AMENDMENT MAY 2013

ENVIRONMENTAL IMPACT ASSESSMENT
MARY'S MOUNT BLUE METAL QUARRY

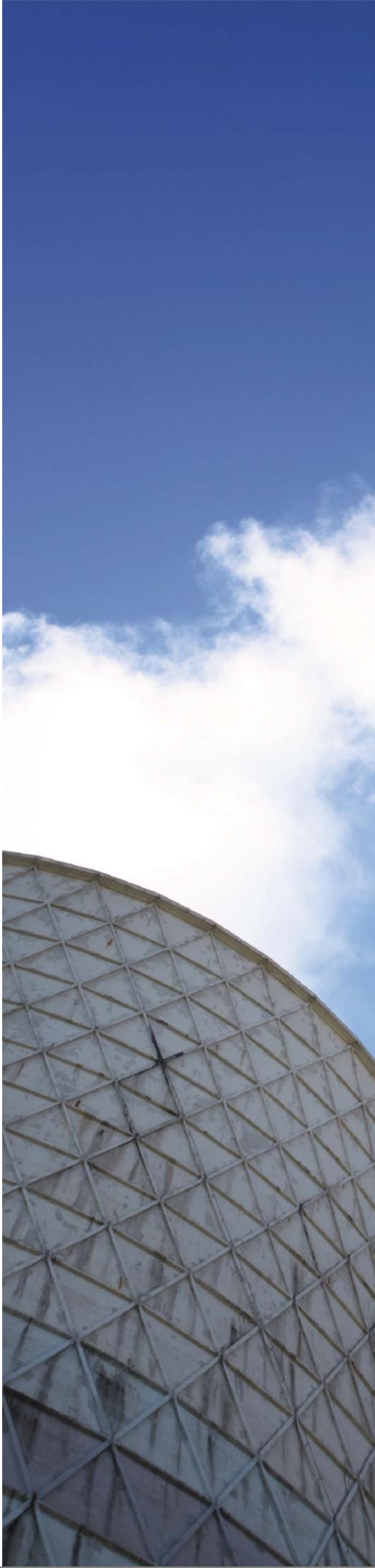
SECTION 4.7
AIR QUALITY ASSESSMENT

PREPARED BY:

Pacific Environmental Limited

Pacific Environment Limited

Consulting • Technologies • Monitoring • Toxicology



REPORT

PROPOSED MARYS MOUNT QUARRY EXPANSION – AMENDED PROJECT REPORT

Gunnedah Quarry Products c/o Stewart Surveys

Job No: 7338

9 May 2013

Pacific Environment Limited

PROJECT TITLE:	**PROPOSED MARYS MOUNT QUARRY EXPANSION – AMENDED PROJECT REPORT**
JOB NUMBER:	**7338**
PREPARED FOR:	**GUNNEDAH QUARRY PRODUCTS C/O STEWART SURVEYS**
APPROVED FOR RELEASE BY:	J. Cox
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DECLARATION OF INFORMATION IN THIS REPORT

I hereby declare that the information I have presented in the Mary's Mount Blue Metal Quarry Environmental Impact Statement is neither false nor misleading.

Report/Section provided: ____Air Quality Impact Assessment________________

Company: ______Pacific Environment____

Name: ________Judith Cox____

Signature: ______JACox____

Date: ___________09/05/2012____

EXECUTIVE SUMMARY

Overview

Gunnedah Quarry Products Pty Limited is proposing to expand its existing quarry off Barker Road at Marys Mount, located approximately 33 by road or 26 direct line km west of Gunnedah in New South Wales. The proposed extension would extract up to 360,000 tpa of material.

With the exception of one residence located within 50m of the quarry footprint, the closest sensitive receivers are located between 1.49 km and 3.3 km from the site.

The operations over the life of the quarry would progress through staging of construction, operation and rehabilitation. In order to assess the worst case scenario, Stage 1.5/2.1 of the quarry plans has been modelled, as this has the largest exposed quarry area. And the operations are closest to the nearest sensitive receiver. As some drilling and blasting may be required during Stage 3.1, an emission inventory for Stage 3.1 has also been prepared and compared with Stage 1.5/2.1.

Emissions and Existing Environment

The Project activities of aggregate extraction, hauling and stockpiling have the potential to generate fugitive dust emissions. Fugitive dust emissions can also be expected during construction, from vegetation stripping, earthworks and material handling.

Meteorological data from the Bureau of Meteorology's Automatic Weather station at Gunnedah Airport have been used in this assessment. The winds for this region are predominantly from a southeasterly direction and to a lesser extent the south-southeast.

No onsite air quality data are available for the Project site. Data from nearby mines and Tamworth's Environment Protection Agency's (EPA's) monitoring station have been used for background ambient air quality in the cumulative assessment.

Emissions and Modelling Assessment

Dispersion modelling has been used to predict ground level concentrations (glcs) of key pollutants associated with the project. Dust emissions from the Stage 1.5/2.1 and Stage 3.1 have been estimated by analysing the activities taking place for the Project. Emission estimates are presented for a maximum production scenario of 360 ktpa of product. Since PM_{10} emissions are more likely to have a negative impact on human health, Stage 1.5/2.1 was modelled to represent the worst case scenario.

As the total PM_{10} emissions (and PM_{10} emissions are more likely to have a negative impact on human health than TSP emissions), Stage 1.5/2.1 was modelled to represent the worst case scenario.

The results of the modelling indicate that the predicted incremental TSP at the closest residential receivers are all below the impact assessment criteria. PM_{10} and dust deposition was predicted to be above the assessment criteria at R1, which is located within 50m of the pit. No exceedances were predicted at any other of the nearby residences.

A cumulative assessment, incorporating background levels, indicates that the Project is unlikely to result in any additional exceedances of relevant impact assessment criteria at the neighbouring receivers (other than R1).

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1 INTRODUCTION

Gunnedah Quarry Products Pty Limited (the Proponent) is proposing to expand the quarry off Barker Road at Marys Mount (the Project). The existing quarry is located approximately 33 km west of Gunnedah in New South Wales.

The proposed quarry would extract up to 360,000 tpa of material suitable for a large range of uses.

This report presents an updated air quality assessment of the project following modifications to the quarry design.

The majority of the sensitive receivers are located 1.49 km to 3.3 km from the site and an assessment of the air quality concentrations at these receivers is required for submission with an Environmental Assessment as part of the development application. An assessment of air quality concentrations has also been made for the single residence located within the Project boundary, located approximately 50m from the pit. It is understood that the Proponent has a clause in their licence agreement with the land holder regarding the dust and noise impacts and that the land holder accepts these impacts.

1.1 Study Requirements

The Air Quality Impact Assessment has been prepared in accordance with the Director-General's Environmental Assessment Requirements (DGRs) for the Project, which was issued in August 2012.

Table 1.1 below outlines the DGRs relevant to air quality assessment and where each is addressed within this report. The requirements provided by NSW Environmental Protection Agency (EPA) and are listed in **Table 1.2**.

The Air Quality Assessment has been prepared in accordance with the DGRs, the NSW OEH "Approved Methods for the Modelling and Assessment of Air Pollutants in NSW" (*Approved Methods*) (**DEC, 2005**) and other relevant agency comments.

Table 1.1: Director-General's environmental assessment requirements

Discipline	Requirement
Air	*"including an adequate assessment of:* ▪ *Dust impacts associated with the proposal and impacts on sensitive receivers.*

Table 1.2: EPA requirements

ENVIROMENT PROTECTION AGENCY	
The EIS should include an air quality impact assessment (AQIA). The AQIA should:	
Assess the risk associated with potential discharges of fugitive and point source emissions for all stages of the proposal. Assessment of risk relates to environmental harm, risk of human health and amenity.	**Section 4**
Justify the level of assessment undertaken on the basis of risk factors, including but not limited to: ▪ *Proposal location* ▪ *Characteristics of the receiving environment* ▪ *Type and quantity of pollutants emitted.*	**Section 2 and 3**
Describe the receiving environment in detail. The proposal must be contextualised within the receiving environment (local, regional and inter-regional as appropriate). The description must include but not be limited to: ▪ *Meteorology and climate* ▪ *Topography* ▪ *Surrounding land-use; receivers; and* ▪ *Ambient air quality*	**Section 3 and 5**
Include a detailed description of the proposal. All processes that could result in air emissions be identified and described. Sufficient detail to accurately communicate the characteristics and quantity of all emissions must be provided.	**Section 2**
Include a consideration of 'worst case' emission scenarios and impacts at proposed emission limits.	**Section 7**
Account for cumulative impacts associated with existing emission sources as well as any currently approved developments linked to the receiving environment.	**Section 5.2.4 and 8.2**
Include air dispersion modelling where there is a risk of adverse air quality impacts, or where there is sufficient uncertainty to warrant a rigorous numerical impact assessment. Air dispersion modelling must be conducted in accordance with the "Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW". http://www.environment .nsw.gov.au/air/.	**Section 8**
Demonstrate the proposal's ability to comply with the relevant regulatory framework, specifically the "Protection of the Environment Operations" (POEO) Act (1997) and the POEO (Clean Air) Regulation (2002)	**Section 8**
Detail emission control techniques/practices that will be employed by the proposal.	**Section 7.1.1**

2 PROJECT DESCRIPTION

Gunnedah Quarry Products Pty Ltd is proposing to expand the existing quarry off Barker Road, Marys Mount. Key features of the Project include:

- The operation of a blue metal quarry extracting up to 360,000 tonnes of quarry products per year.
- Quarry activities and related activities will occur between 7am and 3-6pm six days a week for a period of 30 years.
- Materials extracted will be suitable for a number of uses including blue metal, railway ballast, crusher dust, concrete aggregate, road base, mine stemming gravel and many other civil construction and commercial building applications.
- Transporting of quarry products.

The proposed Mary's Mount Blue Metal Quarry has a pit area of 14 hectares, a project boundary area of 17.64 hectares surrounding the pit and 1.17 hectares of existing stockpile area north of the pit. The proposed extraction rate at the quarry is 120,000bcm a year or 360,000 tonnes.

The sequence of quarrying has been divided into three stages. Each stage has a span of approximately 12 years. The boundaries of these stages are shown on the proposed quarry site plan (see **Figure 2-1**).

Stage 1 Extends from the existing, currently operating pit footprint, in a westerly direction. Excavation in this stage is to 440m AHD and the pit meets the existing levels along the northern and western boundaries. The quarrying method proposed for this stage is mechanical.

Stage 2 has a similar footprint to Stage 1, excavating deeper to the final pit levels as shown in the proposed quarry site plan. At approximately year 19 of operation a new haul route will need to be built at the north eastern extent of the project site. This stage may require some drill and blast operations dependant on basalt density at lower levels.

Stage 3 is located east of the existing quarry footprint meeting with existing levels to the north and eastern boundary of the project. This stage may require some drill and blast operations dependant on the basalt density at lower levels.

All highwalls within the pit will be benched to a width of 5 metres at 10 metre vertical intervals. The pit will drain along the northern base of the highwall out letting in the north eastern section of the site where it will be collected by contour banks and diverted into a farm dam which is being expanded as part of the proposed development. Rehabilitation will be progressive and completed as each area of the quarry reaches it full life.

In order to assess the worst case scenario, Stage 1.5/2.1 of the quarry plans has been modelled, as this has the largest exposed quarry area. And the operations are closest to the nearest sensitive receiver (see **Figure 2-2**). As some drilling and blasting may be required during Stage 3, an emission inventory for Stage 3.1 has also been prepared and compared with Stage 1.5/2.1 (see **Section 7**).

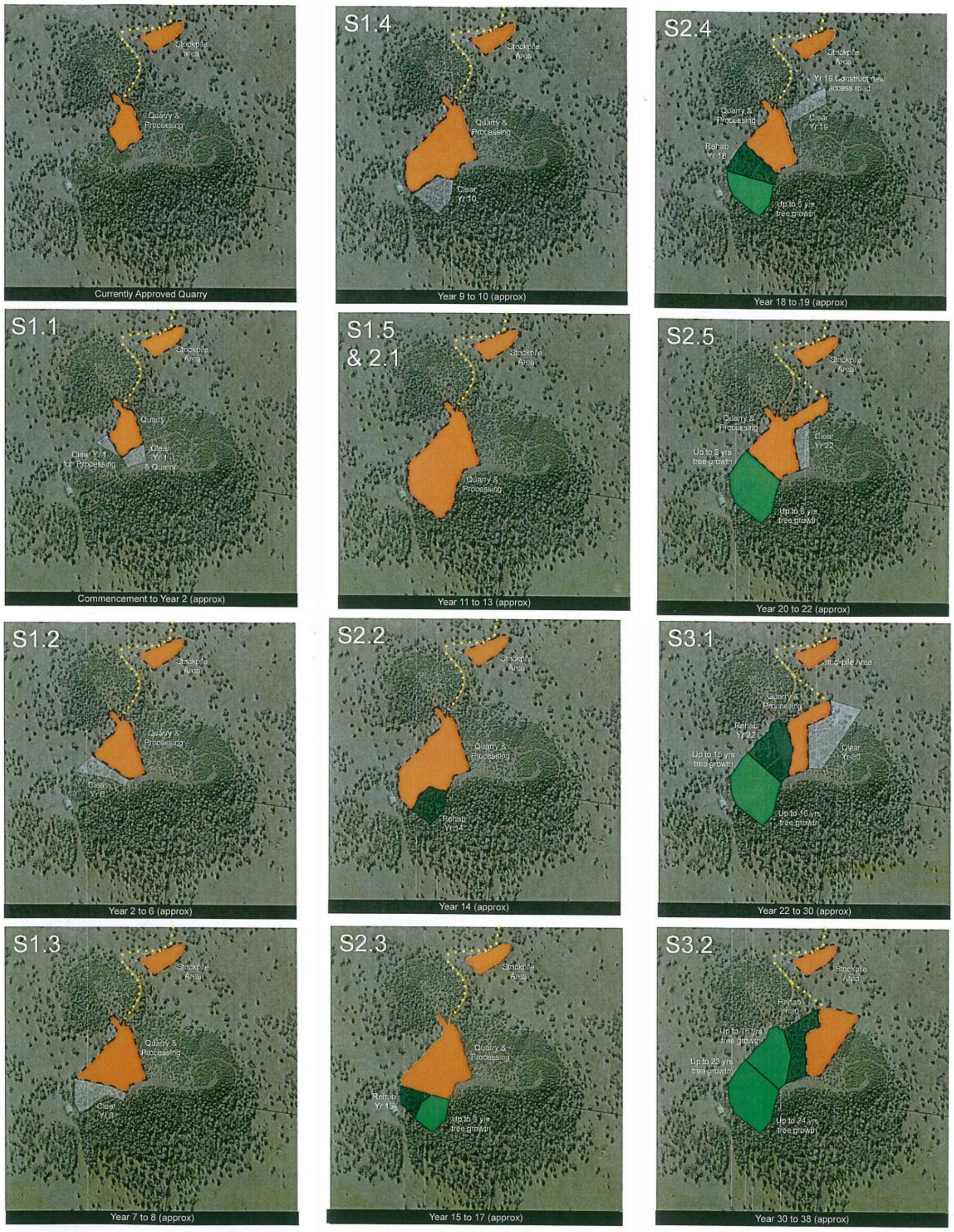

Figure 2-1: Staged project layout

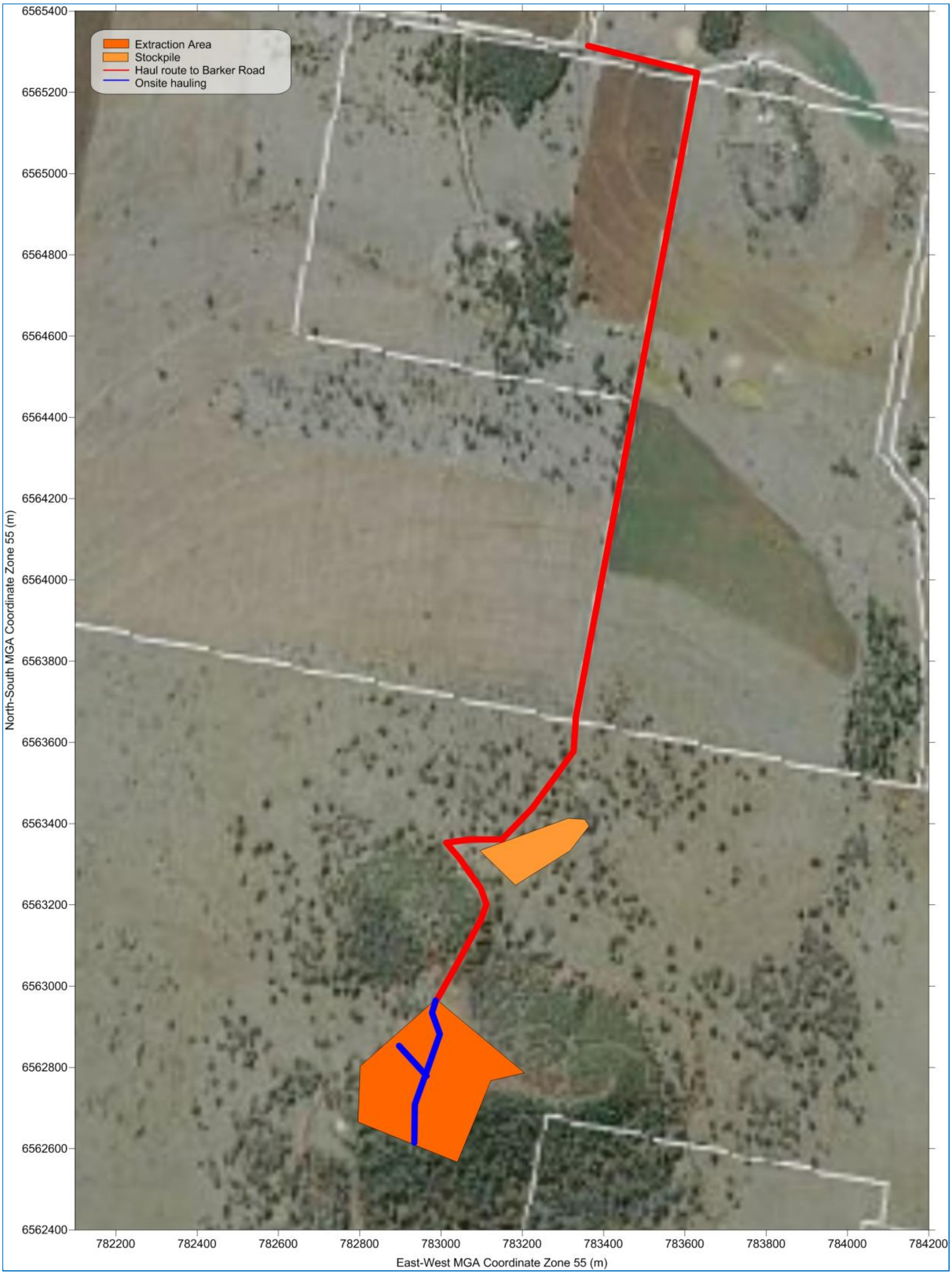

Figure 2-2: Stage 1.5 & 2.1 Operation and haul route

3 LOCAL SETTING

The site for the proposed quarry extension is located off Barker Road, Marys Mount Gunnedah (see **Figure 2-1**). The site is located at the northern side of Burlieth Hill which is surrounded by relatively flat terrain that has a predominately cultivated land use.

For the purposes of assessing impacts from the Project, discrete receiver locations have been selected and presented in **Table 3.1** and **Figure 3-1**. These receivers represent assessment locations in close proximity to the facilities for the Project.

Figure 3-1 also shows a pseudo three-dimensional (3D) representation of the local topography in the area of the proposed quarry and surrounds. Vertical exaggeration is applied to emphasize terrain features.

Table 3.1: Relevant Receiver Locations

Receiver ID	Easting	Northing
R1	782738	6562663
R2	782776	6560821
R3	782388	6560982
R4	783110	6564791
R5	783799	6565198
R6	783639	6565955
R7	779610	6565098
R8	779052	6563068
R9	781353	6561326
R10	786613	6560977
R11	786554	6561369
R12	781967	6566068
R13	783204	6558955

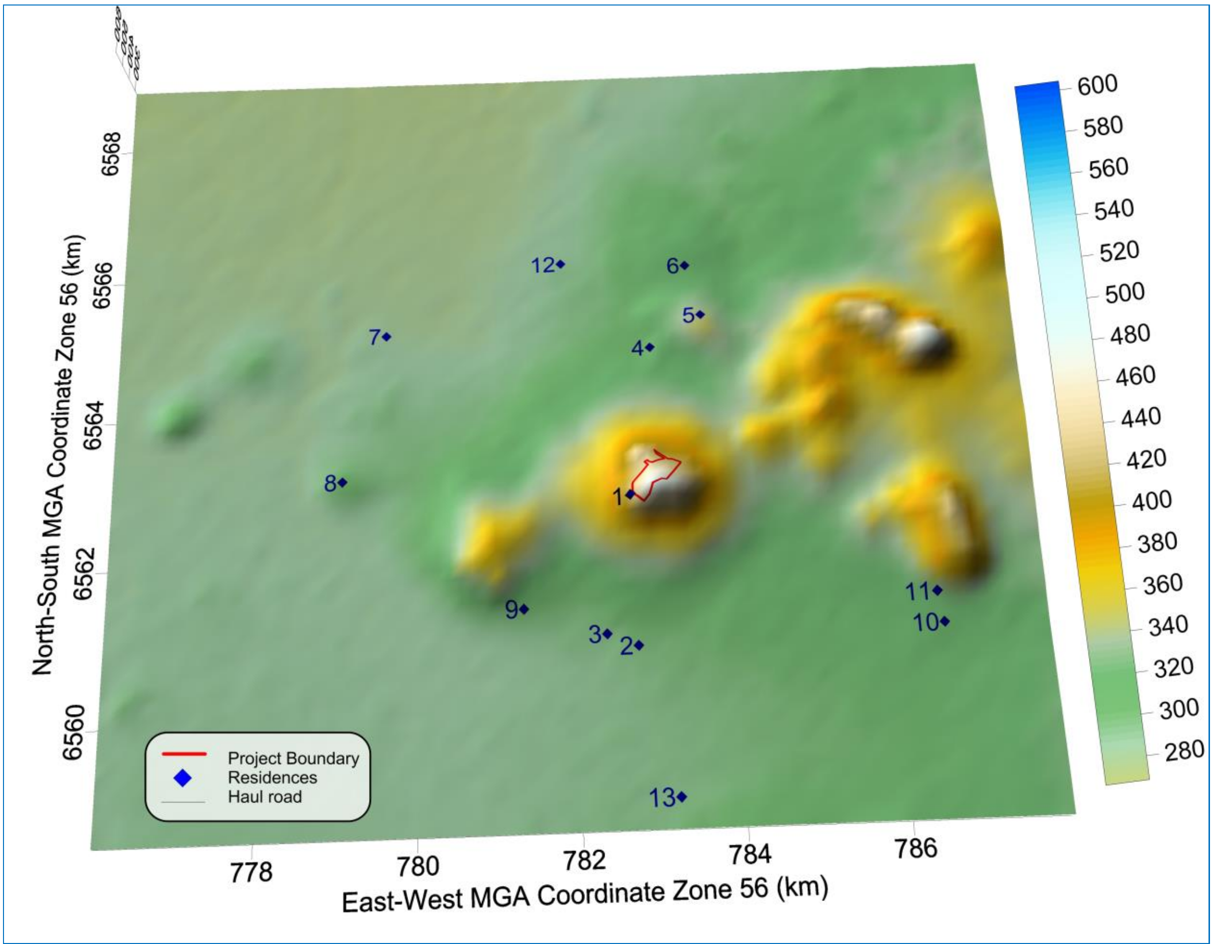

Figure 3-1: Pseudo 3-D representation of regional topography within modelling domain

4 AIR QUALITY CRITERIA

4.1 Emissions to Air

The potential emissions to air from the Project are summarised as follows:

- Project activities described in **Section 2** have the potential to generate fugitive dust emissions, particularly from aggregate extraction, hauling and stockpiling. Fugitive dust emissions can also be expected during construction, from vegetation stripping, earthworks and material handling.
- Combustion of diesel in quarrying equipment will result in emission of fine fractions of particulate matter (PM_{10} and $PM_{2.5}$), oxides of nitrogen (NO_x), carbon monoxide (CO), sulfur dioxide (SO_2) and organic compounds. The fleet associated with the quarry is relatively small and emissions from diesel-powered equipment during both construction and operation would not result in significant off-site concentrations. It is noted that emissions of particulate matter from diesel consumption in equipment is accounted for in the estimates of fugitive particulate emissions for relevant sources (i.e. dozers).

The following sections provide information on the air quality criteria used to assess the impact of dust and other emissions.

4.2 Particulate Matter and Health Effects

Particulate matter has the capacity to affect health and to cause nuisance effects, and is categorised by size and/or by chemical composition. The potential for harmful effects depends on both. The particulate size ranges are commonly described as:

- Total Suspended Particulate (TSP) – refers to all suspended particles in the air. In practice, the upper size range is typically 30 µm to 50 µm.
- Particulate Matter less than 10 microns (PM_{10}) – refers to all particles with equivalent aerodynamic diameters of less than 10 µm, that is, all particles that behave aerodynamically in the same way as spherical particles with diameters less than 10 µm and with a unit density. PM_{10} are a sub-component of TSP.
- $PM_{2.5}$ – refers to all particles with equivalent aerodynamic diameters of less than 2.5 µm diameter (a subset of PM_{10}). These are often referred to as the fine particles and are a sub-component of PM_{10}.
- $PM_{2.5-10}$ – defined as the difference between PM_{10} and $PM_{2.5}$ mass concentrations. These are often referred to as coarse particles.

Evidence suggests that health effects from exposure to airborne particulate matter are predominantly related to the respiratory and cardiovascular systems. The human respiratory system has in-built defensive systems that prevent larger particles from reaching the more sensitive parts of the respiratory system. Particles larger than 10 µm, while not implicated in health effects, can soil materials and generally degrade aesthetic elements of the environment. For this reason, air quality goals make reference to measures of the total mass of all particles suspended in the air and is referred to as TSP. In practice particles larger than 30 to 50 µm settle out of the atmosphere too quickly to be regarded as air pollutants. The upper size range for TSP is usually taken to be 30 µm (**WHO 2004**, **HEI 2002**, **US EPA 2005**).

Both natural and anthropogenic processes contribute to the atmospheric load of particulate matter. Coarse particles ($PM_{2.5-10}$) are derived primarily from mechanical processes resulting in the suspension of dust, soil, or other crustal[a] materials (**US EPA 1996**) from roads, farming, mining, dust storms, and so forth. Coarse particles also include sea salts, pollen, mould, spores, and other plant parts. Mining dust is likely to be composed of predominantly coarse particulate matter (and larger).

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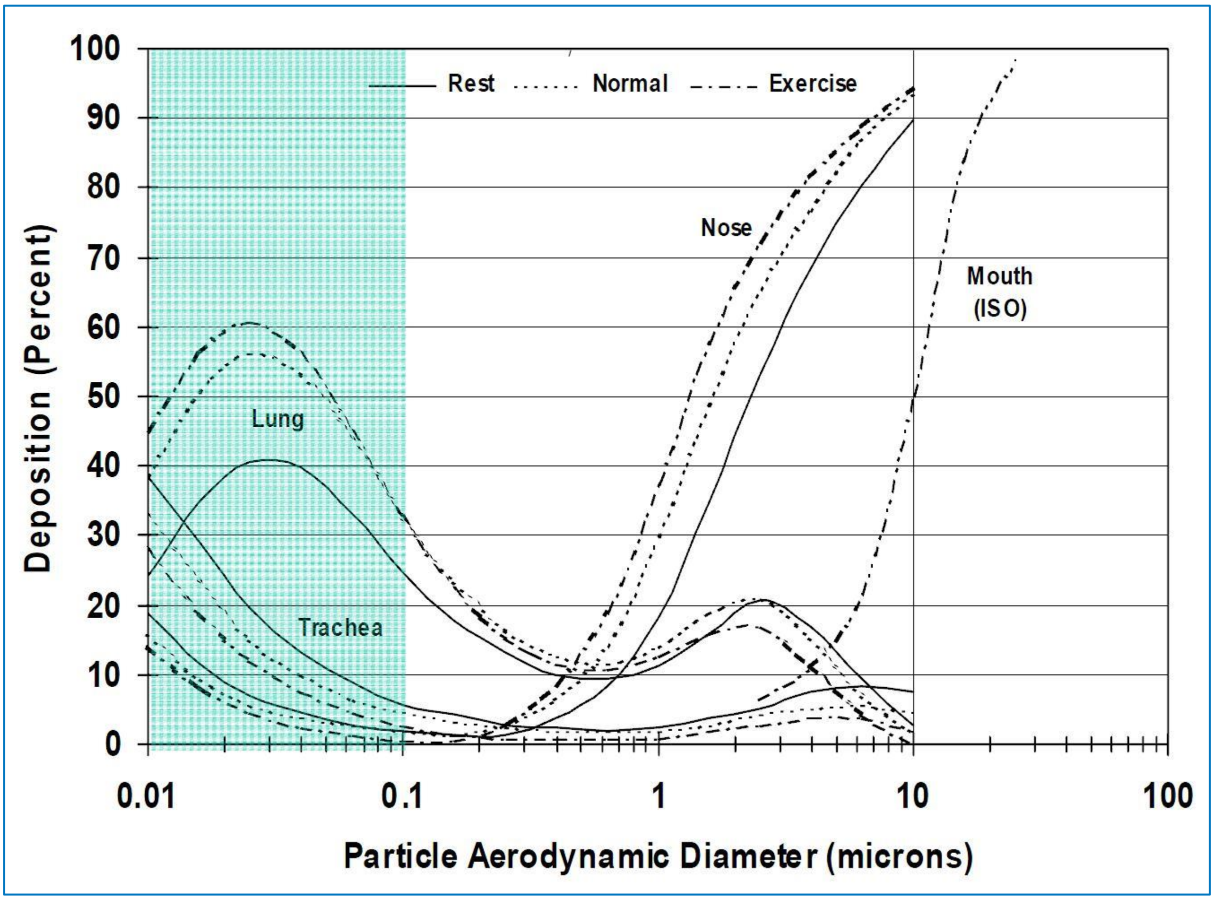
[a] Crustal dust refers to dust generated from materials derived from the earth's crust.

Fine particles or $PM_{2.5}$ are derived primarily from combustion processes, such as vehicle emissions, wood burning, coal burning for power generation, and natural processes such as bush fires. Fine particles also consist of transformation products, including sulphate and nitrate particles, and secondary organic aerosol from volatile organic compound emissions. $PM_{2.5}$, and in particular the ultrafine sub-micron particles, may penetrate beyond the larynx and into the thoracic respiratory tract and evidence suggests that particles in this size range are more harmful than the coarser component of PM_{10} (**DEH 2004**; **US EPA 2005**).

Emissions of these fine particles from quarrying operations are primarily restricted to emissions from the combustion of diesel and would be relatively minor for this Project and are not considered further.

The size of particles determine their behaviour in the respiratory system, including how far the particles are able to penetrate, where they deposit, and how effective the body's clearance mechanisms are in removing them. This is demonstrated in **Figure 4-1**, which shows the relative deposition by particle size within various regions of the respiratory tract. Additionally, particle size is an important parameter in determining the residence time and spatial distribution of particles in ambient air; key considerations in assessing exposure.



Source: **Phalen et al, 1991**

Figure 4-1: Particle Deposition within the Respiratory Track

The health-based assessment criteria used by the EPA have, to a large extent, been developed by reference to epidemiological studies undertaken in urban areas with large populations where the primary pollutants are the products of combustion (**EPA**, **1998**; **National Environment Protection Council** [**NEPC**], **1998a**; **NEPC**, **1998b**). This means that, in contrast to dust of crustal origin, the particulate matter from urban areas would be composed of smaller particles and would generally contain acidic and carcinogenic substances that are associated with combustion.

4.3 EPA Criteria

The Approved Methods specifies air quality assessment criteria relevant for assessing impacts from air pollution (**DEC, 2005**). The air quality goals relate to the total dust burden in the air and not just the dust from the Project. In other words, consideration of background dust levels needs to be made when using these goals to assess potential impacts. These criteria are health-based (i.e. they are set at levels to protect against health effects).

These criteria are consistent with the *National Environment Protection Measure for Ambient Air Quality* (referred to as the Ambient Air-NEPM) (**NEPC, 1998a**). However, the EPA's criteria include averaging periods, which are not provided in the Ambient Air-NEPM, and also reference other measures of air quality, namely dust deposition and TSP.

Table 4.1 summarises the air quality goals for pollutants that are relevant to this study. It is important to note that the criteria are applied to the cumulative impacts due to the Proposal and other sources.

Table 4.1: EPA Air Quality Standards/Goals for Particulate Matter Concentrations

Pollutant	Standard	Averaging Period	Source
TSP	90 $\mu g/m^3$	Annual	National Health and Medical Research Council
PM_{10}	50 $\mu g/m^3$	24-Hour average	NSW DEC (2005) (assessment criteria) EPA impact assessment criteria; and Ambient Air NEPM reporting goal which allows five exceedances per year.
	30 $\mu g/m^3$	Annual	EPA impact assessment criteria

Notes: $\mu g/m^3$ – micrograms per cubic metre.

In addition to health impacts, airborne dust also has the potential to cause nuisance effects by depositing on surfaces, including vegetation. Larger particles do not tend to remain suspended in the atmosphere for long periods of time and will fall out relatively close to source. Dust fallout can soil materials and generally degrade aesthetic elements of the environment, and are assessed for nuisance or amenity impacts.

Table 4.2 shows the maximum acceptable increase in dust deposition over the existing dust levels from an amenity perspective. These criteria for dust fallout levels are set to protect against nuisance impacts (**DEC, 2005**).

Table 4.2: EPA Criteria for Dust (Insoluble Solids) Fallout

Pollutant	Averaging period	Maximum increase in deposited dust level	Maximum total deposited dust level
Deposited dust	Annual	2 $g/m^2/month$	4 $g/m^2/month$

Notes: $g/m^2/month$ – grams per square metre per month.

5 EXISTING ENVIRONMENT

5.1 Meteorology

5.1.1 Local Climatic Conditions

The Bureau of Meteorology (BoM) collects climatic information in the vicinity of the Project. A range of climatic information collected from the Gunnedah Pool (Site Number 055023) which is located approximately 28 km northeast of the Project is presented in **Table 5.1**. Temperature and humidity data consist of monthly averages of 9am and 3pm readings. Monthly daily averages of maximum and minimum temperatures are also provided. Rainfall data consist of mean monthly rainfall and the average number of rain days per month.

The annual average maximum and minimum temperatures recorded at the Gunnedah Pool are 26 °C and 10.9°C respectively. On average, January is the hottest month, with an average maximum temperature of 34°C. July is the coldest month, with average minimum temperature of 3°C.

The annual average relative humidity reading collected at 9am from the Gunnedah Pool station is 67% and at 3pm the annual average is 46%. The month with the highest relative humidity on average is June with 9am averages of 79% and the months with the lowest relative humidity is November and December 3.00 pm averages of 40%.

Rainfall data collected at the Gunnedah Pool station shows that January is the wettest month, with an average rainfall of 71.3 mm over 5.6 rain days. The average annual rainfall is 621.8 mm with an average of 58.1 rain days.

Table 5.1: Climate Averages for the Gunnedah AWS

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
9am Mean Dry-bulb and Wet-bulb Temperatures (°C) and Relative Humidity (%)													
Dry-bulb	25.0	23.8	22.1	18.3	13.3	9.8	8.8	10.9	15.0	19.1	22.1	24.4	17.7
Humidity	61	65	65	67	73	79	77	71	65	61	59	58	67
3pm Mean Dry-bulb and Wet-bulb Temperatures (°C) and Relative Humidity (%)													
Dry-bulb	31.2	30.3	28.7	24.9	20.0	16.7	15.8	17.7	21.3	24.5	27.7	30.2	24.1
Humidity	43	45	44	46	51	55	53	48	44	43	40	40	46
Daily Maximum Temperature (°C)													
Mean	34.0	32.9	30.7	26.4	21.3	17.6	16.9	18.9	22.8	26.7	30.3	32.9	26.0
Daily Minimum Temperature (° C)													
Mean	18.4	18.1	15.8	11.4	7.1	4.3	3.0	4.2	7.0	10.8	14.2	16.8	10.9
Rainfall (mm)													
Mean	71.3	67.3	47.7	37.5	42.5	43.6	42.7	41.3	40.3	55.1	62.6	70.1	621.8
Rain days (Number)													
Mean	5.6	5.1	3.9	3.4	4.1	4.8	4.8	4.8	4.5	5.4	5.7	6.0	58.1

Source: BOM (2012) Climate averages for Station: 055023; Commenced: 1876; Latitude: 30.98 °S; Longitude: 150.25 °E

5.2 Existing Ambient Air Quality

Air quality standards and goals refer to pollutant levels which include the contribution from proposed projects as well as other sources. To fully assess impacts against all the relevant air quality standards and goals it is necessary to have information or estimates on existing dust concentration and deposition levels in the area in which the Project is likely to contribute to these levels.

5.2.1 PM_{10} Concentrations

There are no onsite monitoring data for PM_{10}, TSP or dust deposition. The EPA site at Tamworth is one of the closest set of publicly available PM_{10} data, located approximately 90 km east of the Project site. A summary of the EPA monitoring site data are presented in **Table 5.2.**

The highest average 24-hour average PM_{10} concentrations occurred in late 2002 to early 2003 and April and September 2009. The 2002/2003 exceedances are associated with dust storms and bushfires during these periods. The 2009 extreme values are associated with regional dust storms that affected a widespread area of NSW (April 2009) and the eastern coast of Australia (September 2009). Generally the 24-hour average PM_{10} concentrations remain below the relevant air quality criteria.

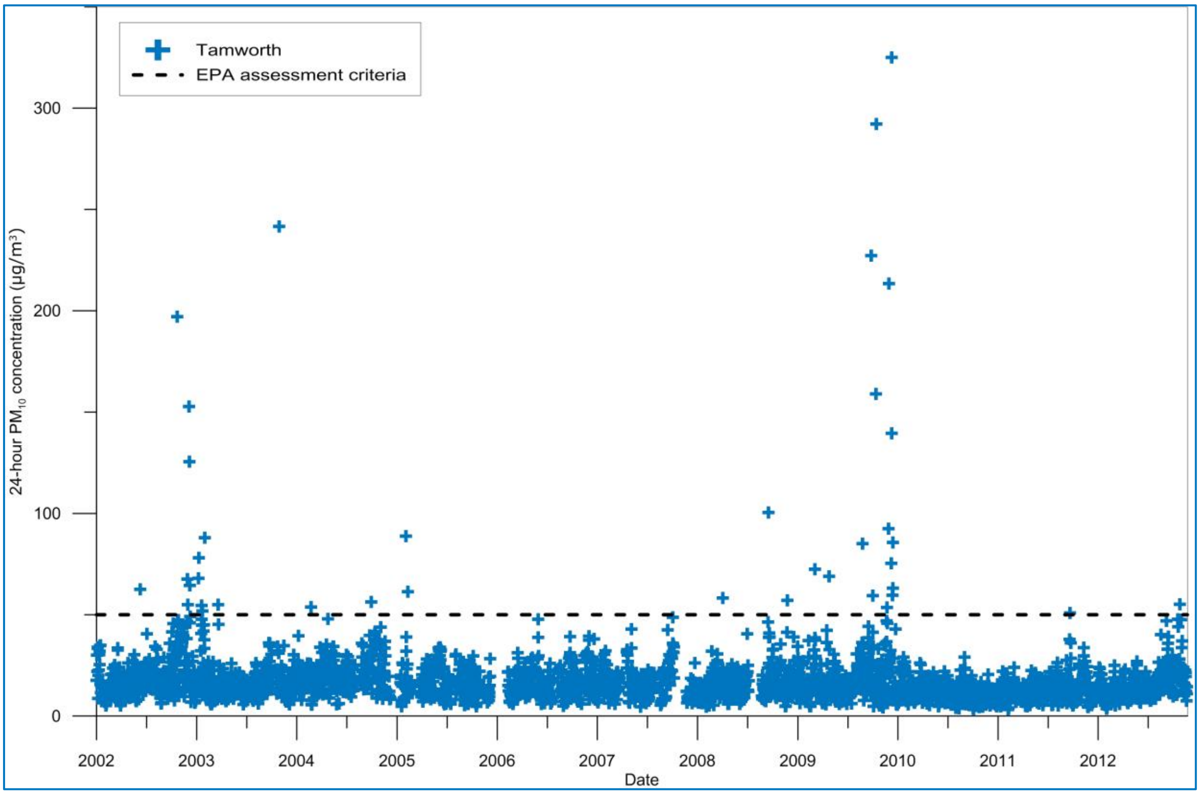


Figure 5-1: 24hr PM_{10} concentrations for January 2002 to November 2012

Annual average concentrations of PM_{10} are all below the relevant air quality goals for the monitoring period (refer to **Table 5.2**). The average annual PM_{10} at the Tamworth monitoring site for the monitoring period is 17 µg/m^3.

Table 5.2: Summary of annual average PM_{10} from the Tamworth EPA monitoring site

Date	Tamworth PM_{10} Annual average (µg/m³)
2002	20.6
2003	17.9
2004	20.7
2005	16.5
2006	16.7
2007	15.8
2008	15.8
2009	22.1
2010	12.0
2011	13.1
2012	15.7
Average	17.0

There are a number of mines operating in the surrounding region to the northeast of the Project site within 20-40 km, plus another site 75 km to the southeast.

Table 5.3 presents the PM_{10} monitoring data from the Annual Reports from coals mines surrounding the Gunnedah region. There are no exceedances of the EPA's assessment criteria for PM_{10} across any of these mine monitoring sites. The average of all these monitoring sites of 15 µg/m³ is slightly less than that recorded at Tamworth. For the cumulative assessment the local value of 15 µg/m³ will be used, which captures mining and agriculture in the Gunnedah region.

Table 5.3: Summary of annual average PM_{10} from the mines in the Gunnedah area

Year	Rocglen		Sunnyside		Tarrawonga		Werris Creek			
	PM_{10} Annual Average		PM_{10} Annual Average		PM_{10} Annual Average		PM_{10} Annual Average			
	Glen Roc	Roseberry /Surrey	SA1	SA2	Templemore	Merriown	WCHV 1	WCHV 2	WCHV 3	WCHV 4
2007	-	-	-	-	12.7	13.7	-	-	-	-
2008	22.7	13.5	-	-	19.6	10.9	-	-	-	-
2009	24.1	16.5	21.2	16.2	20.8	20.7	-	-	-	-
2010	12.2	-	9.0	8.0	13.0	11.9	-	-	-	-
2011	14.5	10.1			15.1	10.7	19.3	15.5	35.0	12.8
2012	-	-	-	-	-	8.3	9.0	9.0	9.7	8.3
Average	**18.4**	**13.4**	**15.1**	**12.1**	**16.2**	**12.7**	**14.1**	**12.3**	**22.3**	**10.5**

Source: Whitehaven Coal AEMRs 2010, 2011a, 2011b and 2012

5.2.2 TSP Concentrations

The closest publically available TSP measurements are recorded at Werris Creek, which is located approximately 75 km southeast of the Project site (see **Table 5.4**). The average of the recorded TSP is 37.5 µg/m³.

Table 5.4: Summary of annual average TSP from Werris Creek TSP monitoring site

Year	Werris Creek TSP Annual Average WCTSP
2011	50.4
2012	24.6
Average	**37.5**

Additionally annual average TSP concentrations can be estimated from the PM_{10} measurements by assuming that 40% of the TSP is PM_{10}. This relationship was obtained from data collected by co-located TSP and PM_{10} monitors operated for long periods of time in the Hunter Valley (**NSW Minerals Council, 2000**). Use of this relationship on the adopted PM_{10} annual average of 15 µg/m³ gives an existing annual average TSP concentration is approximately 37.5 µg/m³.

5.2.3 Dust deposition

Annual averages from dust deposition monitoring around the nearby Sunnyside coal mine are shown in **Table 5.5**. The average of all measurements for the period from December 2009-November 2010 is 1 $g/m^2/month$ and is adopted as the existing dust deposition background for Marys Mount.

Table 5.5: Dust deposition at Sunnyside Coal mine, Gunnedah NSW

Period: Dec 2009 - Nov 2010 Monitoring site ID	Total Insoluble Solids ($g/m^2/month$) Average
SD-1	0.8
SD-3	0.5
SD-4	0.5
SD-5	1.3
SD-6	1.6
SD-7	1.5
Average	**1.0**

5.2.4 Existing Air Quality for Assessment Purposes

In summary, for the purposes of assessing potential air quality impacts, the following existing air quality levels are assumed.

- Annual average PM_{10} concentration of 15 $\mu g/m^3$,
- 24-hour average PM_{10} concentrations – daily varying,
- Annual average TSP concentration of 37.5 $\mu g/m^3$,
- Annual average dust deposition of 1 $g/m^2/month$.

6 MODELLING APPROACH

This Air Quality Assessment has been conducted in accordance with the Approved Methods (**DEC, 2005**) and the approach is described in the following sections.

6.1 Modelling System

AERMOD was chosen as the most suitable model due to the source types, location of nearest receivers and nature of local topography. AERMOD is the US-EPA's recommended steady-state plume dispersion model for regulatory purposes. AERMOD replaced the Industrial Source Complex (ISC) model for regulatory purposes in the US in December 2006 as it provides more realistic results. Ausplume, a steady state Gaussian plume dispersion model developed by the Victorian EPA and frequently used in Australia for simple near-field applications is based on ISC, which has now been replaced by AERMOD.

A significant feature of AERMOD is the Pasquill-Gifford stability based dispersion is replaced with a turbulence-based approach that uses the Monin-Obukhov length scale to account for the effects of atmospheric turbulence based dispersion.

The AERMOD system includes AERMET, used for the preparation of meteorological input files and AERMAP, used for the preparation of terrain data.

Terrain data was sourced from NASA's Shuttle Radar Topography Mission (SRTM) Data (3 arc-second (~90m) resolution) and processed within AERMAP to create the necessary input files.

AERMET requires surface and upper air meteorological data as input. Surface data, including cloud cover was sourced from the Gunnedah Airport AWS. Appropriate values for three surface characteristics are required for AERMET as follows:

- Surface roughness, which is the height at which the mean horizontal wind speed approaches zero, based on a logarithmic profile.
- Albedo, which is an indicator of reflectivity of the surface.
- Bowen ratio, which is an indicator of surface moisture.

Values of surface roughness, Bowen ratio and albedo were determined based on a review of aerial photography for a radius of 3 km centered on the quarry site. Default values for cultivated land where chosen for the entire area.

6.2 Dispersion Meteorology

A windrose for the Gunnedah Airport AWS is shown in **Figure 6-1**. The predominant winds across the site are southeasterly and south-southeasterly. These predominant winds occur throughout all seasons, and when compared to previous years this feature is also seen.

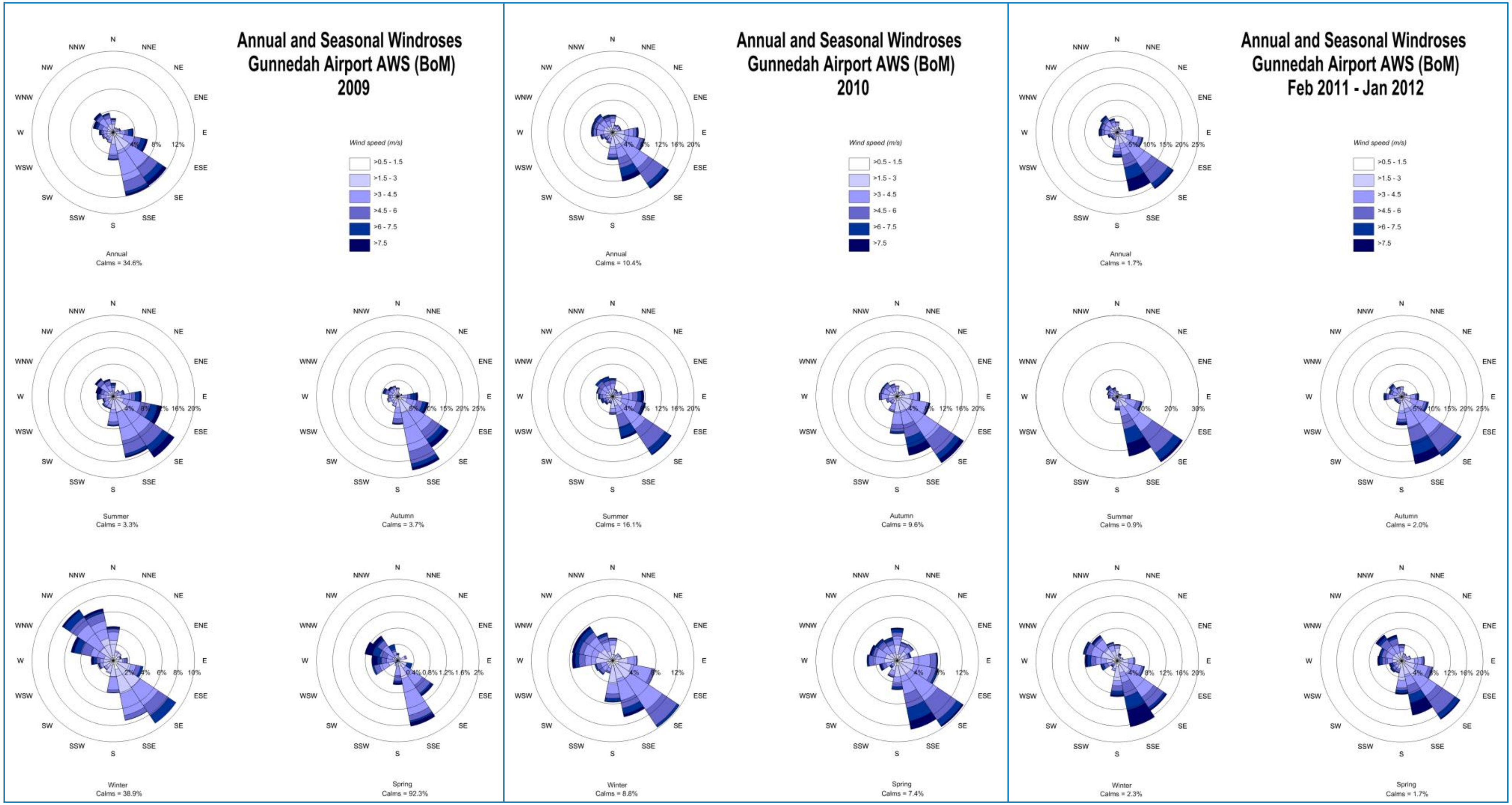


Figure 6-1: CALMET windrose extracted for the Gunnedah AWS – 2009, 2010 and Feb 2011-Jan 2012

7 EMISSIONS TO AIR

7.1 Operation Phase

During operations, the Project will result in emissions of particulate matter, primarily from material handling and hauling in the extraction area and screening, crushing and stockpile loading in the processing area. During Stage 3, there will be additional emissions from drilling and blasting operations. A maximum of seven blasts per year is anticipated.

Dust emissions during operations have been estimated by analysing the activities taking place for the Project. Stage 1.5/2.1 has been modelled as discussed in **Section 2** and emission estimates are presented for a maximum operational production of 360,000 tpa of product.

The estimated dust emissions for the Stage 1.5/2.1 operational scenario are presented in **Table 7.1**. In estimating dust emissions, consideration has been given to best practice management and controls, including watering on haul roads. The controlled emission factors for crushing and screening have been used to capture the demisters used with these activities.

The estimated dust emissions for the Stage 3.1 operational scenario are presented in **Table 7.2**. A comparison of the annual TSP emissions from Stage 3 with Stage 1.5/2.1 shows that Stage 3 will generate 4% more emissions and as such would result in higher predicated concentrations for TSP than Stage 1.5/2.1. A comparison of the annual PM_{10} emissions from Stage 3 with Stage 1.5/2.1 shows that Stage 3 will generate 13% less emissions resulting in lower predicted concentrations for PM_{10} than Stage 1.5/2.1. Since PM_{10} emissions are more likely to have a negative impact on human health, Stage 1.5/2.1 was modelled to represent the worst case scenario.

Table 7.1: Estimated Annual Dust Emissions Stage 1.5/2.1

Activity	TSP (kg/y)	PM_{10} (kg/y)
Quarry Area		
Dozers	93,431	25,499
Excavator loading	353	167
Processing Area		
Hauling to processing area (unsealed)	3,887	999
Unloading at processing area	353	167
Rehandle rock to hopper	353	167
Primary Crushing	216	97
Crushing (Fines)	540	216
Screening (controlled)	396	133
Stacking stockpiles	232	110
FEL loading trucks	232	110
Hauling product to stockpile (unsealed)	3,887	999
Hauling product to stockpile (sealed)	13,714	2,632
Stockpile Area		
Unloading at stockpile	232	110
Loading at stockpile	232	110
Hauling product to Barker Road (sealed)	37,504	7,199
Wind Erosion		
WE - Extraction Area	7,884	3,942
WE - Stockpile	2,015	1,007
Grading roads	11,829	4,133
Total (kg/y)	**177,228**	**47,796**

Table 7.2: Estimated Annual Dust Emissions Stage 3.1

Activity	TSP (kg/y)	PM_{10} (kg/y)
Quarry Area		
Dozers	93,431	12,128
Excavator loading	353	167
Blasting & Drilling		
Drilling	496	258
Blasting	118	61
Processing Area		
Hauling to processing area (unsealed)	9,069	2,876
Unloading at processing area	353	167
Rehandle rock to hopper	353	167
Primary Crushing	216	97
Crushing (Fines)	540	216
Screening (controlled)	396	133
Stacking stockpiles	232	110
FEL loading trucks	232	110
Hauling product to stockpile (unsealed)	9,069	2,876
Hauling product to stockpile (sealed)	18,285	4,333
Stockpile Area		
Unloading at stockpile	232	110
Loading at stockpile	232	110
Hauling product to Barker Road (sealed)	34,095	6,544
Wind Erosion		
WE - Extraction Area	2,628	3,040
WE - Stockpile	1,927	964
WE – Active Rehad	532	3,445
Grading roads	11,829	4,133
Total (kg/y)	**184,616**	**42,044**

All activities and emissions are assumed to occur between 7am and 6pm, seven days per week to be conservative[b]. TSP, PM_{10} and $PM_{2.5}$ emission rates were calculated using emission factors derived from **US EPA (1995)** and **NERDDC (1988)** work (see **Appendix A**).

7.1.1 Best Practice mitigation measures

The Project will employ a number of best practice mitigation measures on-site to ensure that dust impacts are minimised. Recommended measures to be employed for the Project include:

- Use of water carts/trucks to control emissions from haul roads.
- Enforcement of speed limits onsite and on right of way.
- Training and implementation of standard operating procedures.
- Progressive rehabilitation of exposed areas.
- Application of water at the crusher and on conveyor transfer points.
- Minimising drop height of material during truck loading and unloading.
- Sheltering of stockpiles and transfer points where possible.
- Management of dust generating activities during unfavourable meteorological conditions.

[b] Quarry operations will only occur 6 days a week; however the modelling must assume operations occur 7 days per week.

7.2 Emissions from nearby sources

The background values to be used in the cumulative assessment (see **Section 8.2**) have been taken from publically available air quality monitoring data recorded at a number of mines in the Gunnedah region (summarised in **Section 5.2.4**).

8 IMPACT ASSESSMENT

8.1 Incremental impact

The predicted impacts due to the Project alone are presented in the sections below. The contour plots are indicative of the concentrations that could potentially be reached under the conditions modelled. A summary of the predicted pollutant concentrations at each of the receiver locations are presented in **Table 8.1**.

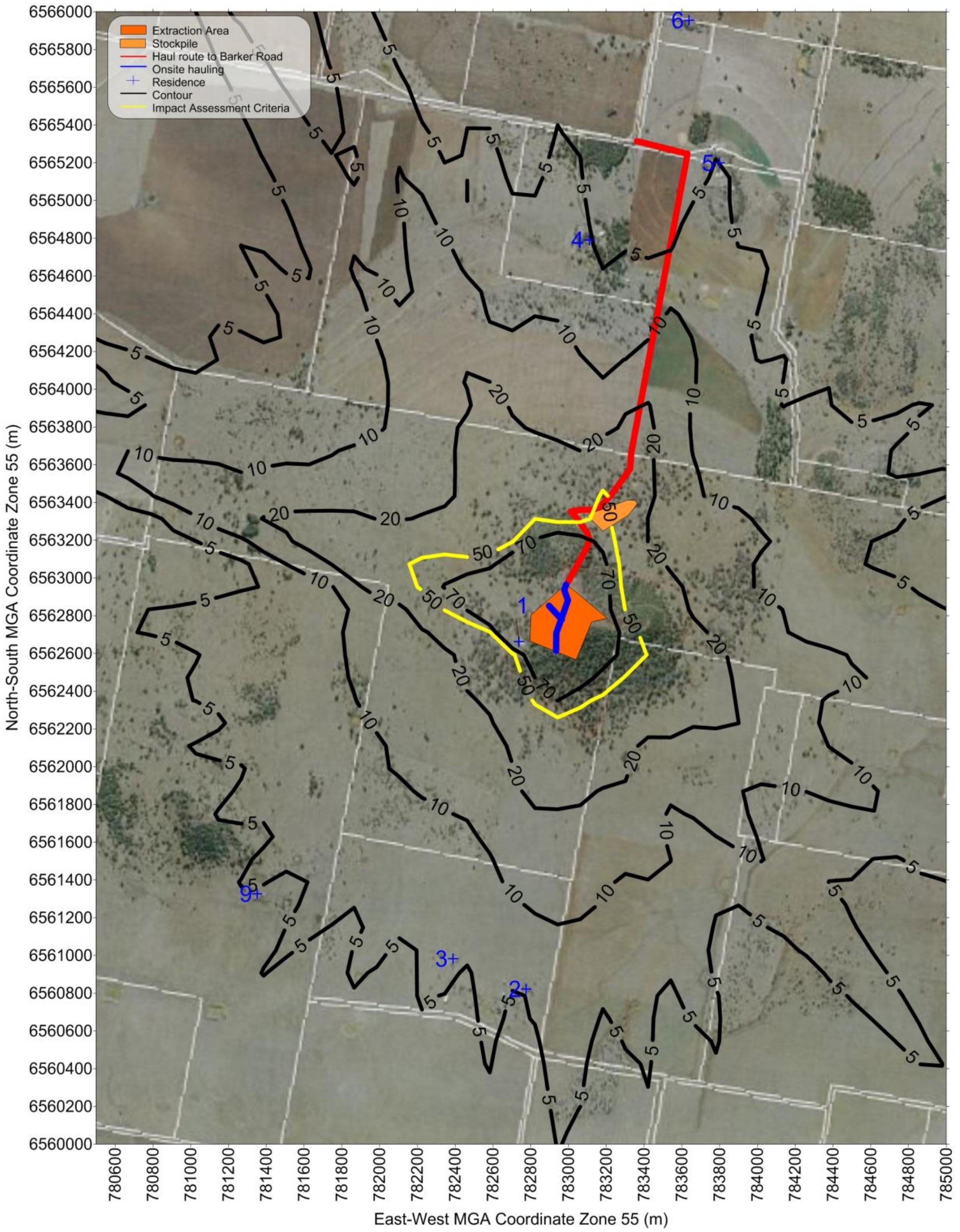
There are no privately owned receivers that are predicted to experience glcs above the assessment criteria for PM_{10}, TSP or dust deposition, due to emissions from the Project alone. The residence closest to the pit

Table 8.1: Predicted Incremental Ground Level Concentrations at Receiver Locations

Marys Mount Blue Steel Quarry				
ID	Project alone			
	PM_{10} (µg/m³)		TSP (µg/m³)	Dust deposition (g/m²/month)
	Averaging period			
	24-hr	Annual	Annual	Annual
	Assessment criteria			
	50	30	90	2
R1	67	7	12	17
R2	4	<1	<1	<1
R3	6	<1	<1	<1
R4	5	<1	<1	<1
R5	5	<1	<1	<1
R6	2	<1	<1	<1
R7	1	<1	<1	<1
R8	1	0	0	<1
R9	5	<1	<1	<1
R10	2	<1	<1	<1
R11	3	<1	<1	<1
R12	4	<1	<1	<1
R13	1	0	0	0

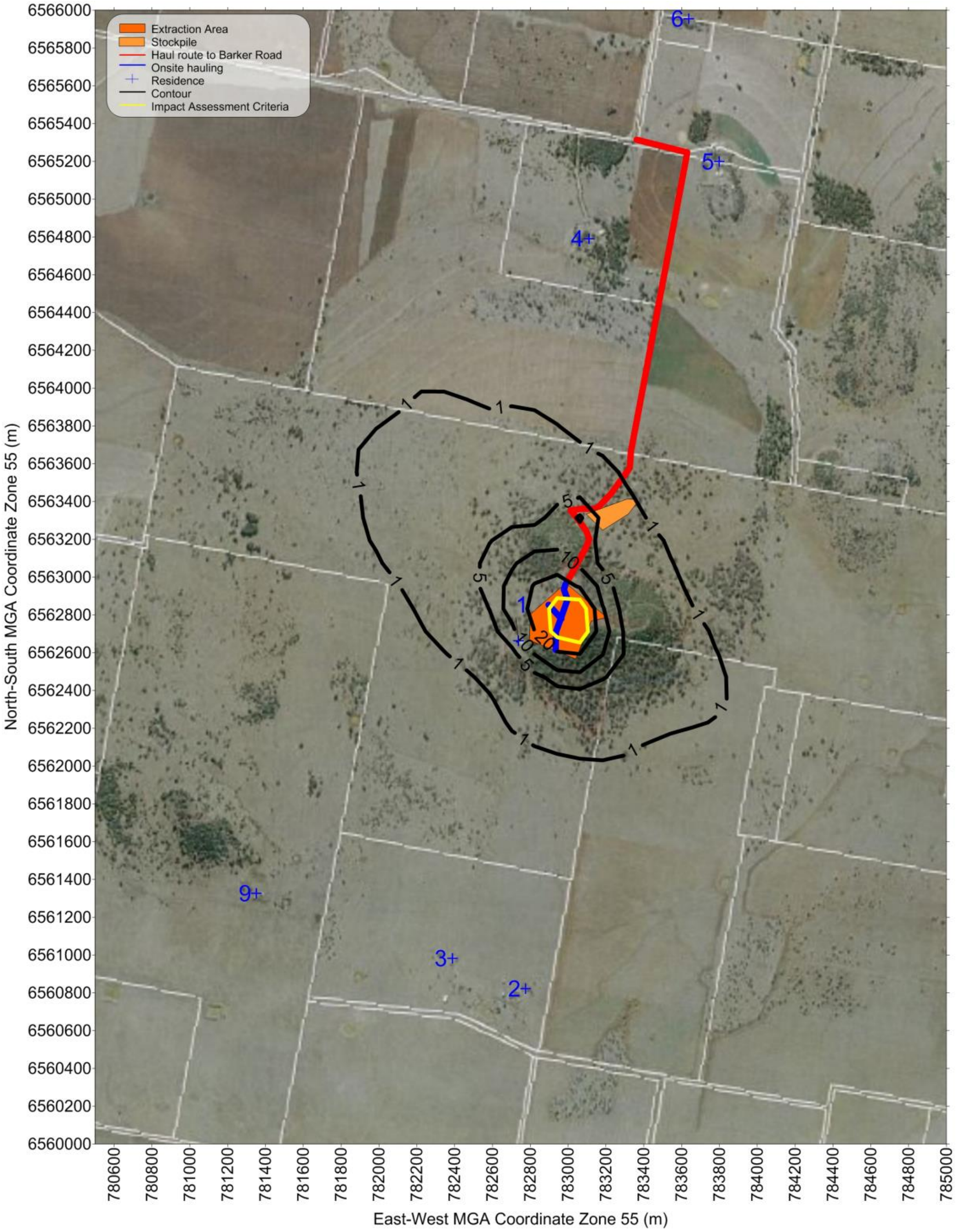
8.1.1 Incremental Ground Level PM_{10} Concentrations

Contour plots for the predicted ground level concentrations (glcs) of PM_{10} are presented in **Figure 8-1**, and **Figure 8-2**. Predicted 24-hour and annual average PM_{10} are presented for Stage 1.5/2.1. One privately owned receiver (R1, located approximately 50m from the edge of the quarry) is predicted to experience glcs of 24-hour average PM_{10} above the assessment criteria, due to emissions from the Project. At this location, the predicted incremental 24-hour average PM_{10} concentration is 67 µg/m³. The predicted annual average PM_{10} concentration is 7 µg/m³.



Species:	**Location:**	**Scenario:**	**Percentile:**	**Averaging Time:**
PM_{10}	Marys Mount Blue Steel Quarry	Stage 1.5/2.1	Maximum	24-Hour
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
AERMOD v 8.0.5	µg/m³	N/A	AERMET generated	G. Laing

Figure 8-1: Incremental Max 24-Hour PM_{10} Concentration – Stage 1.5/2.1

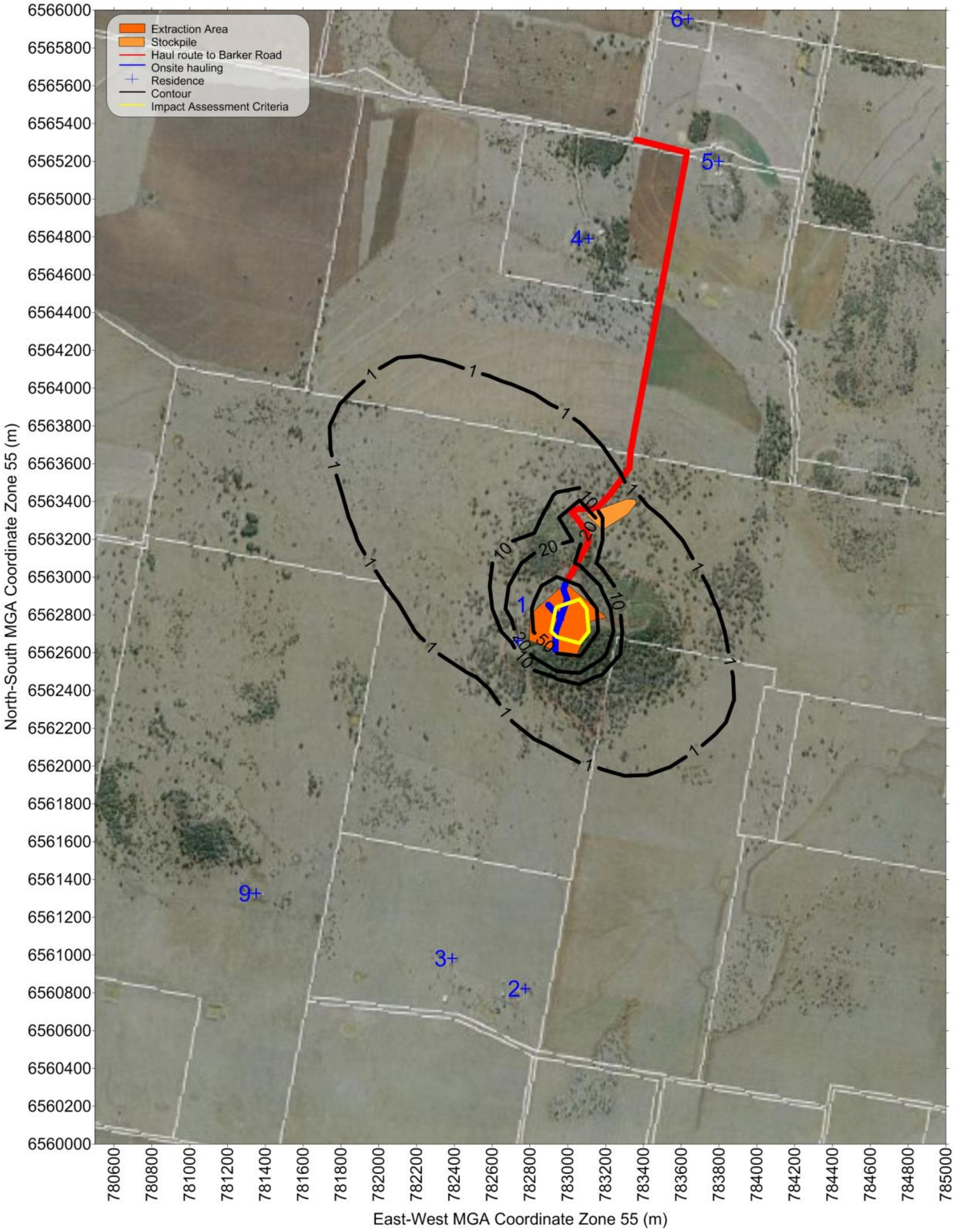


Species:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	Marys Mount Blue Steel Quarry	Stage 1.5/2.1	Average	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
AERMOD v8.0.5	µg/m³	N/A	AERMET generated	G. Laing

Figure 8-2: Incremental Annual Average PM_{10} Concentration - Stage 1.5/2.1

8.1.1.1 Incremental Ground Level TSP Concentrations

Contour plots for the predicted glcs of TSP are presented in **Figure 8-3**. Annual average TSP predictions are presented for Stage 1.5/2.1. There are no receivers that are predicted to experience glcs of TSP above the assessment criteria, due to emissions from the Project. The highest predicted glcs occur at the R1. At this location, the predicted incremental annual average TSP concentration is 12 µg/m^3.



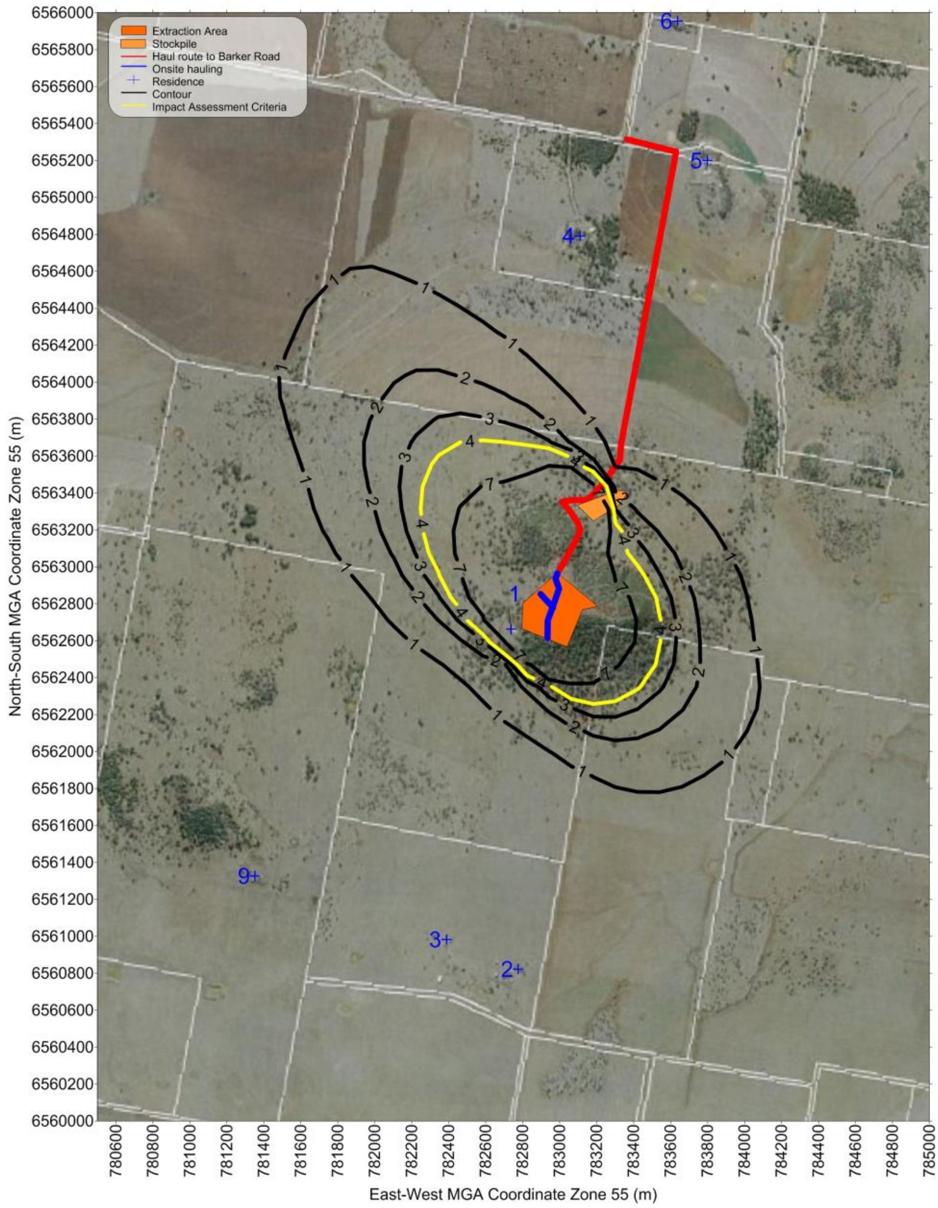
Species:	Location:	Scenario:	Percentile:	Averaging Time:
TSP	Marys Mount Blue Steel Quarry	Stage 1.5/2.1	Average	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
AERMOD v8.0.5	µg/m³	N/A	AERMET generated	G. Laing

Figure 8-3: Incremental Annual Average TSP Concentration – Stage 1.5/2.1

8.1.2 Incremental Ground Level Dust Deposition Level

Contour plots for the predicted dust deposition levels are presented in **Figure 8-4**. Annual average dust deposition predictions are presented for the operational scenario. The relevant impact assessment criterion of 2 g/m^2/month is shown by the yellow contour line.

One residence (R1) is predicted to experience dust deposition above the assessment criteria, due to emissions from the Project during the worst case Stage 1.5/2.1. At this location, the predicted incremental annual average dust deposition is 17 g/m^2/month. No other receivers were predicted to exceed the criteria.



Species:	Location:	Scenario:	Percentile:	Averaging Time:
Dust Deposition	Marys Mount Blue Steel Quarry	Stage 1.5/2.1	Average	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
AERMOD v8.0.5	g/m^2/month	2 g/m^2/month	AERMET generated	G. Laing

Figure 8-4: Incremental Annual Average Dust Deposition – Stage 1.5/2.1

8.2 Cumulative Impact Assessment

8.2.1 24-Hour average PM_{10}

There are no available continuous 24-hour average PM_{10} data for the area. HVAS data are available every sixth day, however, this is insufficient to provide a representative background for each day of the model simulation.

A statistical approach (using a Monte Carlo Simulation) is therefore presented to investigate the potential for cumulative 24-hour average PM_{10} impacts. The approach takes all of the available background monitoring data adopted for the assessment (refer **Section 5**) and randomly generates a daily 24-hour average PM_{10}. This random daily background concentration is added to model predictions for each day of the year, at selected receiver locations. The addition of the random background to the model predicted 24-hour average PM_{10} is repeated 250,000 times to generate a probability distribution of cumulative 24-hour average PM_{10} concentrations. The Monte Carlo Simulation is run using the Oracle Crystal Ball software (version 11.1.1.2).

The process assumes that a randomly selected background value from the real dataset would have a chance equal to that of any other background value from the dataset of occurring on the given future day when the Project is operational. With sufficient repetition, this yields a good statistical estimate of the combined and independent effects of varying background and Project contributions to total 24-hour PM_{10}.

The results of the simulation are shown in **Figure 8-5** for all of the closest receivers to the Project site. The plots show the predicted frequency distribution of cumulative 24-hour average PM_{10} concentration compared with the assumed background (dashed red line). It is clear from **Figure 8-5** that other than at R1, the addition of the project would be unlikely to result in many additional days over the impact assessment criteria and at the 50 µg/m³ level, as the statistical distribution of cumulative glcs are largely indistinguishable from background.

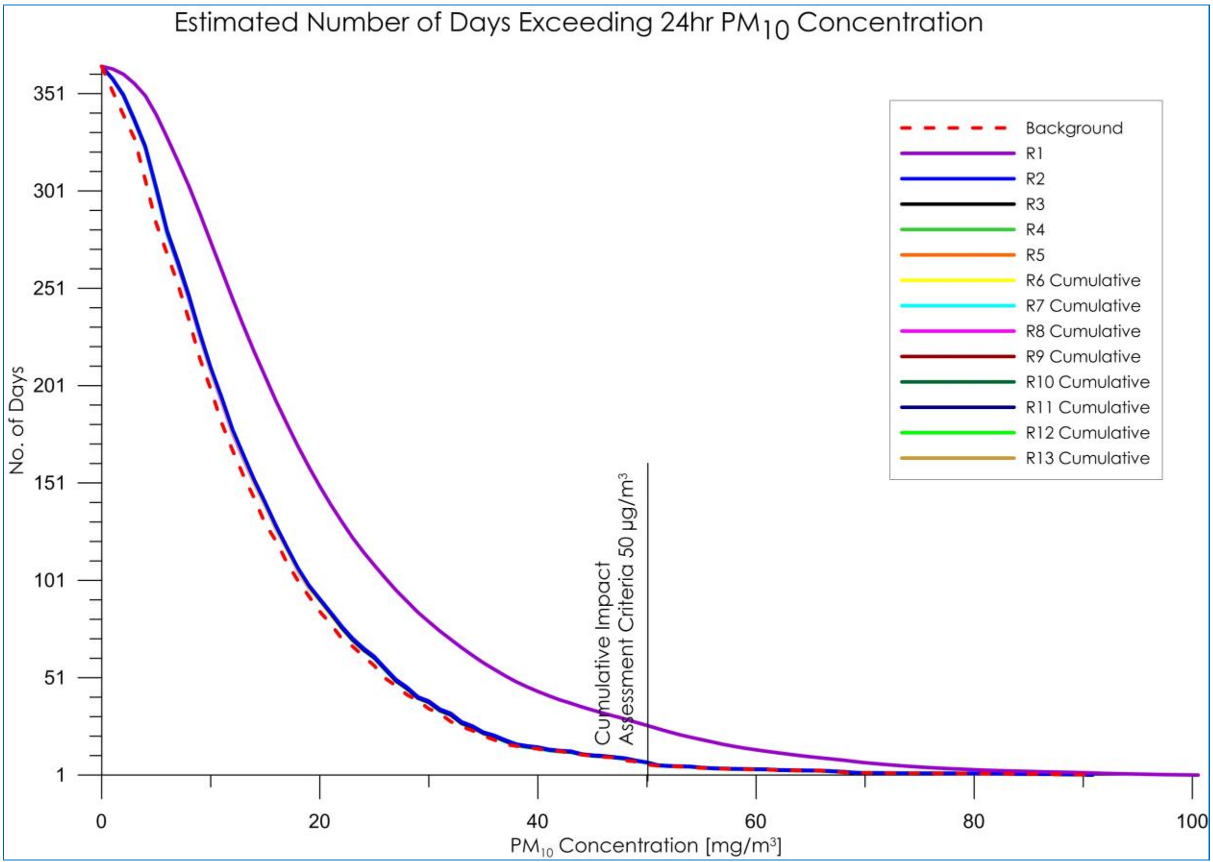


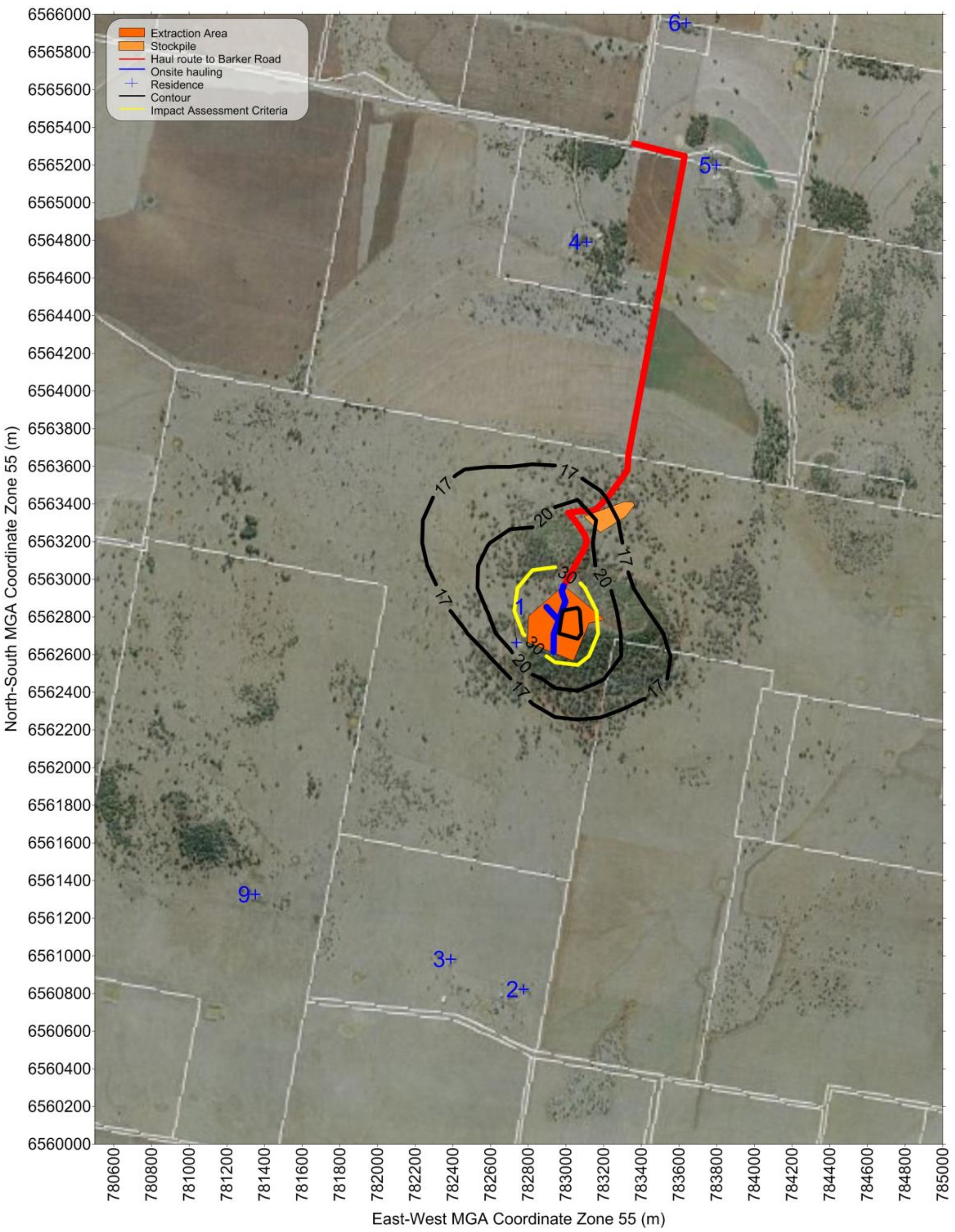
Figure 8-5: Predicted Number of Days Over 24-Hour average PM_{10} Concentration

8.2.2 Annual average

The predicted pollutant concentrations at each of the sensitive receivers are added to the adopted background levels and presented in **Table 8.2**. When existing background concentrations are included, there are no privately owned receivers that are predicted to exceed the annual average assessment TSP criterion of 90 µg/m³, or the annual average PM_{10} criterion of 30 µg/m³, however, R1 is predicted to experience a large exceedance of the dust deposition criterion of 4 g/m²/month.

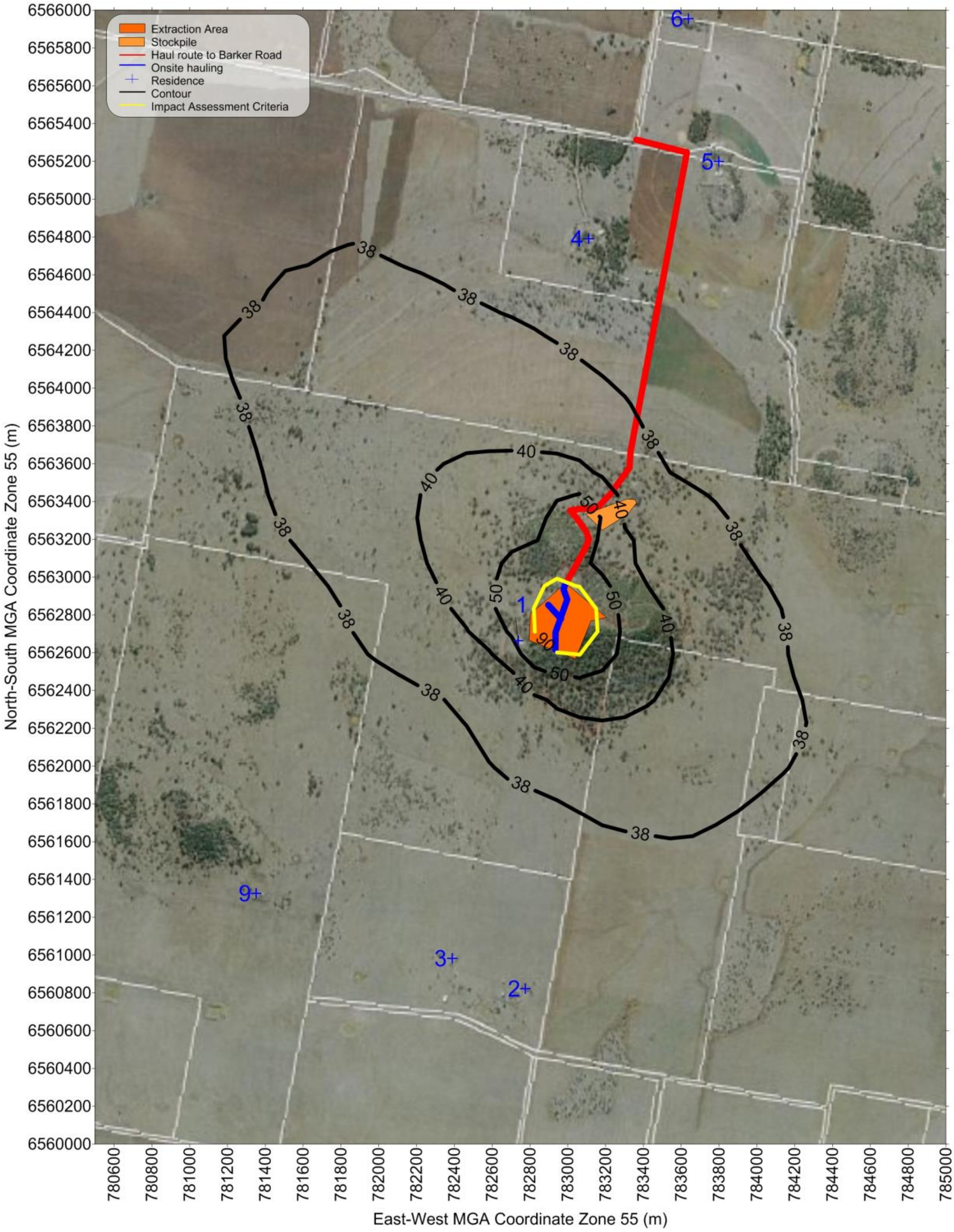
Table 8.2: Predicted Cumulative Annual Average PM_{10} concentrations at Receiver Locations

Marys Mount Blue Steel Quarry			
ID	Cumulative		
	PM_{10} (µg/m³)	TSP (µg/m³)	Dust deposition (g/m²/month)
	Averaging period		
	Annual	Annual	Annual
	Assessment criteria		
	30	**90**	**4**
	17	**37.5**	**1**
R1	24	50	18
R2	17	38	1
R3	17	38	1
R4	17	38	1
R5	17	38	1
R6	17	38	1
R7	17	38	1
R8	17	38	1
R9	17	38	1
R10	17	38	1
R11	17	38	1
R12	17	38	1
R13	17	38	1



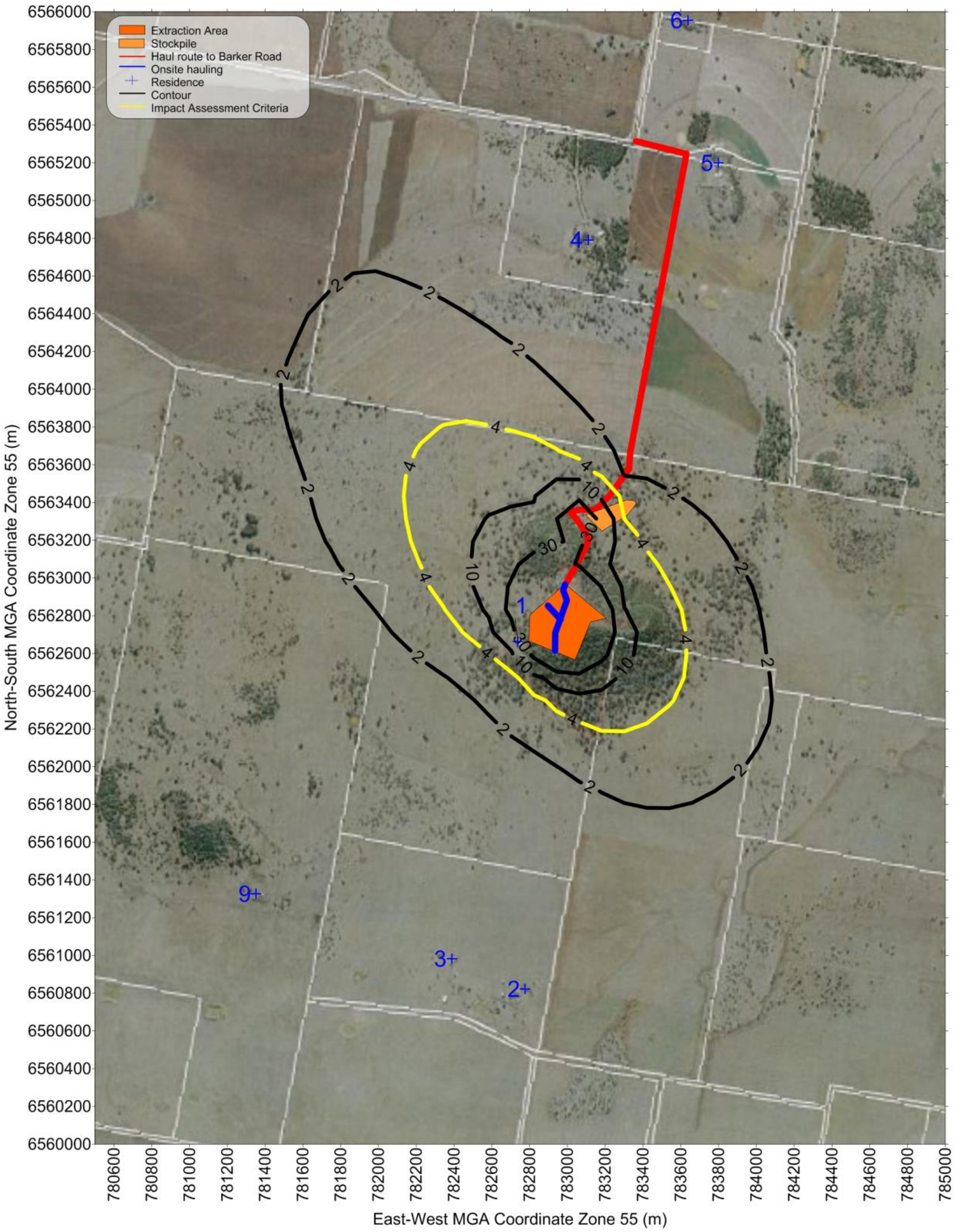
Species:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	Marys Mount Blue Steel Quarry	Stage 1.5/2.1	Average	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
AERMOD v8.0.5	g/m²/month	30 µg/m³	AERMET generated	G. Laing

Figure 8-6: Cumulative Annual Average PM_{10} – Stage 1.5/2.1



Species:	Location:	Scenario:	Percentile:	Averaging Time:
TSP	Marys Mount Blue Steel Quarry	Stage 1.5/2.1	Average	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
AERMOD v8.0.5	g/m²/month	90 µg/m³	AERMET generated	G. Laing

Figure 8-7: Cumulative Annual Average TSP – Stage 1.5/2.1



Species:	Location:	Scenario:	Percentile:	Averaging Time:
Dust Deposition	Marys Mount Blue Steel Quarry	Stage 1.5/2.1	Average	Annual
Model Used:	**Units:**	**Guideline:**	**Met Data:**	**Plot:**
AERMOD v8.0.5	g/m^2/month	4 g/m^2/month	AERMET generated	G. Laing

Figure 8-8: Cumulative Annual Average Dust Deposition – Stage 1.5/2.1

9 CONSTRUCTION PHASE EMISSIONS

The principal emissions from the construction phase of the Project will be dust and particulate matter, occurring from the following activities:

- Vegetation clearing and earthmoving during site preparation and access road construction.
- Excavation and stockpiling of excavated material.
- Movement of heavy plant and machinery within the site.
- Graders / scrapers working access road construction.
- Wind erosion from exposed surfaces.

It is anticipated that dust emissions during the construction phase of the project will be considerably less than emissions during operation of the quarry. Procedures for controlling dust impacts during construction will include, but not necessarily be limited to the following:

9.1.1 Clearing / Excavation

Emissions from vegetation stripping, topsoil clearing and excavation can occur, particularly during dry and windy conditions. Emissions can be effectively controlled by increasing the moisture content of the soil / surface. Other controls that will be considered are:

- Modify working practices by limiting excavation during periods of high winds.
- Limiting the extent of clearing of vegetation and topsoil to the designated footprint required for construction and appropriate staging of any clearing.

9.1.2 Access Road

The use of earth moving equipment can be significant sources of dust, and emissions should be controlled through the use of water sprays during road construction. Where conditions are excessively dusty and windy, and fugitive dust can be seen leaving the site, work practices should be modified by limiting scraper / grader activity.

9.1.3 Haulage and Heavy Plant and Equipment

Vehicles travelling over paved or unpaved surfaces tend to produce wheel generated dust and can result in dirt track-out on paved surfaces surrounding the work areas.

- All vehicles on-site should be confined to a designated route with speed limits enforced;
- Trips and trip distances should be controlled and reduced where possible, for example by coordinating delivery and removal of materials to avoid unnecessary trips;
- Dirt that has been tracked onto sealed roads should be cleaned as soon as practicable;
- When conditions are excessively dusty and windy, and dust can be seen leaving the works site the use of a water truck (for water spraying of travel routes) should be used;
- Seal the main access roads as soon as practical.

9.1.4 Wind Erosion

Wind erosion from exposed ground should be limited by avoiding unnecessary vegetation clearing and ensure rehabilitation occurs as quickly as possible. Wind erosion from temporary soil stockpiles can be limited by minimising the number of stockpiles on-site and minimising the number of work faces on stockpiles.

10 CONCLUSION

Pacific Environment has completed an Air Quality Assessment for the Project, in accordance with the Director General Requirements issued.

Two operational scenarios were assessed based Stage 1.5/2.1 and Stage 3.2. Dispersion modelling was conducted for a worst case scenario, based on Stage 1.5/2.1 to predict the ground level concentrations for all relevant pollutants.

The results of the modelling indicate that the predicted incremental TSP at the closest residential receivers are all below the impact assessment criteria. PM_{10} and dust deposition was predicted to be above the assessment criteria at R1, which is located within 50m of the pit. No exceedances were predicted at any other of the nearby residences.

A cumulative assessment, incorporating existing background levels, indicates that the Project is unlikely to result in any additional exceedances of relevant impact assessment criteria at the neighbouring receivers.

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APPENDIX A - ESTIMATION OF EMISSIONS

Marys Mount Blue Metal Quarry

Estimated emissions are presented for all significant dust generating activities associated with the operation of the Project.

Fugitive dust emissions can be expected during operation from the following activities:

- Loading/unloading to trucks.
- Crushing and screening – primary/secondary.
- Hauling.
- Wind erosion.
- Grading roads.
- Drilling/Blasting.

Silt and moisture content

Silt and moisture content values for in pit activities are based on values used in other assessments of similar facilities. Testing reports were provided for a number of product stockpiles and the highest moisture content of 2.7 % was used for all stockpiling and loading of final products.

Activity	Silt content (%)	Moisture content (%)
In pit	15	2
Stockpiles	-	2.7
Haul roads	5	-

Loading / transfer material dumping waste rock

Each tonne of material loaded will generate a quantity of particulate matter that will depend on the wind speed and the moisture content according to the US EPA emission factor equation (**US EPA, 1985 and updates**) shown below:

$$E\ (kg/t) = k\ \times 0.0016\ \times \left(\frac{\left(\frac{U}{2.2}\right)^{1.3}}{\left(\frac{M}{2}\right)^{1.4}} \right)$$

Where:

K = 0.74 for TSP and 0.35 for PM_{10}

U – wind speed (m/s)

M – moisture content (%)

The moisture content of waste material is assumed to be 2% and the wind speed is taken Gunnedah BoM station.

Hauling material on unsealed surfaces

The emission estimate of wheel generated dust associated with hauling at the pit top areas (i.e. for hauling of waste rock material during construction is based the US EPA AP42 emission equation for unpaved surfaces at industrial sites (**US EPA, 1985 and updates**) shown below:

$$E_{TSP}\ (kg/VKT) = 0.2819 \times 4.9 \times [\times (s/12)^\wedge 0.7 \times ((W \times 1.1023)/3)^\wedge 0.45]$$

$$E_{PM_{10}}\ (kg/VKT) = 0.2819 \times 1.5 \times [\times (s/12)^\wedge 0.9 \times ((W \times 1.1023)/3)^\wedge 0.45]$$

Where:

s = silt content of road surface
W = mean vehicle weight
The silt content (s) for the haulage routes is assumed to be 5%.

The mean vehicle weight used in the emissions estimates is an average of the loaded and unloaded gross vehicle mass, to account for one empty trip and one loaded trip.

Client supplied	Vehicle type	Unloaded (tare) weight	Loaded (GVM) including load	Capacity (tonnes)
On site	CAT 740 DUMP	33.1	72.6	39.5
Onsite	Semi tipper	15.5	42.5	27
Offsite	Truck and Dog	16	48.5	32

Crushing and Screening

The emission factor used for crushing have been taken to from the US EPA emission factors (**US EPA, 1985 and updates**), which are shown in the table below:

Activity	TSP	PM_{10}
Tertiary crushing (controlled)	0.0006	0.00027
Fines crushing (controlled)	0.0015	0.0006
Screening (controlled)	0.0011	0.00037

Dozers

Emissions from dozers on waste have been calculated using the US EPA emission factor equation (**US EPA, 1985 and updates**).

$$E_{TSP}(kg/hr) = 2.6 \times \frac{s^{1.2}}{M^{1.3}}$$

$$E_{PM_{10}}(kg/hr) = 0.3375 \times \frac{s^{1.5}}{M^{1.4}}$$

Where:

s = silt content (assumed to be 15%)

M = moisture content (assumed to be 2%).

Wind Erosion

The emission factor used for wind erosion has been taken to be a quarter of the SPCC average value 0.4 – i.e. 0.1 kg/ha for TSP and 0.05 kg/ha for PM_{10} (**SPCC, 1983**).

Grading roads

Estimates of TSP emissions from grading roads have been made using the **US EPA (1985 and updates)** emission factor equation (Equation 8).

$$E_{TSP} = 0.0034 \times S^{2.5}$$
$$E_{PM_{10}} = 0.00336 \times S^{2.0}$$

Where:

S = speed of the grader in km/h (taken to be 8 km/h)

Drilling and Blasting

The emissions generated from drilling were calculated using the AP42 11.9 equation

$$E_{TSP} = 0.59$$
$$E_{PM_{10}} = 0.59 \times TSP$$

The emissions generated from blasting were calculated using the AP42 11.9 equation

$$E_{TSP} = 0.00022 \times A^{1.5}$$
$$E_{PM_{10}} = 0.52 \times TSP$$

TSP emission inventory

ACTIVITY	TSP emission (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Control	Units	Source type	Emission Factor Source	Assumptions
Quarry Area																				
Dozers	93431	3432	h/y	27.22	h/y	15	Silt content	2	moisture content									1	AP 42 11.9 Table 11.9-2	Assuming 1 Dozer running 11 hours a day, six days per week
Excavator loading	353	360000	t/y	0.00098	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %									2	Ap 42 13.2.4	Assuming 2% moisture content
Processing Area																				
Hauling to processing area (unsealed)	3,887	360000	t/y	0.043	kg/t	40	t/load	52.85	Vehicle gross mass (t)	0.6	km/return trip	2.8430522	kg/VKT	5	% silt content	75	% control	1	AP 42 13.2.2	
Unloading at processing area	353	360000	t/y	0.00098	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %									2	Ap 42 13.2.4	
Rehandle rock to hopper	353	360000	t/y	0.00098	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %									2	Ap 42 13.2.4	
Primary Crushing	216	360000	t/y	0.0006	kg/t													1	AP 42 11.19.2 Table 11.19.2-1	Assumed AP42 tertiary (controlled) crushing emission factor
Crushing (Fines)	540	360000	t/y	0.0015	kg/t													1	AP 42 11.19.2 Table 11.19.2-1	Assumed AP42 fines (controlled) crushing emission factor
Screening (controlled)	396	360000	t/y	0.0011	kg/t													1	AP 42 11.19.2 Table 11.19.2-1	Assumed AP42 Screening (controlled) emission factor
Stacking stockpiles	232	360000	t/y	0.00064	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2.7	moisture content in %									2	Ap 42 13.2.4	Taken from the sampling reports provided
FEL loading trucks	232	360000	t/y	0.00064	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2.7	moisture content in %									2	Ap 42 13.2.4	Taken from the sampling reports provided
Hauling product to Stockpile (unsealed)	3,887	360000	t/y	0.043	kg/t	40	t/load	52.85	Vehicle gross mass (t)	0.6	km/return trip	2.8430522	kg/VKT	5	% silt content	75	% control	1	AP 42 13.2.2	
Hauling product to Stockpile (sealed)	13,714	360000	t/y	0.038	kg/t	40	t/load	52.85	Vehicle gross mass (t)	1.2	km/return trip	1.2539465	kg/VKT	8.2	silt loading (g/m2)			1	AP 42 13.2.1	
Stockpile Area																				
Unloading at stockpile	232	360000	t/y	0.00064	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2.7	moisture content in %									2		
Loading at stockpile	232	360000	t/y	0.00064	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2.7	moisture content in %									2		
Hauling product to Barker Road (sealed)	37,504	360000	t/y	0.104	kg/t	32	t/load	32.25	Vehicle gross mass (t)	4.4	km/return trip	0.7576584	kg/VKT	8.2	silt loading (g/m2)			1	AP 42 13.2.1	
Wind Erosion																				
WE - Extraction Area	7884	9.00	ha	0.1	kg/ha/h	8760	h/y											3	AP 42 13.2.5	
WE - Stockpile	2015	2.30	ha	0.1	kg/ha/h	8760	h/y											3	AP 42 13.2.5	
Grading roads	11829	19,219	km	1	kg/ha/h	8	speed of graders in km/h											1	AP 42 11.9 Table 11.9-2	1 grader operating 70% of operating hours at 8 km/r
Total (kg/y)	**177,288**																			

PM$_{10}$ emission inventory

ACTIVITY	PM$_{10}$ emission (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Control	Units	Source type	Emission Factor Source	Assumptions
Quarry Area																				
Dozers	25499	3432	h/y	7.43	h/y	15	Silt content	2	moisture content									1	AP 42 11.9 Table 11.9-2	Assuming 1 Dozer running 11 hours a day, six days per week
Excavator loading	167	360000	t/y	0.00046	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %									2	Ap 42 13.2.4	Assuming 2% moisture content
Processing Area																				
Hauling to processing area (unsealed)	999	360000	t/y	0.011	kg/t	40	t/load	52.85	Vehicle gross mass (t)	0.6	km/return trip	0.7305295	kg/VKT	5	% silt content	75	% control	1	AP 42 13.2.2	
Unloading at processing area	167	360000	t/y	0.00046	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %									2	Ap 42 13.2.4	
Rehandle rock to hopper	167	360000	t/y	0.00046	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %									2	Ap 42 13.2.4	
Primary Crushing	97	360000	t/y	0.0003	kg/t													1	AP 42 11.19.2 Table 11.19.2-1	Assumed AP42 tertiary (controlled) crushing emission factor
Crushing (Fines)	216	360000	t/y	0.0006	kg/t													1	AP 42 11.19.2 Table 11.19.2-1	Assumed AP42 fines (controlled) crushing emission factor
Screening (controlled)	133	360000	t/y	0.0004	kg/t													1	AP 42 11.19.2 Table 11.19.2-1	Assumed AP42 Screening (controlled) emission factor
Stacking stockpiles	110	360000	t/y	0.00030	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2.7	moisture content in %									2	Ap 42 13.2.4	Taken from the sampling reports provided
FEL loading trucks	110	360000	t/y	0.00030	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2.7	moisture content in %									2	Ap 42 13.2.4	Taken from the sampling reports provided
Hauling product to stockpile (unsealed)	999	360000	t/y	0.011	kg/t	40	t/load	52.85	Vehicle gross mass (t)	0.6	km/return trip	0.7305295	kg/VKT	5	% silt content	75	% control	1	AP 42 13.2.2	
Hauling product to stockpile (sealed)	2,632	360000	t/y	0.007	kg/t	40	t/load	52.85	Vehicle gross mass (t)	1.2	km/return trip	0.2406956	kg/VKT	8.2	silt loading (g/m2)			1	AP 42 13.2.1	
Stockpile Area																				
Unloading at stockpile	110	360000	t/y	0.00030	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2.7	moisture content in %											
Loading at stockpile	110	360000	t/y	0.00030	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2.7	moisture content in %											
Hauling product to Barker Road (sealed)	7,199	360000	t/y	0.020	kg/t	32	t/load	32.25	Vehicle gross mass (t)	4.4	km/return trip	0.1454329	kg/VKT	8.2	silt loading (g/m2)			1	AP 42 13.2.1	
Wind Erosion																				
WE - Extraction Area	3942	9.00	ha	0.05	kg/ha/h	8760	h/y											3	AP 42 13.2.5	
WE - Stockpiles	1007	2.30	ha	0.05	kg/ha/h	8760	h/y											3	AP 42 13.2.5	Assuming 50% of processing area is covered by stockpiles - as per email 15/11/12
Grading roads	4133	19,219	km	0.2	kg/ha/h	8	speed of graders in km/h											1	AP 42 11.9 Table 11.9-2	1 grader operating 70% of operating hours at 8 km/r
Total (kg/y)	**47,796**																			

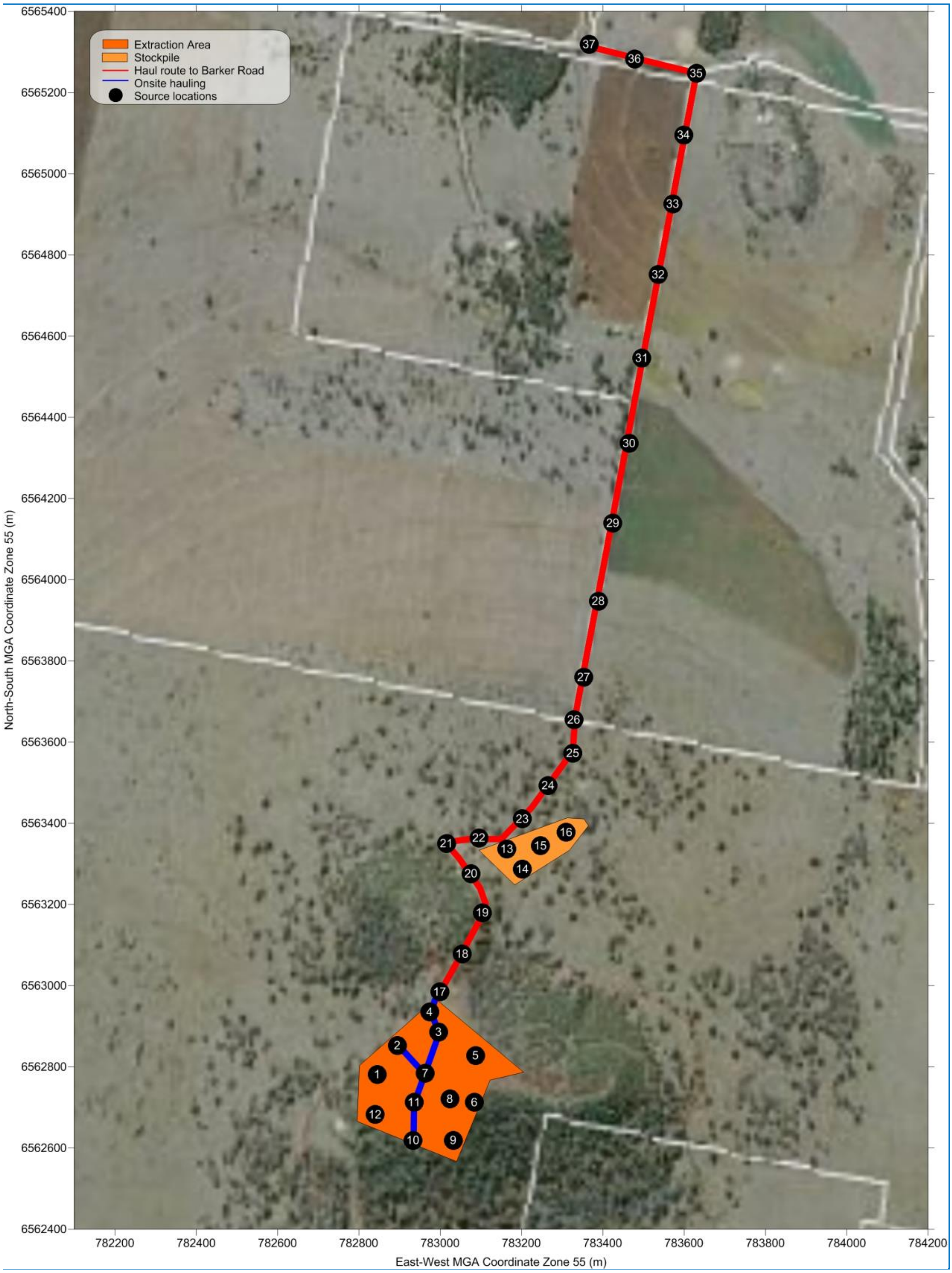
TSP emission inventory

ACTIVITY	TSP emission (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Control	Units	Source type	Emission Factor Source	Assumptions
Quarry Area																				
Dozers	93431	3432	h/y	27.22	h/y	15	Silt content	2	moisture content									1	AP 42 11.9 Table 11.9-2	Assuming 1 Dozer running 11 hours a day, six days per week
Excavator loading	353	360000	t/y	0.00098	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %									2	Ap 42 13.2.4	Assuming 2% moisture content
Blasting & Drilling																				
Drilling	496	840	holes/y	0.59	kg/hole															
Blasting	118	7	blasts/y	17	kg/blast	1800	Area of blast (m2)													
Processing Area																				
Hauling to processing area (unsealed)	9069	360000	t/y	0.101	kg/t	40	t/load	52.85	Vehicle gross mass (t)	1.4	km/return trip	2.8430522	kg/VKT	5	% silt content	75	% control	1	AP 42 13.2.2	
Unloading at processing area	353	360000	t/y	0.00098	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %									2	Ap 42 13.2.4	
Rehandle rock to hopper	353	360000	t/y	0.00098	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %									2	Ap 42 13.2.4	
Primary Crushing	216	360000	t/y	0.0006	kg/t													1	AP 42 11.19.2 Table 11.19.2-1	Assumed AP42 tertiary (controlled) crushing emission factor
Crushing (Fines)	540	360000	t/y	0.0015	kg/t													1	AP 42 11.19.2 Table 11.19.2-1	Assumed AP42 fines (controlled) crushing emission factor
Screening (controlled)	396	360000	t/y	0.0011	kg/t													1	AP 42 11.19.2 Table 11.19.2-1	Assumed AP42 Screening (controlled) emission factor
Stacking stockpiles	232	360000	t/y	0.00064	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2.7	moisture content in %									2	Ap 42 13.2.4	Taken from the sampling reports provided
FEL loading trucks	232	360000	t/y	0.00064	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2.7	moisture content in %									2	Ap 42 13.2.4	Taken from the sampling reports provided
Hauling product to stockpile (unsealed)	9069	360000	t/y	0.101	kg/t	40	t/load	52.85	Vehicle gross mass (t)	1.4	km/return trip	2.8430522	kg/VKT	5	% silt content	75	% control	1	AP 42 13.2.2	
Hauling product to stockpile (sealed)	18,285	360000	t/y	0.051	kg/t	40	t/load	52.85	Vehicle gross mass (t)	1.6	km/return trip	1.2539465	kg/VKT	8.2	silt loading (g/m2)			1	AP 42 13.2.1	
Stockpile Area																				
Unloading at stockpile	232	360000	t/y	0.00064	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2.7	moisture content in %											
Loading at stockpile	232	360000	t/y	0.00064	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2.7	moisture content in %											
Hauling product to Barker Road (sealed)	34,095	360000	t/y	0.095	kg/t	32	t/load	32.25	Vehicle gross mass (t)	4	km/return trip	0.7576584	kg/VKT	8.2	silt loading (g/m2)			1	AP 42 13.2.1	
Wind Erosion																				
WE - Extraction Area	2628	3.00	ha	0.1	kg/ha/h	8760	h/y											3	AP 42 13.2.5	
WE - Stockpile	1927	2.20	ha	0.1	kg/ha/h	8760	h/y											3	AP 42 13.2.5	
WE - Active Rehab	532	2.02	ha	0.1	kg/ha/h	8760	h/y									70	% control	3	AP 42 13.2.5	
Grading roads	11829	19,219	km	1	kg/ha/h	8	speed of graders in km/h											1	AP 42 11.9 Table 11.9-2	1 grader operating 70% of operating hours at 8 km/r
Total (kg/y)	**184,616**																			

PM_{10} emission inventory

ACTIVITY	PM_{10} emission (kg/y)	Intensity	Units	Emission factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Control	Units	Source type	Emission Factor Source	Assumptions
Quarry Area																				
Dozers	12128	3432	h/y	3.53	h/y	15	Silt content	2	moisture content									1	AP 42 11.9 Table 11.9-2	Assuming 1 Dozer running 11 hours a day, six days per week
Excavator loading	167	360000	t/y	0.00046	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %									2	Ap 42 13.2.4	Assuming 2% moisture content
Blasting & Drilling																				
Drilling	258	840	holes/y	0.31	kg/hole															
Blasting	61	7	blasts/y	9	kg/blast	1800	Area of blast (m2)													
Processing Area																				
Hauling to processing (unsealed)	2876	360000	t/y	0.032	kg/t	32	t/load	52.85	Vehicle gross mass (t)	1.4	km/return trip	0.7305295	kg/VKT	5	% silt content	75	% control	1	AP 42 13.2.2	
Unloading at processing area	167	360000	t/y	0.00046	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %									2	Ap 42 13.2.4	
Rehandle rock to hopper	167	360000	t/y	0.00046	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2	moisture content in %									2	Ap 42 13.2.4	
Primary Crushing	97	360000	t/y	0.0003	kg/t													1	AP 42 11.19.2 Table 11.19.2-1	Assumed AP42 tertiary (controlled) crushing emission factor
Crushing (Fines)	216	360000	t/y	0.0006	kg/t													1	AP 42 11.19.2 Table 11.19.2-1	Assumed AP42 fines (controlled) crushing emission factor
Screening (controlled)	133	360000	t/y	0.0004	kg/t													1	AP 42 11.19.2 Table 11.19.2-1	Assumed AP42 Screening (controlled) emission factor
Stacking stockpiles	110	360000	t/y	0.00030	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2.7	moisture content in %									2	Ap 42 13.2.4	Taken from the sampling reports provided
FEL loading trucks	110	360000	t/y	0.00030	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2.7	moisture content in %									2	Ap 42 13.2.4	Taken from the sampling reports provided
Hauling product to stockpile (unsealed)	2876	360000	t/y	0.032	kg/t	32	t/load	52.85	Vehicle gross mass (t)	1.4	km/return trip	0.7305295	kg/VKT	5	% silt content	75	% control	1	AP 42 13.2.2	
Hauling product to stockpile (sealed)	4,333	360000	t/y	0.012	kg/t	32	t/load	52.85	Vehicle gross mass (t)	1.6	km/return trip	0.2406956	kg/VKT	8.2	silt loading (g/m2)			1	AP 42 13.2.1	
Stockpile Area																				
Unloading at stockpile	110	360000	t/y	0.00030	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2.7	moisture content in %											
Loading at stockpile	110	360000	t/y	0.00030	kg/t	2.19	average of (wind speed/2.2)^1.3 in m/s	2.7	moisture content in %											
Hauling product to Barker Road (sealed)	6,544	360000	t/y	0.018	kg/t	32	t/load	32.25	Vehicle gross mass (t)	4	km/return trip	0.1454329	kg/VKT	8.2	silt loading (g/m2)			1	AP 42 13.2.1	
Wind Erosion																				
WE - Extraction Area	3040	6.94	ha	0.05	kg/ha/h	8760	h/y											3	AP 42 13.2.5	
WE - Stockpile	964	2.20	ha	0.05	kg/ha/h	8760	h/y											3	AP 42 13.2.5	
WE - Active Rehab	3445	4.26	ha	0.31	kg/ha/h	8760	h/y									70	% control	3	AP 42 13.2.5	
Grading roads	4133	19,219	km	0.2	kg/ha/h	8	speed of graders in km/h											1	AP 42 11.9 Table 11.9-2	1 grader operating 70% of operating hours at 8 km/r
Total (kg/y)	**42,044**																			

Source location map



APPENDIX B - MONITORING REPORTS

Rocglen PM_{10} data

Date	PM10 µg/m³	
	Glen Roc	Roseberry /Surrey
8/10/2008	24	7
14/10/2008	31	10
20/10/2008	43	17
26/10/2008	32	15
1/11/2008	36	20
7/11/2008	15	10
13/11/2008	18	9
19/11/2008	5	5
25/11/2008		9
1/12/2008	15	11
7/12/2008	11	14
13/12/2008	16	16
19/12/2008	23	14
25/12/2008	12	12
31/12/2008	37	33
6/01/2009	29	28
12/01/2009	16	18
18/01/2009	23	12
24/01/2009	14	15
30/01/2009	15	13
5/02/2009	44	14
11/02/2009	19	14
17/02/2009	5	4
23/02/2009	20	11
1/03/2009	28	19
7/03/2009	35	17
13/03/2009	21	16
19/03/2009	25	21
25/03/2009	31	19
31/03/2009	5	5
6/04/2009	11	2
12/04/2009	3	4
18/04/2009	27	23
24/04/2009	22	12
30/04/2009	33	10
6/05/2009	26	26
12/05/2009	66	25
18/05/2009	29	22
24/05/2009	12	30
30/05/2009	9	30
5/06/2009	2	8
11/06/2009	11	1
17/06/2009	6	30
23/06/2009	3	3
29/06/2009	6	4
5/07/2009	3	0.5
11/07/2009	13	5
17/07/2009	3	2
23/07/2009	14	11
29/07/2009	15	2
4/08/2009	20	5
10/08/2009	34	22
16/08/2009	32	22
22/08/2009	24	22
28/08/2009	34	26
3/09/2009	41	26
9/09/2009	2	5
15/09/2009	32	22
21/09/2009	19	13
27/09/2009	48	30
3/10/2009	32	30
9/10/2009	12	9
15/10/2009	21	33
21/10/2009	43	68
27/10/2009	4	5
2/11/2009	23	37
8/11/2009	9	9
14/11/2009	21	
20/11/2009	50	
26/11/2009	37	
2/12/2009	21	
8/12/2009	90	
14/12/2009	113	
20/12/2009	23	
26/12/2009	17	
1/01/2010	10	
7/01/2010	22	
13/01/2010	35	
19/01/2010	38	
25/01/2010	55	
31/01/2010	10	
6/02/2010	8	
12/02/2010	17	
18/02/2010	15	
24/02/2010	19	
2/03/2010	11	
8/03/2010	9	
14/03/2010	11	
20/03/2010	28	
26/03/2010	37	
1/04/2010	10	
7/04/2010	3	
13/04/2010	20	
19/04/2010	9	
25/04/2010	5	
1/05/2010	24	
7/05/2010	18	
13/05/2010	22	
19/05/2010	26	
25/05/2010	10	
31/05/2010	1	
6/06/2010	2	
12/06/2010	9	
18/06/2010	3	
24/06/2010	4	
30/06/2010	30	
6/07/2010	3	

Date	PM10 µg/m³ Glen Roc	PM10 µg/m³ Roseberry /Surrey
12/07/2010	5	
18/07/2010	9	
24/07/2010	2	
30/07/2010	3	
5/08/2010	15	
11/08/2010	4	
17/08/2010	17	
23/08/2010	4	
29/08/2010	4	
4/09/2010	5	
10/09/2010	2	
16/09/2010	2	
22/09/2010	17	
28/09/2010	14	
4/10/2010	0	
10/10/2010	5	
16/10/2010	3	
22/10/2010	15	

Date	PM10 µg/m³ Glen Roc	PM10 µg/m³ Roseberry /Surrey
28/10/2010	8	
3/11/2010	4	
9/11/2010	5.6	
15/11/2010	3.8	
21/11/2010	7.1	
27/11/2010	11.5	
3/12/2010	4.6	
9/12/2010	2.7	
15/12/2010	34.6	
21/12/2010	9.2	
27/12/2010	5.7	
2/01/2011	11.1	10.4
8/01/2011	8.2	6.2
14/01/2011	5.5	8.2
20/01/2011	10.3	6.5
26/01/2011	20.6	19.2
1/02/2011	29.8	34
7/02/2011	11	9.3

Date	PM10 µg/m³ Glen Roc	PM10 µg/m³ Roseberry /Surrey
13/02/2011	14.7	5.8
19/02/2011	8.3	7.4
25/02/2011	16.8	15.1
3/03/2011	5	6.2
9/03/2011	14.9	10.4
15/03/2011	11.8	3.6
21/03/2011	1.5	3.4
27/03/2011	8.5	8.8
2/04/2011	11.7	9.8
8/04/2011	18.1	6.1
14/04/2011	23.2	13.5
20/04/2011	18.1	14.7
26/04/2011	6.5	4.8
2/05/2011	49.1	14.2
8/05/2011	43.5	16.2
14/05/2011	7.9	6
20/05/2011	40.4	23.2
26/05/2011	3.9	15.7

Date	PM10 µg/m³ Glen Roc	PM10 µg/m³ Roseberry /Surrey
1/06/2011	6.1	3.9
7/06/2011	14.3	12.2
13/06/2011	2.7	3.2
19/06/2011	7.7	5.3
25/06/2011	9.4	6.7
1/07/2011	11.1	6
7/07/2011	13.5	6.8
13/07/2011	23.6	17.1
19/07/2011	6.5	3.6
25/07/2011	8.8	12.6
31/07/2011	18.9	7.9

Sunnyside PM10 data

Date	PM10 µg/m³ SA1 Illili	PM10 µg/m³ SA2 Lilydale
24/01/2009	25	25
30/01/2009	37	28
5/02/2009	23	25
11/02/2009	30	17
17/02/2009	7	4
23/02/2009	19	16
1/03/2009	36	28
7/03/2009	31	20
13/03/2009	26	18
19/03/2009	21	19
25/03/2009	26	22
31/03/2009	12	8
6/04/2009	13	23
12/04/2009	12	12
18/04/2009	28	25
24/04/2009	22	16
30/04/2009	15	12
6/05/2009	15	14
12/05/2009	40	26
18/05/2009	34	20
24/05/2009	6	4
30/05/2009	5	5
5/06/2009	2	2
11/06/2009	1	2

Date	PM10 µg/m³ SA1 Illili	PM10 µg/m³ SA2 Lilydale
17/06/2009	4	2
23/06/2009	2	3
29/06/2009	4	5
5/07/2009	3	4
11/07/2009	7	4
17/07/2009	7	8
23/07/2009	11	11
29/07/2009	2	3
4/08/2009	13	11
10/08/2009	21	20
16/08/2009	24	26
22/08/2009	12	10
28/08/2009	19	22
3/09/2009	17	24
9/09/2009	0.5	1
15/09/2009	27	21
21/09/2009	12	13
27/09/2009	48	36
3/10/2009	30	26
9/10/2009	19	5
15/10/2009	20	14
21/10/2009	31	17
27/10/2009	3	10
2/11/2009	21	
8/11/2009	8	9

Date	PM10 µg/m³ SA1 Illili	PM10 µg/m³ SA2 Lilydale
14/11/2009	27	19
20/11/2009	48	36
26/11/2009	43	7
2/12/2009	23	9
8/12/2009	109	67
14/12/2009	70	46
20/12/2009	23	16
26/12/2009	14	13
1/01/2010	10	7
7/01/2010	12	9
13/01/2010	28	29
19/01/2010	19	21
25/01/2010	26	25
31/01/2010	14	10
6/02/2010	7	7
12/02/2010	23	17
18/02/2010	20	9
24/02/2010	16	9
20/03/2010		16
26/03/2010	33	24
1/04/2010	8	14
7/04/2010	4	6
13/04/2010	13	9
19/04/2010	8	5
25/04/2010	5	4

Date	PM10 µg/m³ SA1 Illili	PM10 µg/m³ SA2 Lilydale
1/05/2010	13	10
7/05/2010	8	4
13/05/2010	9	8
19/05/2010	13	9
25/05/2010	4	2
31/05/2010	0	17
6/06/2010	1	1
12/06/2010	5	2
18/06/2010	2	2
24/06/2010	2	1
30/06/2010	4	4
6/07/2010	4	2
12/07/2010	5	4
18/07/2010	9	
24/07/2010	4	5
30/07/2010	0	0
5/08/2010	4	5
11/08/2010	6	5
17/08/2010	3	6
23/08/2010	5	5
29/08/2010	4	3
4/09/2010	6	6
10/09/2010	4	4
16/09/2010	1	2
22/09/2010	11	13

Date	PM10	
	µg/m³	
	SA1 Illili	SA2 Lilydale
28/09/2010	13	19
4/10/2010	12	0
10/10/2010	8	8

Date	PM10	
	µg/m³	
	SA1 Illili	SA2 Lilydale
16/10/2010	10	4
22/10/2010	6	5
28/10/2010	14	13

Date	PM10	
	µg/m³	
	SA1 Illili	SA2 Lilydale
3/11/2010	8	4.7
9/11/2010	5.2	2.6
15/11/2010	4.4	4.4

Date	PM10	
	µg/m³	
	SA1 Illili	SA2 Lilydale
21/11/2010	5.2	6.3
27/11/2010	11.5	7.9

Tarrawonga PM_{10} data:

Date	PM10 µg/m³ Templemore	Date	PM10 µg/m³ Merriown
5/05/2007	49	28/04/2007	8
11/05/2007	14	22/05/2007	8
17/05/2007	11	28/05/2007	5
23/05/2007	9	3/06/2007	5
29/05/2007	17	9/06/2007	4
4/06/2007	4	16/06/2007	5
10/06/2007	2	21/06/2007	5
16/06/2007	1	27/06/2007	11
22/06/2007	0	4/07/2007	6
28/06/2007	0	10/07/2007	7
4/07/2007	4	15/07/2007	10
10/07/2007	3	21/07/2007	9
16/07/2007	7	28/07/2007	4
22/07/2007	5	21/08/2007	15
28/07/2007	6	26/08/2007	16
3/08/2007	5	1/09/2007	12
9/08/2007	14	7/09/2007	11
15/08/2007	18	14/09/2007	28
21/08/2007	2	19/09/2007	38
27/08/2007	3	25/09/2007	31
2/09/2007	12	1/10/2007	22
8/09/2007	3	7/10/2007	26
14/09/2007	27	19/10/2007	28
20/09/2007	32	25/10/2007	14
26/09/2007	30	31/10/2007	18
2/10/2007	33	6/11/2007	5
8/10/2007	25	12/11/2007	26

Date	PM10 µg/m³ Templemore	Date	PM10 µg/m³ Merriown
14/10/2007	20	18/11/2007	11
20/10/2007	29	24/11/2007	16
26/10/2007	29	30/11/2007	9
1/11/2007	13	6/12/2007	15
7/11/2007	3	12/12/2007	11
13/11/2007	11	18/12/2007	21
19/11/2007	12	30/12/2007	7
25/11/2007	8	5/01/2008	12
1/12/2007	4	11/01/2008	2
7/12/2007	10	17/01/2008	15
13/12/2007	9	23/01/2008	9
19/12/2007	10	29/01/2008	8
25/12/2007	12	4/02/2008	7
31/12/2007	15	10/02/2008	2
6/01/2008	17	16/02/2008	20
12/01/2008	25	22/02/2008	6
18/01/2008	17	28/02/2008	1.8
24/01/2008	21	5/03/2008	10.6
30/01/2008	32	11/03/2008	5.4
5/02/2008	9	18/03/2008	15.2
11/02/2008	12	23/03/2008	0.4
17/02/2008	6	29/03/2008	18.7
23/02/2008	42	4/04/2008	7.6
29/02/2008	5	10/04/2008	0.1
6/03/2008	27	16/04/2008	0.1
12/03/2008	32	22/04/2008	4.8
18/03/2008	22	28/04/2008	6
24/03/2008	24	4/04/2008	1

Date	PM10 µg/m³ Templemore	Date	PM10 µg/m³ Merriown
30/03/2008	18	16/05/2008	6.7
5/04/2008	18	22/05/2008	3.3
11/04/2008	11	28/05/2008	1.3
17/04/2008	11	3/06/2008	2.7
23/04/2008	1	9/06/2008	5.6
29/04/2008	3	15/06/2008	1.8
5/05/2008	26	21/06/2008	2.5
11/05/2008	8	3/07/2008	8.5
17/05/2008	15	9/07/2008	3.4
23/05/2008	4	15/07/2008	4.9
29/05/2008	13	21/07/2008	7.4
4/06/2008	2	27/07/2008	7.8
10/06/2008	4	2/08/2008	5.2
16/06/2008	1	8/08/2008	8.5
22/06/2008	1	14/08/2008	10.6
28/06/2008	9	20/08/2008	8.4
4/07/2008	4	26/08/2008	10.6
10/07/2008	1	1/09/2008	34.4
16/07/2008	3	7/09/2008	17.7
22/07/2008	9	13/09/2008	26
28/07/2008	1	19/09/2008	19.7
3/08/2008	1	25/09/2008	30.3
9/08/2008	3	1/10/2008	9.8
15/08/2008	5	7/10/2008	9.9
21/08/2008	10	13/10/2008	12.2
27/08/2008	18	19/10/2008	6.8
2/09/2008	4	25/10/2008	14.2
8/09/2008	4	6/11/2008	16.6

Date	PM10 µg/m³ Templemore	Date	PM10 µg/m³ Merriown
14/09/2008	11	12/11/2008	20.8
20/09/2008	32	18/11/2008	25.3
26/09/2008	6	24/11/2008	11
2/10/2008	31	30/11/2008	13.5
8/10/2008	9	6/12/2008	19.4
14/10/2008	9	12/12/2008	27.8
20/10/2008	25	18/12/2008	18.2
26/10/2008	14	24/12/2008	28.1
1/11/2008	25	30/12/2008	19.7
7/11/2008	18	17/02/2009	8.8
13/11/2008	22	23/02/2009	21.2
19/11/2008	2	1/03/2009	15.2
25/11/2008	9	7/03/2009	17.9
1/12/2008	12.77	13/03/2009	18.9
7/12/2008	12.87	19/03/2009	25.1
13/12/2008	12.95	25/03/2009	13.5
19/12/2008	12.93	31/03/2009	7.5
25/12/2008	13	6/04/2009	14.1
31/12/2008	13.28	12/04/2009	8.3
6/01/2009	15	18/04/2009	30
12/01/2009	13	24/04/2009	17
18/01/2009	14	30/04/2009	25.3
24/01/2009	14	6/05/2009	13.8
30/01/2009	14	12/05/2009	26.8
5/02/2009	18	19/05/2009	8.1
11/02/2009	22	25/05/2009	8.6
17/02/2009	2	31/05/2009	11.4
23/02/2009	20	6/06/2009	8.6
1/03/2009	24	12/06/2009	10.3
7/03/2009	26	18/06/2009	9.9

Date	PM10 µg/m³ Templemore	Date	PM10 µg/m³ Merriown
13/03/2009	22	24/06/2009	10
19/03/2009	40	30/06/2009	61.4
25/03/2009	45	6/07/2009	15.4
31/03/2009	6	12/07/2009	7.6
6/04/2009	6	18/07/2009	14.5
12/04/2009	3	24/07/2009	8.9
18/04/2009	23	30/07/2009	18.4
24/04/2009	13	5/08/2009	13.8
30/04/2009	17	17/08/2009	15.8
6/05/2009	37	23/08/2009	17.3
12/05/2009	36	29/08/2009	9.3
18/05/2009	24	4/09/2009	26.2
24/05/2009	12	10/09/2009	32.5
30/05/2009	6	16/09/2009	17.6
5/06/2009	2	24/09/2009	22.2
11/06/2009	9	30/09/2009	17.4
17/06/2009	1	6/10/2009	18.6
23/06/2009	1	13/10/2009	34.9
29/06/2009	4	19/10/2009	27.4
5/07/2009	2	25/10/2009	16.4
11/07/2009	11	31/10/2009	11.4
17/07/2009	3	6/11/2009	0
23/07/2009	14	12/11/2009	27.2
29/07/2009	1	19/11/2009	86.6
4/08/2009	6	25/11/2009	36.6
10/08/2009	23	1/12/2009	0.1
16/08/2009	30	7/12/2009	50.3
22/08/2009	27	13/12/2009	43.8
28/08/2009	24	20/12/2009	26.4
3/09/2009	25	26/12/2009	28

Date	PM10 µg/m³ Templemore	Date	PM10 µg/m³ Merriown
9/09/2009	4	9/01/2010	28.9
15/09/2009	32	9/01/2010	28.9
21/09/2009	20	15/01/2010	18.2
27/09/2009	54	21/01/2010	7.7
3/10/2009	36	27/01/2010	11
9/10/2009	14	2/02/2010	28.1
15/10/2009	39	8/02/2010	16.6
21/10/2009	40	14/02/2010	16.6
27/10/2009	4	20/02/2010	24.4
2/11/2009	21	2/03/2010	13.2
8/11/2009	8	8/03/2010	7.9
14/11/2009	20	14/03/2010	10
20/11/2009	54	20/03/2010	7
26/11/2009	33	26/03/2010	16.4
2/12/2009	14	1/04/2010	16
8/12/2009	97	7/04/2010	21.3
14/12/2009	68	13/04/2010	19.2
20/12/2009	20	19/04/2010	16.6
26/12/2009	17	25/04/2010	16.4
1/01/2010	9	1/05/2010	6.9
7/01/2010	23	8/05/2010	7.1
13/01/2010	35	16/05/2010	6.1
19/01/2010	32	22/05/2010	10.9
25/01/2010	37	28/05/2010	4.5
31/01/2010	11	3/06/2010	4.4
6/02/2010	12	9/06/2010	1.5
12/02/2010	7	15/06/2010	1.5
18/02/2010	18	21/06/2010	0.9
24/02/2010	21.7	27/06/2010	5.5
2/03/2010	21.66	3/07/2010	4.3

Date	PM10 µg/m³ Templemore	Date	PM10 µg/m³ Merriown
8/03/2010	18	9/07/2010	4.8
14/03/2010	8	16/07/2010	6
20/03/2010	27	22/07/2010	6.8
26/03/2010	91	28/07/2010	4.8
1/04/2010	5	3/08/2010	11.8
7/04/2010	5	9/08/2010	11.8
13/04/2010	13	15/08/2010	0.1
19/04/2010	11	21/08/2010	18.9
25/04/2010	6	27/08/2010	6.1
1/05/2010	34	2/09/2010	5.5
7/05/2010	18	8/09/2010	10.1
13/05/2010	27	14/09/2010	20
19/05/2010	14	20/09/2010	9.7
25/05/2010	17	6/10/2010	3.5
31/05/2010	4	12/10/2010	30.6
6/06/2010	2	18/10/2010	32.4
12/06/2010	3	27/10/2010	3.8
18/06/2010	3	2/11/2010	7.7
24/06/2010	5	8/11/2010	9.6
30/06/2010	5	14/11/2010	10.6
6/07/2010	8	20/11/2010	7.1
12/07/2010	6	26/11/2010	0.1
18/07/2010	8	2/12/2010	9.5
24/07/2010	6	8/12/2010	11.7
30/07/2010	1	14/12/2010	0.1

Date	PM10 µg/m³ Templemore	Date	PM10 µg/m³ Merriown
5/08/2010	10	20/12/2010	44.6
11/08/2010	5	2/01/2011	0.1
17/08/2010	2	9/01/2011	17.2
23/08/2010	5	15/01/2011	11.8
29/08/2010	4	21/01/2011	10.5
4/09/2010	4	27/01/2011	13.5
10/09/2010	7	2/02/2011	9.3
16/09/2010	3	8/02/2011	10.3
22/09/2010	15	14/02/2011	16.5
28/09/2010	15	20/02/2011	17.7
4/10/2010	6	26/02/2011	10.5
10/10/2010	7	4/03/2011	17.4
16/10/2010	7	10/03/2011	15
22/10/2010	19	16/03/2011	9.6
28/10/2010	16	22/03/2011	10.7
3/11/2010	7.5	28/03/2011	19.6
9/11/2010	7.8	3/04/2011	8.8
15/11/2010	9.2	9/04/2011	12.5
21/11/2010	8.6	15/04/2011	7.3
27/11/2010	9.8	21/04/2011	9.8
3/12/2010	7.7	27/04/2011	20.9
9/12/2010	12.8	3/05/2011	16.4
15/12/2010	16.6	9/05/2011	12.6
21/12/2010	9.8	15/05/2011	19
27/12/2010	4.4	21/05/2011	13

Date	PM10 µg/m³ Templemore	Date	PM10 µg/m³ Merriown
2/01/2011	8.6	27/05/2011	7.2
8/01/2011	8.3	2/06/2011	8.3
14/01/2011	9.3	8/06/2011	15.5
20/01/2011	10.1	14/06/2011	5
26/01/2011	47.2	20/06/2011	3.4
1/02/2011	25.9	28/06/2011	2.2
7/02/2011	3.5	2/07/2011	3.3
13/02/2011	12.7	8/07/2011	11
19/02/2011	13.8	14/07/2011	11.2
25/02/2011	28.4	20/07/2011	17.2
3/03/2011	10.7	26/07/2011	0.8
9/03/2011	8.7	1/08/2011	1.2
15/03/2011	8.8	7/08/2011	0.1
21/03/2011	4.1	13/08/2011	3.8
27/03/2011	9.2	19/08/2011	14.7
2/04/2011	6.6	25/08/2011	11.1
8/04/2011	8.8	6/09/2011	5.8
14/04/2011	31.3	12/09/2011	11.4
20/04/2011	21.4	18/09/2011	12.5
26/04/2011	6.2	24/09/2011	2.4
2/05/2011	33	30/09/2011	2.2

Werris Creek PM10 data:

Date	PM10				TSP
	µg/m³				
	WCHV1	WCHV2	WCHV3	WCHV4	WCTSP
2/04/2011	11	15	11	13	19
8/04/2011	25	11		9	
14/04/2011	24	20	39	15	97
20/04/2011	51	21	50	18	114
26/04/2011	11	7	12	7	28
2/05/2011	38	26	35	16	85
8/05/2011	13	16	12	12	20
14/05/2011	7	5	14	7	50
20/05/2011	34	34	50	28	100
26/05/2011	27	17	13	16.1	25.7
1/06/2011	58	52	50	7.7	95
7/06/2011	62	56	80	9	256
13/06/2011	49	48	47	5.4	
19/06/2011	7	8	7	5.5	155
25/06/2011	18	13	14	13.1	25
1/07/2011	11	8	4	4	10.1
7/07/2011	10	4	35	5	105
13/07/2011	15	15	19	25	47.5
19/07/2011	8	4	14	4	44.3
25/07/2011	8	8	10	19	16.9
31/07/2011	9	11	10	15	24.5
6/08/2011	9	10	12	20	31.3
12/08/2011	21	12	17	7	38.7
18/08/2011	5	2	13	3	46.8
24/08/2011	25	11	13	5	47.8

Date	PM10				TSP
	µg/m³				
	WCHV1	WCHV2	WCHV3	WCHV4	WCTSP
30/08/2011	30	21	22	13	47
5/09/2011	15	12	32	15	65
11/09/2011	5	5	6	5	14
17/09/2011	12	18	15	17	37
23/09/2011	41	32	46	36	91
29/09/2011	8	7	8	7	16
5/10/2011	27	17	16	10	36
11/10/2011	22	11	32	7	67
17/10/2011	15	12	10	11	19
23/10/2011	16	21	18	16	44
29/10/2011	7	9	8	16	29
4/11/2011	16	15	14	13	47
10/11/2011	24	20	22	24	41
16/11/2011	21	21	20	22	28
22/11/2011	18	19	16	28	35
28/11/2011	8	8	14	10	30
4/12/2011	6	4	10	5	30
10/12/2011	15	10	4	13	8
16/12/2011	8	6	9	5	19
22/12/2011	15	12	7	11	16
28/12/2011	1	1	10	16	16
3/01/2012				15	50
9/01/2012	16	15	25	13	71
15/01/2012	8	17	16	8	34
21/01/2012	12	12	11	9	22

Date	PM10				TSP
	µg/m³				
	WCHV1	WCHV2	WCHV3	WCHV4	WCTSP
27/01/2012	5	4	3	4	9
2/02/2012	5	3	2	3	9
8/02/2012	7	8	5	5	11
14/02/2012	10	10	7	6	16
20/02/2012	6	7	6	9	13
26/02/2012	6	7	6	6	13
4/03/2012	4	4	5	5	8
10/03/2012	8	11	20	10	46
16/03/2012	13	11	7	17	14
22/03/2012	17	8	13	6	28