid the likelihood of cosmetic building damage from ground vibration. Sources of vibration addressed by the standard include blasting carried out during mineral extraction or construction excavation.

The guide values for transient vibration judged to give minimal risk of cosmetic damage to residential buildings are 3.7 mm/s at 1 Hz, rising to 15 mm/s at a frequency of 4 Hz, increasing to 20 mm/s at a frequency of 15 Hz, then to 50 mm/s at a frequency of 40 Hz and above, (see **Appendix 24**).

Typically the dominant frequencies associated with blasting are between 5 Hz and 30 Hz. Thus the vibration limits are effectively between about 15 mm/s and almost 40 mm/s peak particle velocity (PPV).

24.4.5.2 DIN 4150.3 - Buried Pipework and Telecommunication Cables

The German Standard, DIN 4150.3-1999 Structural Vibration – Part 3: Effects of vibration on structures, provides guideline values to avoid damage to underground pipe work. The limits for buried pipe work are provided in **Table 24-6**.

Table 24-6 Vibration Limits for Buried Pipework from DIN 4150.3-1999

Pipe material	Peak Wall Vibration Velocity (mm/s)	
	Short Term	Long Term
Steel (including welded pipes)	100	50
Clay, concrete, reinforced concrete, pre-stressed concrete, metal with or without flange (other than steel)	80	40
Masonry, Plastic	50	25

24.4.6 Railway Noise Objectives

Queensland Rail (QR) (now Aurizon) sets noise level limits from railways in Queensland. The planning levels for a railway, assessed 1 m in front of the most exposed part of an affected noise sensitive place are:

a) 65 dB(A), assessed as the 24 hour average equivalent continuous A-weighted sound pressure level; and
b) 87 dB(A), assessed as a single event maximum sound pressure level.

Typically the planning objectives for coal train operations are met close to the railway (i.e. at distances up to approximately 50 m).

It is beyond the scope of this EIS to assess the noise from the operation of trains along the GAP rail line. The study will focus on the balloon loop and railway spur for the south and north TLFs that connect to the GAP rail line.

Both the $L_{Aeq\ 24\ hour}$ noise level and the single event maximum sound pressure level of 87 dB(A) have been adopted as the objectives for railway noise level. This is generally met within 100 m of the railway and the closest receptor is located approximately 2 km from the railway.

24.4.7 Road Traffic Noise Objectives

The Department of Transport and Main Roads (DTMR) sets noise level limits from road traffic on public roads in Queensland. Typically the planning objectives for roads are met close (approximately 30 m) to the road. There are no noise sensitive receptors close to the Collinsville-Elphinstone Road between Glenden and the project site or any local roads which may be used for the project.

There are no criteria in Queensland to assess the impact of noise from a road traffic-generating development. However an increase of 3dB(A) over a short period of time is considered to be a significant increase in traffic noise and an increase which justifies consideration of noise control.

A 3 decibel or more increase in the $L_{Aeq\ 24\ hour}$ noise levels over existing noise levels has been adopted as a measure of a significant change in the road traffic noise levels.

24.4.8 WHO Night Noise Goal

The World Health Organisation (WHO) Night Noise Guidelines for Europe (2009) have been developed as an extension of the WHO Guidelines for Community Noise (1999). The WHO European Night Noise Level Goal is an annual average night L_{Aeq} of 40 dB(A) and called the $L_{night,outside}$. The limit developed for the standard does not readily translate to Queensland conditions since the assumed reduction of noise though the building envelope is based on European buildings and climate, rather than that experienced in Queensland. However, to account for the differences in building type in Queensland a goal of 30 dB(A) to 35 dB(A) $L_{night,outside}$ would be appropriate.

24.5 Noise Modelling

24.5.1 Modelling Methodology

A detailed description of the noise modelling methodology is included in **Appendix 24**.

In summary, a digital terrain noise model of the site and surroundings has been developed using PEN3D software which incorporates a 3D terrain model allowing accurate representation of the ground, ground cover, tree zones, mounds, barriers and weather conditions. The model is corrected for meteorology conditions. Thus, at night or during downwind predictions, the PEN calculations are likely to result in conservatively high results (i.e. the modelled noise levels are likely to be higher than the measured levels).

24.5.2 Meteorology/Climate

The meteorology for the project was modelled as part of the Air Quality Assessment (see **Chapter 22,** and **Appendix 23**). A single year, 2004, was extracted from that meteorological database.

The information provided model inputs for the following parameters:

- wind speed and wind direction
- variances in the temperature and the stability on wind speed and direction
- vertical temperature gradient ranges.

Two night-time cases were developed as follows:

- Case 1 modelled winds from the east, the most common night time meteorology.

- Case 2 modelled winds from the west, likely to lead to the highest noise levels in at homesteads to the west of the site.

The modelling has been carried out for each relevant sensitive receptor for every hour of the day and every day of the year, resulting in a total of almost 9,000 meteorological cases being modelled for every noise sensitive receptor.

24.5.3 Noise Model Parameters

24.5.3.1 Construction and Decommissioning Phases

The proposed construction (and decommissioning) plant and equipment comprise similar but typically smaller equipment than that which will be used during the operational phase.

Construction plant and equipment is expected to be quieter and used at lower activity levels than operational plant and equipment and the noise levels associated with the construction phase are anticipated to be significantly lower than the operational phase.

The assessment undertaken for the operational phase has therefore also been applied to the construction phase since it predicts higher noise levels than 'worst case' construction noise scenarios. Operational Phase.

Key noise generating equipment items are listed below. The numbers will vary with the project scheduling, however the model input assumes worst case parameters. The operational noise sources comprise:

- dragline
- shovel operation in the pit
- dozers
- rock drill
- blasting
- dump trucks (in-pit)
- CHPP
- various surface earth working machines.

The likely equipment noise levels are contained in **Table 24-7**. The noise levels are expressed as a sound power level and a sound pressure level at 100 m from a working machine. The octave band sound power levels are "linear" while the overall sound pressure levels are "A" weighted.

Table 24-7 Summary of Maximum Noise Levels From Mining Equipment

Item	Maximum Sound Power Levels (dB) in Octave Band Centre Frequency [Hz]								Overall dB(A)	Overall Sound Pressure Level at 100 m dB(A)
	63[#1]	125	250	500	1,000	2,000	4,000	8,000[#2]		
Dragline (Engine)	91	108	104	107	106	108	101	95	114	64
Dragline (Sheaves)	114	115	119	125	127	128	125	114	133	85
500T Excavation (EX5500)	115	107	115	110	108	105	103	94	120	66
350T Excavator (EX3600)	96	104	109	109	113	114	105	99	118	70
240T Haul Truck (CAT 789)	112	119	115	116	114	112	106	102	123	71
180T Haul Truck (Cat 777D)	109	108	112	119	113	117	105	101	123	73
Caterpillar D10T Tracked Dozer	86	101	98	99	116	103	99	92	117	68
Caterpillar D11T Tracked Dozer	89	104	101	102	121	106	102	95	121	73
Caterpillar 994 wheeled dozer	110	109	98	99	104	98	92	87	114	58
Caterpillar 16M Grader	106	108	110	102	104	101	99	93	114	61
100T off highway water truck	124	122	118	115	112	110	103	99	127	70
Rock Drill	113	117	112	116	115	114	116	115	124	74
CHPP	128	122	121	120	117	114	110	107	130	74
Rail load out	110	105	104	103	104	104	104	101	114	63
Product Coal Stacker	110	106	101	101	97	93	86	84	102	54

Note 1: All energy in the frequencies below 63 Hz is added to the 63 Hz octave band

Note 2: All energy in the frequencies above 8,000 Hz is added to the 8,000 Hz octave band

All the noise sources have been placed in exposed positions in the noise model. For instance, the overburden trucks have been placed on top of the waste rock emplacement. This is an elevated position and completely unscreened. This is a conservative approach to the modelling because in practice, an operational mine may choose to operate trucks at night in positions that are screened by stockpiles, and consequently significant noise reductions are likely. The purpose of this model is to highlight the likely worst-case noise levels.

To calculate the L_{Aeq} from the maximum sound power corrections were made to account for load and operational cycles which represent the difference between the absolute maximum noise level and the average noise levels of a single operating machine having various loads and operating conditions and (for mobile plant) moving around a site changing direction and orientation. The dump trucks in elevated and exposed locations are key noise source in all noise models.

Comparatively quiet or infrequently operated minor noise sources are excluded from the noise model. These noise sources will not make a noticeable difference in the calculated noise levels at sensitive receptors.

24.5.3.2 Blasting

PEN3D contains a blasting module that includes the effects of meteorology. This assessment is based on a charge weight of 500 kg. For a charge weight of 500 kg, the blast overpressure at 1000 m is 115 dB Lin peak and the peak vibration velocity at 1000 m is 4.6 mm/s.

24.5.3.3 Modelling Years

Three modelling cases are addressed representing Year 5, Year 17 and Year 36 to represent the local maxima in relation to overall waste rock production. They also represent the early phases of most of the pits when the activity in the pit is close to the surface and the out-of-pit landforms are being developed. These operations are expected to lead to higher environmental noise levels.

- **Year 5** is at the end of the ramp-up phase of the mine, when the projected waste rock is 142.2 million bank cubic meters (Mbcm).
- **Year 17** includes the open North Pit when the projected waste rock is 125.8 Mbcm.
- **Year 36** includes the opening of the eastern pits. The projected waste rock is 166.1 Mbcm.

All cases relate to the maximum rate of handling of waste rock for the respective mining phases. During the first 16 years of the mine life there is only one case where the total waste rock exceeds 142.2 Mbcm, with the typical mining rate being less than 120 Mbcm.

During the later phase of the mine, the peak waste rock is in the 27th year of the mine operation. In this year total waste production is 185 Mbcm, slightly higher than the year 35 case of 166.1 Mbcm. However, unlike the cases considered, much of the waste movement occurs at depth in the pit.

The detailed equipment lists and correction values for the mining phases are included in **Appendix 24**.

24.5.4 Noise Modelling Results

Full results tables are included in **Appendix 24**. The calculated noise levels for each sensitive receptor are presented for each modelled year in **Table 24-8** to **Table 24-10** below.

Typical adverse noise levels are contained in **Figure 24-2** to **Figure 24-7** based on adverse night modelling cases.

There are no modelled scenarios where noise levels at sensitive receptors exceed noise level objectives.

Table 24-8 Calculated Noise Levels [dB(A)] for each Sensitive Receptor Surrounding the Project - Mining Year 5

Location	Receptor	$L_{A01\ (1\ hour)}$ (Annual Maximum)			$L_{A10\ (1\ hour)}$ (Annual Maximum)			$L_{Aeq\ (1\ hour)}$ (Annual Maximum)			$L_{Aeq\ (1\ hour)}$ (Annual Average)		
		Day	Eve.	Night	Day	Eve.	Night	Day	Eve.	Night	Day	Eve	Night[#1]
Objectives for Acoustic Quality		**50**	**50**	**45**	**45**	**45**	**40**	**40**	**40**	**35**	**40**	**40**	**35**
Objectives for Background Creep Cerito Station Homestead		-	-	-	-	-	-	*36*	*30*	*28*	*36*	*30*	*28*
Objectives for Background Creep Byerwen and all other sensitive receptors		-	-	-	-	-	-	*28*	*28*	*28*	*28*	*28*	*28*
Glenden Township	-	18	13	15	18	13	15	16	15	13	0	0	0
Suttor Creek Station Homestead	R2	26	23	25	26	23	25	24	24	22	16	16	16
Lancewood Station Homestead	R3	21	19	20	21	19	20	18	17	17	12	13	13
Cerito Station Homestead	R5	30	29	29	30	29	29	28	27	27	21	23	23
Byerwen Station Homestead	R6	21	19	20	21	19	20	19	18	17	0	5	5
Weetalaba Station Homestead	R7	16	15	16	16	15	16	14	14	13	0	3	3
Glenden Station Homestead	R8	18	14	16	18	14	16	17	15	13	0	0	0
Fig Tree Station Homestead	R10	16	14	15	16	14	15	14	14	13	0	4	4

Note #1 The $L_{Aeq(Annual\ Average)}$ at night is equivalent to the WHO $L_{night,outside}$ with a goal of 30 to 35 dB(A).

Table 24-9 Calculated Noise Levels for each Sensitive Receptor Surrounding the Project - Mining Year 17

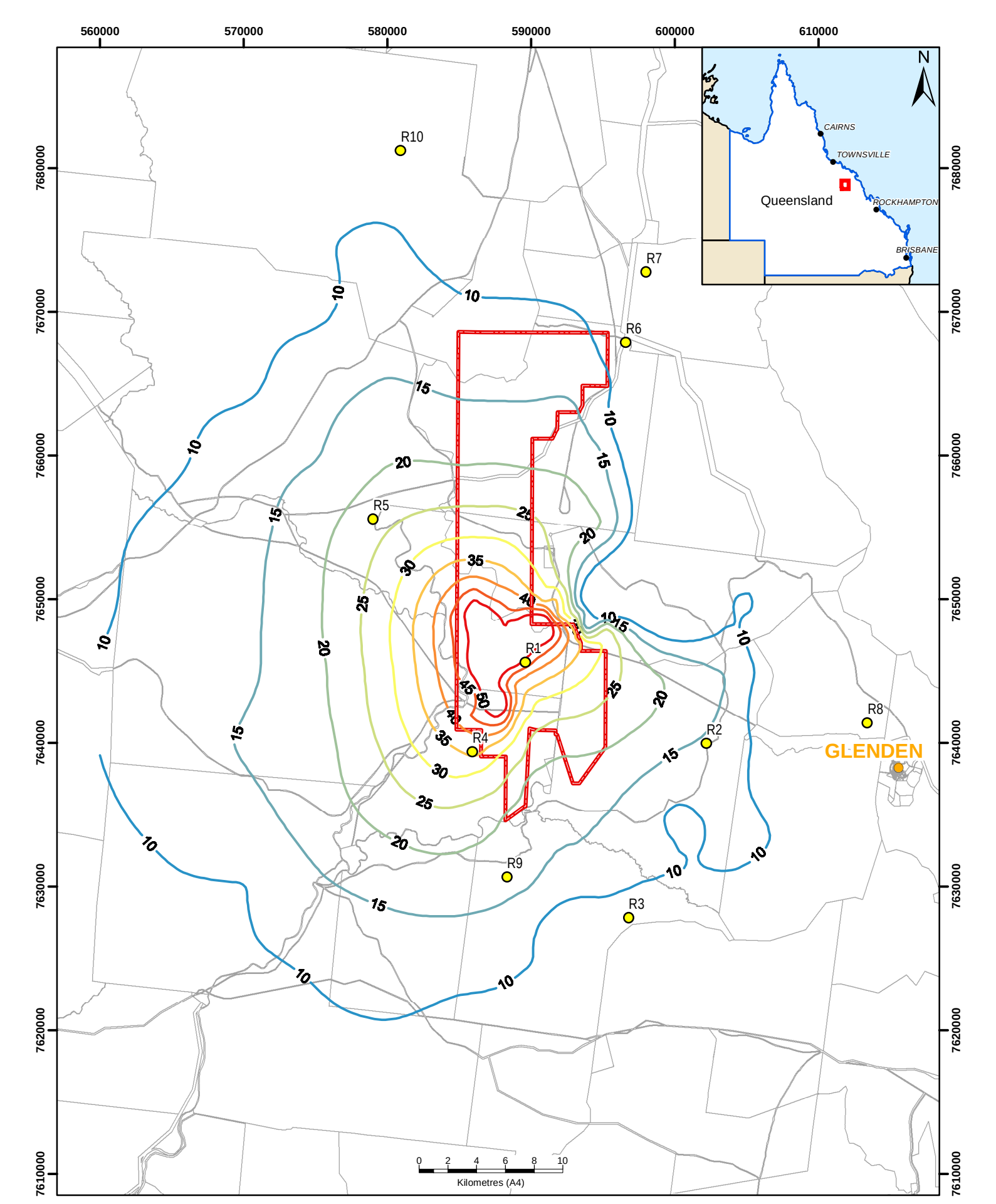
Location	Receptor	$L_{A01\ (1\ hour)}$ (Annual Maximum)			$L_{A10\ (1\ hour)}$ (Annual Maximum)			$L_{Aeq\ (1\ hour)}$ (Annual Maximum)			$L_{Aeq\ (1\ hour)}$ (Annual Average)		
		Day	Eve.	Night	Day	Eve.	Night	Day	Eve.	Night	Day	Eve	Night[#1]
Objectives for Acoustic Quality		**50**	**50**	**45**	**45**	**45**	**40**	**40**	**40**	**35**	**40**	**40**	**35**
Objectives for Background Creep Cerito Station Homestead		-	-	-	-	-	-	*36*	*30*	*28*	*36*	*30*	*28*
Objectives for Background Creep Byerwen and all other sensitive receptors		-	-	-	-	-	-	*28*	*28*	*28*	*28*	*28*	*28*
Glenden Township	-	17	12	14	17	12	14	15	14	12	1	1	0
Suttor Creek Station Homestead	R2	25	22	24	25	22	24	23	24	22	15	16	16
Lancewood Station Homestead	R3	20	19	19	20	19	19	17	17	17	12	14	13
Cerito Station Homestead	R5	29	28	29	29	28	29	26	26	26	21	24	23
Byerwen Station Homestead	R6	22	21	22	22	21	22	19	20	19	0	6	6
Weetalaba Station Homestead	R7	17	16	17	17	16	17	14	15	14	0	5	4
Glenden Station Homestead	R8	17	13	15	17	13	15	16	15	13	2	1	1
Fig Tree Station Homestead	R10	17	16	17	17	16	17	14	15	14	0	6	5

Note #1 The $L_{Aeq(Annual\ Average)}$ at night is equivalent to the WHO $L_{night,outside}$ with a goal of 30 to 35 dB(A).

Table 24-10 Calculated Noise Levels for each Sensitive Receptor Surrounding the Project - Mining Year 36

Location	Receptor	$L_{A01\ (1\ hour)}$ (Annual Maximum)			$L_{A10\ (1\ hour)}$ (Annual Maximum)			$L_{Aeq\ (1\ hour)}$ (Annual Maximum)			$L_{Aeq\ (1\ hour)}$ (Annual Average)		
		Day	Eve.	Night	Day	Eve.	Night	Day	Eve.	Night	Day	Eve	Night[#1]
Objectives for Acoustic Quality		**50**	**50**	**45**	**45**	**45**	**40**	**40**	**40**	**35**	**40**	**40**	**35**
Objectives for Background Creep Cerito Station Homestead		-	-	-	-	-	-	*36*	*30*	*28*	*36*	*30*	*28*
Objectives for Background Creep Byerwen and all other sensitive receptors		-	-	-	-	-	-	*28*	*28*	*28*	*28*	*28*	*28*
Glenden Township	-	19	15	18	19	15	18	18	18	15	5	4	3
Suttor Creek Station Homestead	R2	28	26	29	28	26	29	26	27	26	13	14	14
Lancewood Station Homestead	R3	21	19	21	21	19	21	18	18	18	13	14	14
Cerito Station Homestead	R5	29	28	29	29	28	29	27	27	26	20	23	23
Byerwen Station Homestead	R6	19	18	19	19	18	19	18	18	17	5	9	8
Weetalaba Station Homestead	R7	15	14	15	15	14	15	13	14	13	1	6	5
Glenden Station Homestead	R8	20	16	19	20	16	19	19	18	16	6	5	4
Fig Tree Station Homestead	R10	15	13	14	15	13	14	14	13	12	0	4	4

Note #1 The $L_{Aeq(Annual\ Average)}$ at night is equivalent to the WHO $L_{night,outside}$ with a goal of 30 to 35 dB(A).



Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors

Noise Level (LAeq)

10 15 20 25 30 35 40 45 50

LAeq Noise Level for Night with East Wind - Mining Year 05		QCOAL GROUP
Figure 24-2	**Byerwen Coal Project**	elp environmental and licensing professionals pty ltd
Date: *23/01/2013*	**Author:** samuel.ferguson	
	Map Scale: 1:330,000	
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55	
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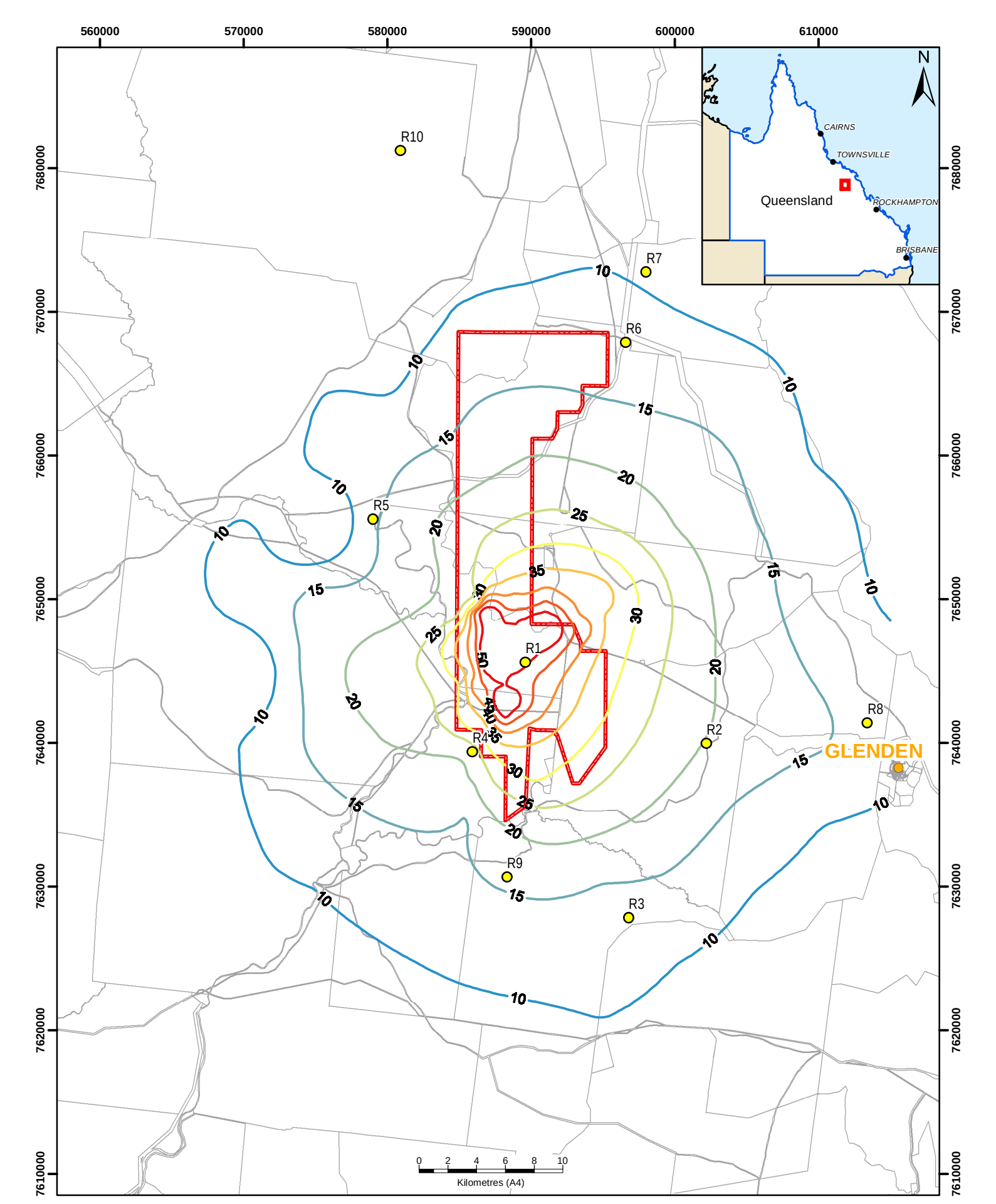

Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors

Noise Level (LAeq)

10 15 20 25 30 35 40 45 50

LAeq Noise Level for Night with West Wind - Mining Year 5	QCOAL GROUP
Figure 24-3	**Byerwen Coal Project**
Date: *24/01/2013*	**Author:** samuel.ferguson
	Map Scale: 1:330,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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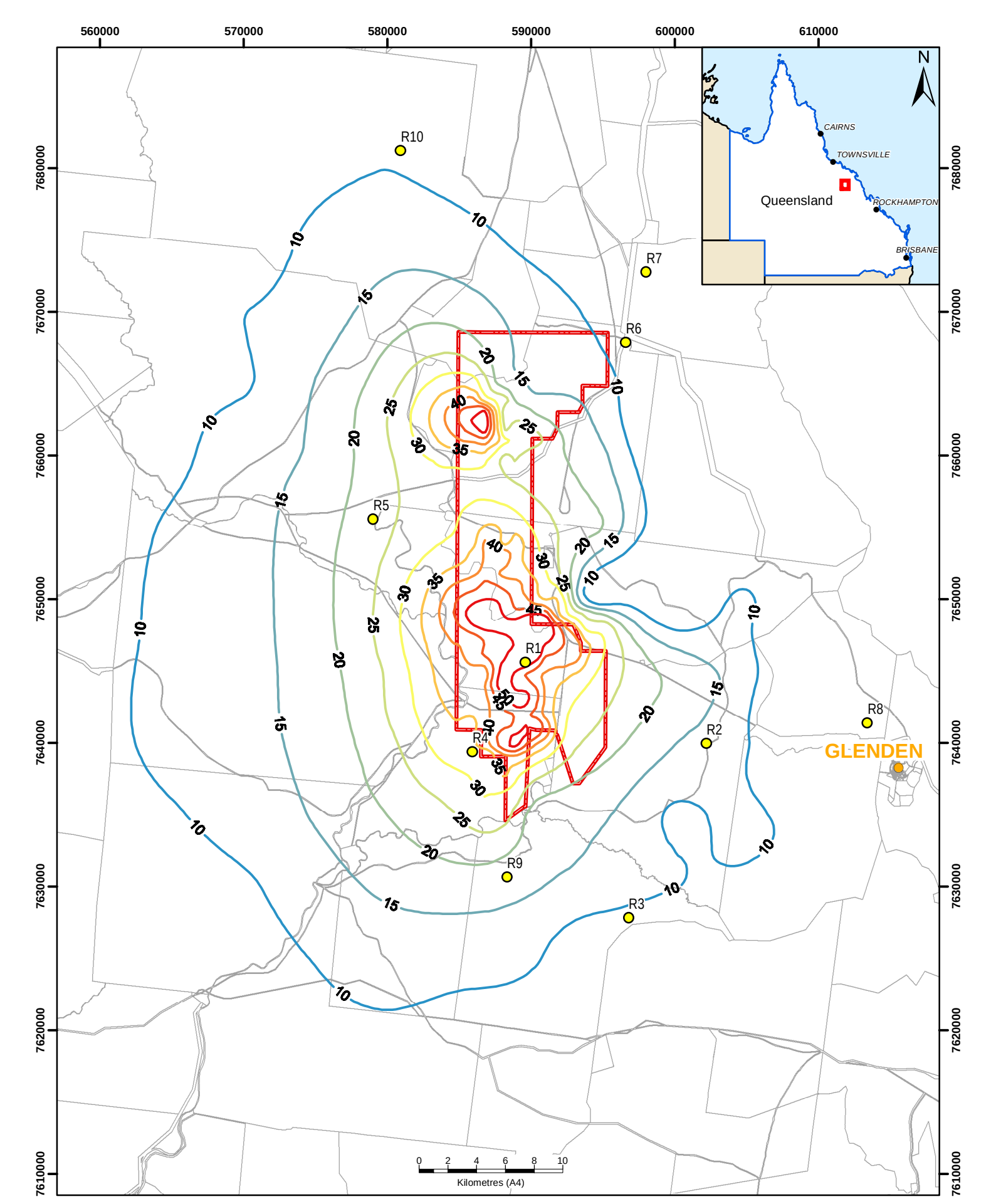

Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors

Noise Level (LAeq)

10 15 20 25 30 35 40 45 50

LAeq Noise Level for Night with East Wind - Mining Year 17	QCOAL GROUP
Figure 24-4	**Byerwen Coal Project**
Date: *23/01/2013*	**Author:** samuel.ferguson
	Map Scale: 1:330,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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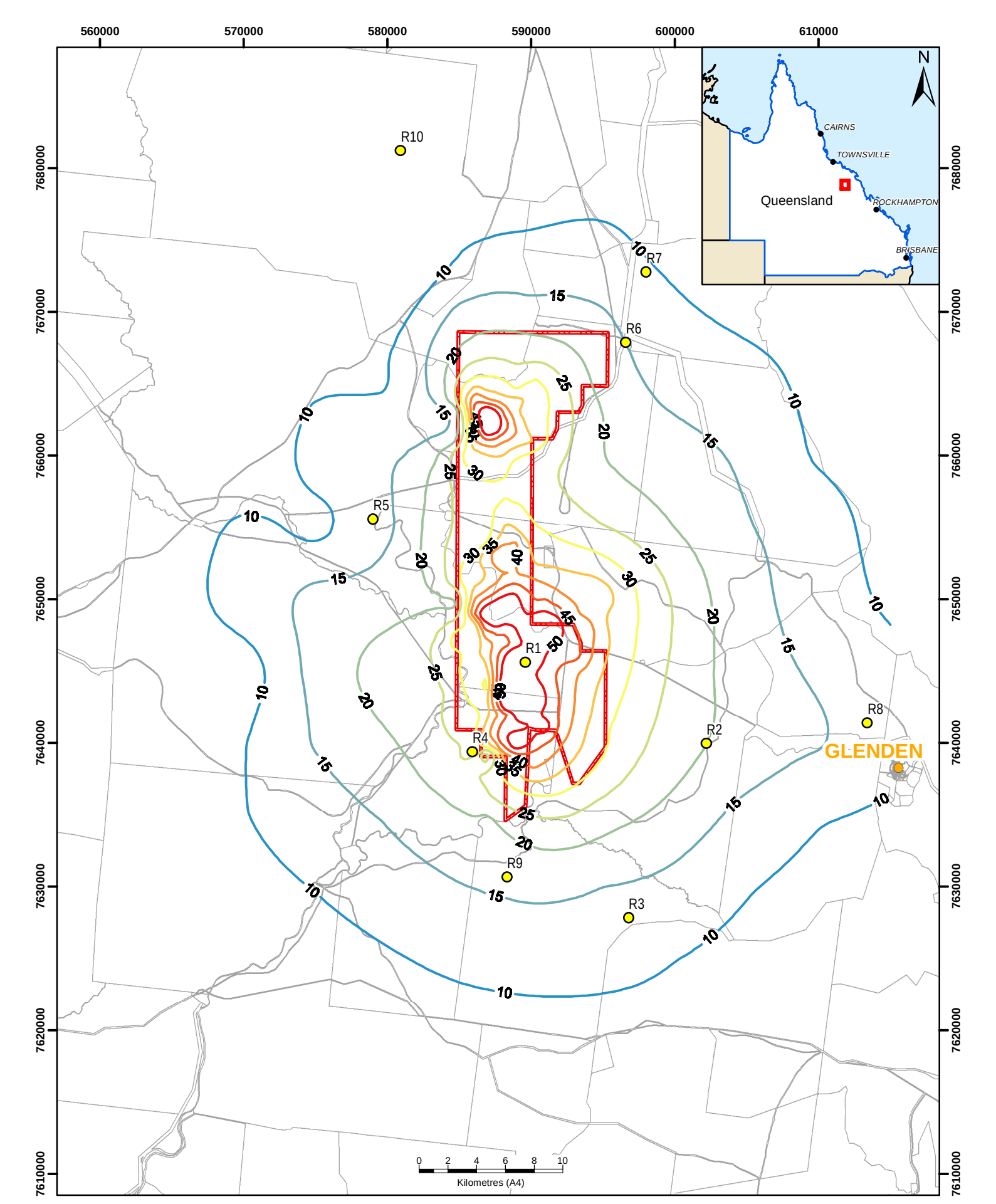

Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors

Noise Level (LAeq)

10 15 20 25 30 35 40 45 50

LAeq Noise Level for Night with West Wind - Mining Year 17		QCOAL GROUP
Figure 24-5	**Byerwen Coal Project**	elp environmental and licensing professionals pty ltd
Date: *23/01/2013*	**Author:** samuel.ferguson	
	Map Scale: 1:330,000	
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55	
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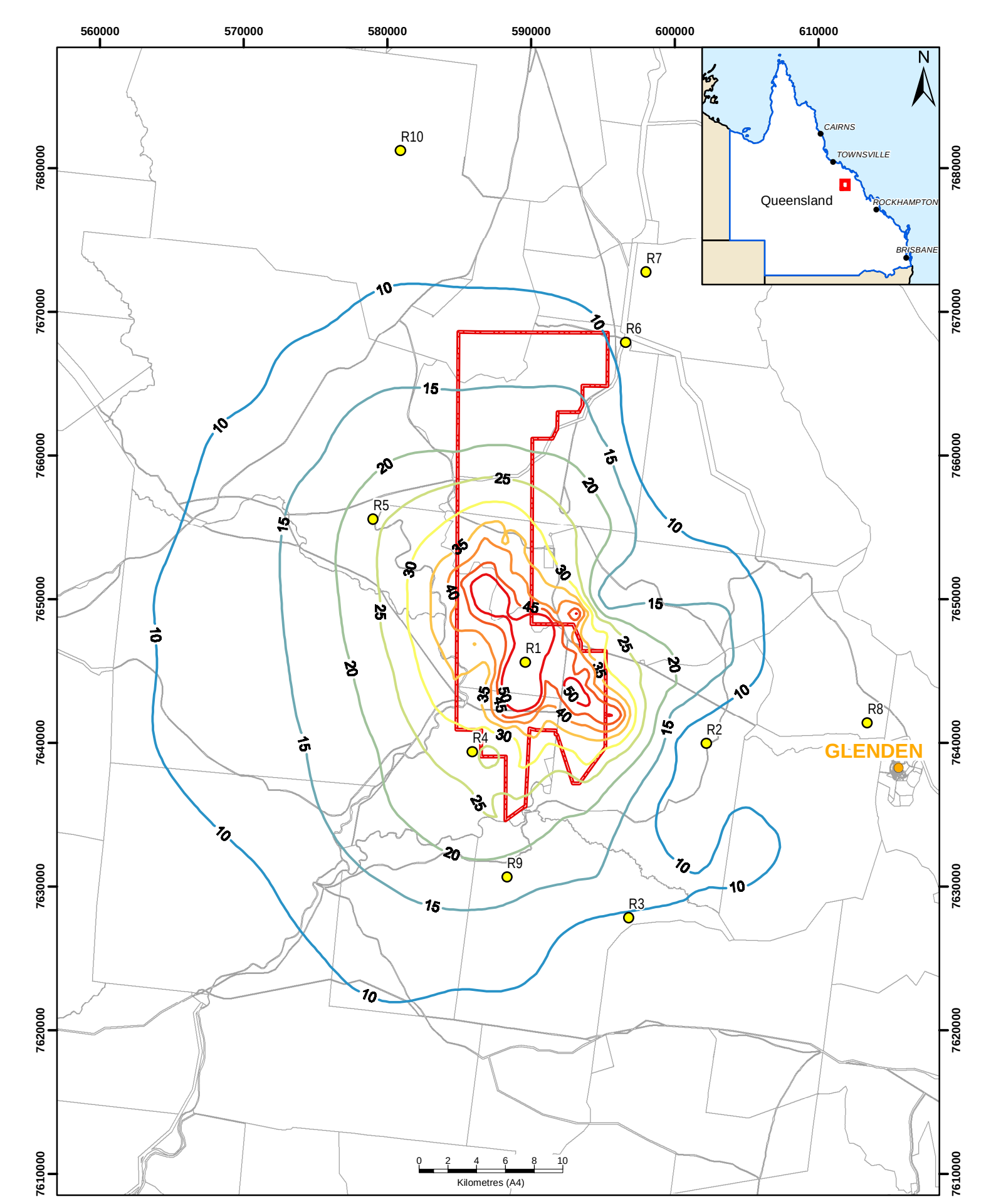

Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors

Noise Level (LAeq)

10 15 20 25 30 35 40 45 50

LAeq Noise Level for Night with East Wind - Mining Year 36	QCOAL GROUP
Figure 24-6	**Byerwen Coal Project**
Date: *23/01/2013*	**Author:** samuel.ferguson
	Map Scale: 1:330,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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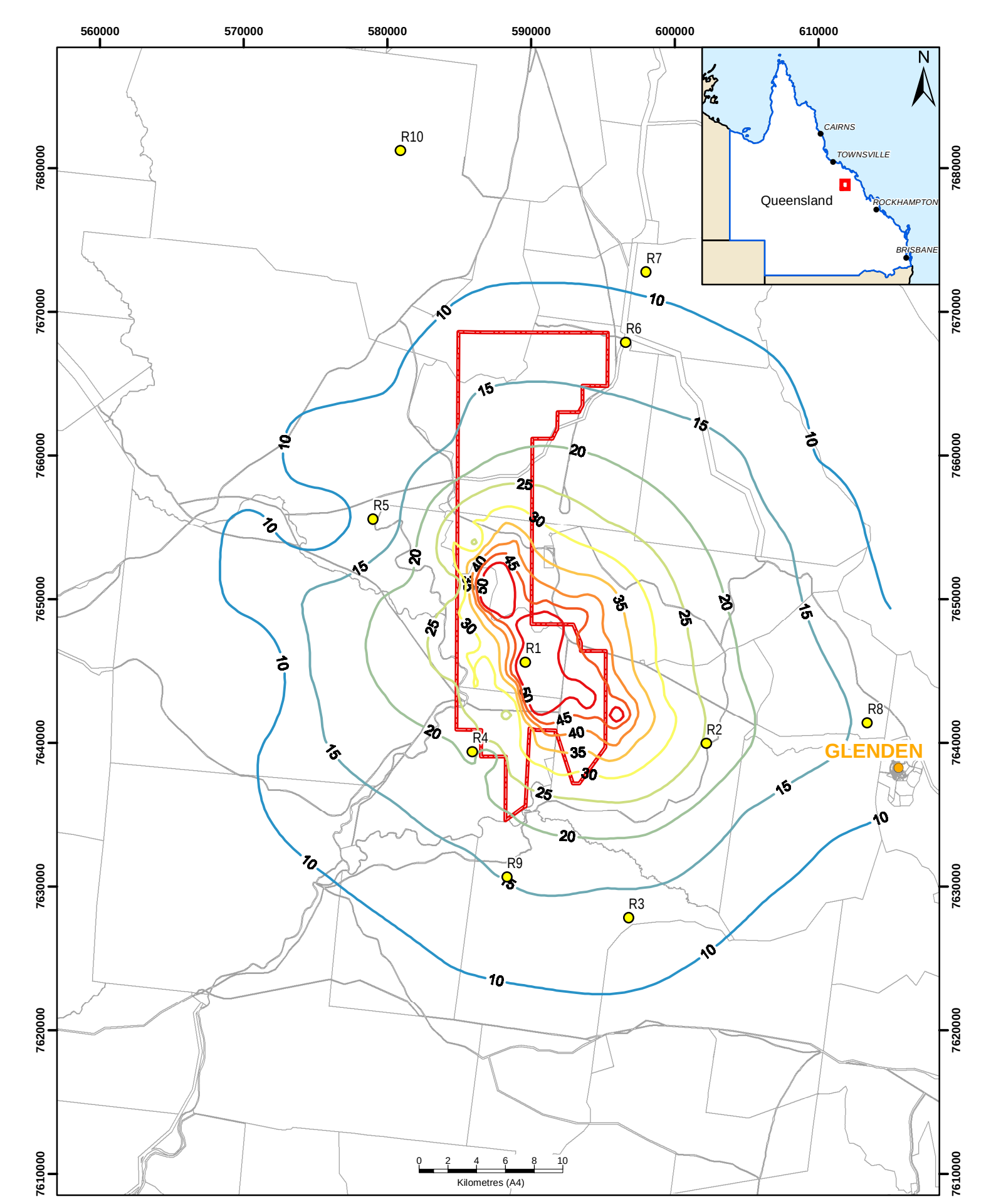

Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors

Noise Level (LAeq)

10 15 20 25 30 35 40 45 50

LAeq Noise Level for Night with West Wind - Mining Year 36		QCOAL GROUP
Figure 24-7	**Byerwen Coal Project**	elp environmental and licensing professionals pty ltd
Date: *23/01/2013*	**Author:** samuel.ferguson	
	Map Scale: 1:330,000	
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55	
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24.5.5 Low Frequency Noise

Night time low frequency noise levels for the modelled years are shown in **Table 24-11.** The objective levels are met at all sensitive receptors.

Table 24-11 Low Frequency Noise Levels at Night [dB(Lin)] for Mining Years 5, 17 and 36.

Location	Receptor	*Low frequency noise level $L_{Aeq(1\ hour)}$ [dB(Lin])*		
		Year 5	Year 17	Year 36
Objective		**50**	**50**	**50**
Glenden Township	-	32.0	32.7	33.6
Suttor Creek Station Homestead	R2	38.5	39.2	39.9
Lancewood Station Homestead	R3	34.8	35.4	35.5
Cerito Yards and Quarters	R5	39.9	40.5	40.7
Byerwen Station Homestead	R6	33.8	35.0	34.9
Weetalaba Station Homestead	R7	31.5	32.6	32.4
Glenden Station Homestead	R8	32.5	32.9	33.8
Fig Tree Station Homestead	R10	28.5	29.6	29.2

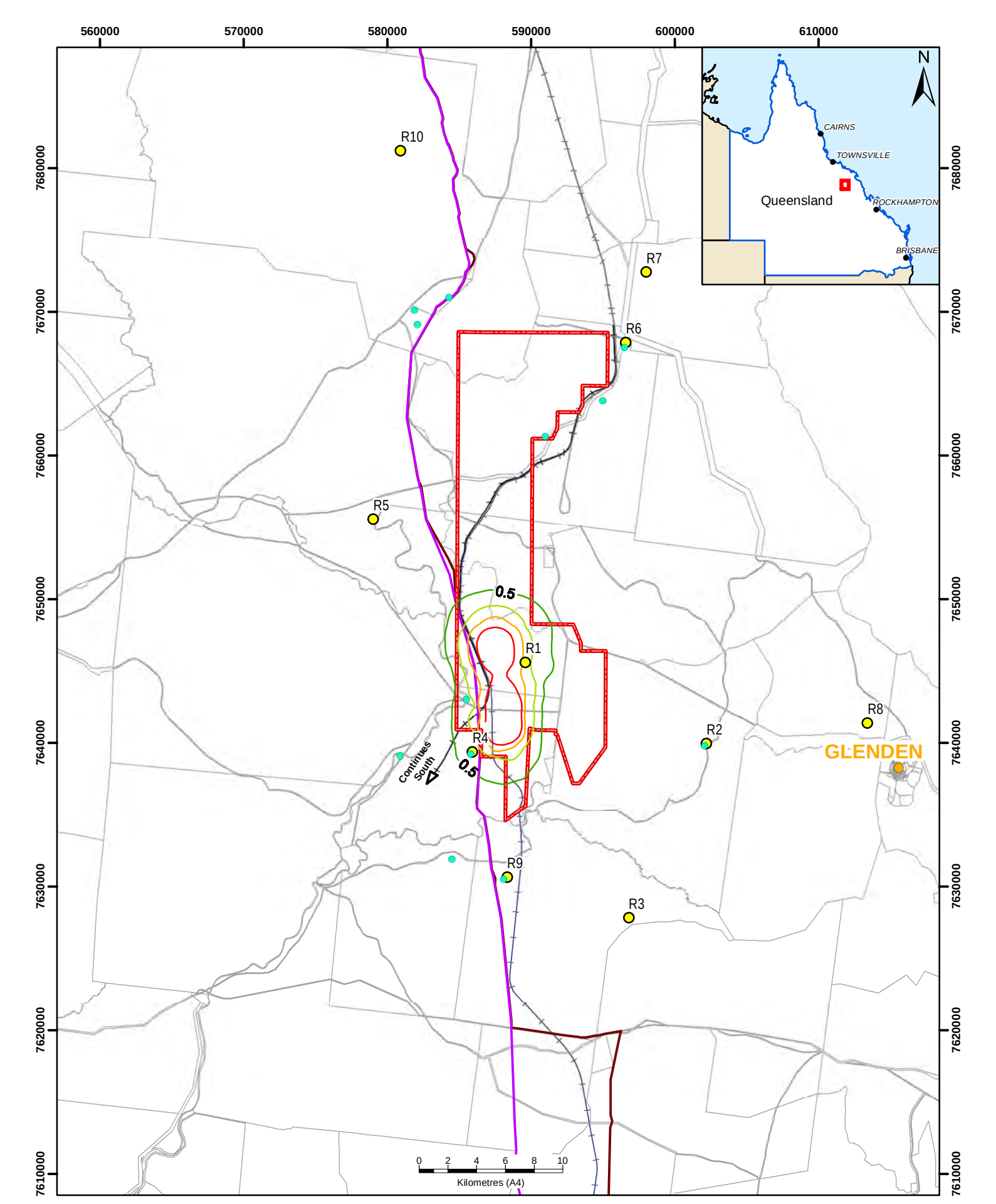
24.5.6 Blast Overpressure and Vibration

The blast overpressure and vibrations at all sensitive receptors are contained in **Table 24-12**. For a charge weight of 500 kg, the blast overpressure and vibration levels are well below the objectives at all sensitive receptors.

Contours of the blast vibration and blast overpressure are contained in **Figure 24-8** to **Figure 24-13**.

Table 24-12 Predicted Noise and Vibration Levels from Blasting at the Project (for 500 kg MIC)

Location	Receptor	Mining Year 5 Vibration and Blast Overpressure		Mining Year 17 Vibration and Blast Overpressure		Mining Year 36 Vibration and Blast Overpressure	
		Blast Overpressure [dBLin]	Vibrations [mm/s]	Blast Overpressure [dBLin]	Vibrations [mm/s]	Blast Overpressure [dBLin]	Vibrations [mm/s]
Objective		**115**	**5**	**115**	**5**	**115**	**5**
Glenden Township	-	<80	<0.5	<80	<0.5	<80	<0.5
Suttor Creek Station Homestead	R2	90	<0.5	92	<0.5	90	<0.5
Lancewood Station Homestead	R3	88	<0.5	98	<0.5	98	<0.5
Cerito Station Homestead	R5	92	<0.5	106	<0.5	108	<0.5
Byerwen Station Homestead	R6	80	<0.5	96	<0.5	96	<0.5
Weetalaba Station Homestead	R7	<70	<0.5	96	<0.5	94	<0.5
Glenden Station Homestead	R8	<80	<0.5	<80	<0.5	<80	<0.5
Fig Tree Station Homestead	R10	70	<0.5	98	<0.5	95	<0.5



Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors
- North Queensland Gas Pipeline
- GAP Rail Line
- Alpha Coal Project Rail Line
- Burdekin to Moranbah Pipeline

Vibration Level (mm/s)

0.5 1 2 5

- Historical Cultural Heritage Site Location

Vibration Levels in mm/s for Mining Year 5	QCOAL GROUP
Figure 24-8	**Byerwen Coal Project**
Date: *5/02/2013*	**Author:** Shahram.Nasiri
	Map Scale: 1:330,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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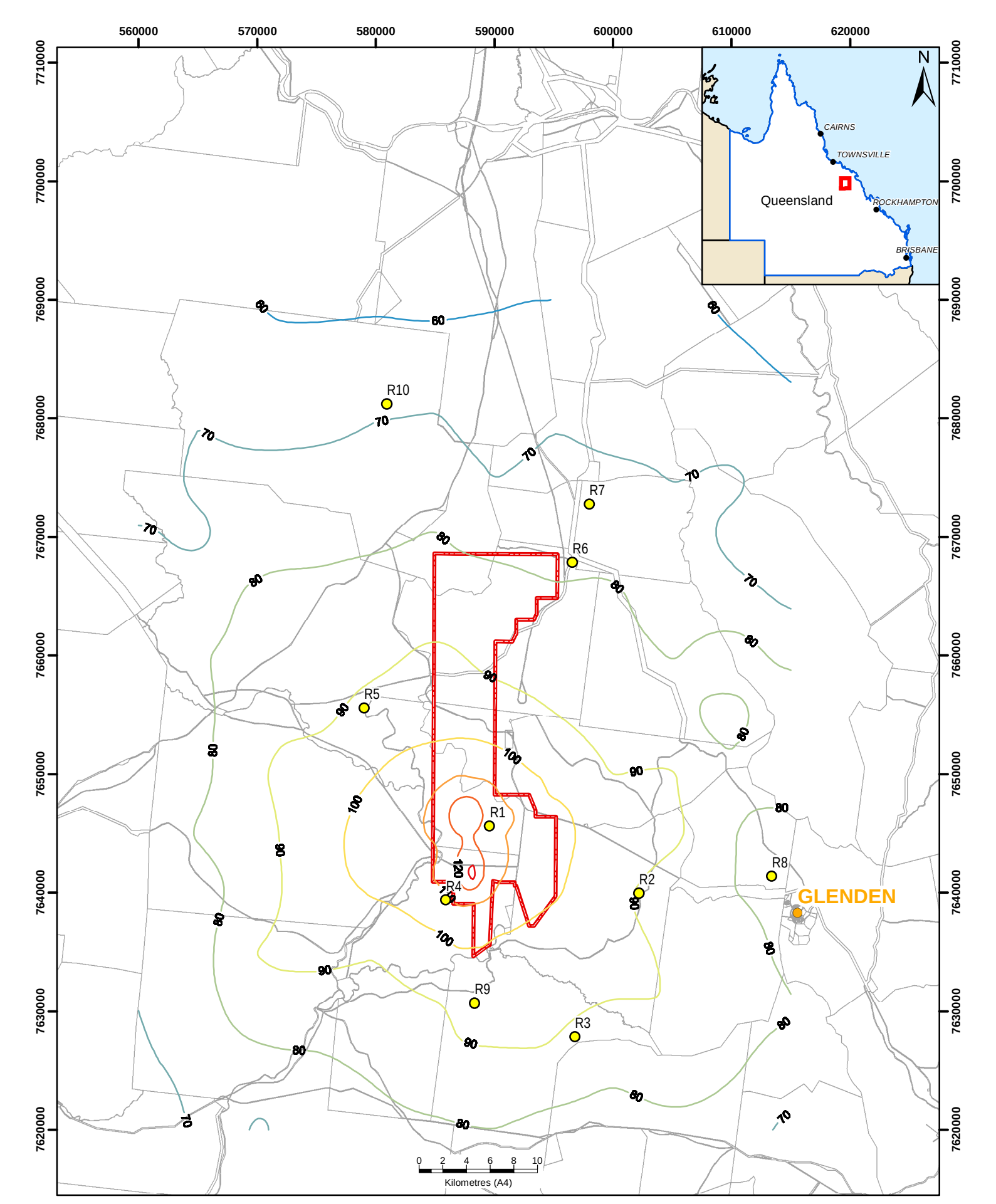

Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors

Peak Sound Pressure (dBLin)

60 70 80 90 100 110 120 130

Peak Sound Pressure Levels in dBLin for Mining Year 5		QCOAL GROUP
Figure 24-9	**Byerwen Coal Project**	elp environmental and licensing professionals pty ltd
Date: *23/01/2013*	**Author:** samuel.ferguson	
	Map Scale: 1:400,000	
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55	
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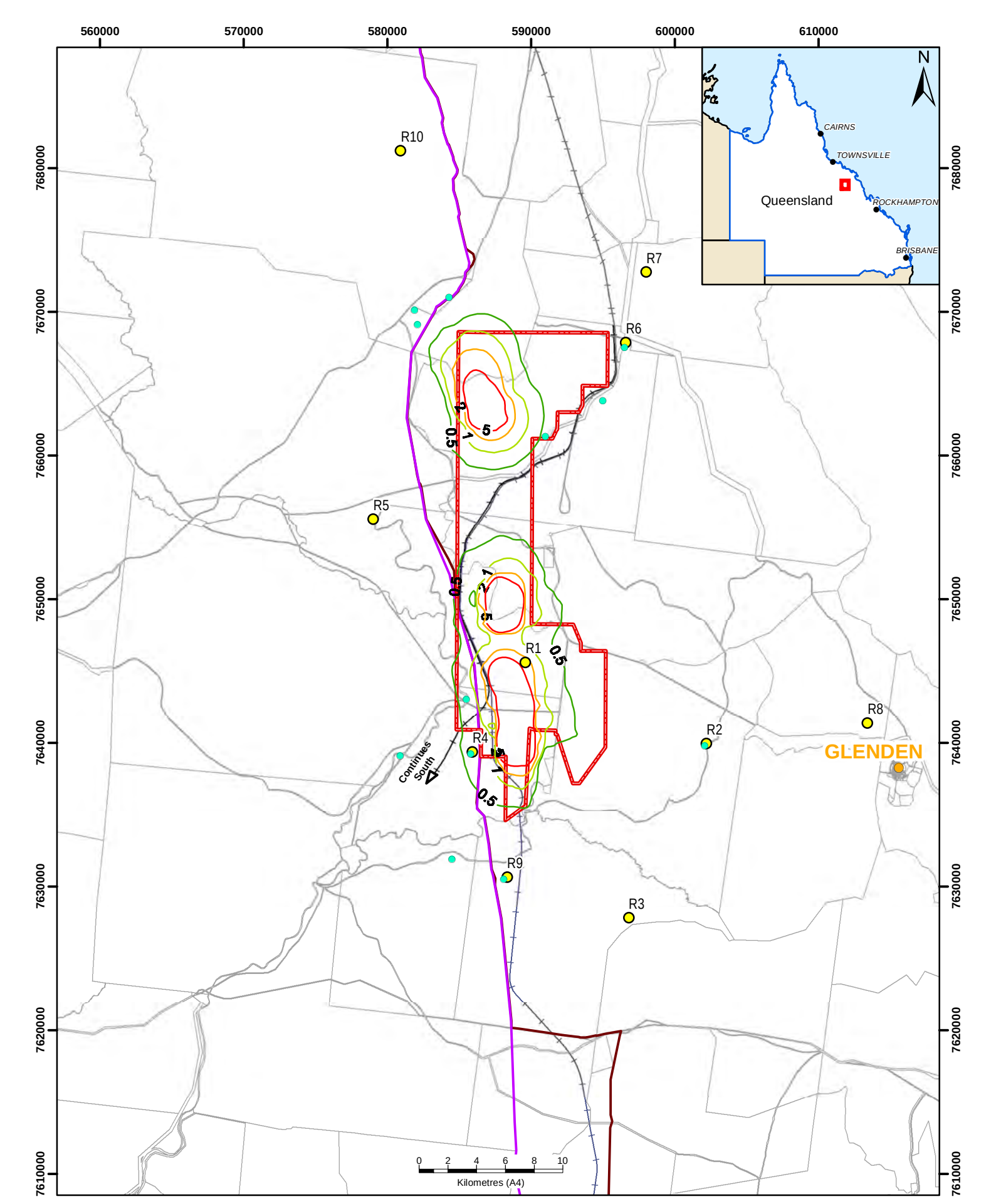

Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors
- North Queensland Gas Pipeline
- GAP Rail Line
- Alpha Coal Project Rail Line
- Burdekin to Moranbah Pipeline

Vibration Level (mm/s)

0.5 1 2 5

- Historical Cultural Heritage Site Location

Vibration Levels in mm/s for Mining Year 17	QCOAL GROUP
Figure 24-10	**Byerwen Coal Project**
Date: *5/02/2013*	**Author:** Shahram.Nasiri
	Map Scale: 1:330,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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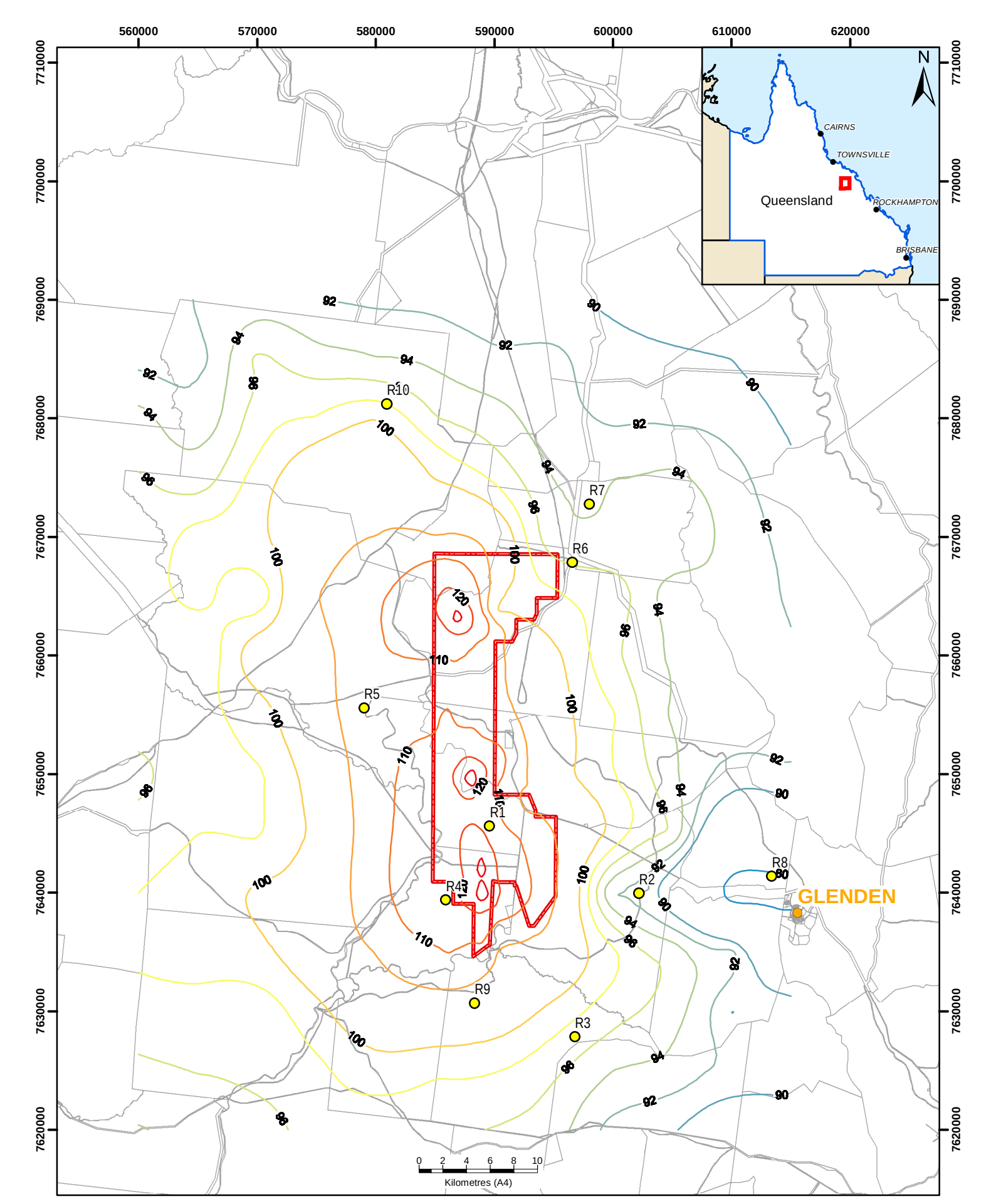

Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors

Peak Sound Pressure (dBLin)

80 90 92 94 96 98 100 105 110 120 130

Peak Sound Pressure Levels in dBLin for Mining Year 17		QCOAL GROUP
Figure 24-11	**Byerwen Coal Project**	elp environmental and licensing professionals pty ltd
Date: *23/01/2013*	**Author:** samuel.ferguson	
	Map Scale: 1:400,000	
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55	
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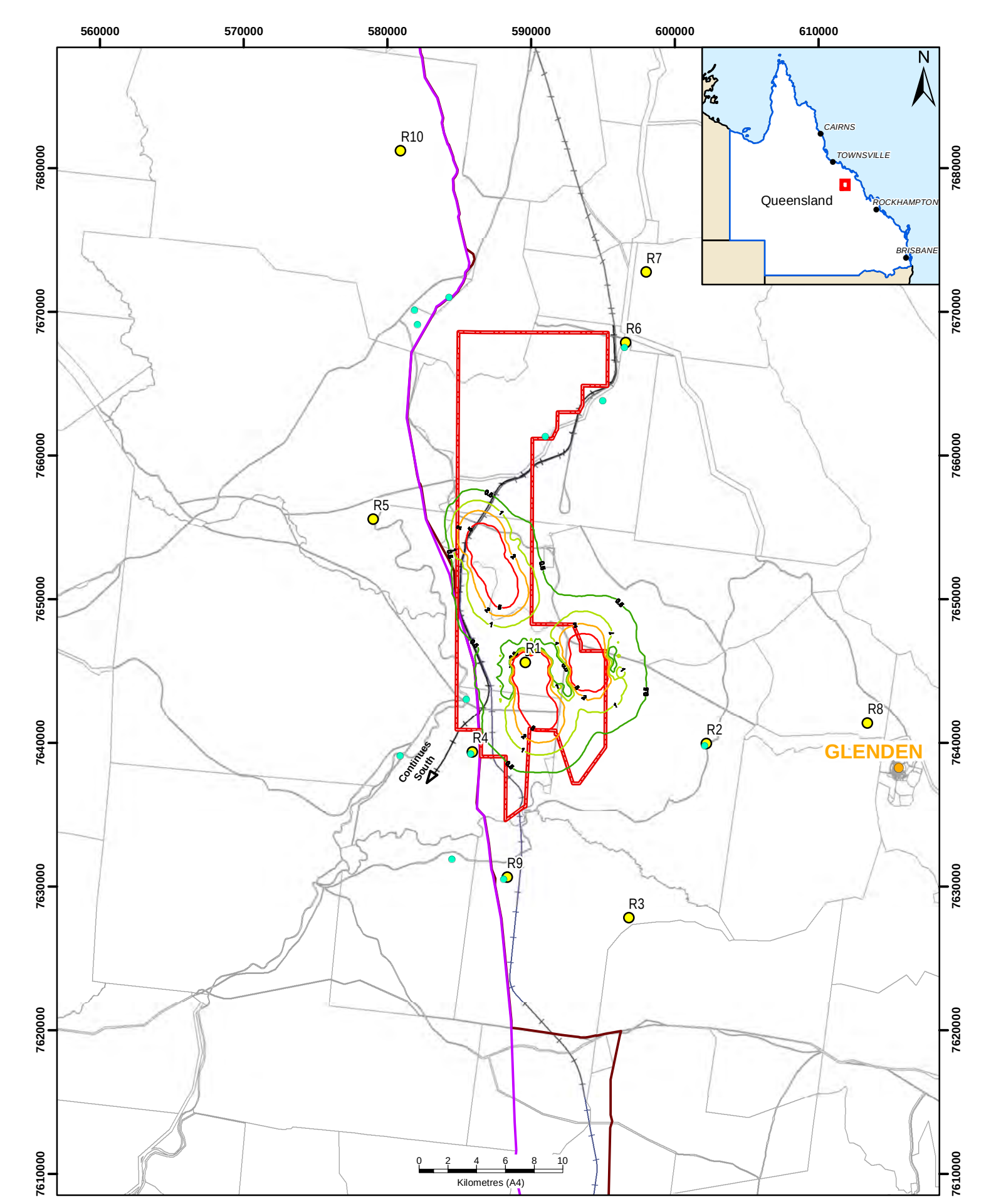

Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors
- North Queensland Gas Pipeline
- GAP Rail Line
- Alpha Coal Project Rail Line
- Burdekin to Moranbah Pipeline

Vibration Level (mm/s)

0.5 1 2 5

- Historical Cultural Heritage Site Location

Vibration Levels in mm/s for Mining Year 36	QCOAL GROUP
Figure 24-12	**Byerwen Coal Project**
Date: *5/02/2013*	**Author:** Shahram.Nasiri
	Map Scale: 1:330,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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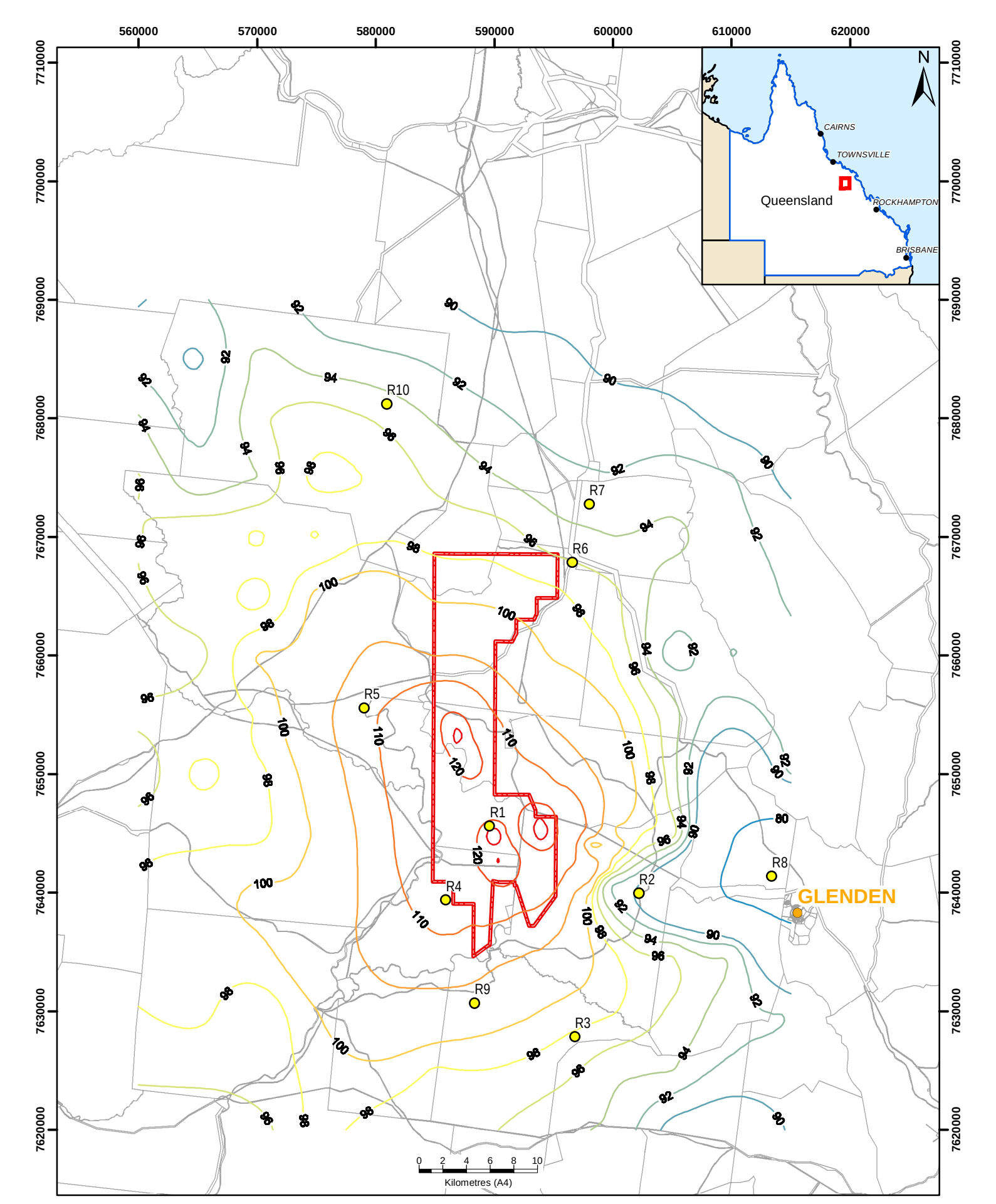

Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors

Peak Sound Pressure (dBLin)

80 90 92 94 96 98 100 105 110 120 130

Peak Sound Pressure Levels in dBLin for Mining Year 36		QCOAL GROUP
Figure 24-13	**Byerwen Coal Project**	elp environmental and licensing professionals pty ltd
Date: *23/01/2013*	**Author:** samuel.ferguson	
	Map Scale: 1:400,000	
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55	
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24.5.7 Railway Noise

Two proposed train loading facilities (including rail spur and balloon loop) will be constructed off the GAP rail line which intersects the project.

The noise levels from diesel electric trains in Savery & Associates (2011) has been based on a survey of existing diesel electric coal trains. The noise levels comprise:

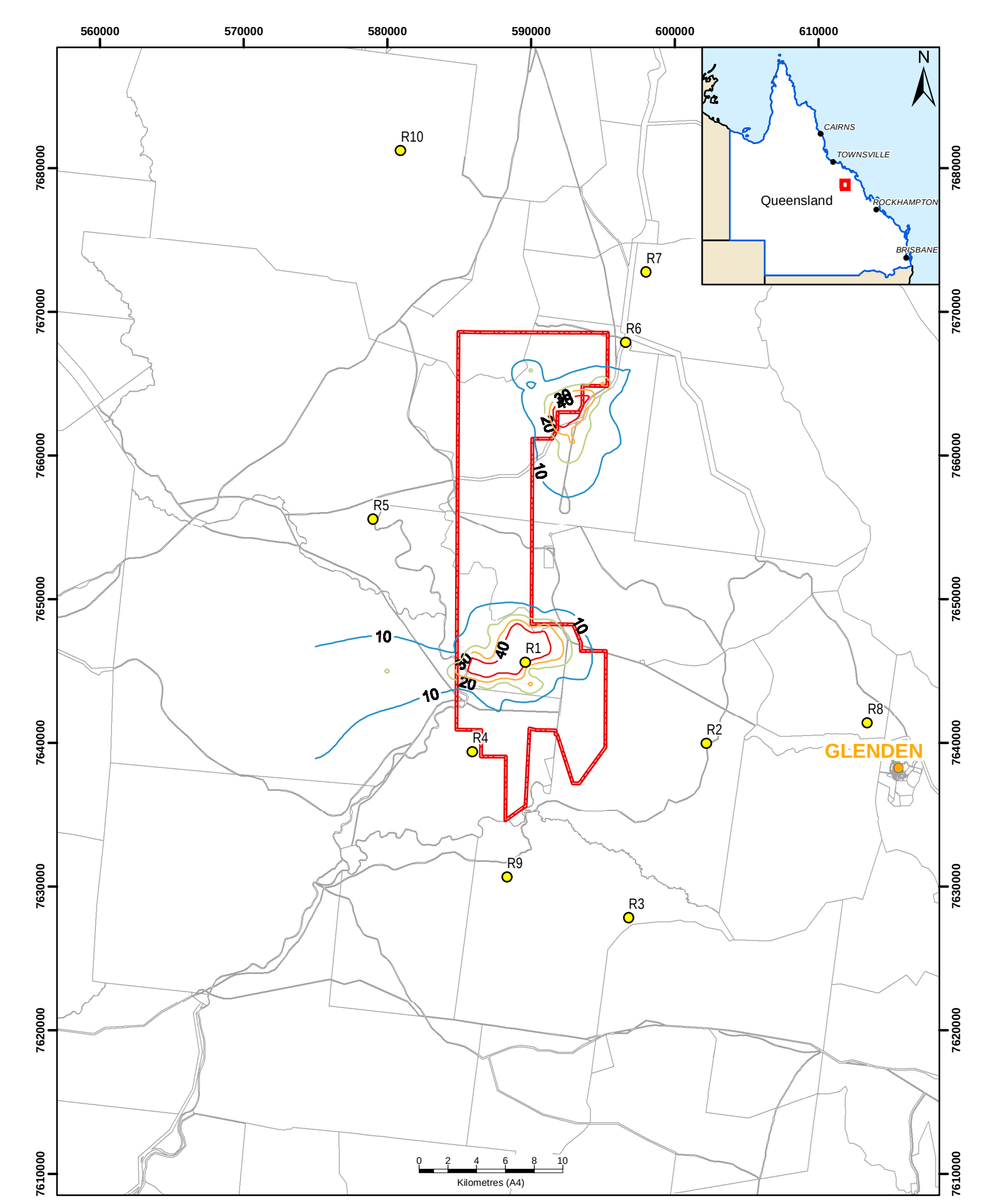
- L_{Amax} of 117 dB(A) (sound power level)
- L_{Aeq} of 72 dB(A) per lineal metre for 15 Mtpa.

The likely noise levels from trains is shown in **Figure 24-14** and **Figure 24-15** for the maximum noise level and the $L_{Aeq(24\ hour)}$ respectively. Tight-radius curves are likely to generate wheel squeal. Wheel squeal is a high-pitched noise caused by a slip-stick movement of the wheels in tight-corners having radius of less than about 100 times the bogie wheelbase (FTA, 2006). It is understood that most bogies on QR wagons are shorter than approximately 1.8 m. Thus wheel-squeal is unlikely to occur on the curves having a radius of at least 180 m. All the curves associated with the balloon track are predicted to have a radius of more than 180 m.

24.5.8 Road Traffic Noise

The road access to the mine will occur along Collinsville-Elphinstone Road. The traffic generated by the development will vary through the stages of the mine operation and construction. The proponent anticipates that the workforce will reside in Glenden.

Chapter 27 assessed all roads likely to be affected by increased traffic, which shows that the maximum increase in traffic is 10.5% for the route between site and Glenden on the Collinsville-Elphinstone Road (south of development). A 10.5% increase in traffic will lead to a 0.6 dB(A) or lower increase in traffic noise along the route, which is considered negligible (5 times less) in comparison to the 3 dB(A) increase which would require further investigation (as stated in **Section 24.4.7**).



Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors

Noise Level [dB(A)]

10 20 30 40

Calculated Maximum Noise Levels from Operation of the TLFs [dB(A)]		QCOAL GROUP
Figure 24-14	**Byerwen Coal Project**	elp environmental and licensing professionals pty ltd
Date: *23/01/2013*	**Author:** samuel.ferguson	
	Map Scale: 1:330,000	
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55	
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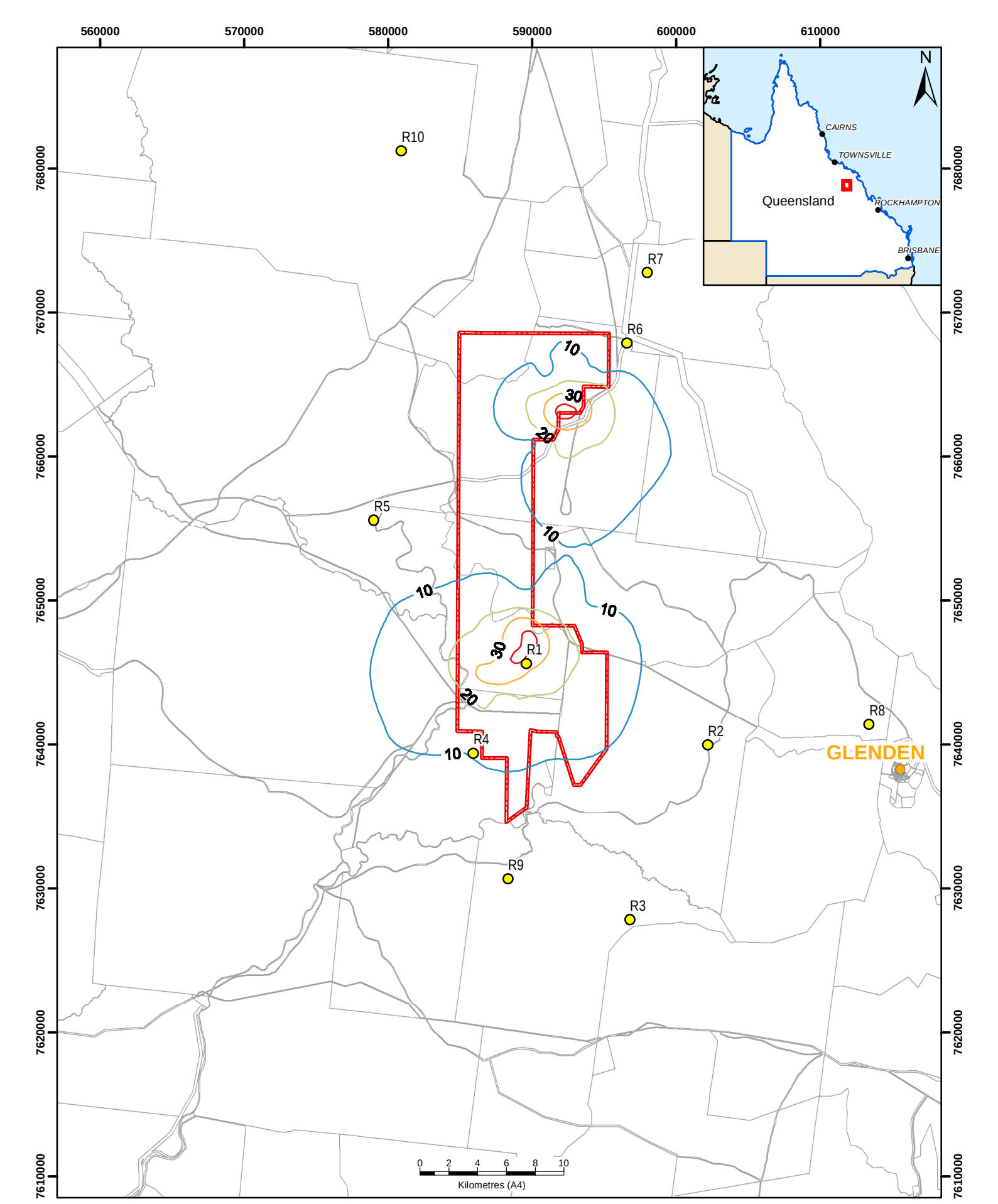

Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors

Noise Level [dB(A)]

10 20 30 40

Calculated LAeq(24 hour) from Operation of the TLFs [dB(A)]		QCOAL GROUP
Figure 24-15	**Byerwen Coal Project**	elp environmental and licensing professionals pty ltd
Date: *23/01/2013*	**Author:** samuel.ferguson	
	Map Scale: 1:330,000	
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55	
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24.6 Potential Impacts and Mitigation Measures

As detailed in **Section 24.5**, the construction phase plant and equipment comprise similar but typically smaller (and quieter) equipment used at lower activity levels than that used for the operations phase. Therefore, the assessment of the operational phase also applies to construction phase.

24.6.1 Acoustic Quality Objectives

The modelled noise levels generated by the project comply with the acoustic quality objectives during the day, evening and night at all sensitive receptors.

The noise modelling shows that at all times the indoor noise level objectives to protect sleep disturbance are met at all sensitive receptors.

24.6.2 Background Creep

The EPP (Noise) (in conjunction with the Ecoaccess Guideline "Planning for Noise Control") contains a methodology to avoid background creep and the objective is related to the background noise level. It is noted that some of the rural areas surrounding the project are very quiet. In these circumstances the methodology permits a minimum background noise level of 25 dB(A).

The modelling shows that the calculated noise levels at the identified sensitive receptors are expected to comply with the identified objectives to avoid background creep for all time periods.

The enHealth Council (2004) document provides a review of the health effects, other than hearing loss, of environmental noise and reviews measures aimed at the management of environmental noise. The document addresses annoyance and quality of life, sleep disturbance, performance and learning with school children, cardio vascular disease, mental health and neuro-physiological stress. The goals adopted in this report comply with all aspects of this document as do the predicted noise levels from the project.

24.6.3 Low Frequency Noise

The low-frequency noise level goals are expected to be met at all sensitive receptors.

24.6.4 Blasting Vibration and Overpressure – Sensitive Receptors

The recommended vibration goal of 5 mm/s PPV, from the Queensland Ecoaccess guideline, is met at all sensitive receptors. This goal is designed to protect avoid the adverse impacts for occupiers at sensitive receptors.

The vibration limits from the *Environmental Protection Act 1994* are also met at all sensitive receptors.

24.6.5 Blasting Vibration and Overpressure – Buildings and Infrastructure

Buildings and infrastructure with the potential to be impacted by vibration include homesteads of sensitive receptors, historical cultural heritage sites and third party linear infrastructure (GAP rail line, Alpha Coal Project rail line, SunWater Burdekin to Moranbah pipeline and North Queensland Gas Pipeline). **Figure 24-8**, **Figure 24-10** and **Figure 24-12** show that there are no buildings and infrastructure that are expected to experience vibration levels in excess of the criteria described in **Section 24.4.5**. **Figure 24-8**, **Figure 24-10** and **Figure 24-12** show that the GAP rail line and Alpha Coal Project rail line are within the zone that may marginally exceed vibration greater than 5 mm/s. However it is inferred that the criteria of 40 mm/s will not be exceeded.

However, to protect linear infrastructure from excessive vibration, if blasting encroaches within 1 km of the infrastructure, the blast vibrations will be monitored to demonstrate compliance.

24.6.6 Railway Noise

Due to the large separation distances between the TLFs and sensitive receptors, all sensitive receptors readily comply with the QR noise level goals.

24.6.7 Road Traffic Noise

The generation of road traffic by the site is minor leading to a maximum increase of less than 1 dB(A) along the most adversely affected road. This is considered a minor increase in traffic noise in comparison to the 3 dB(A) increase which would require further investigation (as stated in **Section 24.4.7**) and complies with the project noise level goals for road traffic noise.

24.6.8 WHO European Night Time Goal

The annual average night noise levels are presented in **Table 24-8**, **Table 24-9** and **Table 24-10** for the three modelling cases respectively. The highest predicted annual average night noise levels $L_{night, outside}$ is 23 for Cerito Station Homestead. With a goal between 30 to 35 dB(A) all locations comply with the WHO European night time goal.

24.6.9 Fauna

Potential noise impacts to fauna are described in **Chapter 18 – Terrestrial Ecology** and **Chapter 19 – Aquatic Ecology**.

24.7 Conclusion

Existing noise levels were measured at four locations surrounding the project. The noise levels at all the homesteads are low and industrial or commercial noise is not currently a feature of the existing noise levels at the homesteads.

The EPP (Noise) was reviewed for applicability and the acoustic quality objectives were considered relevant. These objectives are designed to protect the amenity of an acoustic environment. It was found that the EPP (Noise) noise objectives for background creep were more stringent than the acoustic quality objectives and that these objectives, particularly at the sensitive receptor homesteads, are the most stringent noise level objectives applied in Queensland.

This report has modelled the L_{01}, L_{A10} and L_{Aeq} noise levels over a variety of modelling scenarios, including adverse meteorological conditions. The methodology assumes worst case operations to calculate noise levels.

The modelled noise levels generated by the project comply with the acoustic quality objectives during the day, evening and night at all sensitive receptors. The noise modelling shows that at all times the indoor noise level objectives to protect sleep disturbance are met at all sensitive receptors.

The modelling shows that the calculated noise levels at the identified sensitive receptors are expected to comply with the identified objectives to avoid background creep for all time periods. These objectives provide the lowest noise level goals possible under the approach described in the EcoAccess guideline.

The WHO European night time goals are expected to be met at all sensitive receptors.

The low-frequency noise level goals are expected to be met at all sensitive receptors.

The blasting vibration levels are expected to be met at all sensitive receptors. The blast overpressure objectives are readily met at all sensitive receptors.

There are no buildings and infrastructure that are expected to experience vibration levels in excess of the criteria. The GAP rail line and Alpha Coal Project rail line are within the zone that may marginally exceed vibration greater than 5 mm/s. However it is inferred that the vibration criteria of 40 mm/s will

not be exceeded. However, to protect linear infrastructure from excessive vibration, if blasting encroaches within 1 km of the infrastructure, the blast vibrations will be monitored to demonstrate compliance.

The project will limit blasting to the hours of 9 am to 3 pm, Monday to Friday, and from 9 am to 1 pm on Saturdays unless there is no likelihood of persons in a noise-sensitive place being affected because of the remote location of the blast site.

Due to the large separation distances between the TLFs and sensitive receptors, all sensitive receptors readily comply with the QR noise level goals.

The generation of road traffic by the site is minor leading to a maximum increase of less than 1 dB(A) along the most adversely affected road. This is considered a minor increase in traffic noise in comparison to the 3dB(A) increase which would require further investigation (as stated in **Section 24.4.7**) and complies with the project noise level goals for road traffic noise.