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Air Quality and Greenhouse Gas Impact Assessment

BYLONG COAL PROJECT
Environmental Impact Statement

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ENVIRONMENTAL CONSULTANTS

Pacific Environment Limited

Consulting • Technologies • Monitoring • Toxicology

Report

BYLONG COAL PROJECT – AIR QUALITY & GREENHOUSE GAS IMPACT ASSESSMENT

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Job ID. 05832

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Pacific Environment Limited

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EXECUTIVE SUMMARY

Overview

KEPCO Bylong Australia Pty Ltd (KEPCO) is seeking the approval for the construction and operation of the Bylong Coal Project (the Project), to recover approximately 124 Million tonnes of Run of Mine (ROM) coal utilising open cut and underground mining methods. The Project mine life is anticipated to be approximately 25 years, with construction activities occurring in the first 2 years. Open cut mining areas will be developed following construction and operations will continue for eight years with underground mining operations commencing in Year 7.

The key potential air quality issues were identified as:

- Dust from the general mining activities; and
- Fume from blasting; and
- Odour and other substances due to potential spontaneous combustion of coal.

Existing Environment

Site specific baseline air quality and meteorological data have been collected since August 2011. The prevailing wind patterns for Bylong are generally aligned along a northwest – east-southeast axis, reflected in the general alignment of surrounding terrain. The monitoring data also indicates that ambient air quality for the area is good and well below air quality criteria, with the exceptions of periods of regional bushfire activity.

Emissions and Modelling Assessment

The conceptual mine plans for the Project were analysed to develop detailed emissions inventories for the key dust generating activities for three staged mine years. The three years utilised were considered representative of worst-case operations, where coal and waste production are highest or where operations are located closest to receptors.

The dust emissions that will be generated during the construction phase are significantly less than those that will occur during operations phase of the Project. Suitable dust mitigation measures would be implemented and have been incorporated into the emissions to ensure that dust emissions are kept to a minimum, especially during adverse meteorological conditions.

Impact Assessment

The objectives the study was to address the Secretary's Environmental Assessment Requirements (SEARs) and Agency requirements.

A computer-based dispersion model was used to predict dust concentrations and deposition levels due to the Project at off-site sensitive receptors. These predictions were then compared to the EPA's impact assessment criteria, and the DP&E acquisition and mitigation criteria.

Dispersion modelling results are presented for each scenario. The modelling results show that no private sensitive receptor is predicted to experience ground level concentrations of PM_{10}, $PM_{2.5}$, TSP and dust deposition above the relevant assessment criteria, due to the Project alone or cumulatively.

An assessment of NO_x fume from blasting and diesel combustion is also presented. The maximum predicted 1-hour NO_2 from blasting, even when added to a conservatively high urban background NO_2 concentration (from data collected at the OEH Wallsend monitoring station), is less than 40% of the ambient air quality criteria at any sensitive receptor.

Greenhouse Gas Assessment

A Greenhouse Gas (GHG) assessment was completed based on national and international methods. The assessment of GHG emissions associated with the Project indicates that average annual scope 1 emissions would represent approximately 0.02% of Australia's commitment under the Kyoto Protocol and a very small portion of global greenhouse emissions.

Management and Monitoring

The proposed dust controls for the Project are based on recommendations of the coal mining best practice report. All reasonable and feasible measures to minimise GHG emissions from the Project will also be implemented. The existing monitoring network will be reviewed and augmented for the operation of the Project, outlined in the Air Quality Management Plan.

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1 INTRODUCTION

KEPCO Bylong Australia Pty Ltd (KEPCO) is seeking the approval for the construction and operation of a coal mine to recover approximately 124 Million tonnes of Run of Mine (ROM) coal utilising open cut and underground mining methods for a period of up to 25 years. WorleyParsons Services Pty Ltd (WorleyParsons) was appointed by KEPCO, to manage the approval process for the Bylong Coal Project (the Project).

Pacific Environment Limited (PEL) has been commissioned by Hansen Bailey, on behalf of WorleyParsons, to prepare an Air Quality and Greenhouse Gas Impact Assessment for the Project.

1.1 Study requirements

The Air Quality and Greenhouse Gas Impact Assessment is guided by the Secretary's Environmental Assessment Requirements (SEARs) and Agency requirements, as outlined in **Table 1.1,** and the NSW Environment Protection Agency (EPA) *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW* (the Approved Methods) (**NSW EPA, 2005**).

Table 1.1: Agency Requirements for Air Quality and Greenhouse Impact Assessment

Requirement	Agency	Relevant section of report
Air Quality- including:	Department of Planning and Environment	
An assessment of the likely air quality impacts of the development in accordance with the *Approved Methods for the Modelling and Assessment of Air Pollutants in NSW*, including the likely $PM_{2.5}$ emissions		Section 8
An assessment of the likely greenhouse gas impacts of the development, dealing with OEH's requirements		Section 12
The EA should include a detailed air quality impact assessment (AQIA). The AQIA should:	Environment Protection Authority	
1. 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 to human health and amenity.		Section 7
2. Justify the level of assessment undertaken on the basis of risk factors, including but not limited to: a. proposed location; b. characteristics of the receiving environment; and c. type and quantity of pollutants emitted.		Sections 3, 5 and 7
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 need not be limited to: a. meteorology and climate; b. topography; c. surrounding land-use; receptors; and d. ambient air quality.		Section 5
4. Include a detailed description of the proposal. All processes that could result in air emissions must be identified and described. Sufficient detail to accurately communicate the characteristics and quantity of all emissions must be provided.		Sections 2 and 7
5. Include a consideration of 'worst case' emission scenarios and impacts at proposed emission limits.		Section 7
6. Account for cumulative impacts associated with existing emission sources as well as any currently approved developments linked to the receiving environment.		Section 8
7. 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 for the Modelling and Assessment of Air Pollutants in NSW (2005).		Sections 6 and 8

Requirement	Agency	Relevant section of report
8. Demonstrate the projects ability to comply with the relevant regulatory framework, specifically the Protection of the Environment Operations Act 1997 and the Protection of the Environment Operations (Clean Air) Regulation 2002.		Section 4.3.2
9. Provide an assessment of the project in terms of the priorities and targets adopted under the NSW State Plan 2010 and its implementation plan Action for Air.		Section 4.3.1
10. Detail air emission control techniques/practices that will be employed by the proposal and demonstrate that these are best management practice, by applying the procedure outlined in Coal Mine Particulate Matter Control Best Practice - Site-specific determination guideline		Section 7.1
11. Detail emission control techniques/practices that will be employed by the proposal, including the development of real-time monitoring/management procedures, response (adverse weather) trigger levels and predictive meteorological monitoring/modelling for dust management.		Section 13.4
12. Assess the potential for spontaneous combustion of coal stockpiles, and any other stockpiles, and provide the management measures that will be implemented should it be determined that there is a propensity for combustion of stockpiled materials.		Section 11
Greenhouse Gases- including:	Department of Planning and Environment	
a quantitative assessment of potential Scope 1, 2 and 3 greenhouse gas emissions		Section 12
a qualitative assessment of the potential impacts of these emissions on the environment		Section 12.3
an assessment of reasonable and feasible measures to minimise greenhouse gas emissions and ensure energy efficiency		Section 12.5
1. The EA should include a comprehensive assessment of, and report on, the project's predicted greenhouse gas emissions ($tC0_2e$). Emissions should be reported broken down by:	Office of Environment and Heritage	Section 12
a. direct emissions (scope 1 as defined by the Greenhouse Gas Protocol- see reference below), b. indirect emissions from electricity (scope 2), and c. upstream and downstream emissions (scope 3), before and after implementation of the project, including annual emissions for each year of the project (construction, operation and decommissioning).		Section 12
2. The EA should include an estimate of the greenhouse emissions intensity (per unit of production). Emissions intensity should be compared with best practice if possible.		Section 12.4
3. The emissions should be estimated using an appropriate methodology, in accordance with NSW, Australian and international guidelines.		Section 12.1
4. The proponent should also evaluate and report on the feasibility of measures to reduce greenhouse gas emissions associated with the project. This could include a consideration of energy efficiency opportunities or undertaking an energy use audit for the site.		Section 12.5

2 PROJECT DESCRIPTION

The Project life is anticipated to be approximately 25 years, comprising an approximate two year construction period and a 23 year operational period, with open-cut mining during Years 3 to 10 and underground mining operations commencing in around Year 7. Various rehabilitation and decommissioning activities will be undertaken during both the course of, and following the 25 years of the Project.

A conceptual project layout is shown in **Figure 2.1**. The Project comprises of the following main aspects:

- The initial development of two open cut mining areas with associated haul roads and Overburden Emplacement Areas (OEAs), utilising a mining fleet of excavators and trucks and supporting ancillary equipment.
- The two open cut mining areas will be developed and operated 24 hours a day, 7 days a week over an approximately 10 year period and will ultimately provide for the storage of coal processing reject materials from the longer term underground mining activities.
- Construction and operation of administration, workshop, bathhouse, explosives magazine and other open cut mining related facilities.
- Construction and operation of an underground coal mine operating 24 hours a day, 7 days a week for a 20 year period, commencing mining in around year 7 of the Project.
- A combined maximum extraction rate of up to 6.5 Million tonnes per annum (Mtpa) Run of Mine (ROM) coal.
- A workforce of up to approximately 800 during the initial construction phase and a peak of 470 full-time equivalent operations employees at full production.
- Underground mining operations utilising longwall mining techniques with primary access provided via drifts constructed adjacent to the rail loop and Coal Handling and Preparation Plant (CHPP).
- The construction and operation of facilities to support underground mining operations including personnel and materials access to the underground mining area, ventilation shafts, workshop, offices and employee amenities, fuel and gas management facilities.
- Construction and operation of a CHPP with a designed throughput of approximately 6 Mtpa of ROM coal, with capacity for peak fluctuations beyond this.
- The dewatering of fine reject materials through belt press filters within the CHPP and the co-disposal of dewatered fine and coarse reject materials within OEAs and final open cut voids (avoiding the need for a tailings dam).
- Construction and operation of a rail loop and associated rail load out facility and connection to the Sandy Hollow to Gulgong Railway Line to facilitate the transport of product coal.
- The construction and operation of surface and groundwater management and water reticulation infrastructure including diversion drains, dams (clean, dirty and raw water), pipelines and pumping stations.
- The installation of communications and electricity reticulation infrastructure.
- Construction and operation of a Workforce Accommodation Facility (WAF) and associated access road from the Bylong Valley Way.
- The upgrade of Upper Bylong Road and the construction and operation of a Mine Access Road to provide access to the site facilities.

- Relocation of sections of some existing public roads to enable alternate access routes for private landholders surrounding the Project.
- Infilling of mining voids, progressive rehabilitation of disturbed areas, decommissioning of Project infrastructure and rehabilitation of the land progressively following mining operations.

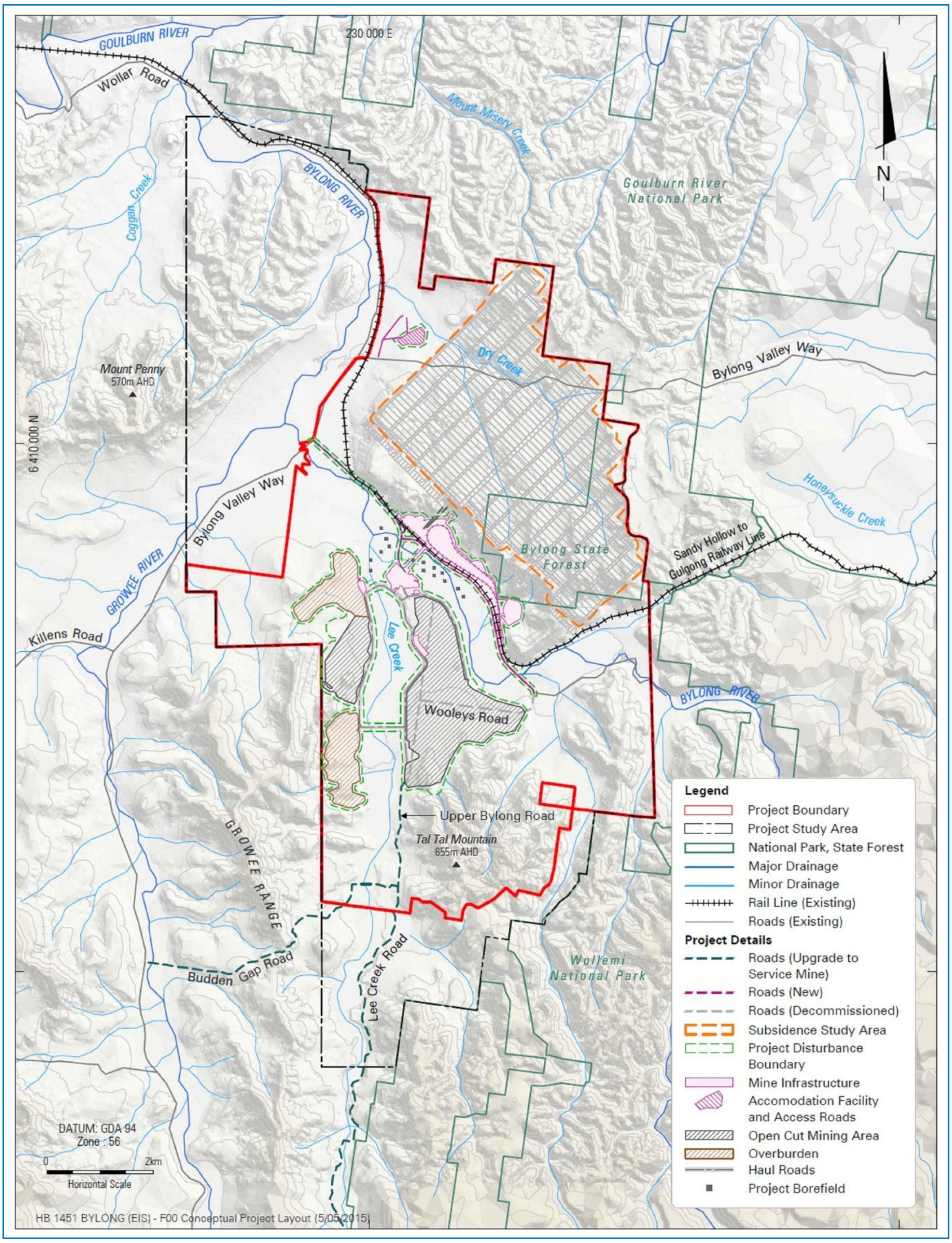


Figure 2.1: Conceptual Project Layout

3 LOCAL SETTING

The Project is located wholly within Authorisation (A) 287 and A342 (the Authorisations) which are located within the Mid-Western Regional Council (MWRC) Local Government Area (LGA) and cover an area of approximately 10,300 hectares, as shown in **Figure 3.1**. The Project is located approximately 55 km south-west of Mudgee and approximately 230 km by rail from the Port of Newcastle.

The Project Boundary is located partly on cleared and pasture improved agricultural land within the lower valley areas and native woodland and forest within the more elevated Bylong State Forest and other portions of Crown Land. The land within the Project Boundary is currently being utilised for fodder cropping and grazing activities on the lower slopes and cattle grazing on the steeper slopes. The small settlement of Bylong Village is located to the northwest of the Project Boundary.

The land within the Project Boundary comprises complex topography. To the north-west of Bylong Village is Mt Penny, rising to a height of approximately 570 m Australian Height Datum (AHD). Goulburn River National Park is located immediately northeast of the Project Boundary with the Wollemi National Park to the east and southeast of the Project Boundary. The Growee Range borders the south-western side of the Project Boundary. A northwest-southeast oriented ridge is located to the immediate northeast of the proposed open cut areas and mine infrastructure areas, rising to a height of approximately 480 m AHD and comprising the Bylong State Forest. Located south of the proposed open-cut area is Tal Tal Mountain, rising to a height of approximately 655 m AHD. The local topography for the local area and surrounds is shown in **Figure 3.2.**

Land ownership and receptor locations are illustrated on **Figure 3.3** and **Figure 3.4**. Since purchasing the Project in 2010, KEPCO has acquired a substantial proportion of the freehold land within the Project Boundary. It is noted that there are two sensitive receptors (142A and 142B) shown on **Figure 3.3** and **Figure 3.4** that will not exist at time of mining. These properties are owned by the Department of Education and Training who has confirmed with KEPCO that the properties (a school) will either be relocated or permanently closed. For this reason, these receptors have been not further assessed in this report.

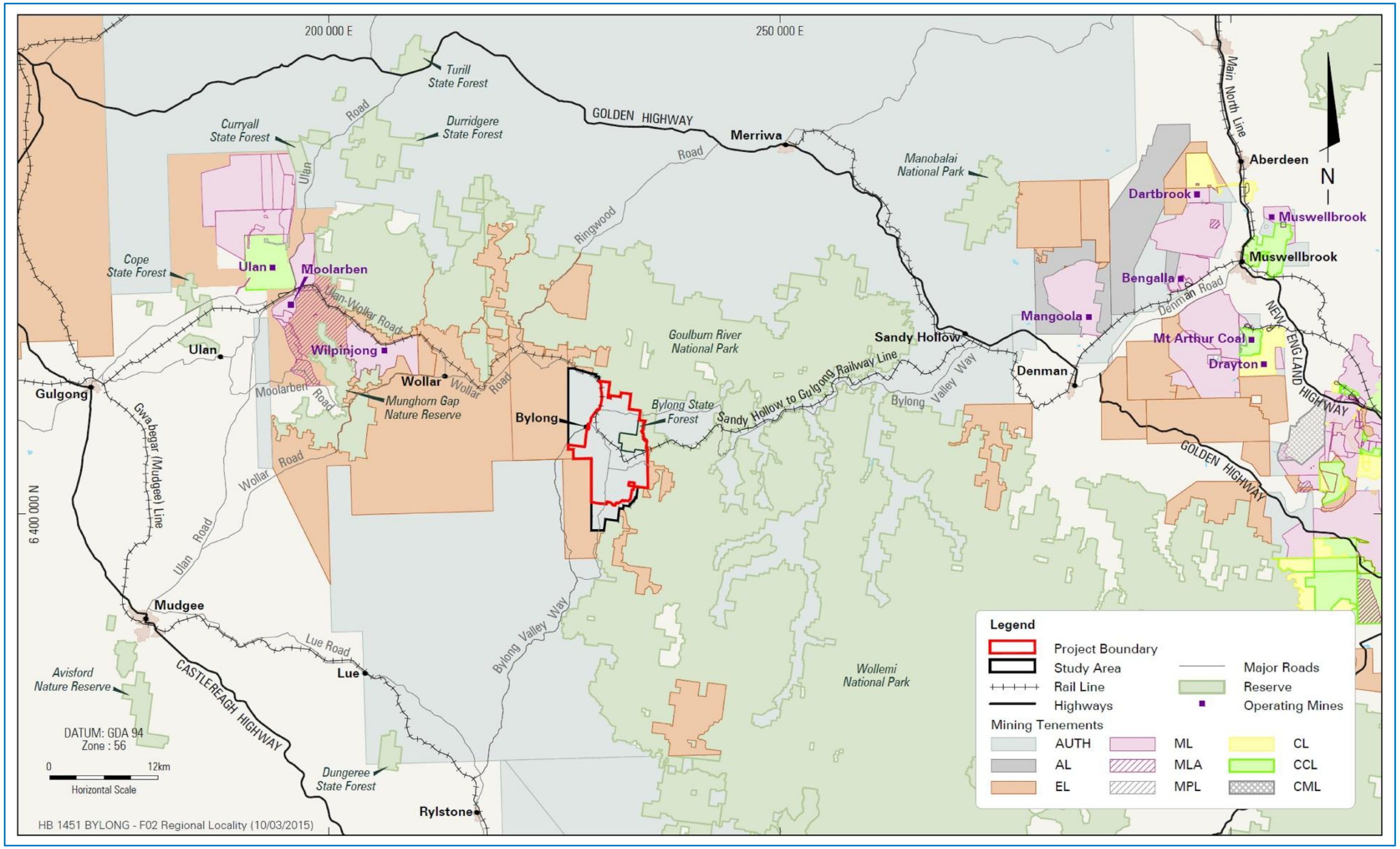


Figure 3.1: Local Setting

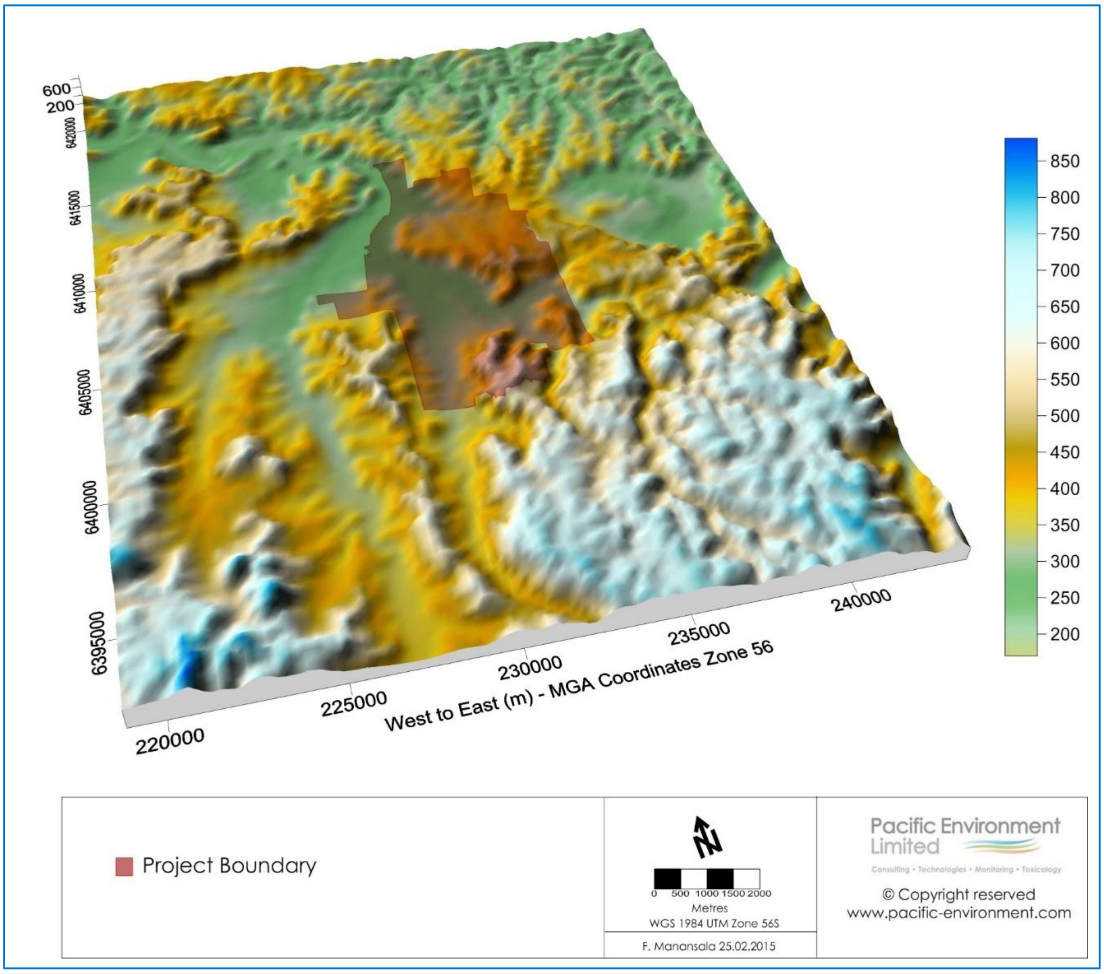


Figure 3.2: 3-D terrain image of the Project area

Table 3.1: Sensitive Receptor List

ID	Owner	Receiver Type	MGA Coordinates Zone 56	
			x	y
Privately-Owned Receptors				
4	Justin Kennedy Lewis Pty Limited	Residential	225751	6416995
5	Justin Kennedy Lewis Pty Limited	Residential	225667	6416840
17	Bridgelo School 1914	Residential	230178	6414455
41A	NA Fieldsend	Residential	226801	6416207
41B	NA Fieldsend	Residential	226796	6416131
42	PJ & LJ Kelleher	Residential	227687	6415328
43	W Zappa	Residential	227777	6416196
44	WD & PAS Evans	Residential	228833	6415736
47	Suntala Pty Ltd	Residential	228445	6415552
49	Suntala Pty Ltd	Residential	229126	6415335
50	Suntala Pty Ltd	Residential	229421	6414790
53	RF & BW Murdoch	Residential	233708	6410993
56	Locaway Pty Ltd	Residential	226800	6409519
57A	Locaway Pty Ltd	Residential	225827	6408583
57B	Locaway Pty Ltd	Residential	225736	6408534
57C	Locaway Pty Ltd	Residential	225826	6408529
58	J Mead	Residential	226848	6408342
60	Jarvet Pty Limited	Residential	228482	6409419
61A	St Stephens Church - Anglican Church Property Trust Diocese of Bathurst	Place of Worship	228454	6409700
61B	St Stephens Church - Anglican Church Property Trust Diocese of Bathurst	Passive Recreation Area	228480	6409697
65A	JB Watson (Bylong General Store)	Residential	228660	6409734
63	TA Rixon	Residential	228651	6409610
68	RNK Wright	Residential	228921	6410018
69	RNK Wright	Residential	229442	6409398
141	JD & VK & AJ & LF & MG & NJ & K Brown & AN Bonarius	Residential	235184	6406104
142A	Minister for Education and Training	School	231041	6405605
142B	Minister for Education and Training	School	231038	6405565
146	PA Frost & CD Shaw	Residential	234104	6403024
151	PR Grieve	Residential	229691	6401019
158	PR Grieve	Residential	230384	6400727
161	JB Watson & JA Nancarrow	Residential	230854	6400087
162	JB Watson & JA Nancarrow	Residential	231496	6400026
165	J Garling & D & P & R Loneragan	Residential	229919	6399688
168	J Garling & D & P & R Loneragan	Residential	229542	6398753
181A	Icelink Pty Ltd	Residential	224814	6407172
181B	Icelink Pty Ltd	Residential	224845	6407060
181C	Icelink Pty Ltd	Residential	224812	6406984
181D	Icelink Pty Ltd	Residential	224978	6406981
225	Timnath Pty Ltd	Residential	226224	6402091
226	Timnath Pty Ltd	Residential	225909	6401119
242	Ian Ross & Kay Carol Tindale	Residential	226263	6397961
292	Iwi Cattle Co Pty Ltd	Residential	225257	6402067
317	LL Braithwaite	Residential	226709	6396556
349	J Garling & D & P & R Loneragan	Residential	229379	6396433
348	J Garling & D & P & R Loneragan	Residential	229574	6396942
Bylong Oval	Bylong Council	Active Recreation Area	228585	6409672
Bylong Community Hall	Bylong Council	Commercial	228609	6409781
KEPCO Owned Receptors				
K1	KEPCO Bylong Australia Pty Ltd	Residential	230269	6414258
K2	KEPCO Bylong Australia Pty Ltd	Residential	230044	6413815
K3	KEPCO Bylong Australia Pty Ltd	Residential	230530	6412524
K4	KEPCO Bylong Australia Pty Ltd	Residential	230582	6412451
K5	KEPCO Bylong Australia Pty Ltd	Residential	229931	6411232
K6	KEPCO Bylong Australia Pty Ltd	Residential	228956	6410183
K7	KEPCO Bylong Australia Pty Ltd	Residential	228903	6410218
K8	KEPCO Bylong Australia Pty Ltd	Residential	228834	6410246

ID	Owner	Receiver Type	MGA Coordinates Zone 56	
			x	y
K9	KEPCO Bylong Australia Pty Ltd	Residential	228650	6409688
K10	KEPCO Bylong Australia Pty Ltd	Residential	229347	6409099
K11	KEPCO Bylong Australia Pty Ltd	Residential	229224	6408942
K12	KEPCO Bylong Australia Pty Ltd	Residential	230880	6407498
K13	KEPCO Bylong Australia Pty Ltd	Residential	230966	6407295
K14	KEPCO Bylong Australia Pty Ltd	Residential	231545	6407033
K15	KEPCO Bylong Australia Pty Ltd	Residential	231776	6406549
K16	KEPCO Bylong Australia Pty Ltd	Residential	231195	6406387
K17	KEPCO Bylong Australia Pty Ltd	Residential	231101	6406579
K18	KEPCO Bylong Australia Pty Ltd	Residential	231130	6406563
K19	KEPCO Bylong Australia Pty Ltd	Residential	222936	6405820
K20	KEPCO Bylong Australia Pty Ltd	Residential	223212	6405757
K21	KEPCO Bylong Australia Pty Ltd	Residential	230978	6405482
K22	KEPCO Bylong Australia Pty Ltd	Residential	230368	6404500
K23	KEPCO Bylong Australia Pty Ltd	Residential	230513	6404341
K24	KEPCO Bylong Australia Pty Ltd	Residential	230483	6403594
K25	KEPCO Bylong Australia Pty Ltd	Residential	229922	6403263
K26	KEPCO Bylong Australia Pty Ltd	Residential	230460	6402369
K27	KEPCO Bylong Australia Pty Ltd	Residential	232976	6405173
K28	KEPCO Bylong Australia Pty Ltd	Residential	233862	6405511
K29	KEPCO Bylong Australia Pty Ltd	Residential	235214	6405633
K144	KEPCO Bylong Australia Pty Ltd	Residential	229756	6403726
K130	KEPCO Bylong Australia Pty Ltd	Residential	231539	6406905
KTPHB	KEPCO Bylong Australia Pty Ltd	Commercial	231208	6406983
22	Bylong Station Stables	Commercial	230726	6412434

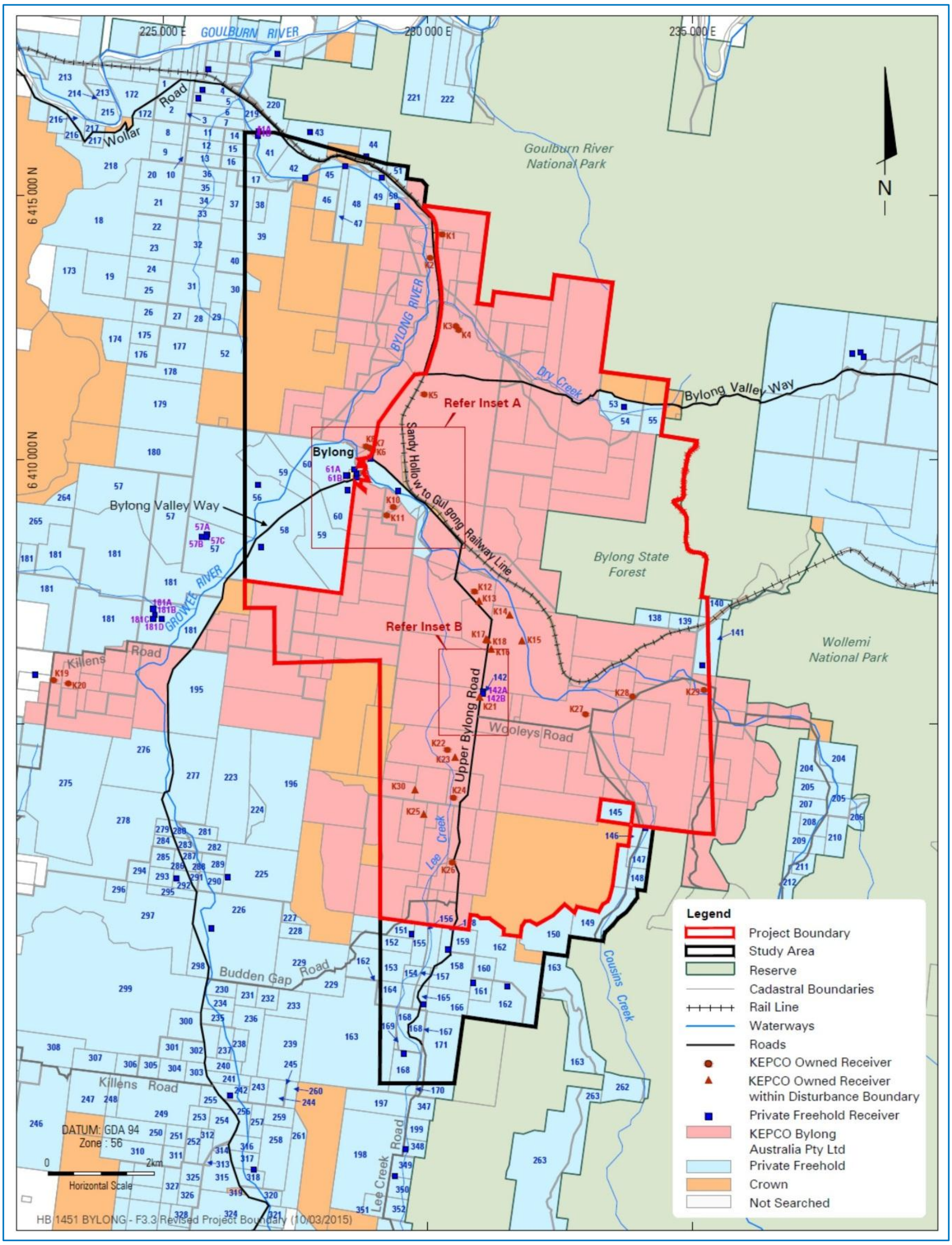


Figure 3.3: Land ownership plan

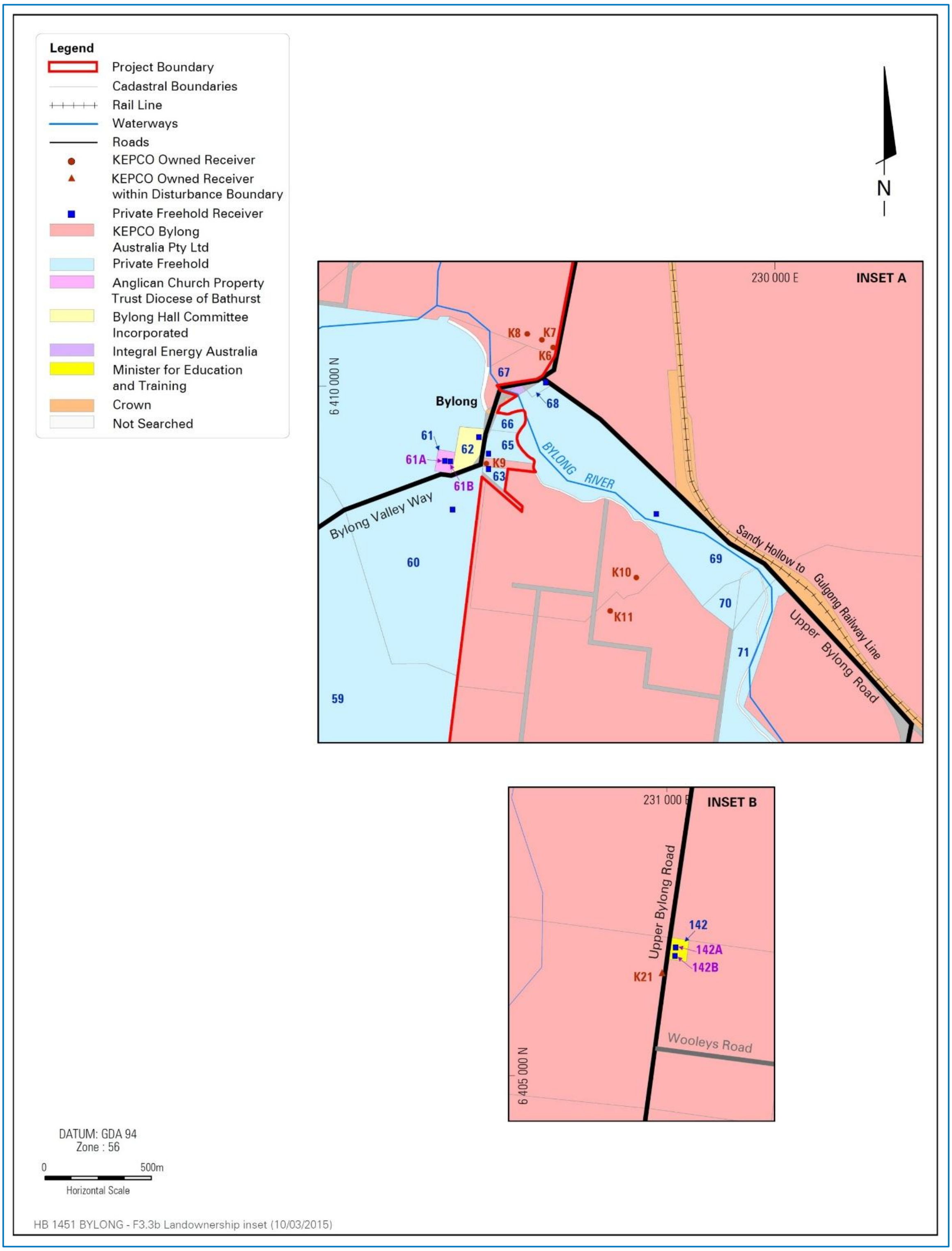


Figure 3.4: Land ownership plan - inset

4 AIR QUALITY CRITERIA

Mining activities have the potential to generate fugitive dust emissions in the form of particulate matter, described in detail in **Section 4.1.1**. In addition, combustion of diesel fuel in mining equipment results in emissions of fine particulate matter, nitrogen dioxide (NO_2), carbon monoxide (CO), sulphur dioxide (SO_2) and organic hydrocarbons.

Emissions of particles from diesel combustion is accounted for in the estimates of fugitive emissions of particles (refer to **Section 7**), which include diesel particles as well as particles derived from the materials being handled. NO_x emissions from diesel combustion (and blasting) are also assessed and presented in **Section 9**.

The low sulphur content of Australian diesel, in combination with the fact that mining equipment is widely dispersed over the Site, is such that the ambient air quality criteria for SO_2 would not be exceeded, even in mining operations that use large quantities of diesel. This has been observed in the modelling results of other major mining projects such as the Watermark Coal Project and the Bulga Optimisation Project where the highest predicted maximum 1-hour average SO_2 concentration at a sensitive receptor were 0.01% and 0.03% of the criteria respectively. It is noted that these assessments were based on much higher diesel usage that for this Project (i.e. a maximum of 65,899kL for Watermark and 97,112kL for Bulga compared with a maximum of 29,594kL for this Project (**PAEHolmes 2012a and PAEHolmes 2012b**). For this reason, no detailed study is required to demonstrate that emissions of SO_2 from the Project would not significantly affect ambient SO_2 concentrations. Similarly, ambient concentrations of organic hydrocarbons rarely reach levels where air quality goals are compromised and accordingly no detailed assessment is presented within this report.

Other emissions to air from the Project include GHG such as fugitive methane (CH_4) from exposed coal, carbon dioxide (CO_2) from the combustion of fuel in combustion engines, blasting, and indirect GHG emissions from the use of extracted coal for energy production (refer to **Section 12**).

Section 4.1 and **Section 4.2** provide information on the air quality criteria used to assess the impact of dust and NO_x emissions, respectively. To assist in interpreting the significance of predicted concentration and deposition levels, some background discussion is also provided.

4.1 Particulate Matter

4.1.1 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 between 30 microns (µm) to 50 µm.
- Particulate Matter less than 10 µm (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 (**WHO, 2011**). 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 less significant in terms of 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.

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 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).

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}.

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.

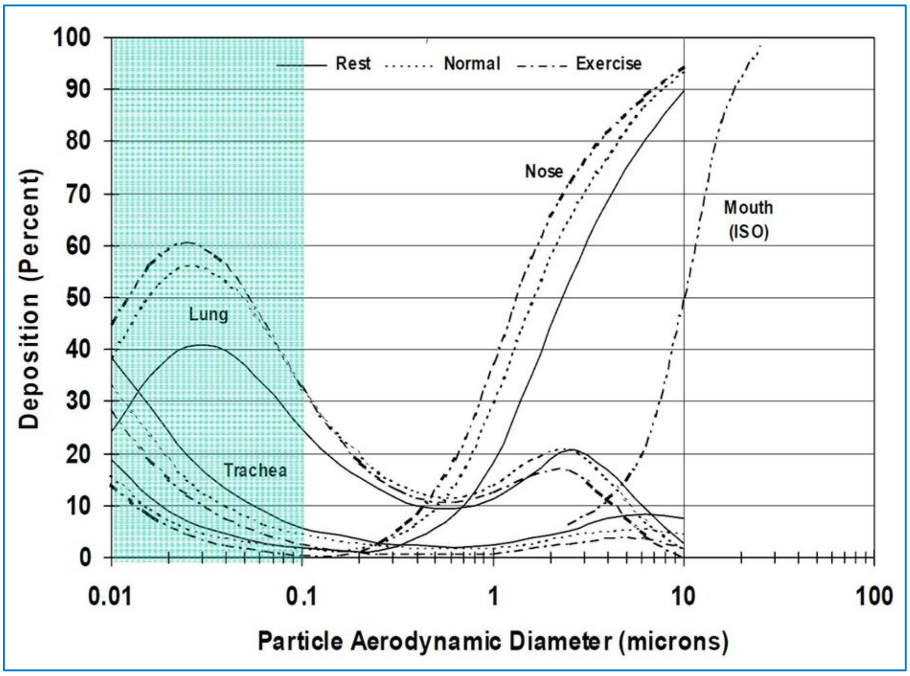


Figure 4.1: Particle Deposition within the Respiratory Track (Source: Chow, 1995)

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 (**NSW EPA, 1998**; **National Environment Protection Council [NEPC], 1998; NEPC, 1998a**). This means that, in contrast to dust of crustal origin, the particulate

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

matter from urban areas would be composed of smaller particles and would generally contain acidic and carcinogenic substances that are associated with combustion.

4.1.2 NSW EPA Impact Assessment Criteria/NEPM Advisory Reporting Standards

The Approved Methods specifies air quality assessment criteria relevant for assessing impacts from air pollution (**NSW EPA, 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.

In May 2003, the NEPC released a variation to the Ambient Air-NEPM (**NEPC, 2003**) to include advisory reporting standards for particulate matter with an equivalent aerodynamic diameter of 2.5 µm or less ($PM_{2.5}$). The purpose of the variation was to gather sufficient data nationally to facilitate the review of the Ambient Air NEPM, which is currently underway. The variation includes a protocol setting out monitoring and reporting requirements for $PM_{2.5}$ particles. It is noted that the Ambient Air NEPM $PM_{2.5}$ advisory reporting standards are not impact assessment criteria.

Notwithstanding the above, in the absence of any other relevant standard/goal, the advisory reporting standards have been used in this report for comparison against dispersion modelling results. **Table 4.1** presents 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 Project and other sources.

At the time of writing, the Ambient-Air NEPM was under review but no regulatory changes had been made to the assessment criteria summarised in **Table 4.1** that are relevant to this study.

Table 4.1: EPA Air Quality Criteria/NEPM Advisory Reporting Standards for Particulate Matter Concentrations

Pollutant	Standard	Averaging Period	Source
TSP	90 µg/m³	Annual	NSW DEC (2005) (assessment criterion)
PM_{10}	50 µg/m³	24-Hour	NSW DEC (2005) (assessment criterion)
	30 µg/m³	Annual	NSW DEC (2005) (assessment criterion)
	50 µg/m³	24-Hour	NSW DEC (2005) (assessment criterion) NEPM (allows five exceedances per year)
$PM_{2.5}$	25 µg/m³	24-Hour	NEPM Advisory Reporting Standard
	8 µg/m³	Annual	NEPM Advisory Reporting Standard

Notes: µg/m³ – 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 (**NSW EPA, 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/m²/month	4 g/m²/month

Notes: g/m²/month – grams per square metre per month.

4.1.3 NSW Department of Planning and Environment Voluntary Land Acquisition and Mitigation Policy

On 15 December 2014, NSW Department of Planning and Environment (DP&E) released a policy relating to voluntary mitigation and land acquisition criteria for air quality and noise (**DP&E, 2014**).

The policy sets out voluntary mitigation and land acquisition rights where it is not possible to comply with the EPA impact assessment criteria even with the implementation of all reasonable and feasible avoidance and/or mitigation measures.

The voluntary mitigation and acquisition criteria are summarised in **Table 4.3** and **Table 4.4**, respectively. The Project has been assessed against these criteria, in addition to the EPA impact assessment criteria discussed in **Section 4.1.2**.

Table 4.3: DP&E particulate matter mitigation criteria

Pollutant	Criterion	Averaging Period	Application
TSP	90 $\mu g/m^3$	Annual mean	Total impact
PM_{10}	50 $\mu g/m^3$	24-hour average	Incremental impact[(a)]
	30 $\mu g/m^3$	Annual mean	Total impact
Deposited dust	2 g/m^2/month	Annual mean	Incremental impact[(a)]
	4 g/m^2/month	Annual mean	Total impact

Note:
(a) Zero allowable exceedances of the criterion over the life of the development.

Table 4.4: DP&E particulate matter acquisition criteria

Pollutant	Criterion	Averaging Period	Application[(a)]
TSP	90 $\mu g/m^3$	Annual mean	Total impact
PM_{10}	50 $\mu g/m^3$	24-hour average	Incremental impact[(b)]
	30 $\mu g/m^3$	Annual mean	Total impact
Deposited dust	2 g/m^2/month	Annual mean	Incremental impact[(b)]
	4 g/m^2/month	Annual mean	Total impact

Notes:
(a) Voluntary acquisition rights apply where the Project contributes to exceedances of the acquisition criteria at any residence or workplace on privately-owned land, or, on more than 25% of any privately-owned land, and a dwelling could be built on that land under exiting planning controls.
(b) Up to five allowable exceedances of the criterion over the life of the development.

Total impact includes the impact of the Project and all other sources, whilst incremental impact refers to the impact of the Project considered in isolation.

4.2 Oxides of Nitrogen

The key gaseous pollutant assessed for diesel combustion and blast fume is oxides of nitrogen (NO_x). NO_x is comprised of nitric oxide (NO) and nitrogen dioxide (NO_2), however NO is not generally considered harmful to human health and not considered an air pollutant at the concentrations that are typically found in ambient environments. Effects of NO_2 include respiratory infections, asthma and chronic lung disease.

Concern with nitric oxide is related to its transformation to nitrogen dioxide and its role in the formation of photochemical smog. Nitrogen dioxide has been reported to have an effect on respiratory function, although the evidence concerning effects has been mixed and conflicting. NSW EPA prescribes ambient impact assessment criteria for NO_2, as outlined in **Table 4.5**.

Table 4.5: Ambient Air Quality Criteria for NO_2

Pollutant	Averaging Period	Criteria	
Nitrogen Dioxide	1-Hour	0.12 ppm	246 $\mu g/m^3$
	Annual	0.03 ppm	62 $\mu g/m^3$

4.3 Other Legislative Requirements

4.3.1 NSW Action for Air

The NSW State Plan identifies cleaner air and progress on GHG reductions as priorities. In 1998, the NSW Government implemented a 25 year air quality management plan, Action for Air, for Sydney, Wollongong and the Lower Hunter (**DECCW, 2009**). Action for Air is a key strategy for implementing the NSW State Plan's cleaner air goals. Action for Air seeks to provide long-term ongoing emission reductions. It does not target acute and extreme exceedances from events such as bushfires. The aims of Action for Air include:

- Meeting the national air quality standards for six pollutants as identified in the Ambient Air-NEPM; and
- Reducing the population's exposure to air pollution, and the associated health costs.

The six pollutants in the Ambient Air-NEPM include CO, NO_2, SO_2, lead, ozone and PM_{10}. The main pollutants from the Project that are relevant to the Action for Air include PM_{10} and NO_2. Action for Air aims to reduce air emissions to enable compliance with the Ambient Air-NEPM targets to achieve the aims described above, with a focus on motor vehicle emissions. Whilst the Project is not located within the areas relevant to the Action for Air plan (i.e. Sydney, Wollongong and the Lower Hunter), the Project generally addresses the aims of the Action for Air Plan in the following ways:

- Potential mitigation measures have been reviewed, and a range of measures have been adopted for the Project (see **Section 7.1**);
- Air quality emissions potentially associated with the Project have been quantified (see **Section 7.2**); and
- Dispersion modelling has been conducted to predict the impact of these emissions on nearby receivers, and assess the effect of the emissions on ambient concentrations which can then be compared with the Ambient Air-NEPM goals (see **Section 8**).

4.3.2 Protection of the Environment Operations (POEO) Act, 1997

If approved, the Project would require an Environmental Protection Licence (EPL) to be issued by the EPA under the *Protection of the Environment Operations Act 1997* (POEO Act). Relevant to air quality, the EPL would outline the Project's requirements to minimise dust emissions and specify air quality monitoring requirements. The *Protection of the Environment Operations (Clean Air) Regulations 2010* (POEO (Clean Air) Regulation) (**POEO, 2010**) sets out standards of concentration for emissions to air from scheduled activities. The maximum pollution levels allowed under the regulations for general activities are provided in **Table 4.6**.

Table 4.6: Maximum Allowable Emission Levels

Air Impurity	Activity or Plant	Standard of Concentration
Solid Particles	Any process emitting solid particles	50 mg/m^3

In addition, the POEO (Clean Air) Regulation prescribes requirements for domestic solid fuel heaters, control of burning, motor vehicle emissions and industrial emissions. Motor vehicle emissions would be addressed by regular maintenance of all vehicles associated with the Project. In addition, no burning on-site would be conducted to minimise potential for smoke impacts on neighbouring receivers.

4.3.3 The Best Practice Report

The NSW EPA commissioned *the NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining* (**Donnelly et al., 2011**) (hereafter referred to as the Best Practice Report).

The Best Practice report provides guidance on controls for reducing emissions and is benchmarked on the international best practice for the following activities:

- Haul roads.
- Wind erosion of exposed materials and stockpiles.
- Bulldozing.
- Blasting.
- Drilling.
- Draglines.
- Loading and dumping overburden.
- Loading and dumping ROM coal.
- Monitoring, proactive and reactive management.

The full set of potential best practice control measures to be adopted by the Project, have been summarised in **Section 7.1**.

5 EXISTING ENVIRONMENT

5.1 Overview

Baseline air quality and meteorological data has been collected for the Project since August 2011. The locations for baseline monitoring are summarised in **Table 5.1** and shown in **Figure 5.1**.

Table 5.1: Overview of Monitoring

Site	Description	Type	Installation Date	Easting (m)	Northing (m)
DDG1	Crown land north of Project Boundary	Deposition Dust Gauge (DDG)	March 2012	228678	6415740
DDG2	Bylong Village			229066	6409966
DDG3	Wingarra			224803	6406953
DDG4	Upper Bylong School			231035	6405658
DDG5	Redbank Cottage			231543	6400082
TEOM	Site Office	Continuous PM_{10} and $PM_{2.5}$ Monitor (TEOM)	August 2011	230898	6407373
Met1	Property Adjacent to Site Office	Automatic Weather Station (AWS)	July 2011	230807	6407505

Notes: Site coordinates provide in MGA (Zone 56).

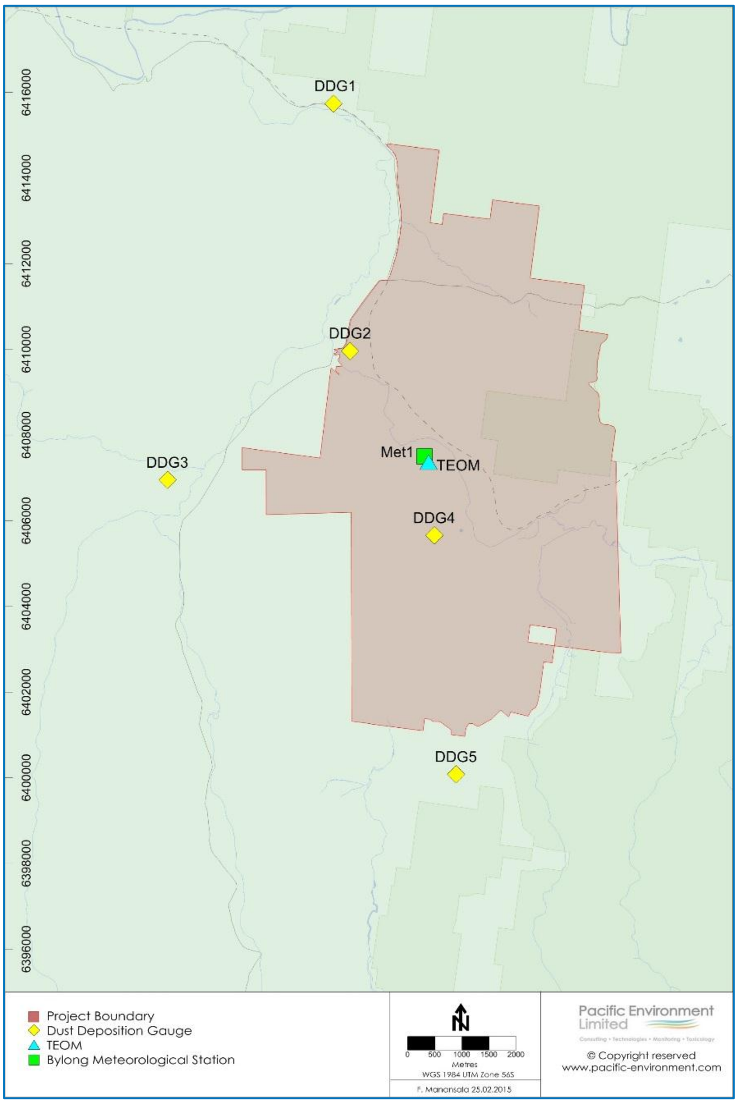


Figure 5.1: Location of monitoring sites

All monitoring is conducted in accordance with the NSW EPA "*Approved methods for the sampling and analysis of air pollutants in NSW*" (**NSW EPA, 2007**), specifically:

- AM-1 – Guide for the siting of sampling equipment.
- AM-2 – Guide for measurement of horizontal wind for air quality applications.
- AM-19 – Particulates – deposited matter – gravimetric method.
- AM-22 – Particulate matter – PM_{10} – TEOM.

AM-1 refers to the Australian Standard (AS) 2922 – 1987, however this has been superseded by AS/NZS 3580.1.1:2007 *Methods for sampling and analysis of ambient air - Guide to siting air monitoring equipment*". The siting of instrumentation is undertaken in accordance with the requirements set out in both AS 2922 and AS 3580.1.1: 2007.

AM-2 refers to the Australian Standard AS 2923 – 1987 *Ambient Air – Guide for Measurement of Horizontal Wind for Air Quality Applications*. AS 2923 applies to the determination of wind speed and direction for the purpose of air quality applications and sets out requirements for apparatus, calibration and maintenance, siting and installation and data recording and processing (including appropriate methods for wind averaging).

AM-19 refers to the method outlined in AS/NZS 3580.10.1:2003 *Methods for sampling and analysis of ambient air - Determination of particulate matter - Deposited matter - Gravimetric method*. Dust Deposition monitoring is conducted in accordance with AS 3580.10.1: 2003.

AM-22 refers to AS/NZS 3580.9.8 – 2008 *Methods for sampling and analysis of ambient air – Method 9.8 Determination of suspended particulate matter –PM_{10} continuous direct mass method using a tapered element oscillating microbalance analyser*. The Tapered Element Oscillating Microbalance (TEOM) is an EPA Approved Method for PM_{10}. There is no current EPA Approved Method for $PM_{2.5}$, although Australian Standards do exist. The TEOM installed at Bylong is a TEOM-DF model and is a US EPA designated equivalence method for both PM_{10} and $PM_{2.5}$. PM_{10} and $PM_{2.5}$ monitoring is conducted in general accordance with AS 3580.9.8: 2008.

5.2 Meteorology

5.2.1 Wind data

The Approved Methods include guidelines for the preparation of meteorological data to be used in dispersion modelling. Meteorological data have been collected at an onsite AWS since August 2011. An input file for modelling was generated using data collected between September 2011 and August 2012. This period was chosen due to it being the most complete period of data available during the initial assessments of the Project. The Approved Methods states that a Level 2 impact assessment must be completed using at least one year of site-specific and that these data must be 90% complete data. It is noted that as the meteorological model for this Project is CALMET, multiple meteorological sites are included in the model and the 90% data recovery condition is inherently met. Notwithstanding the above, as shown in **Table 5.2**, the Bylong meteorological station had 97% data recovery for the modelling period.

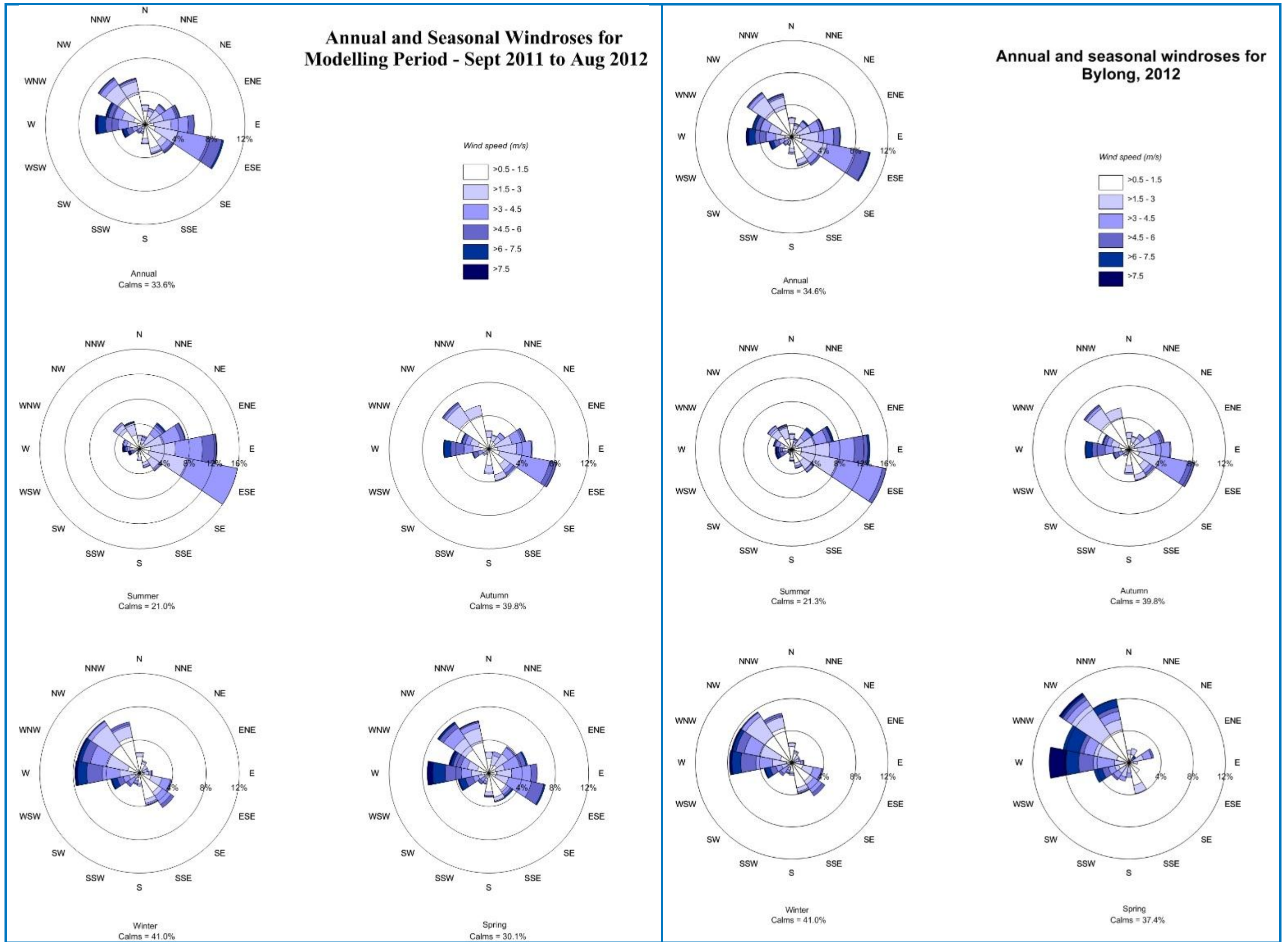
The data collected between September 2011 and August 2012 has been compared to longer term meteorological data collected since then and wind roses for the modelling period are presented in **Figure 5.2**, alongside wind roses for the calendar years 2012, 2013 and 2014 (shown in **Figure 5.3**). As shown in **Figure 5.2** and **Figure 5.3**, the period chosen for modelling is representative of the annual and seasonal wind patterns.

The wind roses indicate that wind patterns are generally aligned along a northwest – east-southeast axis, reflected in the general alignment of surrounding terrain features relative to the positioning of the

AWS. The pattern is reflected across all seasons with more frequent east-southeast winds in summer and northwest winds in winter. A summary of the data collected to date are shown in **Table 5.2**. The mean hourly wind speed is comparable for each period presented and the percentage occurrence of calm conditions (<= 0.5m/s) is relatively high, ranging from 20% - 30%.

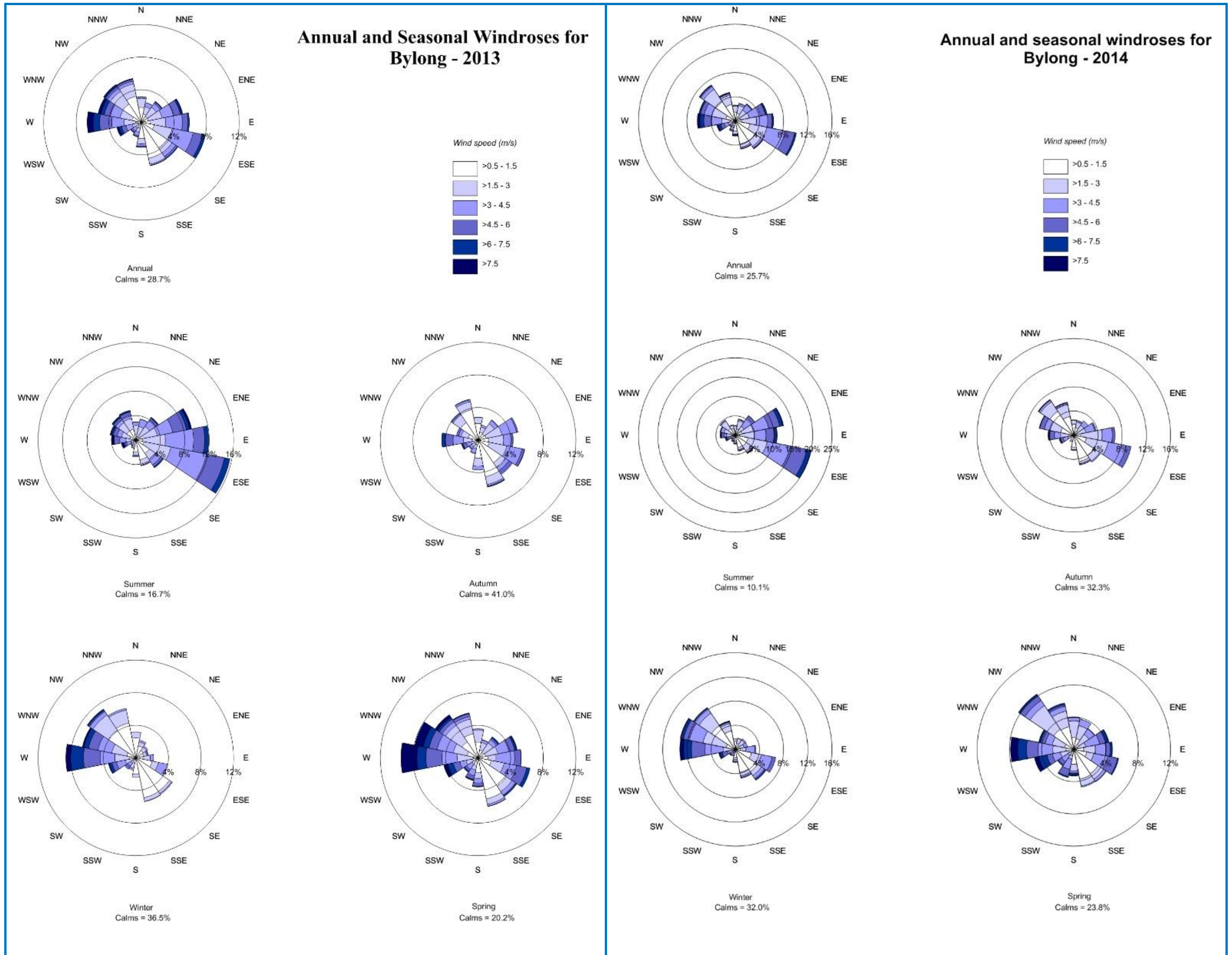
Table 5.2: Summary Statistics for wind data recorded at the onsite AWS

Parameter (units)	Parameter	Sept 2011 – August 2012	2012	2013	2014
Wind Speed (m/s)	Mean	1.8	2.0	2.1	2.0
	% Calms	34%	35%	29%	26%
	% Complete	97%	93%	95%	85%
Wind Direction	% Complete	92%	75%	95%	85%



Period for modelling (Sept 2011 – August 2012)	Annual period for calendar year 2012

Figure 5.2: Windroses for the onsite AWS for the modelling period (September 2011 – August 2012) and for 2012



Annual period for calendar year 2013	Annual Period for calendar year 2014

Figure 5.3: Windroses for the onsite AWS for 2013 and 2014

5.2.2 Temperature

A plot of the minimum, maximum and average daily temperature is shown in **Figure 5.4** as collected at the Bylong AWS for the period August 2011 to December 2014.

The average temperature across the entire period is 15.4°C. The minimum and maximum temperatures across the period are -6.9°C and 43.5 °C respectively.

Seasonal variation is clearly demonstrated in the data.

There is a distinct gap in the data during the period of late September 2012 to early December 2012 which is the result of an instrument fault.

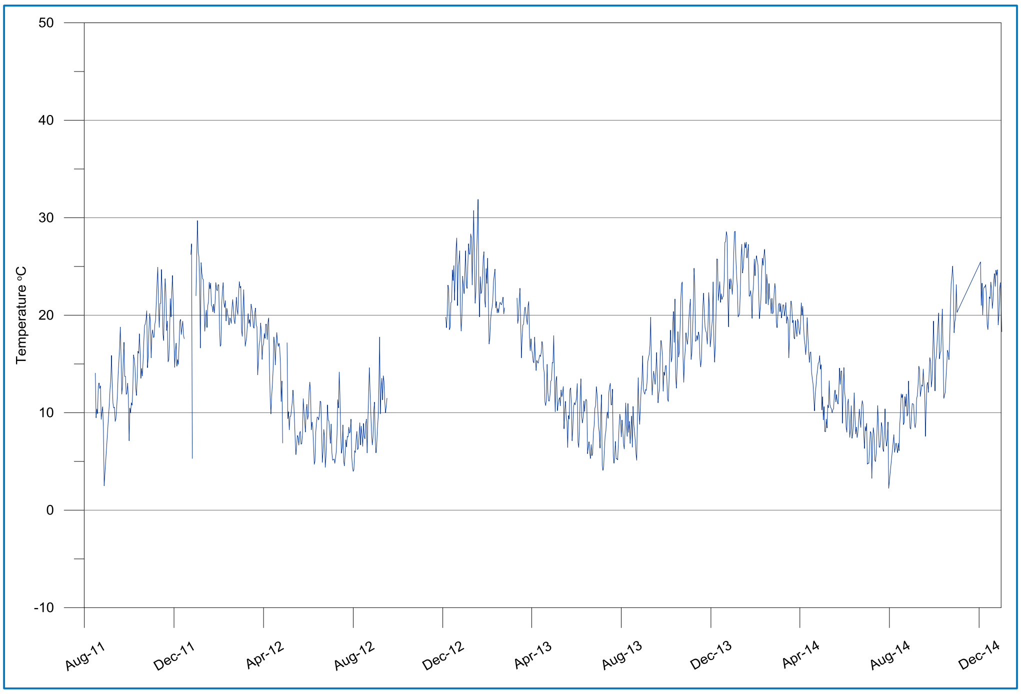


Figure 5.4: Daily average temperature recorded at the onsite AWS for August 2011 to December 2014

5.2.3 Rainfall

A summary of the rainfall data collected to date are shown in **Table 5.3** as collected at the Bylong AWS for the period August 2011 to December 2014. A plot of the total monthly rainfall is shown in **Figure 5.5**.

The total annual rainfall collected at the station is between 298 and 608 mm per year between 2012 and 2014 and the monthly average rainfall collected is between 25 and 59 mm per year between 2011 and 2014.

It is noted rainfall collected in 2013 appears significantly lower than that collected in 2011, 2012 and 2014. A comparison has therefore been made to rainfall collected at the closest BoM rainfall station located at Bylong (Glenview) within 2 km of the Project. **Table 5.4** provides a summary of data collected for this station for the period of 2011 to 2014. The rainfall collected in 2013 is significantly higher than that collected at the Bylong AWS and is consistent with the other years of rain data. These data imply that there was in fact an issue with the 2013 rainfall data collected at the Bylong AWS.

It is important to note that rainfall processes and dust suppression due to rainfall are not explicitly included in the dispersion modelling and as such all results are considered to represent a conservative assessment.

Table 5.3: Summary Statistics of rainfall recorded at Bylong AWS

Parameter (units)	Measure	2011[a]	2012	2013	2014[b]
Rainfall (mm)	Monthly maximum	125 (Nov)	136 (Feb)	72 (Jun)	107 (Feb)
	Monthly average	59	51	25	38
	Annual total	N/A	608	298	458

Note: [a] data available from August 2011 only.

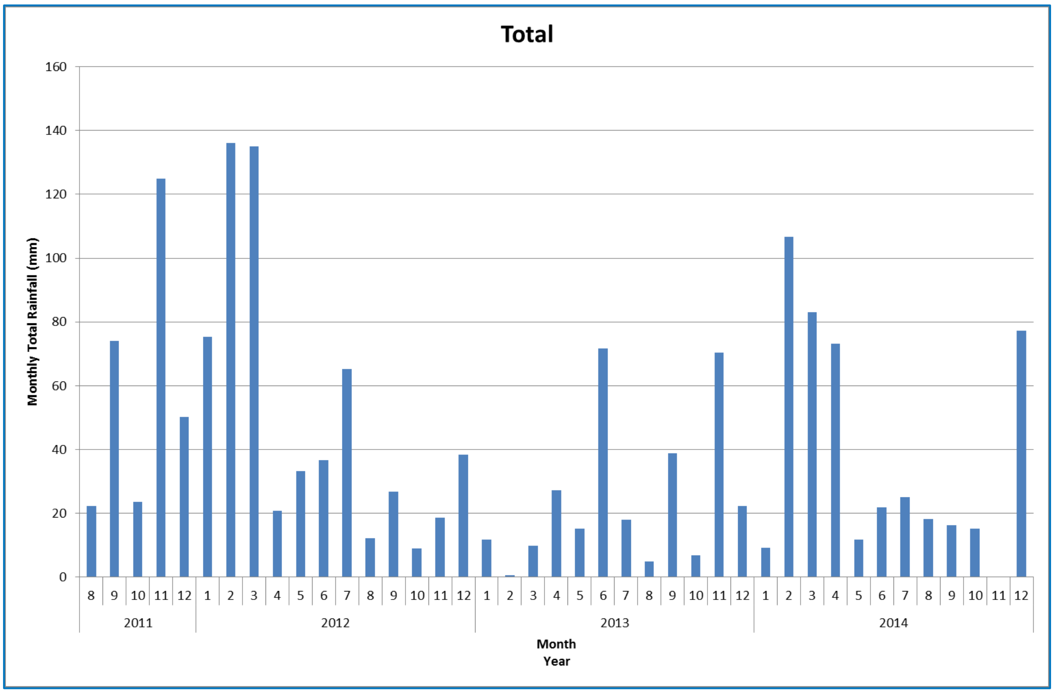


Figure 5.5: Monthly Rainfall (mm) from the onsite AWS

Table 5.4: Summary Statistics of rainfall recorded at the BoM Bylong (Glenview) rainfall station

Parameter (units)	Measure	2011	2012	2013	2014
Rainfall (mm)	Monthly maximum	155 (Nov)	146 (Mar)	105 (Jan)	149 (Mar)
	Monthly average	47	51	45	44
	Annual total	569	562	540	526

5.3 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.

5.3.1 PM_{10} and $PM_{2.5}$

A statistical summary of the monitoring data recorded at the TEOM is provided in **Table 5.5**. Due to instrument failures, the valid data recovery for the period August 2011 to June 2014 (for 24-hour average) is 42%. There have been a number of instrument issues which have resulted in the low data recovery.

The most continuous period of validated monitoring data available is between August 2011 and June 2012 and covers the majority of the modelling period for this study (September 2011 to August 2012).

For the available validated data, the period average PM_{10} concentration is 12.9 µg/m^3 and the average $PM_{2.5}$ concentration is 6.5 µg/m^3. There were a number of exceedances of the criteria for PM_{10} and $PM_{2.5}$, all of which occurred in October / November 2013 and January 2014 when extensive bushfire activity occurred across much of NSW, including the Blue Mountains, Lithgow and Bathurst areas. The effect of the bushfires is clearly seen in the validated 24-hour PM_{10} and $PM_{2.5}$ concentrations presented in **Figure 5.6.** Median values are also presented and provide an indication of average conditions in the absence of outliers in the data caused by significant events such as bushfires and dust storms. These median values have been used to determine representative background values for the cumulative assessment.

Table 5.5: Summary statistics for PM_{10}/$PM_{2.5}$ (August 2011 – June 2014)

Statistical measure	PM_{10} (µg/m^3)	$PM_{2.5}$ (µg/m^3)
Mean	12.9	6.5
Median	10.2	4.7
Maximum	80.2	61.9
Days over the criteria	11	17
% complete validated data	42%	42%

The onsite data are also compared to the closest NSW OEH monitoring site at Merriwa, located 45 km to the northeast of the Project Boundary. Monitoring of PM_{10} concentrations commenced at Merriwa in February 2012 as part of the Upper Hunter Valley Air Quality Monitoring Network. The period average from February 2012 to June 2014 at Merriwa for PM_{10} concentration is 14.7 µg/m^3 which, although the data has been recorded during different periods, is very similar to the period average of 12.9 µg/m^3 for PM_{10} concentrations recorded at Bylong.

At Merriwa, there were only two recorded exceedances of the criteria for PM_{10} (compared to 11 at Bylong). The exceedances at Merriwa occurred in October 2013 and January 2014, corresponding to the same periods where elevated concentrations occurred at Bylong.

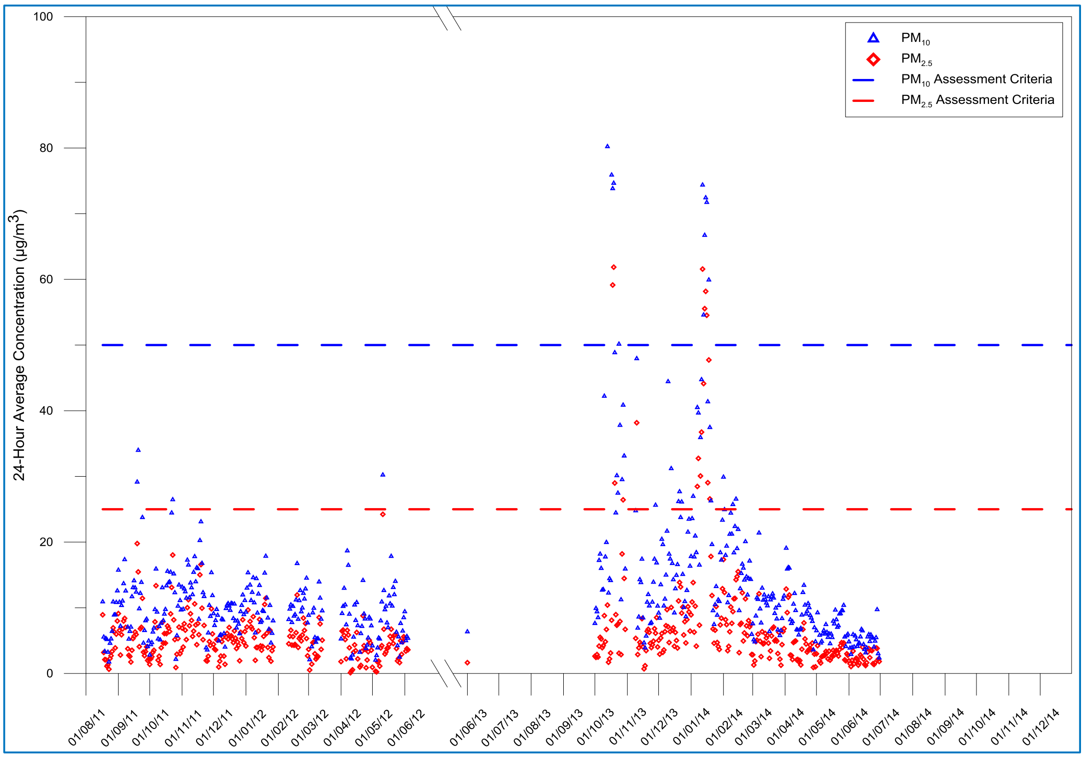


Figure 5.6: 24-Hour PM_{10} and $PM_{2.5}$ Monitoring

5.3.2 Dust deposition

Dust deposition monitoring has been carried out at five sites across the Project Boundary since March 2012. The annual average dust deposition levels for each monitoring site are summarised in **Table 5.6** (expressed as insoluble solids in g/m²/month). In general, annual average dust deposition levels were recorded to be approximately 20% of the impact assessment criteria of 4 g/m²/month.

Table 5.6: Monthly Dust Deposition Level (g/m²/month)

Year	DDG1	DDG2	DDG3	DDG4	DDG5
2012	1.0	0.9	0.8	0.5	0.3
2013	0.9	1.3	0.8	0.5	0.4
2014	0.9	0.9	1.3	0.9	0.4
Average	**0.9**	**1.0**	**1.0**	**0.6**	**0.4**
Average across all sites for all years					**0.8**

Note: * Data available to July 2014 only

5.3.3 TSP concentrations

No TSP measurements have been made specifically for the Project. Estimates of annual average TSP concentrations can be made 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**). Applying this relationship to the PM_{10} average concentration of 12.9 µg/m³ gives an average TSP concentration of approximately 32 µg/m³.

5.3.4 Assumed background for assessment

In summary, the following background air quality levels are assumed for all existing sources to which the Project will contribute:

- 24-hour PM_{10} and $PM_{2.5}$ – varies daily.
- Annual median PM_{10} concentration of 10.2 µg/m³.

- Annual median $PM_{2.5}$ concentration of 4.7 µg/m³.
- Annual average TSP concentration of 32 µg/m³.
- Annual average dust deposition of 0.8 g/m²/month.

6 MODELLING APPROACH

6.1 Modelling system

The CALMET/CALPUFF modelling system has been selected for this assessment as it is considered by the EPA to be appropriate for locations with complex terrain (**NSW EPA, 2005**).

CALMET is a meteorological pre-processor that includes a wind field generator containing objective analysis and parameterised treatments of slope flows, terrain effects and terrain blocking effects. The pre-processor produces fields of wind components, air temperature, relative humidity, mixing height and other micro-meteorological variables to produce the 3-dimensional (3D) meteorological fields that are utilised in the CALPUFF dispersion model.

CALPUFF is a multi-layer, multi-species non-steady state puff dispersion model that can simulate the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal (**Scire *et al.*, 2000**). In March 2011, generic guidance and optional settings for the CALPUFF modelling system were published for inclusion in the Approved Methods (**TRC, 2011**). The model set up for this study has been conducted in consideration of these guidelines.

6.2 Model set up

CALMET was run for a grid domain of 25 km x 30 km at a 200 m resolution. Observed hourly surface data were incorporated from the onsite AWS. In addition, cloud amount and height were sourced from the closest available Bureau of Meteorology (BoM) hourly observations (at Merriwa, located approximately 25 km to the northeast of Project).

Upper air information was incorporated through the use of prognostic 3D data extracted from The Air Pollution Model (TAPM). TAPM was also used to fill in any gaps in the observational data. Further details on the TAPM set up are provided in **Appendix A**.

Land use for the modelling domain was determined from aerial photography (Google Earth) using the land use creator tool in the CALPUFF view software. Terrain data for the modelling was sourced from NASA Shuttle Radar Topographic Mission (SRTM) data. SRTM data for Australia is sampled at three arc seconds resulting in an approximate resolution of 90 m. Regional terrain data was supplemented with detailed local mine terrain for each modelled mine scenario. This enables sources to be released from the terrain heights appropriate to their location (i.e. in an open cut mining area or on an overburden emplacement area (OEA)).

The modelling domain used for this assessment is shown **Figure 6.1**. Further details on the modelling system are provided in **Appendix A**, including model set up, inputs and the options selected for key model settings. It is noted on **Figure 6.1** the western end of the CALMET/CALPUFF domain is flush with the western end of the 3 km TAPM domain. These domains were chosen as such as the CALMET/CALPUFF model would not run with a larger domain to the west as it crossed over two map zones (Zone 55 and Zone 56). It is noted however that mining operations lie approximately 13 km away from the boundary and the closest receptors are approximately 4.5 km away. It is therefore considered that receptors would not be affected by model boundary conditions and that the domains chosen for modelling are acceptable.

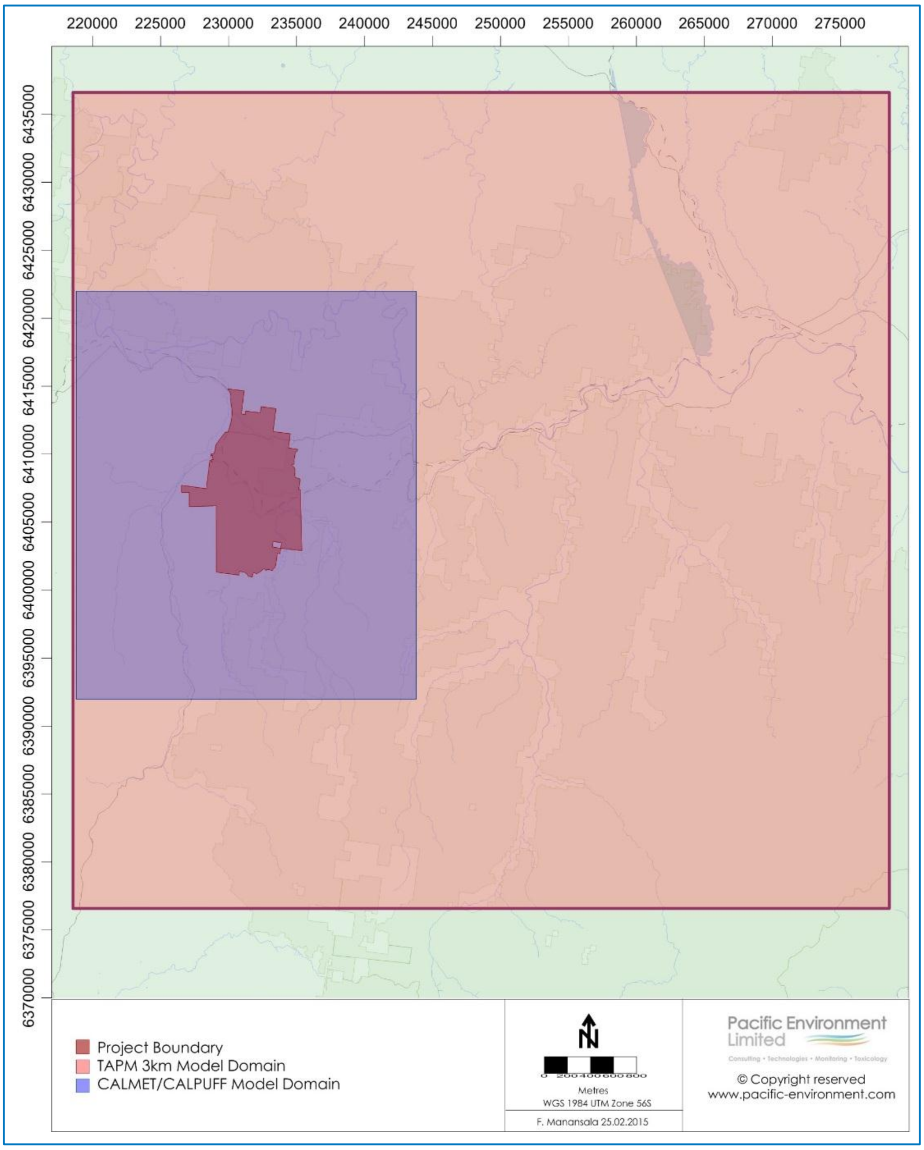


Figure 6.1: Model domain

6.3 Model performance

The CALMET generated wind rose is compared with the measured data from the Bylong AWS and presented in **Figure 6.2**. It is important to note that CALMET is not a steady state model; rather it produces three dimensional meteorological fields that vary across the entire domain. The wind roses presented in **Figure 6.2** are extracted for a single grid point (near the Bylong AWS) and therefore an over simplification of the meteorological conditions used by the model to predict pollutant dispersion. However, the comparison with the observed data is useful to demonstrate that the model performs reasonably well.

The CALMET extract displays similar characteristics to the measured data with dominant winds from east-southeast and northwest. The CALMET wind speeds are similar as indicated by the colour shading in the wind rose and by comparing the annual wind speeds (1.8 m/s for both observed and predicted). The percentage occurrence of calm conditions (defined as wind speeds <0.5 m/s) are similar with 34% for observed data compared with 29% predicted data by CALMET.

Also presented in **Figure 6.3** is a snapshot of space-varying wind fields for an area around the Project Boundary. A random hour was chosen to display a wind field and the corresponding measured wind, for that hour is also presented. The CALMET wind field (at the location of the AWS shown by the square) matches well with the wind direction measured for that hour.

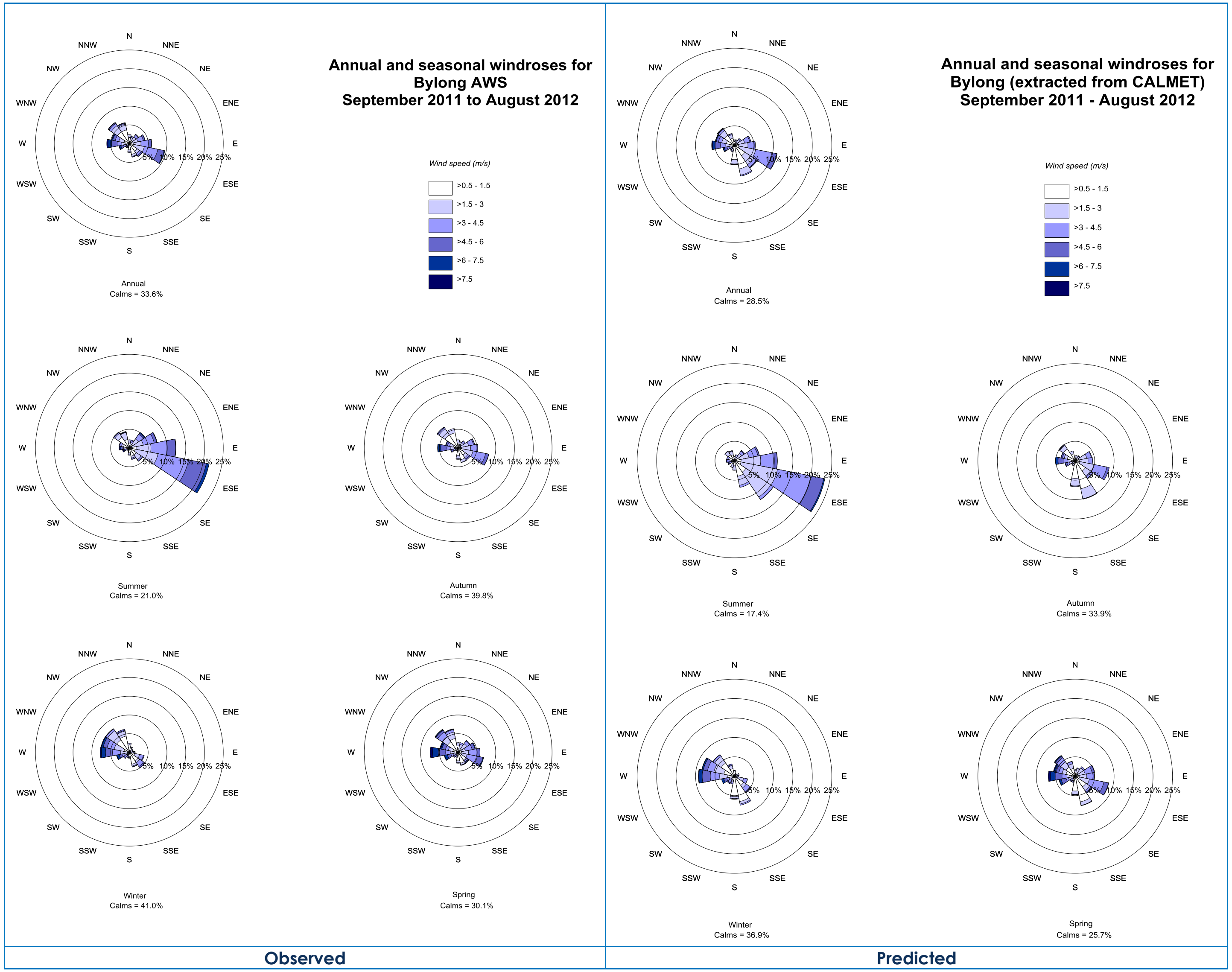


Figure 6.2: Annual and Seasonal Windroses Generated by CALMET for the Project

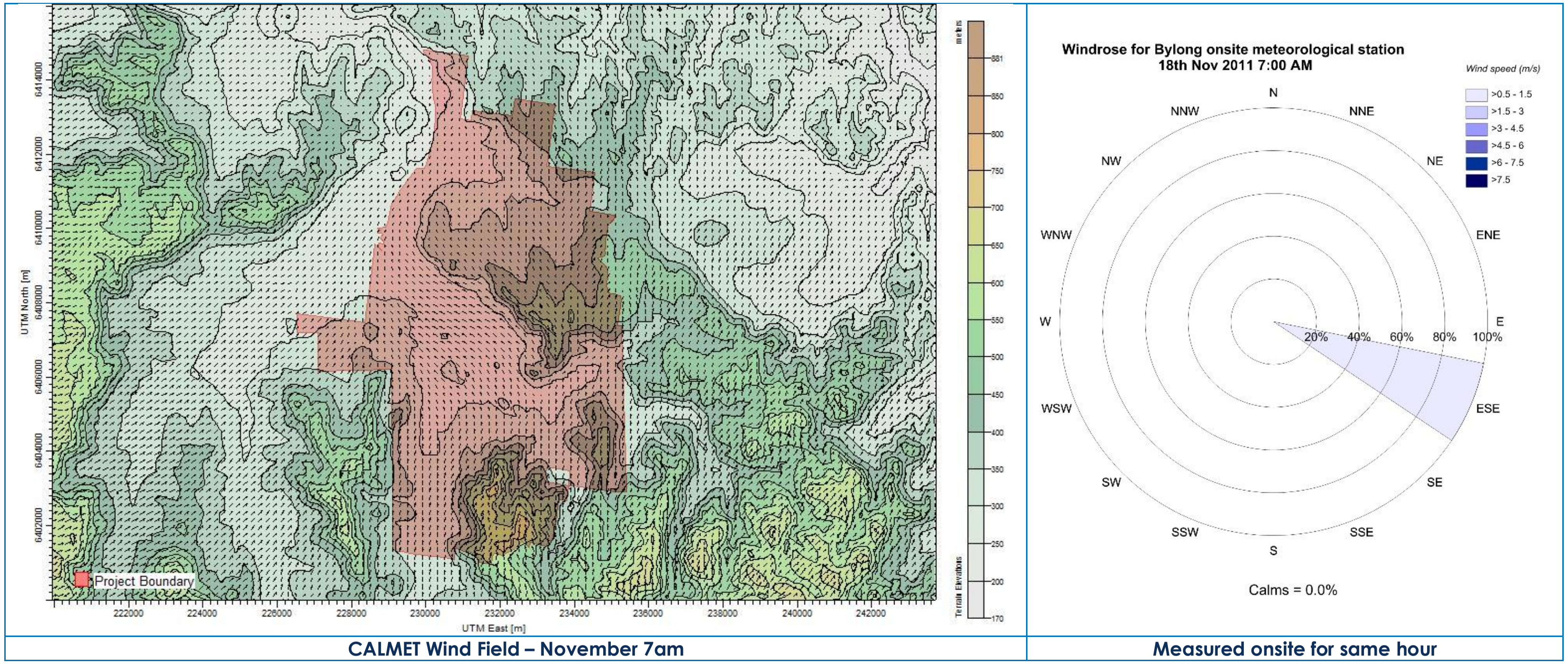


Figure 6.3: Wind field for modelling domain

7 EMISSIONS TO AIR

The mine plans for the Project have been analysed and detailed emissions inventories for the key dust generating activities have been prepared for three indicative staged mine years. These mine plans have been selected as years to be representative of worst-case operations. For example, where coal and waste production are highest, where extraction or wind erosion areas are largest or where operations are located closest to receivers.

The modelled mine plan years and the rationale for selection are:

- Year 3 – representative of open cut mining in both the western and eastern open cut and overburden emplacement in the north-western OEA. This scenario presents potential for worst case impacts for private residences to the north.
- Year 5 – representative of maximum open cut mining rate of approximately 5.5 Mtpa ROM coal in both the western and eastern open cut and overburden emplacement in the eastern and south-western OEA.
- Year 9 – maximum combined open cut and underground production at the maximum combined production rate of 6.5 Mtpa ROM coal.

Dispersion modelling results for the above years are considered to represent the worst case operational scenarios for the Project, at any particular sensitive receptor.

Emission factors developed both locally and by the US EPA, have been applied to estimate the amount of dust produced by each activity. The emission factors applied are considered to be the most reliable or up-to-date methods for determining dust generation rates. Detailed calculations are provided in **Appendix B** which provides information on the equations used, the basic assumptions about material properties (e.g. moisture content, silt content etc.), information on the way in which equipment would be used to undertake different mining operations and the quantities of materials that would be handled in each modelled mine plan year.

It is noted that the Wilpinjong Mine, located approximately 24 km to the west of the Project, is currently in the process of preparing an application for the extension of mining operations. Given its distance from the Project, it is not considered that Wilpinjong Mine would have any discernible impact on private receptors assessed in this study when considered cumulatively with the Project and as such it has not been included as a separate emission source. It is acknowledged however that the background monitoring data collected and used for this Project will include any contribution from the existing environment (and therefore any existing contribution from Wilpinjong Mine).

7.1 Overview of Best Practice Dust Control

The proposed dust controls for the Project are based on recommendations of the *NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining* (**Donnelly *et al.*, 2011**) (the Best Practice Report), a study that was commissioned by the NSW EPA.

Table 7.1 provides an overview of the applicable best practice management (BPM) measures recommended by EPA and those adopted for the assessment. When preparing the emission inventory for modelling the relevant percentage controls adopted from the BPM are shown in **Table 7.1**.

Table 7.1: Best Practice Dust Management

OEH best practice Section	OEH best practice Table	Mining Activity	Best Practice Control		Applied at site (Y/N/Other)	Level of control applied in modelling	Comments For example: -Is there any site-specific information on effectiveness? -Are controls applied consistently (e.g. are some roads treated and not others)?
9.2	66	Hauling on Unsealed Roads	Vehicle restrictions	Speed reduction from 75 km/h to 50 km/h	N/A		Speed limits will be in place, however reductions for specific speeds are not applicable for modelling. Grader speed of 8km/hr assumed for modelling.
				Speed reduction from 65 km/h to 30 km/h	N/A		
				Grader speed reduction from 16 km/h to 8 km/h	N/A		
			Surface improvements	Pave the surface	N/A		Surface treatments to be used.
				Low silt aggregate	N/A		
				Oil and double chip surface	N/A		
			Surface treatments	Watering (standard procedure)	Y	85%	Higher level of controls assumed as the 'Dust Stop' PRPs requires 80% plus control. Higher levels of control can be achieved through water and/or use of suppressants.
				Watering Level 1 (2 L/m^2/h)	Y	85%	
				Watering Level 2 (>2 L/m^2/h)	Y	85%	
				Watering grader routes	Y	50%	
				Watering twice a day for industrial unpaved road	N/A		
				Dust suppressants (please specify)	N/A		
			Other	Use of larger vehicles	Y	N/A	Larger (220t capacity) trucks to be used for some overburden hauling but as split not known, the modelling conservatively assumed same as coal (150t capacity) resulting in higher emissions than will occur in practice.
				Conveyors	N/A		
9.3	71	Wind Erosion on Exposed Areas & Overburden Emplacements	Avoidance	Minimise pre-strip	Y		Not quantified in modelling
			Surface stabilisation	Watering	N/A		
				Chemical suppressants	N/A		
				Paving and cleaning	N/A		
				Application of gravel to stabilise disturbed open areas	N/A		
				Rehabilitation goals	Y	70%	Control assumed for rehabilitation areas
			Wind speed reduction	Fencing, bunding, shelterbelts or in-pit dump	Y	70%	Controls assumed for sheltering and input exposed areas
				Vegetative ground cover	Y	70%	As part of rehabilitation goals
9.3	72	Wind Erosion and Maintenance - Coal Stockpiles	Avoidance	Bypassing stockpiles	N/A		
			Surface stabilisation	Water sprays	Y	50%	Water sprays on stockpiles
				Chemical wetting agents	N/A		
				Surface crusting agent	N/A		
				Carry over wetting from load in	N/A		
			Enclosure	Silo with bag house	N/A		
				Cover storage pile with a tarp during high winds	N/A		
			Wind speed	Vegetative windbreaks	N/A		

OEH best practice Section	OEH best practice Table	Mining Activity	Best Practice Control		Applied at site (Y/N/Other)	Level of control applied in modelling	Comments For example: -Is there any site-specific information on effectiveness? -Are controls applied consistently (e.g. are some roads treated and not others)?
			reduction	Reduced pile height	N/A		
				Wind screens/fences	N/A		
				Pile shaping/orientation	Y	N/A	Stockpiles orientated along prevailing wind /valley axis.
				Erect 3-sided enclosure around storage piles	N/A		
9.4	76	Bulldozers on OB	Minimise travel speeds and distance		Y	N/A	
			Travel routes and material kept moist		Y	50%	
9.5	81	Blasting and drilling	Blasting	Delay shot to avoid unfavourable weather conditions	Y	N/A	Blast Management Plan will outline measures to ensure favourable blasts
				Minimise area blasted	Y	N/A	
	82		Drilling	Fabric filters	N/A		
				Cyclone	N/A		
				Water injection while drilling	Y	70%	
9.6	85	Draglines	Minimise drop height		N/A		Not used
			Minimising drop height		N/A		
			Modify activities in windy conditions		N/A		
			Water sprays		N/A		
			Minimise side casting		N/A		
9.7	90	Loading and dumping overburden	Excavator	Minimise drop height	Y	30%	Achieved through operator training
			Truck dumping	Minimise drop height	Y	30%	
				Water application	N/A		
				Modify activities in windy conditions	Y	N/A	Achieved as part of real-time management system
9.8	95	Loading and dumping ROM coal	Avoidance	Bypass ROM stockpiles	Y	N/A	Direct dump to hopper where possible
			Truck or loader dumping coal	Minimise drop height	Y	30%	Achieved through operator training
				Water sprays on ROM pad	N/A		
			Truck or loader dumping to ROM bin	Water sprays on ROM bin or ROM pad	Y	50%	Water sprays at ROM hopper or partial enclosure
				Three sided and roofed enclosure of ROM bin	N/A		
				Three sided and roofed enclosure of ROM bin + water sprays	N/A		
				Enclosure with control device	N/A		
9.9	96	Conveyors and transfers	Conveyors	Application of water at transfers	N/A		
				Wind shielding - roof OR side wall	Y	50%	Shielding assumed on at least one side of conveyor
				Wind shielding - roof AND side wall	N/A		
				Belt cleaning and spillage minimisation	N/A		
			Transfers	Enclosure	N/A		

OEH best practice		Mining Activity	Best Practice Control		Applied at site (Y/N/Other)	Level of control applied in modelling	Comments
Section	Table						For example: -Is there any site-specific information on effectiveness? -Are controls applied consistently (e.g. are some roads treated and not others)?
9.10	97	Stacking and reclaiming product coal	Avoidance	Bypass coal stockpiles	N/A		
			Loading coal stockpiles	Variable height stack	Y	30%	To minimise drop height to stockpile
				Boom tip water sprays	N/A		
				Telescopic chute with water sprays	N/A		
			Unloading coal stockpiles	Bucket-wheel, portal or bridge reclaimer with water application	N/A		
9.11	-	Train and truck load out and transportation	Limit load size to ensue coal is below sidewalls		Y	N/A	Overloading will be avoided
			Maintain a consistent profile		Y	N/A	Loading profile will be implemented
			Water sprays		Y	50%	Water sprays when unloading to trains
			Use bed liners to minimise seepage		N/A		No truck haulage
			Cover load with tarpaulin		N/A		
			Utilise truck wheel wash		N/A		

7.2 Emission Estimates

Estimates of emissions for each source were developed on an hourly time step taking into account the activities that would take place at that location. Thus, for each source, for each hour, an emission rate was determined which depended upon the level of activity and the wind speed.

Dust generating activities were represented by a series of volume sources situated according to the location of activities for the selected mine plans, shown in **Figure 7.1** to **Figure 7.3**. To model the effect of pit retention for emissions within the open cut, detailed mine terrain has been incorporated into the modelling. All activities have been modelled for 24 hours per day except for blasting which has been modelled between the hours of 9am and 5pm.

For each model year shown in **Figure 7.1** to **Figure 7.3**, a corresponding emissions inventory has been developed. The dust emission inventories are based on mine production data and mine plan drawings (used to determine haul road distances and routes, stockpile and pit areas) combined with various activity data.

A summary of the emissions inventory for each year is presented in **Table 7.2, Table 7.3** and **Table** 7.4.

Full details of the emission equations and activity data used in developing the emissions inventories for each mine plan year are presented in **Appendix B**.

7.2.1 Particle Size Categories

Emission rates of TSP, PM_{10} and $PM_{2.5}$ have been calculated using emission factors developed both within NSW and by the US EPA. Modelling of PM_{10} and $PM_{2.5}$ was undertaken using the particle size specific inventories and was assumed to emit and deposit from the plume in accordance with the deposition rate appropriate for particles with an aerodynamic diameter equal to the geometric mass of the particle size range.

Modelling was completed for three particle size categories; TSP, Coarse Matter (CM) and $PM_{2.5}$. TSP and $PM_{2.5}$ particles were modelled using TSP and $PM_{2.5}$ emissions rates. The coarse fraction was modelled using $PM_{2.5-10}$ emission rates (PM_{10} emissions minus $PM_{2.5}$ emissions). The particle mass mean diameters were determined from particle size distribution data for various coal mining activities (presented in **SPCC, 1986**).

The resultant predicted CM and $PM_{2.5}$ concentrations were then summed to determine the PM_{10} concentrations.

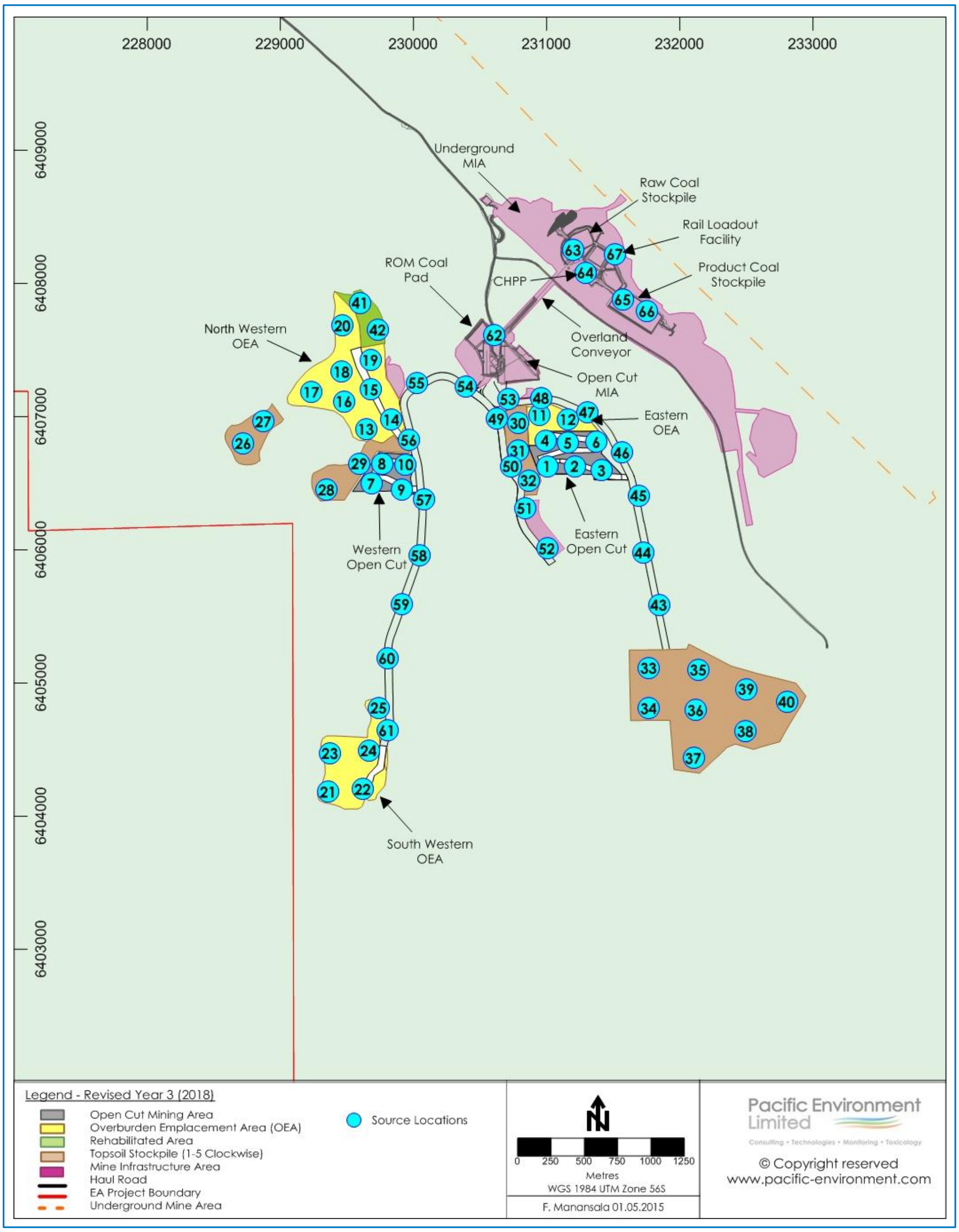


Figure 7.1: Modelled source locations for Year 3

Pacific Environment Limited

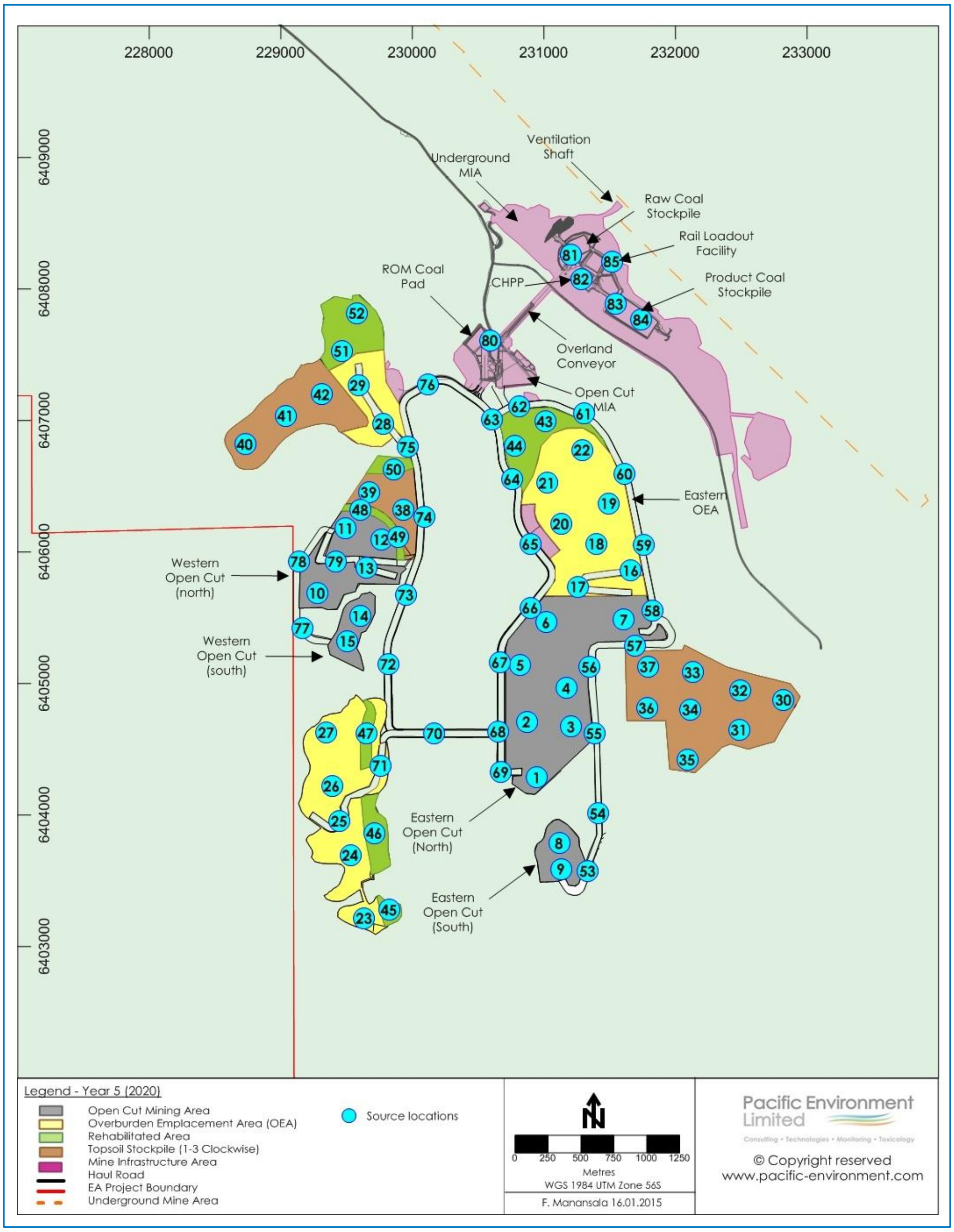


Figure 7.2: Modelled source locations for Year 5

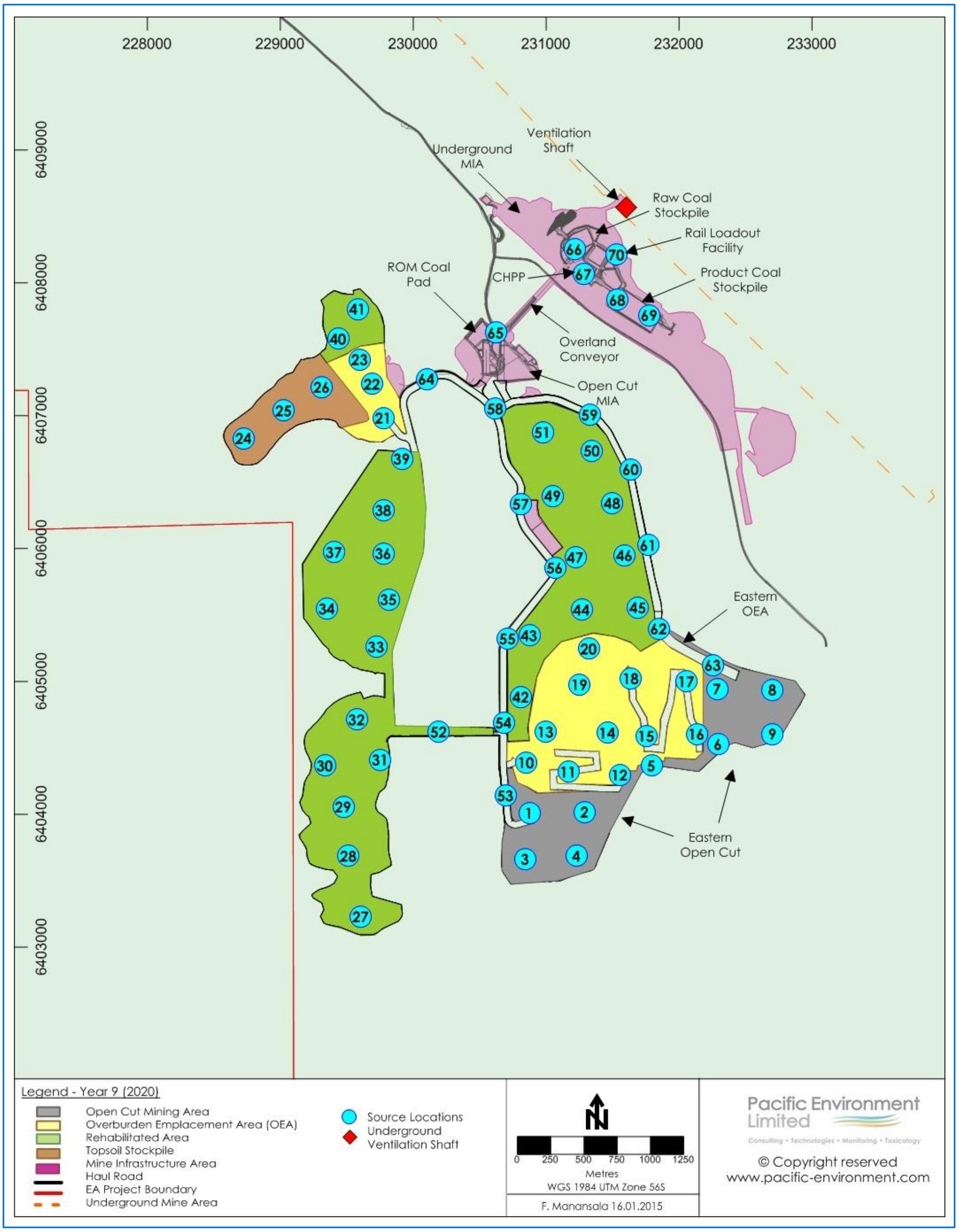


Figure 7.3: Modelled source locations for Year 9

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Table 7.2: Estimated annual dust emissions – Year 3

Activity - Year 3	Estimated Emissions (kg/y)		
	TSP	PM_{10}	$PM_{2.5}$
Topsoil Removal - Dozers stripping topsoil for all expit haul roads	3,150	710	331
Topsoil Removal - Dozers stripping topsoil at South-Western OEA	2,596	585	273
Topsoil Removal - Dozers stripping topsoil at North-Western OEA	4,625	1,043	486
Topsoil Removal - Dozers stripping topsoil at Eastern Open Cut Excavation and Inpit Emplacement Areas	2,161	487	227
Topsoil Removal - Dozers stripping topsoil at Western Open Cut Excavation and Inpit Emplacement Areas	1,019	230	107
Topsoil removal - Sh/Ex/FELs loading topsoil at North-Western OEA	230	109	16
Topsoil removal - Sh/Ex/FELs loading topsoil for all expit haul roads	157	74	11
Topsoil removal - Sh/Ex/FELs loading topsoil at South-Western OEA	129	61	9
Topsoil removal - Sh/Ex/FELs loading topsoil at Eastern Open Cut Excavation and Inpit Emplacement Areas	108	51	8
Topsoil removal - Sh/Ex/FELs loading topsoil at Western Open Cut Excavation and Inpit Emplacement Areas	51	24	4
Topsoil removal - Hauling topsoil from Eastern Open Cut ex-pit haul roads to Eastern topsoil stockpile (north) Stockpiles 3&4	8,898	2,197	220
Topsoil removal - Hauling topsoil from Eastern Open Cut Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (north) Stockpiles 3&4	1,944	480	48
Topsoil removal - Hauling topsoil from Eastern Open Cut Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (south) Stockpile 5	8,628	2,131	213
Topsoil removal - Hauling topsoil from Western Open Cut expit haul roads to Western topsoil stockpile (south) Stockpile 2	4,803	1,186	119
Topsoil removal - Hauling topsoil from Western Open Cut Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (south) Stockpile 5	11,326	2,797	280
Topsoil removal - Hauling topsoil from NW OEA to Eastern topsoil stockpile (south) Stockpile 5	49,756	12,287	1,229
Topsoil removal - Hauling topsoil from SW OEA to Western topsoil stockpile (north) Stockpile 1	15,778	3,897	390
Topsoil removal - Hauling topsoil from SW OEA to Western topsoil stockpile (south) Stockpile 2	3,985	984	98
Topsoil removal - Emplacing topsoil from Pit1 expit haul roads to Eastern topsoil stockpile (north) Stockpiles 3&4	116	55	8
Topsoil removal - Emplacing topsoil from Open Cut Pit1 Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (north) Stockpiles 3&4	25	12	2
Topsoil removal - Emplacing topsoil from Open Cut Pit1 Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (south) Stockpile 5	128	61	9
Topsoil removal - Emplacing topsoil from Pit5 expit haul roads to Western topsoil stockpile (south) Stockpile 2	108	51	8
Topsoil removal - Emplacing topsoil from Open Cut Pit5 Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (south) Stockpile 5	12,025	34	5
Topsoil removal - Emplacing topsoil from NW OEA to Eastern topsoil stockpile (south) Stockpile 5	54,481	156	24
Topsoil removal - Emplacing topsoil from SW OEA to Western topsoil stockpile (north) Stockpile 1	23,339	67	10
Topsoil removal - Emplacing topsoil from SW OEA to Western topsoil stockpile (south) Stockpile 2	7,239	21	3
OB - Drilling at Eastern Open Cut	228	118	7
OB - Drilling at Western Open Cut	87	45	3
OB - Blasting at Eastern Open Cut	1,821	947	55
OB - Blasting at Western Open Cut	699	363	21
OB - Sh/Ex/FELs loading OB to trucks at Eastern Open Cut	6,653	3,147	477
OB - Sh/Ex/FELs loading OB to trucks at Western Open Cut	2,685	1,270	192
OB - Hauling OB from Eastern Open Cut to Eastern OEA	176,503	43,588	4,359
OB - Hauling OB from Western Open Cut to Western Open Cut Emplacement Area	29,621	7,315	731
OB - Hauling OB from Eastern Open Cut to Ex-Pit North (WOEA)	292,604	72,260	7,226
OB - Hauling OB from Western Open Cut to Ex-Pit North (WOEA)	74,816	18,476	1,848
OB - Hauling OB from Eastern Open Cut to Ex-Pit South (SOEA)	201,859	49,850	4,985
OB - Hauling OB from Western Open Cut to Ex-Pit South (SOEA)	92,842	22,928	2,293
OB - Trucks emplacing OB from Eastern Open Cut to Eastern Open Cut In-Pit Emplacement Area	6,240	2,951	447
OB - Trucks emplacing OB from Western Open Cut to Western Open Cut In-Pit Emplacement Area	1,560	738	112
OB - Trucks emplacing OB from Eastern Open Cut to Ex-Pit North (WOEA)	2,095	991	150
OB - Trucks emplacing OB from Western Open Cut to Ex-Pit North (WOEA)	1,106	523	79
OB - Trucks emplacing OB from Eastern Open Cut to Ex-Pit South (SOEA)	1,170	553	84
OB - Trucks emplacing OB from Western Open Cut to Ex-Pit South (SOEA)	1,170	553	84
OB - Dozers on Eastern OEA	16,544	3,730	1,737
OB - Dozers on Western Open Cut Dump Area	19,388	4,371	2,036
OB - Dozers on Ex-Pit North (WOEA)	37,364	8,425	3,923

Activity - Year 3	Estimated Emissions (kg/y)		
	TSP	PM_{10}	$PM_{2.5}$
OB - Dozers on Ex-Pit South (WOEA)	23,303	5,254	2,447
CL - Dozers ripping/pushing/clean-up on Eastern Open Cut	32,418	9,183	713
CL - Dozers ripping/pushing/clean-up on Western Open Cut	20,058	5,682	441
CL - Drilling at Eastern Open Cut	94	49	3
CL - Drilling at Western Open Cut	20	10	1
CL - Blasting at Eastern Open Cut	4,386	2,281	132
CL - Blasting at Western Open Cut	930	484	28
CL - Loading ROM coal from Eastern Open Cut to trucks	91,243	13,816	1,734
CL - Loading ROM coal from Western Open Cut to trucks	18,009	2,727	342
CL - Hauling ROM coal from Eastern Open Cut to the hopper at the ROM coal pad	121,385	29,976	2,998
CL - Hauling ROM coal from Western Open Cut to the hopper at the ROM coal pad	16,960	4,188	419
CL - Unloading ROM coal from Eastern & Western Open Cuts to the hopper ROM coal pad	78,037	11,817	1,483
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile	243	115	17
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile - Unloading Conveyor	243	115	17
CL - Conveyer transfer - Raw Coal Stockpile to CHPP	243	115	17
CL - Conveyer transfer - Raw Coal Stockpile to CHPP - Unloading Conveyor	243	115	17
CL - Crushing OC ROM coal at the CHPP	2,406	1,083	201
CL - Screening OC ROM coal at the CHPP	4,411	1,484	100
CL - Conveyer transfer - CHPP to Product Coal Stockpile	124	59	9
CL - Conveyer transfer - CHPP to Product Coal Stockpile - Unloading Conveyor	124	59	9
CL - Dozer/FEL on Raw Coal Stockpile	24,153	6,841	531
CL - Dozer/FEL on Product Coal Stockpile	19,962	5,572	439
CL - Hauling rejects from wash plant to Ex-Pit North (WOEA)	59,285	14,641	1,464
CL - Loading product coal to trains	124	59	9
WE - Eastern Open Cut	15,023	7,512	1,127
WE - Western Open Cut	9,296	4,648	697
WE - Eastern OEA	7,932	3,966	595
WE - Ex-Pit North (Western OEA) - Area Disturbed	46,351	23,175	3,476
WE - Ex-Pit South (Southern OEA) - Area Disturbed	26,015	13,008	1,951
WE - Rehab North Western OEA	2,004	1,002	150
WE - Topsoil Stockpile (1) - Area Disturbed	4,468	2,234	335
WE - Topsoil Stockpile (2) - Area Disturbed	5,300	2,650	397
WE - Topsoil Stockpile (3) - Area Disturbed	1,971	986	148
WE - Topsoil Stockpile (4) - Area Disturbed	2,497	1,248	187
WE - Topsoil Stockpile (5) - Area Disturbed	34,602	17,301	2,595
WE - Raw Coal Stockpile	1,018	509	76
WE - Product Coal Stockpile	2,595	1,297	195
Grading roads	10,635	3,716	330
TOTAL	**1,871,969**	**471,907**	**60,814**

Table 7.3: Estimated annual dust emissions – Year 5

Activity - Year 5	Estimated Emissions (kg/y)		
	TSP	PM_{10}	$PM_{2.5}$
Topsoil Removal - Dozers stripping topsoil at Eastern Open Cut - northern area	1,275	287	134
Topsoil Removal - Dozers stripping topsoil at Eastern Open Cut - southern area	181	41	19
Topsoil Removal - Dozers stripping topsoil at Western Open Cut - northern area	420	95	44
Topsoil Removal - Dozers stripping topsoil at Western Open Cut - southern area	146	33	15
Topsoil removal - Sh/Ex/FELs loading topsoil at Eastern Open Cut - northern area	152	72	11
Topsoil removal - Sh/Ex/FELs loading topsoil at Eastern Open Cut - southern area	22	10	2
Topsoil removal - Sh/Ex/FELs loading topsoil at Western Open Cut - northern area	50	24	4
Topsoil removal - Sh/Ex/FELs loading topsoil at Western Open Cut - southern area	17	8	1
Topsoil removal - Hauling topsoil from Eastern Open Cut - northern area to Eastern topsoil stockpile	24,680	6,095	609
Topsoil removal - Hauling topsoil from Eastern Open Cut - southern area to Eastern topsoil stockpile	3,056	755	75
Topsoil removal - Hauling topsoil from Western Open Cut - northern area to Western topsoil stockpile (north)	5,742	1,418	142
Topsoil removal - Hauling topsoil from Western Open Cut - southern area to Western topsoil stockpile (south)	2,419	597	60
Topsoil removal - Emplacing topsoil from Eastern Open Cut - northern area to Eastern topsoil stockpile	218	103	16
Topsoil removal - Emplacing topsoil from Eastern Open Cut - southern area to Eastern topsoil stockpile	31	15	2
Topsoil removal - Emplacing topsoil from Western Open Cut - northern area to Western topsoil stockpile (north)	72	34	5
Topsoil removal - Emplacing topsoil from Western Open Cut - southern area to Western topsoil stockpile (south)	25	12	2
OB - Drilling at Eastern Open Cut - northern area	936	486	28
OB - Drilling at Eastern Open Cut - southern area	133	69	4
OB - Drilling at Western Open Cut - northern area	399	207	12
OB - Drilling at Western Open Cut - southern area	139	72	4
OB - Blasting at Eastern Open Cut - northern area	7,547	3,925	226
OB - Blasting at Eastern Open Cut - southern area	1,069	556	32
OB - Blasting at Western Open Cut - northern area	3,217	1,673	97
OB - Blasting at Western Open Cut - southern area	1,121	583	34
OB - Sh/Ex/FELs loading OB to trucks at Eastern Open Cut - northern area	9,054	4,282	648
OB - Sh/Ex/FELs loading OB to trucks at Eastern Open Cut - southern area	1,283	607	92
OB - Sh/Ex/FELs loading OB to trucks at Western Open Cut - northern area	3,875	1,833	278
OB - Sh/Ex/FELs loading OB to trucks at Western Open Cut - southern area	1,350	638	97
OB - Hauling OB from Eastern Open Cut (northern area) to Eastern OEA	798,426	197,174	19,717
OB - Hauling OB from Eastern Open Cut (southern area) to Eastern OEA	123,979	30,617	30,617
OB - Hauling OB from Eastern Open Cut (northern area) to Western Open Cut (northern area) Dump Area	289,616	71,522	7,152
OB - Hauling OB from Western Open Cut (northern area) to Western Open Cut (northern area) Dump Area	220,973	54,570	5,457
OB - Hauling OB from Eastern Open Cut to Ex-Pit South (SOEA)	485,665	119,937	11,994
OB - Trucks emplacing OB from Eastern Open Cut (northern area) to Eastern OEA	7,515	3,554	538
OB - Trucks emplacing OB from Eastern Open Cut (southern area) to Eastern OEA	1,065	504	76
OB - Trucks emplacing OB from Eastern Open Cut (northern area) to Western Open Cut (northern area) Dump Area	1,585	749	113
OB - Trucks emplacing OB from Western Open Cut (northern area) to Western Open Cut (northern area) Dump Area	7,464	3,530	535
OB - Trucks emplacing from Eastern Open Cut to Ex-Pit South (SOEA)	4,602	2,177	330
OB - Dozers on Eastern OEA	56,658	12,775	1,341
OB - Dozers on Western Open Cut (northern area) Dump Area	29,536	6,660	699
OB - Dozers on Ex-Pit South (SOEA)	43,933	9,906	1,040
CL - Dozers ripping/pushing/clean-up on Eastern Open Cut (northern area)	36,481	10,333	803
CL - Dozers ripping/pushing/clean-up on Eastern Open Cut (southern area)	5,169	1,464	114
CL - Dozers ripping/pushing/clean-up on Western Open Cut (northern area)	12,015	3,403	264
CL - Dozers ripping/pushing/clean-up on Western Open Cut (southern area)	4,185	1,185	92
CL - Drilling at Eastern Open Cut (northern area)	78	40	2
CL - Drilling at Eastern Open Cut (southern area)	11	6	0
CL - Drilling at Western Open Cut (northern area)	57	29	2
CL - Drilling at Western Open Cut (southern area)	20	10	1
CL - Blasting at Eastern Open Cut (northern area)	3,706	1,927	111
CL - Blasting at Eastern Open Cut (southern area)	526	274	16
CL - Blasting at Western Open Cut (northern area)	2,711	1,410	81
CL - Blasting at Western Open Cut (southern area)	944	491	28
CL - Loading ROM coal from Eastern Open Cut (northern area) to trucks	70,033	10,605	1,331
CL - Loading ROM coal from Eastern Open Cut (southern area) to trucks	9,924	1,503	189
CL - Loading ROM coal from Western Open Cut (northern area) to trucks	51,217	7,756	973

Activity - Year 5	Estimated Emissions (kg/y)		
	TSP	PM_{10}	$PM_{2.5}$
CL - Loading ROM coal from Western Open Cut (southern area) to trucks	17,839	2,701	339
CL - Hauling ROM coal from Eastern Open Cut (northern area) to the hopper at the ROM coal pad	131,881	32,568	3,257
CL - Hauling ROM coal from Eastern Open Cut (southern area) to the hopper at the ROM coal pad	22,722	5,611	561
CL - Hauling ROM coal from Western Open Cut (northern area) to the hopper at the ROM coal pad	63,763	15,747	1,575
CL - Hauling ROM coal from Western Open Cut (southern area) to the hopper at the ROM coal pad	29,219	7,216	722
CL - Unloading ROM coal from Eastern & Western Open Cuts to the hopper ROM coal pad	106,438	16,117	2,022
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile	331	157	24
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile - Unloading Conveyor	331	157	24
CL - Conveyer transfer - Raw Coal Stockpile to CHPP	331	157	24
CL - Conveyer transfer - Raw Coal Stockpile to CHPP - Unloading Conveyor	331	157	24
CL - Crushing OC ROM coal at the CHPP	3,282	1,477	273
CL - Screening OC ROM coal at the CHPP	6,017	2,024	137
CL - Conveyer transfer - CHPP to Product Coal Stockpile	215	102	15
CL - Conveyer transfer - CHPP to Product Coal Stockpile - Unloading Conveyor	205	97	15
CL - Dozer/FEL on Raw Coal Stockpile	77,421	21,930	1,408
CL - Dozer/FEL on Product Coal Stockpile	63,987	17,861	14
CL - Hauling rejects from wash plant to Ex-Pit South (SOEA)	43,881	10,837	1,084
CL - Loading product coal to trains	215	102	15
WE - Eastern Open Cut Pit (northern area)	85,656	42,828	6,424
WE - Eastern Open Cut Pit (southern area)	12,138	6,069	910
WE - Western Open Cut Pit (northern area)	28,212	14,106	2,116
WE - Western Open Cut Pit (southern area)	9,826	4,913	737
WE - Eastern OEA	72,967	36,483	5,472
WE - Ex-Pit South (Southern OEA)	56,578	28,289	4,243
WE - Ex-Pit North (Northern OEA)	20,737	10,369	1,555
WE - Rehab Eastern OEA	5,253	2,626	394
WE - Rehab Southern OEA	4,086	2,043	306
WE - Rehab Western Open Cut	1,938	969	145
WE - Rehab Northern OEA	5,150	2,575	386
WE - Topsoil Stockpile (1)	17,777	8,889	1,333
WE - Topsoil Stockpile (2)	7,814	3,907	586
WE - Topsoil Stockpile (3)	34,602	17,301	2,595
WE - Raw Coal Stockpile	1,018	509	76
WE - Product Coal Stockpile	2,595	1,297	195
Grading roads	31,906	11,148	989
TOTAL	**3,303,381**	**907,978**	**126,306**

Table 7.4: Estimated annual dust emissions – Year 9

Activity - Year 9	Estimated Emissions (kg/y)		
	TSP	PM_{10}	$PM_{2.5}$
OB - Drilling at Eastern Open Cut	2,997	1,558	90
OB - Blasting at Eastern Open Cut	24,174	12,571	725
OB - Sh/Ex/FELs loading OB to trucks at Eastern Open Cut	13,432	6,353	962
OB - Hauling OB from Eastern Open Cut to Eastern OEA	2,220,759	548,425	54,842
OB - Trucks emplacing OB from Eastern Open Cut (Pit 1) to Eastern Open Cut Dump Area	19,188	9,076	1,374
OB - Dozers on Eastern OEA	136,904	30,868	14,375
CL - Dozers ripping/pushing/clean-up on Eastern Open Cut	36,701	10,396	807
CL - Drilling at Eastern Open Cut	362	188	11
CL - Blasting at Eastern Open Cut	17,227	8,958	517
CL - Loading ROM coal from Eastern Open Cut to trucks	77,560	11,744	1,474
CL - Hauling ROM coal from Eastern Open Cut to the hopper at the ROM coal pad	111,840	27,619	2,762
CL - Unloading ROM coal from Eastern Open Cut to the hopper ROM coal pad	55,400	8,389	1,053
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile	172	81	12
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile - Unloading Conveyor	172	81	12
CL - Conveyer transfer - Raw Coal Stockpile to CHPP	172	81	12
CL - Conveyer transfer - Raw Coal Stockpile to CHPP - Unloading Conveyor	172	81	12
UG - Conveyor transfer - UG coal to ROM coal stockpile at CHPP	221	105	16
UG - Conveyor transfer - UG coal to ROM coal stockpile at CHPP - Unloading Conveyor	221	105	16
UG - Ventilation Shaft	16,556	16,556	16,556
CL - Crushing OC & UG ROM coal at the CHPP	3,900	1,755	325
CL - Screening OC & UG ROM coal at the CHPP	7,150	2,405	163
CL - Conveyer transfer - CHPP to Product Coal Stockpile	116	55	8
CL - Conveyer transfer - CHPP to Product Coal Stockpile - Unloading Conveyor	116	55	8
CL - Dozer/FEL on Raw Coal Stockpile	92,476	26,194	2,034
CL - Dozer/FEL on Product Coal Stockpile	76,429	21,334	1,681
CL - Hauling rejects from wash plant to Eastern OEA	129,433	31,964	3,196
CL - Loading product coal (OC + UG) to trains	219	104	16
WE - Eastern Open Cut	84,876	42,438	6,366
WE - Eastern OEA	116,529	58,264	8,740
WE - Ex-Pit North (Northern OEA)	21,313	10,656	1,598
WE - Topsoil Stockpile	10,626	5,313	797
WE - Rehab Eastern OEA	39,279	19,639	2,946
WE - Rehab Southern OEA	56,088	28,044	4,207
WE - Rehab Northern OEA	4,880	2,440	366
WE - Raw Coal Stockpile	1,018	509	76
WE - Product Coal Stockpile	2,595	1,297	195
Grading roads	10,635	3,716	330
TOTAL	**3,391,908**	**949,420**	**128,682**

7.2.2 Ventilation shaft

The ventilation shaft site was modelled as a vertically discharging point source. The assumed air flow is 370 m^3/s with an exit velocity of 9.6 m/s. To provide an indication of potential emissions from the proposed ventilation shaft, reference is made to particulate matter testing, conducted at other underground mines in NSW. An assessment undertaken by Pacific Environment Limited (formerly PAEHolmes) reviewed particulate matter concentrations for a number of underground mines in the southern coal fields of NSW (**PAEHolmes, 2012c**). Particulate concentrations were in the range 0.4 mg/m^3 to 2 mg/m^3 (see **Table 7.5**) and the highest value is chosen for the Project and conservatively applied to each size fraction.

Table 7.5: Ventilation shaft emissions data reviewed for Particulate Matter

Source	Pollutant	Concentration
West Cliff Main Vent Duct	TSP	1.5 mg/m^3
		1.1 mg/m^3
Dendrobium Mine Vent Shaft #1	TSP	1.6 mg/m^3
	PM_{10}	1.1 mg/m^3
	$PM_{2.5}$	1.4 mg/m^3
Metropolitan Colliery	TSP	0.42 mg/m^3
West Cliff Colliery Ventilation Air (SGS 2009)	TSP	2.0 mg/m^3

The adopted pollutant concentrations were used to derive emission rates for the proposed ventilation shaft, based on a design flow rate of 370 m^3/s (see **Table 7.6**).

Table 7.6: Modelling parameters used for the ventilation shaft

Parameter	Value
Height	4.0 m
Internal Diameter	6.8 m
Exit Velocity	9.6 m/s
Assumed Temperature	293 K
Flow Rate	370 m^3/s
Particulate Matter Concentration (TSP, PM_{10}, $PM_{2.5}$)	2 mg/m^3
Particulate Emissions Rate (TSP, PM_{10}, $PM_{2.5}$)	0.53 g/s

7.3 Construction Phase

During construction of Project surface infrastructure, fugitive dust emissions can be expected from activities including:

- Vegetation clearing/stripping.
- Bulk earthworks and material handling.
- Hauling along unsealed surfaces.
- Wind erosion on exposed areas.

An estimate of the amount of dust produced during the construction phase is presented in **Table 7.7**.

The total estimated emissions are less than 20% of the TSP emissions estimated to occur during operation of the Project in Year 5 (refer **Section 7.2**) and therefore further assessment for construction is not considered necessary. It is noted that Year 5 is the highest estimated emissions of the three operational model years. Compliance with air quality criteria during the operation of the mine is assumed to represent compliance during mine construction.

Notwithstanding the above, suitable dust mitigation measures would be implemented during the construction phase of the Project to ensure that dust emissions are kept to a minimum, especially during adverse meteorological conditions. These mitigation measures are discussed in **Section 13.1.**

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Table 7.7: Estimated dust emissions – construction

ACTIVITY	TSP emission for construction (kg/y)
Infrastructure (Roads, MIA, Rail Loop)	
Dozers clearing vegetation	7,707
Loading of excavated material to trucks	756
Hauling of excavated materials to working area	355,990
Unloading cut material to working area	1,080
FEL/dozer shaping material	7,707
Wind erosion from exposed areas	65,038
Grading roads	5,584
CHPP	
Dozers clearing vegetation	2,569
Loading of excavated material to trucks	122
Hauling of excavated materials to working area	57,651
Unloading cut material to working area	175
FEL/dozer shaping material	2,569
Wind erosion from exposed areas	901
Grading roads	1,861
Dams	
Dozers clearing vegetation	7,707
Loading of excavated material to trucks	307
Hauling of excavated materials to working area	144,585
Unloading cut material to working area	439
FEL/dozer shaping material	7,707
Wind erosion from exposed areas	901
Grading roads	1,861
Total TSP emissions for construction (kg/year)	**673,218**

7.4 Underground Only Scenario

Of the three scenarios considered for modelling within this assessment, none have included underground operations only. Whilst emissions from an underground only scenario would be considerably less than the scenarios assessed, an emissions inventory has been completed for completeness and discussion.

Year 18 was selected for analysis as this is the maximum ROM coal production rate from underground only. Estimated TSP emissions from this year are provided in **Table 7.8** below.

The total estimated emissions represent 17% of the TSP emissions, 23% of the PM_{10} emissions and 31% of the $PM_{2.5}$ emissions estimated to occur during the highest estimated emission year (Year 9) of the Project (refer **Section 7.2**).

As the estimated emissions from Year 18 represent such a small percentage of those estimated from the modelled years, modelling for this year has not been further considered as model results would be considerably less than has been assessed in detail for the other years.

Table 7.8: Estimated annual dust emissions – Year 18 (underground only)

Activity - Year 18	Estimated Emissions (kg/y)		
	TSP	PM_{10}	$PM_{2.5}$
Topsoil removal - Loading topsoil from North West topsoil stockpile to trucks	86	41	41
Topsoil removal - Hauling topsoil from North West topsoil stockpile to Eastern OEA and Eastern Open Cut haul roads	40,367	9,969	9,969
Topsoil removal - Emplacing topsoil from Eastern Open Cut to northwest topsoil stockpile	173	82	82
UG - Conveyor transfer - UG coal to ROM coal stockpile at CHPP	381	180	27
UG - Conveyor transfer - UG coal to ROM coal stockpile at CHPP - Unloading Conveyor	381	180	27
UG - Ventilation Shaft	16,556	16,556	16,556
UG - Crushing UG ROM coal at the CHPP	3,778	1,700	315
UG - Screening UG ROM coal at the CHPP	6,926	2,330	157
UG - Dozer/FEL on Raw Coal Stockpile	92,310	26,148	2,031
UG - Dozer/FEL on Product Coal Stockpile	92,310	26,148	2,031
UG - Hauling rejects from rejects bin to Eastern Void	121,969	30,121	3,012
UG - Loading UG product coal to trains	175	83	13
WE - Eastern OEA	159,314	79,657	11,949
WE - North-western topsoil stockpile	35,419	17,710	2,656
WE - Raw Coal Stockpile	1,018	509	76
WE - Product Coal Stockpile	2,595	1,297	195
Grading roads	7,090	2,477	220
TOTAL	**580,848**	**215,186**	**49,356**

7.5 Emissions from diesel generators

It is noted that there will be three generators used at the Project for varying lengths of time. The generators will be used in the following areas of the mine:

- Accommodation Facility generator of 1.2 MW. This generator will be in operation during Years 1 and 2 of the Project (construction phase) and will then become standby units. The generator will be relocated to the MIAs for emergency use only following completion of the Accommodation Facility at Year 6 of the Project.
- Underground MIA of 750 kW for emergency use only.
- Ventilation Fan Facility of 1 MW for emergency use only.

Due to the small size of the generators and the fact that they would only be used for short, intermittent periods during mine operational years, emissions from these sources will be low and any air quality impacts considered to be negligible, and therefore have not been assessed further in this report.

8 IMPACT ASSESSMENT

Dispersion model predictions have been made for years 3, 5 and 9 of Project mining operations. Contour plots of dust concentrations and deposition levels show the areas that are predicted to be affected by dust at different levels. It is important to note that the isopleth figures are presented to provide a visual representation of the predicted impacts. To produce the isopleths, it is necessary to make interpolations, and as a result the isopleths will not always match exactly with predicted impacts at any specific location.

The actual predicted concentrations at nearby private receivers are presented in tabular form, with those that are predicted to experience levels above the assessment criteria highlighted in bold.

8.1 Year 3 results

A summary of the predicted dust concentrations at each of the sensitive receptor locations are presented in **Table 8.1**. The incremental increase as a result of the Project are shown, as well as cumulative impacts with the addition of existing background, as described in **Section 5.3**. The cumulative 24-hour PM_{10} and $PM_{2.5}$ results as shown in **Table 8.1**, were derived by adding the measured 24-hour data from the Bylong TEOM to the predicted 24-hour concentrations at each receptor. This is further detailed below.

The modelling results show that no private sensitive receptor is predicted to experience ground level concentrations of PM_{10}, $PM_{2.5}$, TSP and dust deposition greater than the relevant impact assessment criteria, due to the Project alone or cumulatively. There are a number of mine-owned receptors predicted to experience concentrations above the impact assessment criteria however, it is noted that many of these are located within operating mine areas and will not actually exist at time of mining. These properties are shown for completeness only.

It is noted that due to technical issues with the monitoring equipment during the baseline monitoring period, there are gaps present in the background dataset for cumulative assessment of 24-hour average PM_{10} and $PM_{2.5}$. This is demonstrated in **Figure 8.3** and **Figure 8.4** which illustrate time-series of background and modelled incremental 24-hour PM_{10} and $PM_{2.5}$ concentrations for the worst impacted residence (R69) during Year 3.

Figure 8.3 and **Figure 8.4** demonstrate that, although there are no cumulative 24-hour concentrations greater than the relevant impact assessment criteria, there are some short periods when no contemporaneous background is available for cumulative assessment. Additional analysis is therefore presented, using a statistical simulation, to predict the number of days that PM_{10} and $PM_{2.5}$ air quality concentrations are greater than the impact assessment criteria into the future.

A Monte Carlo simulation randomly selects background and incremental concentrations to produce a distribution of possible cumulative outcomes. The simulation takes all of the available validated background monitoring data from the on-site TEOM (from August 2011 to June 2014) and randomly generates a daily concentration of 24-hour PM_{10} and $PM_{2.5}$. This random daily background concentration is added to model predictions for each day of the year, at selected receptor locations, and repeated 250,000 times to generate a probability distribution of cumulative 24-hour PM_{10} and $PM_{2.5}$ concentrations. 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. The results of the simulation are extracted and the predicted number of days that cumulative 24-hour concentrations would exceed certain levels is determined at the worst impacted receptor in Year 3 (R69). **Figure 8.5** and **Figure 8.6** show the predicted cumulative 24-hour PM_{10} and $PM_{2.5}$ concentration compared with the existing background. These figures demonstrate that there is a very low probability for the occurrence of any additional days where cumulative PM_{10} concentrations would be greater than the relevant criteria.

Contour plots of incremental 24-hour PM_{10} and $PM_{2.5}$ concentrations and annual average PM_{10}, $PM_{2.5}$, TSP and deposition levels for Year 3 are shown in **Figure 8.1** to **Figure 8.10.**

Under hot, dry and windy conditions, elevated monitoring levels may, in practice, have some correlation with elevated concentrations due to the Project (windblown dust in particular). It is acknowledged that this potential association is a limitation of the Monte Carlo analysis, however it is likely to be accounted for in the large number of repetitions undertaken to achieve the 'cumulative' data set. Notwithstanding this, the Monte Carlo approach has been accepted by the EPA for quantifying cumulative short-term concentrations from mining projects such as this one.

Table 8.1: Predicted incremental and cumulative ground level concentrations for Year 3

ID	PM_{10}				$PM_{2.5}$				TSP		Dust Deposition	
	24 hour		Annual		24 hour		Annual		Annual		Annual	
	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative
Units	µg/m³										g/m²/month	
Impact Assessment criteria	**N/A**	**50**	**N/A**	**30**	**N/A**	**25**	**N/A**	**8**	**N/A**	**90**	**2**	**4**
Voluntary Acquisition/ Mitigation criteria	**50**	**N/A**	**N/A**	**30**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**90**	**2**	**4**
Private Receptors												
4	2.2	34.0	0.2	10	0.3	24.2	0.0	5	0.4	32	0.01	0.81
5	2.3	34.0	0.2	10	0.3	24.2	0.0	5	0.4	32	0.01	0.81
17	3.2	34.0	0.3	11	0.6	24.2	0.1	5	0.8	33	0.01	0.81
41A	2.0	34.0	0.2	10	0.4	24.2	0.0	5	0.5	32	0.01	0.81
41B	2.1	34.0	0.2	10	0.4	24.2	0.0	5	0.5	32	0.01	0.81
42	1.5	34.0	0.2	10	0.4	24.2	0.0	5	0.6	33	0.01	0.81
43	1.4	34.0	0.2	10	0.4	24.2	0.0	5	0.5	32	0.01	0.81
44	1.5	34.0	0.2	10	0.4	24.2	0.0	5	0.5	33	0.01	0.81
47	1.5	34.0	0.2	10	0.4	24.2	0.0	5	0.5	33	0.01	0.81
49	1.7	34.0	0.2	10	0.4	24.2	0.0	5	0.6	33	0.01	0.81
50	2.2	34.0	0.3	10	0.5	24.2	0.1	5	0.7	33	0.01	0.81
53	5.4	34.4	0.4	11	0.7	24.4	0.1	5	1.0	33	0.02	0.82
56	12.4	34.0	1.9	12	1.7	24.2	0.3	5	5.4	37	0.09	0.89
57A	8.1	34.0	1.1	11	1.2	24.2	0.2	5	3.0	35	0.06	0.86
57B	8.1	34.0	1.0	11	1.2	24.2	0.2	5	2.9	35	0.06	0.86
57C	8.4	34.0	1.1	11	1.2	24.2	0.2	5	3.0	35	0.06	0.86
58	12.4	34.1	1.9	12	1.8	24.3	0.3	5	5.4	37	0.14	0.94
60	21.3	34.7	5.5	16	3.2	24.4	0.8	6	15.6	48	0.20	1.00
61A	18.6	34.1	4.7	15	2.7	24.3	0.7	5	13.1	45	0.16	0.96
61B	19.0	34.1	4.8	15	2.7	24.3	0.7	5	13.3	45	0.16	0.96
65A	21.4	34.4	5.2	15	3.0	24.4	0.8	5	14.4	46	0.17	0.97
63	21.9	35.2	5.6	16	3.2	24.4	0.8	6	15.4	47	0.18	0.98
68	15.9	36.0	4.7	15	2.8	24.4	0.7	5	12.8	45	0.14	0.94
69	27.5	42.5	9.3	19	4.6	24.9	1.4	6	25.4	57	0.27	1.07
141	4.9	35.1	0.5	11	0.8	24.5	0.1	5	1.3	33	0.06	0.86
146	1.9	34.8	0.2	10	0.3	24.3	0.0	5	0.4	32	0.02	0.82
151	2.0	34.0	0.1	10	0.4	24.2	0.0	5	0.3	32	0.01	0.81
158	1.9	34.1	0.1	10	0.4	24.2	0.0	5	0.2	32	0.01	0.81
161	1.1	34.1	0.1	10	0.2	24.2	0.0	5	0.2	32	0.01	0.81
162	0.8	34.1	0.1	10	0.2	24.2	0.0	5	0.2	32	0.01	0.81
165	1.4	34.0	0.1	10	0.3	24.2	0.0	5	0.2	32	0.00	0.80
168	1.0	34.0	0.1	10	0.2	24.2	0.0	5	0.1	32	0.00	0.80
181A	2.9	34.0	0.4	11	0.6	24.2	0.1	5	1.1	33	0.02	0.82
181B	2.8	34.0	0.4	11	0.6	24.2	0.1	5	1.1	33	0.02	0.82
181C	2.8	34.0	0.4	11	0.6	24.2	0.1	5	1.1	33	0.02	0.82
181D	3.0	34.0	0.4	11	0.6	24.2	0.1	5	1.1	33	0.03	0.83
225	0.9	34.0	0.1	10	0.2	24.2	0.0	5	0.2	32	0.01	0.81

ID	PM10				PM2.5				TSP		Dust Deposition	
	24 hour		Annual		24 hour		Annual		Annual		Annual	
	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative
Units	µg/m³										g/m²/month	
226	0.8	34.0	0.1	10	0.2	24.2	0.0	5	0.2	32	0.00	0.80
242	0.6	34.0	0.0	10	0.1	24.2	0.0	5	0.1	32	0.00	0.80
292	0.8	34.0	0.1	10	0.2	24.2	0.0	5	0.2	32	0.01	0.81
317	0.5	34.0	0.0	10	0.1	24.2	0.0	5	0.1	32	0.00	0.80
348	0.7	34.0	0.0	10	0.2	24.2	0.0	5	0.1	32	0.00	0.80
349	0.7	34.0	0.0	10	0.2	24.2	0.0	5	0.1	32	0.00	0.80
Bylong Community Hall	20.5	34.1	4.9	15	2.9	24.3	0.7	5	13.6	46	0.16	0.96
Bylong Oval	20.7	34.2	5.2	15	3.0	24.3	0.8	5	14.3	46	0.17	0.97
Mine-Owned Receptors												
K1	3.4	34.0	0.4	11	0.6	24.2	0.1	5	0.9	33	0.01	0.81
K2	3.6	34.0	0.4	11	0.6	24.2	0.1	5	1.1	33	0.02	0.82
K3	5.9	34.0	0.7	11	0.9	24.3	0.1	5	1.8	34	0.02	0.82
K4	6.1	34.0	0.7	11	0.9	24.3	0.1	5	1.8	34	0.02	0.82
K5	8.8	34.0	1.5	12	1.4	24.3	0.2	5	3.9	36	0.04	0.84
K6	14.6	36.2	4.1	14	2.6	24.3	0.6	5	11.2	43	0.12	0.92
K7	14.2	35.9	4.0	14	2.5	24.3	0.6	5	10.8	43	0.12	0.92
K8	14.0	35.5	3.9	14	2.5	24.3	0.6	5	10.4	42	0.12	0.92
K9	21.6	34.6	5.3	16	3.0	24.4	0.8	6	14.7	47	0.17	0.97
K12	298.7	**311.8**	132.4	**143**	40.3	**54.1**	17.5	**22**	402.6	**435**	**4.73**	**5.53**
K13	487.9	**501.0**	208.6	**219**	64.2	**71.8**	27.2	**32**	655.3	**687**	**7.81**	**8.61**
K25	8.3	34.6	0.4	11	1.5	24.2	0.1	5	1.2	33	0.03	0.83
K26	3.6	34.3	0.2	10	0.6	24.2	0.0	5	0.5	32	0.02	0.82
K10	36.5	48.9	12.1	22	6.0	**25.1**	1.8	7	33.7	66	0.37	1.17
K11	41.2	**52.2**	12.8	23	6.8	**25.1**	1.9	7	36.0	68	0.40	1.20
K14	299.9	**299.9**	97.8	**108**	34.5	**49.6**	11.6	**16**	320.5	**352**	**4.44**	**5.24**
K15	288.4	**288.4**	33.7	**44**	34.6	**34.6**	4.0	**9**	112.0	**144**	1.89	2.69
K16	243.8	**251.8**	34.0	**44**	29.1	**33.0**	4.1	**9**	113.2	**145**	1.76	2.56
K17	556.9	**556.9**	118.4	**129**	63.2	**63.2**	13.5	**18**	431.6	**464**	**8.58**	**9.38**
K18	491.6	**491.6**	101.0	**111**	56.2	**56.2**	11.6	**16**	363.8	**396**	**6.93**	**7.73**
K19	1.7	34.0	0.2	10	0.4	24.2	0.0	5	0.4	32	0.01	0.81
K20	1.7	34.0	0.2	10	0.4	24.2	0.0	5	0.4	32	0.01	0.81
K21	25.8	41.7	3.7	14	3.3	24.9	0.5	5	12.8	45	0.28	1.08
K22	13.3	40.6	1.9	12	2.2	24.7	0.3	5	5.7	38	0.17	0.97
K23	8.8	38.5	1.2	11	1.4	24.6	0.2	5	3.5	35	0.11	0.91
K24	5.3	36.0	0.5	11	0.9	24.3	0.1	5	1.3	33	0.04	0.84
K27	10.9	40.3	1.7	12	1.6	24.5	0.2	5	7.2	39	0.24	1.04
K28	6.7	36.2	0.7	11	1.0	24.5	0.1	5	2.4	34	0.10	0.90
K29	4.0	34.9	0.4	11	0.6	24.4	0.1	5	1.0	33	0.06	0.86
K130	423.2	**423.1**	151.6	**162**	48.4	**57.4**	17.3	**22**	522.7	**555**	**7.44**	**8.24**
K144	15.8	37.4	0.9	11	2.8	24.2	0.2	5	2.7	35	0.07	0.87
KTPHB	789.7	**789.7**	367.1	**377**	121.5	**128.3**	49.7	**54**	1280.6	**1313**	**23.63**	**24.43**
22	6.0	34.0	0.7	11	0.9	24.3	0.1	5	1.7	34	0.02	0.82

Note: A value shown in **bold** indicates an exceedance of the impact assessment criteria.

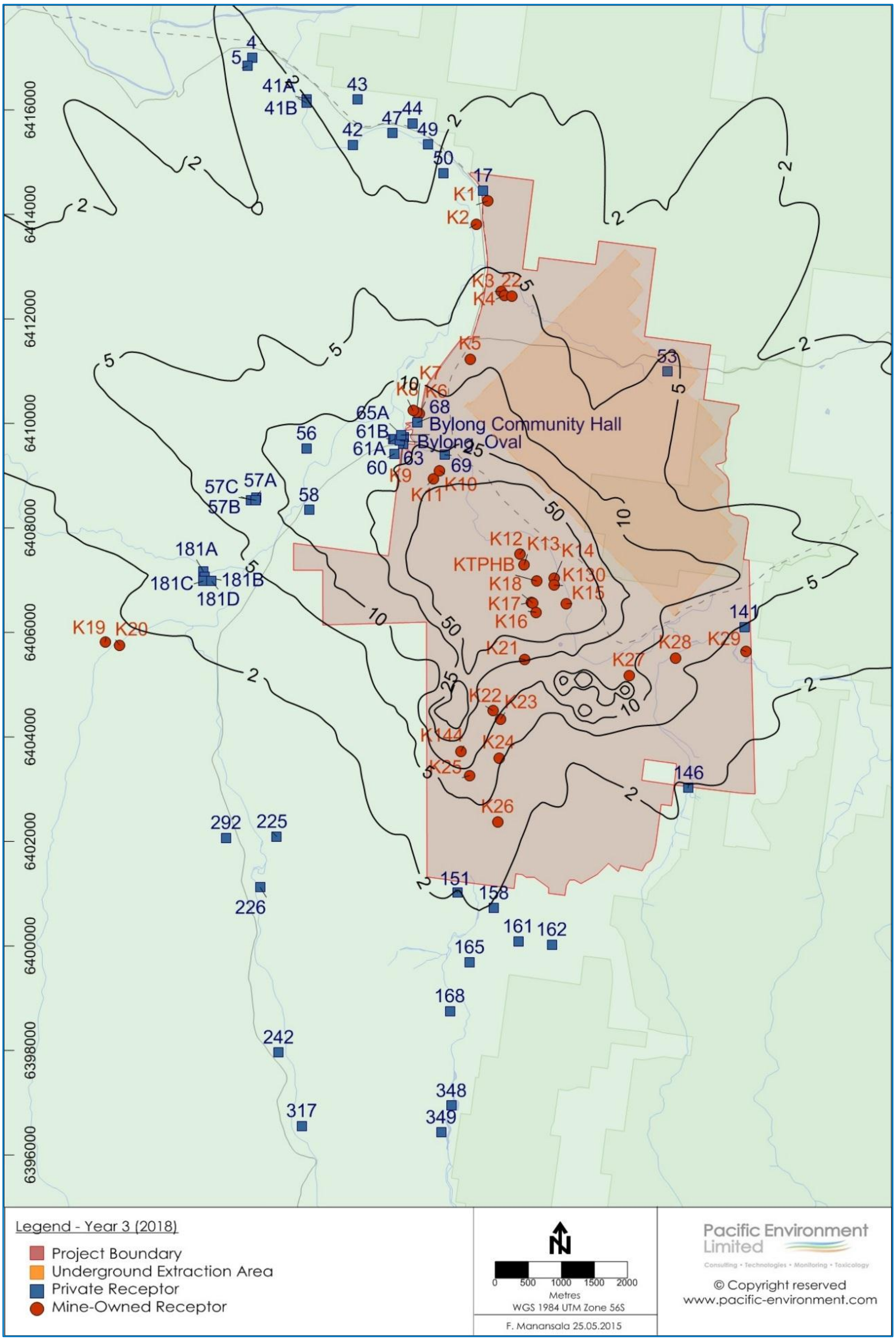


Figure 8.1: Year 3 maximum 24 hour average ground level concentrations of PM_{10}

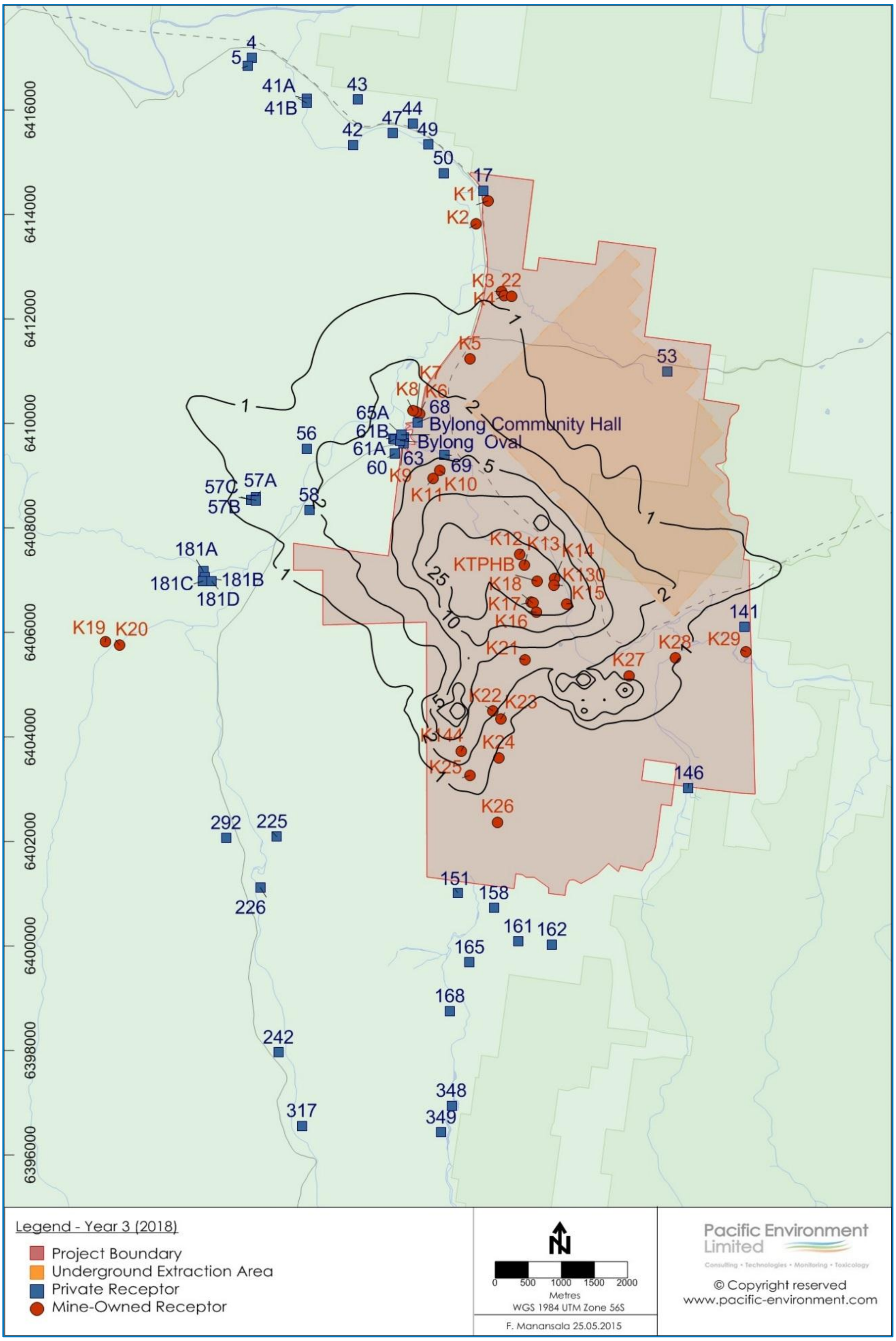


Figure 8.2: Year 3 maximum 24 hour average ground level concentrations of $PM_{2.5}$

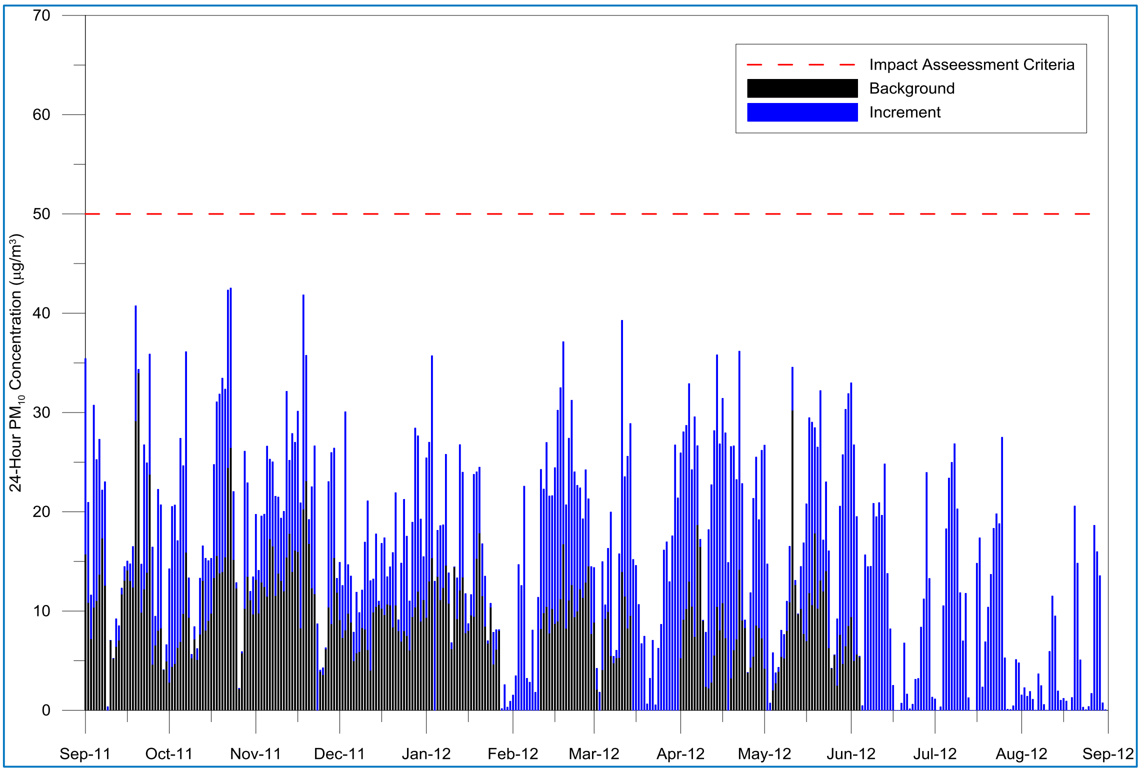


Figure 8.3: Year 3 - Cumulative 24-hour PM_{10} concentrations (background and increment) for R69

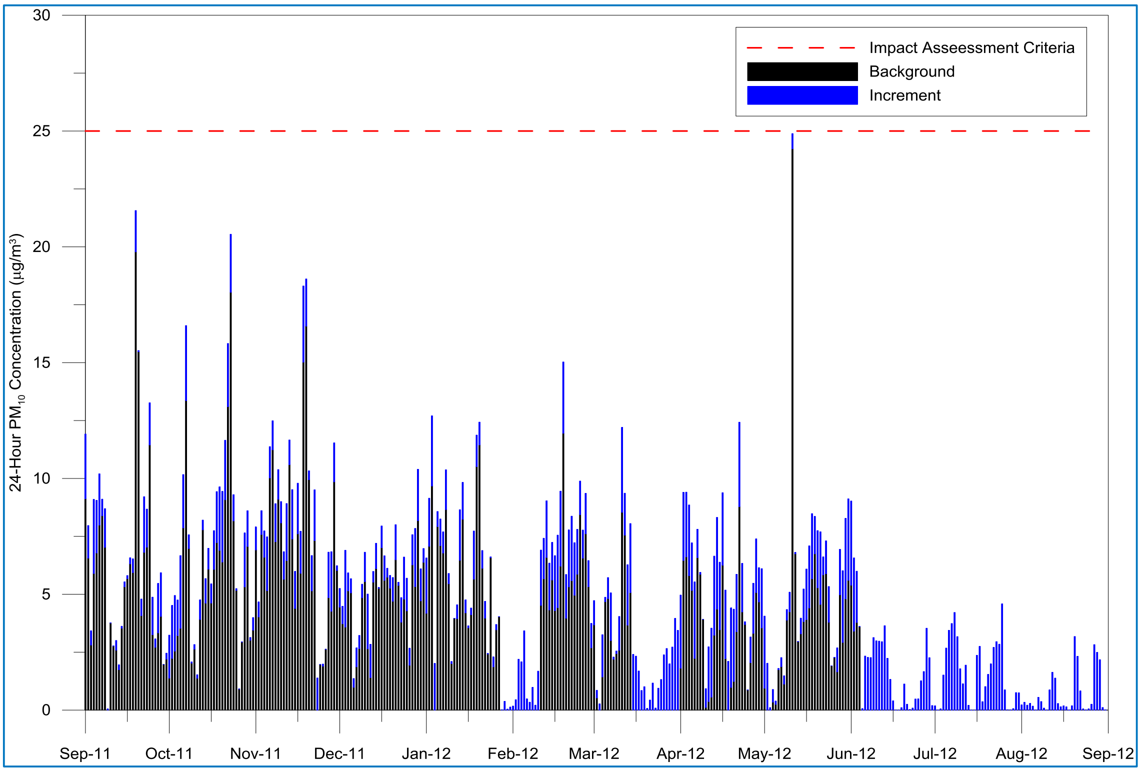


Figure 8.4: Year 3 - Cumulative 24-hour $PM_{2.5}$ concentrations (background and increment) for R69

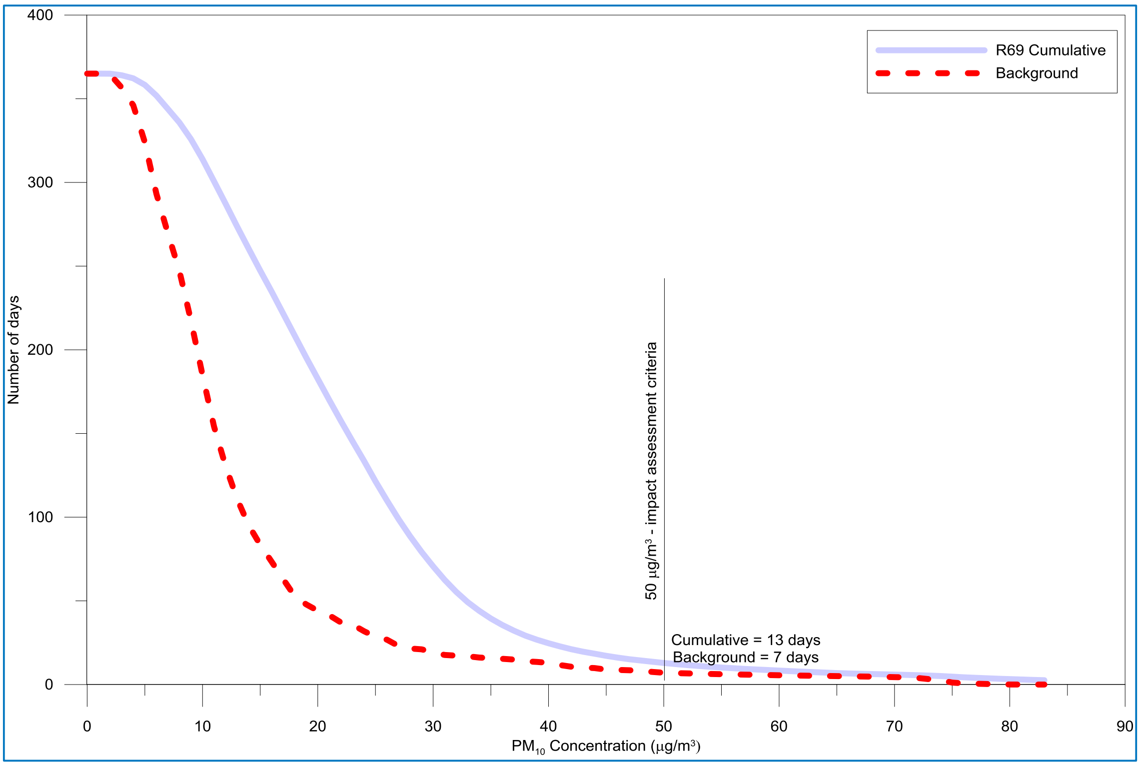


Figure 8.5: Year 3 - Predicted days over 24-Hour average PM_{10} concentration

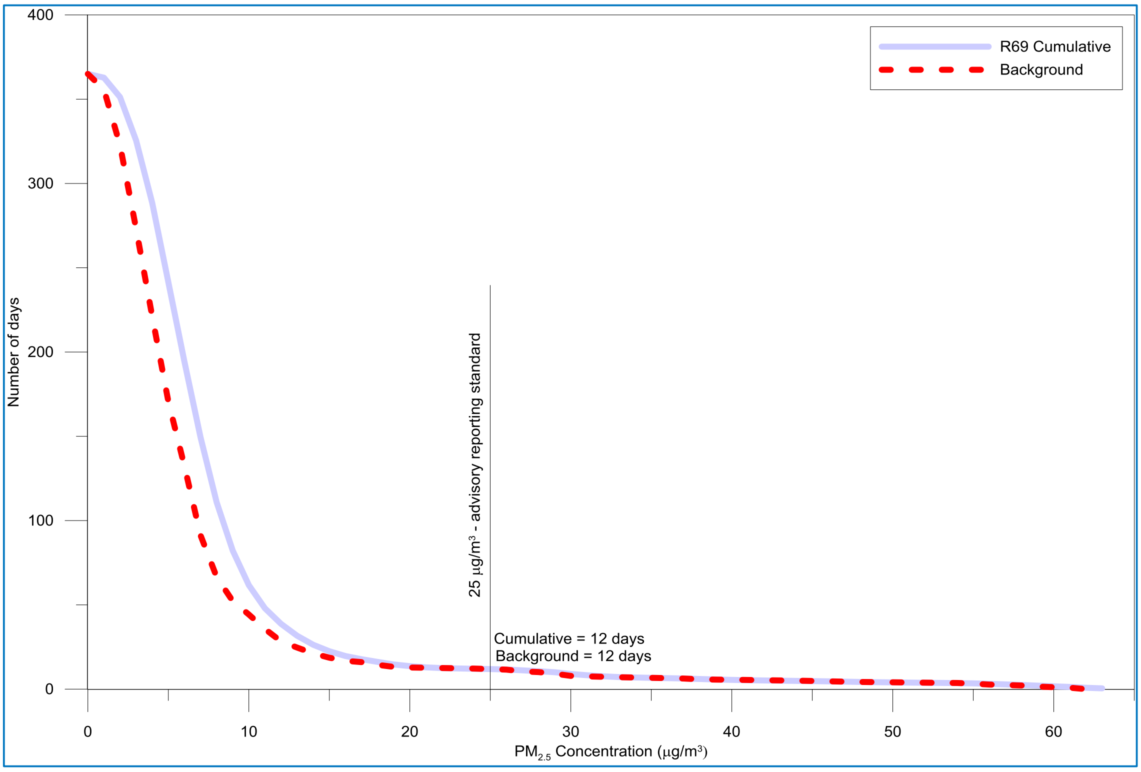
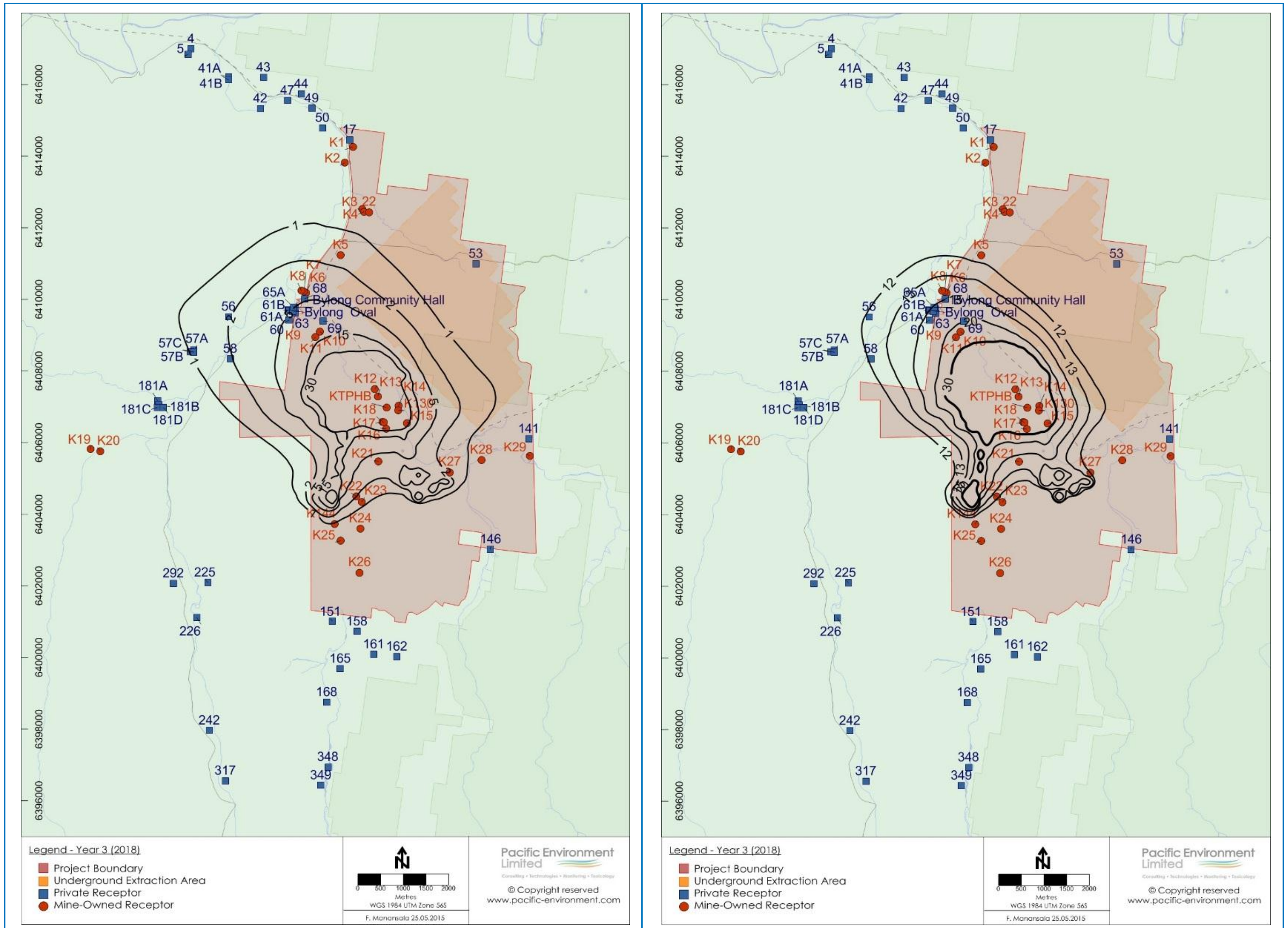
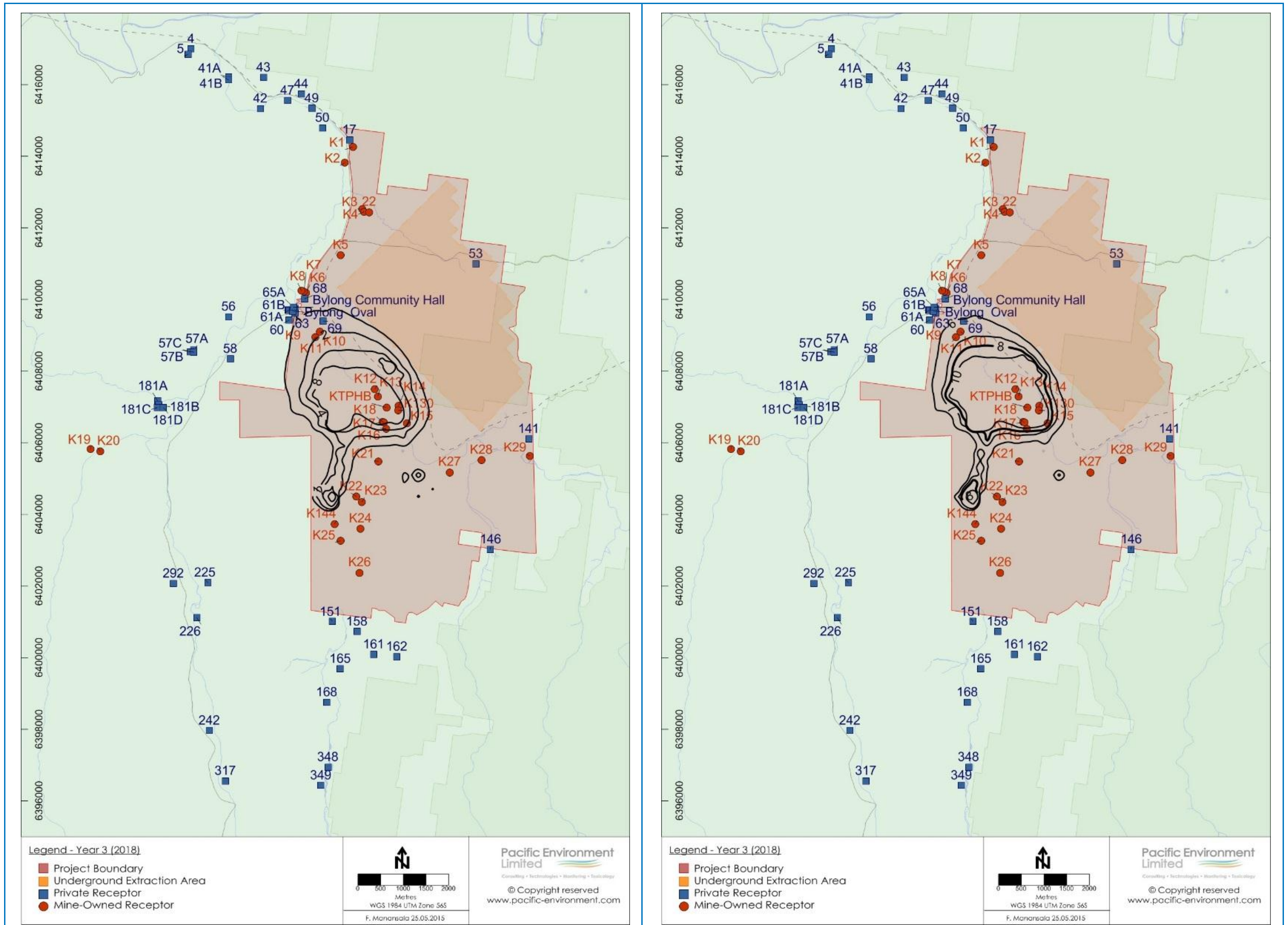


Figure 8.6: Year 3 - Predicted days over 24-hour average $PM_{2.5}$ concentrations



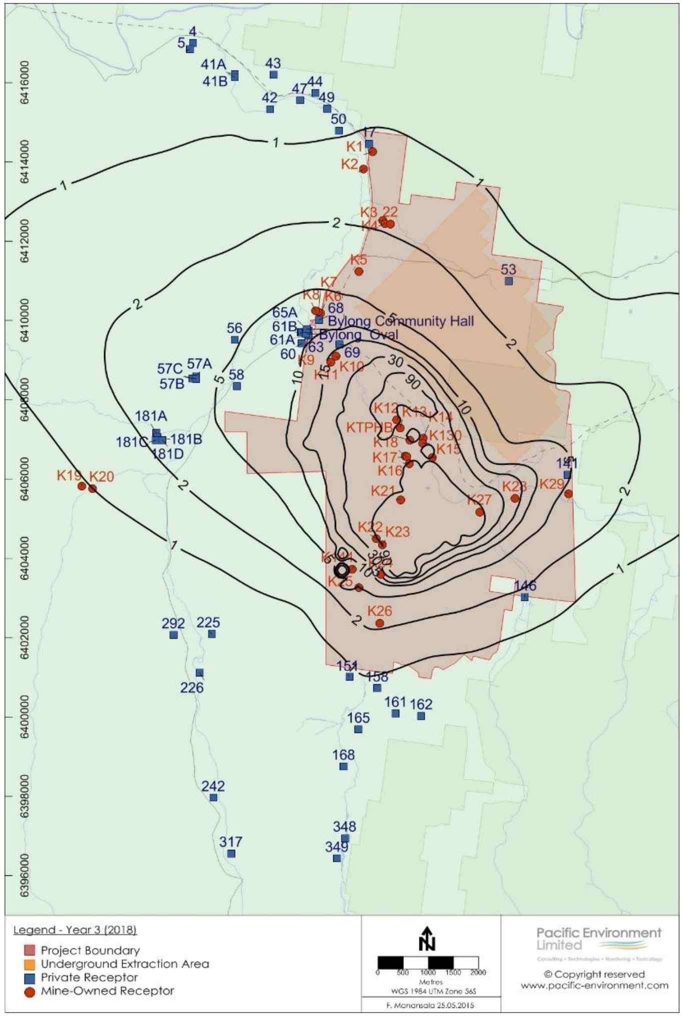
Project Only | Cumulative

Figure 8.7: Year 3 annual average ground level concentrations of PM_{10}

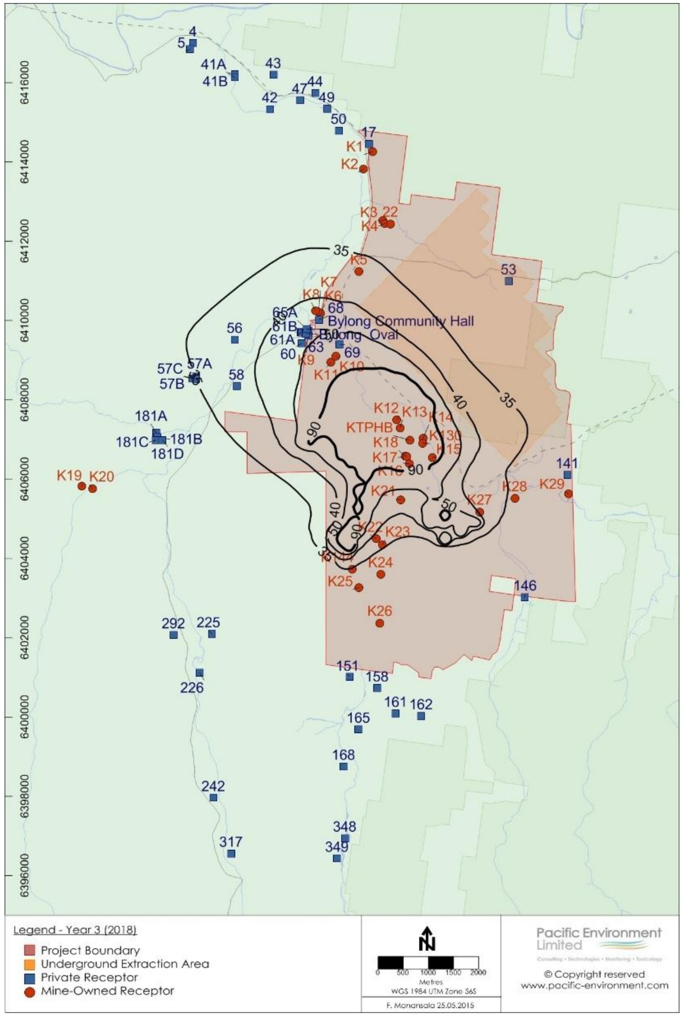


Project Only	Cumulative

Figure 8.8: Year 3 annual average ground level concentrations of $PM_{2.5}$



Project Only



Cumulative

Figure 8.9: Year 3 annual average ground level concentrations of TSP

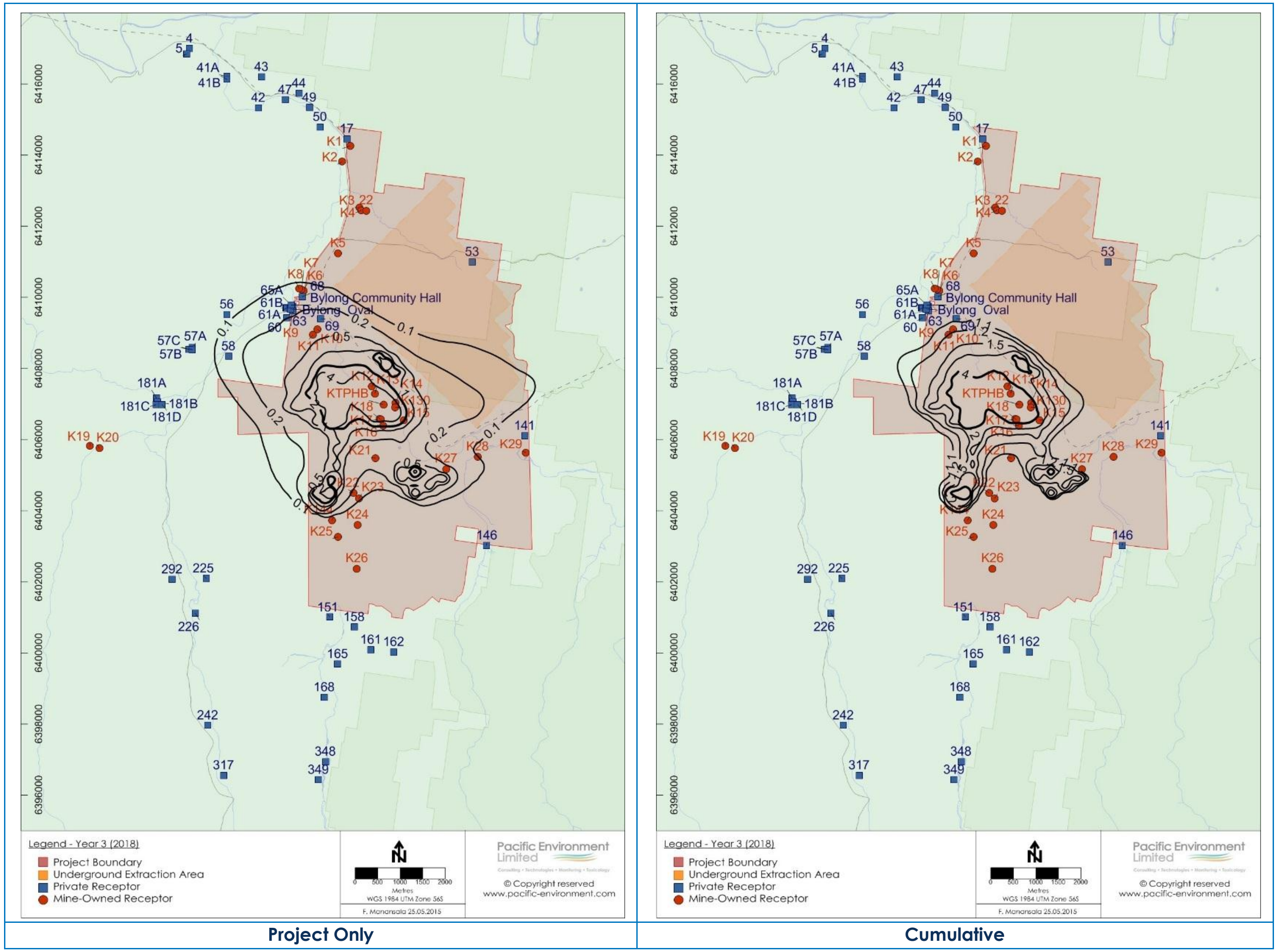


Figure 8.10: Year 3 annual average ground level dust deposition

8.2 Year 5 results

A summary of the predicted dust concentrations at each of the receptor locations are presented in **Table 8.2**. The incremental increase as a result of the Project are shown, as well as cumulative impacts with the addition of existing background, as described in **Section 5.3**.

The modelling results show that no private receptor is predicted to experience ground level concentrations of PM_{10}, $PM_{2.5}$, TSP and dust deposition above the relevant impact assessment criteria, due to the Project alone or cumulatively.

Figure 8.13 and **Figure 8.14** show time-series of background and modelled incremental 24-hour PM_{10} and $PM_{2.5}$ concentrations for the worst impacted residence (R69) during Year 5. There are no cumulative 24-hour concentrations above the impact assessment criteria. However, as discussed in **Section 5.3**, there are some short periods when no contemporaneous background is available for cumulative assessment. The additional Monte Carlo analysis is presented in **Figure 8.15** and **Figure 8.16** and show there is a very low probability for any additional days where cumulative 24-hour concentrations are greater than the relevant criteria for any private receptor.

Contour plots of 24-hour PM_{10} and $PM_{2.5}$ concentrations and annual average PM_{10}, $PM_{2.5}$, TSP and deposition levels for Year 5 are shown in **Figure 8.11** to **Figure 8.20**.

Table 8.2: Predicted incremental and cumulative ground level concentrations for Year 5

ID	PM_{10}				$PM_{2.5}$				TSP		Dust Deposition	
	24 hour		Annual		24 hour		Annual		Annual		Annual	
	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative
Units	µg/m³										g/m²/month	
Impact Assessment criteria	**N/A**	**50**	**N/A**	**30**	**N/A**	**25**	**N/A**	**8**	**N/A**	**90**	**2**	**4**
Voluntary Acquisition/ Mitigation criteria	**50**	**N/A**	**N/A**	**30**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**90**	**2**	**4**
Private Receptors												
4	3.5	34	0.3	10	0.5	24	0.0	5	0.7	33	0.01	0.81
5	3.8	34	0.3	10	0.6	24	0.0	5	0.7	33	0.01	0.81
17	5.4	34	0.5	11	1.0	24	0.1	5	1.2	33	0.02	0.82
41A	2.5	34	0.3	11	0.6	24	0.1	5	0.8	33	0.01	0.81
41B	2.6	34	0.3	11	0.6	24	0.1	5	0.8	33	0.01	0.81
42	2.7	34	0.4	11	0.8	24	0.1	5	0.9	33	0.02	0.82
43	2.4	34	0.3	10	0.7	24	0.1	5	0.7	33	0.01	0.81
44	2.6	34	0.3	11	0.7	24	0.1	5	0.8	33	0.02	0.82
47	2.7	34	0.3	11	0.8	24	0.1	5	0.9	33	0.02	0.82
49	2.9	34	0.4	11	0.8	24	0.1	5	0.9	33	0.02	0.82
50	3.8	34	0.4	11	0.8	24	0.1	5	1.1	33	0.02	0.82
53	7.6	34	0.5	11	1.1	24	0.1	5	1.5	33	0.03	0.83
56	10.1	34	2.5	13	1.6	24	0.4	5	6.9	39	0.11	0.91
57A	12.4	34	1.9	12	2.0	24	0.3	5	5.1	37	0.10	0.90
57B	11.7	34	1.9	12	1.9	24	0.3	5	4.9	37	0.09	0.89
57C	12.2	34	1.9	12	1.9	24	0.3	5	5.1	37	0.10	0.90
58	16.1	34	3.0	13	2.4	24	0.5	5	8.1	40	0.19	0.99
60	20.0	37	5.8	16	3.7	24	0.8	6	16.7	49	0.22	1.02
61A	19.4	37	5.0	15	3.5	24	0.7	5	14.4	46	0.19	0.99
61B	19.7	38	5.1	15	3.5	24	0.7	5	14.6	47	0.19	0.99
65A	21.2	40	5.4	16	3.6	24	0.8	5	15.4	47	0.19	0.99
63	21.8	39	5.7	16	3.7	24	0.8	6	16.4	48	0.21	1.01
68	19.5	40	4.9	15	3.4	24	0.7	5	13.6	46	0.16	0.96
69	28.2	43	8.2	18	4.2	25	1.1	6	23.1	55	0.26	1.06
141	12.3	37	1.1	11	1.9	25	0.2	5	2.9	35	0.13	0.93
146	4.4	36	0.4	11	0.8	24	0.1	5	0.9	33	0.06	0.86
151	6.6	34	0.3	10	1.3	24	0.1	5	0.7	33	0.02	0.82
158	4.8	35	0.2	10	0.9	24	0.0	5	0.6	33	0.02	0.82
161	2.6	35	0.2	10	0.5	24	0.0	5	0.4	32	0.01	0.81
162	2.4	34	0.2	10	0.4	24	0.0	5	0.4	32	0.01	0.81
165	4.1	34	0.2	10	0.8	24	0.0	5	0.4	32	0.01	0.81
168	3.2	34	0.1	10	0.7	24	0.0	5	0.3	32	0.01	0.81
181A	6.4	34	1.0	11	1.1	24	0.2	5	2.4	34	0.05	0.85
181B	6.1	34	0.9	11	1.0	24	0.2	5	2.4	34	0.05	0.85
181C	6.1	34	0.9	11	1.0	24	0.2	5	2.3	34	0.05	0.85
181D	6.3	34	1.0	11	1.0	24	0.2	5	2.4	34	0.06	0.86

ID	PM_{10}				$PM_{2.5}$				TSP		Dust Deposition	
	24 hour		Annual		24 hour		Annual		Annual		Annual	
	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative
Units	µg/m³										g/m²/month	
225	2.2	34	0.2	10	0.4	24	0.0	5	0.5	33	0.01	0.81
226	1.5	34	0.1	10	0.3	24	0.0	5	0.4	32	0.01	0.81
242	1.3	34	0.1	10	0.3	24	0.0	5	0.2	32	0.01	0.81
292	2.0	34	0.2	10	0.4	24	0.0	5	0.4	32	0.01	0.81
317	1.1	34	0.1	10	0.3	24	0.0	5	0.2	32	0.00	0.80
348	2.2	34	0.1	10	0.4	24	0.0	5	0.2	32	0.01	0.81
349	1.8	34	0.1	10	0.4	24	0.0	5	0.2	32	0.01	0.81
Bylong Community Hall	20.6	39	5.2	15	3.5	24	0.7	5	14.8	47	0.18	0.98
Bylong Oval	20.9	39	5.4	16	3.6	24	0.8	5	15.5	47	0.20	1.00
Mine-Owned Receptors												
K1	5.7	34	0.5	11	1.0	24	0.1	5	1.3	33	0.02	0.82
K2	6.0	34	0.6	11	1.0	24	0.1	5	1.5	34	0.02	0.82
K3	8.6	34	0.9	11	1.5	24	0.2	5	2.3	34	0.03	0.83
K4	8.7	34	0.9	11	1.5	24	0.2	5	2.3	34	0.03	0.83
K5	11.4	34	1.7	12	1.8	24	0.3	5	4.5	36	0.05	0.85
K6	18.2	40	4.3	15	3.2	24	0.6	5	11.9	44	0.14	0.94
K7	17.8	40	4.2	14	3.2	24	0.6	5	11.7	44	0.14	0.94
K8	17.3	40	4.1	14	3.2	24	0.6	5	11.4	43	0.13	0.93
K9	21.4	39	5.5	16	3.6	24	0.8	5	15.7	48	0.20	1.00
K12	131.2	**144**	62.6	**73**	22.9	**39**	9.5	**14**	205.2	**237**	**2.70**	3.50
K13	163.2	**176**	68.6	**79**	30.0	**43**	11.2	**16**	214.5	**246**	**2.66**	3.46
K25	36.1	**70**	4.4	15	6.6	25	0.7	5	11.4	43	0.79	1.59
K26	10.0	36	0.6	11	1.8	24	0.1	5	1.7	34	0.05	0.85
K10	32.8	45	10.1	20	5.0	25	1.4	6	29.1	61	0.34	1.14
K11	33.7	47	10.6	21	5.4	25	1.4	6	30.7	63	0.37	1.17
K144	36.3	**143**	8.1	18	4.9	**42**	1.1	6	24.1	56	1.56	2.36
K15	145.3	**145**	47.1	**57**	26.8	**42**	8.5	**13**	148.8	**181**	**2.36**	3.16
K16	238.7	**239**	89.8	**100**	43.9	**49**	16.5	**21**	285.3	**317**	**4.37**	**5.17**
K17	337.6	**347**	123.5	**134**	65.5	**69**	23.3	**28**	400.4	**432**	**7.48**	**8.28**
K18	315.7	**325**	110.6	**121**	59.0	**62**	20.7	**25**	350.0	**382**	**7.20**	**8.00**
K19	3.4	34	0.4	11	0.8	24	0.1	5	0.9	33	0.02	0.82
K20	3.6	34	0.4	11	0.8	24	0.1	5	0.9	33	0.02	0.82
K21	1346.0	**1356**	506.6	**517**	162.3	**165**	56.6	**61**	1867.0	**1899**	**43.30**	**44.10**
K22	92.4	**94**	15.2	25	10.5	25	2.0	7	49.5	82	1.25	2.05
K23	114.5	**124**	14.5	25	13.9	**29**	1.9	7	47.8	80	1.34	2.14
K24	33.5	48	2.5	13	4.6	25	0.4	5	6.9	39	0.21	1.01
K27	35.5	50	4.1	14	5.8	**26**	0.7	5	10.7	43	0.36	1.16
K28	22.0	40	2.1	12	3.6	25	0.4	5	5.6	38	0.22	1.02
K29	11.5	36	0.9	11	2.0	25	0.2	5	2.4	34	0.14	0.94
K130	165.7	**166**	64.6	**75**	30.5	**44**	11.3	**16**	202.8	**235**	**2.88**	3.68
K144	36.3	**63**	8.1	18	4.9	**25**	1.1	6	24.1	56	1.56	2.36
KTPHB	208.9	**219**	88.7	**99**	40.6	**50**	16.3	**21**	284.1	**316**	**3.98**	**4.78**

ID	PM10				PM2.5				TSP		Dust Deposition	
	24 hour		Annual		24 hour		Annual		Annual		Annual	
	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative
Units	µg/m³										g/m²/month	
22	8.2	34	0.9	11	1.4	24	0.1	5	2.3	34	0.03	0.83

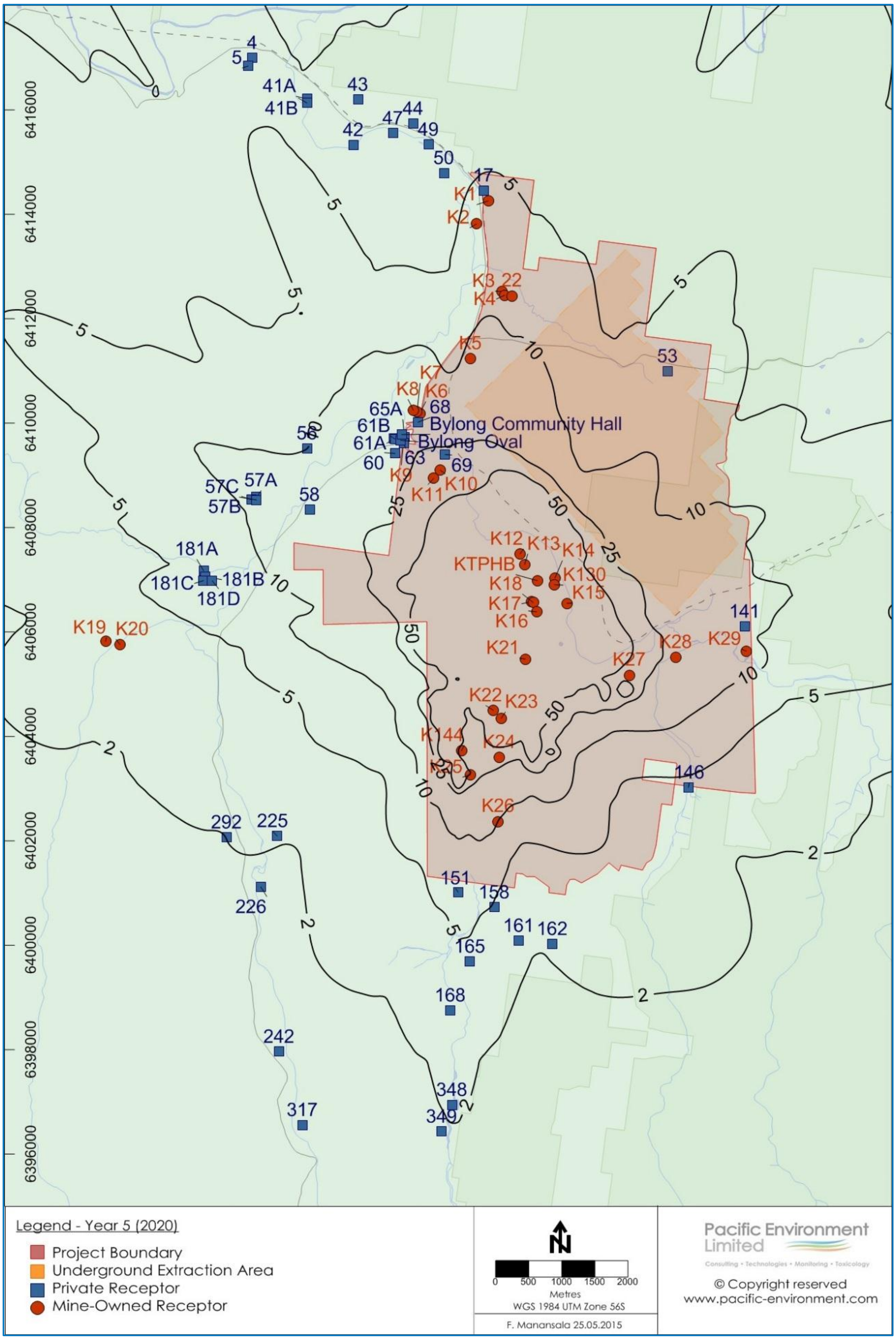


Figure 8.11: Year 5 maximum 24 hour average ground level concentrations of PM_{10}

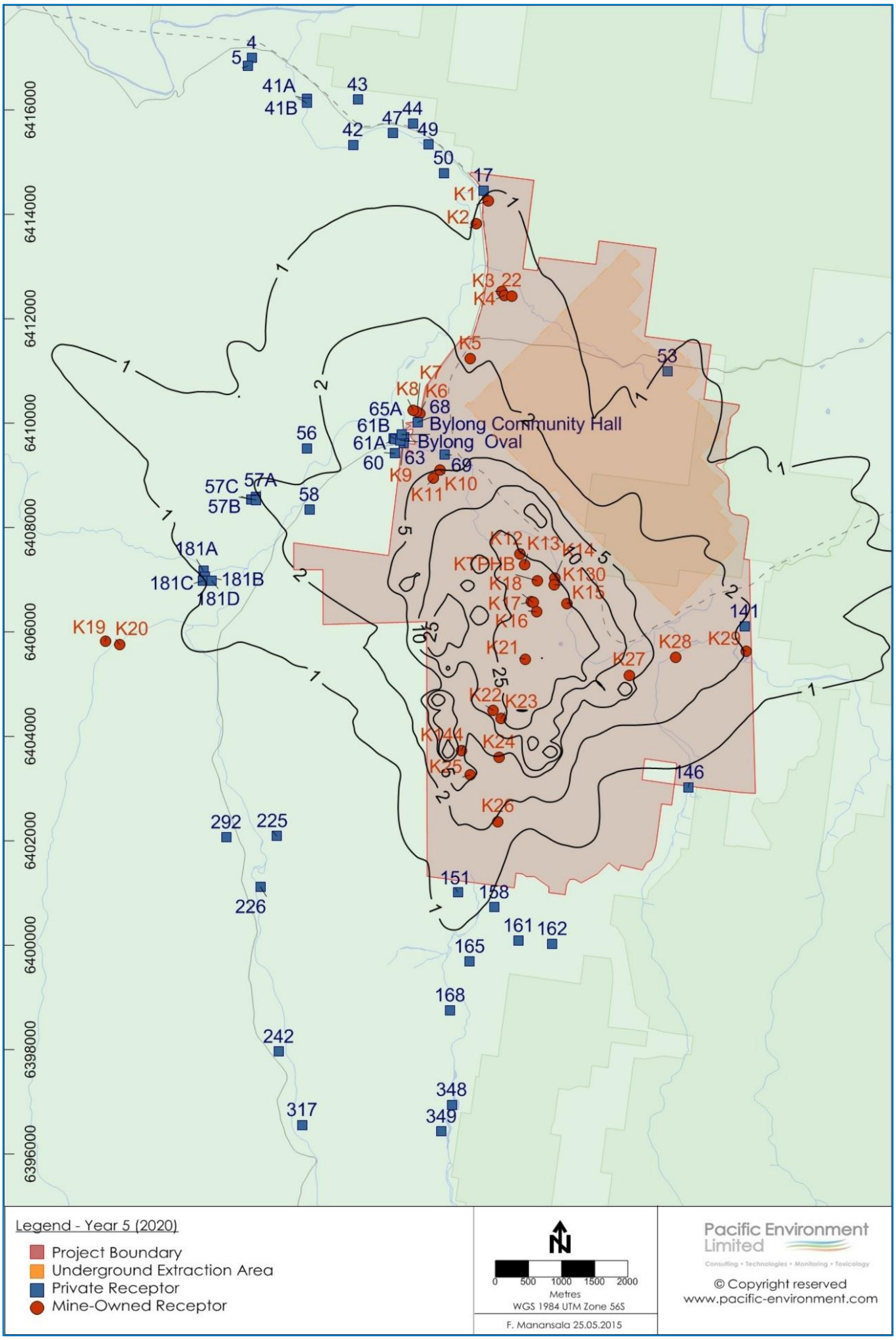


Figure 8.12: Year 5 maximum 24 hour average ground level concentrations of $PM_{2.5}$

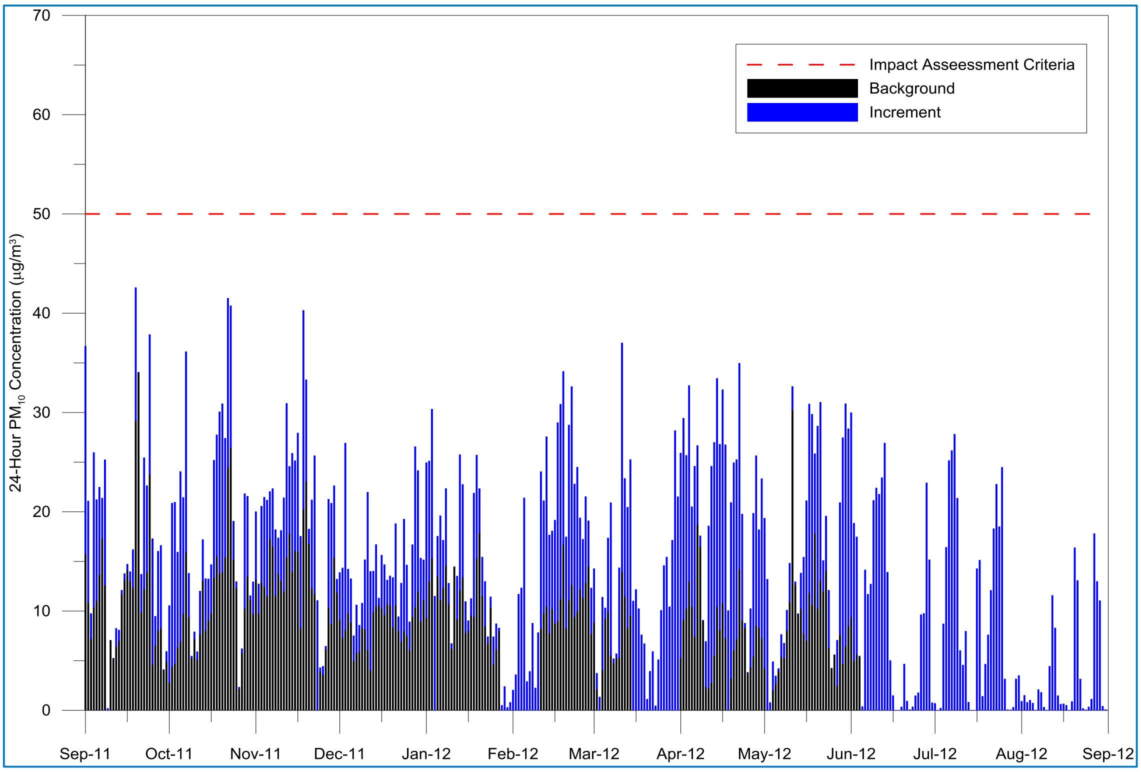


Figure 8.13: Year 5 - Cumulative 24-hour PM_{10} concentrations (background and increment) for R69

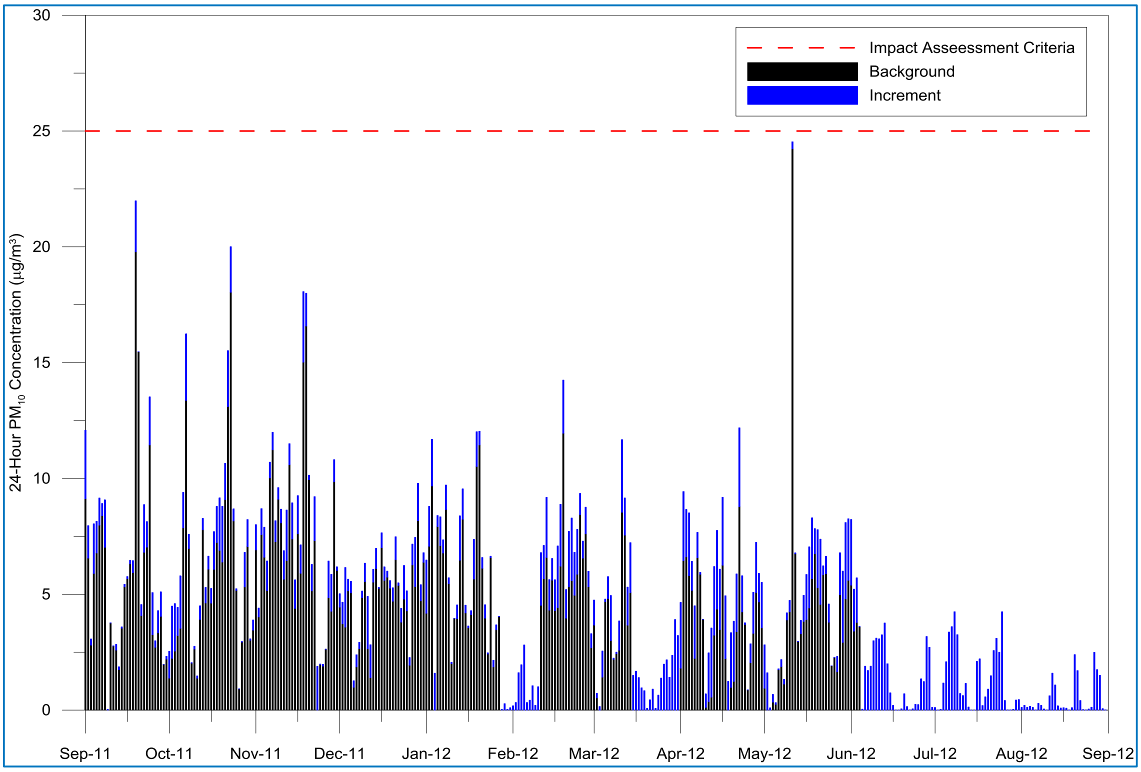


Figure 8.14: Year 5 - Cumulative 24-hour $PM_{2.5}$ concentrations (background and increment) for R69

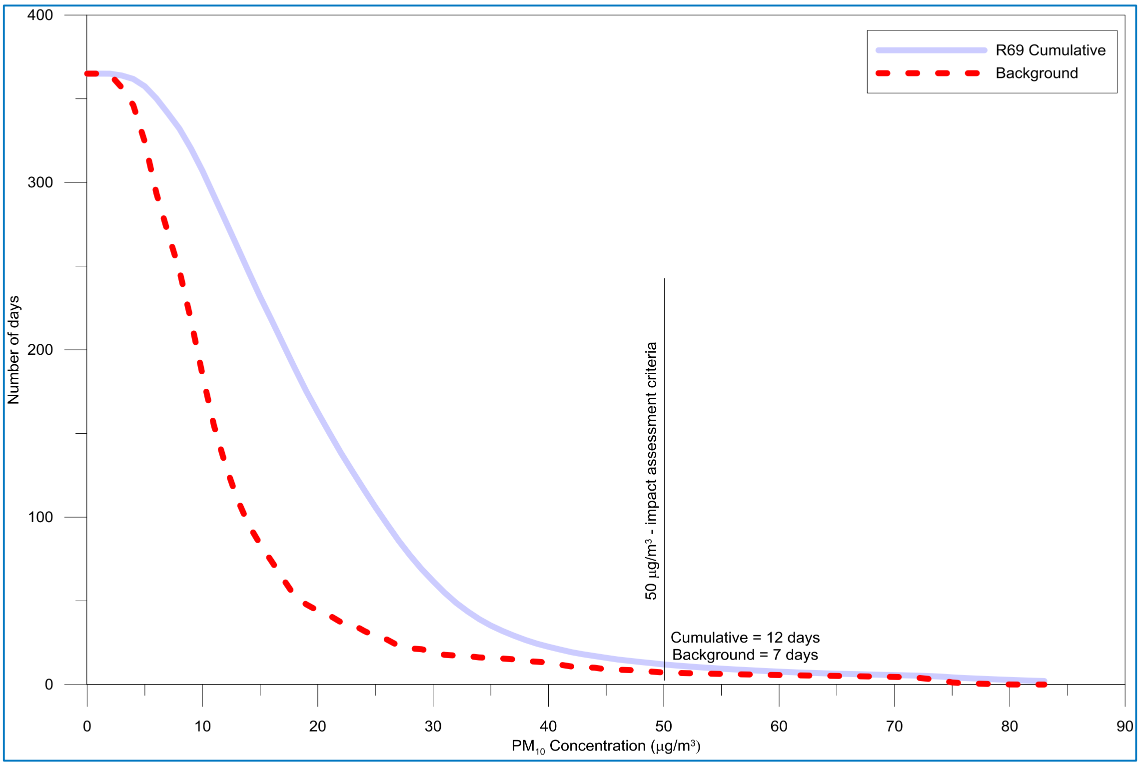


Figure 8.15: Year 5 - Predicted days over 24-Hour PM_{10} concentration

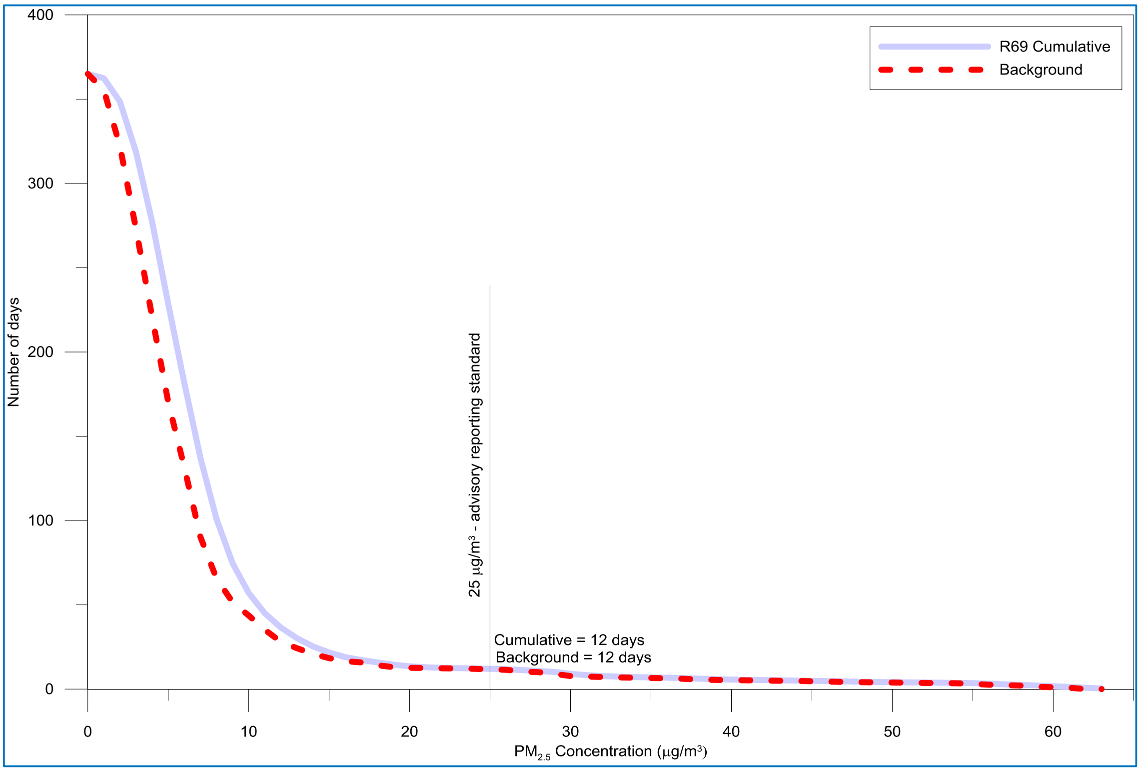
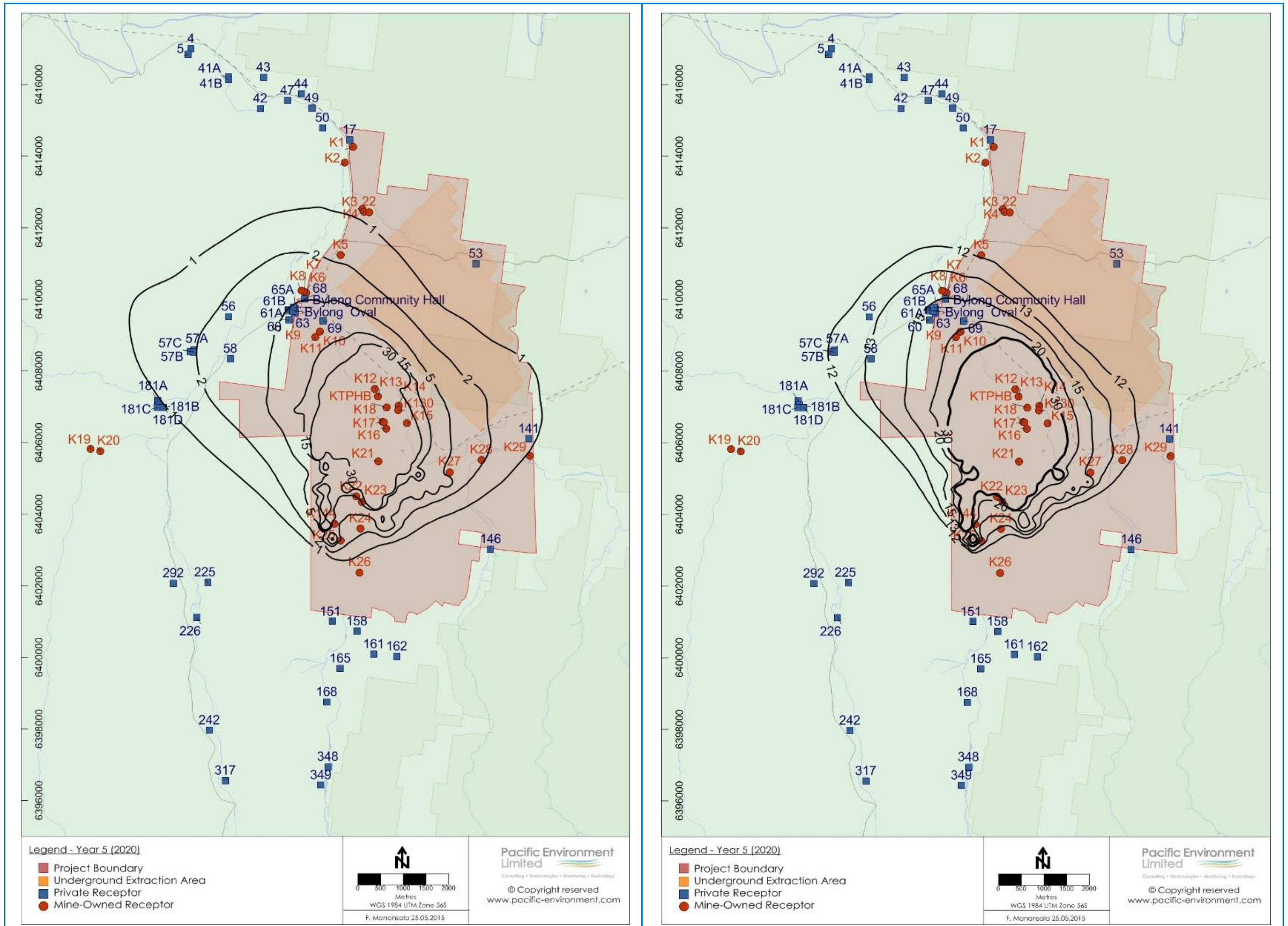
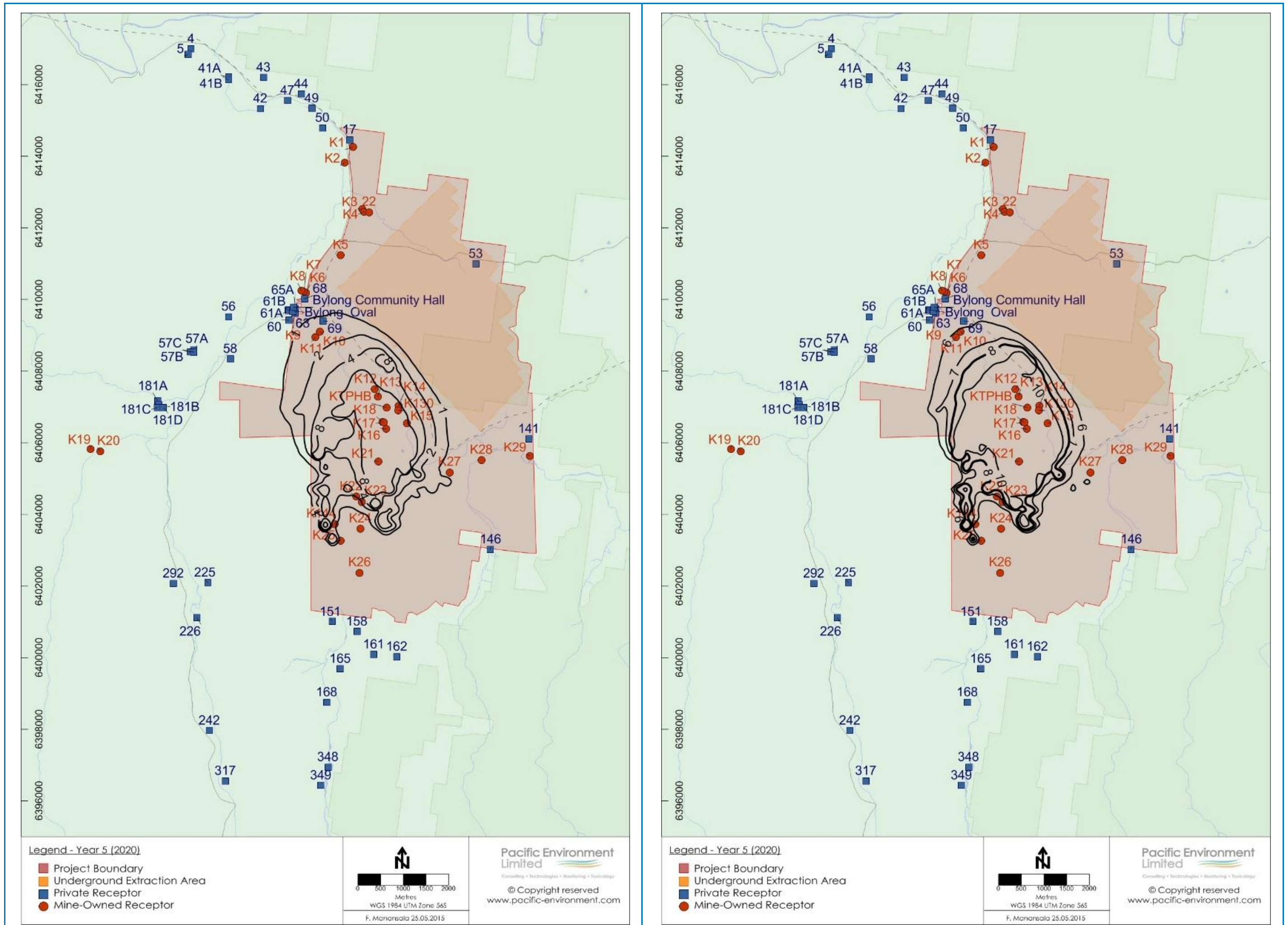


Figure 8.16: Year 5 - Predicted days over 24-Hour $PM_{2.5}$ concentrations



Project Only | Cumulative

Figure 8.17: Year 5 annual average ground level concentrations of PM_{10}



Project Only	Cumulative

Figure 8.18: Year 5 annual average ground level concentrations of $PM_{2.5}$

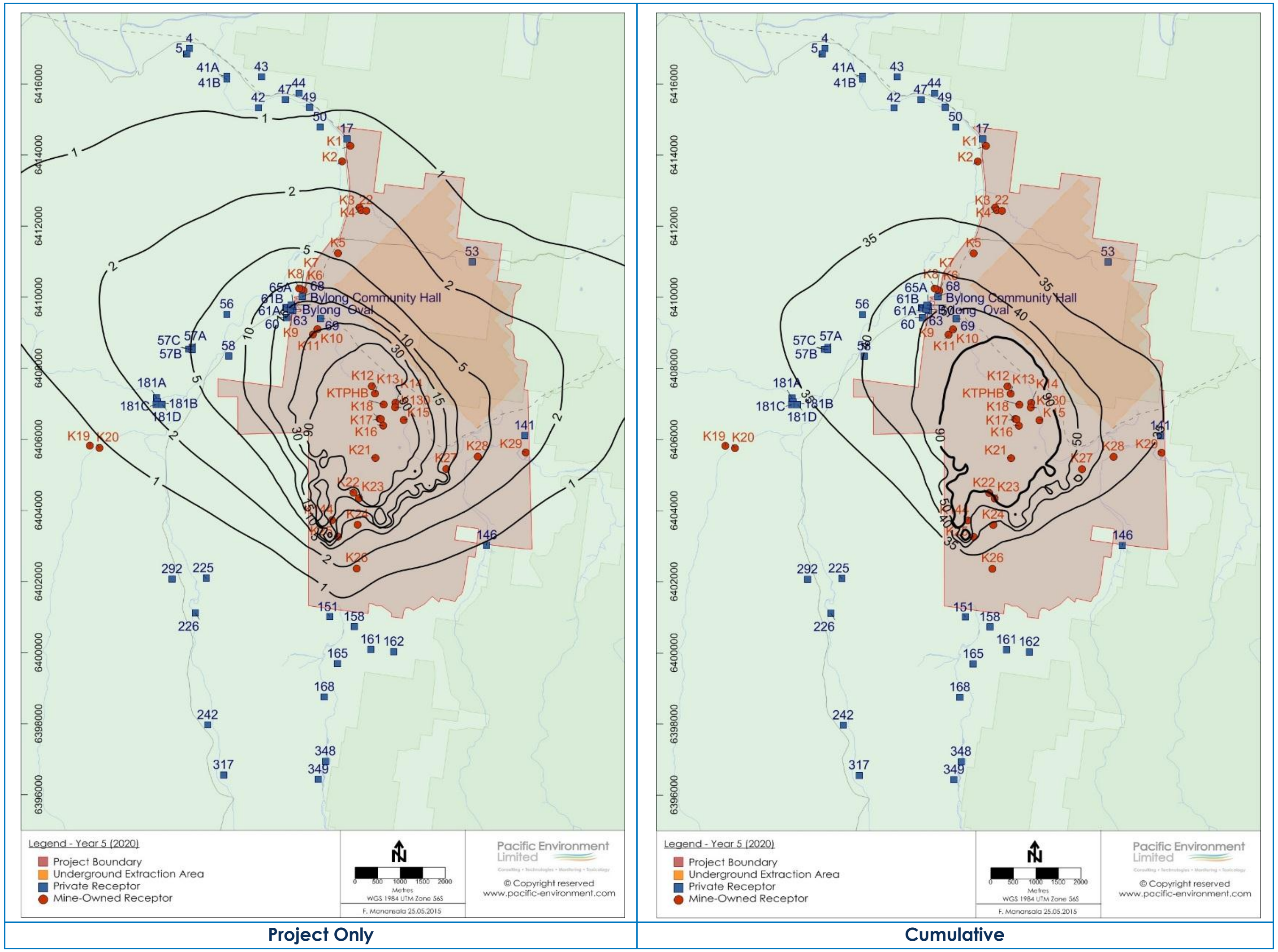
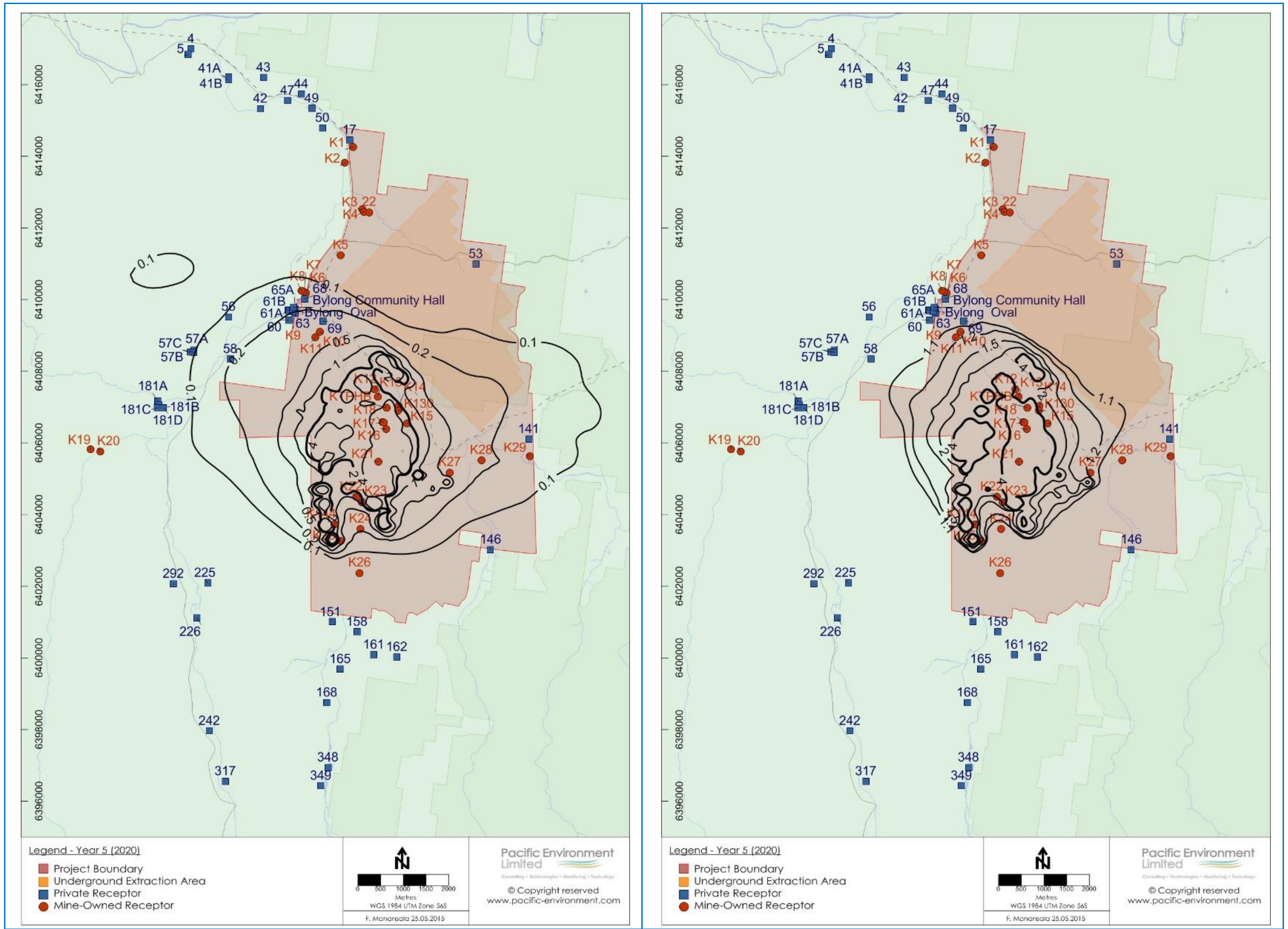


Figure 8.19: Year 5 annual average ground level concentrations of TSP



Project Only | Cumulative

Figure 8.20: Year 5 annual average ground level dust deposition

8.3 Year 9 results

A summary of the predicted dust concentrations at each of the receptor locations are presented in **Table 8.3**. The incremental increase as a result of the Project are shown, as well as cumulative impacts with the addition of existing background, as described in **Section 5.3**.

The modelling results show that there is no private sensitive receptor that is predicted to experience ground level concentrations of PM_{10}, $PM_{2.5}$, TSP and dust deposition greater than the relevant impact assessment criteria, due to the Project alone or cumulatively.

Figure 8.23 and **Figure 8.24** show time-series of background and modelled incremental 24-hour PM_{10} and $PM_{2.5}$ concentrations for the worst impacted residence (R141) during Year 9. There are no private receptors predicted to exceed the cumulative 24-hour impact assessment criteria. However, as discussed in **Section 5.3**, there are some short periods when no contemporaneous background is available for cumulative assessment. The additional Monte Carlo analysis is presented in **Figure 8.15** and **Figure 8.16** and show there is a very low probability for any additional days where cumulative 24-hour concentrations are greater than the relevant criteria for any private receptor.

Contour plots of 24-hour PM_{10} and $PM_{2.5}$ concentrations and annual average PM_{10}, $PM_{2.5}$, TSP and deposition levels for Year 9 are shown in **Figure 8.27** to **Figure 8.30**.

Table 8.3: Predicted incremental and cumulative ground level concentrations for Year 9

ID	PM_{10}				$PM_{2.5}$				TSP		Dust Deposition	
	24 hour		Annual		24 hour		Annual		Annual		Annual	
	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative
Units	µg/m³										g/m²/month	
Impact Assessment criteria	**N/A**	**50**	**N/A**	**30**	**N/A**	**25**	**N/A**	**8**	**N/A**	**90**	**2**	**4**
Voluntary Acquisition/ Mitigation criteria	**50**	**N/A**	**N/A**	**30**	**N/A**	**N/A**	**N/A**	**N/A**	**N/A**	**90**	**2**	**4**
Private Receptors												
4	2.9	34	0.2	10	0.4	24	0.0	5	0.6	33	0.01	0.81
5	3.2	34	0.2	10	0.4	24	0.0	5	0.6	33	0.01	0.81
17	4.8	34	0.4	11	0.7	24	0.1	5	1.1	33	0.02	0.82
41A	2.1	34	0.3	10	0.5	24	0.0	5	0.7	33	0.01	0.81
41B	2.1	34	0.3	10	0.5	24	0.0	5	0.7	33	0.01	0.81
42	2.6	34	0.3	11	0.6	24	0.0	5	0.8	33	0.02	0.82
43	2.3	34	0.3	10	0.5	24	0.0	5	0.7	33	0.01	0.81
44	2.5	34	0.3	10	0.6	24	0.0	5	0.8	33	0.01	0.81
47	2.6	34	0.3	11	0.6	24	0.0	5	0.8	33	0.02	0.82
49	2.6	34	0.3	11	0.6	24	0.1	5	0.8	33	0.02	0.82
50	2.9	34	0.4	11	0.6	24	0.1	5	1.0	33	0.02	0.82
53	6.8	34	0.5	11	0.8	24	0.1	5	1.4	33	0.03	0.83
56	7.8	34	1.7	12	1.1	24	0.2	5	4.7	37	0.08	0.88
57A	9.5	34	1.5	12	1.4	24	0.2	5	4.1	36	0.08	0.88
57B	9.5	34	1.5	12	1.4	24	0.2	5	4.0	36	0.08	0.88
57C	9.6	34	1.5	12	1.4	24	0.2	5	4.1	36	0.08	0.88
58	10.0	34	2.1	12	1.4	24	0.3	5	5.8	38	0.14	0.94
60	11.7	34	3.2	13	2.5	24	0.4	5	9.4	41	0.14	0.94
61A	11.2	34	2.9	13	2.4	24	0.4	5	8.3	40	0.12	0.92
61B	11.3	34	2.9	13	2.5	24	0.4	5	8.4	40	0.12	0.92
65A	11.8	35	3.1	13	2.5	24	0.4	5	8.8	41	0.12	0.92
63	12.0	35	3.3	13	2.6	24	0.4	5	9.3	41	0.13	0.93
68	11.9	36	2.9	13	2.4	24	0.4	5	8.1	40	0.10	0.90
69	17.6	37	5.0	15	2.8	24	0.6	5	13.9	46	0.17	0.97
141	15.1	40	1.9	12	2.1	25	0.3	5	5.3	37	0.19	0.99
146	7.2	38	0.6	11	1.1	24	0.1	5	1.7	34	0.10	0.90
151	7.3	34	0.3	11	1.3	24	0.0	5	0.9	33	0.02	0.82
158	6.4	35	0.3	11	0.9	24	0.0	5	0.9	33	0.02	0.82
161	4.2	35	0.2	10	0.6	24	0.0	5	0.6	33	0.02	0.82
162	3.1	35	0.2	10	0.5	24	0.0	5	0.5	33	0.02	0.82
165	5.2	34	0.2	10	0.8	24	0.0	5	0.6	33	0.01	0.81
168	3.3	34	0.2	10	0.6	24	0.0	5	0.4	32	0.01	0.81
181A	5.6	34	0.9	11	0.9	24	0.1	5	2.4	34	0.05	0.85
181B	5.7	34	0.9	11	0.9	24	0.1	5	2.3	34	0.05	0.85
181C	5.6	34	0.9	11	0.9	24	0.1	5	2.3	34	0.05	0.85

ID	PM10				PM2.5				TSP		Dust Deposition	
	24 hour		Annual		24 hour		Annual		Annual		Annual	
	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative
Units	µg/m³										g/m²/month	
181D	5.9	34	0.9	11	0.9	24	0.1	5	2.4	34	0.06	0.86
225	2.8	34	0.2	10	0.4	24	0.0	5	0.6	33	0.02	0.82
226	1.9	34	0.2	10	0.3	24	0.0	5	0.4	32	0.01	0.81
242	1.2	34	0.1	10	0.3	24	0.0	5	0.2	32	0.01	0.81
292	2.5	34	0.2	10	0.4	24	0.0	5	0.5	33	0.01	0.81
317	1.1	34	0.1	10	0.2	24	0.0	5	0.2	32	0.01	0.81
348	2.5	34	0.1	10	0.4	24	0.0	5	0.3	32	0.01	0.81
349	2.0	34	0.1	10	0.4	24	0.0	5	0.2	32	0.01	0.81
Bylong Community Hall	11.6	35	3.0	13	2.5	24	0.4	5	8.5	40	0.12	0.92
Bylong Oval	11.7	35	3.1	13	2.5	24	0.4	5	8.8	41	0.12	0.92
Mine-Owned Receptors												
K1	5.1	34	0.4	11	0.8	24	0.1	5	1.1	33	0.02	0.82
K2	4.7	34	0.5	11	0.7	24	0.1	5	1.3	33	0.02	0.82
K3	7.4	34	0.7	11	1.1	24	0.1	5	1.8	34	0.03	0.83
K4	7.7	34	0.7	11	1.1	24	0.1	5	1.9	34	0.03	0.83
K5	6.9	34	1.2	11	1.4	24	0.2	5	3.2	35	0.04	0.84
K6	11.5	36	2.7	13	2.4	24	0.4	5	7.3	39	0.09	0.89
K7	11.2	36	2.6	13	2.4	24	0.4	5	7.1	39	0.09	0.89
K8	11.0	36	2.5	13	2.4	24	0.3	5	6.9	39	0.09	0.89
K9	11.9	35	3.2	13	2.5	24	0.4	5	9.0	41	0.12	0.92
K12	83.9	**90**	28.4	**39**	10.0	**27**	3.5	8	99.3	**131**	1.40	2.20
K13	68.6	**74**	24.9	**35**	8.1	**27**	3.0	8	81.7	**114**	1.09	1.89
K25	23.4	38	1.8	12	3.0	24	0.2	5	4.9	37	0.18	0.98
K26	14.6	38	0.8	11	1.9	24	0.1	5	2.3	34	0.07	0.87
K10	18.8	37	5.8	16	3.2	24	0.7	5	16.5	48	0.21	1.01
K11	18.2	36	5.7	16	3.3	24	0.7	5	16.4	48	0.22	1.02
K144	19.9	**64**	2.6	13	2.7	**28**	0.4	5	7.0	39	0.32	1.12
K15	61.4	**74**	26.2	**36**	7.5	**28**	3.2	8	85.6	**118**	1.27	2.07
K16	45.2	**63**	22.3	**32**	6.1	**29**	2.9	8	68.6	**101**	1.31	2.11
K17	49.0	**62**	20.8	**31**	6.3	**28**	2.7	7	65.6	**98**	0.94	1.74
K18	47.8	**61**	20.7	**31**	6.1	**28**	2.7	7	65.3	**97**	0.94	1.74
K19	2.9	34	0.4	11	0.6	24	0.1	5	0.9	33	0.02	0.82
K20	3.0	34	0.4	11	0.6	24	0.1	5	1.0	33	0.02	0.82
K21	61.8	**67**	31.9	**42**	8.8	**29**	4.3	**9**	102.9	**135**	**2.31**	3.11
K22	89.4	**93**	23.9	**34**	11.3	25	3.0	8	76.8	**109**	1.94	2.74
K23	110.5	**111**	26.0	**36**	13.8	**27**	3.1	8	84.6	**117**	**2.11**	2.91
K24	73.7	**80**	5.4	16	8.3	24	0.6	5	15.5	48	0.49	1.29
K27	189.8	**190**	34.9	**45**	22.1	**34**	4.0	**9**	115.7	**148**	**2.07**	2.87
K28	38.3	49	6.0	16	4.9	**26**	0.8	5	18.4	50	0.54	1.34
K29	15.2	38	1.5	12	2.1	25	0.2	5	4.3	36	0.22	1.02
K130	61.1	**73**	27.8	**38**	7.3	**28**	3.3	8	89.5	**121**	1.23	2.03
K144	19.9	**63**	2.6	13	2.7	**25**	0.4	5	7.0	39	0.32	1.12

ID	PM_{10}				$PM_{2.5}$				TSP		Dust Deposition	
	24 hour		Annual		24 hour		Annual		Annual		Annual	
	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative	Increment	Cumulative
Units	µg/m³										g/m²/month	
KTPHB	66.8	**219**	25.7	**36**	7.7	**50**	3.1	8	83.2	**115**	1.37	2.17
22	8.1	34	0.7	11	1.1	24	0.1	5	1.8	34	0.03	0.83

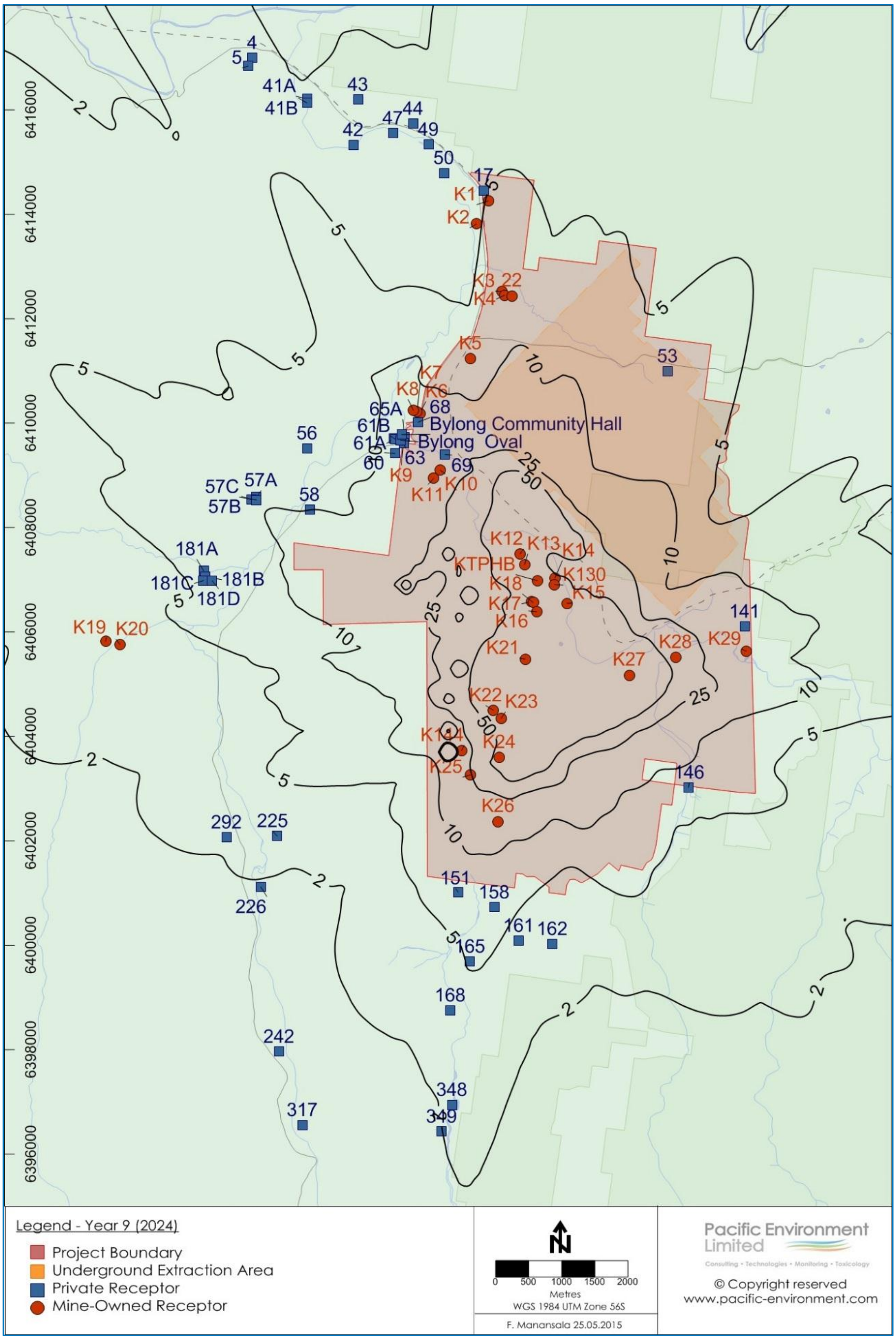


Figure 8.21: Year 9 maximum 24 hour average ground level concentrations of PM_{10}

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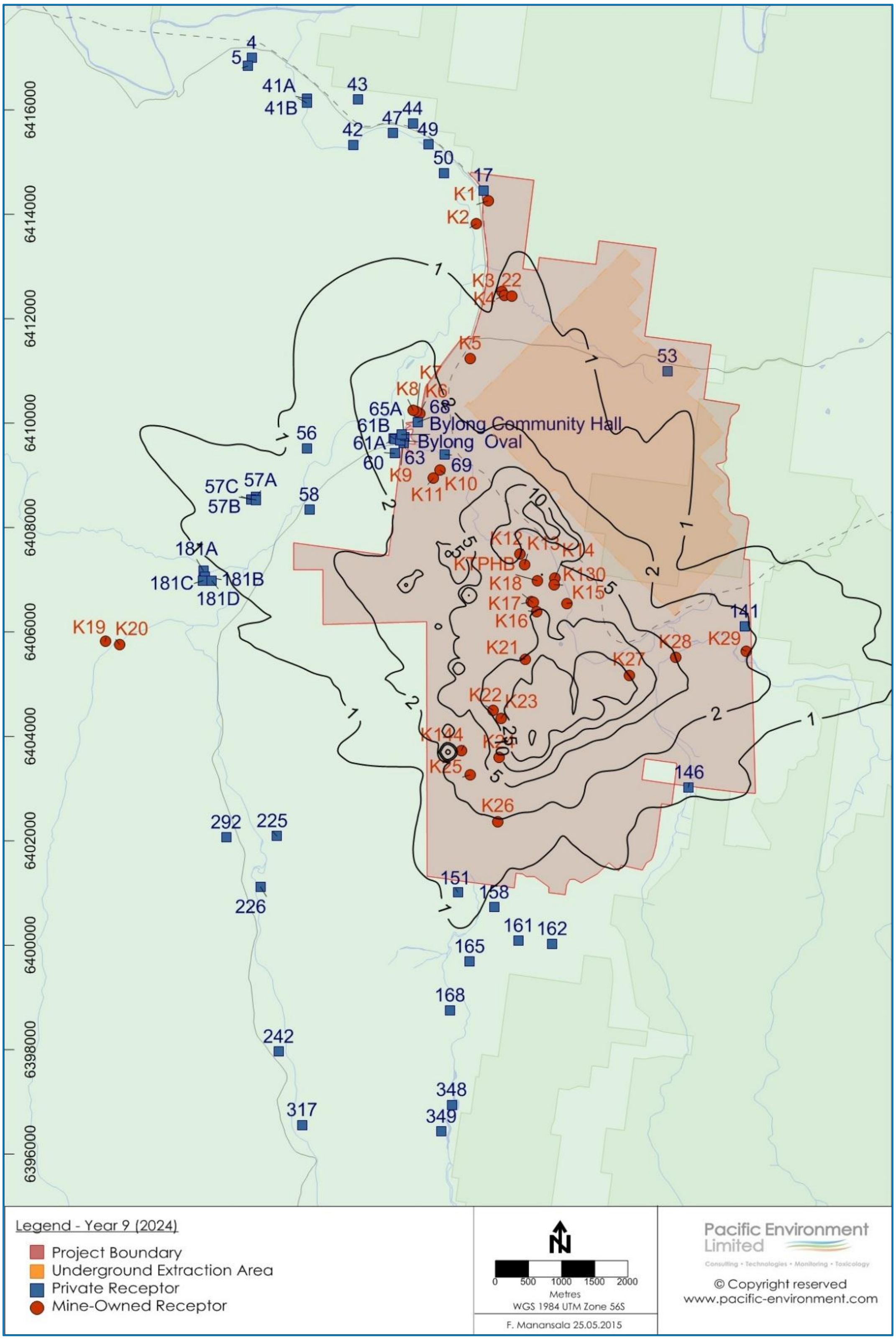


Figure 8.22: Year 9 maximum 24 hour average ground level concentrations of $PM_{2.5}$

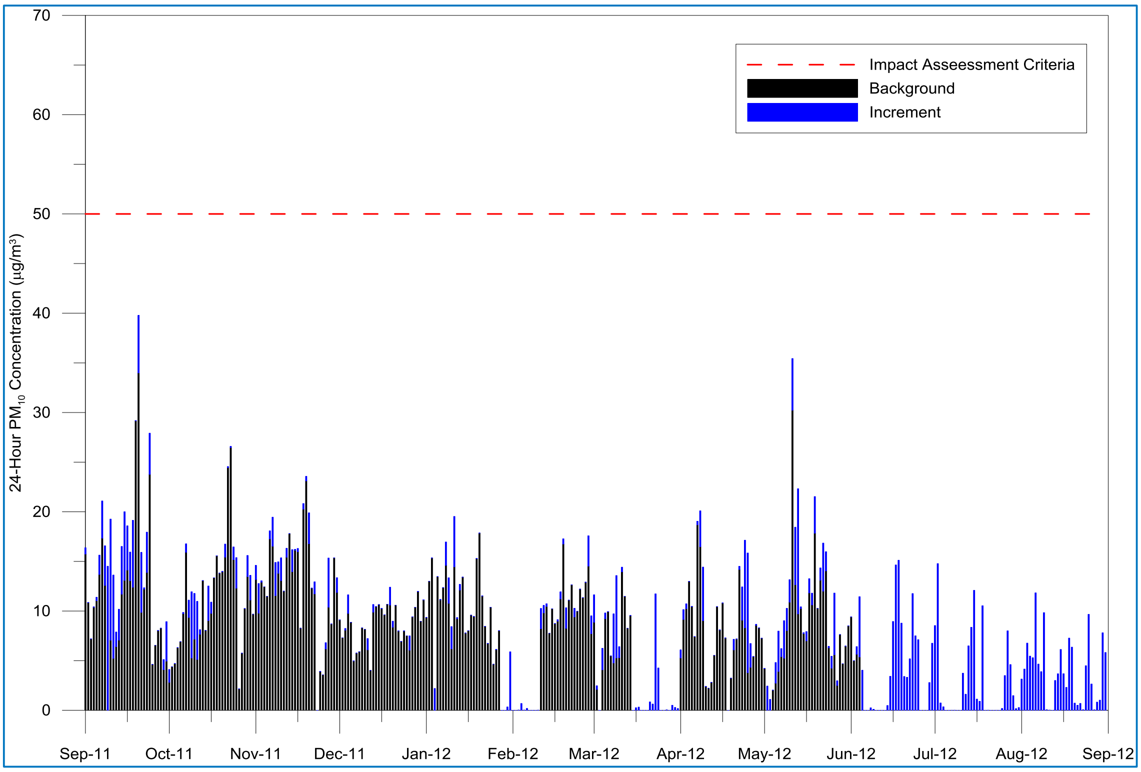


Figure 8.23: Year 9 - Cumulative 24-hour PM_{10} concentrations (background and increment) for R141

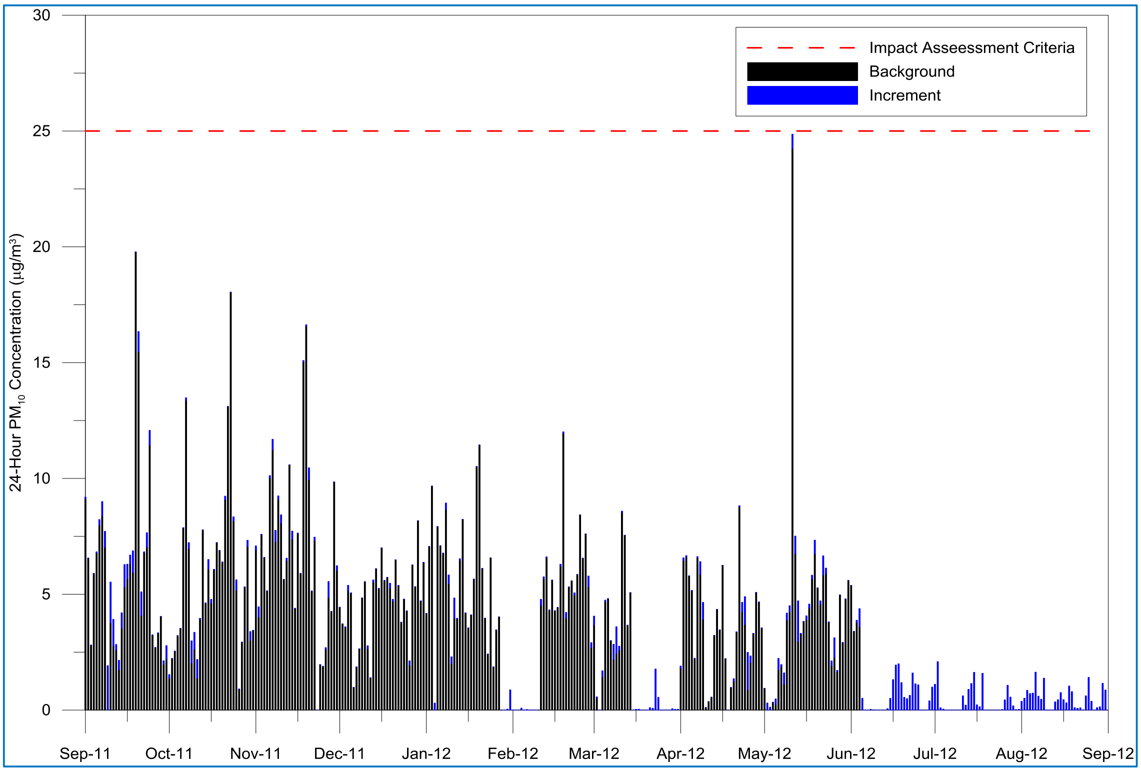


Figure 8.24: Year 9 - Cumulative 24-hour $PM_{2.5}$ concentrations (background and increment) for R141

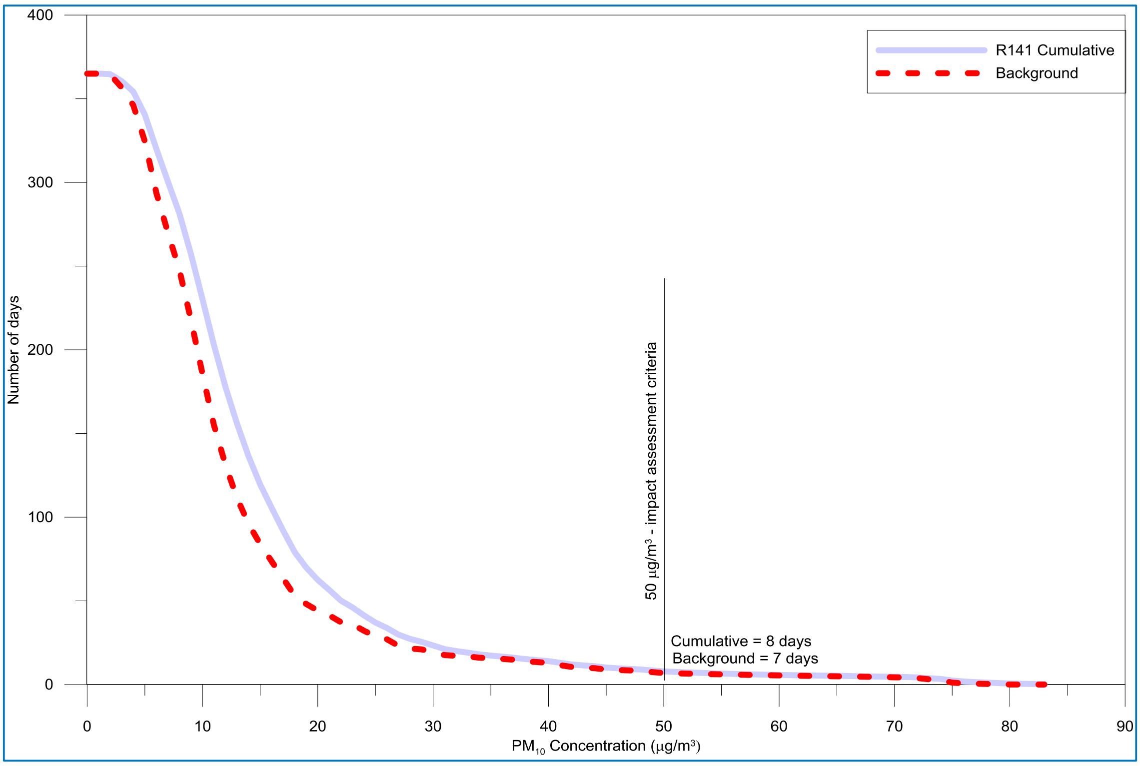


Figure 8.25: Year 9 - Predicted days over 24-Hour PM_{10} concentration

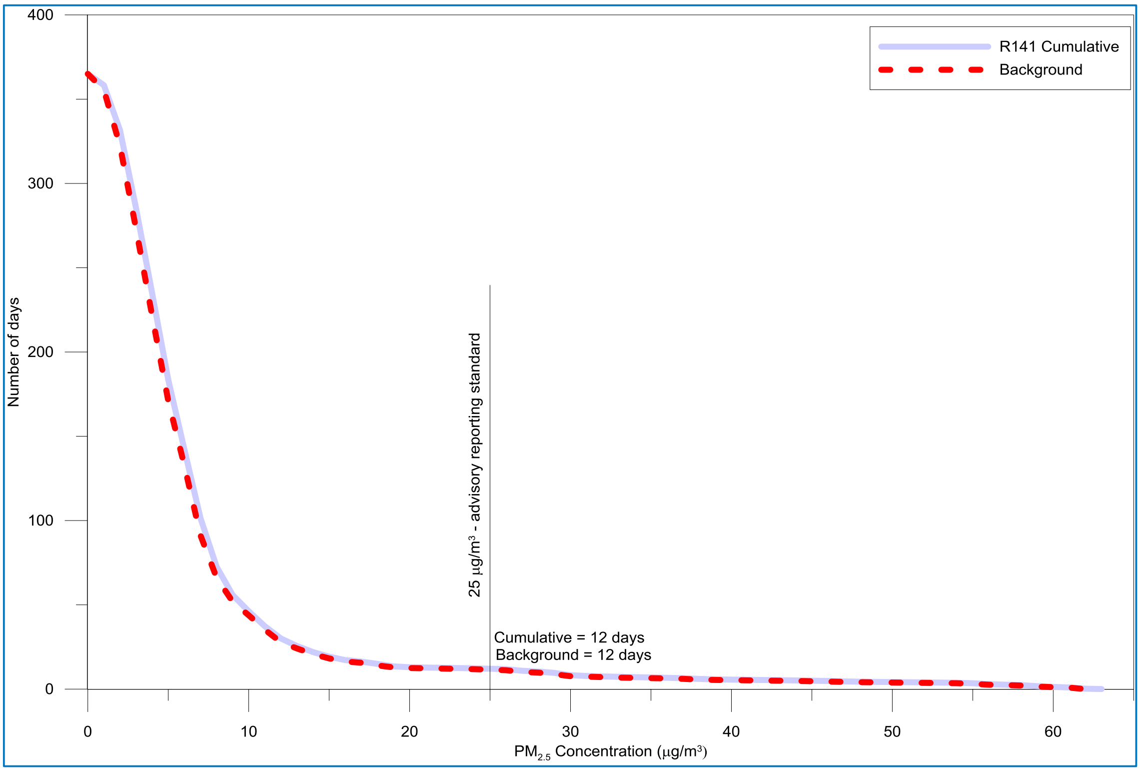
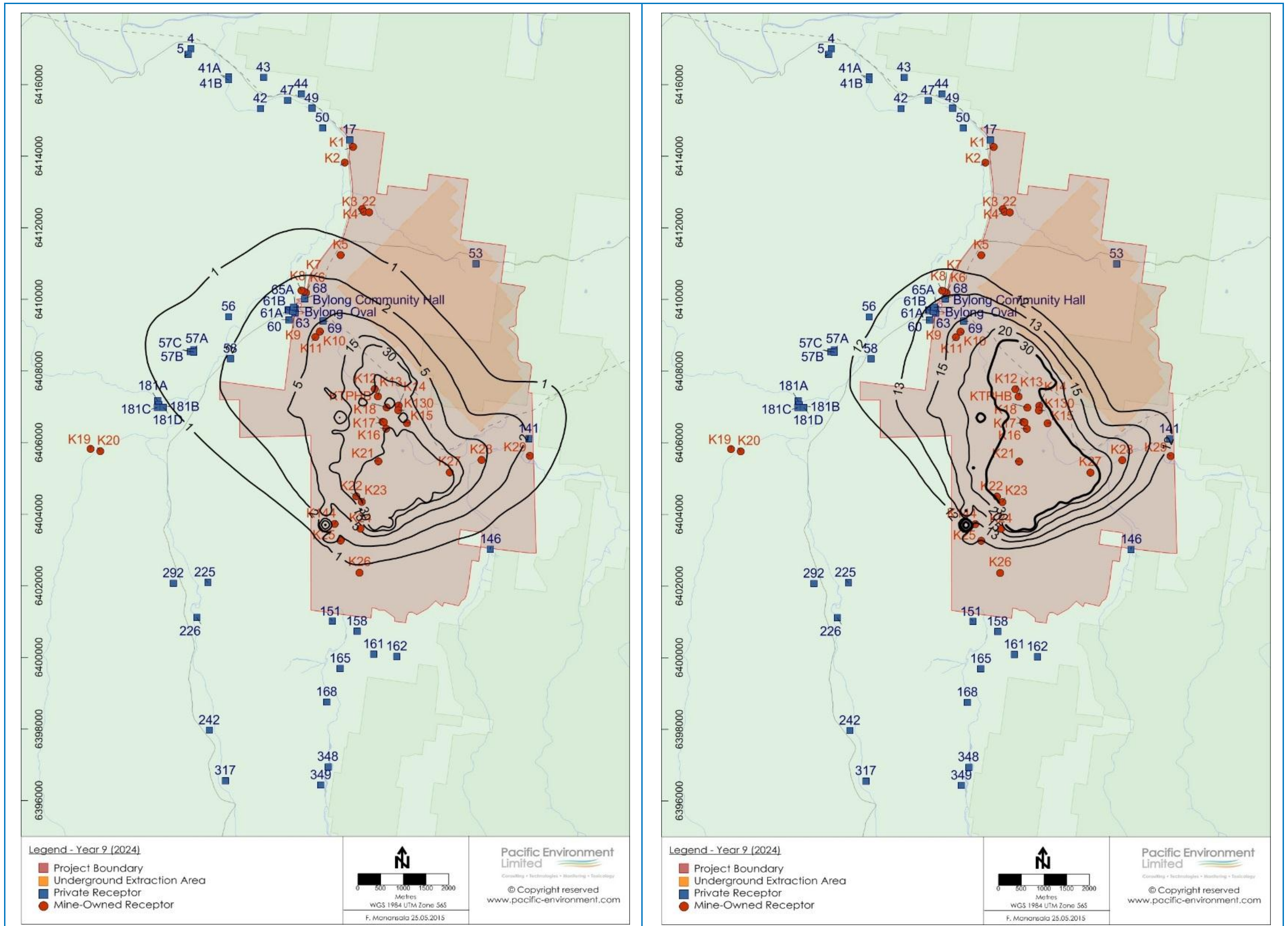
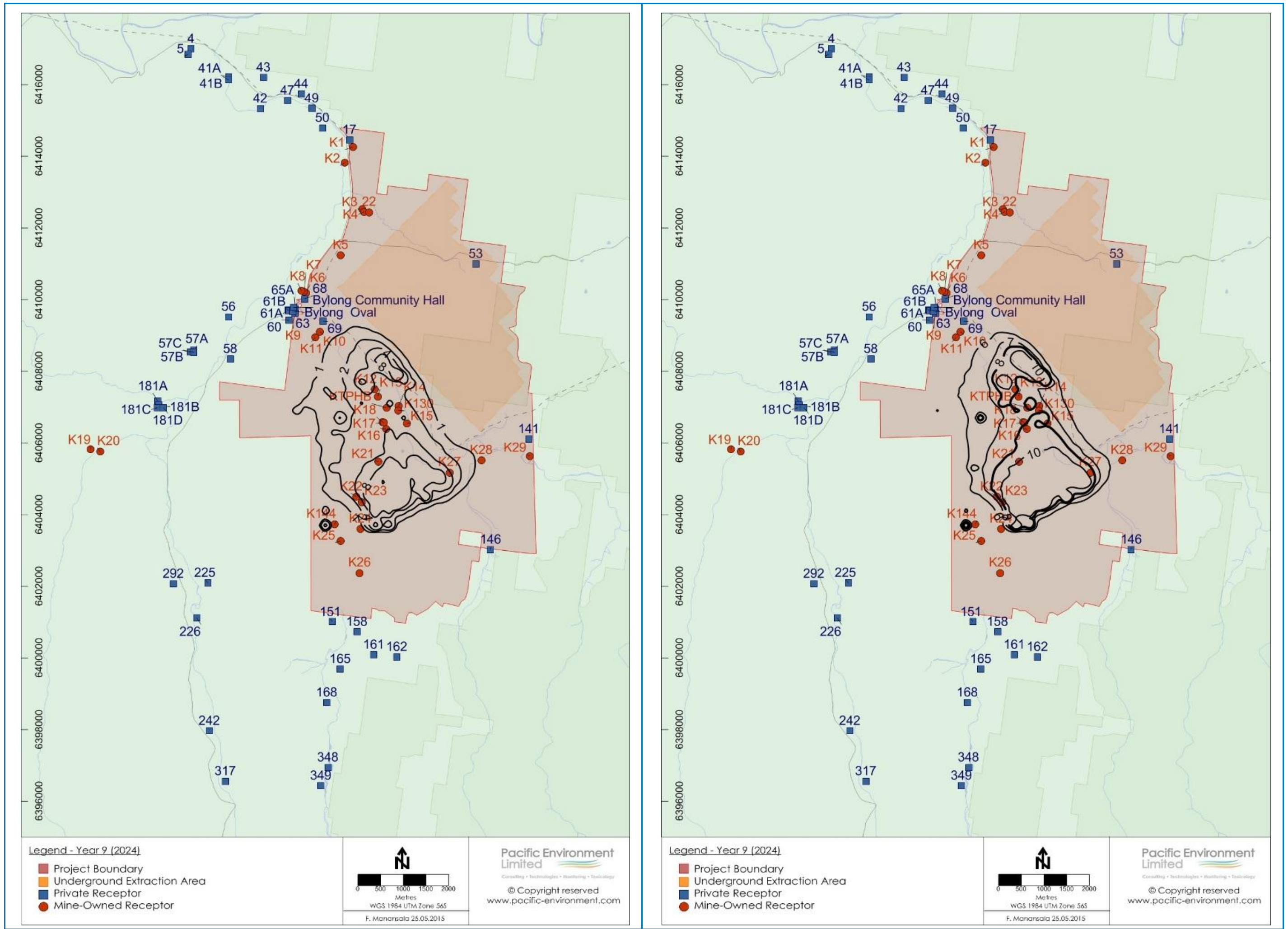


Figure 8.26: Year 9 - Predicted days over 24-Hour $PM_{2.5}$ concentrations



Project Only | Cumulative

Figure 8.27: Year 9 annual average ground level concentrations of PM_{10}



Project Only	Cumulative

Figure 8.28: Year 9 annual average ground level concentrations of $PM_{2.5}$

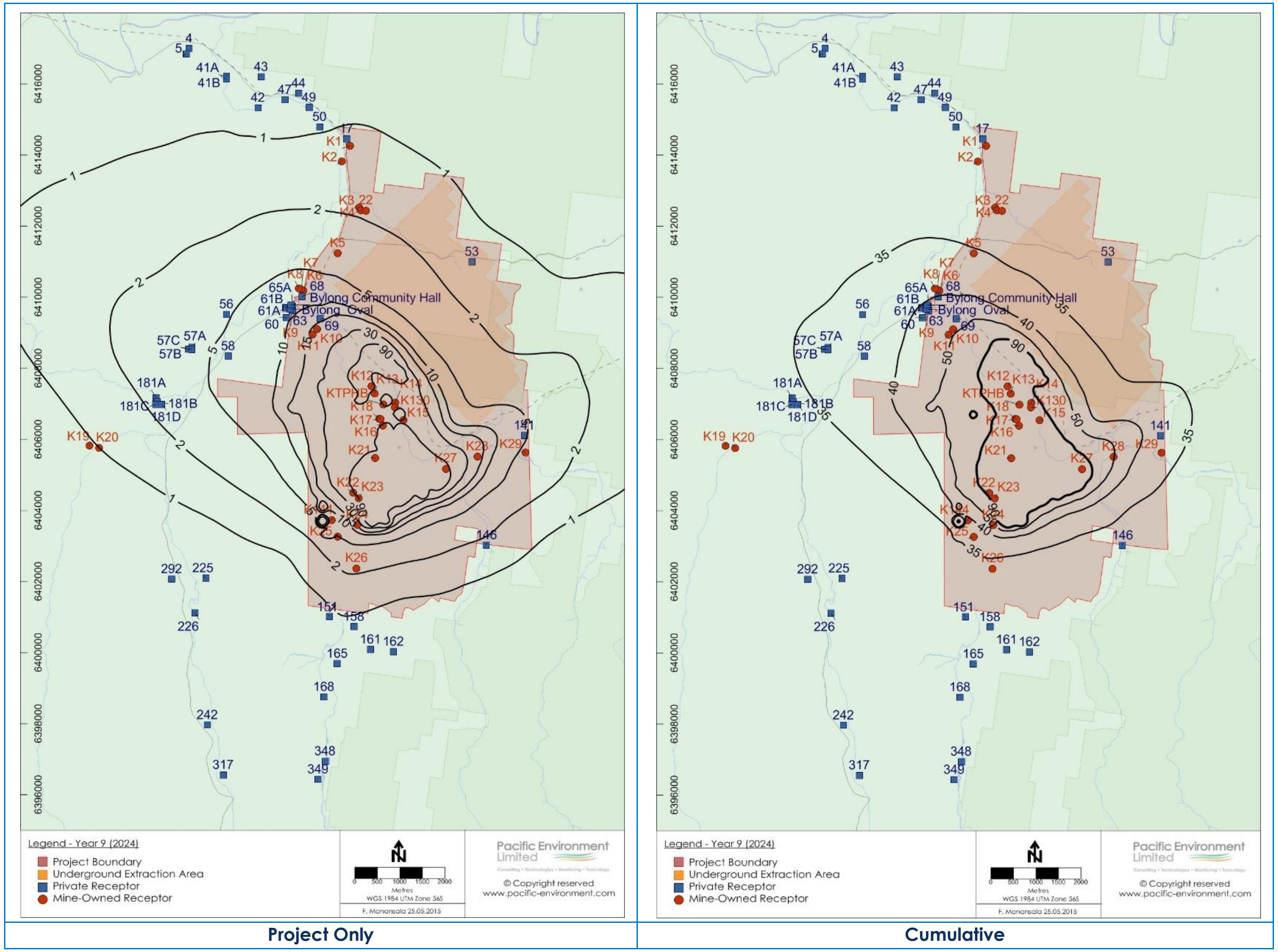
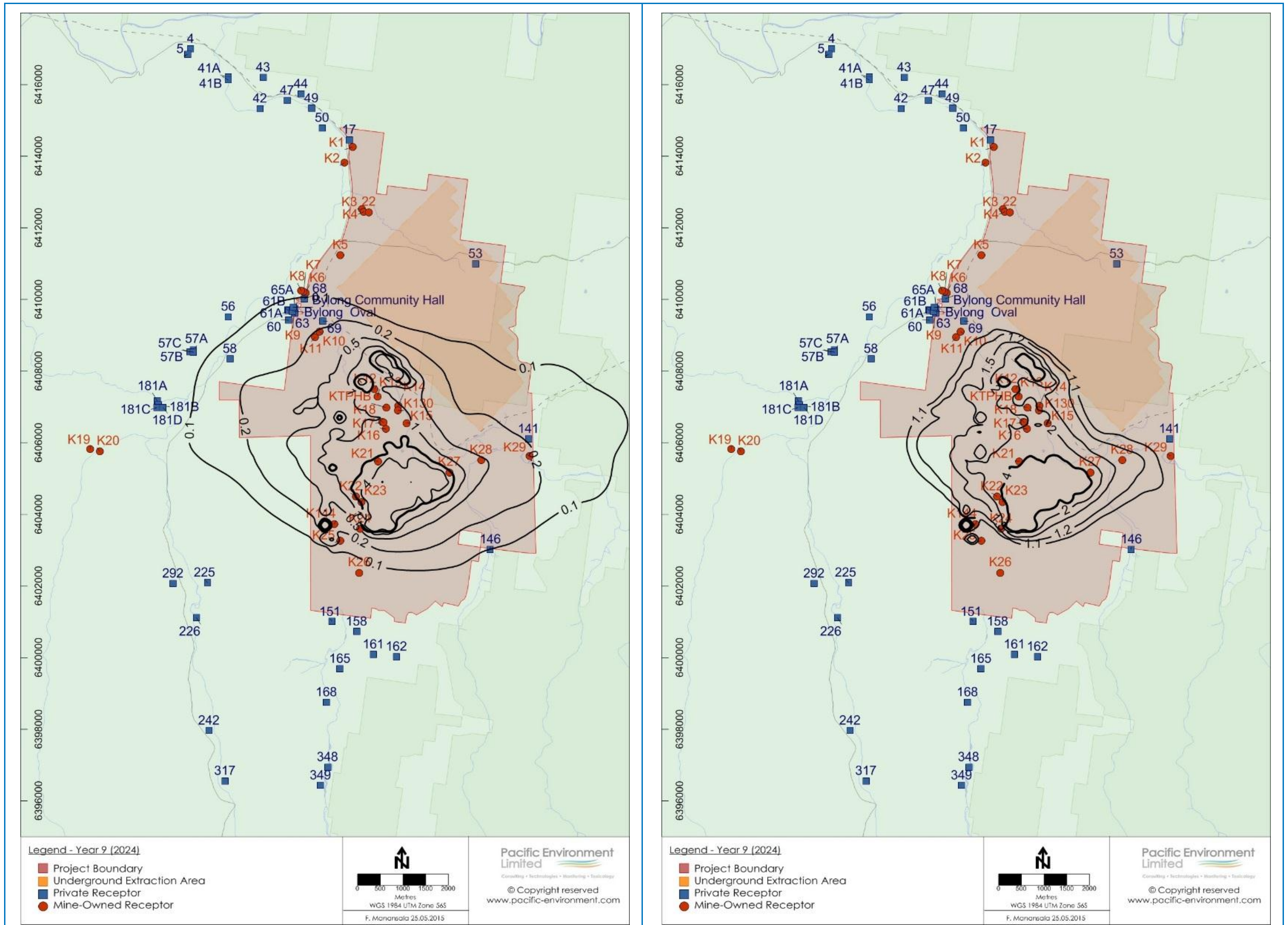


Figure 8.29: Year 9 annual average ground level concentrations of TSP



Project Only	Cumulative

Figure 8.30: Year 9 annual average ground level dust deposition

9 ASSESSMENT OF NO_X FUME FROM BLASTING AND DIESEL

9.1 Introduction

Nitrogen oxides (NO_x) are emitted from the combustion of diesel fuel in mining equipment and from blast fume as a result of the chemical reaction of ammonium nitrate explosives during the blasting process. NO_x principally comprise nitric oxide (NO) and nitrogen dioxide (NO_2). Typically, at the point of emission (e.g. in diesel powered equipment), NO_x would consist of approximately 90-95% NO and 5-10% NO_2. Ultimately, all nitric oxides emitted into the atmosphere are oxidised to NO_2 and to other higher oxides of nitrogen. The rate at which this oxidation takes place depends on prevailing atmospheric conditions including temperature, humidity and the presence of other substances in the atmosphere such as ozone (O_3). It can vary from a few minutes to many hours. The rate of conversion is quite important because from the point of emission to the point of maximum ground level concentration there will be an interval of time during which some oxidation will take place. If the dispersion is sufficient to have diluted the plume to the point where the concentration is very low, it is unimportant that the oxidation has taken place. However, if the oxidation is rapid then high concentrations of NO_2 can occur when inadequate dispersion / dilution conditions exist.

Generally, for plumes close to the source, the time interval for oxidation is not sufficient to have converted a large proportion of the plume to NO_2.

Blasting and diesel combustion also result in fugitive particulate matter emissions. Particulate matter emissions from mining equipment and blasting are included in the dispersion modelling results presented in **Section 8**.

9.2 NO_x emissions from blasting

Blasting explosives predominately use ammonium nitrate/fuel oil (ANFO) throughout the open cut coal mining industry. **Attalla *et al* (2007)** note that there are several variations of the ANFO material but, generally, it is around 94 percent ammonium nitrate and six percent fuel oil (i.e. diesel). Under ideal conditions, the only gaseous products from the explosion are carbon dioxide (CO_2), water (H_2O) and nitrogen (N_2), as shown in Equation 1.

$$3NH_4NO_3 + CH_2 \rightarrow 3N_2 + CO_2 + 7H_2O$$ **Equation 1**

However, even quite small changes in the stoichiometry (either in the bulk material or caused by localised conditions such as moisture in the blast holes, mineral matter or other factors) can result in a less than optimal explosive reaction and lead to the formation of carbon monoxide (CO) and nitric oxide (NO) as shown in Equation 2 and Equation 3.

$$2NH_4NO_3 + CH_2 \rightarrow 2N_2 + CO + 5H_2O$$ **Equation 2**

$$5NH_4NO_3 + CH_2 \rightarrow 4N_2 + 2NO + CO_2 + 7H_2O$$ **Equation 3**

In addition, some of the NO formed may oxidise in the presence of oxygen (O_2) and ozone (O_3) to produce NO_2, as shown in Equation 4 and Equation 5.

$$2NO + O_2 \rightarrow 2NO_2$$ **Equation 4**

$$NO + O_3 \rightarrow NO_2 + O_2$$ **Equation 5**

Section 13.5 outlines management measures that would be implemented to ensure the potential for NO_x formation is minimised.

9.2.1 Blast Fume Impact Assessment

In order to estimate the potential NO_2 concentrations at the private receptors, CALPUFF dispersion modelling was completed for 10 private receptors for Year 5. Year 5 was selected as the 'worst-case' year for modelling in terms of the PM results, extent of mining and proximity to sensitive receptors. The 10 receptors included in the blast modelling were also chosen based on this criteria and are shown in **Figure 9.1** below.

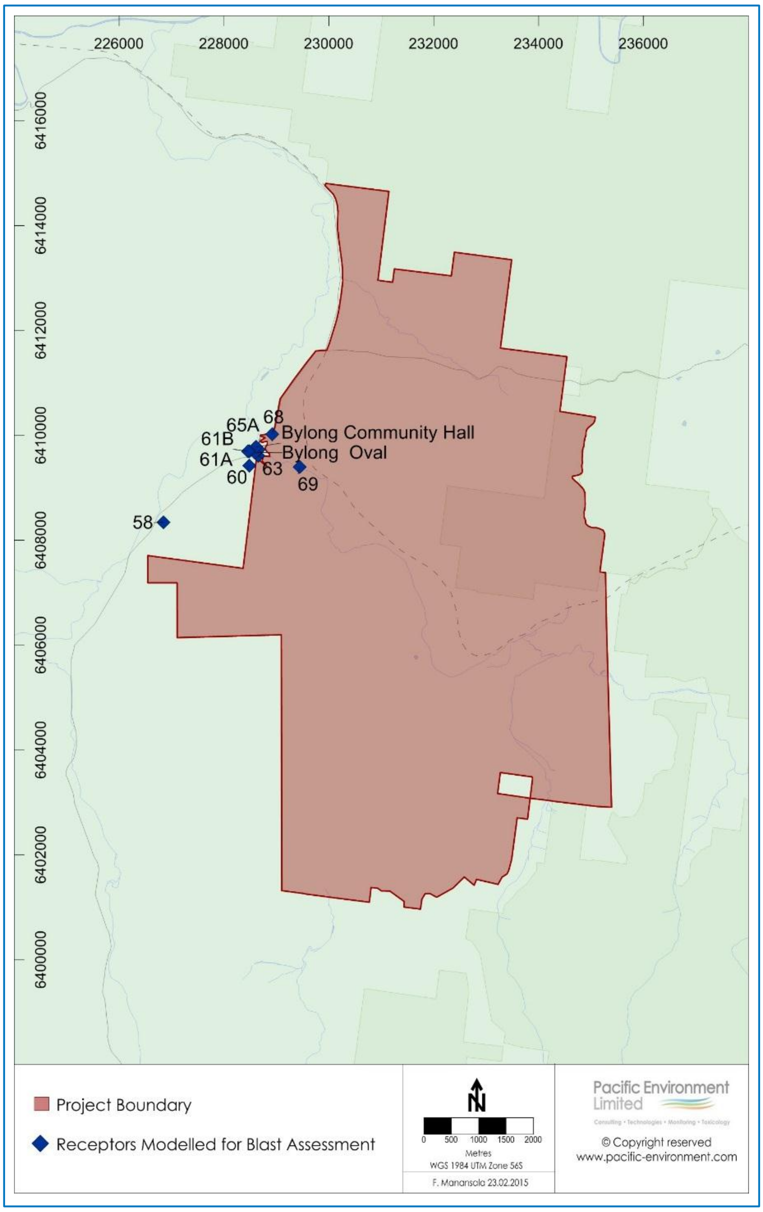


Figure 9.1: Receptors Included in Blast Assessment

The blast size assumed in the modelling (based on data provided by KEPCO and its consultants) is 220 m long by 72 m wide and was modelled as three volume sources (73 m by 73 m each), with a release height of 20 m, and an initial vertical plume spread (sigma z) of 10 m to give an equivalent plume spread of 40 m.

The NO_x emissions from the blast were calculated based on data presented in the Queensland Guidance Note for the management of oxides in open cut blasting (**DEEDI, 2011**). It was conservatively assumed that the initial NO_2 concentration in the plume would be 70 parts per million (ppm) (144 mg/m³) based on the Rating 4 Fume Category in the Queensland Guidance Note. A rating of 4 Fume Category would typically appear as an orange / red plume.

The initial NO_2 concentration in the plume was converted to a total NO_x emission rate based on a detailed measurement program of NO_x in blast plumes in the Hunter Valley made by **Attalla *et al.* (2008)** which found that the NO:NO_2 ratio was typically 27:1, giving a NO_x:NO_2 ratio of approximately 18.6 g NO_x/g NO_2.

Based on a blast fume source dimension of 220 m x 72 m x 40 m, and an emission release of 10-minutes (600s), the emission rate was calculated to be 943.24 g/s per source (see Equation 6). Assuming an average use of 210 tonnes of explosive per blast (**Attalla *et al.* 2008**) this equates to an emission rate of 8.1 kg NO_x/tonne of explosive. This is similar to the current NPI emission factor of 8 kg NOx/tonne of explosive, and higher than the range of 0.04–5.3 kg/ tonne of explosive measured by **Attalla *et al.* 2008**.

Equation 6

$$NO_x\ emission\ rate\ [g/s/source] = volume\ of\ source\ [m^3] \times initial\ NO_2\ concentration\ in\ plume\ \left[\frac{mg}{m^3}\right] \times \frac{1}{1000}\left[\frac{g}{mg}\right] \times \frac{1}{600\ [s]} \times \frac{1}{3\ [sources]} \times 18.6\left(\frac{g\ NO_x}{g\ NO_2}\right)$$

It was assumed that the blast emissions would be present for a 10-minute period and only occur between the hours 9am and 5pm, in line with typical blast hours. It is important to note that the modelling assumes blasting could take place on any day of the week, when in reality blasting may only occur Monday to Friday (and Saturday from 9am to 1pm) and not on public holidays, consistent with ANZECC guidelines and similar project approvals. Thus the modelling conservatively assumes a possible 2,920 hours per year when blasting could occur (8 hours a day, 365 days a year).

9.2.2 Conversion of NO_x to NO_2

A number of approaches to determine the NO_2 concentrations at the representative private receptors are outlined in **NSW EPA (2005)**. For this assessment, the Ozone Limiting Method (OLM) was used. The OLM assumes that at any given receptor location, the amount of NO that is converted to NO_2 by this reaction is proportional to the ambient O_3 concentration. If the O_3 concentration is less than the NO concentration, the amount of NO_2 formed by this reaction is limited. If the O_3 concentration is greater than or equal to the NO concentration, all of the NO is assumed to be converted to NO_2.

This is described by Equation 7 below.

Equation 7

$$NO_{2_{pred}} = \left[0.1 \times NO_{x_{pred}}\right] + MIN\left[\left(0.9 \times NO_{x_{pred}}\right)\ or\ \left(\left(\frac{46}{48}\right) \times O_{3_{bkgd}}\right)\right] + NO_{2_{bkgd}}$$

Where:

$[NO_2]_{pred}$	= predicted NO_2 concentration (µg/m³)
$[NO_x]_{pred}$	= model predicted NO_x concentration (µg/m³)
MIN	= the minimum of the two quantities within the brackets
$[O_3]_{bkgd}$	= ambient O_3 concentration (µg/m³)

(46/48) = molecular weight of NO_2 divided by the molecular weight of O_3

$[NO_2]_{bkgd}$ = background concentration of NO_2 (µg/m^3)

In the equation above, the predicted NO_x concentration is multiplied by 10 percent to account for the assumed thermal conversion of NO_x to NO_2. The remaining 90 percent of the modelled NO_x (assumed to be NO) reacts with the background O_3 concentration to determine the quantity of NO that is converted to NO_2. The background concentration of NO_2 is then added to this concentration to give the total predicted NO_2 value.

It is important to note that O_3 only forms when there are sufficient concentrations of NO and volatile organic compounds (VOCs), adequate sunlight, and high enough temperatures to allow the photochemical reactions to occur. Elevated O_3 concentrations occur when dispersion of the resulting pollution is constrained by meteorological conditions and local topography. There are no O_3 monitoring data collected near the site, and while EPA data collected in the Sydney and Illawarra regions do sometimes exceed the relevant air quality criteria, in the Lower Hunter there have been only two exceedances of the 1-hour O_3 criteria since 1999 (as of August 2010) (**DECCW 2010**).

NO_2 is primarily a result of fuel combustion (i.e. motor vehicles and industry). There are no NO_2 monitoring data collected near Bylong and while exceedances of the 1-hour NO_2 criteria were common in Sydney during the 1980s, they have not been exceeded there since 1988 and levels in the Illawarra and Lower Hunter are even lower (**DECCW, 2010**). It would be expected that levels near the site would be significantly below the criteria.

The closest EPA monitoring station that collects NO_2 is located in Muswellbrook, however, the station does not collect O_3 data, and only started operating in November 2011. As the meteorological data used in the blast fume emissions assessment covers the period November 2010 to October 2011, and both NO_2 and O_3 data are required, the hourly data from the Wallsend OEH monitoring station were used.

9.2.3 Results

Table 9.1 and **Table 9.2** present the maximum predicted NO_2 concentrations at each sensitive receptor due to blasting. The results shown are separated by each pit operating in Year 5 as there would only be one blast at any given time at the mine.

There are no receptors predicted to experience NO_2 concentrations above the 1-hour impact assessment criterion of 246 µg/m^3. The highest maximum predicted 1–hour NO_2 concentration is 62 µg/m^3 at R58 in the Western Open Cut and 54 µg/m^3 at the same receptor in the Eastern Open Cut. The results also show that at most receptors, the contribution from the mine is 0 which shows that the background is the dominant factor in the cumulative analysis. Where the mine contribution is higher than the background, these receptors are located closest to blasting activities.

Table 9.1: Maximum predicted 1-hour NO_2 concentrations to occur due to blasting operations in Year 5 at the Eastern Open Cut

Receptor ID	Year 5 Eastern Open Cut Maximum NO_2 Concentrations (µg/m³)		
	Project Only	Background	Cumulative
Impact Assessment Criterion = 246 µg/m³			
Private Receptor			
R58	19	35	54
R60	0	45	45
R61A	0	45	45
R61B	0	45	45
R65A	0	45	45
R65B	0	45	45
R68	0	45	45
R69	0	45	45
Bylong Oval	0	45	45
Bylong Community Hall	0	45	45

Table 9.2: Maximum predicted 1-hour NO_2 concentrations to occur due to blasting operations in Year 5 at the Eastern Open Cut

Receptor ID	Year 5 Western Open Cut Maximum NO_2 Concentrations (µg/m³)		
	Project Only	Background	Cumulative
Impact Assessment Criterion = 246 µg/m³			
Private Receptor			
R58	43	18	62
R60	28	21	49
R61A	0	45	45
R61B	0	45	45
R65A	0	45	45
R65B	0	45	45
R68	0	45	45
R69	38	21	59
Bylong Oval	0	45	45
Bylong Community Hall	0	45	45

9.3 Diesel Fume Assessment

The diesel fume assessment addresses predicted emissions of NO_2 concentrations as this is the main pollutant of concern from vehicle emissions. Emissions of carbon monoxide (CO), and sulphur dioxide (SO_2) will occur from diesel-powered equipment used on-site; however these emissions are typically minor and too widely dispersed to give rise to significant off-site concentrations. It is noted that as the AP-42 emission factors used in the dust assessment of this project include particulate emissions from diesel, a separate assessment of PM emissions has not been completed in the diesel assessment as it would be considered double-counting of these emissions (**Chatten Cowherd 2015, pers. comm, 12 March 2015**).

Estimates for diesel exhaust emissions are based on the Project's estimated diesel consumption for Year 5 as this year has the highest equal diesel consumption and mining activities are also closest to private receptors in Bylong Village. The US-EPA Tier 2 NO_x emissions standard of 30.36 kg/kL for non-road diesel was applied. **Environ (2010)** reports that approximately 70% of industrial diesel engines in Australia (as of 2008) were compliant with Tier 2 or higher. Only 9% were compliant with the more stringent US-EPA Tier 4 standards. Therefore the use of Tier 2 emission standards to derive emissions rates for a future mining operation is a reasonable and conservative approach.

Modelling results for 1-hour and annual average NO_2 are presented in **Table 9.3** and show that there are no predicted exceedances of the 1-hour impact assessment criteria (246 µg/m³) or annual average impact assessment criteria (62 µg/m³) at private or mine-owned receptor locations. The highest predicted 1-hour NO_2 concentration is 92 µg/m^3 at receptor 69 and the highest annual average prediction is 23 µg/m^3 at the same receptor.

This includes background NO_2 contribution (from the urban background OEH Wallsend monitoring data *http://www.environment.nsw.gov.au/AQMS/search.htm*). It is also noted that given the Wallsend site's location adjacent to a major residential area of Newcastle, in close proximity to major roads and industrial and commercial activities, the use of monitoring data from the OEH monitoring site at Wallsend for background NO_2 and O_3 levels provides an overestimation and is considered to be highly conservative of the background concentrations within the Bylong area. This approach adds to the conservative nature of the predictions.

Table 9.3: Maximum 1-hour and annual average NO_2 concentrations (μg/m³) from diesel combustion at selected receptors in worst case year (Year 5)

Receptor ID	Maximum 1-hr NO_2 concentration (μg/m³)	Annual average NO_2 concentration (μg/m³)
	Impact Assessment Criteria (μg/m³)	
	246	*62*
Private Receptors		
58	83	19
60	88	21
61A	89	21
61B	89	21
65A	89	21
65B	89	21
68	90	21
69	92	23
Bylong Oval	89	21
Bylong Community Hall	89	21

9.4 Cumulative NO_2 impacts

A cumulative assessment of NO_2 impacts to receptors due to blast fumes, diesel fumes and background concentrations was completed. **Table 9.4** presents the maximum predicted NO_2 concentrations at each sensitive receptor due to blasting, diesel and with background NO_2 concentrations included.

This assessment found that there are no private receptors predicted to experience NO_2 concentrations above the 1-hour impact assessment criterion of 246 µg/m^3 when considered cumulatively. The highest maximum predicted cumulative NO_2 concentration at a private receptor is 94 µg/m^3 at receptor 58 in the Eastern Open Cut and 92 µg/m^3 at receptor 69 in the Western Open Cut.

Table 9.4: Maximum Predicted NO_2 concentrations to occur due to diesel and blasting (including background NO_2)

Receptor ID	Year 5 Eastern Open Cut	Year 5 Western Open Cut
	Maximum 1-hour NO_2 Concentrations (µg/m^3)	
Impact Assessment Criterion = 246 µg/m^3		
58	94	82
60	90	88
61A	89	89
61B	89	89
65A	89	89
65B	89	89
68	90	90
69	92	92
Bylong Oval	89	89
Bylong Community Hall	89	89

10 COAL TRANSPORTATION

The Project will involve the construction and operation of a Rail Loop and associated Load-out Facility to facilitate the transportation of coal by rail to the Port of Newcastle. Dust emissions associated with train loading have been included as part of the modelling assessment of mining operations as described in **Section 7**. Potential impacts from the fugitive dust emissions from coal wagons and diesel emissions from engines during rail transportation have not been quantitatively assessed within the modelling assessment and are discussed below.

To ensure fugitive dust emissions from coal transportation are kept to a minimum, KEPCO are committed to water spraying of the coal surface during train loading, as well as best practice load profiling. A recent study of dust emissions from rail transport at Duralie Coal mine found that the water spray system in place at the train loading facility was very effective in controlling dust emissions from rail transport, achieving 99% control of emissions (**Katestone, 2012a**).

Recent studies completed for the Australian Rail Track Corporation (ARTC), assessed particulate emissions from coal trains (**Environ, 2012** and **Katestone, 2012b**). Both studies investigated particulate matter (PM) emissions from coal trains (loaded and unloaded) compared with emissions from passenger and freight trains. The Environ study found that at one site there was no statistical difference in concentrations across all particulate size fractions for all train types. At the other site, it was concluded that concentrations coinciding with loaded and unloaded coal train passes are statistically higher for PM_{10}, but not other size fractions, compared with concentrations recorded during passenger train passes. There was no statistical difference between loaded coal train and unloaded coal trains.

The **Katestone 2012b** study concluded that loaded coal trains were not associated with a statistically significant difference in PM_{10} and $PM_{2.5}$ compared with concentrations when no train passed. Unloaded coal trains were associated with a statistically significant difference in PM_{10} and $PM_{2.5}$ compared with concentrations when no train passed.

A subsequent re-analysis of the data collected for **Katestone 2012b** (**Ryan and Wand, 2014**) found evidence that that particulate levels were elevated when all train types passed by the monitoring station, with the strongest correlation for loaded and unloaded coal trains, for all particle size fractions. **Ryan and Wand (2014)** note that since coal dust is likely to reflected in the larger particle counts (TSP and PM_{10}) this finding suggests that other contaminants such as diesel may be of more concern that coal dust.

For both studies, PM concentrations were recorded at short distances from the track and for short averaging periods to coincide train passes, therefore no quantification of impact at residential areas can be inferred from the studies. Notwithstanding this, KEPCO is committed to making sure exposed coal in loaded wagons is moistened when loaded to minimise the potential for wind erosion.

To put the potential fugitive emissions from loaded coal trains into context, an estimate has been made as to the levels of PM that may occur. Assuming a loaded train contains a maximum of 90 wagons, each 16.1 m in length and 2 m in width, the total surface area of exposed coal would be just under 2,900 m^2 (0.29 ha). **Katestone (2012a)** suggests that if the product is watered as it is loaded to trains, then emissions can be controlled by up to 99%. Assuming a conservative control factor of 50% (allowing time for the coal to dry somewhat en-route to Newcastle), and an emission factor of 0.1 kg/ha/y (**USEPA, 1985**), then the total windblown TSP emissions from loaded coal trains may be of the order of 125 kg/y. Even if no control factor was taken into account this would be approximately 250 kg/y (TSP), which constitutes less than 0.01 % of the total annual emissions for the worst-case operational year (Year 5), calculated in **Section 7** and would be spread across a large area between Bylong and Newcastle. Any resulting ground level concentrations due to this source would therefore be extremely low. Emissions from loaded coal trains are not considered further in this assessment.

In summary, the rail load out facility would be designed such that:

- Load size is limited to ensure coal deposited into wagons is profiled such that it avoids overfilling and spillage.
- Loading is such that a consistent profile is maintained.

As noted in **Ryan and Wand (2014),** the findings suggests that other contaminants, such as the products of combustion due to the use of diesel in the locomotives, may be of more concern than coal dust. Australia currently has no national exhaust standards for new or re-manufactured locomotives. In order to start addressing this, the NSW EPA published a Diesel and Marine Emissions Strategy (the Strategy) in January 2015 (**NSW EPA, 2015**). The Strategy has the objective to '*progressively control and reduce diesel and marine emissions from priority sectors – shipping, locomotives and non-road equipment used by EPA- licensed activities*'.

The Strategy sets out actions that the EPA has implemented and further steps it is taking to ensure that NSW benefits from the availability of feasible and cost-effective approaches and technologies to reduce non-road diesel and marine emissions. With respect to rail locomotives, the Strategy sets the following goals:

- Investigate feasibility and support adoption of new emissions controls for locomotives
- Update the NSW regulatory framework to ensure accountability of diesel locomotive operators for improved emissions performance.

Table 10.1 presents a summary of the goals, associated milestones and the timing for implementation.

Table 10.1: Strategy overview for locomotives

Focus area	Goals	Milestones	Timing
Rail – locomotives and rail construction	■ Investigate feasibility and support adoption of new emissions control technology for locomotives.	■ Proposed change to Schedule 1 of POEO Act.	■ 2nd quarter 2015
		■ Pilot locomotive emission upgrade program	■ Complete by 3^{rd} quarter 2015
	■ Update NSW regulatory framework to ensue accountability of diesel locomotive operators for improved emissions performance.	■ Licensing of rolling stock operators and of rail construction activities as separate scheduled activities	■ Expected to commence 4^{th} quarter 2015

11 SPONTANEOUS COMBUSTION

Spontaneous combustion occurs when coal and other carbonaceous materials undergo oxidation and generate heat. Under the right conditions, the heat from the oxidation reaction can build-up to a point where the coal and contaminated overburden materials will ignite and burn. For self-heating to occur, the composition of the coal must be such that low temperature oxidation can occur. Further, the material must be confined in such a way that heat from the oxidation is trapped, allowing the temperature to build-up, but not so confined as to preclude the ingress of oxygen to the combustible material at a rate sufficient to promote the combustion and release of heat energy. Once the coal reaches a high enough temperature it will liberate smoke (fine particulate matter), steam and volatile organic compounds (VOCs), some of which are odorous and some of which can be harmful in high concentrations.

A spontaneous combustion assessment of core samples from Project has been conducted (**CB3, 2013**). The assessment concluded the risk of spontaneous combustion can be reduced to a level defined as "*as low as reasonably possible*" by implementing appropriate controls. The assessment of coal physical properties and site specific factors demonstrates that the risk of coal self-heating can be moderated significantly and appropriate controls will be identified as part of a Spontaneous Combustion Management Plan for the Project.

The issue of spontaneous combustion will continue to be evaluated and managed as part of the Project. This will involve the inclusion of testing for areas prone to spontaneous combustion within the routine geochemical sampling and testing program. Measures to minimise oxygen exposure to potentially susceptible material will include:

- Co-disposal with overburden and capping of coarse and fine emplacement areas and placement at depth within the final landform.
- Selectively handling and burying at depth, overburden material that is identified as being prone to spontaneous combustion to prevent exposure of this material.
- Inspection regimes for coal stockpiles, reject areas and coal conveyance areas.
- Maintenance and removal of fine coal build up around coal transfer points.

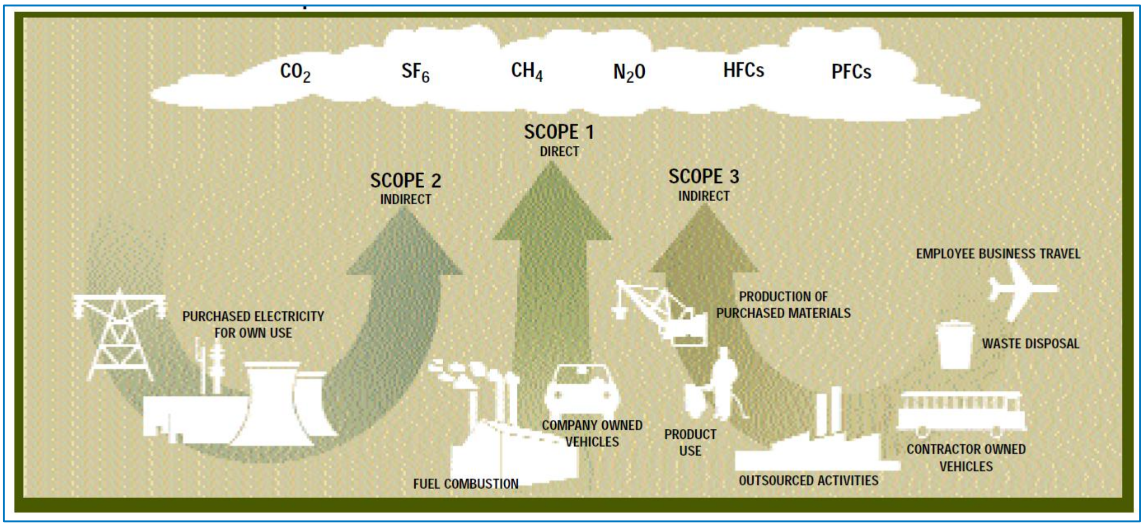
12 GREENHOUSE GAS ASSESSMENT

12.1 Introduction

Greenhouse gas (GHG) emissions have been estimated based on the methods outlined in the following documents:

- The World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD) Greenhouse Gas Protocol *The Greenhouse Gas Protocol – A Corporate Accounting and Reporting Standard Revised Edition* (**WRI/WBCSD, 2004**).
- National Greenhouse and Energy Reporting (Measurement) Amendment Determination 2014 (No. 1).
- The Australian Government Department of the Environment (DoE) National Greenhouse Accounts (NGA) Factors 2014 (**DoE, 2014**).

The GHG Protocol establishes an international standard for accounting and reporting of GHG emissions. The GHG Protocol has been adopted by the International Standard Organisation, endorsed by GHG initiatives (such as the Carbon Disclosure Project) and is compatible with existing GHG trading schemes. Three 'scopes' of emissions (scope 1, scope 2 and scope 3) are defined for GHG accounting and reporting purposes, as described below and in **Figure 12.1**. This terminology has been adopted in Australian GHG reporting and measurement methods and has been employed in this assessment. The 'scope' of an emission is relative to the reporting entity. Indirect scope 2 and scope 3 emissions would be reportable as direct scope 1 emissions from another facility.



Source: Figure 3, WRI/WBCSD, 2004

Figure 12.1: Overview of scopes and emissions across a reporting entity

12.2 Greenhouse Gas Emission Estimates

Project-related GHG sources included in the assessment are as follows:

Scope 1:

- Fuel consumption (diesel) during mining operations and construction.
- Release of fugitive CH_4 during and post mining.

Scope 2:

- Indirect emissions associated with purchased electricity brought into the organisational boundary to supplement the on-site electricity generation.

Scope 3:

- Indirect emissions associated with the production and transport of fuels.
- Emissions from coal transportation.
- Emissions from the use of the product coal.

Emissions of CO_2 and CH_4 comprise the most significant GHGs for the Project. These gases are formed and released during the combustion of fuels used on site and from fugitive emissions occurring during the mining process, due to the liberation of CH_4 from coal seams.

Different gases have the potential to contribute to atmospheric warming to varying degrees due to the variation in their chemical structures. This is referred to as global warming potentials, or GWPs. Emission factors take into account the GWPs of the gases created during combustion. The estimated emissions are referred to in terms of carbon dioxide-equivalent (CO_2-e) emissions by applying the relevant GWP. Inventories of GHG emissions can be calculated using published emission factors. The GHG assessment has been conducted using the NGA Factors, published by the **DoE (2014)**.

A summary of the annual GHG emissions is provided in **Table 12.1**. Full details of all calculations are provided in **Appendix C**.

Table 12.1: Summary of Annual Greenhouse Gas Emissions

	Scope 1 Emissions ($t\ CO_2$-e)				Scope 2 Emissions ($t\ CO_2$-e)	Scope 3 Emissions ($t\ CO_2$-e)				
Year	Diesel	Coal Seam Methane	Blasting	*Total*	Electricity	Diesel	Electricity	Use of Thermal Coal	Rail	*Total*
Construction										
Y1	17,009	0	13	*17,022*	0	1,290	0	0	0	*1,290*
Y2	17,009	0	0	*17,009*	0	1,290	0	0	0	*1,290*
Operation										
Y3	55,996	50,086	17	*106,099*	16,677	4,246	2,521	5,663,004	7,105	*5,676,876*
Y4	72,463	53,983	68	*126,514*	16,207	5,494	2,450	7,234,450	9,076	*7,251,470*
Y5	79,243	68,315	340	*147,897*	20,467	6,008	3,094	9,850,905	12,359	*9,872,366*
Y6	84,166	65,231	1,037	*150,434*	21,780	6,382	3,292	9,511,723	11,933	*9,533,330*
Y7	85,692	69,128	1,598	*156,418*	34,543	6,497	5,222	10,151,781	12,736	*10,176,236*
Y8	83,613	57,381	1,581	*142,575*	27,514	6,340	4,159	8,349,262	10,475	*8,370,236*
Y9	73,880	81,182	1,683	*156,745*	66,125	5,602	9,996	10,101,630	12,673	*10,129,900*
Y10	40,183	62,023	714	*102,921*	57,171	3,047	8,642	9,153,169	11,483	*9,176,341*
Y11	4,360	70,533	0	*74,893*	70,739	331	10,693	9,178,335	11,515	*9,200,874*
Y12	4,430	75,456	0	*79,886*	75,579	336	11,425	10,074,918	12,640	*10,099,318*
Y13	4,411	74,086	0	*78,497*	74,229	334	11,221	9,966,014	12,503	*9,990,072*
Y14	4,260	62,740	0	*67,001*	61,656	323	9,320	9,243,300	11,596	*9,264,539*
Y15	4,384	70,563	0	*74,947*	68,615	332	10,372	10,986,071	13,783	*11,010,558*
Y16	4,401	70,133	0	*74,534*	66,234	334	10,012	11,111,530	13,940	*11,135,816*
Y17	4,188	57,108	0	*61,296*	55,289	318	8,358	8,657,888	10,862	*8,677,425*
Y18	4,391	78,641	0	*83,032*	77,923	333	11,779	8,010,038	10,049	*8,032,199*
Y19	4,333	67,932	0	*72,264*	67,136	329	10,149	7,400,389	9,284	*7,420,150*
Y20	4,341	68,615	0	*72,956*	67,901	329	10,264	7,360,851	9,235	*7,380,679*
Y21	4,308	66,457	0	*70,765*	65,932	327	9,966	7,298,587	9,157	*7,318,037*
Y22	4,263	69,714	0	*73,977*	68,971	323	10,426	8,192,939	10,279	*8,213,967*
Y23	4,420	73,639	0	*78,058*	72,455	335	10,952	9,056,518	11,362	*9,079,167*
Y24	4,194	59,020	0	*63,215*	59,174	318	8,945	6,793,464	8,523	*6,811,249*
Y25	4,344	74,724	0	*79,067*	74,102	329	11,202	9,132,511	11,457	*9,155,500*
Total	**674,284**	**1,546,689**	**7,051**	**2,228,023**	**1,286,419**	**51,126**	**194,459**	**202,479,277**	**254,023**	**202,978,885**

12.3 Impact on the Environment

According to the Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report, global surface temperature has increased by 0.89°C ± 0.2°C during the 100 years ending 2012 (**IPCC, 2013**). The IPCC has determined "most of the observed increase in globally averaged temperatures since the mid-twentieth century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations". "Very likely" is defined by the IPCC as greater than 90% probability of occurrence (**IPCC, 2013**).

Climate change projections specific to Australia have been determined by the CSIRO and the Australian Bureau of Meteorology (BoM), based on global emissions scenarios predicted by the latest IPCC assessment (**CSIRO, 2015**). These projections supersede those released by CSIRO and the BoM in 2007. Although the findings are similar to those of the 2007 projections, the range of emissions scenarios is broader than those used for the 2007 projections. The latest projections begin with concentration levels, rather than socio-economic assumptions followed by inferred emissions.

The projected changes have been prepared for four Representative Concentration Pathways (RCPs), which represent the following scenarios for emissions of greenhouse gases, aerosols and land-use change, relative to the 1996-2005 period:

- RCP8.5 (high emissions) - represents a future with little curbing of emissions, with CO_2 concentrations continuing to rapidly rise, reaching 940 parts per million (ppm) by 2100.
- RCP6.0 (intermediate emissions) - represents lower emissions, achieved by application of some mitigation strategies and technologies. This scenario results in the CO_2 concentration rising less rapidly than RCP8.5, but still reaching 660 ppm by 2100.
- RCP4.5 (intermediate emissions) - represents a similar scenario to RCP6.0, but emissions peak earlier (around 2040), and the CO_2 concentration reaches 540 ppm in 2100.
- RCP2.6 (low emissions) -assumes a very strong emissions reductions from a peak at around 2020 to reach a CO_2 concentration at about 420 ppm by 2100. This pathway would require early participation from all emitters, including developing countries, as well as the application of technologies for actively removing carbon dioxide from the atmosphere.

For climate change projections, a regionalisation scheme using natural resource management regional boundaries has been used to divide Australia up into 8 clusters and 15 sub-clusters. For the projections described above, **Table 12.2** presents the changes in annual temperature relative to the 1986-2005 period for the east coast south sub-cluster in which the Project is located.

Table 12.2: Projected Changes in Annual Temperature (relative to the 1986-2005 period)

2030 – RCP2.6 (low emissions scenario)	2030 –RCP4.5 (intermediate emissions scenario)	2030 – RCP8.5 (high emissions scenario)	2090 – RCP2.6 (low emissions scenario)	290 – RCP4.5 (intermediate emissions scenario)	2090 – RCP8.5 (high emissions scenario)
Temperature (°C)					
0.7 (0.5 to 1.1)	0.9 (0.6 to 1.1)	1 (0.7 to 1.3)	1 (0.6 to 1.5)	1.8 (1.3 to 2.5)	3.7 (2.9 to 4.6)

Notes: The table gives the median (50th percentile) change with the 10th and 90th percentile range given within brackets.
RCP6.0 is not included due to a smaller sample of model simulations available compared to the other RCPs. (CSIRO, 2015).
Source: CSIRO (2015) Climate Change in Australia – Technical Report 2015, Commonwealth Scientific and Industrial Research Organisation.

The CSIRO also details projected changes to other meteorological parameters (for example rainfall, potential evaporation, wind speed, relative humidity and solar radiation) and the predicted changes to the prevalence of extreme weather events (for example droughts, bush fires and cyclones). The potential social and economic impacts of climate change to Australia are detailed in the Garnaut Climate Change Review (**Garnaut, 2008**), which draws on IPCC assessment work and the CSIRO climate projections. The Garnaut review details the negative and positive impacts associated with predicted climate change with respect to agricultural productivity, water supply infrastructure, urban water supplies, buildings in coastal settlements, temperature related deaths, ecosystems and biodiversity.

The Project's contribution to projected climate change, and the associated impacts, would be in proportion with its contribution to global GHG emissions. Average annual scope 1 emissions from the Project (0.09 million tonnes [Mt] CO_2-e) would represent approximately 0.02% of Australia's commitment under the Kyoto Protocol (591.5 Mt CO_2-e) and a very small portion of global greenhouse emissions, given that Australia contributed approximately 1.25% of global GHG emissions in 2012 (**PBL Netherlands Environmental Assessment Agency, 2013**). A comparison of predicted annual GHG emissions from the Project with global, Australian and NSW emissions inventories are presented in **Table 12.3**.

Table 12.3: Comparison of Greenhouse Gas Emissions

Geographic coverage	Source coverage	Timescale	Emissions Mt CO_2-e	Reference
Project	Scope 1 only	Average annual	0.09	This report.
Global	Consumption of fossil fuels	Total since industrialisation 1750 – 1994	865,000	IPCC (2007a). Figure 7.3 converted from Carbon unit basis to CO_2 basis. Error is stated greater than ±20%.
Global	CO_2-e emissions	2012	34,500	PBL Netherlands Environmental Assessment Agency, 2013
Global	CO_2-e emission increase 2011 to 2012	2012	500	PBL Netherlands Environmental Assessment Agency, 2013.
Australia	1990 Base	1990	547.7	United Nations Framework on Climate Change – Kyoto Protocol base year data http://unfccc.int/ghg_data/kp_data_unfccc/base_year_data/items/4354.php
Australia	Kyoto target	Average annual 2008 – 2012	591.5	Based on 1990 net emissions multiplied by 108% Australia's Kyoto emissions target.
Australia	Total	2012	554.6	Taken from the National Greenhouse Gas Inventory 2012 http://www.environment.gov.au/system/files/resources/6b894230-f15f-4a69-a50c-5577fecc8bc2/files/national-inventory-report-2012-vol1.pdf
NSW	Total	2011/12	154.7	Taken from the State and Territory National Greenhouse Gas Inventory (2011/12) http://www.environment.gov.au/system/files/resources/255447ab-3c51-412e-9756-921ef23cb8aa/files/state-territory-inventories-11-12.pdf

The commitment from the Australian Government to reduce GHG emissions is proposed to be achieved through the introduction of the Australian Government's proposed *Direct Action Plan*. The centrepiece of the plan is Emissions Reduction Fund which will provide incentives for emissions reduction activities across the Australian economy.

12.4 Greenhouse Gas Emissions Intensity

The estimated Scope 1 GHG emissions intensity of the Project is approximately 0.02 t CO_2-e/t saleable coal. The estimated emissions intensity of the Project are at the lower end of emissions intensity of open cut and underground coal mines in Australia (**Deslandes, 1999**). **Figure 12.2** (derived from Deslandes, 1999) shows the GHG intensity of the Project compared to other Australian coal mines.

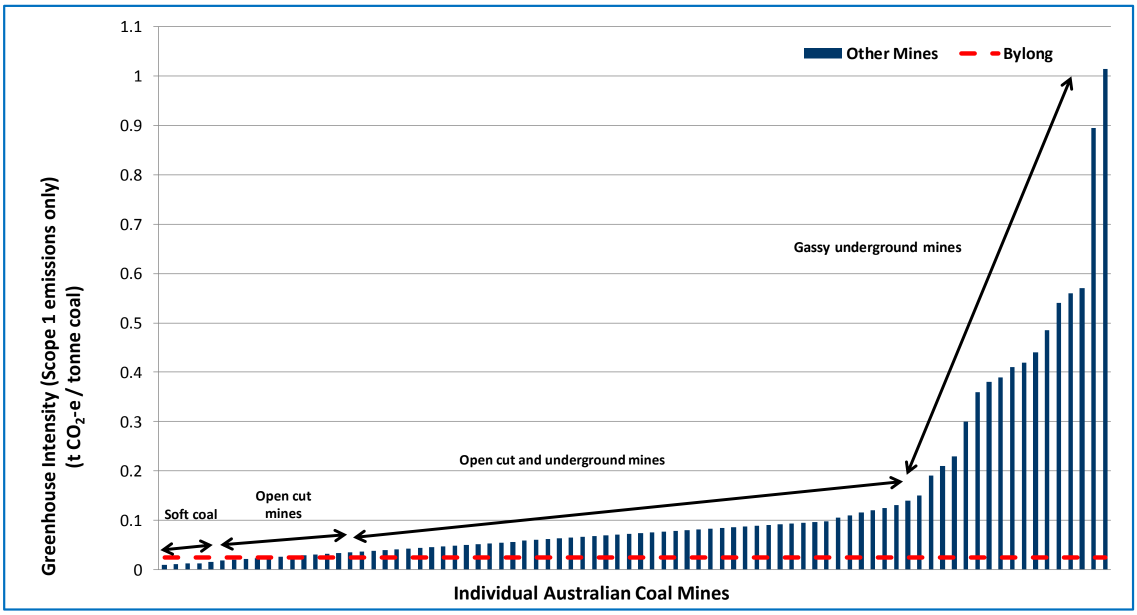


Figure 12.2: GHG Intensity Comparison

12.5 Project Greenhouse Gas and Energy Reduction Measures

The Project will develop an Energy and Greenhouse Gas Management Plan which will describe a number of reasonable and feasible measures to be implemented to minimise GHG emissions from the Project. Measures to be considered in an Energy and Greenhouse Gas Management Plan are outlined in **Table 12.4**.

Table 12.4: Potential GHG and energy efficiencies measures

Type of Mitigation	Description
Creation of mine plan	■ Maximising energy efficiency is a key consideration in the development of the mine plan. For example, significant savings of GHG emissions (through increased energy efficiency) can be achieved by mine planning decisions which minimise haul distances and therefore fuel usage.
Mining operations	■ Investigation of options for capture and treatment of fugitive methane emissions from underground mine ventilation. ■ Sealing of underground mining panels to reduce methane emissions from the goaf. ■ Use of ventilation control devices in sections of the mine not in active use enabling them not to be ventilated (unless required for safety purposes), thereby reducing fugitive emissions.
Monitoring	■ Use of real-time gas (methane and carbon dioxide), temperature, pressure and associated volumetric flow monitoring at the ventilation shaft site to allow accurate measurement of ventilation (including methane and carbon dioxide) emissions, which will then allow further feasibility assessment of reuse options.
Recording	■ Ensuring maintenance, calibration and record keeping is undertaken on the main ventilation shaft and fans to allow for the calculation of greenhouse gas emissions. ■ Maintaining records for monthly electricity and diesel use and monthly ROM coal production to allow for the calculation of greenhouse gas emissions.

13 MANAGEMENT AND MONITORING

13.1 Construction Dust Management

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 of portal and ventilation shafts and stockpiling of excavated material.
- Excavated material handling, shaping, and bund construction.
- Movement of heavy plant and machinery within the site.
- Graders / scrapers working on access road construction.
- Wind erosion from exposed surfaces.
- Blasting associate infrastructure.

Procedures for controlling dust impacts during construction will include, but are not necessarily be limited to those described in the following sections.

13.1.1 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:

- Modification of 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, where possible.
- When conditions are excessively dusty and windy, and dust can be seen leaving the works site, the increased use of a water truck (for water spraying of exposed surfaces) should be considered.

13.1.2 Road construction

The use of earth moving equipment can be significant source of dust generation, 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 or a water truck should be considered.

13.1.3 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. Controls that will be considered for this type of dust generation are:

- 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 increased use of a water truck (for water spraying of travel routes) should be considered.

- Sealing the main access roads as soon as practical.

13.1.4 Wind Erosion

Wind erosion from exposed ground should be limited by avoiding unnecessary vegetation clearing and ensuring that rehabilitation is undertaken 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. 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) should be considered.

13.2 Operational Dust Control

Sources of emissions during operation of the Project are described in **Section 7** and the proposed management measures are outlined in **Section 7.1**. Based on the predicted impacts from the Project, the proposed management measures, developed in accordance with the NSW EPA best practice document '*NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining*' (**Donnelly et al., 2011**), are considered feasible and reasonable.

13.3 Monitoring

The air quality emissions from operational activities will be monitored using the existing environmental monitoring network (**Section 5**) to evaluate compliance with the relevant air quality criteria.

The existing monitoring network will be reviewed and augmented for the operation of the Project and would be outlined in the Air Quality Management Plan.

The existing air quality monitoring includes a TEOM which continuously records concentrations of PM_{10} and $PM_{2.5}$ in the vicinity of the current site office. This will need to be relocated or augmented with (at least) one additional continuous monitor in Bylong Village and used for real-time dust management. A short-term average performance indicator will be set at a level that allows proactive dust management if dust levels are expected to approach the 24-hour PM_{10} impact assessment criteria in the upcoming 24 hours.

13.4 Real time air quality monitoring and management

KEPCO is committed to leading practice dust management for the Project through the use of a real-time and proactive dust management system. This would enable the mine operators to pro-actively manage the short-term impacts of the Project and prevent or minimise dust impacts at privately-owned receivers to the greatest practical extent.

Mine operators would be able to respond to the potential for excessive dust impacts through the use of a network of real-time dust monitors in the vicinity of the Project. The real-time monitoring network would continuously log short-term dust concentrations (15 minute (min), 30 min and 1-hour averages) and report the data a suitable recording system.

When certain short-term trigger levels are reached or exceeded, a message would be delivered to mine operators, alerting them to the elevated dust levels. The on-site weather station would report wind conditions at the time, allowing appropriate operational personnel to determine the origin of the elevated dust levels.

The short-term trigger levels (e.g. 1-hour average) would be set at a level where a few consecutive readings at these high levels may be at risk of a breach to the 24-hour impact assessment criteria. During the life of the Project, should more suitable technology become available, this system may be modified and enhanced.

An additional component of the real time system would include the development of a meteorological and air quality forecasting system to predict, one day in advance, what the meteorological conditions and air quality impacts will be. This would allow the appropriate personnel to proactively manage the intensity of activities for that day, increase controls or limit activity to various areas of the Project. Details of the above measures will be incorporated into the Air Quality Management Plan for the Project.

13.5 Blast fume management

Measures to minimise or avoid imperfect blasts would be implemented in accordance with the Code of Good Practice: Prevention and Management of Blast Generated NO_x Gases in Surface Blasting (**Australian Explosives Industry and Safety Group Inc., 2011**). These measures would be identified in a Blast Fume Management Strategy which would be appended to the Blast Management Plan for the Project. The Blast Fume Management Strategy would address factors known to contribute to fume generation, including geology, meteorological conditions, blast design, product selection, quality and blast crew education, on bench practices and emergency response procedures.

14 CONCLUSION

The key air quality issue associated with the Project are emissions of dust during the operation of the Project. Three open-cut mining scenarios were modelled (Year 3, Year 5 and Year 9), representative of worst-case operations, where coal and waste production are highest or where operations are located closest to neighbouring private receptor. A construction scenario and underground only mining scenario (Year 18) were also assessed using a semi-quantitative approach.

Dispersion modelling was completed for each of the three scenarios to predict the ground level concentrations for all relevant pollutants. For each scenario, the modelling results show that no private residence is predicted to experience ground level concentrations of PM_{10}, $PM_{2.5,}$ TSP and dust deposition above the relevant impact assessment criteria, due to the Project alone or cumulatively. A number of mine-owned receptors are predicted to experience ground level concentrations of dust above the impact assessment criteria however it is noted that many of these will not occur at time of mining.

An assessment of NO_x fume from blasting and diesel combustion was also completed. The maximum predicted 1-hour NO_2 from blasting, even when added to a conservatively high urban background concentration, was less than 40% of the ambient air quality criteria.

An assessment of the GHG emissions associated with the Project indicates that average annual Scope 1 emissions would represent approximately 0.02% of Australia's commitment under the Kyoto Protocol and a very small portion of global greenhouse emissions.

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Appendix A MODEL SET UP

A.1 MODELLING SYSTEM

The air dispersion modelling conducted for this assessment is based on an advanced modelling system using the models TAPM and CALMET/CALPUFF (see **Figure B1**). This system overcomes some of the limitations of steady-state Gaussian plume models such as AUSPLUME and ISC. The modelling system works as follows:

- TAPM is a prognostic meteorological model that generates gridded three-dimensional meteorological data for each hour of the model run period. TAPM was used to generate upper air information, incorporated through the use of prognostic 3-dimensional (3D) data extracted from. TAPM was also used to fill in any gaps in the observational data;
- CALMET, the meteorological pre-processor for the dispersion model CALPUFF, calculates fine resolution three-dimensional meteorological data based upon observed ground and upper level meteorological data, as well as observed or modelled upper air data generated for example, by TAPM;
- CALPUFF then calculates the dispersion of plumes within this three-dimensional meteorological field; and
- CALPOST is used to post-process the results from CALPUFF to determine the predicted ground-level concentrations.

CALPUFF-CALMET is endorsed by the US EPA, and has been used in many studies in NSW, Queensland and other parts of Australia. CALPUFF-CALMET is approved by the NSW EPA where non-steady conditions can be expected (e.g. where complex terrain exists).

Details on the model configuration and data inputs are provided in the following sections.

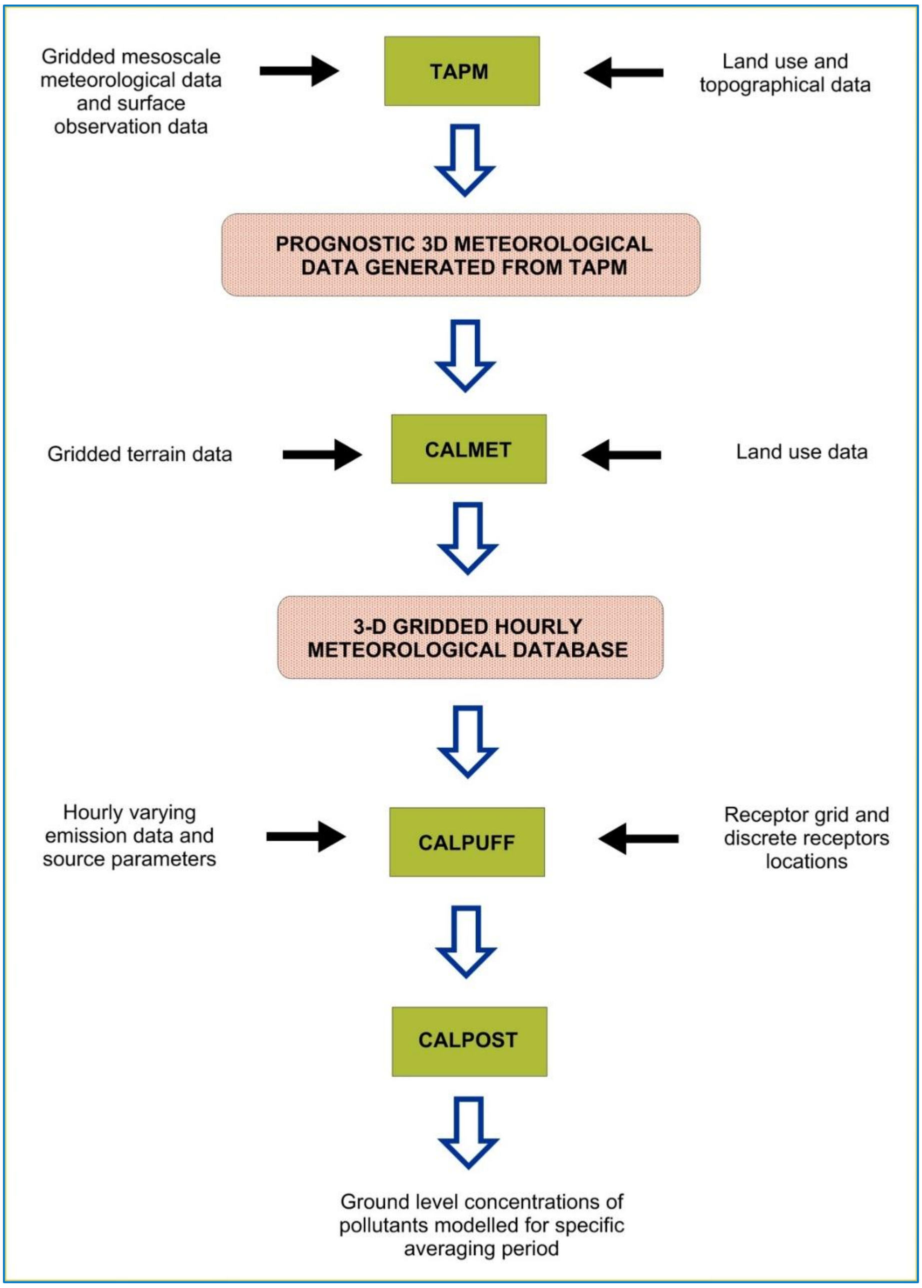

Figure B-1: Modelling methodology used in this assessment

A.1.1 TAPM

The Air Pollution Model, or TAPM, is a three dimensional meteorological and air pollution model developed by the CSIRO Division of Atmospheric Research. Detailed descriptions of the TAPM model and its performance can be found in **Hurley (2008)** and ***Hurley et al. (2009)***. TAPM utilises fundamental fluid dynamics and scalar transport equations to predict meteorology and (optionally) pollutant concentrations. It consists of coupled prognostic meteorological and air pollution concentration components. The model predicts airflows important to local scale air pollution, such as sea breezes and terrain induced flows, against a background of larger scale meteorology provided by synoptic analyses.

A.1.2 CALMET/CALPUFF

CALMET is a meteorological pre-processor that includes a wind field generator containing objective analysis and parameterised treatments of slope flows, terrain effects and terrain blocking effects. The pre-processor produces fields of wind components, air temperature, relative humidity, mixing height and other micro-meteorological variables to produce the 3D meteorological fields that are utilised in the CALPUFF dispersion model. CALMET uses the meteorological inputs in combination with land use and geophysical information for the modelling domain to predict gridded meteorological fields for the region. CALPUFF (**Scire *et al.*, 2000a**) is a multi-layer, multi-species, non-steady state puff dispersion model that can simulate the effects of time and space varying meteorological conditions on pollutant transport, transformation and removal. The model contains algorithms for near-source effects such as building downwash, partial plume penetration, sub-grid scale interactions as well as longer-range effects such as pollutant removal, chemical transformation, vertical wind shear and coastal interaction effects. The model employs dispersion equations based on a Gaussian distribution of pollutants across the puff and takes into account the complex arrangement of emissions from point, area, volume, and line sources.

Table A.1: TAPM setup

Parameter	Setting
Model Version	TAPM v.4.0.4
Number of grids (spacing)	3 (30 km, 10 km, 3 km)
Number of horizontal grid points	20 x 20
Vertical grids / vertical extent	35 / 8000m
Year of analysis	September 2011 – August 2012
Terrain and land use	Default TAPM values based on land-use and soils data sets from Geoscience Australia and the US Geological Survey, Earth Resources Observation Systems (EROS) Data Center Distributed Active Archive Center (EDC DAAC).
Centre of analysis (local coordinates)	Centre of grid domain (248.600, 6406.000 km)

Table A.2: CALMET setup

Parameter	Setting
Meteorological grid domain	25 km x 30 km
Meteorological grid resolution	0.2 km
Number of grid points	125 x 150
Vertical grids / vertical extent	8 cell heights / 3000m
Surface meteorological stations	- Bylong on-site AWS - Merriwa (BoM)
Upper air meteorology	Prognostic 3D.dat extracted from TAPM at 3 km grid

Table A.3: CALMET Model Options used

Flag	Descriptor	Default	Value Used
IEXTRP	Extrapolate surface wind observations to upper layers	Similarity theory	Similarity theory
BIAS (NZ)	Relative weight given to vertically extrapolated surface observations versus upper air data	NZ * 0	-1, 0 for all other layers
TERRAD	Radius of influence of terrain	No default (typically 5- 15km)	6 km
RMAX1 and RMAX2	Maximum radius of influence over land for observations in layer 1 and aloft	No Default	3km
R1 and R2	Distance from observations in layer 1 and aloft at which observations and Step 1 wind fields are weighted equally	No Default	1.5 km

Table A.4: CALPUFF Model Options used

Flag	Flag Descriptor	Default Value	Value Used	Value Description
MCHEM	Chemical Transformation	1	0	Not modelled
MDRY	Dry Deposition	1	1	Yes
MTRANS	Transitional plume rise allowed?	1	1	Yes
MTIP	Stack tip downwash?	1	1	Yes
MRISE	Method to compute plume rise	1	1	Briggs plume rise
MSHEAR	Vertical wind Shear	0	0	Vertical wind shear not modelled
MPARTL	Partial plume penetration of elevated inversion?	1	1	Yes
MSPLIT	Puff Splitting	0	0	No puff splitting
MSLUG	Near field modelled as slugs	0	0	Not used
MDISP	Dispersion Coefficients	3	2	Based on micrometeorology
MPDF	Probability density function used for dispersion under convective conditions	0	1	Yes
MROUGH	PG sigma y, z adjusted for z	0	0	No
MCTADJ	Terrain adjustment method	3	3	Partial Plume Adjustment

Appendix B EMISSION ESTIMATION

B.1 EMISSION FACTOR EQUATIONS

Silt and moisture content

In the absence of site specific silt and moisture content, the following values are assumed as follows:

Parameter	Silt content (%)	Moisture content (%)
Topsoil	10	4
Overburden	10	4
ROM Coal	10	9.5
Product Coal	10	11
Haul Roads	4.1	-

As the Bylong Coal Project is a Greenfield site, site-specific measurements of silt and moisture contents were not available. In the absence of these data, the topsoil and overburden data were assumed as per other similar studies. The ROM and product coal silt contents were also assumed however the moisture contents were provided by KEPCO as representative of the coal at the Project site. The silt content adopted for haul roads was based on an average of measurements taken for the final Australian Coal Industry's Research Program's (ACARP) final study report.

Drilling overburden and coal

The emission factor used for drilling has been taken to be 0.59 kg/hole for TSP and then multiplied by 0.52 for PM_{10} and by 0.03 for $PM_{2.5}$ (**US EPA, 1985 and updates**).

Blasting overburden and coal

TSP emissions from blasting were estimated using the **US EPA** (**1985 and updates**) emission factor equation given in Equation 2.

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

$$E_{TSP} = 0.52 \times E_{TSP}$$

$$E_{TSP} = 0.03 \times E_{TSP}$$

Where,

A = area to be blasted in m^2

The area blasted for each scenario is based on ha per blast provided in mine schedule each year.

Loading / transfer material dumping

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} and 0.053 $PM_{2.5}$

U – wind speed (m/s)

M – moisture content (%)

The wind speed was taken from the on-site AWS.

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:

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

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

$$E_{PM_{2.5}}\ \ (kg/VKT) = 0.2819 \times 0.15 \times [\times (s/12)\text{^}0.9 \times ((W \times 1.1023)/3)\text{^}0.45]$$

Where:

s = silt content of road surface
W = mean vehicle weight (average weight between loading and unloaded)

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. It is noted that the 150t truck was conservatively assumed to transport both overburden and coal however in reality, a number of 220t trucks would be used to transport overburden.

Vehicle type	Unloaded (tare) weight	Loaded (GVM) including load	Capacity (tonnes)
Hitachi EH3500AC-3	174	324	150
Hitachi EH4000AC-3	166	386	220

Dozers on Overburden

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

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

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

$$E_{PM_{2.5}}(kg/hr) =\ 0.105 \times E_{TSP}$$

Where:

s = silt content (%)

M = moisture content (%)

Dozers on Coal

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

$$E_{TSP}(kg/hr) = 35.6\ \times \frac{s^{1.2}}{M^{1.3}}$$

$$E_{PM_{10}}(kg/hr) =\ 6.33 \times \frac{s^{1.5}}{M^{1.4}}$$

$$E_{PM_{2.5}}(kg/hr) =\ 0.022 \times E_{TSP}$$

Where:

s = silt content (%)

M = moisture content (%)

Loading/unloading coal

The **US EPA** (**1985 and updates**) emission factor equation has been used.

$$E_{TSP}\left({}^{kg}/_{t}\right) = \frac{5.8}{M^{1.2}}$$

$$E_{PM_{10}}\left({}^{kg}/_{t}\right) = \frac{0.0447}{M^{0.9}}$$

$$E_{PM_{2.5}}\left({}^{kg}/_{t}\right) = 0.019 \times E_{TSP}$$

Where,

M = moisture (%)

Crushing

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}	$PM_{2.5}$
Tertiary crushing (controlled)	0.0006	0.00027	0.00005

Grading roads

Estimates of emissions from grading roads have been made using the US EPA AP42 emission factor equations for each particle size fraction, as shown below.

$$E_{TSP}\left(\frac{kg}{km}\right) = 0.0034 \times S^{2.5}$$

$$E_{PM_{10}}\left(\frac{kg}{km}\right) = 0.00336 \times S^{2.0}$$

$$E_{PM_{2.5}}\left(\frac{kg}{km}\right) = 0.0001054 \times S^{2.5}$$

Where,

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

Wind Erosion

The emission factor used for wind erosion has been taken as 0.1 kg/ha for TSP, 0.5 kg/ha for PM_{10} and 0.075 for $PM_{2.5}$ **US EPA (1985 and updates)**

B.2 EMISSION INVENTORIES

Table B.1: Year 3 TSP Emissions

ACTIVITY	TSP emission for Year 3 (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units	Emission Factor Source
Topsoil Removal - Dozers stripping topsoil for all expit haul roads	3,150	927	h/y	6.80	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil Removal - Dozers stripping topsoil at South-Western OEA	2,596	764	h/y	6.80	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil Removal - Dozers stripping topsoil at North-Western OEA	4,625	1,361	h/y	6.80	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil Removal - Dozers stripping topsoil at Eastern Open Cut Excavation and Inpit Emplacement Areas	2,161	636	h/y	6.80	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil Removal - Dozers stripping topsoil at Western Open Cut Excavation and Inpit Emplacement Areas	1,019	300	h/y	6.80	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil removal - Sh/Ex/FELs loading topsoil at North-Western OEA	230	809,550	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Sh/Ex/FELs loading topsoil for all expit haul roads	157	551,561	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Sh/Ex/FELs loading topsoil at South-Western OEA	129	454,373	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Sh/Ex/FELs loading topsoil at Eastern Open Cut Excavation and Inpit Emplacement Areas	108	378,416	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Sh/Ex/FELs loading topsoil at Western Open Cut Excavation and Inpit Emplacement Areas	51	178,678	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Hauling topsoil from Eastern Open Cut ex-pit haul roads to Eastern topsoil stockpile (north) Stockpiles 3&4	8,898	284,630	t/y	0.2084	kg/t	150	t/load	249	Vehicle gross mass (t)	6.3	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from Eastern Open Cut Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (north) Stockpiles 3&4	1,944	62,170	t/y	0.2084	kg/t	150	t/load	249	Vehicle gross mass (t)	6.3	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from Eastern Open Cut Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (south) Stockpile 5	8,628	186,027	t/y	0.3092	kg/t	150	t/load	249	Vehicle gross mass (t)	9.3	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from Western Open Cut expit haul roads to Western topsoil stockpile (south) Stockpile 2	4,803	266,931	t/y	0.1199	kg/t	150	t/load	249	Vehicle gross mass (t)	3.6	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from Western Open Cut Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (south) Stockpile 5	11,326	178,678	t/y	0.4226	kg/t	150	t/load	249	Vehicle gross mass (t)	12.8	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from NW OEA to Eastern topsoil stockpile (south) Stockpile 5	49,756	809,550	t/y	0.4097	kg/t	150	t/load	249	Vehicle gross mass (t)	12.4	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from SW OEA to Western topsoil stockpile (north) Stockpile 1	15,778	346,800	t/y	0.3033	kg/t	150	t/load	249	Vehicle gross mass (t)	9.2	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from SW OEA to Western topsoil stockpile (south) Stockpile 2	3,985	107,573	t/y	0.2470	kg/t	150	t/load	249	Vehicle gross mass (t)	7.5	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Emplacing topsoil from Pit1 expit haulroads to Eastern topsoil stockpile (north) Stockpiles 3&4	116	284,630	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from Open Cut Pit1 Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (north) Stockpiles 3&4	25	62,170	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from Open Cut Pit1 Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (south) Stockpile 5	128	316,246	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from Western Open Cut expit haulroads to Western topsoil stockpile (south) Stockpile 2	108	266,931	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from Western Open Cut Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (south) Stockpile 5	12,025	178,678	t/y	0.0673	kg/t	150	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from NW OEA to Eastern topsoil stockpile (south) Stockpile 5	54,481	809,550	t/y	0.0673	kg/t	150	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from SW OEA to Western topsoil stockpile (north) Stockpile 1	23,339	346,800	t/y	0.0673	kg/t	150	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from SW OEA to Western topsoil stockpile (south) Stockpile 2	7,239	107,573	t/y	0.0673	kg/t	150	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Drilling at Eastern Open Cut	228	1,287	holes/y	0.59	kg/hole											70	% Control	AP-42 Table 11.9-4
OB - Drilling at Western Open Cut	87	494	holes/y	0.59	kg/hole											70	% Control	AP-42 Table 11.9-5
OB - Blasting at Eastern Open Cut	1,821	4	blasts/y	420	kg/blast	15,388	Area of blast in square metres	297	holes/blast							0	% Control	AP-42 Table 11.9-2
OB - Blasting at Western Open Cut	699	2	blasts/y	420	kg/blast	15,388	Area of blast in square metres	297	holes/blast							0	% Control	AP-42 Table 11.9-3
OB - Sh/Ex/FELs loading OB to trucks at Eastern Open Cut	6,653	23,396,033	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% Control	AP-42 c13s2.4.3
OB - Sh/Ex/FELs loading OB to trucks at Western Open Cut	2,685	9,442,032	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% Control	AP-42 c13s2.4.4
OB - Hauling OB from Eastern Open Cut to Eastern OEA	176,503	15,360,000	t/y	0.076607	kg/t	150	t/load	249	Vehicle gross mass (t)	2.3	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Western Open Cut to Western Open Cut Emplacement Area	29,621	3,840,000	t/y	0.051425	kg/t	150	t/load	249	Vehicle gross mass (t)	1.6	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Eastern Open Cut to to Ex-Pit North (WOEA)	292,604	5,156,033	t/y	0.378332	kg/t	150	t/load	249	Vehicle gross mass (t)	11.4	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Western Open Cut to Ex-Pit North (WOEA)	74,816	2,722,032	t/y	0.183235	kg/t	150	t/load	249	Vehicle gross mass (t)	5.5	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Eastern Open Cut to Ex-Pit South (SOEA)	201,859	2,880,000	t/y	0.467265	kg/t	150	t/load	249	Vehicle gross mass (t)	14.1	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Western Open Cut to Ex-Pit South (SOEA)	92,842	2,880,000	t/y	0.214912	kg/t	150	t/load	249	Vehicle gross mass (t)	6.5	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Trucks emplacing OB from Eastern Open Cut to Eastern Open Cut In-Pit Emplacement Area	6,240	15,360,000	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing OB from Western Open Cut to Western Open Cut In-Pit Emplacement Area	1,560	3,840,000	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing OB from Eastern Open Cut to Ex-Pit North (WOEA)	2,095	5,156,033	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing OB from Western Open Cut to Ex-Pit North (WOEA)	1,106	2,722,032	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing OB from Eastern Open Cut to Ex-Pit South (SOEA)	1,170	2,880,000	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing OB from Western Open Cut to Ex-Pit South (SOEA)	1,170	2,880,000	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Dozers on Eastern OEA	16,544	4,868	h/y	6.8	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
OB - Dozers on Western Open Cut Dump Area	19,388	5,705	h/y	6.8	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
OB - Dozers on Ex-Pit North (WOEA)	37,364	10,995	h/y	6.8	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
OB - Dozers on Ex-Pit South (WOEA)	23,303	6,857	h/y	6.8	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2

Table B.2: Year 3 TSP Emissions (cont.)

ACTIVITY	TSP emission for Year 3 (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units	Emission Factor Source
CL - Dozers ripping/pushing/clean-up on Eastern Open Cut	32,418	2,145	h/y	30.2	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Dozers ripping/pushing/clean-up on Western Open Cut	20,058	1,327	h/y	30.2	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-3
CL - Drilling at Eastern Open Cut	94	3,128	holes/y	0.1	kg/hole											70	% Control	AP-42 Table 11.9-4
CL - Drilling at Western Open Cut	20	663	holes/y	0.1	kg/hole											70	% Control	AP-42 Table 11.9-5
CL - Blasting at Eastern Open Cut	4,386	11	blasts/y	409	kg/blast	15,117	Area of blast in square metres	292	holes/blast							0	% Control	AP-42 Table 11.9-2
CL - Blasting at Western Open Cut	930	2	blasts/y	409	kg/blast	15,117	Area of blast in square metres	292	holes/blast							0	% Control	AP-42 Table 11.9-3
CL - Loading ROM coal from Eastern Open Cut to trucks	91,243	3,349,218	t/y	0.039	kg/t	9.5	moisture content in %									30	% control	AP-42 Table 11.9-2
CL - Loading ROM coal from Western Open Cut to trucks	18,009	661,038	t/y	0.039	kg/t	9.5	moisture content in %									30	% control	AP-42 Table 11.9-3
CL - Hauling ROM coal from Eastern Open Cut to the hopper at the ROM coal pad	121,385	3,349,218	t/y	0.2416	kg/t	150	t/load	249	Vehicle gross mass (t)	7.3	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
CL - Hauling ROM coal from Western Open Cut to the hopper at the ROM coal pad	16,960	661,038	t/y	0.1710	kg/t	150	t/load	249	Vehicle gross mass (t)	5.2	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.3
CL - Unloading ROM coal from Eastern & Western Open Cuts to the hopper ROM coal pad	78,037	4,010,256	t/y	0.039	kg/t	9.5	moisture content in %									50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile	243	4,010,256	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile - Unloading Conveyor	243	4,010,256	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - Raw Coal Stockpile to CHPP	243	4,010,256	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - Raw Coal Stockpile to CHPP - Unloading Conveyor	243	4,010,256	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Crushing OC ROM coal at the CHPP	2,406	4,010,256	t/y	0.0006	kg/t											0	% control	AP-42 Table 11.19.2-1
CL - Screening OC ROM coal at the CHPP	4,411	4,010,256	t/y	0.0011	kg/t											0	% control	AP-42 Table 11.19.2-1
CL - Conveyer transfer - CHPP to Product Coal Stockpile	124	2,511,349	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - CHPP to Product Coal Stockpile - Unloading Conveyor	124	2,511,349	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Dozer/FEL on Raw Coal Stockpile	24,153	1,598	h/y	30.2	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Dozer/FEL on Product Coal Stockpile	19,962	1,598	h/y	25.0	kg/h	10	silt content in %	11	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Hauling rejects from wash plant to Ex-Pit North (WOEA)	59,285	1,551,931	t/y	0.2547	kg/t	150	t/load	249	Vehicle gross mass (t)	7.7	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
CL - Loading product coal to trains	124	2,511,349	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content in %							50	% Control	AP-42 c13s2.4.3
WE - Eastern Open Cut	15,023	17.2	ha	0.1	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Western Open Cut	9,296	10.6	ha	0.1	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Eastern OEA	7,932	9.1	ha	0.1	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Ex-Pit North (Western OEA) - Area Disturbed	46,351	52.9	ha	0.1	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Ex-Pit South (Southern OEA) - Area Disturbed	26,015	29.7	ha	0.1	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Rehab North Western OEA	2,004	7.6	ha	0.1	kg/ha/h	8,760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (1) - Area Disturbed	4,468	10.2	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (2) - Area Disturbed	5,300	12.1	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (3) - Area Disturbed	1,971	4.5	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (4) - Area Disturbed	2,497	5.7	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (5) - Area Disturbed	34,602	79.0	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Raw Coal Stockpile	1,018	2.3	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Product Coal Stockpile	2,595	5.9	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
Grading roads	10,635	34,560	km	0.62	kg/km	8	speed of graders in km/h	4,320	grader hours							50	% Control	AP-42 Table 11.9-2
Total TSP emissions for Year 3 (2018) (kg/yr)	**1,871,969**																	

Table B.3: Year 3 PM_{10} Emissions

ACTIVITY	PM_{10} emission for Year 3 (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units	Emission Factor Source
Topsoil Removal - Dozers stripping topsoil for all expit haul roads	710	927	h/y	1.53	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil Removal - Dozers stripping topsoil at South-Western OEA	585	764	h/y	1.53	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil Removal - Dozers stripping topsoil at North-Western OEA	1,043	1,361	h/y	1.53	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil Removal - Dozers stripping topsoil at Eastern Open Cut Excavation and Inpit Emplacement Areas	487	636	h/y	1.53	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil Removal - Dozers stripping topsoil at Western Open Cut Excavation and Inpit Emplacement Areas	230	300	h/y	1.53	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil removal - Sh/Ex/FELs loading topsoil at North-Western OEA	109	809,550	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Sh/Ex/FELs loading topsoil for all expit haul roads	74	551,561	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Sh/Ex/FELs loading topsoil at South-Western OEA	61	454,373	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Sh/Ex/FELs loading topsoil at Eastern Open Cut Excavation and Inpit Emplacement Areas	51	378,416	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Sh/Ex/FELs loading topsoil at Western Open Cut Excavation and Inpit Emplacement Areas	24	178,678	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Hauling topsoil from Eastern Open Cut ex-pit haul roads to Eastern topsoil stockpile (north) Stockpiles 3&4	2,197	284,630	t/y	0.0515	kg/t	150	t/load	249	Vehicle gross mass (t)	6.3	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from Eastern Open Cut Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (north) Stockpiles 3&4	480	62,170	t/y	0.0515	kg/t	150	t/load	249	Vehicle gross mass (t)	6.3	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from Eastern Open Cut Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (south) Stockpile 5	2,131	186,027	t/y	0.0764	kg/t	150	t/load	249	Vehicle gross mass (t)	9.3	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from Western Open Cut expit haul roads to Western topsoil stockpile (south) Stockpile 2	1,186	266,931	t/y	0.0296	kg/t	150	t/load	249	Vehicle gross mass (t)	3.6	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from Western Open Cut Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (south) Stockpile 5	2,797	178,678	t/y	0.1044	kg/t	150	t/load	249	Vehicle gross mass (t)	12.8	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from NW OEA to Eastern topsoil stockpile (south) Stockpile 5	12,287	809,550	t/y	0.1012	kg/t	150	t/load	249	Vehicle gross mass (t)	12.4	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from SW OEA to Western topsoil stockpile (north) Stockpile 1	3,897	346,800	t/y	0.0749	kg/t	150	t/load	249	Vehicle gross mass (t)	9.2	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from SW OEA to Western topsoil stockpile (south) Stockpile 2	984	107,573	t/y	0.0610	kg/t	150	t/load	249	Vehicle gross mass (t)	7.5	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Emplacing topsoil from Pit1 expit haulroads to Eastern topsoil stockpile (north) Stockpiles 3&4	55	284,630	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from Open Cut Pit1 Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (north) Stockpiles 3&4	12	62,170	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from Open Cut Pit1 Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (south) Stockpile 5	61	316,246	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from Western Open Cut expit haulroads to Western topsoil stockpile (south) Stockpile 2	51	266,931	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from Western Open Cut Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (south) Stockpile 5	34	178,678	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from NW OEA to Eastern topsoil stockpile (south) Stockpile 5	156	809,550	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from SW OEA to Western topsoil stockpile (north) Stockpile 1	67	346,800	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from SW OEA to Western topsoil stockpile (south) Stockpile 2	21	107,573	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Drilling at Eastern Open Cut	118	1,287	holes/y	0.31	kg/hole											70	% Control	AP-42 Table 11.9-4
OB - Drilling at Western Open Cut	45	494	holes/y	0.31	kg/hole											70	% Control	AP-42 Table 11.9-5
OB - Blasting at Eastern Open Cut	947	4	blasts/y	218.37	kg/blast	15,388	Area of blast in square metres	297	holes/blast							0	% Control	AP-42 Table 11.9-2
OB - Blasting at Western Open Cut	363	2	blasts/y	218.37	kg/blast	15,388	Area of blast in square metres	297	holes/blast							0	% Control	AP-42 Table 11.9-3
OB - Sh/Ex/FELs loading OB to trucks at Eastern Open Cut	3,147	23,396,033	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% Control	AP-42 c13s2.4.3
OB - Sh/Ex/FELs loading OB to trucks at Western Open Cut	1,270	9,442,032	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% Control	AP-42 c13s2.4.4
OB - Hauling OB from Eastern Open Cut to Eastern OEA	43,588	15,360,000	t/y	0.01892	kg/t	150	t/load	249	Vehicle gross mass (t)	2.3	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Western Open Cut to Western Open Cut Emplacement Area	7,315	3,840,000	t/y	0.01270	kg/t	150	t/load	249	Vehicle gross mass (t)	1.6	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Eastern Open Cut to to Ex-Pit North (WOEA)	72,260	5,156,033	t/y	0.09343	kg/t	150	t/load	249	Vehicle gross mass (t)	11.4	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Western Open Cut to Ex-Pit North (WOEA)	18,476	2,722,032	t/y	0.04525	kg/t	150	t/load	249	Vehicle gross mass (t)	5.5	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Eastern Open Cut to Ex-Pit South (SOEA)	49,850	2,880,000	t/y	0.11539	kg/t	150	t/load	249	Vehicle gross mass (t)	14.1	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Western Open Cut to Ex-Pit South (SOEA)	22,928	2,880,000	t/y	0.05307	kg/t	150	t/load	249	Vehicle gross mass (t)	6.5	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Trucks emplacing OB from Eastern Open Cut to Eastern Open Cut In-Pit Emplacement Area	2,951	15,360,000	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing OB from Western Open Cut to Western Open Cut In-Pit Emplacement Area	738	3,840,000	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing OB from Eastern Open Cut to Ex-Pit North (WOEA)	991	5,156,033	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing OB from Western Open Cut to Ex-Pit North (WOEA)	523	2,722,032	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing OB from Eastern Open Cut to Ex-Pit South (SOEA)	553	2,880,000	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing OB from Western Open Cut to Ex-Pit South (SOEA)	553	2,880,000	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Dozers on Eastern OEA	3,730	4,868	h/y	1.5	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
OB - Dozers on Western Open Cut Dump Area	4,371	5,705	h/y	1.5	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
OB - Dozers on Ex-Pit North (WOEA)	8,425	10,995	h/y	1.5	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
OB - Dozers on Ex-Pit South (WOEA)	5,254	6,857	h/y	1.5	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2

Table B.4: Year 3 PM_{10} Emissions (cont.)

ACTIVITY	PM_{10} emission for Year 3 (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units	Emission Factor Source
CL - Dozers ripping/pushing/clean-up on Eastern Open Cut	9,183	2,145	h/y	8.6	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Dozers ripping/pushing/clean-up on Western Open Cut	5,682	1,327	h/y	8.6	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-3
CL - Drilling at Eastern Open Cut	49	3,128	holes/y	0.052	kg/hole											70	% Control	AP-42 Table 11.9-4
CL - Drilling at Western Open Cut	10	663	holes/y	0.052	kg/hole											70	% Control	AP-42 Table 11.9-5
CL - Blasting at Eastern Open Cut	2,281	11	blasts/y	212.6	kg/blast	15,117	Area of blast in square metres	292	holes/blast							0	% Control	AP-42 Table 11.9-2
CL - Blasting at Western Open Cut	484	2	blasts/y	212.6	kg/blast	15,117	Area of blast in square metres	292	holes/blast							0	% Control	AP-42 Table 11.9-3
CL - Loading ROM coal from Eastern Open Cut to trucks	13,816	3,349,218	t/y	0.006	kg/t	9.5	moisture content in %									30	% control	AP-42 Table 11.9-2
CL - Loading ROM coal from Western Open Cut to trucks	2,727	661,038	t/y	0.006	kg/t	9.5	moisture content in %									30	% control	AP-42 Table 11.9-3
CL - Hauling ROM coal from Eastern Open Cut to the hopper at the ROM coal pad	29,976	3,349,218	t/y	0.0597	kg/t	150	t/load	249	Vehicle gross mass (t)	7.3	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
CL - Hauling ROM coal from Western Open Cut to the hopper at the ROM coal pad	4,188	661,038	t/y	0.0422	kg/t	150	t/load	249	Vehicle gross mass (t)	5.2	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.3
CL - Unloading ROM coal from Eastern & Western Open Cuts to the hopper ROM coal pad	11,817	4,010,256	t/y	0.006	kg/t	9.5	moisture content in %									50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile	115	4,010,256	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile - Unloading Conveyor	115	4,010,256	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - Raw Coal Stockpile to CHPP	115	4,010,256	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - Raw Coal Stockpile to CHPP - Unloading Conveyor	115	4,010,256	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Crushing OC ROM coal at the CHPP	1,083	4,010,256	t/y	0.00027	kg/t											0	% control	AP-42 Table 11.19.2-1
CL - Screening OC ROM coal at the CHPP	1,484	4,010,256	t/y	0.00037	kg/t											0	% control	AP-42 Table 11.19.2-1
CL - Conveyer transfer - CHPP to Product Coal Stockpile	59	2,511,349	t/y	0.00005	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - CHPP to Product Coal Stockpile - Unloading Conveyor	59	2,511,349	t/y	0.00005	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Dozer/FEL on Raw Coal Stockpile	6,841	1,598	h/y	8.6	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Dozer/FEL on Product Coal Stockpile	5,572	1,598	h/y	7.0	kg/h	10	silt content in %	11	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Hauling rejects from wash plant to Ex-Pit North (WOEA)	14,641	1,551,931	t/y	0.0629	kg/t	150	t/load	249	Vehicle gross mass (t)	7.7	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
CL - Loading product coal to trains	59	2,511,349	t/y	0.00005	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content in %							50	% Control	AP-42 c13s2.4.3
WE - Eastern Open Cut	7,512	17.2	ha	0.05	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Western Open Cut	4,648	10.6	ha	0.05	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Eastern OEA	3,966	9.1	ha	0.05	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Ex-Pit North (Western OEA) - Area Disturbed	23,175	52.9	ha	0.05	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Ex-Pit South (Southern OEA) - Area Disturbed	13,008	29.7	ha	0.05	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Rehab North Western OEA	1,002	7.6	ha	0.05	kg/ha/h	8,760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (1) - Area Disturbed	2,234	10.2	ha	0.05	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (2) - Area Disturbed	2,650	12.1	ha	0.05	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (3) - Area Disturbed	986	4.5	ha	0.05	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (4) - Area Disturbed	1,248	5.7	ha	0.05	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (5) - Area Disturbed	17,301	79	ha	0.05	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Raw Coal Stockpile	509	2.3	ha	0.05	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Product Coal Stockpile	1,297	5.9	ha	0.05	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
Grading roads	3,716	34,560	km	0.22	kg/km	8	speed of graders in km/h	4320	grader hours							50	% Control	AP-42 Table 11.9-2
Total TSP emissions for Year 3 (2018) (kg/yr)	**471,907**																	

Table B.5: Year 3 $PM_{2.5}$ Emissions

ACTIVITY	$PM_{2.5}$ emission for Year 3 (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units	Emission Factor Source
Topsoil Removal - Dozers stripping topsoil for all expit haul roads	331	927	h/y	0.71	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil Removal - Dozers stripping topsoil at South-Western OEA	273	764	h/y	0.71	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil Removal - Dozers stripping topsoil at North-Western OEA	486	1,361	h/y	0.71	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil Removal - Dozers stripping topsoil at Eastern Open Cut Excavation and Inpit Emplacement Areas	227	636	h/y	0.71	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil Removal - Dozers stripping topsoil at Western Open Cut Excavation and Inpit Emplacement Areas	107	300	h/y	0.71	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil removal - Sh/Ex/FELs loading topsoil at North-Western OEA	16	809,550	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Sh/Ex/FELs loading topsoil for all expit haul roads	11	551,561	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Sh/Ex/FELs loading topsoil at South-Western OEA	9	454,373	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Sh/Ex/FELs loading topsoil at Eastern Open Cut Excavation and Inpit Emplacement Areas	8	378,416	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Sh/Ex/FELs loading topsoil at Western Open Cut Excavation and Inpit Emplacement Areas	4	178,678	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Hauling topsoil from Eastern Open Cut ex-pit haul roads to Eastern topsoil stockpile (north) Stockpiles 3&4	220	284,630	t/y	0.0051	kg/t	150	t/load	249	Vehicle gross mass (t)	6.3	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from Eastern Open Cut Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (north) Stockpiles 3&4	48	62,170	t/y	0.0051	kg/t	150	t/load	249	Vehicle gross mass (t)	6.3	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from Eastern Open Cut Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (south) Stockpile 5	213	186,027	t/y	0.0076	kg/t	150	t/load	249	Vehicle gross mass (t)	9.3	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from Western Open Cut expit haul roads to Western topsoil stockpile (south) Stockpile 2	119	266,931	t/y	0.0030	kg/t	150	t/load	249	Vehicle gross mass (t)	3.6	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from Western Open Cut Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (south) Stockpile 5	280	178,678	t/y	0.0104	kg/t	150	t/load	249	Vehicle gross mass (t)	12.8	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from NW OEA to Eastern topsoil stockpile (south) Stockpile 5	1,229	809,550	t/y	0.0101	kg/t	150	t/load	249	Vehicle gross mass (t)	12.4	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from SW OEA to Western topsoil stockpile (north) Stockpile 1	390	346,800	t/y	0.0075	kg/t	150	t/load	249	Vehicle gross mass (t)	9.2	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from SW OEA to Western topsoil stockpile (south) Stockpile 2	98	107,573	t/y	0.0061	kg/t	150	t/load	249	Vehicle gross mass (t)	7.5	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Emplacing topsoil from Pit1 expit haulroads to Eastern topsoil stockpile (north) Stockpiles 3&4	8	284,630	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from Open Cut Pit1 Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (north) Stockpiles 3&4	2	62,170	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from Open Cut Pit1 Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (south) Stockpile 5	9	316,246	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from Western Open Cut expit haulroads to Western topsoil stockpile (south) Stockpile 2	8	266,931	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from Western Open Cut Excavation and Inpit Emplacement Areas to Eastern topsoil stockpile (south) Stockpile 5	5	178,678	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from NW OEA to Eastern topsoil stockpile (south) Stockpile 5	24	809,550	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from SW OEA to Western topsoil stockpile (north) Stockpile 1	10	346,800	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from SW OEA to Western topsoil stockpile (south) Stockpile 2	3	107,573	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Drilling at Eastern Open Cut	7	1,287	holes/y	0.02	kg/hole											70	% Control	AP-42 Table 11.9-4
OB - Drilling at Western Open Cut	3	494	holes/y	0.02	kg/hole											70	% Control	AP-42 Table 11.9-5
OB - Blasting at Eastern Open Cut	55	4	blasts/y	12.6	kg/blast	15,388	Area of blast in square metres	297	holes/blast							0	% Control	AP-42 Table 11.9-2
OB - Blasting at Western Open Cut	21	2	blasts/y	12.6	kg/blast	15,388	Area of blast in square metres	297	holes/blast							0	% Control	AP-42 Table 11.9-3
OB - Sh/Ex/FELs loading OB to trucks at Eastern Open Cut	477	23,396,033	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% Control	AP-42 c13s2.4.3
OB - Sh/Ex/FELs loading OB to trucks at Western Open Cut	192	9,442,032	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% Control	AP-42 c13s2.4.4
OB - Hauling OB from Eastern Open Cut to Eastern OEA	4,359	15,360,000	t/y	0.00189	kg/t	150	t/load	249	Vehicle gross mass (t)	2.3	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Western Open Cut to Western Open Cut Emplacement Area	731	3,840,000	t/y	0.00127	kg/t	150	t/load	249	Vehicle gross mass (t)	1.6	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Eastern Open Cut to to Ex-Pit North (WOEA)	7,226	5,156,033	t/y	0.00934	kg/t	150	t/load	249	Vehicle gross mass (t)	11.4	km/return trip	0.1	kg/VKT	4	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Western Open Cut to Ex-Pit North (WOEA)	1,848	2,722,032	t/y	0.00453	kg/t	150	t/load	249	Vehicle gross mass (t)	5.5	km/return trip	0.1	kg/VKT	4	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Eastern Open Cut to Ex-Pit South (SOEA)	4,985	2,880,000	t/y	0.01154	kg/t	150	t/load	249	Vehicle gross mass (t)	14.1	km/return trip	0.1	kg/VKT	4	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Western Open Cut to Ex-Pit South (SOEA)	2,293	2,880,000	t/y	0.00531	kg/t	150	t/load	249	Vehicle gross mass (t)	6.5	km/return trip	0.1	kg/VKT	4	% silt content	85	% control	AP-42 c13s2.2.2
OB - Trucks emplacing OB from Eastern Open Cut to Eastern Open Cut In-Pit Emplacement Area	447	15,360,000	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing OB from Western Open Cut to Western Open Cut In-Pit Emplacement Area	112	3,840,000	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing OB from Eastern Open Cut to Ex-Pit North (WOEA)	150	5,156,033	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing OB from Western Open Cut to Ex-Pit North (WOEA)	79	2,722,032	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing OB from Eastern Open Cut to Ex-Pit South (SOEA)	84	2,880,000	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing OB from Western Open Cut to Ex-Pit South (SOEA)	84	2,880,000	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Dozers on Eastern OEA	1,737	4,868	h/y	0.7	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
OB - Dozers on Western Open Cut Dump Area	2,036	5,705	h/y	0.7	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
OB - Dozers on Ex-Pit North (WOEA)	3,923	10,995	h/y	0.7	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
OB - Dozers on Ex-Pit South (WOEA)	2,447	6,857	h/y	0.7	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2

Table B.6: Year 3 $PM_{2.5}$ Emissions (cont.)

ACTIVITY	$PM_{2.5}$ emission for Year 3 (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units	Emission Factor Source
CL - Dozers ripping/pushing/clean-up on Eastern Open Cut	713	2,145	h/y	0.7	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Dozers ripping/pushing/clean-up on Western Open Cut	441	1,327	h/y	0.7	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-3
CL - Drilling at Eastern Open Cut	3	3,128	holes/y	0.003	kg/hole											70	% Control	AP-42 Table 11.9-4
CL - Drilling at Western Open Cut	1	663	holes/y	0.003	kg/hole											70	% Control	AP-42 Table 11.9-5
CL - Blasting at Eastern Open Cut	132	11	blasts/y	12.268	kg/blast	15,117	Area of blast in square metres	292	holes/blast							0	% Control	AP-42 Table 11.9-2
CL - Blasting at Western Open Cut	28	2	blasts/y	12.268	kg/blast	15,117	Area of blast in square metres	292	holes/blast							0	% Control	AP-42 Table 11.9-3
CL - Loading ROM coal from Eastern Open Cut to trucks	1,734	3,349,218	t/y	0.001	kg/t	9.5	moisture content in %									30	% control	AP-42 Table 11.9-2
CL - Loading ROM coal from Western Open Cut to trucks	342	661,038	t/y	0.001	kg/t	9.5	moisture content in %									30	% control	AP-42 Table 11.9-3
CL - Hauling ROM coal from Eastern Open Cut to the hopper at the ROM coal pad	2,998	3,349,218	t/y	0.0060	kg/t	150	t/load	249	Vehicle gross mass (t)	7.3	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
CL - Hauling ROM coal from Western Open Cut to the hopper at the ROM coal pad	419	661,038	t/y	0.0042	kg/t	150	t/load	249	Vehicle gross mass (t)	5.2	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.3
CL - Unloading ROM coal from Eastern & Western Open Cuts to the hopper ROM coal pad	1,483	4,010,256	t/y	0.001	kg/t	9.5	moisture content in %									50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile	17	4,010,256	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile - Unloading Conveyor	17	4,010,256	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - Raw Coal Stockpile to CHPP	17	4,010,256	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - Raw Coal Stockpile to CHPP - Unloading Conveyor	17	4,010,256	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Crushing OC ROM coal at the CHPP	201	4,010,256	t/y	0.00005	kg/t											0	% control	AP-42 Table 11.19.2-1
CL - Screening OC ROM coal at the CHPP	100	4,010,256	t/y	0.000025	kg/t											0	% control	AP-42 Table 11.19.2-1
CL - Conveyer transfer - CHPP to Product Coal Stockpile	9	2,511,349	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - CHPP to Product Coal Stockpile - Unloading Conveyor	9	2,511,349	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Dozer/FEL on Raw Coal Stockpile	531	1,598	h/y	0.7	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Dozer/FEL on Product Coal Stockpile	439	1,598	h/y	0.5	kg/h	10	silt content in %	11	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Hauling rejects from wash plant to Ex-Pit North (WOEA)	1,464	1,551,931	t/y	0.0063	kg/t	150	t/load	249	Vehicle gross mass (t)	7.7	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
CL - Loading product coal to trains	9	2,511,349	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content in %							50	% Control	AP-42 c13s2.4.3
WE - Eastern Open Cut	1,127	17.2	ha	0.0075	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Western Open Cut	697	10.6	ha	0.0075	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Eastern OEA	595	9.1	ha	0.0075	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Ex-Pit North (Western OEA) - Area Disturbed	3,476	52.9	ha	0.0075	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Ex-Pit South (Southern OEA) - Area Disturbed	1,951	29.7	ha	0.0075	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Rehab North Western OEA	150	7.6	ha	0.0075	kg/ha/h	8,760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (1) - Area Disturbed	335	10.2	ha	0.0075	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (2) - Area Disturbed	397	12.1	ha	0.0075	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (3) - Area Disturbed	148	4.5	ha	0.0075	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (4) - Area Disturbed	187	5.7	ha	0.0075	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (5) - Area Disturbed	2,595	79.0	ha	0.0075	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Raw Coal Stockpile	76	2.3	ha	0.0075	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Product Coal Stockpile	195	5.9	ha	0.0075	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
Grading roads	330	34,560	km	0.02	kg/km	8	speed of graders in km/h	4320	grader hours							50	% Control	AP-42 Table 11.9-2
Total $PM_{2.5}$ emissions for Year 3 (2018) (kg/yr)	**60,814**																	

Table B.4: Year 5 TSP Emissions

ACTIVITY	TSP emission for Year 5 (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units	Emission Factor Source
Topsoil Removal - Dozers stripping topsoil at Eastern Open Cut - northern area	1,275	375	h/y	6.80	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil Removal - Dozers stripping topsoil at Eastern Open Cut - southern area	181	53	h/y	6.80	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil Removal - Dozers stripping topsoil at Western Open Cut - northern area	420	124	h/y	6.80	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil Removal - Dozers stripping topsoil at Western Open Cut - southern area	146	43	h/y	6.80	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil removal - Sh/Ex/FELs loading topsoil at Eastern Open Cut - northern area	152	536,015	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Sh/Ex/FELs loading topsoil at Eastern Open Cut - southern area	22	75,955	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Sh/Ex/FELs loading topsoil at Western Open Cut - northern area	50	176,541	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Sh/Ex/FELs loading topsoil at Western Open Cut - southern area	17	61,489	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Hauling topsoil from Eastern Open Cut - northern area to Eastern topsoil stockpile	24,680	536,015	t/y	0.3070	kg/t	150	t/load	249	Vehicle gross mass (t)	9.3	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from Eastern Open Cut - southern area to Eastern topsoil stockpile	3,056	75,955	t/y	0.2682	kg/t	150	t/load	249	Vehicle gross mass (t)	8.1	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from Western Open Cut - northern area to Western topsoil stockpile (north)	5,742	176,541	t/y	0.2168	kg/t	150	t/load	249	Vehicle gross mass (t)	6.5	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from Western Open Cut - southern area to Western topsoil stockpile (south)	2,419	61,489	t/y	0.2622	kg/t	150	t/load	249	Vehicle gross mass (t)	7.9	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Emplacing topsoil from Eastern Open Cut - northern area to Eastern topsoil stockpile	218	536,015	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from Eastern Open Cut - southern area to Eastern topsoil stockpile	31	75,955	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from Western Open Cut - northern area to Western topsoil stockpile (north)	72	176,541	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from Western Open Cut - southern area to Western topsoil stockpile (south)	25	61,489	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Drilling at Eastern Open Cut - northern area	936	5,285	holes/y	0.59	kg/hole											70	% Control	AP-42 Table 11.9-4
OB - Drilling at Eastern Open Cut - southern area	133	749	holes/y	0.59	kg/hole											70	% Control	AP-42 Table 11.9-4
OB - Drilling at Western Open Cut - northern area	399	2,253	holes/y	0.59	kg/hole											70	% Control	AP-42 Table 11.9-5
OB - Drilling at Western Open Cut - southern area	139	785	holes/y	0.59	kg/hole											70	% Control	AP-42 Table 11.9-5
OB - Blasting at Eastern Open Cut - northern area	7,547	17	blasts/y	432	kg/blast	15,676	Area of blast in square metres	302	holes/blast							0	% Control	AP-42 Table 11.9-2
OB - Blasting at Eastern Open Cut - southern area	1,069	2	blasts/y	432	kg/blast	15,676	Area of blast in square metres	302	holes/blast							0	% Control	AP-42 Table 11.9-2
OB - Blasting at Western Open Cut - northern area	3,217	7	blasts/y	432	kg/blast	15,676	Area of blast in square metres	302	holes/blast							0	% Control	AP-42 Table 11.9-3
OB - Blasting at Western Open Cut - southern area	1,121	3	blasts/y	432	kg/blast	15,676	Area of blast in square metres	302	holes/blast							0	% Control	AP-42 Table 11.9-3
OB - Sh/Ex/FELs loading OB to trucks at Eastern Open Cut - northern area	9,054	31,836,934	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% Control	AP-42 c13s2.4.3
OB - Sh/Ex/FELs loading OB to trucks at Eastern Open Cut - southern area	1,283	4,511,369	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% Control	AP-42 c13s2.4.3
OB - Sh/Ex/FELs loading OB to trucks at Western Open Cut - northern area	3,875	13,625,823	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% Control	AP-42 c13s2.4.4
OB - Sh/Ex/FELs loading OB to trucks at Western Open Cut - southern area	1,350	4,745,874	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% Control	AP-42 c13s2.4.4
OB - Hauling OB from Eastern Open Cut (Pit 1 - northern area) to Eastern OEA	798,426	18,498,691	t/y	0.288	kg/t	150	t/load	249	Vehicle gross mass (t)	8.7	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Eastern Open Cut (southern area) to Eastern OEA	123,979	2,621,309	t/y	0.315	kg/t	150	t/load	249	Vehicle gross mass (t)	9.5	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Eastern Open Cut (northern area) to Western Open Cut In-Pit 5 (northern area) Dump Area	289,616	3,900,303	t/y	0.495	kg/t	150	t/load	249	Vehicle gross mass (t)	14.9	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Western Open Cut (northern area) to Western Open Cut In-Pit 5 (northern area) Dump Area	220,973	18,371,697	t/y	0.080	kg/t	150	t/load	249	Vehicle gross mass (t)	2.4	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Eastern Open Cut to Ex-Pit South (SOEA)	485,665	11,328,000	t/y	0.286	kg/t	150	t/load	249	Vehicle gross mass (t)	8.6	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Trucks emplacing OB from Eastern Open Cut (northern area) to Eastern OEA	7,515	18,498,691	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing OB from Eastern Open Cut (southern area) to Eastern OEA	1,065	2,621,309	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing OB from Eastern Open Cut (northern area) to Western Open Cut In-Pit 5 (northern area) Dump Area	1,585	3,900,303	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing OB from Western Open Cut (northern area) to Western Open Cut In-Pit 5 (northern area) Dump Area	7,464	18,371,697	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing from Eastern Open Cut to Ex-Pit South (SOEA)	4,602	11,328,000	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Dozers on Eastern OEA	56,658	16,672	h/y	6.8	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
OB - Dozers on Western Open Cut (northern area) Dump Area	29,536	8,691	h/y	6.8	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
OB - Dozers on Ex-Pit South (SOEA)	43,933	12,928	h/y	6.8	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2

Table B.4: Year 5 TSP Emissions (cont.)

ACTIVITY	TSP emission for Year 3 (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units	Emission Factor Source
CL - Dozers ripping/pushing/clean-up on Eastern Open Cut	32,418	2,145	h/y	30.2	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Dozers ripping/pushing/clean-up on Western Open Cut	20,058	1,327	h/y	30.2	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-3
CL - Drilling at Eastern Open Cut	94	3,128	holes/y	0.1	kg/hole											70	% Control	AP-42 Table 11.9-4
CL - Drilling at Western Open Cut	20	663	holes/y	0.1	kg/hole											70	% Control	AP-42 Table 11.9-5
CL - Blasting at Eastern Open Cut	4,386	11	blasts/y	409	kg/blast	15,117	Area of blast in square metres	292	holes/blast							0	% Control	AP-42 Table 11.9-2
CL - Blasting at Western Open Cut	930	2	blasts/y	409	kg/blast	15,117	Area of blast in square metres	292	holes/blast							0	% Control	AP-42 Table 11.9-3
CL - Loading ROM coal from Eastern Open Cut to trucks	91,243	3,349,218	t/y	0.039	kg/t	9.5	moisture content in %									30	% control	AP-42 Table 11.9-2
CL - Loading ROM coal from Western Open Cut to trucks	18,009	661,038	t/y	0.039	kg/t	9.5	moisture content in %									30	% control	AP-42 Table 11.9-3
CL - Hauling ROM coal from Eastern Open Cut to the hopper at the ROM coal pad	121,385	3,349,218	t/y	0.2416	kg/t	150	t/load	249	Vehicle gross mass (t)	7.3	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
CL - Hauling ROM coal from Western Open Cut to the hopper at the ROM coal pad	16,960	661,038	t/y	0.1710	kg/t	150	t/load	249	Vehicle gross mass (t)	5.2	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.3
CL - Unloading ROM coal from Eastern & Western Open Cuts to the hopper ROM coal pad	78,037	4,010,256	t/y	0.039	kg/t	9.5	moisture content in %									50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile	243	4,010,256	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile - Unloading Conveyor	243	4,010,256	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - Raw Coal Stockpile to CHPP	243	4,010,256	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - Raw Coal Stockpile to CHPP - Unloading Conveyor	243	4,010,256	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Crushing OC ROM coal at the CHPP	2,406	4,010,256	t/y	0.0006	kg/t											0	% control	AP-42 Table 11.19.2-1
CL - Screening OC ROM coal at the CHPP	4,411	4,010,256	t/y	0.0011	kg/t											0	% control	AP-42 Table 11.19.2-1
CL - Conveyer transfer - CHPP to Product Coal Stockpile	124	2,511,349	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - CHPP to Product Coal Stockpile - Unloading Conveyor	124	2,511,349	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Dozer/FEL on Raw Coal Stockpile	24,153	1,598	h/y	30.2	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Dozer/FEL on Product Coal Stockpile	19,962	1,598	h/y	25.0	kg/h	10	silt content in %	11	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Hauling rejects from wash plant to Ex-Pit North (WOEA)	59,285	1,551,931	t/y	0.2547	kg/t	150	t/load	249	Vehicle gross mass (t)	7.7	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
CL - Loading product coal to trains	124	2,511,349	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content in %							50	% Control	AP-42 c13s2.4.3
WE - Eastern Open Cut	15,023	17.2	ha	0.1	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Western Open Cut	9,296	10.6	ha	0.1	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Eastern OEA	7,932	9.1	ha	0.1	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Ex-Pit North (Western OEA) - Area Disturbed	46,351	52.9	ha	0.1	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Ex-Pit South (Southern OEA) - Area Disturbed	26,015	29.7	ha	0.1	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Rehab North Western OEA	2,004	7.6	ha	0.1	kg/ha/h	8,760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (1) - Area Disturbed	4,468	10.2	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (2) - Area Disturbed	5,300	12.1	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (3) - Area Disturbed	1,971	4.5	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (4) - Area Disturbed	2,497	5.7	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (5) - Area Disturbed	34,602	79.0	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Raw Coal Stockpile	1,018	2.3	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Product Coal Stockpile	2,595	5.9	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
Grading roads	10,635	34,560	km	0.62	kg/km	8	speed of graders in km/h	4,320	grader hours							50	% Control	AP-42 Table 11.9-2
Total TSP emissions for Year 3 (2018) (kg/yr)	**1,871,969**																	

Table B.5: Year 5 PM_{10} Emissions

ACTIVITY	TSP emission for Year 5 (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units	Emission Factor Source
CL - Dozers ripping/pushing/clean-up on Eastern Open Cut (northern area)	36,481	2,414	h/y	30.2	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Dozers ripping/pushing/clean-up on Eastern Open Cut (southern area)	5,169	342	h/y	30.2	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Dozers ripping/pushing/clean-up on Western Open Cut (northern area)	12,015	795	h/y	30.2	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-3
CL - Dozers ripping/pushing/clean-up on Western Open Cut (southern area)	4,185	277	h/y	30.2	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-3
CL - Drilling at Eastern Open Cut (northern area)	78	2,587	holes/y	0.1	kg/hole											70	% Control	AP-42 Table 11.9-4
CL - Drilling at Eastern Open Cut (southern area)	11	367	holes/y	0.1	kg/hole											70	% Control	AP-42 Table 11.9-4
CL - Drilling at Western Open Cut (northern area)	57	1,889	holes/y	0.1	kg/hole											70	% Control	AP-42 Table 11.9-5
CL - Drilling at Western Open Cut (southern area)	20	658	holes/y	0.1	kg/hole											70	% Control	AP-42 Table 11.9-5
CL - Blasting at Eastern Open Cut (northern area)	3,706	9	blasts/y	436	kg/blast	15,778	Area of blast in square metres	304	holes/blast							0	% Control	AP-42 Table 11.9-2
CL - Blasting at Eastern Open Cut (southern area)	526	1	blasts/y	439	kg/blast	15,840	Area of blast in square metres	306	holes/blast							0	% Control	AP-42 Table 11.9-2
CL - Blasting at Western Open Cut (northern area)	2,711	6	blasts/y	439	kg/blast	15,840	Area of blast in square metres	306	holes/blast							0	% Control	AP-42 Table 11.9-3
CL - Blasting at Western Open Cut (southern area)	944	2	blasts/y	439	kg/blast	15,840	Area of blast in square metres	306	holes/blast							0	% Control	AP-42 Table 11.9-3
CL - Loading ROM coal from Eastern Open Cut (northern area) to trucks	70,033	2,570,656	t/y	0.039	kg/t	9.5	moisture content in %									30	% control	AP-42 Table 11.9-2
CL - Loading ROM coal from Eastern Open Cut (southern area) to trucks	9,924	364,268	t/y	0.039	kg/t	9.5	moisture content in %									30	% control	AP-42 Table 11.9-2
CL - Loading ROM coal from Western Open Cut (northern area) to trucks	51,217	1,880,002	t/y	0.039	kg/t	9.5	moisture content in %									30	% control	AP-42 Table 11.9-3
CL - Loading ROM coal from Western Open Cut (southern area) to trucks	17,839	654,805	t/y	0.039	kg/t	9.5	moisture content in %									30	% control	AP-42 Table 11.9-3
CL - Hauling ROM coal from Eastern Open Cut (northern area) to the hopper at the ROM coal pad	131,881	2,570,656	t/y	0.3420	kg/t	150	t/load	249	Vehicle gross mass (t)	10.3	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
CL - Hauling ROM coal from Eastern Open Cut (southern area) to the hopper at the ROM coal pad	22,722	364,268	t/y	0.4158	kg/t	150	t/load	249	Vehicle gross mass (t)	12.6	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
CL - Hauling ROM coal from Western Open Cut (northern area) to the hopper at the ROM coal pad	63,763	1,880,002	t/y	0.2261	kg/t	150	t/load	249	Vehicle gross mass (t)	6.8	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.3
CL - Hauling ROM coal from Western Open Cut (southern area) to the hopper at the ROM coal pad	29,219	654,805	t/y	0.2975	kg/t	150	t/load	249	Vehicle gross mass (t)	9.0	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.3
CL - Unloading ROM coal from Eastern & Western Open Cuts to the hopper ROM coal pad	106,438	5,469,730	t/y	0.039	kg/t	9.5	moisture content in %									50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile	331	5,469,730	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile - Unloading Conveyor	331	5,469,730	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - Raw Coal Stockpile to CHPP	331	5,469,730	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - Raw Coal Stockpile to CHPP - Unloading Conveyor	331	5,469,730	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Crushing OC ROM coal at the CHPP	3,282	5,469,730	t/y	0.0006	kg/t											0	% control	AP-42 Table 11.19.2-1
CL - Screening OC ROM coal at the CHPP	6,017	5,469,730	t/y	0.0011	kg/t											0	% control	AP-42 Table 11.19.2-1
CL - Conveyer transfer - CHPP to Product Coal Stockpile	215	4,368,540	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - CHPP to Product Coal Stockpile - Unloading Conveyor	205	4,166,756	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Dozer/FEL on Raw Coal Stockpile	77,421	5,122	h/y	30.2	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Dozer/FEL on Product Coal Stockpile	63,987	5,122	h/y	25.0	kg/h	10	silt content in %	11	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Hauling rejects from wash plant to Ex-Pit South (SOEA)	43,881	1,148,684	t/y	0.2547	kg/t	150	t/load	249	Vehicle gross mass (t)	7.7	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
CL - Loading product coal to trains	215	4,368,540	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content in %							50	% Control	AP-42 c13s2.4.3
WE - Eastern Open Cut Pit (northern area)	85,656	97.8	ha	0.1	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Eastern Open Cut Pit (southern area)	12,138	13.9	ha	0.1	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Western Open Cut Pit (northern area)	28,212	32.2	ha	0.1	kg/ha/h	8,760	h/y									-	% Control	AP-42 Table 11.9-2
WE - Western Open Cut Pit (southern area)	9,826	11.2	ha	0.1	kg/ha/h	8,760	h/y									-	% Control	AP-42 Table 11.9-2
WE - Eastern OEA	72,967	83.3	ha	0.1	kg/ha/h	8,760	h/y									-	% Control	AP-42 Table 11.9-2
WE - Ex-Pit South (Southern OEA)	56,578	64.6	ha	0.1	kg/ha/h	8,760	h/y									-	% Control	AP-42 Table 11.9-2
WE - Ex-Pit North (Northern OEA)	20,737	23.7	ha	0.1	kg/ha/h	8,760	h/y									-	% Control	AP-42 Table 11.9-2
WE - Rehab Eastern OEA	5,253	20.0	ha	0.1	kg/ha/h	8,760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Rehab Southern OEA	4,086	15.5	ha	0.1	kg/ha/h	8,760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Rehab Western Open Cut	1,938	7.4	ha	0.1	kg/ha/h	8,760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Rehab Northern OEA	5,150	19.6	ha	0.1	kg/ha/h	8,760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (1)	17,777	40.6	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (2)	7,814	17.8	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (3)	34,602	79.0	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Raw Coal Stockpile	1,018	2.3	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Product Coal Stockpile	2,595	5.9	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
Grading roads	31,906	103,680	km	0.62	kg/km	8	speed of graders in km/h	12,960	grader hours							50	% Control	AP-42 Table 11.9-2
Total TSP emissions for Year 5 (2020) (kg/yr)	**3,303,381**																	

Table B.5: Year 5 PM_{10} Emissions (cont.)

ACTIVITY	PM_{10} emission for Year 3 (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units	Emission Factor Source
CL - Dozers ripping/pushing/clean-up on Eastern Open Cut	9,183	2,145	h/y	8.6	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Dozers ripping/pushing/clean-up on Western Open Cut	5,682	1,327	h/y	8.6	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-3
CL - Drilling at Eastern Open Cut	49	3,128	holes/y	0.052	kg/hole											70	% Control	AP-42 Table 11.9-4
CL - Drilling at Western Open Cut	10	663	holes/y	0.052	kg/hole											70	% Control	AP-42 Table 11.9-5
CL - Blasting at Eastern Open Cut	2,281	11	blasts/y	212.6	kg/blast	15,117	Area of blast in square metres	292	holes/blast							0	% Control	AP-42 Table 11.9-2
CL - Blasting at Western Open Cut	484	2	blasts/y	212.6	kg/blast	15,117	Area of blast in square metres	292	holes/blast							0	% Control	AP-42 Table 11.9-3
CL - Loading ROM coal from Eastern Open Cut to trucks	13,816	3,349,218	t/y	0.006	kg/t	9.5	moisture content in %									30	% control	AP-42 Table 11.9-2
CL - Loading ROM coal from Western Open Cut to trucks	2,727	661,038	t/y	0.006	kg/t	9.5	moisture content in %									30	% control	AP-42 Table 11.9-3
CL - Hauling ROM coal from Eastern Open Cut to the hopper at the ROM coal pad	29,976	3,349,218	t/y	0.0597	kg/t	150	t/load	249	Vehicle gross mass (t)	7.3	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
CL - Hauling ROM coal from Western Open Cut to the hopper at the ROM coal pad	4,188	661,038	t/y	0.0422	kg/t	150	t/load	249	Vehicle gross mass (t)	5.2	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.3
CL - Unloading ROM coal from Eastern & Western Open Cuts to the hopper ROM coal pad	11,817	4,010,256	t/y	0.006	kg/t	9.5	moisture content in %									50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile	115	4,010,256	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile - Unloading Conveyor	115	4,010,256	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - Raw Coal Stockpile to CHPP	115	4,010,256	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - Raw Coal Stockpile to CHPP - Unloading Conveyor	115	4,010,256	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Crushing OC ROM coal at the CHPP	1,083	4,010,256	t/y	0.00027	kg/t											0	% control	AP-42 Table 11.19.2-1
CL - Screening OC ROM coal at the CHPP	1,484	4,010,256	t/y	0.00037	kg/t											0	% control	AP-42 Table 11.19.2-1
CL - Conveyer transfer - CHPP to Product Coal Stockpile	59	2,511,349	t/y	0.00005	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - CHPP to Product Coal Stockpile - Unloading Conveyor	59	2,511,349	t/y	0.00005	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Dozer/FEL on Raw Coal Stockpile	6,841	1,598	h/y	8.6	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Dozer/FEL on Product Coal Stockpile	5,572	1,598	h/y	7.0	kg/h	10	silt content in %	11	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Hauling rejects from wash plant to Ex-Pit North (WOEA)	14,641	1,551,931	t/y	0.0629	kg/t	150	t/load	249	Vehicle gross mass (t)	7.7	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
CL - Loading product coal to trains	59	2,511,349	t/y	0.00005	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content in %							50	% Control	AP-42 c13s2.4.3
WE - Eastern Open Cut	7,512	17.2	ha	0.05	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Western Open Cut	4,648	10.6	ha	0.05	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Eastern OEA	3,966	9.1	ha	0.05	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Ex-Pit North (Western OEA) - Area Disturbed	23,175	52.9	ha	0.05	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Ex-Pit South (Southern OEA) - Area Disturbed	13,008	29.7	ha	0.05	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Rehab North Western OEA	1,002	7.6	ha	0.05	kg/ha/h	8,760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (1) - Area Disturbed	2,234	10.2	ha	0.05	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (2) - Area Disturbed	2,650	12.1	ha	0.05	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (3) - Area Disturbed	986	4.5	ha	0.05	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (4) - Area Disturbed	1,248	5.7	ha	0.05	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (5) - Area Disturbed	17,301	79	ha	0.05	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Raw Coal Stockpile	509	2.3	ha	0.05	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Product Coal Stockpile	1,297	5.9	ha	0.05	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
Grading roads	3,716	34,560	km	0.22	kg/km	8	speed of graders in km/h	4320	grader hours							50	% Control	AP-42 Table 11.9-2
Total TSP emissions for Year 3 (2018) (kg/yr)	**471,907**																	

Table B.6: Year 5 $PM_{2.5}$ Emissions

ACTIVITY	$PM_{2.5}$ emission for Year 5 (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units	Emission Factor Source
Topsoil Removal - Dozers stripping topsoil at Eastern Open Cut - northern area	134	375	h/y	0.71	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil Removal - Dozers stripping topsoil at Eastern Open Cut - southern area	19	53	h/y	0.71	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil Removal - Dozers stripping topsoil at Western Open Cut - northern area	44	124	h/y	0.71	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil Removal - Dozers stripping topsoil at Western Open Cut - southern area	15	43	h/y	0.71	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
Topsoil removal - Sh/Ex/FELs loading topsoil at Eastern Open Cut - northern area	11	536,015	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in r	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Sh/Ex/FELs loading topsoil at Eastern Open Cut - southern area	2	75,955	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in r	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Sh/Ex/FELs loading topsoil at Western Open Cut - northern area	4	176,541	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in r	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Sh/Ex/FELs loading topsoil at Western Open Cut - southern area	1	61,489	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in r	4	moisture content in %							30	% control	AP-42 c13s2.4.3
Topsoil removal - Hauling topsoil from Eastern Open Cut - northern area to Eastern topsoil stockpile	609	536,015	t/y	0.0076	kg/t	150	t/load	249	Vehicle gross mass (t)	9.3	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from Eastern Open Cut - southern area to Eastern topsoil stockpile	75	75,955	t/y	0.0066	kg/t	150	t/load	249	Vehicle gross mass (t)	8.1	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from Western Open Cut - northern area to Western topsoil stockpile (north)	142	176,541	t/y	0.0054	kg/t	150	t/load	249	Vehicle gross mass (t)	6.5	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Hauling topsoil from Western Open Cut - southern area to Western topsoil stockpile (south)	60	61,489	t/y	0.0065	kg/t	150	t/load	249	Vehicle gross mass (t)	7.9	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
Topsoil removal - Emplacing topsoil from Eastern Open Cut - northern area to Eastern topsoil stockpile	16	536,015	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in r	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from Eastern Open Cut - southern area to Eastern topsoil stockpile	2	75,955	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in r	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from Western Open Cut - northern area to Western topsoil stockpile (north)	5	176,541	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in r	4	moisture content in %							0	% control	AP-42 c13s2.4.3
Topsoil removal - Emplacing topsoil from Western Open Cut - southern area to Western topsoil stockpile (south)	2	61,489	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in r	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Drilling at Eastern Open Cut - northern area	28	5,285	holes/y	0.02	kg/hole											70	% Control	AP-42 Table 11.9-4
OB - Drilling at Eastern Open Cut - southern area	4	749	holes/y	0.02	kg/hole											70	% Control	AP-42 Table 11.9-4
OB - Drilling at Western Open Cut - northern area	12	2,253	holes/y	0.02	kg/hole											70	% Control	AP-42 Table 11.9-5
OB - Drilling at Western Open Cut - southern area	4	785	holes/y	0.02	kg/hole											70	% Control	AP-42 Table 11.9-5
OB - Blasting at Eastern Open Cut - northern area	226	17	blasts/y	12.95	kg/blast	15,676	Area of blast in square metres	302	holes/blast							0	% Control	AP-42 Table 11.9-2
OB - Blasting at Eastern Open Cut - southern area	32	2	blasts/y	12.95	kg/blast	15,676	Area of blast in square metres	302	holes/blast							0	% Control	AP-42 Table 11.9-2
OB - Blasting at Western Open Cut - northern area	97	7	blasts/y	12.95	kg/blast	15,676	Area of blast in square metres	302	holes/blast							0	% Control	AP-42 Table 11.9-3
OB - Blasting at Western Open Cut - southern area	34	3	blasts/y	12.95	kg/blast	15,676	Area of blast in square metres	302	holes/blast							0	% Control	AP-42 Table 11.9-3
OB - Sh/Ex/FELs loading OB to trucks at Eastern Open Cut - northern area	648	31,836,934	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in r	4	moisture content in %							30	% Control	AP-42 c13s2.4.3
OB - Sh/Ex/FELs loading OB to trucks at Eastern Open Cut - southern area	92	4,511,369	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in r	4	moisture content in %							30	% Control	AP-42 c13s2.4.3
OB - Sh/Ex/FELs loading OB to trucks at Western Open Cut - northern area	278	13,625,823	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in r	4	moisture content in %							30	% Control	AP-42 c13s2.4.4
OB - Sh/Ex/FELs loading OB to trucks at Western Open Cut - southern area	97	4,745,874	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in r	4	moisture content in %							30	% Control	AP-42 c13s2.4.4
OB - Hauling OB from Eastern Open Cut (Pit 1 - northern area) to Eastern OEA	19,717	18,498,691	t/y	0.007	kg/t	150	t/load	249	Vehicle gross mass (t)	8.7	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Eastern Open Cut (southern area) to Eastern OEA	30,617	2,621,309	t/y	0.078	kg/t	150	t/load	249	Vehicle gross mass (t)	9.5	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Eastern Open Cut (northern area) to Western Open Cut In-Pit 5 (northern area) Dump Area	7,152	3,900,303	t/y	0.012	kg/t	150	t/load	249	Vehicle gross mass (t)	14.9	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Western Open Cut (northern area) to Western Open Cut In-Pit 5 (northern area) Dump Area	5,457	18,371,697	t/y	0.002	kg/t	150	t/load	249	Vehicle gross mass (t)	2.4	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Hauling OB from Eastern Open Cut to Ex-Pit South (SOEA)	11,994	11,328,000	t/y	0.007	kg/t	150	t/load	249	Vehicle gross mass (t)	8.6	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Trucks emplacing OB from Eastern Open Cut (northern area) to Eastern OEA	538	18,498,691	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in r	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing OB from Eastern Open Cut (southern area) to Eastern OEA	76	2,621,309	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in r	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing OB from Eastern Open Cut (northern area) to Western Open Cut In-Pit 5 (northern area) Dump Area	113	3,900,303	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in r	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing OB from Western Open Cut (northern area) to Western Open Cut In-Pit 5 (northern area) Dump Area	535	18,371,697	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in r	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Trucks emplacing from Eastern Open Cut to Ex-Pit South (SOEA)	330	11,328,000	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in r	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Dozers on Eastern OEA	1,341	16,672	h/y	0.161	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
OB - Dozers on Western Open Cut (northern area) Dump Area	699	8,691	h/y	0.161	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
OB - Dozers on Ex-Pit South (SOEA)	1,040	12,928	h/y	0.161	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2

Table B.6: Year 5 $PM_{2.5}$ Emissions (cont.)

ACTIVITY	$PM_{2.5}$ emission for Year 5 (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units	Emission Factor Source
CL - Dozers ripping/pushing/clean-up on Eastern Open Cut (northern area)	803	2,414	h/y	0.7	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Dozers ripping/pushing/clean-up on Eastern Open Cut (southern area)	114	342	h/y	0.7	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Dozers ripping/pushing/clean-up on Western Open Cut (northern area)	264	795	h/y	0.7	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-3
CL - Dozers ripping/pushing/clean-up on Western Open Cut (southern area)	92	277	h/y	0.7	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-3
CL - Drilling at Eastern Open Cut (northern area)	2	2,587	holes/y	0.003	kg/hole											70	% Control	AP-42 Table 11.9-4
CL - Drilling at Eastern Open Cut (southern area)	0	367	holes/y	0.003	kg/hole											70	% Control	AP-42 Table 11.9-4
CL - Drilling at Western Open Cut (northern area)	2	1,889	holes/y	0.003	kg/hole											70	% Control	AP-42 Table 11.9-5
CL - Drilling at Western Open Cut (southern area)	1	658	holes/y	0.003	kg/hole											70	% Control	AP-42 Table 11.9-5
CL - Blasting at Eastern Open Cut (northern area)	111	9	blasts/y	13.08	kg/blast	15,778	Area of blast in square metres	304	holes/blast							0	% Control	AP-42 Table 11.9-2
CL - Blasting at Eastern Open Cut (southern area)	16	1	blasts/y	13.16	kg/blast	15,840	Area of blast in square metres	306	holes/blast							0	% Control	AP-42 Table 11.9-2
CL - Blasting at Western Open Cut (northern area)	81	6	blasts/y	13.16	kg/blast	15,840	Area of blast in square metres	306	holes/blast							0	% Control	AP-42 Table 11.9-3
CL - Blasting at Western Open Cut (southern area)	28	2	blasts/y	13.16	kg/blast	15,840	Area of blast in square metres	306	holes/blast							0	% Control	AP-42 Table 11.9-3
CL - Loading ROM coal from Eastern Open Cut (northern area) to trucks	1,331	2,570,656	t/y	0.001	kg/t	9.5	moisture content in %									30	% control	AP-42 Table 11.9-2
CL - Loading ROM coal from Eastern Open Cut (southern area) to trucks	189	364,268	t/y	0.001	kg/t	9.5	moisture content in %									30	% control	AP-42 Table 11.9-2
CL - Loading ROM coal from Western Open Cut (northern area) to trucks	973	1,880,002	t/y	0.001	kg/t	9.5	moisture content in %									30	% control	AP-42 Table 11.9-3
CL - Loading ROM coal from Western Open Cut (southern area) to trucks	339	654,805	t/y	0.001	kg/t	9.5	moisture content in %									30	% control	AP-42 Table 11.9-3
CL - Hauling ROM coal from Eastern Open Cut (northern area) to the hopper at the ROM coal pad	3,257	2,570,656	t/y	0.0084	kg/t	150	t/load	249	Vehicle gross mass (t)	10.322	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
CL - Hauling ROM coal from Eastern Open Cut (southern area) to the hopper at the ROM coal pad	561	364,268	t/y	0.0103	kg/t	150	t/load	249	Vehicle gross mass (t)	12.55	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
CL - Hauling ROM coal from Western Open Cut (northern area) to the hopper at the ROM coal pad	1,575	1,880,002	t/y	0.0056	kg/t	150	t/load	249	Vehicle gross mass (t)	6.824	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.3
CL - Hauling ROM coal from Western Open Cut (southern area) to the hopper at the ROM coal pad	722	654,805	t/y	0.0073	kg/t	150	t/load	249	Vehicle gross mass (t)	8.978	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.3
CL - Unloading ROM coal from Eastern & Western Open Cuts to the hopper ROM coal pad	2,022	5,469,730	t/y	0.001	kg/t	9.5	moisture content in %									50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile	24	5,469,730	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in n	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile - Unloading Conveyor	24	5,469,730	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in n	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - Raw Coal Stockpile to CHPP	24	5,469,730	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in n	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - Raw Coal Stockpile to CHPP - Unloading Conveyor	24	5,469,730	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in n	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Crushing OC ROM coal at the CHPP	273	5,469,730	t/y	0.00005	kg/t											0	% control	AP-42 Table 11.19.2-1
CL - Screening OC ROM coal at the CHPP	137	5,469,730	t/y	0.000025	kg/t											0	% control	AP-42 Table 11.19.2-1
CL - Conveyer transfer - CHPP to Product Coal Stockpile	15	4,368,540	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in n	11	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - CHPP to Product Coal Stockpile - Unloading Conveyor	15	4,166,756	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in n	11	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Dozer/FEL on Raw Coal Stockpile	1,408	5,122	h/y	0.55	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Dozer/FEL on Product Coal Stockpile	14	5,122	h/y	0.01	kg/h	10	silt content in %	11	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Hauling rejects from wash plant to Ex-Pit South (SOEA)	1,084	1,148,684	t/y	0.0063	kg/t	150	t/load	249	Vehicle gross mass (t)	7.686	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
CL - Loading product coal to trains	15	4,368,540	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in n	11	moisture content in %							50	% Control	AP-42 c13s2.4.3
WE - Eastern Open Cut Pit (northern area)	6,424	98	ha	0.0075	kg/ha/h	8760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Eastern Open Cut Pit (southern area)	910	14	ha	0.0075	kg/ha/h	8760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Western Open Cut Pit (northern area)	2,116	32	ha	0.0075	kg/ha/h	8760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Western Open Cut Pit (southern area)	737	11	ha	0.0075	kg/ha/h	8760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Eastern OEA	5,472	83	ha	0.0075	kg/ha/h	8760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Ex-Pit South (Southern OEA)	4,243	65	ha	0.0075	kg/ha/h	8760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Ex-Pit North (Northern OEA)	1,555	24	ha	0.0075	kg/ha/h	8760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Rehab Eastern OEA	394	20	ha	0.0075	kg/ha/h	8760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Rehab Southern OEA	306	16	ha	0.0075	kg/ha/h	8760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Rehab Western Open Cut	145	7	ha	0.0075	kg/ha/h	8760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Rehab Northern OEA	386	20	ha	0.0075	kg/ha/h	8760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (1)	1,333	41	ha	0.0075	kg/ha/h	8760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (2)	586	18	ha	0.0075	kg/ha/h	8760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile (3)	2,595	79	ha	0.0075	kg/ha/h	8760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Raw Coal Stockpile	76	2	ha	0.0075	kg/ha/h	8760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Product Coal Stockpile	195	6	ha	0.0075	kg/ha/h	8760	h/y									50	% Control	AP-42 Table 11.9-2
Grading roads	989	103,680	km	0.02	kg/km	8	speed of graders in km/h	12,960	grader hours							50	% Control	AP-42 Table 11.9-2
Total TSP emissions for Year 5 (2020) (kg/yr)	**126,306**																	

Table B.7: Year 9 TSP Emissions

ACTIVITY	TSP emission for Year 9 (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units	Emission Factor Source
OB - Drilling at Eastern Open Cut	2,997	16,931	holes/y	0.59	kg/hole											70	% Control	AP-42 Table 11.9-4
OB - Blasting at Eastern Open Cut	24,174	56	blasts/y	432	kg/blast	15,673	Area of blast in square metres	302	holes/blast							0	% Control	AP-42 Table 11.9-2
OB - Sh/Ex/FELs loading OB to trucks at Eastern Open Cut	13,432	47,232,000	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							30	% Control	AP-42 c13s2.4.3
OB - Hauling OB from Eastern Open Cut to Eastern OEA	2,220,759	47,232,000	t/y	0.313	kg/t	150	t/load	249	Vehicle gross mass (t)	9.5	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Trucks emplacing OB from Eastern Open Cut to Eastern Open Cut Dump Area	19,188	47,232,000	t/y	0.0004	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Dozers on Eastern OEA	136,904	40,286	h/y	6.8	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
CL - Dozers ripping/pushing/clean-up on Eastern Open Cut	36,701	2,428	h/y	30.2	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Drilling at Eastern Open Cut	362	12,075	holes/y	0.1	kg/hole											70	% Control	AP-42 Table 11.9-4
CL - Blasting at Eastern Open Cut	17,227	40	blasts/y	431	kg/blast	15,649	Area of blast in square metres	302	holes/blast							0	% Control	AP-42 Table 11.9-2
CL - Loading ROM coal from Eastern Open Cut to trucks	77,560	2,846,936	t/y	0.039	kg/t	9.5	moisture content in %									30	% control	AP-42 Table 11.9-2
CL - Hauling ROM coal from Eastern Open Cut to the hopper at the ROM coal pad	111,840	2,846,936	t/y	0.2619	kg/t	150	t/load	249	Vehicle gross mass (t)	7.9	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
CL - Unloading ROM coal from Eastern Open Cut to the hopper ROM coal pad	55,400	2,846,936	t/y	0.039	kg/t	9.5	moisture content in %									50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile	172	2,846,936	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile - Unloading Conveyor	172	2,846,936	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - Raw Coal Stockpile to CHPP	172	2,846,936	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - Raw Coal Stockpile to CHPP - Unloading Conveyor	172	2,846,936	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
UG - Conveyor transfer - UG coal to ROM coal stockpile at CHPP	221	3,653,064	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
UG - Conveyor transfer - UG coal to ROM coal stockpile at CHPP - Unloading Conveyor	221	3,653,064	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
UG - Ventillation Shaft	16,556	350	m^3/s	1.5	mg/m^3											0	% control	-
CL - Crushing OC & UG ROM coal at the CHPP	3,900	6,500,000	t/y	0.0006	kg/t											0	% control	AP-42 Table 11.19.2-1
CL - Screening OC & UG ROM coal at the CHPP	7,150	6,500,000	t/y	0.0011	kg/t											0	% control	AP-42 Table 11.19.2-1
CL - Conveyer transfer - CHPP to Product Coal Stockpile	116	2,357,125	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - CHPP to Product Coal Stockpile - Unloading Conveyor	116	2,357,125	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Dozer/FEL on Raw Coal Stockpile	92,476	6,119	h/y	30.2	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Dozer/FEL on Product Coal Stockpile	76,429	6,119	h/y	25.0	kg/h	10	silt content in %	11	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Hauling rejects from wash plant to Eastern OEA	129,433	2,132,123	t/y	0.4047	kg/t	150	t/load	249	Vehicle gross mass (t)	12.2	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
CL - Loading product coal (OC + UG) to trains	219	4,450,648	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content in %							50	% Control	AP-42 c13s2.4.3
WE - Eastern Open Cut	84,876	96.9	ha	0.1	kg/ha/h	8,760	h/y									0.0	% Control	AP-42 Table 11.9-2
WE - Eastern OEA	116,529	133.0	ha	0.1	kg/ha/h	8,760	h/y									0.0	% Control	AP-42 Table 11.9-2
WE - Ex-North (Northern OEA)	21,313	24.3	ha	0.1	kg/ha/h	8,760	h/y									0.0	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile	10,626	40.4	ha	0.1	kg/ha/h	8,760	h/y									70.0	% Control	AP-42 Table 11.9-2
WE - Rehab Eastern OEA	39,279	149.5	ha	0.1	kg/ha/h	8,760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Rehab Southern OEA	56,088	213.4	ha	0.1	kg/ha/h	8,760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Rehab Northern OEA	4,880	18.6	ha	0.1	kg/ha/h	8,760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Raw Coal Stockpile	1,018	2.3	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Product Coal Stockpile	2,595	5.9	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
Grading roads	10,635	34,560	km	0.62	kg/km	8	speed of graders in km/h	4,320	grader hours							50	% Control	AP-42 Table 11.9-2
Total TSP emissions for Year 9 (2024) (kg/yr)	**3,391,908**																	

Table B.8: Year 9 PM_{10} Emissions

ACTIVITY	PM_{10} emission for Year 9 (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units	Emission Factor Source
OB - Drilling at Eastern Open Cut	1,558	16,931	holes/y	0.31	kg/hole											70	% Control	AP-42 Table 11.9-4
OB - Blasting at Eastern Open Cut	12,571	56	blasts/y	224	kg/blast	15,673	Area of blast in square metres	302	holes/blast							0	% Control	AP-42 Table 11.9-2
OB - Sh/Ex/FELs loading OB to trucks at Eastern Open Cut	6,353	47,232,000	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m	4	moisture content in %							30	% Control	AP-42 c13s2.4.3
OB - Hauling OB from Eastern Open Cut to Eastern OEA	548,425	47,232,000	t/y	0.077	kg/t	150	t/load	249	Vehicle gross mass (t)	9.5	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Trucks emplacing OB from Eastern Open Cut to Eastern Open Cut Dump Area	9,076	47,232,000	t/y	0.0002	kg/t	0.91	average of (wind speed/2.2)^1.3 in m	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Dozers on Eastern OEA	30,868	40,286	h/y	1.5	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
CL - Dozers ripping/pushing/clean-up on Eastern Open Cut	10,396	2,428	h/y	8.6	kg/h	10	silt content in %	10	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Drilling at Eastern Open Cut	188	12,075	holes/y	0.052	kg/hole											70	% Control	AP-42 Table 11.9-4
CL - Blasting at Eastern Open Cut	8,958	40	blasts/y	224	kg/blast	15,649	Area of blast in square metres	302	holes/blast							0	% Control	AP-42 Table 11.9-2
CL - Loading ROM coal from Eastern Open Cut to trucks	11,744	2,846,936	t/y	0.006	kg/t	10	moisture content in %									30	% control	AP-42 Table 11.9-2
CL - Hauling ROM coal from Eastern Open Cut to the hopper at the ROM coal pad	27,619	2,846,936	t/y	0.0647	kg/t	150	t/load	249	Vehicle gross mass (t)	7.9	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
CL - Unloading ROM coal from Eastern Open Cut to the hopper ROM coal pad	8,389	2,846,936	t/y	0.006	kg/t	10	moisture content in %									50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile	81	2,846,936	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m	10	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile - Unloading Conveyor	81	2,846,936	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m	10	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - Raw Coal Stockpile to CHPP	81	2,846,936	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m	10	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - Raw Coal Stockpile to CHPP - Unloading Conveyor	81	2,846,936	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m	10	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
UG - Conveyor transfer - UG coal to ROM coal stockpile at CHPP	105	3,653,064	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m	10	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
UG - Conveyor transfer - UG coal to ROM coal stockpile at CHPP - Unloading Conveyor	105	3,653,064	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m	10	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
UG - Ventillation Shaft	16,556	350	m3/s	1.5	mg/m3											-	% control	-
CL - Crushing OC & UG ROM coal at the CHPP	1,755	6,500,000	t/y	0.00027	kg/t											0	% control	AP-42 Table 11.19.2-1
CL - Screening OC & UG ROM coal at the CHPP	2,405	6,500,000	t/y	0.00037	kg/t											0	% control	AP-42 Table 11.19.2-1
CL - Conveyer transfer - CHPP to Product Coal Stockpile	55	2,357,125	t/y	0.00005	kg/t	0.91	average of (wind speed/2.2)^1.3 in m	11	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - CHPP to Product Coal Stockpile - Unloading Conveyor	55	2,357,125	t/y	0.00005	kg/t	0.91	average of (wind speed/2.2)^1.3 in m	11	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Dozer/FEL on Raw Coal Stockpile	26,194	6,119	h/y	8.6	kg/h	10	silt content in %	10	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Dozer/FEL on Product Coal Stockpile	21,334	6,119	h/y	7.0	kg/h	10	silt content in %	11	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Hauling rejects from wash plant to Eastern OEA	31,964	2,132,123	t/y	0.0999	kg/t	150	t/load	249	Vehicle gross mass (t)	12.2	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
CL - Loading product coal (OC + UG) to trains	104	4,450,648	t/y	0.00005	kg/t	0.91	average of (wind speed/2.2)^1.3 in m	11	moisture content in %							50	% Control	AP-42 c13s2.4.3
WE - Eastern Open Cut	42,438	97	ha	0.05	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Eastern OEA	58,264	133	ha	0.05	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Ex-North (Northern OEA)	10,656	24	ha	0.05	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile	5,313	40	ha	0.05	kg/ha/h	8,760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Rehab Eastern OEA	19,639	149	ha	0.05	kg/ha/h	8,760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Rehab Southern OEA	28,044	213	ha	0.05	kg/ha/h	8,760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Rehab Northern OEA	2,440	19	ha	0.05	kg/ha/h	8,760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Raw Coal Stockpile	509	2	ha	0.05	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Product Coal Stockpile	1,297	6	ha	0.05	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
Grading roads	3,716	34,560	km	0.22	kg/km	8	speed of graders in km/h	4,320	grader hours							50	% Control	AP-42 Table 11.9-2
Total PM_{10} emissions for Year 9 (2024) (kg/yr)	**949,420**																	

Table B.7: Year 9 $PM_{2.5}$ Emissions

ACTIVITY	$PM_{2.5}$ emission for Year 9 (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units	Emission Factor Source
OB - Drilling at Eastern Open Cut	90	16,931	holes/y	0.02	kg/hole											70	% Control	AP-42 Table 11.9-4
OB - Blasting at Eastern Open Cut	725	56	blasts/y	13	kg/blast	15,673	Area of blast in square metres	302	holes/blast							0	% Control	AP-42 Table 11.9-2
OB - Sh/Ex/FELs loading OB to trucks at Eastern Open Cut	962	47,232,000	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m	4	moisture content in %							30	% Control	AP-42 c13s2.4.3
OB - Hauling OB from Eastern Open Cut to Eastern OEA	54,842	47,232,000	t/y	0.008	kg/t	150	t/load	249	Vehicle gross mass (t)	9.5	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
OB - Trucks emplacing OB from Eastern Open Cut to Eastern Open Cut Dump Area	1,374	47,232,000	t/y	0.00003	kg/t	0.91	average of (wind speed/2.2)^1.3 in m	4	moisture content in %							0	% control	AP-42 c13s2.4.3
OB - Dozers on Eastern OEA	14,375	40,286	h/y	0.7	kg/h	10	silt content in %	4	moisture content in %							50	% control	AP-42 Table 11.9-2
CL - Dozers ripping/pushing/clean-up on Eastern Open Cut	807	2,428	h/y	0.67	kg/h	10	silt content in %	10	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Drilling at Eastern Open Cut	11	12,075	holes/y	0.003	kg/hole											70	% Control	AP-42 Table 11.9-4
CL - Blasting at Eastern Open Cut	517	40	blasts/y	13	kg/blast	15,649	Area of blast in square metres	302	holes/blast							0	% Control	AP-42 Table 11.9-2
CL - Loading ROM coal from Eastern Open Cut to trucks	1,474	2,846,936	t/y	0.001	kg/t	10	moisture content in %									30	% control	AP-42 Table 11.9-2
CL - Hauling ROM coal from Eastern Open Cut to the hopper at the ROM coal pad	2,762	2,846,936	t/y	0.0065	kg/t	150	t/load	249	Vehicle gross mass (t)	7.9	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
CL - Unloading ROM coal from Eastern Open Cut to the hopper ROM coal pad	1,053	2,846,936	t/y	0.001	kg/t	10	moisture content in %									50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile	12	2,846,936	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m	10	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - ROM coal pad to Raw Coal Stockpile - Unloading Conveyor	12	2,846,936	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m	10	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - Raw Coal Stockpile to CHPP	12	2,846,936	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m	10	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - Raw Coal Stockpile to CHPP - Unloading Conveyor	12	2,846,936	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m	10	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
UG - Conveyor transfer - UG coal to ROM coal stockpile at CHPP	16	3,653,064	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m	10	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
UG - Conveyor transfer - UG coal to ROM coal stockpile at CHPP - Unloading Conveyor	16	3,653,064	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m	10	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
UG - Ventillation Shaft	16,556	350	m3/s	1.5	mg/m3											-	% control	-
CL - Crushing OC & UG ROM coal at the CHPP	325	6,500,000	t/y	0.00005	kg/t											0	% control	AP-42 Table 11.19.2-1
CL - Screening OC & UG ROM coal at the CHPP	163	6,500,000	t/y	0.000025	kg/t											0	% control	AP-42 Table 11.19.2-1
CL - Conveyer transfer - CHPP to Product Coal Stockpile	8	2,357,125	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m	11	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Conveyer transfer - CHPP to Product Coal Stockpile - Unloading Conveyor	8	2,357,125	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m	11	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
CL - Dozer/FEL on Raw Coal Stockpile	2,034	6,119	h/y	0.67	kg/h	10	silt content in %	10	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Dozer/FEL on Product Coal Stockpile	1,681	6,119	h/y	0.55	kg/h	10	silt content in %	11	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
CL - Hauling rejects from wash plant to Eastern OEA	3,196	2,132,123	t/y	0.0100	kg/t	150	t/load	249	Vehicle gross mass (t)	12.2	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
CL - Loading product coal (OC + UG) to trains	16	4,450,648	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m	11	moisture content in %							50	% Control	AP-42 c13s2.4.3
WE - Eastern Open Cut	6,366	97	ha	0.0075	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Eastern OEA	8,740	133	ha	0.0075	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Ex-North (Northern OEA)	1,598	24	ha	0.0075	kg/ha/h	8,760	h/y									0	% Control	AP-42 Table 11.9-2
WE - Topsoil Stockpile	797	40	ha	0.0075	kg/ha/h	8,760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Rehab Eastern OEA	2,946	149	ha	0.0075	kg/ha/h	8,760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Rehab Southern OEA	4,207	213	ha	0.0075	kg/ha/h	8,760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Rehab Northern OEA	366	19	ha	0.0075	kg/ha/h	8,760	h/y									70	% Control	AP-42 Table 11.9-2
WE - Raw Coal Stockpile	76	2	ha	0.0075	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Product Coal Stockpile	195	6	ha	0.0075	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
Grading roads	330	34,560	km	0.02	kg/km	8	speed of graders in km/h	4,320	grader hours							50	% Control	AP-42 Table 11.9-2
Total $PM_{2.5}$ emissions for Year 9 (2024) (kg/yr)	**128,682**																	

Table B.8: Year 18 TSP Emissions

ACTIVITY	TSP emission for Year 18 (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units	Emission Factor Source
UG - Conveyor transfer - UG coal to ROM coal stockpile at CHPP	381	6,296,531	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
UG - Conveyor transfer - UG coal to ROM coal stockpile at CHPP - Unloading Conveyor	381	6,296,531	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
UG - Ventillation Shaft	16,556	350	m^3/s	1.5	mg/m^3											0	% control	-
UG - Crushing UG ROM coal at the CHPP	3,778	6,296,531	t/y	0.0006	kg/t											0	% control	AP-42 Table 11.19.2-1
UG - Screening UG ROM coal at the CHPP	6,926	6,296,531	t/y	0.0011	kg/t											0	% control	AP-42 Table 11.19.2-1
UG - Dozer/FEL on Raw Coal Stockpile	92,310	6,108	h/y	30.2	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
UG - Dozer/FEL on Product Coal Stockpile	92,310	6,108	h/y	30.2	kg/h	10	silt content in %	10	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
UG - Hauling rejects from rejects bin to Eastern OEA	178,848	2,744,353	t/y	0.4345	kg/t	150	t/load	249	Vehicle gross mass (t)	13.1	km/return trip	5.0	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
UG - Loading UG product coal to trains	175	3,552,178	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content in %							50	% Control	AP-42 c13s2.4.3
WE - Eastern OEA	159,314	181.9	ha	0.1	kg/ha/h	8,760	h/y									-	% Control	AP-42 Table 11.9-2
WE - Raw Coal Stockpile	1,018	2.3	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Product Coal Stockpile	2,595	5.9	ha	0.1	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
Grading roads	7,090	23,040	km	0.62	kg/km	8	speed of graders in km/h	2,880	grader hours							50	% Control	AP-42 Table 11.9-2
Total TSP emissions for Year 18 (2033) (kg/yr)	**561,681**																	

Table B.9: Year 18 PM_{10} Emissions

ACTIVITY	PM_{10} emission for Year 18 (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units	Emission Factor Source
UG - Conveyor transfer - UG coal to ROM coal stockpile at CHPP	180	6,296,531	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
UG - Conveyor transfer - UG coal to ROM coal stockpile at CHPP - Unloading Conveyor	180	6,296,531	t/y	0.0001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
UG - Ventillation Shaft	16,556	350	m^3/s	1.5	mg/m^3											0	% control	-
UG - Crushing UG ROM coal at the CHPP	1,700	6,296,531	t/y	0.00027	kg/t											0	% control	AP-42 Table 11.19.2-1
UG - Screening UG ROM coal at the CHPP	2,330	6,296,531	t/y	0.00037	kg/t											0	% control	AP-42 Table 11.19.2-1
UG - Dozer/FEL on Raw Coal Stockpile	633	41.9	h/y	30.2	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
UG - Dozer/FEL on Product Coal Stockpile	633	41.9	h/y	30.2	kg/h	10	silt content in %	10	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
UG - Hauling rejects from rejects bin to Eastern OEA	44,167	2,744,353	t/y	0.1073	kg/t	150	t/load	249	Vehicle gross mass (t)	13.1	km/return trip	1.2	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
UG - Loading UG product coal to trains	83	3,552,178	t/y	0.00005	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content in %							50	% Control	AP-42 c13s2.4.3
WE - Eastern OEA	79,657	181.9	ha	0.05	kg/ha/h	8,760	h/y									-	% Control	AP-42 Table 11.9-2
WE - Raw Coal Stockpile	509	2.3	ha	0.05	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Product Coal Stockpile	1,297	5.9	ha	0.05	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
Grading roads	2,477	23,040	km	0.22	kg/km	8	speed of graders in km/h	2,880	grader hours							50	% Control	AP-42 Table 11.9-2
Total PM_{10} emissions for Year 18 (2033) (kg/yr)	**150,403**																	

Table B.10: Year 18 $PM_{2.5}$ Emissions

ACTIVITY	$PM_{2.5}$ emission for Year 18 (kg/y)	Intensity	Units	Emission Factor	Units	Variable 1	Units	Variable 2	Units	Variable 3	Units	Variable 4	Units	Variable 5	Units	Variable 6	Units	Emission Factor Source
UG - Conveyor transfer - UG coal to ROM coal stockpile at CHPP	27	6,296,531	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
UG - Conveyor transfer - UG coal to ROM coal stockpile at CHPP - Unloading Conveyor	27	6,296,531	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	9.5	moisture content of coal in %							50	% control	AP-42 Table 11.9-2
UG - Ventillation Shaft	16,556	350	m^3/s	1.5	mg/m^3											0	% control	-
UG - Crushing UG ROM coal at the CHPP	315	6,296,531	t/y	0.00005	kg/t											0	% control	AP-42 Table 11.19.2-1
UG - Screening UG ROM coal at the CHPP	157	6,296,531	t/y	0.000025	kg/t											0	% control	AP-42 Table 11.19.2-1
UG - Dozer/FEL on Raw Coal Stockpile	0	0.1	h/y	0.7	kg/h	10	silt content in %	9.5	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
UG - Dozer/FEL on Product Coal Stockpile	0	0.1	h/y	0.7	kg/h	10	silt content in %	10	moisture content of coal in %							50	% Control	AP-42 Table 11.9-2
UG - Hauling rejects from rejects bin to Eastern OEA	4,417	2,744,353	t/y	0.0107	kg/t	150	t/load	249	Vehicle gross mass (t)	13.1	km/return trip	0.1	kg/VKT	4.1	% silt content	85	% control	AP-42 c13s2.2.2
UG - Loading UG product coal to trains	13	3,552,178	t/y	0.00001	kg/t	0.91	average of (wind speed/2.2)^1.3 in m/s	11	moisture content in %							50	% Control	AP-42 c13s2.4.3
WE - Eastern OEA	11,949	181.9	ha	0.0075	kg/ha/h	8,760	h/y									-	% Control	AP-42 Table 11.9-2
WE - Raw Coal Stockpile	76	2.3	ha	0.0075	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
WE - Product Coal Stockpile	195	5.9	ha	0.0075	kg/ha/h	8,760	h/y									50	% Control	AP-42 Table 11.9-2
Grading roads	220	23,040	km	0.02	kg/km	8	speed of graders in km/h	2,880	grader hours							50	% Control	AP-42 Table 11.9-2
Total $PM_{2.5}$ emissions for Year 18 (2033) (kg/yr)	**33,952**																	

Appendix C GHG EMISSIONS ESTIMATION

C.1 FUEL CONSUMPTION

GHG emissions from diesel consumption were estimated using the following equation:

$$E_{CO_2-e} = \frac{Q \times EF}{1000}$$

where:

E_{CO2-e}	=	Emissions of GHG from diesel combustion	(t CO_2-e)[1]
Q	=	Estimated combustion of diesel	(GJ)[2]
EF	=	Emission factor (scope 1 or scope 3) for diesel combustion	(kg CO_2-e/GJ)[3]

1 tCO_2-e = tonnes of carbon dioxide equivalent.
2 GJ = gigajoules.
3 kg CO_2-e/GJ = kilograms of carbon dioxide equivalents per gigajoule.

The quantity of diesel consumed (Q) for open cut mining for each year of construction and operation has been provided by KEPCO.

GHG emission factors and energy content for diesel were sourced from the NGA Factors (**DoE, 2014**). The estimated annual and Project total GHG emissions from diesel usage are presented in **Table C.1**.

Table C.1: Estimated CO_2-e (tonnes) for diesel consumption

Year	Diesel Consumption (kL)				Emissions (t CO_2-e)		
	Mobile Plant	Major Equipment OC	Underground	Total	Scope 1	Scope 3	Total
Construction							
Y1	N/A			6,304	17,009	1,290	18,299
Y2	N/A			6,304	17,009	1,290	18,299
Operation							
Y3	586	20,168	0	20,754	55,996	4,246	60,242
Y4	665	26,192	0	26,857	72,463	5,494	77,958
Y5	1,029	28,341	0	29,369	79,243	6,008	85,251
Y6	965	29,030	1,200	31,194	84,166	6,382	90,548
Y7	966	29,594	1,200	31,760	85,692	6,497	92,189
Y8	798	28,991	1,200	30,989	83,613	6,340	89,953
Y9	773	25,373	1,235	27,382	73,880	5,602	79,481
Y10	758	12,900	1,235	14,893	40,183	3,047	43,230
Y11	381	0	1,235	1,616	4,360	331	4,690
Y12	407	0	1,235	1,642	4,430	336	4,766
Y13	400	0	1,235	1,635	4,411	334	4,746
Y14	344	0	1,235	1,579	4,260	323	4,583
Y15	390	0	1,235	1,625	4,384	332	4,717
Y16	396	0	1,235	1,631	4,401	334	4,735
Y17	317	0	1,235	1,552	4,188	318	4,506
Y18	428	0	1,200	1,628	4,391	333	4,724
Y19	371	0	1,235	1,606	4,333	329	4,661
Y20	374	0	1,235	1,609	4,341	329	4,670
Y21	362	0	1,235	1,597	4,308	327	4,635
Y22	380	0	1,200	1,580	4,263	323	4,586
Y23	403	0	1,235	1,638	4,420	335	4,755
Y24	319	0	1,235	1,554	4,194	318	4,512
Y25	410	0	1,200	1,610	4,344	329	4,673
Y26	**12,219**	**200,589**	**24,490**	**249,907**	**674,284**	**51,126**	**725,410**

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C.2 ELECTRICITY

GHG emissions from electricity usage were estimated using the following equation:

$$E_{CO_2-e} = \frac{Q \times EF}{1000}$$

where:

E_{CO2-e}	=	Emissions of GHG from electricity usage	(tCO_2-e/annum)
Q	=	Estimated electricity usage	(kWh/annum)[1]
EF	=	Emission factor (Scope 2 or Scope 3) for electricity usage	($kgCO_2$-e/kWh)[2]

[1] kWh/annum = kilowatt hours per annum
[2] $kgCO_2$-e/kWh = kilograms of carbon dioxide equivalents per kilowatt hour

Scope 2 and Scope 3 emissions have been calculated using the energy content and emission factors sourced from the NGA Factors (**DoE, 2014**) and the values for NSW presented in **Table C.2**. In the absence of projections of the future carbon intensity of the NSW power generation system. It has been assumed that that these emission factors stay contact for the life of the Project

Table C.2: Consumption of purchased electricity GHG emission factors

Fuel type	Emission factor (kg CO_{2-e}/kWh)	
	Scope 2	Scope 3
Consumption purchased electricity	0.86	0.13

Source: Table 41, **DoE, 2014**

The quantity of electricity to be used during each year of operation was provided by KEPCO. No electricity will be used during construction.

GHG emission factors were sourced from the NGA Factors (**DoE, 2014**). The estimated annual and Project total GHG emissions from electricity usage are presented in **Table C.3**.

Table C.3: Estimated CO_2-e (tonnes) for electricity

Year	Electricity Consumption (kWh)			Emissions (t CO_2-e)		
	CHPP	Underground	Total	Scope 2	Scope 3	Total
Construction						
Y1	0	0	0	0	0	0
Y2	0	0	0	0	0	0
Operation						
Y3	19,392,335	0	19,392,335	16,677	2,521	19,198
Y4	18,845,512	0	18,845,512	16,207	2,450	18,657
Y5	23,799,170	0	23,799,170	20,467	3,094	23,561
Y6	23,564,668	1,760,727	25,325,395	21,780	3,292	25,072
Y7	26,533,676	13,632,290	40,165,966	34,543	5,222	39,764
Y8	21,039,827	10,952,723	31,992,550	27,514	4,159	31,673
Y9	28,333,708	48,555,668	76,889,376	66,125	9,996	76,120
Y10	30,515,867	35,962,291	66,478,158	57,171	8,642	65,813
Y11	25,781,596	56,473,293	82,254,889	70,739	10,693	81,432
Y12	27,467,251	60,415,082	87,882,333	75,579	11,425	87,004
Y13	26,994,593	59,318,328	86,312,921	74,229	11,221	85,450
Y14	21,459,227	50,234,166	71,693,393	61,656	9,320	70,976
Y15	23,288,133	56,497,050	79,785,183	68,615	10,372	78,987
Y16	20,862,477	56,153,329	77,015,806	66,234	10,012	76,246
Y17	18,565,171	45,724,235	64,289,406	55,289	8,358	63,647
Y18	27,642,435	62,965,309	90,607,744	77,923	11,779	89,702
Y19	23,674,939	54,390,542	78,065,481	67,136	10,149	77,285
Y20	24,016,859	54,937,666	78,954,525	67,901	10,264	78,165
Y21	23,455,027	53,210,262	76,665,289	65,932	9,966	75,899
Y22	24,381,081	55,817,884	80,198,965	68,971	10,426	79,397
Y23	25,289,587	58,960,054	84,249,641	72,455	10,952	83,407
Y24	21,551,138	47,255,570	68,806,708	59,174	8,945	68,119
Y25	26,336,873	59,828,790	86,165,663	74,102	11,202	85,304

Total	**552,791,147**	**943,045,259**	**1,495,836,406**	**1,286,419**	**194,459**	**1,480,878**

C.3 FUGITIVE METHANE

Emissions from fugitive CH_4 were estimated using the following equation:

$$E_{co2-e} = Q \times EF$$

where:

E_{CO2-e}	=	Emissions of GHG from fugitive CH_4	(t CO_2-e/annum)
Q	=	ROM coal extracted during the year	(t)
EF	=	Scope 1 emission factor	(t CO_2-e/tonne)

Emission factors for fugitive methane (12.5 kg CO_2-e /tonne ROM) have been calculated based on the following data contained in the Feasibility Study:

- Average gas content = 1.6 m^3/t
- Average CH_4 content = 48%
- Average CO_2 content = 52%

Based on these values and taking into account the global warming potential of methane, the total fugitive CO_2-e emissions were estimated at 12.5 kilograms per tonne ROM (kg/tonne ROM).

This emission factor is applied for open cut fugitive emissions and underground mine ventilation air (MVA). The estimated annual and Project total GHG emissions from fugitive CH_4 are presented in **Table C.4.**

Table C.4: Estimated CO_2-e (tonnes) for fugitive methane

Year	ROM (tpa)		Scope 1 Emissions (t CO_2-e)		
	Open cut	Underground	Fugitive Open cut	MVA Underground	Total
Construction					
Y1	0	0	0	0	0
Y2	0	0	0	0	0
Operation					
Y3	4,010,256	0	50,086	0	50,086
Y4	4,322,206	0	53,983	0	53,983
Y5	5,469,730	0	68,315	0	68,315
Y6	5,155,110	67,714	64,385	846	65,231
Y7	5,010,491	524,326	62,579	6,549	69,128
Y8	4,173,033	421,252	52,119	5,261	57,381
Y9	2,846,936	3,653,064	35,557	45,625	81,182
Y10	1,369,788	3,596,227	17,108	44,915	62,023
Y11	0	5,647,335	0	70,533	70,533
Y12	0	6,041,505	0	75,456	75,456
Y13	0	5,931,835	0	74,086	74,086
Y14	0	5,023,418	0	62,740	62,740
Y15	0	5,649,709	0	70,563	70,563
Y16	0	5,615,335	0	70,133	70,133
Y17	0	4,572,424	0	57,108	57,108
Y18	0	6,296,531	0	78,641	78,641
Y19	0	5,439,051	0	67,932	67,932
Y20	0	5,493,761	0	68,615	68,615
Y21	0	5,321,022	0	66,457	66,457
Y22	0	5,581,787	0	69,714	69,714
Y23	0	5,896,007	0	73,639	73,639
Y24	0	4,725,560	0	59,020	59,020
Y25	0	5,982,877	0	74,724	74,724
Total	**32,357,549**	**91,480,740**	**404,132**	**1,142,557**	**1,546,689**

C.4 EXPLOSIVES

Emissions from explosive usage were estimated based on the using the following equation:

$$E_{co2-e} = Q \times EF$$

Where:

$E_{CO2\text{-}e}$	=	Emissions of greenhouse gases from explosives	(t CO_2-e/annum)
Q	=	Quantity of explosive used (assumed ANFO)	(t)
EF	=	Scope 1 emission factor	(t CO_2-e/tonne explosive)

Greenhouse gas emission factor (0.17 t CO_2-e / tonne product) were sourced from the Australian Greenhouse Office (AGO) Factors and Methods Workbook – December 2006. It is noted that the AGO Factors and Methods were replaced by the NGA Factors (**DoE, 2014**), however the emission factor for explosives has been omitted since 2007 as emissions from explosives do not have to be reported under NGERs. They have been included here for completeness.

The estimated annual and Project total GHG emissions from explosive usage are presented in **Table C.5**.

Table C.5: Estimated CO_2-e (tonnes) for explosives

Year	Explosive ANFO (tonnes)	Scope 1 Emissions (t CO_2-e)
Construction		
Y1	75	13
Y2	0	0
Operation		
Y3	100	17
Y4	400	68
Y5	2,000	340
Y6	6,100	1,037
Y7	9,400	1,598
Y8	9,300	1,581
Y9	9,900	1,683
Y10	4,200	714
Total	**41,475**	**7,051**

C.5 PRODUCT COAL TRANSPORTATION

The scope 3 emissions associated with product coal transportation have been estimated based on all product coal being transported to Newcastle for export by rail. Emissions associated with product coal transportation have been estimated based on an emission factor for loaded trains of 12.3 grams per net tonne per kilometre (**QR Network Access, 2002**). Emission factors were not available for unloaded trains so the factor for loaded trains is conservatively applied for the return trip. The return rail trip to the port of Newcastle is estimated to be 230 km. The total estimated GHG emissions from rail transport of product coal are provided in **Table C.6**.

Table C.6: Estimated CO_2-e (tonnes) for product coal transportation

Year	Product Coal (tpa)	Scope 3 Emissions (t CO_2-e)
Construction		
Y1	0	0
Y2	0	0
Operation		
Y3	2,511,349	7,105
Y4	3,208,231	9,076
Y5	4,368,540	12,359
Y6	4,218,124	11,933
Y7	4,501,968	12,736
Y8	3,702,613	10,475
Y9	4,479,728	12,673
Y10	4,059,118	11,483
Y11	4,070,278	11,515
Y12	4,467,882	12,640
Y13	4,419,587	12,503
Y14	4,099,088	11,596
Y15	4,871,947	13,783
Y16	4,927,584	13,940
Y17	3,839,478	10,862
Y18	3,552,178	10,049
Y19	3,281,820	9,284
Y20	3,264,286	9,235
Y21	3,236,674	9,157
Y22	3,633,289	10,279
Y23	4,016,256	11,362
Y24	3,012,669	8,523
Y25	4,049,957	11,457
Total	**89,792,647**	**254,023**

Emissions from the shipping of product coal are not included in this assessment due to the difficulties in emission estimates, including uncertainty in export markets and limited data on emission factors and/or fuel consumption for ocean going vessels.

C.6 ENERGY PRODUCTION FROM PRODUCT COAL

The scope 3 emissions associated with the combustion of product coal were estimated using the following equation:

$$E_{CO_2-e} = \frac{Q \times EC \times EF}{1000}$$

Where:

E_{CO2-e}	=	Emissions of GHG from coal combustion	(t CO_2-e)
Q	=	Quantity of product coal burnt	(GJ)
EC	=	Energy Content Factor for black / coking coal	(GJ/t)[1]
EF	=	Emission factor for black / coking coal combustion	(kg CO_2-e/GJ)

[1] GJ/t = gigajoules per tonne

The quantity of thermal saleable coal is based on the production rate in tpa. This is converted to GJ using an energy content factor for black coal of 27 GJ/t. The GHG emission factor and energy content for coal were sourced from the NGA Factors (**DoE, 2104**). The emissions associated with the use of the product coal are presented in **Table C.7**.

Table C.7: Scope 3 emissions for energy production from product coal

Year	Product Coal (tpa)	Scope 3 Emissions (t CO_2-e) Thermal
Construction		
Y1	0	0
Y2	0	0
Operation		
Y3	2,511,349	5,663,004
Y4	3,208,231	7,234,450
Y5	4,368,540	9,850,905
Y6	4,218,124	9,511,723
Y7	4,501,968	10,151,781
Y8	3,702,613	8,349,262
Y9	4,479,728	10,101,630
Y10	4,059,118	9,153,169
Y11	4,070,278	9,178,335
Y12	4,467,882	10,074,918
Y13	4,419,587	9,966,014
Y14	4,099,088	9,243,300
Y15	4,871,947	10,986,071
Y16	4,927,584	11,111,530
Y17	3,839,478	8,657,888
Y18	3,552,178	8,010,038
Y19	3,281,820	7,400,389
Y20	3,264,286	7,360,851
Y21	3,236,674	7,298,587
Y22	3,633,289	8,192,939
Y23	4,016,256	9,056,518
Y24	3,012,669	6,793,464
Y25	4,049,957	9,132,511
Total	**89,792,647**	**202,479,277**