HANCOCK PROSPECTING PTY LTD

Alpha Coal Project Environmental Impact Statement

H | Air Quality

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Hancock Prospecting Pty Ltd

Alpha Coal Railway Project

Air Quality Assessment

September 2010

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

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Abbreviations/Glossary

APSDA	Abbot Point State Development Area
AUSROADS	Gaussian plume developed by EPA Victoria
Ballast	Railway substrate used to support sleepers and track.
BoM	Bureau of Meteorology
GLC	Ground Level Concentration
Line source	A class of source(s) in air dispersion modelling with an elongated geometry such as a road or other transport corridor.
PM2.5	Particulate matter with an equivalent aerodynamic diameter of 2.5 micrometres or less.
PM10	Particulate matter with an equivalent aerodynamic diameter of 10 micrometres or less.
QR	Queensland Rail
Ruling Grade	The ruling grade of a section of railway line is the steepest section of that line. The ruling gradient is important in assigning locomotives to trains, as the locomotives must have sufficient power to pull the train over the ruling gradient of a line.
Sensitive locations	Residential areas and zones involving the presence of the individual people for extended periods except in the course their employment and recreation.
TSP	Total suspended particulates
US CALINE4 model	Simple line source dispersion model for predicting the near-road impact of transport emissions.

1. Introduction

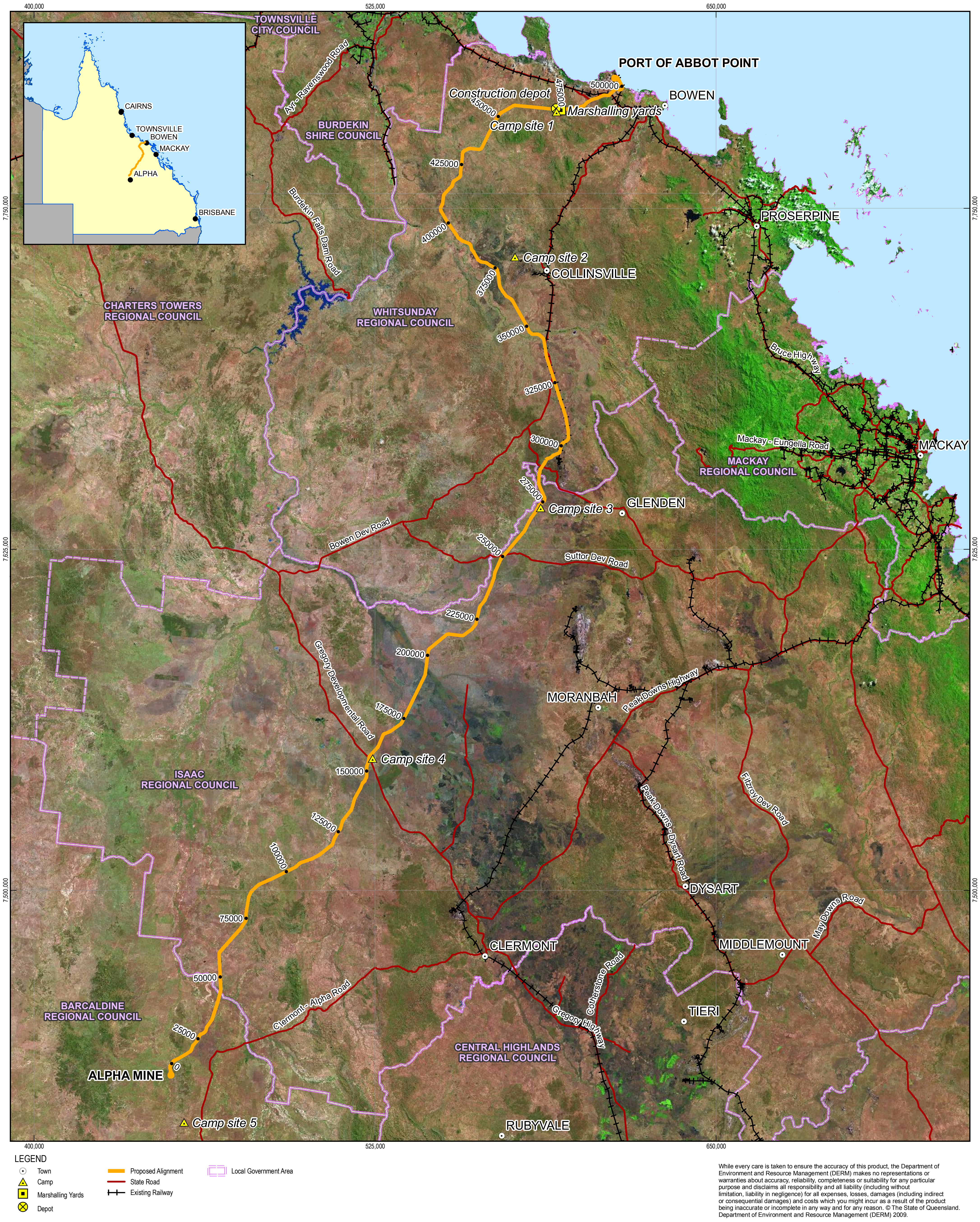
1.1 Project Overview

Hancock Prospecting Pty Ltd (HPPL) (the Proponent) is proposing to construct a standard gauge, single track, non-electrified, 495 km long railway line for the purposes of transporting processed coal from the Alpha Coal Mine to the Port of Abbot Point, north of Bowen. Initially, the Project will transport 30 million tonnes per annum (Mtpa) with potential to increase up to 80 Mtpa. For the purposes of this assessment, 60 Mtpa has been taken into consideration, which includes both the Alpha Coal Mine and the Kevin's Corner Mine outputs.

The Project passes approximately 70 km to the northeast of the town of Clermont, 55 km to the northeast of the town of Moranbah, 35 km to the east of Mt Coolon, 20 km to the west of Collinsville, and enters the Abbot Point State Development Area (APSDA) area 25 km west of Bowen (refer to Figure 1-1).

In September 2009, GHD was commissioned by HPPL to undertake an Environmental Impact Statement (EIS) for the Project. A component of the EIS involves assessing the Project air quality impacts associated with the construction and operation of the Project.

Refer to Volume 3, Section 2 of this EIS for a full description of the Project.



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0 5 10 20 30 40 50
Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

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HANCOCK PROSPECTING PTY LTD

Alpha Coal Project
Environmental Impact Statement

Job Number	41-22090
Revision	A
Date	06-08-2010

PROJECT OVERVIEW WITH PROPOSED ROUTE

Figure: 1-1

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1.2 Scope of this Project

The scope of this air quality assessment is as follows:

- describing the environmental values present within the Project area;
- describing the existing air environment within the Project area, including background dust levels and local climate and meteorology;
- identifying the relevant air criteria and legislation;
- identifying environmentally sensitive areas that may be directly or indirectly affected by the Project;
- identifying the construction dust impact and its effect on sensitive areas;
- characterising the predicted changes in air quality at sensitive receptors expected from operations, including the operation of diesel powered locomotives and fugitive coal dust from coal trains in transit; and
- identifying mitigation measures for both construction and operation phases, if required.

The approach in undertaking the air quality assessment included:

- a desktop assessment of the existing air environment; and
- dispersion modeling to predict changes to air quality due to operations.

This report describes the existing environmental (air) values of the Project area, discusses the potential impacts associated with the construction and operation phases of the Project and recommends measures to mitigate these impacts. The report is structured as follows:

- Section 2 - Description of the operational plan, including train composition;
- Section 3 - Description of existing conditions;
- Section 4 – Description of potential impacts and outline of the relevant criteria;
- Section 5 - Discussion of potential impacts associated with construction of the Project and the recommended mitigation measures;
- Section 6 - Discussion of potential impacts associated with operation of the mine-to-port rail link and the recommended mitigation measures; and
- Conclusion.

2. Proposed Configuration of the Project

2.1 Route/s

The current Project corridor runs from the Alpha Coal Mine, 38 km northwest of the Township of Alpha, and ends at the Port of Abbot Point coal export terminal, 25 km north of Bowen. Through an initial assessment, pre-feasibility study and structural engineering studies the preferred railway alignment was determined. extensive geotechnical. The current EIS alignment avoids all Reserves, National Parks and State Forests and minimises the potential for sterilisation of other resource areas. For further information regarding the railway option refinement refer to Volume 3, Section 2.3.4 of this EIS.

The current EIS alignment includes 495 km of greenfield railway, extending from the Alpha Coal Mine in a north-easterly direction to Eaglefield and Newlands. It then runs adjacent to the existing QR Newlands line to join the Abbot Point rail corridor. The final approach to the Port of Abbot Point would be on a greenfield track. The total length of the Project corridor is 495 km.

For the purposes of this assessment, the Project footprint comprised of:

- an easement of 495 km long and 500 m[1] wide;
- a series of laydown areas and construction nodes;
- local construction access tracks (that will be used during construction only); and
- local maintenance access tracks (that will be used and maintained through the operational phase).

2.2 Track Parameters

The details of the track structure parameters that will be applied to the current alignment are listed below:

- Standard rail width (1435 mm);
- Non-electrified;
- Design life: 30 years;
- Axle load: 32 tonnes;
- Continuously welded rail;
- Sleeper: concrete;
- Ballast profile: 300 mm under sleeper and 400 mm shoulder width; and
- Formation width: 6.0 m.

The details of the track alignment parameters that will be applied to the current alignment are listed below:

- Design speed: 80 km/h (loaded);
- Maximum grade:

[1] A 60m wide corridor will be required for the construction of the Project so as to accommodate for all access tracks and supporting construction infrastructure. For only the purposes of this assessment a 500m corridor was used. This corridor width allows for a more accurate air quality assessment.

- 1 in 320 (loaded);
  - 1 in 200 (passing loops);
  - 1 in 100 (empty); and
- Minimum main line track horizontal radius: R1000 m.

2.3 Train and Wagon Composition

2.3.1 Rollingstock

The current design calls for 32 tonne axle loads for rollingstock, consistent with other heavy haul coal railways around the world. It is desired to use proven diesel locomotives similar to those in use in the Pilbara in Western Australia.

HPPL has selected the same ‘ruling grade’ protocol based on current practice from the Pilbara heavy haul railways. The 1 in 320 grade allows for 24,000 tonne payloads to be hauled by three locomotives with a total traction power of 13,500 hp (one train). The current design plans allow for the transportation of up to 60 Mtpa of coal which includes the Alpha Coal Mine and the Kevin’s Corner Mine outputs. Transport of this tonnage would require seven trains on average, one way each day (14 train movements over a 24 hour period).

HPPL has chosen to use proven diesel locomotives either from GE Transportation Systems such as the GE ES44AC model or the EMD SD73ACe. However, due to more stringent emission requirements that came into effect in the United States on January 1, 2005, the Dash 9-44CW has been replaced in production by the GE ES44DC, and a photograph of this example locomotive is displayed in Figure 2-1. Relevant specifications include:

- Builder: GE Transportation Systems;
- Model: GE ES44DC;
- Gauge: 1435 mm (standard);
- Wheel diameter: 1.07 m;
- Length: 22.3 m ;
- Width: 3.12 m;
- Height: 4.7 m;
- Weight: 212 tonnes;
- Engine type: Gevo-12 turbocharged ('clean diesel');
- Generator: EMD AR10-JJD-D18 (Some units converted to AR10-CA5);
- Traction Motors: GE 5GE752AH;
- Transmission: Alternator, silicon diode rectifiers, DC traction motors;
- Power Output: 3,300 kW (4,400 hp);
- Top Speed: varies between 113 km/h – 121 km/h; and
- Fuel Capacity: 18,900 Litres.

Figure 2-1 Example GE Locomotive

2.3.2 Wagons

In order to limit the environmental impact of the Project it is planned to utilise a coal rail wagon which is a development of the standard gauge wagon currently in use in the NSW Hunter Valley service. These wagons will have lip seals on the bottom dump doors to prevent coal loss through the doors, angled sills to prevent coal from remaining on the sills after loading and subsequently dislodging en-route, and a high body design which substantially shrouds the coal payload resulting in reduced dust emissions. Figure 2-2 below displays coal wagons currently in use in the Hunter Valley system.

Based on standard coal wagons each of 106 tonne capacity, about 234 wagons will be needed to be attached to each locomotive 3-unit set to carry the proposed 24,000 tonnes of coal per train, resulting in a total length of 4 km.

Figure 2-2 Coal wagons in Hunter Valley[2]

[2] Photographs retrieved from: Pacific National Pty Ltd. (2004). Photo Gallery. Accessed on 21st of September 2010 from http://www.pacificnational.com.au/library/photos/rollingstock/rollingstock_img_1.asp .

3. Existing Conditions

3.1 Existing Air Environment and Background

Some areas along the 495 km Project corridor contain existing sources of smoke and dust. Products of combustion (POCs) from engines and turbines produce fine particulates typically less than 2 microns (NSW Mineral's Council, 2000, p. 2-7). Smoke from low-temperature scrub and agricultural burning also produces more $PM_{2.5}$ than PM_{10} or TSP (United States Environmental Protection Agency (USEPA), 1997, table 13.1). As there is little urbanised area along the Project corridor from the Galilee Basin to Abbot Point, fine particulate matter ($PM_{2.5}$) from engine combustion (including the power generation by diesel engines in townships along the Project corridor) is not produced in great quantities or expected to travel far, however $PM_{2.5}$ from vegetation fires is common during the dry periods in the year.

The major source of crustal dust disturbance in the area is wind erosion. Wind speeds around the Project area are not typically strong enough to re-suspend larger TSP particles into the air. Consequently the majority of dust generated by natural wind erosion will be composed of particles less than 10 microns (PM_{10}). In contrast, mechanically disturbed crustal dust contains a high proportion of large particles, known as Total Suspended Particulates (TSP) (Dames & Moore and TUNRA, 1986, p. 38).

At present the bulk of air pollution around the Project site originates from scrub fires and some from natural wind erosion leading to the assumption that the majority of the particulate load in the ambient air is composed of $PM_{2.5}$ and PM_{10}.

Natural sources of dust include:

- wind erosion;
- sea salt; and
- scrub fires initiated by lightning strikes.

Anthropogenic sources of dust include:

- motor vehicle exhaust/buses/trucks;
- industrial processes;
- heating and power generation; and
- fuel reduction burning for agricultural and fire safety purposes.

Around the Project area, natural sources of dust are more prevalent than anthropogenic sources. However, for particulates from vegetation burning the opposite is true with human initiated burns contributing more than natural sources. Since there is limited or no control over the variability in background dust levels (widespread sources), the focus is to mitigate the generation of local dust during construction and limit coal losses during operational activity.

3.1.1 Particulate Matter – In-air Concentrations

There are no existing data available for the average concentrations of PM_{10} and $PM_{2.5}$ within the Project area. Parsons Brinckerhoff (PB) conducted an Air Impact Assessment study of the Sonoma Project near Collinsville in 2005 (Air Impact Assessment for the Sonoma Project, Parsons Brinckerhoff, 2005), as part of an EIS for the mine. In this study the PB assessment assumed a background PM_{10} concentration of 16.8 µg/m^3 (which was based on the Mackay (1999) data provided by the EPA). The same value has been adopted for this Project. However, the background PM_{10} value may be slightly higher inland away from the coast due to:

- natural regional inland conditions; and
- the presence of industry and other physical facilities (i.e. Alpha Coal Mine) along the Project corridor which can either act as a buffer zone or an additional source.

As there is no existing data along the proposed route, background values for all other constituents are considered to be negligible as the area is remote with a very low number of anthropogenic sources, such as cars and industry.

3.1.2 Dust Deposition

From the same Parsons Brinckerhoff (PB) assessment study, indicative background levels of dust deposition rate for regional conditions in Mackay (1999) were derived from EPA[3] records and applied when running the dispersion models, to calculate annual TSP deposition levels for three locations (*i.e.*, Sonoma, Belmore and Collinsville). The modelling assumed an existing background level of 40 mg/m^2/day for dust deposition.

However, dust deposition sampling recently conducted within the Sonoma Project site (post mine commissioning and subsequent to the PB modelling) indicate slightly higher deposition levels resulting in a adopted deposition background of 65 mg/m^2/day (corresponding to about 2 g/m^2/month).

3.2 Climate and Meteorology

The climate along the Project area can be considered to be subtropical, with a sub-classification consisting of 'distinctly dry winter' (Objective classification of Australian Climates - Harvey Stern, Graham de Hoedt and Jeneanne Ernst). A subtropical climate generally consists of a warm, wet summer ('wet season') along with a mild, dry winter ('dry season').

As the proposed route covers a large distance of 495 km, a single site-specific meteorological data set is not appropriate. However, as the proposed route runs close to a number of current Bureau of Meteorology (BoM) sites, where information is currently available, an analysis of their information can provide an insight to the expected local meteorological conditions along the Project. These sites include Bowen, Collinsville, Moranbah and Clermont. Table 3-1 below outlines the individual location and site information of these relevant BoM stations.

[3] Queensland Environment Protection Agency (EPA) is now the Department of Environment and Resource Management (DERM).

Table 3-1 BoM Stations

BoM Site	Site Number	Latitude, Longitude	Elevation	Data Period	Status
Bowen Airport	033257	20.02° S, 148.22° E	5 m	1987 - Present	Open
Collinsville Post Office	033013	20.55° S, 147.85° E	196 m	1939 - Present	Open
Moranbah Water Treatment Plant	034038	21.99° S, 148.03° E	260 m	1972 - Present	Open
Clermont Sirus ST	035019	22.82° S, 147.64° E	260 m	1870 - Present	Open

3.2.1 Temperature

Monthly mean temperatures for the appropriate BoM stations are displayed in Table 3-2 along with the highest and lowest maximum and minimum, which shows the seasonal variation in the expected temperature range. Daytime summer maximum temperatures are mostly warm in the low to mid 30's with a peak in December/January, while minimum winter overnight temperatures are mostly mild between 6 and 13 degrees in June/July.

Table 3-2 Temperature

Climate Site	Annual Mean Maximum (°C)	Annual Mean Minimum (°C)	Highest Monthly Maximum (°C)	Lowest Monthly Maximum (°C)	Highest Monthly Minimum (°C)	Lowest Monthly Minimum (°C)
Bowen Airport	28.6	19.5	31.5 (January)	24.5 (July)	23.9 (January and February)	13.5 (July)
Collinsville Post Office	30.2	16.4	34.0 (December)	24.9 (July)	21.9 (January and February)	9.0 (July)
Moranbah Water Treatment Plant	29.8	16.7	34.1 (December)	23.7 (July)	21.9 (January)	9.8 (July)
Clermont Sirus ST	29.7	15	34.9 (December)	23.1 (June and July)	21.6 (January)	6.7 (July)

3.2.2 Rainfall

The annual mean rainfall over the four locations is dominated by the warm months producing convectively driven rainfall. This is shown in Table 3-3 with the five month period November through March, inclusive, accounting for over 68% of the annual mean rainfall (henceforth referred to as the wet season). The wettest months occur in February near the coast, and January further inland, while driest months occur in September near the coast and in August further inland.

Table 3-3 Rainfall monthly and annual means (mm)

Climate Site	Annual Mean	Jan	Feb	Mar	April	May	June	July	Aug	Sep	Oct	Nov	Dec
Bowen Airport	844.8	178.3	**242.9**	75.7	62.2	44.4	23.9	19.3	22.4	**7.2**	13.4	35.4	135.1
Collinsville Post Office	711.7	134.0	**164.7**	93.2	41.6	32.4	27.3	20.2	17.1	**11.0**	21.5	50.5	95.0
Moranbah Water Treatment Plant	591.3	**102.0**	100.6	48.1	36.8	35.9	22.1	18.5	22.5	**7.9**	36.1	67.1	94.7
Clermont Sirus ST	662.3	**117.6**	115.7	73.7	39.0	35.0	34.3	24.9	**19.0**	19.3	35.4	57.1	91.8

3.2.3 Humidity

An analysis of relative humidity throughout the year, at the morning and afternoon observing times for all four locations, indicates that the highest humidity conditions occur during the wetter summer months (66% at 9 am and 47% at 3 pm), with the lowest occur in the dryer winter months (66% at 9 am and 40% at 3 pm).

3.2.4 Wind

The effect of wind on pollutant dispersion patterns can be examined using the general wind climate and atmospheric stability class distribution. The general wind climate at a site is most readily displayed by means of wind rose plots, giving the incidence of winds from different directions for various wind speed ranges. The atmospheric stability class distribution can also be displayed using a stability rose plot.

The features of particular interest in this assessment are: (i) the prevailing wind directions and (ii) the relative incidence of more stable light wind conditions (periods of poorest dispersion from ground based sources, in this case a ‘line source’.

As the four BoM stations are located at a low latitude of around 20º S, the area of the Project will therefore be principally affected by easterly trade winds, which are warm and moist at low levels, and dry aloft. There are very little intervening topographical features, (the surrounding area has low to insignificant topographical relief) and the site is not unduly influenced by coastal effects (such as sea and land breezes), except for the coastal strip 50-100 km in from Bowen, there should be little significant differences in wind rose patterns between the four stations.

Figure 3-1 shows the average annual wind rose for the period 1 June 2008 to 31 May 2009 adopted for the Project using (Collinsville BoM data) with an annual average wind speed of 2.35 m/s. It can be seen that the distribution of flows are predominantly from the east, including northeast and southeast (comprising of 74% of incident winds), with a low distribution from the south (6% of winds) and north (5% of winds) directions. The observed wind speed distribution indicates the largest proportion of high wind speeds (> 6 m/s) from the east and northeast.

Figure 3-1 Annual Wind Rose for the Project (Collinsville)

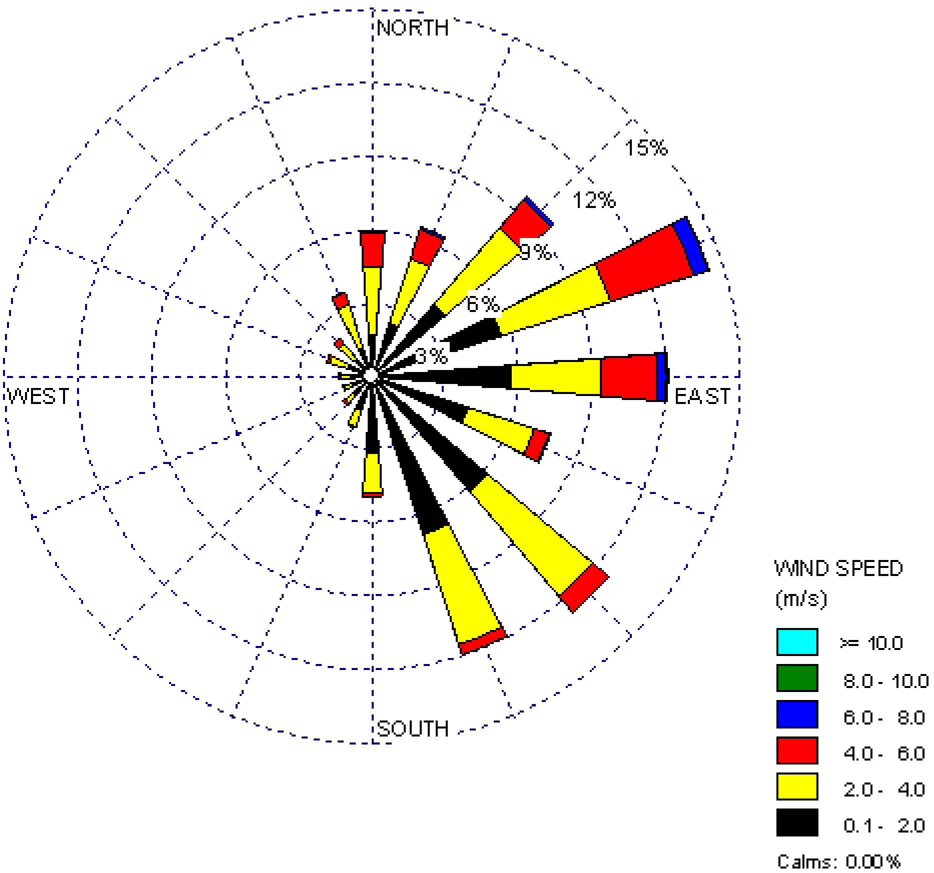


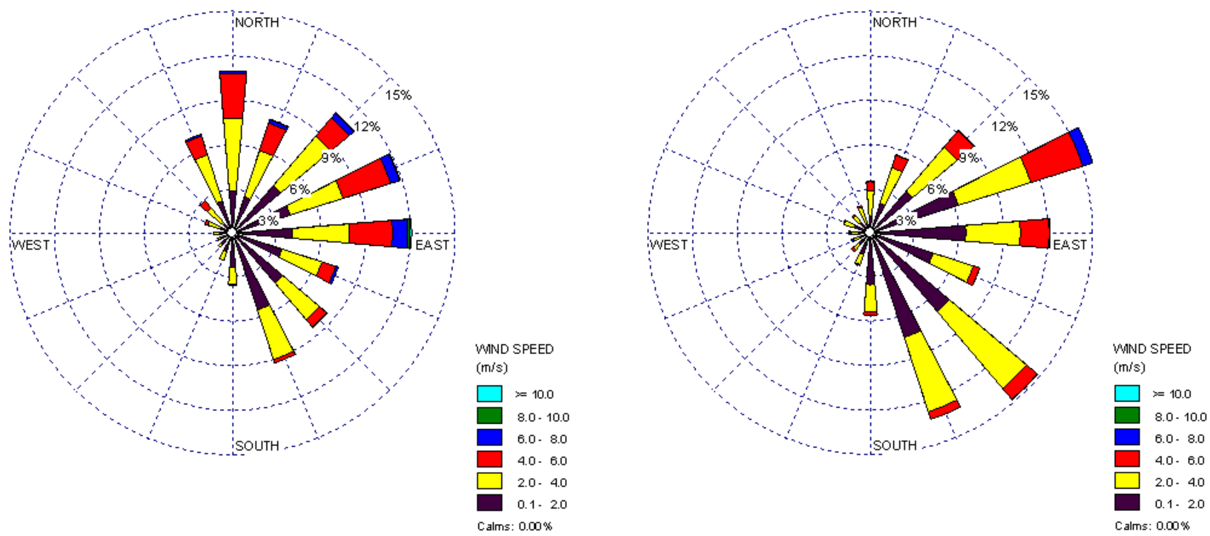
Figure 3-2 presents wind roses showing the average seasonal (wet and dry) wind distribution over the year 2008/09.

Prevailing wind directions vary seasonally, with the wet season being predominantly east to north-east (27.8% of incident winds) and southeast to south-southeast (28.0% of incident winds) while the dry season is predominantly east to north-easterly (35.4% of incident winds) and a secondary northerly peak (11% of incident winds). The seasonal incidence of high winds (>6 m/s) is greatest in the wet season while the incidence of light (<2 m/s) winds is greatest in the dry season.

The direction and high proportion of light winds in the dry season, with associated cooler temperatures, is predominantly south east, reflecting the direction of cool air drainage flows down-slope of the broad river valleys. These drainage flows are likely to be associated with high stability, and can be expected to define the directions of poor dispersion for 'line' sources. While the greater proportion of higher winds (>6 m/s) from the east to north-east, in the warmer months (the wet season), are due to the effects of the sea breeze reinforcing the trade winds from the Pacific Ocean.

Figure 3-2 Expected Wet and Dry Season Winds for the Project (Collinsville)

Wet Season (mean wind speed 2.58 m/s) Dry Season (mean wind speed 2.25 m/s)



3.2.5 Pattern of Atmospheric stability

In the Pasquill/Gifford atmospheric stability scheme, stability is classified into six classes A through F. A, B and C stability classes represent strongly, moderately and slightly unstable atmospheres respectively. Dispersion of emissions from near-ground sources (i.e. a 'line" source) is good due to convectively vertical turbulent mixing under unstable conditions. Stability category D denotes neutral atmospheric conditions (strong winds in moderate temperatures or lighter winds on partly cloudy days). Categories E and F denote slightly and moderately stable atmospheres when dispersion is poor, as vertical mixing of air is suppressed. Stable atmospheric conditions occur in the absence of strong gradient winds, and mostly on nights with clear skies. They are often associated with ground-based radiation inversions.

Neutral stability (D class) conditions occur most frequently and along with prevailing wind direction can indicate the most common direction for potential pollutant impact. Under night-time E and F class conditions, pollutant emissions result in a downwind plume that is detectable to a greater distance than during the day.

Figure 3-3 shows that over the year 2008/09, the E and F stable wind conditions occur 25% of the time with the directions mostly from the east-northeast (14.3% incidence).

Figure 3-3 Expected Annual Variation in Atmospheric Stability for the Alpha Coal Project (Collinsville)

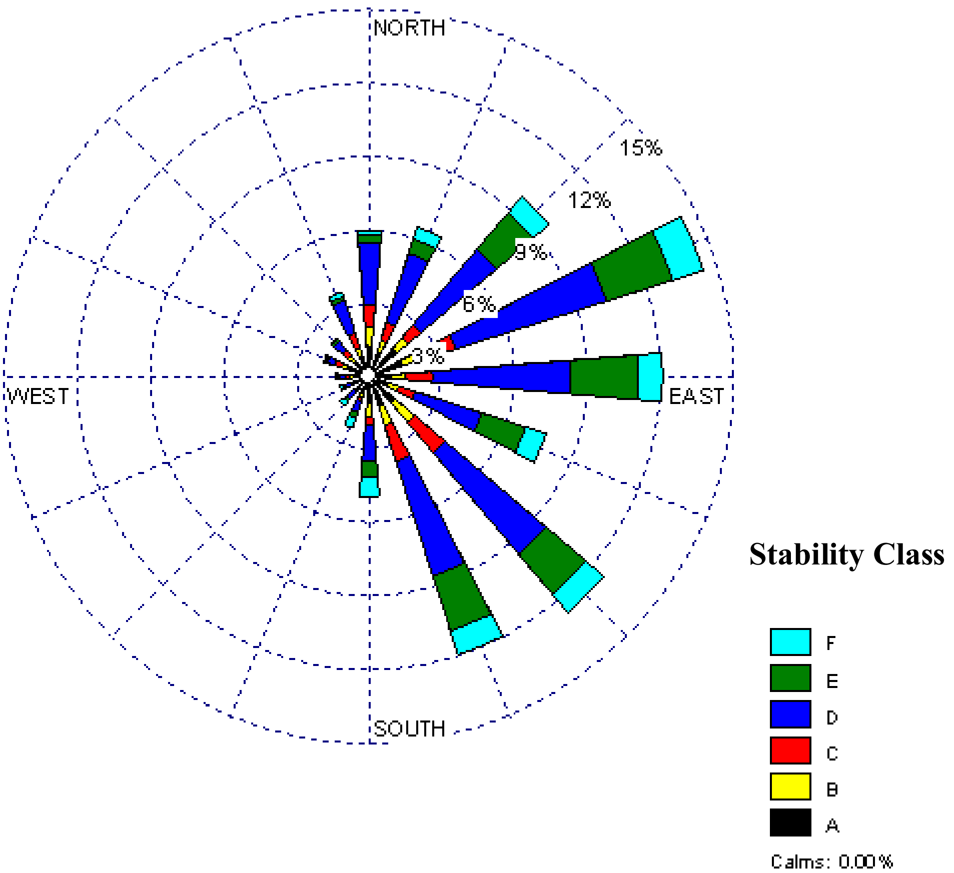
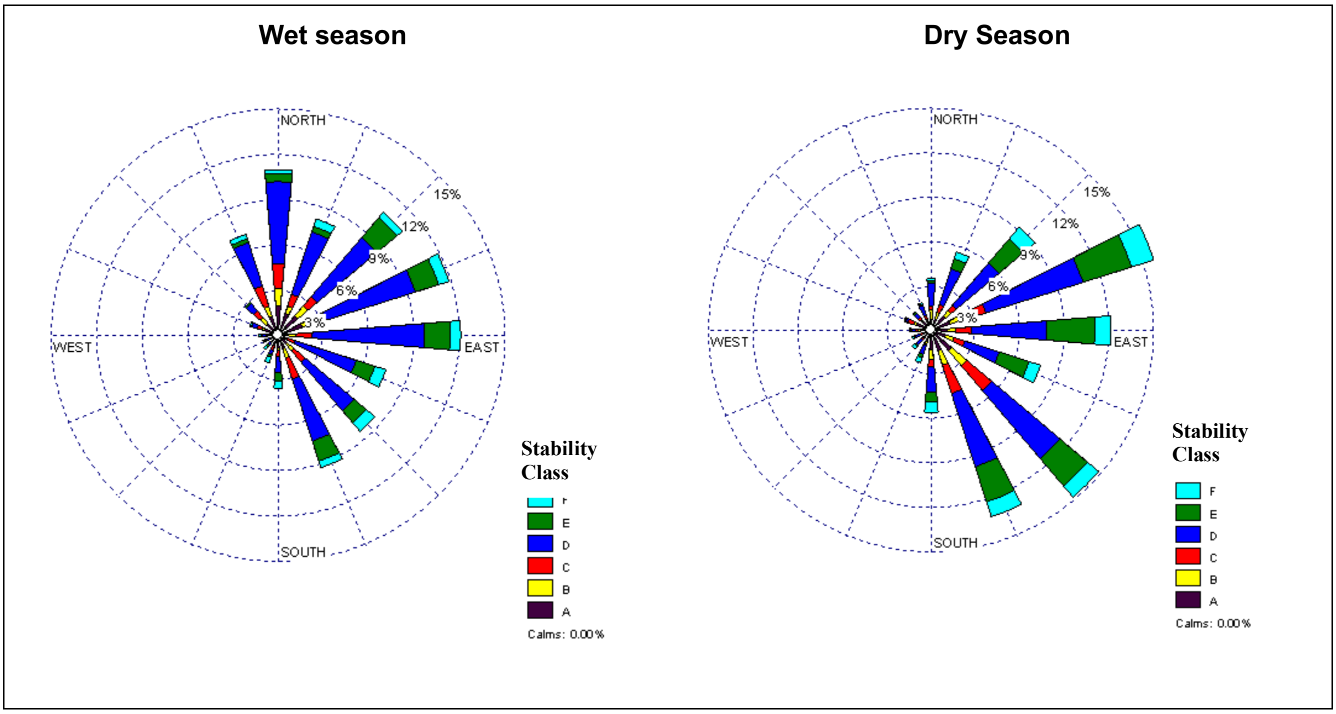


Figure 3-4 shows the following seasonal variation trends in atmospheric stability:

- In the wet season, the peak incidence of stable winds is from the east to northeast (7%); and
- In the dry season, stable winds predominate from the east to north-east (9.3%) with a lesser extent from the south-east to south-south-east (6.9%).

Figure 3-4 Expected Seasonal Variation in Atmospheric Stability for the Project (Collinsville)



4. Potential Impacts and Relevant Criteria

4.1 Potential Impacts

Potential impacts from the 495 km Project corridor include possible effects to human health and wellbeing, the health and biodiversity of ecosystems, the aesthetics of the environment and agriculture. These arise from emission to air from construction activity, surface and construction vehicles, diesel powered locomotive engines and fugitive coal dust from coal trains in transit.

4.1.1 Sensitive Receptors

Table 4-1 lists potential human sensitive receptors identified within 500 m of the Project corridor (refer to Figure 4-1).

Table 4-1 Human sensitive receptors

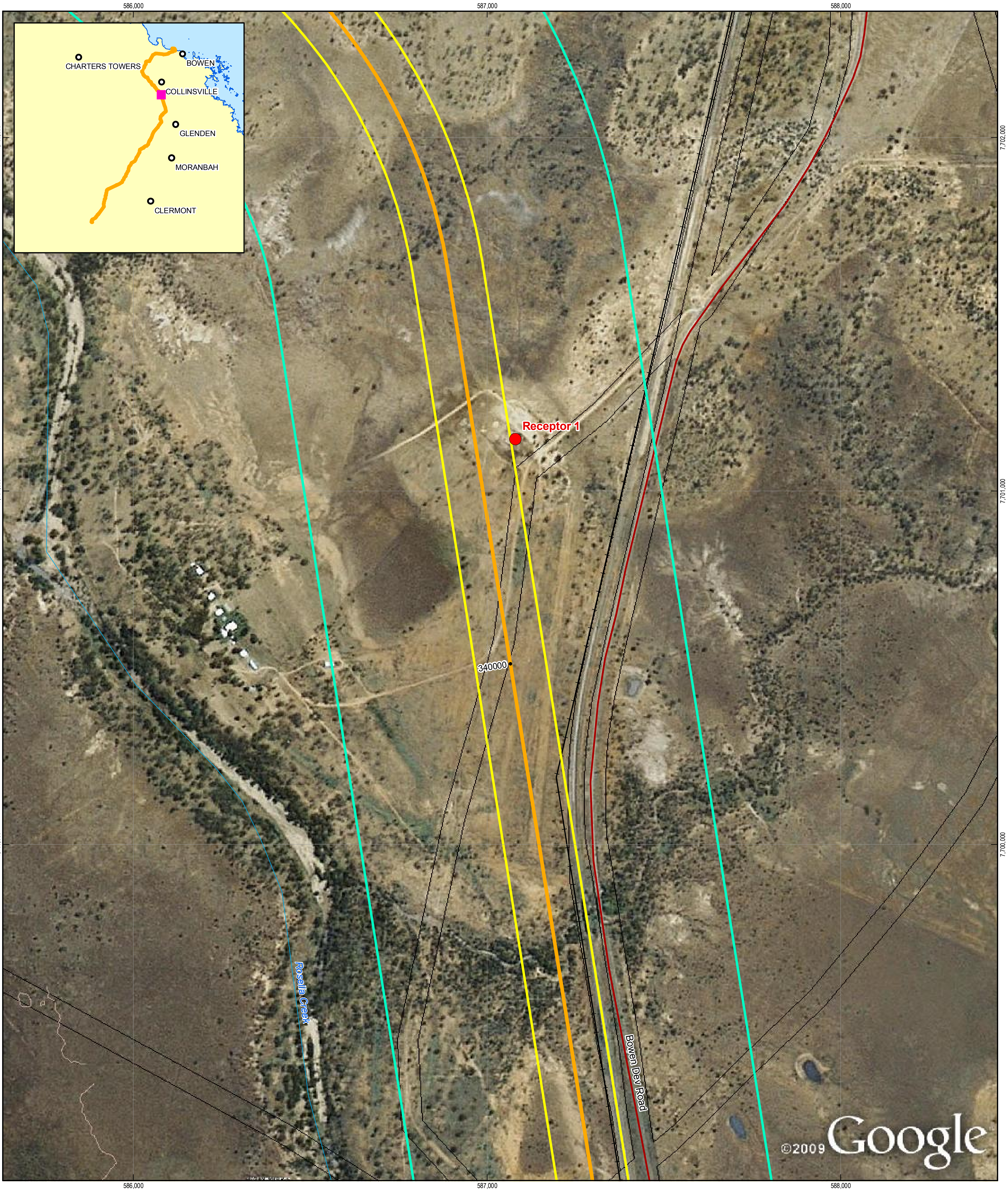
Site	Easting	Northing	Distance from proposed track (m)	Description of sensitive receptor[4]
1	587079	7701147	113	Dwelling
2	549381	7748039	260	Dwelling

The Project also passes several other areas relevant in terms of sensitive receptors, namely:

- areas of GQAL Class A, being areas suitable for cropping. Deposition of dust on crops may affect plant growth, as well as the quality of the product. As most crops are grown on annual or shorter cycles, this may be significant, since an entire crop may be affected. Where areas adjacent to the Project are being used for cropping, dust mitigation measures are likely to be required to prevent dust deposition on crops.
- the Caley Valley wetland and permanent watercourses crossed by the Project. Dust plumes may deposit on these waters, with subsequent degradation of water quality. This is discussed further in Volume 3, Section 10.3.2 of this EIS. Dust mitigation measures will be necessary when constructing in any areas that feature permanent surface water within 500m of the Project.
- areas of high conservation value native vegetation such as Endangered Regional Ecosystems and threatened ecological communities (refer to Volume 3, Section 9.2 of this EIS). Dust deposition on vegetation may cause short term growth retardation, but plants should quickly recover once construction is complete (refer to Volume 3, Section 9.3.1 of this EIS). Nevertheless, effort should be made to minimise dust deposition impacts in sensitive ecological areas.

Note also that dust control is likely to be required to protect worker health and amenity and avoid safety issues associated with obscuring visibility that may occur as a result of dust plumes. Workplace health and safety is not addressed here as a separate legislative process exists for this.

[4] This sensitive receptor has been identified on the basis of aerial imagery and a conservative approach has been taken in assuming that it is a fully occupied residence.



LEGEND

- Sensitive Receptor
- Proposed Alignment
- Existing Railway
- State Road
- Watercourse

Contour (5m)

- Major Contour
- Minor Contour
- Cadastre
- Easement
- 1000m Corridor
- 200m Corridor

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Kilometres

Map Projection: Universal Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia 1994
Grid: Map Grid of Australia, Zone 55

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Alpha Coal Project
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SENSITIVE RECEPTORS

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Figure: 4-1
Sheet 1 of 2

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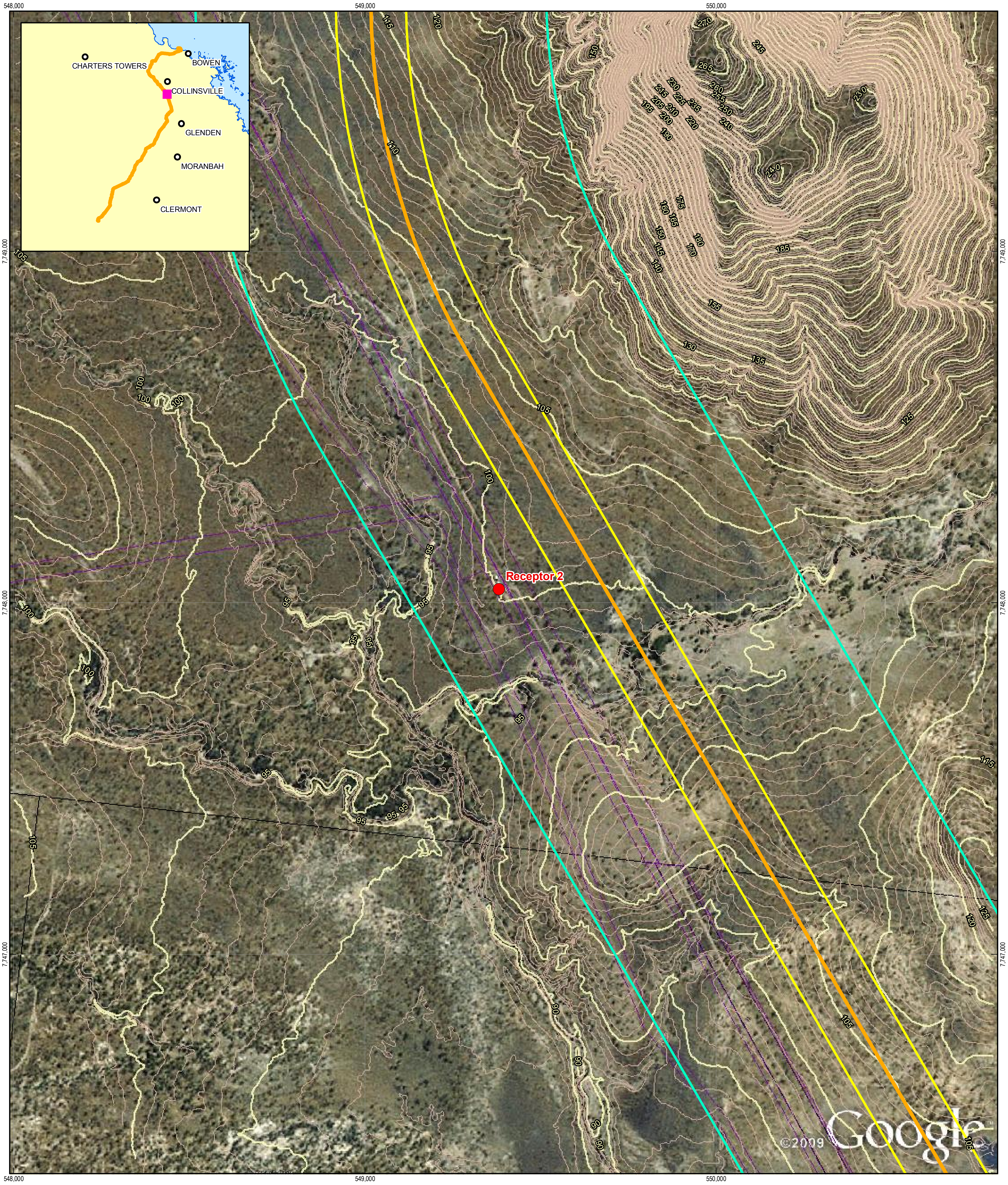

LEGEND

- Sensitive Receptor
- Proposed Alignment
- Existing Railway
- State Road
- Watercourse

Contour (5m)

- Major Contour
- Minor Contour
- Cadastre
- Easement
- 1000m Corridor
- 200m Corridor

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Kilometres

Map Projection: Universal Transverse Mercator
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SENSITIVE RECEPTORS

Figure: 4-1
Sheet 2 of 2

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4.1.2 Exposure during Construction

During construction of the railway line and associated infrastructure, it is anticipated that dust will be the most pertinent air pollutant of concern.

The impacts of dust emissions fall under two distinct categories, being health and amenity. Potential health impacts are attributable to the concentration of respirable particles in ambient air. Respirable particles of dust have an aerodynamic equivalent diameter of 10 microns or less and are otherwise known as PM_{10} with a finer fraction of $PM_{2.5}$ (being a subset of PM_{10} which is also important). PM_{10} emissions will have maximum impact under light winds and stable atmospheric conditions. These conditions occur most frequently overnight and very early in the morning. These times are generally outside construction hours of activity when confined to day shifts.

The presence of larger suspended dust particles, greater than 35 micron, is likely to affect amenity by way of reducing visibility (whilst in the air column) and by soiling of materials via dust deposition. The collection of all size fractions of particulate matter in the air is termed Total Suspended Particulate (TSP) matter. Amenity impacts are most marked in high wind conditions, when larger particles from exposed surfaces (stockpiles etc) may be entrained into the air column and transported significant distances before being deposited and so soiling surfaces. Mitigation of amenity related to total dust impacts will also act to reduce potential health impacts arising from the fine fractions in TSP dust emissions.

Extensive emission inventories (US EPA 2001; NPI 2001) for PM_{10} and TSP for various classes of earth moving machinery are commonly used to characterise the source dust emission rates from activities on-site during the construction phase. At this stage, the reference design will not be specifying the schedule of operations or the exact type and number of dozers, scrapers, trucks and other earthmoving equipment, so that it is not currently possible to characterise these sources. Moreover, the construction Right of Way (ROW) is remote from any sensitive receiver locations for a large proportion of the route so that detailed characterisation of source emissions may not be required.

Refer to Section 5.2 for a framework for the management of dust emissions during construction.

4.1.3 Exposure During Operations

The operations phase will involve the combustion of diesel by trains running on tracks above ground with emissions directly entering into the atmosphere. Exhaust emissions from these engines will produce Particulate Matter (PM_{10} and $PM_{2.5}$), Carbon Monoxide, Nitrogen Dioxide, Sulphur Dioxide, Benzene, and VOC's. Also during operations, fugitive coal dust emissions (TSP, PM_{10} and $PM_{2.5}$) are expected to enter the atmosphere from the uncovered coal wagons in transit in addition to other fugitive losses of coal dust material.

4.2 Relevant Air Quality Criteria

4.2.1 State and Federal Standards

Schedule 1 of the *Queensland Environmental Protection (Air) Policy 2008*, hereafter referred to as the EPP (Air), contains a list of air quality goals (to be used as design criteria), which nominate the maximum allowable levels for atmospheric contaminants (air quality indicators), applicable at all locations outside a dwelling or workplace. According to Queensland Government (1995, s.9) a workplace is defined as:

"A workplace is any place where work is, or is to be, performed by – (a) a worker; or (b) a person conducting a business or undertaking".

The impacts of emissions to air from the construction and operation are to be assessed against the EPP (Air) air quality objectives; these goals are almost identical to those laid out in the *National Environment Protection Measure for Ambient Air Quality* (NEPM Air).

The Terms of Reference (TOR) for this Project specify that the predicted emission levels also be compared with the NEPM (Air). The NEPM (Air) is designed as a framework for the assessment of air quality monitoring (rather than modelling) and the air quality goals listed therein are applicable to monitoring results taken at a location that is representative of the general population.

4.2.2 Environmental Values

The environmental values to be enhanced or protected under the Queensland Environmental Protection (Air) Policy 2008 are the qualities of the environment that are conducive to:

- protecting the health and biodiversity of ecosystems;
- human health and wellbeing;
- protecting the aesthetics of the environment, including the appearance of buildings, structures and other property; and
- protecting agricultural use of the environment.

4.2.3 Dust Criteria

A comparison of the EPP (Air) and NEPM (Air) objectives and goals for PM_{10} and $PM_{2.5}$ show that they are almost identical; the criteria are given in Table 4-2. Note that within the NEPM (Air), the objectives for $PM_{2.5}$ are listed as *advisory reporting standards* only because insufficient data have been gathered to define a specific goal. As such, the number of permissible exceedances per annum is not specified. In adopting the NEPM (Air) objectives, the EPP (Air) interprets this lack of specification as allowing zero/nil exceedances per annum. Given that the NEPM allows 5 exceedances of the PM_{10} goal per annum to account for natural events such as bush fires (common to the area) or 'dust storm' events, it is likely that once sufficient NEPM-reported data have been collected by state jurisdictions to define specific goals for $PM_{2.5}$ that a number of exceedances will be permitted per annum. The results presented in Section 6.3 should be viewed in this context.

Table 4-2 Relevant dust criteria

	Air Quality Indicator	Criterion, $\mu g/m^3$	Averaging Period	Permissible non-compliances
EPP (Air) and NEPM (Air)	$PM_{2.5}$	25	24 hours	-
		8	1 year	-
	PM_{10}	50	24 hours	5 days each year
EPP (Air)	Total suspended particles	90	1 year	-

4.2.4 Criteria for other Constituents

The criteria for other constituents (those that result from combustion of fossil fuel and which are ubiquitous in populated areas) are also identical in the state and federal spheres. Table 4-3 shows the corresponding criteria for EPP (Air) and NEPM (Air). Note that the NEPM (Air) does not specify any criteria for Benzene, Toluene or Xylenes.

Table 4-3 Relevant gaseous pollutant criteria

	Air Quality Indicator	Criterion, $\mu g/m^3$ at 0°C	Averaging Period	Permissible non-compliances
EPP(Air) and NEPM (Air)	Carbon Monoxide	11,000 (9.0 ppm[1])	8 hours	1 day each year
	Sulphur Dioxide	570 (0.20 ppm[1])	1 hour	1 day each year
		230 (0.08 ppm[1])	24 hours	1 day each year
		57 (0.02 ppm[1])	1 year	-
	Nitrogen Dioxide	250 (0.12 ppm[1])	1 hour	1 day each year
		62 (0.03 ppm[1])	1 year	-
EPP(Air)	Benzene	10	1 year	-
	Toluene	4,100	24 hours	-
		410	1 year	-
	Xylenes	1,200	24 hours	-
		950	1 year	-

1 Converted from ppm to $\mu g/m^3$ at zero degrees Celsius.

5. Dust Impact – Construction Phase

The types of emissions to air during the construction phase (and in the event of decommissioning) of the Project would primarily consist of:

- dust emissions from mechanical disturbance: emissions brought about by construction and maintenance vehicles/ equipment;
- wind erosion of crustal material: dust emissions from exposed disturbed soil surfaces under high wind speeds; and
- exhaust emissions from the range of motor vehicle and mobile plant required for the Project.

5.1 Description of Proposed Construction Operations

The construction of the Project will result in dust emissions along the corridor which will be adjacent to a limited number of sensitive receptors. A rail corridor width of 60m has been nominated, which is considered sufficient to accommodate the majority of the permanent infrastructure. The following sections aim to provide representative dust management measures required to comply with the relevant dust criteria in Table 4-2.

5.1.1 Types of Dust

During the construction phase the emitted particulate matter can be classified as three main components:

- TSP;
- PM_{10}; and
- $PM_{2.5}$.

These are the primary constituents of concern. Definitions can be found in Section 4.1.

5.1.2 Potential Dust Sources

The major potential dust sources during the construction phase are expected to include the following works:

- clearance of vegetation, rock and soil material;
- general surface earthworks and excavation works;
- pneumatic rock-breaking, where required;
- top soil and soil handling (stockpiling, loading, dumping);
- leveling and grading of disturbed soil surfaces;
- placement of ballast;
- laying of concrete sleepers and rail;
- passage of construction and administrative vehicles over unsealed sections of road or localised unconsolidated soil surfaces; and
- wind erosion of unstable/uncovered surfaces and stockpiles and other unconsolidated surfaces.

It is considered that the dominant sources of dust emissions during the construction works would be during activities that cause large mechanical disturbances during their operations, such as operations of a bulldozer, grader, scraper, track laying equipment or haul truck.

Civil Works

Civil works are to involve the following works:

- earthworks;
- drainage work;
- road/track work; and
- bridge work.

The following is a list of construction equipment likely to be required for the civil works, which are expected to cause large mechanical disturbances during their operation, and be possible sources of dust emissions:

- bulldozers;
- excavators;
- wheel loaders;
- graders;
- scrapers;
- rollers;
- backhoes;
- dump trucks;
- water carts;
- cranes;
- piling rigs; and
- support vehicles.

The bulk earthworks will be undertaken using scrapers for the short hauls, and with excavators and dump trucks used for long distance earthmoving. It is intended that the majority of the general fill will be obtained from the cutting excavations. The alignment has been designed so as to maximise the balance between cut to fill (refer to Volume 3, Section 2 of this EIS).

5.1.3 During Track Construction

Track construction is to involve the following activities:

- track laying,
- signalling installation and
- communications installation.

The following is a list of construction equipment likely to be required for the track construction, which is expected to cause large mechanical disturbances during their operations, and be possible sources of dust emissions:

- excavators;
- backhoes;
- ballast wagons;
- tamper;
- water carts;
- sleeper layer;
- track layer.

Track laying is likely to be undertaken using a specialised track layer machine. It is envisaged that track laying will commence from the port end and head towards the mine in one construction front. The civil works are required to be completed and handed over such that there is no delay to the track laying.

Note that construction material such as borrow material, capping material, ballast and construction water may have to be sourced from outside the 60 m rail corridor. This will be determined from ground breaking investigations planned to be undertaken as part of the detailed design phase of the Project.

Analysis of the local wind climate indicates a higher occurrence of wind from the east (including both northeast and southeast), which means sensitive receptors to the west (along with northwest and southwest) of the Project corridor would have a higher frequency of exposure to dust potentially emitted from the Project construction. There is a significantly lower occurrence of wind from the north and south, along with infrequent winds from the west (including northwest and southwest) which means that sensitive receptors located to the south, north and east (northeast and southeast) of the Project would have a relatively lower frequency of potential dust exposure.

The potential for air quality impact is greatest at receptors located at the edge of the Project corridor or at construction areas with the level of impact decreasing with distance from the construction areas. Based on previous experience with similar construction projects, sensitive land uses located less than approximately 500 m should be considered, with particular attention (perhaps leading to enhanced mitigation measures during the period that the construction front is proximate to the sensitive land uses) given to receptors located within 100 m (not required for this Project as the closest receptor is 113 m from the track).

It should also be noted that the above equipment lists are estimates only and the actual type and number of vehicles is to be determined by construction contractors. Hence at this stage, only a qualitative, not quantitative, assessment can be conducted.

5.2 Construction Dust Mitigation Measures

A selection of dust control measures relevant for this Project from Part 4.5 of the EPA Document *Best Practice Environmental Management – Environmental Guidelines for Major Construction sites (Publication 480)*, is recommended by GHD for mitigation measures to be considered for implementation during construction:

- Storage piles should be placed in areas protected from the wind and away from public places where possible. Spoil stockpiles should be lightly compacted after placement;
- Existing vegetation should be retained where possible or cleared areas and stockpiles re-vegetated with fast growing species for rapid coverage to temporarily or permanently stabilise soil;
- Construction traffic should be controlled by designating specific routes for haulage and access. Vehicle speeds on unsealed surfaces should be limited to 50 km/hr;
- All trucks hauling dirt, sand, soil or other loose materials to and from the construction site should be covered when travelling at higher speeds on public roads;
- Wheel wash units or rumble pads should be installed where vehicles enter and exit unpaved roads onto paved roads. Wash-off equipment for trucks and any equipment should be available for any vehicles leaving the site to remove excessive dirt, mud or debris from tyres and other under-surfaces. Material spillage on sealed roads should be cleaned up as soon as possible;
- All construction vehicles, mobile plant and machinery should be maintained and operated in accordance with the manufacturers' specifications to minimise exhaust emissions; and
- A line of communication should be established between the construction contractor and the local community prior to the start of construction as part of a complaints management system. All complaints lodged by nearby residents should be recorded on a complaints register, which should also document the investigation into the source of the emission giving rise to the complaint, as well as any corrective actions taken to rectify the cause of complaint.

Enhanced mitigations to further reduce construction dust are not required as these generally apply to receptors within 100m of the track. None of the receptors are within this distance.

6. Air Quality Impact – Operation Phase

6.1 Emissions Inventory

Potential sources of air emissions from the operation phase of the Project include:

- exhaust emissions from diesel powered locomotive engines; and
- fugitive coal dust emissions from uncovered coal wagons in transit.

6.1.1 Diesel Powered Trains

Locomotive exhaust

Exhaust emissions from diesel engines have been sourced from the National Pollutant Inventory (NPI) *Emissions Estimation Technique Manual for Railway Operations*, (NPI, 2008) and include carbon monoxide (CO), oxides of nitrogen (NOx), sulphur dioxide (SO_2), benzene, particulate matter less than 10 μm in equivalent aerodynamic diameter (PM_{10}) and trace hydrocarbons.

Air emission rates for coal locomotives were calculated based on daily movement profiles, diesel fuel consumption rates, published NPI emission factors and the following assumptions:

- exhaust emission data for diesel engines from the National Pollutant Inventory (NPI) *Emissions Estimation Technique Manual for Railway Operations*, (DEWHA, 2008d).
- total one-way track distance of 495 km;
- average coal train capacities of 24,000 net tonnes;
- coal train average diesel fuel consumption of 0.0018 litres per net tonne km;
- 14 movements per day, spread evenly over a 24 hour period (corresponding to production rate of 60 Mtpa including both Alpha Coal Mine and the Kevin's Corner Mine outputs);
- train speed of 80 km/h; and
- an emission rate of 5.6 kg/km of TSP from fugitive coal release estimates based on *Environmental Evaluation of Coal Dust Emissions* study (Connell Hatch, 2008) together with a 25% loading to account for coal spillage along the Project corridor.

This assessment looks at the worst case scenario of maximum operations (60 Mtpa transported from both the Alpha Coal Mine and the Kevin's Corner Mine) occurring, beyond 2016. The resulting emission estimates are shown in Table 6-1 for the entire 495 km route.

Table 6-1 Locomotive Emission Rates for 60[5] Mtpa operations (entire Project corridor)

Pollutant	Emission rate (kilograms/day)
	Year 2016
NO_2	6,612[1]
CO	13,742
SO_2	8.9
PM_{10}	1,879
$PM_{2.5}$	939
Benzene	186
VOC's	2,272

[1] Directly emitted NO_2 from trains is not significant in atmospheric NO_2 concentrations as the emissions of oxides of nitrogen are mainly as the NO component of NOx. Predicted peak nitrogen dioxide emission rates have therefore been based on air quality data that indicates that 28% of NOx is emitted as NO_2 (Yao et al., 2005).

Note that future improvements in locomotive engine technology may reduce these train emissions.

6.1.2 Coal Dust from Trains in Operation

An Environmental Evaluation of Coal Dust Emissions study on coal trains in the Central Queensland region by Connell Hatch (2008) was undertaken on behalf of Queensland Rail (QR) Limited. This report identified the following coal dust emission sources in the coal rail system:

- 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; and
- Parasitic coal load on sills, shear plates and bogies of wagons.

The primary mechanism for coal dust lift-off from coal trains is the erosion of the coal by the movement of air over the coal surface. The speed of the air passing over the coal surface, determined principally by train speed, was found to be the key factor contributing to coal dust emission rates. The total suspended particulate (TSP) emission factor equation (see below) detailed in the Coal Dust study was adopted for this assessment utilising the expected train speed (80 km/hour) and assuming calm wind conditions.

Equation 1: $m = k1 \times v \hat{} 2 + k2 \times v + k3$ (g/km/tonne of coal)

Where: $k1$ = 0.0000378, $k2$ =-0.000126, $k3$ =0.000063 and v is the airspeed relative to the train.

[5] It should be noted that transport of 60 Mtpa of coal includes both the Alpha Coal Mine and Kevin's Corner coal outputs.

This provided an estimate of TSP emissions from loaded coal wagons of 0.23 grams per kilometre per tonne coal hauled. The same assumptions concerning train numbers and frequency applied for the locomotive emission inventory were applied here.

The resulting emission estimates are shown in Table 6-2.

Table 6-2 Coal Wagon Dust Emissions for 60[6] Mtpa operations (entire Project corridor)

Pollutant	Emission rate (kilograms/day)
	Year 2016
TSP	19,285
PM_{10}[1]	6,750
$PM_{2.5}$[2]	3,375

[1] PM_{10} emissions were assumed to comprise 35% of TSP emissions from coal wagons.

[2] $PM_{2.5}$ emissions were assumed to be 50% of PM_{10}.

Note however, that other factors contribute to emissions including mine-specific coal properties (dustiness, moisture content and particle size), wagon vibrations, coal load profile, exposure to wind and precipitation. GHD's literature review found that an additional 25% is required to account for additional dust emissions due to coal spillage along the transport corridor, ballast and parasitic events. However, this will be a worse case scenario as the coal wagons to be used by the Project (refer to Section 2.3.2) are to use an advanced design where the majority of the wagon is covered, and will result in less coal spillage along the transport corridor and lower emission rates.

Furthermore, the 5.6 kg/km emission factor for TSP used here is within the literature review range of 2.8 to 32 kg/km. The QR environmental evaluation study showed that trackside measurements of peak dust levels can vary by a factor of six due to the influence of climatic conditions, coal and train properties and prevailing weather. The use of an emission factor at the low end of the range is justified due to the proposed use of wagons with better coal dust retention properties that are currently on the QR network.

It was also assumed that, on average, the coal wagon emission rate as determined from equation 1 can be calculated with a velocity of 80 km/h. That is, the effect of local wind direction will on average be a small increase in wagon emissions when the wind component parallel to the track is opposed to the train direction and a decrease in emissions when the wind component parallel to the track is in the train direction.

6.2 Dispersion Models – AUSROADS and Ausplume

The predicted peak in-air concentrations were modelled using the Gaussian plume model AUSROADS, developed by EPA Victoria, while dust deposition was modelled using the regulatory approved dispersion model Ausplume (version 6) also developed by EPA Victoria, as AUSROADS cannot model dust deposition.

[6] It should be noted that transport of 60 Mtpa of coal includes both the Alpha Coal Mine and Kevin's Corner coal outputs.

Diesel train emissions are diluted by a complicated emission and mixing process. Buoyancy induced and wind shear induced turbulence occurs behind a moving train which contributes to mixing the emissions, and thus thoroughly mixing the exhaust emissions into the recirculation zone of air behind a travelling train. If the zone of initial mixing is expanded to include a flow of trains travelling on a single track, the emissions can be characterised as a 'line source' of contaminants. For this situation the modelling of railway emissions can be performed using a Gaussian plume model configured to emulate the dispersion of contaminants from this type of line source. The model utilises a full year of meteorological conditions and thus gives seasonal variations.

For predicted peak in-air concentrations the Gaussian plume model used is AUSROADS. AUSROADS methodology is based on the US CALINE4 model which is a simple line source dispersion model for predicting the near-road impact of transport emissions, and in this case the same principles can be applied to a moving train instead of passenger and freight vehicles. The functionality of AUSROADS is improved compared to CALINE4 as data entry is easier and a number of artificial limitations have been removed. It is more-user friendly and has enhanced capabilities such as:

- An increased number of links and receptor locations that can be modelled;
- A full year of local meteorological data can be entered and read by the program via an external file; and
- Track geometry, train numbers, emission factors and receptor location information can be entered from a graphical user interface (GUI) or external file.

6.2.1 AUSROADS Model Configuration

The application of AUSROADS to modelling the train line emissions was made by considering the emissions from a typified line section of 1 km oriented in the northeast-southwest direction – this being the general direction of the line. Receptors were placed at varying lateral distances from the line at up to 200 m distance. Simulations were evaluated for a 12-month meteorological data set at hourly intervals.

The parameters and input data selection for the AUSROADS simulations are listed below;

- 12-month meteorological file (Collinsville BoM) as discussed in Section 3.2;
- Anemometer height of 10 m (Bureau of Meteorology standard);
- Meteorological site surface roughness of 0.3 m;
- Sigma-theta averaging period of 60 minutes;
- Pasquill-Gifford horizontal dispersion;
- Mixing depth;
- Irwin rural wind exponent;
- Link geometry – one single track;
- Lane (track) widths assumed to be 3 m;
- Link geometry consisted of 1 km track section with orientation NE-SW;
- Averaging periods of 1-hour, 8-hours, 24-hours and 1 year were selected as appropriate for assessment against EPP (Air) criteria;
- Discrete receptors were set 10, 20, 40, 50, 75, 100, 125, 150 and 200 m intervals in a lateral direction away from both sides of the track;

- Emissions data derived from emission estimation in g/km and trains per hour (assumed the same number of trains per hour on weekdays and weekends for a worst case scenario); and
- Post-processing was performed to obtain worst case ground level concentrations.

An example AUSROADS output file can be found in Appendix A.

6.3 Dispersion Modelling Results

6.3.1 Predicted Peak In-air Concentrations

6.3.2 Locomotive Emissions

Predicted carbon monoxide, nitrogen dioxide, sulphur dioxide, benzene, VOC's, $PM_{2.5}$ and PM_{10} concentrations from the exhaust of diesel locomotives are shown in Table 6-3.

The table below also shows the respective DEPP (Air) air quality criteria. Any predicted peak incremental concentrations will be presented in bold text when the total impact may potentially exceed the air quality goal.

Table 6-3 Highest Locomotive Exhaust Predicted Peak Incremental impacts (μg/m^3)

Pollutant	Averaging Period	EPP (Air) Criteria μg/m^3	Predicted peak incremental concentration at distance from the railway (m)					
			10	**20**	**40**	**50**	**100**	**200**
CO	8 hours	11,000	17.2	11.4	8.1	7.3	5.1	2.6
SO_2	1 hour	570	0.018	0.012	0.008	0.007	0.004	0.002
	24 hours	230	0.007	0.005	0.003	0.003	0.002	0.001
	1 year	57	0.002	0.0013	0.0008	0.0007	0.0004	0.0002
NO_2	1 hour	250	9.4	6.1	4.0	3.4	2.1	1.2
	1 year	62	1.0	0.7	0.4	0.4	0.2	0.1
Benzene	1 year	10	0.041	0.026	0.017	0.015	0.009	0.005
$PM_{2.5}$	24 hours	25	0.7	0.5	0.3	0.3	0.2	0.1

	1 year	8	0.20	0.13	0.09	0.07	0.05	0.02
PM_{10}	24 hours	50	1.4	1.0	0.7	0.6	0.4	0.2

Table 6-3 shows that the maximum predicted ground level signal from the locomotive exhaust in isolation. All concentrations of carbon monoxide, sulphur dioxide, nitrogen dioxide, benzene, and particulate matter ($PM_{2.5}$ and PM_{10}), are found to be well below their respective EPP (Air) criteria within 10 m from the railway with the most significant contribution seen to be from NO_2 (at 3.8% of it's 250 µg/m^3 criterion). Furthermore, nitrogen dioxide emissions from rail infrastructure are not expected to be a significant contributor to total nitrogen dioxide emissions within the Project area. It is also seen that for all predicted ground level concentrations there is a rapid decrease with distance from the railway.

Predicted VOC concentrations were well below their criteria with a near non-existent impact (0.00005% of assessment criteria), therefore results were not included.

Locomotive and Coal Wagon Emissions

The predicted $PM_{2.5}$, PM_{10} and TSP concentrations and total deposited dust levels from the operation of diesel locomotives with coal train fugitive dust emissions added to the model are shown in Table 6-4.

Table 6-4 Highest Locomotive Exhaust plus Coal Wagon Predicted Peak Incremental impacts (µg/m^3)

Pollutant	Averaging Period	EPP (Air) Criteria	Predicted peak incremental concentration at distance from the railway (m)					
			10	**20**	**40**	**50**	**100**	**200**
$PM_{2.5}$	24 hours	25	3.9	2.7	1.9	1.7	1.2	0.6
	1 year	8	1.2	0.8	0.5	0.4	0.3	0.1
PM_{10}	24 hours	50	7.8	5.5	3.9	3.5	2.4	1.2
TSP	1 year	90	6.4	4.1	2.7	2.3	1.4	0.8

Table 6-4 shows that predicted ground level concentrations for dust, TSP (annual), PM_{10} and $PM_{2.5}$ (24-hour average and annual) impacts attributed to the combined emission of diesel locomotive exhaust and fugitive dust from coal wagons. The predicted impacts for all constituents are below their respective EPP (Air) criteria within 10 m from the railway, but there is a distinct increase in particulate matter (PM_{10} and $PM_{2.5}$ - 24-hour averages) from the addition of the coal wagons, with both predicting to be 2.8% (train engine emission signal on its own) to 15.6% (locomotive engine plus coal wagon) of their respective criteria. Again, the highest value is directly beside the railway with ground level concentrations falling rapidly with increasing distance away from the railway. For example, the PM_{10} (24-hour average) at 10 m is 15.6 %, while at 200 m it is 2.4% of the 50 µg/m^3 criterion.

Applying the adopted background PM_{10} concentration of 16.8 µg/m^3 (see Section 3.1) to the highest predicted ground level concentration, for the locomotive engine plus wagon, the impact is predicted to be below the 50 µg/m^3 criterion. For example, at a 10 m distance away from the railway the PM_{10} concentration is 24.6 µg/m^3 corresponding to 49% of its criterion. Even with a slightly higher background from the surrounding inland locations when moving away from the coast, there is over half the criterion remaining, consequently results would be expected to be under the EPP (Air) criteria for dust.

6.3.3 Dust Deposition

Modelling of the deposition rate of particulates was also conducted using Ausplume, where the source release geometry was taken to be an area source (eleven, 100 m x 4.5 m sub-area sources) at 2 m above ground level. The total emission rate per kilometre was equally proportioned between the evenly spaced sub-area sources for the worst case scenario (track lying northeast to southwest), with discrete receptors again set at 10, 20, 40, 50, 75, 100, 125, 150 and 200 m intervals in a lateral direction away from both sides of the track to gauge a worst case predicted impact. The particulate size distribution for the transported coal was assumed from SPCC data (Air Pollution from Coal Mining and Related Developments, 1983), and a background dust deposition rate of 2 g/m^2/month was also adopted (see Section 3.1).

Table 6-5 Peak Locomotive Exhaust plus Coal Wagon Predicted Peak Incremental dust deposition impact (g/m^2/month)

Pollutant	Averaging Period	Criteria	Predicted peak incremental concentration at distance from the track (m)					
			10	20	40	50	100	200
TSP	1 year	4 g/m^2/month	0.44	0.28	0.14	0.11	0.04	0.02

From Table 6-5 the total dust deposition rates were found to be below the deposition criterion of 4 g/m^2/month at 0.44 g/m^2/month at 10 m from the railway. This is also below the maximum incremental dust deposition level of 2 g/m^2/month.

Even with the application of the adopted worst case background deposition of 65 mg/m^2/day (equating to about 2 g/m^2/month) to the predicted peak exhaust plus coal wagon impact results in 2.44 g/m^2/month, which is still well below the 4 g/m^2/month criterion (61% of criterion).

6.3.4 Predicted Impact at Nominated Sensitive Receptors

From the above results, during the worst case scenario (the locomotive exhaust together with full coal wagons) and background concentrations included, it can be demonstrated that within 10 m from the railway **ALL** predicted concentrations are compliant with the EPP (Air) criteria. The closest sensitive receptor from Table 4-1 is Receptor 1 (R1) which is located 113 m away from the Project corridor. Even under worst case conditions the highest predicted peak concentrations for PM_{10} and $PM_{2.5}$ are well below their EPP (Air) criteria, where at 100 m from the railway they are, at most, only 4.8% (both PM_{10} and $PM_{2.5}$) of their respective criteria. Consequently, at the only other identified sensitive receptor (R2), the impact from the railway in peak operation would be negligible, as it is beyond 200 m distance from the railway (260 m from the railway).

With the application of the adopted background for PM_{10} of 16.8 $\mu g/m^3$, at 100 m from the railway, the ground level concentrations are predicted to be 38% of the 50 $\mu g/m^3$ criterion, (at 19.2 $\mu g/m^3$) and therefore compliant with the EPP (Air) criteria. Hence, representative background PM_{10} levels at locations adjacent to the rail corridor are paramount to assess the potential for the PM_{10} criteria to be exceeded at the two sensitive receptors along the Project corridor.

Dust deposition is also found to be below its respective criterion at both sensitive receptors including the closest (receptor 1 at 113 m distance away) where at 100 m distance from the railway it is 0.04 g/m^2/month (only 1.0% of criterion). Even applying the adopted background deposition of 2 g/m^2/month the impact is only 51% of the 4 g/m^2/month criterion, thus having no significant effect on either of the two sensitive receptors.

6.4 Operational Mitigation Options

Recommended standard mitigation measures to lower the emissions further during the operation of the Project are as follows:

- Railway verges (where maintenance operations may be frequent-signalling at passing loops for example) should be covered using cobbles or coarse gravel to reduce fugitive dust emissions;
- Significant coal spillage (from a derailment for example) in the corridor should be cleaned up on a regular basis;
- Adopt improved coal loading techniques to reduce parasitic loads and over-filling to reduce coal spillage onto the rail corridor;
- Employ water or air blow-down to reduce parasitic loads on wagons exiting load-out;
- Improve the profile of the coal load to reduce surface erosion during transport;
- Coal surface veneering using chemical dust suppressants as the loaded wagons exit the load-out facility (only consider this if operations prove to be of concern at the mine end of the route);
- Trains should not idle near sensitive receivers (if possible); and
- Where practicable, consideration should be given to maintaining or establishing a stand of trees or other suitable vegetation on properties adjacent to the Project to aid dispersion and potentially remove dust particles through impingement on the foliage.

7. Conclusions

7.1 Construction Dust Impact Assessment

The construction of the 495 km Project corridor from the Alpha Coal Mine to the Port of Abbot Point will result in dust emissions along the transport corridor which is proximate, to a limited number of sensitive locations. The particulates of emission to air during the construction phase of the Project are expected to come from:

- dust emissions from mechanical disturbance: due to construction and maintenance vehicles/ equipment;
- wind erosion of crustal material: from exposed disturbed soil surfaces under high wind speeds; and
- exhaust emissions from the range of motor vehicle and mobile plant required for the Project.

Analysis of the local wind climate indicates a higher occurrence of wind from the east (including both northeast and southeast). The implication that follows is that sensitive receptors to the west of the Project corridor would have a higher frequency of exposure to dust potentially emitted from the Project construction then do receptors located east of the rail line. Thus, the best practice dust control measures outlined in various – *Environmental Guidelines* should be sufficient for a Dust Management Framework to be implemented during construction of the Project.

7.2 Operational impact Assessment

The following conclusions may be drawn for the operational phase impact assessment:

- Predicted emissions of CO, SO_2, NO_2, Benzene, PM_{10} and $PM_{2.5}$ from locomotive exhausts alone from the proposed operation are compliant with EPP (Air) criteria within 10 m from the railway, with the greatest impact resulting from NO_2;
- Predicted emissions of dust including TSP, PM_{10} and $PM_{2.5}$ from locomotive exhausts combined with the fully loaded coal wagons in transport along the proposed alignment are compliant with the applicable EPP (Air) criteria within 10 m from the railway;
- There is a sharp fall away of all predicted concentrations with distance from the railway with both R1 and R2 below the applicable EPP (Air) criteria for all constituents. Whilst the elevated adopted background concentrations contribute to the particulate matter results, **BOTH** of the sensitive receptors (R1 and R2) will be **compliant** and have no negative impact to environmental values for all constituents including dust; and
- Finally, predicted dust deposition from the worst case scenario of locomotive engines plus fully loaded coal wagons is below the criterion within 10 m from the railway and at both of the sensitive receptors. At 100 m distance from the railway the predicted deposition rate with background included is 2.04 $g/m^2/month$, thus no significant effect from dust deposition is expected at either of the sensitive receptors.

The operational mitigation options listed in Section 6.4 are to further reduce the impact of emissions not only at the sensitive receptors but also to protect the natural environment and the immediate surrounds of the load-out facility.

8. Limitations

This report presents the results of an air quality assessment prepared for the purpose of this commission. The data and advice provided herein relate only to the Project and structures described herein and must be reviewed by a competent engineer / scientist before being used for any other purpose. GHD Pty Ltd accepts no responsibility for other use of the data.

Where monitoring results, physical tests, data collection and similar work have been performed and recorded by others the data is included and used in the form provided. The responsibility for the accuracy of such data remains with the issuing authority, not with GHD. This air quality report was based on current Project information which is subject to revision and has changed during the time of the assessment.

An understanding of a site's air quality depends on the integration of many pieces of information, some regional, some site specific, some structural specific and some experience based. Hence this report should not be altered, amended or abbreviated, issued in part or issued incomplete in any way without prior checking and approval by GHD. GHD accepts no responsibility for any circumstances, which arise from the issue of a report, which has been modified in any way as outlined above.

9. References

Connell Hatch. (2008). Final Report Environmental Evaluation of Fugitive Coal Dust Emission from Coal Trains Goonyella, Blackwater and Moura Coal Rail Systems. Queensland Rail Limited, 31 March 2008 Revision 1. Reference H327578-N00-EE00.00.

National Pollutant Inventory. (2008). *NPI Emissions Estimation Technique Manual for Railway Operations*. SPCC dust deposition data, Air Pollution from Coal Mining and Related Developments, 1983

Yao, X, Lau, N, Chanz, C, and Fang, M, 2005. *The use of tunnel profile data to determine the ratio of NO_2/NOx directly emitted from vehicles.* Atmospheric Chemistry and Physics Discussions 5, 12723-12740, 2005.

Appendix A

Output AUSROADS file

Alpha Coal Unity NE-SW COL

VARIABLES AND OPTIONS SELECTED FOR THIS RUN

Emission rate units: g/v-km
Concentration units: micrograms/m3
Aerodynamic roughness: 0.40 (M)
Aerodynamic roughness at wind vane site: 0.30 (M)
Anemometer height: 10.0 (M)
Read sigma theta values from the met file? No
Use Pasquill Gifford for horizontal dispersion? Yes
Sigma theta averaging periods: 60 (min.)
Wind profile exponents set to: Irwin Urban
Use hourly varying background concentrations? No
Use constant background concentrations? Yes
Constant background concentrations set to: 0.00E+00 micrograms/m3
External file for emission rates and traffic volumes? No

LINK GEOMETRY

LINK NAME	TYPE	LINK COORDINATES (M) X1	Y1	X2	Y2	HEIGHT (M)	MIXING ZONE WIDTH (M)
LNK1	AG	-500.0	-500.0	500.0	500.0	0.0	12.0

LINK ACTIVITY

NOTE: TF = TRAFFIC VOLUMES; EF = EMISSION FACTORS

LNK1 HOUR	TF WEEK DAY	EM WEEK DAY	TF SATURDAY	EM SATURDAY	TF SUNDAY	EM SUNDAY
1	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
2	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
3	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
4	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
5	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
6	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
7	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
8	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
9	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
10	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
11	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
12	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
13	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
14	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
15	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
16	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
17	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
18	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
19	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
20	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
21	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
22	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
23	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00
24	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00	1.00E+00

RECEPTOR LOCATIONS

NAME	No.	COORDINATES (M) X	Y	Z	NAME	No.	COORDINATES (M) X	Y	Z
RCP1	1	-7.1	7.1	0.0	RCP2	2	-14.1	14.1	0.0
RCP3	3	-28.3	28.3	0.0	RCP4	4	-35.4	35.4	0.0
RCP5	5	-53.0	53.0	0.0	RCP6	6	-70.7	70.7	0.0
RCP7	7	-88.4	88.4	0.0	RCP8	8	-106.1	106.1	0.0

RCP9 9 -141.4 141.4 0.0 |

METEOROLOGICAL DATA

Meteorolofical data entered via the input file:
G:\31\26160\Tech\met\Col.met

Title of the meteorological data file is:
Collinsville Queensland March 08 - Feb 09

AVERAGE OVER ALL HOURS AND FOR ALL SOURCES
in micrograms/m3

Concentrations at the discrete receptors (No. : Value):

1:3.77E-02 2:2.39E-02 3:1.52E-02 4:1.31E-02 5:9.97E-03 6:8.12E-03 7:6.85E-03 8:5.88E-03
9:4.46E-03

Peak values for the 100 worst cases - in micrograms/m3
AVERAGING TIME = 1 HOUR

Rank	Value	Time Recorded hour,date	Coordinates		
1	4.60E-01	@Hr19,24/04/08	(-7.1,	7.1,	0.0)
2	4.60E-01	@Hr01,06/05/08	(-7.1,	7.1,	0.0)
3	4.60E-01	@Hr03,26/05/08	(-7.1,	7.1,	0.0)
4	4.60E-01	@Hr04,26/05/08	(-7.1,	7.1,	0.0)
5	4.60E-01	@Hr02,27/03/08	(-7.1,	7.1,	0.0)
6	4.60E-01	@Hr02,01/04/08	(-7.1,	7.1,	0.0)
7	4.60E-01	@Hr22,22/04/08	(-7.1,	7.1,	0.0)
8	4.60E-01	@Hr20,28/04/08	(-7.1,	7.1,	0.0)
9	4.60E-01	@Hr19,04/05/08	(-7.1,	7.1,	0.0)
10	4.60E-01	@Hr01,05/05/08	(-7.1,	7.1,	0.0)
11	4.60E-01	@Hr04,09/05/08	(-7.1,	7.1,	0.0)
12	4.60E-01	@Hr04,16/05/08	(-7.1,	7.1,	0.0)
13	4.60E-01	@Hr04,17/05/08	(-7.1,	7.1,	0.0)
14	4.60E-01	@Hr05,17/05/08	(-7.1,	7.1,	0.0)
15	4.60E-01	@Hr20,27/05/08	(-7.1,	7.1,	0.0)
16	4.60E-01	@Hr21,27/05/08	(-7.1,	7.1,	0.0)
17	4.60E-01	@Hr04,10/06/08	(-7.1,	7.1,	0.0)
18	4.60E-01	@Hr03,12/06/08	(-7.1,	7.1,	0.0)
19	4.60E-01	@Hr05,17/06/08	(-7.1,	7.1,	0.0)
20	4.60E-01	@Hr01,20/06/08	(-7.1,	7.1,	0.0)
21	4.60E-01	@Hr06,03/07/08	(-7.1,	7.1,	0.0)
22	4.60E-01	@Hr02,17/07/08	(-7.1,	7.1,	0.0)
23	4.60E-01	@Hr19,19/07/08	(-7.1,	7.1,	0.0)
24	4.60E-01	@Hr21,19/07/08	(-7.1,	7.1,	0.0)
25	4.60E-01	@Hr04,26/07/08	(-7.1,	7.1,	0.0)
26	4.60E-01	@Hr01,03/08/08	(-7.1,	7.1,	0.0)
27	4.60E-01	@Hr24,20/08/08	(-7.1,	7.1,	0.0)
28	4.60E-01	@Hr23,23/08/08	(-7.1,	7.1,	0.0)
29	4.60E-01	@Hr05,27/08/08	(-7.1,	7.1,	0.0)
30	4.60E-01	@Hr01,28/08/08	(-7.1,	7.1,	0.0)
31	4.60E-01	@Hr04,09/09/08	(-7.1,	7.1,	0.0)
32	4.60E-01	@Hr04,14/10/08	(-7.1,	7.1,	0.0)
33	4.60E-01	@Hr04,20/10/08	(-7.1,	7.1,	0.0)
34	4.60E-01	@Hr02,27/10/08	(-7.1,	7.1,	0.0)
35	4.60E-01	@Hr03,27/10/08	(-7.1,	7.1,	0.0)
36	4.60E-01	@Hr04,09/12/08	(-7.1,	7.1,	0.0)
37	4.60E-01	@Hr03,16/12/08	(-7.1,	7.1,	0.0)
38	4.37E-01	@Hr05,27/05/08	(-7.1,	7.1,	0.0)
39	4.00E-01	@Hr22,25/06/08	(-7.1,	7.1,	0.0)
40	3.94E-01	@Hr04,27/05/08	(-7.1,	7.1,	0.0)
41	3.80E-01	@Hr02,29/04/08	(-7.1,	7.1,	0.0)
42	3.80E-01	@Hr03,17/07/08	(-7.1,	7.1,	0.0)
43	3.51E-01	@Hr01,17/07/08	(-7.1,	7.1,	0.0)
44	3.51E-01	@Hr19,06/08/08	(-7.1,	7.1,	0.0)
45	3.51E-01	@Hr22,23/08/08	(-7.1,	7.1,	0.0)

46	3.02E-01	@Hr23,02/04/08	(-7.1,	7.1,	0.0)
47	3.02E-01	@Hr23,05/05/08	(-7.1,	7.1,	0.0)
48	3.02E-01	@Hr24,05/05/08	(-7.1,	7.1,	0.0)
49	3.02E-01	@Hr19,25/05/08	(-7.1,	7.1,	0.0)
50	3.02E-01	@Hr20,25/05/08	(-7.1,	7.1,	0.0)
51	3.02E-01	@Hr21,25/05/08	(-7.1,	7.1,	0.0)
52	3.02E-01	@Hr22,25/05/08	(-7.1,	7.1,	0.0)
53	3.02E-01	@Hr23,25/05/08	(-7.1,	7.1,	0.0)
54	3.02E-01	@Hr24,25/05/08	(-7.1,	7.1,	0.0)
55	3.02E-01	@Hr01,26/05/08	(-7.1,	7.1,	0.0)
56	3.02E-01	@Hr02,26/05/08	(-7.1,	7.1,	0.0)
57	3.02E-01	@Hr21,30/07/08	(-7.1,	7.1,	0.0)
58	3.02E-01	@Hr04,23/09/08	(-7.1,	7.1,	0.0)
59	3.02E-01	@Hr03,01/10/08	(-7.1,	7.1,	0.0)
60	3.02E-01	@Hr04,01/10/08	(-7.1,	7.1,	0.0)
61	3.02E-01	@Hr03,04/03/08	(-7.1,	7.1,	0.0)
62	3.02E-01	@Hr05,28/03/08	(-7.1,	7.1,	0.0)
63	3.02E-01	@Hr03,01/04/08	(-7.1,	7.1,	0.0)
64	3.02E-01	@Hr23,12/04/08	(-7.1,	7.1,	0.0)
65	3.02E-01	@Hr22,28/04/08	(-7.1,	7.1,	0.0)
66	3.02E-01	@Hr03,29/04/08	(-7.1,	7.1,	0.0)
67	3.02E-01	@Hr23,01/05/08	(-7.1,	7.1,	0.0)
68	3.02E-01	@Hr21,03/05/08	(-7.1,	7.1,	0.0)
69	3.02E-01	@Hr02,05/05/08	(-7.1,	7.1,	0.0)
70	3.02E-01	@Hr05,09/05/08	(-7.1,	7.1,	0.0)
71	3.02E-01	@Hr19,11/05/08	(-7.1,	7.1,	0.0)
72	3.02E-01	@Hr22,11/05/08	(-7.1,	7.1,	0.0)
73	3.02E-01	@Hr22,13/05/08	(-7.1,	7.1,	0.0)
74	3.02E-01	@Hr19,14/05/08	(-7.1,	7.1,	0.0)
75	3.02E-01	@Hr22,14/05/08	(-7.1,	7.1,	0.0)
76	3.02E-01	@Hr23,14/05/08	(-7.1,	7.1,	0.0)
77	3.02E-01	@Hr03,19/05/08	(-7.1,	7.1,	0.0)
78	3.02E-01	@Hr21,21/05/08	(-7.1,	7.1,	0.0)
79	3.02E-01	@Hr22,27/05/08	(-7.1,	7.1,	0.0)
80	3.02E-01	@Hr04,19/06/08	(-7.1,	7.1,	0.0)
81	3.02E-01	@Hr24,19/06/08	(-7.1,	7.1,	0.0)
82	3.02E-01	@Hr03,21/06/08	(-7.1,	7.1,	0.0)
83	3.02E-01	@Hr02,23/06/08	(-7.1,	7.1,	0.0)
84	3.02E-01	@Hr03,23/06/08	(-7.1,	7.1,	0.0)
85	3.02E-01	@Hr04,23/06/08	(-7.1,	7.1,	0.0)
86	3.02E-01	@Hr03,24/06/08	(-7.1,	7.1,	0.0)
87	3.02E-01	@Hr05,24/06/08	(-7.1,	7.1,	0.0)
88	3.02E-01	@Hr19,26/06/08	(-7.1,	7.1,	0.0)
89	3.02E-01	@Hr19,27/06/08	(-7.1,	7.1,	0.0)
90	3.02E-01	@Hr05,28/06/08	(-7.1,	7.1,	0.0)
91	3.02E-01	@Hr06,07/07/08	(-7.1,	7.1,	0.0)
92	3.02E-01	@Hr02,12/07/08	(-7.1,	7.1,	0.0)
93	3.02E-01	@Hr24,12/07/08	(-7.1,	7.1,	0.0)
94	3.02E-01	@Hr04,17/07/08	(-7.1,	7.1,	0.0)
95	3.02E-01	@Hr22,17/08/08	(-7.1,	7.1,	0.0)
96	3.02E-01	@Hr24,17/08/08	(-7.1,	7.1,	0.0)
97	3.02E-01	@Hr23,19/08/08	(-7.1,	7.1,	0.0)
98	3.02E-01	@Hr01,26/08/08	(-7.1,	7.1,	0.0)
99	3.02E-01	@Hr04,27/08/08	(-7.1,	7.1,	0.0)
100	3.02E-01	@Hr03,28/08/08	(-7.1,	7.1,	0.0)

Peak values for the 100 worst cases - in micrograms/m3
AVERAGING TIME = 8 HOURS

Rank	Value	Time Recorded hour,date	Coordinates		
1	2.89E-01	@Hr08,17/07/08	(-7.1,	7.1,	0.0)
2	2.59E-01	@Hr24,25/05/08	(-7.1,	7.1,	0.0)
3	2.57E-01	@Hr08,26/05/08	(-7.1,	7.1,	0.0)
4	2.56E-01	@Hr24,27/05/08	(-7.1,	7.1,	0.0)
5	2.36E-01	@Hr08,28/06/08	(-7.1,	7.1,	0.0)
6	2.21E-01	@Hr08,01/04/08	(-7.1,	7.1,	0.0)
7	2.21E-01	@Hr08,17/05/08	(-7.1,	7.1,	0.0)
8	2.12E-01	@Hr08,27/10/08	(-7.1,	7.1,	0.0)
9	2.10E-01	@Hr08,05/05/08	(-7.1,	7.1,	0.0)
10	2.05E-01	@Hr08,28/08/08	(-7.1,	7.1,	0.0)
11	1.98E-01	@Hr08,23/06/08	(-7.1,	7.1,	0.0)
12	1.95E-01	@Hr08,18/08/08	(-7.1,	7.1,	0.0)
13	1.95E-01	@Hr08,27/03/08	(-7.1,	7.1,	0.0)
14	1.94E-01	@Hr08,25/05/08	(-7.1,	7.1,	0.0)
15	1.90E-01	@Hr08,01/10/08	(-7.1,	7.1,	0.0)
16	1.89E-01	@Hr08,26/10/08	(-7.1,	7.1,	0.0)
17	1.89E-01	@Hr08,27/08/08	(-7.1,	7.1,	0.0)

18	1.87E-01	@Hr08,27/05/08	(	-7.1,	7.1,	0.0)
19	1.86E-01	@Hr24,14/05/08	(	-7.1,	7.1,	0.0)
20	1.81E-01	@Hr08,27/09/08	(	-7.1,	7.1,	0.0)
21	1.78E-01	@Hr24,05/05/08	(	-7.1,	7.1,	0.0)
22	1.68E-01	@Hr08,09/05/08	(	-7.1,	7.1,	0.0)
23	1.68E-01	@Hr24,24/05/08	(	-7.1,	7.1,	0.0)
24	1.64E-01	@Hr24,28/08/08	(	-7.1,	7.1,	0.0)
25	1.64E-01	@Hr24,26/09/08	(	-7.1,	7.1,	0.0)
26	1.63E-01	@Hr08,16/05/08	(	-7.1,	7.1,	0.0)
27	1.63E-01	@Hr08,03/06/08	(	-7.1,	7.1,	0.0)
28	1.63E-01	@Hr08,29/08/08	(	-7.1,	7.1,	0.0)
29	1.62E-01	@Hr08,14/10/08	(	-7.1,	7.1,	0.0)
30	1.60E-01	@Hr24,19/06/08	(	-7.1,	7.1,	0.0)
31	1.59E-01	@Hr08,19/06/08	(	-7.1,	7.1,	0.0)
32	1.55E-01	@Hr08,24/06/08	(	-7.1,	7.1,	0.0)
33	1.54E-01	@Hr24,27/06/08	(	-7.1,	7.1,	0.0)
34	1.54E-01	@Hr08,09/12/08	(	-7.1,	7.1,	0.0)
35	1.52E-01	@Hr24,19/07/08	(	-7.1,	7.1,	0.0)
36	1.51E-01	@Hr24,20/08/08	(	-7.1,	7.1,	0.0)
37	1.51E-01	@Hr08,12/07/08	(	-7.1,	7.1,	0.0)
38	1.48E-01	@Hr08,13/04/08	(	-7.1,	7.1,	0.0)
39	1.45E-01	@Hr24,12/04/08	(	-7.1,	7.1,	0.0)
40	1.44E-01	@Hr24,22/06/08	(	-7.1,	7.1,	0.0)
41	1.43E-01	@Hr08,16/12/08	(	-7.1,	7.1,	0.0)
42	1.43E-01	@Hr24,02/04/08	(	-7.1,	7.1,	0.0)
43	1.41E-01	@Hr08,17/06/08	(	-7.1,	7.1,	0.0)
44	1.40E-01	@Hr24,13/05/08	(	-7.1,	7.1,	0.0)
45	1.37E-01	@Hr24,25/06/08	(	-7.1,	7.1,	0.0)
46	1.36E-01	@Hr08,21/05/08	(	-7.1,	7.1,	0.0)
47	1.33E-01	@Hr24,26/08/08	(	-7.1,	7.1,	0.0)
48	1.32E-01	@Hr24,23/08/08	(	-7.1,	7.1,	0.0)
49	1.31E-01	@Hr24,25/10/08	(	-7.1,	7.1,	0.0)
50	1.30E-01	@Hr24,28/04/08	(	-7.1,	7.1,	0.0)
51	1.29E-01	@Hr24,22/04/08	(	-7.1,	7.1,	0.0)
52	1.28E-01	@Hr24,10/06/08	(	-7.1,	7.1,	0.0)
53	1.27E-01	@Hr08,21/08/08	(	-7.1,	7.1,	0.0)
54	1.24E-01	@Hr24,20/05/08	(	-7.1,	7.1,	0.0)
55	1.24E-01	@Hr24,21/05/08	(	-7.1,	7.1,	0.0)
56	1.23E-01	@Hr08,11/06/08	(	-7.1,	7.1,	0.0)
57	1.23E-01	@Hr08,28/03/08	(	-7.1,	7.1,	0.0)
58	1.23E-01	@Hr24,17/08/08	(	-7.1,	7.1,	0.0)
59	1.23E-01	@Hr08,23/12/08	(	-7.1,	7.1,	0.0)
60	1.22E-01	@Hr08,29/04/08	(	-7.1,	7.1,	0.0)
61	1.22E-01	@Hr24,11/05/08	(	-7.1,	7.1,	0.0)
62	1.21E-01	@Hr08,02/04/08	(	-7.1,	7.1,	0.0)
63	1.20E-01	@Hr08,20/10/08	(	-7.1,	7.1,	0.0)
64	1.19E-01	@Hr24,09/09/08	(	-7.1,	7.1,	0.0)
65	1.18E-01	@Hr24,30/07/08	(	-7.1,	7.1,	0.0)
66	1.18E-01	@Hr08,09/09/08	(	-7.1,	7.1,	0.0)
67	1.17E-01	@Hr08,26/07/08	(	-7.1,	7.1,	0.0)
68	1.16E-01	@Hr08,10/06/08	(	-7.1,	7.1,	0.0)
69	1.15E-01	@Hr24,06/11/08	(	-7.1,	7.1,	0.0)
70	1.14E-01	@Hr24,08/01/09	(	-7.1,	7.1,	0.0)
71	1.14E-01	@Hr08,15/12/08	(	-7.1,	7.1,	0.0)
72	1.14E-01	@Hr24,24/06/08	(	-7.1,	7.1,	0.0)
73	1.12E-01	@Hr08,05/12/08	(	-7.1,	7.1,	0.0)
74	1.12E-01	@Hr24,14/12/08	(	-7.1,	7.1,	0.0)
75	1.12E-01	@Hr08,05/09/08	(	-7.1,	7.1,	0.0)
76	1.12E-01	@Hr24,11/06/08	(	-7.1,	7.1,	0.0)
77	1.11E-01	@Hr08,28/10/08	(	-7.1,	7.1,	0.0)
78	1.11E-01	@Hr24,01/05/08	(	-7.1,	7.1,	0.0)
79	1.10E-01	@Hr08,18/02/09	(	-7.1,	7.1,	0.0)
80	1.10E-01	@Hr08,12/06/08	(	-7.1,	7.1,	0.0)
81	1.10E-01	@Hr08,15/05/08	(	-7.1,	7.1,	0.0)
82	1.10E-01	@Hr24,29/06/08	(	-7.1,	7.1,	0.0)
83	1.09E-01	@Hr08,07/07/08	(	-7.1,	7.1,	0.0)
84	1.09E-01	@Hr24,28/06/08	(	-7.1,	7.1,	0.0)
85	1.07E-01	@Hr24,08/05/08	(	-7.1,	7.1,	0.0)
86	1.05E-01	@Hr24,08/12/08	(	-7.1,	7.1,	0.0)
87	1.05E-01	@Hr24,20/06/08	(	-7.1,	7.1,	0.0)
88	9.98E-02	@Hr08,03/07/08	(	-7.1,	7.1,	0.0)
89	9.81E-02	@Hr08,20/08/08	(	-7.1,	7.1,	0.0)
90	9.80E-02	@Hr08,22/07/08	(	-7.1,	7.1,	0.0)
91	9.79E-02	@Hr24,12/07/08	(	-7.1,	7.1,	0.0)
92	9.75E-02	@Hr08,14/05/08	(	-7.1,	7.1,	0.0)
93	9.64E-02	@Hr08,08/07/08	(	-7.1,	7.1,	0.0)
94	9.61E-02	@Hr08,24/08/08	(	-7.1,	7.1,	0.0)
95	9.46E-02	@Hr08,13/07/08	(	-7.1,	7.1,	0.0)
96	9.41E-02	@Hr24,09/05/08	(	-7.1,	7.1,	0.0)
97	9.30E-02	@Hr08,04/03/08	(	-7.1,	7.1,	0.0)

98	9.27E-02	@Hr24,02/06/08 (	-7.1,	7.1,	0.0)
99	9.23E-02	@Hr24,01/04/08 (	-7.1,	7.1,	0.0)
100	9.21E-02	@Hr08,29/10/08 (	-7.1,	7.1,	0.0)

Peak values for the 100 worst cases - in micrograms/m3
AVERAGING TIME = 24 HOURS

Rank	Value	Time Recorded hour,date	Coordinates		
1	1.68E-01	@Hr24,25/05/08 (	-7.1,	7.1,	0.0)
2	1.65E-01	@Hr24,27/05/08 (	-7.1,	7.1,	0.0)
3	1.48E-01	@Hr24,05/05/08 (	-7.1,	7.1,	0.0)
4	1.32E-01	@Hr24,28/08/08 (	-7.1,	7.1,	0.0)
5	1.27E-01	@Hr24,28/06/08 (	-7.1,	7.1,	0.0)
6	1.26E-01	@Hr24,17/07/08 (	-7.1,	7.1,	0.0)
7	1.22E-01	@Hr24,19/06/08 (	-7.1,	7.1,	0.0)
8	1.20E-01	@Hr24,26/05/08 (	-7.1,	7.1,	0.0)
9	1.13E-01	@Hr24,01/04/08 (	-7.1,	7.1,	0.0)
10	1.07E-01	@Hr24,24/06/08 (	-7.1,	7.1,	0.0)
11	1.04E-01	@Hr24,21/05/08 (	-7.1,	7.1,	0.0)
12	1.04E-01	@Hr24,14/05/08 (	-7.1,	7.1,	0.0)
13	9.86E-02	@Hr24,09/05/08 (	-7.1,	7.1,	0.0)
14	9.67E-02	@Hr24,02/04/08 (	-7.1,	7.1,	0.0)
15	9.54E-02	@Hr24,20/08/08 (	-7.1,	7.1,	0.0)
16	9.38E-02	@Hr24,03/06/08 (	-7.1,	7.1,	0.0)
17	9.30E-02	@Hr24,27/03/08 (	-7.1,	7.1,	0.0)
18	9.28E-02	@Hr24,10/06/08 (	-7.1,	7.1,	0.0)
19	9.26E-02	@Hr24,12/07/08 (	-7.1,	7.1,	0.0)
20	9.26E-02	@Hr24,24/05/08 (	-7.1,	7.1,	0.0)
21	8.92E-02	@Hr24,11/06/08 (	-7.1,	7.1,	0.0)
22	8.82E-02	@Hr24,26/10/08 (	-7.1,	7.1,	0.0)
23	8.80E-02	@Hr24,17/05/08 (	-7.1,	7.1,	0.0)
24	8.68E-02	@Hr24,09/09/08 (	-7.1,	7.1,	0.0)
25	8.67E-02	@Hr24,23/06/08 (	-7.1,	7.1,	0.0)
26	8.63E-02	@Hr24,26/08/08 (	-7.1,	7.1,	0.0)
27	8.48E-02	@Hr24,27/09/08 (	-7.1,	7.1,	0.0)
28	8.45E-02	@Hr24,13/05/08 (	-7.1,	7.1,	0.0)
29	8.43E-02	@Hr24,27/10/08 (	-7.1,	7.1,	0.0)
30	8.40E-02	@Hr24,12/04/08 (	-7.1,	7.1,	0.0)
31	8.35E-02	@Hr24,25/06/08 (	-7.1,	7.1,	0.0)
32	8.31E-02	@Hr24,17/06/08 (	-7.1,	7.1,	0.0)
33	8.20E-02	@Hr24,01/10/08 (	-7.1,	7.1,	0.0)
34	8.03E-02	@Hr24,18/08/08 (	-7.1,	7.1,	0.0)
35	8.01E-02	@Hr24,13/07/08 (	-7.1,	7.1,	0.0)
36	7.89E-02	@Hr24,08/01/09 (	-7.1,	7.1,	0.0)
37	7.84E-02	@Hr24,29/04/08 (	-7.1,	7.1,	0.0)
38	7.78E-02	@Hr24,27/06/08 (	-7.1,	7.1,	0.0)
39	7.76E-02	@Hr24,07/07/08 (	-7.1,	7.1,	0.0)
40	7.73E-02	@Hr24,11/05/08 (	-7.1,	7.1,	0.0)
41	7.67E-02	@Hr24,29/06/08 (	-7.1,	7.1,	0.0)
42	7.67E-02	@Hr24,26/09/08 (	-7.1,	7.1,	0.0)
43	7.60E-02	@Hr24,28/10/08 (	-7.1,	7.1,	0.0)
44	7.51E-02	@Hr24,22/04/08 (	-7.1,	7.1,	0.0)
45	7.48E-02	@Hr24,09/12/08 (	-7.1,	7.1,	0.0)
46	7.46E-02	@Hr24,16/05/08 (	-7.1,	7.1,	0.0)
47	7.43E-02	@Hr24,13/04/08 (	-7.1,	7.1,	0.0)
48	7.42E-02	@Hr24,29/08/08 (	-7.1,	7.1,	0.0)
49	7.19E-02	@Hr24,27/08/08 (	-7.1,	7.1,	0.0)
50	7.08E-02	@Hr24,25/10/08 (	-7.1,	7.1,	0.0)
51	6.96E-02	@Hr24,15/12/08 (	-7.1,	7.1,	0.0)
52	6.91E-02	@Hr24,01/05/08 (	-7.1,	7.1,	0.0)
53	6.89E-02	@Hr24,04/05/08 (	-7.1,	7.1,	0.0)
54	6.88E-02	@Hr24,21/08/08 (	-7.1,	7.1,	0.0)
55	6.74E-02	@Hr24,24/08/08 (	-7.1,	7.1,	0.0)
56	6.62E-02	@Hr24,19/10/08 (	-7.1,	7.1,	0.0)
57	6.58E-02	@Hr24,24/04/08 (	-7.1,	7.1,	0.0)
58	6.54E-02	@Hr24,20/05/08 (	-7.1,	7.1,	0.0)
59	6.30E-02	@Hr24,30/07/08 (	-7.1,	7.1,	0.0)
60	6.25E-02	@Hr24,14/10/08 (	-7.1,	7.1,	0.0)
61	6.20E-02	@Hr24,05/12/08 (	-7.1,	7.1,	0.0)
62	6.19E-02	@Hr24,12/06/08 (	-7.1,	7.1,	0.0)
63	6.18E-02	@Hr24,08/05/08 (	-7.1,	7.1,	0.0)
64	6.13E-02	@Hr24,17/08/08 (	-7.1,	7.1,	0.0)
65	6.13E-02	@Hr24,28/03/08 (	-7.1,	7.1,	0.0)
66	6.13E-02	@Hr24,02/01/09 (	-7.1,	7.1,	0.0)
67	6.07E-02	@Hr24,28/05/08 (	-7.1,	7.1,	0.0)
68	6.07E-02	@Hr24,15/05/08 (	-7.1,	7.1,	0.0)
69	6.04E-02	@Hr24,16/12/08 (	-7.1,	7.1,	0.0)

70	6.04E-02	@Hr24,03/07/08	(	-7.1,	7.1,	0.0)
71	6.02E-02	@Hr24,22/07/08	(	-7.1,	7.1,	0.0)
72	5.99E-02	@Hr24,18/09/08	(	-7.1,	7.1,	0.0)
73	5.97E-02	@Hr24,30/04/08	(	-7.1,	7.1,	0.0)
74	5.93E-02	@Hr24,09/04/08	(	-7.1,	7.1,	0.0)
75	5.88E-02	@Hr24,18/06/08	(	-7.1,	7.1,	0.0)
76	5.86E-02	@Hr24,08/12/08	(	-7.1,	7.1,	0.0)
77	5.80E-02	@Hr24,20/06/08	(	-7.1,	7.1,	0.0)
78	5.80E-02	@Hr24,25/08/08	(	-7.1,	7.1,	0.0)
79	5.79E-02	@Hr24,29/10/08	(	-7.1,	7.1,	0.0)
80	5.77E-02	@Hr24,22/06/08	(	-7.1,	7.1,	0.0)
81	5.75E-02	@Hr24,18/02/09	(	-7.1,	7.1,	0.0)
82	5.73E-02	@Hr24,12/10/08	(	-7.1,	7.1,	0.0)
83	5.72E-02	@Hr24,11/02/09	(	-7.1,	7.1,	0.0)
84	5.68E-02	@Hr24,26/07/08	(	-7.1,	7.1,	0.0)
85	5.63E-02	@Hr24,06/11/08	(	-7.1,	7.1,	0.0)
86	5.60E-02	@Hr24,12/05/08	(	-7.1,	7.1,	0.0)
87	5.59E-02	@Hr24,04/03/08	(	-7.1,	7.1,	0.0)
88	5.55E-02	@Hr24,08/07/08	(	-7.1,	7.1,	0.0)
89	5.51E-02	@Hr24,03/08/08	(	-7.1,	7.1,	0.0)
90	5.50E-02	@Hr24,23/05/08	(	-7.1,	7.1,	0.0)
91	5.49E-02	@Hr24,11/04/08	(	-7.1,	7.1,	0.0)
92	5.48E-02	@Hr24,21/02/09	(	-7.1,	7.1,	0.0)
93	5.40E-02	@Hr24,14/07/08	(	-7.1,	7.1,	0.0)
94	5.35E-02	@Hr24,19/07/08	(	-7.1,	7.1,	0.0)
95	5.30E-02	@Hr24,22/05/08	(	-7.1,	7.1,	0.0)
96	5.28E-02	@Hr24,23/08/08	(	-7.1,	7.1,	0.0)
97	5.27E-02	@Hr24,11/10/08	(	-7.1,	7.1,	0.0)
98	5.21E-02	@Hr24,14/02/09	(	-7.1,	7.1,	0.0)
99	5.15E-02	@Hr24,20/03/08	(	-7.1,	7.1,	0.0)
100	5.14E-02	@Hr24,23/04/08	(	-7.1,	7.1,	0.0)

Simulation started at 16:35:13 on 24/05/2010
Simulation finished at 16:35:15 on 24/05/2010

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Document Status

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