SARAJI EAST MINING LEASE PROJECT

Environmental Impact Statement

Chapter 11
Air Quality and Greenhouse Gas

BHP

Contents

Saraji East Mining Lease Project

11 Air Quality and Greenhouse Gas

11.1 Introduction

Mining projects have the potential to generate significant emissions to air simply due to the nature of their activities.

This chapter discusses the potential air quality and greenhouse gas (GHG) impacts resulting from the Project, in support of the Project's Environmental Impact Statement (EIS). The objective of this chapter is to determine if the Project will be operated in a way that protects the environmental values of air. The underpinning air quality impact assessment for the Project was completed by Advanced Environmental Dynamics Pty Ltd (AED), on behalf of BMA. The AED Air Quality Technical Report that details the assessment is provided in **Appendix H-1 Air Quality Technical Report**.

The potential air quality impacts of the Project have been assessed by:

- a review of the relevant air quality legislation and guidelines
- assessment of potential emission sources and the development of an emissions inventory
- describing the environmental values of the Project Site and surrounds
- predicting dust impacts using dispersion modelling software
- proposing mitigation and management measures.

The assessment of potential GHG and climate change impacts of the Project entailed:

- outlining the regulatory framework for GHG management in Australia
- estimating the direct and indirect GHG emissions resulting from activities during the operations phase
- identifying mitigation measures designed to reduce GHG emissions during the operations phase
- undertaking a preliminary climate change risk assessment for the Project.

11.2 Legislative framework

11.2.1 Commonwealth Legislation

Commonwealth legislation

National ambient air quality standards and goals are set by the National Environmental Protection Council (NEPC) and are specified within the Ambient Air Quality National Environmental Protection Measure (Ambient Air Quality NEPM) Variation 2015, effective 3 February 2016. The Ambient Air Quality NEPM provides guidance relating to air in the external environment and does not include air inside buildings or structures.

The Ambient Air Quality NEPM outlines monitoring, assessment and reporting procedures for the following pollutants:

- particulate matter with an aerodynamic diameter less than 10 microns (PM_{10})
- particulate matter with an aerodynamic diameter less than 2.5 microns ($PM_{2.5}$)
- nitrogen dioxide (NO_2)
- carbon monoxide
- ozone
- sulphur dioxide (SO_2).

The Ambient Air Quality NEPM standards are intended to be applied to air quality experienced by the general population in a region and not to air quality in areas in the region affected by localised air emissions, such as individual industrial sources. The standards were set at a level intended to adequately protect human health and wellbeing.

The Ambient Air Quality NEPM pollutants applicable to the Project are PM_{10} and $PM_{2.5}$.

Queensland legislation

In Queensland (QLD), air quality is managed under *the Environmental Protection Act 1994* (EP Act), the Environmental Protection Regulation 2019 and the Environmental Protection (Air) Policy 2019 (EPP Air). The EPP Air was prepared by the Queensland Government to enhance or protect the atmospheric environment in Queensland by providing air quality objectives. These objectives are to be achieved in various environments with reference to sensitive receptors. It does not apply to workplaces and the air quality objectives set out in the EPP Air are intended to be progressively achieved over the long term.

The EPP Air recommends different strategies to control emissions for different types of activities, including:

- identifying environmental values to be enhanced or protected
- stating indicators and air quality objectives for enhancing or protecting the environmental values
- providing a framework for making consistent, equitable and informed decisions about the air environment.

Pollutants relevant to the air quality impact assessment are described in Section 11.3.1. The EPP Air pollutants applicable to the Project are Total Suspended Particles (TSP), PM_{10} and $PM_{2.5}$.

In addition to the ambient air objectives for suspended particulates, the Department of Environment and Science (DES) typically adopts a deposited dust guideline of 120 milligrams per metre squared per day ($mg/m^2/day$) derived from a history of dust investigations, subjective observations and establishing nuisance effects.

Project adopted ambient air quality goals

Ambient air quality goals used in the Project's air quality impact assessment were adopted in consideration of both national and state legislation. The standards in the Ambient Air Quality NEPM relevant to the Project correspond to the EPP Air objectives protecting the health and wellbeing environmental values. The Ambient Air Quality NEPM standards relevant to the Project are consequently addressed in the air quality objectives in the EPP Air.

These goals are summarised in Table 11.1

Table 11.1 Project adopted ambient air quality goals

Pollutant	Averaging period	Project goal	Allowable exceedances	Source
TSP	Annual	90 µg/m^3	None	**QLD EPP(Air)**
PM_{10}	24 hour	50 µg/m^3	None	**QLD EPP(Air)**
	Annual	25 µg/m^3	None	**QLD EPP(Air)**
$PM_{2.5}$	24 hour	25 µg/m^3	None	**QLD EPP(Air)**
	Annual	8 µg/m^3	None	**QLD EPP(Air)**
Dust deposition	30 day	120 mg/m^2/day	None	**QLD DES**

11.2.2 Greenhouse gas legislation

National Greenhouse and Energy Reporting Act 2007

The Commonwealth *National Greenhouse and Energy Reporting Act 2007* (NGER Act) establishes a national system for reporting corporate GHG emissions, energy consumption and production. The NGER Act requires corporations that exceed certain GHG emission thresholds to publicly report their GHG emissions, energy consumption and production each financial year.

The current GHG reporting thresholds for corporations are as follows:

- emission of more than 50,000 tonnes (t) of carbon dioxide equivalents (CO_2-e), or
- consumption of more than 200 terajoules (TJ) of energy per year.

The current GHG reporting thresholds for individual facilities are as follows:

- emission of more than 25,000 t CO_2-e, or
- consumption of more than 100 TJ of energy per year.

During the construction and operation phases, it is anticipated that the Project will be under the operational control of BMA. BMA is registered as a controlling corporation under the NGER Act. Therefore, the Project's annual GHG emissions, energy consumption and production will be included in BMA's annual NGER report.

International policy

The Kyoto Protocol was negotiated and concluded at the third United Nations Framework Convention on Climate Change (UNFCCC) in late 1997. It generally entered into force in 2005, with Australia ratifying the Kyoto Protocol in December 2007. The objective of the Kyoto Protocol is to reduce human-induced GHG emissions by setting country-specific GHG emissions targets relative to 1990 emission levels. In November 2016, Australia ratified the Doha Amendment to the Kyoto Protocol, the objective of which is to further reduce GHG emissions between 2013 and 2020.

The Kyoto Protocol sets out three flexible mechanisms for achieving GHG targets:

- The Clean Development Mechanism
- Joint Implementation
- International Emissions Trading.

All three mechanisms allow GHG reductions to be made at the point where the marginal cost of that reduction is lowest.

An industrialised country sponsoring a GHG reduction project in a developing country can also claim that reduction towards its Kyoto Protocol target and subsequently trade those GHG reductions.

Australia's climate change policy

A review of the Australia's climate change policies was completed in 2017 by the former Department of the Environment and Energy (DoEE). This review found that the Australian Government is committed to addressing climate change, while concurrently ensuring energy security and affordability, and the competitiveness of the energy industry.

Australia ratified the Paris Agreement in November 2016, an extension of the Kyoto Protocol, which further demonstrates the Australian Government's stance on acting on climate change. As part of the Paris Agreement, Australia set a target to reduce emissions by 26 to 28 per cent below 2005 levels by 2030. This builds on the 2020 target of reducing emissions by five per cent below 2000 levels.

Emissions Reduction Fund

The Emissions Reduction Fund (ERF) provides incentives for Australian businesses, farmers, land holders and citizens to adopt new practices and technologies to reduce Australia's GHG emissions. The DAWE and the Clean Energy Regulator are responsible for managing the ERF. The fund has three key elements, as described in Table 11.2.

Table 11.2 Key elements of the emissions reduction fund

Element	Description
Crediting emissions reductions	Crediting involves determining a quantity of emissions avoided/reduced by a project. Projects can claim emissions reductions that go beyond business-as-usual standards. There are specific methods for estimating the quantity of emissions avoided/reduced by a project.
Purchasing emissions reductions	ERF participants can sell their emissions reductions in the form of Australian Carbon Credit Units (ACCUs) to the Government through competitive reverse auctions run by the Clean Energy Regulator.
Safeguarding emissions reductions	The safeguard mechanism complements the ERF by providing a framework for Australia's largest emitters to measure, report and manage their emissions.

State policy and initiatives

On 13 July 2017, the Queensland Government signed the international "Under2MOU", which is a coalition of subnational governments leading by example to combat climate change. The agreement aims to:

- limit global warming to 2 degrees Celsius (ºC)
- by 2050, reduce GHG emissions to between 80 and 95 per cent of 1990 levels, or to less than two tonnes per capita, per year.

In order to achieve these goals, the Queensland Government's *Climate Transition Strategy* has made three key climate change commitments:

1. power Queensland with 50 per cent renewable energy by 2030
2. achieve zero net emissions by 2050
3. achieve an interim emissions reduction target of at least 30 per cent below 2005 levels by 2030.

BHP's corporate policy framework

BHP accepts the Intergovernmental Panel on Climate Change (IPCC) assessment of climate change science and acknowledges the need for significant reductions in human generated GHG emissions. To address this ongoing and global issue, BHP has developed a climate change strategy which "*focuses on reducing operational GHG emissions, supporting emissions reductions in the value chain, partnering to accelerate the transition to a low carbon future, promoting product stewardship, identifying signposts for climate-related risk and opportunity, and working with others to enhance the global policy and market response*" (BHP, 2020).

BHP engages with governments and other stakeholders to contribute to the development of an effective, long-term policy framework that can deliver a measured transition to a lower carbon economy. To display support of the Paris Agreement, BHP became a signatory of the UNFCCC 'Paris Pledge' and set company emission reduction targets. As of July 2017, BHP is working towards a five-year target of maintaining total operational emissions in Financial Year (FY) 2022 at or below FY 2017 levels while continuing to grow as a business. The company has also set a long-term goal of achieving net-zero operational GHG emissions in the latter half of this century, in line with the Paris Agreement.

BHP currently has a suite of initiatives aimed at achieving reductions across their major operational emission sources, and are detailed below:

- Zero-carbon electricity supply: emissions from electricity use make up 46 per cent of operational emissions. This includes both the power generated by BHP and the power BHP buys from grids around the world. BHP's strategy seeks to accelerate the transition to lower carbon sources of electricity while balancing cost, reliability and emissions reductions.
- Zero-carbon material movement: emissions from fuel and distillate make up 35 per cent of operational emissions, primarily from the consumption of diesel in the course of material movement (for example haul trucks). BHP's strategy is to accelerate and de-risk technologies and innovations that can transition operations over time to alternate fuels and greater electrification of mining equipment and mining methods.
- Fugitive emissions: fugitive methane emissions from our petroleum and coal assets make up 18 per cent of operational emissions. BHP's strategy is to pursue innovation in mitigation technologies for these emissions, which are among the most technically and economically challenging to reduce (BHP, 2018a).

As a member of the BHP group, BMA follow both BHP's operational and environmental management framework. Therefore, the initiatives are likely to be applied to the Project.

11.3 Methodology

11.3.1 Air quality

Pollutant emission sources

Underground mines are associated with significantly less dust generation when compared with an open cut mine alternative. Both mining methods may share a number of common dust generating sources, such as ROM stockpiles, breaker stations, conveyors, and stacker/reclaimers as well as windblown dust from waste spoil dumps and pit-related disturbance areas. However, the release of fugitive dust emissions associated with material handling by open cut mining methods are replaced by the release of dust to the atmosphere via ventilation shafts in the underground mine.

For this Project, the extent of the disturbance footprint is established early, i.e. during the construction phase of the project and remains relatively stable throughout the life of the Project. That part of the disturbance footprint associated with the construction of the accommodation village (for example) can be minimised through the stabilising of at-risk surfaces (such as roads, paths, etc.) and the rehabilitation of surfaces as soon as practicable.

As such, the pollutant emissions source for this Project is focused on the construction and operation phases of the Project. Although not identified specifically, the decommissioning and commissioning phases of the Project may be considered conservatively represented by the earliest and latter stages of the mining operations. The potential for substantial quantities of dust to be generated during other stages of the project (e.g. commissioning, decommissioning, rehabilitation) is considered to be low and where necessary, may be adequately managed through air quality management practices typical of mining operations.

Construction phase

Construction is anticipated to take between one and three years with the majority of the construction work expected to occur between FY 2021-2023. Emissions of air pollutants may occur in relation to construction activities associated with the development of the mine entry portal, mine infrastructure area (MIA), coal handling and preparation plant (CHPP), rail spur, water storage infrastructure, powerline, access roads, and accommodation village.

The main pollutant of concern during construction will be the generation of dust associated with heavy vehicle movements, land clearing and wind erosion. Small amounts of other pollutants (such as oxides of nitrogen and volatile organic compounds) may be released in association with the combustion of diesel fuel by plant and equipment, although these sources of pollutants are anticipated to be relatively minor.

Operations phase

The Project CHPP will have the capacity to process seven million tonnes per annum (Mtpa) run-of mine (ROM) coal with excess ROM coal trucked from the CHPP to the Saraji Mine CHPP for processing.

The operational phase of the Project will potentially emit a range of pollutants associated with (but not limited to) the following:

- conveying of coal from the mine portal to the CHPP including transfer points and surge bins
- processing of coal including sizing at the breaker stations (Project CHPP and Saraji Mine CHPP)
- stacking/reclaiming of stockpiles (Project CHPP and Saraji Mine CHPP)
- dozer activities on stockpiles (Project CHPP)
- wheel generated dust associated with the transport of coal via haul trucks from the Project CHPP to the Saraji Mine CHPP
- truck dumping of coal at the Saraji Mine CHPP ROM stockpile
- wheel generated dust associated with rejects hauling (Project CHPP and Saraji Mine CHPP)
- exhaust gas associated with the underground ventilation outlets
- flaring and/or venting of off-gases
- combustion of diesel and petrol fuels in mobile and/or fixed plant and equipment.

Pollutants that may be emitted into the airshed as a result of the operation of the Project include:

- dust (as TSP, PM_{10} and $PM_{2.5}$)
- oxides of nitrogen, carbon monoxide and volatile organic compounds (e.g. combustion of fuels)
- methane (venting of incidental mine gas)
- carbon dioxide (e.g. flaring of incidental mine gas).

Pollutant management and mitigation options for the Project are discussed Section 11.6.1.

Although the Project design incorporates a number of significant dust reduction features (e.g. the transport of ROM coal by conveyor from the mine portal to the CHPP), the risk of adverse impacts of dust on the air quality environment associated with coal handling is likely to exceed those from other activities. Therefore, the focus of the assessment is the quantification of operation phase Project-related impacts for TSP, PM_{10}, $PM_{2.5}$ and dust deposition.

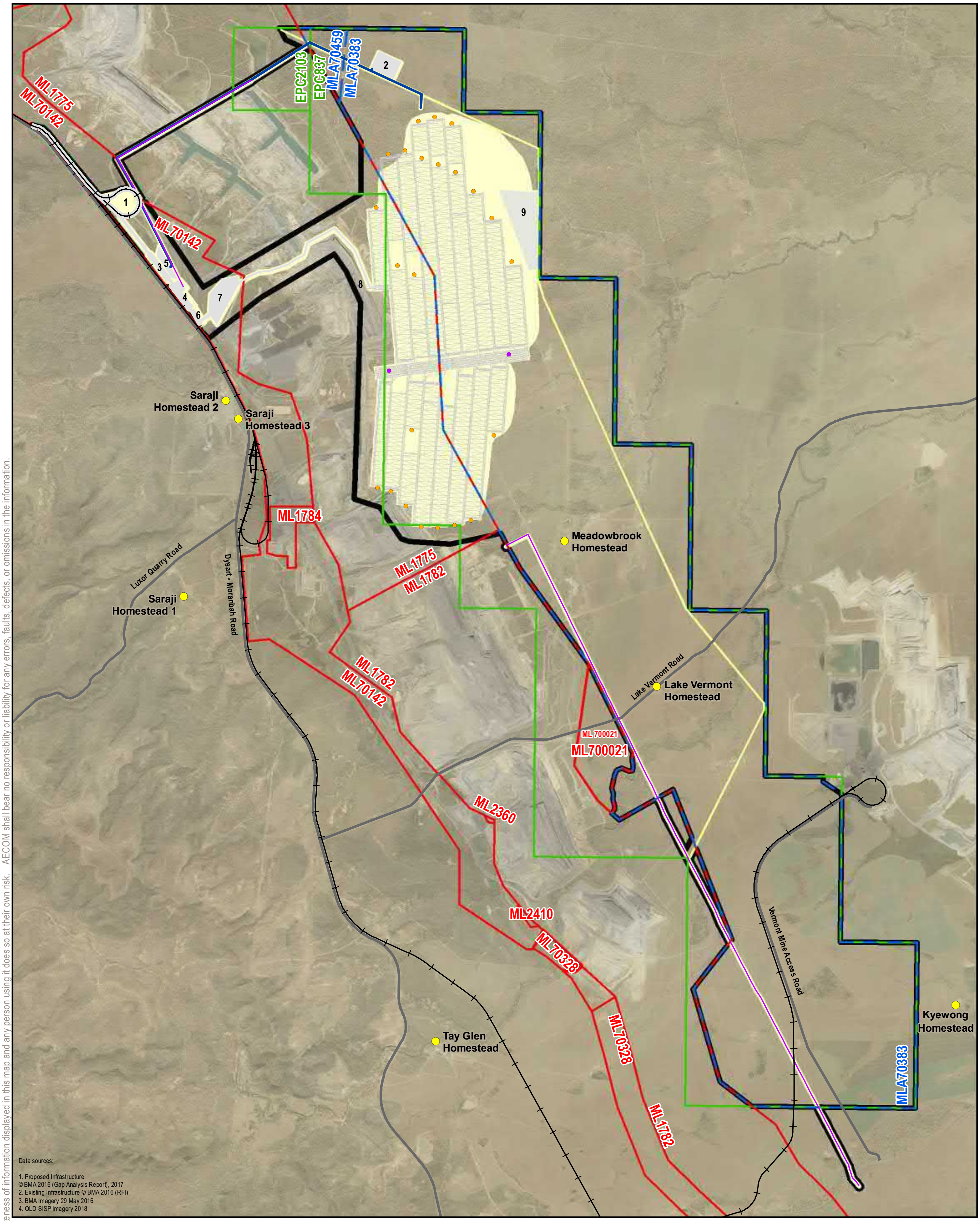
Sensitive receptors

A sensitive receptor is defined as a location that may be sensitive to impacts from the Project, such as residences, commercial or industrial facilities where people are present for an extended period of time. At air sensitive receptors, air quality goals must be met. Therefore, locations considered as part of this assessment are sensitive receptors located in the vicinity of the Project Site Table 11.3 and Figure 11-1.

With the exception of the Lake Vermont Homestead and Meadowbrook Homestead, all assessment locations are privately owned (see Table 11.3). There are currently co-existence agreements in place between BMA and landholders at Saraji Homestead 2 and Saraji Homestead 3. Discussions between BMA and the Saraji Homestead 1 landholder concerning a co-existence agreement have commenced. Despite these agreements in place, all homesteads within the vicinity of the Project have been assessed as sensitive receptors.

Table 11.3 Assessment locations

Location ID	Property reference	Ownership	Location
1	Kyewong Homestead	Private landholder	148.426, -22.511
2	Lake Vermont Homestead	BMA	148.360, -22.448
3	Saraji Homestead 1	Private landholder	148.259, -22.428
4	Saraji Homestead 2	Private landholder	148.268, -22.389
5	Saraji Homestead 3	Private landholder	148.268, -22.396
6	Tay Glen Homestead	Private landholder	148.313, -22.520
7	Meadowbrook Homestead	BMA	148.339, -22.420



LEGEND

- Project Site
- Project Footprint
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Underground layout (optimised)
- Surface Infrastructure
- Transport and Infrastructure Corridor
- Homestead
- Flare
- Vent
- Public Road
- Existing Railway
- 66kV Powerline
- Pipeline
- Rail Loop

1 Rail Loading Balloon Loop
2 Process Water Dam
3 Product Stockpiles
4 CHPP
5 Raw Water Dam
6 ROM Pad
7 Future MIA
8 Conveyor
9 Construction Village

N

Figure 11-1
Project Layout and Homesteads

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.5 1 2
Kilometres

Scale: 1:110,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

BHP

DATE: 2/12/2020 VERSION: 3

Emission scenario

Construction Phase

The main pollutant of concern during construction will be the generation of dust associated with heavy vehicle movements, land clearing, and wind erosion. With the construction of the mine entry portal, conveyor, and CHPP occurring at already disturbed areas within the Saraji Mine ML, the generation of dust associated with these activities will be immaterial compared to other localised activities.

Based on publicly available data, estimates of current disturbance for open cut mines surrounding the Project Area indicate the disturbance footprint of the proposed accommodation village contributes less than 0.1% of the total disturbance of Saraji Mine (43.2%), Peak Downs Mine (49.8%) and Lake Vermont Mine (6.9%). Thus, within the context of the surrounding environment, the disturbance area of the proposed construction accommodation village is considered immaterial.

Operational phase

In order to highlight the impact of dust emissions associated with the Operational Phase of the Project, two dust emission scenarios has been explicitly modelled:

- Project-Only Case (Typical Operating Conditions): Underground mining at a rate of 11 Mtpa ROM coal. As this is representative of the maximum annual production rate of coal from the Project, this scenario is considered to be conservative and representative of peak as opposed to typical operations. Results from the dispersion modelling for this scenario will be presented in isolation of any other dust emission sources, i.e. results will not include an estimate of current or future dust levels as a result of other dust emission sources that exist within the local airshed.
- Project-Only Case (Upset Conditions): As per the typical operating conditions case but incorporating less dust reduction measures, for example reduced haul road watering capacity. As these conditions are considered a-typical, results for this scenario are only presented for the 24-hour average concentration of PM10.

Production data

The Project will mine a maximum of 11 Mtpa ROM coal. The Project CHPP will have the capacity to process seven Mtpa ROM coal with excess ROM coal trucked from the CHPP to the Saraji Mine CHPP for processing.

For the purposes of this assessment, an hourly peak throughput of 800 tonnes per hour (tph) through the Project CHPP and 500 tph through the Saraji Mine CHPP was assumed.

Dust emission sources

Dust emission sources that were explicitly accounted for in the dispersion modelling include:

- the conveying of coal from the underground mine portal to the Project CHPP
- the sizing of ROM coal
- the stacking and reclaiming of coal
- use of a dozer to assist reclaiming at the Project CHPP
- wind erosion from stockpiles located at the Project CHPP
- the transport of excess ROM coal to the Saraji Mine CHPP
- the dumping of ROM coal at the Saraji Mine CHPP
- stacking/reclaiming and sizing of coal at the Saraji Mine CHPP
- ventilation outlets.

The following potential air emission sources were not included in the dust dispersion model:

- emissions associated with the flaring of off-gases (emissions of greenhouse gases have been addressed in Section 11.5.2)
- emissions of dust associated with the handling of product coal which is considered to be immaterial due to its relatively high moisture content.

Dust management and reduction measures

Dust reduction measures that were adopted into the dispersion model for the Project are:

- watering of haul roads at a rate of more than two litres per metre squared per hour (i.e. level 2 watering)
- water sprays during crushing
- water sprays on stockpiles.

Upset conditions

From an air quality perspective, upset conditions could arise in relation to a failure of dust controls resulting in an increase in the amount of dust released into the atmosphere. As dust reduction measures typically rely on the availability of adequate water supply, any constraints in relation to water availability and/or the ability to deliver the required level of dust suppression (in particular) to haul routes, may lead to dust impacts in excess of that predicted based on typical operating conditions. Upset conditions as a result of water constraints have been considered in this assessment.

Dust emissions inventory

The National Pollutant Inventory (NPI) has produced a series of Emission Estimation Technique Manuals (EETM) that are intended to provide data on emissions of air pollutants from a wide variety of industries/activities.

For this assessment, the NPI EETM for Mining V3.1 (NPI, 2012) was used to provide data to estimate the amount of dust emitted from the various activities associated with the Project, incorporating site-specific information where available. Emission factors from the NPI EETM for Mining were supplemented with those from the US EPA's AP42 (USEPA, 1995) when required and/or considered appropriate.

A summary of the dust emission estimates for the Project is presented in Table 11.4 and presented in Figure 11-2 for typical operating conditions and Table 11.5 and Figure 11-4 for upset conditions. When developing estimates for $PM_{2.5}$, it was conservatively assumed that 20 per cent of PM_{10} is in the form of $PM_{2.5}$.

To determine the relative scale of the predicted impact on air quality, the Project's dust emissions inventory will be compared to publicly available information for fugitive emissions of PM_{10} from Saraji Mine, Peak Downs Mine and Lake Vermont mines Section 11.5.1.

Further information regarding the development of the Project emissions inventory is available in **Appendix H-1 Air Quality Technical Report**.

Table 11.4 Project emission estimations (Typical conditions)

Emission source	Control	TSP (kg/year)	PM_{10} (kg/year)	$PM_{2.5}$ (kg/year)
Operational Phase (Typical)				
Activities at Project CHPP				
Conveying of coal	50% unshaped	1,659	829	166
Coal processing (breaker station)	50% water spray	193,070	69,861	13,972
Stacking/reclaiming coal	50% water spray	26,192	11,388	2,278
Dozers on coal	No controls	43,777	12,615	2,523
Wind erosion of stockpiles	No controls	2,393	1,197	239
Transport of excess ROM coal to Saraji CHPP	75% Level 2 watering	175,200	43,800	8,760
Activities at Saraji Mine CHPP				
Dumping of coal	50% water spray	33,288	12,045	2,409
Coal processing (breaker station)	50% water spray	21,900	9,198	1,840
Stacking/reclaiming coal	50% water spray	66,576	24,090	4,818
	No controls	49,720	24,860	4,972
Project total (kg/year)		**657,553**	**222,498**	**44,500**

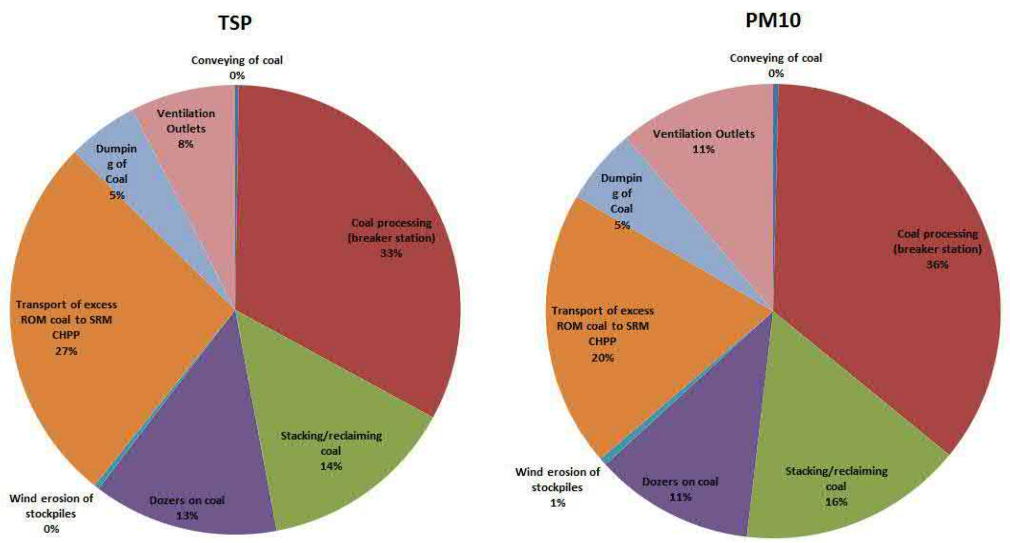


Figure 11-2 Project Only Case: Summary of Emissions Inventory (Typical Conditions)

Table 11.5 Project emission estimations (Upset conditions)

Emission source	Control	TSP (kg/year)	PM_{10} (kg/year)	$PM_{2.5}$ (kg/year)
Operational Phase (Upset)				
Activities at Project CHPP				
Conveying of coal	50% unshaped	1,659	829	166
Coal processing (breaker station)	50% water spray	386,141	139,722	27,944
Stacking/reclaiming coal	50% water spray	52,385	22,776	4,555
Dozers on coal	No controls	87,554	25,230	5,046
Wind erosion of stockpiles	No controls	2,393	1,197	239
Transport of excess ROM coal to Saraji CHPP	75% Level 2 watering	175,200	43,800	8,760
Activities at Saraji Mine CHPP				
Dumping of coal	50% water spray	33,288	12,045	2,409
Coal processing (breaker station)	50% water spray	21,900	9,198	1,840
Stacking/reclaiming coal	50% water spray	66,576	24,090	4,818
	No controls	49,720	24,860	4,972
Project total (kg/year)		**910,104**	**315,792**	**63,158**

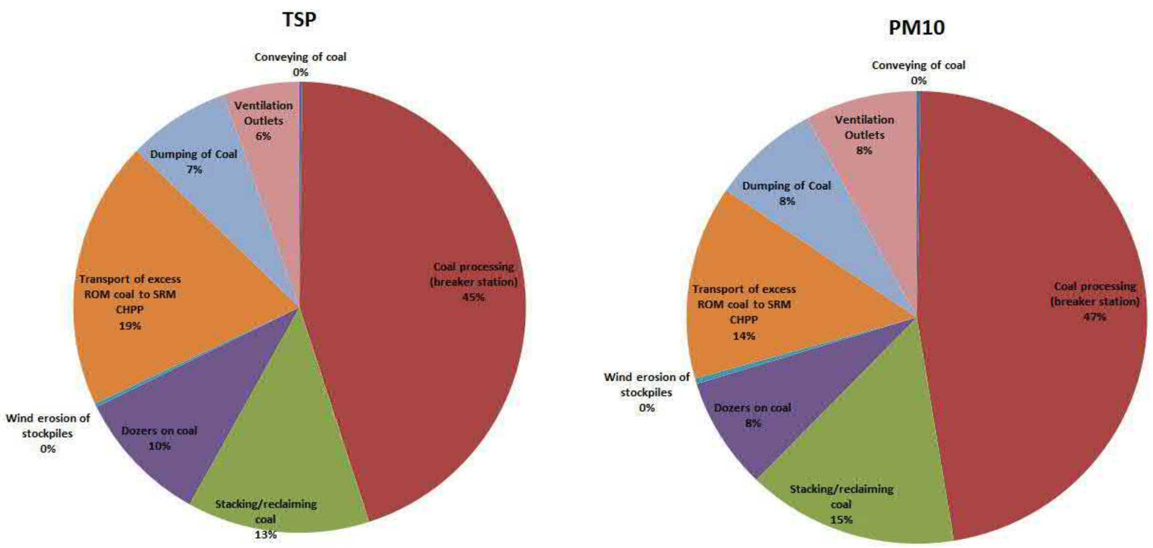


Figure 11-3 Project Only Case: Summary of Emissions Inventory (Typical Conditions)

Dust dispersion model

The dispersion model that was used for this assessment is based on the CALMET/CALPUFF suite of modelling tools (Scire, 2000).

Regional, three-dimensional wind fields that are used as input into the dispersion model were prepared using a combination of The Air Pollution Model (TAPM) developed by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) (Hurley, 2008), and CALMET, the meteorological pre-cursor for CALPUFF (Scire, 2000). Due to the large areal extent of the model domain and the lack of observational data, data assimilation was not undertaken. In order to capture a wide range of meteorological conditions, a total of five years of numerically simulated, hourly meteorology was developed corresponding to years 2008 through to 2012.

Further information about the dispersion modelling assessment methodology, including the development of meteorology for the Project Site is available in **Appendix H-1 Air Quality Technical Report**.

11.3.2 Greenhouse gas inventory methodology

An inventory of GHG emissions for the Project was prepared in accordance with the Australian Standard (AS) ISO14064.1 (2006): *Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals*.

GHG emissions attributable to the Project were considered in terms of three ‘scopes’ of emission categories. These three ‘scopes’ are described below and in Figure 11-4.

- **Scope 1 emissions -** releases of GHG into the atmosphere as a direct result of a Project activity or series of Project activities (including ancillary activities). For example, fugitive emissions released from the coal seam as coal is extracted during the production process, or emissions from diesel consumed onsite in machinery.
- **Scope 2 emissions -** releases of GHG into the atmosphere as a direct result of one or more Project activities that generate electricity, heating, cooling or steam that is consumed by the Project but that do not form part of the Project. For example, the consumption of electricity by Project infrastructure, where the electricity has been generated outside of the Project Footprint.
- **Scope 3 emissions -** other indirect GHG emissions that occur outside the Project Footprint. For example, third party emissions from transportation of coal and subsequent use of the coal.

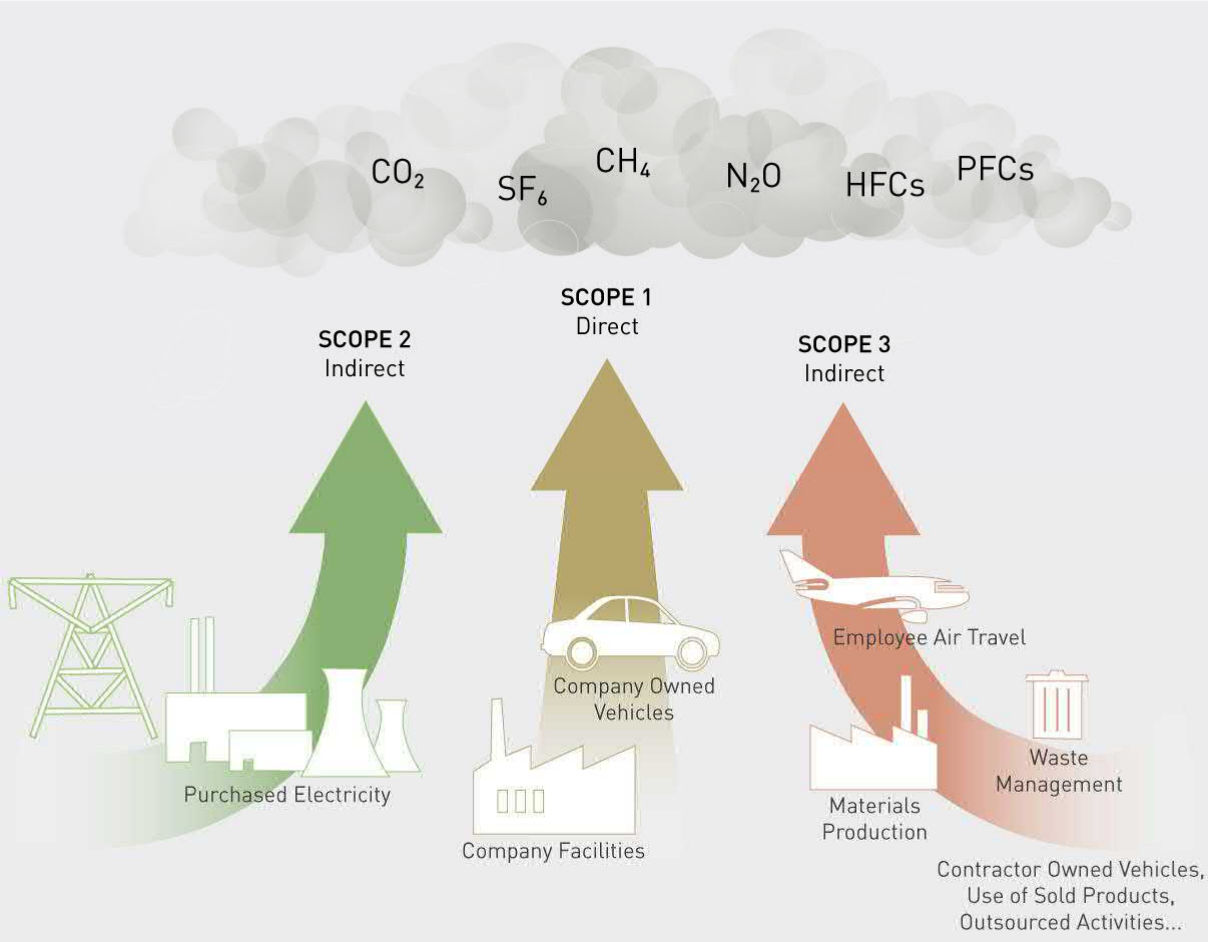


Figure 11-4 Overview of scope and emissions across a reporting entity (Source: Greenfleet)

The purpose of separating different types of emissions into scopes is to avoid the potential for double counting. Double counting occurs when two or more organisations assume responsibility for the same emissions.

Scope 1 and Scope 2 emissions must be reported under the NGER Act; however, reporting Scope 3 emissions is voluntary. The NGER Act states that the following gases must be reported:

- carbon dioxide (CO_2)
- methane (CH_4)
- nitrous oxide (N_2O)
- hydrofluorocarbons (HFC)
- perfluorocarbons (PFC)
- sulphur hexafluoride (SF_6).

CO_{2-e} was used to assess GHG emissions from the Project. For a given mixture and amount of GHG, CO_{2-e} describes the amount of CO_2 that would have the same global warming potential (GWP) when measured over a specified time scale (100 years). The GWP of a GHG is the radiative forcing impact contributing to global warming, relative to one unit of CO_2. Because CO_2 is used as the reference gas, it has a GWP of one.

Inventory principles

The GHG inventory in Table 11.7 was developed to satisfy AS ISO14064.1 (2006): *Specification with guidance at the organization level for quantification and reporting of greenhouse gas emissions and removals* as well as The Greenhouse Gas Protocol (WBCSD & WRI, 2004).

The principles behind the GHG inventory, and how/where they have been addressed in the context of the Project, are provided in Table 11.6.

Table 11.6 Principles of the GHG inventory

Principle	Requirements	Addressed
Relevance	Ensure the inventory appropriately reflects the emissions of the Project.	GHG emissions from the Project have been estimated as per Terms of Reference (ToR) for the EIS. Scope 1 and Scope 2 emissions cover emissions from the Mining Lease (ML). Scope 3 emissions cover emissions associated with transporting personnel and the end use(s) of coal from the proposed mine.
Completeness	Account for, and report on, all GHG emission sources and activities within the chosen inventory boundary. Disclose and justify any specific exclusions.	The GHG inventory covers all Scope 1 and Scope 2 emissions from the Project. GHG emissions from the following sources are relatively minor in terms of the overall emissions and therefore have not been estimated: • land clearing • petrol vehicles • fugitive emissions from wastewater treatment.
Consistency	Use consistent methodologies to allow for meaningful comparisons of emissions over time.	Emissions have been estimated using the published emission factors provided in Table 11.7. Estimating future GHG emissions and reporting emissions under the NGER Act will follow the same methodology.
Transparency	Address all relevant issues in a factual and coherent manner, based on a clear audit trail. Disclose any relevant assumptions and make appropriate references to the accounting and calculation methodologies, and data sources used.	Emissions have been estimated using the published emission factors provided in Table 11.7.
Accuracy	Ensure that the quantification of GHG emissions is systematically neither over nor under actual emissions, as far as can be judged, and that uncertainties are reduced as far as practicable. Achieve sufficient accuracy to enable users to make decisions with reasonable assurance as to the integrity of the reported information.	Although care was taken when estimating the Project's projected energy usage and coal production rates, a high level of uncertainty surrounds the predicted GHG emissions from the Project. The inherent uncertainty associated with using the latest National Greenhouse Accounts (NGA) emission factors (July 2017) to estimate future emissions, without allowing for futuristic changes to emission factors, is a major source of uncertainty.

Principle	Requirements	Addressed
		Currently, the emissions factor of electricity purchased from the Queensland grid is 0.79 t CO_2-e per megawatt hour (MWh). In the future, the emissions factor might decrease as the penetration of renewable energy increases.

Emission factors

The NGA emissions factors (DoEE, 2017) presented in Table 11.7 were used to prepare the GHG inventory.

Table 11.7 National Greenhouse Accounts emissions factors

Emission source	Energy content	Scope of emissions	GHG emission factor	Units	Source
Coal mine waste gas that is captured for combustion	0.0377 GJ / m^3	1	56.03	kg CO_2-e/GJ of incidental mine gas combusted	National Greenhouse Accounts Factors (July 2018) (DoEE, 2017b)
Post-mining activities associated with gassy underground mines	N/A	1	0.017	t CO_2-e per tonne of raw coal mined	
Consumption of diesel fuel	38.6 GJ/kL	1	70.2	kg CO_2-e/GJ of diesel fuel consumed	
Consumption of electricity	-	2	0.80	kg CO_2-e/MWh consumed	
Consumption of coking coal	30 GJ/t	3	92.02	kg CO_2-e/GJ consumed	
Transporting coal by rail	N/A	3	13	Grams of CO_2-e per net tonne of coal, per kilometre travelled	BMA supplied estimation of rail emissions (electric locos)
Handling coal at the terminal	N/A	3	1,174	t CO_2-e per Mt of coal handled	BMA supplied estimation of coal terminal emissions
Diesel consumption by the coal bulk carrier	N/A	3	65.7	kL/Mt coal	Caval Ridge Mine EIS, 2010
Kerosene for use as an aviation fuel (for transporting fly in fly out workers)	36.8 GJ/kL	3	70.21	kg CO_2-e/kGJ	National Greenhouse Accounts Factors (July 2018) (DoEE, 2017b)
Electricity purchased	N/A	3	0.13	kg CO_2-e/MWh generated	
Diesel fuel combusted	N/A	3	3.6	kg CO_2-e/GJ	

11.4 Description of environmental values

11.4.1 Climate and meteorology

The Project is located in Central Queensland approximately 30 km north of Dysart and 170 km south west of Mackay. The Central Queensland region generally experiences a warm subtropical climate, with distinct wet and dry seasons.

The nearest Australian Bureau of Meteorology (BoM) operated weather station to the Project with long term climate data available is the Moranbah Water Treatment Plant, located approximately 2.1 km north east of Moranbah. Long term climatic trends in the vicinity of the Project Site have therefore been described by monitoring data collected at Moranbah Water Treatment Plant station. A summary of long term average temperature and rainfall is presented in Table 11.8, and long-term wind roses are presented in Figure 11-5 and Figure 11-6.

Monthly mean rainfall values vary greatly, ranging from 9.1 millimetres (mm) (September) to 103.9 mm (December). Rainfall is highest in the months of summer: an average of 103.9 mm in December, 103.8 mm in January and 100.7 mm in February. Approximately 50 per cent of average annual rainfall is recorded during this season. Winter (June, July and August) is the clear dry season, with approximately 11 per cent of total annual average rain occurring in these months.

In summer, the average maximum temperature ranges from 33.1°C (November) to 34.0°C (December) and the average minimum temperature ranges from 21.1°C (December) to 21.9°C (January). In winter, the average maximum temperature ranges from 23.7°C (June and July) to 25.5°C (August) and the average minimum temperature ranges from 9.9°C (July) to 11.2°C (June).

Table 11.8 Long term monthly averages for rainfall and mean max and minimum temperatures recorded at Moranbah Water Treatment Plant BoM station (operational 1972 – 2012)

Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean rainfall (mm)	103.8	100.7	55.4	36.4	34.5	22.1	18.0	25.0	9.1	35.7	69.3	103.9	613.9
Mean maximum temperature (°C)	33.8	33.1	32.1	29.5	26.5	23.7	23.7	25.5	29.2	32.3	33.1	34.0	29.7
Mean minimum temperature (°C)	21.9	21.8	20.2	17.6	14.2	11.2	9.9	11.1	14.1	17.6	19.4	21.1	16.7

The BoM annual 9 am wind rose Figure 11-5 shows that over 40 per cent of winds at this time are from the east, and are of low to moderate strength. Winds at 3 pm Figure 11-6 are also most frequently from the east and are also of low to moderate strength.

In addition, the BoM observed data a site specific numerically simulated dataset was developed using CALMET. Further details on the CALMET dataset are provided in **Appendix H-1 Air Quality Technical Report**.

Rose of Wind direction versus Wind speed in km/h (10 Jan 1986 to 26 Mar 2012)

Custom times selected, refer to attached note for details

MORANBAH WATER TREATMENT PLANT

Site No: 034038 • Opened Jan 1972 • Closed Apr 2012 • Latitude: -21.9947° • Longitude: 148.0308° • Elevation 260m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.

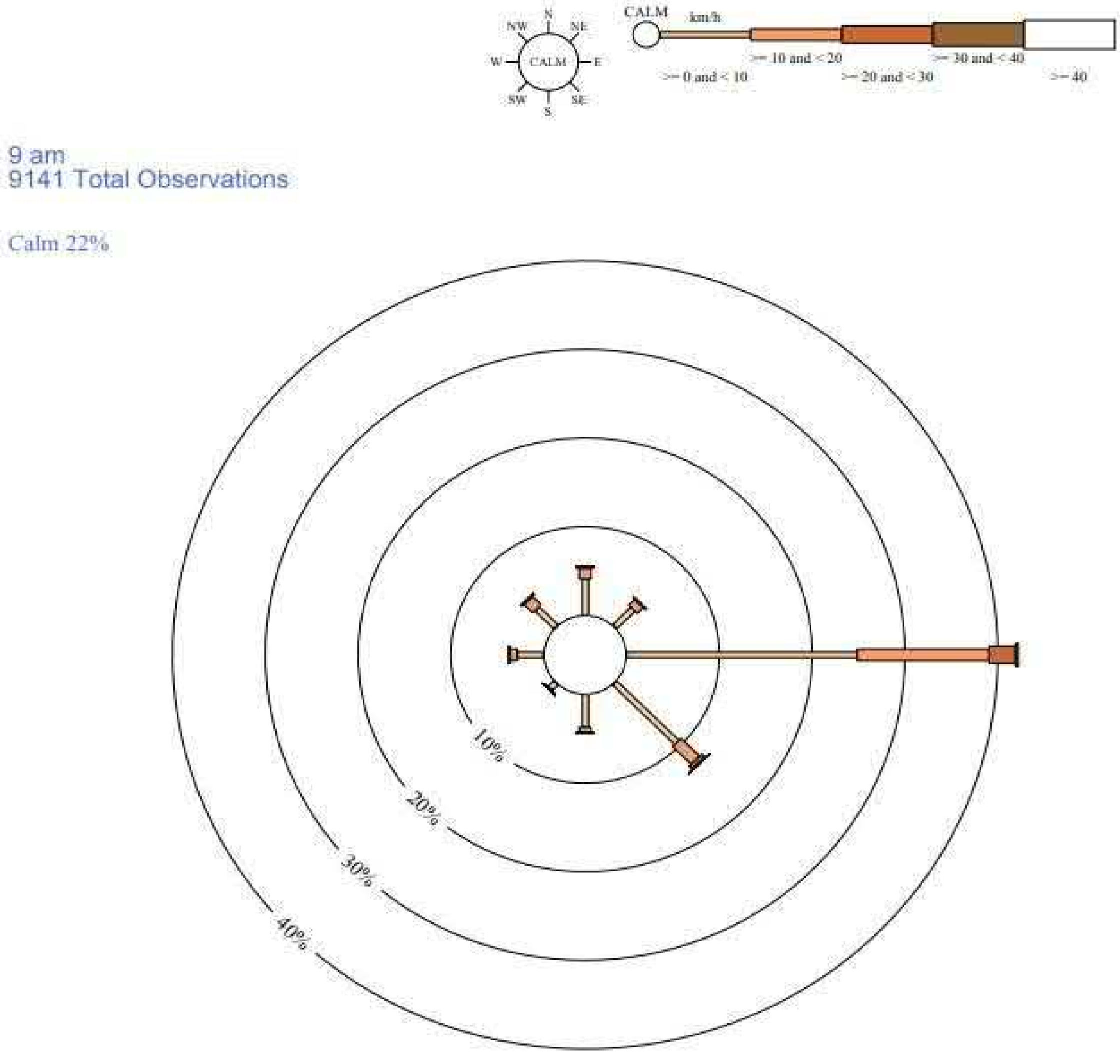


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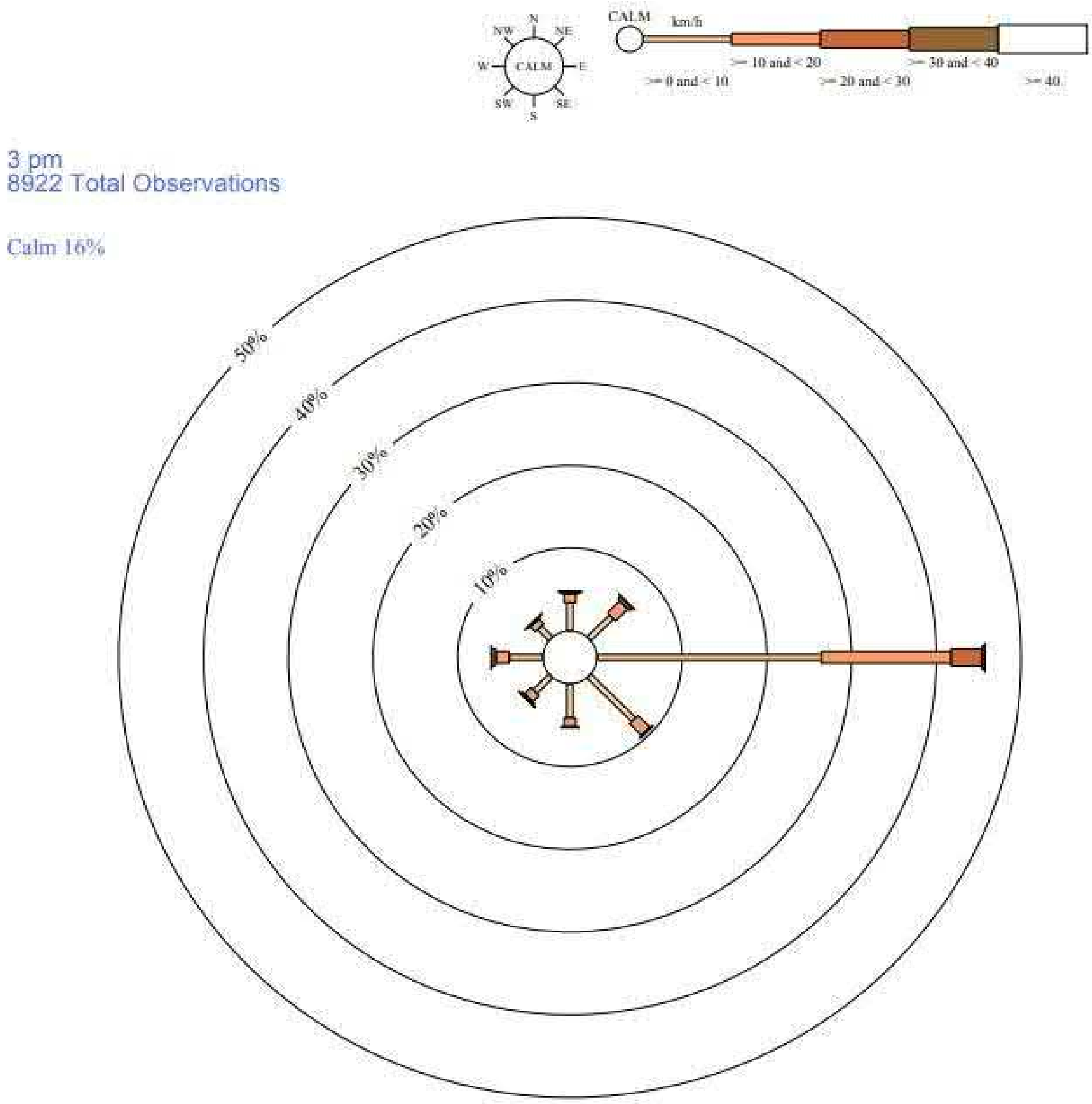
Figure 11-5 BoM Moranbah Water Treatment Plant annual 9 am wind rose

Rose of Wind direction versus Wind speed in km/h (10 Jan 1986 to 26 Mar 2012)
Custom times selected, refer to attached note for details

MORANBAH WATER TREATMENT PLANT
Site No: 034038 • Opened Jan 1972 • Closed Apr 2012 • Latitude: -21.9947° • Longitude: 148.0308° • Elevation 260m

An asterisk (*) indicates that calm is less than 0.5%.
Other important info about this analysis is available in the accompanying notes.



Australian Government
Bureau of Meteorology

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Figure 11-6 BoM Moranbah Water Treatment Plant annual 3 pm wind rose

11.4.2 Background air quality

The Project is to be located within an airshed that includes BMA's Saraji Mine, Peak Downs Mine and Norwich Park Mine, as well as Jellinbah Group's Lake Vermont Mine.

For this assessment (and in the absence of suitable site-specific data from which to calculate background levels of dust) estimates of background dust levels (Table 11.9) were developed using data from the Caval Ridge Mine Site 2 (BMA CVM Site 2) ambient air monitoring station located approximately four kilometres (km) northwest of the Moranbah Airport, 2.5 km south of Moranbah and 38 km north-northwest of the Project Site. This location is considered to be sufficiently representative of the background level of dust that would occur in the vicinity of the Project in the absence of anthropogenic activities.

As recommended by the Victorian Environment Protection Authority (Vic EPA), 70th percentile values were used to estimate background levels for the 24 hour average concentration of PM_{10} and $PM_{2.5}$. Background levels of annual average TSP, PM_{10} and $PM_{2.5}$ were estimated using annual average values. The estimated background level of dust deposition is based on an average of data for the period February 2014 through November 2015. For further information see **Appendix H-1 Air Quality Technical Report**.

Table 11.9 below includes the percentage of the Project goal that is represented by the estimated background level, ranging from 36 per cent for dust deposition to 91 per cent for the annual average concentration of the PM_{10}.

Table 11.9 Estimated background air pollutant levels

Pollutant	Averaging period	Estimated background level	Percentage of goal	Source
TSP	Annual	39.4 µg/m^3	44%	**BMA CVM Site 2**
PM_{10}	24 hour	24.7 µg/m^3	49%	**BMA CVM Site 2**
	Annual	22.8 µg/m^3	91%	**BMA CVM Site 2**
$PM_{2.5}$	24 hour	18.8 µg/m^3	75%	**BMA CVM Site 2**
	Annual	4.1 µg/m^3	51%	**BMA CVM Site 2**
Dust deposition	Monthly	43.6 mg/m^2/day	36%	**BMA CVM Site 2**

11.5 Potential impacts

11.5.1 Air quality impacts

Presented in this section are the results for the annual average concentration of TSP, the 24 hour and annual average concentration of PM_{10} and $PM_{2.5}$, as well as the monthly average dust deposition for the Project-only case.

Health related criteria

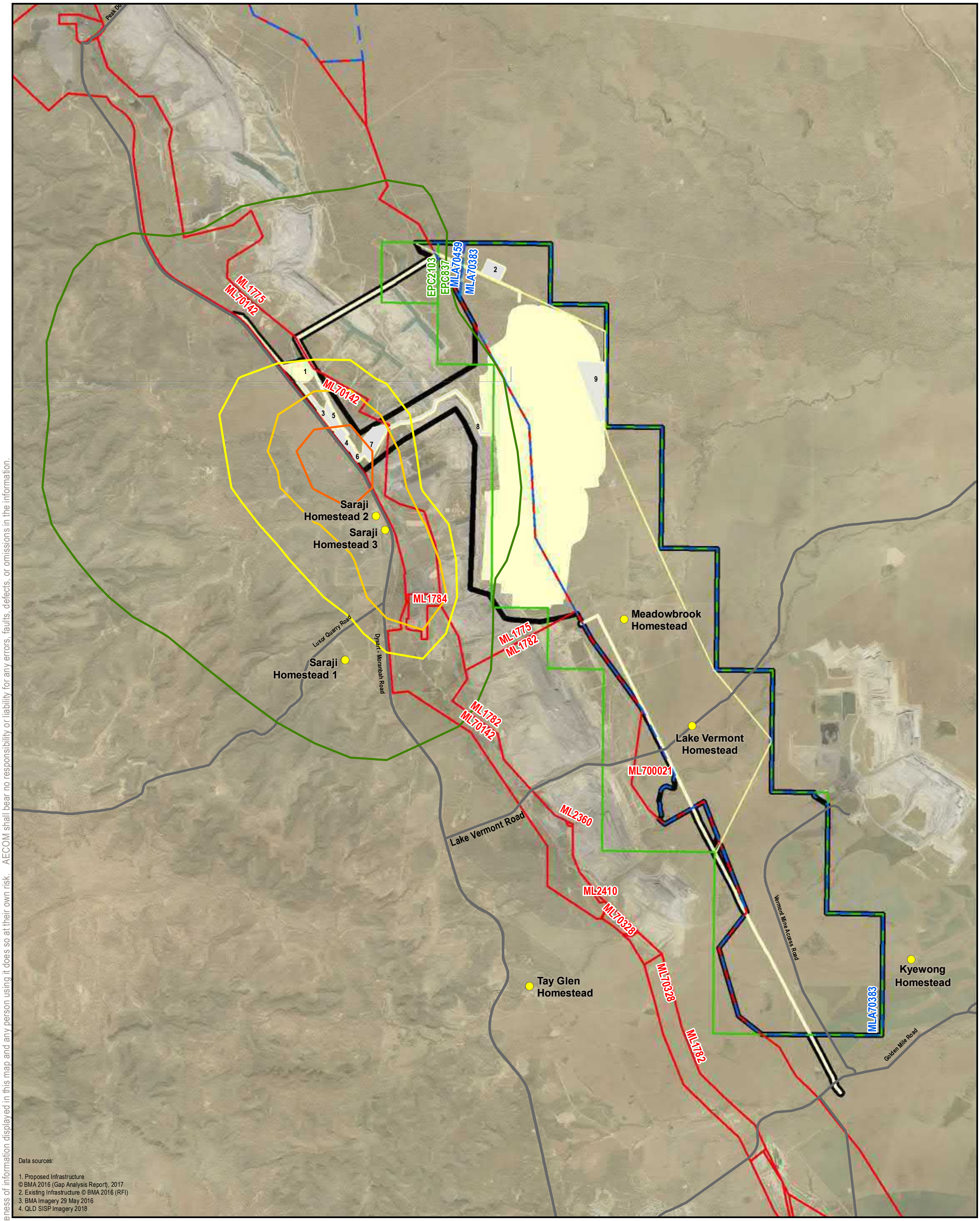
Results for TSP

Presented in Table 11.10 are the results for the annual average concentration of TSP based on five years of meteorology (2008 - 2012). Results of the dispersion modelling do not highlight any significant issues in relation to emission of TSP from the Project (in isolation) with annual concentrations predicted to be less than approximately 24 per cent of the Project goal of 90 microgram per cubic metre (µg/m^3) at receptor locations.

Table 11.10 Project-only predicted emissions of TSP at receptor locations

ID	Description	Averaging period	Project-only (µg/m³)	Percentage of goal
1	Kyewong Homestead	Annual	0.0	0%
2	Lake Vermont Homestead	Annual	0.1	0%
3	Saraji Homestead 1	Annual	3.5	4%
4	Saraji Homestead 2	Annual	22.2	25%
5	Saraji Homestead 3	Annual	21.5	24%
6	Tay Glen Homestead	Annual	0.2	0%
7	Meadowbrook Homestead	Annual	0.2	0%

Presented in Figure 11-7 is a contour plot of the maximum annual average concentration of TSP based on five years of meteorology (2008 - 2012).



LEGEND

- Project Site
- Project Footprint
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Surface Infrastructure
- Transport and Infrastructure Corridor
- Homestead
- Public Road

Total Suspended Particulate µg/m³

- 1
- 5
- 10
- 25

1 Rail Loading Balloon Loop
2 Process Water Dam
3 Product Stockpiles
4 CHPP
5 Raw Water Dam
6 ROM Pad
7 Future MIA
8 Conveyor
9 Construction Village

N

Figure 11-7
Maximum annual average concentration of total suspended particulate

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.75 1.5 3
Kilometres

Scale: 1:150,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

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Results for PM_{10}

Presented in Table 11.11 is the maximum predicted 24 hour average and annual average concentration of PM_{10} at the receptor locations as a result of emissions of dust from the Project (in isolation of other dust emissions sources). Results for both the Typical and Upset Conditions scenarios are included in the table. The results presented exclude estimates of background levels of dust.

Under typical operating conditions, Project-only contributions to the maximum 24 hour average concentration of PM_{10} are predicted to exceed the Project goal of 50 µg/m^3 at Saraji Homestead 2 (120 per cent) (bolded), and reach 85 per cent of the Project goal at Saraji Homestead 3. These two receptor locations are located in close proximity to the Project CHPP. Co-existence agreements between the tenant and BMA have been established at these two homesteads.

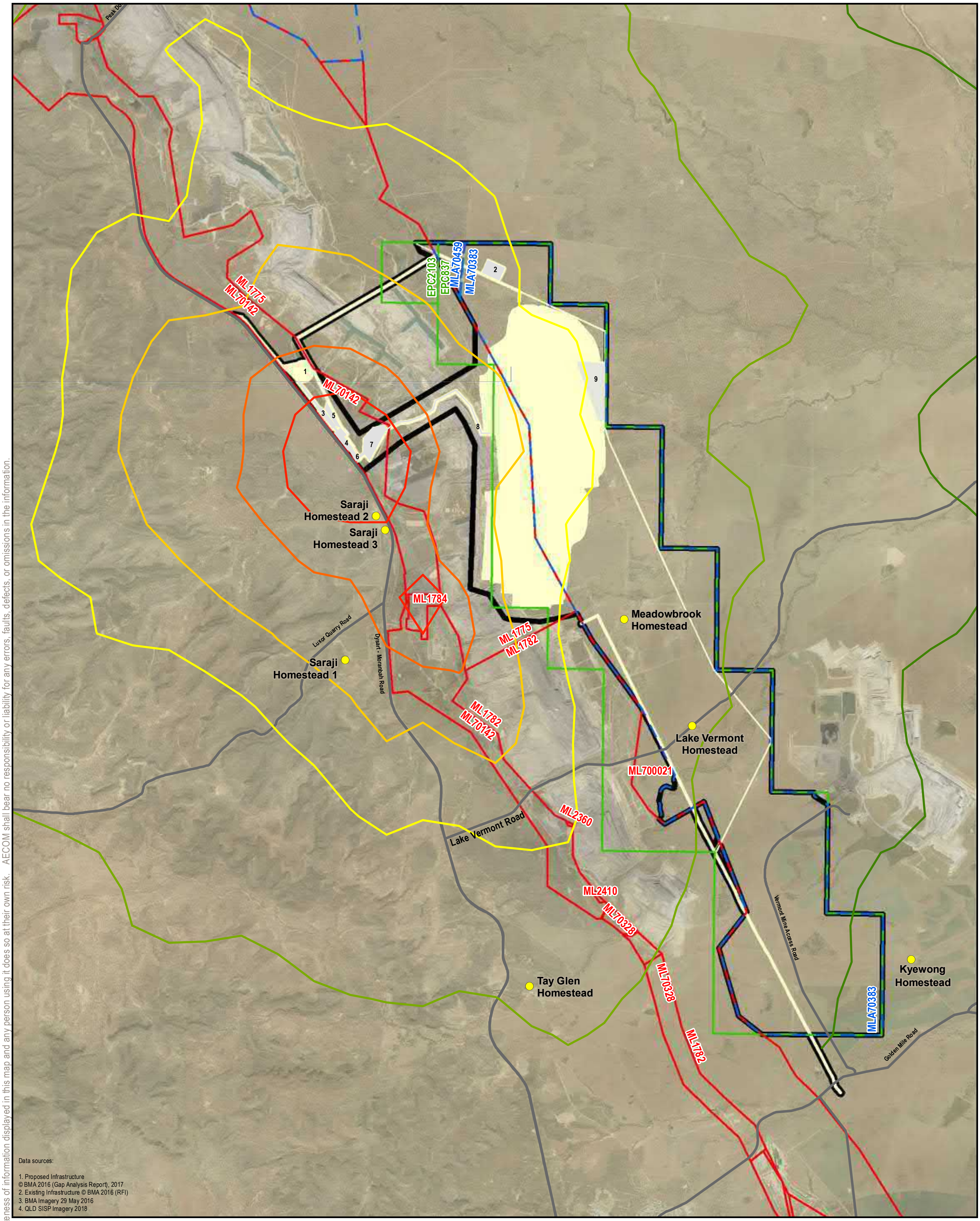
Results of the dispersion modelling based on Upset Conditions highlight the potential for adverse impacts of dust at both Saraji Homestead 2 and Saraji Homestead 3 based on Project dust emission sources alone.

Background levels for the 24 hour average concentration of PM_{10} are estimated to be 24.7 µg/m^3 (or 49 per cent of the Project goal) (Section 11.4.2). Therefore results of the dispersion modelling suggest that exceedances of the Project goal for PM_{10} are predicted to occur at Saraji Homestead 2 and may occur at Saraji Homestead 3 during the 24 hour averaging period as a result of the Project operating concurrently with existing open cut mining operations (including BMA's Saraji Mine, Peak Downs Mine and Norwich Park Mine, and Jellinbah Group's Lake Vermont Mine).

Table 11.11 Project-only predicted emissions of PM_{10} at receptor locations

ID	Description	Averaging period	Typical		Upset	
			Project-only (µg/m^3)	Percentage of goal	Project-only (µg/m^3)	Percentage of goal
1	Kyewong Homestead	24 hour	0.8	2%	1.1	2%
		Annual	0.0	0%	-	-
2	Lake Vermont Homestead	24 hour	2.3	5%	3.2	6%
		Annual	0.1	0%	-	-
3	Saraji Homestead 1	24 hour	14.3	29%	19.2	38%
		Annual	2.0	8%	-	-
4	Saraji Homestead 2	24 hour	62.7	125%	108.5	217%
		Annual	8.3	33%	-	-
5	Saraji Homestead 3	24 hour	44.5	89%	71.3	143%
		Annual	7.8	31%	-	-
6	Tay Glen Homestead	24 hour	2.5	5%	3.5	7%
		Annual	0.2	1%	-	-
7	Meadowbrook Homestead	24 hour	3.3	7%	4.9	10%
		Annual	0.1	0%	-	-

Figure 11-8 is a contour plot of the maximum 24 hour average concentration of PM_{10} for the Project-Only Case. Contour plot for the Project-Only Case based on Upset Conditions is included as Figure 11-9 Presented in Figure 11-10 is a contour plot of the maximum annual average concentration of PM_{10} for the Project-Only Case based on five years of meteorology (2008 -2012).



LEGEND

- Project Site
- Project Footprint
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Surface Infrastructure
- Transport and Infrastructure Corridor
- Homestead
- Public Road

PM10 µg/m³

- 1
- 2
- 5
- 10
- 25
- 50

1 Rail Loading Balloon Loop
2 Process Water Dam
3 Product Stockpiles
4 CHPP
5 Raw Water Dam
6 ROM Pad
7 Future MIA
8 Conveyor
9 Construction Village

Figure 11-8
Maximum 24 hour average concentration of PM10 (Typical conditions)

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.75 1.5 3
Kilometres

Scale: 1:150,000 (when printed at A4)
Projection: Map Grid of Australia - Zone 55 (GDA94)

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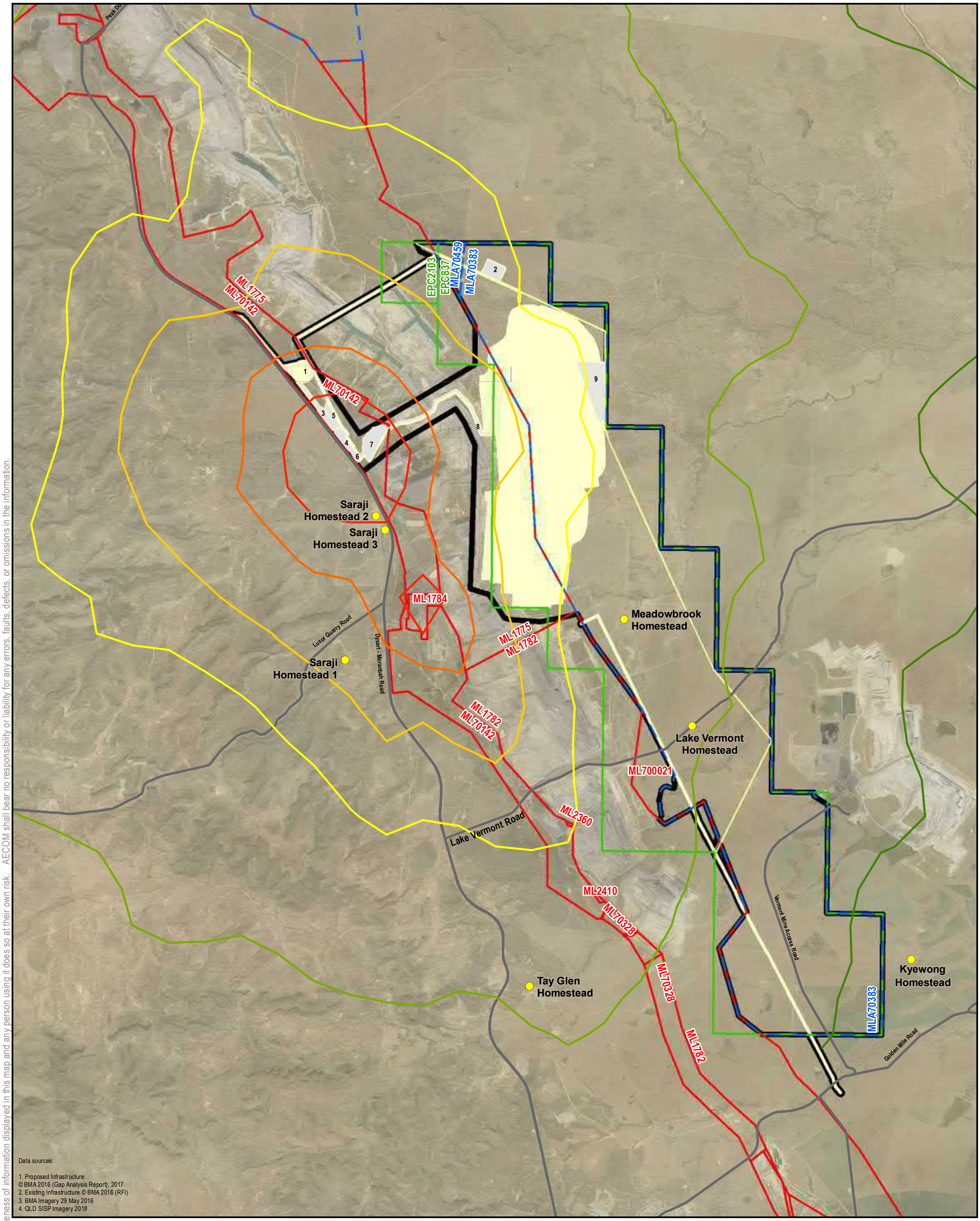

LEGEND

- Project Site
- Project Footprint
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Surface Infrastructure
- Transport and Infrastructure Corridor
- Homestead
- Public Road

PM10 µg/m³

- 1
- 2
- 5
- 10
- 25
- 50

1 Rail Loading Balloon Loop
2 Process Water Dam
3 Product Stockpiles
4 CHPP
5 Raw Water Dam
6 ROM Pad
7 Future MIA
8 Conveyor
9 Construction Village

N

Figure 11-9
Maximum 24 hour average concentration of PM10 (Upset conditions)

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.75 1.5 3
Kilometres

Scale: 1:150,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

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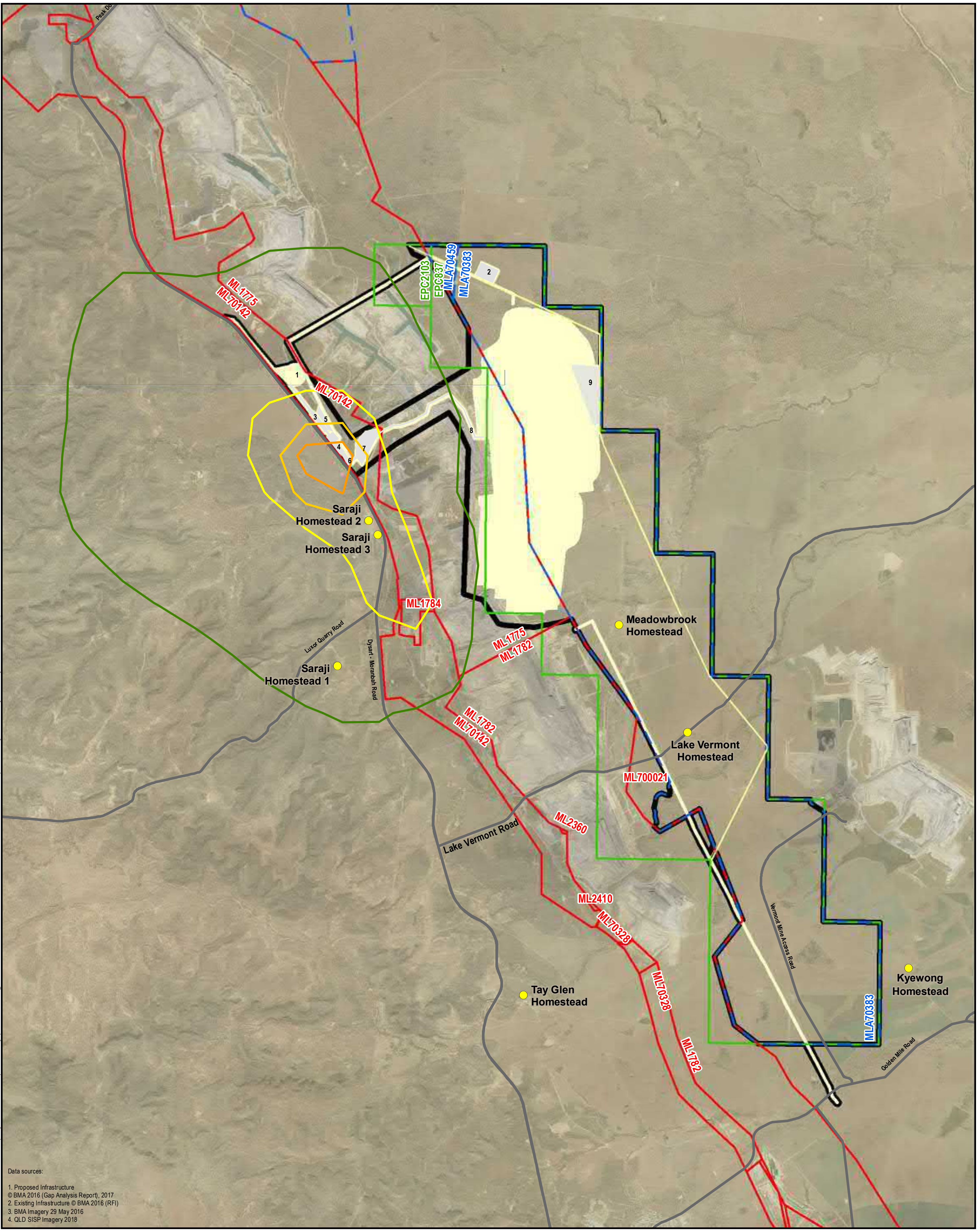

LEGEND

- Project Site
- Project Footprint
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Surface Infrastructure
- Transport and Infrastructure Corridor
- Homestead
- Public Road

PM10 Annual Average µg/m³

- 1
- 5
- 10
- 15

1 Rail Loading Balloon Loop
2 Process Water Dam
3 Product Stockpiles
4 CHPP
5 Raw Water Dam
6 ROM Pad
7 Future MIA
8 Conveyor
9 Construction Village

N

Figure 11-10
Maximum annual average concentration of PM10

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.75 1.5 3
Kilometres

Scale: 1:150,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

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Results for $PM_{2.5}$

Table 11.12 presents the results for the maximum 24-hour average and annual average concentration of $PM_{2.5}$ for the Project-only case at receptor locations.

Project-only contributions to the 24-hour average concentrations of $PM_{2.5}$ at the Saraji 2 Homestead and Saraji 3 Homestead are predicted to be 50 per cent and 36 per cent of the Project goal of 25 µg/m^3 for $PM_{2.5}$ respectively. Project-only contributions to $PM_{2.5}$ impacts at all other receptors are predicted to be minor and below the Project goal of 25 µg/m^3.

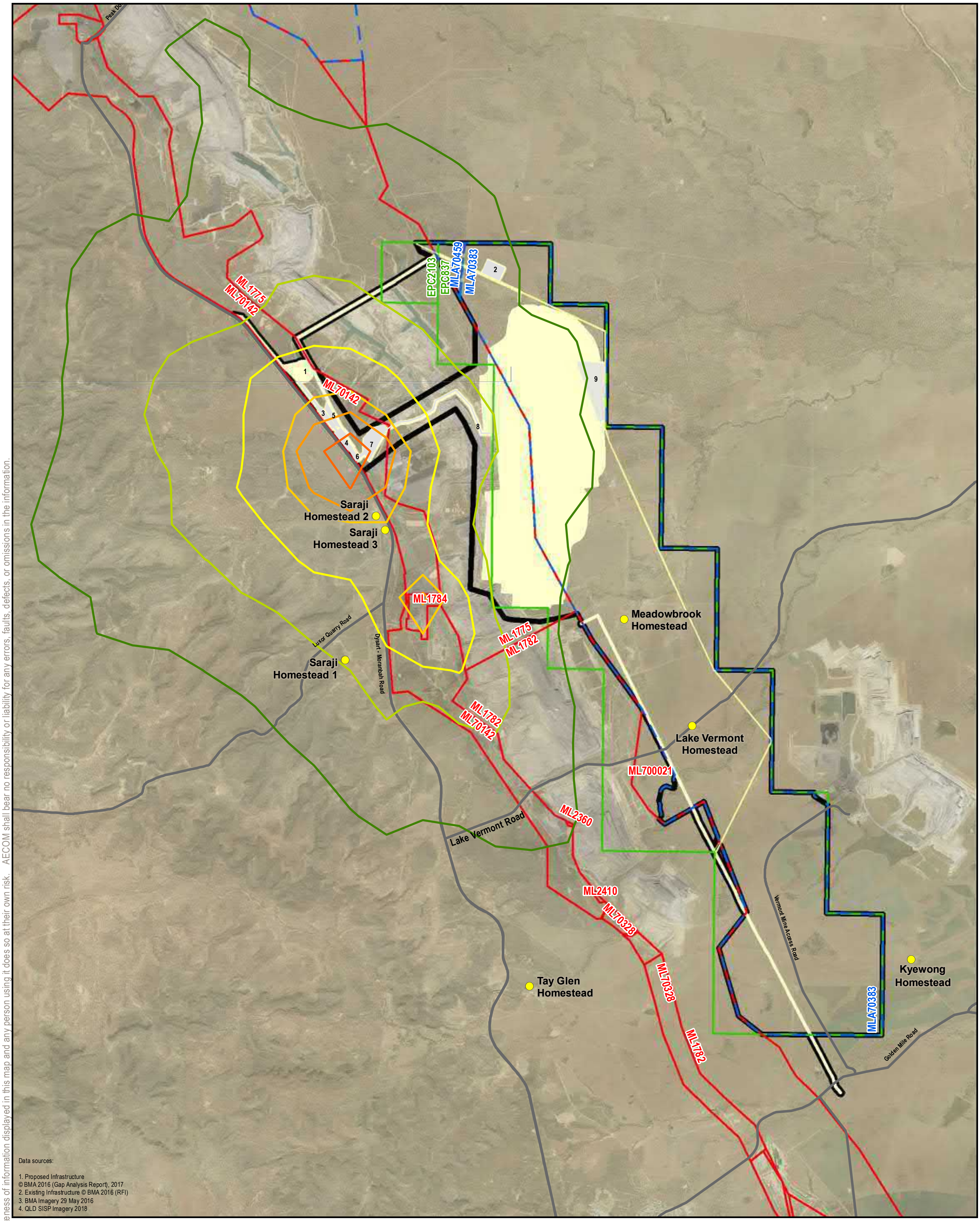
Background levels for the 24-hour average concentration of $PM_{2.5}$ are estimated to be 17.7 µg/m^3 (or 75 per cent of the Project goal, refer Table 11.8). Therefore results of the dispersion modelling suggest that exceedances of the Project goal for $PM_{2.5}$ may occur at Saraji Homestead 2 and Saraji Homestead 3 during the 24 hour averaging period as a result of the Project operating concurrently with existing open cut mining operations (including BMA's Saraji Mine, Peak Downs Mine and Norwich Park Mine, and Jellinbah Group's Lake Vermont Mine).

Figure 11-11 presents the maximum 24 hour average concentration of $PM_{2.5}$.

Table 11.12 Project-only predicted emissions of $PM_{2.5}$ at receptor locations

ID	Description	Averaging period	Project-only (µg/m3)	Percentage of goal
1	Kyewong Homestead	24 hour	0.2	1%
		Annual	0.0	0%
2	Lake Vermont Homestead	24 hour	0.5	2%
		Annual	0.0	0%
3	Saraji Homestead 1	24 hour	2.9	11%
		Annual	0.4	5%
4	Saraji Homestead 2	24 hour	12.5	50%
		Annual	1.7	21%
5	Saraji Homestead 3	24 hour	8.9	36%
		Annual	1.6	20%
6	Tay Glen Homestead	24 hour	0.5	2%
		Annual	0.0	0%
7	Meadowbrook Homestead	24 hour	0.7	3%
		Annual	0.0	0%

No significant air quality issues attributable to the Project were identified in relation to the maximum annual average concentration of $PM_{2.5}$ with Project-only contributions predicted to be less than 22 per cent of the Project goal of eight µg/m^3. A contour plot is presented in Figure 11-12 for the maximum annual average concentration of $PM_{2.5}$ based on five years of meteorology (2008 - 2012).



LEGEND

- Project Site
- Project Footprint
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Surface Infrastructure
- Transport and Infrastructure Corridor
- Homestead
- Public Road

PM2.5 µg/m³

- 1
- 2.5
- 5
- 10
- 15
- 25

1 Rail Loading Balloon Loop
2 Process Water Dam
3 Product Stockpiles
4 CHPP
5 Raw Water Dam
6 ROM Pad
7 Future MIA
8 Conveyor
9 Construction Village

N

Figure 11-11
Maximum 24 hour average concentration of PM2.5

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.75 1.5 3
Kilometres

Scale: 1:150,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

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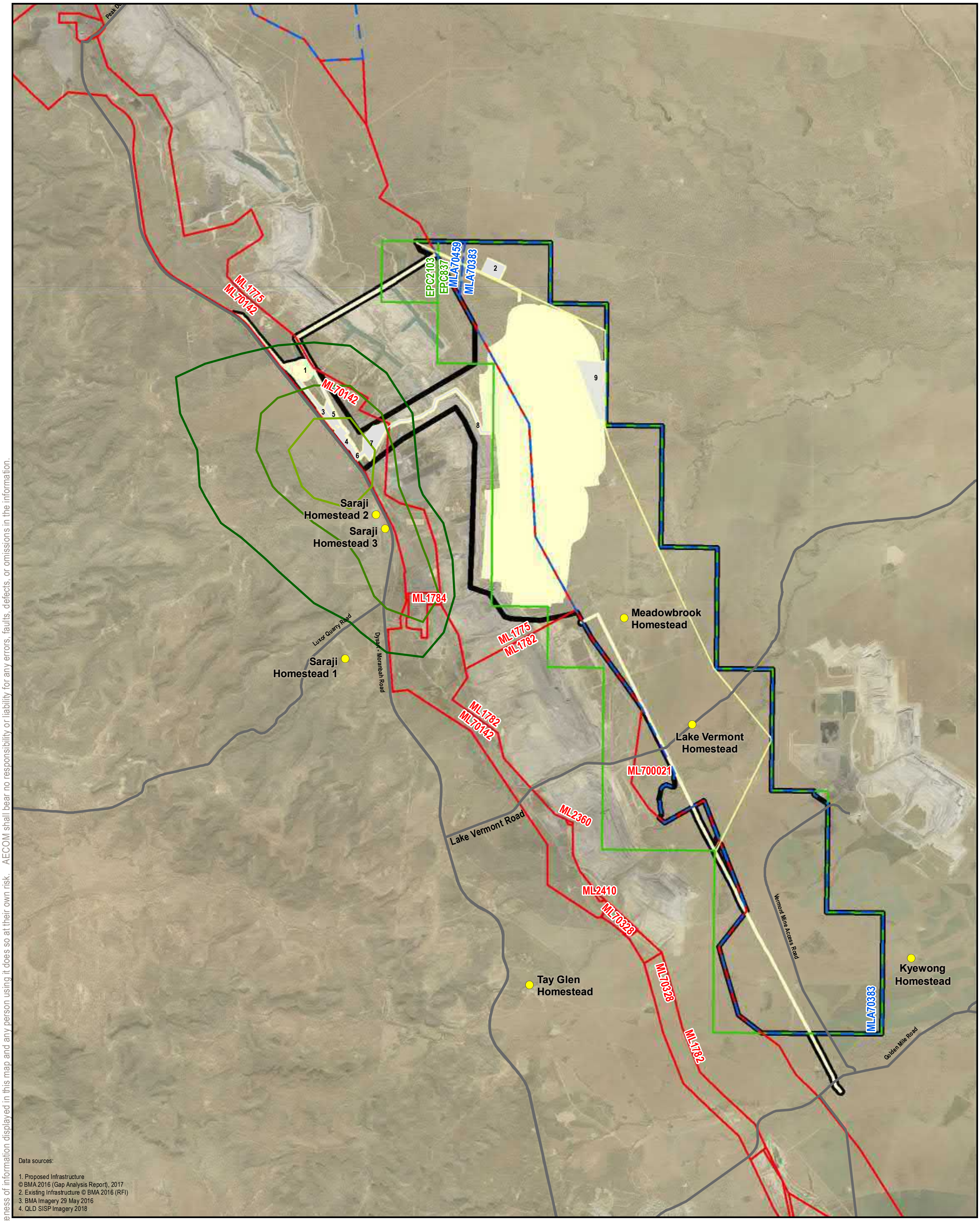

LEGEND

- Project Site
- Project Footprint
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Surface Infrastructure
- Transport and Infrastructure Corridor
- Homestead
- Public Road

Average Annual PM2.5 µg/m³

- 0.5
- 1
- 2

1 Rail Loading Balloon Loop
2 Process Water Dam
3 Product Stockpiles
4 CHPP
5 Raw Water Dam
6 ROM Pad
7 Future MIA
8 Conveyor
9 Construction Village

Figure 11-12
Maximum annual average concentration of PM2.5

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.75 1.5 3
Kilometres

Scale: 1:150,000 (when printed at A4)
Projection: Map Grid of Australia - Zone 55 (GDA94)

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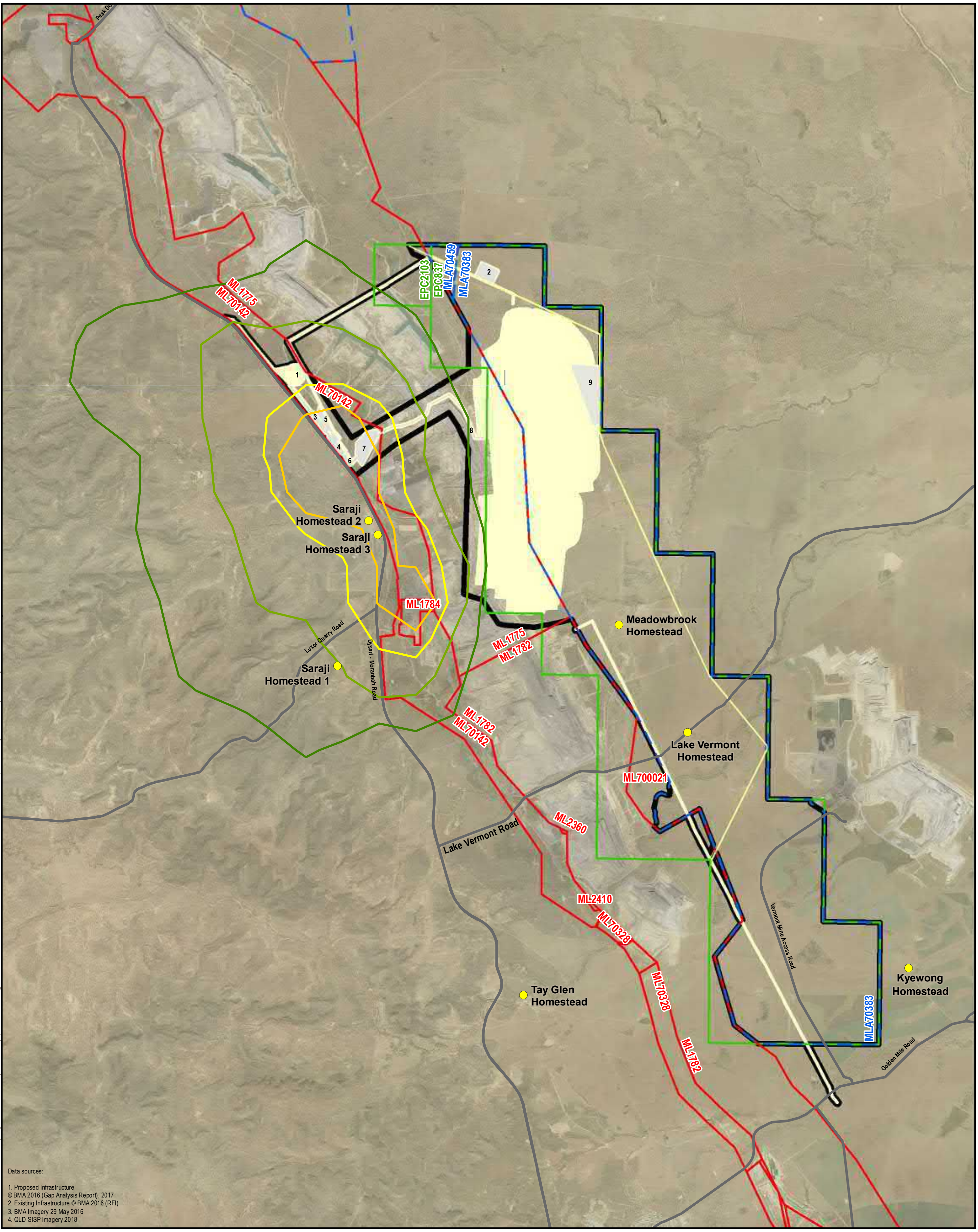
Nuisance related criteria – dust deposition results

Table 11.13 shows the results for dust deposition for the Project-only case. No air quality issues have been identified, with Project-only contributions predicted to be less than or equal to ten per cent of the Project goal at all receptor locations.

A contour plot is included as Figure 11-13 based on five years of meteorology (2008 - 2012).

Table 11.13 Project-only predicted emissions of dust deposition at receptor locations

ID	Description	Averaging period	Project-only (mg/m^2/day)	Percentage of goal
1	Kyewong Homestead	30 day	0.0	0%
2	Lake Vermont Homestead	30 day	0.1	0%
3	Saraji Homestead 1	30 day	2.2	2%
4	Saraji Homestead 2	30 day	12.1	10%
5	Saraji Homestead 3	30 day	11.2	9%
6	Tay Glen Homestead	30 day	0.1	0%
7	Meadowbrook Homestead	30 day	0.1	0%



LEGEND

- Project Site
- Project Footprint
- Exploration Permit Coal (EPC)
- Mining Lease (ML)
- Mining Lease Application (MLA)
- Surface Infrastructure
- Transport and Infrastructure Corridor
- Homestead
- Public Road

30 Day Average Dust Deposition µg/m³

- 1
- 2
- 5
- 10

1 Rail Loading Balloon Loop
2 Process Water Dam
3 Product Stockpiles
4 CHPP
5 Raw Water Dam
6 ROM Pad
7 Future MIA
8 Conveyor
9 Construction Village

N

Figure 11-13
Maximum 30 Day Average Dust Deposition

Environmental Impact Statement
Saraji East Mining Lease Project

0 0.75 1.5 3
Kilometres

Scale: 1:150,000 (when printed at A4)

Projection: Map Grid of Australia - Zone 55 (GDA94)

BHP

DATE: 2/12/2020 VERSION: 3

Filename: \\aubne1fp003\Projects\605X\60507031\4. Tech Work Area\4.99 GIS\02_MXDs\06 Environmental Impact Statement\11 Air Quality\60507031_G265_v3_A4P.mxd

Cumulative impacts

Cumulative impacts considered the estimated background pollutant levels in Table 11.8. Dispersion modelling results indicate that the Project goals for PM_{10} and $PM_{2.5}$ may be exceeded at one or more sensitive receptor locations as a result of the Project operating concurrently with existing open cut mining operations. Table 11.14 provides a comparison of fugitive emissions of PM_{10} from the Project with those reported by the local mining operations of Saraji Mine, Peak Downs Mine and Lake Vermont Mine to the NPI for FY 2017.

Annual emissions of PM_{10} associated with the Project are estimated Section 11.4.2, Table 11.9 to be less than 1.1 per cent of those released by the neighbouring Saraji Mine and less than 0.4 per cent of the total airshed loading from all four mining operations combined. This assumes that production at the Saraji, Peak Downs and Lake Vermont open cut mines is maintained at their current level through to FY 44. Future increases or decreases in open cut mining production rates may have a significant influence on airshed loading of PM_{10} whilst the Project contribution is anticipated to be relatively consistent throughout the 20-year production schedule of the Project.

Thus, impacts on local air quality that are attributable to the Project are considered to be immaterial when compared to the air quality environment resulting from neighbouring open cut mining operations and will have minimal impact on the future air quality environment.

Table 11.14 Fugitive emissions of PM_{10} from local mining operations

Mine	Mining method	Fugitive PM_{10} emission (tonnes/year)	Source
Saraji Mine	Open cut	21,000	**NPI FY2017**
Lake Vermont Mine	Open cut	11,425	**NPI FY2017**
Peak Downs Mine	Open cut	28,000	**NPI FY2017**
The Project	Underground	223	**Table 11.9**
	Total	**60,648**	

In relation to emissions of TSP and PM_{10}, it is noted that annual reporting to the NPI is not required for emissions of TSP and only combustion-related emissions are required to be reported for $PM_{2.5}$. Thus, a similar comparison of Project emissions with other significant dust emissions sources within the local airshed is not able to be undertaken based on NPI data.

However, based on a review of Table 2 of the NPI Emissions Estimation Technique Manual for Mining Version 3.1 (January 2012) (NPI EETM Mining), a ratio of PM10 to TSP of 0.4 has been used to estimate TSP emissions from the open cut mining operations listed in Table 11.15.

In order to estimate emissions of PM2.5 from these same open cut mining operations (Table11.16) an estimate of 20% of PM10 is assumed to be in the form of PM2.5 has been adopted.

Table 11.15 Fugitive emissions of TSP from local mining operations

Mine	Mining method	Fugitive TSP emission (tonnes/year)	Source
Saraji Mine	Open cut	52,635	**NPI EETM Mining**
Lake Vermont Mine	Open cut	32,619	**NPI EETM Mining**
Peak Downs Mine	Open cut	70,107	**NPI EETM Mining**
The Project	Underground	658	**Table 11.9**
	Total	**159,019**	

Table 11.16 Fugitive emissions of $PM_{2.5}$ from local mining operations

Mine	Mining method	Fugitive $PM_{2.5}$ emission (tonnes/year)	Source
Saraji Mine	Open cut	4,210	**Estimate**
Lake Vermont Mine	Open cut	2,609	**Estimate**
Peak Downs Mine	Open cut	5,608	**Estimate**
The Project	Underground	45	**Table 11.9**
	Total	**12,472**	

11.5.2 Greenhouse gas emissions

Sources of greenhouse gas emissions

The main sources of Scope 1 and Scope 2 GHG emissions from the Project are:

- direct CO_2 emissions from fuel combusted by mining equipment
- direct CO_2 emissions from incidental mine gas captured and flared
- fugitive emissions of CH_4 and CO_2 due to underground air ventilation processes
- fugitive emissions from post-mining activities (including coal stockpiles and conveyors)
- indirect CO_2 emissions from electricity generation
- fugitive emission of CH_4 from the decommissioned mine for up to 20 years post-closure.

Scope 3 GHG emissions for the Project include:

- transporting coal by rail to the domestic port for export
- coal handling at the domestic port, and transportation by ship to the export destinations
- transporting Project personnel on a fly in fly out (FIFO) basis
- emissions associated with the end use(s) of product coal.

Activity data and key assumptions

Estimates of the annual Project usage of diesel, electricity, incidental mine gas and ventilation air for the lifetime of the Project are presented in Table 11.17.

Table 11.17 Estimates of the annual Project usage of diesel, electricity, mine waste gas and ventilation air

Source	Annual usage	Basis
Diesel	7,102 kilolitres (kL) per year, equating to 142.1 megalitres over 20 years.	Based on proposed mine equipment listed in **Chapter 3 Project Description**.
Electricity	74 gigawatt hours (GWh) per year.	Estimated from 14 MW power demand noted in Chapter 3 Project Description with a 60% utilisation rate.
Flaring incidental mine gas	Estimated 3.675 petajoules (PJ) of gas flared per year, equating to 73.5 PJ over 20 years.	BMA estimation of pre-drainage methane and goaf gas.
Venting fugitive emissions of CH_4 and CO_2 from	Total ventilation flow of 320m^3/s, comprised of:	Based on proposed mine ventilation rate outlined in Chapter 3 Project Description.

Source	Annual usage	Basis
Underground ventilation	• CH_4 concentration of 0.15 % v/v • CO_2 concentration of 0.15 % v/v.	
Post mining activities associated with gassy underground mines	Calculated 220 Mt of ROM coal based on production rate of 11 Mtpa of ROM coal over the 20 year production schedule.	Based on proposed ROM coal rate described in Chapter 3 Project Description.
Fugitive emissions from the decommissioned underground mine	• Emissions from the mine for the last full year of operation are 0.285 Mt CO2-e (excluding flaring and post mining emissions). • Emission factors and the proportion of the mine flooded are based on methods in Sections 3.32, 3.33, 3.34 and 3.4 of the guidelines for a period of 20 years.	Estimated as per the NGER Technical Guidelines (DCCEE, 2011b)

Greenhouse gas emissions and energy use

Estimates of the Project's diesel usage, electricity consumption, incidental mine gas consumption and fugitive emissions for 20 year production schedule are presented in Table 11.15, based on the activity data in Table 11.17 and emission factors in Table 11.7. Scope 1 and Scope 2 emissions from these activities are also presented in Table 11.15.

Table 11.18 Scope 1 and 2 GHG emissions from the Project over the 20 year mine production schedule

Scope of emissions	Emissions source	Usage	GHG emissions (t CO_2-e)	Energy content (PJ)
1	Diesel	142 ML	386,569	5.5
1	Flaring incidental mine gas	Nil	4,035,841	73.5
1	CH_4 in ventilation air	206 kilotonnes CH_4	5,137,991	NA
1	CO_2 in ventilation air	564 kilotonnes CO_2	563,779	NA
1	Fugitive emissions from post mining activities associated with gassy underground mines	220 Mt	3,740,000	NA
1	Fugitive emissions from the decommissioned underground mine	20 years post mining	1,221,144	NA
2	Electricity consumption	1480 GWh	1,184,000	5.3
-	TOTAL		**16,270,325**	84.3

The operation phase of the Project is estimated to result in approximately 16.3 Mt CO_2-e of GHG over the 20-year production schedule, equivalent to 0.81 Mt CO_2-e per year.

The greatest sources of GHG emissions from the Project are:

- fugitive emissions associated with underground ventilation air (35 per cent)
- flaring of incidental mine gas (25 per cent)
- fugitive emissions from post-mining activities (23 per cent)
- fugitive emissions from decommissioned underground mine (8 per cent).

A breakdown of Scope 1 and Scope 2 emissions from the Project's operation phase (over 20 years) are presented in Figure 11-14

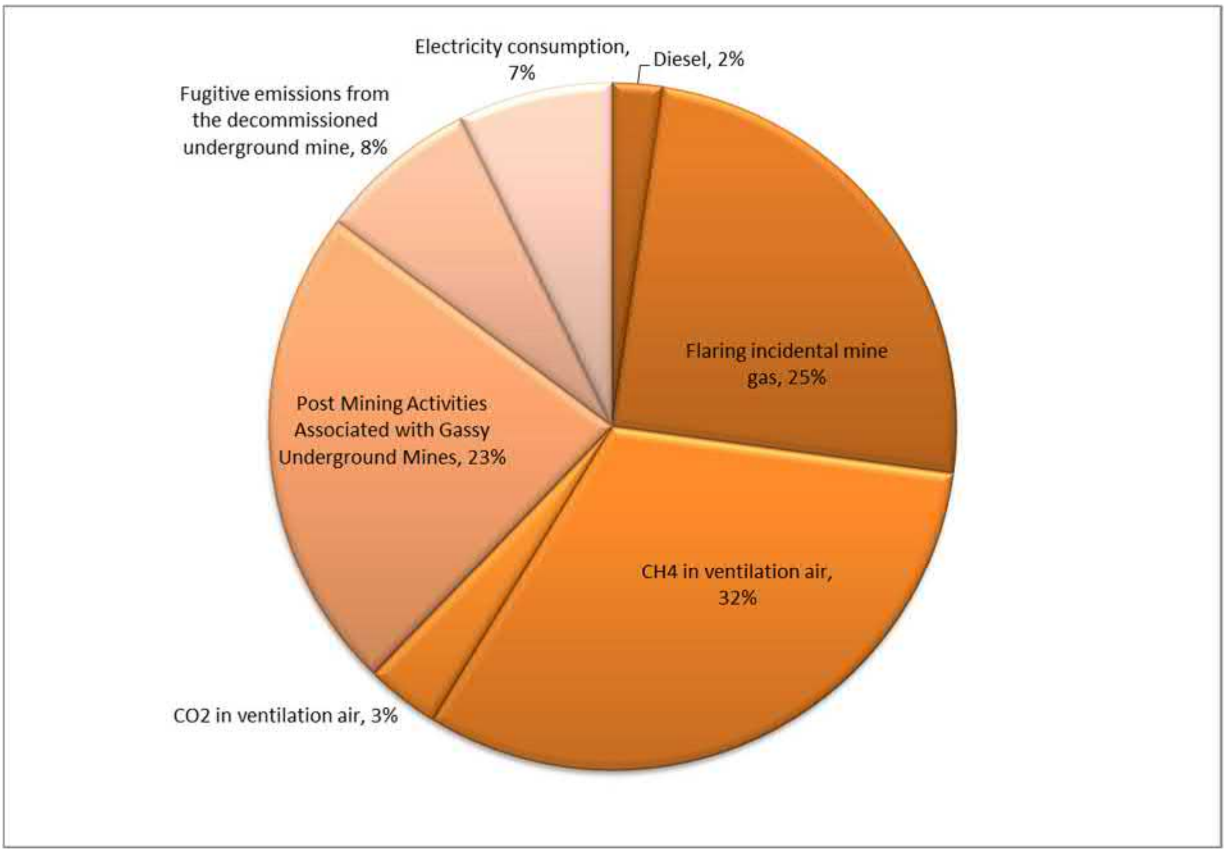


Figure 11-14 Scope 1 and Scope 2 emissions from the Project's operation phase over 20 years

Scope 3 greenhouse gas emissions

Scope 3 GHG emissions are presented in Table 11.16. The estimated Scope 3 emissions over the 20 year production schedule are 451 Mt CO_2-e.

Table 11.19 Scope 3 GHG emissions over the 20 year life of Project

Emissions source	GHG emissions (t CO_2-e)
Product use	441,696,000
Flights for remote workforce	120,918
Rail transport of product coal	416,052
Handling of product coal at domestic port	187,840
Shipping product coal to overseas markets	7,879,812
Embodied emissions in electricity	192,400
Embodied in diesel	19,739
TOTAL	**450,512,762**

The following key assumptions were used to estimate Scope 3 emissions from the Project:

- Embodied GHG emission factors for diesel (0.139 t CO_2-e per kL of diesel) and electricity (0.13 t CO_2-e per MWh of electricity), published by the Department of Climate Change and Energy (DCCEE) (2011a)
- Emissions from product use have been estimated using the NGA emission factor for coking coal as per the National Greenhouse Accounts Factors, July 2018
- 15 return flights Brisbane to Moranbah per week over the 20 year operation of the Project, with each flight assumed to consume 3,000 litres of aviation fuel.

Emissions intensity

The GHG emissions intensity of Scope 1 and Scope 2 emissions over the operation of the Project is estimated to be 0.07 CO_2-e/t ROM coal. The GHG intensity for the Project is in line with emissions assessed for similar mining operations in the area such as the Olive Downs Project which is estimated at 0.118 CO_2-e/t ROM coal (Pembroke Olive Downs, 2018).

Comparison with Australian emissions

The DCCEE (2018) publish GHG emissions inventories for Australia from 1990 to 2016. Australia's total GHG emissions (including land use, land use change and forestry activities), was 532.9 Mt CO_2-e in 2016 (DCCEE, 2018). The breakdown of Australia's GHG emissions by state is presented in Figure 11-15.

The annual GHG emissions predicted for the Project (Scope 1 and Scope 2) represent 0.15 per cent of Australia's 2016 GHG emissions and 0.6 per cent of Queensland's 2016 GHG emissions.

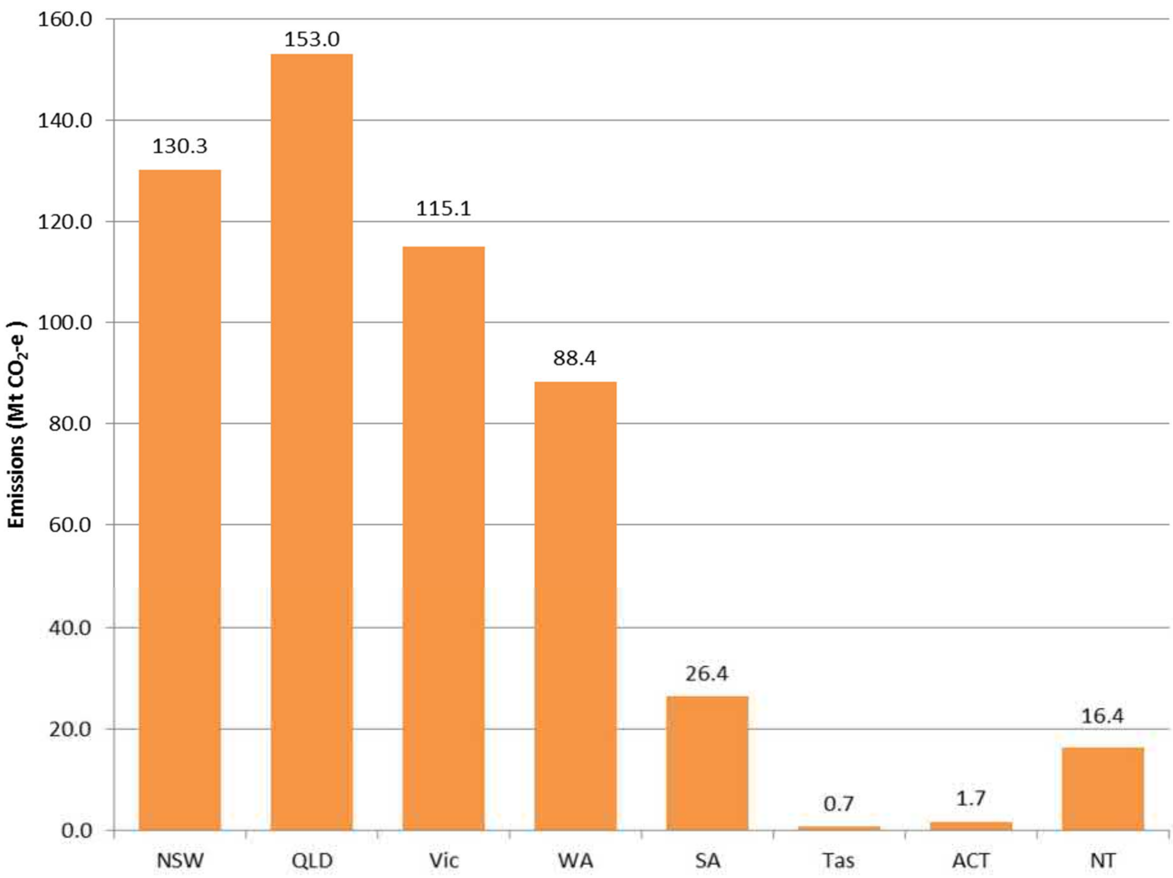


Figure 11-15 Breakdown of Australia's emissions by state in 2016

11.6 Management and mitigation measures

11.6.1 Air quality

The Project is to be located within an airshed that includes BMA's Saraji Mine, Peak Downs Mine and Norwich Park Mine, as well as Jellinbah Group's Lake Vermont Mine. Dispersion modelling indicates that the Project goals for PM_{10} and $PM_{2.5}$ may be exceeded at one or more sensitive receptor locations due to mining activities within the Project's airshed. Given the existing air quality environment, the overall impacts on local air quality that are attributable to the Project are considered to be immaterial. The Project is not anticipated to have an impact on the future air quality environment given the nature and scale of Project activities. Nonetheless, opportunities to minimise the release of dust emissions pollutants during all phases of the Project will be incorporated into an Air Management Plan, to be developed prior to construction.

When requested by the administering authority or as a result of an air quality complaint (which is neither frivolous nor vexatious nor based on mistaken belief in the opinion of the authorised officer), dust and particulate monitoring will be undertaken and the results notified to the administering authority.

The Air Management Plan for the Project will include details of the proposed air quality monitoring program. The air quality monitoring program for the Project will use continuous dust monitors to monitor PM_{10}, and automatic weather stations to record meteorological conditions at ground level. A temperature inversion tower will also be considered for the Project to allow measurement of meteorological conditions at height.

Construction phase

During construction of the Project, the application of water as/when required to minimise visible dust emissions will be one of the primary mitigation measures available.

General management strategies for the minimisation of pollutant generation during construction may include (but not be limited to):

- minimising the extent of exposed areas. Disturbed areas would be stabilised as soon as practicable to prevent or minimise wind-blown dust
- use of water sprays on haul routes, exposed areas and stockpiles as required to adequately dampen and prevent the emission of dust from the site
- reducing vehicle speed on unsealed roads to reduce dust generation and keep vehicles to well-defined roads
- strict adherence to plant and equipment maintenance programs
- minimising haulage distances between construction sites to spoil stockpiles
- addressing equipment for dust control under performance in a timely manner by keeping it in good operation condition
- ensuring all personnel are familiar with the objectives and requirements of the Project's Air Management Plan
- stockpiles would be maintained in a condition that minimises windblown generated dust
- erosion and sediment control structures would be regularly maintained to ensure silt does not become a source of dust
- unsealed trafficable areas would be kept damp during high wind events to minimise dust generation.

Operational phase

The Project incorporates a number of key dust reduction features, most notably the transport of ROM coal by conveyor from the mine portal to the Project CHPP. Although dust emissions from the Project are predicted to have a small incremental impact on air quality at assessment locations, dust mitigation should be considered during the detailed design phase in order to capitalise on opportunities to minimise overall dust emissions.

Examples of possible engineering options are included in Table 11.20 which, where feasible, may be considered for the Project during the design phase. Engineering solutions incorporated during the design phase of the Project will typically be more cost effective than retrofitting solutions once the Project is constructed.

Table 11.20 Proposed mitigation options

Emission source	Mitigation options
Conveyors	Partial or full enclosure
	Belt scrapers
	Water sprays / foggers
Transfer points	Partial or full enclosure
	Water sprays
	Belt scrapers
Bins	Limit drop height into surge bin
	Enclose chute

Emission source	Mitigation options
Stacking and reclaiming	Water sprays
	Use of low dust-generating techniques such as telescopic stackers with chutes and scraper reclaimers
Sizing stations	Partial or full enclosure
	Water sprays
ROM dump	Partial or full enclosure
	Water sprays
Ventilation outlets	Use of dust collection system
Flares	Ensure use of high destruction efficiency flares
Rail haul to export	Load profiling
	Veneering

Potential impacts during the operation of the Project will be managed through the Air Management Plan, which will consider the following:

- minimising vehicle and plant speed to suit road conditions and around stockpiles
- watering of haul roads and other high risk areas with increased frequency during adverse weather conditions
- optimising the use of water sprays
- strict adherence to plant and equipment maintenance schedules to minimise dust emissions
- address equipment under performance in a timely manner to reduce air pollutant emissions and maximise fuel efficiency
- water spraying would be applied during high wind speed events
- unutilised exposed areas would be progressively sealed and/or revegetated
- revegetation of topsoil stockpiles would be undertaken progressively based on a risk based approach.

It is an Aurizon requirement for all mines transporting coal on the Aurizon coal network to implement dust mitigation measures contained in the Aurizon's Central Queensland Coal Dust Management Plan. As identified in Table 11.20, measures associated with load profiling, coal wagon veneering systems and associated support systems would be implemented during rail-haul of coal to export.

Rehabilitation

Commitments to rehabilitate disturbed areas after the closure of the mine will prevent ongoing wind erosion. Rehabilitation will be undertaken progressively as longwall mining activity has been completed in accordance with the Rehabilitation Management Plan.

A detailed rehabilitation management plan has been outlined in **Appendix K-1 Rehabilitation Management Plans**. The plan provides details of revegetation that will be an effective dust control measure. Improving the effectiveness and time for rehabilitation measures will result in reduced dust emissions from exposed areas, however these benefits cannot be incorporated into modelling until the rehabilitation strategy has been formulated.

11.6.2 Greenhouse gas

Site based greenhouse mitigation measures

The following management measures are proposed for the Project to minimise GHG emissions during operation:

- flaring of incidental mine gas
- preferencing fuel efficient mining equipment during procurement
- maintaining mining equipment in good working order that so fuel efficiency is maximised
- using appropriately sized equipment.

Flaring of incidental mine gas (which can have a CH_4 content of up to 75 per cent) significantly reduces GHG emissions. The oxidation of CH_4, with a GWP of 25 to CO_2 (GWP of 1) reduces CO_2 equivalent emissions by more than eight times on a mass basis.

Further abatement opportunities are associated with drainage of incidental mine gas from the Project. BMA will assess the following initiatives for incidental mine gas from the Project:

- the combustion of incidental mine gas for the purposes of on-site power generation
- the sale of incidental mine gas to a third-party for use off-site.

Based on the Project's estimated annual GHG emissions and energy use (0.77 Mt CO_2-e and 3.95 PJ respectively) the following actions will be undertaken to fulfil legislative and corporate requirements:

- report annual GHG emissions under the National Greenhouse and Energy Reporting System under the NGER Act (facility threshold is 25,000 t CO2-e)
- comply with any prevailing regulatory mechanisms for reducing emissions, such as the Federal Government's Safeguard Mechanism and other similar and successor policies
- investigate cost effective opportunities to reduce emissions in accordance with BHP's management standards and contribute if and as required to the delivery of the company's emissions reduction targets.

11.6.3 Climate change risk assessment

Changes in local weather patterns resulting from climate change have the potential to affect the operation of the Project in the future. A preliminary climate change risk assessment was undertaken for the operations phase of the Project.

11.6.4 Predicted change in climate

The preliminary climate change risk assessment is based on climate change scenarios for the Whitsunday, Hinterland and Mackay Region outlined in *'ClimateQ: toward a greener Queensland'* (DERM, 2009). The climate change scenarios for 2030 and 2050 are presented in Table 11.18. A projected southward shift in the primary regions of cyclone development may result in a greater cyclone impact for the Whitsunday, Hinterland and Mackay Region, with potential to increase extreme daily rainfall and increase flood peaks.

Table 11.21 Projected climate change scenarios for the Whitsunday, Hinterland and Mackay Region relative to 1990 (Source: OCC 2009)

Variable	Season	2030 – medium emissions	2050 – low emissions	2050 – high emissions
Temperature (°C)	Annual	+0.9	+1.1	+1.9
	Summer	+0.9	+1.1	+1.9
	Autumn	+0.9	+1.1	+1.8
	Winter	+0.9	+1.1	+1.9
	Spring	+0.9	+1.1	+1.9
Rainfall (%)	Annual	-3	-4	-7
	Summer	-2	-3	-4
	Autumn	-4	-5	-8
	Winter	-3	-4	-6
	Spring	-7	-8	-13
Potential evaporation	Annual	+3	+4	+7
	Summer	+3	+3	+6
	Autumn	+4	+4	+8
	Winter	+4	+5	+7
	Spring	+3	+4	+6

The potential risk to the Project posed by each climate change parameter was assessed and mitigation measures have been proposed (where appropriate). This is outlined in Table 11.22.

Table 11.22 Potential impacts of climate change and proposed mitigation measures

Potential climate change impacts	Risk scenario	Risk to Project	Mitigation measures (if required)
Increase in annual average temperature	Potential to affect reliability of mine infrastructure and/or equipment	Low	Not applicable
	Health impacts on mine personnel from increased temperatures (i.e. heat stress)	Medium	Compliance with BHP Safety Our Requirements (BHP, 2018b)
Decrease in annual average rainfall	Reduced yield from on-site water storage systems	Low	Responsive water management system to manage water
Change in seasonal average rainfall	Decrease in rainfall during autumn, winter and spring	Low	Responsive water management system to manage water
Increase in annual average potential evaporation	Reduced yield from on-site water storage systems	Low	Responsive water management system to manage water
	Increased dust emissions due to drier surface conditions, resulting in increased water demand for dust suppression	Low	Dust control measures including watering of haul roads and stockpiles
	Increased impacts from flood events	Medium	Emergency response procedures and flood

Potential climate change impacts	Risk scenario	Risk to Project	Mitigation measures (if required)
Increased risk of tropical cyclone impact			forecasting will be incorporated into operating procedures
	Increased risk of erosion especially from exposed areas due to increase in rainfall intensity	Medium	Adaptive management as soon as practical to minimise risk

The Project generally has a limited vulnerability to climate change impacts, with the greatest potential impacts an increased risk of flooding, and potential for increased soil erosion due to increase in rainfall intensity.

11.7 Summary

11.7.1 Air quality

AED has undertaken an air quality assessment of the Project, focused on impacts associated with the emission of dust from the Project on the receiving environment. In order to highlight the nature and extent of potential impacts, results from the dispersion modelling considered those for the Project in isolation of other dust generating sources within the local airshed (i.e. Saraji, Peak Downs and Lake Vermont open cut mining operations). Two dust emissions scenarios were modelled:

- typical operating conditions based on a mining rate of 11 mtpa rom coal incorporating typical dust management practices; and
- upset conditions based on a mining rate of 11 Mtpa ROM coal with an assumed reduced dust mitigation capacity.

Results of the dispersion modelling have highlighted the potential for adverse impacts of dust from the Project at the location of the Saraji 2 Homestead and Saraji 3 Homestead during peak operations. It is noted that the Saraji 2 Homestead and the Saraji 3 Homestead are situated in close proximity to the Project CHPP, the haulage route from the Project CHPP and the Saraji Mine CHPP. As discussed in Section 11.3.1 there are currently co-existence agreements in place between BMA and landholders at Saraji Homestead 2 and Saraji Homestead 3.

In particular, adverse risks of impacts on air quality at the Saraji 2 Homestead and the Saraji 3 Homestead are predicted. Thus the implementation of additional dust mitigation measures may be required when excess ROM coal is transported from the Project CHPP to the Saraji Mine CHPP during adverse meteorological conditions at any time during the operation of the Project.

Results of the dust assessment did not highlight any significant air quality issues attributable to the Project at any of the other assessment locations.

Publically available information was used to estimate the mass of TSP, PM_{10} and $PM_{2.5}$ annually released into the local airshed from Saraji Mine, Peak Downs Mine and Lake Vermont Mine. Emissions of PM_{10} associated with the Project were estimated be less than 0.4 per cent of the total airshed loading from all four mining operations combined (i.e. Saraji East Mine, Saraji Mine, Peak Downs Mine and Lake Vermont Mine). This comparison assumed that the current levels of production at the neighbouring open cut mines are maintained into the future. Future increases or decreases in open cut mining production rates may have a significant influence on airshed loading of PM_{10} whilst the Project contribution is anticipated to be relatively consistent throughout the 20 year production schedule of the Project.

Therefore, overall impacts on local air quality that are attributable to the Project are considered to be immaterial when compared to the air quality environment resulting from neighbouring open cut mining operations and will have minimal impact on the future air quality environment.

The Air Management Plan for the Project will include details of the proposed air quality monitoring program which will use continuous dust monitors to measure PM_{10} and automatic weather stations to record meteorological conditions The monitoring program will allow conditions to be monitored, allowing Project activities to be adjusted to minimise impacts as far as reasonably practicable.

11.7.2 Greenhouse gas

The operational phase of the Project is estimated to result in approximately 16.3 Mt CO_2-e of GHG (Scope 1 and Scope 2) over the Project's 20 year proposed production schedule. This equates to 0.81 Mt CO_2-e on an annual basis. The annual GHG emissions predicted for the Project represent 0.15 per cent of Australia's 2016 GHG emissions.

The Project is considered to have a low vulnerability to the effects of climate change.