Chapter 22

Air Quality

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22. AIR QUALITY

22.1 Introduction

This chapter provides a description of existing air quality in the project area. It also identifies any likely change in the air quality environment resulting from project construction and operations and proposes measures to mitigate impacts. This EIS chapter is based on the findings of the Air Quality and Greenhouse Gas Technical Report (2013) provided in **Appendix 23**. A description of project activities, including process flow diagrams is provided in **Chapter 6** and **Chapter 7**.

22.2 Sensitive Receptors and Ambient Air Quality

22.2.1 Sensitive Receptors

The potentially sensitive locations in the vicinity of the project comprise the homesteads of grazing properties and Glenden township. The closest potentially sensitive locations are shown on **Figure 22-1** along with the mine site. The locations and separation distances are contained in **Table 22-1**. Several sensitive receptors are either not occupied for the duration of the project or are occupied on a part-time basis. These sites have been identified for completeness but were not considered as sensitive receptors for the purposes of impact assessment.

Table 22-1 Sensitive Receptors Adjacent to Project Area, Project Footprint and TLFs

Sensitive receptor	Considered as a receptor	Permanently occupied for duration of project	Separation distance (km) and direction to sensitive receptor from		
			Project area boundary	Project footprint	Train loading facilities
Glenden Township	Yes	Yes	19.4 km E	20.0 km E	25.7 km NE
R1 Suttor North Station Homestead (not occupied for duration of project)	No	No	(on lease)	-	-
R2 Suttor Creek Station Homestead	Yes	Yes	6.8 km E	7.3 km NW	14.2 km NW
R3 Lancewood Station Homestead	Yes	Yes	9.7 km SE	13.3 km NW	19.5 km NW
R4 Wollombi Station Homestead (not occupied for duration of project)	No	No	0.5 km E	0.6 km E	1.4 km E
R5 Cerito Station Homestead (occasional occupancy)	Yes	No	5.8 km W	7.0 km SE	12.7 km SE
R6 Byerwen Station	Yes	Yes	1.5 km E	7.9 km SW	5.5 km SW

Sensitive receptor	Considered as a receptor	Permanently occupied for duration of project	Separation distance (km) and direction to sensitive receptor from		
			Project area boundary	Project footprint	Train loading facilities
Homestead					
R7 Weetalaba Station Homestead	Yes	Yes	4.9 km NE	12.4 km SW	10.7 km SW
R8 Glenden Station Homestead	Yes	Yes	18.2 km E	18.5 km E	24.0 km NE
R9 Two Sheds	No	No	3.7 km N	8.3 km N	14.6 km N
R10 Fig Tree Station Homestead	Yes	Yes	13.2 km SE	17.2 km SE	20.8 km SE

22.2.2 Climate

The project is situated between Moranbah and Collinsville, both locations maintain a Bureau of Meteorology (BOM) weather monitoring station. **Appendix 23** includes a summary of the main statistics collected at these sites. Moranbah (Latitude -21.99, Longitude 148.03) and Collinsville (Latitude -20.55, Longitude 147.85) are manual stations with the weather records recorded twice daily.

The region has a warm climate with two distinct seasons, a dry winter season and a wet summer season. Dry season temperatures generally range between 9°C to 30°C, while wet season temperatures range from 20°C to 33°C. The rainfall is seasonal and highly variable and ranges from around 200 mm to above 1,200 mm each year, falling mostly between November and April.

22.2.3 Dust

During the wet summer season the soil moisture content increases and there is increased grass ground cover, resulting in lower dust emissions from most activities. During the dry winter season the soil moisture content reduces and grass cover reduces. Dust emissions from all (non-mining) activities are more prevalent during this period.

The winter season is also the period when grass fires (including permitted fires) are likely to occur. These types of fire release significant quantities of smoke into the lower atmosphere.

Potential sources of particulate emissions from the surrounding environment primarily comprise:

- farming and grazing activities
- existing commercial operations
- unsealed roads
- smoke from grass/bush fires (permitted or otherwise).

Existing atmospheric dust concentrations of particulate matter (PM_{10} and $PM_{2.5}$ in fifteen minute intervals) were measured between 29 July 2011 and 11 August 2011 and the 24 hour averages were calculated from the samples for the three locations as summarised in **Table 22-2.** A description of the methodology and results is provided in **Appendix 23**. The equipment was located near homesteads in the house compounds at least 4 m from buildings. Monitoring locations are shown on **Figure 22-1**.

Table 22-2 Ambient Atmospheric Dust Concentrations (PM_{10} and $PM_{2.5}$)

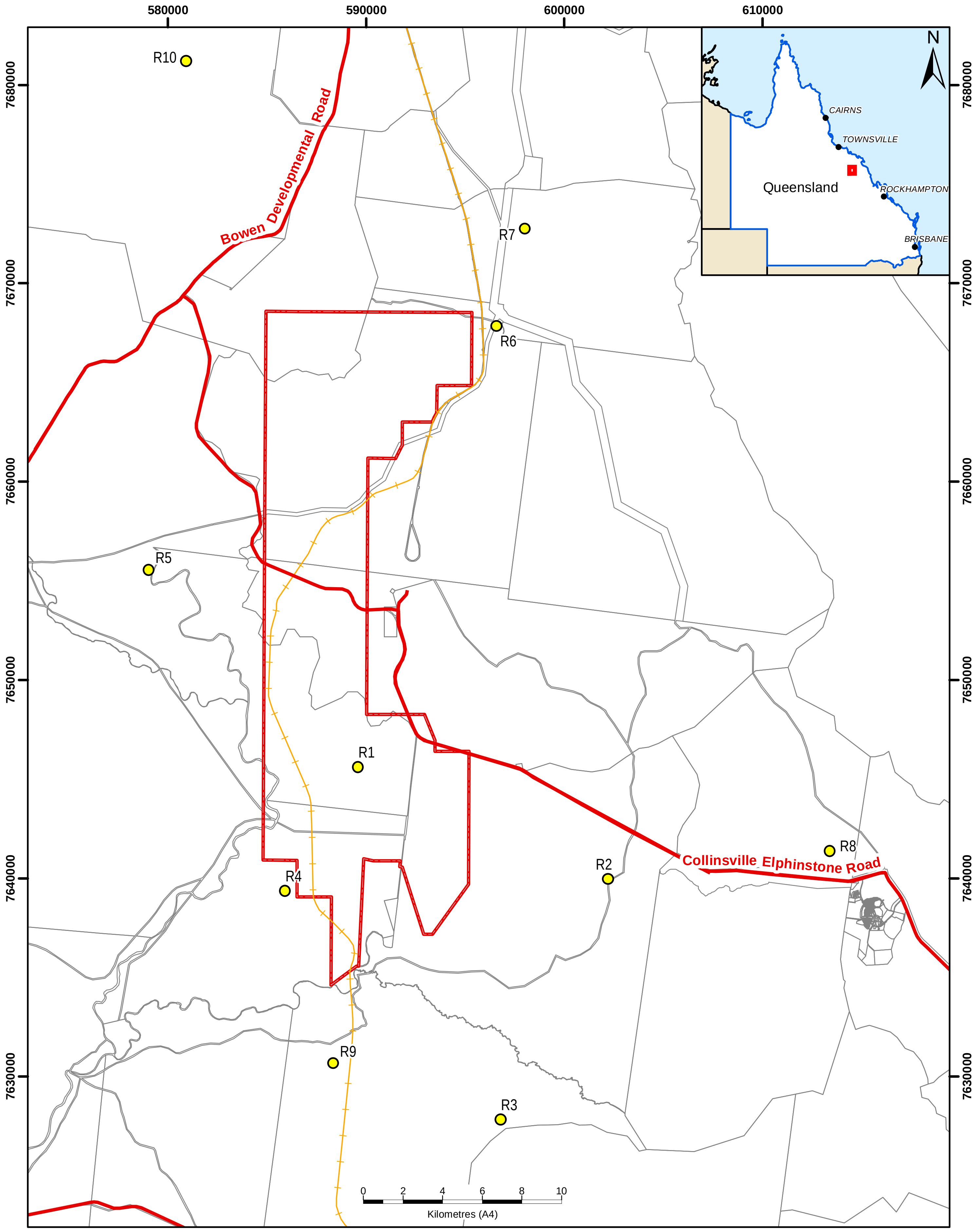
Date	Ambient Dust Concentrations - 24 Hour Average					
	Wollombi Homestead (R4)		Cerito Station Homestead (R5)		Reference Site close to the South MIA (R1)	
	$PM_{2.5}$ (µg/m^3)	PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)	PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)	PM_{10} (µg/m^3)
29 July 2011	8 (Note 1)	38 (Note 1)	12 (Note 1)	15 (Note 1)	7 (Note 1)	15 (Note 1)
30 July 2011	5	32	11	18	5	14
31 July 2011	5	28	9	15	5	10
1 Aug 2011	7	32	12	17	6	12
2 Aug 2011	9	35	12	17	8	14
3 Aug 2011	7	28	11	17	6	13
4 Aug 2011	5	24	9	15	5	13
5 Aug 2011	4	25	9	18	4	12
6 Aug 2011	5	25	9	15	4 (Note 1)	7 (Note 1)
7 Aug 2011	6	26	11	18	-	-
8 Aug 2011	9	38	6	19	-	-
9 Aug 2011	5	30	-	-	-	-
10 Aug 2011	9	35	-	-	-	-
11 Aug 2011	16 (Note 1)	39 (Note 1)	-	-	-	-
Median	**6**	**31**	**11**	**17**	**5**	**13**
Maximum	**16**	**39**	**12**	**19**	**8**	**15**

Note 1: Averaging period less than 24 hours

It was noted that there was construction/repair works taking place on the railway in the vicinity of Wollombi station. The construction works involved significant earthworks and it is likely that those works contributed to the higher PM_{10} exposure levels at this location.

The lowest exposure levels recorded were near the South MIA. The area surrounding the MIA was covered in green pasture at least 0.5 m high. This site represents the lowest likely dust exposures. The measurements at the MIA are considered to be representative of the lowest dust levels likely in the region.

The area surrounding Cerito Station Homestead comprised of a mix of bare earth and closely cropped grass (a fire break and working area) surrounding the stock yards. There was some human activity on the site. The measurements at R5 Cerito Station Homestead are adopted in this report as representative of the short-term ambient levels at all homesteads. The $PM_{2.5}$ at the MIA is taken to be representative on the annual average $PM_{2.5}$ for all sites.



Legend

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

Sensitive Receptors and Monitoring Locations	
Figure 22-1	**Byerwen Coal Project**
Date: *5/03/2013*	**Author:** samuel.ferguson
	Map Scale: 1:250,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55

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22.3 Air Quality Criteria

22.3.1 Environmental Protection (Air) Policy

The Queensland Environmental Protection (Air) Policy 2008 (EPP (Air) 2008) addresses the protection and enhancement of qualities of the air environment which are conducive to:

a) protecting the health and biodiversity of ecosystems
b) human health and wellbeing
c) protecting the aesthetics of the environment, including the appearance of buildings, structures and other property
d) protecting agricultural use of the environment.

Schedule 1 of the EPP (Air) nominates relevant particulates[1] indicators and goals as follows:

a) Total suspended particulate (TSP) 90 µg/m^3 averaged over a year.
b) $PM_{2.5}$ 8 µg/m^3 averaged over one year.
c) $PM_{2.5}$ 25 µg/m^3 averaged over 24 hours.
d) no greater than 5 days per year where the dust concentration of PM_{10} averaged over 24 hours, or PM_{10} (24 hour), is greater than 50 µg/m^3 (i.e. the 5th highest).

All these indicators are qualities of the air environment that are conducive to human health and wellbeing. The indicators apply at any sensitive or commercial place, such as residences, parks, gardens, schools, shopping precincts, etc.

22.3.2 EHP Guidelines

The EPP (Air) 2008 does not address dust deposition monitoring. Dust sampling is conducted in accordance with Australian Standard AS3580.10.1. Mine licenses issued by EHP generally will include consideration of dust deposition air quality.

The relevant guideline for the assessment of air quality is the EHP “Preparing an Environmental Management Overview Strategy (EMOS) for Non-standard Mining Projects” which prescribes the maximum permissible measured dust levels relevant to the project as:

a) Dust deposition of 120 mg/m^2/day, averaged over one month; and
b) PM_{10} 150 µg/m^3 averaged over 24 hours, at a sensitive or commercial place downwind of the operational land.

The PM_{10} criterion has been superseded by the more recent and more stringent EPP (Air) 2008 levels for PM_{10} (i.e. 50 µg/m^3 for no greater than 5 days per year).

22.3.3 National Environmental Protection Measure Air

The National Environmental Protection Measure (NEPM) (Air) 1998 was developed by the National Environment Protection Council and adopts the same goal for particulates as that contained in the EPP (Air).

22.3.4 Vegetation

The direct physical and chemical effects of dusts on vegetation became apparent only at relatively high surface loads. There are a number of influential factors including *inter-alia* aerosol properties, vegetation condition as well as the deposition rate. It is not possible to determine the precise nature of

[1] PM_{10} is particulate matter 10 micrometers or less in diameter, $PM_{2.5}$ is particulate matter 2.5 micrometers or less in diameter.

a plants response to dust load, however Doley (2006) examined the physical effects of dust on vegetation and suggested that the most sensitive plant functions may be altered with monthly dust loads (deposition) of about 8 g/m^2 (266 mg/m^2/day) for dust with medium diameters of 50 µm.

An assessment of vegetation including the development of vegetation mapping and potential impacts was undertaken as part of the terrestrial ecology component of the EIS (refer **Section 22.6** and see **Chapter 18**).

22.3.5 Site Specific Air Quality Objectives

The adopted air quality objectives for the project are:

- dust concentration of $PM_{2.5}$ 25 µg/m^3 averaged over 24 hours
- dust concentration of $PM_{2.5}$ 8 µg/m^3 averaged over a year
- no greater than 5 days per year where the dust concentration of PM_{10} (24 hours) is greater than 50 µg/m^3;
- total suspended particulate (TSP) 90 µg/m^3 averaged over a year
- dust deposition of 120 mg/m^2/day.
- for vegetation a maximum month dust deposition 266 mg/m^2/day is proposed.

22.4 Scope and Methodology

22.4.1 Scope of Assessment

The combustion of diesel in mining machines, as well as in locomotives associated with approximately 4 to 5 trains per day on the project's two train load out facilities (TLFs), which are approximately 10.5 km in total length and connect the project to the Goonyella to Abbot Point (GAP) rail line, will result in some gaseous emissions of carbon dioxide (CO_2), oxides of nitrogen (NO_X) and sulphur dioxide (SO_2). In addition blasting can also result in gaseous emissions.

As described in **Appendix 23**, the sources of gaseous emissions were considered in the assessment and were qualitatively evaluated as being inherently widely dispersed, having low levels of emission and having very localised impact. Thus the likelihood of exceeding emission related environmental air quality objectives beyond the project area boundary is minimal. As a consequence gaseous emissions from the combustion of diesel and blasting are not considered further in this chapter.

However, the use of diesel fuels, along with release of methane from coal and other matters makes the project a source of greenhouse gases. Accordingly **Chapter 23** addresses the emissions of greenhouse gases using the Australian Department of Climate Change and Energy Efficiency, National Greenhouse Accounts (NGA) Factors' (June 2012).

In addition, it is noted that, emissions from trains on the GAP rail line were assessed as part of the Goonyella to Abbot Point Expansion (GAPE) Project EIS (and are therefore not included in the scope of this EIS). The assessment does however consider dust emissions from the operation of the two TLFs (north and south) between the CHPPs and the GAP rail line.

The storage and handling of potentially hazardous substances is described in **Chapter 32**. Material Safety Data Sheets (MSDS) will be available on site where these substances are to be stored or used and all substances will be stored and handled in accordance with the Australian Standards. Risks to air quality from hazardous substances will be managed in accordance with the measures described in **Chapter 32**.

Storage of construction materials will be within the footprint of project operations and are therefore considered as part of dust management on the project. Project construction and operational processes will result in the release of particulate matter into the atmosphere. There is a potential for the ground level concentration of particulates and deposition of particulate matter to exceed environmental air quality objectives (see **Section 22.3**).

The assessment of particulates identifies the following issues:

- the existing exposure level in the environment without the project
- the likely emissions from project activities incorporating controls for dust suppression provided by:;
  - rainfall
  - standard water application
  - enhanced water application
  - additional analysis of mine operations management measures to control dust in extreme weather scenarios to achieve compliance.
- the meteorology for the site to determine the off-site transport and dilution effects of the atmosphere
- calculated cumulative atmospheric dust concentration at nearest sensitive receptors, including the effects from other nearby proposed mines (See **Chapter 34**).

22.4.2 Modelling Methodology

Key stages in the project have been modelled using The Air Pollution Model (TAPM) developed at the Commonwealth Scientific and Industrial Research Organisation (CSIRO).The modelling adopted involved the identification of emissions for each hour over a two year period using TAPM derived meteorological data to refine the emission rates. This approach allowed a realistic estimate of dust emissions to be made incorporating the usual industry standard control methods adopted by mining operations.

A detailed modelling methodology is included in **Appendix 23**. In summary the air quality modelling methodology comprised three phases namely:

a) preparation of meteorological data
b) development of an emissions database using US-EPA AP-42 (2003) 5th Update 2003 and the Australian National Pollution Inventory (NPI) "Emission Estimation Technique Manual for Mining Version 2.3"
c) modelling of the likely downwind ground level concentrations using TAPM.

The averaging period for ground level concentrations of pollutants are consistent with the relevant averaging periods for air quality indicators and goals in the EPP (Air) 2008 and the National Environmental Protection Measure (NEPM) Air. The Terms of Reference (ToR) indicates that the modelling of PM_{10} is to be conducted for 1-hour, 24-hours and annual averaging periods. All modelling of dusts is based on a one hour modelling period, with the 24-hour and annual average periods calculated from the one hour modelling results.

22.4.3 Preparation of Meteorological Data

TAPM is highly regarded in the scientific community as a suitable tool to develop meteorological data sets for sites without site-specific meteorological observations. It predicts meteorology and pollutant concentration for a range of pollutants. The model predicts the flows important to local-scale air pollution, such as sea breezes and terrain induced flows, against a background of larger-scale meteorology.

The TAPM meteorological file developed for the site covered the two year period 2004 and 2005. This period was used for modelling since Queensland was generally free from extreme weather events such as cyclones. The years 2004 and 2005 were also towards the end of an extended drought, so the climate is representative of a period likely to experience naturally high dust exposures.

The general features of winds affecting plume dispersion are illustrated in the wind rose for the year 2004 and 2005 shown in **Figure 22-2** (see **Appendix 23** for tabulated values), which summarises the wind statistics at a 10 m height on site and the frequency of occurrence of winds by direction and strength in km/h. The most common winds are either from the N to NNE, approximately 23% of the time or from the E to SE, approximately 47% of the time.

Pasquil stability classes (based on data from TAPM) were used to represent the stability of the atmosphere. **Table 22-3** shows the frequency of stability classes for the project area.

Table 22-3 Frequency of Stability Classes for the Project Area

Stability Class	Description	Frequency of Occurrence (%)
A	Very unstable	3
B	Moderately unstable	11
C	Slightly unstable	23
D	Neutral	12
E	Slightly stable	25
F	Stable	26

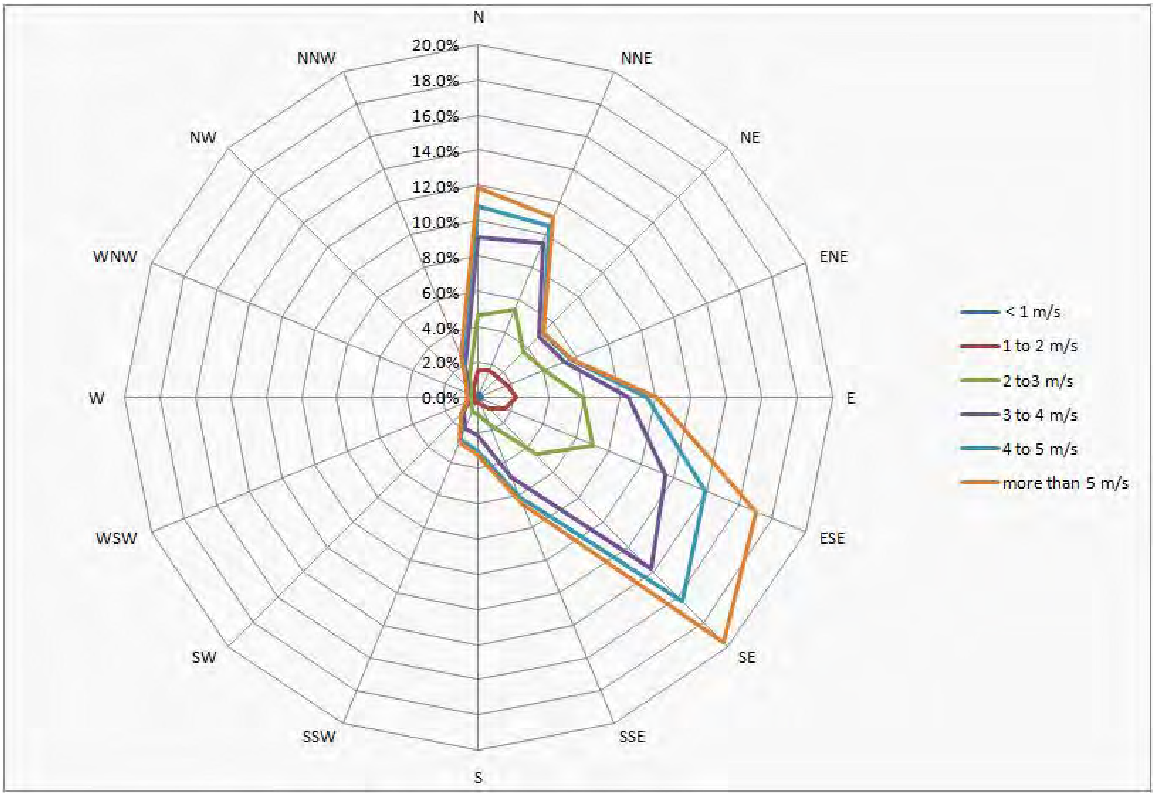


Figure 22-2 Annual Windrose for the Project Area

22.5 Potential Impacts on Air Quality

22.5.1 Development of the Emissions Database

22.5.1.1 Construction and Decommissioning Phases

Construction will involve vegetation clearance and some earthworks, but will be at a level of activity less than the operational coal mine. Decommissioning activities will involve infrastructure removal and final rehabilitation activities. Dust emissions will occur during construction and decommissioning. However the construction and decommissioning activities are relatively minor in comparison to emissions from the operational mine and will take place within the operational project footprint.

The construction and decommissioning phases have not been modelled since the dust emissions during these phases are predicted to be substantially lower than the emissions modelled for an operational mine. Conservatively, the assessment of the operational mine applies for all phases of the project life.

22.5.1.2 Operational Phase

The development of an accurate and representative emissions database has been primarily based on the National Pollution Inventory Emission Estimation Technique Manual for Mining Version 2.3 (NPI 2012) as well as US-EPA AP-42 (2003) 5th Update.

The main mining activities and processes that produce, or could produce, dust emissions were identified for the project operations. Flowcharts for handling of overburden, interburden, coal and waste rock were developed and an emission factor (from NPI) was attributed to every handling point, handling activity and transport section. In addition, emissions for exposed surfaces were identified and included in the database. It is not expected that haulage will occur outside of the project area on unsealed roads. Greenhouse gas emissions estimates provided in **Chapter 23** include emissions from the operation of haul trucks, with operation comprising all operational activities including operating on haul roads.

All emission factor equations and default emission factors in the NPI document are for uncontrolled emissions. However this database has included the control effects from rainfall and from dust suppression water trucks on haul roads. The effectiveness of dust controls has also been extracted from the NPI document. Several dust control activities have been provided at key emission points, as per **Table 22-4**.

The NPI 2012 describes standard (level 1) and enhanced (level 2) watering rates for dust control. Whilst there may be some onsite testing required to assess the actual water application rate, for the purposes of this assessment modelling assumes that enhanced (level 2) watering provides 75% dust control efficiency and standard (level 1) watering provides 50% dust control efficiency, compared to no watering. Level 2 controls may also comprise more specific methods for loading of haul trucks (designed to avoid spillage) and timely spillage control or spot watering of spills rather than a generalised increase in the watering rate for all hours and all roads.

Table 22-4 Dust Control for Mine (Mitigation) (Source NPI 2012)

Dust Source	Control	Effectiveness of Control
Pit retention factor	Natural ability of pits to retain dust	50% retention for TSP, 5% retention for PM_{10} and $PM_{2.5}$
Haul roads	Enhanced watering (Level 2)	Up to 75%, see discussion
Haul roads	Standard watering (Level 1)	Up to 50%, see discussion
Haul roads	Chemical	Up to 95% control

Dust Source	Control	Effectiveness of Control
Spray cannons	During overburden dumping by truck	Up to 50% control

In summary, the model uses a methodology which provides an emission rate from every operation, for each hour of the simulation period and includes the effects of dust emission controls due to rainfall and the operation of water trucks. The emissions from wind-generated dusts have also been included, with control only provided by rainfall. The dust emissions were calculated for every hour of the day for the two years of the modelling simulation.

The reported emission database excludes the pit retention factor[2]. Heavier fractions of dust tend to be trapped by the pit and the emission reduction factor specified in the NPI 2012 is 50% for TSP, 5% for PM_{10} and 5% for $PM_{2.5}$ is included in the modelling.

The main dust sources comprise dragline operation, trucks and shovels, unpaved roads, dumping ROM coal, dumping and spreading overburden and loading trucks and trains.

Since the pit is progressively backfilled as mining progresses eastwards, waste rock emplacement will take place in the pit. The emplacement and re-profiling of waste rock also takes place on waste rock emplacements elevated above the pit. Once final heights of the waste rock dumps are reached they will be progressively rehabilitated.

Three main cases (modelling scenarios) are addressed representing Year 5, Year 17 and Year 36 of operations:

- **Case 1 (Year 5)** - The modelling year is during the initial phase of the mine, Year 5 when the projected waste rock is 142.2 million bank cubic meters (Mbcm). The ROM coal for this year is approximately 15 Mtpa. The mining taking place in West Pit 1 and South Pit 2 is in an early development phase with out of pit dumping of overburden.
- **Case 2 (Year 17)** - The modelling year includes the initial stage of the North Pit and the South and West Pits are well developed with in-pit placement of waste rock. The waste rock for the year is approximately 125.8 Mbcm. The ROM coal for this year is approximately 15 Mtpa.
- **Case 3 (Year 36)** - The modelling year includes the two East Pits. The North Pit and northern ROM has ceased operation. The projected waste rock volume is 166.1 Mtpa and ROM coal is approximately 15 Mtpa.

A description of modelling years and annual emission rates from each activity in each location are provided in **Appendix 23**. The methodology for calculating emission rates inherently addresses the worst case emissions scenario. Specifically the modelling contains the following:

- The models have been based on the maximum production rate likely during the life of the mine.
- The model comprises 52 weeks of operation with a 9% contingency factor.
- The level of dust control is randomly varied for each hour throughout the year, from effective to not very effective control. This is particularly relevant to the watering of roads since it is possible watering is not applied as often as required for the heat load or truck usage rates. Hence the modelling incorporates a less than optimum dust control throughout the modelling period and in

[2] The pit retention factor is used in the modelling of dust emissions from mines to represent the natural tendency of larger dust particles to remain within the pit, and thus not become a nuisance to health at residential locations.

doing so it implies that worst-case emissions (low levels of dust control) are also incorporated in the modelling.

- The modelling is based on a two year modelling simulation, specifically years 2004 and 2005. These were years that were in the middle of a six year period of below average rainfall for Queensland. The period was also hotter than the long-term average for Queensland and with lower than average high wind events. All of these considerations imply that adopting the years 2004 and 2005 for the purpose of the simulation will lead to 'worst case' meteorology.

Hence, all aspects of the modelling have been designed to achieve realistic worst-case down-wind atmospheric dust concentrations for modelling dust emissions from project activities.

22.5.2 Results of Dispersion Modelling – Dust Emissions

The calculated dust emissions described in **Section 22.5** were included in the TAPM model at the appropriate locations. The likely dust concentration and dust deposition levels, from operation of the mine, at each nearby sensitive receptor are shown in **Table 22-5** to **Table 22-8** for:

- Year 5 with standard dust controls
- Year 5 with enhanced dust control
- Year 17 with enhanced dust control
- Year 36 with enhanced dust control.

Standard dust controls were modelled for Year 5 only, to provide a starting point of reference to guide the control levels that would be most relevant for subsequent modelling runs. Results showed that for Years 17 and 36, modelling runs using enhanced dust control would be more relevant.

The predicted dust concentration/deposition presented include the assumed background level.

Table 22-5 Predicted Dust Concentration and Dust Deposition at Sensitive Receptors (Including Assumed Ambient Levels) – Year 5 Standard Controls

Receptor	Calculated dust levels at nearby residences					
	$PM_{2.5}$(24 hour) (maximum) (µg/m^3)	$PM_{2.5}$ (annual average) (µg/m^3)	PM_{10}(24 hour) (5th highest) (µg/m^3)	PM_{10}(24 hour) (µg/m^3)	TSP (annual average) (µg/m^3)	Dust Deposition (maximum month) (mg/m^2/day)
Air quality objectives	**25**	**8**	**50**	**NA***	**90**	**120**
Existing ambient	**12**	**5**	**19**	**19**	**25**	**43**
R2 Suttor Creek Station Homestead	15	5	26	38	26	50
R3 Lancewood Station Homestead	17	5	26	59	26	50
R5 Cerito Station Homestead	19	6	64	75	35	75
R6 Byerwen Station Homestead	15	5	34	45	26	45
R7 Weetalaba Station Homestead	15	5	29	39	26	45

Receptor	Calculated dust levels at nearby residences					
	$PM_{2.5}$(24 hour) (maximum) (µg/m^3)	$PM_{2.5}$ (annual average) (µg/m^3)	PM_{10}(24 hour) (5th highest) (µg/m^3)	PM_{10}(24 hour) (µg/m^3)	TSP (annual average) (µg/m^3)	Dust Deposition (maximum month) (mg/m^2/day)
R8 Glenden Station Homestead	13	5	21	31	25	45
R10 Fig Tree Station Homestead	14	5	27	34	26	45
Glenden Township	13	5	21	29	25	47

*The PM10 (24 hour) maximum is shown for comparative purposes only. The PM10 (24 hour) air quality objective is established in the EPP (Air) as being for the 5th highest exceedance.

Table 22-6 Predicted Dust Concentration and Dust Deposition at Sensitive Receptors (Including Assumed Ambient Levels) – Year 5 - With Enhanced Dust Controls

Receptor	Calculated dust levels at nearby residences					
	$PM_{2.5}$(24 hour) (maximum) (µg/m^3)	$PM_{2.5}$ (annual average) (µg/m^3)	PM_{10}(24 hour) (5th highest) (µg/m^3)	PM_{10}(24 hour) (µg/m^3)	TSP (annual average) (µg/m^3)	Dust Deposition (maximum month) (mg/m^2/day)
Air quality objectives	**25**	**8**	**50**	**NA***	**90**	**120**
Existing ambient	**12**	**5**	**19**	**19**	**25**	**43**
R2 Suttor Creek Station Homestead	14	5.0	25	37	26	48
R3 Lancewood Station Homestead	16	5.0	25	50	26	48
R5 Cerito Station Homestead	18	5.3	55	68	32	68
R6 Byerwen Station Homestead	15	5.0	30	40	26	45
R7 Weetalaba Station Homestead	14	5.0	28	40	26	45
R8 Glenden Station Homestead	13	5.0	21	38	25	45
R10 Fig Tree Station Homestead	13	5.0	27	30	26	45
Glenden Township	13	5.0	21	28	25	45

*The PM10 (24 hour) maximum is shown for comparative purposes only. The PM10 (24 hour) air quality objective is established in the EPP (Air) as being for the 5th highest exceedance.

Table 22-7 Predicted Dust Concentration and Dust Deposition at Sensitive Receptors (Including Assumed Ambient Levels) – Year 17 - With Enhanced Dust Controls

Receptor	Calculated dust levels at nearby residences					
	$PM_{2.5}$(24 hour) (maximum) (µg/m^3)	$PM_{2.5}$ (annual average) (µg/m^3)	PM_{10}(24 hour) (5th highest) (µg/m^3)	PM_{10}(24 hour) (µg/m^3)	TSP (annual average) (µg/m^3)	Dust Deposition (maximum month) (mg/m^2/day)
Air quality objectives	**25**	**8**	**50**	**NA***	**90**	**120**
Existing ambient	**12**	**5**	**19**	**19**	**25**	**43**
R2 Suttor Creek Station Homestead	16	5	28	44	26	48
R3 Lancewood Station Homestead	17	5	28	61	26	50
R5 Cerito Station Homestead	18	6	54	64	35	66
R6 Byerwen Station Homestead	16	5	37	47	26	48
R7 Weetalaba Station Homestead	17	5	29	39	26	48
R8 Glenden Station Homestead	13	5	21	31	25	48
R10 Fig Tree Station Homestead	14	5	29	34	26	48
Glenden Township	13	5	21	29	25	48

*The PM10 (24 hour) maximum is shown for comparative purposes only. The PM10 (24 hour) air quality objective is established in the EPP (Air) as being for the 5th highest exceedance.

Table 22-8 Predicted Dust Concentration and Dust Deposition at Sensitive Receptors (Including Assumed Ambient Levels) – Year 36 - With Enhanced Dust Controls

Receptor	Calculated dust levels at nearby residences					
	$PM_{2.5}$(24 hour) (maximum) (µg/m^3)	$PM_{2.5}$ (annual average) (µg/m^3)	PM_{10}(24 hour) (5th highest) (µg/m^3)	PM_{10}(24 hour) (µg/m^3)	TSP (annual average) (µg/m^3)	Dust Deposition (maximum month) (mg/m^2/day)
Air quality objectives	**25**	**8**	**50**	**NA***	**90**	**120**
Existing ambient	**12**	**5**	**19**	**19**	**25**	**43**
R2 Suttor Creek Station Homestead	17	5	29	49	26	49
R3 Lancewood Station Homestead	22	5	29	89	27	55
R5 Cerito Station Homestead	22	6	74	98	40	85

Receptor	Calculated dust levels at nearby residences					
	$PM_{2.5}$(24 hour) (maximum) (µg/m^3)	$PM_{2.5}$ (annual average) (µg/m^3)	PM_{10}(24 hour) (5th highest) (µg/m^3)	PM_{10}(24 hour) (µg/m^3)	TSP (annual average) (µg/m^3)	Dust Deposition (maximum month) (mg/m^2/day)
R6 Byerwen Station Homestead	20	5	44	70	27	48
R7 Weetalaba Station Homestead	17	5	35	54	26	50
R8 Glenden Station Homestead	14	5	23	34	25	48
R10 Fig Tree Station Homestead	16	5	34	44	26	46
Glenden Township	14	5	23	29	25	48

*The PM10 (24 hour) maximum is shown for comparative purposes only. The PM10 (24 hour) air quality objective is established in the EPP (Air) as being for the 5th highest exceedance.

The calculated dust deposition and concentration contours for Year 5, 17 and 36 are contained in the following figures:

Year 5 Enhanced Dust Controls:

- **Figure 22-3** Year 5 - Maximum $PM_{2.5}$ (24 hour) (Enhanced Dust Controls)
- **Figure 22-4** Year 5 - $PM_{2.5}$ (Annual Average) (Enhanced Dust Controls)
- **Figure 22-5** Year 5 - 5th Highest PM_{10} (24 hour) (Enhanced Dust Controls)
- **Figure 22-6** Year 5 - TSP (Annual Average) (Enhanced Dust Controls)
- **Figure 22-7** Year 5 - Dust Deposition (Maximum Month) (Enhanced Dust Controls).

Year 17 Enhanced Dust Controls:

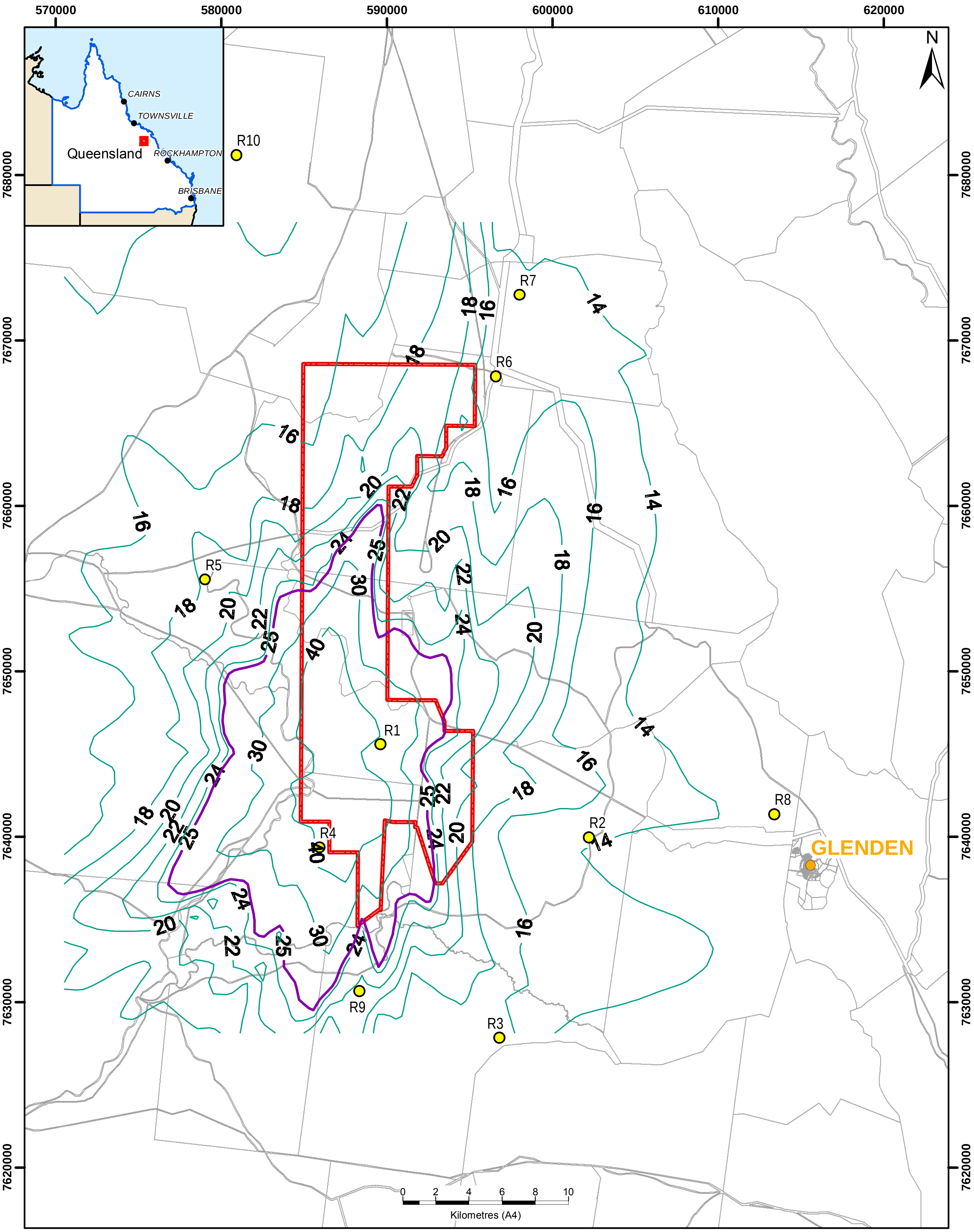
- **Figure 22-8** Year 17 - Maximum $PM_{2.5}$ (24 hour) (Enhanced Dust Controls)
- **Figure 22-9** Year 17 - $PM_{2.5}$ (Annual Average) (Enhanced Dust Controls)
- **Figure 22-10** Year 17 - 5th Highest PM_{10} (24 hour) (Enhanced Dust Controls)
- **Figure 22-11** Year 17 - TSP (Annual Average) (Enhanced Dust Controls)
- **Figure 22-12** Year 17 - Dust Deposition (Maximum Month) (Enhanced Dust Controls).

Year 36 Enhanced Dust Controls:

- **Figure 22-13** Year 36 - Maximum $PM_{2.5}$ (24 hour) (Enhanced Dust Controls)
- **Figure 22-14** Year 36 - $PM_{2.5}$ (Annual Average) (Enhanced Dust Controls)
- **Figure 22-15** Year 36 - 5th Highest PM_{10} (24 hour) (Enhanced Dust Controls)
- **Figure 22-16** Year 36 - TSP (Annual Average) (Enhanced Dust Controls)
- **Figure 22-17** Year 36 - Dust Deposition (Maximum Month) (Enhanced Dust Controls).

Figures showing Year 5 dust deposition and concentration contours using standard dust controls are provided in **Appendix 23**.

The predicted dust concentration/deposition presented in **Table 22-5** to **Table 22-8** and **Figure 22-3** to **Figure 22-17** include the assumed background level.



Legend

Project Area	Maximum $PM_{2.5}$(24 hour) [µg/m^3]
Cadastre	Air Quality Objective Contour
Potentially Sensitive Receptors	

Year 5 - Maximum $PM_{2.5}$ (24 hour) (Enhanced Dust Controls)

QCOAL GROUP

Figure 22-3

Byerwen Coal Project

Date: *5/03/2013*

Author: samuel.ferguson

Map Scale: 1:300,000

Revision: R1

Coordinate System: GDA 1994 MGA Zone 55

environmental and licensing professionals pty ltd

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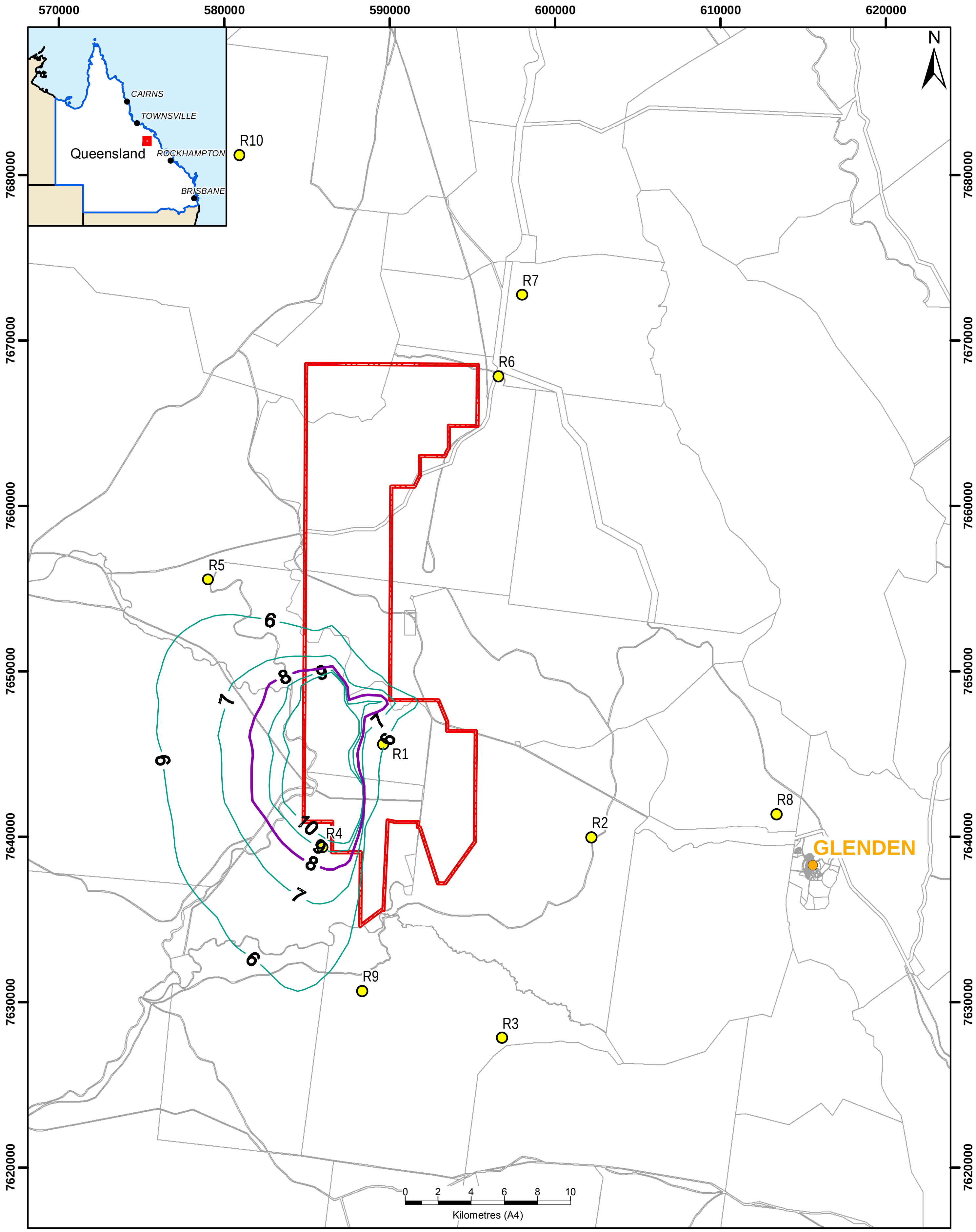

Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors
- $PM_{2.5}$ (Annual Average) [$\mu g/m^3$]
- Air Quality Objective Contour

Year 5 - $PM_{2.5}$ (Annual Average) (Enhanced Dust Controls)		QCOAL GROUP
Figure 22-4	Byerwen Coal Project	environmental and licensing professionals pty ltd
Date: 5/03/2013	**Author:** samuel.ferguson **Map Scale:** 1:300,000	
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55	
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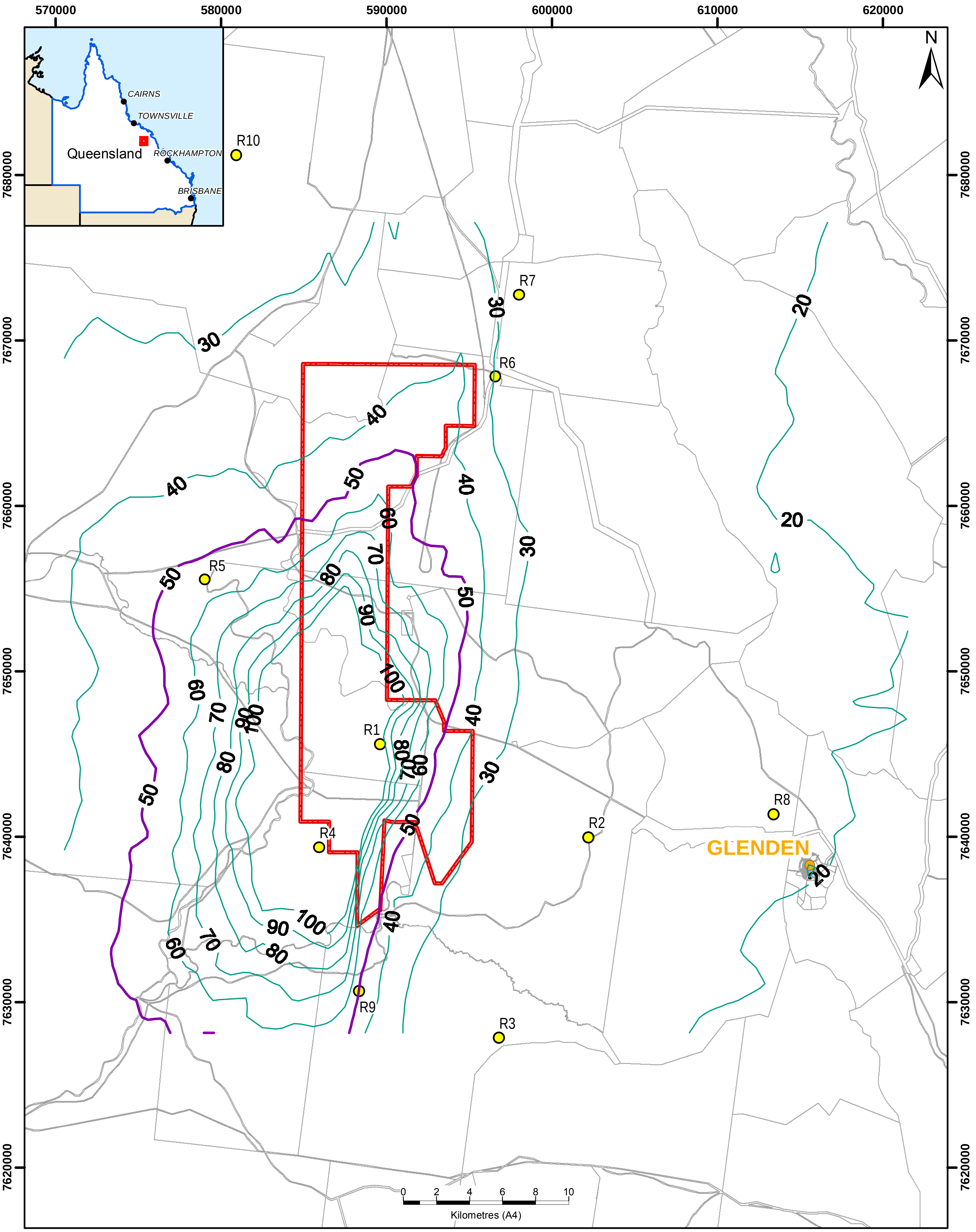

Legend

Project Area

Cadastre

Potentially Sensitive Receptors

5th Highest PM_{10} (24 hour) [μg/m^3]

Air Quality Objective Contour

Year 5 - 5th Highest PM_{10} (24 hour) (Enhanced Dust Controls)	
Figure 22-5	Byerwen Coal Project
Date: *5/03/2013*	**Author:** samuel.ferguson
	Map Scale: 1:300,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55

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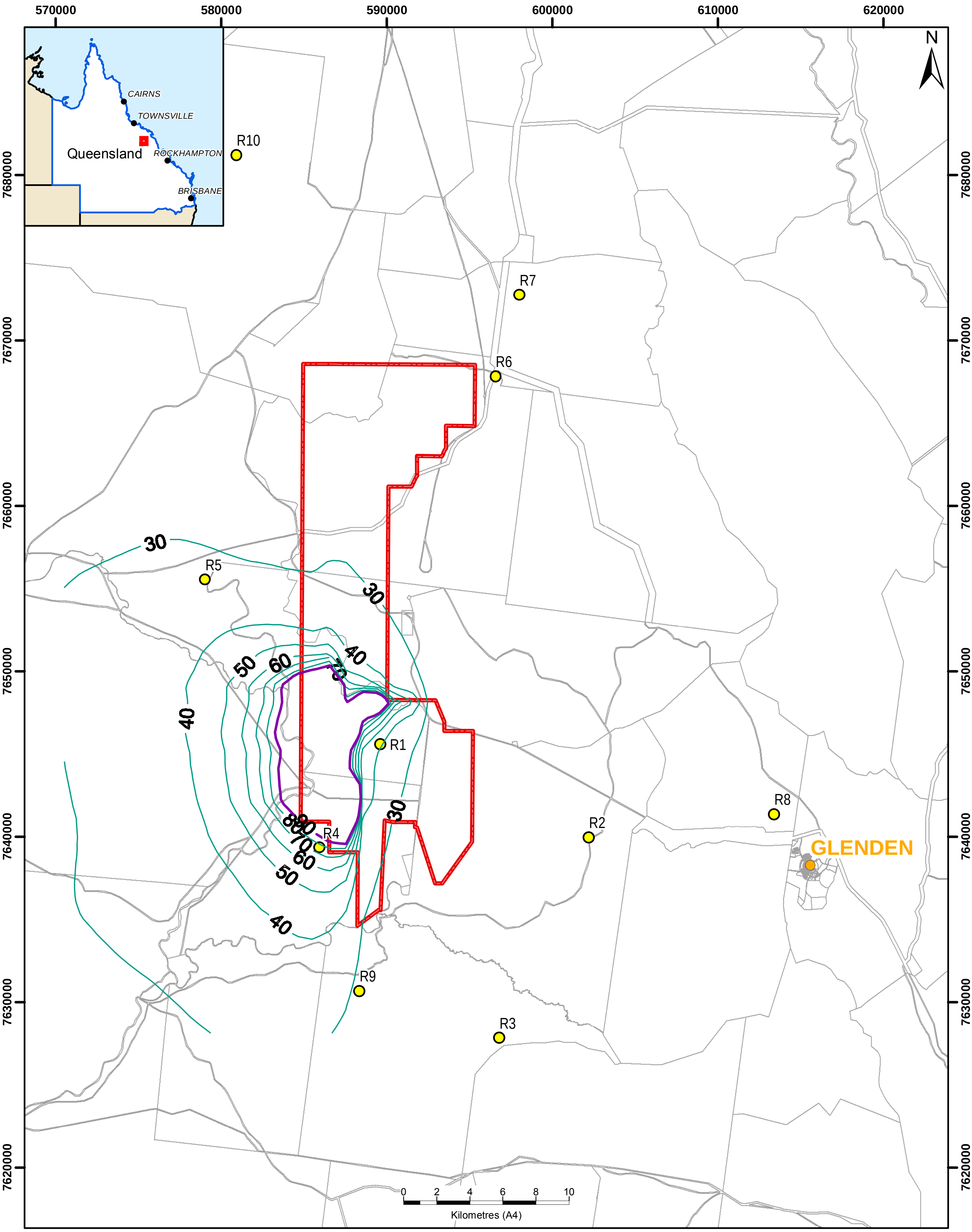

Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors
- TSP (Annual Average) [$\mu g/m^3$]
- Air Quality Objective Contour

Year 5 - TSP (Annual Average) (Enhanced Dust Controls)		
Figure 22-6	Byerwen Coal Project	
Date: 5/03/2013	Author: samuel.ferguson	
	Map Scale: 1:300,000	
Revision: R1	Coordinate System: GDA 1994 MGA Zone 55	
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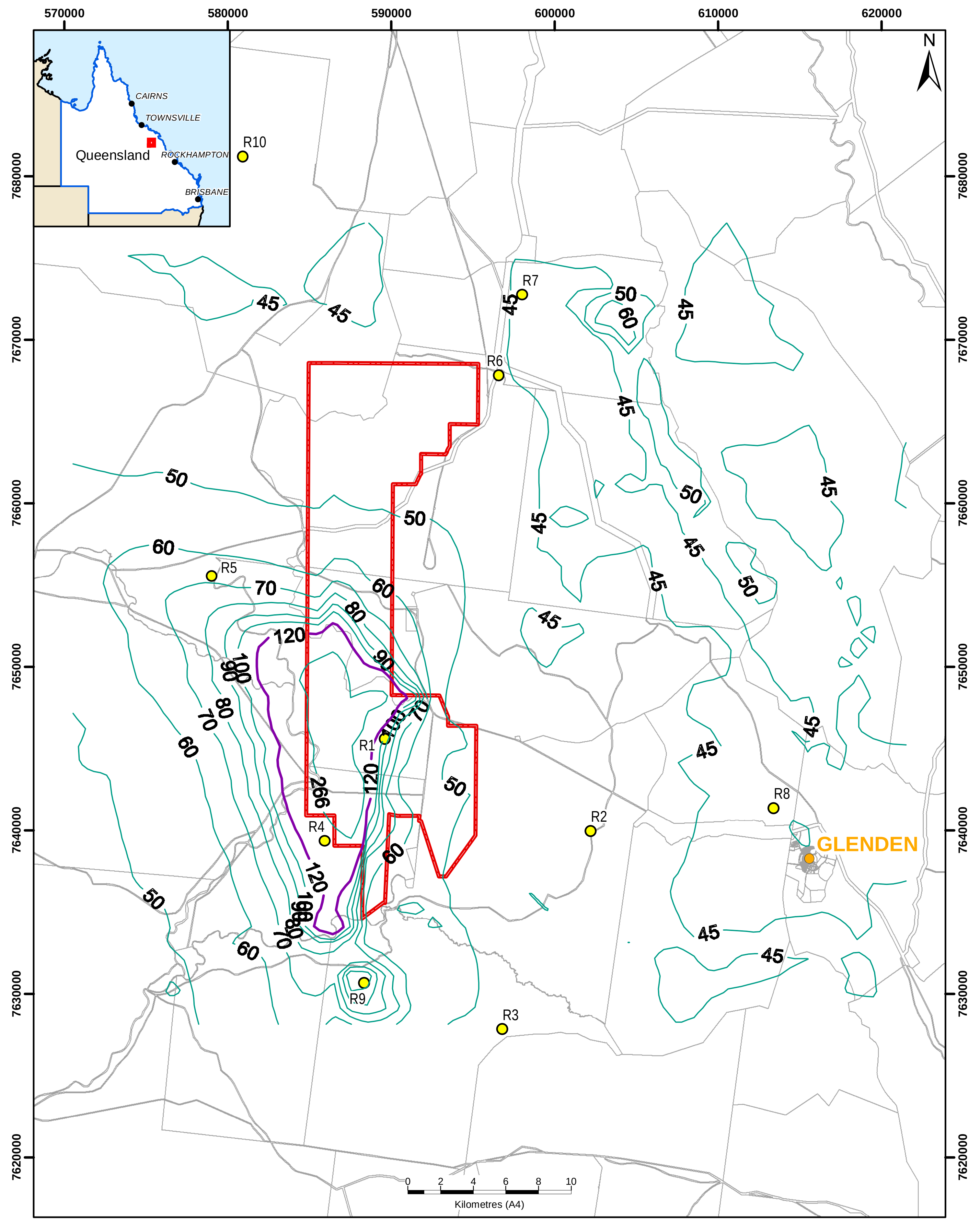

Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors
- Dust Deposition [mg/m^2/day]
- Air Quality Objective Contour

Year 5 - Dust Deposition (Maximum Month) (Enhanced Dust Controls)

Figure 22-7

Byerwen Coal Project

Date: *5/03/2013*

Author: samuel.ferguson

Map Scale: 1:300,000

Revision: R1

Coordinate System: GDA 1994 MGA Zone 55

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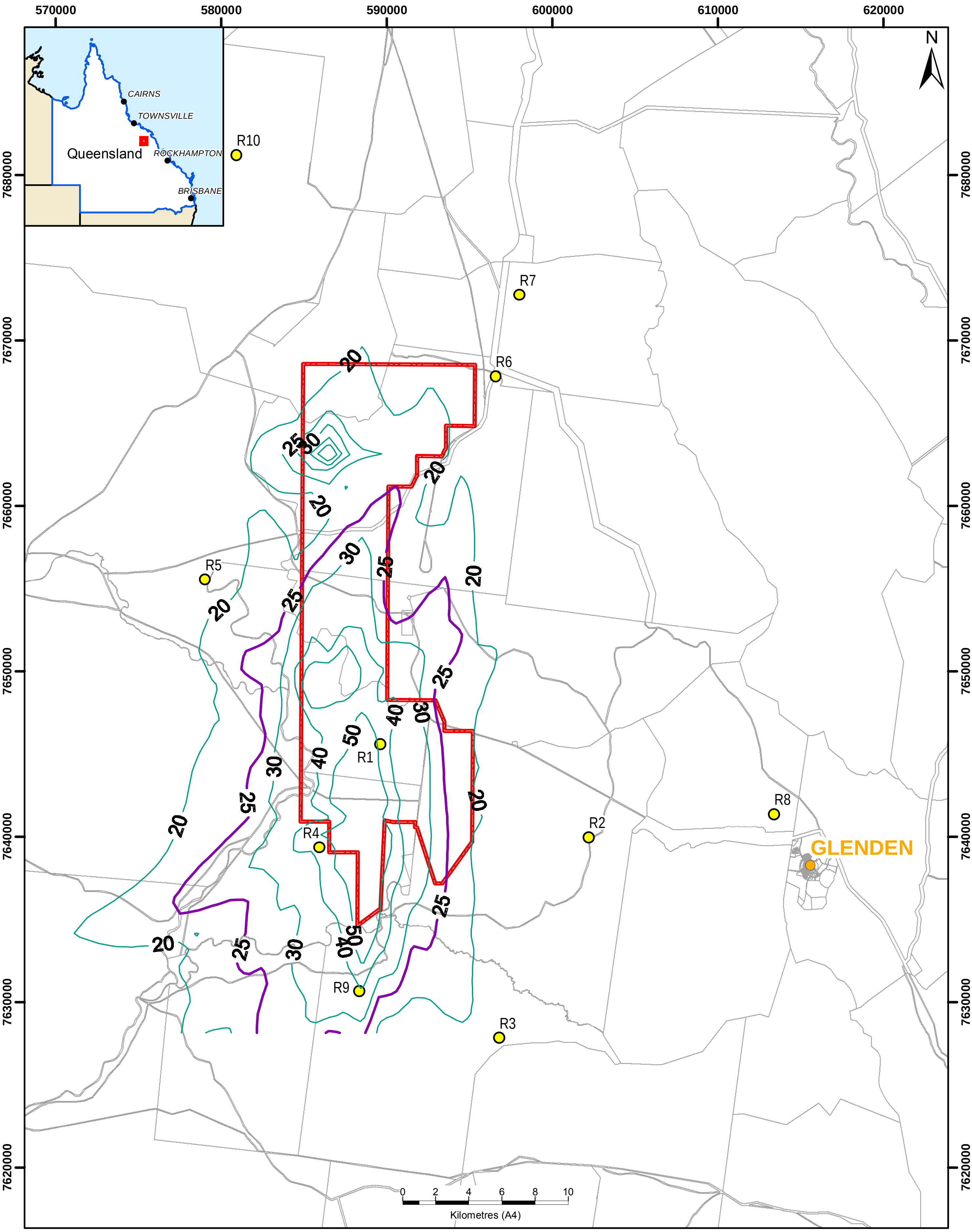

Legend

Project Area

Cadastre

Potentially Sensitive Receptors

Maximum $PM_{2.5}$(24 hour) [$\mu g/m^3$]

Air Quality Objective Contour

Year 17 - Maximum $PM_{2.5}$ (24 hour) (Enhanced Dust Controls)	
Figure 22-8	Byerwen Coal Project
Date: *5/03/2013*	**Author:** samuel.ferguson
	Map Scale: 1:300,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55

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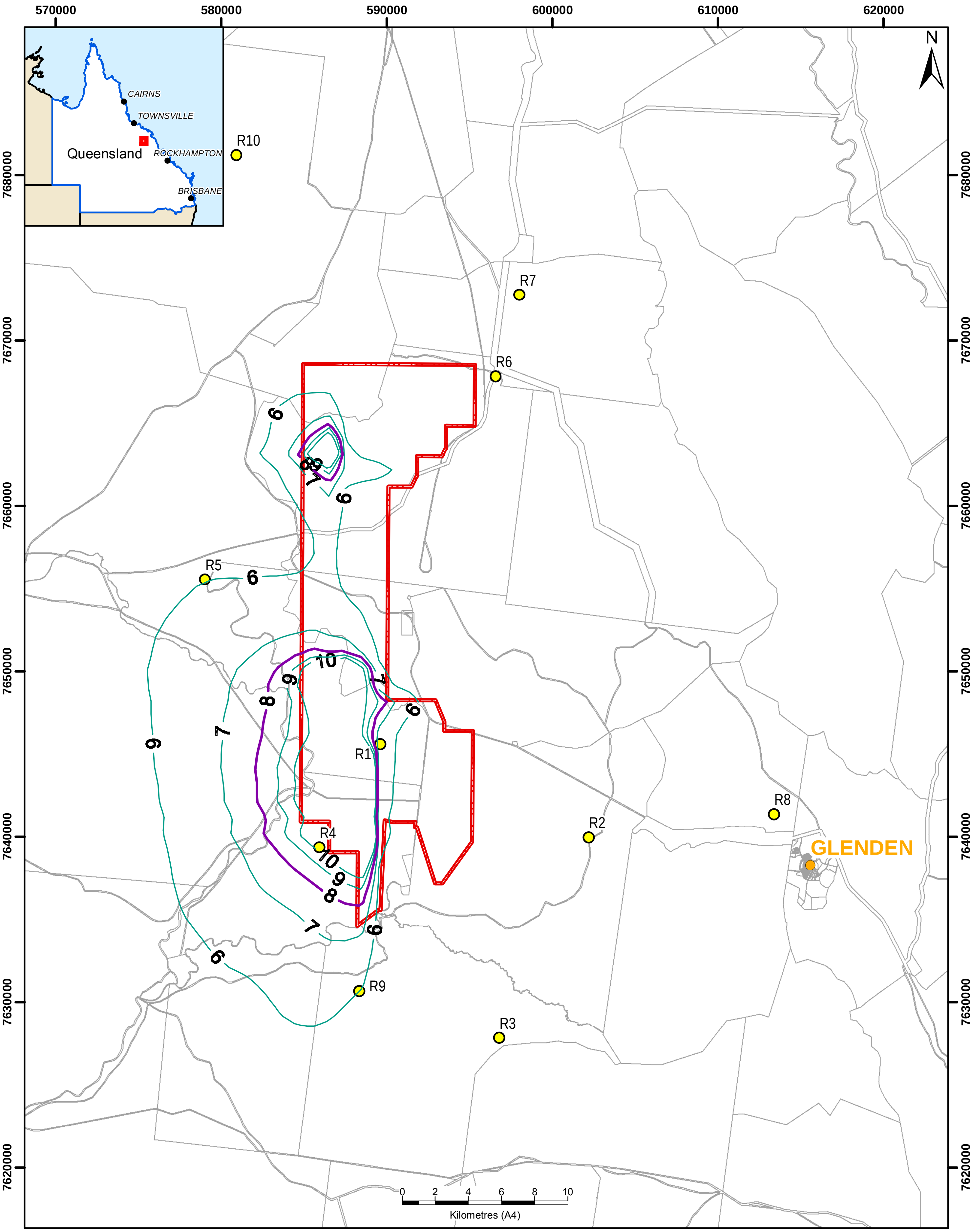

Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors
- $PM_{2.5}$ (Annual Average) [µg/m^3]
- Air Quality Objective Contour

Year 17 - $PM_{2.5}$ (Annual Average) (Enhanced Dust Controls)	
Figure 22-9	Byerwen Coal Project
Date: 5/03/2013	**Author:** samuel.ferguson **Map Scale:** 1:300,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55

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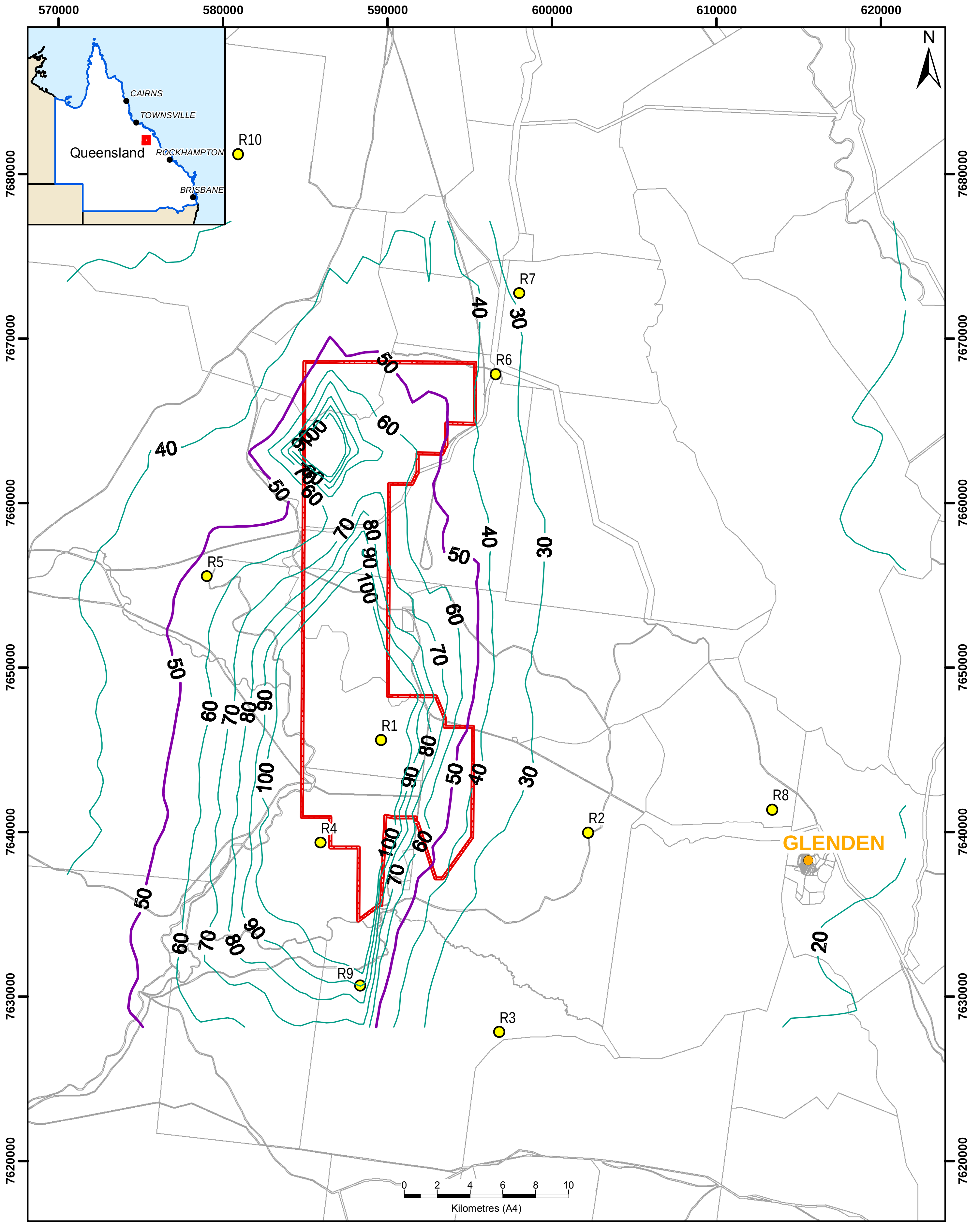

Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors
- 5th Highest PM_{10} (24 hour) [µg/m^3]
- Air Quality Objective Contour

Year 17 - 5th Highest PM_{10} (24 hour) (Enhanced Dust Controls)	QCOAL GROUP
Figure 22-10	Byerwen Coal Project
Date: 5/03/2013	Author: samuel.ferguson
	Map Scale: 1:300,000
Revision: R1	Coordinate System: GDA 1994 MGA Zone 55

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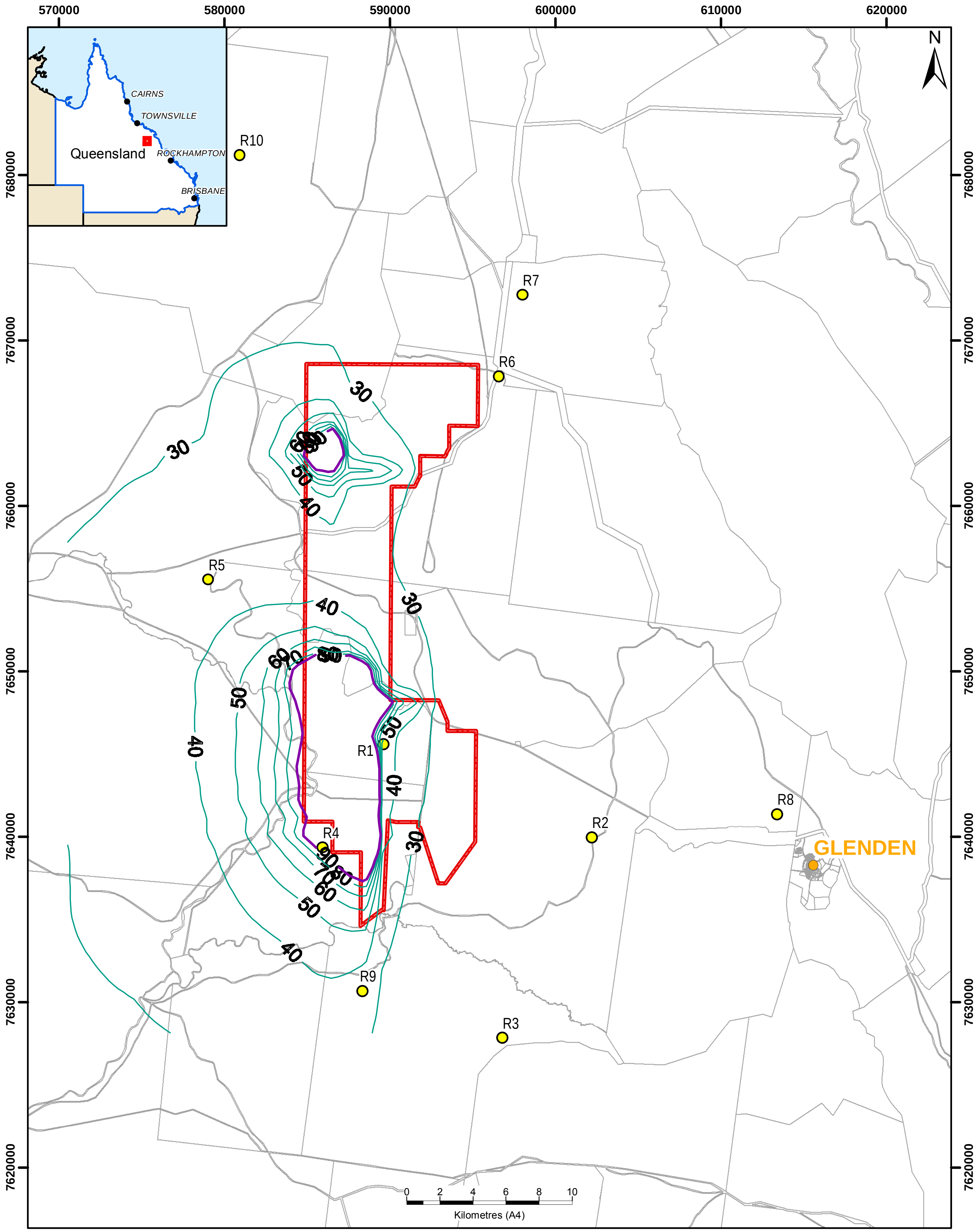

Legend

Project Area

Cadastre

Potentially Sensitive Receptors

TSP (Annual Average) [μg/m^3]

Air Quality Objective Contour

Year 17 - TSP (Annual Average) (Enhanced Dust Controls)	
Figure 22-11	Byerwen Coal Project
Date: 5/03/2013	**Author:** samuel.ferguson **Map Scale:** 1:300,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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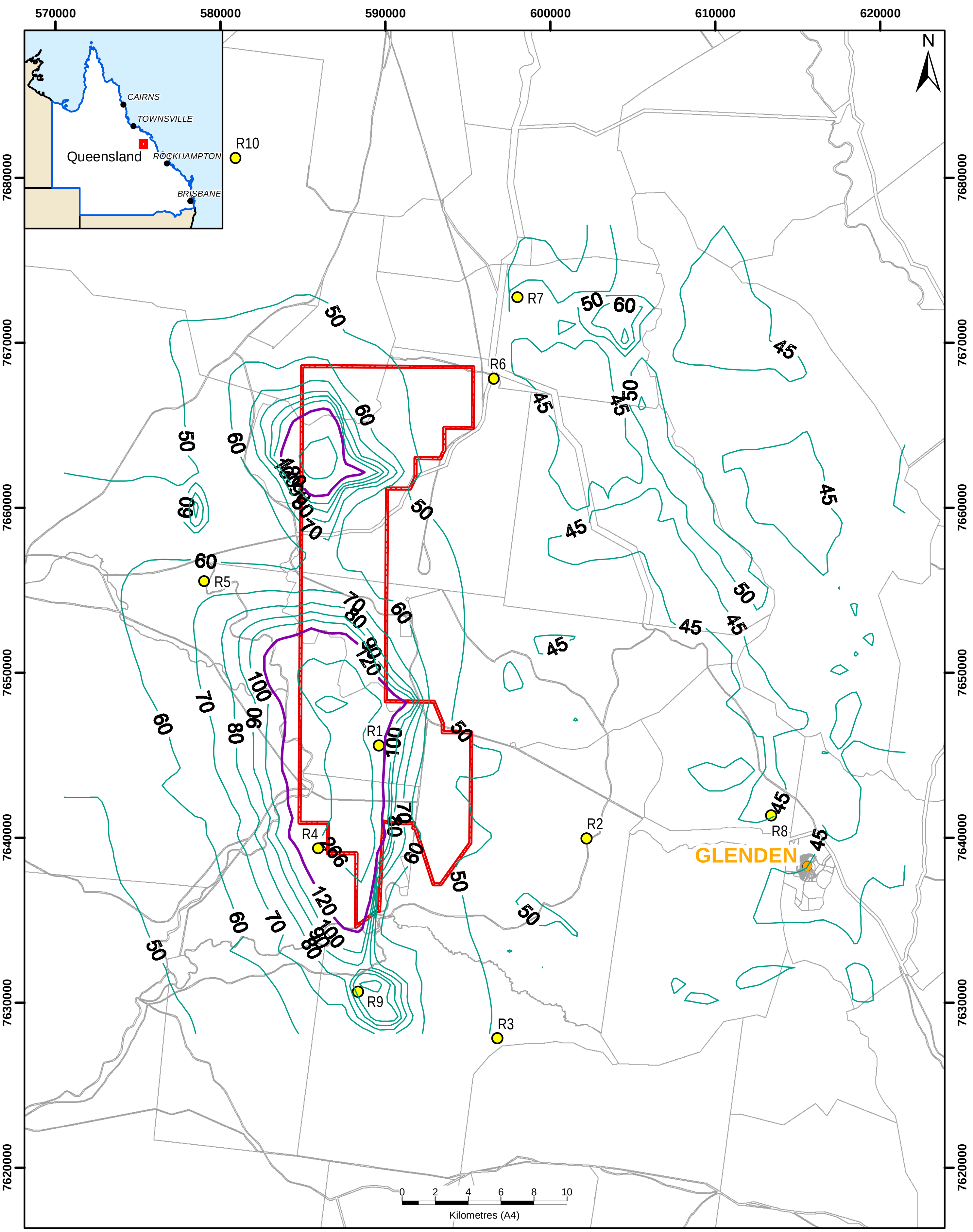

Legend

Project Area

Cadastre

Potentially Sensitive Receptors

Dust Deposition [mg/m^2/day]

Air Quality Objective Contour

Year 17 - Dust Deposition (Maximum Month) (Enhanced Dust Controls)		QCOAL GROUP
Figure 22-12	Byerwen Coal Project	elp environmental and licensing professionals pty ltd
Date: 5/03/2013	Author: samuel.ferguson Map Scale: 1:300,000	
Revision: R1	Coordinate System: GDA 1994 MGA Zone 55	
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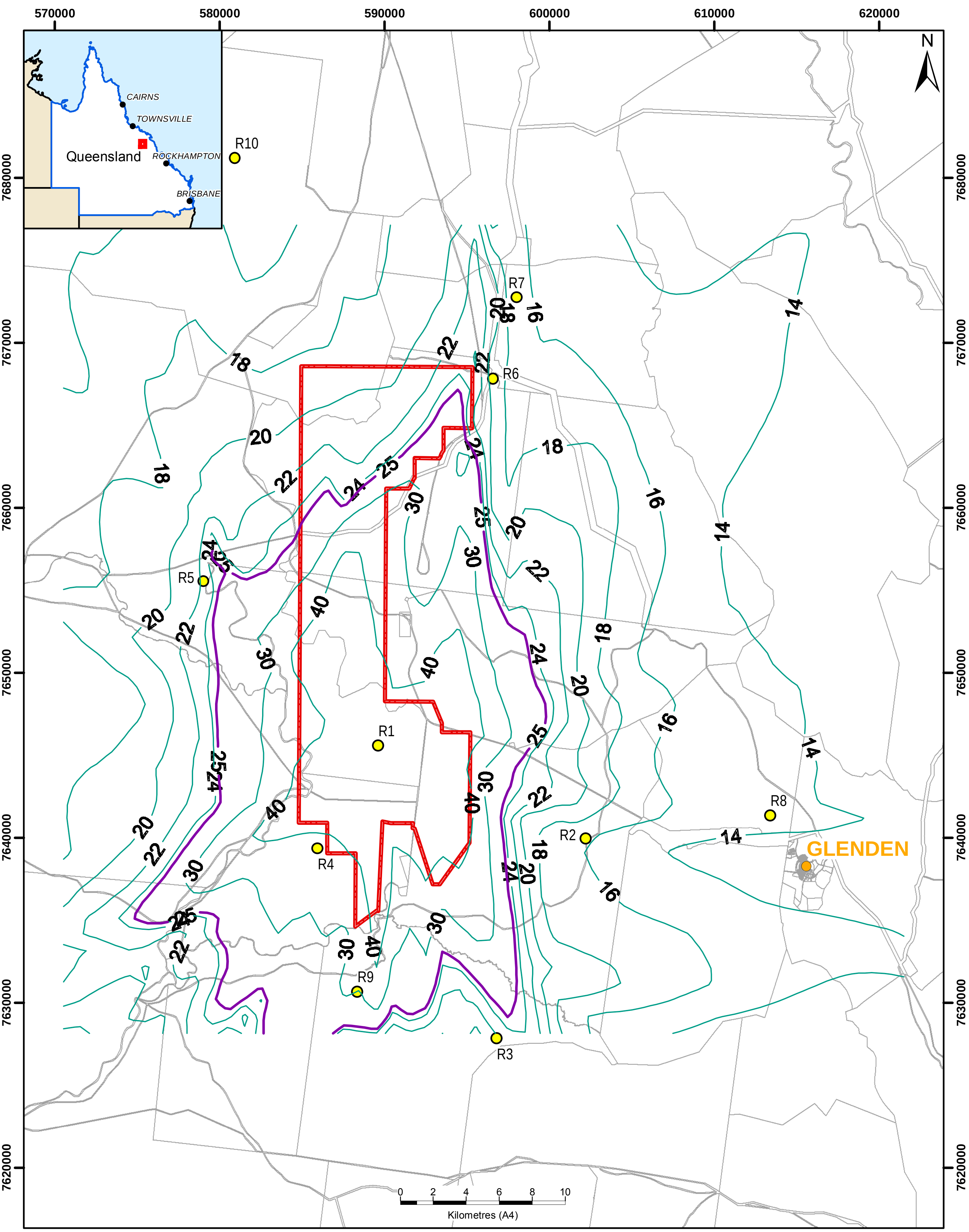

Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors
- Maximum $PM_{2.5}$(24 hour) [μg/m^3]
- Air Quality Objective Contour

Year 36 - Maximum $PM_{2.5}$ (24 hour) (Enhanced Dust Controls)	
Figure 22-13	Byerwen Coal Project
Date: 5/03/2013	Author: samuel.ferguson Map Scale: 1:300,000
Revision: R1	Coordinate System: GDA 1994 MGA Zone 55

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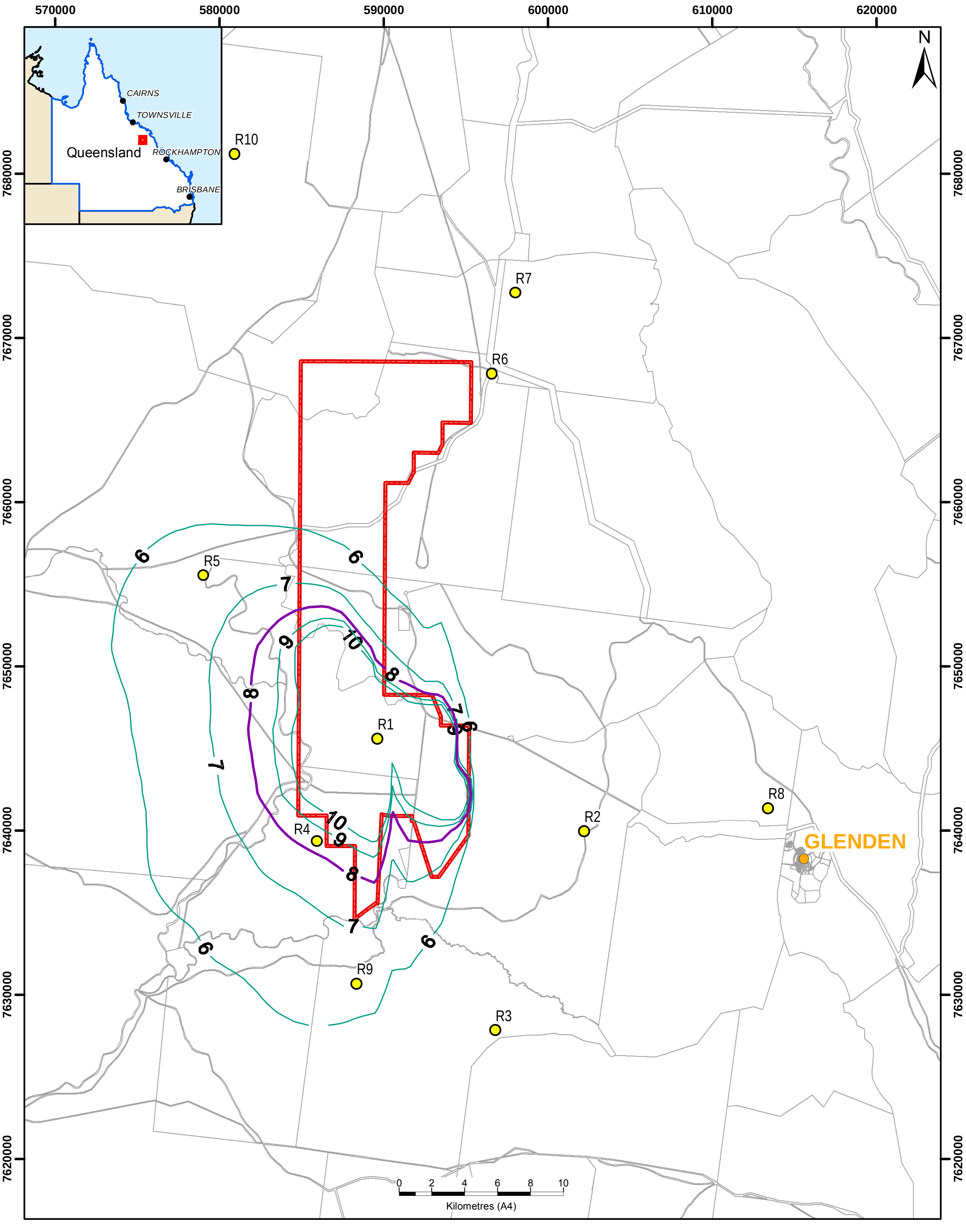

Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors
- $PM_{2.5}$ (Annual Average) [$\mu g/m^3$]
- Air Quality Objective Contour

Year 36 - $PM_{2.5}$ (Annual Average) (Enhanced Dust Controls)	
Figure 22-14	Byerwen Coal Project
Date: 5/03/2013	**Author:** samuel.ferguson **Map Scale:** 1:300,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55
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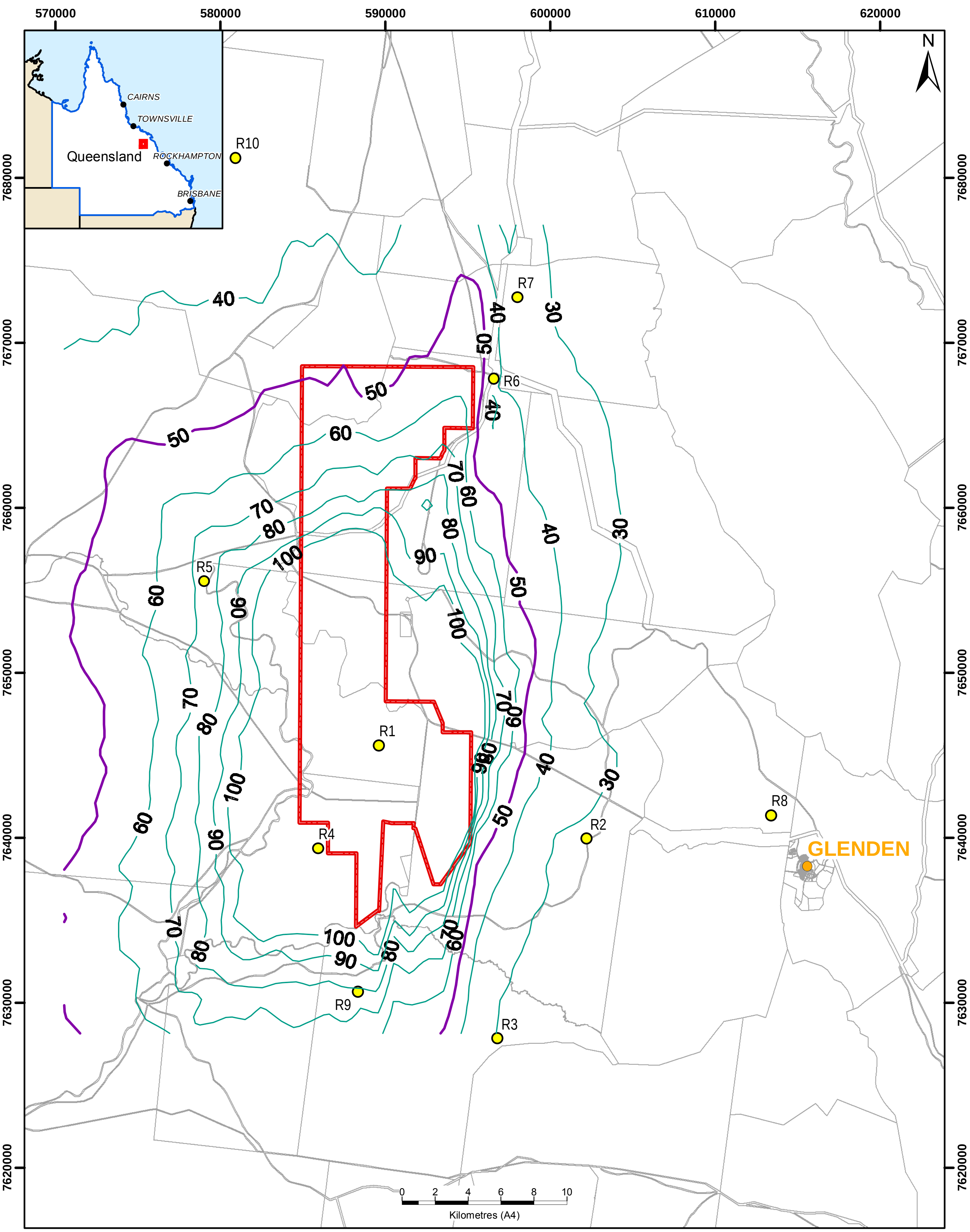

Legend

- Project Area
- Cadastre
- Potentially Sensitive Receptors
- 5th Highest PM_{10} (24 hour) [$\mu g/m^3$]
- Air Quality Objective Contour

Year 36 - 5th Highest PM_{10} (24 hour) (Enhanced Dust Controls)	QCOAL GROUP
Figure 22-15	Byerwen Coal Project
Date: 5/03/2013	Author: samuel.ferguson
	Map Scale: 1:300,000
Revision: R1	Coordinate System: GDA 1994 MGA Zone 55
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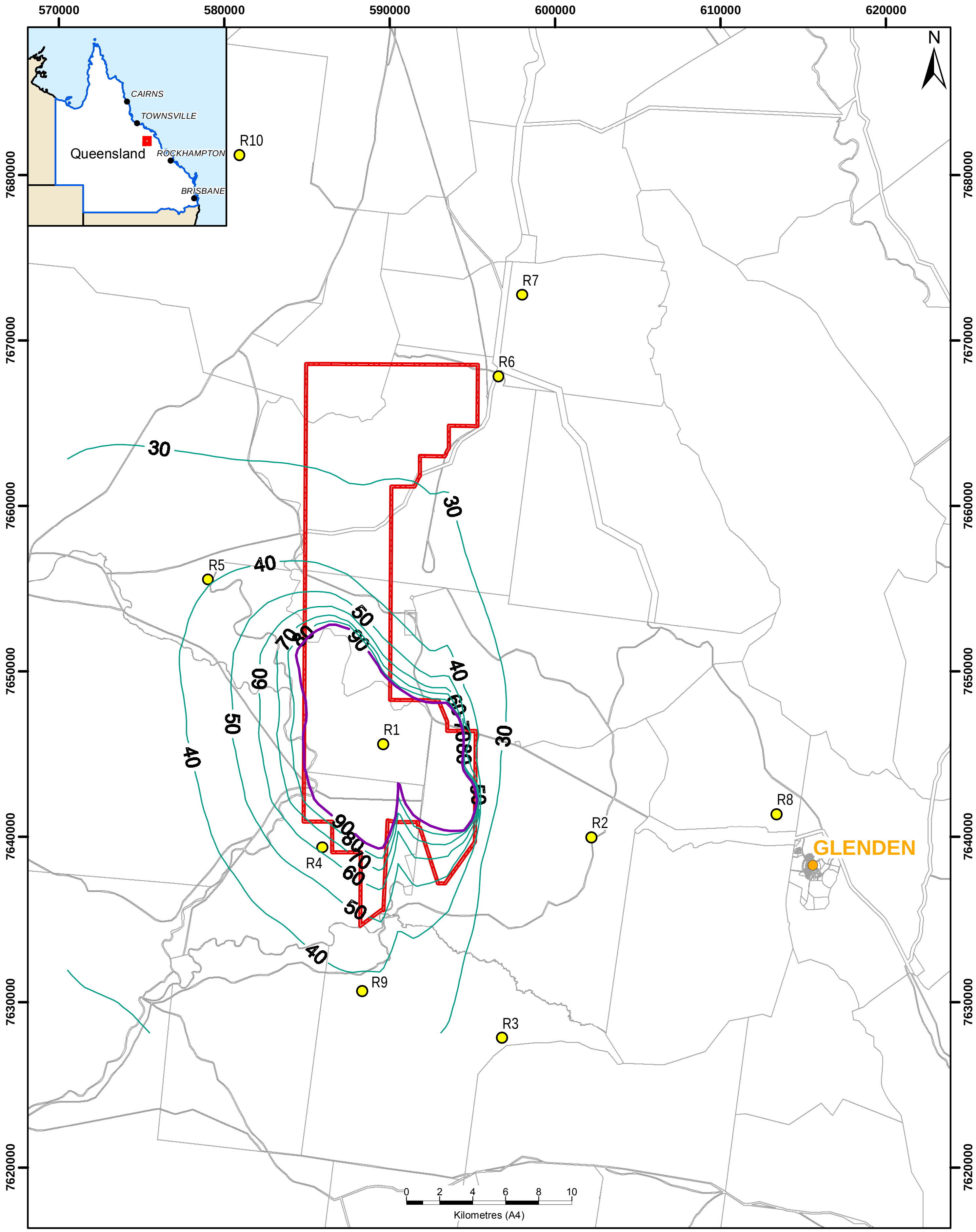

Legend

Project Area

Cadastre

Potentially Sensitive Receptors

TSP (Annual Average) [μg/m^3]

Air Quality Objective Contour

Year 36 - TSP (Annual Average) (Enhanced Dust Controls)	QCOAL GROUP
Figure 22-16	**Byerwen Coal Project**
Date: *5/03/2013*	**Author:** samuel.ferguson **Map Scale:** 1:300,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55

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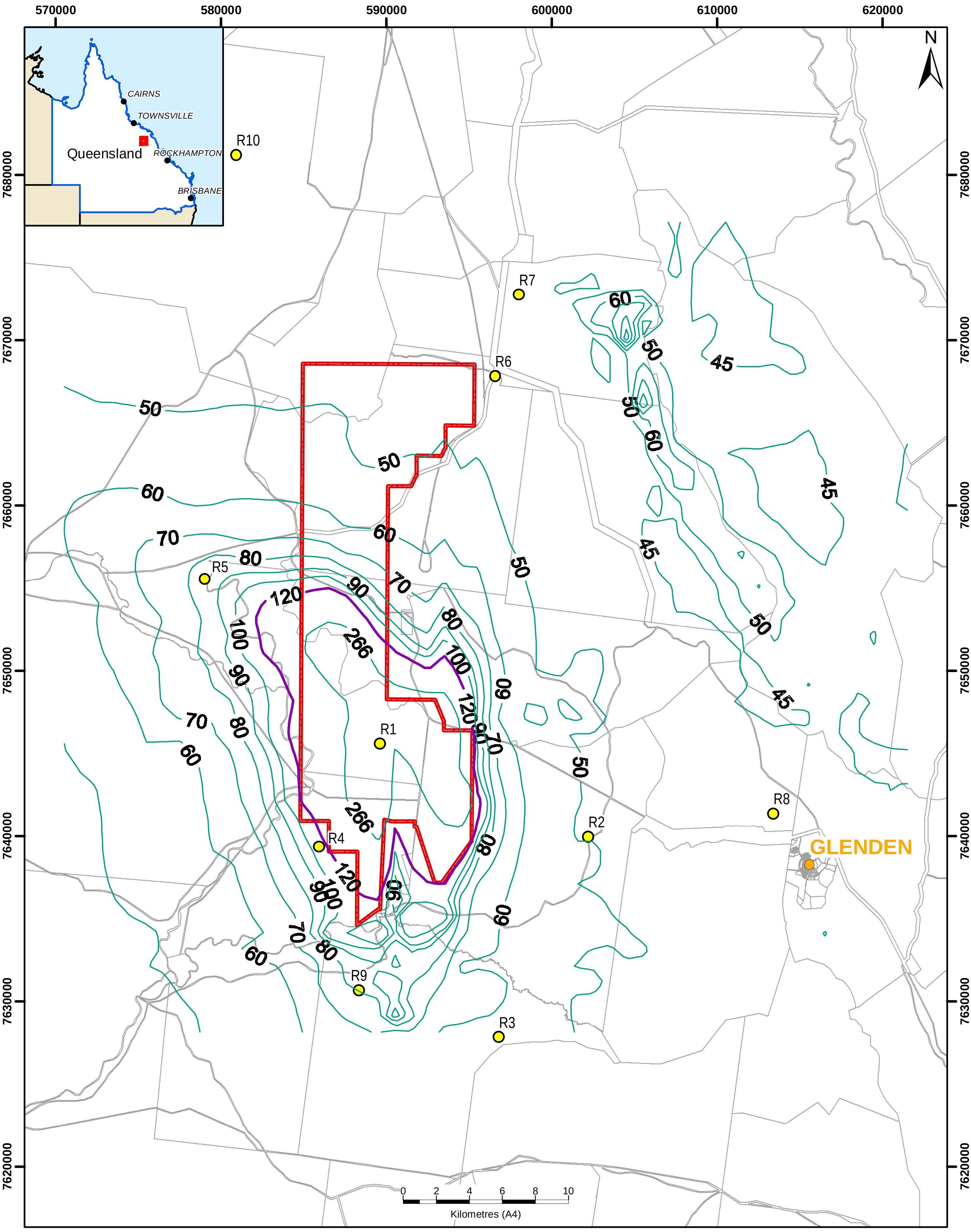

Legend

Project Area

Cadastre

Potentially Sensitive Receptors

Dust Deposition [mg/m²/day]

Air Quality Objective Contour

Year 36 - Dust Deposition (Maximum Month) (Enhanced Dust Controls)	
Figure 22-17	**Byerwen Coal Project**
Date: *5/03/2013*	**Author:** samuel.ferguson
	Map Scale: 1:300,000
Revision: R1	**Coordinate System:** GDA 1994 MGA Zone 55

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22.5.3 Train Loading Facility Modelling

A detailed description of the TLF modelling methodology is included in **Appendix 23**. The TLFs proposed for the project comprises a narrow gauge railway to support up to 6,800 tonne trains. The southern rail spur and rail loop will be approximately 7 km in length and will connect the GAP rail line to the southern CHPP. The northern rail spur and rail loop will be approximately 3.5 km in length and will connect the GAP rail line to the northern CHPP. There will be approximately 4 to 5 trains per day, capable of transporting approximately 6,800 tonnes per train. The assessment considers dust emissions from the operation of the two TLFs (north and south) between the CHPPs and the GAP rail line.

Storage of railway ballast will be within the footprint of project operations, which includes railway easements. The proponent consulted with the Project Manager of the Aurizon Network Division's (formerly QR National Network Division) Coal Loss Management Project regarding rail related dust mitigation measures. As a result of the consultation the proponent has committed to compliance with Aurizon's Coal Dust Management Plan (CDMP) and the requirements of the Transfer Facilities Licence regarding dust mitigation measures including veneering and load profiling.

This assessment is conservatively based on current dust emissions, rather than future controlled (lower) emissions. Dust can be emitted from the following sources in the TLFs:

- coal surface of loaded wagons
- coal leakage from doors of loaded wagons
- wind erosion of spilled coal in corridor
- residual coal in unloaded wagons and leakage of residual coal from doors
- parasitic load on sills, shear plates and bogies of wagons.

The Connell Hatch (Surat Basin Rail EIS) study into dust emissions concluded that dust goals are typically met very close to railways (Connell Hatch 2008). The project railway infrastructure is considered to be a low-impact dust source, hence a simplified model has been developed assuming a coal train travelling at high speed and various setback distances incorporating the site meteorology.

Assuming that the coal train is travelling at 80 km/h with a head wind of 20 km/h (i.e. effectively 100 km/h over the surface of the coal) and an annual tonnage of product coal of either 5, 10 or 15 Mtpa, then the total annual emissions per km of track is 3, 4 or 5.1 tonnes per kilometre of track per year respectively.

There will be approximately 4 to 5 trains per day, capable of transporting approximately 6,800 tonnes per train. Trains will be loaded at a rate of 3,300 tonnes per hour (tph) with a loading time of around 2 hours per train. Each train is expected to have three 4000 class diesel locomotives hauling approximately 85 coal wagons. For the purposes of modelling, the maximum daily emission rate is taken to be 50% higher the long term average (i.e. 6 to 7 trains per day).

Thus the daily emission rate per km of railway line is conservatively assessed to be 0.009 and 0.018 tonnes of TSP where the rail spur carries an annual tonnage of 5 and 10 MTPA respectively. The PM_{10} fraction is taken to be 0.5 of TSP (Connell Hatch 2008) and $PM_{2.5}$ fraction to be 12% of the PM_{10}. The emission rate is a worst-case since modelling assumes that the train is travelling at the maximum speed of 80km/h with a head wind of 20 km/h and the number of trains per day has been increased by 50% above the long term average to account for production fluctuations. In reality the trains on the TLF's will be travelling at slow speed.

22.6 Air Quality Assessment Findings

The predicted average ground level dust concentrations at nearby sensitive areas have been modelled for both normal and potential maximum emission conditions, in combination with the worst case meteorological conditions.

The dust deposition objective for vegetation of 266 mg/m^2/day has included in **Figure 22-7**, **Figure 22-12** and **Figure 22-17** to gauge the extent of vegetation that may experience dust deposition in excess of air quality objectives. Using the information on dust deposition derived from modelling presented in this chapter, an assessment of impacts of dust on vegetation was undertaken as part of the terrestrial ecology component of the EIS (see **Chapter 18**).

22.6.1 Year 5 - Standard Dust Controls

22.6.1.1 $PM_{2.5}$

The modelled maximum $PM_{2.5}$ (24 hour) and $PM_{2.5}$ (annual average) dust concentration levels comply with the air quality objectives at all sensitive receptors.

22.6.1.2 PM_{10}

The PM_{10}(24 hour) air quality objective of no more than 5 days per year where the dust concentration of PM_{10}(24 hour) is greater than 50 µg/m^3 (5th highest) is exceeded at R5, but is met at all other locations. The maximum PM_{10}(24 hour) concentration exceeds 50 µg/m^3 at R3 and R5, however it is the 5th highest which is recognised as the air quality objective under the EPP (Air).

22.6.1.3 TSP

TSP comprises the all fractions of dust. The heavier fractions rarely travel significant distances, especially under meteorological conditions likely to lead to high downwind concentrations (low wind speed, wind direction remaining steady for a long period of time, neutral to stable atmosphere). Thus the increase in the annual average TSP is predicted to be low and will be mostly associated with the lighter dust fractions (i.e. PM_{10}). The TSP (annual average) air quality objective is met at all sensitive receptors.

22.6.1.4 Dust Deposition

The dust deposition (maximum month) contours show that most dust fall will occur west of the project area. The dust fallout at all sensitive receptors complies with the deposition objective. The high dust deposition levels to the north-east of the project area are due to wet deposition (i.e. in dusts/particulates in rainfall), but are still within deposition objectives.

22.6.2 Year 5 - Enhanced Dust Controls

22.6.2.1 $PM_{2.5}$

The modelled maximum $PM_{2.5}$ (24 hour) and $PM_{2.5}$ (annual average) atmospheric dust concentration levels comply with the air quality objective at all sensitive receptors.

22.6.2.2 PM_{10}

The PM_{10}(24 hour) air quality objective of no more than 5 days per year where the dust concentration of PM_{10}(24 hour) is greater than 50 µg/m^3 (5th highest) is exceeded at R5, but is met at all other locations. The maximum PM_{10}(24 hour) concentration exceeds 50 µg/m^3 at R5, however it is the 5th highest which is recognised as the air quality objective under the EPP (Air).

22.6.2.3 TSP

The TSP (annual average) air quality objective is met at all sensitive receptors.

22.6.2.4 Dust Deposition

The dust deposition (maximum month) contours show that most dust fall will occur west of the project area. The dust fallout at all sensitive receptors complies with the deposition goal. The high dust deposition levels to the north-east of the project area is due to wet deposition (i.e. in dusts/particulates in rainfall), but are still within deposition objectives.

22.6.3 Year 17 - Enhanced Dust Controls

22.6.3.1 $PM_{2.5}$

The modelled maximum $PM_{2.5}$ (24 hour) and $PM_{2.5}$ (annual average) atmospheric dust concentration levels comply with the air quality objective at all sensitive receptors.

22.6.3.2 PM_{10}

The dust contours, particularly the maximum 24 hour contours, show that there are periods over the two year modelling simulation when adverse meteorological conditions persist for at least 24 hours leading to elevated dust levels some distance from the project area.

The PM_{10}(24 hour) air quality objective of no more than 5 days per year where the dust concentration of PM_{10}(24 hour) is greater than 50 µg/m^3 (5th highest) is exceeded at R5, but is met at all other locations. The maximum PM_{10}(24 hour) concentration exceeds 50 µg/m^3 at R3 and R5, however it is the 5th highest which is recognised as an air quality objective under the EPP (Air).

22.6.3.3 TSP

The TSP (annual average) air quality objective is met at all sensitive receptors.

22.6.3.4 Dust Deposition

The dust deposition (maximum month) contours show that most dust fall will occur west of the project area. The dust fallout at all sensitive receptors complies with the deposition objective. The high dust deposition levels to the north-east of the project area is due to wet deposition (i.e. in dusts/particulates in rainfall), but are still within deposition objectives.

22.6.4 Year 36- Enhanced Dust Controls

22.6.4.1 $PM_{2.5}$

The modelled maximum $PM_{2.5}$ (24 hour) and $PM_{2.5}$ (annual average) dust concentration levels comply with the air quality objective all permanently occupied sensitive receptors.

22.6.4.2 PM_{10}

The dust contours, particularly the maximum 24 hour contours, show that there are periods over the two year modelling simulation when adverse meteorological conditions persist for at least 24 hours leading to elevated dust levels some distance from the project area.

The PM_{10}(24 hour) air quality objective of no more than 5 days per year where the dust concentration of PM_{10}(24 hour) is greater than 50 µg/m^3 (5th highest) is exceeded at R5, but is met at all other locations. The maximum PM_{10}(24 hour) concentration exceeds 50 µg/m^3 at R3, R5, R6 and R7, however, it is the 5th highest which is recognised as an air quality objective under the EPP (Air).

22.6.4.3 TSP

The TSP (annual average) air quality objective is met at all sensitive receptors.

22.6.4.4 Dust Deposition

The dust deposition (maximum month) contours show that most dust fall will occur west of the project area. The dust fallout at all sensitive receptors complies with the deposition objective. The high dust deposition levels to the north-east of the project area is due to wet deposition (i.e. in dusts/particulates in rainfall), but are still within deposition objectives.

22.6.5 TLF Assessment

Modelling considered both the 4 km (north) and the 7 km (south) rail spurs and loops and the dust concentration at setbacks between 100 m and 2 km from the TLFs. The Ausplume modelling has been run with the TAPM meteorological file developed for the site. The rail spurs and loops were modelled as a series of volume sources with a spacing of 50 m between each source as recommended by the Ausplume manual.

For the purposes of modelling it is assumed that either the north or south TLFs could individually achieve the train loading rate described in **Section 22.5.3**.

The calculated ground level atmospheric dust concentrations are contained in **Table 22-9** for the southern TLF with an annual tonnage of 10 Mtpa, and **Table 22-10** for the northern TLF with an annual tonnage of 5 Mtpa.

Table 22-9 Calculated Dust Concentration Levels at Various Setback Distance from the Southern TLF with Annual Tonnage of 10 Mtpa

Dust Index	Atmospheric Dust Concentrations in (µg/m^3) at various setback distances from Spur					
	100 m	200 m	300 m	500 m	1 km	2 km
Maximum $PM_{2.5}$ (24 hour)	0.3	0.2	0.2	0.1	0.1	0.1
$PM_{2.5}$ (Annual Average)	0.2	0.1	0.1	0.1	0	0
PM_{10} (24 hour) (5th highest)	1.7	1.3	1.1	0.8	0.5	0.3
TSP (Annual Average)	1.3	0.9	0.7	0.4	0.2	0.1

Table 22-10 Calculated Dust Concentration Levels at Various Setback Distance from the Northern TLF with Annual Tonnage of 5 Mtpa

Dust Index	Atmospheric Dust Concentrations in (µg/m^3) at various setback distances from Spur					
	100 m	200 m	300 m	500 m	1 km	2 km
Maximum $PM_{2.5}$ (24 hour)	0.1	0.1	0.1	0.1	0	0
$PM_{2.5}$ (Annual Average)	0.1	0.1	0	0	0	0
PM_{10} (24 hour) (5th highest)	0.8	0.7	0.5	0.4	0.3	0.2
TSP (Annual Average)	0.6	0.5	0.3	0.2	0.1	0.1

The closest sensitive receptor to either of the spur lines is at least 5 km. The modelled dust levels at 2 km from the rail line are extremely low and at 5 km the dusts would be imperceptible. Since the modelled dusts from the rail line are very low, the predicted dust levels from mining at all sensitive receptors would be the same even when including the dusts from the rail line.

22.7 Mitigation Measures

The modelling has demonstrated that sensitive receptor R5 to the west of the operations has the highest ground level concentrations of dust, specifically the PM_{10} (24 hour). Modelling demonstrates that R5 will experience exceedances of the 5^{th} highest PM_{10} (24 hour) air quality objective with the standard and enhanced dust mitigations described in **Section 22.5.1**. The highest dust exposure occurs for modelling year 36, i.e. during the mining phase when all operations are in the southern project area.

In addition to the standard and enhanced dust controls, mitigation measures designed to achieve compliance with air quality objectives at R5, were modelled and are described below. These mitigations are primarily designed to achieve compliance at R5, but will also mitigate dust exposure levels at other sensitive receptors.

22.7.1 Long-term Dust Monitoring

Meteorological and dust monitoring will be implemented to identify the potential for exceedances of air quality objectives resulting in the staged implementation of additional dust mitigation measures described below. In addition to monitoring dust, local meteorological data will be collected from a monitoring station installed on the project area and situated close to the administration area. This station will collect temperature, relative humidity, rainfall and wind data over the life of the project.

22.7.1.1 Dust Deposition Monitoring

A network of dust deposition gauges will be installed at all sensitive receptors surrounding the project. Dust deposition (fallout) monitoring will commence prior to mining operations and continue for the life of the project.

22.7.1.2 Receptor 5 Dust Monitoring

More frequent monitoring of dust will be undertaken at R5 with a monitoring station permanently installed close to the homestead. To assist with identifying weather conditions that lead to high dust events data correlations will be drawn between meteorological conditions and dust monitoring results at R5 to enable prediction of high dust scenarios based on weather conditions and to pre-emptively implement dust controls where required.

22.7.2 Dust Mitigation Measures

The dust emission database has been based on standard emission factors from the NPI 2012. There are a range of dust control measures, in addition to those standard and enhanced controls described in **Section 22.5.1,** that are available to significantly mitigate dust emissions. Examples of these are provided in **Table 22-11**.

Table 22-11 Dust Mitigation Measures

Source	Mitigation Measure
Mining Areas	Disturb the minimum area necessary for mining and rehabilitate promptly.
Coal Handling Area	Use water sprays and water trucks to suppress dust in coal handling areas.

Source	Mitigation Measure
Stockpiles	Maintain water sprays on raw and product coal stockpile and transfer points. Topsoil stockpiles should be sown with an appropriate plant mix and managed to ensure adequate ground cover is maintained.
Loading Haul Trucks	Prevent overloading to avoid spillage in transit.
Draglines	Reduce the drop height.
Haul Roads	Maintain haul roads in good condition and use water trucks regularly to suppress dust. Investigate use of chemical suppressants if haul roads become too slippery.
Other Roads	Keep usage to a minimum and maintain in good condition. Use water trucks regularly to suppress dust.
Waste Rock Emplacements	Keep these areas moist, particularly if used by dump trucks. Keep the recently spread material moist to encourage crusting of surface. Use sprays or water cannon during dumping to control dust from dumping. Up to 70% control is possible for water sprays.

22.7.2.1 Haul Roads

The modelling of dusts from haul roads (refer **Section 22.5**) is based on either standard or enhanced water application. For this model, the adoption of enhanced water control effectively provided a maximum of 75% control with an average of 50% control. The use of chemical dust suppressants would increase effectiveness to 95%.

22.7.2.2 Draglines

NPI 2012 recommends that the equations be used where there is no site specific data for drop distance and/or moisture content. Since this data is not available the default values has been used for the modelling in **Section 22.5**. The default emission rate adopted in NPI 2012 includes results of testing carried out in the Hunter Valley, which showed that approximately 43% of TSP particles will be in the PM_{10} range compared with 18% for the strict application of the equations.

However, the default emission rate is based on a drop height of 12 m and 2% moisture content. Thus reducing the drop height from 12 m to 6 m would result in a reduction in PM_{10} emissions (compared with the modelled emission rate) from the dragline of approximately 53% (including maintaining the Hunter Valley correction) or a reduction of 88% based on the equation.

22.7.2.3 Loading Haul trucks

There is the potential for spillage to occur from haul trucks in transit. This spillage would fall on haul roads and would potentially become dust by the action of subsequent vehicles. Maintaining a suitable profile on the upper surface of the load of haul trucks would avoid spillage in transit.

22.7.3 Mitigation Measures for Adverse Meteorology

At R5 it was determined that for Year 36 the PM_{10} (24 hour) dust concentration with enhanced water control, was likely to exceed the comparative level of 50 µg/m^3 on approximately 40 days per annum. This exceeds the air quality objective of no more than 5 days per year where the PM_{10} (24 hour) dust concentration is greater than 50 µg/m^3 (5th highest). Accordingly a series of sequential dust mitigation measures were modelled for Year 36 to ensure that the project can achieve compliance with this air quality objective at R5.

Modelling was conducted in a staged approach to sequentially include additional mitigation measures until modelling demonstrated compliance with the 5th highest PM_{10} (24 hour) objective. The emission rates used in the modelling retain the 9% contingency factor to account for peak production. The following is a summary of the results of modelling of the mitigation investigations:

- Replacing enhanced watering with chemical dust suppressants of haul roads resulted in a significant reduction in the ground level atmospheric concentration at all sensitive receptors. At R5 the dust concentration of PM_{10} (24 hour) is likely to be greater than 50 µg/m^3 on approximately 23 days per year, which exceeds the objective of no more than 5 days per year.
- Reducing the drop height for the dragline from the modelled 12 m to 6 m, as well as using chemical dust suppression on the haul roads resulted in further significant reductions at all sensitive receptors. At R5 the dust concentration of PM_{10} (24 hour) will be greater than 50 µg/m^3 on approximately 14 days per year (with a modelled maximum of 71 µg/m^3), which exceeds the air quality objective of no more than 5 days per year.
- Reducing the activity rate in the West Pits to 50% as well as reducing dragline drop height and using chemical dust suppressants on the haul roads further reduced the PM_{10} (24 hour) dust concentrations. At R5 the dust concentration of PM_{10} (24 hour) will be greater than 50 µg/m^3 on approximately 8 days per year (with a modelled maximum of 64 µg/m^3), which exceeds the air quality objective of no more than 5 days per year.
- Reducing the activity rate in both the West and East Pits to 50% as well as reducing dragline drop height and using chemical dust suppressants on the haul roads further reduced the PM_{10} (24 hour) dust concentrations. At R5 the dust concentration of PM_{10} (24 hour) will be greater than 50 µg/m^3 on approximately 2 days per year (with a modelled maximum of 58 µg/m^3). This meets the air quality objective of no more than 5 days per year.

The modelling has demonstrated that the air quality objectives can be met for all sensitive receptors with the application of suitable mitigation measures as required based on meteorological conditions at the time. The only mitigation measures likely to affect production is the reduction in the activity rate in either the West Pits or the East pits and modelling shows that this is likely for up to 14 days per year during the years when quantity of waste rock movement being moved is at its peak. For other years, when the quantity of waste rock is less, then there would be fewer days of disrupted production. Furthermore the modelling has included a 9% contingency factor (i.e. production and movement of waste rock increased by 9%). Operating at normal activity levels will result in a reduction in the maximum dust exposures and fewer days when disrupted operations are likely to occur.

22.7.4 Dust Management Plan

A Dust Management Plan will be developed and include an action response plan to mitigate adverse air quality impacts. The application of water is one of the primary dust control measures. However, water is also a valuable resource and hence the dust management plan should investigate optimal application of water. The modelling in **Section 22.5** has indicated that enhanced dust control for haul roads is required to achieve compliance with air quality objectives at all receptors other than R5. Enhanced dust control may not necessarily comprise a generalised increase in the watering rate for all hours and all roads but may involve careful loading of haul trucks (designed to avoid spillage), timely spillage control on haul roads and/or spot watering of spills.

Modelling results presented in **Section 22.5** show that R5 (to the west of the project area) may experience exceedances of the 5th highest PM_{10} (24 hour) air quality objective. It is not unexpected that the greatest exposure is to the west of the project area since easterly winds dominate. Furthermore the closest modelled approach of mining operations to R5 occurs in Year 36.

The Dust Management Plan will address the sequential and incremental adoption of dust mitigation measures in response to adverse meteorological conditions, seasonal effects and monitored dust levels. For instance, during the wet season the dust emissions are likely to be low and additional dust control measures may be minimal. However, during the dry season, monitoring results may be such that the sequential implementation of mitigation measures (excluding reduction in mining operations) may be required until monitoring results demonstrate that compliance with air quality objectives has been achieved. These mitigation measures have been modelled to show compliance with the air quality objectives at all sensitive receptors except R5.

The dust monitoring at R5, when correlated with the with the real time prevailing wind direction measurements, will be used to make decisions regarding specific mining operational changes, to reduce dust exposure at R5. The modelling presented in **Section 22.7.3** has demonstrated that the application of mitigation measures (including a reduction in operational activities in specific open pits) will result in compliance with the air quality objectives at R5.

Although this modelling of dust controls in **Section 22.7.3** was based on Year 36 operations, a similar approach would apply throughout the life of the mine. Initially dust mitigation measures which do not result in a reduction in operations, such as treatment of haul roads and reduction of the drag line drop height, will be implemented. When required, these mitigation measures will be followed by a reduction in operational activities at appropriate pits and locations on the basis of ongoing monitoring of dust levels at R5.

22.8 Conclusion

Ambient air quality was measured within and surrounding the project area. The air quality objectives in the EPP (Air) and other relevant EHP guidelines were used to establish air quality objectives for the project’s dust emissions at sensitive receptors and for flora. The primary impact on air quality from the project is dust and other sources of gaseous emissions are widely dispersed, have low levels of emission, very localised impacts and minimal risk of exceeding air quality objectives at receptors.

Three modelling cases were developed for dust emissions in Year 5, Year 17 and Year 36 of operations since these represented scenarios where maximum dust emissions may occur. Modelling used conservative assumptions with the potential to demonstrate higher dust concentrations than may actually be experienced.

Modelling included standard and enhanced water application measures to reduce dust emissions. The modelling results showed exceedences of the PM_{10} (24 hour) air quality objective at sensitive receptor R5 (i.e. at R5 there were more than 5 days per year when the dust concentration of PM_{10} (24 hour) was greater than 50 µg/m^3), which only occurred during adverse meteorological conditions. Modelling has demonstrated compliance with all other air quality objectives at all other receptors.

A range of operational and direct dust control mitigation measures, in addition to standard and enhanced watering, were then modelled which showed that all air quality objectives could be met at all sensitive receptors. These mitigation measures will only be required during specific meteorological and operational conditions. To enable the proponent to react to the adverse meteorological conditions and sequentially implement dust controls and / or modify operations, dust monitoring will be undertaken at sensitive receptors.

A Dust Management Plan will be developed and implemented to sequentially implement mitigation measures in response to meteorological conditions and to monitor the results. Mitigation measures would be implemented until such time as the meteorological conditions return to a state where monitoring demonstrates that mitigations are no longer required.