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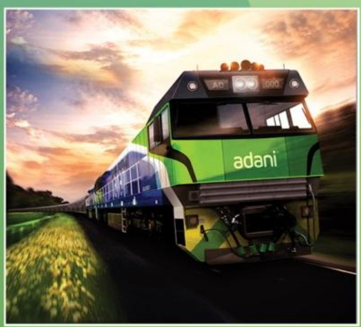

Adani Mining Pty Ltd

NORTH GALILEE BASIN RAIL PROJECT

Environmental Impact Statement

Appendix I Air quality

November 2013

This North Galilee Basin Rail Project air quality report ("the Report") has been prepared by GHD Pty Ltd ("GHD") on behalf of and for Adani Mining Pty Ltd ("Adani") in accordance with an agreement between GHD and Adani.

The Report may only be used and relied on by Adani for the purpose of informing environmental assessments and planning approvals for the proposed North Galilee Basin Rail Project ("the Purpose") and may not be used by, or relied on by any person other than Adani.

The services undertaken by GHD in connection with preparing the Report were limited to those specifically detailed in section 1.2 of the Report.

The Report is based on conditions encountered and information reviewed, including assumptions made by GHD, at the time of preparing the Report. Assumptions made by GHD are contained through the Report, including (but not limited to) concept design and operations information provided by Adani.

To the maximum extent permitted by law GHD expressly disclaims responsibility for or liability arising from:

- *any error in, or omission in connection with assumptions, or*
- *reliance on the Report by a third party, or use of the Report other than for the Purpose.*

Executive summary

This air quality report describes the existing climate and air quality in the region of the North Galilee Basin Rail Project (NGBR Project). This report also contains the outputs of dispersion modelling of the emissions of the NGBR Project.

The study area for this report was defined by the following five meteorological regions traversed by the NGBR Project:

- Coastal
- Bogie River
- Bowen River
- Newlands
- Isaac.

Each of the five meteorological regions was modelled separately, due to differences in climatic regions and local meteorology. The climate of each meteorological region, for the purposes of this report, was defined by its:

- Temperature and humidity
- Rainfall pattern
- Wind speed and direction
- Atmospheric stability and mixing height.

Background particulate matter in the four inland regions (Bogie River, Bowen River, Newlands and Isaac) was characterised using data collected for a greenfield industrial site within the Bowen Basin. On this basis, the assumed ambient level of deposited dust was set at 1.6 g/m^2/month. The assumed level of particulate matter of particle size less than 10 micron (PM_{10}) was a daily mean concentration of 15.0 µg/m^3. The assumed level of $PM_{2.5}$ was a daily mean concentration of 6.6 µg/m^3 and an annual average of 3.7 µg/m^3 and the assumed total suspended particulates (TSP) was a daily mean of 30.0 µg/m^3, as a conservative surrogate for annual mean. The background levels of relevant gaseous compounds were considered to be zero.

Background particulate matter in the coastal region was determined from measurements collected at Townsville, which provides the closest source of available data to the Abbot Point region. On this basis, the assumed existing level of deposited dust was set at 0.5 g/m^2/month, the assumed level of PM_{10} was a daily mean concentration of 18.1 µg/m^3, the assumed level of $PM_{2.5}$ was a daily mean concentration of 5.1 µg/m^3 with an annual average of 5.8 µg/m^3, and the assumed TSP was an annual average of 26.4 µg/m^3. Use of these values is appropriate and adds a high degree of conservatism to the model as Townsville's population is significantly greater than that of Abbot Point, and more so in the sparsely populated coastal plains.

Background nitrogen dioxide (gaseous compounds) in the coastal region was considered to be an hourly value of 55 µg/m^3 (representing the 90th percentile of the daily peak) and an annual value of 9 µg/m^3. Separate SO_2 background concentrations were determined for hourly (11 µg/m^3), daily (6 µg/m^3), and annual (3 µg/m^3) averaging times, representing the 75th percentile values for the hourly and daily measurements, and the median daily measurement respectively. Other background levels of gaseous compounds (carbon monoxide; formaldehyde; toluene; xylenes) were considered to be zero.

An emissions inventory was developed for the construction and operation of the NGBR Project, including crustal dust, exhaust emissions and coal dust. The values were quantified in terms of legislated air quality objectives for each type of emission.

The largest non-dust locomotive pollutant was found to be NO_2, however the *Environmental Protection (Air) Policy 2008* (Air EPP) one-hour NO_2 criterion was met within seven metres of the centreline of the final rail corridor for all representative track sections modelled.

Indicative AUSPLUME modelling suggested daily PM_{10} levels during the construction of the NGBR Project would meet the Air EPP criterion within approximately 500 m. Associated dust deposition was also expected to be well under the guideline value of 2 g/m^2/month by this distance. AUSROADS modelling of operation emissions showed that PM_{10} and $PM_{2.5}$ Air EPP criteria would be met within 228 m of the centreline of the final rail corridor. The annual TSP criterion was shown to be met within 61 m from the centreline. The annual $PM_{2.5}$ criterion was shown to be met within 315 m, however background concentrations (3.7 or 5.8 $\mu g/m^3$ depending on location) accounted for a large proportion of the 8 $\mu g/m^3$ criterion in this case. AUSPLUME dispersion modelling was used with area sources to quantify dust deposition during operations. The maximum incremental dust deposition level is below the deposition guideline equivalent of 2 g/m^2/month at all points in the modelling domain. Given the closest distance to an identified sensitive receptor was 1,060 m, all emissions were expected to comply with relevant criteria at these locations.

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Appendices

Terms and abbreviations

Terms and abbreviations	Definition
$\mu g/m^3$	Micrograms per cubic meter
Adani	Adani Mining Pty Ltd
BOM	Bureau of Meteorology
CALMET	Atmospheric meteorological modelling system
CO	Carbon monoxide
CO_2	Carbon dioxide
DEHP	Department of Environment and Heritage Protection
DERM	Former Queensland Department of Environment and Resource Management
EIS	Environmental Impact Statement
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
EPP	Environment Protection Policy
Final NGBR Project footprint	The final NGBR Project footprint will accommodate all rail infrastructure required for construction and operation, scalable to accommodate 100 mtpa product coal transport, including passing loops, a maintenance road, rolling stock maintenance (provisioning, fuel storage and refuelling, maintenance, etc.), water supply and pipeline, track and signalling maintenance facilities, staff crib, accommodation and training facilities and other necessary infrastructure associated with the operational functions of the NGBR Project. Temporary construction facilities are expected to include laydown areas, construction depots (warehousing, fuel storage, vehicle storage, administration facilities, etc.), sleeper manufacturing yards, construction accommodation camps, quarries and borrow pits, access tracks into the corridor and other necessary infrastructure associated with the construction functions of the NGBR Project.
Final rail corridor	The NGBR Project nominal 100 m wide corridor.
g	Grams
m^2	Square meters
mtpa	Million tonnes per annum
NEPM	National Environment Protection Measure
NGBR	North Galilee Basin Rail
NGBR Project	the North Galilee Basin Rail Project
NO_2	Nitrogen dioxide
NO_x	Oxides of nitrogen
NPI	National Pollutant Inventory

Terms and abbreviations	Definition
O_3	Ozone
PM_{10}	Particulate Matter less than 10 µm
$PM_{2.5}$	Particulate Matter less than 2.5 µm
Preliminary investigation corridor	The NGBR Project nominal 1,000 m wide corridor.
SO_2	Sulphur dioxide
TDMP	Townsville Dust Monitoring Program
TEOM	Tapered Element Oscillating Microbalance
TOR	Terms of Reference
TSP	Total suspended particulates
USEPA	United States Environmental Protection Agency
VKT	Vehicle kilometres travelled
VOC	Volatile Organic Compound

1. Introduction

1.1 Project overview

Adani Mining Pty Ltd (Adani) proposes the construction and operation of the North Galilee Basin Rail Project (NGBR Project), a multiuser, standard gauge, greenfield rail line that will transport coal from mines in the northern Galilee Basin to the Port of Abbot Point. The NGBR Project is approximately 300 km in length and connects the proposed Carmichael Coal Mine and Rail Project's east-west rail corridor, approximately 70 km east of the Carmichael Mine in the vicinity of Mistake Creek, with supporting infrastructure at the Port of Abbot Point (refer Figure 1-1). The NGBR Project will have an operational capacity of up to 100 million tonnes per annum (mtpa) of coal product expected to be sourced from both Adani and third-party mines in the northern Galilee Basin. Key features of the NGBR Project include:

- Approximately 300 km of standard gauge, bi-directional rail track located within a nominal 100 m wide rail corridor (the final rail corridor)
- A rail maintenance access road running parallel to the rail track for approximately 300 km and wholly within the final rail corridor
- Seven passing loops, each 4.3 km in length
- Signalling infrastructure
- Approximately 4.5 km of fill greater than 15 m in depth (11 locations) and approximately 3.4 km of cut greater than 15 m in depth (nine locations)
- At-grade and grade separated road, rail, stock and occupational crossings
- Bridge and culvert structures at major waterways and drainage lines, and various other longitudinal and cross drainage structures
- A rolling stock maintenance facility near the Port of Abbot Point including provisioning line, train maintenance line, wagon and locomotive service sheds, wash bay and queuing line
- Five temporary accommodation camps for construction workers
- A temporary construction depot at the southern end of NGBR Project
- Temporary construction yards, concrete batching plants, bridge and tack laydown areas and heavy vehicle turning circles.

During construction, quarries and borrow pits within acceptable haulage distances will be required to provide a cost effective source of fill, gravel, aggregate and ballast. The number and location of borrow pits and quarries will be investigated further during detailed design and each may require screening and crushing plants to process material.

1.2 Scope of report

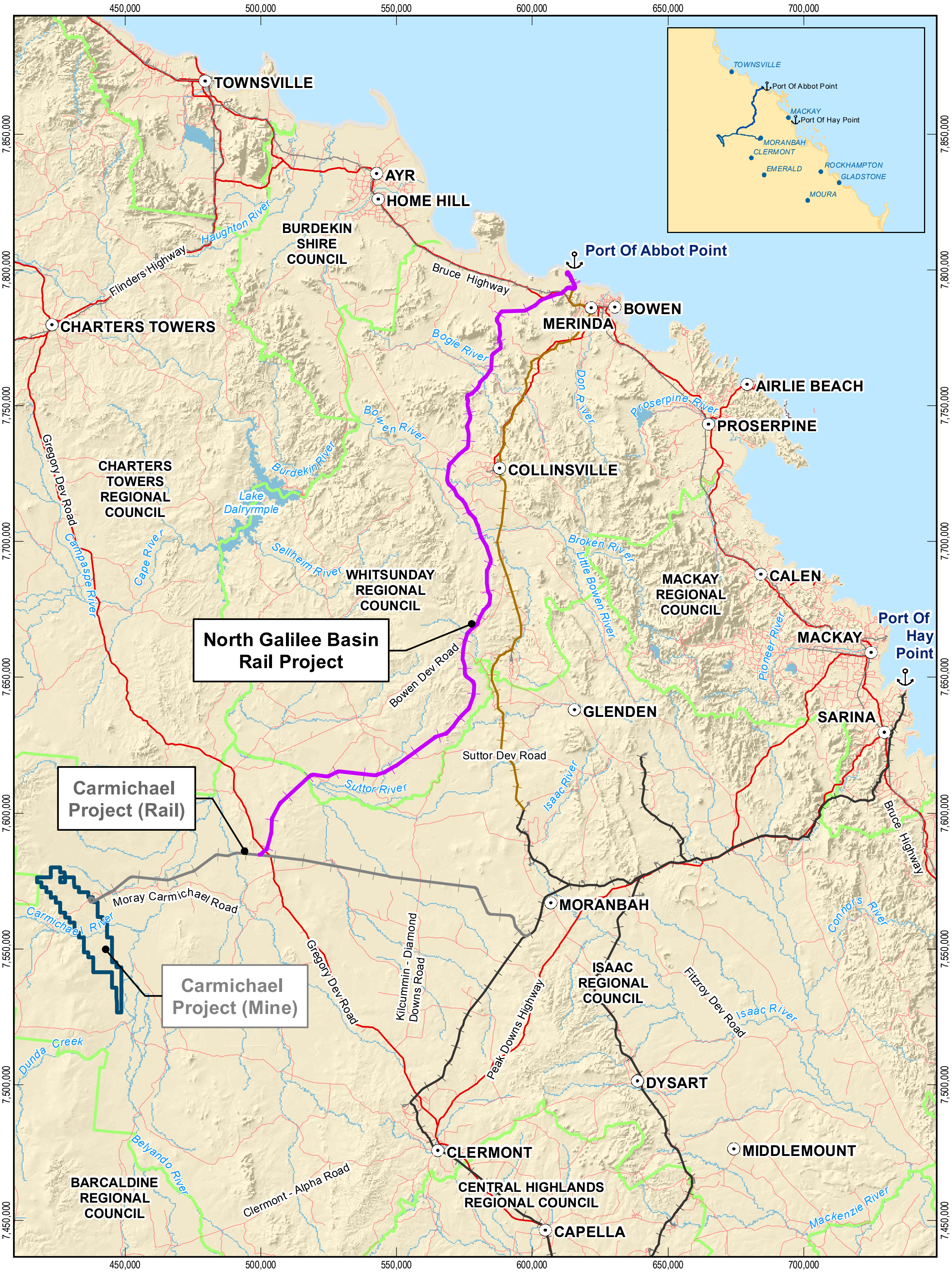
The objectives of this air quality report are to describe the existing air quality in the region of the NGBR Project and to calculate emissions to air from the NGBR Project.

The scope of the air quality assessment was defined by the following tasks:

- Description of the existing climate, and the identification of separate meteorological regions (see Section 3.1)

- Identification of relevant air quality objectives (see Section 4.3)
- Description of the existing background air quality characterising each meteorological region (see Section 3.2)
- Sourcing or developing appropriate AUSPLUME meteorological files for each meteorological region (see Section 3.1.1)
- Dispersion modelling of NGBR Project emissions to air, including:
  - Particulate matter of less than 10 micron (PM_{10})
  - Particulate matter of less than 2.5 micron ($PM_{2.5}$)
  - Total suspended particulates (TSP)
  - Deposited dust
  - Nitrogen dioxide (NO_2)
  - Sulfur dioxide (SO_2)
- Analysis of model results and reporting (see Section 5).

This air quality report was prepared in accordance with the Terms of Reference (TOR) for the NGBR Project. A table that cross-references the contents of this report and the TOR is included as Volume 2 Appendix A TOR cross-reference.



LEGEND

- Town
- Major Port
- Other Rail Network
- Goonyella System
- Newlands System
- Major Road
- Local Road
- Watercourse
- Local Government Area
- Carmichael Project (Rail)
- North Galilee Basin Rail
- Carmichael Project (Mine)

1:2,000,000 (at A4)

0 10 20 30 40 50

Kilometres

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

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GHD adani

Adani Mining Pty Ltd
North Galilee Basin Rail Project

Job Number	41-26457
Revision	B
Date	29 Aug 2013

Project location

Figure 1-1

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Level 9, 145 Ann St Brisbane QLD 4000 T +61 7 3316 3000 F +61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data Source: © Commonwealth of Australia (Geoscience Australia): Town, Railways, Watercourses (2007); DNRM: LGA, (2011), Hillshade (2009); DMR: State Roads (2008); DME: EPC1690 (2010), EPC1080 (2011); Adani: Alignment Opt9 Rev3 (2012), NGBR: Alignment Opt6 Rev 2 (2013).

2. Methodology

2.1 Study area

The study area for this chapter incorporated the nearest potential sensitive receptors identified within approximately six kilometres of the 1,000 m preliminary investigation corridor for the NGBR Project. The study area was divided into five meteorological regions for the purpose of dispersion modelling (refer Section 3.1.1).

2.2 Data sources

The air quality assessment relied on the following data sources:

- North Galilee Basin Rail Concept Design Report (Aarvee Associates 2013)
- Weather records at the following Bureau of Meteorology (BOM) stations
  - Twin Hills Post Office (036047)
  - Collinsville Post Office (035019)
  - Millaroo DPI (Department of Primary Industries) research station (033090)
  - Bowen Airport (033257).
- Local meteorology for model input
  - Cassiopeia Station (473000 mE, 7576000 mN, GDA94)
  - Suttor Creek (585600 mE, 7635900 mN, GDA94)
  - Collinsville South – Sonoma Mine (589747 mE, 7717080 mN, GDA94)
  - Bogie River (580540 mE, 7764097 mN, GDA94)
  - Bowen (625728 mE, 7785873 mN, GDA94).
- Local ambient pollution data used to characterise existing background concentrations
  - Published ambient PM_{10} and $PM_{2.5}$ statistics for a greenfield Industry Partner Site in the Bowen Basin
  - Published US Environment Protection Authority (USEPA) PM_{10} to TSP ratio
  - Published dust deposition rates from the Ensham Central Project (Katestone Environmental, 2006), located within the Bowen Basin
  - Published ambient TSP; dust deposition rate, NO_2 and SO_2 percentile statistics for the Queensland Department of Environment and Heritage Protection (DEHP) Townsville ambient site at Pimlico
  - Published ambient PM_{10} and $PM_{2.5}$ percentile statistics for the DEHP Toowoomba North monitoring site, for the purpose of applying ratios to Townsville data.

2.3 Legislation and guidelines

Legislation and guidelines relevant to this air quality report are as follows:

- *Environmental Protection (Air) Policy 2008* (Air EPP) for air quality objectives
- *National Environment Protection (Ambient Air Quality) Measure*, (Air NEPM) for ambient air quality standards

- *National Environment Protection (Air Toxics) Measure*, (Air Toxics NEPM) for products of combustion and trace gases.

The Air EPP, Air NEPM and Air Toxics NEPM were employed in the development of air quality assessment criteria applicable to the study area (see Section 4). A general explanation of the Air EPP is also provided in Volume 1 Chapter 20 Legislation and approvals.

2.4 Desktop assessment

2.4.1 Meteorological regions

The broad climatic regions crossed by the NGBR Project were identified using a modified Koeppen climate classification derived for Australia (Stern *et al.* 2000). This classification is based on rainfall, temperature and humidity data collected at BOM observation stations. Stations were selected based on their position and the availability and length of the record of these climatic parameters. Sections 3.1.2 and 3.1.3 analyse this data, producing a broad description of the climate of the study area. The limited extent of this data (parameters measured, and the twice-daily frequency of observations) made it unsuitable for direct incorporation into atmospheric dispersion models.

Dispersion of airborne pollutants is mainly dependent upon additional meteorological and geophysical parameters not present in the observational dataset, including:

- Wind speed
- Wind direction
- Atmospheric stability class
- Mixing height
- Track orientation.

The modelling program therefore went beyond the limited monitoring data available at the BOM observation sites, and developed more detailed meteorological files for five distinct meteorological regions within the study area (refer Sections 3.1.4 to 3.1.6).

2.4.2 Background concentrations

Background concentrations were determined through a literature review of published ambient pollution data (refer to Section 3.2).

2.4.3 Derived wind model

AUSPLUME meteorological files were developed for each of the five meteorological regions in the study area. The method of developing an AUSPLUME meteorological file for a given meteorological region was as follows:

- Develop meteorology from BOM observations
- Model meteorology using the MM5 prognostic model, with the results being down-scaled and adjusted to correct for mass consistent flows around topographical features, using the CALMET model
- Directly model meteorology using the TAPM prognostic model.

MM5 and CALMET are freely available international meteorological models while TAPM was developed by the Commonwealth Scientific and Industrial Research Organisation.

2.4.4 Emissions model

AUSROADS and AUSPLUME models were used to model locomotive emissions and dust deposition (see Section 5.2.6). These simulations assumed the transport of 100 mtpa of coal along the NGBR Project, requiring 14 loaded and 14 unloaded trains per day.

The line-source Gaussian model AUSROADS V1.0 was selected for this purpose, as this model is specifically designed for near field impact from linear transport sources. Deposited dust dispersion was modelled using the Gaussian plume model AUSPLUME V6.0. Both are industry recognised techniques for modelling emissions and dust deposition.

Parameters and input data

The parameters and input data used for the AUSROADS simulations were:

- Site representative 12-month meteorological files
- Anemometer readings at height of 10 m (BOM standard)
- Meteorological site surface roughness of 0.3 m
- Sigma-theta averaging period of 60 minutes
- Pasquill-Gifford horizontal dispersion
- Irwin rural wind exponent
- Link geometry – one single track set to a width of 6 m to allow for turbulent mixing from a fast moving train
- Link geometry consisted of a 1 km track section with varying orientations
- Averaging periods of 1-hour, 8-hours, 24-hours and one year were selected as appropriate for assessment against Air EPP criteria
- Hourly emissions were recorded at 2, 5, 10, 20, 40, 50, 100, and 200 m distances perpendicular to both sides of each modeled track section.
- Emissions data derived from emission estimation in grams per vehicle-kilometer-travelled (g/VKT) for a one kilometer straight track segment (‘link’) assuming a fixed number of loaded standard gauge trains per hour on all days (weekdays and weekends)

Background concentrations were incorporated into the predictions, as described in Section 3.2. Full model configuration details are displayed in Appendix A Sample AUSROADS output file.

2.5 Limitations

The level of detail of the air quality assessment was limited to the information provided in the North Galilee Basin Rail Concept Design Report (Aarvee Associates 2013).

No background air quality monitoring was conducted within the final rail corridor prior to the preparation of this report. A review of publicly available data for central Queensland was therefore carried out to provide appropriate background concentrations. Conservative choices were made when defining the background to ensure a high degree of confidence in the robustness of the assessment.

NGBR Project emissions inherited the built-in assumptions of the applied software.

3. Existing environment

3.1 Meteorology

3.1.1 Meteorological regions

A meteorological analysis of available rainfall, temperature, and humidity observations collected at BOM climatic stations determined that the NGBR Project crossed the following five meteorological regions (refer to Figure 3-1):

- Coastal
- Bogie River
- Bowen River
- Newlands
- Isaac.

The climate of each meteorological region can be described by the modified Koeppen classification for climate classification in Australia (Stern *et al.*, 2000), with 'tropical', 'subtropical' and 'grassland' all possible climate descriptors within the study area.

Table 3-1 lists the five meteorological regions within the study area; the nearest BOM climatic sites and their years of operation; and the Koeppen climate classification for each region. The table also describes the associated AUSPLUME and AUSROADS meteorological files that were developed for modelling.

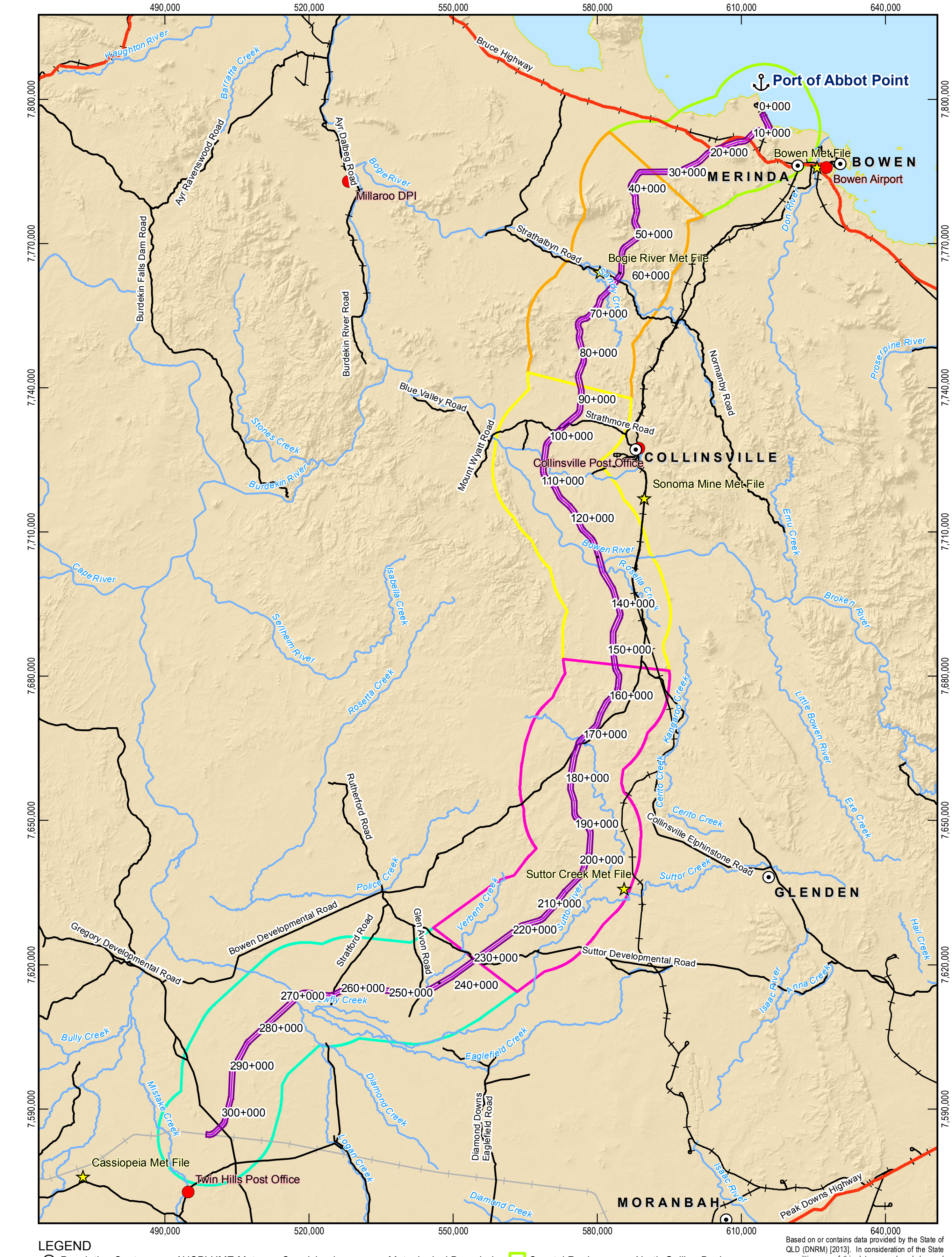
Table 3-1 Meteorological regions adopted for the NGBR Project

Meteorological region	Nearest BOM climatic site [data availability]	Koeppen climate classification	AUSPLUME/ AUSROADS meteorological file	Meteorological file source
Coastal region (Chainage 3.5 km to 35 km)	Bowen Airport (033257) [1987 to present]	Tropical - Savanna	Bowen STP (625728 mE, 7785873 mN, GDA94)	TAPM derived 2004
Bogie River region (Chainage 35 km to 87.5 km)	Millaroo DPI (033090) [1958 to 1993]	Subtropical - Distinctly Dry Winter	Bogie River (580540 mE, 7764097 mN, GDA94)	TAPM derived 2008
Bowen River region (Chainage 87.5 km to 154 km)	Collinsville Post Office (033013) [1939 to present]	Subtropical – Moderately dry winter	Sonoma Mine (589747 mE, 7717080 mN, GDA94)	Derived from on-site measurements 2008/2009

Meteorological region	Nearest BOM climatic site [data availability]	Koeppen climate classification	AUSPLUME/ AUSROADS meteorological file	Meteorological file source
Newlands region (Chainage 154 km to 231.5 km)	N/A	Subtropical – Moderately dry winter (inferred as per neighbouring regions)	Suttor Creek (585600 mE, 7635900 mN, GDA94)	TAPM derived. Adjusted for mechanical mixing height. 2008
Isaac region (Chainage 231.5 km to 306.9 km)	Twin Hills Post Office (036047) [1905 to 1985]	Subtropical – Moderately dry winter	Cassiopeia Station (473000 mE, 7576000 mN, GDA94)	Developed from MM5 / CALMET modelling. 2007

Long-term climatic statistics from BOM climate stations were used to describe the broad-scale variation in Koeppen classification along the NGBR Project. Records of temperature, rainfall and humidity (monthly, or 9 am and 3 pm humidity averages) are described in Sections 3.1.2 and 3.1.3.

Hourly-varying wind speed and direction, atmospheric stability, and mixing height predictions were extracted from the model meteorological files produced for the five meteorological regions in the study area. This data was subsequently analysed and graphed in Sections 3.1.4 to 3.1.6.



LEGEND

- Population Centres
- Major Port
- Chainage Points
- Climate Stations
- AUSPLUME Met File Locations
- Highway
- Main Road
- Carmichael Project (Rail)
- Railway
- Watercourses (Major)

Meteological Boundaries
- Bogie River Region
- Bowen River Region
- Coastal Region
- Isaac Region
- Newlands Region
- North Galilee Basin Rail 1000m Corridor
- North Galilee Basin Rail 100m Corridor

Based on or contains data provided by the State of QLD (DNRM) [2013]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

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0 7.5 15 30

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

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Adani Mining Pty Ltd
North Galilee Basin Rail Project

Meteorological Regions Occuring along the NGBR Project Corridor

Job Number	41-26457
Revision	A
Date	26 Jul 2013

Figure 3-1

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145 Ann Street Brisbane QLD 4000 Australia T 61 7 3316 3000 F 61 7 3316 3333 E bnemail@ghd.com W www.ghd.com

Data source: GA: Populated Places, Railway, Watercourse/2007; Adani: NGBR Corridor 13/05/2013 NGBR Corridor 06/06/2013, Camichael Rail Project/2012, Chainage/2013; BOM: Climate Sections/2013 Meteological Boundaries/2013; GHD: AUSPLUME Met File Locations/2013; DNRM: Roads/2010. Created by:MS

3.1.2 Temperature and humidity

Figure 3-2 to Figure 3-5 graph mean and decile temperature statistics for each month, on the basis of long term BOM observations. There is a distinct difference between the inland and coastal observations.

The long term monthly mean temperatures observed at the inland sites (Twin Hills Post Office; Collinsville Post Office; and Millaroo DPI) are similar, showing that daytime summer temperatures are mostly in the range of 29 to 38 ^{o}C, with winter overnight temperatures dropping to between three and 16 ^{o}C with a mean centred near 8 ^{o}C. Temperatures in the inland region vary between -3.2 ^{o}C (at Twin Hills Post Office) and 44.4 ^{o}C (at Millaroo DPI).

'Hot days', those with temperatures exceeding 35 ^{o}C, can be expected up to 74 days per year at the Twin Hills Post Office and about 35 days per year at the other two inland sites. 'Frost days', those with screen temperatures below 2 ^{o}C are rare at the inland sites with expected return rates of 10 and two days per year respectively.

In contrast the temperature climatology of the coastal Bowen Airport climatic station is more moderate, with the summertime maximum usually varying between 29 and 33 ^{o}C, and overnight winter minimum temperatures between seven and 20 ^{o}C. Overall, the temperature varies between 3.2 ^{o}C and 39.4 ^{o}C during the period of record.

Figure 3-6 to Figure 3-9 show the corresponding 9 am and 3 pm relative humidity statistics for each observing station. It is noted that data for 3 pm relative humidity was not available from Millaroo DPI. In all cases relative humidity is highest in the mornings and lowest in the afternoons. The highest humidity tends to occur during February in the morning, with the lowest during the afternoon in September and October (inland stations) or July and August (Bowen Airport).

Figure 3-2 Monthly mean and decile maximum and minimum temperatures at Bowen airport

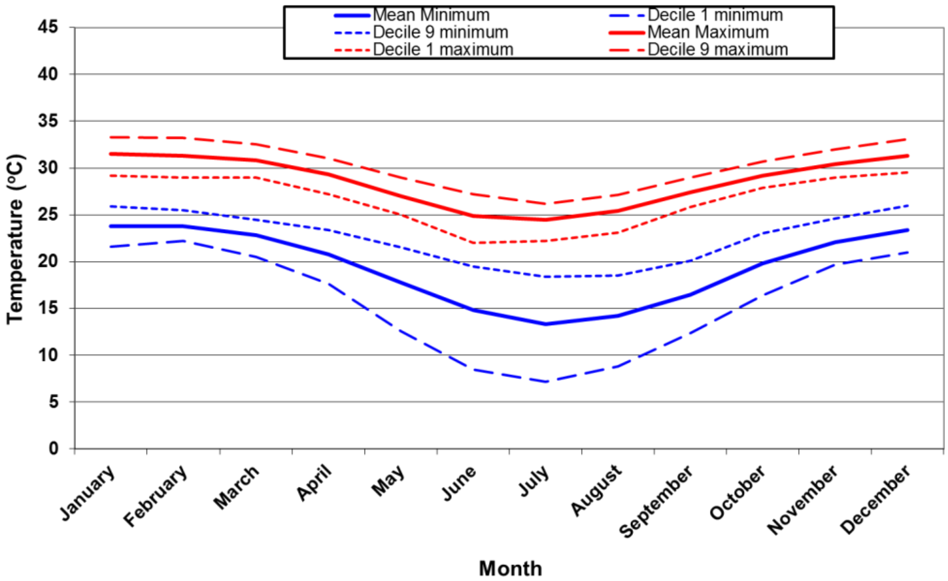


Figure 3-3 Monthly mean and decile maximum and minimum temperatures at Millaroo DPI

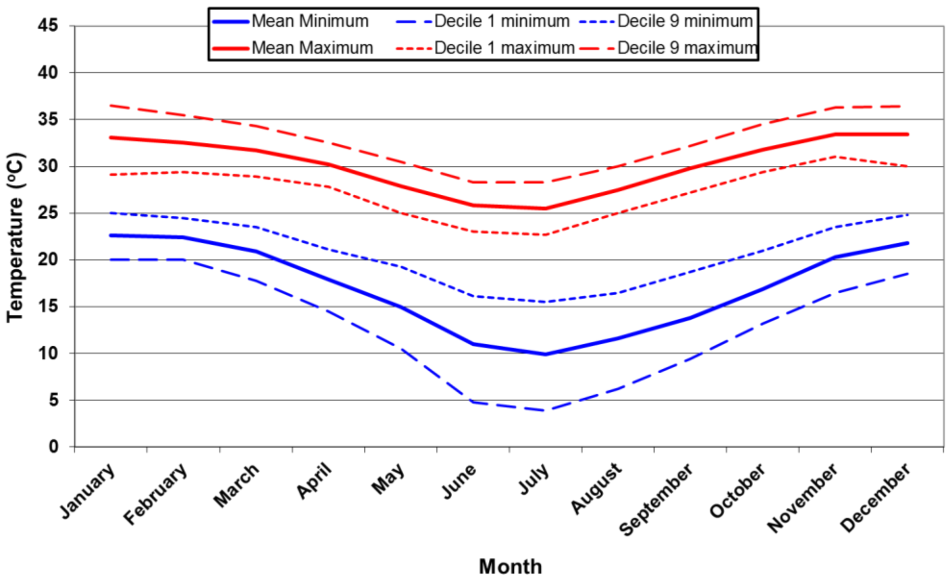


Figure 3-4 Monthly mean and decile maximum and minimum temperatures at Collinsville post office

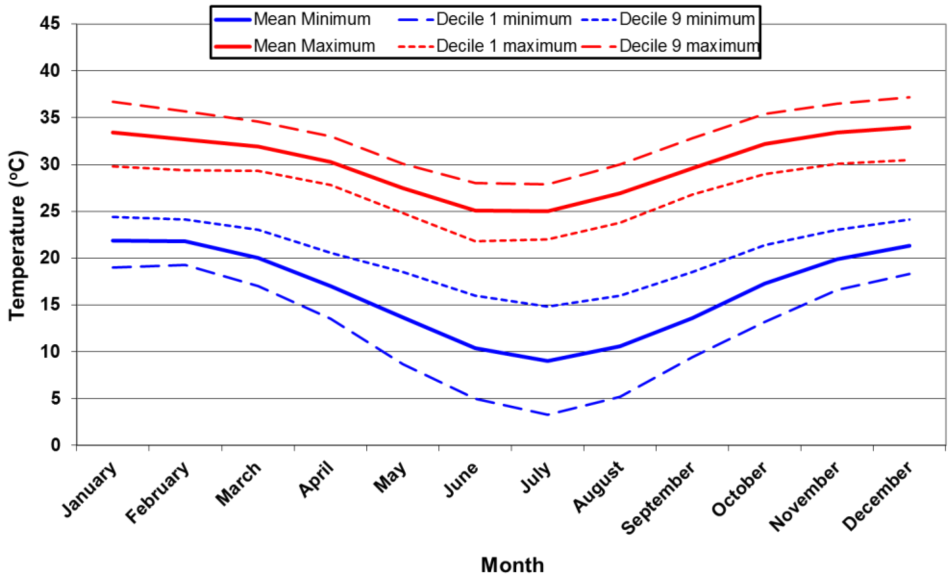


Figure 3-5 Monthly mean and decile maximum and minimum temperatures at Twin Hills post office

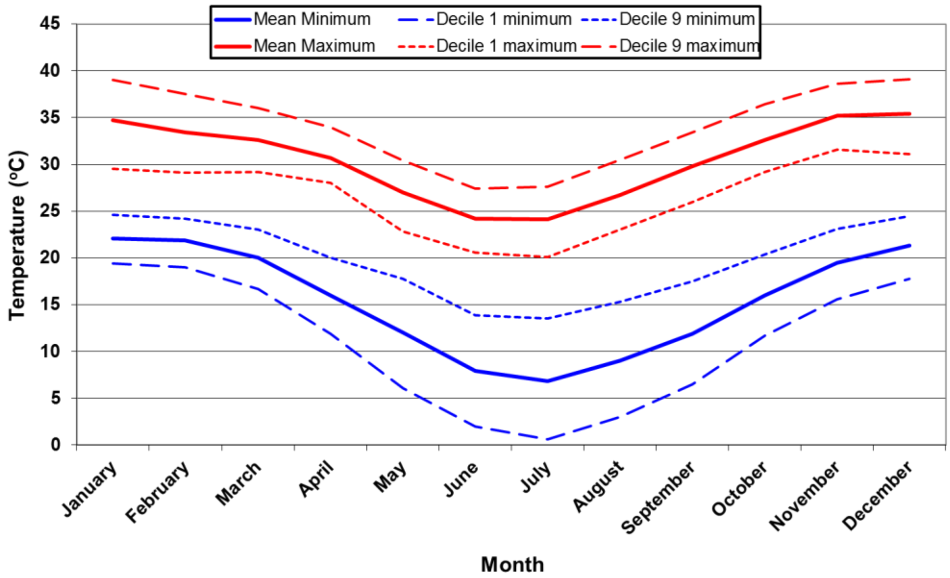


Figure 3-6 Monthly mean 9 am and 3 pm relative humidity at Bowen airport

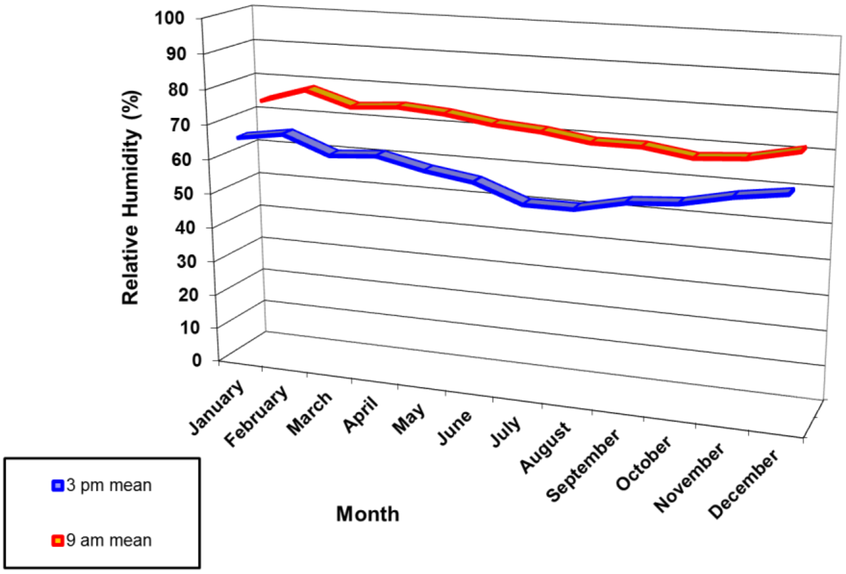


Figure 3-7 Monthly mean 9 am relative humidity at Millaroo DPI

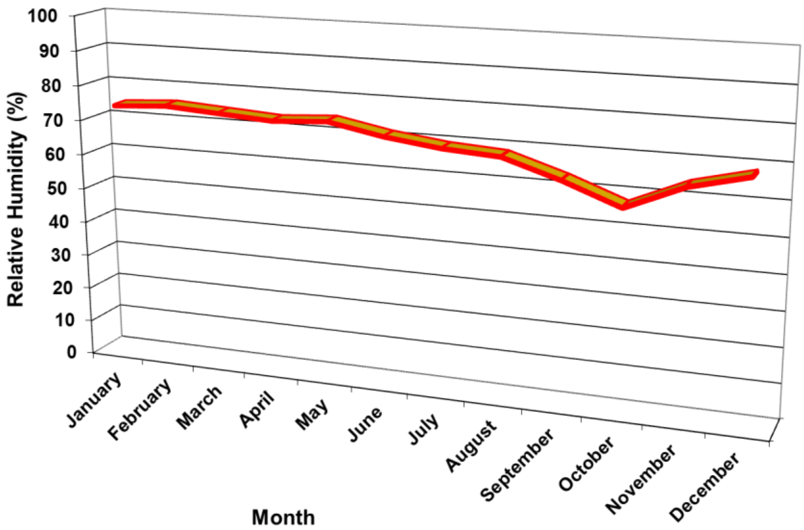


Figure 3-8 Monthly mean 9 am and 3 pm relative humidity at Collinsville post office

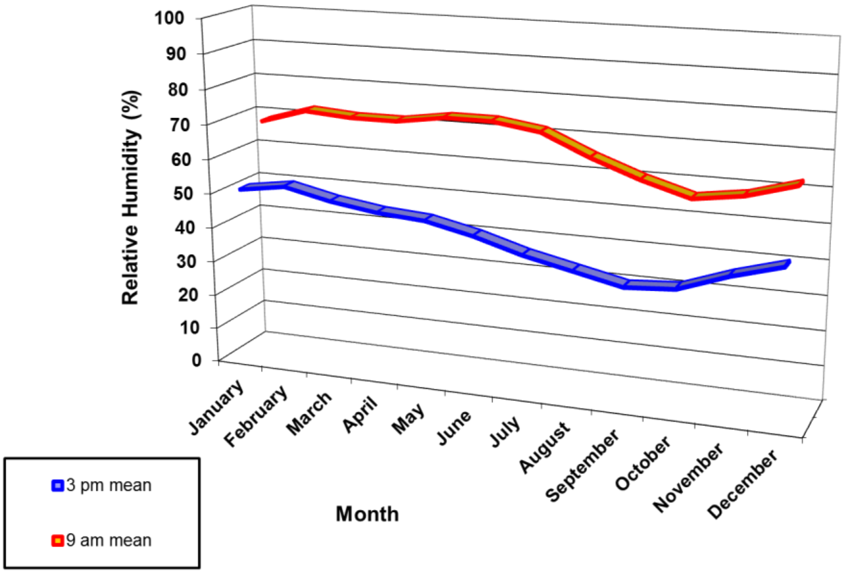
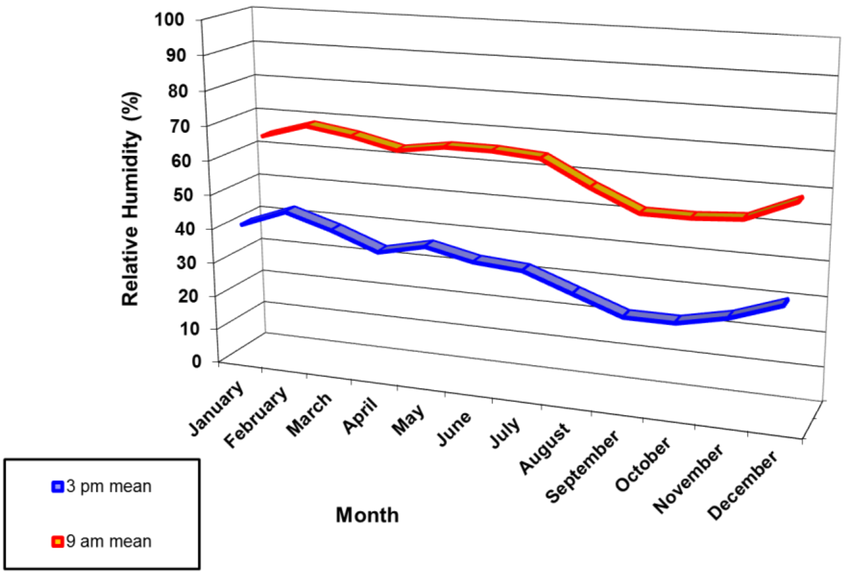


Figure 3-9 Monthly mean 9 am and 3 pm relative humidity at Twin Hills post office



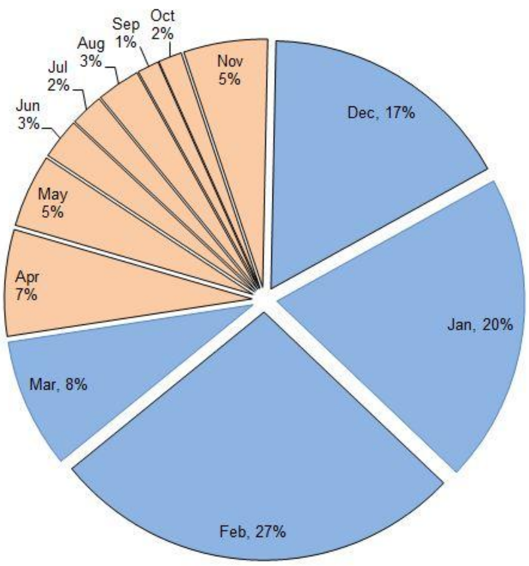
3.1.3 Rainfall

Long term rainfall records clearly show that annual rainfall decreases with distance from the coast. At Bowen Airport the mean annual total is 913 mm/year. This declines to 843 mm/year at Millaroo; 718 mm/year at Collinsville; and 610 mm/year at Twin Hills. The minimum annual rainfall (218 mm/year) was experienced at Twin Hills in 1935; however it is difficult to compare this with the other sites as the Twin Hills record pre-dates those of the other stations. The maximum annual rainfall varies between 1,341 mm/year (Millaroo in 1991) and 2,081 mm/year (Bowen Airport in 2010).

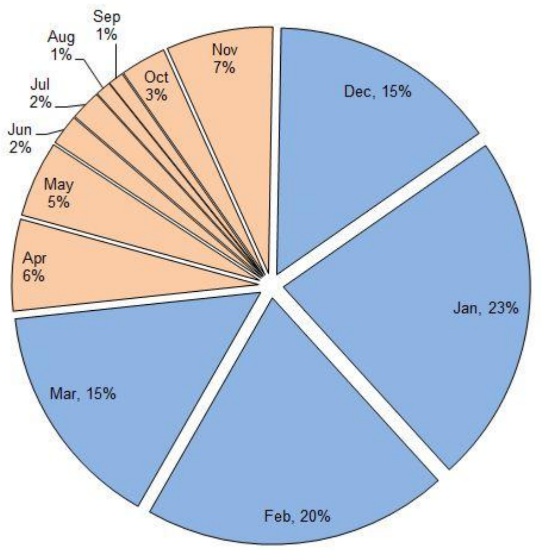
The annual mean rainfall at all sites is dominated by the wet season (December to March) producing convectively driven rainfall (see Figure 3-10). The proportion of summertime rainfall (December through February) declines slightly with distance from the coast (61 per cent at Bowen Airport; 58 per cent at Millaroo DPI; 55 per cent at Collinsville Post Office; and 50 per cent at Twin Hills Post Office).

Figure 3-10 Rainfall proportion by month

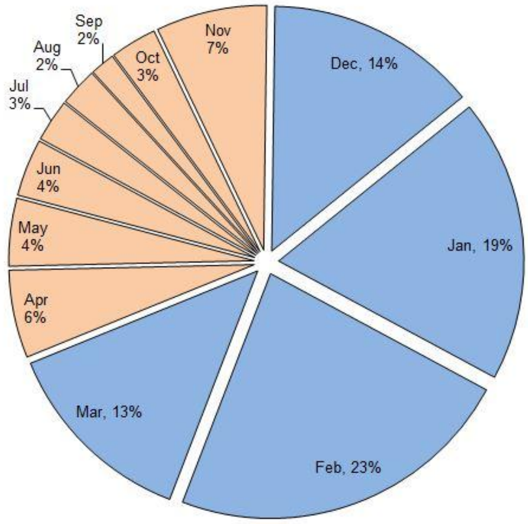
Bowen airport (033257)



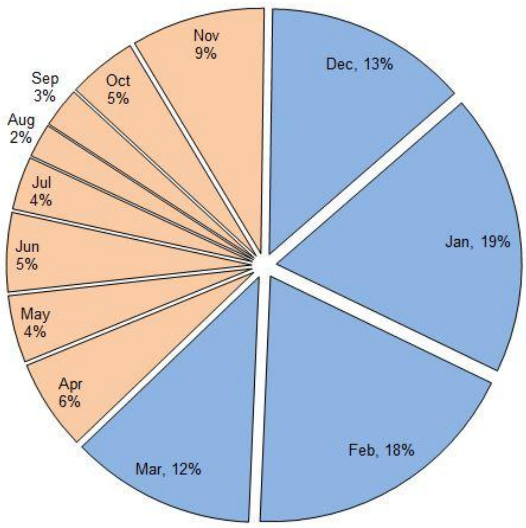
Millaroo DPI (033090)



Collinsville post office (033013)



Twin Hills post office (036047)



Wet season
Dry season

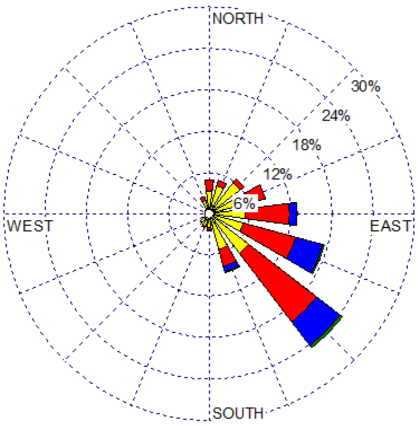
3.1.4 Wind speed and direction

The wind roses in Figure 3-11 show the pattern of the prevailing winds across each section of the study area. As can be expected in this location north of the Tropic of Capricorn, the trade winds out of the south-east sector are dominant, particularly as you approach the coast. The site closest to the coast has the highest average wind speed reflecting a more open exposure to the trade winds for the coastal region. On the leeward side of the Clarke Ranges, the four inland meteorological regions have lower average wind speeds. The lack of westerly component winds is a feature of all sites in the study area.

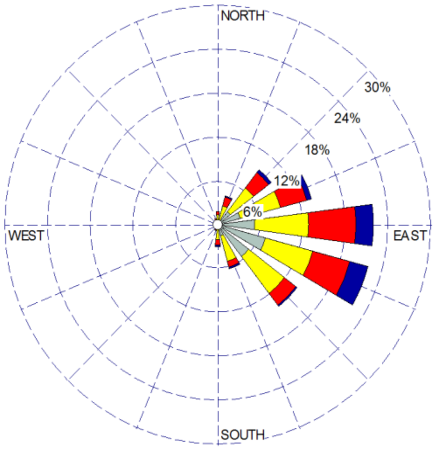
Seasonal influences can be inferred by examining the respective wind roses for the peak of the wet season (December, January, February) and the peak of the dry season (June, July, August). These are displayed in Figure 3-12 and Figure 3-13. The dominant dry season south-east quadrant winds are, at least some of the time, deflected by the monsoonal trough influence during the wet season to more often come out of the north-east quadrant. The strongest winds, however, in all seasons are mostly from the south-east trade direction.

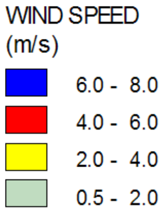
Figure 3-11 Comparison of annual wind roses for each meteorological region

Coastal region (Bowen STP)
0 % calms; mean speed 3.9 m/s;
maximum speed 9.9 m/s

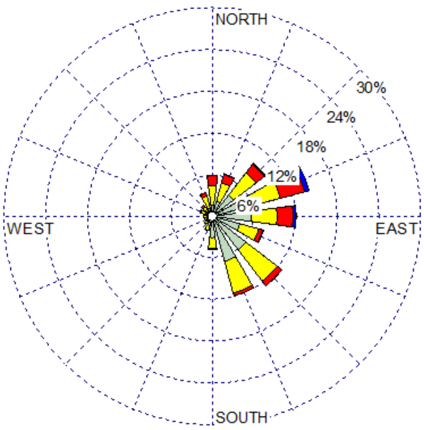


Bogie River region (Bogie River)
0 % calms; mean speed 3.2 m/s;
maximum speed 8.0 m/s

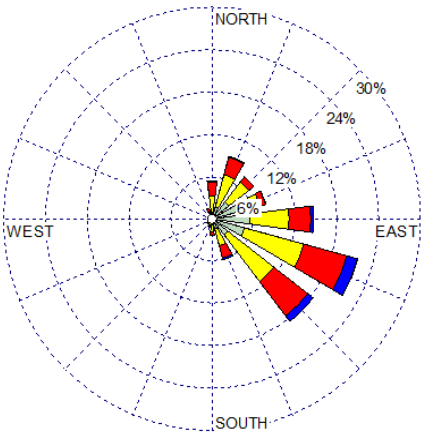




Bowen River region (Sonoma Mine)
0 % calms; mean speed 2.4 m/s;
maximum speed 11.7 m/s



Newlands region (Suttor Creek)
0 % calms; mean speed 3.1 m/s;
maximum speed 8.6 m/s



Isaac region (Cassiopeia Station)
1.34 % calms; mean speed 2.7 m/s;
maximum speed 7.9 m/s

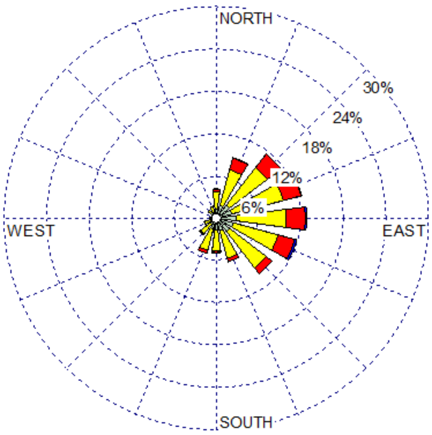
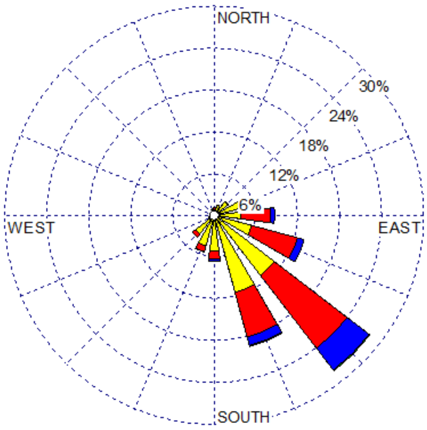


Figure 3-12 Seasonal influences on the wind regime

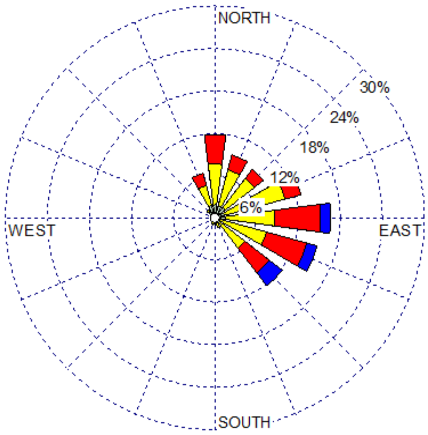
Coastal region (Bowen STP) - peak dry season[1]

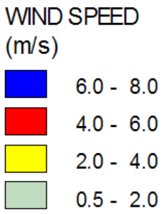
0 % calms; mean speed 3.8 m/s



Coastal region (Bowen STP) - peak wet season[2]

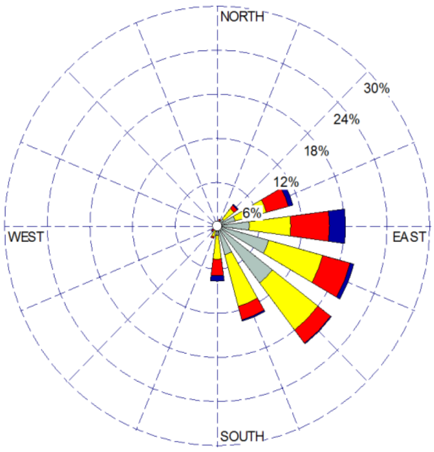
0 % calms; mean speed 3.4 m/s





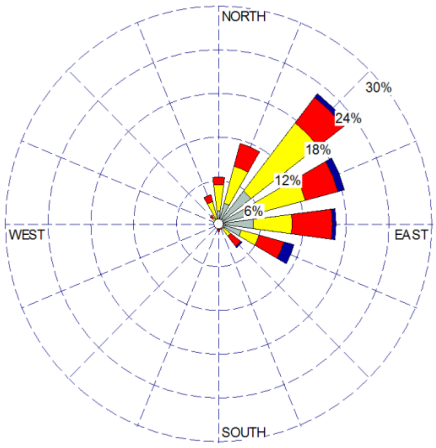
Bogie River region (Bogie River) - peak dry season[1]

0 % calms; mean speed 2.9 m/s



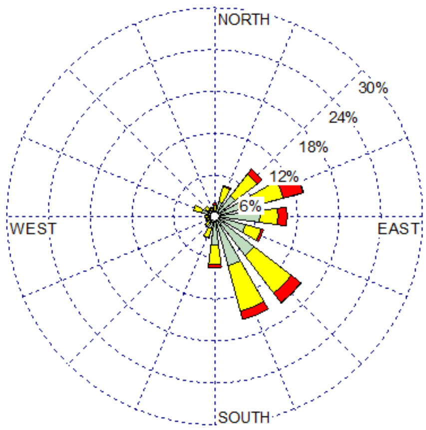
Bogie River region (Bogie River) - peak wet season[2]

0 % calms; mean speed 2.9 m/s



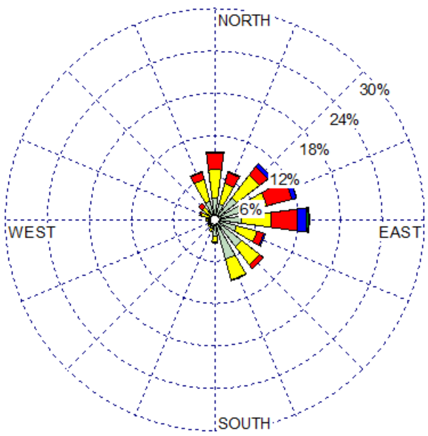
Bowen River region (Sonoma Mine) - peak dry season[1]

0 % calms; mean speed 2.1 m/s



Bowen River region (Sonoma Mine) - peak wet season[2]

0 % calms; mean speed 2.6 m/s



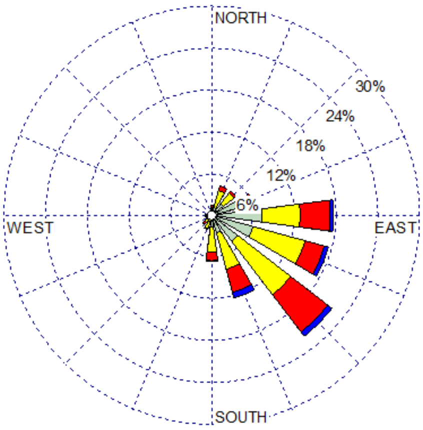
1 June to August

2 December to February

Figure 3-13 Seasonal influences on wind regime (continued)

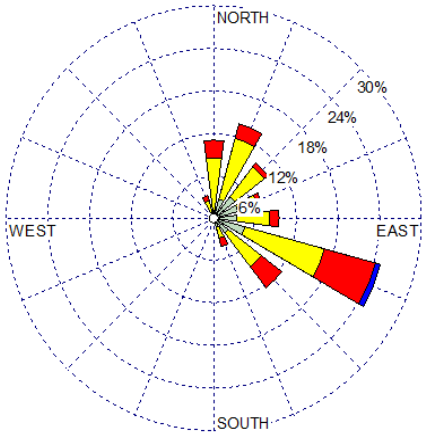
Newlands region (Suttor Creek) - peak dry season[1]

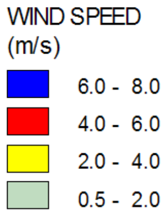
0 % calms; mean speed 2.8 m/s



Newlands region (Suttor Creek) - peak wet season[2]

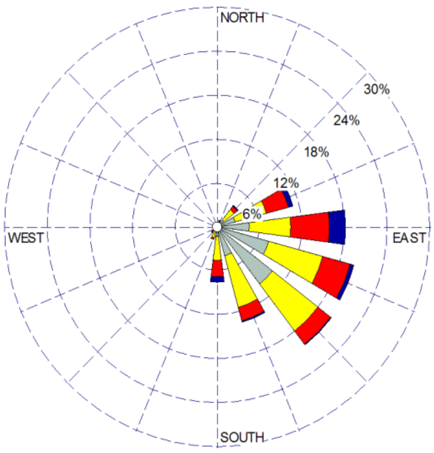
0 % calms; mean speed 2.9 m/s





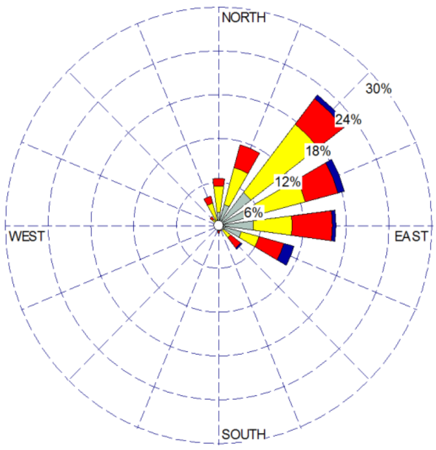
Isaac Region (Cassiopeia) - peak dry season[1]

1.8 % calms; mean speed 2.3 m/s



Isaac Region (Cassiopeia) - peak wet season[2]

0.7 % calms; mean speed 3.1 m/s



1 June to August

2 December to February

3.1.5 Atmospheric stability

Atmospheric stability also has a strong influence on the ability of pollutants to disperse downwind from their respective sources. Atmospheric stability refers to the tendency of the atmosphere to resist or enhance vertical dilution. The Pasquill-Gifford stability scheme, originally developed by Pasquill (1961), defines seven Stability Classes, "A" to "F", to categorise the degree of atmospheric stability:

- A — very unstable
- B — unstable
- C — slightly unstable
- D — neutral
- E — slightly stable
- F — stable
- G — very stable.

A, B, and C refer to unstable conditions occurring during daytime hours. D class stability represents neutral conditions occurring during overcast days or nights, and is associated with moderate to strong winds. E, F, and G class stabilities refer to night-time stable conditions. F and G classes are normally grouped together and are referred to as F class stability.

Figure 3-14 to Figure 3-18 show the distribution of atmospheric stability class for each meteorological region. Neutral conditions occur most commonly, however a high proportion of stable (F-class) conditions also occur, particularly at the inland locations.

Figure 3-14 Coastal region (Bowen STP) – stability class distribution

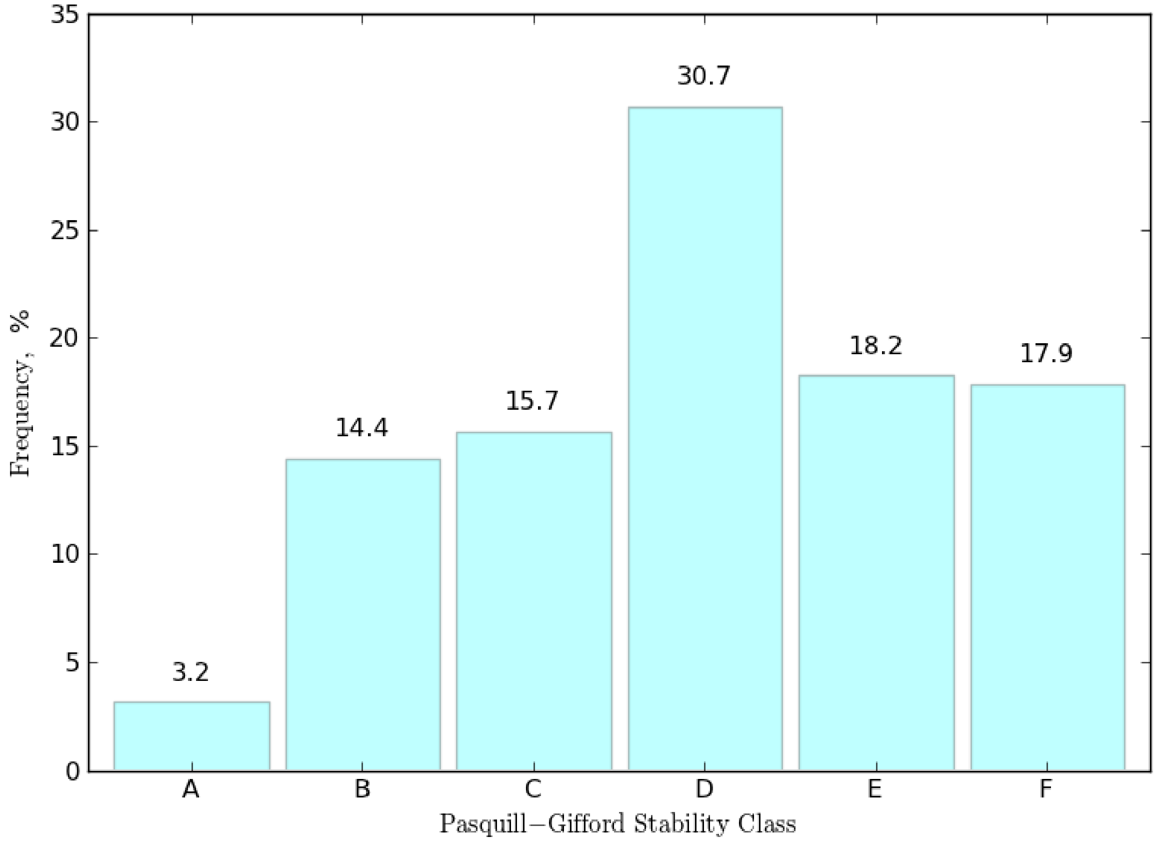


Figure 3-15 Bogie River region (Bogie River) – stability class distribution

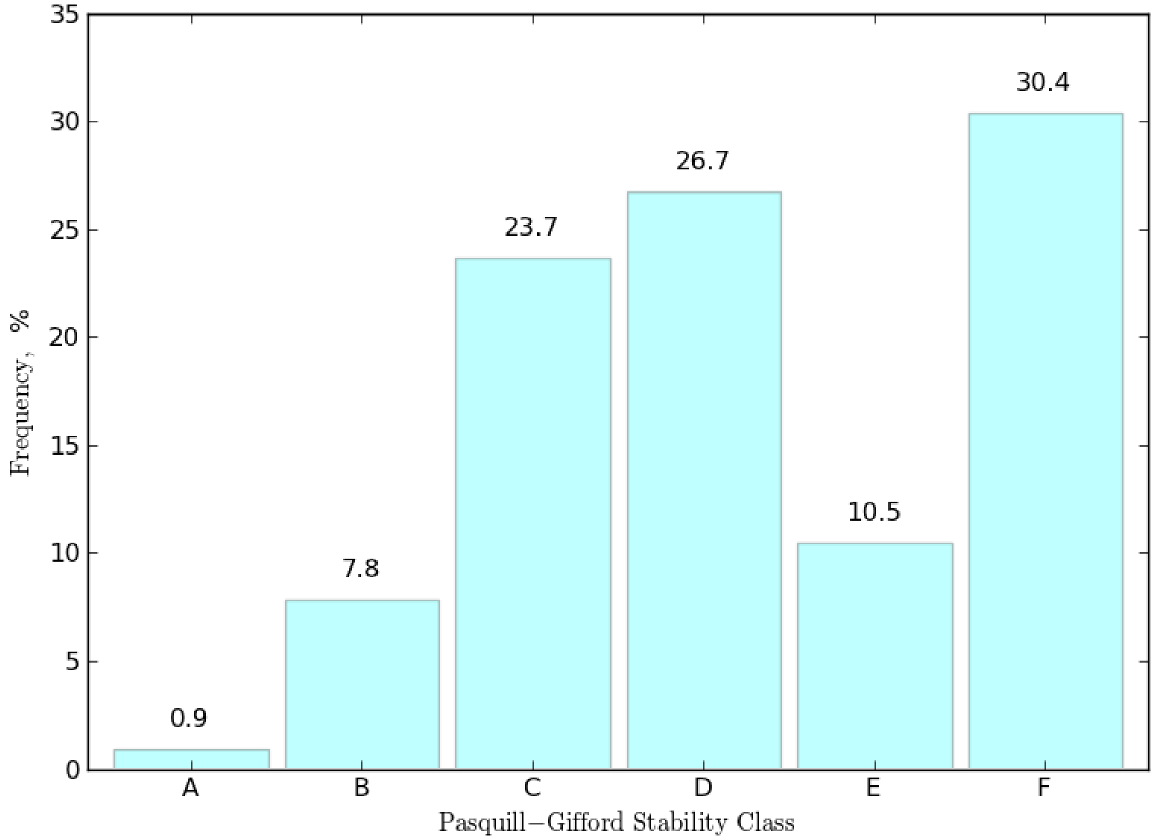


Figure 3-16 Bowen River region (Sonoma Mine) – stability class distribution

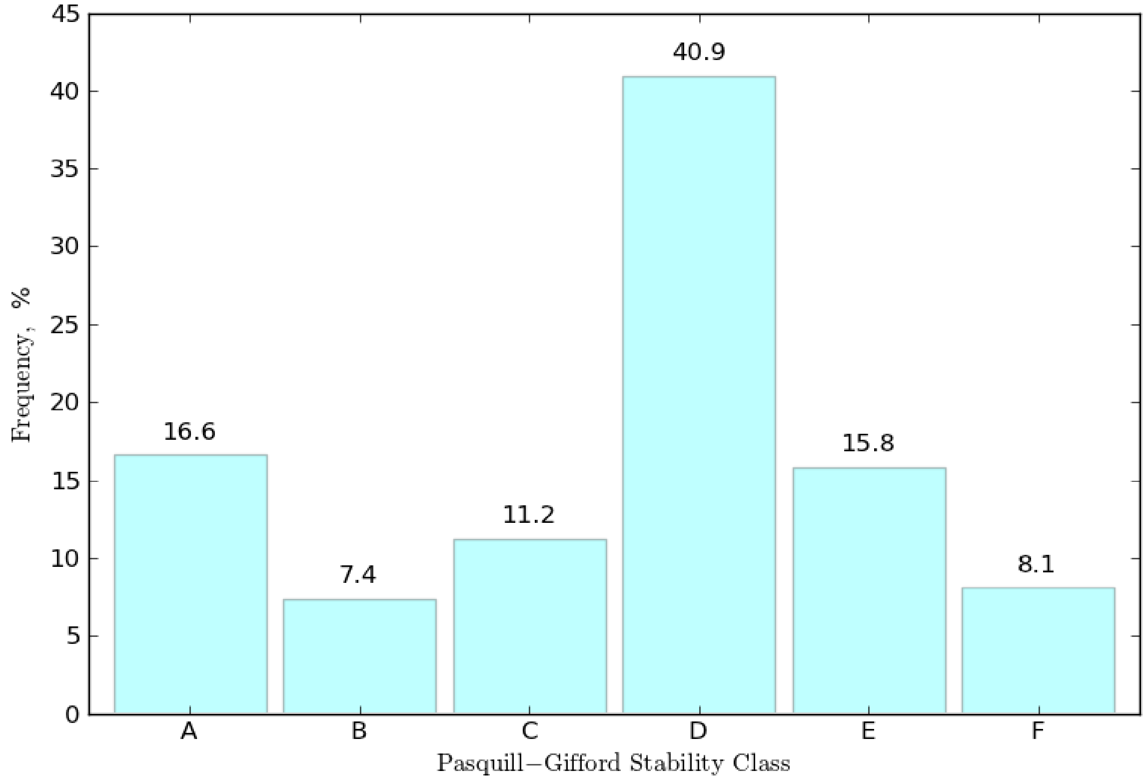


Figure 3-17 Newlands region (Suttor Creek) – stability class distribution

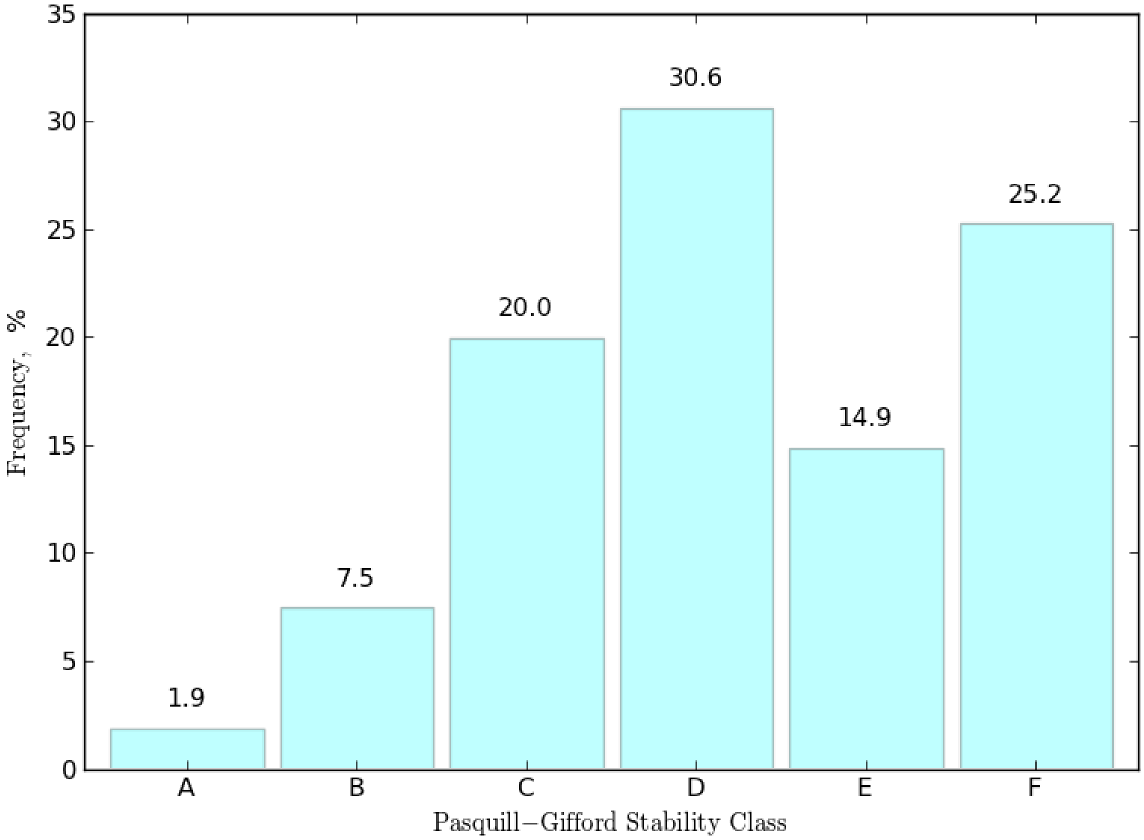
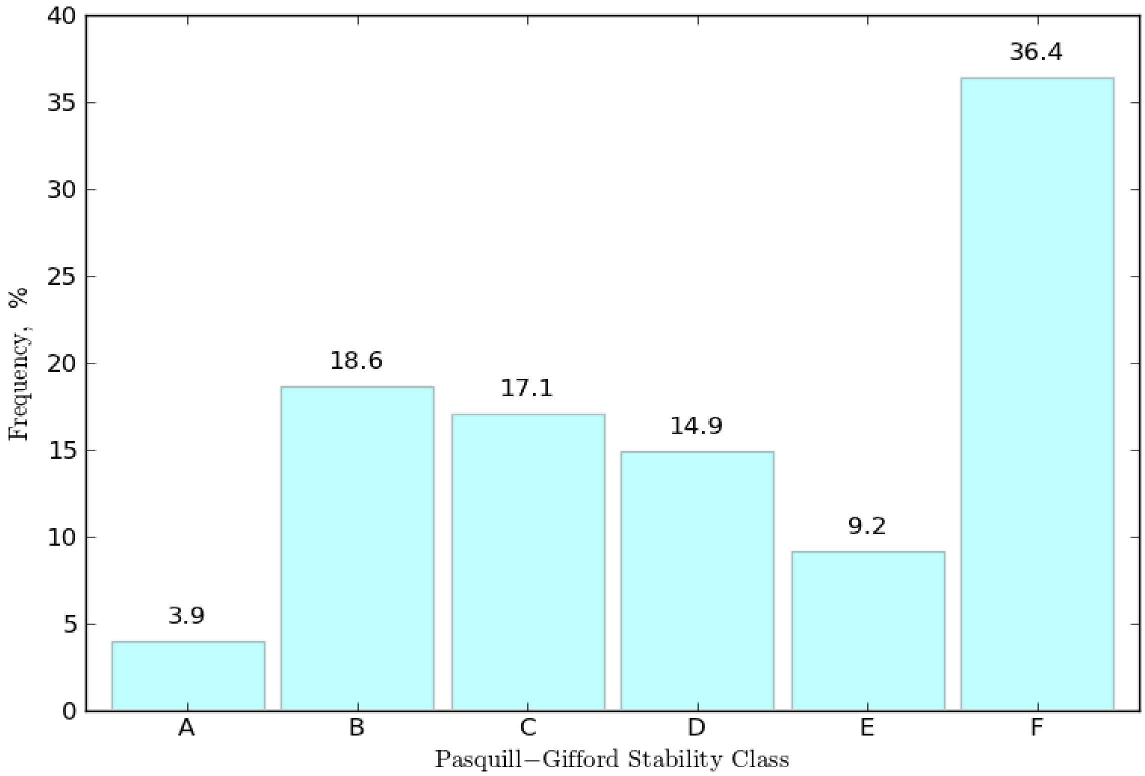


Figure 3-18 Isaac region (Cassiopeia) – stability class distribution



3.1.6 Mixing height

The depth of the mixing height is an indicator of vertical dispersion potential of the atmosphere and arises from a mixture of mechanical and convective influences. Convective conditions dominate during the day in a near desert climate, especially as temperatures are often high in summer. Even the sub-tropical climate in winter has daytime temperatures which are often above 20 ^{o}C. Conversely, the night-time mixing height is dominated by the formation of temperature inversions on the vast majority of nights, with associated F-class stability.

Table 3-2 summarises the regional variation in mixing height statistics, whereas Figure 3-19 to Figure 3-23 indicate the diurnal variation in mixing height for each region.

Table 3-2 Regional variation in mixing height statistics

Region	Minimum (m)	Median (m)	Mean (m)	Maximum (m)
Coastal Region (Bowen)	25	228	338	1,748
Bogie River Region (Bogie River)	49	280	518	5,000
Bowen River Region (Sonoma Mine)	50	1,081	1,300	5,000
Newlands Region (Suttor Creek)	91	889	1,237	5,000
Isaac Region (Cassiopeia Station)	50	235	532	2,444

Figure 3-19 Coastal region (Bowen STP) - diurnal mixing height

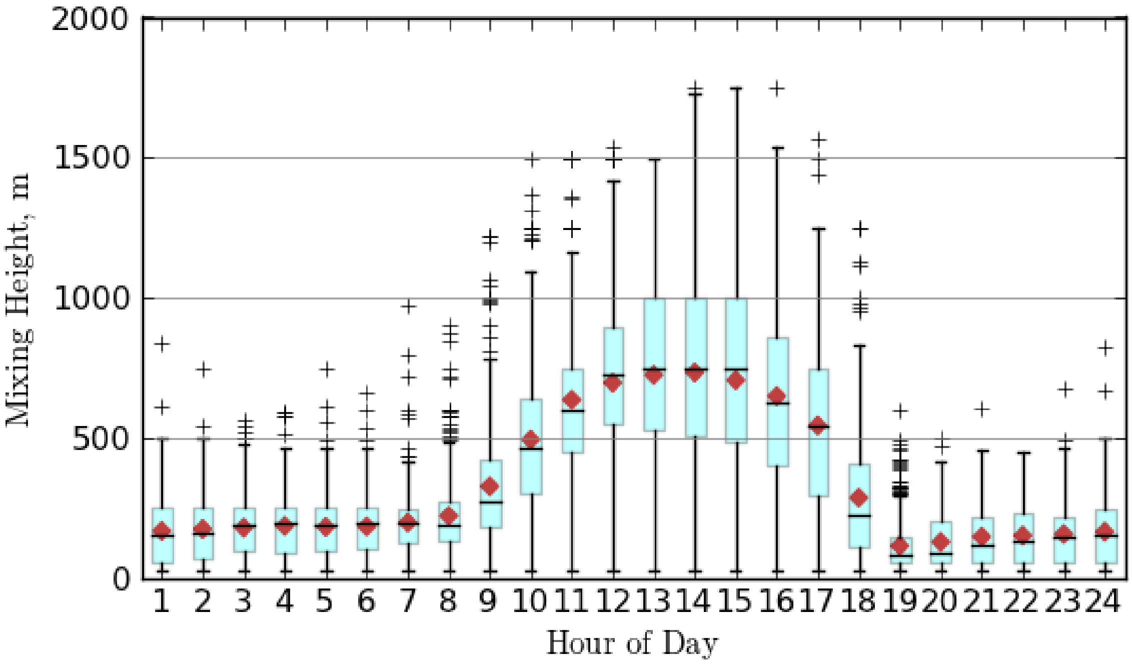


Figure 3-20 Bogie River region (Bogie River) – diurnal mixing height

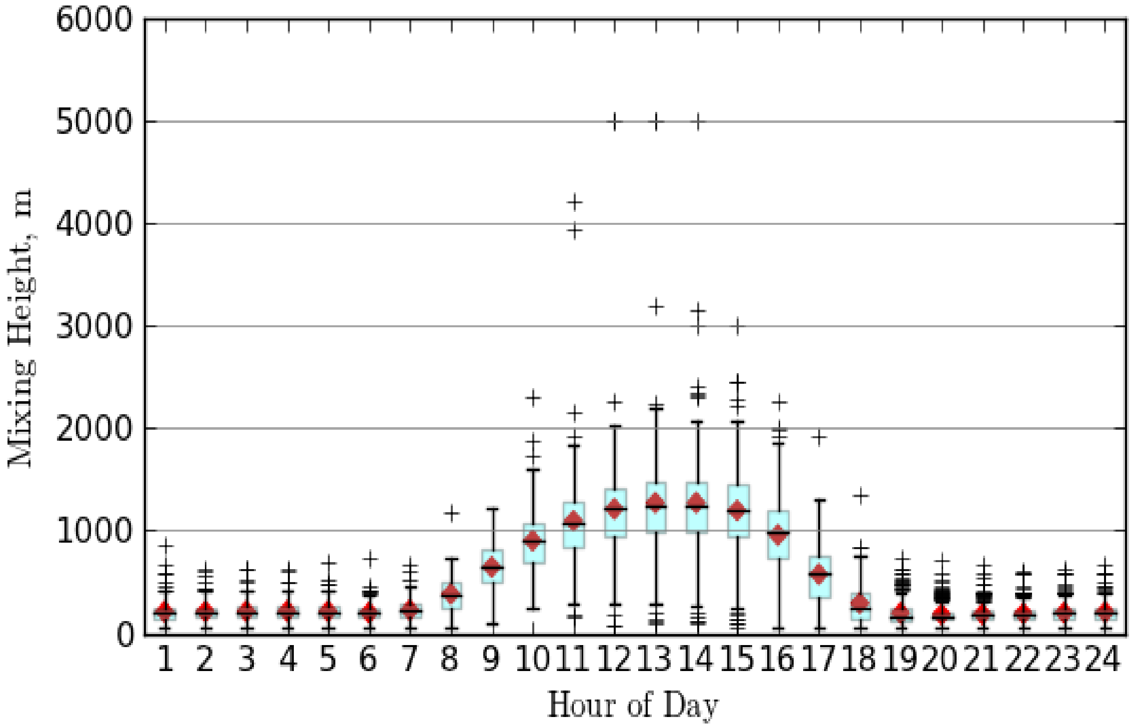


Figure 3-21 Bowen River region (Sonoma Mine) – diurnal mixing height

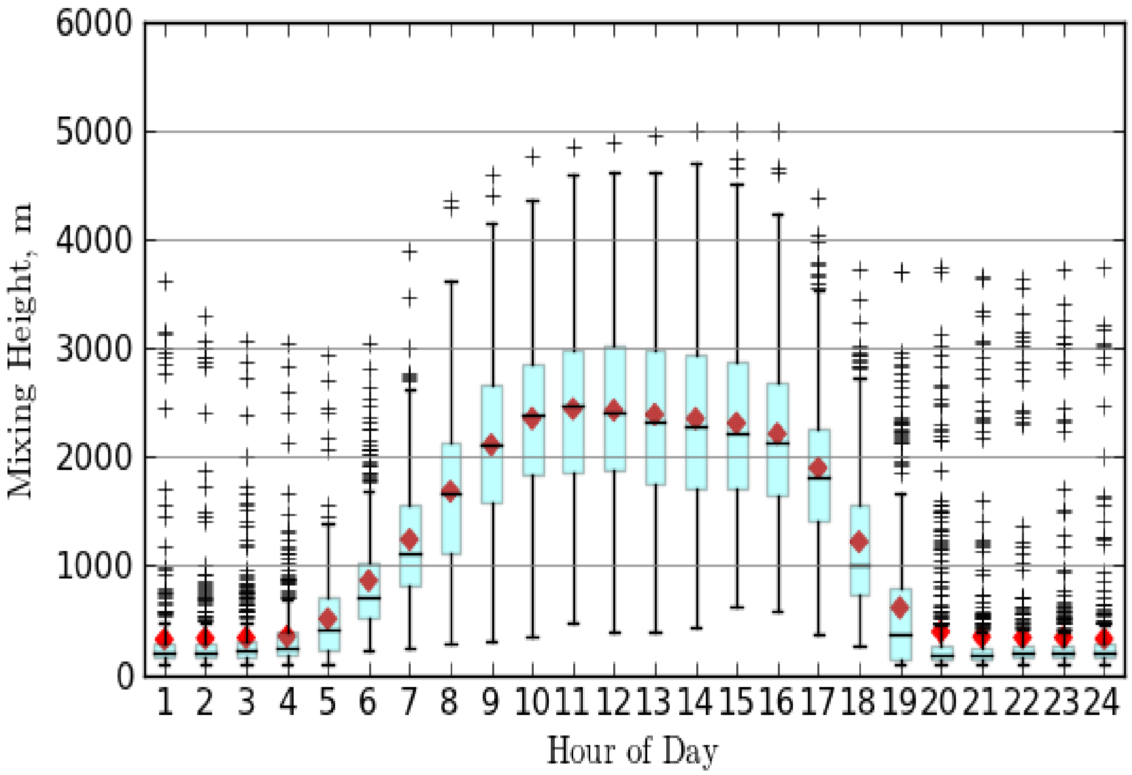


Figure 3-22 Newlands region (Suttor Creek) – diurnal mixing height

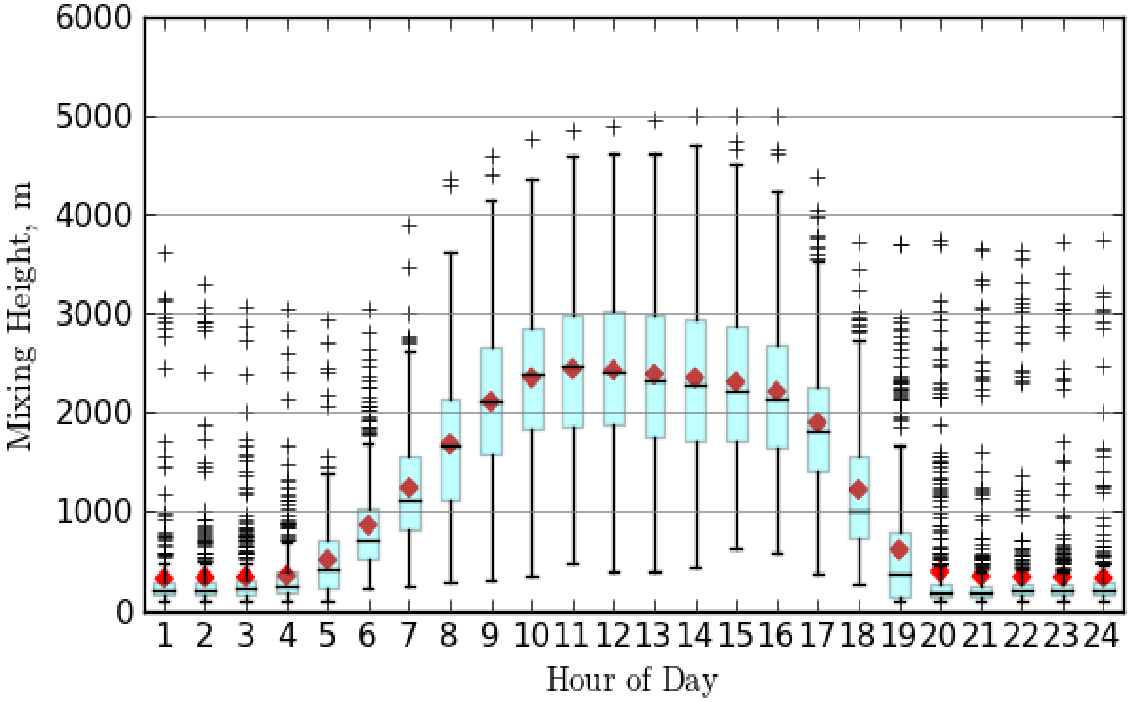
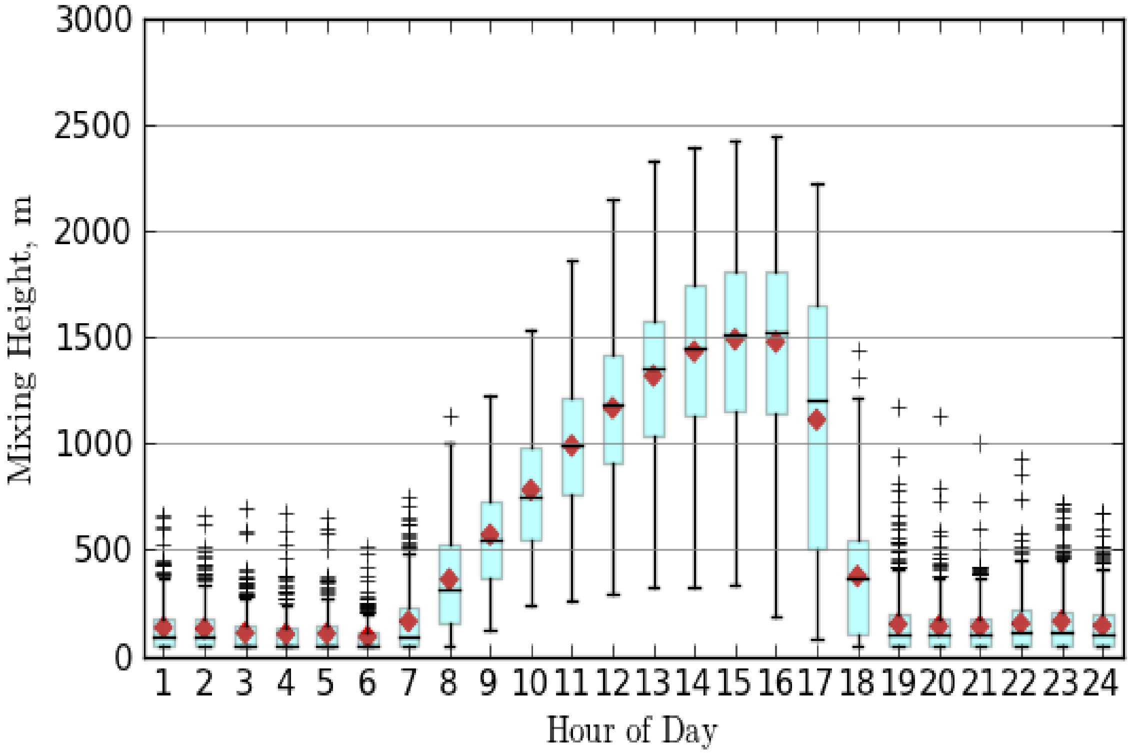


Figure 3-23 Isaac region (Cassiopeia Station) – diurnal mixing height



3.2 Background concentrations

3.2.1 Overview

Ambient air quality monitoring is generally conducted in populated regions, particularly in locations where the population may be exposed to significant quantities of air pollutants, from a range of sources such as motor vehicle traffic and industry.

The majority of the study area (the inland meteorological regions extending from the Isaac region to the Bogie River region) is located in remote areas of central Queensland. These sections are separated from population centres which would contribute significant levels of gaseous air pollutants emitted from industrial and motor vehicle fuel combustion sources. Conversely, the dry, inland environment of these inland meteorological regions means the 'natural' dust load may be significant. For convenience sake, the terms 'particulate matter' and 'dust' are used interchangeably throughout the remainder of this report, except when specific size fractions such as PM_{10} or $PM_{2.5}$ are referred to.

The Coastal region of the study area includes population centres, where the background 'natural' dust concentrations are expected to be lower and the gaseous concentrations higher than those experienced in the inland section.

3.2.2 Particulate matter

The inland regions were characterised using data collected for a greenfield industrial site within the Bowen Basin. The background for the remaining coastal region was determined from measurements collected at Townsville.

Inland regions

Wiebe *et al.* (2011) obtained monitoring data for ambient PM_{10} concentration at a remote rural greenfield site in the Bowen Basin. The data had been collected at the site of a proposed mine using a Tapered Element Oscillating Microbalance (TEOM).

PM_{10} has an assessment criterion that is expressed as a daily average (Section 4.3). The observed 70th percentile daily-mean concentration, for the 633 day period of record, was 15.0 µg/m^3. This value was selected as an appropriate background concentration for daily-mean PM_{10}.

$PM_{2.5}$ has assessment criteria for both daily average and annual average concentrations (Section 4.3). A co-located TEOM at the Bowen Basin site monitored ambient $PM_{2.5}$ concentrations for a shorter 281 day period. The observed 70th percentile daily-mean $PM_{2.5}$ concentration of 6.6 µg/m^3 was selected as an appropriate daily background.

Based on the above PM_{10} and $PM_{2.5}$ background concentrations, the $PM_{2.5}$ to PM_{10} ratio was 44 per cent (6.6 µg / 15.0 µg). This was considered reasonable given that in an inland Queensland region suspended particulates are most likely to arise from soil disturbance, rather than industrial or combustion emission sources which would generate a higher ratio of fine and ultrafine particulates.

Normally the mean concentration for the period of record would be used to determine the annual $PM_{2.5}$ background. In this case the mean concentration (7.3 µg/m^3) is greater than the 70th percentile concentration, due to the distribution being skewed by a relatively small number of dust events. The median concentration of 5.8 µg/m^3 was therefore selected to characterise the annual background $PM_{2.5}$ concentration.

Similar TSP data was not available for the Bowen Basin site, and hence the background TSP concentration had to be estimated using a suitable PM_{10} to TSP ratio. The USEPA (1998) suggests a PM_{10} to TSP ratio of 50 per cent is applicable for ambient conditions such as those found in the inland meteorological regions.

The assumed background daily-mean TSP concentration was therefore set at 30.0 µg/m^3. Given that the health and wellbeing objective for TSP is used to assess annual mean concentrations rather than daily mean concentrations, use of this background concentration is considered to be highly conservative.

Suitable dust deposition measurements were sought from the available literature. Data from the Ensham Central Project (Katestone Environmental, 2006), located within the Bowen Basin, was determined to be most representative of the inland meteorological regions. The rolling annual average from a site that showed deposition rates ranged between 0.09 to 1.6 g/m^2/month. The higher end of the range was determined to be applicable to the inland meteorological regions. The assumed background level for deposited dust was therefore set at 1.6 g/m^2/month.

In October 2012 Adani instigated a dust deposition gauge network of five gauges located throughout the broader inland region. Data is currently available from then up to April 2013. While the period of measurement is biased to the wetter part of the year, the gauge averages across all months range from 0.9 to 1.4 g/m^2/month. Taking the average of the lowest value for each month produces a value of 0.4 g/m^2/month. Before a full year of data is collected, the conservative adopted value of 1.6 g/m^2/month is confirmed.

Coastal region

The Townsville Dust Monitoring Program (TDMP) is the closest monitoring program that is relevant to the coastal region of the study area, and therefore comprises the most suitable dataset to determine background concentrations from. Townsville has a significantly greater population than that of the coastal region, so use of this data is considered to be conservative, especially when characterising the sparsely populated coastal plains approaching Abbot Point.

Monitoring was conducted between March 2008 and December 2009 (DERM 2010). This program had a focus on TSP and dust deposition (PM_{10} being monitored as part of the wider DERM monitoring network). As would be expected in a coastal environment, much of the suspended matter would be soluble marine salts which would contribute little to the nuisance effects potentially caused by insoluble matter.

The lowest recorded annual-average TSP concentration at any of the TDMP network sites was 26.4 µg/m^3 (DERM 2010). This was determined to be suitable for use as a background concentration.

The most recently available PM_{10} monitoring data for the Townsville Pimlico site is for the 2011 calendar year (DERM, 2012). The 75th percentile daily-mean PM_{10} concentration was 18.1 µg/m^3. The background concentration for the coastal region can reasonably be assumed to be slightly less than this, and this value was therefore conservatively adopted as the assessment background.

No known sources of background $PM_{2.5}$ measurements for the coastal region could be found directly in the literature, and $PM_{2.5}$ was not measured in the TDMP study. The usual practice in this instance is to assume a background $PM_{2.5}$ level based on a ratio to the background PM_{10} level.

A ratio of about 50 per cent is generally accepted for locations where the dominant particulate source is crustal dust; however, this can vary significantly due to the variation in the sources that generate fine particulates in different airsheds. Studies using co-located instruments have found that within Australia this ratio can vary "…depending on season and location, and can range from 0.3 to 0.9" (NEPC, 2002, p.5).

In a populated coastal area, such as the coastal region, the particulate load is expected to dominated by sea salt and anthropogenic combustion sources. The $PM_{2.5}$ to PM_{10} ratio will therefore be at the lower end of this range. Suitable $PM_{2.5}$ to PM_{10} ratios, for use at the Townsville site, were estimated using the latest available (2007) monitoring data for co-located PM_{10} and $PM_{2.5}$ samplers at the Toowoomba North monitoring site. $PM_{2.5}$ is rarely measured and only tends to be monitored by DEHP in large, heavily industrialised urban centres. Data from the Toowoomba North monitoring site is a reliable source as it is the smallest and least urbanised of the available DEHP locations and therefore provides the most suitable location to characterise the Abbot Point $PM_{2.5}$ to PM_{10} ratio.

The background $PM_{2.5}$ concentration to be applied to the daily mean predictions was determined using a $PM_{2.5}$ to PM_{10} ratio of 0.28, which was derived using the 75th percentile measurements at Toowoomba. This yielded a daily mean background concentration, for the coastal region, of 5.1 µg/m^3.

For the annual average $PM_{2.5}$ concentration, the background was estimated using a slightly lower $PM_{2.5}$ to PM_{10} ratio of 0.25, which was derived using the median of the 2007 measurements at Toowoomba. The annual background concentration to be applied to the coastal regions of 3.7 µg/m^3, was estimated using the 2011 median daily-mean PM_{10} concentration at Townsville of 15.2 µg/m^3.

The TDMP also monitored insoluble dust-fall at six stations. The maximum monthly dust deposition rate across the stations varied between 0.6 to 2.2 g/m^2/month. The lowest of these can be considered to be an indicator of the 'true' background for a coastal environment with some urban influence. A more detailed analysis showed that the rolling 12 month average of the monthly minimum insoluble solids deposition rate varied from 0.24 to 0.29 g/m^2/month. On the basis of these results, a conservative background dust deposition rate of 0.5 g/m^2/month was adopted for the coastal section of the study area.

3.2.3 Gaseous compounds

Due to the remoteness of the inland region, and the lack of any concentrated form of emission sources (such as industrial, urban or combustion sources), the ambient background levels of gaseous pollutants here was considered to be negligible, and was therefore set at a level of zero for each contaminant.

Background concentrations of nitrogen dioxide and sulphur dioxide within the coastal region were determined on the basis of monitoring data collected at the Townsville Pimlico site during the 2011 calendar year.

For nitrogen dioxide a value of 55 µg/m^3 (0.027 ppm) was selected for the hourly background. This represents the 90th percentile of the daily peak NO_2 concentrations measured at the Pimlico site, and was adopted in the absence of published lower percentile values. Its use to characterise a background concentration is therefore extremely conservative. The 2011 annual mean or median NO_2 concentrations were unavailable. The annual background concentration of 9 µg/m^3 was therefore estimated from the hourly background using the equation below, obtained from the Ausplume 6.0 help file ('C' being concentration).

$$C_{annual} = C_{60} \left(\frac{60}{365 * 24 * 60}\right)^{0.2}$$

Separate SO_2 background concentrations were determined for hourly (11 µg/m^3), daily (6 µg/m^3), and annual (3 µg/m^3) averaging times, representing the 75th percentile values for the hourly and daily measurements, and the median daily measurement respectively.

It is assumed that the background concentrations of the remaining contaminants (carbon monoxide; formaldehyde; toluene; xylenes) are zero.

Table 3-3 summarises the background, or ambient/existing, air quality indicators adopted for the Inland and Coastal regions.

3.2.4 Summary of background concentrations

The background air quality levels for the five meteorological regions that made up the study area are summarised in Table 3-3.

Table 3-3 Adopted background air quality levels for the inland and coastal regions

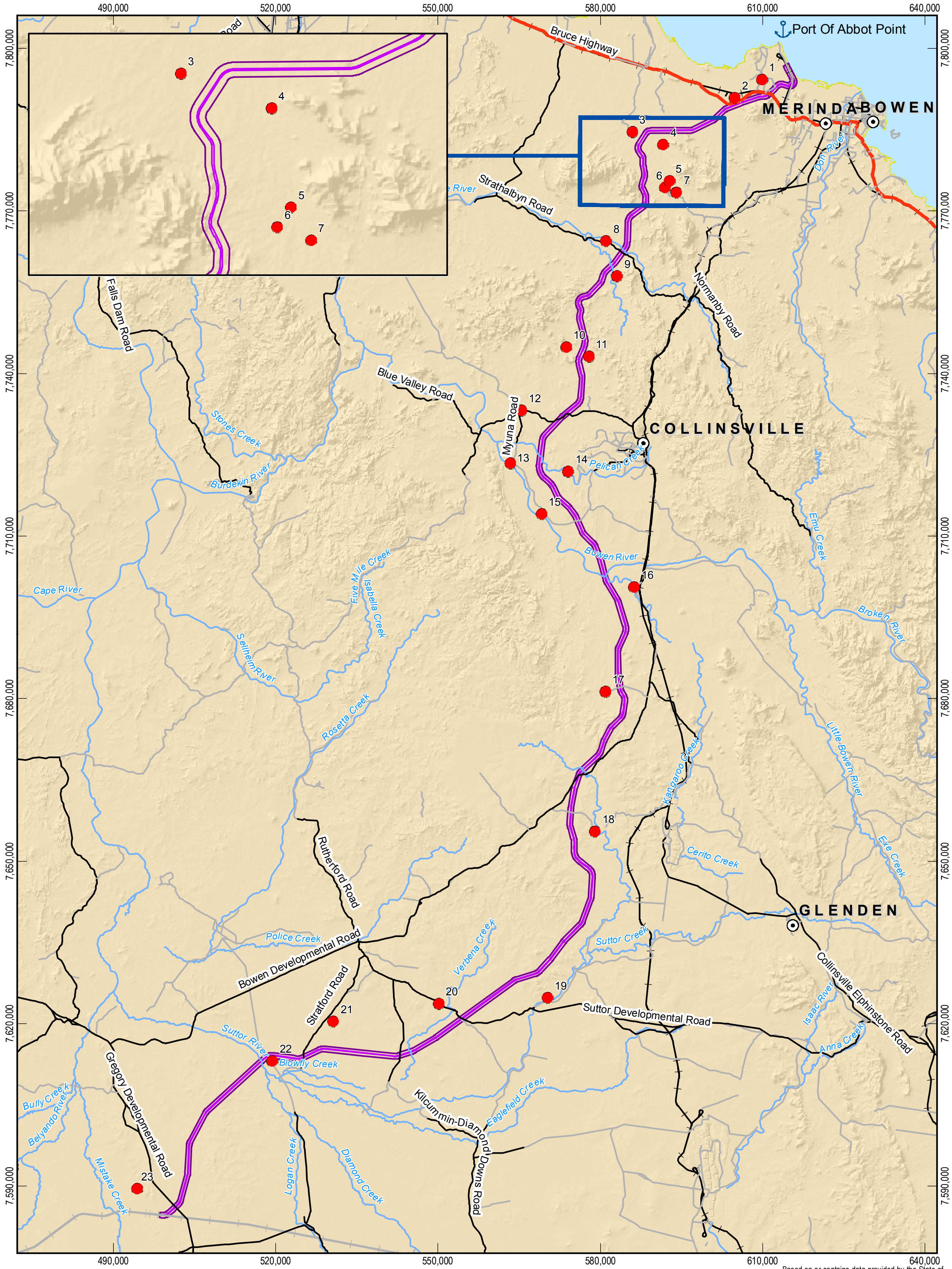
Component	Period	Adopted background level	
		Inland	Coastal
Total suspended particles (µg/m^3)	1 year	30.0	26.4
PM_{10} (µg/m^3)	24 hours	15.0	18.1
$PM_{2.5}$ (µg/m^3)	24 hours	6.6	5.1
	1 year	5.8	3.7
Deposited dust (g/m^2/month)	1 year	1.6	0.5
Benzene (µg/m^3)	1 year	0.0	0.0
Carbon monoxide (µg/m^3)	8 hours	0.0	0.0
Formaldehyde (µg/m^3)	30 minutes	0.0	0.0
	24 hours	0.0	0.0
Nitrogen dioxide (µg/m^3)	1 hour	0.0	55
	1 year	0.0	9
Sulphur dioxide (µg/m^3)	1 hour	0.0	11
	24 hours	0.0	6
	1 year	0.0	3
Toluene (µg/m^3)	30 minutes	0.0	0
	24 hours	0.0	0
	1 year	0.0	0
Xylenes (µg/m^3)	24 hours	0.0	0
	1 year	0.0	0

3.3 Potential sensitive receptors

The study area is generally sparsely populated with the final rail corridor avoiding potential sensitive receptor locations. Nearest potential sensitive receptors identified within approximately six kilometres of the preliminary investigation corridor for the NGBR Project (refer Table 3-4). The average distance of the 23 potential sensitive receptors is approximately 3.7 km from the nominal 100 m final rail corridor, with the closest being approximately 1.1 km distant.

Table 3-4 Summary of sensitive receptors

Sensitive receptor	Easting	Northing	Distance to centreline of final rail corridor (m)
Homestead 1	609916	7794255	2,740
Homestead 2	604874	7790877	1,202
Homestead 3	585906	7784622	2,248
Homestead 4	591656	7782269	2,631
Homestead 5	592845	7775614	4,730
Homestead 6	591975	7774322	3,826
Homestead 7	594112	7773398	5,724
Homestead 8	581086	7764508	3,622
Homestead 9	583141	7758004	2,121
Homestead 10	573776	7744903	2,927
Homestead 11	577907	7743136	1,564
Homestead 12	565463	7733205	6,208
Homestead 13	563357	7723411	5,366
Homestead 14	574094	7721935	3,913
Homestead 15	569153	7714138	4,313
Homestead 16	586276	7700615	3,869
Homestead 17	580954	7681237	2,822
Homestead 18	579067	7655503	4,170
Homestead 19	570319	7624819	4,981
Homestead 20	550182	7623709	4,744
Homestead 21	530696	7620414	5,209
Homestead 22	519416	7613045	1,109
Homestead 23	494429	7589483	6,634



LEGEND

- Population Centres
- Major Port
- Sensitive Receptors
- Highway
- Main Road
- Local Road
- Carmichael Project (Rail)
- Railway
- Watercourse (Major)
- North Galilee Basin Rail 1000m Corridor
- North Galilee Basin Rail 100m Corridor

Based on or contains data provided by the State of QLD (DNRM) [2013]. In consideration of the State permitting use of this data you acknowledge and agree that the State gives no warranty in relation to the data (including accuracy, reliability, completeness, currency or suitability) and accepts no liability (including without limitation, liability in negligence) for any loss, damage or costs (including consequential damage) relating to any use of the data. Data must not be used for marketing or be used in breach of the privacy laws.

1:1,000,000 Paper Size A4

0 7.5 15 30

Kilometres

Map Projection: Transverse Mercator
Horizontal Datum: GDA 1994
Grid: GDA 1994 MGA Zone 55

N

Adani Mining Pty Ltd
North Galilee Basin Rail Project

Job Number	41-26457
Revision	A
Date	29 Aug 2013

Sensitive receptors

Figure 3-24

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145 Ann Street Brisbane QLD 4000 Australia **T** 61 7 3316 3000 **F** 61 7 3316 3333 **E** bnemail@ghd.com **W** www.ghd.com

Data source: GA: Populated Places, Railway, Watercourse/2007; Adani: NGBR Corridor 13/05/2013, NGBR Corridor 06/06/2013, Carmichael Project (Rail) 18/06/2013; Adani\GA\GHD: Sensitive Receptors/2013; DNRM: Roads/2010. Created by:MS

4. Assessment criteria

4.1 Commonwealth legislation

National air quality standards and goals are specified by the Environment Protection and Heritage Council (formerly known as the National Environment Protection Council). The Air NEPM specifies national ambient air quality standards and goals for six criteria air pollutants – nitrogen dioxide (NO_2), sulphur dioxide (SO_2), carbon monoxide (CO), ozone (O_3), particulates (as PM_{10} and $PM_{2.5}$) and lead. The Air Toxics NEPM provides monitoring investigation guidelines, principally for large cities with significant traffic emissions, for five compounds classified as air toxics – benzene, benzo(a)pyrene, formaldehyde, toluene and xylenes.

4.2 State legislation

The Air EPP applies to the air environment of Queensland and identifies the environmental values to be enhanced or protected in the state. These relate to:

- The health and biodiversity of ecosystems
- Human health and wellbeing
- Aesthetics
- Agricultural use.

Schedule 1 of the Air EPP defines air quality objectives for indicators such that environmental values are enhanced or protected.

Air quality standards, goals and monitoring investigation levels of indicators specified in the Air NEPM and Air Toxics NEPM have been adopted as air quality objectives in the Air EPP.

Air quality objectives for deposited dust are not included in the Air EPP. A recent Department of Environment and Heritage Protection (DEHP) guideline, Application requirements for activities with impacts to air 2013, provides an objective for assessing deposited dust measurements collected in accordance with AS/NZS 3580.10.1:2003 – Methods for sampling and analysis of ambient air. Method 10.1: Determination of particulate matter – Deposited matter – Gravimetric method. The amenity guideline of 120 mg/m^2/day, for a one month collection period, is equivalent to 3.7 mg/m^2/month.

It is not possible to measure daily deposition values for each day of a one month collection period; however, it is possible to model dust deposition on daily time scales. For a one month period where the monthly average deposition rate is equal to the amenity guideline, there will be many days where the guideline value is significantly exceeded. Experience has shown that exceedances of monthly deposition criteria are usually related to short term deposition events, associated with adverse meteorology or increased activity, rather than a steady build-up of collected dust throughout the month. Use of this criterion to assess daily modelled data was therefore considered to be inappropriate.

The NSW Office of Environment and Heritage assessment criterion, contained within the Approved methods for the modelling and assessment of air pollutants in NSW (2005), provides assessment criteria for incremental contribution of deposited dust at a sensitive receptor that is more amenable to modelling. The criterion value is 2 g/m^2/month (insoluble solids, annually averaged) at a given sensitive receptor, as well as a maximum total deposited dust level of 4 g/m^2/month (insoluble solids, annually averaged) inclusive of background. These criteria were developed by the NSW Office of Environment and Heritage on the basis of complaints data in the Hunter Valley, and are widely accepted assessment criteria outside of NSW.

The Queensland DEHP has adopted an incremental impact assessment criterion for the maximum incremental dust deposition level equivalent to not exceeding 2 g/m^2/month to ensure adequate protection of dust levels for residential amenity.

4.3 Air quality objectives

The air quality objectives and criteria used in the assessment are presented in Table 4-1.

Table 4-1 Air quality objectives and assessment criteria

Indicator	Environmental value	Air quality objective	Period
TSP	Health and wellbeing	90 µg/m^3 (a)	1 year
PM_{10}	Health and wellbeing	50 µg/m^3 (a) (b)	24 hours
$PM_{2.5}$	Health and wellbeing	25 µg/m^3 (a)	24 hours
		8 µg/m^3 (a)	1 year
Deposited Dust	Protecting aesthetic environment	2 g/m^2 (c) (d)	1 month
		4 g/m^2 (c) (e)	1 month
Benzene	Health and wellbeing	10 µg/m^3 (a)	1 year
Carbon Monoxide	Health and wellbeing	11,000 µg/m^3 (a)	8 hours
Formaldehyde	Health and wellbeing	54 µg/m^3 (a)	24 hours
	Protecting aesthetic environment	110 µg/m^3 (a)	30 minutes
Nitrogen dioxide	Health and wellbeing	250 µg/m^3 (a) (f)	1 hour
		62 µg/m^3 (a)	1 year
	Health and biodiversity of ecosystems	33 µg/m^3 (a)	1 year
Sulphur dioxide	Health and wellbeing	570 µg/m^3 (a) (f)	1 hour
		230 µg/m^3 (a) (g)	1 day
		57 µg/m^3 (a)	1 year
	Protecting agriculture	32 µg/m^3 (a)	1 year
	Health and biodiversity of ecosystems (for forests and natural vegetation)	22 µg/m^3 (a)	1 year
Toluene	Health and wellbeing	4,100 µg/m^3 (a)	24 hours
		410 µg/m^3 (a)	1 year
	Protecting aesthetic environment	1,100 µg/m^3 (a)	30 minutes

Indicator	Environmental value	Air quality objective	Period
Xylenes	Health and wellbeing	1,200 µg/m^3 [(a)]	24 hours
		950 µg/m^3 [(a)]	1 year

[(a)] Queensland Air EPP (2008)
[(b)] Five exceedances of the 24-hour average are allowed
[(c)] NSW Approved Methods for the modelling and assessment of air pollutants in NSW (2005)
[(d)] Maximum increase in deposited dust level, based on annual average of monthly observations
[(e)] Maximum total deposited dust level, based on annual average of monthly observations
[(f)] A one hour exceedance is allowed on one day each year
[(g)] One exceedance of the 24-hour average is allowed

5. Emissions inventory

5.1 Construction activities

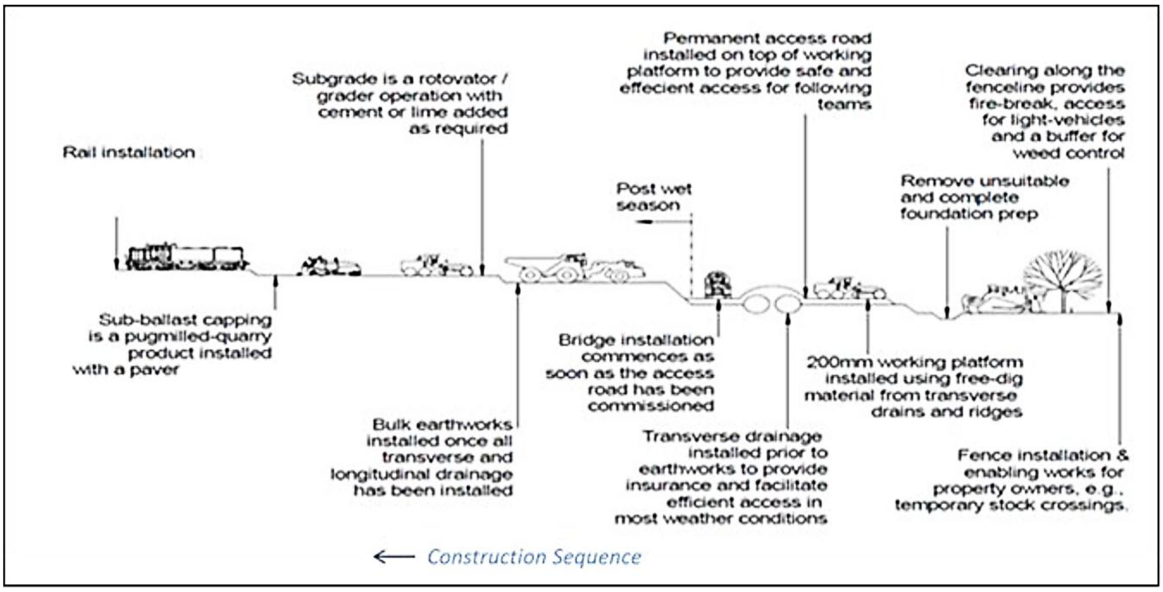
5.1.1 Overview

The emissions during the construction phase of the NGBR Project will primarily consist of:

- Dust emissions from mechanical disturbance by vehicles and equipment; from quarrying activities at sites close to the final rail corridor; and from concrete batching operations
- Dust emissions from exposed disturbed soil surfaces under high wind speeds
- Exhaust emissions from vehicles and mobile plant.

Figure 5-1 provides a high level overview of the construction sequence at any point on the final rail corridor.

Figure 5-1 High level overview of civil works sequencing during rail construction



Source: Figure 5.1, Aarvee Associates (2013)

5.1.2 Dust generation

The major dust sources during the construction of the NGBR Project are:

- Clearing for site preparation
- Quarrying activities
- Earthworks and excavation and where required, pneumatic rock breaking
- Stockpiling, loading and dumping of cut and fill material
- Levelling and grading of disturbed soil surfaces
- Placement of ballast
- Concrete batching plant operations
- Laying of concrete sleepers and rail

- Vehicle movements on unsealed construction access and haul roads or localised unconsolidated surfaces
- Wind erosion of unconsolidated surfaces such exposed clearing and stockpiles.

The dominant sources of dust emissions during the construction phase will be activities involving operation of heavy machinery such as bulldozers, graders, scrapers and haul trucks. Track laying processes are considered to have minimal dust generating potential compared to the corridor clearing and bulk earthworks phase. The Western Regional Air Project Fugitive Dust Handbook (Countess Environmental, 2006) provides an estimate of PM_{10} emission factors for construction activity. A Level 1 emission factor, based only on known area for known duration, is 0.11 tonne/acre-month. This converts to 0.0002958 tonne per square metre on an annual basis. This is for 'average conditions' which would be applicable here as 'active large-scale earth moving operations' will not be a 24/7 operation. This also assumes that the activity is occurring continuously day and night.

If the above annual emission factor is used for an indicative one kilometre long construction zone of 100 m width, indicative AUSPLUME modelling suggests worst case downwind daily PM_{10} levels (for the expected meteorological conditions for this project) are:

- An increment of 100 µg/m^3 at about 100 m
- An increment of 50 µg/m^3 at 200-230 m.

Assuming there is no mitigation with the above emission factor, PM_{10} levels above regulatory criteria are unlikely beyond the range of 500 metres. This is consistent with experience on similar construction projects. Accordingly, dust fallout from PM_{10} (dust deposition) would be expected to be well below 2 g/m^2 at this distance.

Emissions from these sources are readily controllable and due to the temporary nature of the construction activities are not expected to be significant in either magnitude or duration.

5.2 Operation activities

5.2.1 Overview

The main potential emissions sources expected during the operation of the NGBR Project are:

- Exhaust emissions from locomotives, including fine particulate material
- Fugitive coal dust emissions from loaded, uncovered coal wagons in transit
- Leakage from coal wagon bottom-dump unloading doors
- Wind erosion of dust from spilled coal in the final rail corridor.

Relevant exhaust emissions from diesel engines include:

- Carbon monoxide (CO)
- Oxides of nitrogen (NO_x) – assessed as nitrogen dioxide (NO_2)
- Sulphur dioxide (SO_2)
- Benzene
- Trace hydrocarbons
- PM_{10} and $PM_{2.5}$.

The quantification of particulate emissions requires the addition of the two sources of particulates from both diesel exhausts and the fugitive coal sources listed above. The emissions inventory for the particulate matter of all three sub-types (TSP, PM_{10} and $PM_{2.5}$) are considered as dust generation, whereas the non-dust sources are assessed as hazardous air pollutants (refer Section 5.3.2).

5.2.2 Locomotive emissions

Brake horse power (bhp) is a measure of the tractive effort available for locomotion from internal combustion engines. As a result of the expected mixture of locomotives, and the potential for alternate locomotive models to be selected, a range of between 3,000 and 5,000 bhp per locomotive has been considered in the quantification of locomotive emissions.

With four locomotives per train, each train will be able to obtain speeds of up to 100 km/h when unloaded and a maximum speed of 80 km/h when loaded. Trains will be operated in a line-haul mode and emissions as grams per power output are listed in Table 5-1 (DieselNet, 2008).

At this point, it is unknown what manufacturing standards will be applied and this results in consideration of Tier 0, Tier 1 and Tier 2 emission standards. It is worth noting that these emission standards are lower than comparable diesel train engines of equivalent power. Although Tier 3 locomotives may be utilised, the lower Tier 0 emissions standards has been assessed to represent a 'worst case' scenario.

Table 5-1 Line-haul locomotive emissions

Emission standard	Hydrocarbons (g/bhp-h)	CO (g/bhp-h)	NOx (g/bhp-h)	Particulate matter (g/bhp-h)
Tier 0	1.00	5.0	8.0	0.22
Tier 1	0.55	2.2	7.4	0.22
Tier 2	0.30	1.5	5.5	0.10

It is estimated by USEPA (2009) that Volatile Organic Compounds (VOCs) are at a ratio of 1.053 to the hydrocarbon emissions in the standards above. For diesel engines, all of the particulate matter can be considered to consist of the PM_{10} fraction (USEPA, 2009). A further reasonable assumption is that 98 per cent of the PM_{10} is the finer $PM_{2.5}$ fraction (NPI, 2008a, Table 42, p.69).

The range of operating power of the locomotive types and the operating speeds can be used with the above data to give emissions in g/VKT for a single locomotive. These data are summarised in Table 5-2. It is clear that the oldest (Tier 0) and biggest locomotive (5,000 bhp) produces the most emissions, and hence emissions from this class of locomotive have been conservatively used within the modelling program.

Table 5-2 Line-haul locomotive emission for a single locomotive at operating speed

Emission standard	Hydrocarbons (g/VKT)	CO (g/VKT)	NO_X (g/VKT)	PM_{10} (g/VKT)	$PM_{2.5}$ (g/VKT)	VOC (g/VKT)
3,000 bhp locomotive						
Tier 0	37.5	188	300	8.25	8.1	39.5
Tier 1	20.6	82.5	278	8.25	8.1	21.7
Tier 2	11.3	56.2	206	3.75	3.7	11.8
5,000 bhp locomotive						
Tier 0	62.5	312	500	13.8	13.5	65.8
Tier 1	34.4	137	463	13.8	13.5	36.2
Tier 2	18.7	93.7	344	6.25	6.13	19.7

5.2.3 Emission constituents

The oxides of nitrogen data from above needs to be assessed as a ground level value of nitrogen dioxide. Therefore, an assumed NO_2 to NO_X ratio of 20 per cent was used. Sulphur dioxide emissions are highly dependent on the sulphur content of the diesel fuel used. Low-sulphur diesel fuel will be used (maximum of 10 ppm as per Australian Diesel Fuel Standard). SO_2 emissions were estimated by using the same ratio of 0.4 per cent of VOC emissions as found in the emission factor estimation for diesel powered locomotives (NPI 2008b, Table B.1, p.33). In a similar way, the benzene emission factor was estimated by its contribution to eight per cent of total VOCs.

A research paper for the USEPA provides estimating factors for relevant Hazardous Air Pollutant (HAP) constituents using a speciation base of either PM_{10} or VOC (Eastern Research Group, 2011, Table 3-1, p.3-2). The following ratios were used for the (remaining) Air Toxics NEPM compounds of interest:

- Formaldehyde is 0.0945 per cent of PM_{10}
- Toluene is 0.32 per cent of VOC
- Xylene is 0.4 per cent of VOC.

The locomotive diesel exhaust emissions per train consist are summarised in Table 5-3.

Table 5-3 Line-haul locomotive emissions for locomotive consists at loaded operating speed

Constituent g/VKT	3,000 bhp Locomotives			5,000 bhp Locomotives		
	Tier 0	Tier 1	Tier 2	Tier 0	Tier 1	Tier 2
TSP	33.0	33.0	15.0	55.0	55.0	25.0
PM_{10}	33.0	33.0	15.0	55.0	55.0	25.0
$PM_{2.5}$	32.3	32.3	14.7	53.9	53.9	24.5

Constituent g/VKT	3,000 bhp Locomotives			5,000 bhp Locomotives		
	Tier 0	Tier 1	Tier 2	Tier 0	Tier 1	Tier 2
Benzene	51.8	28.5	15.5	86.3	47.5	25.9
CO	750	330	225	1250	550	375
NO_2	240	222	165	400	370	275
Formaldehyde	0.03	0.03	0.01	0.05	0.05	0.02
SO_2	0.62	0.34	0.19	1.03	0.57	0.31
Toluene	0.51	0.28	0.15	0.84	0.46	0.25
Xylene	0.76	0.42	0.23	1.26	0.69	0.38

5.2.4 Dust generation

In addition to the particulate matter emitted by the diesel locomotives, fugitive coal dust emissions will add to the mass of particulate matter per VKT. There is flexibility in regards to the number of return trips required to reach the nominal maximum coal transport rate of 100 mtpa. This will vary as the NGBR Project ramps up to the maximum transport rate, and will be dependent on:

- Number and type of locomotives used
- Number of wagons and their payload capacity.

Table 5-4 summarises the proposed train configurations for the maximum coal transport rate of 100 mtpa (Adani 2013). This will be achieved using standard gauge trains.

Table 5-4 Proposed train consist configurations for the maximum coal transport rate

Parameter	Configuration
Number of locomotives per consist	4
Wagon total axle load (t)	32.5
Number of wagons per consist	240
Payload per wagon (t)	108
Total payload per train (t)	25,920
Loaded (up) trains per day	14
Empty (down) trains per day	14
Total trains per day	28
Loaded (up) trains per hour	0.58
Empty (down) trains per hour	0.58

The emission factor of total coal dust from the moving fully loaded coal train wagons was calculated using the equation detailed in the coal dust study from Connell-Hatch (2008):

g-TSP/km/tonne of loaded coal:

$$\text{Emission Factor (loaded coal train)} = 0.0000378\ V^2 - 0.000126\ V + 0.000063$$

Where V is the speed of the train (km/h).

The speed of the train is greater than ambient wind speeds; therefore, the primary mechanism for coal dust lift-off from coal trains is forced wind erosion off the coal surface. Other factors that contribute to emissions include mine-specific coal properties (dustiness, moisture content and particle size), wagon vibrations, coal load profile, exposure to wind and precipitation.

The loaded standard gauge trains using the final rail corridor will be hauling up to 25,920 tonnes of coal respectively during each trip, at a maximum loaded speed of 80 km/h. The above equation therefore results in an estimated TSP emission factor of 6,011 g/VKT. Though trains will be in operation 320 days per year (at peak production) (Adani 2013), hourly emission rates were modelled for a full year. This represents a 'worst case' scenario for operational movements.

The PM_{10} emission factor was taken to be 50 per cent of the TSP rate. This is based on the emission estimation technique for wind erosion of coal stockpiles used by the National Pollutant Inventory (NPI 2011, Appendix A section 1.1.17, p.57). The same reference does not give a similar ratio for $PM_{2.5}$ to PM_{10} so a conservative assumption of 50 per cent has been used.

For the fully loaded train travelling east from the mine, the emission factors for dust (TSP, PM_{10} and $PM_{2.5}$) for a coal pay load are added to the corresponding diesel exhaust particulate emissions from the worst-case 5,000 bhp locomotive with Tier 0 emission standard. As a numerical example for demonstrative purposes, this will result in a total TSP emission rate for a fully loaded train of 6,066 g/VKT, i.e. 6,011 + 55 (25,920 tonne pay load).

5.2.5 Accounting for return trips

For all loaded train trips, an equal number of unloaded return trips were modelled. Emissions from the unloaded south-west bound trains were added to those from the loaded north-east bound trains. Locomotive emissions were calculated, considering:

- Unloaded trains are much lighter and therefore require less power
- Unloaded trains travel at a higher speed, generating air resistance (drag).

Assuming that the unloaded locomotives will be able to run at 25 per cent of full power, a reducing factor of 0.25 can be applied to locomotive emissions. However, as air resistance is proportional to the square of the speed, the required extra power to maintain 100 km/h as compared to 80 km/h is 56 per cent (a factor of 1.56). For this generalised estimate, a safety factor of 1.5 has been used to conservatively account for the imprecise nature of this calculation. Therefore, an overall unloaded train locomotive emission correction factor of 0.58 (0.25 x 1.56 x 1.5) is applied to the locomotive emissions detailed in Table 5-3.

Locomotives TSP emissions were modified by the 0.58 correction factor to be 55 g/VKT. The TSP emission factor for empty returning trains was calculated assuming that there are no wind erosion emissions from the wagons. As such, particulate emissions from the 'worst case' 5,000 bhp locomotives can be seen to be a small contributor to the overall dust emissions from the railway operations.

5.2.6 Track alignments for the various regions

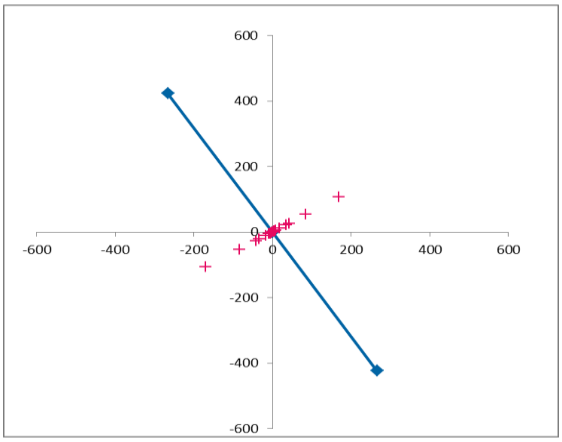
The application of AUSROADS to modelling the train line emissions was made by considering the emissions from typical one kilometre long track alignment sections. For each region, three typical segments were selected to characterise the range of track orientations occurring. With the exception of the coastal region, Section 1 is always aligned along the bearing established by the start and end locations of the region. Sections 2 and 3 represent the most westerly and easterly aligned sections occurring within the region.

Unlike the other regions, the coastal region contains only three significant representative track orientations. In this case Section 1 represents the track orientation at the coast, and Sections 2 and 3 represent the successive track alignments occurring along this section of the NGBR Project.

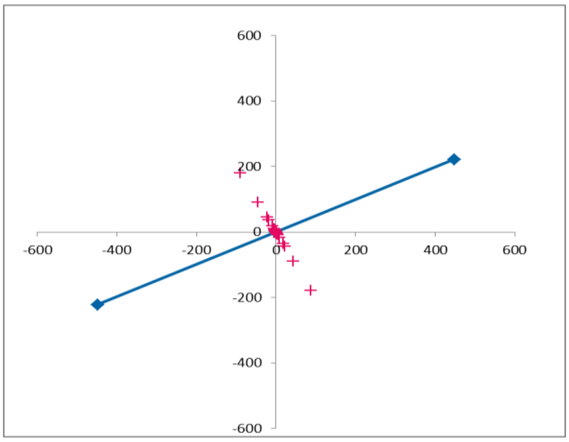
Hourly emissions were modelled at varying lateral distances up to 200 m from either side of the centre of the track orientation line. The track orientations (blue line) and points at varying distances where emissions were quantified (red crosses) are graphically reproduced in Figure 5-2 to Figure 5-6. In each case the blue line represents a one kilometre section of track and its respective orientation.

Figure 5-2 Modelled track alignment in the coastal meteorological region

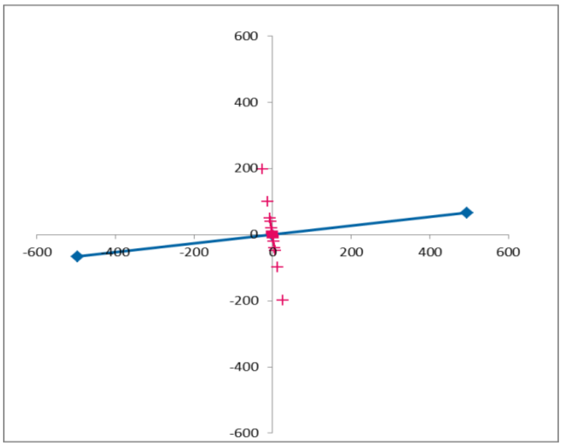
Section 1



Section 2



Section 3



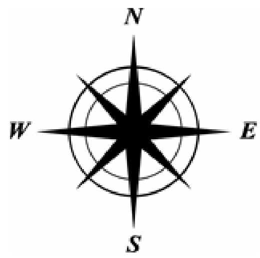
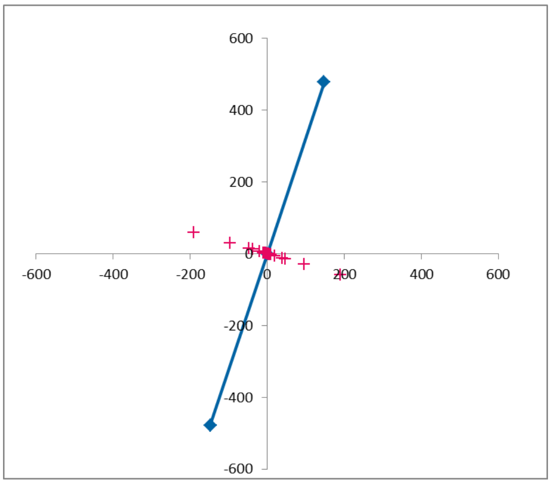


Figure 5-3 Modelled track alignment in the Bogie River meteorological region

Section 1



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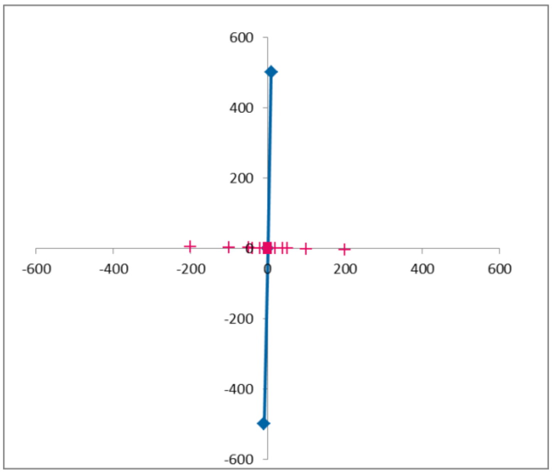

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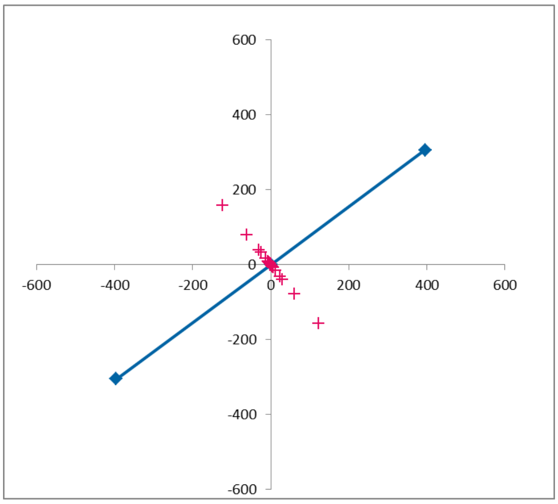


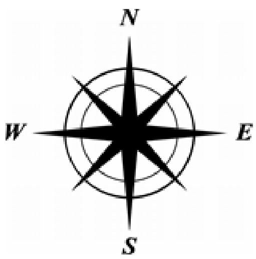
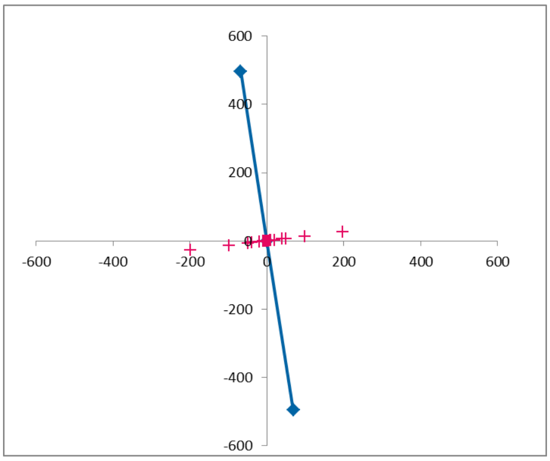
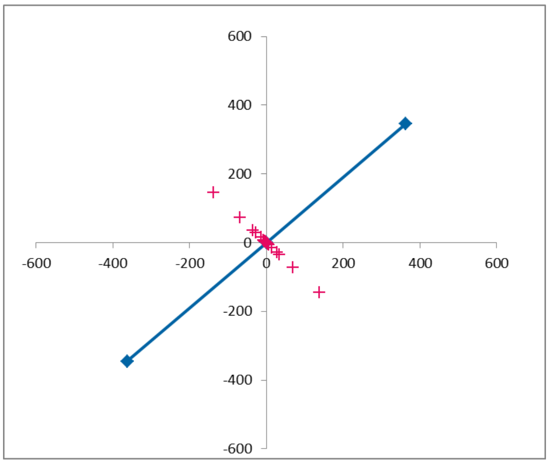


Figure 5-4 Modelled track alignment in the Bowen River meteorological region

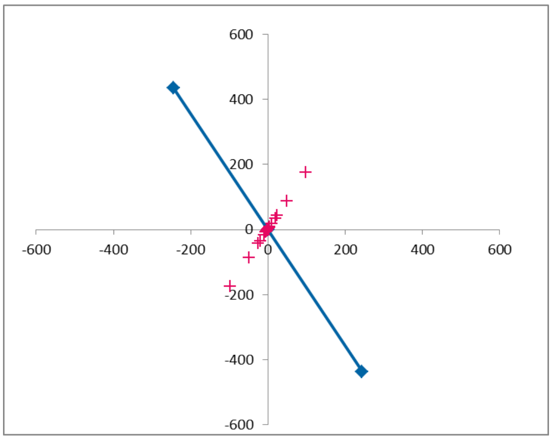
Section 1



Section 2



Section 3



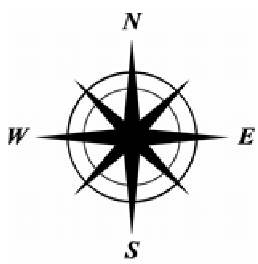
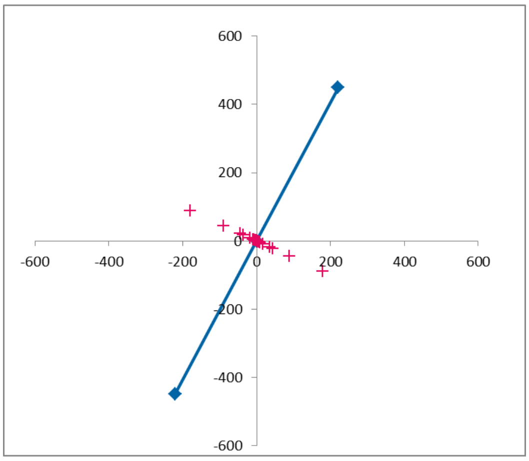


Figure 5-5 Modelled track alignment in the Bowen River meteorological region

Section 1



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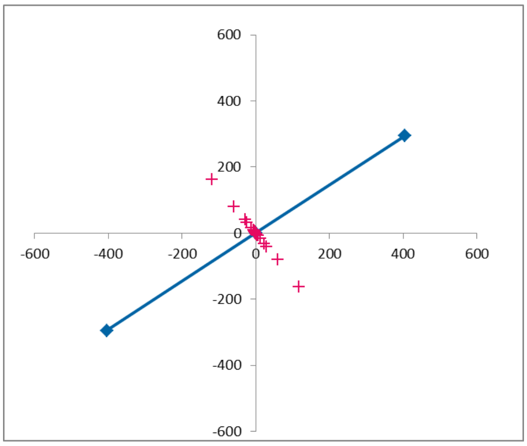
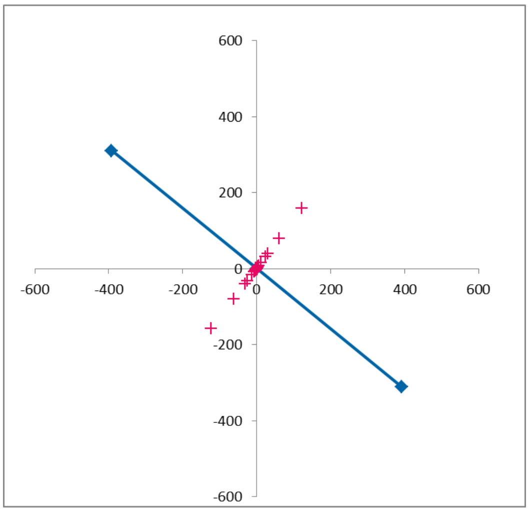


Section 3



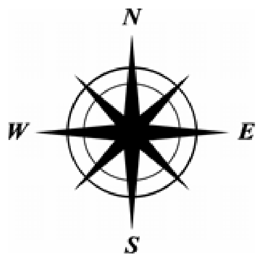
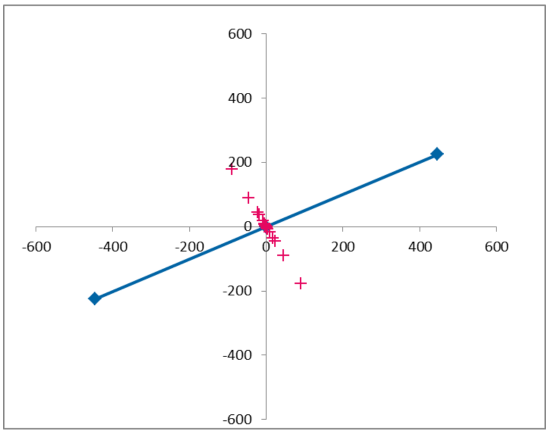


Figure 5-6 Modelled track alignment in Isaac meteorological region

Section 1



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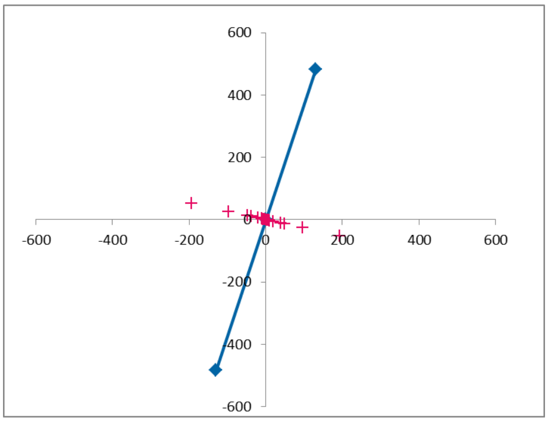

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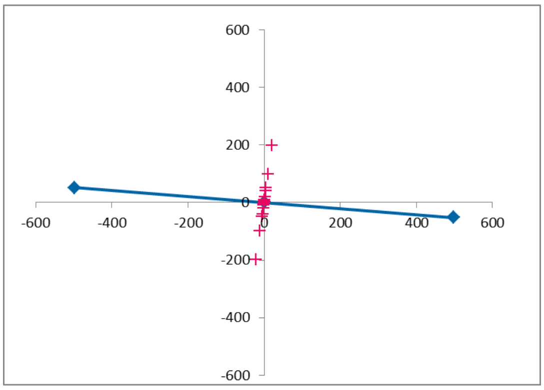
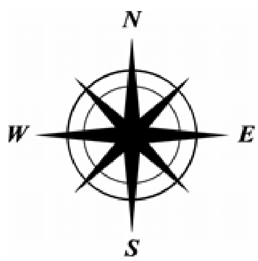




5.3 Predicted emissions

The following sections present the model predictions. Section 5.3.1 summarises the predictions for TSP, PM_{10} and $PM_{2.5}$, arising from the combined effect of locomotive exhaust emissions and fugitive coal wagon emissions. The minor air pollutant predictions from locomotive emissions are presented in Section 5.3.2. The dust deposition results are presented in section 5.3.3.

5.3.1 Particulate matter

A summary of the TSP, PM_{10} and $PM_{2.5}$ predictions for the NGBR Project is presented in Table 5-5 to Table 5-8. Each table provides, for each meteorological region and representative track segment: the background concentration that was applied to the model; the relevant Air EPP criterion; and the distance to compliance with the criterion, as measures from each side of the track segment. A plot of the predicted 24-hour average ground-level concentrations of PM_{10} versus distance from the centreline of the final rail corridor, to the left and right of the track for a loaded train travelling from the mine to the port, is presented in Figure 5-7.

Table 5-5 Predicted annual-mean ground-level concentrations of TSP

Region/rail section	Background (µg/m³)	Criterion (µg/m³)	LTL distance from track centreline to compliance (m)*	LTR distance from track centreline to compliance (m)*
Coastal region				
1	26.4	90	7	27
2	26.4	90	19	8
3	26.4	90	18	9
Bogie River region				
1	30	90	16	< 2
2	30	90	46	4
3	30	90	44	7
Bowen River region				
1	30	90	12	61
2	30	90	53	16
3	30	90	61	20
Newlands region				
1	30	90	39	7
2	30	90	37	10
3	30	90	39	13
Isaac region				
1	30	90	36	19
2	30	90	43	13
3	30	90	28	27

* LTL = Loaded Train Left, and refers to the left hand side of a loaded train travelling towards Abbot Point.
* LTR = Loaded Train Right, and refers to the right hand side of a loaded train travelling towards Abbot Point.
The innermost model grid points are located 2 m on either side of the railway line. In cases where all modelled grid points within a transect meet the criterion, the distance to compliance value is given as '< 2' m.

The annual-mean TSP air quality objective is met within a distance of 61 m, on either side of the track, for all representative track alignments within the five regions. The maximum distance to compliance for the Coastal; Bogie River; Bowen River; Newlands; and Isaac regions are 27 m; 46 m; 61 m; 39 m; and 43 m respectively.

Table 5-6 Predicted maximum daily-mean ground-level concentrations of PM_{10}

Region/Rail section	Background ($\mu g/m^3$)	Criterion ($\mu g/m^3$)	LTL distance from track centreline to compliance (m)*	LTR distance from track centreline to compliance (m)*
Coastal region				
1	18.1	50	50	87
2	18.1	50	71	90
3	18.1	50	79	87
Bogie River region				
1	15	50	102	81
2	15	50	94	95
3	15	50	93	86
Bowen River region				
1	15	50	78	110
2	15	50	147	82
3	15	50	127	87
Newlands region				
1	15	50	121	79
2	15	50	118	86
3	15	50	90	81
Isaac region				
1	15	50	195	189
2	15	50	201	228
3	15	50	173	191

* LTL = Loaded Train Left, and refers to the left hand side of a loaded train travelling towards Abbot Point.
* LTR = Loaded Train Right, and refers to the right hand side of a loaded train travelling towards Abbot Point.

The assessment found that the daily mean PM_{10} air quality objective is met within a distance of 228 m, on either side of the track, for all representative track alignments within the five regions. The maximum distance to compliance for the Coastal; Bogie River; Bowen River; Newlands; and Isaac regions are 90 m; 102 m; 147 m; 121 m; and 228 m respectively.

Figure 5-7 Predicted peak daily-mean PM_{10} concentrations with distance from the rail centreline

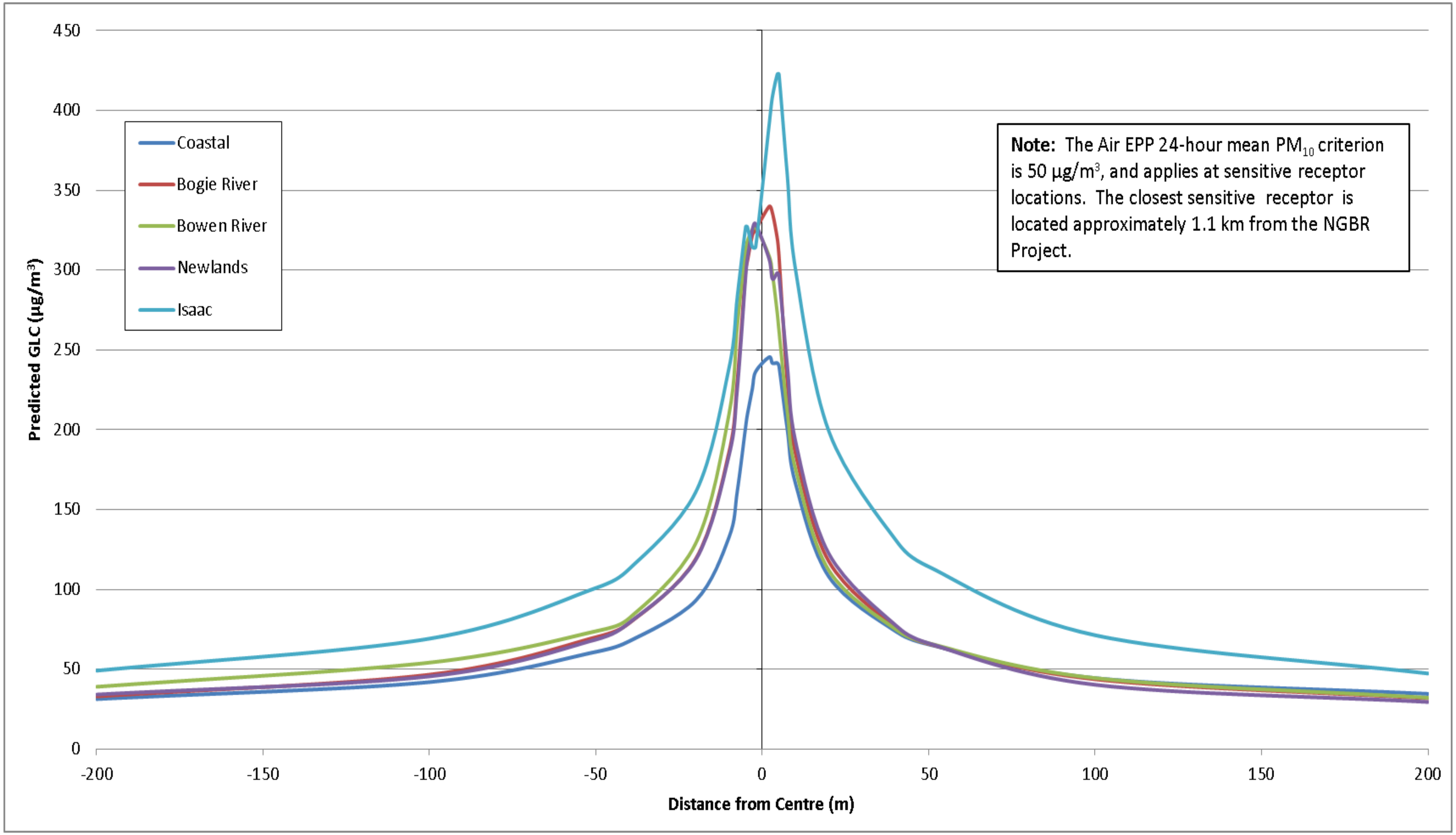


Table 5-7 Predicted maximum daily-mean ground-level concentrations of $PM_{2.5}$

Region/rail section	Background (µg/m³)	Criterion (µg/m³)	LTL distance from track centreline to compliance (m)*	LTR distance from track centreline to compliance (m)*
Coastal region				
1	5.1	25	38	68
2	5.1	25	49	70
3	5.1	25	61	71
Bogie River region				
1	6.6	25	99	80
2	6.6	25	92	93
3	6.6	25	91	84
Bowen River region				
1	6.6	25	76	104
2	6.6	25	143	80
3	6.6	25	122	85
Newlands region				
1	6.6	25	115	77
2	6.6	25	113	84
3	6.6	25	88	80
Isaac region				
1	6.6	25	191	185
2	6.6	25	197	223
3	6.6	25	169	187

* Note: LTL = Loaded Train Left, and refers to the left hand side of a loaded train travelling towards Abbot Point.
LTR = Loaded Train Right, and refers to the right hand side of a loaded train travelling towards Abbot Point.

The daily mean $PM_{2.5}$ air quality objective is met within a distance of 223 m, on either side of the track, for all representative track alignments within the five regions. The maximum distance to compliance for the Coastal; Bogie River; Bowen River; Newlands; and Isaac regions are 71 m; 99 m; 143 m; 115 m; and 223 m respectively.

Table 5-8 Predicted annual-mean ground-level concentrations of $PM_{2.5}$

Region/rail section	Background (µg/m³)	Criterion (µg/m³)	LTL distance from track centreline to compliance (m) *	LTR distance from track centreline to compliance (m) *
Coastal Region				
1	3.7	8	38	144
2	3.7	8	136	43
3	3.7	8	120	58
Bogie River Region				
1	5.8	8	313	25
2	5.8	8	315	24
3	5.8	8	285	61
Bowen River Region				
1	5.8	8	111	279
2	5.8	8	276	151
3	5.8	8	275	182
Newlands Region				
1	5.8	8	288	67
2	5.8	8	270	121
3	5.8	8	249	97
Isaac Region				
1	5.8	8	254	192
2	5.8	8	273	137
3	5.8	8	236	234

* LTL = Loaded Train Left, and refers to the left hand side of a loaded train travelling towards Abbot Point.
* LTR = Loaded Train Right, and refers to the right hand side of a loaded train travelling towards Abbot Point.

The annual $PM_{2.5}$ criterion (8 µg/m^3) is more difficult to meet given the high background concentrations used (3.7 µg/m^3 at the coast and 5.8 µg/m^3 inland). However the objective is met within a distance of 315 m, on either side of the track, for all representative track alignments within the five regions. The maximum distance to compliance for the Coastal; Bogie River; Bowen River; Newlands; and Isaac regions are 144 m; 315 m; 279 m; 288 m; and 273 m respectively. Appendix B provides the full set of model predictions for particulates, in tabular form.

5.3.2 Minor air pollutants

For locomotives exhaust emissions, the most significant constituent emitted is NO_2 (Table 5-9). The highest predicted hourly-mean concentration of NO_2 at any model grid point is 305 µg/m^3, occurring at a distance of two metres from the centreline of the final rail corridor in both the Bowen River and Isaac regions. Despite this the 250 µg/m^3 hourly criterion is met within seven metres of the centreline of the final rail corridor for all representative track alignments, as illustrated in Figure 5-8.

The annual mean NO_2 criterion (62 µg/m^3) is easily met at all modelled grid points. The predicted ground-level concentrations of benzene, CO, formaldehyde, SO_2, toluene and xylene all easily meet their respective Air EPP criteria at all modelled points beyond the final rail corridor (refer Table 5-10). Appendix C provides the full set of model predictions for the minor air pollutants.

Table 5-9 Predicted maximum hourly-mean ground-level concentrations of NO_2

Region/rail section	Background (µg/m³)	Criterion (µg/m³)	LTL distance from track centreline to compliance (m) *	LTR distance from track centreline to compliance (m) *
Coastal region				
1	55	250	< 2	< 2
2	55	250	< 2	< 2
3	55	250	< 2	< 2
Bogie River region				
1	0	250	< 2	< 2
2	0	250	< 2	< 2
3	0	250	< 2	< 2
Bowen River region				
1	0	250	6	6
2	0	250	6	6
3	0	250	7	7
Newlands region				
1	0	250	< 2	< 2
2	0	250	< 2	< 2
3	0	250	< 2	< 2
Isaac region				
1	0	250	6	6
2	0	250	6	6
3	0	250	6	5

* LTL = Loaded Train Left, and refers to the left hand side of a loaded train travelling towards Abbot Point.
* LTR = Loaded Train Right, and refers to the right hand side of a loaded train travelling towards Abbot Point.
The innermost model grid points are located 2 m on either side of the railway line. In cases where all modelled grid points within a transect meet the criterion, the distance to compliance value is given as ‘< 2’ m.

Figure 5-8 Predicted ground-level concentrations peak incremental impacts of the hourly NO_2 from the combinations that have the worst impact

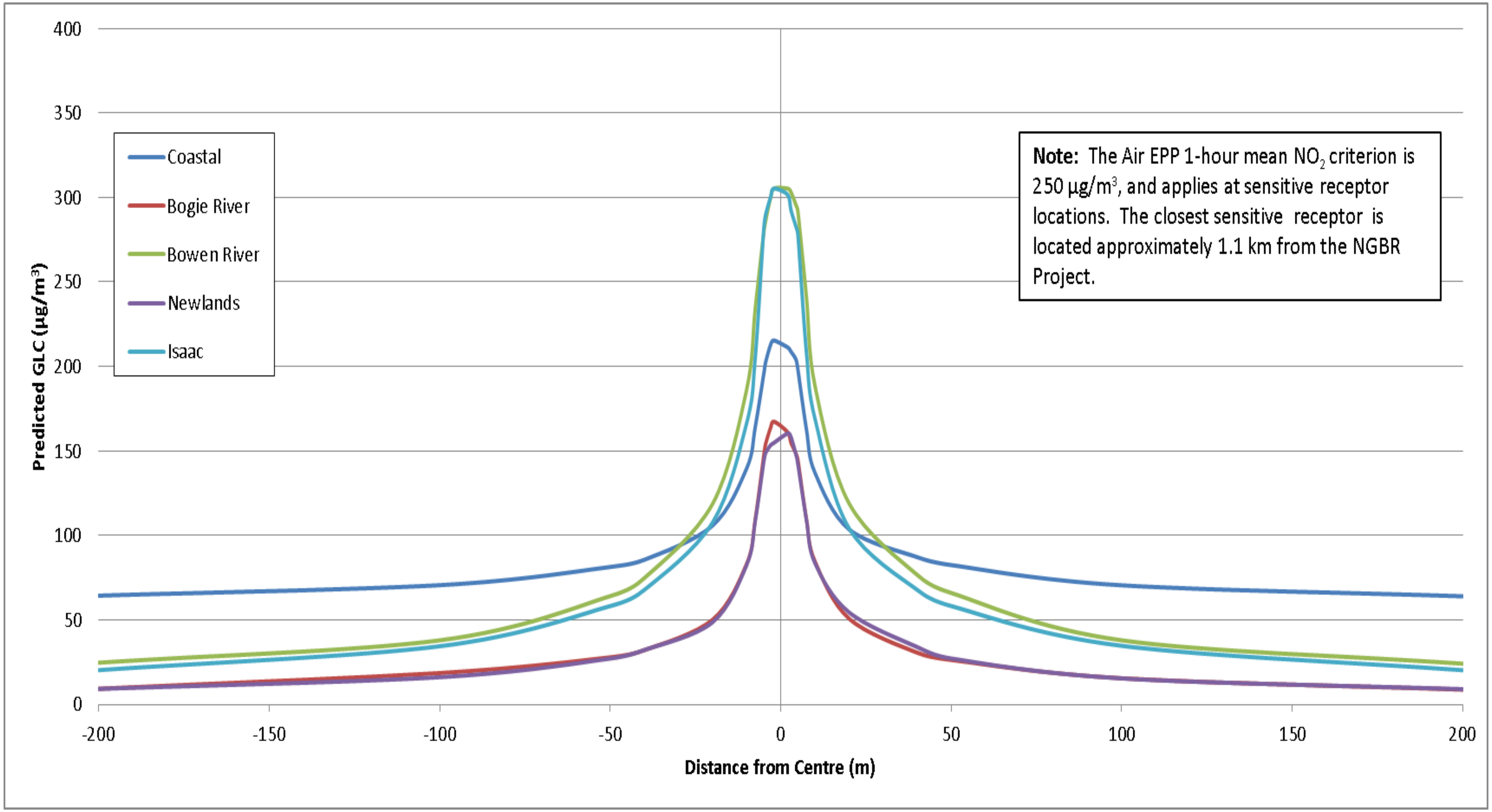


Table 5-10 Maximum modelled concentrations for substances meeting their Air EPP criterion at all modelled grid points

Substance	Averaging time	Statistic	Criterion (µg/m³)	Maximum modelled concentration (µg/m³)	Percentage of criterion (%)
NO_2	1 year	Mean	62	30.7	49.5
Benzene	1 year	Mean	10	6.6	66.3
CO	8 hours	Maximum	11000	391	3.6
Formaldehyde	30 minutes	Maximum	110	0.05	0.04
Formaldehyde	24 hours	Maximum	54	0.01	0.00001
SO_2	1 hour	Maximum	570	11.4	2.0
SO_2	24 hours	Maximum	230	6.2	2.7
SO_2	1 year	Mean	57	3.1	5.4
Toluene	30 minutes	Maximum	1100	0.7	0.07
Toluene	24 hours	Maximum	4100	0.18	0.004
Toluene	1 year	Mean	410	0.06	0.02
Xylene	24 hours	Maximum	1200	0.26	0.02
Xylene	1 year	Mean	950	0.10	0.01

5.3.3 Dust deposition

In modelling the dust deposition rate, AUSPLUME was used with the source release geometry taken to be an area source (1,000 m x 6 m) at four metres above ground level. The rate of dust emission from moving loaded wagons (g/s/m^2) was calculated using the number of trains per hour and the Connell-Hatch (2008) formula utilised earlier to calculate TSP emissions (see Section 5.1.2). This emission rate (2.23 x 10^{-2} g/s/m^2) accounted for deposited dust from trains and wagons under the 100 mtpa scenario, and was evenly apportioned throughout the area source. Emissions were recorded at 2, 5, 10, 20, 40, 50, 100 and 200 m intervals from each side of the track.

Table 5-11 to Table 5-16 and Figure 5-9 show the predicted incremental dust deposition impact at discrete locations away from the NGBR Project.

The maximum incremental dust deposition level is less than the deposition guideline equivalent of 2 g/m^2/month at all modelled locations. Since the background dust deposition is also less than 2 g/m^2/month (see Section 3.2.3) then the total dust deposition rates are also below the total deposition guideline of 4 g/m^2/month.

Table 5-11 Highest locomotive exhaust plus coal wagon predicted peak incremental dust deposition: coastal region

Railway section	Pollutant	Averaging period	Dust criterion (g/m^2/month)	Predicted peak incremental concentration (g/m^2/month) at distance from the railway (m)															
				Left of railway for a loaded train*								Right of railway for a loaded train*							
				200	100	50	40	20	10	5	2	2	5	10	20	40	50	100	200
1	Deposited particles	1 year	2	0.05	0.06	0.07	0.08	0.11	0.14	0.15	0.17	0.17	0.18	0.19	0.23	0.24	0.25	0.25	0.29
2	Deposited particles	1 year	2	0.09	0.14	0.21	0.22	0.25	0.22	0.21	0.19	0.19	0.18	0.18	0.16	0.15	0.15	0.15	0.14
3	Deposited particles	1 year	2	0.09	0.15	0.21	0.23	0.25	0.22	0.21	0.19	0.19	0.18	0.18	0.16	0.15	0.15	0.15	0.14

* For a loaded train travelling towards Abbot Point

Table 5-12 Highest locomotive exhaust plus coal wagon predicted peak incremental dust impacts: Bogie River region

Railway section	Pollutant	Averaging period	Dust criterion (g/m^2/month)	Predicted peak incremental concentration (g/m^2/month) at distance from the railway (m)															
				Left of railway for a loaded train*								Right of railway for a loaded train*							
				200	100	50	40	20	10	5	2	2	5	10	20	40	50	100	200
1	Deposited particles	1 year	2	0.05	0.10	0.14	0.15	0.17	0.14	0.12	0.10	0.10	0.09	0.08	0.06	0.06	0.06	0.05	0.05
2	Deposited particles	1 year	2	0.05	0.10	0.14	0.16	0.17	0.13	0.12	0.09	0.09	0.08	0.07	0.06	0.05	0.05	0.05	0.04
3	Deposited particles	1 year	2	0.04	0.08	0.14	0.14	0.19	0.17	0.17	0.16	0.15	0.15	0.14	0.13	0.12	0.11	0.11	0.10

* For a loaded train travelling towards Abbot Point

Table 5-13 Highest locomotive exhaust plus coal wagon predicted peak incremental dust deposition: Bowen River region

Railway section	Pollutant	Averaging period	Dust criterion (g/m^2/month)	Predicted peak incremental concentration (g/m^2/month) at distance from the railway (m)															
				Left of railway for a loaded train*								Right of railway for a loaded train*							
				200	100	50	40	20	10	5	2	2	5	10	20	40	50	100	200
1	Deposited particles	1 year	2	0.14	0.15	0.18	0.19	0.22	0.24	0.25	0.25	0.25	0.26	0.26	0.28	0.28	0.29	0.30	0.31
2	Deposited particles	1 year	2	0.18	0.22	0.29	0.31	0.35	0.34	0.33	0.32	0.32	0.31	0.30	0.28	0.28	0.28	0.28	0.27
3	Deposited particles	1 year	2	0.19	0.24	0.30	0.34	0.22	0.35	0.34	0.34	0.33	0.33	0.33	0.31	0.31	0.31	0.31	0.30

* For a loaded train travelling towards Abbot Point

Table 5-14 Highest locomotive exhaust plus coal wagon predicted peak incremental dust deposition: Newlands region

Railway section	Pollutant	Averaging period	Dust criterion (g/m^2/month)	Predicted peak incremental concentration (g/m^2/month) at distance from the railway (m)															
				Left of railway for a loaded train*								Right of railway for a loaded train*							
				200	100	50	40	20	10	5	2	2	5	10	20	40	50	100	200
1	Deposited particles	1 year	2	0.14	0.15	0.18	0.19	0.22	0.24	0.25	0.25	0.25	0.26	0.26	0.28	0.28	0.29	0.30	0.31
2	Deposited particles	1 year	2	0.18	0.22	0.29	0.31	0.35	0.34	0.33	0.32	0.32	0.31	0.30	0.28	0.28	0.28	0.28	0.27
3	Deposited particles	1 year	2	0.19	0.24	0.30	0.34	0.22	0.35	0.34	0.34	0.33	0.33	0.33	0.31	0.31	0.31	0.31	0.30

* For a loaded train travelling towards Abbot Point

Table 5-15 Highest locomotive exhaust plus coal wagon predicted peak incremental dust deposition: Newlands region

Railway section	Pollutant	Averaging period	Dust criterion (g/m^2/month)	Predicted peak incremental concentration (g/m^2/month) at distance from the railway (m)															
				Left of railway for a loaded train*								Right of railway for a loaded train*							
				200	100	50	40	20	10	5	2	2	5	10	20	40	50	100	200
1	Deposited particles	1 year	2	0.14	0.15	0.18	0.19	0.22	0.24	0.25	0.25	0.25	0.26	0.26	0.28	0.28	0.29	0.30	0.31
2	Deposited particles	1 year	2	0.18	0.22	0.29	0.31	0.35	0.34	0.33	0.32	0.32	0.31	0.30	0.28	0.28	0.28	0.28	0.27
3	Deposited particles	1 year	2	0.19	0.24	0.30	0.34	0.22	0.35	0.34	0.34	0.33	0.33	0.33	0.31	0.31	0.31	0.31	0.30

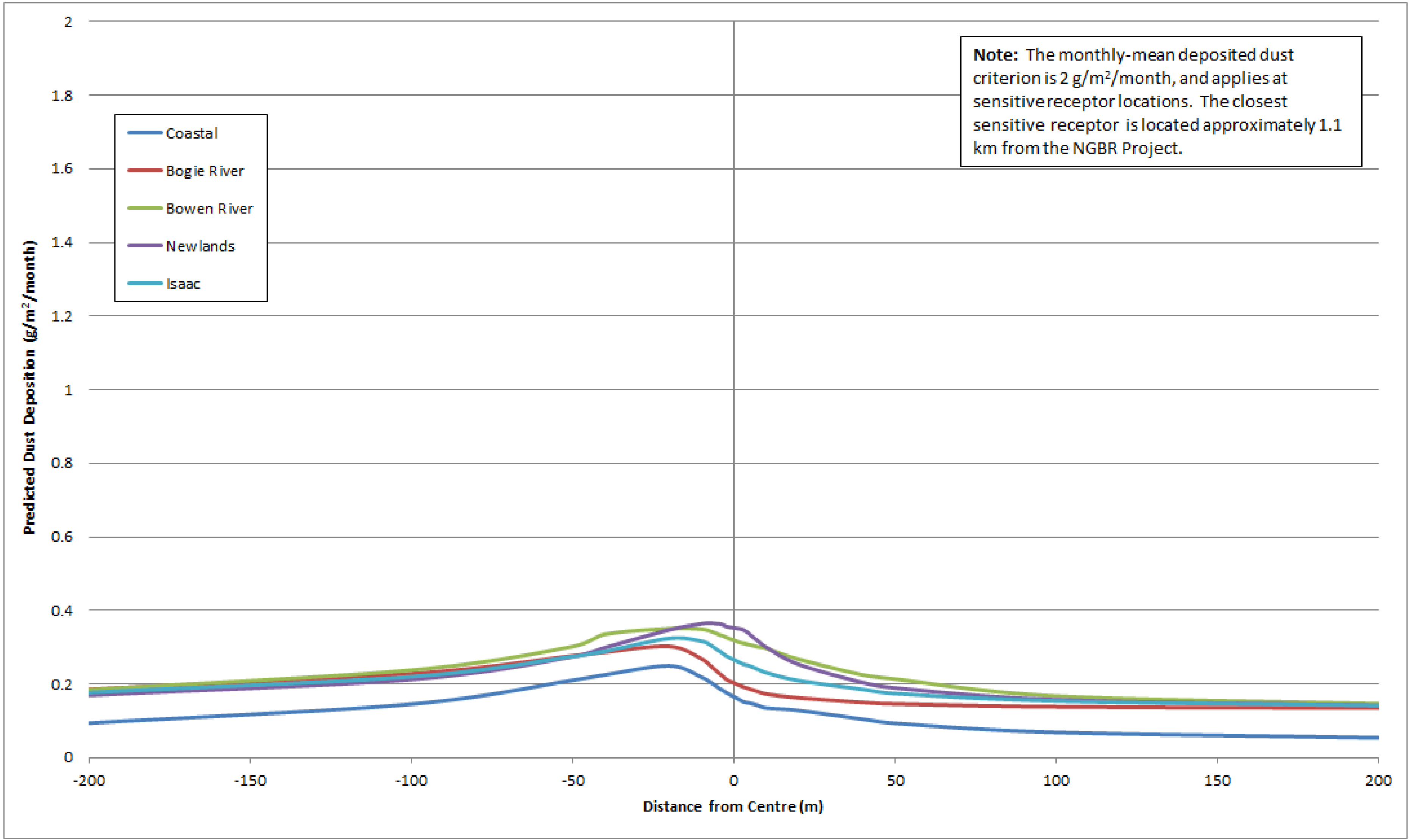
* For a loaded train travelling towards Abbot Point

Table 5-16 Highest locomotive exhaust plus coal wagon predicted peak incremental dust deposition: Isaac region

Railway section	Pollutant	Averaging period	Dust criterion (g/m^2/month)	Predicted peak incremental concentration (g/m^2/month) at distance from the railway (m)															
				Left of railway for a loaded train*								Right of railway for a loaded train*							
				200	100	50	40	20	10	5	2	2	5	10	20	40	50	100	200
1	Deposited particles	1 year	2	0.14	0.15	0.18	0.19	0.22	0.24	0.25	0.25	0.25	0.26	0.26	0.28	0.28	0.29	0.30	0.31
2	Deposited particles	1 year	2	0.18	0.22	0.29	0.31	0.35	0.34	0.33	0.32	0.32	0.31	0.30	0.28	0.28	0.28	0.28	0.27
3	Deposited particles	1 year	2	0.19	0.24	0.30	0.34	0.22	0.35	0.34	0.34	0.33	0.33	0.33	0.31	0.31	0.31	0.31	0.30

* For a loaded train travelling towards Abbot Point

Figure 5-9 Predicted peak incremental impacts of the annual dust deposition



6. Key findings

The construction of the NGBR Project will result in air pollutant and dust emissions to air along the final rail corridor. This is inclusive of the NGBR Project civil works as well as NGBR Project quarries and concrete batching plants. The NGBR Project civil works emissions will be temporary in nature, and will occur as construction works moves past any given point. The nearest sensitive receptor location is approximately 1.1 km from the NGBR Project final rail corridor, and the temporary construction emissions are not expected to impact on any sensitive receptor locations. The locations of quarries and concrete batching plants will be similarly chosen so that emissions from these sources will not impact on sensitive receptor locations.

Potential sources of air emissions from the operational phase of the NGBR Project include exhaust emissions from diesel powered locomotives and fugitive coal dust emissions. Non-'dust' emissions from the locomotives included carbon monoxide, oxides of nitrogen (as nitrogen dioxide), sulphur dioxide, benzene and trace hydrocarbons. Emissions of particulate matter were quantified through the addition of the two sources of particulates, from both diesel exhausts and the fugitive coal wagon sources. An emissions inventory for the particulate matter of all three sub-types of TSP, PM_{10} and $PM_{2.5}$ was constructed.

The operating power of the locomotive types and the operating speeds were used to give emissions in grams per vehicle kilometre travelled (g/VKT) for a single locomotive, thus allowing the locomotive diesel exhaust emissions per train to be derived.

The emission factor of total coal dust from the moving fully loaded coal train was calculated accounting for the speed of the train (and hence wind erosion) and amount of coal hauled. Additionally for particulate matter, allowances were made for return trips.

For the non-dust locomotive exhaust pollutants, the largest non-dust locomotive pollutant was found to be NO_2. However, the Air EPP one-hour NO_2 criterion was met within seven metres of the centreline of the final rail corridor for all representative track alignments modelled. All other non-dust locomotive emissions met their Air EPP criteria at all points on the modelling domain.

For the more significant dust considerations, predicted TSP, PM_{10} and $PM_{2.5}$ concentrations from the operation of the diesel locomotives with coal train fugitive dust emissions added demonstrate that the most influential pollutants are PM_{10} and $PM_{2.5}$. The Air EPP daily-mean criteria for PM_{10} and $PM_{2.5}$ are met within 228 m of the centreline of the final rail corridor in all cases modelled. The annual TSP criterion is similarly met within 61 m of the centreline of the final rail corridor. The annual $PM_{2.5}$ criterion is met 315 m from the centreline of the final rail corridor, not because of high predicted $PM_{2.5}$ concentrations, but because the assumed existing background concentrations (3.7 or 5.8 $\mu g/m^3$ depending on location) account for a large proportion of the 8 $\mu g/m^3$ criterion.

AUSPLUME dispersion modelling was used with area sources to quantify dust deposition. The maximum incremental dust deposition level is below the deposition guideline equivalent of 2 g/m^2/month at all point in the modelling domain.

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Appendices

Appendix A – Sample AUSROADS output file

NGBR Train Dust Unit Emissions: Coastal Zone Section 1

VARIABLES AND OPTIONS SELECTED FOR THIS RUN

Emission rate units:	g/v-km
Concentration units:	micrograms/m3
Aerodynamic roughness:	0.20 (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 Rural
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	X1	Y1	X2	Y2	HEIGHT (M)	MIXING ZONE WIDTH (M)
SEC1	AG	-266.1	423.3	266.1	-423.3	0.0	12.0

LINK ACTIVITY

NOTE: TF = TRAFFIC VOLUMES; EF = EMISSION FACTORS

SEC1 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	169.3	106.4	0.0	RCP2	2	84.7	53.2	0.0
RCP3	3	42.3	26.6	0.0	RCP4	4	33.9	21.3	0.0
RCP5	5	16.9	10.6	0.0	RCP6	6	8.5	5.3	0.0
RCP7	7	6.3	4.0	0.0	RCP8	8	4.2	2.7	0.0
RCP9	9	3.8	2.4	0.0	RCP10	10	2.5	1.6	0.0
RCP11	11	1.7	1.1	0.0	RCP12	12	-1.7	-1.1	0.0
RCP13	13	-2.5	-1.6	0.0	RCP14	14	-3.8	-2.4	0.0
RCP15	15	-4.2	-2.7	0.0	RCP16	16	-6.3	-4.0	0.0
RCP17	17	-8.5	-5.3	0.0	RCP18	18	-16.9	-10.6	0.0
RCP19	19	-33.9	-21.3	0.0	RCP20	20	-42.3	-26.6	0.0
RCP21	21	-84.7	-53.2	0.0	RCP22	22	-169.3	-106.4	0.0

METEOROLOGICAL DATA

Meteorolofical data entered via the input file:
C:\jobs\NGBR Modelling\01Coastal\BOWEN04.met

Title of the meteorological data file is:
AUSPLUME METFILE - TAPM BOWEN STP

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

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

```
   1:7.30E-04    2:1.73E-03    3:3.48E-03    4:4.24E-03    5:7.53E-03
 6:1.33E-02    7:1.76E-02    8:2.88E-02
   9:3.15E-02   10:3.85E-02   11:4.24E-02   12:5.29E-02   13:5.42E-02
14:5.43E-02   15:5.37E-02   16:4.31E-02
  17:3.44E-02   18:2.07E-02   19:1.25E-02   20:1.06E-02   21:5.97E-03
22:2.98E-03
```

HIGHEST RECORDINGS FOR EACH RECEPTOR - in micrograms/m3
AVERAGING TIME = 1 HOUR

At the discrete receptors:

```
  1: 2.54E-02 @Hr05,21/10/04
  2: 4.24E-02 @Hr04,26/07/04
  3: 7.16E-02 @Hr20,04/08/04
  4: 8.31E-02 @Hr20,04/08/04
  5: 1.38E-01 @Hr04,18/01/04
  6: 2.30E-01 @Hr04,18/01/04
  7: 2.96E-01 @Hr04,18/01/04
  8: 3.81E-01 @Hr06,26/01/04
  9: 3.99E-01 @Hr06,26/01/04
 10: 4.28E-01 @Hr06,26/01/04
 11: 4.35E-01 @Hr03,18/01/04
 12: 4.24E-01 @Hr03,18/01/04
 13: 4.17E-01 @Hr04,24/10/04
```

```
 14: 4.04E-01 @Hr04,24/10/04
 15: 3.89E-01 @Hr04,24/10/04
 16: 2.93E-01 @Hr04,24/10/04
 17: 2.23E-01 @Hr04,24/10/04
 18: 1.32E-01 @Hr23,12/05/04
 19: 8.73E-02 @Hr23,02/10/04
 20: 7.46E-02 @Hr23,02/10/04
 21: 4.21E-02 @Hr02,18/01/04
 22: 2.45E-02 @Hr07,29/01/04
```

```
      HIGHEST RECORDINGS FOR EACH RECEPTOR - in micrograms/m3
      AVERAGING TIME =  8 HOURS


At the discrete receptors:

  1: 1.32E-02 @Hr08,07/07/04
  2: 2.59E-02 @Hr08,06/07/04
  3: 4.07E-02 @Hr08,06/07/04
  4: 4.58E-02 @Hr08,06/07/04
  5: 6.82E-02 @Hr08,16/02/04
  6: 1.12E-01 @Hr08,08/03/04
  7: 1.47E-01 @Hr08,18/01/04
  8: 2.13E-01 @Hr08,18/01/04
  9: 2.25E-01 @Hr08,18/01/04
 10: 2.53E-01 @Hr08,18/01/04
 11: 2.66E-01 @Hr08,18/01/04
 12: 2.74E-01 @Hr08,18/01/04
 13: 2.68E-01 @Hr08,18/01/04
 14: 2.43E-01 @Hr08,18/01/04
 15: 2.31E-01 @Hr08,18/01/04
 16: 1.64E-01 @Hr08,18/01/04
 17: 1.25E-01 @Hr08,18/01/04
 18: 7.11E-02 @Hr08,25/10/04
 19: 4.65E-02 @Hr08,25/10/04
 20: 4.05E-02 @Hr08,25/10/04
 21: 2.69E-02 @Hr08,25/10/04
 22: 1.77E-02 @Hr08,25/10/04
```

```
      HIGHEST RECORDINGS FOR EACH RECEPTOR - in micrograms/m3
      AVERAGING TIME = 24 HOURS


At the discrete receptors:

  1: 6.04E-03 @Hr24,16/06/04
  2: 1.05E-02 @Hr24,04/08/04
  3: 1.76E-02 @Hr24,04/06/04
  4: 2.03E-02 @Hr24,04/06/04
  5: 3.12E-02 @Hr24,04/06/04
  6: 4.90E-02 @Hr24,04/06/04
  7: 6.22E-02 @Hr24,05/07/04
  8: 9.14E-02 @Hr24,03/06/04
  9: 9.60E-02 @Hr24,03/06/04
 10: 1.04E-01 @Hr24,03/06/04
 11: 1.13E-01 @Hr24,18/01/04
 12: 1.38E-01 @Hr24,18/01/04
 13: 1.42E-01 @Hr24,18/01/04
 14: 1.40E-01 @Hr24,18/01/04
 15: 1.38E-01 @Hr24,18/01/04
 16: 1.09E-01 @Hr24,18/01/04
 17: 8.56E-02 @Hr24,18/01/04
 18: 5.05E-02 @Hr24,18/01/04
 19: 2.98E-02 @Hr24,18/01/04
 20: 2.50E-02 @Hr24,18/01/04
 21: 1.51E-02 @Hr24,25/10/04
```

```
 22: 9.68E-03 @Hr24,25/10/04
____________________________________________________________________________

      SECOND-HIGHEST RECORDINGS FOR EACH RECEPTOR - in micrograms/m3
      AVERAGING TIME =  1 HOUR


At the discrete receptors:

____________________________________________________________________________

      SECOND-HIGHEST RECORDINGS FOR EACH RECEPTOR - in micrograms/m3
      AVERAGING TIME =  8 HOURS


At the discrete receptors:

____________________________________________________________________________

      SECOND-HIGHEST RECORDINGS FOR EACH RECEPTOR - in micrograms/m3
      AVERAGING TIME = 24 HOURS


At the discrete receptors:

____________________________________________________________________________

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

 Rank     Value   Time Recorded         Coordinates
                   hour,date

  1    4.35E-01  @Hr03,18/01/04  (      1.7,        1.1,      0.0)
  2    4.35E-01  @Hr06,26/01/04  (      1.7,        1.1,      0.0)
  3    4.17E-01  @Hr04,24/10/04  (     -2.5,       -1.6,      0.0)
  4    4.03E-01  @Hr06,23/08/04  (     -1.7,       -1.1,      0.0)
  5    3.91E-01  @Hr04,09/03/04  (      1.7,        1.1,      0.0)
  6    3.89E-01  @Hr01,27/05/04  (     -1.7,       -1.1,      0.0)
  7    3.82E-01  @Hr02,22/02/04  (      1.7,        1.1,      0.0)
  8    3.78E-01  @Hr03,26/07/04  (     -2.5,       -1.6,      0.0)
  9    3.71E-01  @Hr04,18/01/04  (      2.5,        1.6,      0.0)
 10    3.70E-01  @Hr06,18/01/04  (      2.5,        1.6,      0.0)
 11    3.70E-01  @Hr24,11/05/04  (     -2.5,       -1.6,      0.0)
 12    3.48E-01  @Hr07,18/01/04  (     -2.5,       -1.6,      0.0)
 13    3.38E-01  @Hr07,31/08/04  (     -2.5,       -1.6,      0.0)
 14    3.27E-01  @Hr04,20/05/04  (      1.7,        1.1,      0.0)
 15    3.27E-01  @Hr04,22/08/04  (      1.7,        1.1,      0.0)
 16    3.26E-01  @Hr23,03/02/04  (     -1.7,       -1.1,      0.0)
 17    3.24E-01  @Hr03,18/08/04  (     -1.7,       -1.1,      0.0)
 18    3.24E-01  @Hr24,06/07/04  (     -2.5,       -1.6,      0.0)
 19    3.19E-01  @Hr02,20/02/04  (     -2.5,       -1.6,      0.0)
 20    3.17E-01  @Hr04,07/10/04  (     -2.5,       -1.6,      0.0)
 21    3.16E-01  @Hr24,03/08/04  (     -2.5,       -1.6,      0.0)
 22    3.13E-01  @Hr03,16/10/04  (      1.7,        1.1,      0.0)
 23    3.10E-01  @Hr02,15/12/04  (      2.5,        1.6,      0.0)
 24    3.07E-01  @Hr05,30/01/04  (     -1.7,       -1.1,      0.0)
 25    3.07E-01  @Hr04,15/05/04  (      3.8,        2.4,      0.0)
 26    3.05E-01  @Hr02,10/03/04  (     -2.5,       -1.6,      0.0)
 27    3.05E-01  @Hr22,17/07/04  (     -2.5,       -1.6,      0.0)
 28    3.04E-01  @Hr23,12/05/04  (     -3.8,       -2.4,      0.0)
 29    3.04E-01  @Hr20,04/08/04  (      3.8,        2.4,      0.0)
 30    3.02E-01  @Hr03,19/04/04  (      1.7,        1.1,      0.0)
 31    3.00E-01  @Hr02,21/08/04  (      1.7,        1.1,      0.0)
 32    2.98E-01  @Hr01,08/03/04  (     -2.5,       -1.6,      0.0)
 33    2.93E-01  @Hr05,18/01/04  (      4.2,        2.7,      0.0)
 34    2.90E-01  @Hr02,14/05/04  (      3.8,        2.4,      0.0)
 35    2.88E-01  @Hr02,05/01/04  (      1.7,        1.1,      0.0)
```

36	2.86E-01	@Hr02,26/02/04	(-2.5,	-1.6,	0.0)
37	2.85E-01	@Hr24,03/02/04	(-4.2,	-2.7,	0.0)
38	2.83E-01	@Hr01,21/10/04	(2.5,	1.6,	0.0)
39	2.80E-01	@Hr23,27/05/04	(3.8,	2.4,	0.0)
40	2.80E-01	@Hr04,25/09/04	(-1.7,	-1.1,	0.0)
41	2.79E-01	@Hr08,27/01/04	(-1.7,	-1.1,	0.0)
42	2.79E-01	@Hr22,03/02/04	(-1.7,	-1.1,	0.0)
43	2.79E-01	@Hr19,18/06/04	(-1.7,	-1.1,	0.0)
44	2.78E-01	@Hr01,16/02/04	(2.5,	1.6,	0.0)
45	2.78E-01	@Hr04,27/01/04	(-2.5,	-1.6,	0.0)
46	2.77E-01	@Hr03,23/02/04	(-1.7,	-1.1,	0.0)
47	2.76E-01	@Hr06,24/08/04	(-1.7,	-1.1,	0.0)
48	2.74E-01	@Hr04,17/02/04	(-1.7,	-1.1,	0.0)
49	2.73E-01	@Hr03,16/05/04	(1.7,	1.1,	0.0)
50	2.73E-01	@Hr24,28/12/04	(1.7,	1.1,	0.0)
51	2.72E-01	@Hr21,04/06/04	(-3.8,	-2.4,	0.0)
52	2.72E-01	@Hr05,07/03/04	(2.5,	1.6,	0.0)
53	2.70E-01	@Hr05,19/05/04	(-2.5,	-1.6,	0.0)
54	2.70E-01	@Hr06,19/05/04	(-2.5,	-1.6,	0.0)
55	2.70E-01	@Hr22,10/08/04	(-2.5,	-1.6,	0.0)
56	2.69E-01	@Hr03,12/09/04	(3.8,	2.4,	0.0)
57	2.68E-01	@Hr03,10/03/04	(3.8,	2.4,	0.0)
58	2.68E-01	@Hr23,05/07/04	(3.8,	2.4,	0.0)
59	2.68E-01	@Hr04,29/07/04	(-1.7,	-1.1,	0.0)
60	2.68E-01	@Hr04,07/03/04	(-1.7,	-1.1,	0.0)
61	2.68E-01	@Hr04,14/07/04	(1.7,	1.1,	0.0)
62	2.68E-01	@Hr01,13/07/04	(2.5,	1.6,	0.0)
63	2.66E-01	@Hr24,12/07/04	(-1.7,	-1.1,	0.0)
64	2.66E-01	@Hr05,24/08/04	(-1.7,	-1.1,	0.0)
65	2.64E-01	@Hr05,14/07/04	(1.7,	1.1,	0.0)
66	2.62E-01	@Hr24,02/10/04	(-1.7,	-1.1,	0.0)
67	2.62E-01	@Hr01,14/12/04	(-2.5,	-1.6,	0.0)
68	2.62E-01	@Hr23,05/03/04	(2.5,	1.6,	0.0)
69	2.62E-01	@Hr04,19/05/04	(-3.8,	-2.4,	0.0)
70	2.62E-01	@Hr04,24/08/04	(-3.8,	-2.4,	0.0)
71	2.61E-01	@Hr23,02/10/04	(-4.2,	-2.7,	0.0)
72	2.60E-01	@Hr04,29/11/04	(-2.5,	-1.6,	0.0)
73	2.59E-01	@Hr02,08/03/04	(1.7,	1.1,	0.0)
74	2.59E-01	@Hr06,25/05/04	(-1.7,	-1.1,	0.0)
75	2.59E-01	@Hr03,14/07/04	(-1.7,	-1.1,	0.0)
76	2.59E-01	@Hr06,19/09/04	(1.7,	1.1,	0.0)
77	2.58E-01	@Hr02,05/07/04	(2.5,	1.6,	0.0)
78	2.58E-01	@Hr03,21/08/04	(3.8,	2.4,	0.0)
79	2.57E-01	@Hr05,14/11/04	(-1.7,	-1.1,	0.0)
80	2.55E-01	@Hr03,08/03/04	(2.5,	1.6,	0.0)
81	2.54E-01	@Hr05,22/08/04	(3.8,	2.4,	0.0)
82	2.53E-01	@Hr02,26/05/04	(-2.5,	-1.6,	0.0)
83	2.53E-01	@Hr01,14/08/04	(-3.8,	-2.4,	0.0)
84	2.52E-01	@Hr19,03/06/04	(-2.5,	-1.6,	0.0)
85	2.52E-01	@Hr03,29/07/04	(-2.5,	-1.6,	0.0)
86	2.51E-01	@Hr01,18/01/04	(-4.2,	-2.7,	0.0)
87	2.51E-01	@Hr04,23/02/04	(3.8,	2.4,	0.0)
88	2.50E-01	@Hr24,27/08/04	(-1.7,	-1.1,	0.0)
89	2.49E-01	@Hr01,29/12/04	(2.5,	1.6,	0.0)
90	2.49E-01	@Hr02,18/01/04	(-4.2,	-2.7,	0.0)
91	2.49E-01	@Hr02,04/01/04	(3.8,	2.4,	0.0)
92	2.49E-01	@Hr05,29/07/04	(2.5,	1.6,	0.0)
93	2.49E-01	@Hr04,13/08/04	(2.5,	1.6,	0.0)
94	2.48E-01	@Hr02,15/07/04	(1.7,	1.1,	0.0)
95	2.48E-01	@Hr04,20/09/04	(1.7,	1.1,	0.0)
96	2.48E-01	@Hr22,27/05/04	(-4.2,	-2.7,	0.0)
97	2.48E-01	@Hr05,09/10/04	(4.2,	2.7,	0.0)
98	2.48E-01	@Hr24,14/12/04	(3.8,	2.4,	0.0)
99	2.48E-01	@Hr22,09/08/04	(3.8,	2.4,	0.0)
100	2.46E-01	@Hr03,13/12/04	(1.7,	1.1,	0.0)

Peak values for the 100 worst cases - in micrograms/m3

AVERAGING TIME = 8 HOURS

Rank	Value	Time Recorded hour,date	Coordinates		
1	2.74E-01	@Hr08,18/01/04	(-1.7,	-1.1,	0.0)
2	1.92E-01	@Hr08,14/12/04	(-2.5,	-1.6,	0.0)
3	1.85E-01	@Hr08,14/07/04	(1.7,	1.1,	0.0)
4	1.84E-01	@Hr08,01/02/04	(1.7,	1.1,	0.0)
5	1.84E-01	@Hr08,31/01/04	(1.7,	1.1,	0.0)
6	1.79E-01	@Hr08,08/03/04	(3.8,	2.4,	0.0)
7	1.78E-01	@Hr08,14/11/04	(-1.7,	-1.1,	0.0)
8	1.78E-01	@Hr08,24/08/04	(-2.5,	-1.6,	0.0)
9	1.76E-01	@Hr24,03/02/04	(-2.5,	-1.6,	0.0)
10	1.73E-01	@Hr08,25/07/04	(3.8,	2.4,	0.0)
11	1.73E-01	@Hr08,18/04/04	(-1.7,	-1.1,	0.0)
12	1.72E-01	@Hr08,02/07/04	(-2.5,	-1.6,	0.0)
13	1.70E-01	@Hr08,19/05/04	(-2.5,	-1.6,	0.0)
14	1.68E-01	@Hr08,31/07/04	(-1.7,	-1.1,	0.0)
15	1.65E-01	@Hr08,05/07/04	(2.5,	1.6,	0.0)
16	1.63E-01	@Hr08,15/07/04	(1.7,	1.1,	0.0)
17	1.62E-01	@Hr08,21/08/04	(2.5,	1.6,	0.0)
18	1.62E-01	@Hr08,16/02/04	(4.2,	2.7,	0.0)
19	1.62E-01	@Hr08,13/12/04	(1.7,	1.1,	0.0)
20	1.61E-01	@Hr08,27/08/04	(-2.5,	-1.6,	0.0)
21	1.61E-01	@Hr24,03/06/04	(1.7,	1.1,	0.0)
22	1.60E-01	@Hr08,04/07/04	(-1.7,	-1.1,	0.0)
23	1.60E-01	@Hr08,29/07/04	(-1.7,	-1.1,	0.0)
24	1.57E-01	@Hr08,30/01/04	(-1.7,	-1.1,	0.0)
25	1.52E-01	@Hr08,13/08/04	(2.5,	1.6,	0.0)
26	1.51E-01	@Hr24,17/01/04	(-3.8,	-2.4,	0.0)
27	1.50E-01	@Hr08,27/10/04	(-3.8,	-2.4,	0.0)
28	1.49E-01	@Hr08,21/10/04	(4.2,	2.7,	0.0)
29	1.47E-01	@Hr08,20/02/04	(2.5,	1.6,	0.0)
30	1.46E-01	@Hr08,13/07/04	(4.2,	2.7,	0.0)
31	1.45E-01	@Hr24,03/08/04	(-4.2,	-2.7,	0.0)
32	1.45E-01	@Hr08,10/03/04	(1.7,	1.1,	0.0)
33	1.44E-01	@Hr08,11/09/04	(-2.5,	-1.6,	0.0)
34	1.42E-01	@Hr08,23/10/04	(-4.2,	-2.7,	0.0)
35	1.42E-01	@Hr08,27/02/04	(-4.2,	-2.7,	0.0)
36	1.42E-01	@Hr08,20/05/04	(1.7,	1.1,	0.0)
37	1.41E-01	@Hr08,01/08/04	(-2.5,	-1.6,	0.0)
38	1.41E-01	@Hr08,25/10/04	(-4.2,	-2.7,	0.0)
39	1.41E-01	@Hr08,22/08/04	(1.7,	1.1,	0.0)
40	1.40E-01	@Hr08,28/12/04	(-4.2,	-2.7,	0.0)
41	1.38E-01	@Hr08,07/03/04	(-1.7,	-1.1,	0.0)
42	1.36E-01	@Hr08,11/05/04	(3.8,	2.4,	0.0)
43	1.36E-01	@Hr08,28/03/04	(2.5,	1.6,	0.0)
44	1.36E-01	@Hr08,25/05/04	(-2.5,	-1.6,	0.0)
45	1.35E-01	@Hr08,15/02/04	(1.7,	1.1,	0.0)
46	1.35E-01	@Hr24,02/10/04	(-4.2,	-2.7,	0.0)
47	1.35E-01	@Hr08,23/09/04	(4.2,	2.7,	0.0)
48	1.34E-01	@Hr08,23/02/04	(1.7,	1.1,	0.0)
49	1.34E-01	@Hr08,17/02/04	(-1.7,	-1.1,	0.0)
50	1.33E-01	@Hr08,27/01/04	(-1.7,	-1.1,	0.0)
51	1.32E-01	@Hr08,04/02/04	(-4.2,	-2.7,	0.0)
52	1.31E-01	@Hr08,03/06/04	(-1.7,	-1.1,	0.0)
53	1.29E-01	@Hr08,01/07/04	(-3.8,	-2.4,	0.0)
54	1.29E-01	@Hr08,03/10/04	(4.2,	2.7,	0.0)
55	1.29E-01	@Hr08,26/01/04	(-1.7,	-1.1,	0.0)
56	1.28E-01	@Hr08,19/01/04	(-3.8,	-2.4,	0.0)
57	1.28E-01	@Hr08,03/02/04	(-2.5,	-1.6,	0.0)
58	1.27E-01	@Hr08,25/01/04	(-4.2,	-2.7,	0.0)
59	1.27E-01	@Hr08,25/02/04	(-2.5,	-1.6,	0.0)
60	1.27E-01	@Hr08,29/12/04	(4.2,	2.7,	0.0)
61	1.26E-01	@Hr08,27/03/04	(3.8,	2.4,	0.0)
62	1.24E-01	@Hr08,20/09/04	(1.7,	1.1,	0.0)
63	1.24E-01	@Hr08,06/07/04	(4.2,	2.7,	0.0)

64	1.23E-01	@Hr08,12/09/04	(2.5,	1.6,	0.0)
65	1.23E-01	@Hr08,19/04/04	(2.5,	1.6,	0.0)
66	1.22E-01	@Hr08,17/07/04	(4.2,	2.7,	0.0)
67	1.21E-01	@Hr08,02/08/04	(-3.8,	-2.4,	0.0)
68	1.21E-01	@Hr08,28/08/04	(4.2,	2.7,	0.0)
69	1.21E-01	@Hr08,12/07/04	(2.5,	1.6,	0.0)
70	1.20E-01	@Hr08,19/02/04	(-3.8,	-2.4,	0.0)
71	1.20E-01	@Hr08,17/05/04	(-4.2,	-2.7,	0.0)
72	1.20E-01	@Hr08,29/01/04	(-4.2,	-2.7,	0.0)
73	1.19E-01	@Hr08,14/05/04	(4.2,	2.7,	0.0)
74	1.18E-01	@Hr08,31/08/04	(-3.8,	-2.4,	0.0)
75	1.18E-01	@Hr08,26/03/04	(1.7,	1.1,	0.0)
76	1.18E-01	@Hr08,26/02/04	(3.8,	2.4,	0.0)
77	1.17E-01	@Hr08,09/01/04	(-4.2,	-2.7,	0.0)
78	1.17E-01	@Hr24,12/07/04	(-3.8,	-2.4,	0.0)
79	1.17E-01	@Hr24,11/07/04	(1.7,	1.1,	0.0)
80	1.17E-01	@Hr08,01/04/04	(3.8,	2.4,	0.0)
81	1.16E-01	@Hr08,28/01/04	(-4.2,	-2.7,	0.0)
82	1.16E-01	@Hr24,14/06/04	(1.7,	1.1,	0.0)
83	1.16E-01	@Hr24,12/05/04	(-4.2,	-2.7,	0.0)
84	1.15E-01	@Hr08,04/09/04	(-2.5,	-1.6,	0.0)
85	1.15E-01	@Hr08,08/01/04	(-3.8,	-2.4,	0.0)
86	1.14E-01	@Hr08,10/06/04	(2.5,	1.6,	0.0)
87	1.13E-01	@Hr08,15/05/04	(1.7,	1.1,	0.0)
88	1.13E-01	@Hr08,16/07/04	(1.7,	1.1,	0.0)
89	1.13E-01	@Hr08,16/09/04	(2.5,	1.6,	0.0)
90	1.13E-01	@Hr08,16/05/04	(2.5,	1.6,	0.0)
91	1.13E-01	@Hr08,19/10/04	(-4.2,	-2.7,	0.0)
92	1.13E-01	@Hr08,02/05/04	(-4.2,	-2.7,	0.0)
93	1.12E-01	@Hr24,06/07/04	(-4.2,	-2.7,	0.0)
94	1.12E-01	@Hr08,04/06/04	(4.2,	2.7,	0.0)
95	1.11E-01	@Hr24,11/05/04	(-4.2,	-2.7,	0.0)
96	1.11E-01	@Hr08,15/10/04	(-3.8,	-2.4,	0.0)
97	1.11E-01	@Hr08,31/03/04	(3.8,	2.4,	0.0)
98	1.10E-01	@Hr08,15/12/04	(-2.5,	-1.6,	0.0)
99	1.10E-01	@Hr08,20/04/04	(-4.2,	-2.7,	0.0)
100	1.10E-01	@Hr24,10/05/04	(-3.8,	-2.4,	0.0)

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

Rank	Value	Time Recorded hour,date	Coordinates		
1	1.42E-01	@Hr24,18/01/04	(-2.5,	-1.6,	0.0)
2	1.17E-01	@Hr24,03/02/04	(-2.5,	-1.6,	0.0)
3	1.07E-01	@Hr24,03/06/04	(1.7,	1.1,	0.0)
4	1.05E-01	@Hr24,14/12/04	(-2.5,	-1.6,	0.0)
5	1.05E-01	@Hr24,31/01/04	(-1.7,	-1.1,	0.0)
6	1.04E-01	@Hr24,14/07/04	(-2.5,	-1.6,	0.0)
7	1.01E-01	@Hr24,30/01/04	(-2.5,	-1.6,	0.0)
8	9.94E-02	@Hr24,28/12/04	(-4.2,	-2.7,	0.0)
9	9.85E-02	@Hr24,17/01/04	(-2.5,	-1.6,	0.0)
10	9.83E-02	@Hr24,04/07/04	(-2.5,	-1.6,	0.0)
11	9.67E-02	@Hr24,05/07/04	(1.7,	1.1,	0.0)
12	9.39E-02	@Hr24,27/08/04	(-2.5,	-1.6,	0.0)
13	9.30E-02	@Hr24,13/12/04	(-1.7,	-1.1,	0.0)
14	9.26E-02	@Hr24,31/08/04	(-4.2,	-2.7,	0.0)
15	9.22E-02	@Hr24,02/07/04	(-3.8,	-2.4,	0.0)
16	9.18E-02	@Hr24,11/07/04	(-2.5,	-1.6,	0.0)
17	9.12E-02	@Hr24,14/11/04	(-2.5,	-1.6,	0.0)
18	9.01E-02	@Hr24,01/07/04	(-4.2,	-2.7,	0.0)
19	9.00E-02	@Hr24,02/10/04	(-2.5,	-1.6,	0.0)
20	8.92E-02	@Hr24,29/04/04	(-4.2,	-2.7,	0.0)
21	8.85E-02	@Hr24,18/04/04	(-2.5,	-1.6,	0.0)
22	8.81E-02	@Hr24,25/10/04	(-4.2,	-2.7,	0.0)
23	8.81E-02	@Hr24,19/05/04	(-3.8,	-2.4,	0.0)

24	8.74E-02	@Hr24,27/10/04	(	-4.2,	-2.7,	0.0)
25	8.68E-02	@Hr24,26/01/04	(	-4.2,	-2.7,	0.0)
26	8.68E-02	@Hr24,07/03/04	(	-2.5,	-1.6,	0.0)
27	8.64E-02	@Hr24,23/10/04	(	-4.2,	-2.7,	0.0)
28	8.58E-02	@Hr24,25/02/04	(	-4.2,	-2.7,	0.0)
29	8.58E-02	@Hr24,03/08/04	(	-4.2,	-2.7,	0.0)
30	8.57E-02	@Hr24,24/08/04	(	-3.8,	-2.4,	0.0)
31	8.55E-02	@Hr24,12/07/04	(	-1.7,	-1.1,	0.0)
32	8.51E-02	@Hr24,01/02/04	(	-1.7,	-1.1,	0.0)
33	8.48E-02	@Hr24,25/05/04	(	-3.8,	-2.4,	0.0)
34	8.40E-02	@Hr24,13/08/04	(	-2.5,	-1.6,	0.0)
35	8.28E-02	@Hr24,25/01/04	(	-4.2,	-2.7,	0.0)
36	8.26E-02	@Hr24,29/01/04	(	-4.2,	-2.7,	0.0)
37	8.21E-02	@Hr24,23/02/04	(	-2.5,	-1.6,	0.0)
38	8.21E-02	@Hr24,09/05/04	(	-1.7,	-1.1,	0.0)
39	8.19E-02	@Hr24,03/07/04	(	-4.2,	-2.7,	0.0)
40	8.18E-02	@Hr24,04/02/04	(	-3.8,	-2.4,	0.0)
41	8.17E-02	@Hr24,26/08/04	(	-4.2,	-2.7,	0.0)
42	8.10E-02	@Hr24,10/06/04	(	1.7,	1.1,	0.0)
43	8.10E-02	@Hr24,27/02/04	(	-4.2,	-2.7,	0.0)
44	8.08E-02	@Hr24,08/03/04	(	-1.7,	-1.1,	0.0)
45	8.06E-02	@Hr24,15/07/04	(	-1.7,	-1.1,	0.0)
46	8.03E-02	@Hr24,15/02/04	(	-2.5,	-1.6,	0.0)
47	8.01E-02	@Hr24,08/01/04	(	-3.8,	-2.4,	0.0)
48	7.95E-02	@Hr24,02/05/04	(	-4.2,	-2.7,	0.0)
49	7.90E-02	@Hr24,16/07/04	(	-1.7,	-1.1,	0.0)
50	7.89E-02	@Hr24,29/07/04	(	-2.5,	-1.6,	0.0)
51	7.83E-02	@Hr24,27/01/04	(	-3.8,	-2.4,	0.0)
52	7.81E-02	@Hr24,31/07/04	(	-2.5,	-1.6,	0.0)
53	7.76E-02	@Hr24,27/05/04	(	1.7,	1.1,	0.0)
54	7.71E-02	@Hr24,14/06/04	(	2.5,	1.6,	0.0)
55	7.67E-02	@Hr24,28/01/04	(	-4.2,	-2.7,	0.0)
56	7.65E-02	@Hr24,04/06/04	(	2.5,	1.6,	0.0)
57	7.64E-02	@Hr24,09/06/04	(	-1.7,	-1.1,	0.0)
58	7.59E-02	@Hr24,11/05/04	(	-1.7,	-1.1,	0.0)
59	7.55E-02	@Hr24,24/06/04	(	1.7,	1.1,	0.0)
60	7.50E-02	@Hr24,24/10/04	(	-4.2,	-2.7,	0.0)
61	7.48E-02	@Hr24,08/06/04	(	-1.7,	-1.1,	0.0)
62	7.47E-02	@Hr24,26/03/04	(	-2.5,	-1.6,	0.0)
63	7.47E-02	@Hr24,11/06/04	(	1.7,	1.1,	0.0)
64	7.45E-02	@Hr24,02/08/04	(	-4.2,	-2.7,	0.0)
65	7.44E-02	@Hr24,01/08/04	(	-3.8,	-2.4,	0.0)
66	7.37E-02	@Hr24,20/05/04	(	-2.5,	-1.6,	0.0)
67	7.34E-02	@Hr24,28/03/04	(	-1.7,	-1.1,	0.0)
68	7.34E-02	@Hr24,19/01/04	(	-3.8,	-2.4,	0.0)
69	7.32E-02	@Hr24,26/02/04	(	-1.7,	-1.1,	0.0)
70	7.24E-02	@Hr24,25/07/04	(	1.7,	1.1,	0.0)
71	7.21E-02	@Hr24,19/02/04	(	-4.2,	-2.7,	0.0)
72	7.19E-02	@Hr24,11/09/04	(	-3.8,	-2.4,	0.0)
73	7.18E-02	@Hr24,07/06/04	(	-1.7,	-1.1,	0.0)
74	7.15E-02	@Hr24,26/07/04	(	-4.2,	-2.7,	0.0)
75	7.15E-02	@Hr24,17/04/04	(	-3.8,	-2.4,	0.0)
76	7.11E-02	@Hr24,08/05/04	(	-2.5,	-1.6,	0.0)
77	7.10E-02	@Hr24,07/05/04	(	-2.5,	-1.6,	0.0)
78	7.08E-02	@Hr24,13/11/04	(	-3.8,	-2.4,	0.0)
79	7.08E-02	@Hr24,11/04/04	(	-2.5,	-1.6,	0.0)
80	7.05E-02	@Hr24,17/05/04	(	-4.2,	-2.7,	0.0)
81	7.02E-02	@Hr24,12/12/04	(	-3.8,	-2.4,	0.0)
82	7.01E-02	@Hr24,12/04/04	(	-2.5,	-1.6,	0.0)
83	7.00E-02	@Hr24,30/06/04	(	-3.8,	-2.4,	0.0)
84	6.99E-02	@Hr24,23/05/04	(	-3.8,	-2.4,	0.0)
85	6.98E-02	@Hr24,17/02/04	(	-2.5,	-1.6,	0.0)
86	6.96E-02	@Hr24,21/10/04	(	1.7,	1.1,	0.0)
87	6.96E-02	@Hr24,28/10/04	(	-4.2,	-2.7,	0.0)
88	6.94E-02	@Hr24,06/07/04	(	1.7,	1.1,	0.0)
89	6.91E-02	@Hr24,22/01/04	(	-4.2,	-2.7,	0.0)
90	6.90E-02	@Hr24,24/07/04	(	-3.8,	-2.4,	0.0)
91	6.88E-02	@Hr24,15/06/04	(	1.7,	1.1,	0.0)

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 92    6.87E-02  @Hr24,10/03/04  (     -1.7,      -1.1,      0.0)
 93    6.87E-02  @Hr24,08/02/04  (     -3.8,      -2.4,      0.0)
 94    6.85E-02  @Hr24,17/07/04  (      1.7,       1.1,      0.0)
 95    6.84E-02  @Hr24,29/03/04  (      1.7,       1.1,      0.0)
 96    6.84E-02  @Hr24,19/10/04  (     -4.2,      -2.7,      0.0)
 97    6.83E-02  @Hr24,20/02/04  (     -1.7,      -1.1,      0.0)
 98    6.81E-02  @Hr24,13/06/04  (      2.5,       1.6,      0.0)
 99    6.78E-02  @Hr24,24/01/04  (     -4.2,      -2.7,      0.0)
100    6.75E-02  @Hr24,27/07/04  (     -3.8,      -2.4,      0.0)
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 Simulation started  at 15:17:37 on 12/06/2013
 Simulation finished at 15:17:41 on 12/06/2013
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Appendix B Predicted TSP, PM_{10} and $PM_{2.5}$ concentrations arising from dispersion of locomotive emissions and fugitive coal dust emissions from the wagons.

Annual mean TSP predictions (µg/m³). The predictions include the relevant background concentrations (26.4 µg/m³ at the coast, and 30 µg/m³ elsewhere).

Left Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
-200	29	38	37	42	54	50	34	51	51	49	47	45	45	49	42
-100	33	46	44	49	67	64	39	67	69	62	59	59	57	63	52
-50	39	59	56	59	87	85	47	92	96	81	77	80	76	84	68
-40	41	64	62	62	95	94	51	102	108	89	85	89	84	92	74
-20	53	87	83	79	129	129	67	145	157	122	116	126	117	129	101
-10	74	125	119	106	182	185	97	215	241	175	166	186	170	189	145
-7.5	89	149	142	122	213	220	116	258	294	207	197	225	204	225	173
-5	129	176	170	133	236	255	170	306	325	240	232	275	250	267	215
-4.5	138	177	173	131	232	254	183	308	326	239	233	279	254	269	221
-3	163	177	175	122	214	245	221	306	325	231	230	280	261	266	233
-2	177	174	174	116	200	235	243	299	320	223	225	276	262	261	238
Right Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
2	215	150	157	84	137	181	305	251	282	175	190	235	240	217	236
3	219	141	149	75	119	164	315	233	268	160	178	219	229	201	230
4.5	220	125	135	61	91	134	322	200	241	134	155	188	207	173	217
5	217	119	130	56	81	123	321	188	231	124	146	176	198	163	211
7.5	180	90	101	42	53	83	274	134	171	86	108	121	150	117	168
10	149	76	85	39	47	70	228	111	137	73	91	99	125	98	141
20	100	56	61	35	39	52	153	77	90	54	66	68	87	70	99
40	71	44	47	33	35	42	107	57	64	43	51	51	64	53	73
50	64	41	44	32	34	40	96	52	58	40	48	47	59	49	67
100	48	35	37	31	32	34	70	42	45	35	40	38	46	40	52
200	37	31	32	30	31	32	53	35	37	32	34	33	38	35	42

Maximum daily mean PM_{10} predictions ($\mu g/m^3$). The predictions include the relevant background concentrations (18.1 $\mu g/m^3$ at the coast, and 15 $\mu g/m^3$ elsewhere).

Left Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
-200	29	34	31	35	34	33	29	39	39	39	38	34	49	50	45
-100	37	42	42	50	47	47	41	60	54	53	53	45	69	69	64
-50	50	56	61	72	69	70	62	85	74	74	77	69	101	93	96
-40	55	63	68	81	78	79	69	94	82	82	88	79	113	102	108
-20	74	91	93	121	114	119	98	132	129	124	131	119	161	148	151
-10	106	153	133	186	176	186	145	191	210	195	201	184	239	224	219
-7.5	130	198	162	226	213	231	179	226	266	240	248	226	284	275	259
-5	183	280	202	266	255	300	239	271	313	289	296	296	327	340	314
-4.5	191	292	209	269	257	305	248	275	318	289	307	307	327	343	320
-3	206	312	226	287	262	322	268	280	325	305	327	325	314	342	323
-2	222	319	236	298	262	325	275	286	327	309	332	329	314	334	320
Right Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
2	267	310	245	302	273	340	280	271	309	314	318	307	390	322	298
3	274	300	242	295	268	336	287	275	298	313	305	295	408	325	300
4.5	271	271	242	287	250	320	296	271	273	300	296	298	423	322	296
5	267	256	240	284	239	309	296	266	262	291	291	296	423	316	293
7.5	215	200	200	231	189	230	248	208	212	217	221	240	360	273	246
10	173	165	166	187	159	185	204	166	175	174	176	193	300	230	210
20	109	107	108	118	108	117	130	107	112	112	112	122	199	156	147
40	72	72	74	76	76	76	83	71	75	74	74	78	131	109	105
50	63	64	66	66	68	66	72	63	66	64	65	66	114	97	95
100	45	47	44	41	48	44	51	43	44	40	44	40	71	71	69
200	36	37	35	30	32	32	38	34	32	29	32	29	47	55	48

Maximum daily mean $PM_{2.5}$ predictions (µg/m³). The predictions include the relevant background concentrations (5.1 µg/m³ at the coast, and 6.6 µg/m³ elsewhere).

Left Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
-200	11	13	12	17	17	16	14	19	19	19	18	16	24	25	22
-100	15	17	17	25	23	23	20	30	27	26	26	22	34	34	32
-50	21	25	27	36	34	35	31	42	37	37	38	34	51	47	48
-40	24	28	30	41	39	39	34	47	41	41	44	39	57	51	54
-20	34	43	44	61	58	60	49	67	65	62	66	60	82	75	77
-10	50	74	64	94	89	94	73	97	107	99	102	93	121	114	111
-7.5	63	97	79	115	108	118	91	115	135	122	126	115	145	140	132
-5	90	139	100	135	130	153	121	138	159	147	151	151	167	173	160
-4.5	94	146	103	137	131	156	126	140	162	147	157	157	167	175	163
-3	101	156	112	146	134	164	136	143	166	156	167	166	160	174	165
-2	110	160	117	152	134	166	140	146	167	158	170	168	160	171	163
Right Receptors	**Coastal 1**	**Coastal 2**	**Coastal 3**	**Bogie 1**	**Bogie 2**	**Bogie 3**	**Bowen 1**	**Bowen 2**	**Bowen 3**	**Newlands 1**	**Newlands 2**	**Newlands 3**	**Isaac 1**	**Isaac 2**	**Isaac 3**
2	133	155	122	154	139	173	143	138	158	160	162	157	199	164	152
3	137	150	120	150	136	171	146	140	152	159	156	150	209	166	153
4.5	135	135	120	146	127	163	151	138	139	153	151	152	216	164	151
5	133	127	119	145	121	158	151	135	134	148	148	151	216	161	149
7.5	106	99	99	118	96	117	126	106	108	110	112	122	184	139	125
10	84	81	81	95	81	94	104	84	89	88	89	98	153	117	107
20	52	51	51	59	55	59	66	54	56	56	56	62	101	79	74
40	33	33	34	38	38	38	42	36	37	37	37	39	66	55	53
50	28	29	29	33	34	33	36	31	33	32	32	33	58	49	48
100	19	20	19	20	24	21	25	21	22	19	22	20	36	36	34
200	14	15	14	14	15	15	18	16	15	14	15	14	23	27	24

Annual mean $PM_{2.5}$ predictions (µg/m³). The predictions include the relevant background concentrations (3.7 µg/m³ at the coast, and 5.8 µg/m³ elsewhere).

Left Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
-200	4	7	6	12	12	11	7	11	11	11	10	10	10	11	9
-100	5	9	8	15	15	15	8	16	16	14	13	13	13	14	12
-50	7	12	12	20	21	20	10	22	23	19	18	19	18	20	16
-40	8	14	13	22	23	22	11	25	26	21	20	21	20	22	17
-20	11	20	19	31	32	32	16	36	39	30	28	31	28	32	24
-10	16	29	28	45	45	46	23	54	61	44	41	46	42	47	36
-7.5	20	36	34	53	54	55	28	65	75	52	49	57	51	57	43
-5	30	43	41	59	59	64	42	78	83	60	58	70	63	68	54
-4.5	33	43	42	57	58	64	46	78	83	60	59	71	64	68	55
-3	39	43	42	53	54	62	56	78	83	58	58	71	66	67	59
-2	43	42	42	50	50	59	61	76	81	56	57	70	66	66	60
Right Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
2	53	36	38	34	34	45	77	63	71	44	47	59	60	55	59
3	54	34	36	29	29	41	80	59	68	40	44	55	58	50	58
4.5	54	29	32	22	22	33	82	50	61	33	38	47	52	43	54
5	53	28	31	19	19	30	82	47	58	30	36	44	50	40	53
7.5	44	20	23	12	12	20	69	33	43	20	26	30	37	28	42
10	36	17	19	10	10	16	57	27	34	17	22	24	31	23	35
20	23	11	13	8	8	12	38	18	21	12	15	16	21	16	24
40	15	8	9	7	7	9	26	13	15	9	11	11	15	12	17
50	14	7	8	7	7	8	23	12	13	9	10	10	13	11	15
100	9	6	6	6	6	7	16	9	10	7	8	8	10	9	11
200	6	5	5	6	6	6	12	7	8	6	7	7	8	7	9

Appendix C Predicted NO_2; benzene; CO; formaldehyde; SO_2; toluene; & xylene concentrations arising from dispersion of locomotive emissions.

Maximum hourly mean NO_2 predictions (µg/m³). The predictions include a background concentrations of 55 µg/m³ at the coast, with no background applied elsewhere.

Left Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
-200	64	64	64	9	9	9	20	20	25	9	9	9	20	20	20
-100	71	71	70	16	15	19	34	35	38	16	17	16	35	34	33
-50	81	81	81	26	27	28	58	58	64	26	29	27	55	58	58
-40	86	86	86	31	32	32	68	68	75	32	34	32	65	68	68
-20	106	105	106	50	49	50	107	108	119	52	53	49	108	108	104
-10	140	139	139	83	75	83	169	168	187	83	83	83	169	167	169
-7.5	164	164	162	104	95	109	209	209	234	104	109	108	208	205	209
-5	195	198	185	129	136	147	279	282	279	139	143	143	279	281	282
-4.5	202	204	190	137	144	154	284	289	286	147	148	149	286	289	288
-3	213	208	196	152	157	164	295	300	300	158	155	153	300	300	300
-2	215	208	197	157	160	167	303	304	305	160	157	155	305	305	305
Right Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
2	211	214	198	160	160	161	302	295	305	154	160	160	304	302	291
3	209	213	197	158	158	155	300	296	303	148	157	158	300	292	279
4.5	204	204	190	146	147	148	289	289	295	138	149	147	288	282	253
5	198	199	188	139	140	145	281	282	292	136	144	142	279	278	252
7.5	163	163	164	108	98	110	209	209	241	109	109	109	209	209	204
10	137	140	140	85	79	85	169	169	189	85	85	84	169	169	167
20	104	106	106	51	49	51	103	108	119	51	52	55	102	104	108
40	87	86	86	31	31	31	68	68	77	30	30	34	67	68	65
50	83	81	81	26	26	26	58	58	66	26	26	27	58	58	54
100	71	71	71	15	15	16	35	35	38	16	16	15	35	35	35
200	64	64	64	9	9	9	20	20	24	9	9	9	20	20	20

Annual mean NO_2 predictions (µg/m³). The predictions include a background concentrations of 9 µg/m³ at the coast, with no background applied elsewhere.

Left Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
-200	9	10	10	2	2	2	0	2	2	2	2	2	2	2	1
-100	10	11	11	4	4	4	1	4	4	3	3	3	3	3	2
-50	10	12	12	6	6	6	2	6	7	5	5	5	5	6	4
-40	11	13	13	7	7	7	2	7	8	6	6	6	6	6	5
-20	12	15	15	10	10	10	4	12	13	10	9	10	9	10	7
-10	14	19	19	16	16	16	7	19	22	15	14	16	15	16	12
-7.5	15	22	21	19	19	20	9	24	27	18	17	20	18	20	15
-5	20	24	24	21	21	23	14	29	31	22	21	25	23	25	19
-4.5	21	25	24	21	21	23	16	29	31	22	21	26	23	25	20
-3	23	25	24	19	19	22	20	29	31	21	21	26	24	24	21
-2	25	24	24	17	18	21	22	28	30	20	20	25	24	24	22
Right Receptors	**Coastal 1**	**Coastal 2**	**Coastal 3**	**Bogie 1**	**Bogie 2**	**Bogie 3**	**Bowen 1**	**Bowen 2**	**Bowen 3**	**Newlands 1**	**Newlands 2**	**Newlands 3**	**Isaac 1**	**Isaac 2**	**Isaac 3**
2	29	22	23	11	11	16	29	23	26	15	17	21	22	19	21
3	29	21	22	9	9	14	30	21	25	13	15	20	21	18	21
4.5	29	19	20	6	6	11	30	18	22	11	13	16	18	15	19
5	29	19	20	5	5	10	30	16	21	10	12	15	17	14	19
7.5	25	16	17	2	2	6	25	11	15	6	8	9	12	9	14
10	22	14	15	2	2	4	21	8	11	4	6	7	10	7	12
20	17	12	13	1	1	2	13	5	6	2	4	4	6	4	7
40	14	11	11	1	1	1	8	3	4	1	2	2	4	2	4
50	13	11	11	0	0	1	7	2	3	1	2	2	3	2	4
100	11	10	10	0	0	0	4	1	2	0	1	1	2	1	2
200	10	9	10	0	0	0	2	1	1	0	0	0	1	1	1

Annual mean benzene predictions (μg/m³). The predictions assume that there is no existing background concentration.

Left Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
-200	0.06	0.25	0.23	0.52	0.53	0.46	0.09	0.47	0.48	0.43	0.38	0.34	0.34	0.42	0.27
-100	0.14	0.44	0.40	0.82	0.82	0.77	0.20	0.84	0.87	0.71	0.65	0.64	0.61	0.73	0.50
-50	0.28	0.72	0.67	1.26	1.26	1.23	0.39	1.38	1.47	1.14	1.06	1.11	1.03	1.20	0.84
-40	0.34	0.84	0.79	1.43	1.45	1.42	0.47	1.61	1.73	1.31	1.23	1.31	1.21	1.39	0.99
-20	0.60	1.36	1.27	2.18	2.21	2.22	0.84	2.58	2.84	2.06	1.93	2.14	1.94	2.22	1.59
-10	1.06	2.21	2.08	3.35	3.40	3.48	1.49	4.14	4.71	3.24	3.05	3.49	3.13	3.55	2.57
-7.5	1.40	2.74	2.59	4.04	4.10	4.25	1.93	5.09	5.90	3.96	3.73	4.37	3.88	4.36	3.19
-5	2.29	3.34	3.22	4.53	4.61	5.03	3.13	6.18	6.59	4.69	4.52	5.48	4.92	5.31	4.14
-4.5	2.51	3.36	3.27	4.44	4.51	5.00	3.43	6.22	6.63	4.67	4.53	5.56	5.02	5.34	4.26
-3	3.06	3.36	3.33	4.07	4.12	4.80	4.27	6.17	6.59	4.49	4.48	5.59	5.17	5.28	4.54
-2	3.37	3.29	3.30	3.77	3.81	4.59	4.76	6.02	6.48	4.31	4.37	5.50	5.18	5.15	4.65
Right Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
2	4.21	2.77	2.92	2.39	2.39	3.38	6.15	4.93	5.63	3.25	3.58	4.58	4.69	4.18	4.61
3	4.31	2.56	2.75	1.99	1.99	2.99	6.37	4.53	5.31	2.91	3.30	4.22	4.45	3.83	4.48
4.5	4.32	2.20	2.43	1.38	1.36	2.33	6.52	3.81	4.73	2.32	2.80	3.53	3.96	3.21	4.18
5	4.27	2.07	2.31	1.16	1.15	2.08	6.52	3.54	4.50	2.10	2.60	3.26	3.76	2.98	4.04
7.5	3.43	1.42	1.67	0.53	0.51	1.19	5.46	2.33	3.16	1.26	1.73	2.04	2.69	1.95	3.09
10	2.74	1.11	1.32	0.39	0.38	0.90	4.44	1.82	2.39	0.95	1.36	1.54	2.13	1.52	2.48
20	1.65	0.65	0.78	0.21	0.21	0.50	2.76	1.05	1.34	0.53	0.80	0.86	1.28	0.89	1.54
40	0.99	0.39	0.47	0.12	0.11	0.27	1.72	0.60	0.76	0.29	0.47	0.47	0.77	0.52	0.95
50	0.84	0.32	0.40	0.09	0.09	0.21	1.47	0.50	0.63	0.23	0.40	0.38	0.65	0.43	0.82
100	0.47	0.18	0.23	0.05	0.04	0.10	0.90	0.26	0.33	0.11	0.21	0.18	0.36	0.23	0.49
200	0.24	0.10	0.12	0.02	0.02	0.04	0.50	0.12	0.16	0.04	0.10	0.07	0.17	0.11	0.26

Maximum 8-hour mean CO predictions (μg/m³). The predictions assume that there is no existing background concentration.

Left Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
-200	15	18	17	21	19	20	22	32	33	21	21	20	42	37	34
-100	30	28	26	32	30	38	39	60	53	36	37	30	69	56	53
-50	47	47	50	50	57	69	70	92	75	57	62	57	93	98	94
-40	53	54	57	57	67	81	81	103	85	66	74	68	103	116	106
-20	79	85	85	89	104	130	118	147	130	111	123	105	139	180	153
-10	129	150	127	144	157	212	171	214	221	175	192	183	199	264	228
-7.5	169	196	156	184	196	263	203	252	289	222	238	244	240	316	275
-5	245	267	199	242	234	334	236	293	349	300	304	336	279	362	371
-4.5	259	275	206	249	236	344	236	293	355	313	324	350	279	358	380
-3	291	285	217	281	244	361	249	287	364	335	357	369	295	336	391
-2	306	282	222	294	252	358	253	291	364	341	370	371	308	348	389
Right Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
2	316	296	244	348	275	312	301	282	332	356	377	333	344	356	348
3	309	295	243	356	274	296	306	278	325	355	368	313	362	348	347
4.5	280	282	230	353	263	267	305	282	323	341	339	267	379	342	363
5	266	273	222	347	256	253	301	281	319	329	323	263	381	338	364
7.5	189	185	166	275	227	189	247	230	271	225	215	198	327	262	312
10	144	141	131	215	187	147	200	184	215	171	166	154	271	211	259
20	82	88	78	128	120	87	128	121	134	89	97	96	180	131	172
40	54	56	49	75	77	54	80	79	81	55	61	61	116	96	112
50	47	48	43	61	67	47	70	67	71	48	53	52	99	87	96
100	31	29	29	32	41	28	50	39	40	26	34	28	60	64	53
200	20	20	17	17	20	17	30	28	26	16	19	19	33	47	38

Maximum 30-minute mean formaldehyde predictions (µg/m³). The predictions assume that there is no existing background concentration.

Left Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
-200	0.0014	0.0013	0.0014	0.0014	0.0013	0.0014	0.0030	0.0030	0.0037	0.0014	0.0014	0.0014	0.0030	0.0030	0.0030
-100	0.0023	0.0023	0.0023	0.0024	0.0023	0.0028	0.0051	0.0052	0.0057	0.0023	0.0026	0.0024	0.0052	0.0051	0.0049
-50	0.0039	0.0039	0.0039	0.0039	0.0040	0.0042	0.0087	0.0086	0.0096	0.0038	0.0043	0.0041	0.0083	0.0087	0.0087
-40	0.0046	0.0046	0.0047	0.0046	0.0048	0.0048	0.0101	0.0101	0.0112	0.0048	0.0051	0.0048	0.0096	0.0101	0.0101
-20	0.0076	0.0075	0.0076	0.0075	0.0074	0.0075	0.0160	0.0162	0.0177	0.0077	0.0079	0.0073	0.0162	0.0161	0.0155
-10	0.0127	0.0125	0.0126	0.0123	0.0112	0.0124	0.0252	0.0251	0.0278	0.0124	0.0124	0.0123	0.0253	0.0249	0.0253
-7.5	0.0163	0.0163	0.0160	0.0155	0.0143	0.0163	0.0312	0.0312	0.0349	0.0156	0.0163	0.0162	0.0310	0.0306	0.0311
-5	0.0210	0.0214	0.0194	0.0193	0.0204	0.0220	0.0416	0.0421	0.0417	0.0208	0.0214	0.0214	0.0417	0.0420	0.0420
-4.5	0.0220	0.0222	0.0201	0.0204	0.0215	0.0229	0.0423	0.0432	0.0427	0.0219	0.0221	0.0222	0.0427	0.0432	0.0430
-3	0.0236	0.0229	0.0211	0.0227	0.0234	0.0244	0.0440	0.0449	0.0447	0.0236	0.0231	0.0229	0.0449	0.0448	0.0447
-2	0.0239	0.0228	0.0211	0.0235	0.0239	0.0250	0.0452	0.0454	0.0456	0.0239	0.0235	0.0231	0.0455	0.0456	0.0456
Right Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
2	0.0233	0.0237	0.0214	0.0239	0.0239	0.0240	0.0451	0.0441	0.0456	0.0230	0.0239	0.0239	0.0453	0.0450	0.0434
3	0.0229	0.0236	0.0212	0.0236	0.0236	0.0231	0.0448	0.0442	0.0452	0.0221	0.0234	0.0236	0.0449	0.0436	0.0416
4.5	0.0222	0.0223	0.0201	0.0218	0.0219	0.0221	0.0432	0.0431	0.0441	0.0206	0.0222	0.0220	0.0430	0.0422	0.0378
5	0.0214	0.0215	0.0199	0.0208	0.0209	0.0216	0.0419	0.0421	0.0436	0.0203	0.0215	0.0212	0.0416	0.0415	0.0376
7.5	0.0161	0.0162	0.0162	0.0161	0.0146	0.0164	0.0312	0.0312	0.0360	0.0163	0.0163	0.0163	0.0312	0.0311	0.0304
10	0.0123	0.0127	0.0127	0.0127	0.0118	0.0127	0.0252	0.0252	0.0282	0.0127	0.0127	0.0125	0.0252	0.0253	0.0249
20	0.0073	0.0076	0.0076	0.0076	0.0074	0.0076	0.0154	0.0161	0.0178	0.0076	0.0078	0.0081	0.0153	0.0156	0.0161
40	0.0048	0.0047	0.0046	0.0047	0.0046	0.0046	0.0101	0.0101	0.0114	0.0045	0.0045	0.0051	0.0100	0.0101	0.0097
50	0.0041	0.0039	0.0039	0.0039	0.0039	0.0039	0.0087	0.0087	0.0099	0.0039	0.0038	0.0041	0.0087	0.0087	0.0081
100	0.0023	0.0023	0.0023	0.0023	0.0023	0.0023	0.0052	0.0052	0.0057	0.0023	0.0024	0.0023	0.0052	0.0052	0.0052
200	0.0013	0.0013	0.0013	0.0013	0.0013	0.0013	0.0030	0.0030	0.0036	0.0013	0.0013	0.0013	0.0030	0.0030	0.0030

Maximum 24-hour mean formaldehyde predictions (µg/m³). The predictions assume that there is no existing background concentration.

Left Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
-200	0.0003	0.0004	0.0003	0.0005	0.0005	0.0005	0.0004	0.0006	0.0006	0.0006	0.0006	0.0005	0.0009	0.0009	0.0008
-100	0.0005	0.0006	0.0006	0.0009	0.0009	0.0008	0.0007	0.0012	0.0010	0.0010	0.0010	0.0008	0.0014	0.0014	0.0013
-50	0.0008	0.0010	0.0011	0.0015	0.0014	0.0015	0.0012	0.0019	0.0016	0.0016	0.0016	0.0014	0.0023	0.0021	0.0022
-40	0.0010	0.0012	0.0013	0.0018	0.0017	0.0017	0.0014	0.0021	0.0018	0.0018	0.0019	0.0017	0.0026	0.0023	0.0025
-20	0.0015	0.0019	0.0020	0.0028	0.0026	0.0028	0.0022	0.0031	0.0030	0.0029	0.0031	0.0027	0.0039	0.0035	0.0036
-10	0.0023	0.0036	0.0030	0.0045	0.0043	0.0045	0.0035	0.0047	0.0052	0.0048	0.0049	0.0045	0.0059	0.0056	0.0054
-7.5	0.0030	0.0048	0.0038	0.0056	0.0053	0.0057	0.0044	0.0056	0.0067	0.0060	0.0062	0.0056	0.0071	0.0069	0.0065
-5	0.0044	0.0069	0.0049	0.0067	0.0064	0.0076	0.0059	0.0068	0.0079	0.0073	0.0075	0.0075	0.0083	0.0086	0.0080
-4.5	0.0046	0.0073	0.0051	0.0068	0.0064	0.0077	0.0062	0.0069	0.0080	0.0073	0.0078	0.0078	0.0083	0.0087	0.0081
-3	0.0050	0.0078	0.0055	0.0072	0.0066	0.0081	0.0067	0.0070	0.0082	0.0077	0.0083	0.0082	0.0080	0.0087	0.0082
-2	0.0054	0.0080	0.0058	0.0075	0.0066	0.0082	0.0069	0.0072	0.0083	0.0078	0.0084	0.0083	0.0080	0.0085	0.0081
Right Receptors	**Coastal 1**	**Coastal 2**	**Coastal 3**	**Bogie 1**	**Bogie 2**	**Bogie 3**	**Bowen 1**	**Bowen 2**	**Bowen 3**	**Newlands 1**	**Newlands 2**	**Newlands 3**	**Isaac 1**	**Isaac 2**	**Isaac 3**
2	0.0066	0.0078	0.0060	0.0076	0.0069	0.0086	0.0070	0.0068	0.0078	0.0080	0.0080	0.0078	0.0100	0.0081	0.0075
3	0.0068	0.0075	0.0059	0.0074	0.0067	0.0085	0.0072	0.0069	0.0075	0.0079	0.0077	0.0074	0.0104	0.0082	0.0076
4.5	0.0067	0.0067	0.0059	0.0072	0.0062	0.0081	0.0075	0.0068	0.0069	0.0076	0.0075	0.0075	0.0108	0.0081	0.0075
5	0.0066	0.0063	0.0059	0.0071	0.0059	0.0078	0.0075	0.0067	0.0066	0.0073	0.0073	0.0075	0.0108	0.0080	0.0074
7.5	0.0052	0.0048	0.0048	0.0057	0.0046	0.0057	0.0062	0.0051	0.0052	0.0054	0.0055	0.0060	0.0092	0.0069	0.0061
10	0.0041	0.0039	0.0039	0.0046	0.0038	0.0045	0.0050	0.0040	0.0043	0.0042	0.0043	0.0047	0.0076	0.0057	0.0052
20	0.0024	0.0024	0.0024	0.0027	0.0025	0.0027	0.0031	0.0024	0.0026	0.0026	0.0026	0.0029	0.0049	0.0037	0.0035
40	0.0014	0.0014	0.0015	0.0016	0.0016	0.0016	0.0018	0.0015	0.0016	0.0016	0.0016	0.0017	0.0031	0.0025	0.0024
50	0.0012	0.0012	0.0013	0.0013	0.0014	0.0014	0.0015	0.0013	0.0014	0.0013	0.0013	0.0014	0.0026	0.0022	0.0021
100	0.0007	0.0008	0.0007	0.0007	0.0009	0.0008	0.0010	0.0007	0.0008	0.0007	0.0008	0.0007	0.0015	0.0015	0.0014
200	0.0005	0.0005	0.0004	0.0004	0.0005	0.0004	0.0006	0.0005	0.0005	0.0004	0.0005	0.0004	0.0009	0.0011	0.0009

Maximum 1-hour mean SO_2 predictions (µg/m³). The predictions include a background concentrations of 11 µg/m³ at the coast, with no background applied elsewhere.

Left Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
-200	11.020	11.020	11.020	0.020	0.020	0.020	0.050	0.052	0.064	0.024	0.024	0.024	0.052	0.052	0.052
-100	11.040	11.040	11.040	0.040	0.040	0.050	0.090	0.089	0.098	0.041	0.045	0.042	0.089	0.089	0.084
-50	11.070	11.070	11.070	0.070	0.070	0.070	0.150	0.148	0.165	0.066	0.074	0.070	0.142	0.150	0.150
-40	11.080	11.080	11.080	0.080	0.080	0.080	0.170	0.175	0.193	0.082	0.089	0.083	0.166	0.175	0.175
-20	11.130	11.130	11.130	0.130	0.130	0.130	0.280	0.279	0.306	0.133	0.136	0.125	0.279	0.277	0.267
-10	11.220	11.220	11.220	0.210	0.190	0.210	0.430	0.434	0.480	0.214	0.214	0.213	0.436	0.429	0.436
-7.5	11.280	11.280	11.280	0.270	0.250	0.280	0.540	0.538	0.603	0.269	0.281	0.279	0.535	0.528	0.537
-5	11.360	11.370	11.330	0.330	0.350	0.380	0.720	0.726	0.718	0.359	0.368	0.369	0.718	0.724	0.725
-4.5	11.380	11.380	11.350	0.350	0.370	0.400	0.730	0.745	0.735	0.378	0.381	0.382	0.735	0.745	0.741
-3	11.410	11.390	11.360	0.390	0.400	0.420	0.760	0.773	0.771	0.406	0.399	0.395	0.773	0.772	0.771
-2	11.410	11.390	11.360	0.410	0.410	0.430	0.780	0.783	0.786	0.413	0.405	0.399	0.784	0.786	0.786
Right Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
2	11.400	11.410	11.370	0.410	0.410	0.410	0.780	0.760	0.786	0.397	0.413	0.413	0.782	0.776	0.749
3	11.400	11.410	11.370	0.410	0.410	0.400	0.770	0.763	0.780	0.381	0.403	0.407	0.773	0.752	0.717
4.5	11.380	11.380	11.350	0.380	0.380	0.380	0.740	0.744	0.760	0.356	0.383	0.380	0.742	0.727	0.652
5	11.370	11.370	11.340	0.360	0.360	0.370	0.720	0.726	0.752	0.349	0.371	0.366	0.717	0.716	0.649
7.5	11.280	11.280	11.280	0.280	0.250	0.280	0.540	0.538	0.622	0.282	0.281	0.282	0.538	0.537	0.525
10	11.210	11.220	11.220	0.220	0.200	0.220	0.430	0.435	0.486	0.218	0.218	0.215	0.435	0.436	0.430
20	11.130	11.130	11.130	0.130	0.130	0.130	0.270	0.278	0.307	0.131	0.135	0.140	0.264	0.269	0.277
40	11.080	11.080	11.080	0.080	0.080	0.080	0.170	0.175	0.197	0.078	0.078	0.087	0.172	0.175	0.168
50	11.070	11.070	11.070	0.070	0.070	0.070	0.150	0.150	0.170	0.067	0.066	0.070	0.150	0.150	0.139
100	11.040	11.040	11.040	0.040	0.040	0.040	0.090	0.089	0.098	0.040	0.042	0.040	0.089	0.089	0.089
200	11.020	11.020	11.020	0.020	0.020	0.020	0.050	0.052	0.062	0.023	0.023	0.023	0.052	0.052	0.052

Maximum daily-mean SO_2 predictions ($\mu g/m^3$). The predictions include a background concentrations of 6 $\mu g/m^3$ at the coast, with no background applied elsewhere.

Left Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
-200	6.01	6.01	6.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02
-100	6.01	6.01	6.01	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03
-50	6.02	6.02	6.02	0.03	0.03	0.03	0.02	0.04	0.03	0.03	0.03	0.03	0.05	0.04	0.04
-40	6.02	6.02	6.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.04	0.03	0.05	0.05	0.05
-20	6.03	6.04	6.04	0.06	0.05	0.05	0.04	0.06	0.06	0.06	0.06	0.05	0.08	0.07	0.07
-10	6.05	6.07	6.06	0.09	0.08	0.09	0.07	0.09	0.10	0.09	0.10	0.09	0.12	0.11	0.11
-7.5	6.06	6.09	6.08	0.11	0.10	0.11	0.09	0.11	0.13	0.12	0.12	0.11	0.14	0.14	0.13
-5	6.09	6.14	6.10	0.13	0.13	0.15	0.12	0.13	0.16	0.14	0.15	0.15	0.16	0.17	0.16
-4.5	6.09	6.14	6.10	0.13	0.13	0.15	0.12	0.14	0.16	0.14	0.15	0.15	0.16	0.17	0.16
-3	6.10	6.15	6.11	0.14	0.13	0.16	0.13	0.14	0.16	0.15	0.16	0.16	0.16	0.17	0.16
-2	6.11	6.16	6.11	0.15	0.13	0.16	0.14	0.14	0.16	0.15	0.17	0.17	0.16	0.17	0.16
Right Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
2	6.13	6.15	6.12	0.15	0.14	0.17	0.14	0.13	0.15	0.16	0.16	0.15	0.20	0.16	0.15
3	6.13	6.15	6.12	0.15	0.13	0.17	0.14	0.14	0.15	0.16	0.15	0.15	0.21	0.16	0.15
4.5	6.13	6.13	6.12	0.14	0.12	0.16	0.15	0.13	0.14	0.15	0.15	0.15	0.21	0.16	0.15
5	6.13	6.13	6.12	0.14	0.12	0.15	0.15	0.13	0.13	0.15	0.15	0.15	0.21	0.16	0.15
7.5	6.10	6.10	6.10	0.11	0.09	0.11	0.12	0.10	0.10	0.11	0.11	0.12	0.18	0.14	0.12
10	6.08	6.08	6.08	0.09	0.08	0.09	0.10	0.08	0.08	0.08	0.08	0.09	0.15	0.11	0.10
20	6.05	6.05	6.05	0.05	0.05	0.05	0.06	0.05	0.05	0.05	0.05	0.06	0.10	0.07	0.07
40	6.03	6.03	6.03	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.03	0.03	0.06	0.05	0.05
50	6.02	6.02	6.02	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.05	0.04	0.04
100	6.01	6.01	6.01	0.01	0.02	0.02	0.02	0.01	0.02	0.01	0.02	0.01	0.03	0.03	0.03
200	6.01	6.01	6.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.02

Annual-mean SO_2 predictions (µg/m³). The predictions include a background concentrations of 3 µg/m³ at the coast, with no background applied elsewhere.

Left Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
-200	3.00	3.00	3.00	0.006	0.006	0.005	0.001	0.006	0.006	0.005	0.005	0.004	0.004	0.005	0.003
-100	3.00	3.01	3.00	0.010	0.010	0.009	0.002	0.010	0.010	0.009	0.008	0.008	0.007	0.009	0.006
-50	3.00	3.01	3.01	0.015	0.015	0.015	0.005	0.016	0.018	0.014	0.013	0.013	0.012	0.014	0.010
-40	3.00	3.01	3.01	0.017	0.017	0.017	0.006	0.019	0.021	0.016	0.015	0.016	0.014	0.017	0.012
-20	3.01	3.02	3.02	0.026	0.026	0.027	0.010	0.031	0.034	0.025	0.023	0.026	0.023	0.026	0.019
-10	3.01	3.03	3.02	0.040	0.041	0.042	0.018	0.049	0.056	0.039	0.036	0.042	0.037	0.042	0.031
-7.5	3.02	3.03	3.03	0.048	0.049	0.051	0.023	0.061	0.070	0.047	0.045	0.052	0.046	0.052	0.038
-5	3.03	3.04	3.04	0.054	0.055	0.060	0.037	0.074	0.079	0.056	0.054	0.065	0.059	0.063	0.049
-4.5	3.03	3.04	3.04	0.053	0.054	0.060	0.041	0.074	0.079	0.056	0.054	0.066	0.060	0.064	0.051
-3	3.04	3.04	3.04	0.049	0.049	0.057	0.051	0.074	0.079	0.054	0.053	0.067	0.062	0.063	0.054
-2	3.04	3.04	3.04	0.045	0.046	0.055	0.057	0.072	0.077	0.051	0.052	0.066	0.062	0.061	0.055
Right Receptors	**Coastal 1**	**Coastal 2**	**Coastal 3**	**Bogie 1**	**Bogie 2**	**Bogie 3**	**Bowen 1**	**Bowen 2**	**Bowen 3**	**Newlands 1**	**Newlands 2**	**Newlands 3**	**Isaac 1**	**Isaac 2**	**Isaac 3**
2	3.05	3.03	3.03	0.029	0.029	0.040	0.073	0.059	0.067	0.039	0.043	0.055	0.056	0.050	0.055
3	3.05	3.03	3.03	0.024	0.024	0.036	0.076	0.054	0.063	0.035	0.039	0.050	0.053	0.046	0.053
4.5	3.05	3.03	3.03	0.016	0.016	0.028	0.078	0.045	0.056	0.028	0.033	0.042	0.047	0.038	0.050
5	3.05	3.02	3.03	0.014	0.014	0.025	0.078	0.042	0.054	0.025	0.031	0.039	0.045	0.035	0.048
7.5	3.04	3.02	3.02	0.006	0.006	0.014	0.065	0.028	0.038	0.015	0.021	0.024	0.032	0.023	0.037
10	3.03	3.01	3.02	0.005	0.005	0.011	0.053	0.022	0.028	0.011	0.016	0.018	0.025	0.018	0.030
20	3.02	3.01	3.01	0.003	0.003	0.006	0.033	0.013	0.016	0.006	0.010	0.010	0.015	0.011	0.018
40	3.01	3.00	3.01	0.001	0.001	0.003	0.021	0.007	0.009	0.003	0.006	0.006	0.009	0.006	0.011
50	3.01	3.00	3.00	0.001	0.001	0.003	0.018	0.006	0.007	0.003	0.005	0.005	0.008	0.005	0.010
100	3.01	3.00	3.00	0.001	0.001	0.001	0.011	0.003	0.004	0.001	0.003	0.002	0.004	0.003	0.006
200	3.00	3.00	3.00	0.000	0.000	0.001	0.006	0.001	0.002	0.000	0.001	0.001	0.002	0.001	0.003

Maximum 30-minute mean toluene predictions (µg/m³). The predictions assume that there is no existing background concentration.

Left Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
-200	0.023	0.022	0.022	0.023	0.022	0.022	0.049	0.049	0.060	0.023	0.023	0.022	0.049	0.049	0.049
-100	0.038	0.038	0.037	0.038	0.037	0.045	0.083	0.084	0.092	0.038	0.042	0.039	0.084	0.083	0.079
-50	0.064	0.063	0.063	0.063	0.065	0.068	0.141	0.139	0.155	0.062	0.070	0.066	0.134	0.141	0.141
-40	0.074	0.075	0.075	0.075	0.078	0.078	0.164	0.164	0.181	0.077	0.083	0.078	0.156	0.164	0.164
-20	0.123	0.121	0.123	0.121	0.120	0.121	0.260	0.262	0.287	0.125	0.128	0.118	0.262	0.260	0.251
-10	0.205	0.202	0.204	0.200	0.182	0.202	0.408	0.408	0.451	0.202	0.201	0.200	0.409	0.403	0.409
-7.5	0.264	0.265	0.260	0.252	0.231	0.265	0.506	0.506	0.566	0.252	0.264	0.262	0.503	0.496	0.505
-5	0.340	0.347	0.314	0.313	0.330	0.356	0.674	0.682	0.675	0.337	0.346	0.347	0.675	0.680	0.681
-4.5	0.356	0.359	0.326	0.331	0.349	0.372	0.686	0.700	0.691	0.355	0.358	0.359	0.691	0.700	0.697
-3	0.382	0.371	0.342	0.368	0.379	0.396	0.713	0.727	0.725	0.382	0.375	0.371	0.727	0.726	0.725
-2	0.388	0.369	0.342	0.381	0.388	0.405	0.733	0.736	0.738	0.388	0.381	0.375	0.737	0.738	0.738
Right Receptors	**Coastal 1**	**Coastal 2**	**Coastal 3**	**Bogie 1**	**Bogie 2**	**Bogie 3**	**Bowen 1**	**Bowen 2**	**Bowen 3**	**Newlands 1**	**Newlands 2**	**Newlands 3**	**Isaac 1**	**Isaac 2**	**Isaac 3**
2	0.378	0.384	0.346	0.388	0.388	0.390	0.730	0.714	0.738	0.373	0.388	0.388	0.735	0.730	0.704
3	0.372	0.382	0.344	0.382	0.382	0.375	0.726	0.717	0.733	0.359	0.379	0.383	0.727	0.707	0.674
4.5	0.360	0.361	0.326	0.354	0.355	0.359	0.700	0.699	0.714	0.334	0.360	0.357	0.697	0.683	0.613
5	0.347	0.348	0.323	0.337	0.338	0.351	0.680	0.682	0.706	0.328	0.349	0.344	0.674	0.673	0.610
7.5	0.261	0.262	0.263	0.261	0.237	0.266	0.506	0.506	0.584	0.265	0.264	0.265	0.506	0.505	0.493
10	0.199	0.205	0.205	0.205	0.191	0.205	0.408	0.408	0.457	0.205	0.205	0.202	0.408	0.409	0.404
20	0.118	0.123	0.123	0.123	0.120	0.123	0.250	0.261	0.288	0.123	0.127	0.132	0.248	0.252	0.260
40	0.078	0.075	0.075	0.075	0.075	0.074	0.164	0.164	0.186	0.073	0.073	0.082	0.161	0.164	0.158
50	0.067	0.063	0.063	0.063	0.064	0.064	0.141	0.141	0.160	0.063	0.062	0.066	0.141	0.141	0.131
100	0.038	0.038	0.038	0.037	0.037	0.038	0.084	0.084	0.092	0.038	0.039	0.037	0.084	0.084	0.084
200	0.022	0.022	0.022	0.022	0.022	0.021	0.049	0.049	0.058	0.022	0.022	0.022	0.049	0.049	0.049

Maximum daily-mean toluene predictions (µg/m³). The predictions assume that there is no existing background concentration.

Left Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
-200	0.000	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.008	0.015	0.015	0.013
-100	0.010	0.010	0.010	0.020	0.010	0.010	0.010	0.019	0.017	0.016	0.016	0.013	0.023	0.023	0.021
-50	0.010	0.020	0.020	0.020	0.020	0.020	0.020	0.030	0.025	0.025	0.027	0.023	0.037	0.033	0.035
-40	0.020	0.020	0.020	0.030	0.030	0.030	0.020	0.034	0.029	0.029	0.032	0.028	0.042	0.037	0.040
-20	0.020	0.030	0.030	0.050	0.040	0.040	0.040	0.050	0.049	0.047	0.050	0.045	0.063	0.057	0.059
-10	0.040	0.060	0.050	0.070	0.070	0.070	0.060	0.076	0.084	0.077	0.080	0.073	0.096	0.090	0.088
-7.5	0.050	0.080	0.060	0.090	0.090	0.090	0.070	0.091	0.108	0.097	0.100	0.091	0.116	0.112	0.105
-5	0.070	0.110	0.080	0.110	0.100	0.120	0.100	0.110	0.128	0.118	0.121	0.121	0.134	0.140	0.129
-4.5	0.070	0.120	0.080	0.110	0.100	0.130	0.100	0.112	0.130	0.118	0.126	0.126	0.134	0.141	0.131
-3	0.080	0.130	0.090	0.120	0.110	0.130	0.110	0.114	0.134	0.125	0.134	0.134	0.129	0.141	0.133
-2	0.090	0.130	0.090	0.120	0.110	0.130	0.110	0.116	0.134	0.127	0.137	0.135	0.129	0.137	0.131
Right Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
2	0.110	0.130	0.100	0.120	0.110	0.140	0.110	0.110	0.127	0.129	0.130	0.126	0.161	0.132	0.122
3	0.110	0.120	0.100	0.120	0.110	0.140	0.120	0.112	0.122	0.128	0.125	0.120	0.169	0.134	0.123
4.5	0.110	0.110	0.100	0.120	0.100	0.130	0.120	0.110	0.111	0.123	0.121	0.122	0.175	0.132	0.121
5	0.110	0.100	0.100	0.120	0.100	0.130	0.120	0.108	0.106	0.119	0.119	0.121	0.175	0.130	0.120
7.5	0.080	0.080	0.080	0.090	0.080	0.090	0.100	0.083	0.085	0.087	0.089	0.097	0.148	0.111	0.099
10	0.070	0.060	0.060	0.070	0.060	0.070	0.080	0.065	0.069	0.068	0.069	0.076	0.123	0.092	0.084
20	0.040	0.040	0.040	0.040	0.040	0.040	0.050	0.039	0.042	0.042	0.042	0.046	0.079	0.060	0.057
40	0.020	0.020	0.020	0.030	0.030	0.030	0.030	0.024	0.026	0.025	0.025	0.027	0.050	0.041	0.039
50	0.020	0.020	0.020	0.020	0.020	0.020	0.020	0.021	0.022	0.021	0.022	0.022	0.043	0.035	0.035
100	0.010	0.010	0.010	0.010	0.010	0.010	0.020	0.012	0.013	0.011	0.013	0.011	0.024	0.024	0.023
200	0.010	0.010	0.010	0.010	0.010	0.010	0.010	0.008	0.007	0.006	0.007	0.006	0.014	0.017	0.014

Annual-mean toluene predictions (µg/m³). The predictions assume that there is no existing background concentration.

Left Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
-200	0.001	0.002	0.002	0.005	0.005	0.004	0.001	0.005	0.005	0.004	0.004	0.003	0.003	0.004	0.003
-100	0.001	0.004	0.004	0.008	0.008	0.008	0.002	0.008	0.008	0.007	0.006	0.006	0.006	0.007	0.005
-50	0.003	0.007	0.007	0.012	0.012	0.012	0.004	0.013	0.014	0.011	0.010	0.011	0.010	0.012	0.008
-40	0.003	0.008	0.008	0.014	0.014	0.014	0.005	0.016	0.017	0.013	0.012	0.013	0.012	0.014	0.010
-20	0.006	0.013	0.012	0.021	0.022	0.022	0.008	0.025	0.028	0.020	0.019	0.021	0.019	0.022	0.016
-10	0.010	0.022	0.020	0.033	0.033	0.034	0.015	0.040	0.046	0.032	0.030	0.034	0.031	0.035	0.025
-7.5	0.014	0.027	0.025	0.039	0.040	0.041	0.019	0.050	0.058	0.039	0.036	0.043	0.038	0.043	0.031
-5	0.022	0.033	0.031	0.044	0.045	0.049	0.031	0.060	0.064	0.046	0.044	0.053	0.048	0.052	0.040
-4.5	0.024	0.033	0.032	0.043	0.044	0.049	0.033	0.061	0.065	0.046	0.044	0.054	0.049	0.052	0.042
-3	0.030	0.033	0.032	0.040	0.040	0.047	0.042	0.060	0.064	0.044	0.044	0.055	0.050	0.052	0.044
-2	0.033	0.032	0.032	0.037	0.037	0.045	0.046	0.059	0.063	0.042	0.043	0.054	0.051	0.050	0.045
Right Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
2	0.041	0.027	0.028	0.023	0.023	0.033	0.060	0.048	0.055	0.032	0.035	0.045	0.046	0.041	0.045
3	0.042	0.025	0.027	0.019	0.019	0.029	0.062	0.044	0.052	0.028	0.032	0.041	0.043	0.037	0.044
4.5	0.042	0.022	0.024	0.013	0.013	0.023	0.064	0.037	0.046	0.023	0.027	0.034	0.039	0.031	0.041
5	0.042	0.020	0.023	0.011	0.011	0.020	0.064	0.035	0.044	0.020	0.025	0.032	0.037	0.029	0.039
7.5	0.033	0.014	0.016	0.005	0.005	0.012	0.053	0.023	0.031	0.012	0.017	0.020	0.026	0.019	0.030
10	0.027	0.011	0.013	0.004	0.004	0.009	0.043	0.018	0.023	0.009	0.013	0.015	0.021	0.015	0.024
20	0.016	0.006	0.008	0.002	0.002	0.005	0.027	0.010	0.013	0.005	0.008	0.008	0.013	0.009	0.015
40	0.010	0.004	0.005	0.001	0.001	0.003	0.017	0.006	0.007	0.003	0.005	0.005	0.007	0.005	0.009
50	0.008	0.003	0.004	0.001	0.001	0.002	0.014	0.005	0.006	0.002	0.004	0.004	0.006	0.004	0.008
100	0.005	0.002	0.002	0.000	0.000	0.001	0.009	0.003	0.003	0.001	0.002	0.002	0.004	0.002	0.005
200	0.002	0.001	0.001	0.000	0.000	0.000	0.005	0.001	0.002	0.000	0.001	0.001	0.002	0.001	0.003

Maximum daily-mean xylene predictions (µg/m³). The predictions assume that there is no existing background concentration.

Left Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
-200	0.007	0.010	0.009	0.013	0.012	0.012	0.009	0.015	0.015	0.016	0.015	0.012	0.022	0.023	0.019
-100	0.012	0.015	0.015	0.023	0.021	0.020	0.017	0.029	0.025	0.024	0.024	0.020	0.035	0.035	0.031
-50	0.020	0.025	0.028	0.037	0.035	0.036	0.030	0.045	0.038	0.038	0.040	0.035	0.055	0.050	0.052
-40	0.024	0.029	0.032	0.043	0.041	0.041	0.035	0.051	0.043	0.044	0.047	0.041	0.063	0.056	0.060
-20	0.036	0.047	0.048	0.068	0.064	0.067	0.054	0.076	0.073	0.070	0.075	0.067	0.094	0.086	0.088
-10	0.057	0.087	0.074	0.110	0.104	0.110	0.084	0.114	0.126	0.116	0.120	0.109	0.144	0.135	0.132
-7.5	0.072	0.116	0.093	0.136	0.128	0.140	0.106	0.136	0.162	0.146	0.150	0.136	0.174	0.168	0.157
-5	0.106	0.169	0.119	0.162	0.155	0.184	0.144	0.165	0.192	0.177	0.182	0.182	0.201	0.210	0.193
-4.5	0.112	0.177	0.123	0.164	0.156	0.188	0.150	0.168	0.196	0.177	0.189	0.189	0.201	0.212	0.197
-3	0.121	0.190	0.134	0.176	0.160	0.198	0.163	0.171	0.200	0.188	0.201	0.200	0.193	0.211	0.199
-2	0.132	0.194	0.141	0.183	0.160	0.200	0.168	0.175	0.201	0.190	0.205	0.203	0.193	0.206	0.197
Right Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
2	0.161	0.189	0.147	0.185	0.167	0.210	0.171	0.165	0.190	0.193	0.196	0.189	0.242	0.198	0.183
3	0.165	0.182	0.144	0.181	0.163	0.207	0.176	0.168	0.183	0.192	0.188	0.181	0.254	0.200	0.184
4.5	0.163	0.163	0.144	0.176	0.151	0.197	0.182	0.165	0.167	0.184	0.182	0.183	0.263	0.198	0.182
5	0.161	0.154	0.143	0.174	0.144	0.190	0.182	0.162	0.160	0.178	0.178	0.182	0.263	0.194	0.179
7.5	0.127	0.118	0.118	0.140	0.113	0.139	0.150	0.125	0.127	0.130	0.133	0.146	0.222	0.167	0.149
10	0.100	0.095	0.095	0.111	0.093	0.110	0.122	0.098	0.103	0.103	0.104	0.115	0.184	0.139	0.126
20	0.059	0.058	0.058	0.066	0.060	0.066	0.074	0.059	0.063	0.062	0.063	0.069	0.119	0.091	0.085
40	0.035	0.035	0.036	0.039	0.039	0.039	0.044	0.036	0.039	0.038	0.038	0.040	0.075	0.061	0.058
50	0.029	0.029	0.031	0.033	0.034	0.033	0.037	0.031	0.033	0.032	0.032	0.033	0.064	0.053	0.052
100	0.018	0.018	0.017	0.017	0.021	0.019	0.024	0.018	0.019	0.016	0.019	0.016	0.036	0.036	0.035
200	0.011	0.012	0.011	0.009	0.011	0.011	0.015	0.012	0.011	0.009	0.011	0.009	0.021	0.026	0.021

Annual-mean xylene predictions (µg/m³), assuming no existing background concentration.

Left Receptors	Coastal 1	Coastal 2	Coastal 3	Bogie 1	Bogie 2	Bogie 3	Bowen 1	Bowen 2	Bowen 3	Newlands 1	Newlands 2	Newlands 3	Isaac 1	Isaac 2	Isaac 3
-200	0.001	0.004	0.003	0.008	0.008	0.007	0.001	0.007	0.007	0.006	0.006	0.005	0.005	0.006	0.004
-100	0.002	0.006	0.006	0.012	0.012	0.011	0.003	0.012	0.013	0.010	0.010	0.009	0.009	0.011	0.007
-50	0.004	0.011	0.010	0.018	0.019	0.018	0.006	0.020	0.022	0.017	0.015	0.016	0.015	0.018	0.012
-40	0.005	0.012	0.012	0.021	0.021	0.021	0.007	0.024	0.025	0.019	0.018	0.019	0.018	0.020	0.014
-20	0.009	0.020	0.019	0.032	0.032	0.032	0.012	0.038	0.042	0.030	0.028	0.031	0.028	0.032	0.023
-10	0.015	0.032	0.030	0.049	0.050	0.051	0.022	0.061	0.069	0.047	0.045	0.051	0.046	0.052	0.038
-7.5	0.020	0.040	0.038	0.059	0.060	0.062	0.028	0.075	0.086	0.058	0.055	0.064	0.057	0.064	0.047
-5	0.034	0.049	0.047	0.066	0.067	0.074	0.046	0.090	0.097	0.069	0.066	0.080	0.072	0.078	0.061
-4.5	0.037	0.049	0.048	0.065	0.066	0.073	0.050	0.091	0.097	0.068	0.066	0.081	0.073	0.078	0.062
-3	0.045	0.049	0.049	0.060	0.060	0.070	0.063	0.090	0.096	0.066	0.066	0.082	0.076	0.077	0.066
-2	0.049	0.048	0.048	0.055	0.056	0.067	0.070	0.088	0.095	0.063	0.064	0.080	0.076	0.075	0.068
Right Receptors	**Coastal 1**	**Coastal 2**	**Coastal 3**	**Bogie 1**	**Bogie 2**	**Bogie 3**	**Bowen 1**	**Bowen 2**	**Bowen 3**	**Newlands 1**	**Newlands 2**	**Newlands 3**	**Isaac 1**	**Isaac 2**	**Isaac 3**
2	0.062	0.041	0.043	0.035	0.035	0.049	0.090	0.072	0.082	0.048	0.052	0.067	0.069	0.061	0.067
3	0.063	0.038	0.040	0.029	0.029	0.044	0.093	0.066	0.078	0.043	0.048	0.062	0.065	0.056	0.066
4.5	0.063	0.032	0.036	0.020	0.020	0.034	0.095	0.056	0.069	0.034	0.041	0.052	0.058	0.047	0.061
5	0.063	0.030	0.034	0.017	0.017	0.031	0.095	0.052	0.066	0.031	0.038	0.048	0.055	0.044	0.059
7.5	0.050	0.021	0.024	0.008	0.007	0.017	0.080	0.034	0.046	0.018	0.025	0.030	0.039	0.029	0.045
10	0.040	0.016	0.019	0.006	0.006	0.013	0.065	0.027	0.035	0.014	0.020	0.023	0.031	0.022	0.036
20	0.024	0.010	0.011	0.003	0.003	0.007	0.040	0.015	0.020	0.008	0.012	0.013	0.019	0.013	0.022
40	0.015	0.006	0.007	0.002	0.002	0.004	0.025	0.009	0.011	0.004	0.007	0.007	0.011	0.008	0.014
50	0.012	0.005	0.006	0.001	0.001	0.003	0.022	0.007	0.009	0.003	0.006	0.006	0.009	0.006	0.012
100	0.007	0.003	0.003	0.001	0.001	0.001	0.013	0.004	0.005	0.002	0.003	0.003	0.005	0.003	0.007
200	0.003	0.001	0.002	0.000	0.000	0.001	0.007	0.002	0.002	0.001	0.001	0.001	0.003	0.002	0.004

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B	Mike Power	B Cook	Draft	P Bradley	Draft	05/08/2013
0	Mike Power	B Cook		P Bradley		14/08/2013

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