Appendix M

Mine development air quality and greenhouse gas assessment

REGIS
RESOURCES LTD

McPhillamys Gold Project

Air Quality and Greenhouse Gas Assessment

Prepared for LFB Resources NL
August 2019

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McPhillamys Gold Project

Air Quality and Greenhouse Gas Assessment

Report Number

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Client

LFB Resources NL

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This report has been prepared in accordance with the brief provided by the client and has relied upon the information collected at the time and under the conditions specified in the report. All findings, conclusions or recommendations contained in the report are based on the aforementioned circumstances. The report is for the use of the client and no responsibility will be taken for its use by other parties. The client may, at its discretion, use the report to inform regulators and the public.

Executive Summary

LFB Resources NL, a 100% owned subsidiary of Regis Resources Limited (Regis), is seeking development consent for the construction and operation of the McPhillamys Gold Project, a greenfield open-cut gold mine and associated water supply pipeline in the Central West region of New South Wales (NSW).

The project for which development consent is sought comprises two key components; the mine site where the ore will be extracted, processed and gold produced for distribution to the market (the mine development), and an associated water pipeline which will enable the supply of water from near Lithgow to the mine site (the pipeline development). The mine development is approximately 8 km north-east of Blayney, within the Blayney and Cabonne local government areas.

This report assesses the potential air quality impacts associated with the mine development component of the McPhillamys Gold Project. The potential air quality impacts associated with the pipeline development component are addressed in the main report of the Environmental Impact Statement (Volume 1, EMM 2019a). For the purposes of this report, the mine development component of the McPhillamys Gold Project, to which this assessment applies, is referred to as the project.

Existing environmental conditions were quantified primarily using data from the on-site meteorological station, the on-site air quality monitoring network, and the NSW Office of Environment and Heritage air quality monitoring station at Bathurst.

Four specific periods of the project's development — year 1, year 2, year 4 and year 8 — were the focus of emissions quantification and dispersion modelling. Emissions of total suspended particulates (TSP), particulate matter less than 10 micrometres (µm) in aerodynamic diameter (PM_{10}), particulate matter less than 2.5 µm in aerodynamic diameter ($PM_{2.5}$), oxides of nitrogen (NOx), hydrogen cyanide (HCN) and assorted metals and metalloids were estimated and modelled.

The atmospheric dispersion of air pollutant emissions for each mine development scenario was simulated using the AERMOD model.

The results of the dispersion modelling indicated that the project will not result in any exceedances of the applicable cumulative impact assessment criteria at any of the surrounding private residences with the following exception:

- 24-hour average PM_{10} - a single additional exceedance day at receptor R38 during Year 4 operations.

It is noted that Regis have an option to acquire receptor R38 should the project be approved.

The design of the project will incorporate a range of dust mitigation and management measures. A best practice dust control measures review was undertaken for the project, and this identified that the proposed mitigation and management measures will be in accordance with accepted industry best practice for dust control.

To supplement the mitigation measures, Regis commits to the installation and maintenance of a real-time particulate matter monitoring network (PM_{10}) during the life of the project. The real-time network will feature real-time monitoring locations in the Kings Plains area at the southwest, central south and southeast of the project area. In combination with data from the existing meteorological monitoring station and project-specific trigger conditions, the real-time monitoring network will be used to inform reactive management practices to prevent adverse impacts at sensitive receptors.

A greenhouse gas (GHG) assessment was also undertaken for the project. The predicted annual total GHG emissions (Scope 1, 2 and 3) emissions for the project represent approximately 0.107% of total GHG emissions for NSW and 0.026% of total GHG emissions for Australia, based on the National Greenhouse Gas Inventory for 2017.

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1 Introduction

LFB Resources NL is seeking development consent for the construction and operation of the McPhillamys Gold Project, a greenfield open-cut gold mine and associated water supply pipeline in the Central West region of New South Wales (NSW). The project application area is illustrated at a regional scale in Figure 1.1.

As shown in Figure 1.1, the McPhillamys Gold Project comprises two key components; the mine site where the ore will be extracted, processed and gold produced for distribution to the market (the mine development), and an associated water pipeline which will enable the supply of water from approximately 90 km away near Lithgow to the mine site (the pipeline development). This report assesses the potential air quality impacts associated with the mine development component of the McPhillamys Gold Project. References to 'the project' throughout this report are therefore referring to the mine development only. The potential air quality impacts associated with the pipeline development component are addressed in the main report of the Environmental Impact Statement (EIS) (Volume 1, EMM 2019).

LFB Resources NL is a 100% owned subsidiary of Regis Resources Limited (referred to from now on as Regis). The mine development is approximately 8 km north-east of Blayney, within the Blayney and Cabonne local government areas (LGAs).

This air quality impact assessment (AQIA) has been prepared by EMM Consulting Pty Limited (EMM) on behalf of Regis, to assess potential air quality impacts associated with the project on the surrounding environment. The AQIA has been prepared in general accordance with the guidelines specified by the NSW Environment Protection Authority (EPA) in the *Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales* (EPA, 2016), referred to from now on as "the Approved Methods for Modelling". This AQIA supports the EIS for the proposed project (EMM 2019a).

The Department of Planning and Environment (DPE)'s environmental assessment requirements (EARs) for the project were issued on 24 July 2018 and revised on 19 December 2018. The EARs that are relevant to air quality, and where they have been addressed in this document, are provided in Table 1.1.

Table 1.1 Air quality related EARs and agency requirements

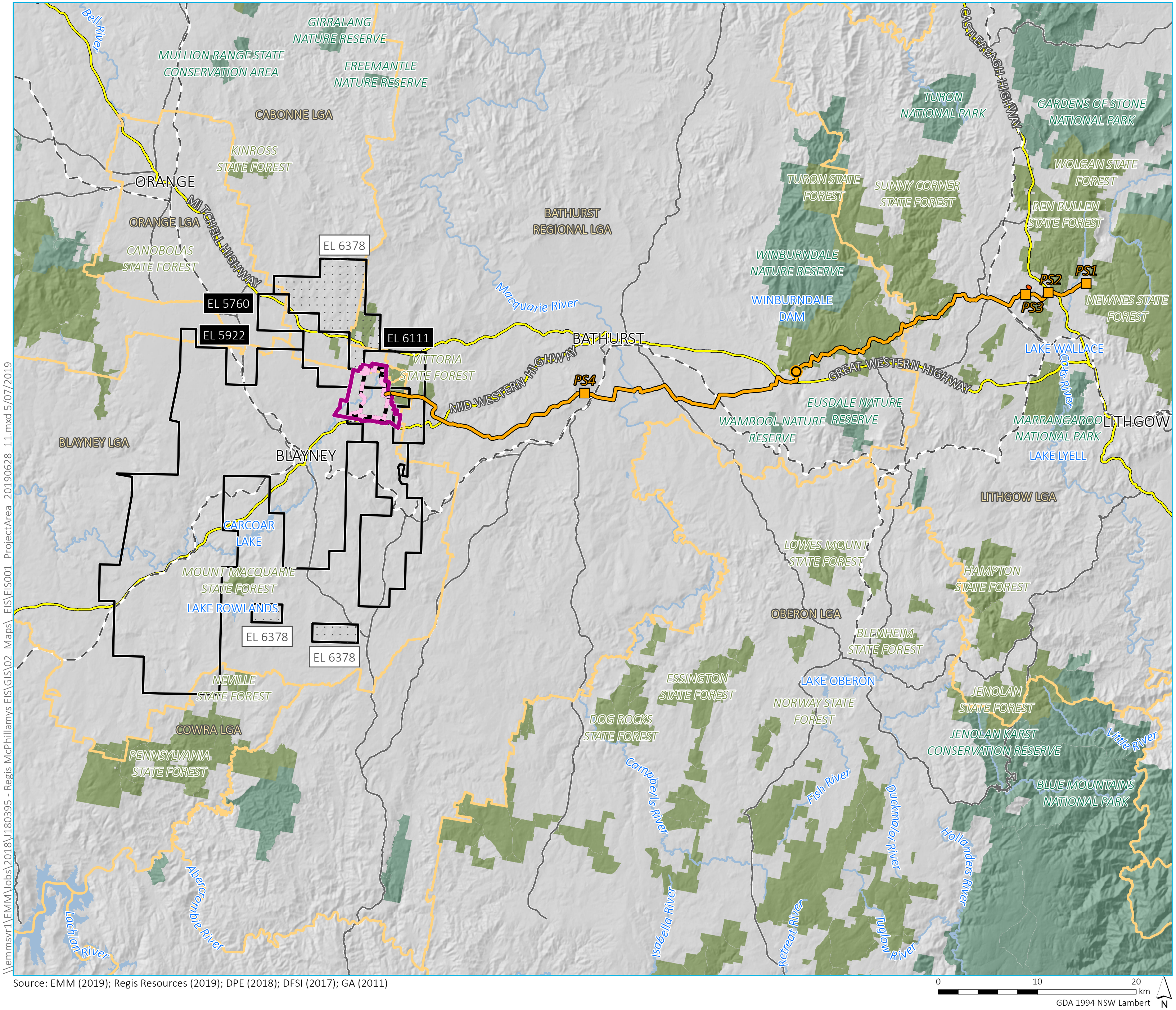
Agency	Requirement	Location in report
DPE	• **Air Quality –** including:	
	– an assessment of the likely air quality impacts of the development, including cumulative impacts from nearby developments, in accordance with the Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW, and having regard to the NSW Government's Voluntary Land Acquisition and Mitigation Policy; and	Section 8
	– an assessment of the likely greenhouse gas impacts of the development;	Section 10
	– a description of the feasibility of measures that would be implemented to monitor and report on the emissions (including fugitive dust and greenhouse gases) of the development;	Section 9
NSW EPA	The AQIA should:	1. Section 8
	1. assess the risk associated with potential discharges of fugitive and point source emissions for all stages of the proposal and assessment of risk relating to environmental harm, risk to human health and amenity	
	2. justify the level of assessment undertaken on the basis of risk factors, including but not limited to:	2. Section 3, 4
	a) proposal location	

Table 1.1 Air quality related EARs and agency requirements

Agency	Requirement	Location in report
	b) characteristics of the receiving environment; and c) type and quantity of pollutants emitted. 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: a) meteorology and climate b) topography c) surrounding land-use, receptors and d) ambient air quality. 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. 5. include a consideration of 'worst-case' emission scenarios and impacts at proposed emission limits 6. account for cumulative impacts associated with existing emission sources as well as any currently approved developments linked to the receiving environment 7. include air dispersion modelling where there is a risk of adverse air quality impacts, or where there is a 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 (2016). 8. demonstrate the projects ability to comply with the relevant regulatory framework, specifically the Protection of the Environment Operations (Clean Air) Regulation 2010. 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 Clean Air 10. detail emission control techniques and practices that will be employed by the proposal	3. Section 2, 4, 5, 6 4. Section 2 5. Section 7 6. Section 6, 8 7. Section 8 8. Section 8 9. Section 8 10. Section 7, 9
EPA	The greenhouse gas assessment should include: 1. the EA should include a comprehensive assessment of, and report on, the project's predicted greenhouse gas emissions (tCO2e). Emissions should be broken down by: a) direct emissions (scope 1 as defined by the Greenhouse Gas Protocol- see reference below), b) Scope 2 and 3 indirect emissions (all other emissions that are a consequence of the mine's activities, including annual emissions for each year of the project, before and after implementation of the project, including annual emissions for each year of the project (construction, operation and decommissioning). 2. if relevant, greenhouse emission intensity (per unit of production) should be compared before and after the project. Emission intensity should be compared with best practice if possible. 3. greenhouse emissions should be estimated using an appropriate methodology in accordance with NSW, Australian and International Guidelines (refer guidelines mentioned in Attachment 2). 4. the EA should identify which emissions would be covered by the Federal Government's Carbon Pollution Reduction Scheme. 5. the EA should also evaluate and report on the feasibility of measures to reduce greenhouse gas emissions associated with the project, concentrating on emissions not covered by the CPRS.	Section 10

Table 1.1 Air quality related EARs and agency requirements

Agency	Requirement	Location in report
	6. the proponent should also identify if there are any cost-effective opportunities to reduce scope 3 emissions (e.g. by using methods of supply or distribution).	
Cabonne Council	Air Quality Control and Management • Dust Control	Section 7



KEY
Mine development project area (2,513.47 ha)
Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
Pressure reducing system
Pumping station facility
Pipeline corridor
Pipeline corridor (Blowdown Pond)
Existing environment
Rail line
Primary road
Arterial road
River
Waterbody
NPWS reserve
State forest
Local government area
Exploration lease boundaries (of interest)
Held by LFB Resources NL (Regis)
Held by others

Source: EMM (2019); Regis Resources (2019); DPE (2018); DFSI (2017); GA (2011)

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Regional setting - project application area

McPhillamys Gold Project
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Figure 1.1

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2 Project overview

2.1 Proposed project operations

The key components of the project are as follows:

- Development and operation of an open-cut gold mine, comprising approximately one to two years of construction, approximately 10 years of mining and processing, and a closure period (including the final rehabilitation phase) of approximately three to four years, noting there may be some overlap of these phases. The total project life for which approval is sought is 15 years.

- Development and operation of a single circular open-cut mine with a diameter of approximately 1,050 metres (m) and a final depth of approximately 460 m, developed by conventional open-cut mining methods encompassing drill, blast, load and haul operations. Up to 8.5 million tonnes per annum (Mtpa) of ore will be extracted during the project life.

- Construction and use of a conventional carbon-in-leach processing facility with an approximate processing rate of 7 Mtpa to produce approximately 200,000 ounces, and up to 250,000 ounces, per annum of product gold. The processing facility will comprise a run-of-mine (ROM) pad and crushing, grinding, gravity, leaching, gold recovery, tailings thickening, cyanide destruction and tailings management circuits. Product gold will be taken off-site to customers via road transport.

- Placement of waste rock into a waste rock emplacement which will include encapsulation of material with the potential to produce a low pH leachate. A portion of the waste rock emplacement will be constructed and rehabilitated early in the project life to act as an amenity bund.

- Construction and use of an engineered tailings storage facility to store tailings material.

- Construction and operation of associated mine infrastructure, including:

  - administration buildings and bathhouse;

  - workshop and stores facilities, including associated plant parking, laydown and hardstand areas, vehicle washdown facilities, and fuel and lubricant storage;

  - internal road network;

  - explosives magazine and ammonium nitrate emulsion (ANE) storage;

  - topsoil, subsoil and capping stockpiles;

  - ancillary facilities, including fences, access roads, car parking areas and communications infrastructure; and

  - on-site laboratory.

- Establishment and use of a site access road, and an intersection with the Mid Western Highway.

- Construction and operation of water management infrastructure, including a raw water storage dam, clean water and process water diversions and storages, and sediment control infrastructure.

- A peak construction workforce of approximately 710 full-time equivalent (FTE) workers. During operations, an average workforce of around 260 FTE employees will be required, peaking at approximately 320 FTEs in around years four and five of the project.

- Construction and operation of a water supply pipeline (approximately 90 km long) from Centennial Coal's Angus Place and SCSO and EA's MPPS operations near Lithgow to the mine project area. The pipeline development will include approximately four pumping station facilities, a pressure-reducing system and a communication system. Approximately 13 megalitres per day (ML/day), up to a maximum of 15.6 ML/day, will be transferred for mining and processing operations.

- Installation and use of environmental management and monitoring equipment.

- Progressive rehabilitation throughout the mine life. At the end of mining, the mine infrastructure will be decommissioned, and disturbed areas will be rehabilitated to integrate with natural landforms as far as practicable. The final landform, apart from the final void, will support land uses similar to current land uses, or land uses which are consistent with the land-use strategies of the relevant LGAs.

The layout of the mine development is illustrated in Figure 2.1.

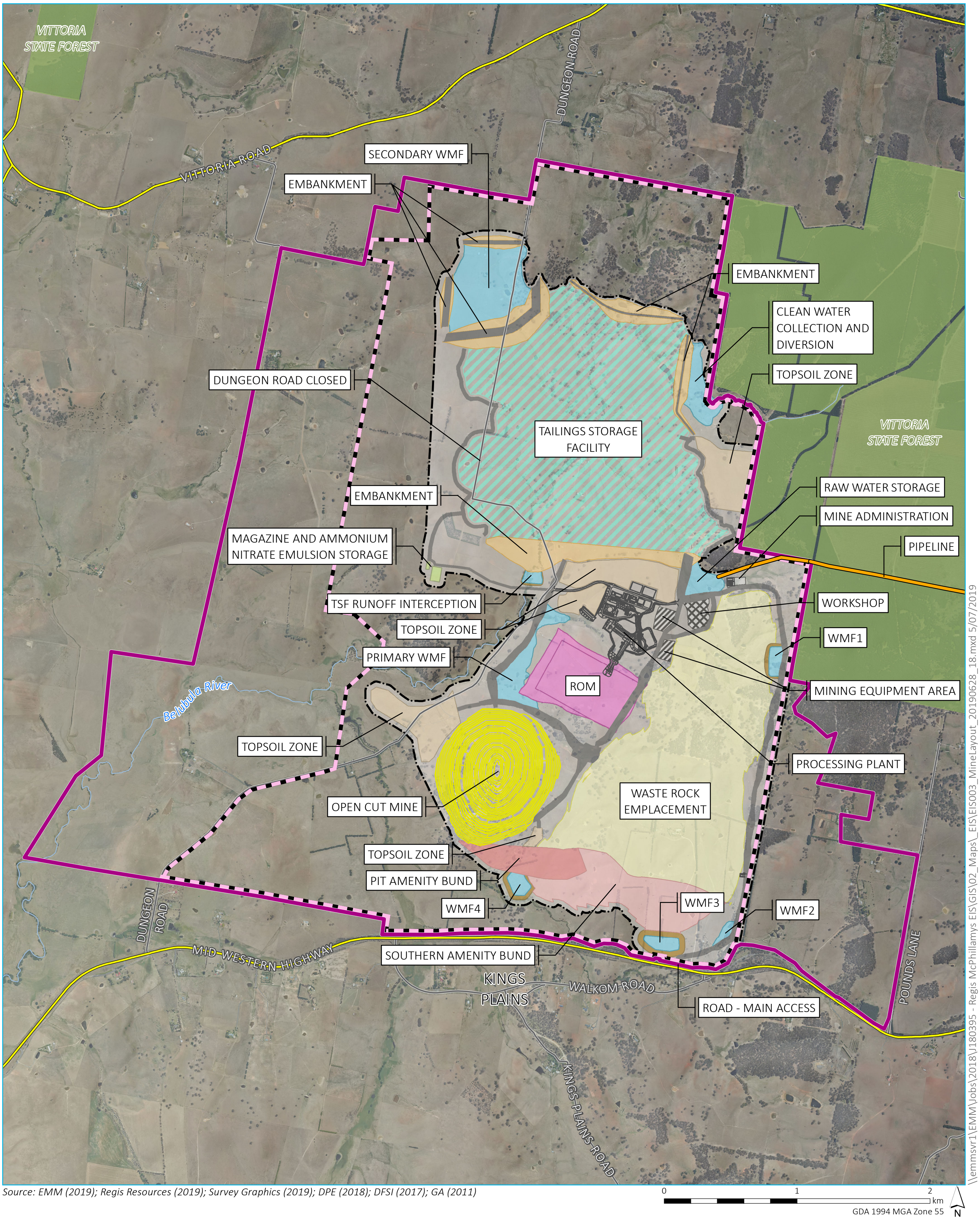
2.2 Project area land use and topography

The mine development is located approximately 8 km north-east of Blayney and 25 km west-south-west of Bathurst in the Central Tablelands region of NSW. The land use in the mine development project area is primarily agricultural for cropping and grazing. Several nature reserves (Winburndale Nature Reserve and Sunny Corner State Forest) are adjacent to the pipeline corridor in the east, and the large reserve area of Fitzgerald's Mount is located to the west.

The project area consists predominately of rolling terrain, increasing in elevation from the south-west to north-east. The topography within the project area is dominated by a series of rounded hills with maximum elevations ranging between 920 m AHD and 980 m AHD. A three-dimensional representation of the local topography is presented in Figure 2.2.

2.3 Surrounding residences

The area surrounding the project area features a number of privately held residential and agricultural properties, with the highest density of receptors located along the southern boundary of the site at Kings Plains. In order to assess potential air quality impacts across the surrounding area, private residences around the project area boundary have been selected as discrete model prediction locations. The locations of the selected receptors (88 in total) are illustrated in Figure 2.3, while the location details are presented in Appendix A.



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DPE (2018); DFSI (2017); GA (2011)

KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor

Project general arrangement
- Plant layout
- Road
- Water management facility (WMF)
- Sediment basin structure

Existing environment
- Main road
- Local road
- Belubula River
- State forest

Mine development general arrangement

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Figure 2.1

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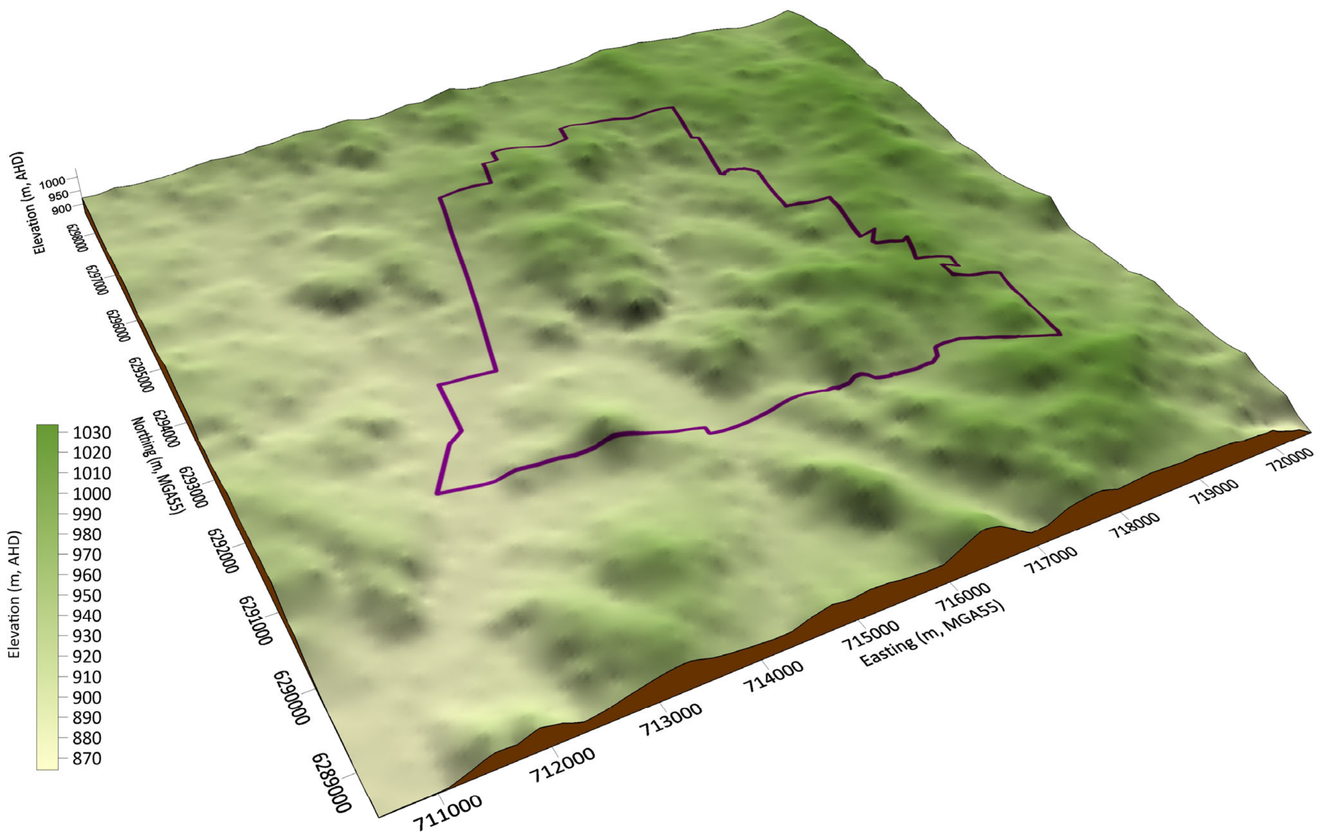
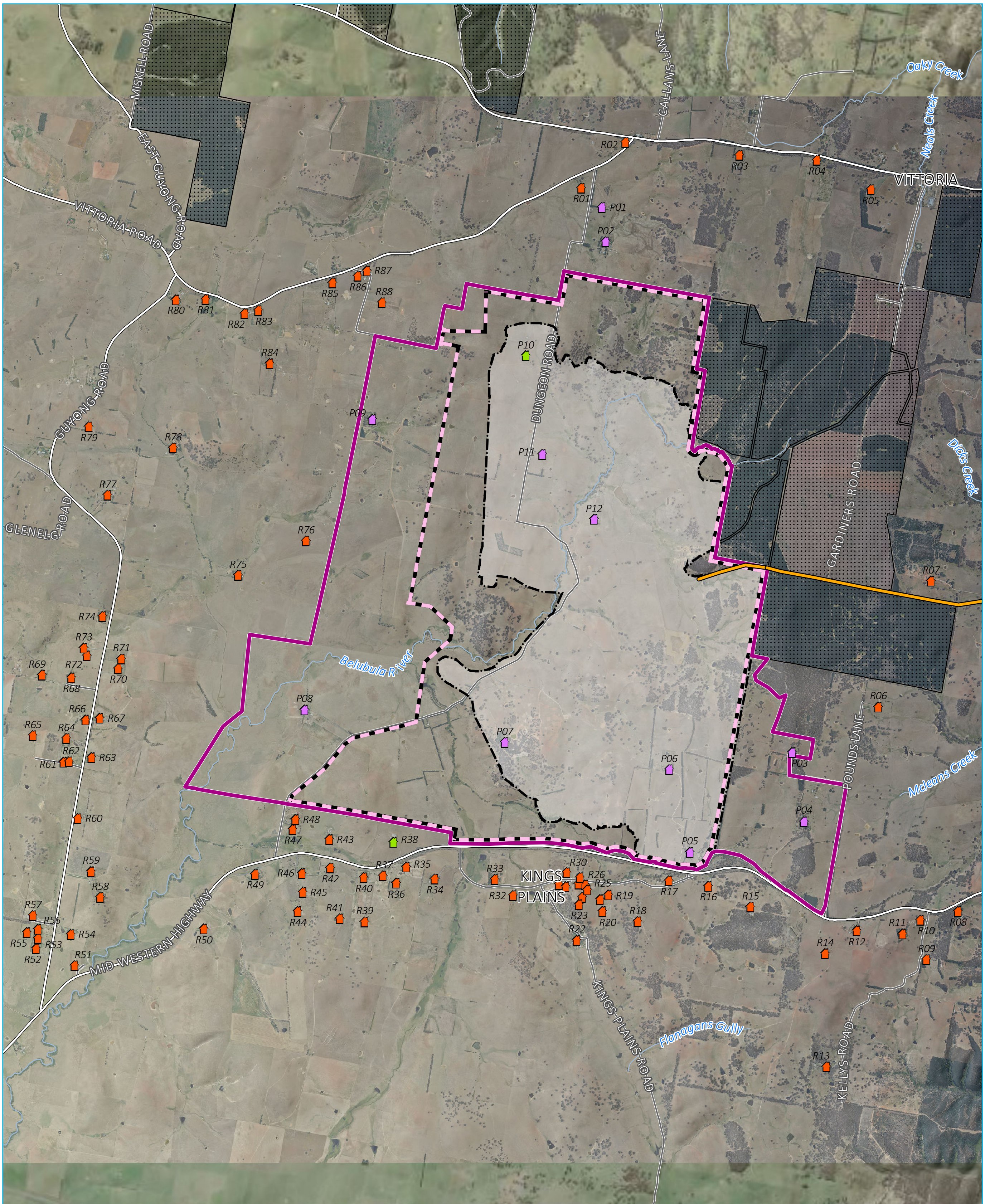


Figure 2.2 3-Dimensional Topography surrounding the project

Notes: Vertical Exaggeration of 4 applied to image



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Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km
GDA 1994 MGA Zone 55
N

KEY

Project application area

- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor

Existing environment

- Main road
- Local road
- Named watercourse
- Vittoria State Forest

Sensitive receptor

- Private
- Residences under option
- Project related (Regis-owned)

Assessment locations

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Figure 2.3

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3 Assessment approach

As stated in Chapter 1, this AQIA has been conducted in general accordance with the guidelines specified by the NSW EPA in the Approved Methods for Modelling. Consistent with Section 2.1 of the Approved Methods for Modelling, this AQIA is classed as a 'Level 2' assessment, consisting of a refined dispersion modelling approach using site-specific and/or representative inputs.

The AQIA consists of the following sections:

- a description of the local setting and surrounds of the project;
- the pollutants which are relevant to the assessment, and the applicable impact assessment criteria;
- a description of the existing environment, specifically:
  - the meteorology and climate; and
  - the existing air quality environment;
- a detailed air pollutant emissions inventory for the staged development of the project;
- atmospheric dispersion modelling for the emission scenarios, including an analysis of project-only and cumulative impacts accounting for baseline air quality;
- an overview of mitigation measures and air quality monitoring for the project; and
- a greenhouse gas assessment.

4 Pollutants and assessment criteria

4.1 Potential air pollutants

The operation of the project has the potential to generate emissions of various air pollutants to the atmosphere. Project emission sources will include a mixture of the following:

- fugitive sources of particulate matter, such as material handling and processing activities, movement of mobile plant and equipment, and wind erosion of exposed surfaces;
- fugitive releases from the ore processing circuit and surface of active Tailings Storage Facility (TSF); and
- combustion sources, such as exhaust emissions from site equipment fleet, emergency generator and processing plant and blasting operations.

A detailed description of emission sources associated with the project is presented in Section 7. Air pollutants emitted by the project will comprise of:

- particulate matter, specifically:
  - total suspended particulate matter (TSP);
  - particulate matter less than 10 micrometres (µm) in aerodynamic diameter (PM_{10}); and
  - particulate matter less than 2.5 µm in aerodynamic diameter ($PM_{2.5}$).
- oxides of nitrogen (NO_x)[1], including nitrogen dioxide (NO_2);
- sulphur dioxide (SO_2);
- carbon monoxide (CO);
- volatile organic compounds (VOCs);
- hydrogen cyanide (HCN); and
- assorted metals and metalloids[2].

The project must demonstrate compliance with the impact assessment criteria for these pollutants, as defined in the Approved Methods for Modelling (EPA, 2016). The impact assessment criteria are designed to maintain ambient air quality that allows for the adequate protection of human health and well-being. The applicable criteria are presented in Section 4.2.

1 By convention, NOx = Nitrous oxide (NO) + NO_2.

2 A metalloid is a chemical element which has properties that are intermediate between those of typical metals and non-metals (eg silicon, arsenic).

4.2 Impact assessment criteria

4.2.1 Particulate matter

The NSW EPA's impact assessment criteria for particulate matter, as documented in Section 7 of the Approved Methods for Modelling, are presented in Table 4.1. The assessment criteria for PM_{10} and $PM_{2.5}$ are consistent with the national air quality standards that are defined in the *National Environment Protection (Ambient Air Quality) Measure* (AAQ NEPM) (Department of the Environment 2016).

TSP, which relates to airborne particles less than around 50 µm in diameter, is used as a metric for assessing amenity impacts (reduction in visibility, dust deposition and soiling of buildings and surfaces) rather than health impacts (NSW EPA, 2013). Particles less than 10 µm in diameter, accounted for in this assessment by PM_{10} and $PM_{2.5}$, are a subset of TSP and are fine enough to enter the human respiratory system and can therefore lead to adverse human health impacts. The NSW EPA impact assessment criteria for PM_{10} and $PM_{2.5}$ are therefore used to assess the potential impacts of airborne particulate matter on human health.

The Approved Methods for Modelling classifies TSP, PM_{10}, $PM_{2.5}$ and dust deposition as 'criteria pollutants'. The impact assessment criteria for criteria pollutants are applied at the nearest existing or likely future off-site sensitive receptors[3], and compared against the 100th percentile (ie the highest) dispersion modelling prediction for the relevant averaging. Both the incremental (project only) and cumulative (project + background) impacts need to be presented, with the latter requiring consideration of the existing ambient background concentrations.

For dust deposition, the NSW EPA (2016) specifies criteria for the project-only increment and cumulative dust deposition levels. Dust deposition impacts are derived from TSP emission rates and particle deposition calculations in the dispersion modelling process.

Table 4.1 Impact assessment criteria for particulate matter

PM metric	Averaging period	Impact assessment criterion
TSP	Annual	90 µg/m^3
PM_{10}	24 hour	50 µg/m^3
	Annual	25 µg/m^3
$PM_{2.5}$	24 hour	25 µg/m^3
	Annual	8 µg/m^3
Dust deposition	Annual	2 g/m^2/month (project increment only)
		4 g/m^2/month (cumulative)

Notes: µg/m^3: micrograms per cubic meter; g/m^2/month: grams per square metre per month

4.2.2 Gaseous pollutants

As stated, the project is anticipated to generate emissions of a range of gaseous pollutants, including NO_x/NO_2, CO, SO_2 and VOCs from fuel combustion and blasting, and HCN from fugitive releases from the processing circuit and TSF facility.

[3] NSW EPA (2016) defines a sensitive receptors as a location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area.

Of the above listed gaseous pollutants, this assessment will focus on NO_2 as the indicator of compliance from fuel combustion and blasting, and HCN emissions from the processing circuit and TSF.

The impact assessment criteria for NO_2 and HCN, as defined by the NSW EPA (2016), are summarised in Table 4.2.

Table 4.2 Impact assessment criteria for NO_2 and HCN

Pollutant	Averaging period	Impact assessment criterion
NO_2	1 hour	246 µg/m^3
	Annual	62 µg/m^3
HCN	99.9^{th} percentile 1-hour average	200 µg/m^3

The impact assessment criteria for NO_2 are applicable at the nearest existing or likely future off-site sensitive receptor. In assessing compliance against the applicable criteria, the maximum cumulative concentration (project increment plus background concentration) at each receptor must be reported as the 100^{th} percentile concentration (i.e. maximum concentration) for the relevant averaging period.

The criterion for HCN is applicable at and beyond the boundary of the project. The criterion is applicable to the project-only (incremental) concentration and is reported as the 99.9^{th} percentile 1-hour average (EPA, 2016).

4.2.3 Metals and metalloids

Emissions of assorted individual metals and metalloids contained within the waste, ore and tailings material may occur during the life of the project. The NSW EPA specifies impact assessment criteria for many principal and individual toxic air pollutants in the Approved Methods for Modelling.

Geochemistry profiles for waste rock, ore and tailings based on site sampling results were provided by Regis. Of the detected elements, those with a NSW EPA impact assessment criterion are presented in Table 4.3.

It is noted that for each of the pollutants listed in Table 4.3, with the exception of lead, the impact assessment criterion specified by the NSW EPA must be applied at and beyond the boundary of the project, with the incremental impact (ie predicted impacts due to the pollutant source alone) for each pollutant reported as the 99.9^{th} percentile 1-hour average concentration. The criterion for lead is an annual average and is applied at the selected sensitive receptors.

Table 4.3 Impact assessment criteria – metals and metalloids

Element	Impact assessment criterion (µg/m³)	Averaging period
Antimony and compounds (Sb)	9.0	99.9th percentile 1-hour
Arsenic and compounds (As)	0.09	99.9th percentile 1-hour
Barium (soluble compound) (Ba)	9.0	99.9th percentile 1-hour
Beryllium and compounds (Be)	0.004	99.9th percentile 1-hour
Cadmium and compounds (Cd)	0.018	99.9th percentile 1-hour
Chromium VI and compounds (Cr)	0.09	99.9th percentile 1-hour
Copper dusts and mists (Cu)	18	99.9th percentile 1-hour
Lead (Pb)	0.5	Annual average
Manganese and compounds (Mn)	18	99.9th percentile 1-hour
Mercury organic (Hg)	0.18	99.9th percentile 1-hour
Nickel and compounds (Ni)	0.18	99.9th percentile 1-hour
Silver (soluble compounds) (Ag)	0.18	99.9th percentile 1-hour

4.3 POEO (Clean Air) regulation

The statutory framework for managing air emissions in NSW is provided in the *Protection of the Environment Operations Act 1997*[4] (POEO Act). The primary regulations for air quality made under the POEO Act are:

- Protection of the Environment Operations (Clean Air) Regulation 2010[5].
- Protection of the Environment Operations (General) Regulation 2009[6].

The project will comply with the POEO regulations as follows:

- as a scheduled activity under the POEO regulations, the project will be required to operate under an environment protection licence (EPL) issued by the NSW EPA and comply with requirements including emission limits, monitoring and pollution-reduction programmes (PRPs);
- best management practice (BMP) is a guiding principle in the POEO Act and requires that all necessary practicable means are used to prevent or minimise air pollution in NSW. A BMP determination has been undertaken for emissions from the project and is outlined in Section 7.3.1, and demonstrates that the emission-control measures designed for the project are consistent with accepted best practice;
- the project does not feature significant odour-generating emission sources and is therefore unlikely to generate odourous emissions; and
- no open burning will be performed on-site.

[4] http://www.legislation.nsw.gov.au/maintop/view/inforce/act+156+1997+cd+0+N

[5] http://www.legislation.nsw.gov.au/maintop/view/inforce/subordleg+428+2010+cd+0+N

[6] http://www.legislation.nsw.gov.au/maintop/view/inforce/subordleg+211+2009+cd+0+N

4.4 Voluntary land acquisition and mitigation policy

In September 2018, the DPE released the *Voluntary Land Acquisition and Mitigation Policy (VLAMP) for State Significant Mining, Petroleum and Extractive Industry Developments*. The VLAMP describes the voluntary mitigation and land acquisition policy to address dust and noise impacts, and outlines mitigation and acquisition criteria for particulate matter.

Under the VLAMP, if a development cannot comply with the relevant impact assessment criteria, or if the mitigation or acquisition criteria may be exceeded, the applicant should consider a negotiated agreement with the affected landowner or acquire the land. In doing so, the land is then no longer subject to the impact assessment, mitigation or acquisition criteria, although provisions do apply to the "use of the acquired land", primarily related to informing and protecting existing or prospective tenants.

In relation to dust, voluntary mitigation rights apply when a development contributes to exceedances of the criteria set out in Table 4.4. Voluntary acquisition rights apply when a development contributes to exceedances of the criteria set out in Table 4.5. The criteria for voluntary mitigation and acquisition are the same, except for the number of days the short-term impact assessment criteria for PM_{10} and $PM_{2.5}$ can be exceeded, which is zero for mitigation and five for acquisition.

Voluntary mitigation rights apply to any residence on privately-owned land or any workplace on privately-owned land where the consequences of the exceedance, in the opinion of the consent authority, are unreasonably deleterious to worker health or the carrying out of business.

Voluntary acquisition rights also apply to any residence or any workplace on privately-owned land, but also apply when an exceedance occurs across more than 25% of any privately-owned land where there is an existing dwelling or where a dwelling could be built under existing planning controls.

Table 4.4 VLAMP mitigation criteria

Pollutant	Averaging period	Mitigation criterion	Impact type
PM_{10}	24-hour	50 µg/m³**	Human health
	Annual	25 µg/m³*	Human health
$PM_{2.5}$	24-hour	25 µg/m³**	Human health
	Annual	8 µg/m³*	Human health
TSP	Annual	90 µg/m³*	Amenity
Deposited dust	Annual	2 g/m²/month**	Amenity
		4 g/m²/month*	

Note: * - cumulative impact (project + background); ** - incremental impact (project only) with zero allowable exceedances of the criteria over the life of the development

Table 4.5 VLAMP acquisition criteria

Pollutant	Averaging period	Mitigation criterion	Impact type
PM_{10}	24-hour	50 µg/m³**	Human health
	Annual	25 µg/m³*	Human health
$PM_{2.5}$	24-hour	25 µg/m³**	Human health
	Annual	8 µg/m³*	Human health
TSP	Annual	90 µg/m³*	Amenity
Deposited dust	Annual	2 g/m²/month**	Amenity
		4 g/m²/month*	

Note: * - cumulative impact (project + background); ** - incremental impact (project only) with five allowable exceedances of the criteria over the life of the development

5 Meteorology and Climate

5.1 Monitoring data resources

Regis maintains a meteorological monitoring station as part of the air quality monitoring network within the project area (see Section 6.2). Data from the on-site meteorological monitoring station was the primary resource for representing meteorological conditions at the project area in the dispersion modelling. Measurements of wind speed, wind direction, standard deviation of wind direction, temperature (2 m and 10 m above ground level), relative humidity and solar radiation were used in the modelling.

These data were supplemented with corresponding observations of station-level pressure and cloud cover taken from the Bureau of Meteorology (BoM) automatic weather station (AWS) at Orange Airport, located 20 km north-west of the project area meteorological station.

The meteorological data recorded by the on-site station were analysed for the five-year period between 2014 and 2018 (Appendix B). The analysis demonstrated a similarity across years in the most important parameters for pollutant dispersion, such as wind speed and wind direction. The winds recorded by the on-site station across all five years were predominately easterly and westerly winds, with a minor north-westerly component. Recorded wind speeds show a high proportion of elevated wind (greater than 5.5 m/s) across all years. The annual average recorded wind speed ranged from 5.7 m/s to 6.1 m/s, while the frequency of calm conditions (wind speeds less than 0.5 m/s) occurred less than 0.2% of the time.

The inter-annual profiles for air temperature and relative humidity were also comparable between 2014 and 2017. The 2018 dataset showed slightly higher temperature and lower relative humidity, which are indicative of the strong drought conditions during the year. Concentrations of particulate matter were also relatively high during 2018 (see Section 6.3.1). Although the 2018 dataset represented the most recent calendar year, it was therefore not considered to be representative of the area relative to the previous four years. Further discussion on ambient particulate matter levels and drought conditions is presented in Section 6.3.1.

Consequently, the 2017 calendar year was adopted as the 12-month modelling period for the purpose of this AQIA. Details relating to the selection of meteorological year and the representativeness of the dataset are provided in Appendix B.

5.2 Meteorological modelling and processing

Atmospheric dispersion modelling for this assessment has been completed using the AMS[7]/USEPA[8] regulatory model (AERMOD) (model version v18081, further discussion presented in Section 8). The meteorological inputs for AERMOD were generated using the AERMET meteorological processor (model version v18081), using local surface observations and upper air profiles generated by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) TAPM meteorological modelling module.

Further details of the TAPM meteorological modelling and AERMET data processing completed to prepare the inputs for AERMOD are documented in Appendix B.

7 AMS - American Meteorological Society

8 USEPA - United States Environmental Protection Agency

5.3 Wind speed and direction

A wind rose showing the wind speed and direction recorded at the on-site meteorological station during 2017 is presented in Figure 5.1. Similar to the inter-annual wind roses presented in Appendix B, the recorded wind pattern for 2017 was dominated by easterly and westerly winds, with a minor north-westerly component. Recorded wind speeds show a high proportion of elevated wind (greater than 5.5 m/s). The annual average recorded wind speed for 2017 was 5.9 m/s, with a frequency of calm conditions (wind speeds less than 0.5 m/s) in the order of 0.1 % of the time.

Seasonal and diurnal wind roses for the on-site meteorological station during 2017 are provided in Figure 5.2 and Figure 5.3 respectively. The seasonal variation in wind speed was minor, with the mean ranging from 5.4 m/s in autumn to 6.4 m/s in spring. However, there was a noticeable seasonal variation in wind direction, with the easterly component most prevalent between spring and early autumn, and winds from the west being most dominant during winter.

Wind speed and wind direction varied on a diurnal basis. The night-time hours featured a higher proportion of easterly winds, while westerly winds were more evident during the daytime. The wind speeds at night were slightly lower on average than during the daytime, with average wind speeds of 6.4 m/s during the day and 5.4 m/s during the night.

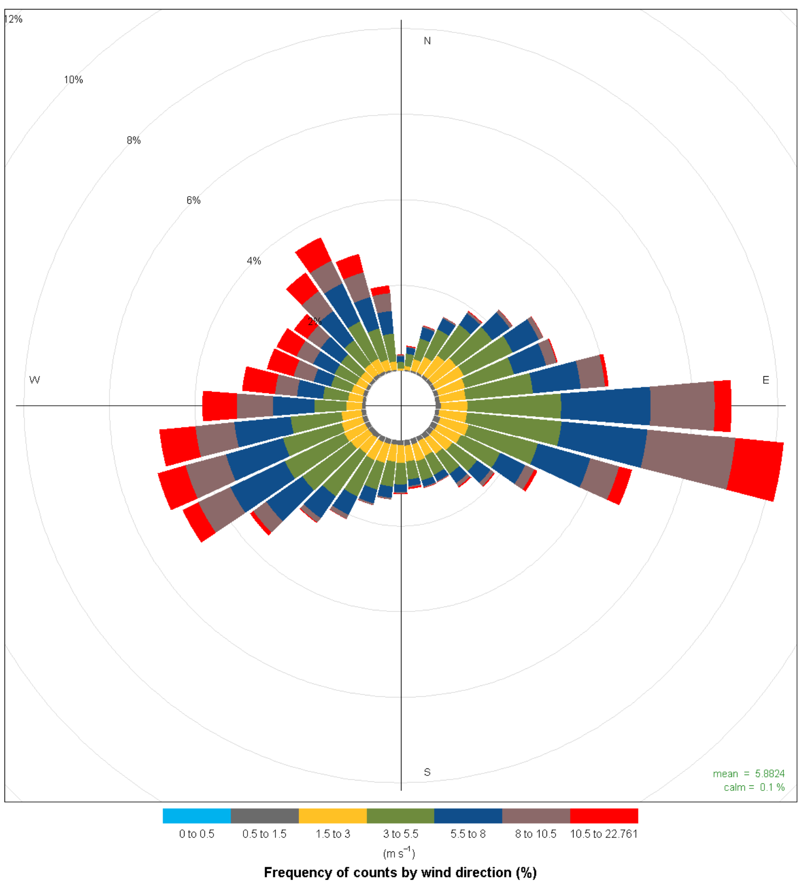


Figure 5.1 Recorded wind speed and direction – on-site meteorological station – 2017

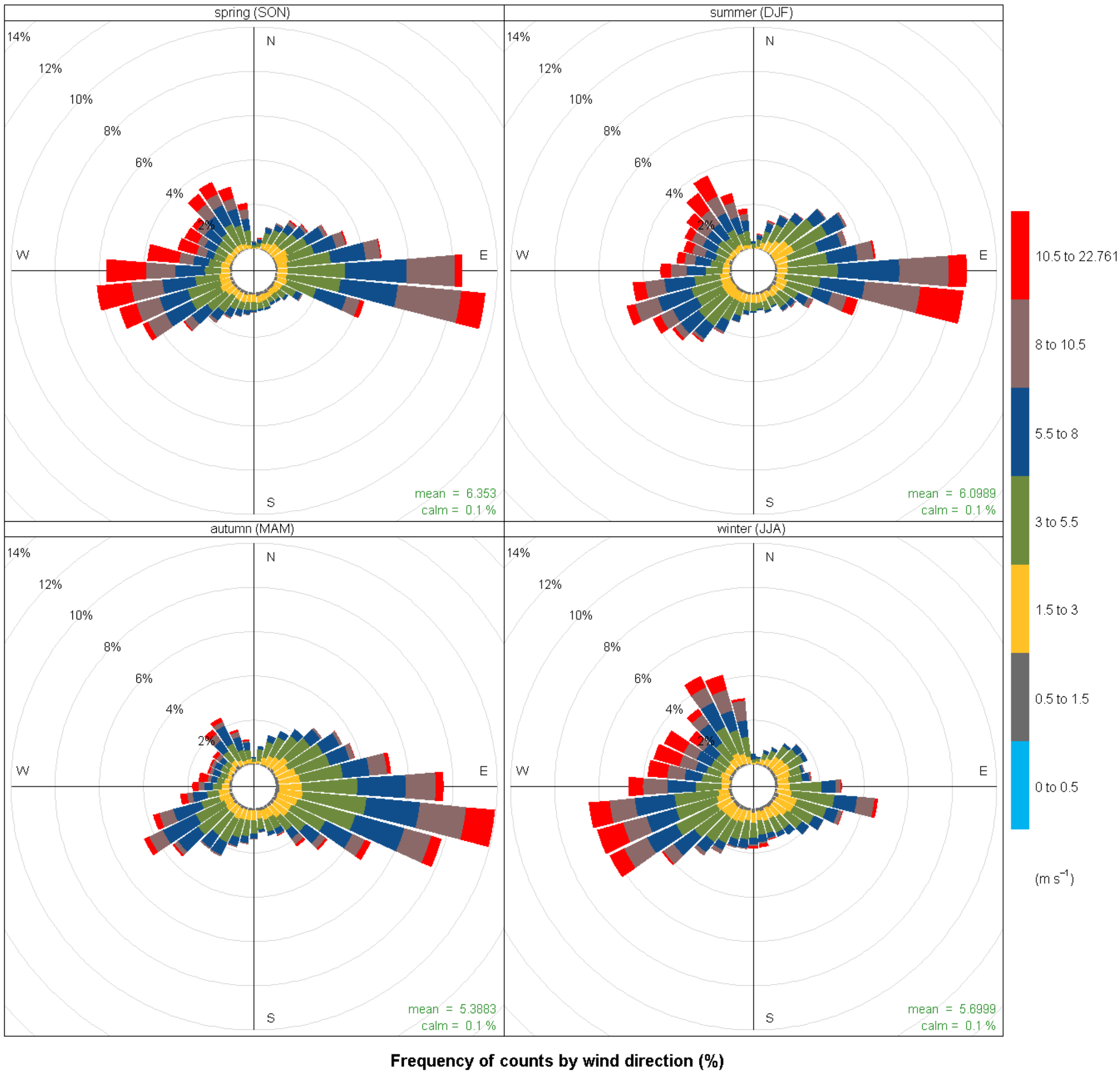


Figure 5.2 Seasonal wind speed and direction – on-site meteorological station – 2017

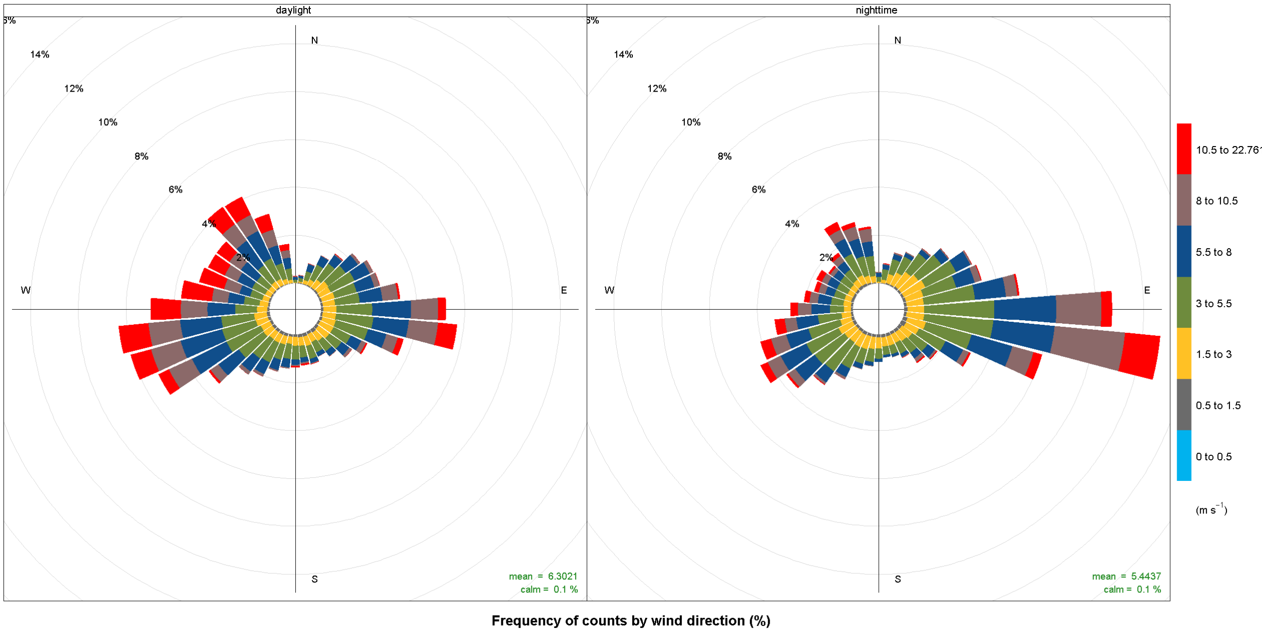


Figure 5.3 Diurnal wind speed and direction – on-site meteorological station – 2017

5.4 Atmospheric stability and mixing depth

Atmospheric stability refers to the degree of turbulence or mixing that occurs within the atmosphere and is a controlling factor in the rate of atmospheric dispersion of pollutants.

The Monin-Obukhov length (L) provides a measure of the stability of the surface layer (ie the layer above the ground in which vertical variation of heat and momentum flux is negligible; typically about 10% of the mixing height). Negative L values correspond to unstable atmospheric conditions, while positive L values correspond to stable atmospheric conditions. Very large positive or negative L values correspond to neutral atmospheric conditions.

Figure 5.4 illustrates the overall diurnal variation of atmospheric stability derived from the Monin-Obukhov length calculated by AERMET based on observations collected at the on-site meteorological station in 2017. The diurnal profile shows that atmospheric instability increases during the daylight hours as the sun generated convective energy increases, whereas stable atmospheric conditions prevail during the night-time. This profile indicates that the potential for effective atmospheric dispersion of emissions would be greatest during day time hours and lowest during evening through to early morning hours.

Mixing depth refers to the height of the atmosphere above ground level within which the dispersion of air pollution can be dispersed. The mixing depth of the atmosphere is influenced by mechanical (associated with wind speed) and thermal (associated with solar radiation) turbulence. Similar to the Monin-Obukhov length analysis above, higher daytime wind speeds and the onset of incoming solar radiation increases the amount of mechanical and convective turbulence in the atmosphere. As turbulence increases, so too does the depth of the boundary layer, generally contributing to higher mixing depths and greater potential for the atmospheric dispersion of pollutants.

Hourly-varying atmospheric boundary layer depths were generated by AERMET, the meteorological processor for the AERMOD dispersion model. The variation in AERMET-calculated boundary layer depth by hour of the day is illustrated in Figure 5.5. Greater boundary layer depths occur during the daytime hours, peaking in the mid to late afternoon.

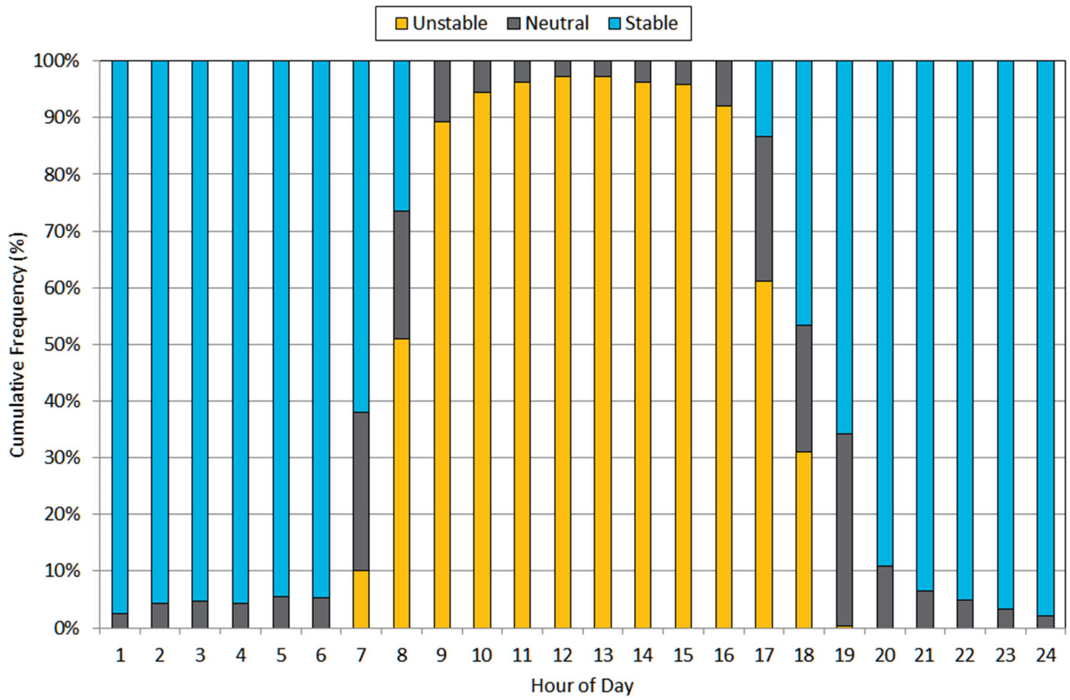


Figure 5.4 **AERMET-calculated diurnal variation in atmospheric stability – on-site meteorological station 2017**

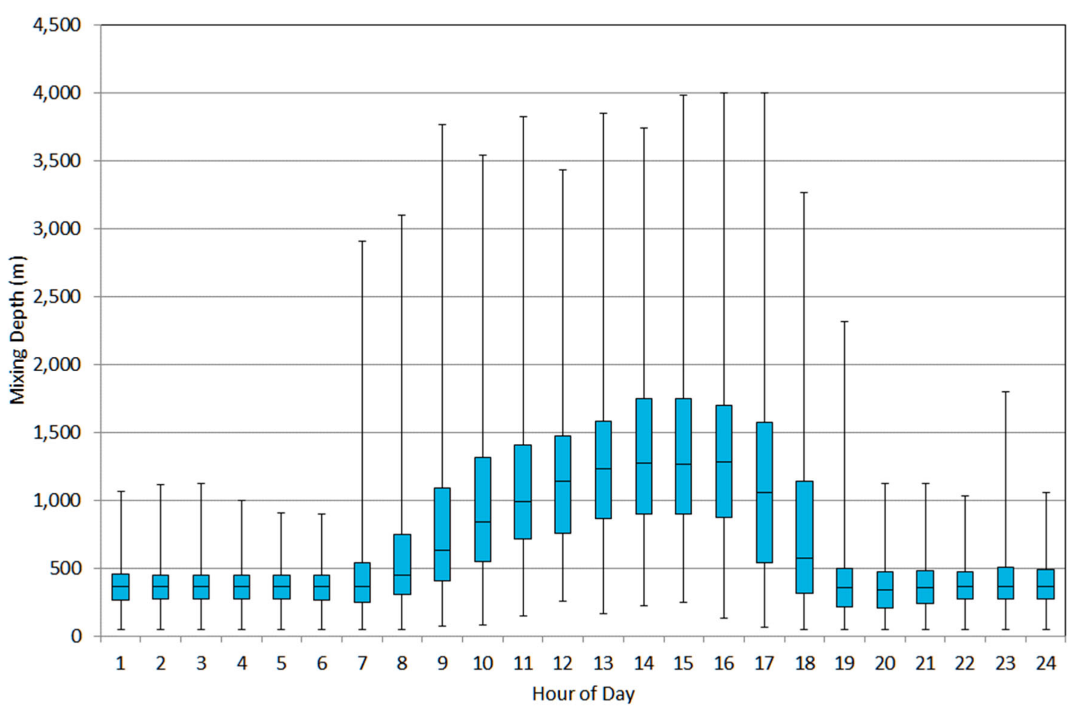


Figure 5.5 **AERMET-calculated diurnal variation in atmospheric mixing depth – on-site meteorological station 2017**

6 Baseline air quality

6.1 Existing sources of emissions

The National Pollutant Inventory (NPI) and NSW EPA environment protection licence databases have been reviewed to identify significant existing sources of air pollutants in the local region. Three reporting facilities were listed in Blayney, approximately 8 km to the south-west of the project area, comprising of:

- APA Moomba to Sydney transmission pipeline natural gas metering station, located 5 km west-southwest of the project area;
- Cadia Valley Operations Dewatering Facility, located 5 km south-southwest of the project area; and
- Nestle Purina Pet Care factory, 7 km to the west-southwest of the project area.

Reported particulate matter emissions from these facilities are low, with annual PM_{10} emissions from the Nestle Purina Pet Care factory totalling 810 kg/annum representing the largest source. The size of these facilities and the distances involved from the project, associated emissions would not cause direct cumulative impacts with potential project emissions.

It is considered that, given the lack of industrial and extractive operations in the region surrounding the project area, the main contributing non-project sources of air pollutant emissions to baseline air quality in the vicinity of the project include:

- dust entrainment due to vehicle movements along unsealed and sealed town and rural roads with high silt loadings;
- agricultural practices;
- dust emissions from agricultural activities at neighbouring properties;
- fuel combustion-related emissions from on-road and non-road engines;
- wind generated dust from exposed areas within the surrounding region;
- seasonal emissions from household wood burning; and
- episodic emissions from vegetation fires.

More remote sources which contribute episodically to suspended particulates in the region include dust storms and bushfires. It is considered that all of the above emission sources are accounted for in the monitoring data analysed in the following sections of this report.

6.2 Air quality monitoring data resources

Regis has commissioned an air quality monitoring network for the project area. The network consists of the following monitoring equipment:

- one high-volume air sampler (HVAS) for the recording of PM_{10} concentrations on a one-in-six day routine;
- four dust deposition gauges for recording monthly dust deposition rates; and

- one meteorological station recording weather conditions, including wind speed and direction, temperature, solar radiation, rainfall and atmospheric pressure.

The locations of the project-specific monitoring equipment are illustrated in Figure 6.1.

To supplement the project-specific monitoring data, hourly average concentrations of PM_{10} and $PM_{2.5}$ for the period 2014-2018 were obtained from the NSW Office of Environment and Heritage (OEH) air quality monitoring station at Bathurst, located approximately 23 km east-north-east of the project area.

6.3 Background air quality environment

6.3.1 PM_{10}

i Onsite HVAS monitoring data

As stated in Section 6.2, 24-hour average PM_{10} concentrations are recorded at the project area by HVAS on a one-in-six day routine. A summary of key statistics for the five years of analysed data from the on-site HVAS is presented in Table 6.1. Exceedances of the NSW EPA 24-hour average criterion of 50 µg/m³ were recorded in 2015 (two occasions) and 2018 (once).

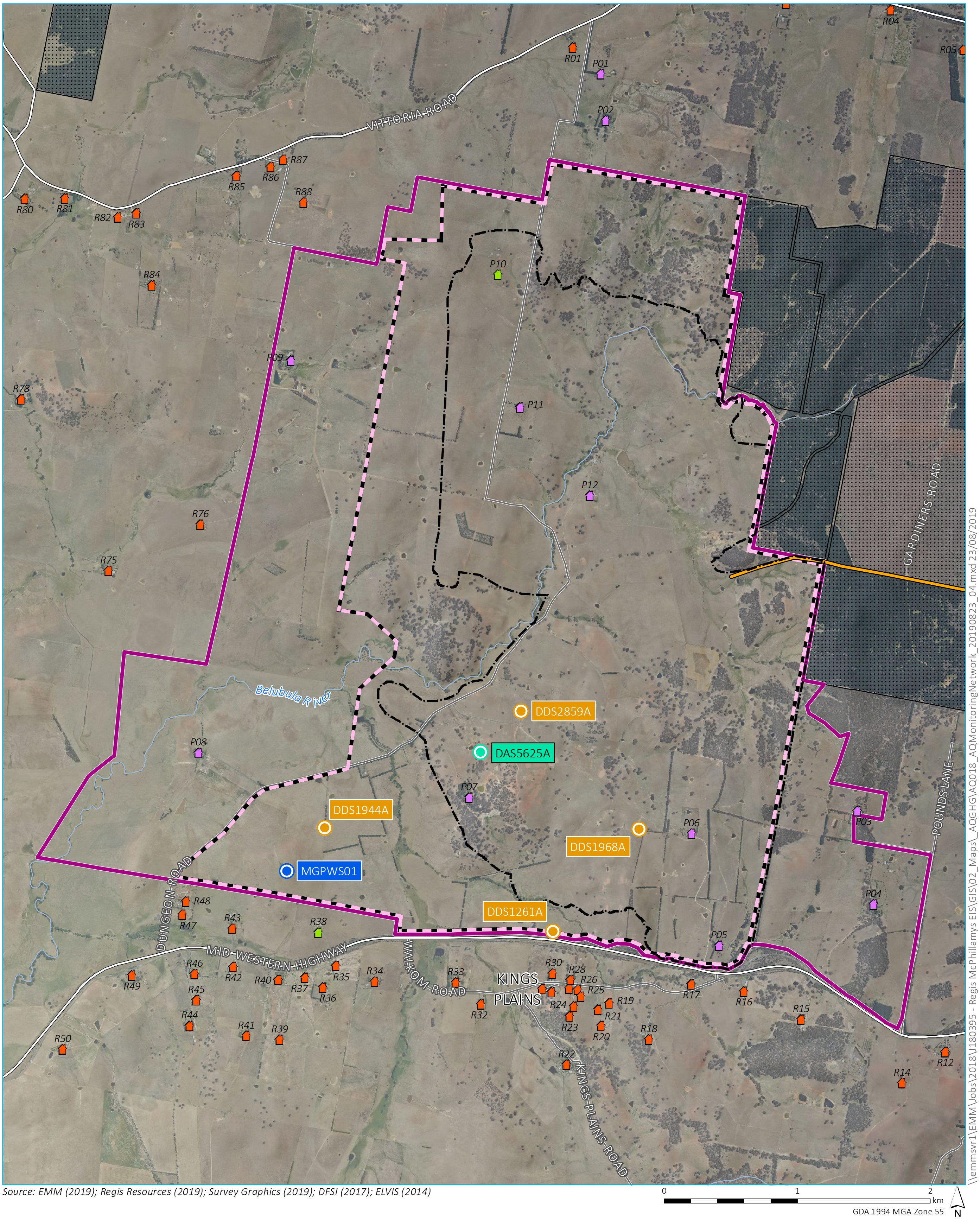
Table 6.1 Statistics for PM_{10} concentrations – on-site HVAS – 2014 to 2018

Year	Maximum	99th percentile	90th percentile	75th percentile	Median	Average	Days > 50 µg/m³
	24-hour average PM_{10} concentration (µg/m³)						
2014	49.0	26.0	24.8	15.0	6.0	9.8	0
2015	**57.0**	54.0	22.8	17.8	8.0	12.3	**2**
2016	39.0	21.0	18.0	15.5	9.0	10.5	0
2017	33.0	32.0	23.6	18.0	12.0	12.8	0
2018	**226.0**	49.0	27.2	17.3	10.0	15.8	**1**

The data in Table 6.2 illustrates that 2018 experienced higher PM_{10} concentrations than the previous four years. The increase in concentrations in 2018 is attributed to extensive drought conditions across NSW west of the Great Dividing Range. A drought indicator map for 2018, generated by the NSW Department of Primary Industries (DPI), is presented in Figure 6.2. This shows that most of the Central Tablelands region was classified as experiencing drought conditions.

Additional information is available from the OEH Community DustWatch monitoring program. This is a citizen-science program involving a network of particulate matter monitoring locations across regional NSW designed to monitor dust storms. Monthly bulletins are released by the OEH relating to the conditions recorded. To illustrate the sustained nature of elevated dust in regional NSW throughout 2018, the summary headline for each DustWatch bulletin published during 2018 is presented below:

- January 2018 - Doubled from last month, 10 times more than January 2017;
- February 2018 - Several dust storms; more dust than in the last three years;
- March 2018 - Dust widespread in the south; increased from February;
- April 2018 - Highest dust activity since April 2009;



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor

Existing environment
- Main road
- Local road
- Named watercourse
- Vittoria State Forest

Sensitive receptor
- Private
- Residences under option
- Project related (Regis-owned)

Project air quality monitoring network
- Dust deposition gauge
- HVAS air sampler
- Weather station

Project air quality monitoring network

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure 6.1

REGIS RESOURCES LTD

EMM creating opportunities

- May 2018 - Second highest dust activity for May on DustWatch record;
- June 2018 - Low due to rain and lack of strong winds;
- July 2018 – Highest on record for the month of July;
- August 2018 – Dustiest August since 2005; Large dust storms;
- September 2018 – Increased in the north-east and south-west NSW;
- October 2018 – Third dustiest October since 2005;
- November 2018 – Second dustiest November in DustWatch records; and
- December 2018 - Dustiest December in DustWatch records.

With respect to this AQIA, the findings of the DustWatch program confirm the exceptional and unrepresentative nature of the 2018 dataset.

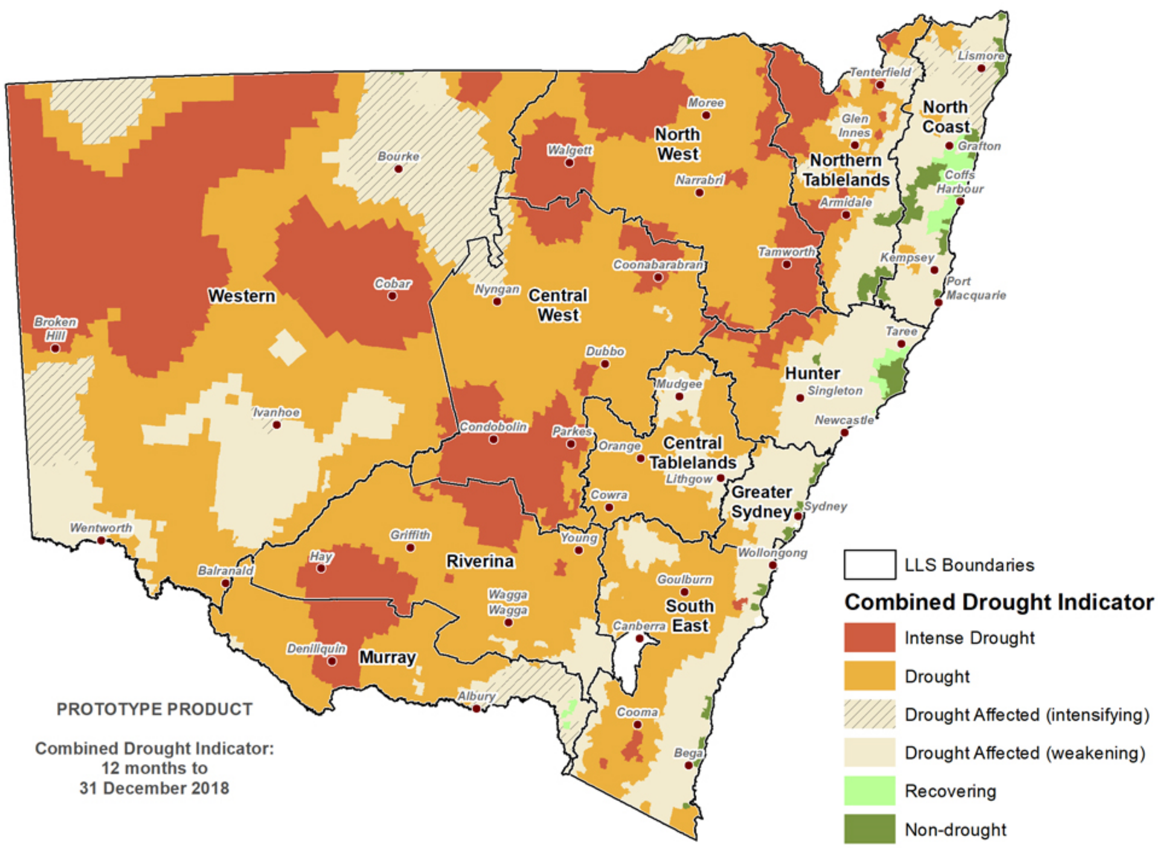


Figure 6.2 Extent of drought conditions across NSW - 2018

Source: NSW DPI (2019) *NSW State Seasonal Update - December 2018.* Figure 1. Verified NSW Combined Drought Indicator to 31 December 2018

ii OEH Bathurst monitoring data

To supplement the one-in-six day onsite HVAS monitoring dataset, continuous PM_{10} monitoring data collected by the OEH Bathurst air quality station (AQS) has been collected for the period between 2014 and 2018. To compare the on-site HVAS and OEH Bathurst datasets, coincident 24-hour average PM_{10} concentrations recorded at the two locations were extracted for the period 2014-2018. The coincident concentrations at the two sites are presented in Figure 6.3, while the average concentrations by year and by season at the two sites are illustrated in Figure 6.4 and Figure 6.5 respectively.

The following points are noted from Figure 6.3, Figure 6.4 and Figure 6.5:

- there was a similar inter-annual fluctuation in PM_{10} concentrations over the five years at the two sites;
- 24-hour PM_{10} concentrations at the two sites were comparable during the spring and summer months, but were higher at the OEH Bathurst station during autumn and winter; and
- the OEH Bathurst station recorded higher average PM_{10} concentrations than the on-site HVAS for all years of monitoring.

Two main factors are considered to contribute to the higher concentrations recorded at Bathurst:

- there were a larger number of data points in the Bathurst dataset (continuous measurements) relative to the on-site HVAS (one-in-six day measurements). Regional-scale events such as dust storms or bushfires can result in elevated concentrations for several days, and these could have been missed by the HVAS monitoring method; and
- the Bathurst site features a higher density of urban development and associated emission sources (motor vehicles, domestic heating, etc) than the area around the project area. In particular, the elevated concentrations during the autumn and winter months were likely attributable to wood heater emissions.

The OEH Bathurst dataset is therefore considered to provide a conservatively high continuous record of 24-hour average PM_{10} concentrations that better meets the data completeness requirements for a Level 2 air quality impact assessment than the HVAS data collected within the project area. To prepare a background dataset for use in the assessment of cumulative PM_{10} impacts from the project, the on-site HVAS dataset and OEH Bathurst datasets for 2017 were combined (ie every 6^{th} background concentration is from the on-site HVAS, with all other concentrations taken from the OEH Bathurst station).

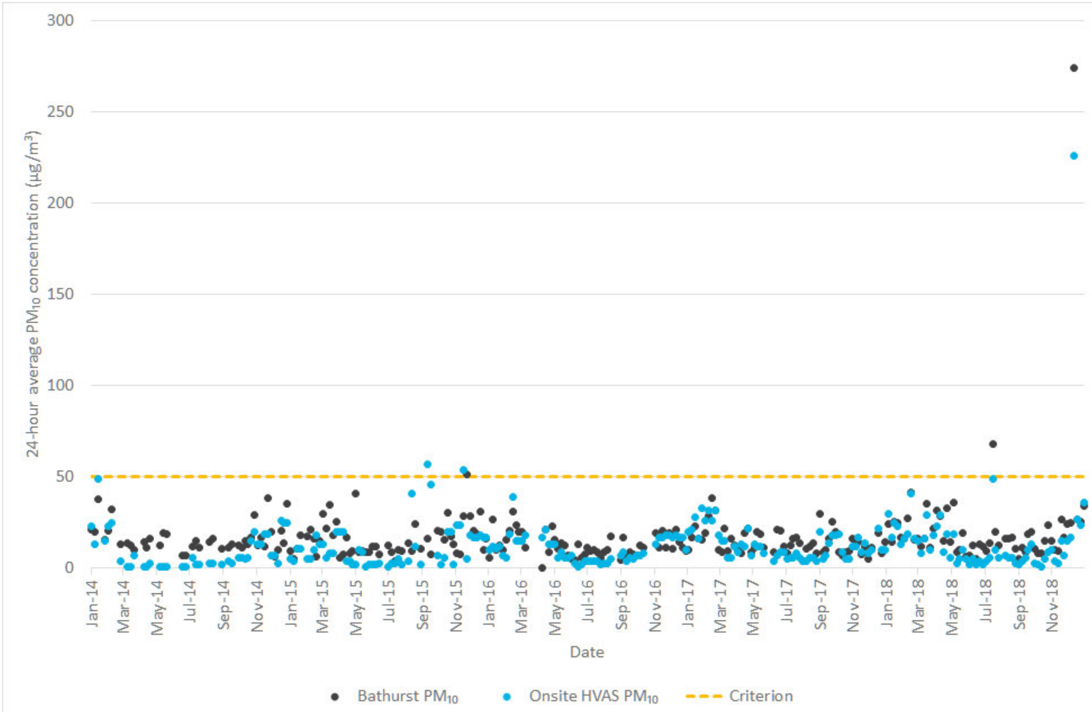


Figure 6.3 **Coincident 24-hour average PM_{10} concentrations – on-site HVAS and OEH Bathurst AQS – 2014 to 2018**

Note: only dates with co-incident 24-hour average PM_{10} concentrations at both the on-site HVAS and OEH Bathurst AQS are illustrated in this figure.

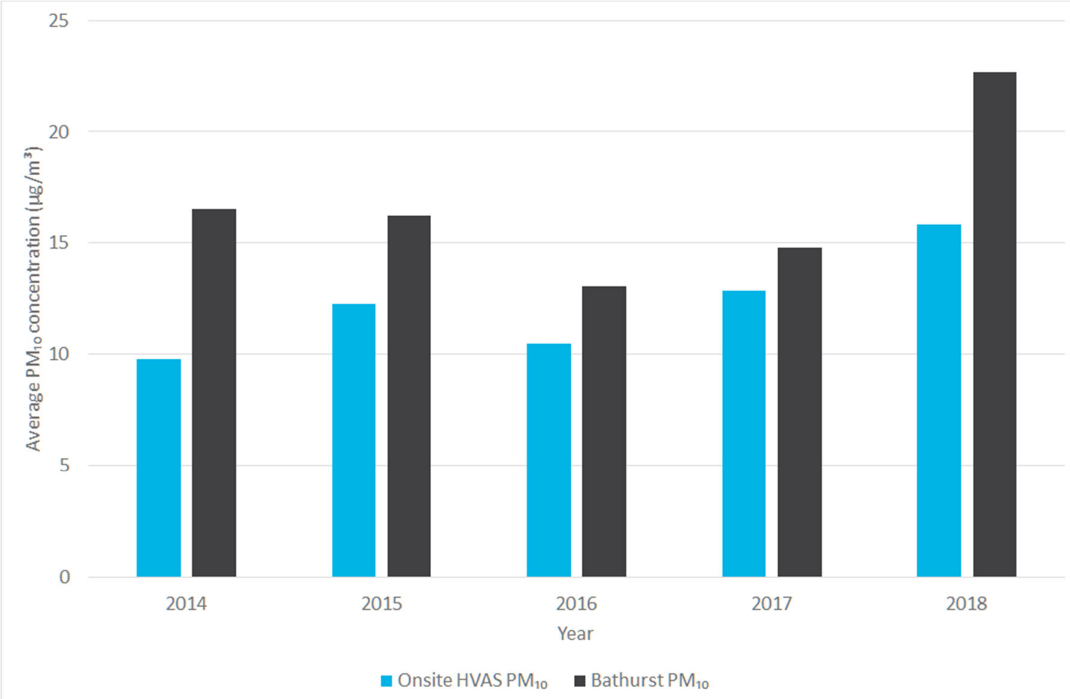


Figure 6.4 Comparison between paired annual average PM_{10} concentrations – on-site HVAS vs OEH Bathurst AQS – 2014 to 2018

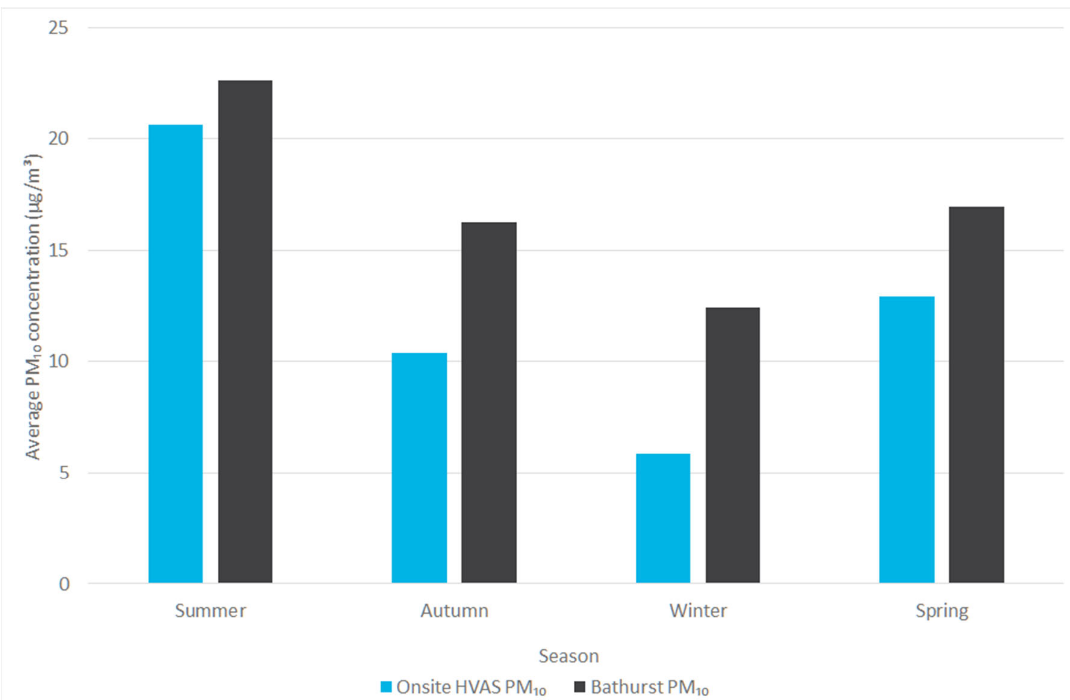


Figure 6.5 Comparison between seasonal average PM_{10} concentrations – on-site HVAS vs OEH Bathurst AQS – 2014 to 2018

A time series of recorded 24-hour average PM_{10} concentrations at the OEH Bathurst station for the period between 2014 and 2018 is presented in Figure 6.6. The recorded 24-hour average PM_{10} concentrations fluctuated throughout the period. Concentrations at Bathurst were typically below the NSW EPA assessment criterion of 50 µg/m³. Two exceedances were recorded in 2015, while eight exceedances were recorded in 2018.

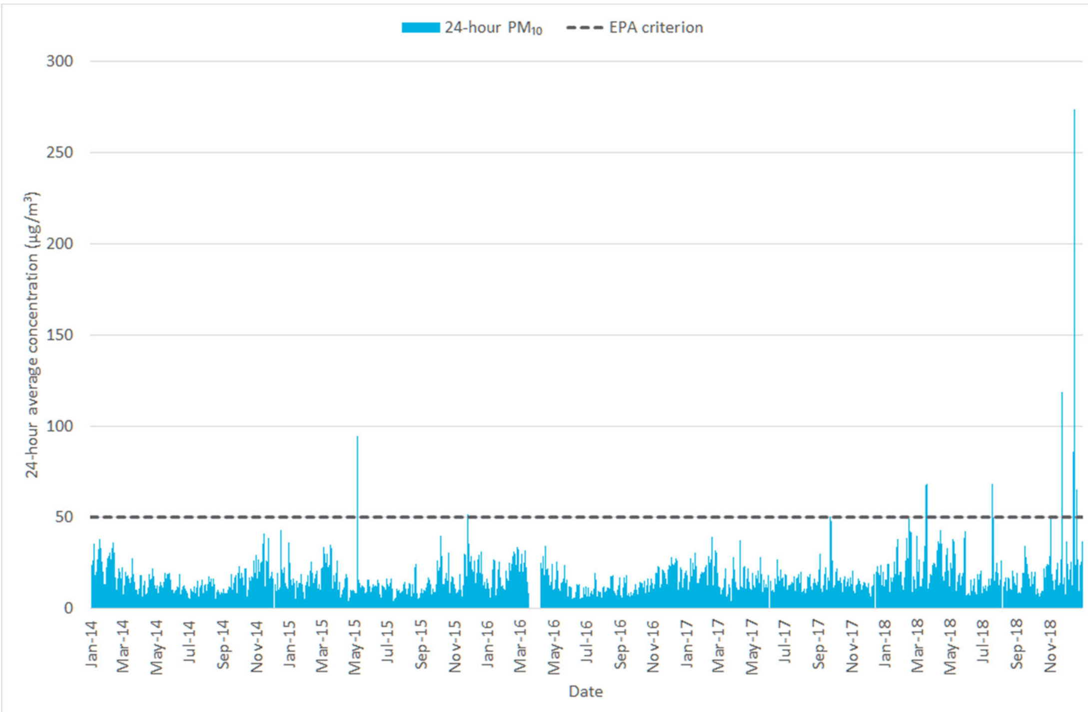


Figure 6.6 Time series of 24-hour average PM_{10} concentrations – OEH Bathurst AQS – 2014 to 2018

Key statistics for the five years of analysed data from the OEH Bathurst station are presented in Table 6.2. The values for 2018 were noticeably higher across all statistics than the values for the four preceding years. Furthermore, the frequency of recorded PM_{10} concentrations at the Bathurst station by year for the period 2014 to 2018 is shown in Figure 6.7. The distribution of recorded PM_{10} concentrations for 2018 featured a higher occurrence of concentrations greater than 30 µg/m³ than the other four years of data.

As discussed for the on-site HVAS monitoring in Section 6.3.1 i, due to the widespread drought conditions across western NSW and associated elevated dust levels, the 2018 dataset is not considered to be representative of ambient air quality conditions typically experienced in the region. The 2017 PM_{10} dataset is considered to be more representative of the typical conditions recorded at the OEH Bathurst AQS and has been adopted as the baseline year for assessment of cumulative impacts from the project.

Table 6.2 Statistics for PM_{10} concentrations – OEH Bathurst – 2014 to 2018

Year	Maximum	99th percentile	90th percentile	75th percentile	Median	Average	Days > 50 µg/m³
	24-hour average PM_{10} concentration (µg/m³)						
2014	42.8	37.6	24.9	18.2	12.6	14.4	0
2015	94.6	36.7	22.2	16.1	11.6	13.3	**2**
2016	34.1	31.1	23.4	16.7	11.3	12.4	0
2017	49.9	36.1	21.0	16.9	12.7	13.7	0*
2018	**274.1**	74.5	32.4	21.4	15.1	18.5	**8**

*Note: Two dates during 2017, 23 and 24 September, were heavily influenced by a regional dust storm event.

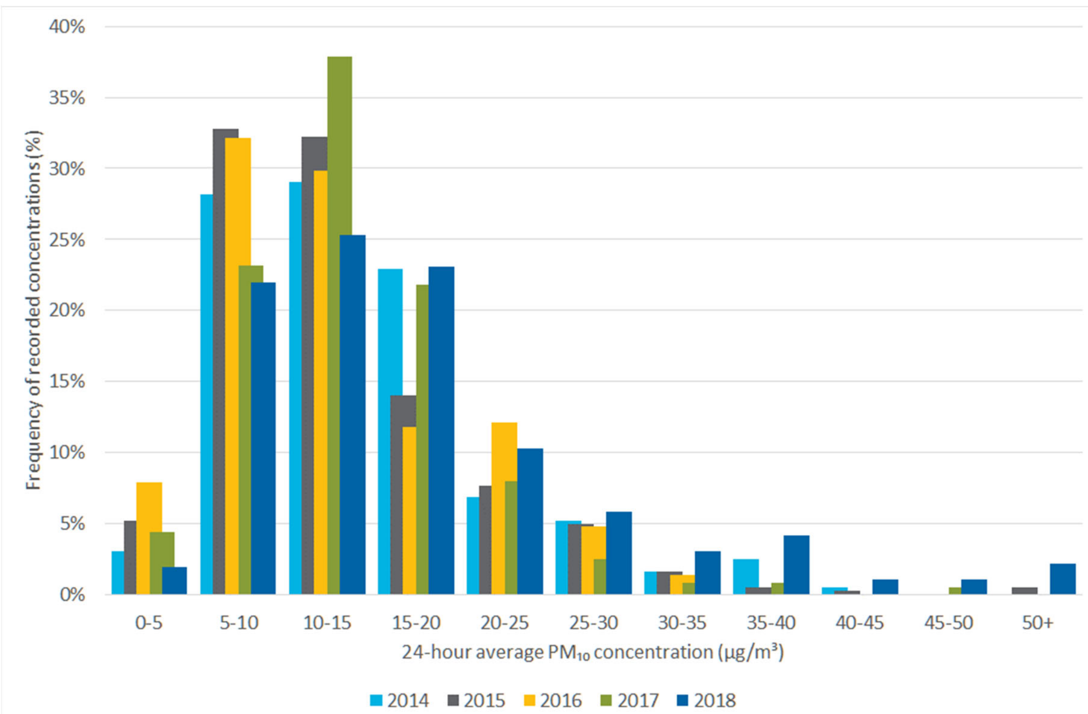


Figure 6.7 Frequency distribution of PM_{10} monitoring data – OEH Bathurst – 2014 to 2018

The two highest 24-hour average PM_{10} concentrations in the 2017 OEH Bathurst AQS dataset were 49.9 µg/m³ and 48 µg/m³, recorded on 23 September and 24 September respectively. Both recorded concentrations were very close to exceeding the NSW EPA criterion of 50 µg/m³. The OEH identified that these dates were influenced by a widespread dust storm event (OEH, 2017), with seven stations exceeding the criterion on 23 September and 19 stations exceeding the criterion on 24 September. The OEH classed all exceedances associated with this dust storm event as exceptional events[9].

[9] The OEH identifies that an exceptional event is not counted towards the NEPM 24-hour average PM_{10} goal of 'no days above the particle standards in a year'

The one-hour average and 24-hour average PM_{10} concentrations recorded at the OEH Bathurst station on 23 September and 24 September are illustrated in Figure 6.8. The spike in hourly PM_{10} concentrations between 8.00 pm on 23 September and 4.00 am on 24 September clearly marks the progression of the dust storm through the Bathurst area. While the 24-hour average criterion was not exceeded on either of these dates at the OEH Bathurst station, the two highest concentrations were classed as exceptional events due to the documented dust storm that influenced both of the dates.

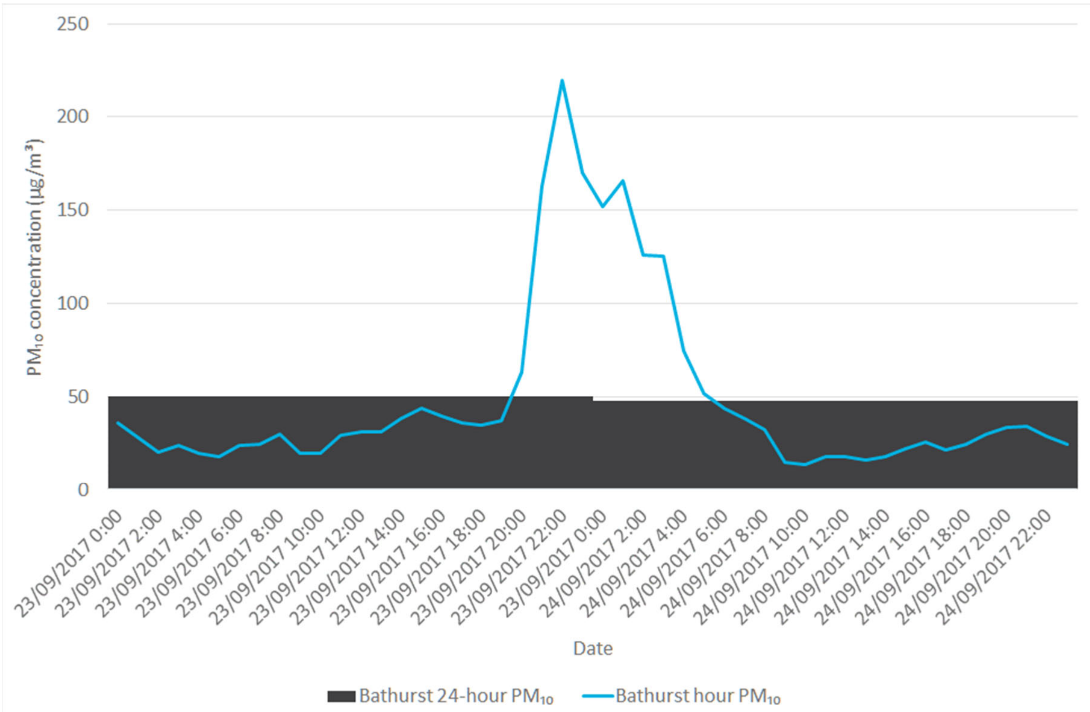


Figure 6.8 Hourly and 24-hour average concentration – OEH Bathurst AQS – 23 September and 24 September 2017

iii Combined background dataset

For the purpose of representing background PM_{10} conditions during the modelling period, a daily-varying dataset for 2017 has been prepared, combining one-in-six day measurements from the on-site HVAS monitoring station and continuous measurements from the OEH Bathurst station (ie 356 individual daily concentrations).

The annual average PM_{10} concentration for the combined on-site HVAS and OEH Bathurst AQS 2017 dataset is 14.1 µg/m³.

6.3.2 $PM_{2.5}$

No monitoring of $PM_{2.5}$ is conducted by the on-site air quality monitoring network. To provide an analysis of background $PM_{2.5}$ concentrations in the absence of on-site measurements, $PM_{2.5}$ concentrations recorded by the OEH Bathurst station were collated. The OEH Bathurst station commenced measurement of $PM_{2.5}$ concentrations in April 2016.

A time series of the recorded 24-hour average $PM_{2.5}$ concentrations at Bathurst is presented in Figure 6.9. Like the PM_{10} concentrations, the recorded 24-hour average $PM_{2.5}$ concentrations fluctuated throughout the presented period. The recorded $PM_{2.5}$ concentrations were generally below the NSW EPA assessment criterion of 25 µg/m³, although two exceedances were recorded in 2018.

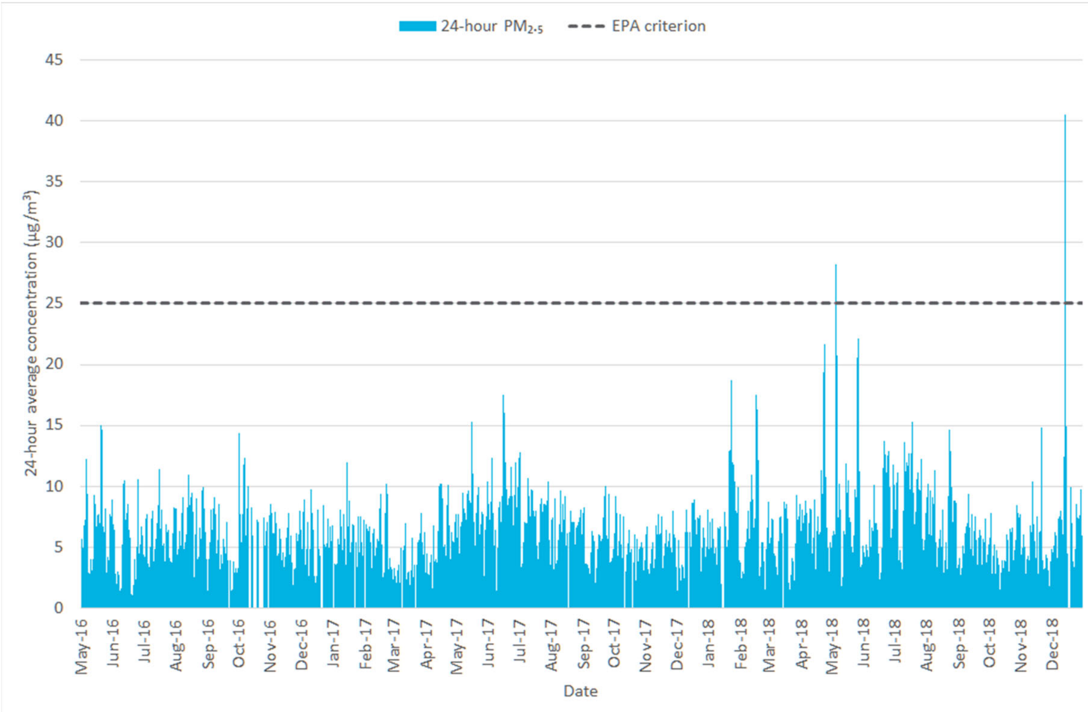


Figure 6.9 Time series of 24-hour average $PM_{2.5}$ concentrations – OEH Bathurst AQS – 2016 to 2018

Note: Monitoring of $PM_{2.5}$ at the Bathurst AQS commenced in April 2016.

Key statistics for the analysed $PM_{2.5}$ monitoring data from the OEH Bathurst station are presented in Table 6.3. As was the case for PM_{10}, the presented statistics for 2018 are higher than the 2016 (partial year) and 2017 datasets. Consistent with PM_{10}, the 2017 calendar year $PM_{2.5}$ dataset from the OEH Bathurst station has been adopted to represent background conditions for the assessment.

Table 6.3 Statistics for $PM_{2.5}$ concentrations – OEH Bathurst AQS – 2016 to 2018

Year	Maximum	95th percentile	90th percentile	75th percentile	Median	Average	Days > 25 µg/m³
	24-hour average $PM_{2.5}$ concentration (µg/m³)						
2016	15.0	12.2	8.2	6.5	4.0	3.8	0
2017	17.5	12.5	9.2	7.6	5.9	6.1	0
2018	**40.5**	21.1	11.3	8.1	6.2	6.9	**2**

Note: Monitoring of $PM_{2.5}$ at the Bathurst AQS commenced in April 2016.

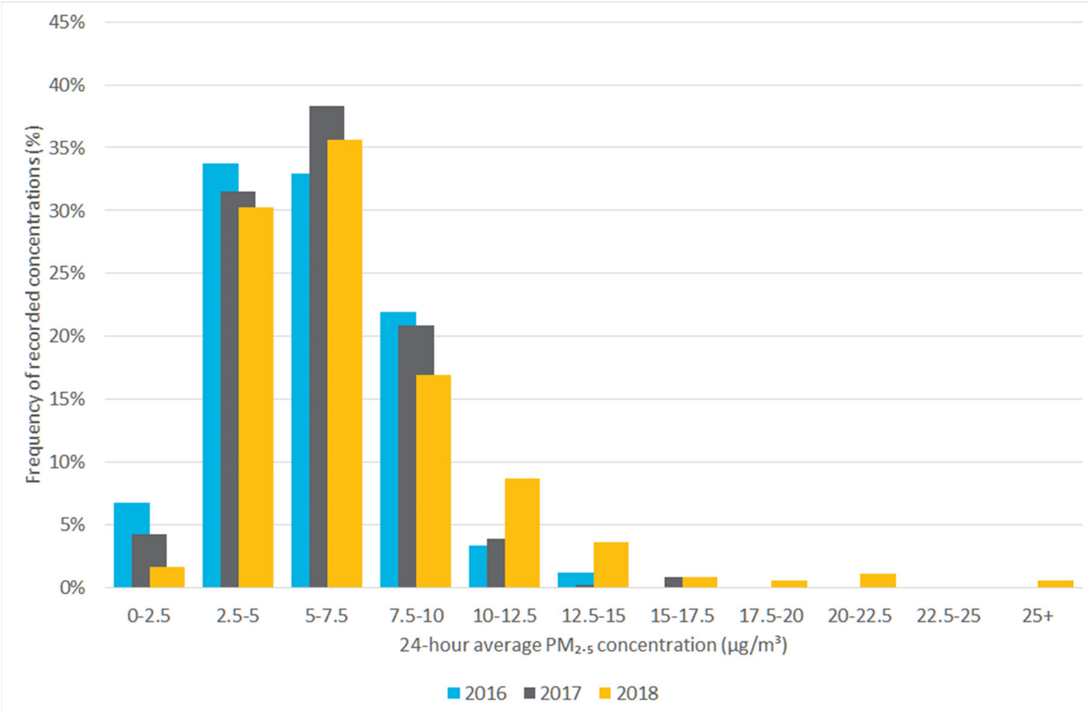


Figure 6.10 Frequency distribution of $PM_{2.5}$ monitoring data – OEH Bathurst AQS – 2016 to 2018

Note: Monitoring of $PM_{2.5}$ at the Bathurst AQS commenced in April 2016.

6.3.3 TSP

There are no measurements of TSP conducted by the on-site air quality monitoring network. The typical ratio between annual average PM_{10} and TSP concentrations is between 0.4 and 0.5. In the absence of locally sourced TSP monitoring data, a ratio of 0.4 has been applied to the annual average PM_{10} concentration for the 2017 on-site HVAS/OEH Bathurst AQS dataset (see Section 6.3.1), returning a TSP background concentration of 35.3 µg/m³.

6.3.4 Dust deposition

As stated in Section 6.3.1, Regis has installed a network of four dust deposition gauges in the vicinity of the project. Recorded dust deposition rates since March 2014 were provided by Regis and have been analysed to determine existing dust deposition levels. Dust deposition results from the four monitoring locations for the previous five years were processed, with the results presented in Table 6.4. Due to missing data, there are no results presented for 2016.

Table 6.4 Annual dust deposition results – on-site monitoring network

Monitoring year	Annual average dust deposition levels (g/m^2/month)			
	DDS_1944A	DDS_1968A	DDS_1261A	DDS_2859A
2014	0.8	0.7	0.6	0.6
2015	0.4	2.1	0.8	0.6
2016	-	-	-	-
2017	0.6	1.4	0.6	0.5
2018	1.9	3.9	1.9	1.3
Criterion	**4**			

For all years of monitoring, the applicable impact assessment criterion was not exceeded at any monitoring location. Consistent with the previously discussed sections, results from the 2018 period are elevated relative to the other years of presented data and is attributed to the influence of discussed drought conditions.

The highest annual average dust deposition level recorded for the 2017 period was 1.4 g/m^2/month at depositional dust gauge (DDS) 1968A (refer to Figure 6.1). This value has been adopted as background for this assessment.

6.3.5 Lead

The impact assessment criterion for lead (Pb) specified by the NSW EPA in the Approved Methods for Modelling is applicable to cumulative concentrations (background plus project increment). No ambient monitoring of Pb is available for the project area. Due to an absence of significant Pb emission sources in the surrounding region, background Pb concentrations in the local airshed are considered to be negligible. This assessment will therefore focus on incremental concentrations of Pb generated by the project only.

6.3.6 Gaseous air pollutants

This assessment has quantified emissions and assess impacts from NO_2 generated by the combustion of diesel and LPG fuel and HCN from fugitive releases at the processing plant and TSF. Further, an analysis of blast fume NO_2 has been undertaken.

Of the above pollutants, only NO_2 has a cumulative impact assessment criterion, with HCN assessed as increment only. To convert predicted concentrations of oxides of nitrogen (NO_x) to NO_2, the ozone limiting method (OLM) prescribed in Section 8.1.2 of the NSW EPA Approved Methods for Modelling (EPA, 2016) has been applied. While further detail relating to this approach is presented in Section 8.2, the OLM requires background concentrations of NO_2 and ozone (O_3).

No monitoring of NO_2 or O_3 is conducted in the immediate vicinity of the project or at the OEH Bathurst station. Regional monitoring stations maintained by OEH and ACT Health were therefore reviewed. The most appropriate NO_2 and O_3 monitoring station with regards to rural setting, urban development and proximity to the coast is the ACT Health Monash station, located approximately 220 km south-south-west of the project. A summary of the maximum and average concentrations recorded between 2014 and 2018 is presented in Table 6.5. Hourly varying NO_2 and O_3 concentrations, concurrent with the 2017 meteorological dataset, have been adopted for this assessment.

Table 6.5 Summary of NO_2 and O_3 concentrations – ACT Health Monash monitoring station – 2014 to 2018

Year	NO_2 (µg/m³)		O_3 (µg/m³)	
	Max 1-hour	Average	Max 1-hour	Average
2014	118.4	9.4	170.5	30.2
2015	60.2	8.5	184.2	28.5
2016	71.4	7.9	111.7	30.9
2017	79.0	8.8	117.6	37.9
2018	73.3	7.8	121.5	40.3
Criterion	**246**	**62**	**214**	**-**

6.3.7 Adopted background summary

The background air quality conditions for the project to be used for cumulative assessment purposes, based on the analysis presented in the preceding sections, are as follows:

- annual average TSP – 35.3 µg/m^3, derived from the annual average PM_{10} concentration;
- 24-hour PM_{10} – daily varying concentrations, combination of one-in-six day measurements from the on-site HVAS monitoring station and continuous measurements from the OEH Bathurst station during 2017. Concentrations range from 3.0 µg/m^{3}to 49.9 µg/m^3;
- annual average PM_{10} – 14.1 µg/m^3, combined from the on-site HVAS and OEH Bathurst AQS results in 2017;
- 24-hour $PM_{2.5}$ – daily varying concentrations from the OEH Bathurst station during 2017. Concentrations range from 1.4 µg/m^{3}to 17.5 µg/m^3;
- annual average $PM_{2.5}$ – 6.1 µg/m^3, from the OEH Bathurst station during 2017;
- annual dust deposition – 1.4 g/m^2/month, from the on-site DDG monitoring network;
- annual Pb – negligible;
- NO_2 – hourly varying concentrations recorded at ACT Health Monash station during 2017 for contemporaneous OLM analysis with modelling period predictions; and
- O_3 – hourly varying concentrations recorded at ACT Health Monash station during 2017 for contemporaneous OLM analysis with modelling period predictions.

7 Emissions inventory

7.1 Emission scenarios

The anticipated annual material extraction and processing totals for the project, as provided by Regis, are illustrated in Figure 7.1.

Four emission scenarios that are representative of different stages of the project have been selected as follows:

- Year 1;
- Year 2;
- Year 4; and
- Year 8.

The four scenarios are considered to provide an indication of impacts under a range of operational conditions during the life of the project. Year 1 accounts for both construction and operational phase emissions. Year 2 and 4 represent the highest periods of material extraction, haulage and processing for the project. Year 8 represents the longest haulage distances for ore material from the developed pit.

7.2 Sources of emissions

Sources of atmospheric emissions for the four scenarios associated with the operation of the project include:

- clearing and transportation of topsoil material;
- drill and blasting activities in pit area;
- loading of blasted waste rock and ore material to haul trucks;
- transport of waste rock to waste rock dumps and infrastructure areas;
- waste rock dump management by dozers
- transport of ore material to the ROM pad;
- material crushing, screening and grinding circuit and associated conveyor transfers;
- wind erosion associated with waste rock dumps, topsoil stockpiles, ore material stockpiles and other exposed surfaces;
- diesel fuel combustion by on-site plant and equipment;
- fuel combustion associated with processing plant furnace and kiln; and
- fugitive releases from the processing circuit and TSF.

Emissions from the initial construction phase comprise of many of these emissions sources and are accounted for in the Year 1 emissions scenario.

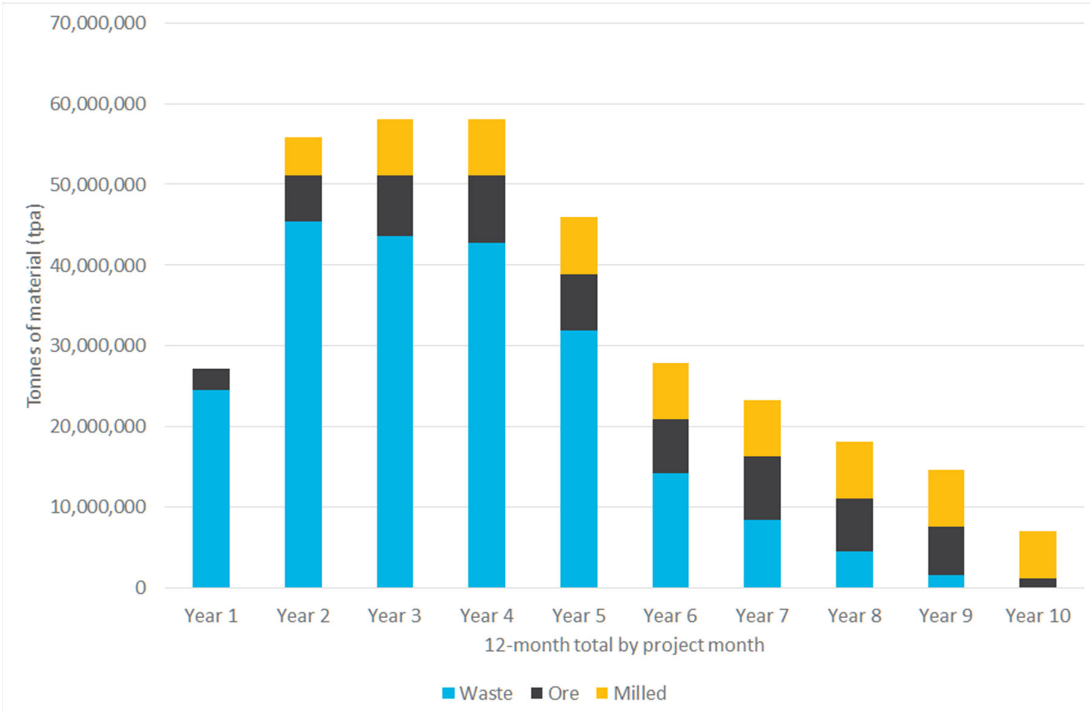


Figure 7.1 Projected 12-month material handling and processing by project year

7.3 Fugitive particulate matter emissions

Fugitive dust sources associated with the project were quantified through the application of NPI emission estimation techniques and USEPA AP-42 emission factor equations. Particulate matter emissions were quantified for the three size fractions identified in Section 4, with the TSP fraction also used to provide an indication of dust deposition rates. Emission rates for coarse particles (PM_{10}) and fine particles ($PM_{2.5}$) were estimated using ratios for the different particle size fractions available in the literature (principally the USEPA AP-42).

7.3.1 Particulate matter emission reduction factors

In order to control particulate matter emissions from the project, Regis will implement a range of mitigation measures and management practices, including the following:

- chemical suppressants will be applied to high traffic haul road routes from pit exits to the waste rock emplacement area and ROM pad. All other unpaved transport routes (eg pit, ramps, WRE tip heads, topsoil haulage) will be controlled through water suppression;
- a road speed limit of 60 km/hr will be posted to all internal roads, however it is noted that the average travel speed of material haul trucks is less than 40 km/h;
- The design of all crushers, screens and associated transfer points at the processing circuit will include dust control, dust extraction and / or filter systems;
- all exposed conveyors at the processing circuit will be covered;
- water sprays will be utilised at the ROM pad hopper / primary crusher dump pocket;

- ROM pad operations will be controlled through the use of water trucks and / or water sprays;
- the fine ore stockpile will be covered;
- in pit drill rigs will be fitted with dry filter capture devices, nominally cyclones;
- wet suppression through watercarts will be applied to dozer activity areas for waste rock and topsoil operations; and
- topsoil stockpiles, waste rock dumps and TSF walls will be progressively rehabilitated through hydro mulching or hydro seeding.

Regarding chemical suppressants, the specific product for implementation has not been selected at the time of reporting. Regis commits to the selection of a product that is both environmentally friendly for human and ecological impacts and achieves the required particulate matter emission reduction. The use of chemical suppressants is widespread at mining operations across NSW and are proven for the effective control of dust emissions while also protecting the surrounding environment, in particular workers in close proximity to product application.

In November 2011, the OEH published the guideline *Coal Mine Particulate Matter Control Best Practice Site-specific determination* (OEH, 2011). This guideline document provides detail of the process to follow when conducting a site-specific determination of best practice measures to reduce emissions of particulate matter from coal mining activities. While not specifically related to the project, a comparison of the proposed dust control measures at the project with best practice dust management techniques, consistent with this guideline, has been undertaken. For the purpose of this report, best practice dust control measures have been collated from the following documents:

- *NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining* (Katestone, 2011); and
- *Best Available Techniques (BAT) Reference Document for the Non-Ferrous Metals Industries* (European Commission, 2017).

The review of proposed dust control measures for the project with best practice measures is presented in Table 7.1. Across the range of particulate matter emission sources listed, the associated control measures proposed for the project are consistent with best practice measures wherever practicable taking the specifics of the project into consideration.

Emission reduction factors for these control measures are presented in Table 7.2. These emission reduction factors have been applied to annual emission calculations for each emissions scenario where applicable.

Table 7.1 Best practice particulate matter control measures review

Emissions source category	Best practice control measures (Katestone, 2011 and Europe BREF, 2017)	Proposed for implementation at project	Comments
Conveyors and transfers	Application of watering at transfer points	Yes	Watering will be implemented at the dump pocket of the primary gyratory crusher. This application will enable carry over moisture through the conveying and transfer process
	Enclosure of transfer points	Yes	All exposed conveyors and transfers will be covered
	Wind shielding of conveyor belts – roof and/or side wall	Yes	All exposed conveyors and transfers will be covered
	Belt cleaning and spillage minimisation	Yes	While not quantified in the emission calculations for this assessment, a belt scraping station has been incorporated into the design of the project
Unpaved haul roads	Surface treatment - chemical suppressants	Yes	Chemical suppressants will be applied to high traffic haul road routes from pit exits to the WRE and ROM
	Surface treatment - watering	Yes	All other unpaved transport routes (eg pit, ramps, WRE tip heads, topsoil haulage) will be controlled through water suppression
	Surface improvements - low silt aggregate	No	Not practicable for size and scale of project to import specific material for haul roads. Unpaved roads at site will be constructed using extracted waste rock material

Table 7.1 Best practice particulate matter control measures review

Emissions source category	Best practice control measures (Katestone, 2011 and Europe BREF, 2017)	Proposed for implementation at project	Comments
	Surface improvements - pave the surface	No	First 1, km of the main access road off the Mid-Western Hwy will be sealed. There is a wheel washdown bay allowed for adjacent to the gate house for truck tyre washing prior to existing site. Not practicable for other roads at the project
	Reduction in vehicle travel speed	Yes	A speed limit of 60 km/h will be marked, however it is noted that the average travel speed of haul trucks for waste rock and ROM ore movements will be below 40 km/hr
	Use larger vehicles rather than smaller vehicles to minimise number of trips	Yes	Haul trucks for waste rock and ore haulage are approx. 180 t in capacity
	Use conveyors in place of haul roads	No	Not practicable to replace haul trucks from pit with conveyors due to planned progression of the project
Wind erosion - exposed areas and overburden emplacements	Avoidance - Minimise pre-strip areas	Yes	The project will feature a staged development. Areas will not be cleared until the necessary to reduce the extent of exposed surfaces at any given time
	Surface stabilisation - Watering	No	Not practicable for size and scale of exposed areas at project
	Surface stabilisation - Chemical suppressants	No	Not practicable for size and scale of exposed areas at project
	Surface stabilisation - Paving and cleaning	No	Not practicable for size and scale of exposed areas at project

Table 7.1 Best practice particulate matter control measures review

Emissions source category	Best practice control measures (Katestone, 2011 and Europe BREF, 2017)	Proposed for implementation at project	Comments
	Surface stabilisation - armour with gravel	No	Not practicable for size and scale of exposed areas at project
	Surface stabilisation - Rehabilitation	Yes	Exposed areas, topsoil stockpiles and completed waste rock dump areas will be progressively hydro mulched or hydro seeded for rehabilitation where practical throughout the life of the project
	Wind speed reduction - fencing, bunding, shelterbelts or in-pit dumps	Yes	Priority construction of the southern end of the waste rock emplacement in the first few years of the project (to act as a noise and visual bund) will provide wind breaks for the active areas of the waste rock dump
	Wind speed reduction - vegetative ground cover	Yes	Progressive rehabilitation of exposed surfaces, topsoil stockpiles and waste rock dump will provide vegetative cover for exposed areas
Wind erosion from ore material stockpiles	Avoidance - bypassing stockpiles	Partial	Approximately 20% - 30% of ROM ore material will be directly dumped to the processing plant hopper. However, ore material stockpiles are a necessary component of the project
	Surface stabilisation - watering	Yes	ROM pad will feature water sprays and / or water carts for dust suppression
	Surface stabilisation - chemical suppressants and crusting agents	No	Not practicable given stockpiles are continually accessed

Table 7.1 Best practice particulate matter control measures review

Emissions source category	Best practice control measures (Katestone, 2011 and Europe BREF, 2017)	Proposed for implementation at project	Comments
	Surface stabilisation - carry over from wetting from load in	Yes	ROM pad will feature water sprays and / or water carts for dust suppression. Material handling at the ROM pad will therefore have moisture carryover
	Enclosure - silo with baghouse	No	ROM stockpile is continually accessed, and enclosure is not practicable
	Enclosure - cover storage pile with tarp during high winds	No	ROM stockpile is continually accessed, and tarping is not practicable
	Wind speed reduction - vegetative wind breaks	No	Not practical for ROM pad area design
	Wind speed reduction - reduced pile height	No	Not practical for ROM pad area design
	Wind speed reduction - wind screens/wind fences	No	Not practical for ROM pad area design
	Wind speed reduction - pile shaping/orientation	No	Not practical for ROM pad area design
	Wind speed reduction - three-sided enclosure around storage piles	Partial	A covered fine ore stockpiling area will be a feature of the ROM/processing area, however enclosure of the main ROM stockpile is not practicable
Bulldozers	Minimising travel speed and distance	Yes	Bulldozer operations will be generally restricted to immediate working areas
	Keep travel routes and materials moist	Yes	Water carts will supply wet suppression to travel routes and working areas
Blasting	Design - Delay shot to avoid unfavourable weather conditions	Yes	Blasting will be conducted in strict accordance with a blast management plan. The BMP will detail adverse weather conditions to be avoided for both noise and air impacts

Table 7.1 Best practice particulate matter control measures review

Emissions source category	Best practice control measures (Katestone, 2011 and Europe BREF, 2017)	Proposed for implementation at project	Comments
	Design - Minimise area blasted	Yes	Blasting will be planned to meet project demands. Size of blasts will be limited to manage the amount of disturbed material generated at any one time
Drilling	Dry collection	Yes	Dry bag filters or cyclones will be used at drill rigs
	Wet suppression - water injection	No	Water will be applied in the vicinity or the active pit, however dry collection will be the specific focus for drilling operations
Loading and dumping waste rock	Excavator - minimise drop height	Yes	Wherever possible, material drop heights will be minimised when loading trucks with waste rock material in the pit
	Truck dumping - minimise drop height	Yes	Wherever possible, material drop heights will be minimised when unloading trucks at the waste rock dump
	Truck dumping - water application	No	Water carts will supply wet suppression to travel routes and working areas at the waste rock dump; however, specific water application to unloading trucks is unlikely to be practical
	Truck dumping - modify activities in windy conditions	Yes	Dumping of material at the waste rock dump will be conducted behind an acoustic/visual bund. Dumping of material will occur at lower levels during periods of elevated winds in the direction of sensitive receptors
Loading and dumping ROM ore	Avoidance - bypassing stockpiles	No	Not practicable given stockpiles are necessary for the project

Table 7.1 Best practice particulate matter control measures review

Emissions source category	Best practice control measures (Katestone, 2011 and Europe BREF, 2017)	Proposed for implementation at project	Comments
	Truck dumping - minimise drop height	Yes	Wherever possible, material drop heights will be minimised when unloading trucks at the waste rock dump
	Truck dumping - water sprays at ROM pad	Yes	Automated water spray system will be fitted to the ROM hopper unloading point
	Truck dumping - three sided enclosure at truck unloading ROM hopper	No	Automated water spray system will be fitted to the ROM hopper unloading point
Processing	Enclose pre-treatment areas and transfer systems for dusty materials	Yes	All conveyers and transfers will be covered. All crushing and screening components will be enclosed, or emissions directed to a baghouse or wet sump arrangement
	Connect pre-treatment and handling operations to dust collectors or extractors via hoods and a ductwork system for dusty materials	Yes	All crushing and screening components will be enclosed, or emissions directed to a baghouse or wet sump arrangement
	Electrically interlock pre-treatment and handling equipment with their dust collector or extractor, in order to ensure that no equipment may be operated unless the dust collector and filtering system are in operation	Yes	Processing circuit emissions capture technology will be fitted with alert signals should collection system malfunction

Table 7.2 Particulate matter control measures – operational scenarios

Emission sources	Control measures	Emission reduction factors (%)[1]
Material haulage using watering only	Route watering Travel speed reduction **Combined emission reduction**	75 44 **86**
Material haulage using chemical suppressant	Suppressant Travel speed reduction **Combined emission reduction**	84 44 **91**
Drilling	Dry bag filter	99
Dozer operations for topsoil and waste rock	High moisture in travel routes / watering	50
ROM Pad operations and stockpiles	Water sprays	50
Processing circuit	Dust capture and filters	99
ROM ore stockpile	Water sprays	50
Rehabilitated areas	Secondary rehabilitation	60

[1] All control reduction factors adopted from *NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and/or Minimise Emissions of Particulate Matter from Coal Mining* (Katestone, 2011). Where multiple controls are in place (eg haulage routes), the multiplicative control factor has been applied as per NPI (2012).

7.3.2 Particulate matter emissions

A summary of annual site emissions by source type, based on the average day scenario, is presented in Table 7.3 and illustrated in Figure 7.3. Particulate matter control measures, as documented in Section 7.3.1 are accounted for in these emission totals.

The most significant source of emissions at the project is associated with the movement of vehicles across unpaved road surfaces. Waste rock dump operations and wind erosion of exposed surfaces are also notable contributing sources of particulate matter on an annual basis. The significance of diesel combustion emissions (mobile equipment and trucks) increases with decreasing particle size. Further details regarding emission estimation factors and assumptions are provided in Appendix C.

It is noted with regards to the processing plant components (eg crushers, screens, etc) that the emission factors adopted account for all associated processes, including conveying to and transfer from the component.

Table 7.3 Calculated annual TSP, PM_{10} and $PM_{2.5}$ emissions – Year 1

Emissions source	Calculated annual emissions (tonnes/annum) by source		
	TSP	PM_{10}	$PM_{2.5}$
Dozer stripping topsoil	23.25	5.79	2.44
Loading to haul truck	0.37	0.18	0.03
Haulage to topsoil dump	9.40	2.38	0.24
Truck dumping of topsoil	0.37	0.18	0.03
Drill	0.30	0.16	0.02
Blast	16.64	8.65	0.50
Blasted waste rock to haul truck	52.82	24.98	3.78
Haulage to waste dump - north - watering	-	-	-
Haulage to waste dump - north - chemical	-	-	-
Haulage to waste dump - central - watering	-	-	-
Haulage to waste dump - central - chemical	-	-	-
Haulage to waste dump - south - watering	110.55	27.94	2.79
Haulage to waste dump - south - chemical	151.62	38.31	3.83
Haulage to waste dump - infrastructure - watering	27.64	6.98	0.70
Haulage to waste dump - infrastructure - chemical	90.97	22.99	2.30
Blasted ore to haul truck	5.98	2.83	0.43
Haulage to ROM pad - watering	13.42	3.39	0.34
Haulage to ROM pad - chemical	20.04	5.06	0.51
Truck dumping of waste rock - north	-	-	-
Truck dumping of waste rock - central	-	-	-
Truck dumping of waste rock - south	42.25	19.98	3.03
Truck dumping of waste rock - infrastructure	10.56	5.00	0.76
Dozer on waste rock dump	53.52	12.30	5.62
Truck dumping ROM pad	5.98	2.83	0.43
Truck unloading direct to ROM hopper	-	-	-
FEL rehandle at ROM pad	-	-	-
Primary Crusher	-	-	-
Secondary crusher	-	-	-
Tertiary crusher	-	-	-
Grinding	-	-	-
Kiln stack	-	-	-
Furnace stack	-	-	-
Grader	2.43	1.79	0.08

Table 7.3 Calculated annual TSP, PM_{10} and $PM_{2.5}$ emissions – Year 1

Emissions source	Calculated annual emissions (tonnes/annum) by source		
	TSP	**PM_{10}**	**$PM_{2.5}$**
Road trucks entering/leaving site	13.59	3.43	0.34
Topsoil cleared area - wind erosion	58.44	29.22	4.38
Topsoil storage piles - wind erosion	12.21	6.10	0.92
Main pit - wind erosion	56.78	28.39	4.26
Cleared waste rock dump - wind erosion	8.67	4.34	0.65
Active waste rock dump - wind erosion	83.35	41.68	6.25
ROM Pad stockpiles - wind erosion	9.99	4.99	0.75
Rehabilitated areas - wind erosion	9.93	4.96	0.74
TSF wind erosion	-	-	-
Diesel combustion - mining fleet	8.72	8.72	8.00
Diesel combustion - road trucks	0.22	0.22	0.20
Total	**900.01**	**323.77**	**54.33**

Table 7.4 Calculated annual TSP, PM_{10} and $PM_{2.5}$ emissions – Year 2

Emissions source	Calculated annual emissions (tonnes/annum) by source		
	TSP	PM_{10}	$PM_{2.5}$
Dozer stripping topsoil	23.25	5.79	2.44
Loading to haul truck	0.34	0.16	0.02
Haulage to topsoil dump	10.18	2.57	0.26
Truck dumping of topsoil	0.34	0.16	0.02
Drill	0.54	0.28	0.04
Blast	40.26	20.94	1.21
Blasted waste rock to haul truck	98.06	46.38	7.02
Haulage to waste dump - north - watering	20.16	5.09	0.51
Haulage to waste dump - north - chemical	23.46	5.93	0.59
Haulage to waste dump - central - watering	-	-	-
Haulage to waste dump - central - chemical	-	-	-
Haulage to waste dump - south - watering	280.41	70.86	7.09
Haulage to waste dump - south - chemical	316.69	80.03	8.00
Haulage to waste dump - infrastructure - watering	12.83	3.24	0.32
Haulage to waste dump - infrastructure - chemical	51.61	13.04	1.30
Blasted ore to haul truck	12.18	5.76	0.87
Haulage to ROM pad - watering	45.51	11.50	1.15
Haulage to ROM pad - chemical	37.87	9.57	0.96
Truck dumping of waste rock - north	4.90	2.32	0.35
Truck dumping of waste rock - central	-	-	-
Truck dumping of waste rock - south	88.26	41.74	6.32
Truck dumping of waste rock - infrastructure	4.90	2.32	0.35
Dozer on waste rock dump	53.52	12.30	5.62
Truck dumping ROM pad	7.91	3.74	0.57
Truck unloading direct to ROM hopper	2.13	1.01	0.15
FEL rehandle at ROM pad	2.97	1.41	0.21
Primary Crusher	9.47	0.95	0.17
Secondary crusher	18.94	1.58	0.29
Tertiary crusher	132.58	7.58	1.39
Grinding	56.82	7.58	1.39
Kiln stack	0.01	0.01	0.00
Furnace stack	0.07	0.07	0.02
Grader	2.43	1.79	0.08

Table 7.4 Calculated annual TSP, PM_{10} and $PM_{2.5}$ emissions – Year 2

Emissions source	Calculated annual emissions (tonnes/annum) by source		
	TSP	PM_{10}	$PM_{2.5}$
Road trucks entering/leaving site	1.29	0.33	0.03
Topsoil cleared area - wind erosion	7.92	3.96	0.59
Topsoil storage piles - wind erosion	55.25	27.63	4.14
Main pit - wind erosion	56.78	28.39	4.26
Cleared waste rock dump - wind erosion	20.32	10.16	1.52
Active waste rock dump - wind erosion	157.42	78.71	11.81
ROM Pad stockpiles - wind erosion	9.99	4.99	0.75
Rehabilitated areas - wind erosion	17.82	8.91	1.34
TSF wind erosion	15.52	7.76	1.16
Diesel combustion - mining fleet	11.37	11.37	10.42
Diesel combustion - road trucks	0.01	0.01	0.01
Total	**1,712.30**	**547.91**	**84.78**

Table 7.5 Calculated annual TSP, PM_{10} and $PM_{2.5}$ emissions – Year 4

Emissions source	Calculated annual emissions (tonnes/annum) by source		
	TSP	PM_{10}	$PM_{2.5}$
Dozer stripping topsoil	23.25	5.79	2.44
Loading to haul truck	0.08	0.04	0.01
Haulage to topsoil dump	0.96	0.24	0.02
Truck dumping of topsoil	0.08	0.04	0.01
Drill	0.53	0.28	0.04
Blast	39.12	20.34	1.17
Blasted waste rock to haul truck	92.29	43.65	6.61
Haulage to waste dump - north - watering	-	-	-
Haulage to waste dump - north - chemical	-	-	-
Haulage to waste dump - central - watering	551.95	139.48	13.95
Haulage to waste dump - central - chemical	397.41	100.43	10.04
Haulage to waste dump - south - watering	-	-	-
Haulage to waste dump - south - chemical	-	-	-
Haulage to waste dump - infrastructure - watering	-	-	-
Haulage to waste dump - infrastructure - chemical	-	-	-
Blasted ore to haul truck	17.95	8.49	1.29
Haulage to ROM pad - watering	161.01	40.69	4.07
Haulage to ROM pad - chemical	47.23	11.94	1.19
Truck dumping of waste rock - north	0.00	0.00	0.00
Truck dumping of waste rock - central	92.29	43.65	6.61
Truck dumping of waste rock - south	-	-	-
Truck dumping of waste rock - infrastructure	-	-	-
Dozer on waste rock dump	53.52	12.30	5.62
Truck dumping ROM pad	11.67	5.52	0.84
Truck unloading direct to ROM hopper	3.14	1.49	0.22
FEL rehandle at ROM pad	4.41	2.08	0.32
Primary Crusher	14.00	1.40	0.26
Secondary crusher	28.00	2.33	0.43
Tertiary crusher	196.00	11.20	2.05
Grinding	84.00	11.20	2.05
Kiln stack	0.01	0.01	0.00
Furnace stack	0.07	0.07	0.02
Grader	2.43	1.79	0.08

Table 7.5 Calculated annual TSP, PM_{10} and $PM_{2.5}$ emissions – Year 4

Emissions source	Calculated annual emissions (tonnes/annum) by source		
	TSP	PM_{10}	$PM_{2.5}$
Road trucks entering/leaving site	1.29	0.33	0.03
Topsoil cleared area - wind erosion	52.62	26.31	3.95
Topsoil storage piles - wind erosion	10.20	5.10	0.77
Main pit - wind erosion	56.78	28.39	4.26
Cleared waste rock dump - wind erosion	36.76	18.38	2.76
Active waste rock dump - wind erosion	19.98	9.99	1.50
ROM Pad stockpiles - wind erosion	5.10	2.55	0.38
Rehabilitated areas - wind erosion	78.12	39.06	5.86
TSF wind erosion	38.63	19.32	2.90
Diesel combustion - mining fleet	8.94	8.94	8.19
Diesel combustion - road trucks	0.01	0.01	0.01
Total	**2,129.78**	**622.79**	**89.93**

Table 7.6 Calculated annual TSP, PM_{10} and $PM_{2.5}$ emissions – Year 8

Emissions source	Calculated annual emissions (tonnes/annum) by source		
	TSP	PM_{10}	$PM_{2.5}$
Dozer stripping topsoil	-	-	-
Loading to haul truck	-	-	-
Haulage to topsoil dump	-	-	-
Truck dumping of topsoil	-	-	-
Drill	0.10	0.05	0.01
Blast	3.05	1.58	0.09
Blasted waste rock to haul truck	9.65	4.56	0.69
Haulage to waste dump - north - watering	126.27	31.91	3.19
Haulage to waste dump - north - chemical	64.65	16.34	1.63
Haulage to waste dump - central - watering	-	-	-
Haulage to waste dump - central - chemical	-	-	-
Haulage to waste dump - south - watering	-	-	-
Haulage to waste dump - south - chemical	-	-	-
Haulage to waste dump - infrastructure - watering	-	-	-
Haulage to waste dump - infrastructure - chemical	-	-	-
Blasted ore to haul truck	14.32	6.77	1.03
Haulage to ROM pad - watering	187.38	47.35	4.74
Haulage to ROM pad - chemical	41.12	10.39	1.04
Truck dumping of waste rock - north	9.65	4.56	0.69
Truck dumping of waste rock - central	-	-	-
Truck dumping of waste rock - south	-	-	-
Truck dumping of waste rock - infrastructure	-	-	-
Dozer on waste rock dump	53.52	12.30	5.62
Truck dumping ROM pad	9.31	4.40	0.67
Truck unloading direct to ROM hopper	2.51	1.19	0.18
FEL rehandle at ROM pad	5.04	2.38	0.36
Primary Crusher	14.00	1.40	0.26
Secondary crusher	28.00	2.33	0.43
Tertiary crusher	196.00	11.20	2.05
Grinding	84.00	11.20	2.05
Kiln stack	0.01	0.01	0.00
Furnace stack	0.07	0.07	0.02
Grader	1.21	0.89	0.04

Table 7.6 Calculated annual TSP, PM_{10} and $PM_{2.5}$ emissions – Year 8

Emissions source	Calculated annual emissions (tonnes/annum) by source		
	TSP	PM_{10}	$PM_{2.5}$
Road trucks entering/leaving site	1.29	0.33	0.03
Topsoil cleared area - wind erosion	-	-	-
Topsoil storage piles - wind erosion	23.83	11.92	1.79
Main pit - wind erosion	56.78	28.39	4.26
Cleared waste rock dump - wind erosion	-	-	-
Active waste rock dump - wind erosion	73.44	36.72	5.51
ROM Pad stockpiles - wind erosion	9.99	4.99	0.75
Rehabilitated areas - wind erosion	93.84	46.92	7.04
TSF wind erosion	51.60	25.80	3.87
Diesel combustion - mining fleet	7.37	7.37	6.75
Diesel combustion - road trucks	0.02	0.02	0.02
Total	**1,168.00**	**333.35**	**54.80**

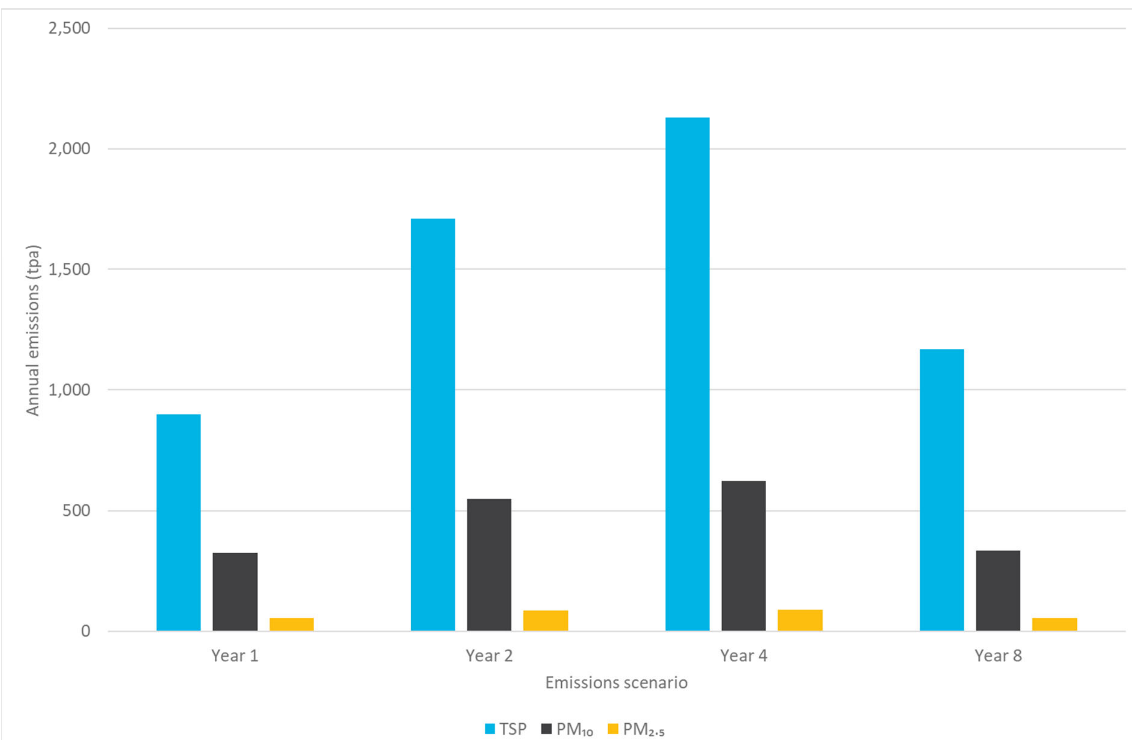


Figure 7.2 Annual emission totals by particle size – all scenarios

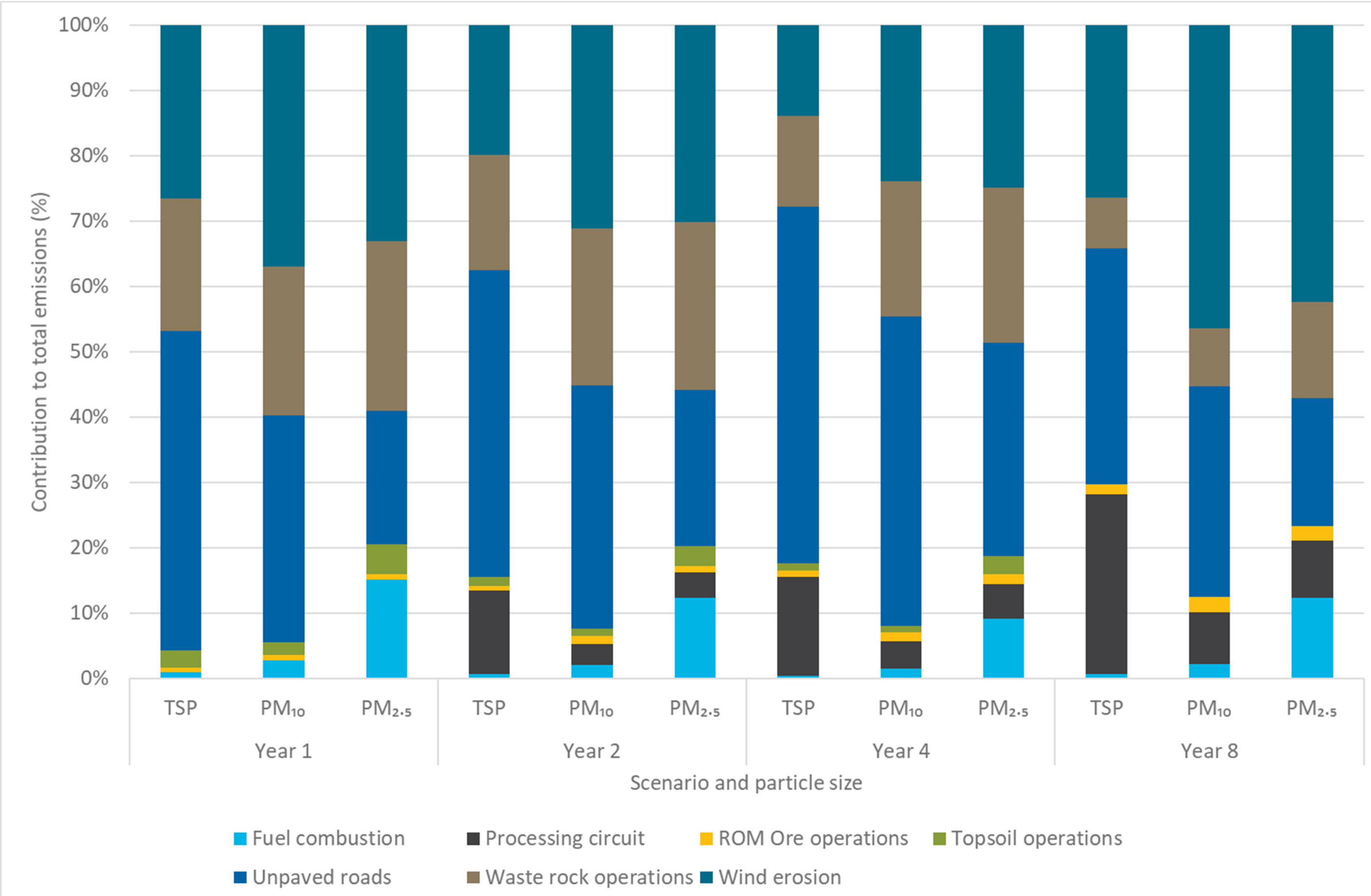


Figure 7.3 Contribution to annual emissions by emissions source type and particle size – all scenarios

7.4 Gaseous pollutants

In addition to particulate matter emissions generated by the crushing, screening and grinding of ore material, the processing circuit will generate emissions of other pollutants to the atmosphere. These include combustion emissions from diesel-fuelled equipment and the furnace and kiln stacks at the processing plant, and fugitive releases from processing circuit tanks and through losses to atmosphere from the tailings deposited to the TSF.

7.4.1 Processing circuit fugitive emissions

The primary fugitive emission from tanks in the processing circuit and active TSF areas is associated with the use of cyanide. According to the *NPI Emission Estimation Technique Manual for Gold Ore Processing* (NPI, 2006), cyanide losses to atmosphere occur due to volatilisation of sodium cyanide to hydrogen cyanide (HCN). Emissions of HCN from the tanks in the processing circuit and active TSF areas have been estimated for Year 8 (largest extent of TSF), using the relevant approaches listed by the NPI (2006) and are detailed in Appendix C.

The calculated HCN emissions by source are summarised in Table 7.7.

Table 7.7 Annual HCN emissions – peak year

Source	Annual HCN emissions (kg/annum)
Storage tanks	12,050.1
TSF	43,782.5

7.4.2 Combustion emissions

Annual diesel consumption totals for the operational mining fleet and emergency diesel generator were provided by Regis. As previously stated, this assessment has focussed on combustion emissions of particulate matter and NO_x.

Annual projections of diesel consumption for the project were sourced from Regis. In order to estimate worst case diesel combustion emissions from the project, the maximum 12 month diesel consumption rate, being 41,193,676 L for Year 5, was adopted. As Year 5 was not a modelling scenario assessed in the particulate matter modelling completed for this assessment, Year 4 model configurations were used to model combustion emission releases. Other assumptions adopted were:

- the proposed mining equipment fleet comprised primarily of equipment with an engine power greater than 225 kW;
- for engines greater than 225 kW, the corresponding USEPA (USEPA, 2016) Tier 2 emission standards for PM and NOx of 0.2 g/kWh and 6.08 g/kWh respectively were selected. The NO_x emission standard correlated to 95% of the USEPA Tier 2 emission standard for non-methane hydrocarbons + NO_x (BAAQMD, 2004);
- the g/kWh emission standard was converted to g per litre of diesel by applying a scaling factor of 3, as per the notes for Table 35 in *NPI Emission Estimation Technique Manual for Combustion Engines* (NPI, 2008); and
- the PM emission standard is assumed to correspond to PM_{10}, with $PM_{2.5}$ emissions derived from the relationship between PM_{10} and $PM_{2.5}$ emission factors presented in Table 35 in NPI, 2008 (91.7%).

Given that the emission standards are the upper limit of emissions from USEPA Tier 2 equipment, it is considered that the use of emission factors equating to the USEPA Tier 2 emission standards provides a conservative upper bound estimate of diesel combustion NO_x emissions from the project.

Emissions from the kiln and furnace at the processing plant have been estimated using projected liquid petroleum gas (LPG) consumption rates and emission factors for LPG combustion from Table 25 of *the NPI Emission Estimation Technique Manual for Combustion in Boilers* (NPI, 2011). To assist with quantifying LPG combustion emissions, Regis has indicated the following:

- the furnace will operate for 10 hours per week, consuming LPG at a rate of 80 L per hour;
- the kiln will operate for 16 hours per day, five days a week, consuming LPG at a rate of 130 L per hour; and
- processing plant emissions will commence from around the end of Year 2 onwards.

Annual diesel and LPG combustion emissions are summarised in Table 7.8.

Table 7.8 Annual particulate matter and NO_X emissions from diesel and LPG combustion

Fuel type	Maximum annual emissions (tonnes/annum)
Diesel – PM_{10}	24.7
LPG – PM_{10}	0.08
Diesel – $PM_{2.5}$	22.7
LPG – $PM_{2.5}$	0.02
Diesel – NO_x	751.4
LPG – NO_x	1.34

Note: for the purpose of this assessment, it is assumed that 100% of TSP emissions are in the PM_{10} range

7.4.3 Blasting emissions

In addition to fuel combustion emissions, the use of explosives during blasting operations within the open cut pit area has the potential to generate emissions of particulate matter and gaseous pollutants. Particulate matter from blasting emissions are addressed in Section 7.3. Emissions of NO_x from blasting operations at the project have been quantified for an anticipated maximum potential blast size and used to model potential blast-related NO_2 concentrations in the surrounding environment (refer to Section 8.6). Further details on blasting emissions are presented in Appendix C.

7.5 Metals and metalloids

Emissions of individual metals and metalloids have been estimated based on the average content by material type from the samples analysed. The material geochemistry profiles have been applied to the following source types:

- waste rock – unpaved road sources, waste rock handling in pit, waste rock dump operations, drill and blast operations, wind erosion of waste and topsoil stockpiles, topsoil activities;
- ore – ore material handling in pit, ROM pad operations, processing plant releases, ROM stockpile wind erosion; and
- tailings – TSF wind erosion.

For each scenario, a weighted average emission scaling factor for each metal and metalloid species was derived based on calculated annual TSP emissions. This approach is considered conservative, as the health-based impact assessment criteria for air quality are linked to the inhalable and respirable fractions of particulate matter (PM_{10} and $PM_{2.5}$) rather than TSP.

Annual emission totals of metals and metalloids are presented in Table 7.9.

Table 7.9 Annual metal and metalloid emission totals – all scenarios

Element	Annual emission (kg/annum) by metal or metalloid and scenario			
	Year 1	Year 2	Year 4	Year 8
Sb	0.24	0.50	0.65	0.41
As	36.72	74.55	95.86	58.12
Ba	62.37	120.93	153.09	87.43
Be	0.10	0.18	0.22	0.12
Cd	0.10	0.22	0.31	0.24
Cr	1.78	6.09	10.93	11.25
Cu	189.35	415.17	536.80	343.33
Fe	53,094.97	103,975.41	130,428.57	73,621.14
Hg	0.02	0.04	0.06	0.05
Mg	13,239.59	24,992.59	31,178.14	16,938.78
Mn	1,157.82	2,298.89	2,895.58	1,663.60
Ni	5.68	11.91	16.40	11.34
Pb	11.71	26.57	37.18	27.23
Ag	1.12	2.20	2.78	1.60
Zn	85.37	170.75	224.29	140.04

8 Air dispersion modelling

8.1 Dispersion model selection and configuration

The atmospheric dispersion modelling completed for this assessment used the AERMOD dispersion model (version v18081). AERMOD is designed to handle a variety of pollutant source types, including surface and buoyant elevated sources, in a wide variety of settings such as rural and urban as well as flat and complex terrain.

In addition to the 88 individual private residential receptor locations (documented in Section 2.3), air pollutant concentrations were predicted over a 10 km by 10 km domain featuring nested grids (a 5 km domain with 250 m resolution, a 7 km domain with 500 m resolution and a 10 km domain with 1,000 m resolution). Model predictions for the nested grid were used to generate concentration isopleth plots (Appendix E).

Each modelling scenario featured the corresponding mine development elevations, including open-cut pit depth and waste rock dump heights. The influence these mine features have on emission dispersion, such as retention of particles from pit depth, were therefore accounted for in the modelling.

Specific activities (hauling, dozers, excavators, wind erosion etc) were represented by a series of volume sources and area sources which were located according to the mine plan for each scenario. The modelled volume source locations and modelled haul road locations are shown in Appendix C.

Simulations were undertaken for the 12 month period of 2017 using the AERMET-generated file based largely on the on-site meteorological monitoring dataset as input (see Chapter 5 for a description of input meteorology).

8.2 Conversion of NO_x to NO_2

NO_x emissions associated with fuel combustion are primarily emitted as NO with some NO_2. The transformation in the atmosphere of NO to NO_2 was accounted for using the USEPA's Ozone Limiting Method (OLM) which requires ambient ozone data, as per the Approved Methods for Modelling.

Reference has been made to the hourly-varying O_3 concentrations recorded at the ACT Health Monash station.

The equation used to calculate NO_2 concentrations from predicted NO_X concentrations is as follows:

$$[NO_2]_{TOTAL} = \{0.1 \text{ x } [NO_x]_{PRED}\} + MIN\{(0.9) \text{ x } [NO_x]_{PRED} \text{ or } (46/48) \text{ x } [O_3]_{BKGD}\} + [NO_2]_{BKGD}$$

Where:

$[NO_2]_{TOTAL}$ = The predicted concentration of NO_2 in µg/m^3;

$[NO_x]_{PRED}$ = The AERMOD prediction of ground level NO_X concentrations in µg/m^3;

MIN = The minimum of the two quantities within the braces;

$[O_3]_{BKGD}$ = The background ambient O_3 concentration – Hourly Varying ACT Health Monash in µg/m^3;

46/48 = the molecular weight of NO_2 divided by the molecular weight of O_3; and

$[NO_2]_{BKGD}$ = The background ambient NO_2 concentration – Hourly Varying ACT Health Monash in µg/m^3.

The USEPA's OLM assumes that all of the available O_3 in the atmosphere will react with NO until either all of the O_3, or all of the NO has reacted. A major assumption of this method is that the reaction is instantaneous. In reality, this reaction takes place over a number of hours and over distance. The OLM will therefore tend to overestimate concentrations at near-source locations.

Furthermore, the method assumes that the complete mixing of the emitted NO and ambient ozone, down to the level of molecular contact, will have occurred by the time the emissions reach the receptor having the maximum ground-level NO_X concentration.

Consequently, concentrations of the NO_2 reported within this assessment should be viewed as highly conservative, providing an upper bound estimate of NO_2 concentrations from the project.

8.3 Incremental (site-only) results

The predicted incremental concentrations and deposition rates from the four modelled scenarios were collated, and the maximum predicted results across the 88 receptors are presented in Table 8.1. In the case of the assorted metals and metalloids and HCN, the maximum predicted project increment concentrations presented in Table 8.1 are the maximum predicted concentration at site boundary.

On the basis that the results presented relate to the maximum predicted concentration across all receptor locations, all other receptors have lower results than those presented in Table 8.1.

The predicted concentrations and deposition rates for all pollutants and averaging periods presented in Table 8.1 are below the applicable NSW EPA assessment criteria. However, with the exception of dust deposition and the assorted metals and metalloids and HCN, the assessment criteria listed are applicable to cumulative concentrations. Analysis of cumulative impact compliance is presented in Section 8.4.

Contour plots, illustrating spatial variations in site-related incremental TSP, PM_{10} and $PM_{2.5}$ concentrations and dust deposition rates are provided in Appendix E. Isopleth plots of the maximum 1-hour or 24-hour average concentrations presented in Appendix E do not represent the dispersion pattern on any individual hour or day, but rather illustrate the maximum hourly or daily concentration that was predicted to occur at each model calculation point given the range of meteorological conditions occurring over the 2017 modelling period.

Table 8.1 Summary of highest predicted project-only increment concentrations and deposition levels across all assessment locations

Pollutant	Averaging period	Unit	Year 1	Year 2	Year 4	Year 8	Criterion
TSP	Annual	µg/m³	3.2	5.1	4.8	1.4	90
PM_{10}	24-hour maximum	µg/m³	25.6	29.3	29.6	7.7	50
	Annual	µg/m³	2.1	3.1	2.7	0.8	25
$PM_{2.5}$	24-hour maximum	µg/m³	5.2	7.0	5.7	1.8	25
	Annual	µg/m³	0.5	0.6	0.5	0.2	8
Dust deposition	Annual	g/m²/month	0.5	0.8	0.8	0.3	2
NO_2	1-hour maximum	µg/m³	150.4				246
	Annual	µg/m³	5.7				62
HCN	99.9th percentile 1-hour	µg/m³	69.6				200
Ag	99.9th percentile 1-hour	µg/m³	3.79E-05	4.96E-05	7.16E-05	3.35E-05	1.8
As	99.9th percentile 1-hour	µg/m³	5.89E-03	7.71E-03	1.11E-02	5.20E-03	0.09
Ba	99.9th percentile 1-hour	µg/m³	1.00E-02	1.31E-02	1.89E-02	8.84E-03	9
Be	99.9th percentile 1-hour	µg/m³	1.56E-05	2.04E-05	2.94E-05	1.38E-05	0.004
Cd	99.9th percentile 1-hour	µg/m³	1.56E-05	2.04E-05	2.95E-05	1.38E-05	0.018
Cr	99.9th percentile 1-hour	µg/m³	2.86E-04	3.74E-04	5.40E-04	2.53E-04	0.09
Cu	99.9th percentile 1-hour	µg/m³	3.04E-02	3.98E-02	5.74E-02	2.68E-02	18
Fe	99.9th percentile 1-hour	µg/m³	8.5	11.1	16.1	7.5	90
Hg	99.9th percentile 1-hour	µg/m³	2.93E-06	3.83E-06	5.53E-06	2.59E-06	0.18
Mg	99.9th percentile 1-hour	µg/m³	2.1	2.8	4.0	1.9	180
Mn	99.9th percentile 1-hour	µg/m³	0.2	0.2	0.4	0.2	18
Ni	99.9th percentile 1-hour	µg/m³	9.12E-04	1.19E-03	1.72E-03	8.05E-04	0.18
Pb	Annual	µg/m³	4.17E-05	6.66E-05	6.25E-05	1.90E-05	0.5
Sb	99.9th percentile 1-hour	µg/m³	1.79E-04	2.35E-04	3.39E-04	1.58E-04	9
Zn	99.9th percentile 1-hour	µg/m³	1.37E-02	1.79E-02	2.59E-02	1.21E-02	90

Note: A single worst case scenario was modelled for each of NO_2 and HCN emissions.

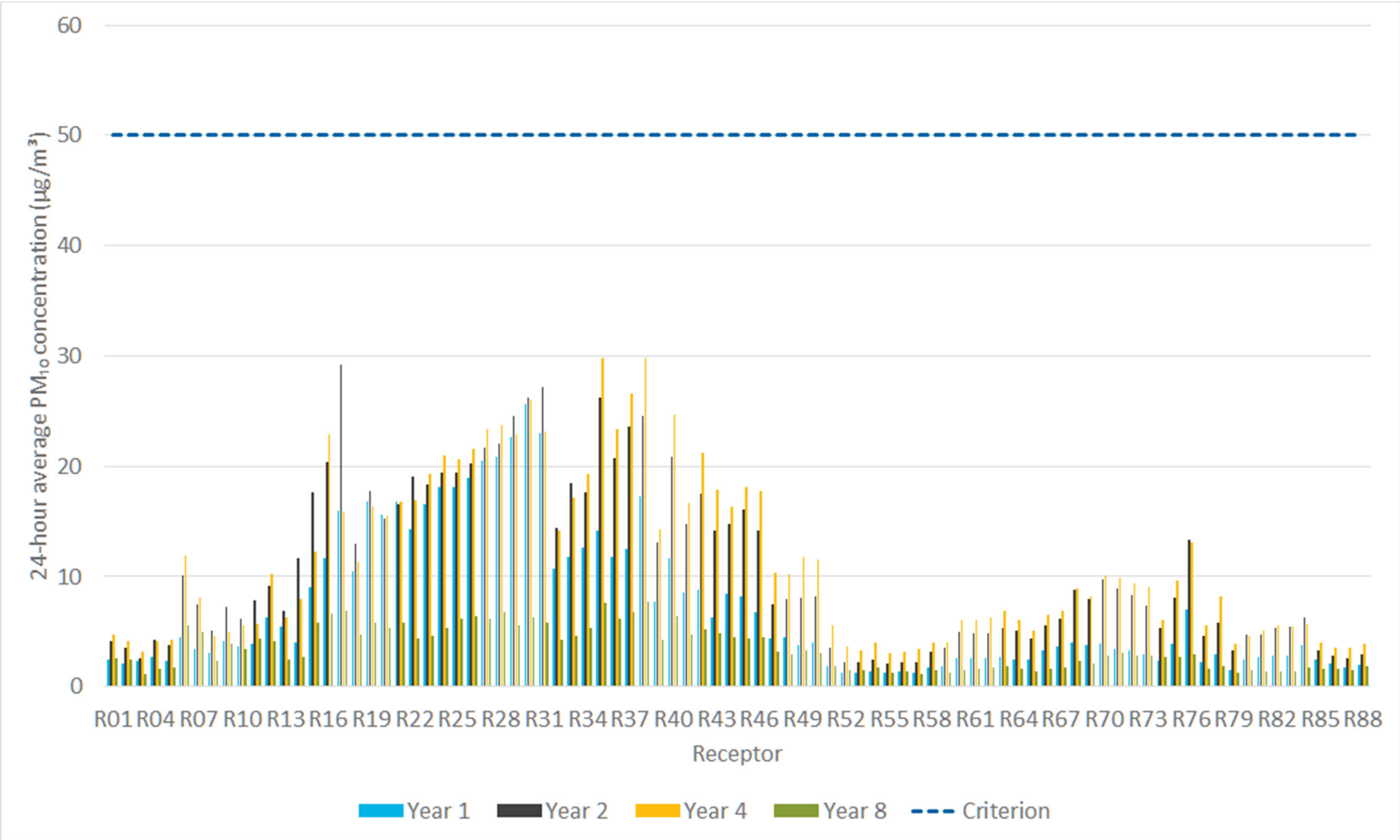


Figure 8.1 **Maximum incremental 24-hour average PM_{10} concentrations – all scenarios**

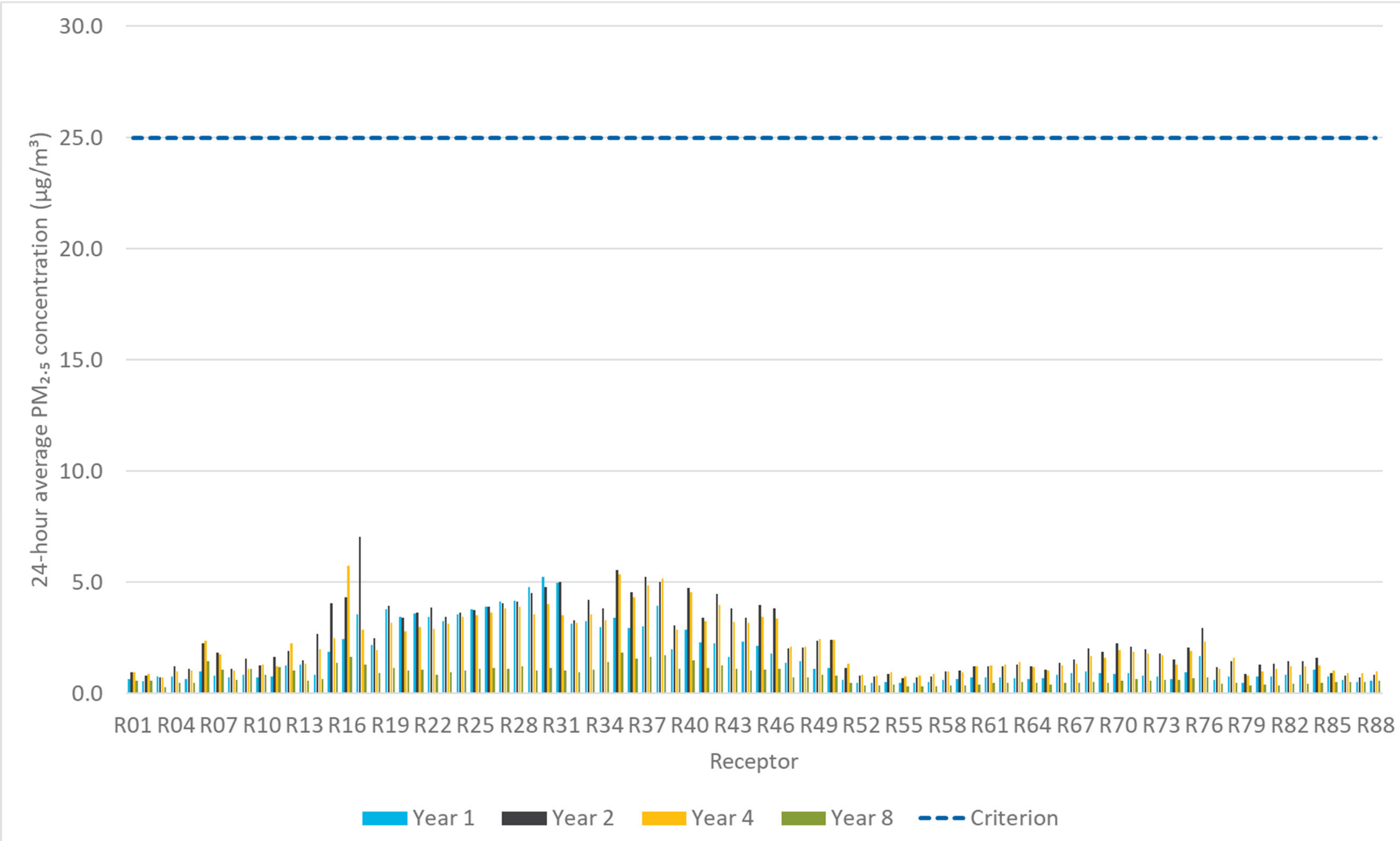


Figure 8.2 **Maximum incremental 24-hour average $PM_{2.5}$ concentrations – all scenarios**

8.4 Cumulative (background + project) results

Cumulative concentrations (project + background) were derived following the contemporaneous assessment approach. For each pollutant and averaging period, the coincident model prediction and corresponding background value were paired together to derive a cumulative concentration at each receptor location. For example, in the case of 24-hour average PM_{10}, at each receptor location the background concentration on the 1st January 2017 was paired with the model prediction on the 1st January 2017 and repeated for the entire modelling period.

Predicted cumulative concentrations and deposition rates from the four modelled scenarios were then collated, and the maximum predicted results across the 88 assessment locations are presented in Table 8.2.

Table 8.2 Summary of highest predicted cumulative (background + project) concentrations and deposition levels across all assessment locations

Pollutant	Averaging period	Unit	Year 1	Year 2	Year 4	Year 8	Criterion
TSP	Annual	µg/m³	38.5	40.4	40.1	36.7	90
PM_{10}	3rd highest 24-hour	µg/m³	44.8	47.2	**50.3**	40.8	50
	Annual	µg/m³	16.1	17.1	16.8	14.9	25
$PM_{2.5}$	24-hour maximum	µg/m³	20.0	21.2	21.7	19.2	25
	Annual	µg/m³	6.5	6.7	6.6	6.2	8
Dust deposition	Annual	g/m²/month	1.9	2.2	2.2	1.7	4
NO_2	1-hour maximum	µg/m³	169.6				246
	Annual	µg/m³	14.2				62

Note: Due to two existing exceptional dust storm events in 2017 (see Section 6.3.1), the third highest cumulative 24-hour average PM_{10} concentration is presented

Note: A single maximum NO_2 modelling scenario based on peak projected diesel consumption was modelled, therefore the same concentrations are presented for all scenarios.

Due to the dust storm event that influenced two days in the 2017 monitoring dataset that was used to define background air quality in the cumulative analysis, the 3rd highest cumulative 24-hour average PM_{10} concentration is reported in Table 8.2. As shown the predicted concentrations and deposition rates for all pollutants and averaging periods are below the applicable NSW EPA assessment criteria, with the following exception:

- 24-hour average PM_{10} - a single additional exceedance day at receptor R38 during Year 4 operations.

To better illustrate this exceedance at receptor R38, the daily-varying cumulative concentrations predicted for Year 4 operations are illustrated in Figure 8.3. It is noted that Regis have an option to acquire receptor R38 should the project be approved.

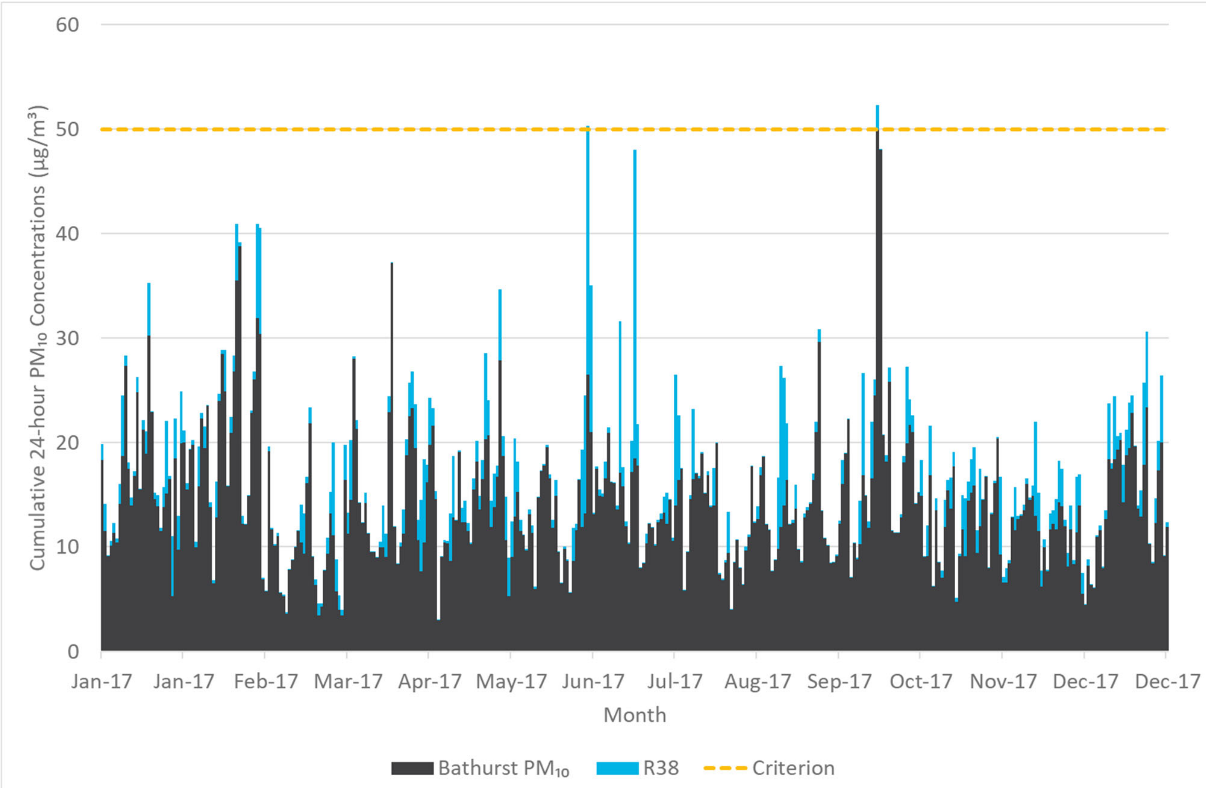


Figure 8.3 **Daily-varying cumulative 24-hour average PM_{10} concentrations – Year 4 operations – receptor R38**

8.5 Voluntary land acquisition criteria

The results presented in Section 8.3 and 8.4 demonstrate compliance with the relevant VLAMP criteria for both mitigation and acquisition presented in Section 4.4. As stated, VLAMP criteria also apply if the development contributes to an exceedance on more than 25% of privately-owned land upon which a dwelling could be built under existing planning controls.

Analysis of the contour plots presented in Appendix E indicates that project-only 24-hour PM_{10} and $PM_{2.5}$ concentrations will not exceed 50 µg/m³ or 25 µg/m³ across more than 25% of any privately-owned land during any of the four modelled scenarios.

To assess against voluntary land acquisition criteria for cumulative annual average PM_{10}, $PM_{2.5}$, TSP or dust deposition, the relevant fixed background value from Section 6.3.7 was added to the incremental contour plots presented in Appendix E. This analysis highlighted that no exceedance of relevant VLAMP criteria across more than 25% of any privately-owned land would occur for the modelled scenarios.

8.6 Post-blast fume impacts

8.6.1 Routine blasting impacts

Emissions of NO_x from routine blasting operations were quantified for an anticipated maximum blast scenario, as discussed in Section 7.4.3 and Appendix C.

Using quantified NOx emissions from the maximum blast calculations, dispersion modelling was conducted assuming the occurrence of a blast on every hour of every day for the 2017 modelling period between the hours of 7 am and 6 pm. Blasting for the project is proposed once every two days, therefore this is not a reflection of actual blasting operations, rather an exercise to identify potential blasting impacts at sensitive receptors under possible dispersion conditions.

Predicted maximum and 1-hour average NO_2 concentrations by hour of the day at a representative receptor along the southern boundary of the project area associated with the modelled blasting scenario are presented in Figure 8.4. The results in this graph highlight the following points:

- on average, predicted 1-hour NO_2 concentrations from blasting are low across all modelled hours;
- under adverse dispersion conditions, the maximum 1-hour average NO_2 concentrations are above the applicable criterion for hours 7 am and 5 pm; and
- maximum 1-hour NO_2 concentrations across all hours between 8 am and 4 pm are below the applicable criteria, with the lowest concentrations occurring in the middle of the day.

From an air quality impacts perspective, blasting events at the project should be restricted to between 8 am and 4 pm. It is noted that there are other environmental considerations, such as acoustics, relating to the timing of blasts that need to be accounted for.

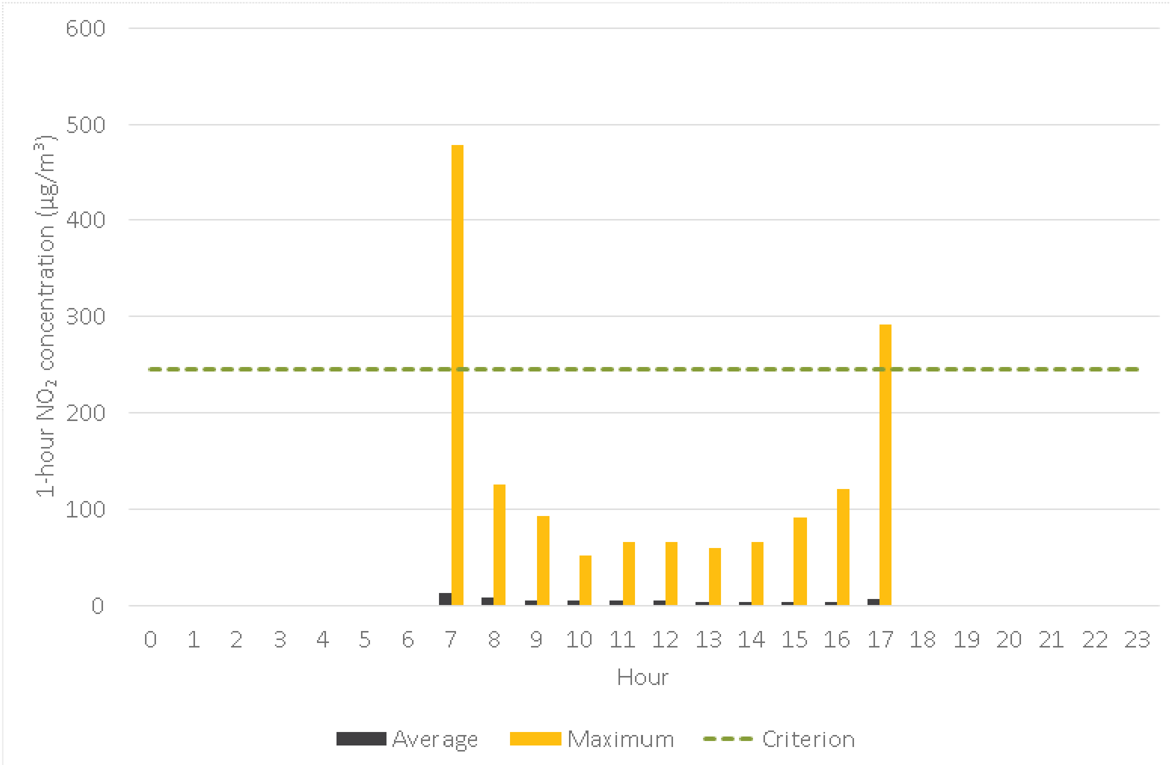


Figure 8.4 Predicted 1-hour NO_2 concentrations from blasting – southern boundary receptor

8.6.2 Blast fume impacts

While impacts from routine blasting operations are addressed in the previous section, non-ideal blast conditions can increase the amount of trace air pollutants emitted. The generation of blast fume is not uncommon in the commercial explosives industry, with the occurrence of such post-detonation fumes being historically associated with wet conditions and not generally viewed with alarm due to the rapid dispersion of the gas into the air. However, large-scale blasts at open cut mining operations involving the detonation of hundreds of tonnes of explosives can result in the periodic occurrence of orange/red clouds. Blast fumes represent a potential safety issue for on-site personnel, with community health concerns being raised due to the migration of some blast fumes off the mine property (Sapka et al, 2002).

Several factors have been identified as contributing to blast formation due to non-ideal detonation behaviour observed in some large mine blasts including (Sapka et al, 2002; Attalla et al, 2005):

- weak overburden which reduces the necessary explosive confinement;
- significant water infiltration during long intervals between loading and firing, which changes the explosive composition;
- long explosive columns that produce bottom hole hydrostatic pressures resulting in a decrease in the probability of successful detonation propagation;
- explosive composition and its homogeneity;
- velocity of detonation;

- charge diameter; and
- explosive re-compression caused by hole-to-hole shock propagation due to wet overburden and clay veins.

Management measures that can be implemented during the operation of the mine development to reduce the potential for post-blast fume are addressed in Section 9.3.

9 Mitigation and monitoring

9.1 Particulate matter emissions

The particulate matter emission mitigation measures and management practices proposed for the project are documented in Section 7.3.1. These controls were incorporated into the emissions calculations and dispersion modelling wherever an appropriate emission reduction factor was available. A best practice management analysis was undertaken, which demonstrated that the mitigation measures proposed are in compliance with accepted best practice for dust control.

9.2 Diesel combustion emissions

The following management practices will be implemented by Regis to minimise emissions from the combustion of diesel during the life of the project:

- where feasible, equipment compliant with a more recent emission standard than USEPA Tier 2 will be sourced;
- where feasible, electricity-powered mining equipment will be adopted;
- open cut pit haulage ramps will be designed to reduce the gradient of travel as much as feasible;
- haul roads will be routinely maintained to reduce truck tyre rolling resistance;
- the distance of material haulage to ROM pad and waste rock dumps will be optimised to reduce haulage distances wherever feasible;
- all equipment will be routinely serviced to maintain manufacturers' emission specifications;
- idling of diesel equipment will be minimised wherever feasible; and
- low-sulphur diesel fuels and lubricants will be used where feasible.

9.3 Blast fume management

It is recommended that the risk of post-blast fume is mitigated through the implementation of the following measures, as appropriate:

- identify the key risk factors for blast fume at the site, and establish and implement site-specific measures to reduce blast fume events;
- prior to developing the project blasting procedure, a blast fume risk analysis will be conducted, considering factors likely to be encountered, such as ground conditions, occurrence of water (wet holes and depth of water), explosives products for use and prevailing and forecast meteorology, and the appropriate response actions to be taken;
- reduce the potential for fume by:
  - delaying blasting to avoid unfavourable weather conditions that are likely to cause or spread a blast fume, including unfavourable ground moisture conditions;

- selecting an explosive product that is correct for the conditions;
- monitoring the amount of hydrocarbon (diesel) in the product;
- preventing water ingress into blast holes;
- keeping sleep time (the amount of time between charging and firing of a blast) to a minimum, well within manufacturer recommended times;
- providing effective stemming; and
- loading the product using the appropriate techniques.

- restrict the blast area and the quantity of explosives to be used in areas prone to blast fume; and
- investigate and record causal factors for post-blast fume events.

9.4 Air quality monitoring

As documented in Section 5.1, Regis has established an air quality monitoring network at the project area comprising of a HVAS (PM_{10}), dust deposition gauges and a meteorological monitoring station. The monitoring locations will be reviewed prior to the commencement of operations.

Regis commits to the installation and maintenance of a real-time particulate matter monitoring network (PM_{10}) during the life of the project. The real-time network will feature real-time monitoring locations in the Kings Plains area at the southwest, central south and southeast of the project area. Additionally, monitoring locations will be established to the east and to the west of the project area. Specific monitoring locations will be finalised taking Australian Standard guidance, land access and mains power access into consideration. This network will provide Regis with comprehensive upwind and downwind monitoring based on the dominant wind directions. In combination with data from the existing meteorological monitoring station and project-specific trigger conditions, the real-time monitoring network will be used to inform reactive management practices to prevent adverse impacts at sensitive receptors.

Daily and annual average PM_{10} concentrations and monthly average dust deposition results will be recorded and reported in annual environmental management reports (the Annual Review) and made available to the public through Regis's website.

To support the air quality monitoring network, an air quality monitoring plan will be developed for the project, documenting monitoring locations, monitoring methods and reporting responsibilities.

10 Greenhouse gas assessment

10.1 Introduction

The estimation of greenhouse gas (GHG) emissions for the project was based on the Australian Government Department of the Environment and Energy (DoEE) National Greenhouse Accounts Factors (NGAF) workbook (DoEE 2018). The methodologies in the NGAF workbook follow a simplified approach, equivalent to the “Method 1” approach outlined in the National Greenhouse and Energy Reporting (Measurement) Technical Guidelines (DoE 2014). The Technical Guidelines are used for the purpose of reporting under the National Greenhouse and Energy Reporting Act 2007 (the NGER Act).

For accounting and reporting purposes, GHG emissions are defined as ‘direct’ and ‘indirect’ emissions. Direct emissions (also referred to as Scope 1 emissions) occur within the boundary of an organisation and as a result of that organisation’s activities. Indirect emissions are generated as a consequence of an organisation’s activities but are physically produced by the activities of another organisation (DoEE 2018). Indirect emissions are further defined as Scope 2 and Scope 3 emissions. Scope 2 emissions occur from the generation of the electricity purchased and consumed by an organisation. Scope 3 emissions occur from all other upstream and downstream activities, for example the downstream extraction and production of raw materials or the upstream use of products and services.

Scope 3 is an optional reporting category (Bhatia et al 2010) and should not be used to make comparisons between organisations, for example in benchmarking GHG intensity of products or services. Typically, only major sources of Scope 3 emissions are accounted and reported by organisations. Specific Scope 3 emission factors are provided in the NGAF workbook for the consumption of fossil fuels and purchased electricity, making it straightforward for these sources to be included in a GHG inventory, even though they are a relatively minor source.

10.2 Emission sources

The GHG emission sources included in this assessment are listed in Table 10.1, representing the most significant sources associated with the project. Emissions of GHGs have been quantified on an annual basis accounting for the construction, operational and rehabilitation phases of the project.

GHG emissions from the project are estimated using the methodologies outlined in the NGAF workbook, using fuel energy contents and scope 1, 2 and 3 emission factors for diesel, LPG, and electricity use in NSW.

Table 10.1 Scope 1, 2 and 3 emission sources

Scope 1	Scope 2	Scope 3
Direct emissions from fuel combustion (diesel) by onsite plant and equipment.	Indirect emissions associated with the consumption of purchased electricity	Indirect upstream emissions from the extraction, production and transport of diesel and petrol
Direct emissions from fuel combustion (LPG) by kiln and furnace at the processing plant		Indirect upstream emissions from electricity lost in delivery in the transmission and distribution network.

10.3 Excluded emissions

There are a number of GHG emissions that are considered minor relative to the emission sources listed in Section 10.2 and have been excluded from this GHG assessment.

These include:

- fugitive leaks from high voltage switch gear and refrigeration (Scope 1);
- land use change and land clearing (Scope 1);
- disposal of solid waste at landfill (Scope 3);
- transport of product to market (Scope 3); and
- travel of employees to and from the project (Scope 3).

In the case of land use change, it is considered that the GHG emissions generated by the changes to the land use in the establishment of the project will be offset by the rehabilitation of the site at the completion of the project.

10.4 Activity data

Estimates of annual diesel and electricity consumption associated with the project have been provided by Regis. A summary of annual energy consumption is presented in Table 10.2. It is noted that Year 1 contains construction-related activities, while Year 11 to Year 14 relate to site rehabilitation activities.

Table 10.2 Project annual energy consumption

Stage of project	Diesel (l)	LPG (l)	Electricity (kWh)
Year 1	14,904,013	-	-
Year 2	18,913,245	582,400	110,071,397
Year 3	23,566,582	582,400	162,721,994
Year 4	28,087,090	582,400	162,721,904
Year 5	41,193,676	582,400	163,167,765
Year 6	18,257,621	582,400	176,244,924
Year 7	16,646,909	582,400	180,802,214
Year 8	12,308,934	582,400	180,802,216
Year 9	9,363,622	582,400	181,297,564
Year 10	2,986,720	582,400	152,571,124
Year 11	3,976,000	582,400	-
Year 12	3,408,000	-	-
Year 13	2,840,000	-	-
Year 14	1,136,000	-	-

10.5 Emission estimates

The following emission factors have been used to estimate GHG emissions from the project:

- diesel consumption on-site (Scope 1) – diesel oil factors from Table 3 of the NGAF workbook (2018);
- LPG consumption (Scope 1) - petrol factors from Table 3 of the NGAF workbook (2018);

- electricity consumption (Scope 2) – NSW Scope 2 emission factor from Table 5 of the NGAF workbook (2018);
- diesel consumption on-site (Scope 3) – diesel oil factor from Table 40 of the NGAF workbook (2018);
- LPG consumption on-site (Scope 3) – LPG factor from Table 40 of the NGAF workbook (2018); and
- electricity consumption (Scope 3) - NSW Scope 3 emission factor from Table 41 of the NGAF workbook (2018).

The estimated annual GHG emissions for each emission source are presented in Table 10.3.

The significance of project GHG emissions relative to state and national GHG emissions is made by comparing annual average GHG emissions against the most recent available total GHG emissions inventories (calendar year 2017[10]) for NSW (128,780.2 kt CO_2-e) and Australia (530,840.9 kt CO_2-e).

Annual average total GHG emissions (Scope 1, 2 and 3) generated by the project represent approximately 0.107% of total GHG emissions for NSW and 0.026% of total GHG emissions for Australia, based on the National Greenhouse Gas Inventory for 2017.

The project's contribution to projected climate change, and the associated environmental impacts, would be in proportion with its contribution to global greenhouse gas emissions.

10.6 Emission management

GHG emissions from the project are principally associated with on-site energy consumption, specifically diesel combustion and consumption of purchased electricity. The proposed mining development features conventional drill, blast and haul techniques, which is largely dependent on the use of diesel-powered equipment. Regis is currently investigating the feasibility of electricity-powered shovels for in pit loading operations.

Ultimately, measures and practices designed to improve energy efficiency, will assist with the management of project GHG emissions. The diesel combustion management strategies listed in Section 9.2 will equally assist with the reduction of associated GHG emissions.

In order to minimise GHG emissions, the following recommendations are made:

- adopt the use of energy efficient lighting technologies and hot water and air conditioning systems wherever practical;
- use of alternative energy sources where feasible, such as solar power;
- conduct periodic audits and reviews on the amounts of materials used, amount of mine waste and non-mine waste generated and disposed; and
- source materials locally where feasible to minimise emissions generated from upstream activities.

In general, opportunities to improve energy efficiency will be investigated on an ongoing basis throughout the life of the project.

The calculated annual Scope 1 and 2 emissions from the project are greater than the NGER Scheme facility reporting threshold of 25,000 tpa CO_2-e. Consequently, Regis will measure energy consumption, and calculate and report Scope 1 and 2 GHG emissions in accordance with the requirements of the NGER Act.

[10] http://ageis.climatechange.gov.au/

Table 10.3 Estimated annual GHG emissions

Stage of project	Scope 1 (t CO_2-e/year)			Scope 2 (t CO_2-e/year)	Scope 3 (t CO_2-e/year)			
	Diesel	LPG	Total	Electricity	Diesel	LPG	Electricity	Total
Year 1	40,217.1	-	40,217.1	-	2,071.1	-	-	2,071.1
Year 2	51,035.7	901.2	51,936.9	90,258.5	2,628.2	53.9	11,007.1	13,689.2
Year 3	63,592.3	901.2	64,493.5	133,432.0	3,274.8	53.9	16,272.2	19,600.9
Year 4	75,790.5	901.2	76,691.7	133,432.0	3,903.0	53.9	16,272.2	20,229.1
Year 5	111,157.4	901.2	112,058.7	133,797.6	5,724.3	53.9	16,316.8	22,094.9
Year 6	49,266.5	901.2	50,167.8	144,520.8	2,537.1	53.9	17,624.5	20,215.5
Year 7	44,920.2	901.2	45,821.4	148,257.8	2,313.3	53.9	18,080.2	20,447.4
Year 8	33,214.5	901.2	34,115.8	148,257.8	1,710.4	53.9	18,080.2	19,844.6
Year 9	25,266.9	901.2	26,168.1	148,664.0	1,301.2	53.9	18,129.8	19,484.8
Year 10	8,059.4	901.2	8,960.6	125,108.3	415.0	53.9	15,257.1	15,726.0
Year 11	10,728.9	901.2	11,630.1	-	552.5	53.9	-	606.4
Year 12	9,196.2	-	9,196.2	-	473.6	-	-	473.6
Year 13	7,663.5	-	7,663.5	-	394.6	-	-	394.6
Year 14	3,065.4	-	3,065.4	-	157.9	-	-	157.9
Average	**38,083.9**	**643.7**	**38,727.6**	**86,123.5**	**1,961.2**	**38.5**	**10,502.9**	**12,502.6**
Total	**533,174.5**	**9,012.3**	**542,186.9**	**1,205,728.9**	**27,456.9**	**538.8**	**147,040.1**	**175,035.8**

11 Conclusions

Dispersion modelling was undertaken for four stages in the development of the project. Atmospheric dispersion modelling was undertaken using the US-EPA regulatory model, AERMOD. Hourly meteorological observations from 2017, collected primarily by the onsite meteorological station, were used as inputs into the dispersion modelling process.

The results of the modelling show that, for all assessed stages of the project development and operation, the predicted concentrations and deposition rates for particulate matter (TSP, PM_{10}, $PM_{2.5}$, dust deposition, metals and metalloids) and gaseous pollutants (NO_2 and HCN) are below the applicable impact assessment criteria at neighbouring sensitive receptors. Cumulative impacts were assessed by combining modelled project impacts with recorded ambient background levels. Despite a range of conservative assumptions in the emission calculations and dispersion modelling techniques, the cumulative results also demonstrated compliance with applicable impact assessment criteria with the following exception:

- 24-hour average PM_{10} - a single additional exceedance day at receptor R38 during Year 4 operations.

It is noted that Regis have an option to acquire receptor R38 should the project be approved.

The design of the project incorporates a range of dust mitigation measures. A review of dust control measures was undertaken for the project, and this identified that the proposed mitigation and management measures will be in accordance with accepted industry best practice. On the basis of the modelling predictions, the proposed mitigation measures will effectively control operational emissions to minimise impacts on the surrounding environment.

To supplement the mitigation measures, Regis commits to the installation and maintenance of a real-time particulate matter monitoring network (PM_{10}) during the life of the project. The real-time network will feature real-time monitoring locations in the Kings Plains area at the southwest, central south and southeast of the project area. In combination with data from the existing meteorological monitoring station and project-specific trigger conditions, the real-time monitoring network will be used to inform reactive management practices to prevent adverse impacts at sensitive receptors.

A GHG assessment was also undertaken for the project. Annual average total GHG emissions (Scope 1, 2 and 3) generated by the project represent approximately 0.107% of total GHG emissions for NSW and 0.026% of total GHG emissions for Australia, based on the National Greenhouse Gas Inventory for 2017.

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Abbreviations

AERMOD	AMS/US-EPA regulatory model
AHD	Australian height datum
Approved Methods for Modelling *in New South Wales*	*Approved Methods for the Modelling and Assessment of Air Pollutants*
Ag	Silver
ANE	Ammonium nitrate emulsion
AQS	Air quality station
As	Arsenic
AWS	Automatic weather station
Ba	Barium
Be	Beryllium
BoM	Bureau of Meteorology
CO_2-e	Carbon dioxide equivalent
CO	Carbon monoxide
Cd	Cadmium
Cr	Chromium
CSIRO	Commonwealth Scientific and Industrial Research Organisation
Cu	Copper
DPE	Department of Planning and Environment
DPI	Department of Primary Industries
DoEE	Department of the Environment and Energy
EPA	Environment Protection Authority
FTE	Full-time equivalent
GHG	Greenhouse gas
HCN	Hydrogen cyanide
Hg	Mercury
HVAS	High volume air sampler
LPG	Liquid petroleum gas
Mn	Manganese
Mtpa	Million tonnes per annum

NGAF	National Greenhouse Accounts Factors
Ni	Nickel
NO_x	Oxides of nitrogen
NPI	National Pollution Inventory
O_3	Ozone
OEH	Office of Environment and Heritage
Pb	Lead
PM_{10}	Particulate matter less than 10 microns in aerodynamic diameter
$PM_{2.5}$	Particulate matter less than 2.5 microns in aerodynamic diameter
ROM	Run-of-mine
Sb	Antimony
SO_2	Sulphur dioxide
TAPM	The Air Pollution Model
TSF	Tailings storage facility
US-EPA	United States Environmental Protection Agency
VLAMP	Voluntary Land Acquisition and Mitigation Policy
VOC	Volatile organic compounds
Zn	Zinc

Appendix A

Assessment locations

A.1 Assessment locations

As stated in Section 2.3, 88 individual private residences have been selected as assessment locations for the dispersion modelling undertaken in this AQIA. The details of these receptors are presented in Table A.1

Table A.1 Assessment locations

Receptor ID	Easting (m, MGA55S)	Northing (m, MGA55S)	Elevation (m, AHD)
R01	716348	6297846	960
R02	716792	6298310	970
R03	717952	6298177	990
R04	718739	6298128	980
R05	719288	6297828	986
R06	719366	6292570	970
R07	719897	6293856	990
R08	720175	6290492	965
R09	719854	6290003	969
R10	719793	6290405	978
R11	719609	6290265	990
R12	719147	6290295	995
R13	718837	6288912	961
R14	718823	6290061	1025
R15	718065	6290538	1001
R16	717636	6290749	966
R17	717238	6290803	941
R18	716920	6290390	975
R19	716623	6290659	941
R20	716560	6290490	945
R21	716537	6290612	940
R22	716299	6290200	925
R23	716324	6290562	950
R24	716354	6290635	947
R25	716409	6290712	939
R26	716385	6290760	938
R27	716321	6290770	940
R28	716331	6290835	936
R29	716189	6290744	937
R30	716196	6290885	935
R31	716118	6290768	929

Table A.1 Assessment locations

Receptor ID	Easting (m, MGA55S)	Northing (m, MGA55S)	Elevation (m, AHD)
R32	715655	6290652	918
R33	715467	6290816	911
R34	714856	6290821	925
R35	714566	6290941	914
R36	714467	6290779	917
R37	714332	6290853	910
R38	714435	6291193	925
R39	714142	6290386	922
R40	714134	6290835	905
R41	713891	6290416	925
R42	713793	6290933	895
R43	713785	6291222	895
R44	713466	6290491	920
R45	713516	6290684	905
R46	713504	6290879	895
R47	713412	6291327	886
R48	713439	6291427	891
R49	713032	6290869	885
R50	712510	6290313	885
R51	711195	6289940	870
R52	710805	6290115	880
R53	710822	6290218	884
R54	711159	6290258	878
R55	710711	6290277	889
R56	710824	6290311	886
R57	710774	6290450	890
R58	711457	6290635	919
R59	711365	6290898	920
R60	711229	6291435	925
R61	711087	6292011	925
R62	711141	6292012	925
R63	711370	6292057	909
R64	711111	6292250	915
R65	710773	6292278	935

Table A.1 Assessment locations

Receptor ID	Easting (m, MGA55S)	Northing (m, MGA55S)	Elevation (m, AHD)
R66	711308	6292437	903
R67	711454	6292457	898
R68	711164	6292868	905
R69	710866	6292894	905
R70	711641	6292962	905
R71	711671	6293059	905
R72	711324	6293089	901
R73	711288	6293167	897
R74	711481	6293491	895
R75	712857	6293911	885
R76	713548	6294259	905
R77	711533	6294724	900
R78	712198	6295202	890
R79	711342	6295417	900
R80	712226	6296709	910
R81	712527	6296713	903
R82	712925	6296570	905
R83	713066	6296599	914
R84	713182	6296059	930
R85	713818	6296881	940
R86	714076	6296950	945
R87	714168	6297004	946
R88	714321	6296680	950

Appendix B

Meteorological modelling and processing

B.1 Meteorological monitoring datasets

As discussed in Section 5.1, meteorological datasets were collated from the following monitoring stations:

- On-site meteorological monitoring station; and
- BoM Orange Airport AWS, located 20 km to the northwest of the project.

The on-site meteorological monitoring station is the primary resource for meteorological data in this assessment. Data from this station was collected for the period between January 2014 and December 2018. Data availability and analysis of inter-annual trends for this five-year period is presented in the following sections.

B.1.1 Data availability

A summary of data availability for the on-site meteorological station dataset for the period between 2014 and 2018 is provided in Figure B.1. The following points are noted:

- with the exception of missing data for relative humidity between July 2014 and January 2017, data completeness is close to 100% for all parameters for all years between 2014 and 2018. Therefore, only 2017 and 2018 meet the minimum 90% data completeness requirements for all parameters specified with Section 4.1 of the Approved Methods for Modelling (EPA, 2016); and
- the 2018 calendar year was the most recent and complete period of monitoring data from the on-site meteorological station.

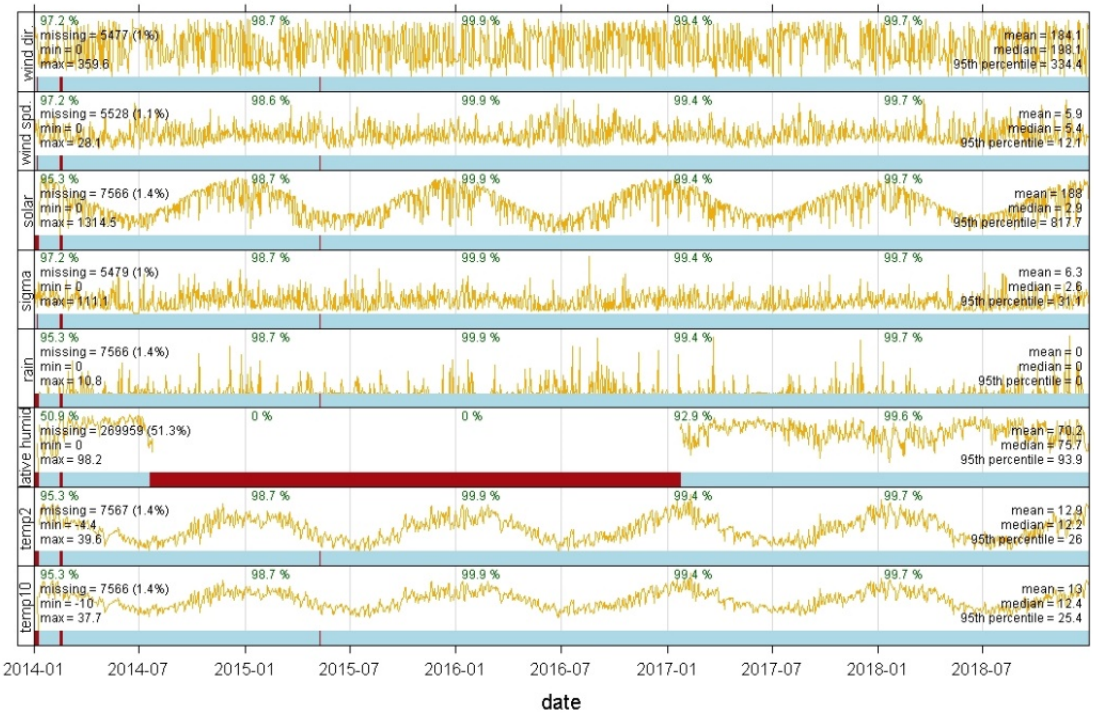


Figure B.1 Five-year data completeness analysis plot – on-site meteorological station – 2014 to 2018

B.1.2 Selection of a representative year

While 2018 was the most recent and complete year of monitoring data from the on-site meteorological station, in order to determine the most representative year of data for modelling an analysis of inter-annual trends was conducted. Inter-annual wind roses are presented in Figure B.2, while the diurnal distribution of wind speed (Figure B.3), wind direction (Figure B.4), temperature (Figure B.5) and relative humidity (Figure B.6) recorded between 2014 and 2018 are also analysed.

The following points are noted from these figures:

- the recorded wind speed and direction profile is comparable across all years, although 2016 had a slightly less frequent easterly component than the other four years of data;
- afternoon to night time air temperatures (midday to midnight) were typically higher during 2018 relative to the previous four years of data. This was associated with the drought conditions experienced in 2018;
- similarly, the relative humidity was typically lower during 2018, although the incomplete nature of the relative humidity dataset is noted.

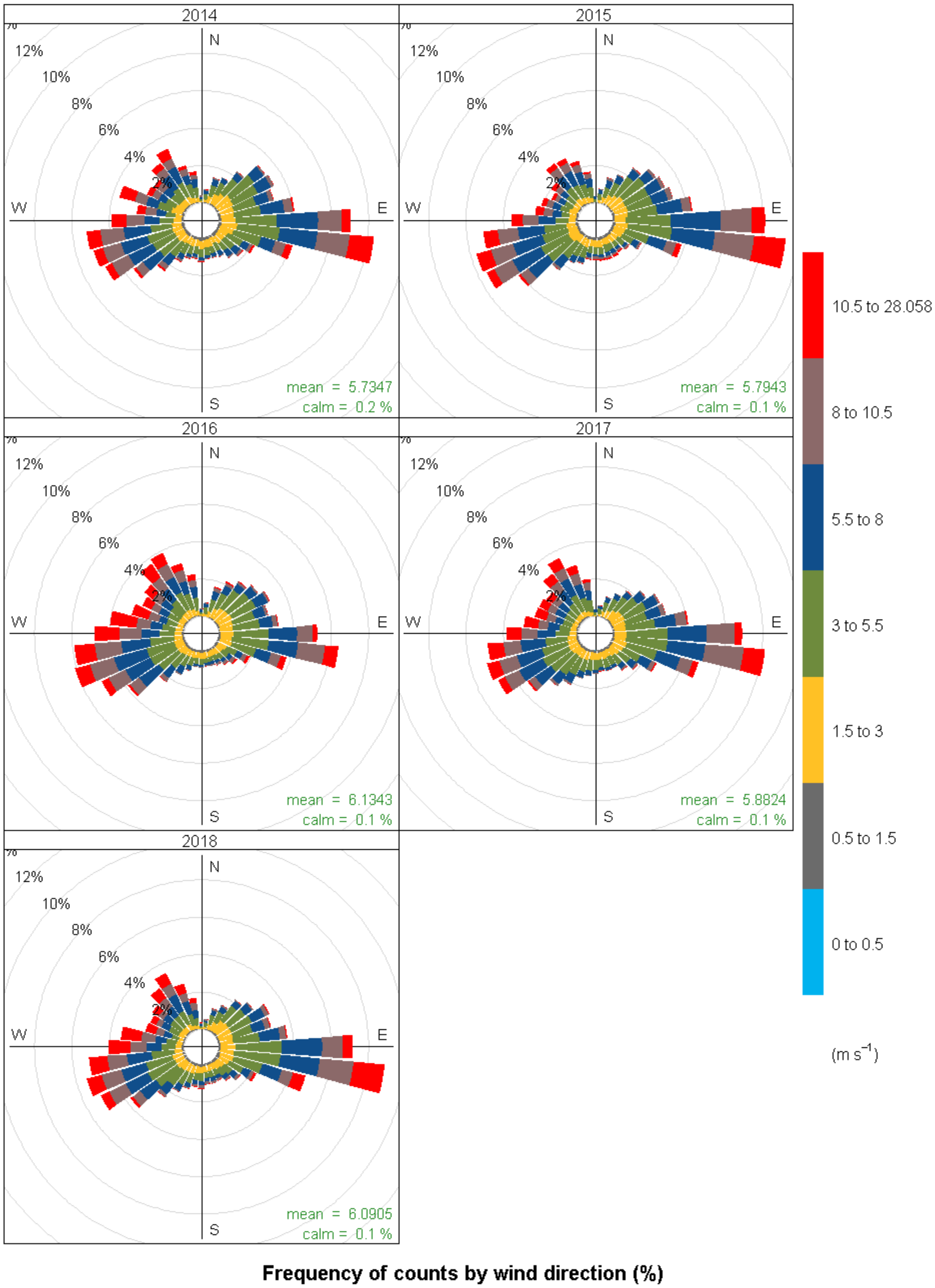


Figure B.2 Inter-annual wind roses – on-site meteorological station – 2014 to 2018

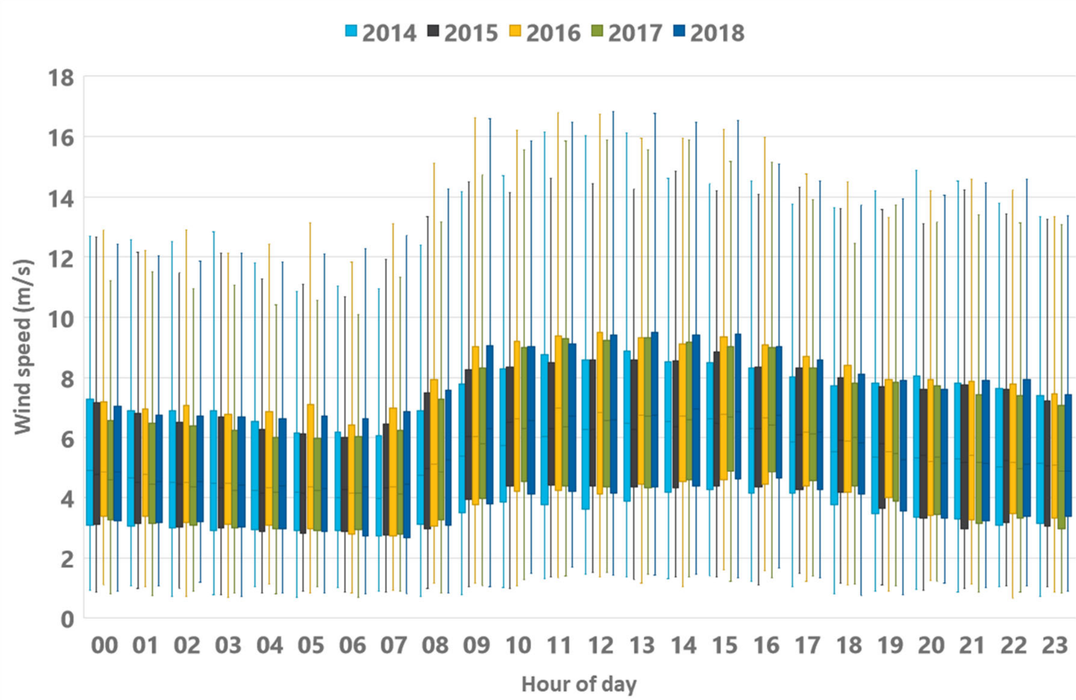


Figure B.3 Inter-annual variability in diurnal wind speed – on-site meteorological station – 2014 to 2018

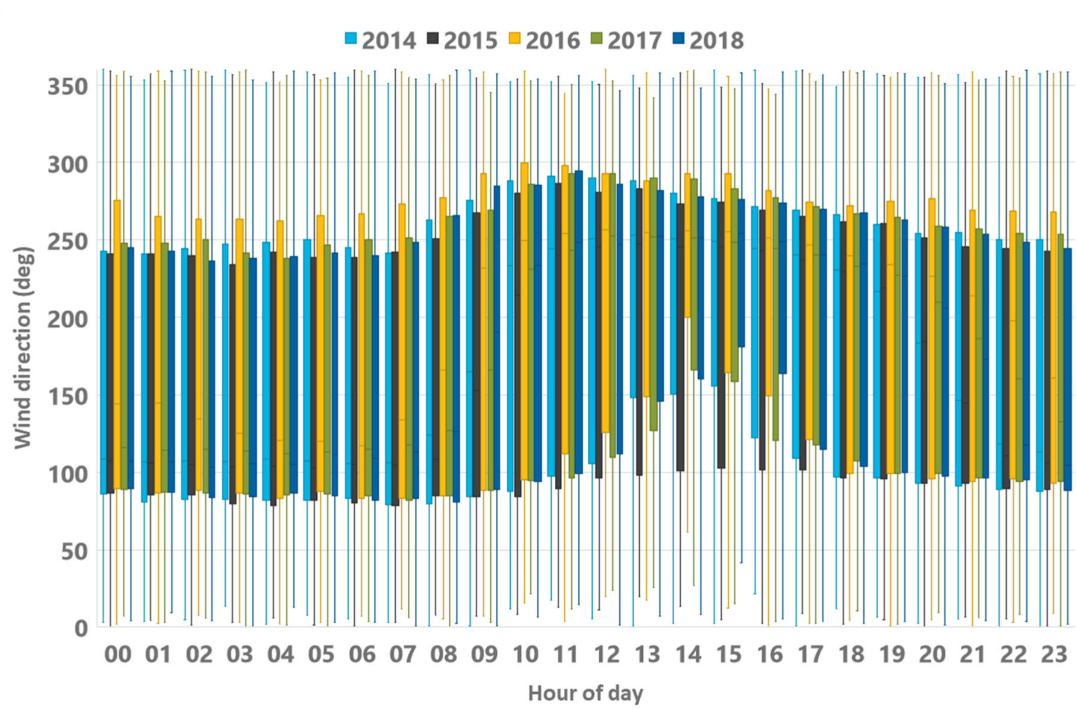


Figure B.4 Inter-annual variability in diurnal wind direction – on-site meteorological station – 2014 to 2018

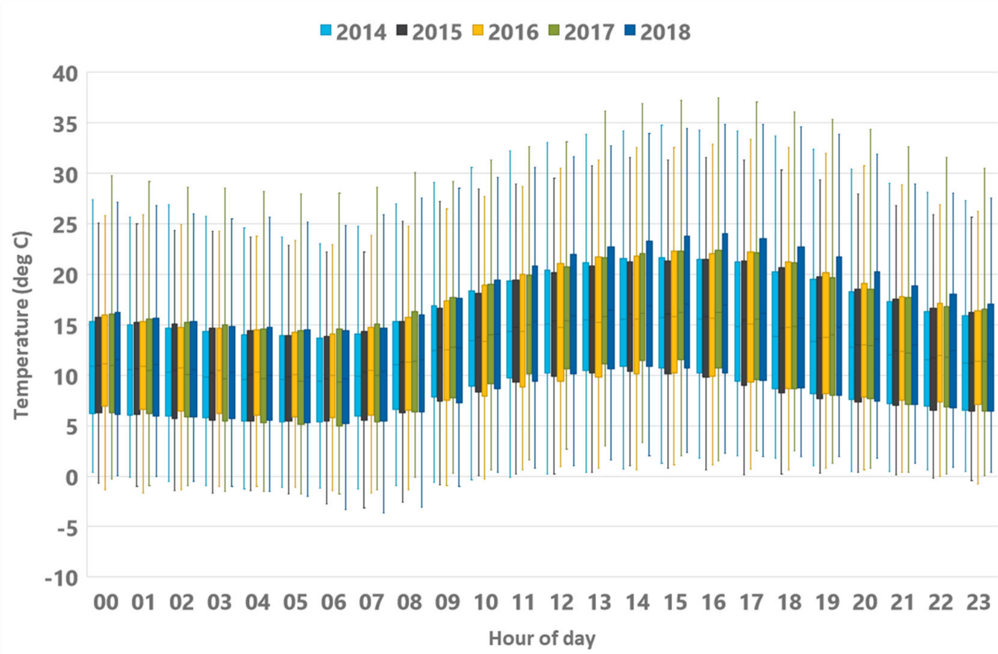


Figure B.5 Inter-annual variability in diurnal air temperature – on-site meteorological station – 2014 to 2018

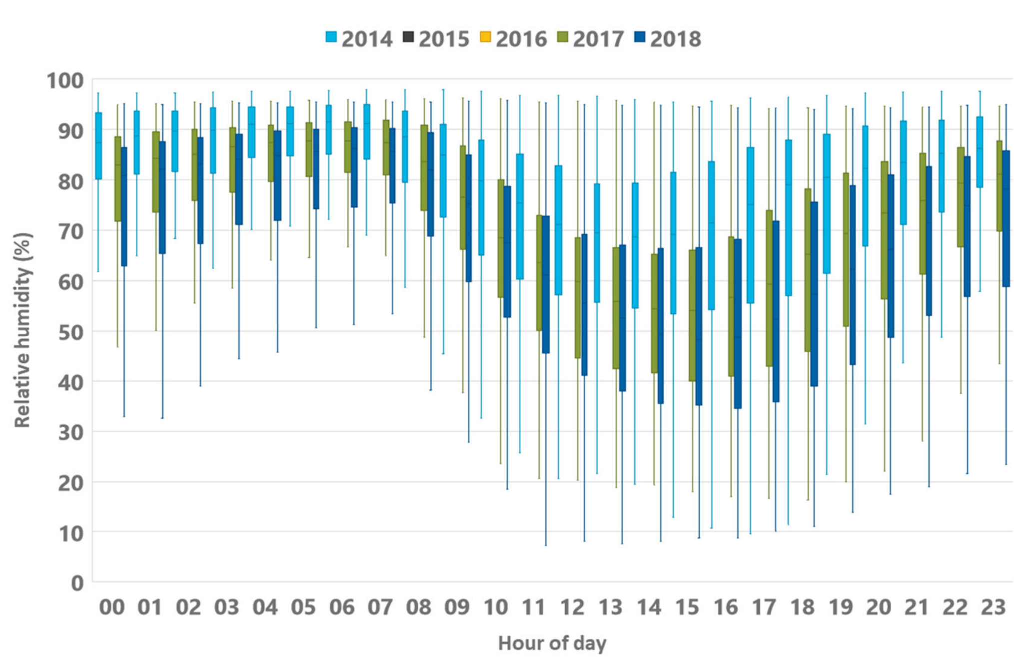


Figure B.6 Inter-annual variability in diurnal relative humidity – on-site meteorological station – 2014 to 2018

B.2 TAPM modelling

To supplement the meteorological monitoring datasets adopted for this assessment, the Commonwealth Scientific and Industry Research Organisation (CSIRO) prognostic meteorological model The Air Pollution Model (TAPM) was used to generate required parameters that are not routinely measured, specifically mixing height and vertical wind/temperature profile.

TAPM was configured and run in accordance with the Section 4.5 of the Approved Methods for Modelling as follows:

- TAPM version 4.0.5;
- inclusion of high resolution (90 m) regional topography (improvement over default 250 m resolution data);
- Grid domains with cell resolutions of 30 km, 10 km, 3 km, 1 km and 0.3 km. Each grid domain features 25 x 25 horizontal grid points and 25 vertical levels;
- TAPM default databases for land use, synoptic analyses and sea surface temperature; and
- TAPM defaults for advanced meteorological inputs.

B.3 AERMET meteorological processing

The meteorological inputs for AERMOD were generated using the AERMET meteorological processor. The following sections provide an overview of meteorological processing completed for this assessment.

B.3.1 Surface characteristics

Prior to processing meteorological data, the surface characteristics of the area surrounding the adopted monitoring station require parameterisation. The following surface parameters are required by AERMET:

- surface roughness length;
- albedo; and
- Bowen ratio.

As detailed by USEPA (2013), the surface roughness length is related to the height of obstacles to the wind flow (eg vegetation, built environment) and is, in principle, the height at which the mean horizontal wind speed is zero based on a logarithmic profile. The surface roughness length influences the surface shear stress and is an important factor in determining the magnitude of mechanical turbulence and the stability of the boundary layer. The albedo is the fraction of total incident solar radiation reflected by the surface back to space without absorption. The daytime Bowen ratio, an indicator of surface moisture, is the ratio of sensible heat flux to latent heat flux and is used for determining planetary boundary layer parameters for convective conditions driven by the surface sensible heat flux.

The land cover of the 10 km by 10 km area surrounding the on-site meteorological station was mapped (see Figure B.7). Using the AERSURFACE tool and following the associated guidance of USEPA (2013), surface roughness was determined for 12 (30 degree) sectors grouped by similar land use types within a 1 km radius around the on-site meteorological station, while the Bowen ratio and albedo were determined for the total 10 km by 10 km area. Monthly-varying values for surface roughness, Bowen ratio and albedo were allocated to each sector based on the values prescribed by USEPA (2013), as specified in Table B.1 and Table B.2. The following profiles were applied to individual months:

- Midsummer – January, February, March, December;
- Autumn – April, May;
- Late autumn / winter without snow – June, July, August; and
- Transitional spring – September, October, November.

The surface moisture characteristics for the 2017 calendar year was determined by comparing annual rainfall for 2017 to the previous 30-year rainfall records from BoM rainfall stations in the surrounding region (data from Blayney Post Office, Orange Airport and Blayney [Orange Road] were collated). Annual rainfall for 2017 was 577 mm, which places the year in the middle 40th-percentile for the previous 30 years, and therefore an 'average' surface moisture classification was allocated.

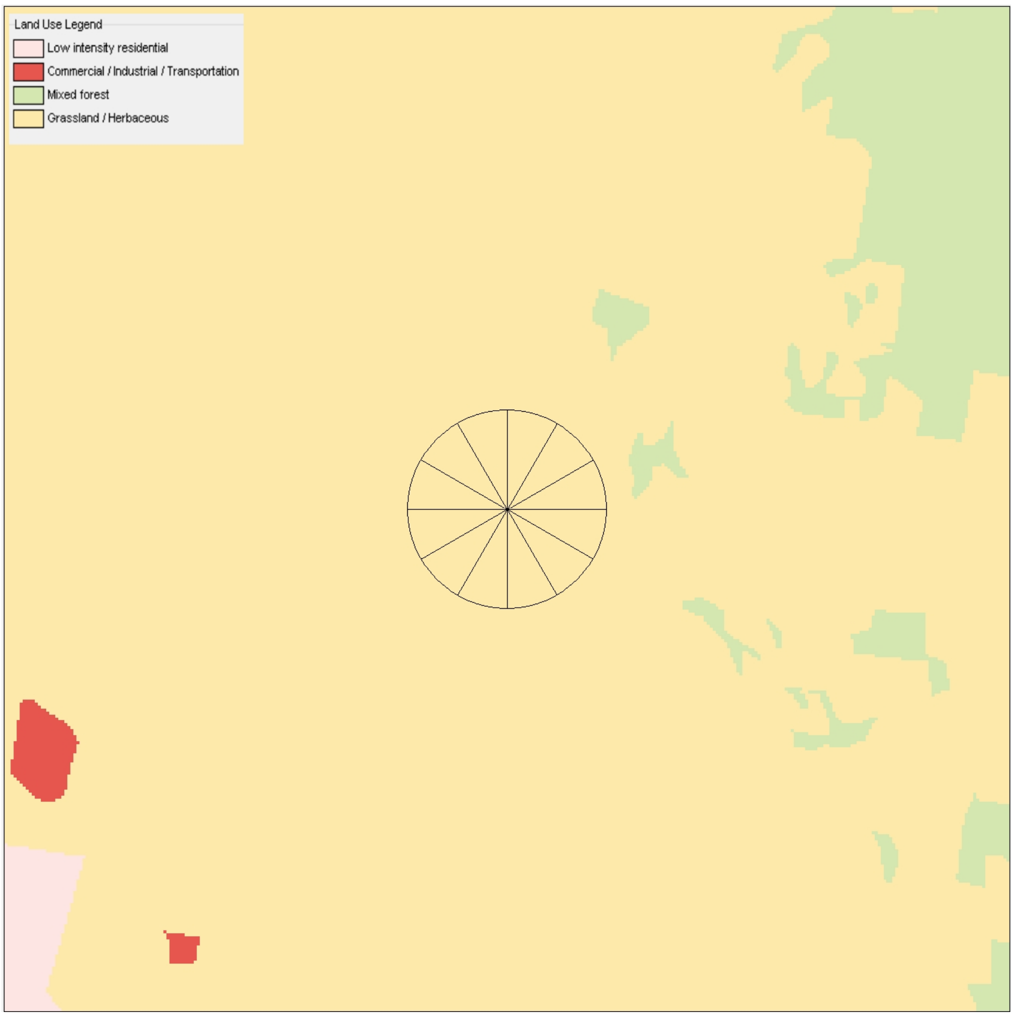


Figure B.7 Land use map for AERSURFACE processing – on-site meteorological station

Note: Marked in figure are the 1 km radius for surface roughness (12 sectors defined) and 10 km x 10 km for albedo/bowen ratio (total image shown)

Table B.1 Monthly surface roughness length values by sector

Month	Surface roughness length (m) by sector (degrees)											
	0-30	30-60	60-90	90-120	120-150	150-180	180-210	210-240	240-270	270-300	300-330	330-0
Jan	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Feb	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Mar	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Apr	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
May	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Jun	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Jul	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Aug	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Sep	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Oct	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Nov	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
Dec	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Table B.2 Monthly Bowen ratio and albedo values (all sectors)

Month	Monthly value (all sectors)	
	Bowen ratio	Albedo
January	0.74	0.18
February	0.74	0.18
March	0.99	0.18
April	0.99	0.18
May	0.99	0.18
June	0.99	0.19
July	0.99	0.19
August	0.99	0.19
September	0.99	0.19
October	0.42	0.18
November	0.42	0.18
December	0.74	0.18

B.3.2 Meteorological inputs

Monitoring data from the on-site meteorological station and BoM Orange Airport AWS were combined with TAPM meteorological modelling outputs for input to AERMET. The following parameters were input as on-site data to AERMET:

- wind speed and direction – on-site;
- sigma-theta (standard deviation of wind direction) - on-site;
- temperature (heights of 2 m and 10 m) - on-site;
- relative humidity - on-site;
- station level pressure – Orange Airport;
- cloud cover - Orange Airport;
- solar insolation - on-site; and
- mixing depth – TAPM at on-site station.

The period of meteorological data input to AERMET was 1 January 2017 to 31 December 2017.

B.3.3 Upper air profile

Due to the absence of necessary local upper air meteorological measurements, the hourly profile file generated by TAPM at the on-site meteorological station location was adopted. Using the temperature difference between levels, the TAPM-generated vertical temperature profile for each hour was adjusted relative to the hourly surface (10m) temperature observations from the on-site station.

Appendix C

Emissions inventory background

C.1 Introduction

Air emission sources associated with the various phases of the project were identified and quantified through the application of accepted published emission estimation factors, collated from a combination of United States Environmental Protection Agency (US-EPA) AP-42 Air Pollutant Emission Factors and NPI emission estimation manuals.

Particulate matter emissions were quantified for various particle size fractions. The emission and dispersion of TSP emissions was simulated to predict dust deposition rates. Coarse and fine particulate matter (PM_{10} and $PM_{2.5}$) were estimated using ratios for the different particle size fractions available within the literature (principally the US-EPA AP-42), as documented in subsequent sections. Emissions of NOx resulting from (diesel) fuel combustion were also determined. Emissions of metals and metalloids were estimated based on the content within relevant material and calculated TSP emissions. Hydrogen cyanide (HCN) emissions were estimated for fugitive emissions from the ore processing circuit and tailings storage facilities (TSF).

C.2 Particulate matter emission factors applied

The emission factors and input assumptions for each identified emission source are presented in Table C.1 through to Table C.4 for the four identified emission scenarios.

Table C.1 Year 1 particulate matter emissions inventory

Emission source	Emission factor source	Activity Rate	Unit	Parameter 1	Value	Parameter 2	Value	Parameter 3	Value	Parameter 4	Value	TSP EF	PM_{10} EF	$PM_{2.5}$ EF	EF Unit
Dozer stripping topsoil	AP-42 11.9 - Bulldozer on Material Other Than Coal	Hours per year	5,621.0	Moisture content (%)	5.0	Silt content (%)	15.0	-	-	-	-	8.27	2.06	0.22	kg/hour
Loading to haul truck	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	309,375.0	Average wind speed (m/s)	6.0	Moisture content (%)	5.0	-	-	-	-	0.00121	0.00057	0.00009	kg/tonne
Haulage to topsoil dump	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	17,451.9	Road silt content (%)	4.6	Haul distance (km)	2.2	Loads per year	3,966.35	Ave Truck Weight (t)	117.90	3.85	0.97	0.10	kg/VKT
Truck dumping of topsoil	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	309,375.0	Average wind speed (m/s)	6.0	Moisture content (%)	5.0	-	-	-	-	0.00121	0.00057	0.00009	kg/tonne
Drill	AP-42 11.9 - Drilling factor	Holes per year	50,491.8	Holes/blast	280.5	-	-	-	-	-	-	0.59	0.31	0.05	kg/hole
Blast	AP-42 11.9 - Blasting Equation	Blasts per year	180.0	Area/blast (m^2)	5,610.2	-	-	-	-	-	-	92.45	48.07	7.21	kg/blast
Blasted waste rock to haul truck	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	24,491,164.4	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
Haulage to waste dump - south - watering	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	155,059.9	Road silt content (%)	4.6	Haul distance (km)	0.7	Loads per year	110,757.10	Ave Truck Weight (t)	219.70	5.09	1.29	0.13	kg/VKT
Haulage to waste dump - south - chemical	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	332,271.3	Road silt content (%)	4.6	Haul distance (km)	1.5	Loads per year	110,757.10	Ave Truck Weight (t)	219.70	5.09	1.29	0.13	kg/VKT
Haulage to waste dump - infrastructure - watering	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	38,765.0	Road silt content (%)	4.6	Haul distance (km)	0.7	Loads per year	27,689.28	Ave Truck Weight (t)	219.70	5.09	1.29	0.13	kg/VKT

Table C.1 Year 1 particulate matter emissions inventory

Emission source	Emission factor source	Activity Rate	Unit	Parameter 1	Value	Parameter 2	Value	Parameter 3	Value	Parameter 4	Value	TSP EF	PM_{10} EF	$PM_{2.5}$ EF	EF Unit
Haulage to waste dump - infrastructure - chemical	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	199,362.8	Road silt content (%)	4.6	Haul distance (km)	3.6	Loads per year	27,689.28	Ave Truck Weight (t)	219.70	5.09	1.29	0.13	kg/VKT
Blasted ore to haul truck	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	2,774,423.8	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
Haulage to ROM pad - watering	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	18,820.3	Road silt content (%)	4.6	Haul distance (km)	0.6	Loads per year	15,683.57	Ave Truck Weight (t)	219.70	5.09	1.29	0.13	kg/VKT
Haulage to ROM pad - chemical	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	43,914.0	Road silt content (%)	4.6	Haul distance (km)	1.4	Loads per year	15,683.57	Ave Truck Weight (t)	219.70	5.09	1.29	0.13	kg/VKT
Truck dumping of waste rock - south	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	19,592,931.6	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
Truck dumping of waste rock - infrastructure	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	4,898,232.9	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
Dozer on waste rock dump	AP-42 11.9 - Bulldozer on Material Other Than Coal	Hours per year	12,264.0	Moisture content (%)	3.3	Silt content (%)	10.0	-	-	-	-	8.73	2.01	0.21	kg/hour
Truck dumping ROM pad	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	2,774,423.8	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
Grader	AP-42 11.9 - Grading equation	VKT per year	51,100.0	Number of units	2.0	Travel speed (km/hr)	5.0	-	-	-	-	0.19	0.14	0.01	kg/VKT

Table C.1 Year 1 particulate matter emissions inventory

Emission source	Emission factor source	Activity Rate	Unit	Parameter 1	Value	Parameter 2	Value	Parameter 3	Value	Parameter 4	Value	TSP EF	PM_{10} EF	$PM_{2.5}$ EF	EF Unit
Road trucks entering/leaving site	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	26,144.0	RSC (%)	4.6	Haul distance (km)	4.3	Loads per year	3,040.00	Ave Truck Weight (t)	30.00	2.08	0.53	0.05	kg/VKT
Topsoil cleared area - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	68.8	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
Topsoil storage piles - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	14.4	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
Main pit - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	66.8	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
Cleared waste rock dump - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	10.2	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
Active waste rock dump - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	98.1	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
ROM Pad stockpiles - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	23.5	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
Rehabilitated areas - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	29.2	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year

Table C.2 Year 2 particulate matter emissions inventory

Emission source	Emission factor source	Activity Rate	Unit	Parameter 1	Value	Parameter 2	Value	Parameter 3	Value	Parameter 4	Value	TSP EF	PM_{10} EF	$PM_{2.5}$ EF	EF Unit
Dozer stripping topsoil	AP-42 11.9 - Bulldozer on Material Other Than Coal	Hours per year	5,621.0	Moisture content (%)	5.0	Silt content (%)	15.0	-	-	-	-	8.27	2.06	0.22	kg/hour
Loading to haul truck	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	283,500.0	Average wind speed (m/s)	6.0	Moisture content (%)	5.0	-	-	-	-	0.00121	0.00057	0.00009	kg/tonne
Haulage to topsoil dump	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	18,900.0	Road silt content (%)	4.6	Haul distance (km)	2.6	Loads per year	3,634.62	Ave Truck Weight (t)	117.90	3.85	0.97	0.10	kg/VKT
Truck dumping of topsoil	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	283,500.0	Average wind speed (m/s)	6.0	Moisture content (%)	5.0	-	-	-	-	0.00121	0.00057	0.00009	kg/tonne
Drill	AP-42 11.9 - Drilling factor	Holes per year	91,004.4	Holes/blast	505.6	-	-	-	-	-	-	0.59	0.31	0.05	kg/hole
Blast	AP-42 11.9 - Blasting Equation	Blasts per year	180.0	Area/blast (m^2)	10,111.6	-	-	-	-	-	-	223.69	116.32	17.45	kg/blast
Blasted waste rock to haul truck	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	45,472,234.5	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
Haulage to waste dump - north - watering	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	28,275.6	Road silt content (%)	4.6	Haul distance (km)	1.1	Loads per year	12,852.53	Ave Truck Weight (t)	219.70	5.09	1.29	0.13	kg/VKT
Haulage to waste dump - north - chemical	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	51,410.1	Road silt content (%)	4.6	Haul distance (km)	2.0	Loads per year	12,852.53	Ave Truck Weight (t)	219.70	5.09	1.29	0.13	kg/VKT
Haulage to waste dump - south - watering	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	393,287.3	Road silt content (%)	4.6	Haul distance (km)	0.9	Loads per year	231,345.46	Ave Truck Weight (t)	219.70	5.09	1.29	0.13	kg/VKT

Table C.2 Year 2 particulate matter emissions inventory

Emission source	Emission factor source	Activity Rate	Unit	Parameter 1	Value	Parameter 2	Value	Parameter 3	Value	Parameter 4	Value	TSP EF	PM_{10} EF	$PM_{2.5}$ EF	EF Unit
Haulage to waste dump - south - chemical	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	694,036.4	Road silt content (%)	4.6	Haul distance (km)	1.5	Loads per year	231,345.46	Ave Truck Weight (t)	219.70	5.09	1.29	0.13	kg/VKT
Haulage to waste dump - infrastructure - watering	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	17,993.5	Road silt content (%)	4.6	Haul distance (km)	0.7	Loads per year	12,852.53	Ave Truck Weight (t)	219.70	5.09	1.29	0.13	kg/VKT
Haulage to waste dump - infrastructure - chemical	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	113,102.2	Road silt content (%)	4.6	Haul distance (km)	4.4	Loads per year	12,852.53	Ave Truck Weight (t)	219.70	5.09	1.29	0.13	kg/VKT
Blasted ore to haul truck	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	5,646,352.4	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
Haulage to ROM pad - watering	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	63,836.7	Road silt content (%)	4.6	Haul distance (km)	1.0	Loads per year	31,918.33	Ave Truck Weight (t)	219.70	5.09	1.29	0.13	kg/VKT
Haulage to ROM pad - chemical	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	82,987.7	Road silt content (%)	4.6	Haul distance (km)	1.3	Loads per year	31,918.33	Ave Truck Weight (t)	219.70	5.09	1.29	0.13	kg/VKT
Truck dumping of waste rock - north	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	2,273,611.7	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
Truck dumping of waste rock - south	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	40,925,011.0	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
Truck dumping of waste rock - infrastructure	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	2,273,611.7	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne

Table C.2 Year 2 particulate matter emissions inventory

Emission source	Emission factor source	Activity Rate	Unit	Parameter 1	Value	Parameter 2	Value	Parameter 3	Value	Parameter 4	Value	TSP EF	PM_{10} EF	$PM_{2.5}$ EF	EF Unit
Dozer on waste rock dump	AP-42 11.9 - Bulldozer on Material Other Than Coal	Hours per year	12,264.0	Moisture content (%)	3.3	Silt content (%)	10.0	-	-	-	-	8.73	2.01	0.21	kg/hour
Truck dumping ROM pad	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	3,670,129.1	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
Truck unloading direct to ROM hopper	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	1,976,223.3	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
FEL rehandle at ROM pad	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	2,758,844.6	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
Primary Crusher	AP-42 11.24 Primary Crusher - low moisture ore	Tonnes per year	4,735,067.9	-	-	-	-	-	-	-	-	0.20	0.02	0.00	kg/tonne
Secondary crusher	AP-42 11.24 Secondary Crusher - low moisture ore	Tonnes per year	3,156,711.9	-	-	-	-	-	-	-	-	0.60	0.05	0.01	kg/tonne
Tertiary crusher	AP-42 11.24 Tertiary Crusher - low moisture ore	Tonnes per year	9,470,135.8	-	-	-	-	-	-	-	-	1.40	0.08	0.01	kg/tonne
Grinding	AP-42 11.24 Dry Grinding - no air conveying - low moisture ore	Tonnes per year	4,735,067.9	-	-	-	-	-	-	-	-	1.20	0.16	0.03	kg/tonne

Table C.2 Year 2 particulate matter emissions inventory

Emission source	Emission factor source	Activity Rate	Unit	Parameter 1	Value	Parameter 2	Value	Parameter 3	Value	Parameter 4	Value	TSP EF	PM_{10} EF	$PM_{2.5}$ EF	EF Unit
Grader	AP-42 11.9 - Grading equation	VKT per year	51,100.0	Number of units	2.0	Travel speed (km/h)	5.0	-	-	-	-	0.19	0.14	0.01	kg/VKT
Road trucks entering/leaving site	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	2,476.8	Road silt content (%)	4.6	Haul distance (km)	4.3	Loads per year	288.00	Ave Truck Weight (t)	30.00	2.08	0.53	0.05	kg/VKT
Topsoil cleared area - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	9.3	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
Topsoil storage piles - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	65.0	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
Main pit - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	66.8	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
Cleared waste rock dump - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	23.9	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
Active waste rock dump - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	185.2	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
ROM Pad stockpiles - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	23.5	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
Rehabilitated areas - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	52.4	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year

Table C.2 Year 2 particulate matter emissions inventory

Emission source	Emission factor source	Activity Rate	Unit	Parameter 1	Value	Parameter 2	Value	Parameter 3	Value	Parameter 4	Value	TSP EF	PM_{10} EF	$PM_{2.5}$ EF	EF Unit
TSF wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	18.3	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year

Table C.3 Year 4 particulate matter emissions inventory

Emission source	Emission factor source	Activity Rate	Unit	Parameter 1	Value	Parameter 2	Value	Parameter 3	Value	Parameter 4	Value	TSP EF	PM_{10} EF	$PM_{2.5}$ EF	EF Unit
Dozer stripping topsoil	AP-42 11.9 - Bulldozer on Material Other Than Coal	Hours per year	5,621.0	Moisture content (%)	5.0	Silt content (%)	15.0	-	-	-	-	8.27	2.06	0.22	kg/hour
Loading to haul truck	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	63,000.0	Average wind speed (m/s)	6.0	Moisture content (%)	5.0	-	-	-	-	0.00121	0.00057	0.00009	kg/tonne
Haulage to topsoil dump	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	1,776.9	Road silt content (%)	4.6	Haul distance (km)	1.1	Loads per year	807.69	Ave Truck Weight (t)	117.90	3.85	0.97	0.10	kg/VKT
Truck dumping of topsoil	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	63,000.0	Average wind speed (m/s)	6.0	Moisture content (%)	5.0	-	-	-	-	0.00121	0.00057	0.00009	kg/tonne
Drill	AP-42 11.9 - Drilling factor	Holes per year	89,269.7	Holes/blast	495.9	-	-	-	-	-	-	0.59	0.31	0.05	kg/hole
Blast	AP-42 11.9 - Blasting Equation	Blasts per year	180.0	Area/blast (m^2)	9,918.9	-	-	-	-	-	-	217.33	113.01	16.95	kg/blast
Blasted waste rock to haul truck	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	42,795,967.6	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
Haulage to waste dump - central - watering	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	774,149.8	Road silt content (%)	4.6	Haul distance (km)	1.6	Loads per year	241,921.81	Ave Truck Weight (t)	219.70	5.09	1.29	0.13	kg/VKT
Haulage to waste dump - central - chemical	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	870,918.5	Road silt content (%)	4.6	Haul distance (km)	1.8	Loads per year	241,921.81	Ave Truck Weight (t)	219.70	5.09	1.29	0.13	kg/VKT

Table C.3 Year 4 particulate matter emissions inventory

Emission source	Emission factor source	Activity Rate	Unit	Parameter 1	Value	Parameter 2	Value	Parameter 3	Value	Parameter 4	Value	TSP EF	PM_{10} EF	$PM_{2.5}$ EF	EF Unit
Blasted ore to haul truck	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	8,322,607.6	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
Haulage to ROM pad - watering	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	225,825.4	Road silt content (%)	4.6	Haul distance (km)	2.4	Loads per year	47,046.96	Ave Truck Weight (t)	219.70	5.09	1.29	0.13	kg/VKT
Haulage to ROM pad - chemical	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	103,503.3	Road silt content (%)	4.6	Haul distance (km)	1.1	Loads per year	47,046.96	Ave Truck Weight (t)	219.70	5.09	1.29	0.13	kg/VKT
Truck dumping of waste rock - central	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	42,795,967.6	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
Truck dumping of waste rock - south	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	0.0	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
Dozer on waste rock dump	AP-42 11.9 - Bulldozer on Material Other Than Coal	Hours per year	12,264.0	Moisture content (%)	3.3	Silt content (%)	10.0	-	-	-	-	8.73	2.01	0.21	kg/hour
Truck dumping ROM pad	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	5,409,694.9	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
Truck unloading direct to ROM hopper	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	2,912,912.7	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne

Table C.3 Year 4 particulate matter emissions inventory

Emission source	Emission factor source	Activity Rate	Unit	Parameter 1	Value	Parameter 2	Value	Parameter 3	Value	Parameter 4	Value	TSP EF	PM_{10} EF	$PM_{2.5}$ EF	EF Unit
FEL rehandle at ROM pad	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	4,087,086.5	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
Primary Crusher	AP-42 11.24 Primary Crusher - low moisture ore	Tonnes per year	6,999,999.2	-	-	-	-	-	-	-	-	0.20	0.02	0.00	kg/tonne
Secondary crusher	AP-42 11.24 Secondary Crusher - low moisture ore	Tonnes per year	4,666,666.1	-	-	-	-	-	-	-	-	0.60	0.05	0.01	kg/tonne
Tertiary crusher	AP-42 11.24 Tertiary Crusher - low moisture ore	Tonnes per year	13,999,998.4	-	-	-	-	-	-	-	-	1.40	0.08	0.01	kg/tonne
Grinding	AP-42 11.24 Dry Grinding - no air conveying - low moisture ore	Tonnes per year	6,999,999.2	-	-	-	-	-	-	-	-	1.20	0.16	0.03	kg/tonne
Grader	AP-42 11.9 - Grading equation	VKT per year	51,100.0	Number of units	2.0	Travel speed (km/h)	5.0	-	-	-	-	0.19	0.14	0.01	kg/VKT
Road trucks entering/leaving site	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	2,476.8	Road silt content (%)	4.6	Haul distance (km)	4.3	Loads per year	288.00	Ave Truck Weight (t)	30.00	2.08	0.53	0.05	kg/VKT
Topsoil cleared area - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	61.9	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
Topsoil storage piles - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	12.0	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year

Table C.3 Year 4 particulate matter emissions inventory

Emission source	Emission factor source	Activity Rate	Unit	Parameter 1	Value	Parameter 2	Value	Parameter 3	Value	Parameter 4	Value	TSP EF	PM_{10} EF	$PM_{2.5}$ EF	EF Unit
Main pit - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	66.8	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
Cleared waste rock dump - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	43.3	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
Active waste rock dump - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	23.5	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
ROM Pad stockpiles - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	12.0	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
Rehabilitated areas - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	229.8	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
TSF wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	45.5	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year

Table C.4 Year 8 particulate matter emissions inventory

Emission source	Emission factor source	Activity Rate	Unit	Parameter 1	Value	Parameter 2	Value	Parameter 3	Value	Parameter 4	Value	TSP EF	PM_{10} EF	$PM_{2.5}$ EF	EF Unit
Drill	AP-42 11.9 - Drilling factor	Holes per year	16,282.6	Holes/blast	90.5	-	-	-	-	-	-	0.59	0.31	0.05	kg/hole
Blast	AP-42 11.9 - Blasting Equation	Blasts per year	180.0	Area/blast (m^2)	1,809.2	-	-	-	-	-	-	16.93	8.80	1.32	kg/blast
Blasted waste rock to haul truck	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	4,475,542.5	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
Haulage to waste dump - north - watering	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	177,098.9	Road silt content (%)	4.6	Haul distance (km)	3.5	Loads per year	25,299.84	Ave Truck Weight (t)	219.70	5.09	1.29	0.13	kg/VKT
Haulage to waste dump - north - chemical	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	141,679.1	Road silt content (%)	4.6	Haul distance (km)	2.8	Loads per year	25,299.84	Ave Truck Weight (t)	219.70	5.09	1.29	0.13	kg/VKT
Blasted ore to haul truck	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	6,641,625.8	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
Haulage to ROM pad - watering	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	262,811.6	Road silt content (%)	4.6	Haul distance (km)	3.5	Loads per year	37,544.52	Ave Truck Weight (t)	219.70	5.09	1.29	0.13	kg/VKT
Haulage to ROM pad - chemical	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	90,106.9	Road silt content (%)	4.6	Haul distance (km)	1.2	Loads per year	37,544.52	Ave Truck Weight (t)	219.70	5.09	1.29	0.13	kg/VKT
Truck dumping of waste rock - north	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	4,475,542.5	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
Dozer on waste rock dump	AP-42 11.9 - Bulldozer on Material Other Than Coal	Hours per year	12,264.0	Moisture content (%)	3.3	Silt content (%)	10.0	-	-	-	-	8.73	2.01	0.21	kg/hour

Table C.4 Year 8 particulate matter emissions inventory

Emission source	Emission factor source	Activity Rate	Unit	Parameter 1	Value	Parameter 2	Value	Parameter 3	Value	Parameter 4	Value	TSP EF	PM_{10} EF	$PM_{2.5}$ EF	EF Unit
Truck dumping ROM pad	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	4,317,056.7	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
Truck unloading direct to ROM hopper	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	2,324,569.0	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
FEL rehandle at ROM pad	AP-42 13.2.4 - Materials Handling Equation / NPI Mining Equation 10	Tonnes per year	4,675,430.2	Average wind speed (m/s)	6.0	Moisture content (%)	3.3	-	-	-	-	0.00216	0.00102	0.00015	kg/tonne
Primary Crusher	AP-42 11.24 Primary Crusher - low moisture ore	Tonnes per year	6,999,999.2	-	-	-	-	-	-	-	-	0.20	0.02	0.00	kg/tonne
Secondary crusher	AP-42 11.24 Secondary Crusher - low moisture ore	Tonnes per year	4,666,666.1	-	-	-	-	-	-	-	-	0.60	0.05	0.01	kg/tonne
Tertiary crusher	AP-42 11.24 Tertiary Crusher - low moisture ore	Tonnes per year	13,999,998.4	-	-	-	-	-	-	-	-	1.40	0.08	0.01	kg/tonne
Grinding	AP-42 11.24 Dry Grinding - no air conveying - low moisture ore	Tonnes per year	6,999,999.2	-	-	-	-	-	-	-	-	1.20	0.16	0.03	kg/tonne
Grader	AP-42 11.9 - Grading equation	VKT per year	25,550.0	Number of units	1.0	Travel speed (km/h)	5.0	-	-	-	-	0.19	0.14	0.01	kg/VKT

Table C.4 Year 8 particulate matter emissions inventory

Emission source	Emission factor source	Activity Rate	Unit	Parameter 1	Value	Parameter 2	Value	Parameter 3	Value	Parameter 4	Value	TSP EF	PM_{10} EF	$PM_{2.5}$ EF	EF Unit
Road trucks entering/leaving site	AP-42 13.2.2 - Unpaved Road Equation	VKT per year	2,476.8	Road silt content (%)	4.6	Haul distance (km)	4.3	Loads per year	288.00	Ave Truck Weight (t)	30.00	2.08	0.53	0.05	kg/VKT
Topsoil storage piles - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	28.0	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
Main pit - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	66.8	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
Active waste rock dump - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	86.4	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
ROM Pad stockpiles - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	23.5	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
Rehabilitated areas - wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	276.0	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year
TSF wind erosion	AP-42 11.9 - Wind erosion of exposed areas factor	Area (ha)	60.7	-	-	-	-	-	-	-	-	850.00	425.00	63.75	kg/ha/year

C.3 Project-related input data and particulate matter emission estimates

The material property inputs used in the emission estimates are summarised in Table C.5. It was assumed that the waste rock and ROM ore had similar characteristics at the point of extraction, which is retained through the entire mine process.

Table C.5 Material property inputs for emission estimation (all scenarios)

Material properties	Units	Value	Source of information
Moisture content of waste and ore	%	3.3	Average of site-specific samples
Moisture content of topsoil	%	15	Assumed from similar project experience
Silt content of waste and ore	%	10	NPI default
Silt content of topsoil	%	15	Assumed from similar project experience
Silt content of unpaved roads	%	4.6	ACARP Report C20023 (Pacific Environment 2014) - average of uncontrolled haul roads

C.4 Fugitive emissions of HCN from processing tanks and TSF

In addition to particulate matter emissions generated by the crushing, screening and handling of ROM Ore, fugitive releases can be generated from the leach and adsorption tanks and from the surface of active TSF areas. According to the NPI Emission Estimation Technique Manual for Gold Ore Processing (NPI 2006), cyanide losses to the atmosphere occur due to the volatilisation of cyanide to hydrogen cyanide (HCN).

In estimating emissions from the processing tanks, the approach presented within Section 6.2.1 of NPI (2006) was applied. This approach applies the following equation:

$$E = ([0.013 \times \{HCN_{(aq)}\} + 0.46] \times A \times T \times 0.96/10^3)$$

where,

E	=	emissions (kg CN);
$HCN_{(aq)}$	=	NaCN x $^{10(9.2\text{-pH})}$;
NaCN	=	concentration (as mg/l) of sodium cyanide (NaCN) in the leach/adsorption tank;
pH	=	pH level in leach/adsorption tank;
A	=	surface area (m^2) of leach/adsorption tank; and
T	=	period of emissions (hours).

Details for the above parameters have been sourced from Regis. The adopted parameters applied in the calculations of fugitive HCN emissions from the processing tanks are listed in Table C.6.

Table C.6 Processing circuit tank parameters

Tank	Surface area (m^2)	NaCN	pH	HCN_{aq}	Time (hours)
Tank 1	33	1,500	10.5	75.2	8760
Tank 2	161	500.0	10	79.2	8760
Tank 3	161	442.9	10	70.2	8760
Tank 4	161	385.7	10	61.1	8760
Tank 5	161	328.6	10	52.1	8760
Tank 6	161	271.4	10	43.0	8760
Tank 7	161	214.3	10	34.0	8760
Tank 8	161	157.1	10	24.9	8760
Tank 9	161	100.0	10	15.8	8760

Cyanide emissions from the surface of the TSF were estimated from the following equation from Section 6.2.2 of the NPI (2006):

$$E = (CNconc \times TSFvol) \times V\%/100$$

where:

E = CN from TSF (kg);

CNconc = titratable cyanide concentration in water entering TSF (kg CN /m^3);

TSFvol = volume of water to TSF (m^3); and

V% = percentage of natural degradation due to volatilisation (%).

The amount of titratable CN concentration in the tailings water is 0.03 kg/m^3 as provided by Regis. The amount of tailings water to TSF is 833 m^3/hour based on information provided by Regis. Based on the expected pH level of 10, a V% value of 20% has been adopted from Table 3 of the NPI (2006).

The total calculated HCN emissions for peak TSF size are presented in Section 7.4.1of the report.

C.5 Gaseous pollutant blasting emissions

The use of explosives such as ammonium nitrate for blasting at open cut mining operations releases primarily CO_2, water and nitrogen. Air pollutants released from blasts include a range of gases such as CO, nitric oxide (NO), hydrocarbons (HC) and lesser amounts of NO_2 and SO_2. The extent of the latter depends on the sulphur content of the fuel oil used. Particulates are also produced by blasts, but due to the large quantities of particulate generated in the shattering of rock and earth in the explosion, the quantity of particulates from the explosive charge cannot be distinguished.

NO_2 is a direct product of the detonation process. It is also produced post-detonation by secondary oxidation of NO to NO_2 as the cloud mixes with air. NO_2 has a greater potential to impact on human health, compared to NO, in the event that exposure occurs. While NO and CO are not visible, NO_2 appears as a yellow to reddish-brown gas.

Emission factors for explosives detonation for Australian blast practices has been assessed by Attalla *et al.* (2007). Maximum and average emission rates derived by Attalla *et al.* (2007) for ammonium nitrate fuel oil (ANFO) explosives use are listed within Table C.7.

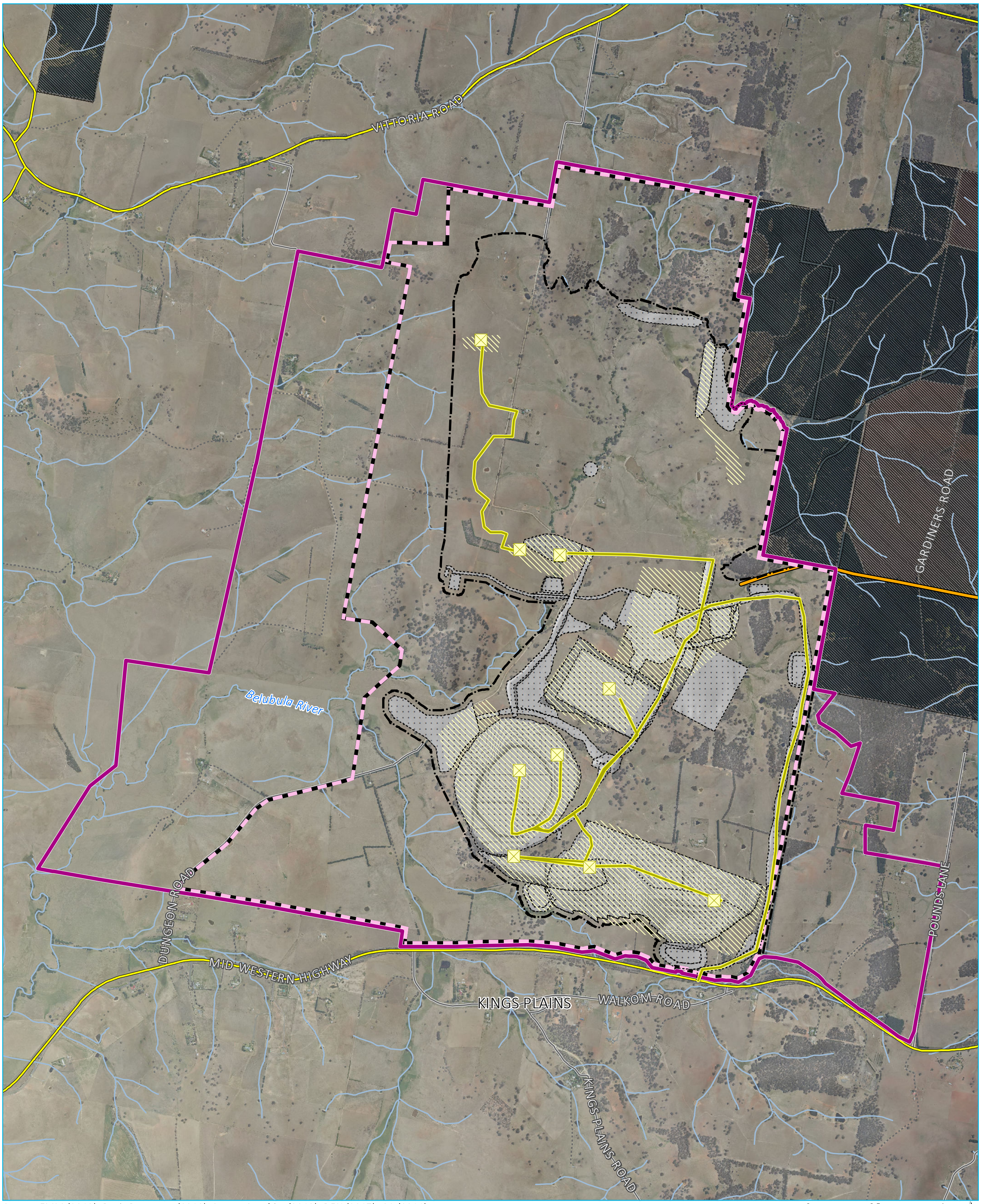
Table C.7 Blasting emission factors derived by Attalla et al. (2007)

	Emission factors (kg pollutant per t of explosives)				
	CO	**NO**	**NO_2**	**NO_x**	**SO_2**
Maximum	97.2	5.0	0.32	5.3	2.4
Average	19.2	0.9	0.06	0.9	0.4

In order to estimate likely maximum blasting emissions from the mining development, the following assumptions were made:

- 500 holes per blast;
- 200 kg explosives per blast hole;
- 100,000 kg of ANFO explosives per blast; and
- a maximum NOx emission rate of 5.3 kg/t from Table C.7 was adopted.

Emissions and impacts of NO2 from blasting are presented in Section 7.4.3 and Section 8.6.1 respectively.



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); GA (2011)

0 0.5 1 km
GDA 1994 MGA Zone 55
N

KEY

- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 1

Emission source

- Volume
- Line volume
- Area

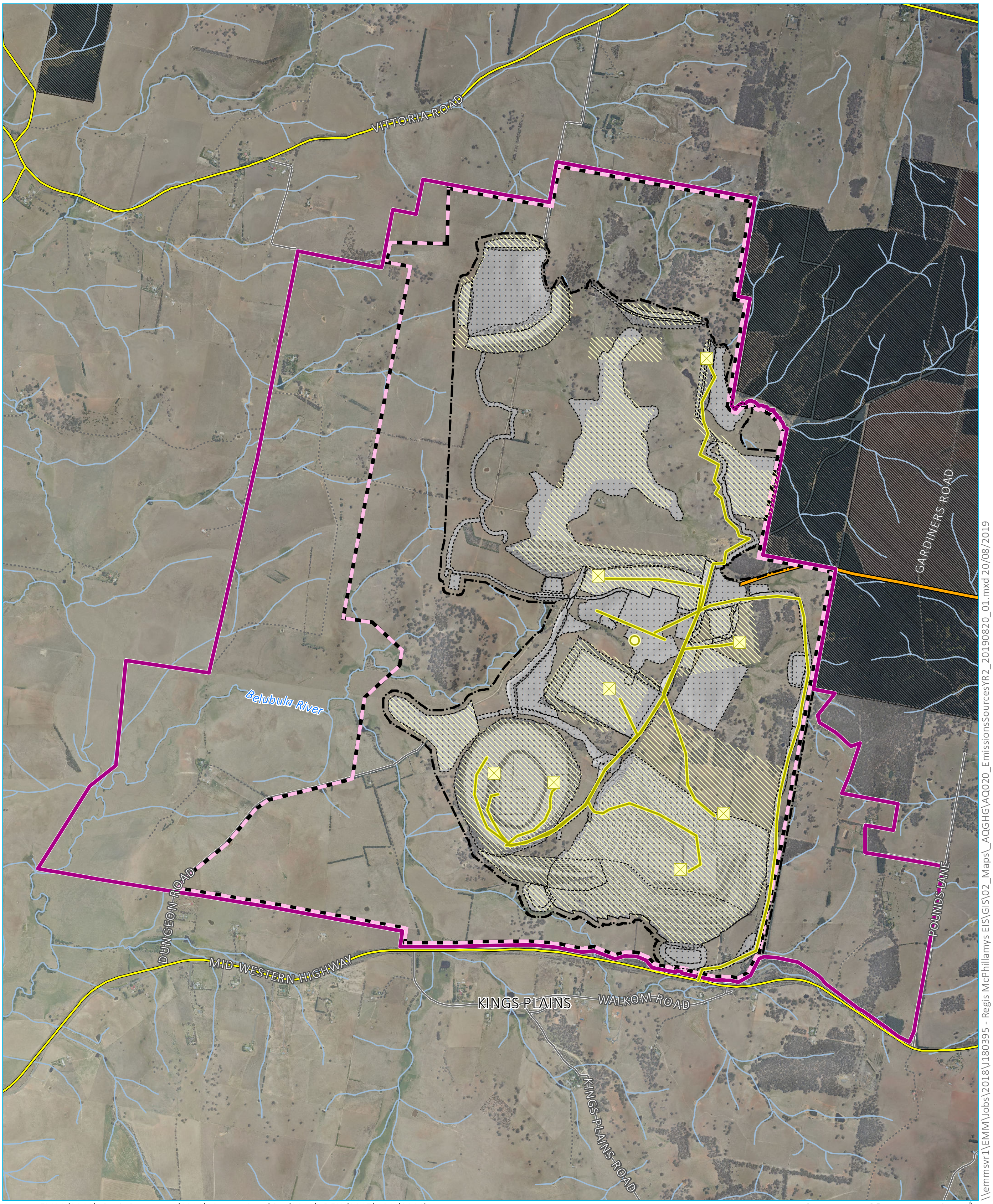
Existing environment

- Main road
- Local road
- Vehicular track
- Watercourse/drainage line
- Vittoria State Forest

Emission source locations - Year 1

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure C.1

REGIS RESOURCES LTD
EMM creating opportunities



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); GA (2011)

0 0.5 1 km
GDA 1994 MGA Zone 55
N

KEY

- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 2

Emission source

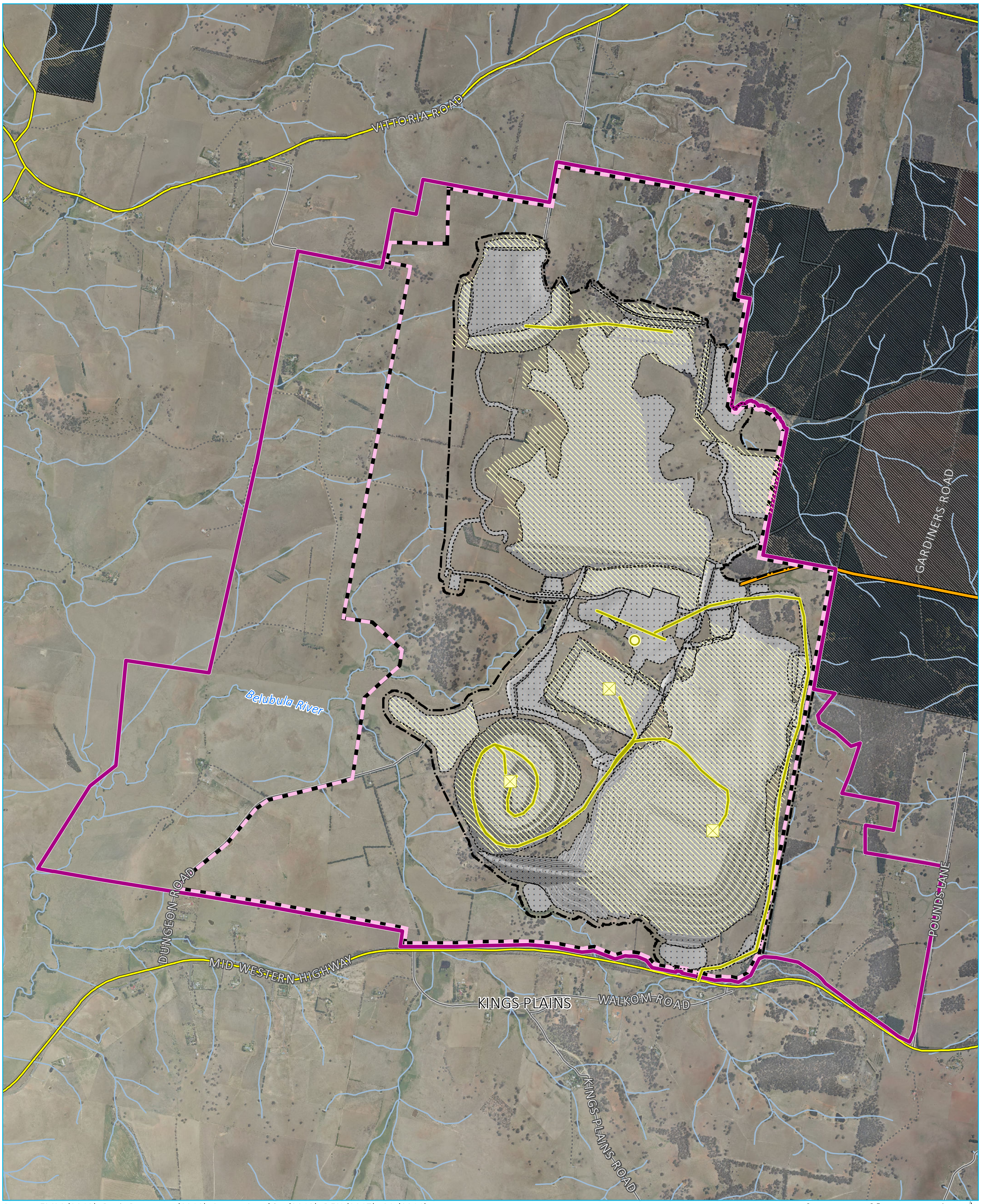
- Point
- Volume
- Line volume
- Area

Existing environment

- Main road
- Local road
- Vehicular track
- Watercourse/drainage line
- Vittoria State Forest

Emission source locations - Year 2

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure C.2



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); GA (2011)

0 0.5 1 km
GDA 1994 MGA Zone 55
N

KEY

- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 4

Emission source

- Point
- Volume
- Line volume
- Area

Existing environment

- Main road
- Local road
- Vehicular track
- Watercourse/drainage line
- Vittoria State Forest

Emission source locations - Year 4

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure C.3

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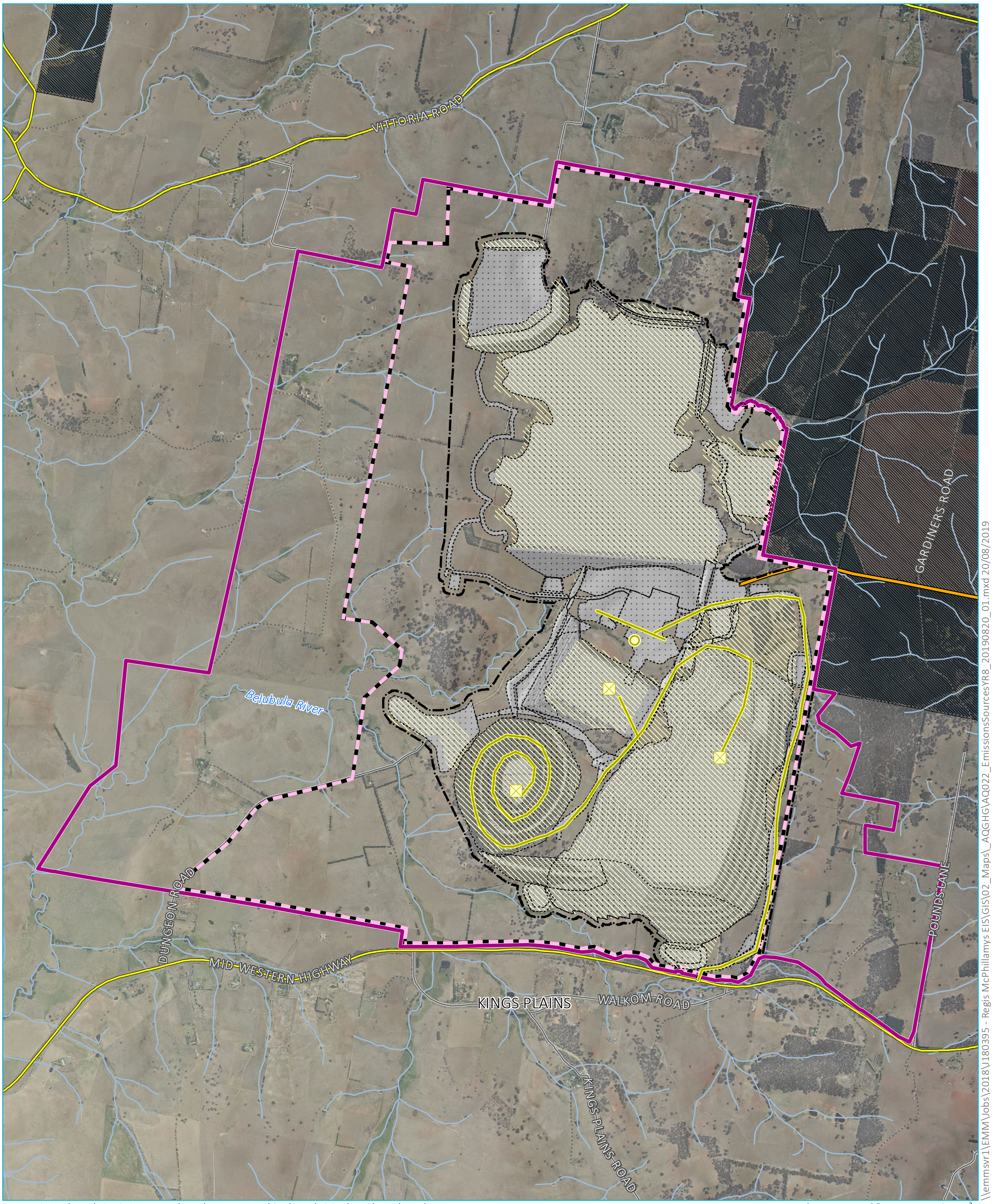
EMM creating opportunities



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); GA (2011)

0 0.5 1 km
GDA 1994 MGA Zone 55
N

KEY

- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 8

Emission source

- Point
- Volume
- Line volume
- Area

Existing environment

- Main road
- Local road
- Vehicular track
- Watercourse/drainage line
- Vittoria State Forest

Emission source locations - Year 8

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure C.4

REGIS RESOURCES LTD
EMM creating opportunities

Appendix D

Predicted incremental and cumulative concentrations – all receptors

Table D.1 Incremental and cumulative annual average TSP concentration – all scenarios

Receptor ID	Incremental annual average TSP concentration (µg/m³) – criterion 90 µg/m³				Cumulative annual average TSP concentration (µg/m³) – criterion 90 µg/m³			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
R01	0.2	0.4	0.4	0.2	35.5	35.7	35.7	35.5
R02	0.2	0.3	0.4	0.2	35.5	35.6	35.7	35.5
R03	0.2	0.3	0.4	0.2	35.5	35.6	35.7	35.5
R04	0.2	0.4	0.4	0.2	35.5	35.7	35.7	35.5
R05	0.2	0.4	0.5	0.2	35.5	35.7	35.8	35.5
R06	1.2	2.7	2.8	1.3	36.5	38.0	38.1	36.6
R07	0.8	1.9	2.1	1.2	36.1	37.2	37.4	36.5
R08	0.4	0.9	0.9	0.4	35.7	36.2	36.2	35.7
R09	0.4	0.9	0.9	0.4	35.7	36.2	36.2	35.7
R10	0.5	1.0	1.0	0.5	35.8	36.3	36.3	35.8
R11	0.5	1.0	1.0	0.5	35.8	36.3	36.3	35.8
R12	0.6	1.3	1.3	0.7	35.9	36.6	36.6	36.0
R13	0.5	1.0	1.1	0.5	35.8	36.3	36.4	35.8
R14	0.6	1.3	1.4	0.7	35.9	36.6	36.7	36.0
R15	1.4	2.9	2.6	1.1	36.7	38.2	37.9	36.4
R16	2.6	4.5	3.5	1.3	37.9	39.8	38.8	36.6
R17	2.9	4.7	3.4	1.4	38.2	40.0	38.7	36.7
R18	1.9	2.7	2.6	0.9	37.2	38.0	37.9	36.2
R19	2.8	4.0	3.8	1.2	38.1	39.3	39.1	36.5
R20	2.2	3.3	3.2	1.0	37.5	38.6	38.5	36.3
R21	2.5	3.8	3.7	1.2	37.8	39.1	39.0	36.5
R22	1.2	2.4	2.3	0.7	36.5	37.7	37.6	36.0
R23	2.0	3.3	3.2	1.0	37.3	38.6	38.5	36.3
R24	2.3	3.7	3.6	1.1	37.6	39.0	38.9	36.4
R25	2.7	4.3	4.1	1.3	38.0	39.6	39.4	36.6
R26	2.9	4.5	4.3	1.3	38.2	39.8	39.6	36.6
R27	2.8	4.5	4.3	1.3	38.1	39.8	39.6	36.6
R28	3.2	5.0	4.7	1.4	38.5	40.3	40.0	36.7
R29	2.4	4.1	3.9	1.1	37.7	39.4	39.2	36.4
R30	3.2	5.1	4.8	1.4	38.5	40.4	40.1	36.7
R31	2.3	4.1	3.9	1.1	37.6	39.4	39.2	36.4
R32	1.4	2.5	2.3	0.7	36.7	37.8	37.6	36.0
R33	1.8	3.1	2.8	0.9	37.1	38.4	38.1	36.2

Table D.1 Incremental and cumulative annual average TSP concentration – all scenarios

Recept or ID	Incremental annual average TSP concentration (µg/m³) – criterion 90 µg/m³				Cumulative annual average TSP concentration (µg/m³) – criterion 90 µg/m³			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
R34	1.6	2.8	2.8	0.9	36.9	38.1	38.1	36.2
R35	1.4	2.8	2.9	0.9	36.7	38.1	38.2	36.2
R36	1.2	2.3	2.4	0.8	36.5	37.6	37.7	36.1
R37	1.2	2.3	2.5	0.8	36.5	37.6	37.8	36.1
R38	1.7	3.1	3.2	1.1	37.0	38.4	38.5	36.4
R39	0.8	1.6	1.6	0.6	36.1	36.9	36.9	35.9
R40	1.1	2.1	2.3	0.8	36.4	37.4	37.6	36.1
R41	0.8	1.5	1.5	0.5	36.1	36.8	36.8	35.8
R42	0.9	1.8	2.1	0.7	36.2	37.1	37.4	36.0
R43	1.1	2.1	2.5	0.9	36.4	37.4	37.8	36.2
R44	0.7	1.3	1.4	0.5	36.0	36.6	36.7	35.8
R45	0.7	1.5	1.7	0.6	36.0	36.8	37.0	35.9
R46	0.8	1.6	1.8	0.7	36.1	36.9	37.1	36.0
R47	1.0	1.9	2.2	0.8	36.3	37.2	37.5	36.1
R48	1.1	2.0	2.4	0.8	36.4	37.3	37.7	36.1
R49	0.6	1.3	1.6	0.6	35.9	36.6	36.9	35.9
R50	0.4	0.9	1.1	0.4	35.7	36.2	36.4	35.7
R51	0.3	0.5	0.7	0.3	35.6	35.8	36.0	35.6
R52	0.3	0.5	0.6	0.3	35.6	35.8	35.9	35.6
R53	0.3	0.5	0.7	0.3	35.6	35.8	36.0	35.6
R54	0.3	0.6	0.7	0.3	35.6	35.9	36.0	35.6
R55	0.3	0.5	0.6	0.3	35.6	35.8	35.9	35.6
R56	0.3	0.5	0.7	0.3	35.6	35.8	36.0	35.6
R57	0.3	0.5	0.7	0.3	35.6	35.8	36.0	35.6
R58	0.3	0.7	0.8	0.3	35.6	36.0	36.1	35.6
R59	0.4	0.7	0.9	0.3	35.7	36.0	36.2	35.6
R60	0.5	0.9	1.0	0.4	35.8	36.2	36.3	35.7
R61	0.6	1.1	1.3	0.5	35.9	36.4	36.6	35.8
R62	0.6	1.2	1.3	0.5	35.9	36.5	36.6	35.8
R63	0.6	1.3	1.5	0.6	35.9	36.6	36.8	35.9
R64	0.6	1.3	1.5	0.6	35.9	36.6	36.8	35.9
R65	0.6	1.1	1.3	0.5	35.9	36.4	36.6	35.8
R66	0.7	1.4	1.7	0.7	36.0	36.7	37.0	36.0

Table D.1 Incremental and cumulative annual average TSP concentration – all scenarios

Receptor ID	Incremental annual average TSP concentration (µg/m³) – criterion 90 µg/m³				Cumulative annual average TSP concentration (µg/m³) – criterion 90 µg/m³			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
R67	0.8	1.5	1.8	0.7	36.1	36.8	37.1	36.0
R68	0.7	1.4	1.8	0.7	36.0	36.7	37.1	36.0
R69	0.6	1.3	1.6	0.7	35.9	36.6	36.9	36.0
R70	0.8	1.6	2.1	0.8	36.1	36.9	37.4	36.1
R71	0.7	1.5	2.0	0.8	36.0	36.8	37.3	36.1
R72	0.7	1.4	1.8	0.8	36.0	36.7	37.1	36.1
R73	0.6	1.3	1.8	0.7	35.9	36.6	37.1	36.0
R74	0.6	1.1	1.5	0.7	35.9	36.4	36.8	36.0
R75	0.7	1.4	1.8	0.9	36.0	36.7	37.1	36.2
R76	0.8	1.4	1.6	0.8	36.1	36.7	36.9	36.1
R77	0.4	0.7	0.9	0.4	35.7	36.0	36.2	35.7
R78	0.3	0.6	0.8	0.4	35.6	35.9	36.1	35.7
R79	0.3	0.5	0.6	0.3	35.6	35.8	35.9	35.6
R80	0.2	0.4	0.5	0.2	35.5	35.7	35.8	35.5
R81	0.2	0.4	0.5	0.2	35.5	35.7	35.8	35.5
R82	0.2	0.4	0.5	0.2	35.5	35.7	35.8	35.5
R83	0.2	0.4	0.5	0.2	35.5	35.7	35.8	35.5
R84	0.3	0.6	0.7	0.3	35.6	35.9	36.0	35.6
R85	0.2	0.4	0.4	0.2	35.5	35.7	35.7	35.5
R86	0.2	0.4	0.4	0.2	35.5	35.7	35.7	35.5
R87	0.2	0.4	0.4	0.2	35.5	35.7	35.7	35.5
R88	0.2	0.5	0.5	0.2	35.5	35.8	35.8	35.5

Table D.2 Maximum incremental and 3rd highest cumulative 24-hour average PM_{10} concentration – all scenarios

Receptor ID	Maximum incremental 24-hour average PM_{10} concentration (µg/m³) – criterion 50 µg/m³				3rd highest cumulative 24-hour average PM_{10} concentration (µg/m³) – criterion 50 µg/m³			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
R01	2.5	4.1	4.8	2.7	38.9	39.0	39.1	38.9
R02	2.1	3.5	4.1	2.5	38.9	39.0	39.0	38.9
R03	2.4	2.6	3.1	1.2	38.8	38.8	38.8	38.8
R04	2.7	4.3	4.1	1.7	38.8	38.8	38.8	38.8

Table D.2 Maximum incremental and 3rd highest cumulative 24-hour average PM_{10} concentration – all scenarios

Receptor ID	Maximum incremental 24-hour average PM_{10} concentration (µg/m³) – criterion 50 µg/m³				3rd highest cumulative 24-hour average PM_{10} concentration (µg/m³) – criterion 50 µg/m³			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
R05	2.3	3.8	4.2	1.7	38.8	38.8	38.9	38.8
R06	4.5	10.1	11.9	5.6	39.2	39.7	39.8	39.2
R07	3.4	7.4	8.0	5.0	39.1	39.3	39.4	39.2
R08	3.0	5.2	4.7	2.4	38.9	38.9	38.9	38.9
R09	4.1	7.3	5.0	3.9	38.9	39.0	39.0	38.9
R10	3.7	6.2	5.5	3.4	38.9	39.0	39.0	38.9
R11	3.9	7.9	5.7	4.4	38.9	39.0	39.0	39.0
R12	6.3	9.2	10.2	4.2	38.9	39.1	39.1	39.0
R13	5.5	6.9	6.3	2.5	39.0	39.2	39.3	39.1
R14	4.0	11.7	8.0	2.7	39.0	39.3	39.2	39.1
R15	9.1	17.6	12.2	5.8	39.5	40.5	40.3	39.6
R16	11.6	20.3	22.9	6.6	40.7	42.5	42.0	39.9
R17	16.0	29.3	15.9	6.9	41.4	47.2	41.9	40.1
R18	10.4	13.0	11.3	4.8	41.1	42.3	42.2	39.8
R19	16.7	17.7	16.2	5.9	42.0	44.3	43.4	40.1
R20	15.6	15.3	15.4	5.4	42.0	43.9	43.3	40.0
R21	16.8	16.6	16.7	5.9	42.1	44.3	43.5	40.1
R22	14.3	19.1	16.8	4.5	41.2	43.8	43.6	40.1
R23	16.6	18.4	19.2	4.8	42.4	44.3	43.7	40.2
R24	18.1	19.4	20.9	5.5	42.8	44.6	43.9	40.3
R25	18.1	19.4	20.6	6.3	42.9	44.7	44.0	40.4
R26	18.9	20.3	21.6	6.5	43.1	44.8	44.1	40.4
R27	20.4	21.8	23.3	6.3	43.5	45.0	44.5	40.5
R28	20.8	22.1	23.7	6.8	43.8	45.0	44.6	40.6
R29	22.6	24.6	22.7	5.7	43.6	45.2	45.0	40.6
R30	25.6	26.3	25.8	6.4	44.8	45.9	45.6	40.8
R31	23.0	27.2	22.9	5.9	43.5	45.5	45.6	40.7
R32	10.8	14.4	14.0	4.2	42.5	43.2	43.7	40.1
R33	11.8	18.4	17.0	4.6	43.0	45.3	45.3	40.3
R34	12.6	17.6	19.3	5.4	40.1	43.9	45.8	39.5
R35	14.2	26.2	29.6	7.6	39.2	45.2	48.1	39.1
R36	11.8	20.8	23.3	6.2	39.2	42.9	43.8	39.0

Table D.2 Maximum incremental and 3rd highest cumulative 24-hour average PM_{10} concentration – all scenarios

Receptor ID	Maximum incremental 24-hour average PM_{10} concentration (µg/m³) – criterion 50 µg/m³				3rd highest cumulative 24-hour average PM_{10} concentration (µg/m³) – criterion 50 µg/m³			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
R37	12.5	23.6	26.4	6.8	39.1	43.3	45.5	38.9
R38	17.2	24.5	29.5	7.7	39.2	44.1	**50.3**	39.0
R39	7.7	13.1	14.2	4.3	39.0	39.1	40.1	38.9
R40	11.6	20.8	24.4	6.4	39.0	41.8	45.9	38.9
R41	8.6	14.8	16.5	4.8	38.9	39.0	40.1	38.9
R42	8.8	17.6	20.9	5.2	39.0	39.2	41.3	38.9
R43	6.2	14.2	17.6	4.8	39.1	39.4	39.9	39.0
R44	8.5	14.8	16.1	4.5	38.9	39.0	38.9	38.8
R45	8.2	16.0	17.7	4.4	39.0	39.1	39.0	38.9
R46	6.7	14.1	17.4	4.5	39.0	39.2	39.0	38.9
R47	4.3	7.5	10.3	3.2	39.1	39.4	39.3	39.0
R48	4.5	8.0	10.1	3.0	39.1	39.4	39.4	39.0
R49	3.8	8.1	11.7	3.3	39.0	39.1	39.1	38.9
R50	4.0	8.3	11.4	3.0	38.9	39.0	38.9	38.9
R51	1.9	3.5	5.5	1.9	38.9	38.9	38.9	38.9
R52	1.3	2.2	3.6	1.6	38.9	39.0	38.9	38.9
R53	1.3	2.2	3.3	1.5	38.9	39.0	39.0	38.9
R54	1.5	2.5	4.1	1.7	38.9	39.0	39.0	38.9
R55	1.3	2.2	3.1	1.3	38.9	39.0	39.0	38.9
R56	1.4	2.2	3.2	1.4	38.9	39.0	39.0	38.9
R57	1.3	2.3	3.4	1.2	38.9	39.0	39.0	38.9
R58	1.8	3.2	4.1	1.5	38.9	39.0	39.0	38.9
R59	1.9	3.5	4.0	1.2	38.9	39.1	39.1	38.9
R60	2.6	5.0	6.0	1.5	38.9	39.1	39.2	39.0
R61	2.6	4.8	6.1	1.7	38.9	39.0	39.0	38.9
R62	2.6	4.9	6.2	1.7	38.9	39.0	39.0	38.9
R63	2.7	5.3	6.9	1.9	38.9	39.0	39.0	38.9
R64	2.5	5.1	5.9	1.7	38.9	38.9	38.9	38.9
R65	2.5	4.4	5.1	1.4	38.9	38.9	38.9	38.9
R66	3.3	5.6	6.5	1.7	38.9	38.9	38.9	38.9
R67	3.6	6.2	6.8	1.8	38.9	38.9	38.9	38.9
R68	4.0	8.8	8.8	2.3	38.9	38.9	38.9	38.8

Table D.2 Maximum incremental and 3rd highest cumulative 24-hour average PM_{10} concentration – all scenarios

Receptor ID	Maximum incremental 24-hour average PM_{10} concentration (µg/m³) – criterion 50 µg/m³				3rd highest cumulative 24-hour average PM_{10} concentration (µg/m³) – criterion 50 µg/m³			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
R69	3.8	7.9	8.2	2.2	38.8	38.9	38.9	38.8
R70	3.9	9.8	10.0	2.9	38.9	38.9	38.9	38.8
R71	3.5	9.0	9.8	3.1	38.9	38.9	38.9	38.8
R72	3.3	8.3	9.3	2.8	38.9	38.9	38.9	38.8
R73	2.9	7.4	9.0	2.9	38.8	38.9	38.9	38.8
R74	2.4	5.4	6.0	2.7	38.8	38.9	38.9	38.8
R75	3.9	8.1	9.6	2.8	38.9	38.9	38.9	38.8
R76	7.0	13.4	12.9	3.0	38.9	38.9	38.9	38.9
R77	2.2	4.6	5.5	1.6	38.8	38.9	38.9	38.8
R78	2.9	5.8	8.2	1.9	38.8	38.9	38.9	38.8
R79	1.6	3.3	3.9	1.3	38.8	38.8	38.8	38.8
R80	2.5	4.7	4.6	1.5	38.8	38.8	38.8	38.8
R81	2.7	4.8	5.1	1.4	38.8	38.8	38.8	38.8
R82	2.9	5.3	5.6	1.4	38.8	38.8	38.8	38.8
R83	2.8	5.4	5.5	1.4	38.8	38.8	38.8	38.8
R84	3.8	6.3	5.7	1.8	38.8	38.8	38.8	38.8
R85	2.5	3.3	4.0	1.7	38.8	38.8	38.8	38.8
R86	2.1	2.8	3.6	1.6	38.8	38.8	38.8	38.8
R87	1.7	2.6	3.6	1.5	38.8	38.8	38.8	38.8
R88	2.0	2.9	3.9	1.9	38.8	38.8	38.8	38.8

Table D.3 Incremental and cumulative annual average PM_{10} concentration – all scenarios

Receptor ID	Incremental annual average PM_{10} concentration (µg/m³) – criterion 25 µg/m³				Cumulative annual average PM_{10} concentration (µg/m³) – criterion 25 µg/m³			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
R01	0.1	0.2	0.3	0.1	14.2	14.3	14.3	14.2
R02	0.1	0.2	0.2	0.1	14.2	14.3	14.3	14.2
R03	0.1	0.2	0.2	0.1	14.2	14.3	14.3	14.2
R04	0.1	0.2	0.3	0.1	14.2	14.3	14.3	14.2
R05	0.1	0.3	0.3	0.1	14.2	14.3	14.4	14.2
R06	0.7	1.5	1.5	0.6	14.8	15.6	15.6	14.7

Table D.3 Incremental and cumulative annual average PM_{10} concentration – all scenarios

Recept or ID	Incremental annual average PM_{10} concentration (µg/m³) – criterion 25 µg/m³				Cumulative annual average PM_{10} concentration (µg/m³) – criterion 25 µg/m³			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
	0.5	1.0	1.1	0.5	14.6	15.1	15.2	14.6
R08	0.3	0.5	0.5	0.2	14.4	14.6	14.6	14.3
R09	0.3	0.5	0.5	0.2	14.4	14.6	14.5	14.3
R10	0.3	0.6	0.5	0.2	14.4	14.6	14.6	14.3
R11	0.3	0.6	0.5	0.2	14.4	14.6	14.6	14.3
R12	0.4	0.7	0.7	0.3	14.4	14.8	14.7	14.4
R13	0.3	0.6	0.6	0.3	14.4	14.7	14.7	14.3
R14	0.3	0.6	0.7	0.3	14.4	14.7	14.8	14.4
R15	0.8	1.6	1.4	0.5	14.8	15.6	15.5	14.6
R16	1.5	2.6	2.0	0.7	15.6	16.7	16.1	14.8
R17	1.8	2.8	2.0	0.8	15.9	16.9	16.1	14.9
R18	1.1	1.5	1.4	0.5	15.2	15.6	15.5	14.6
R19	1.8	2.5	2.2	0.7	15.9	16.5	16.3	14.8
R20	1.4	2.0	1.8	0.6	15.5	16.1	15.9	14.6
R21	1.7	2.4	2.1	0.6	15.7	16.4	16.2	14.7
R22	0.9	1.5	1.4	0.4	15.0	15.6	15.5	14.5
R23	1.3	2.0	1.8	0.5	15.4	16.1	15.9	14.6
R24	1.5	2.2	2.0	0.6	15.6	16.3	16.1	14.7
R25	1.8	2.6	2.3	0.7	15.9	16.7	16.4	14.8
R26	1.9	2.8	2.4	0.7	16.0	16.8	16.5	14.8
R27	1.8	2.7	2.4	0.7	15.9	16.8	16.5	14.8
R28	2.1	3.0	2.6	0.8	16.1	17.1	16.7	14.8
R29	1.6	2.5	2.2	0.6	15.7	16.6	16.3	14.7
R30	2.1	3.1	2.7	0.8	16.1	17.1	16.8	14.8
R31	1.6	2.6	2.3	0.6	15.7	16.7	16.3	14.7
R32	1.0	1.7	1.5	0.4	15.1	15.8	15.6	14.5
R33	1.3	2.1	1.9	0.5	15.4	16.2	15.9	14.6
R34	1.2	1.8	1.7	0.5	15.2	15.9	15.8	14.6
R35	1.0	1.9	1.8	0.5	15.1	15.9	15.9	14.6
R36	0.9	1.5	1.5	0.4	15.0	15.6	15.6	14.5
R37	0.8	1.6	1.5	0.5	14.9	15.6	15.6	14.5
R38	1.2	1.9	1.9	0.6	15.3	16.0	16.0	14.7
R39	0.6	1.1	1.0	0.3	14.7	15.1	15.1	14.4

Table D.3 Incremental and cumulative annual average PM_{10} concentration – all scenarios

Recept or ID	Incremental annual average PM_{10} concentration (µg/m³) – criterion 25 µg/m³				Cumulative annual average PM_{10} concentration (µg/m³) – criterion 25 µg/m³			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
R40	0.7	1.4	1.4	0.4	14.8	15.5	15.5	14.5
R41	0.6	1.0	1.0	0.3	14.6	15.0	15.0	14.4
R42	0.6	1.2	1.3	0.4	14.7	15.3	15.4	14.5
R43	0.8	1.4	1.5	0.5	14.8	15.5	15.6	14.5
R44	0.5	0.9	0.9	0.3	14.6	14.9	15.0	14.4
R45	0.5	1.0	1.0	0.3	14.6	15.0	15.1	14.4
R46	0.6	1.0	1.1	0.4	14.6	15.1	15.2	14.4
R47	0.6	1.2	1.3	0.4	14.7	15.3	15.4	14.5
R48	0.7	1.3	1.4	0.4	14.8	15.4	15.5	14.5
R49	0.4	0.8	1.0	0.3	14.5	14.9	15.0	14.4
R50	0.3	0.6	0.7	0.2	14.4	14.7	14.7	14.3
R51	0.2	0.4	0.4	0.1	14.3	14.4	14.5	14.2
R52	0.2	0.3	0.4	0.1	14.3	14.4	14.5	14.2
R53	0.2	0.3	0.4	0.1	14.3	14.4	14.5	14.2
R54	0.2	0.4	0.5	0.2	14.3	14.4	14.5	14.2
R55	0.2	0.3	0.4	0.1	14.3	14.4	14.5	14.2
R56	0.2	0.3	0.4	0.1	14.3	14.4	14.5	14.2
R57	0.2	0.4	0.4	0.1	14.3	14.4	14.5	14.2
R58	0.2	0.5	0.5	0.2	14.3	14.5	14.6	14.2
R59	0.3	0.5	0.5	0.2	14.3	14.6	14.6	14.2
R60	0.3	0.6	0.6	0.2	14.4	14.6	14.7	14.3
R61	0.4	0.7	0.7	0.3	14.5	14.8	14.8	14.3
R62	0.4	0.7	0.7	0.3	14.5	14.8	14.8	14.3
R63	0.4	0.8	0.8	0.3	14.5	14.8	14.9	14.4
R64	0.4	0.8	0.8	0.3	14.5	14.8	14.9	14.4
R65	0.4	0.7	0.7	0.3	14.5	14.8	14.8	14.3
R66	0.5	0.8	1.0	0.3	14.5	14.9	15.0	14.4
R67	0.5	0.9	1.0	0.4	14.6	15.0	15.1	14.4
R68	0.4	0.9	1.0	0.4	14.5	14.9	15.0	14.4
R69	0.4	0.8	0.9	0.3	14.5	14.8	15.0	14.4
R70	0.5	1.0	1.1	0.4	14.6	15.0	15.2	14.5
R71	0.5	0.9	1.1	0.4	14.6	15.0	15.2	14.5
R72	0.4	0.8	1.0	0.4	14.5	14.9	15.1	14.4

Table D.3 Incremental and cumulative annual average PM_{10} concentration – all scenarios

Recept or ID	Incremental annual average PM_{10} concentration (µg/m³) – criterion 25 µg/m³				Cumulative annual average PM_{10} concentration (µg/m³) – criterion 25 µg/m³			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
R73	0.4	0.8	1.0	0.4	14.5	14.9	15.0	14.4
R74	0.4	0.7	0.8	0.3	14.5	14.8	14.9	14.4
R75	0.5	0.8	1.0	0.4	14.6	14.9	15.1	14.5
R76	0.5	0.8	0.9	0.4	14.6	14.9	15.0	14.5
R77	0.3	0.4	0.5	0.2	14.4	14.5	14.6	14.3
R78	0.2	0.4	0.5	0.2	14.3	14.5	14.6	14.3
R79	0.2	0.3	0.4	0.2	14.3	14.4	14.5	14.2
R80	0.1	0.3	0.3	0.1	14.2	14.3	14.4	14.2
R81	0.1	0.3	0.3	0.1	14.2	14.3	14.4	14.2
R82	0.2	0.3	0.3	0.1	14.2	14.4	14.4	14.2
R83	0.2	0.3	0.3	0.1	14.2	14.4	14.4	14.2
R84	0.2	0.4	0.4	0.2	14.3	14.4	14.5	14.3
R85	0.1	0.2	0.3	0.1	14.2	14.3	14.4	14.2
R86	0.1	0.2	0.3	0.1	14.2	14.3	14.4	14.2
R87	0.1	0.2	0.3	0.1	14.2	14.3	14.3	14.2
R88	0.2	0.3	0.3	0.1	14.2	14.4	14.4	14.2

Table D.4 Maximum incremental and cumulative 24-hour average $PM_{2.5}$ concentrations – all scenarios

Recept or ID	Maximum incremental 24-hour average $PM_{2.5}$ concentration (µg/m³) – criterion 25 µg/m³				Maximum incremental 24-hour average $PM_{2.5}$ concentration (µg/m³) – criterion 25 µg/m³			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
R01	0.6	1.0	1.0	0.6	17.5	17.6	17.6	17.5
R02	0.5	0.8	0.9	0.6	17.5	17.6	17.5	17.5
R03	0.8	0.7	0.7	0.3	17.5	17.6	17.5	17.5
R04	0.8	1.2	1.0	0.5	17.5	17.6	17.5	17.5
R05	0.7	1.1	1.0	0.5	17.5	17.6	17.5	17.5
R06	1.0	2.2	2.4	1.4	17.6	17.7	17.7	17.6
R07	0.8	1.8	1.7	1.1	17.5	17.6	17.6	17.5
R08	0.7	1.1	1.0	0.6	17.5	17.6	17.6	17.5
R09	0.8	1.6	1.1	1.1	17.6	17.7	17.6	17.5
R10	0.7	1.3	1.3	0.8	17.5	17.7	17.6	17.5

Table D.4 Maximum incremental and cumulative 24-hour average $PM_{2.5}$ concentrations – all scenarios

Recept or ID	Maximum incremental 24-hour average $PM_{2.5}$ concentration (µg/m³) – criterion 25 µg/m³				Maximum incremental 24-hour average $PM_{2.5}$ concentration (µg/m³) – criterion 25 µg/m³			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
R11	0.8	1.7	1.2	1.2	17.5	17.6	17.6	17.5
R12	1.3	1.9	2.3	1.0	17.6	17.7	17.6	17.6
R13	1.3	1.5	1.3	0.6	17.6	17.8	17.9	17.7
R14	0.8	2.7	2.0	0.6	17.5	17.6	17.7	17.6
R15	1.9	4.0	2.5	1.4	17.6	18.0	18.2	17.7
R16	2.4	4.3	5.7	1.6	17.9	18.6	18.1	17.7
R17	3.5	7.0	2.8	1.3	18.1	18.6	18.1	17.7
R18	2.2	2.5	2.0	0.9	18.0	18.2	18.0	17.7
R19	3.8	3.9	3.2	1.1	18.7	18.8	18.4	17.8
R20	3.4	3.4	2.8	1.0	18.3	18.5	18.3	17.8
R21	3.6	3.6	3.0	1.1	18.6	18.8	18.4	17.8
R22	3.4	3.9	2.9	0.8	17.9	18.1	18.0	17.7
R23	3.2	3.4	3.1	1.0	18.3	18.6	18.2	17.7
R24	3.6	3.6	3.4	1.0	18.4	18.8	18.4	17.8
R25	3.8	3.7	3.5	1.1	18.7	19.1	18.5	17.8
R26	3.9	3.9	3.6	1.2	18.7	19.5	18.7	17.8
R27	4.1	4.1	3.8	1.1	18.6	19.8	18.9	17.8
R28	4.2	4.1	3.9	1.2	18.7	20.4	19.3	17.9
R29	4.8	4.5	3.6	1.0	18.4	20.2	19.2	17.8
R30	5.2	4.8	4.0	1.2	18.6	21.1	19.9	17.9
R31	5.0	5.0	3.5	1.0	18.4	20.5	19.5	17.8
R32	3.1	3.3	3.2	1.0	18.3	19.4	18.9	17.9
R33	3.3	4.2	3.6	1.1	19.0	19.5	18.8	18.1
R34	3.0	3.8	3.3	1.4	20.0	20.9	20.7	18.5
R35	3.4	5.5	5.3	1.8	19.9	21.2	20.8	18.9
R36	2.9	4.5	4.3	1.6	19.7	20.8	20.4	18.7
R37	3.0	5.2	4.8	1.6	19.4	21.0	20.8	18.9
R38	3.9	5.0	5.1	1.7	19.7	21.2	21.7	19.2
R39	2.0	3.0	2.9	1.1	19.3	20.0	19.9	18.5
R40	2.8	4.7	4.5	1.5	19.0	20.9	20.9	18.9
R41	2.3	3.4	3.3	1.2	19.1	19.9	19.9	18.6
R42	2.3	4.5	4.0	1.2	18.7	20.0	20.2	18.6
R43	1.7	3.8	3.2	1.1	18.8	20.1	20.1	18.5

Table D.4 Maximum incremental and cumulative 24-hour average $PM_{2.5}$ concentrations – all scenarios

Recept or ID	Maximum incremental 24-hour average $PM_{2.5}$ concentration (µg/m³) – criterion 25 µg/m³				Maximum incremental 24-hour average $PM_{2.5}$ concentration (µg/m³) – criterion 25 µg/m³			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
R44	2.3	3.4	3.2	1.0	18.5	19.5	19.8	18.5
R45	2.1	4.0	3.4	1.1	18.5	19.6	19.8	18.5
R46	1.8	3.8	3.4	1.1	18.5	19.5	19.6	18.4
R47	1.4	2.0	2.1	0.7	18.9	19.5	19.6	18.2
R48	1.4	2.1	2.1	0.7	18.9	19.6	19.6	18.2
R49	1.1	2.4	2.4	0.8	18.5	19.1	19.1	18.1
R50	1.1	2.4	2.4	0.8	18.2	18.6	18.7	18.0
R51	0.6	1.1	1.3	0.5	17.9	18.2	18.3	17.8
R52	0.5	0.8	0.8	0.4	17.9	18.1	18.2	17.7
R53	0.4	0.8	0.8	0.3	17.9	18.2	18.2	17.7
R54	0.5	0.9	0.9	0.4	18.0	18.2	18.3	17.8
R55	0.4	0.7	0.8	0.3	17.9	18.2	18.2	17.7
R56	0.4	0.7	0.8	0.3	17.9	18.2	18.3	17.7
R57	0.5	0.8	0.9	0.3	17.9	18.2	18.3	17.7
R58	0.6	1.0	1.0	0.4	18.1	18.4	18.4	17.8
R59	0.6	1.0	0.9	0.3	18.1	18.3	18.3	17.7
R60	0.7	1.2	1.2	0.4	18.1	18.2	18.3	17.7
R61	0.7	1.2	1.3	0.4	18.0	18.2	18.2	17.7
R62	0.7	1.2	1.3	0.5	18.0	18.2	18.2	17.7
R63	0.7	1.3	1.4	0.5	17.9	18.3	18.3	17.7
R64	0.7	1.2	1.2	0.4	17.8	18.1	18.1	17.7
R65	0.7	1.1	1.0	0.4	17.8	17.9	18.0	17.7
R66	0.8	1.4	1.3	0.4	17.8	18.0	18.0	17.7
R67	0.9	1.5	1.3	0.5	17.8	18.0	18.1	17.7
R68	1.0	2.0	1.7	0.5	17.7	17.8	17.8	17.6
R69	0.9	1.9	1.6	0.5	17.7	17.8	17.8	17.6
R70	0.9	2.3	1.9	0.6	17.7	17.8	17.9	17.7
R71	0.9	2.1	1.9	0.6	17.7	17.8	17.9	17.7
R72	0.8	2.0	1.8	0.6	17.7	17.8	17.9	17.7
R73	0.8	1.8	1.7	0.6	17.7	17.8	17.9	17.7
R74	0.7	1.5	1.3	0.6	17.7	17.8	18.0	17.7
R75	0.9	2.0	1.9	0.7	18.0	18.3	18.4	17.8
R76	1.7	3.0	2.3	0.7	18.3	18.9	18.8	17.9

Table D.4 Maximum incremental and cumulative 24-hour average $PM_{2.5}$ concentrations – all scenarios

Recept or ID	Maximum incremental 24-hour average $PM_{2.5}$ concentration (µg/m³) – criterion 25 µg/m³				Maximum incremental 24-hour average $PM_{2.5}$ concentration (µg/m³) – criterion 25 µg/m³			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
R77	0.6	1.2	1.1	0.4	17.7	17.9	17.9	17.6
R78	0.8	1.4	1.6	0.5	17.9	18.2	18.3	17.7
R79	0.4	0.9	0.8	0.3	17.8	18.0	18.0	17.7
R80	0.8	1.3	1.0	0.4	17.7	17.8	17.9	17.6
R81	0.8	1.4	1.1	0.3	17.7	17.8	17.8	17.6
R82	0.8	1.5	1.2	0.4	17.7	17.7	17.8	17.6
R83	0.8	1.4	1.2	0.4	17.7	17.7	17.7	17.6
R84	1.1	1.6	1.2	0.5	17.7	17.8	17.9	17.7
R85	0.8	0.9	1.0	0.5	17.6	17.7	17.6	17.6
R86	0.6	0.8	0.9	0.5	17.6	17.7	17.6	17.6
R87	0.5	0.7	0.9	0.5	17.6	17.7	17.6	17.5
R88	0.6	0.8	1.0	0.6	17.6	17.7	17.6	17.6

Table D.5 Incremental and cumulative annual average $PM_{2.5}$ concentration – all scenarios

Recept or ID	Incremental annual average $PM_{2.5}$ concentration (µg/m³) – criterion 8 µg/m³				Cumulative annual average $PM_{2.5}$ concentration (µg/m³) – criterion 8 µg/m³			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
R01	<0.1	0.1	0.1	<0.1	6.1	6.1	6.1	6.1
R02	<0.1	0.1	0.1	<0.1	6.1	6.1	6.1	6.1
R03	<0.1	0.1	0.1	<0.1	6.1	6.1	6.1	6.1
R04	<0.1	0.1	0.1	<0.1	6.1	6.1	6.1	6.1
R05	<0.1	0.1	0.1	<0.1	6.1	6.1	6.1	6.1
R06	0.2	0.3	0.3	0.2	6.2	6.4	6.4	6.2
R07	0.1	0.2	0.2	0.1	6.2	6.3	6.3	6.2
R08	0.1	0.1	0.1	0.1	6.1	6.2	6.2	6.1
R09	0.1	0.1	0.1	0.1	6.1	6.2	6.2	6.1
R10	0.1	0.1	0.1	0.1	6.2	6.2	6.2	6.1
R11	0.1	0.1	0.1	0.1	6.1	6.2	6.2	6.1
R12	0.1	0.2	0.1	0.1	6.2	6.2	6.2	6.2
R13	0.1	0.2	0.1	0.1	6.2	6.2	6.2	6.1
R14	0.1	0.1	0.2	0.1	6.1	6.2	6.2	6.1

Table D.5 Incremental and cumulative annual average $PM_{2.5}$ concentration – all scenarios

Receptor ID	Incremental annual average $PM_{2.5}$ concentration (µg/m³) – criterion 8 µg/m³				Cumulative annual average $PM_{2.5}$ concentration (µg/m³) – criterion 8 µg/m³			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
R15	0.2	0.3	0.3	0.1	6.2	6.4	6.4	6.2
R16	0.3	0.6	0.4	0.2	6.4	6.7	6.5	6.2
R17	0.4	0.6	0.4	0.2	6.5	6.7	6.5	6.2
R18	0.2	0.3	0.3	0.1	6.3	6.4	6.3	6.2
R19	0.4	0.5	0.4	0.1	6.5	6.6	6.5	6.2
R20	0.3	0.4	0.3	0.1	6.4	6.5	6.4	6.2
R21	0.4	0.5	0.4	0.1	6.5	6.6	6.5	6.2
R22	0.2	0.3	0.3	0.1	6.3	6.4	6.3	6.2
R23	0.3	0.4	0.3	0.1	6.4	6.5	6.4	6.2
R24	0.3	0.5	0.4	0.1	6.4	6.5	6.4	6.2
R25	0.4	0.5	0.4	0.1	6.5	6.6	6.5	6.2
R26	0.4	0.6	0.4	0.2	6.5	6.7	6.5	6.2
R27	0.4	0.6	0.4	0.2	6.5	6.6	6.5	6.2
R28	0.5	0.6	0.5	0.2	6.5	6.7	6.6	6.2
R29	0.4	0.5	0.4	0.1	6.5	6.6	6.5	6.2
R30	0.5	0.6	0.5	0.2	6.5	6.7	6.6	6.2
R31	0.4	0.5	0.4	0.1	6.5	6.6	6.5	6.2
R32	0.3	0.4	0.3	0.1	6.3	6.5	6.4	6.2
R33	0.3	0.5	0.4	0.1	6.4	6.5	6.4	6.2
R34	0.3	0.4	0.3	0.1	6.4	6.5	6.4	6.2
R35	0.3	0.4	0.3	0.1	6.3	6.5	6.4	6.2
R36	0.2	0.3	0.3	0.1	6.3	6.4	6.4	6.2
R37	0.2	0.4	0.3	0.1	6.3	6.4	6.4	6.2
R38	0.3	0.4	0.3	0.1	6.4	6.5	6.4	6.2
R39	0.2	0.2	0.2	0.1	6.2	6.3	6.3	6.2
R40	0.2	0.3	0.3	0.1	6.3	6.4	6.3	6.2
R41	0.1	0.2	0.2	0.1	6.2	6.3	6.3	6.2
R42	0.2	0.3	0.3	0.1	6.2	6.4	6.3	6.2
R43	0.2	0.3	0.3	0.1	6.3	6.4	6.4	6.2
R44	0.1	0.2	0.2	0.1	6.2	6.3	6.3	6.1
R45	0.1	0.2	0.2	0.1	6.2	6.3	6.3	6.2
R46	0.1	0.3	0.2	0.1	6.2	6.3	6.3	6.2
R47	0.2	0.3	0.3	0.1	6.2	6.4	6.3	6.2

Table D.5 Incremental and cumulative annual average $PM_{2.5}$ concentration – all scenarios

Receptor ID	Incremental annual average $PM_{2.5}$ concentration (µg/m³) – criterion 8 µg/m³				Cumulative annual average $PM_{2.5}$ concentration (µg/m³) – criterion 8 µg/m³			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
R48	0.2	0.3	0.3	0.1	6.3	6.4	6.3	6.2
R49	0.1	0.2	0.2	0.1	6.2	6.3	6.3	6.2
R50	0.1	0.2	0.1	0.1	6.2	6.2	6.2	6.1
R51	0.1	0.1	0.1	<0.1	6.1	6.2	6.2	6.1
R52	0.1	0.1	0.1	<0.1	6.1	6.2	6.2	6.1
R53	0.1	0.1	0.1	<0.1	6.1	6.2	6.2	6.1
R54	0.1	0.1	0.1	<0.1	6.1	6.2	6.2	6.1
R55	0.1	0.1	0.1	<0.1	6.1	6.2	6.2	6.1
R56	0.1	0.1	0.1	<0.1	6.1	6.2	6.2	6.1
R57	0.1	0.1	0.1	<0.1	6.1	6.2	6.2	6.1
R58	0.1	0.1	0.1	<0.1	6.2	6.2	6.2	6.1
R59	0.1	0.1	0.1	<0.1	6.2	6.2	6.2	6.1
R60	0.1	0.1	0.1	0.1	6.2	6.2	6.2	6.1
R61	0.1	0.2	0.2	0.1	6.2	6.3	6.2	6.1
R62	0.1	0.2	0.2	0.1	6.2	6.3	6.2	6.1
R63	0.1	0.2	0.2	0.1	6.2	6.3	6.3	6.1
R64	0.1	0.2	0.2	0.1	6.2	6.3	6.3	6.1
R65	0.1	0.2	0.2	0.1	6.2	6.2	6.2	6.1
R66	0.1	0.2	0.2	0.1	6.2	6.3	6.3	6.2
R67	0.1	0.2	0.2	0.1	6.2	6.3	6.3	6.2
R68	0.1	0.2	0.2	0.1	6.2	6.3	6.3	6.2
R69	0.1	0.2	0.2	0.1	6.2	6.3	6.3	6.2
R70	0.1	0.2	0.2	0.1	6.2	6.3	6.3	6.2
R71	0.1	0.2	0.2	0.1	6.2	6.3	6.3	6.2
R72	0.1	0.2	0.2	0.1	6.2	6.3	6.3	6.2
R73	0.1	0.2	0.2	0.1	6.2	6.3	6.3	6.2
R74	0.1	0.2	0.2	0.1	6.2	6.3	6.3	6.2
R75	0.1	0.2	0.2	0.1	6.2	6.3	6.3	6.2
R76	0.1	0.2	0.2	0.1	6.2	6.3	6.3	6.2
R77	0.1	0.1	0.1	0.1	6.2	6.2	6.2	6.1
R78	0.1	0.1	0.1	0.1	6.1	6.2	6.2	6.1
R79	0.1	0.1	0.1	<0.1	6.1	6.2	6.2	6.1
R80	<0.1	0.1	0.1	<0.1	6.1	6.2	6.2	6.1

Table D.5 Incremental and cumulative annual average $PM_{2.5}$ concentration – all scenarios

Receptor ID	Incremental annual average $PM_{2.5}$ concentration (µg/m³) – criterion 8 µg/m³				Cumulative annual average $PM_{2.5}$ concentration (µg/m³) – criterion 8 µg/m³			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
R81	<0.1	0.1	0.1	<0.1	6.1	6.2	6.2	6.1
R82	<0.1	0.1	0.1	<0.1	6.1	6.2	6.2	6.1
R83	<0.1	0.1	0.1	<0.1	6.1	6.2	6.2	6.1
R84	0.1	0.1	0.1	<0.1	6.1	6.2	6.2	6.1
R85	<0.1	0.1	0.1	<0.1	6.1	6.1	6.1	6.1
R86	<0.1	0.1	0.1	<0.1	6.1	6.1	6.1	6.1
R87	<0.1	0.1	0.1	<0.1	6.1	6.1	6.1	6.1
R88	<0.1	0.1	0.1	<0.1	6.1	6.2	6.2	6.1

Table D.6 Incremental and cumulative annual average dust deposition rates – all scenarios

Receptor ID	Incremental annual average dust deposition rate (g/m²/month) – criterion 2 g/m²/month				Cumulative annual average dust deposition rate (g/m²/month) – criterion 4 g/m²/month			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
R01	<0.1	<0.1	<0.1	<0.1	1.4	1.4	1.4	1.4
R02	<0.1	<0.1	<0.1	<0.1	1.4	1.4	1.4	1.4
R03	<0.1	<0.1	<0.1	<0.1	1.4	1.4	1.4	1.4
R04	<0.1	<0.1	<0.1	<0.1	1.4	1.4	1.4	1.4
R05	<0.1	0.1	0.1	<0.1	1.4	1.5	1.5	1.4
R06	0.2	0.5	0.5	0.3	1.6	1.9	1.9	1.7
R07	0.1	0.3	0.3	0.3	1.5	1.7	1.7	1.7
R08	0.1	0.2	0.2	0.1	1.5	1.6	1.6	1.5
R09	0.1	0.2	0.2	0.1	1.5	1.6	1.6	1.5
R10	0.1	0.2	0.2	0.1	1.5	1.6	1.6	1.5
R11	0.1	0.2	0.2	0.1	1.5	1.6	1.6	1.5
R12	0.1	0.2	0.2	0.1	1.5	1.6	1.6	1.5
R13	0.1	0.2	0.2	0.1	1.5	1.6	1.6	1.5
R14	0.1	0.3	0.3	0.2	1.5	1.7	1.7	1.6
R15	0.3	0.5	0.5	0.2	1.7	1.9	1.9	1.6
R16	0.5	0.8	0.8	0.3	1.9	2.2	2.2	1.7
R17	0.5	0.8	0.8	0.3	1.9	2.2	2.2	1.7
R18	0.3	0.4	0.4	0.2	1.7	1.8	1.8	1.6

Table D.6 Incremental and cumulative annual average dust deposition rates – all scenarios

Recept or ID	Incremental annual average dust deposition rate (g/m²/month) – criterion 2 g/m²/month				Cumulative annual average dust deposition rate (g/m²/month) – criterion 4 g/m²/month			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
R19	0.4	0.6	0.6	0.2	1.8	2.0	2.0	1.6
R20	0.3	0.5	0.5	0.2	1.7	1.9	1.9	1.6
R21	0.4	0.6	0.6	0.2	1.8	2.0	2.0	1.6
R22	0.1	0.3	0.3	0.1	1.5	1.7	1.7	1.5
R23	0.3	0.5	0.5	0.2	1.7	1.9	1.9	1.6
R24	0.3	0.6	0.6	0.2	1.7	2.0	2.0	1.6
R25	0.4	0.6	0.6	0.2	1.8	2.0	2.0	1.6
R26	0.4	0.7	0.7	0.2	1.8	2.1	2.1	1.6
R27	0.4	0.7	0.7	0.2	1.8	2.1	2.1	1.6
R28	0.5	0.7	0.7	0.3	1.9	2.1	2.1	1.7
R29	0.3	0.6	0.6	0.2	1.7	2.0	2.0	1.6
R30	0.4	0.7	0.7	0.2	1.8	2.1	2.1	1.6
R31	0.3	0.6	0.6	0.2	1.7	2.0	2.0	1.6
R32	0.2	0.3	0.3	0.1	1.6	1.7	1.7	1.5
R33	0.2	0.4	0.4	0.1	1.6	1.8	1.8	1.5
R34	0.2	0.3	0.3	0.1	1.6	1.7	1.7	1.5
R35	0.2	0.4	0.4	0.2	1.6	1.8	1.8	1.6
R36	0.1	0.3	0.3	0.1	1.5	1.7	1.7	1.5
R37	0.1	0.3	0.3	0.1	1.5	1.7	1.7	1.5
R38	0.2	0.4	0.4	0.2	1.6	1.8	1.8	1.6
R39	0.1	0.2	0.2	0.1	1.5	1.6	1.6	1.5
R40	0.1	0.3	0.3	0.1	1.5	1.7	1.7	1.5
R41	0.1	0.2	0.2	0.1	1.5	1.6	1.6	1.5
R42	0.1	0.2	0.2	0.1	1.5	1.6	1.6	1.5
R43	0.2	0.3	0.3	0.2	1.6	1.7	1.7	1.6
R44	0.1	0.2	0.2	0.1	1.5	1.6	1.6	1.5
R45	0.1	0.2	0.2	0.1	1.5	1.6	1.6	1.5
R46	0.1	0.2	0.2	0.1	1.5	1.6	1.6	1.5
R47	0.1	0.3	0.3	0.1	1.5	1.7	1.7	1.5
R48	0.2	0.3	0.3	0.2	1.6	1.7	1.7	1.6
R49	0.1	0.2	0.2	0.1	1.5	1.6	1.6	1.5
R50	0.1	0.1	0.1	0.1	1.5	1.5	1.5	1.5
R51	<0.1	0.1	0.1	<0.1	1.4	1.5	1.5	1.4

Table D.6 Incremental and cumulative annual average dust deposition rates – all scenarios

Receptor ID	Incremental annual average dust deposition rate (g/m²/month) – criterion 2 g/m²/month				Cumulative annual average dust deposition rate (g/m²/month) – criterion 4 g/m²/month			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
R52	<0.1	0.1	0.1	<0.1	1.4	1.5	1.5	1.4
R53	<0.1	0.1	0.1	<0.1	1.4	1.5	1.5	1.4
R54	<0.1	0.1	0.1	0.1	1.4	1.5	1.5	1.5
R55	<0.1	0.1	0.1	<0.1	1.4	1.5	1.5	1.4
R56	<0.1	0.1	0.1	<0.1	1.4	1.5	1.5	1.4
R57	<0.1	0.1	0.1	<0.1	1.4	1.5	1.5	1.4
R58	<0.1	0.1	0.1	0.1	1.4	1.5	1.5	1.5
R59	0.1	0.1	0.1	0.1	1.5	1.5	1.5	1.5
R60	0.1	0.1	0.1	0.1	1.5	1.5	1.5	1.5
R61	0.1	0.2	0.2	0.1	1.5	1.6	1.6	1.5
R62	0.1	0.2	0.2	0.1	1.5	1.6	1.6	1.5
R63	0.1	0.2	0.2	0.1	1.5	1.6	1.6	1.5
R64	0.1	0.2	0.2	0.1	1.5	1.6	1.6	1.5
R65	0.1	0.2	0.2	0.1	1.5	1.6	1.6	1.5
R66	0.1	0.3	0.3	0.1	1.5	1.7	1.7	1.5
R67	0.1	0.3	0.3	0.2	1.5	1.7	1.7	1.6
R68	0.1	0.3	0.3	0.2	1.5	1.7	1.7	1.6
R69	0.1	0.2	0.2	0.2	1.5	1.6	1.6	1.6
R70	0.1	0.3	0.3	0.2	1.5	1.7	1.7	1.6
R71	0.1	0.3	0.3	0.2	1.5	1.7	1.7	1.6
R72	0.1	0.3	0.3	0.2	1.5	1.7	1.7	1.6
R73	0.1	0.3	0.3	0.2	1.5	1.7	1.7	1.6
R74	0.1	0.2	0.2	0.2	1.5	1.6	1.6	1.6
R75	0.1	0.2	0.2	0.2	1.5	1.6	1.6	1.6
R76	0.1	0.2	0.2	0.2	1.5	1.6	1.6	1.6
R77	0.1	0.1	0.1	0.1	1.5	1.5	1.5	1.5
R78	<0.1	0.1	0.1	0.1	1.4	1.5	1.5	1.5
R79	<0.1	0.1	0.1	0.1	1.4	1.5	1.5	1.5
R80	<0.1	0.1	0.1	<0.1	1.4	1.5	1.5	1.4
R81	<0.1	0.1	0.1	<0.1	1.4	1.5	1.5	1.4
R82	<0.1	0.1	0.1	<0.1	1.4	1.5	1.5	1.4
R83	<0.1	0.1	0.1	<0.1	1.4	1.5	1.5	1.4
R84	<0.1	0.1	0.1	0.1	1.4	1.5	1.5	1.5

Table D.6 Incremental and cumulative annual average dust deposition rates – all scenarios

Recept or ID	Incremental annual average dust deposition rate (g/m^2/month) – criterion 2 g/m^2/month				Cumulative annual average dust deposition rate (g/m^2/month) – criterion 4 g/m^2/month			
	Year 1	Year 2	Year 4	Year 8	Year 1	Year 2	Year 4	Year 8
R85	<0.1	0.1	0.1	<0.1	1.4	1.5	1.5	1.4
R86	<0.1	<0.1	<0.1	<0.1	1.4	1.4	1.4	1.4
R87	<0.1	<0.1	<0.1	<0.1	1.4	1.4	1.4	1.4
R88	<0.1	0.1	0.1	<0.1	1.4	1.5	1.5	1.4

Table D.7 Maximum incremental and cumulative 1-hour average and annual NO_2 concentration – all scenarios

Receptor ID	Maximum incremental 1-hour average NO_2 concentration ($\mu g/m^3$) – criterion 246 $\mu g/m^3$		Annual average NO_2 concentration ($\mu g/m^3$) – criterion 62 $\mu g/m^3$	
	Incremental	Cumulative	Incremental	Cumulative
R01	79.5	119.4	0.7	9.3
R02	74.2	98.8	0.6	9.2
R03	68.4	115.4	0.6	9.1
R04	73.0	118.1	0.7	9.2
R05	68.7	103.0	0.8	9.3
R06	105.3	145.3	2.9	11.4
R07	89.7	128.8	2.3	10.9
R08	112.7	126.6	1.2	9.7
R09	104.0	131.4	1.1	9.6
R10	129.9	134.4	1.2	9.8
R11	104.9	132.6	1.2	9.7
R12	115.4	123.0	1.4	9.9
R13	109.1	116.6	1.5	10.1
R14	99.4	129.0	1.6	10.1
R15	150.4	157.9	3.0	11.5
R16	125.8	167.2	4.1	12.7
R17	139.7	169.6	4.3	12.9
R18	105.6	150.0	3.1	11.7
R19	116.2	164.8	4.9	13.5
R20	109.4	158.3	4.3	12.8
R21	115.0	162.4	4.8	13.3
R22	103.0	143.8	3.4	11.9

Table D.7 Maximum incremental and cumulative 1-hour average and annual NO_2 concentration – all scenarios

Receptor ID	Maximum incremental 1-hour average NO_2 concentration (µg/m³) – criterion 246 µg/m³		Annual average NO_2 concentration (µg/m³) – criterion 62 µg/m³	
	Incremental	Cumulative	Incremental	Cumulative
R23	114.0	148.0	4.1	12.7
R24	116.7	147.7	4.6	13.1
R25	120.7	159.6	5.2	13.7
R26	123.6	160.4	5.4	13.9
R27	126.1	155.6	5.3	13.8
R28	125.0	160.2	5.7	14.2
R29	108.8	153.2	4.9	13.4
R30	131.3	155.6	5.7	14.2
R31	119.8	155.0	5.0	13.5
R32	114.5	153.1	3.7	12.2
R33	118.6	156.3	4.2	12.7
R34	137.7	156.5	3.7	12.3
R35	142.3	166.7	3.9	12.4
R36	132.4	156.8	3.4	11.9
R37	134.0	158.5	3.4	11.9
R38	129.0	149.7	4.0	12.5
R39	110.0	143.9	2.5	11.0
R40	121.9	146.3	3.2	11.7
R41	120.9	145.4	2.4	10.9
R42	120.1	140.7	3.0	11.6
R43	135.0	155.6	3.3	11.8
R44	106.3	130.7	2.2	10.7
R45	109.4	133.7	2.5	11.0
R46	119.1	139.9	2.7	11.2
R47	123.2	145.0	3.0	11.6
R48	118.8	147.0	3.2	11.7
R49	119.2	139.9	2.4	10.9
R50	103.3	127.9	1.8	10.3
R51	99.8	121.7	1.3	9.8
R52	101.9	122.6	1.2	9.7
R53	102.4	123.1	1.2	9.7
R54	103.8	124.5	1.3	9.8

Table D.7 Maximum incremental and cumulative 1-hour average and annual NO_2 concentration – all scenarios

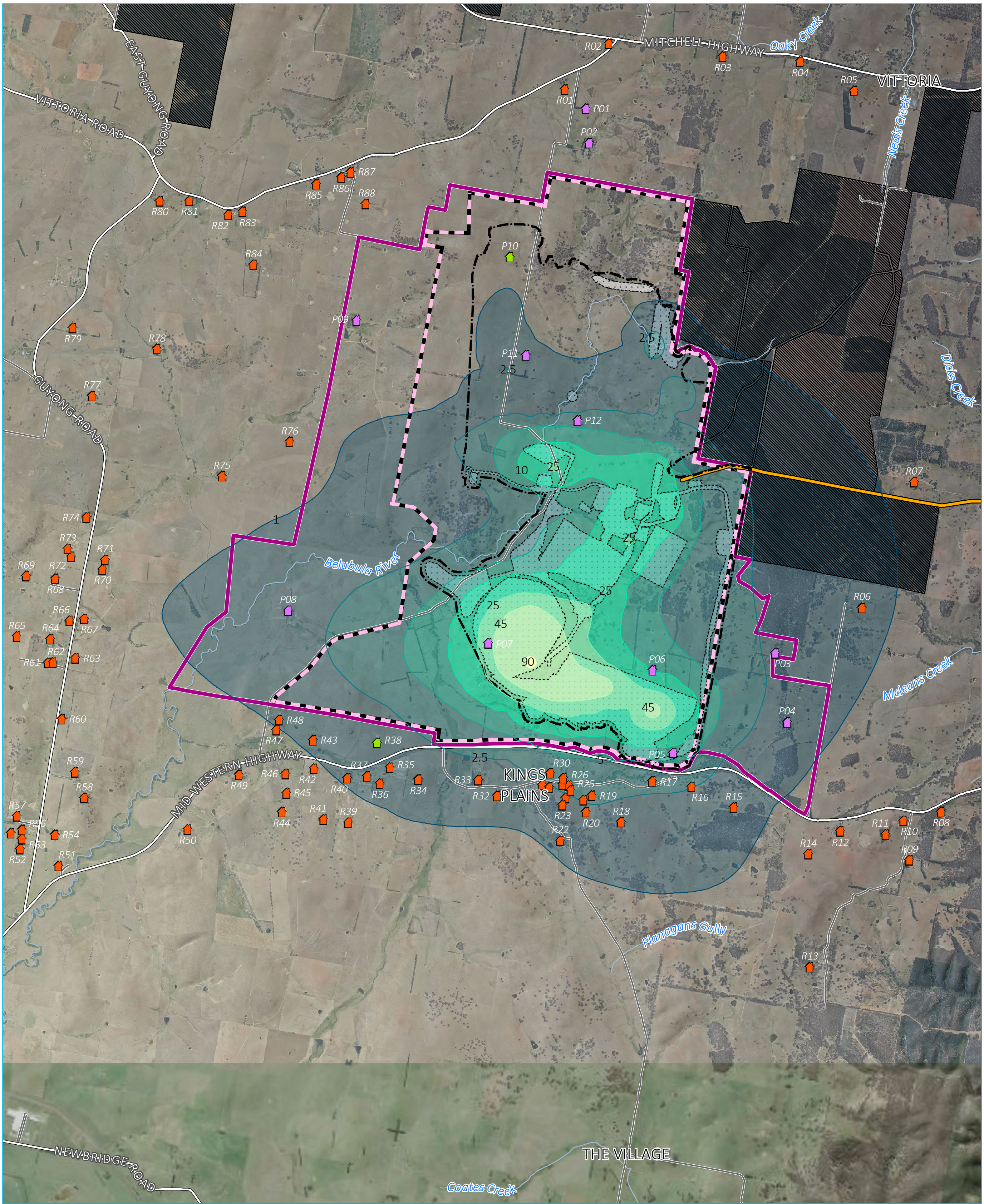
Receptor ID	Maximum incremental 1-hour average NO_2 concentration (µg/m³) – criterion 246 µg/m³		Annual average NO_2 concentration (µg/m³) – criterion 62 µg/m³	
	Incremental	Cumulative	Incremental	Cumulative
R55	101.2	124.4	1.2	9.7
R56	101.8	125.5	1.2	9.7
R57	99.4	129.6	1.2	9.7
R58	99.6	132.0	1.4	9.9
R59	95.5	119.3	1.4	9.9
R60	99.8	135.7	1.6	10.1
R61	101.7	131.2	1.9	10.4
R62	101.7	131.7	1.9	10.4
R63	104.9	136.8	2.1	10.6
R64	94.7	122.5	2.1	10.6
R65	88.0	112.5	1.8	10.3
R66	89.0	130.1	2.3	10.9
R67	90.2	136.2	2.5	11.0
R68	93.2	145.8	2.3	10.8
R69	92.5	145.2	2.2	10.7
R70	95.1	147.7	2.5	11.1
R71	94.9	145.7	2.5	11.0
R72	93.1	145.6	2.3	10.8
R73	94.5	144.3	2.2	10.7
R74	89.6	134.8	2.0	10.5
R75	99.6	121.9	2.3	10.8
R76	99.5	118.9	2.1	10.6
R77	82.7	112.1	1.3	9.9
R78	82.1	114.5	1.3	9.8
R79	81.2	113.2	1.0	9.6
R80	71.6	91.7	0.8	9.3
R81	77.8	106.0	0.8	9.4
R82	83.6	110.0	0.9	9.4
R83	82.4	94.3	0.8	9.3
R84	91.0	108.7	1.0	9.5
R85	81.3	109.4	0.7	9.2
R86	81.6	119.2	0.7	9.2

Table D.7 Maximum incremental and cumulative 1-hour average and annual NO_2 concentration – all scenarios

Receptor ID	Maximum incremental 1-hour average NO_2 concentration (µg/m³) – criterion 246 µg/m³		Annual average NO_2 concentration (µg/m³) – criterion 62 µg/m³	
	Incremental	Cumulative	Incremental	Cumulative
R87	80.2	117.8	0.7	9.2
R88	82.9	120.5	0.8	9.3

Appendix E

Predicted incremental isopleth plots



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

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GDA 1994 MGA Zone 55
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KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 1

Existing environment
- Main road
- Local road
- Named watercourse
- Vittoria State Forest

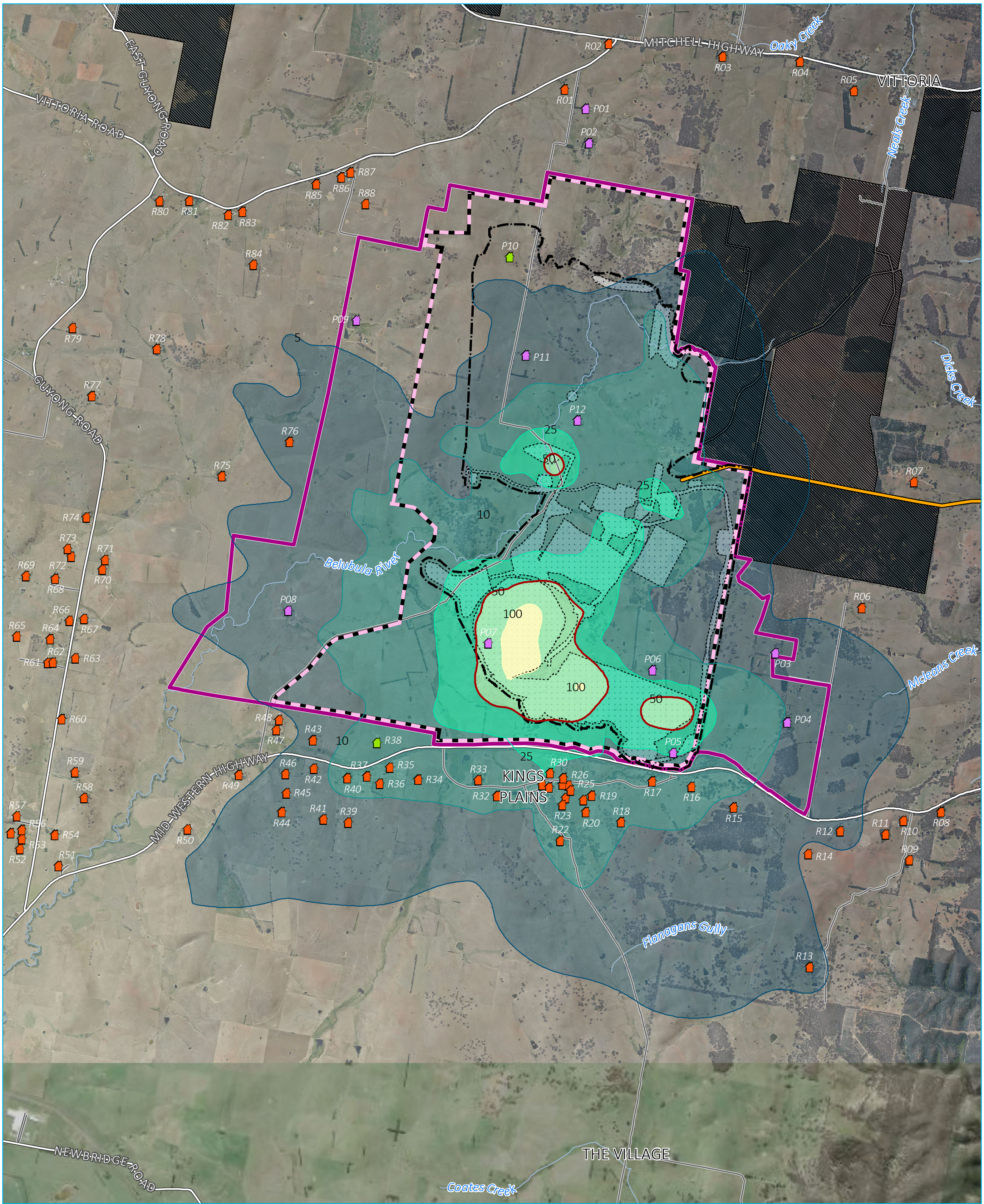
Sensitive receptor
- Private
- Residences under option
- Project related (Regis-owned)

Annual average TSP concentrations
- 1 µg/m³
- 2.5 µg/m³
- 5 µg/m³
- 10 µg/m³
- 25 µg/m³
- 45 µg/m³
- 90 µg/m³

Annual average TSP concentration range
- 1 - 2.5 µg/m³
- 2.5 - 5 µg/m³
- 5 - 10 µg/m³
- 10 - 25 µg/m³
- 25 - 45 µg/m³
- 45 - 90 µg/m³
- > 90 µg/m³

Predicted annual average TSP concentrations (µg/m³) – Year 1 operations only

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure E.1



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km

GDA 1994 MGA Zone 55

N

KEY

Project application area

- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 1

Existing environment

- Main road
- Local road
- Named watercourse
- Vittoria State Forest

Sensitive receptor

- Private
- Residences under option
- Project related (Regis-owned)

24-hour average PM_{10} concentrations

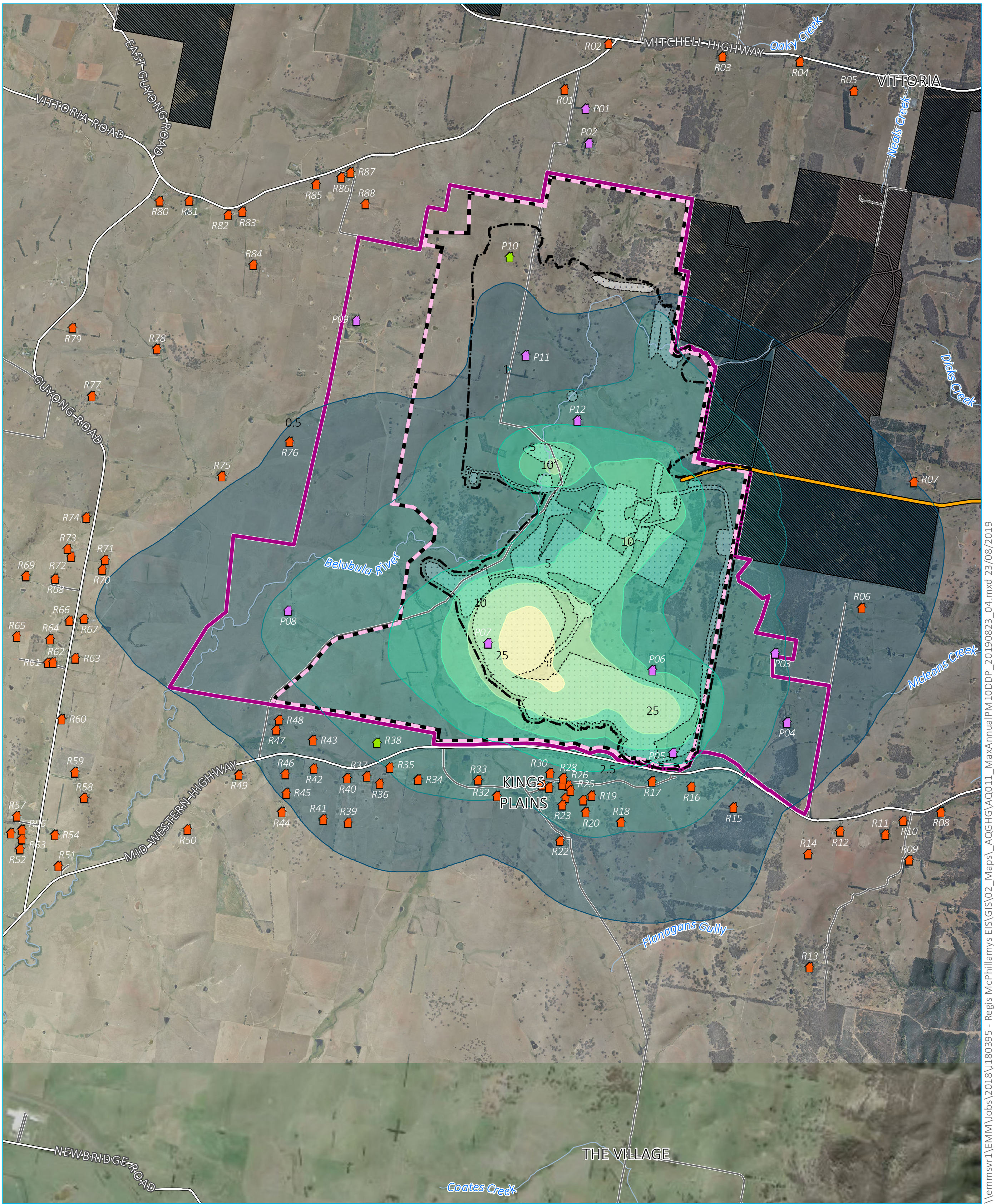
- 5 µg/m³
- 10 µg/m³
- 25 µg/m³
- 50 µg/m³ (incremental VLAMP mitigation criteria)
- 100 µg/m³

24-hour average PM_{10} concentration range

- 5 - 10 µg/m³
- 10 - 25 µg/m³
- 25 - 50 µg/m³
- 50 - 100 µg/m³
- > 100 µg/m³

Maximum predicted 24-hour average PM_{10} concentrations (µg/m³) – Year 1 operations only

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure E.2



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km
GDA 1994 MGA Zone 55
N

KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 1

Existing environment
- Main road
- Local road
- Named watercourse
- Vittoria State Forest

Sensitive receptor
- Private
- Residences under option
- Project related (Regis-owned)

Annual average PM_{10} concentrations
- 0.5 µg/m³
- 1 µg/m³
- 2.5 µg/m³
- 5 µg/m³
- 10 µg/m³
- 25 µg/m³

Annual average PM_{10} concentration range
- 0.5 - 1 µg/m³
- 1 - 2.5 µg/m³
- 2.5 - 5 µg/m³
- 5 - 10 µg/m³
- 10 - 25 µg/m³
- > 25 µg/m³

Predicted annual average PM_{10} concentrations (µg/m³) – Year 1 operations only

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure E.3

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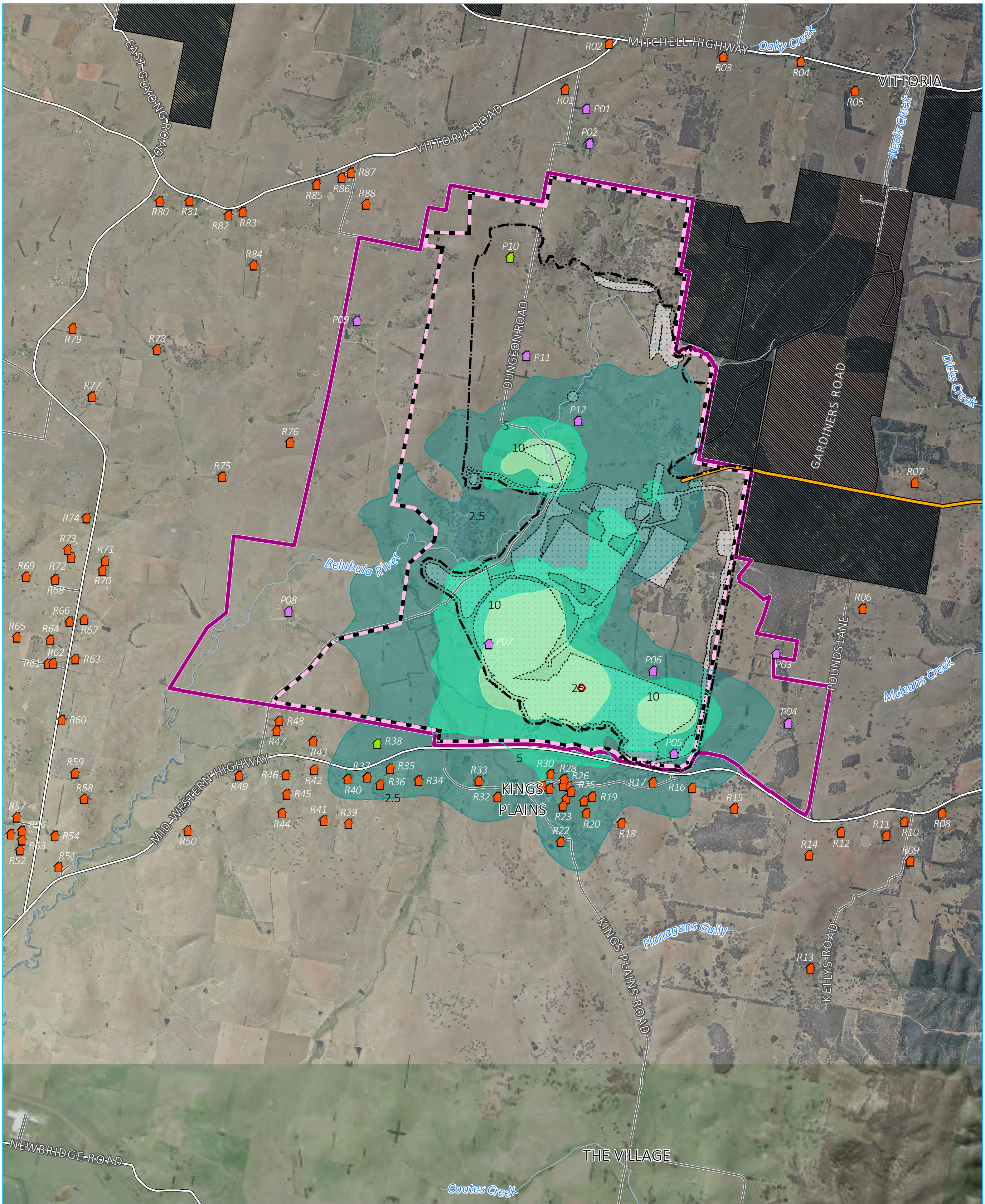


Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km
GDA 1994 MGA Zone 55
N

KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 1

Existing environment
- Main road
- Local road
- Named watercourse
- Vittoria State Forest

Sensitive receptor
- Private Residences
- under option
- Project related (Regis-owned)

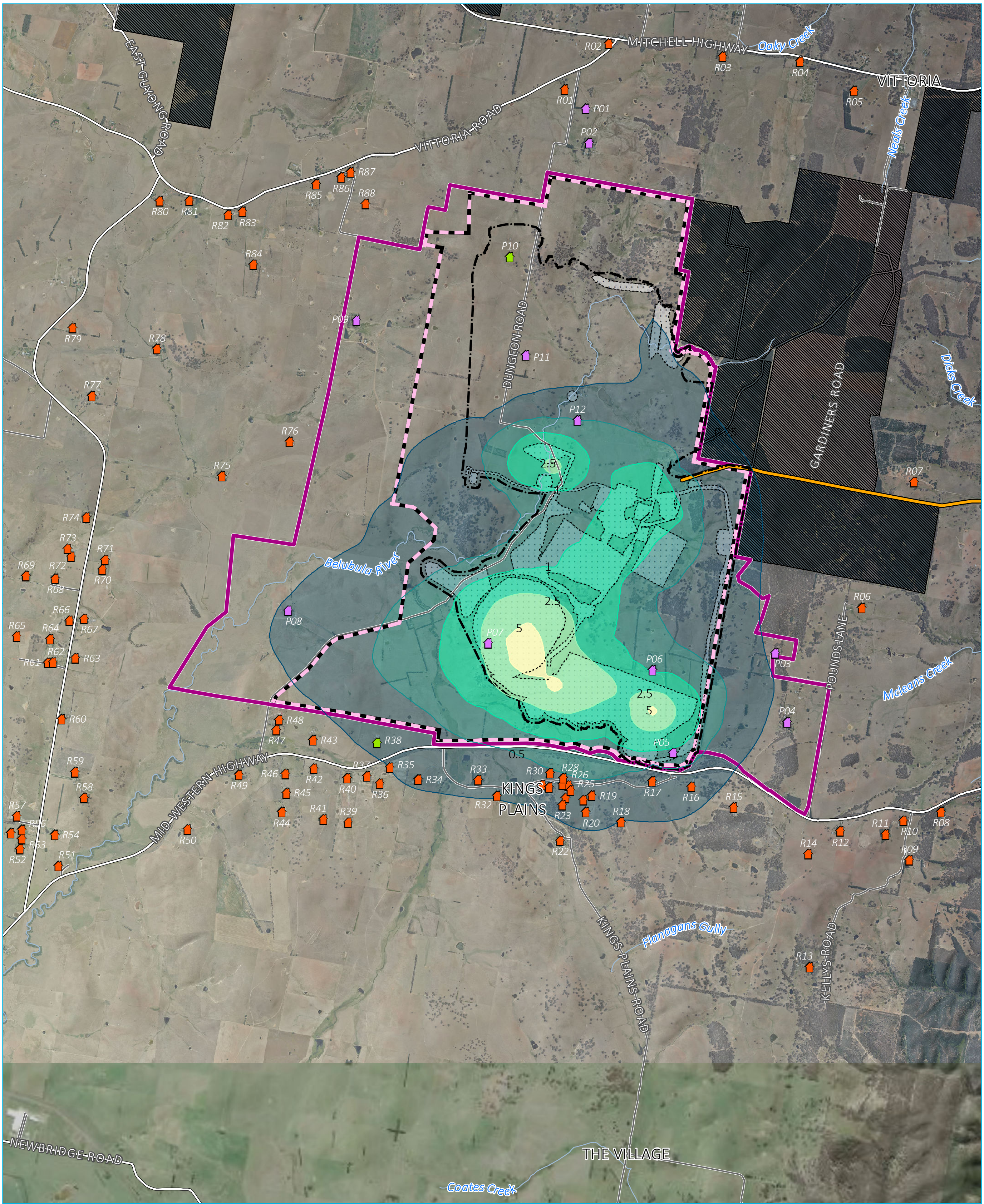
24-hour average $PM_{2.5}$ concentrations
- 2.5 µg/m³
- 5 µg/m³
- 10 µg/m³
- 25 µg/m³

24-hour average $PM_{2.5}$ concentration range
- 2.5 - 5 µg/m³
- 5 - 10 µg/m³
- 10 - 25 µg/m³
- > 25 µg/m³

Maximum predicted 24-hour average $PM_{2.5}$ concentrations (µg/m³) – Year 1 operations only

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure E.4

\\emmsvr1\EMM\Jobs\2018\J180395 - Regis McPhillamys EIS\GIS\02_Maps_AQGHG\AQ012_Max24hrPM25DDP_20190823_04.mxd 23/08/2019



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km
GDA 1994 MGA Zone 55

\\emmsvr1\EMM\Jobs\2018\J180395 - Regis McPhillamys EIS\GIS\02_Maps_AQGHG\AQ013_MaxAnnualPM25DDP_20190823_04.mxd 23/08/2019

KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 1

Existing environment
- Main road
- Local road
- Named watercourse
- Vittoria State Forest

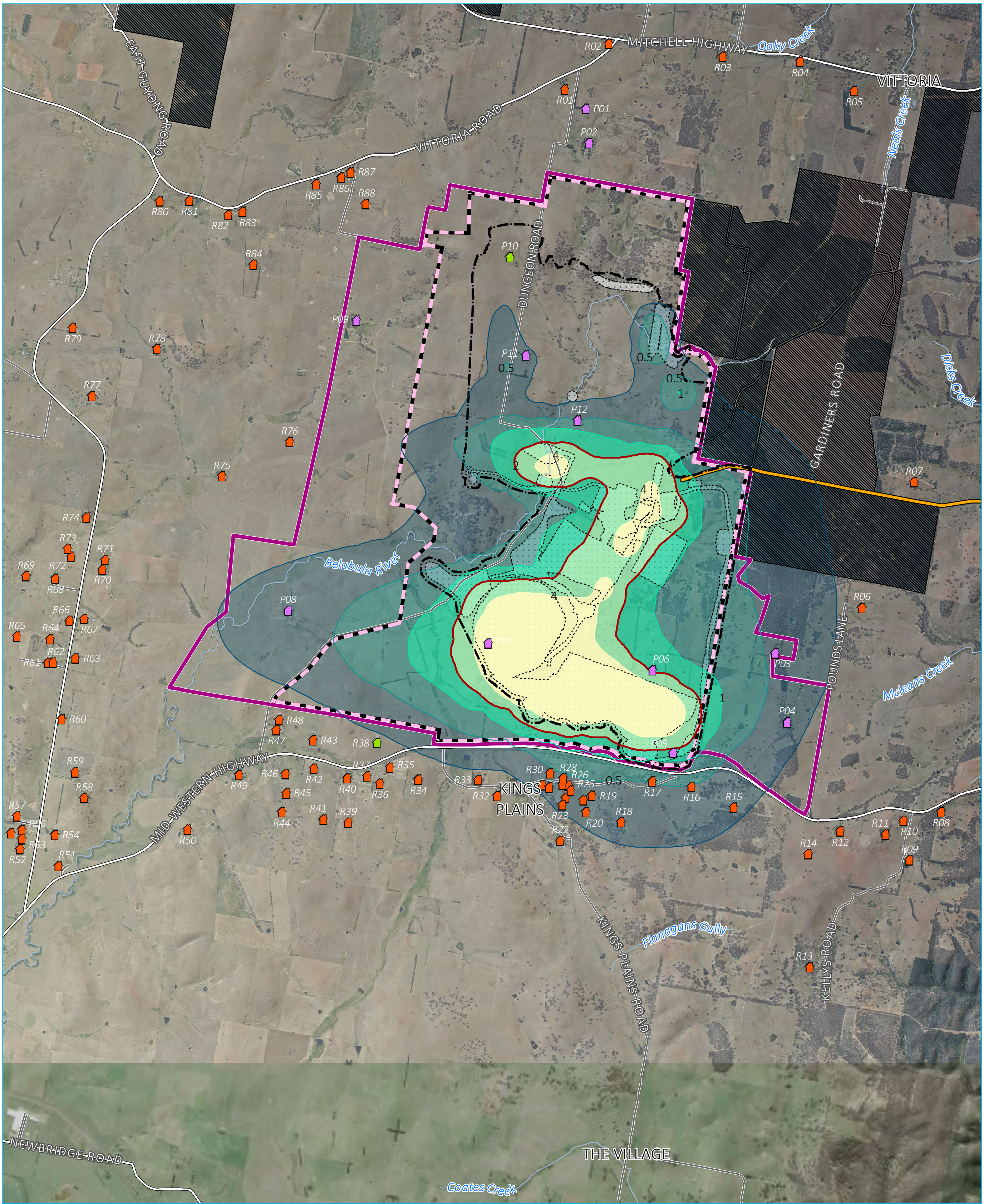
Sensitive receptor
- Private
- Residences under option
- Project related (Regis-owned)

Annual average $PM_{2.5}$ concentrations
- 0.25 µg/m³
- 0.5 µg/m³
- 1 µg/m³
- 2.5 µg/m³
- 5 µg/m³

Annual average $PM_{2.5}$ concentration range
- 0.25 - 0.5 µg/m³
- 0.5 - 1 µg/m³
- 1 - 2.5 µg/m³
- 2.5 - 5 µg/m³
- > 5 µg/m³

Predicted annual average $PM_{2.5}$ concentrations (µg/m³) – Year 1 operations only

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure E.5



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km
GDA 1994 MGA Zone 55
N

KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- pipeline corridor
- Mine development general arrangement - Year 1

Existing environment
- Main road
- Local road
- Named watercourse
- Vittoria State Forest

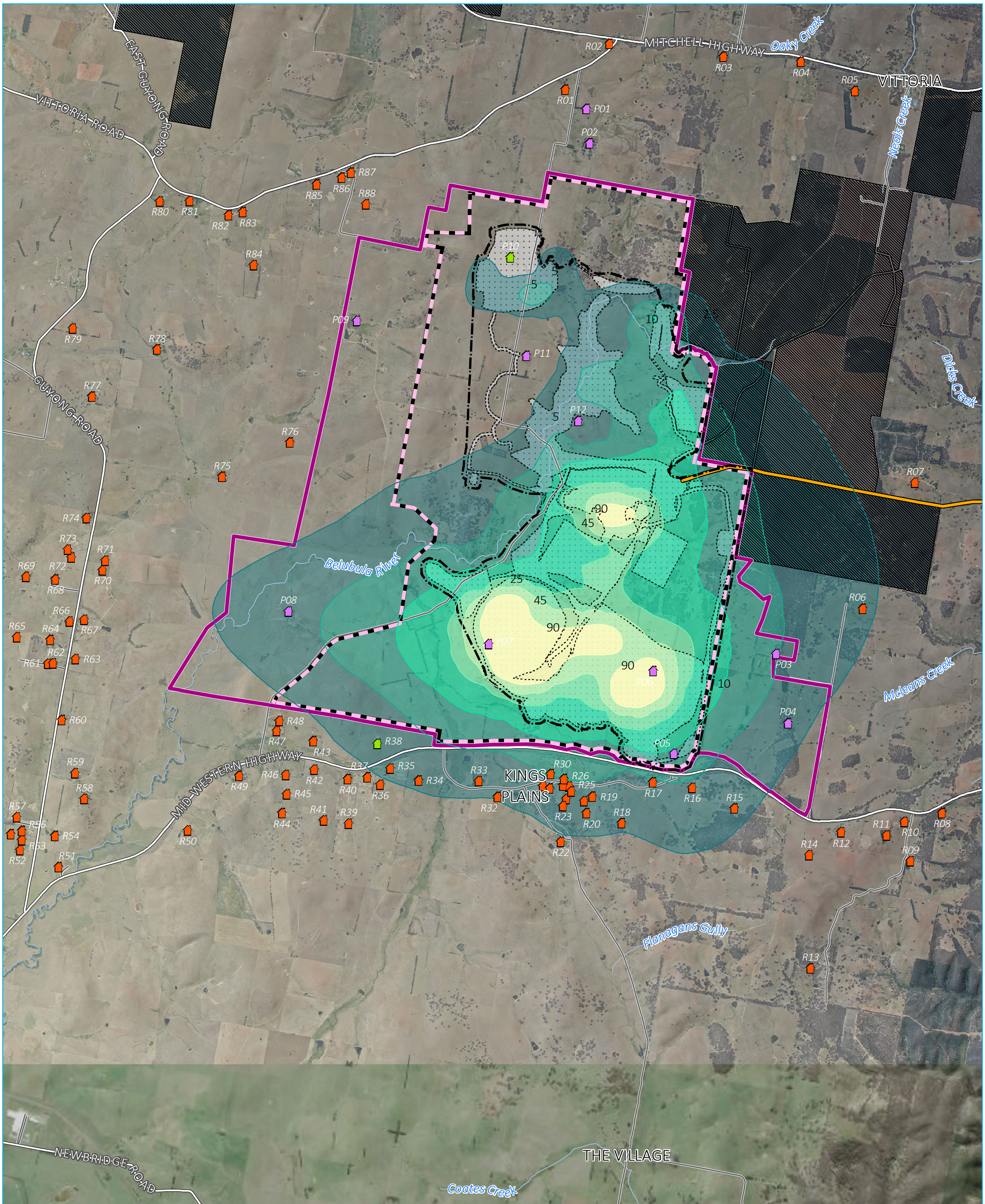
Sensitive receptor
- Private
- Residences under option
- Project related (Regis-owned)

Average dust deposition levels
- 0.25 g/m²/month
- 0.5 g/m²/month
- 1 g/m²/month
- 2 g/m²/month (incremental VLAMP mitigation criteria)
- 4 g/m²/month

Average dust deposition level range
- 0.25 - 0.5 g/m²/month
- 0.5 - 1 g/m²/month
- 1 - 2 g/m²/month
- 2 - 4 g/m²/month
- > 4 g/m²/month

Predicted annual average dust deposition levels (g/m²/month) – Year 1 operations only

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure E.6



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km

GDA 1994 MGA Zone 55

N

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KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 2

Existing environment
- Main road
- Local road
- Named watercourse
- Vittoria State Forest

Sensitive receptor
- Private
- Residences under option
- Project related (Regis-owned)

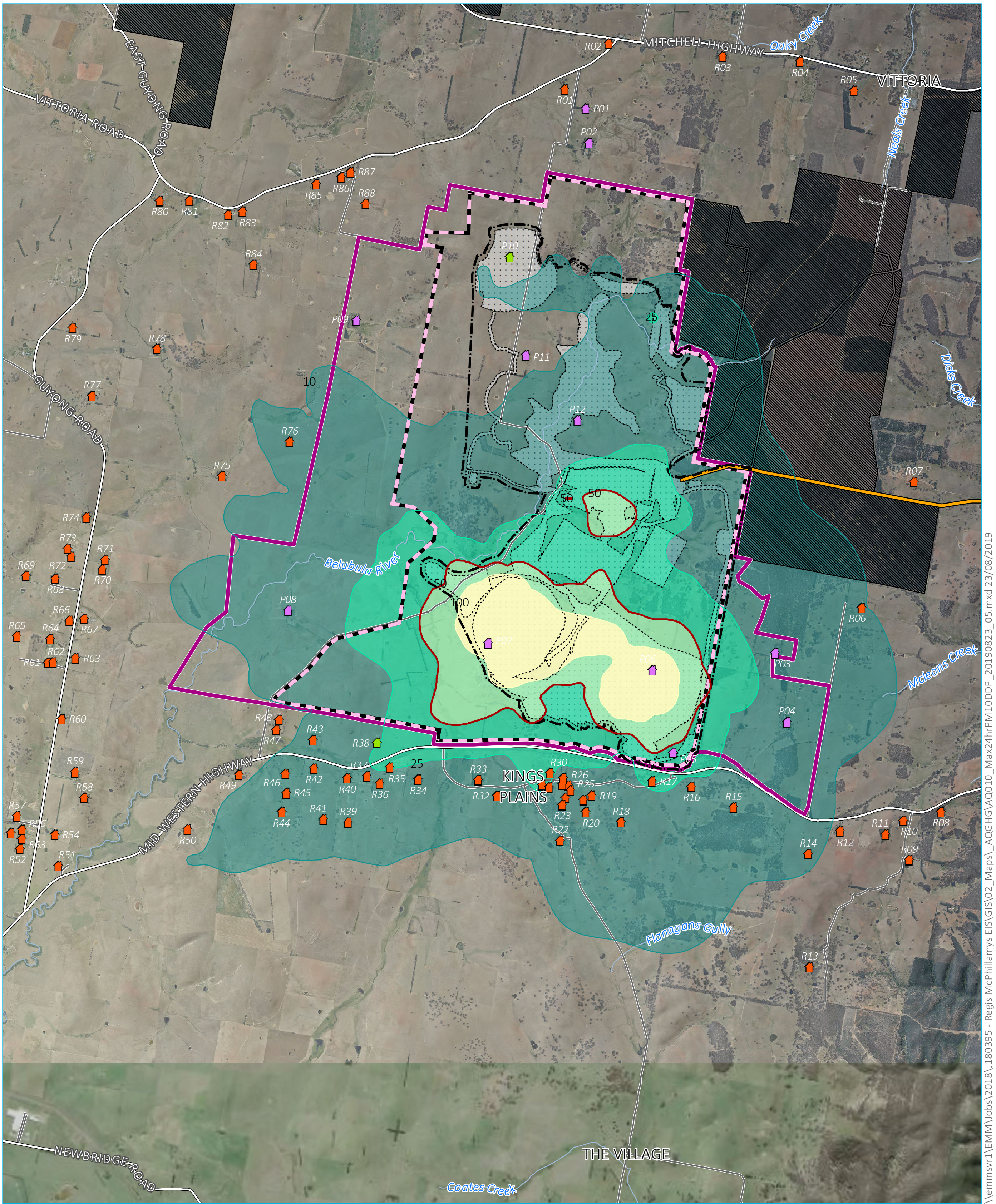
Annual average TSP concentrations
- 2.5 µg/m³
- 5 µg/m³
- 10 µg/m³
- 25 µg/m³
- 45 µg/m³
- 90 µg/m³

Annual average TSP concentration range
- 2.5 - 5 µg/m³
- 5 - 10 µg/m³
- 10 - 25 µg/m³
- 25 - 45 µg/m³
- 45 - 90 µg/m³
- > 90 µg/m³

Predicted annual average TSP concentrations (µg/m³) – Year 2 operations only

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure E.7

REGIS RESOURCES LTD
EMM creating opportunities



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 2

Existing environment
- Main road
- Local road
- Named watercourse
- Vittoria State Forest

Sensitive receptor
- Private
- Residences under option
- Project related (Regis-owned)

24-hour average PM_{10} concentrations
- 10 μg/m³
- 25 μg/m³
- 50 μg/m³ (incremental VLAMP mitigation criteria)
- 100 μg/m³

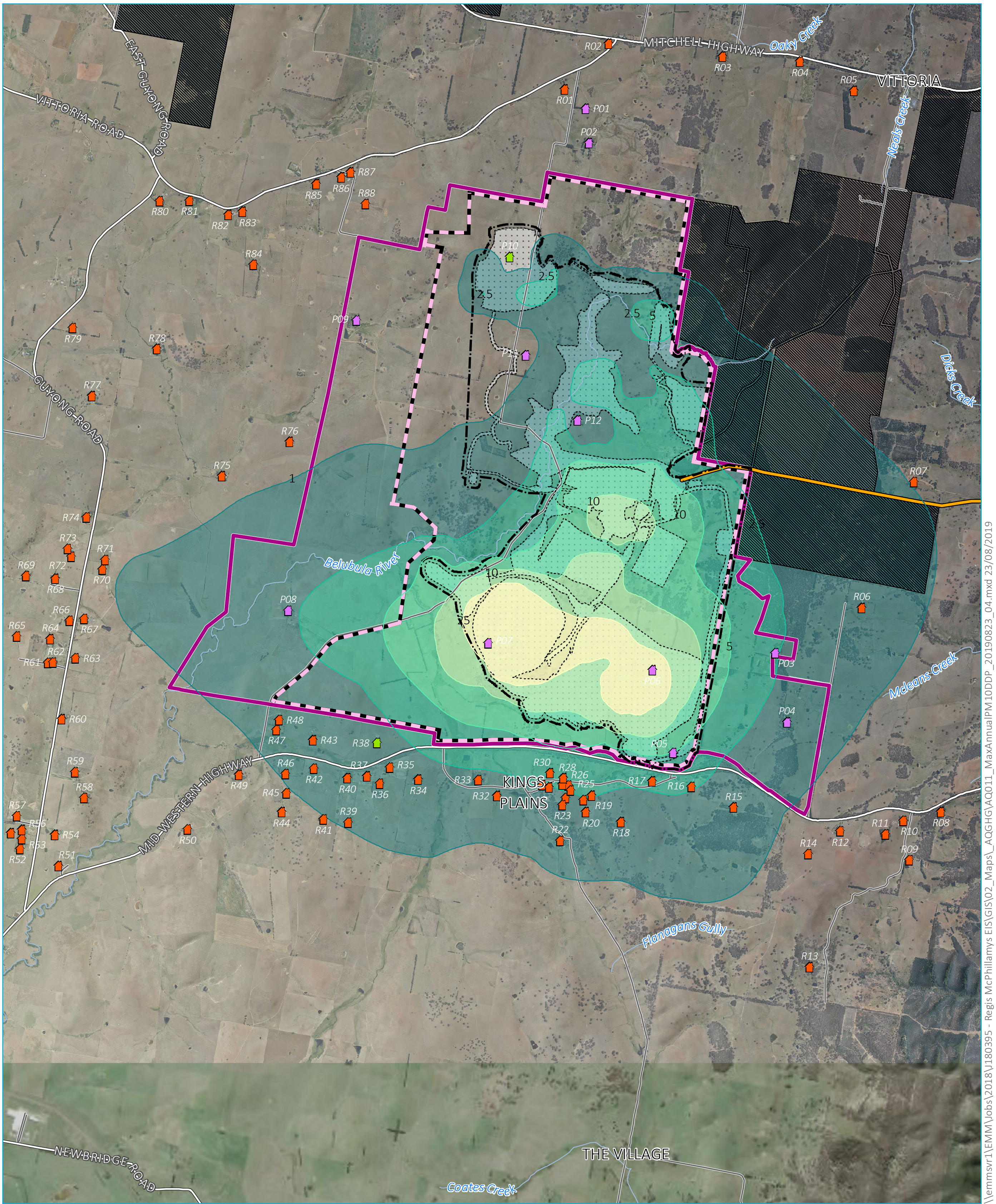
24-hour average PM_{10} concentration range
- 10 - 25 μg/m³
- 25 - 50 μg/m³
- 50 - 100 μg/m³
- > 100 μg/m³

Maximum predicted 24-hour average PM_{10} concentrations (μg/m³) – Year 2 operations only

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure E.8

REGIS RESOURCES LTD

EMM creating opportunities



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km
GDA 1994 MGA Zone 55
N

KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 2

Existing environment
- Main road
- Local road
- Named watercourse
- Vittoria State Forest

Sensitive receptor
- Private
- Residences under option
- Project related (Regis-owned)

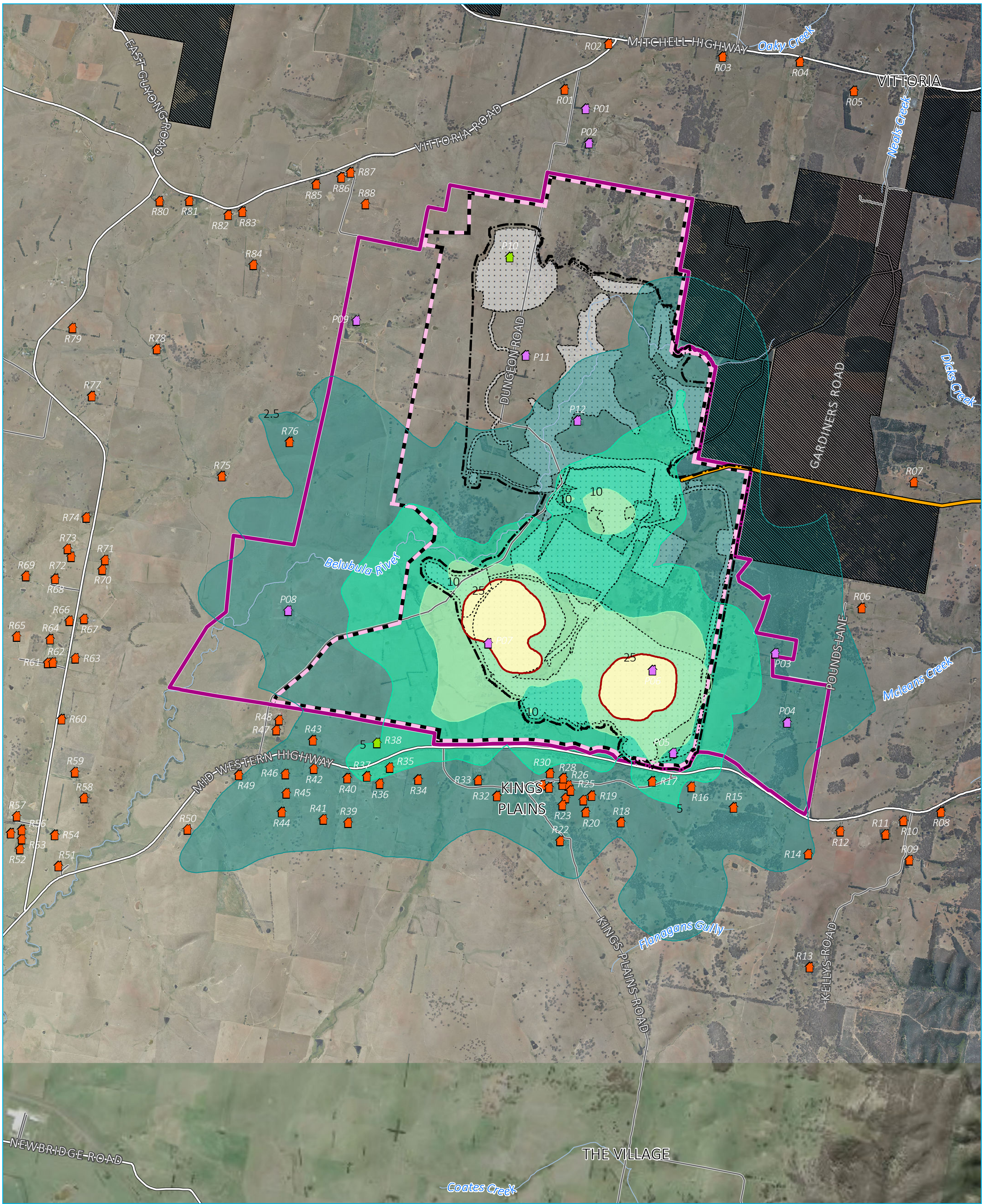
Annual average PM_{10} concentrations
- 1 µg/m³
- 2.5 µg/m³
- 5 µg/m³
- 10 µg/m³
- 25 µg/m³

Annual average PM_{10} concentration range
- 1 - 2.5 µg/m³
- 2.5 - 5 µg/m³
- 5 - 10 µg/m³
- 10 - 25 µg/m³
- > 25 µg/m³

Predicted annual average PM_{10} concentrations (µg/m³) – Year 2 operations only

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure E.9

REGIS RESOURCES LTD
EMM creating opportunities



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km
GDA 1994 MGA Zone 55
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KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 2

Existing environment
- Main road
- Local road
- Named watercourse
- Vittoria State Forest

Sensitive receptor
- Private
- Residences under option
- Project related (Regis-owned)

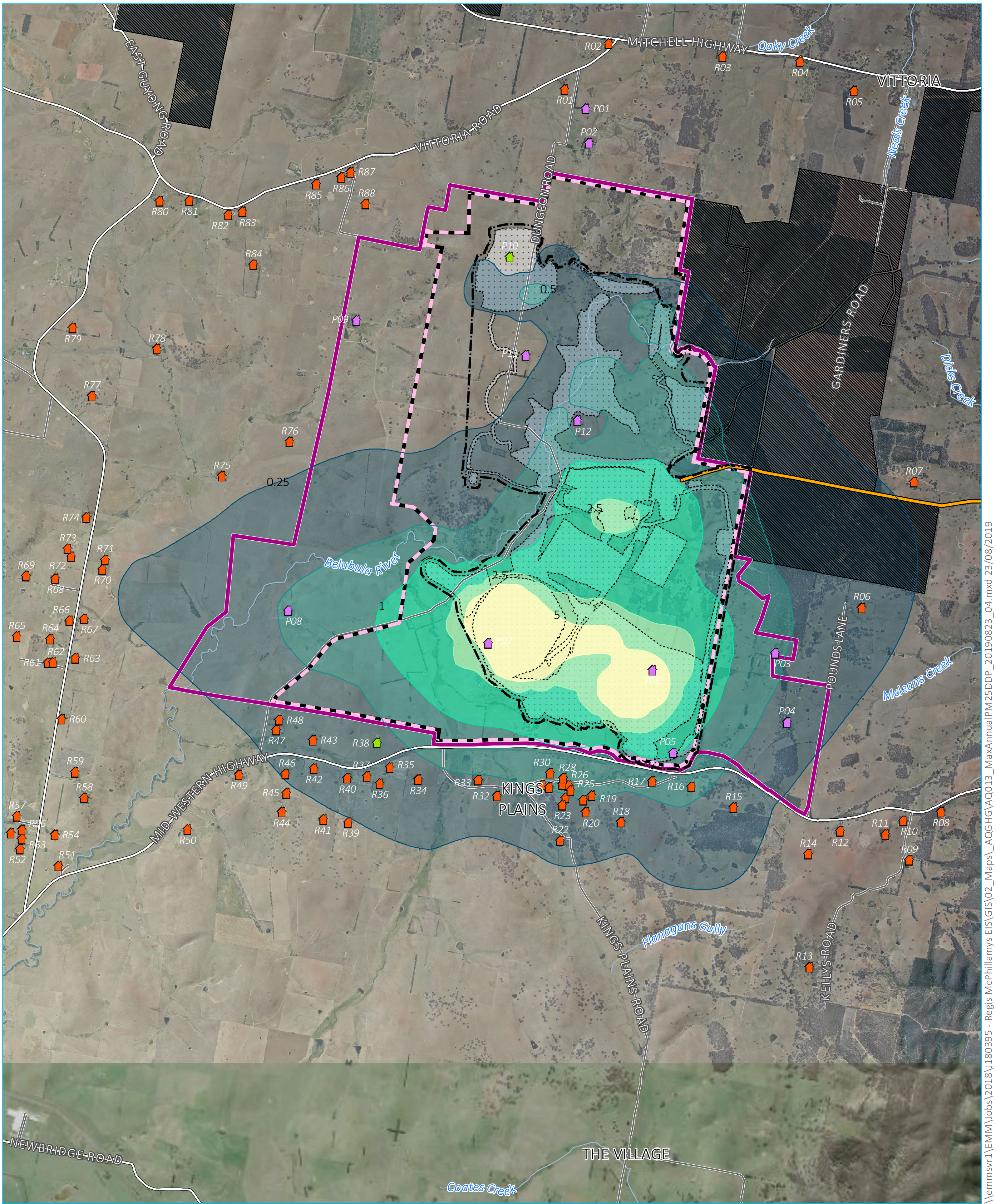
24-hour average $PM_{2.5}$ concentrations
- 2.5 µg/m³
- 5 µg/m³
- 10 µg/m³
- 25 µg/m³

24-hour average $PM_{2.5}$ concentration range
- 2.5 - 5 µg/m³
- 5 - 10 µg/m³
- 10 - 25 µg/m³
- > 25 µg/m³

Maximum predicted 24-hour average $PM_{2.5}$ concentrations (µg/m³) – Year 2 operations only

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure E.10

REGIS RESOURCES LTD
EMM creating opportunities



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km
GDA 1994 MGA Zone 55

KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 2

Existing environment
- Main road
- Local road
- Named watercourse
- Vittoria State Forest

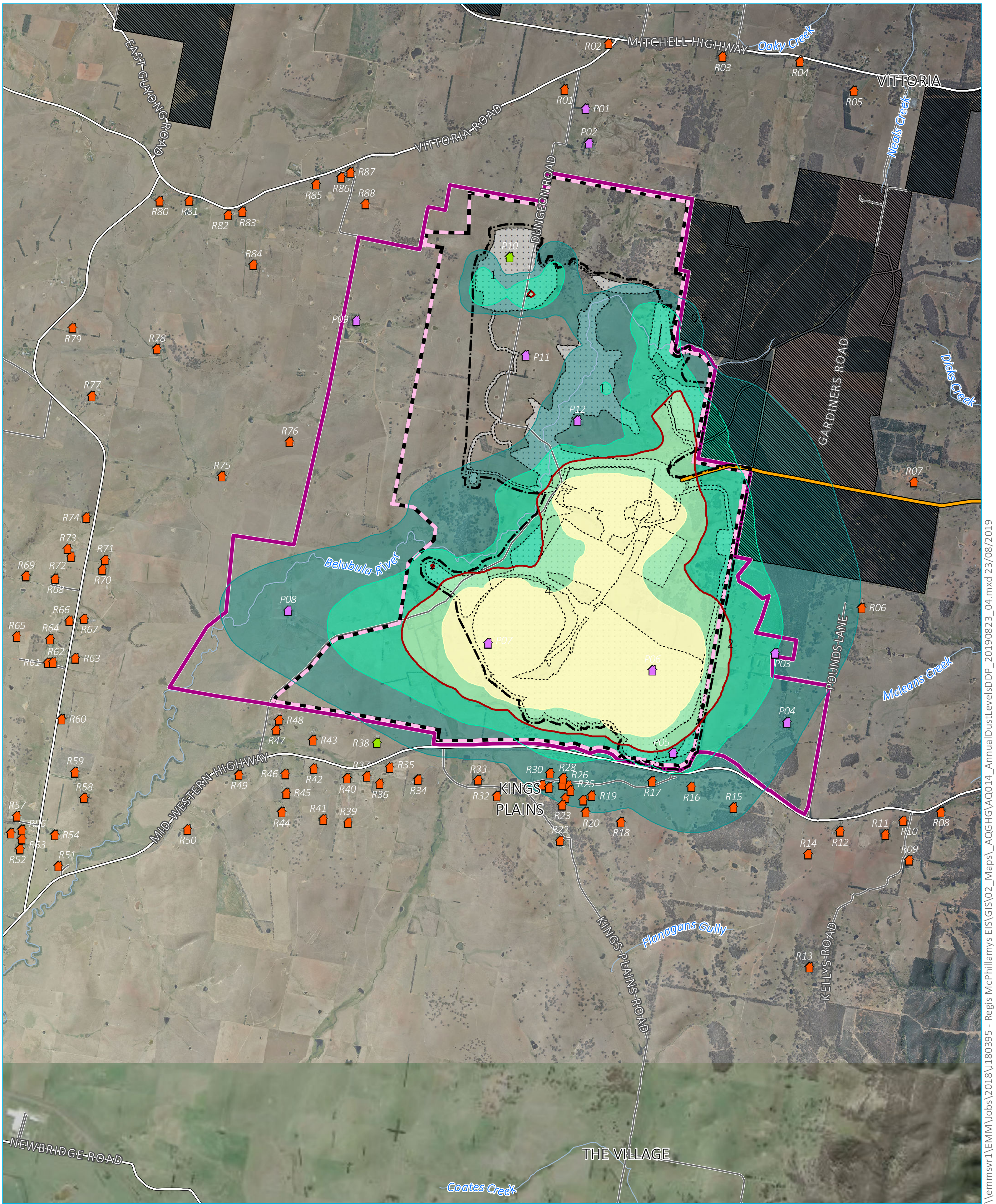
Sensitive receptor
- Private
- Residences under option
- Project related (Regis-owned)

Annual average $PM_{2.5}$ concentrations
- 0.25 µg/m³
- 0.5 µg/m³
- 1 µg/m³
- 2.5 µg/m³
- 5 µg/m³

Annual average $PM_{2.5}$ concentration range
- 0.25 - 0.5 µg/m³
- 0.5 - 1 µg/m³
- 1 - 2.5 µg/m³
- 2.5 - 5 µg/m³
- > 5 µg/m³

Predicted annual average $PM_{2.5}$ concentrations (µg/m³) – Year 2 operations only

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure E.11



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km

GDA 1994 MGA Zone 55

N

KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- pipeline corridor
- Mine development general arrangement - Year 2

Existing environment
- Main road
- Local road
- Named watercourse
- Vittoria State Forest

Sensitive receptor
- Private
- Residences under option
- Project related (Regis-owned)

Average dust deposition levels
- 0.5 g/m²/month
- 1 g/m²/month
- 2 g/m²/month (incremental VLAMP mitigation criteria)
- 4 g/m²/month

Average dust deposition level range
- 0.5 - 1 g/m²/month
- 1 - 2 g/m²/month
- 2 - 4 g/m²/month
- > 4 g/m²/month

Predicted annual average dust deposition levels (g/m²/month) – Year 2 operations only

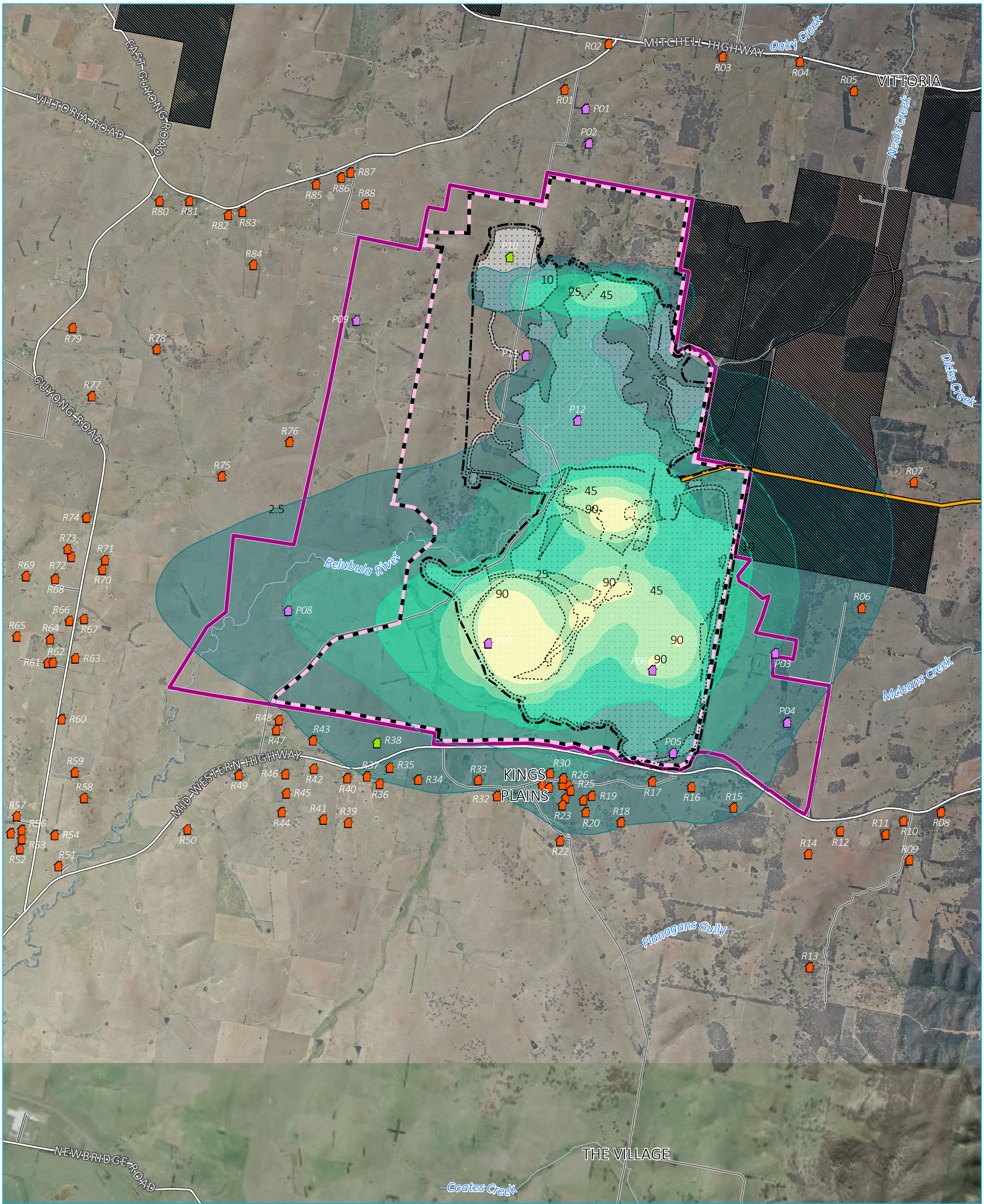
McPhillamys Gold Project

Air quality and greenhouse gas assessment

Figure E.12

REGIS RESOURCES LTD

EMM creating opportunities



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km

GDA 1994 MGA Zone 55

N

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KEY

Project application area

- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 4

Existing environment

- Main road
- Local road
- Named watercourse
- Vittoria State Forest

Sensitive receptor

- Private
- Residences under option
- Project related (Regis-owned)

Annual average TSP concentrations

- 2.5 µg/m³
- 5 µg/m³
- 10 µg/m³
- 25 µg/m³
- 45 µg/m³
- 90 µg/m³

Annual average TSP concentration range

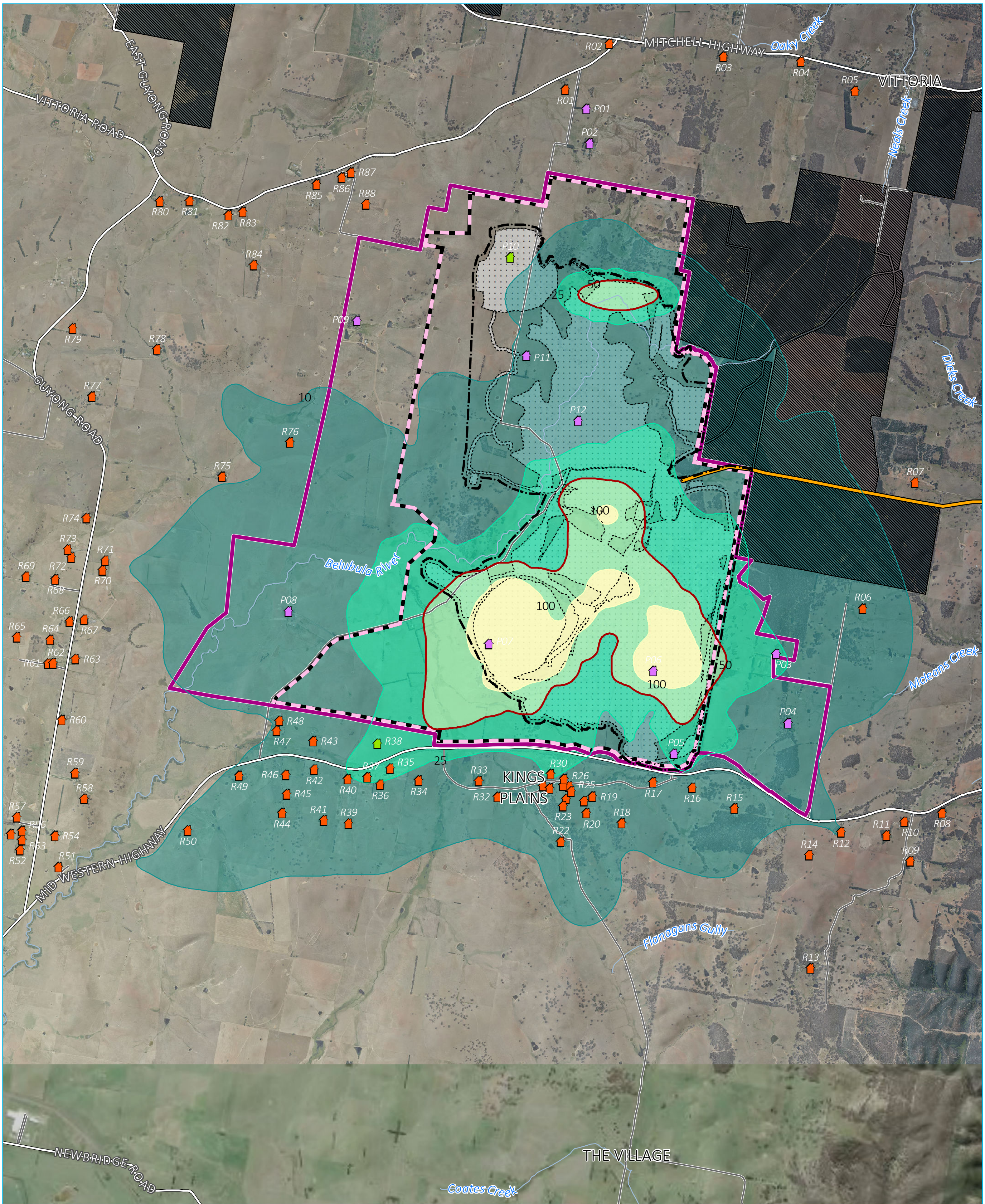
- 2.5 - 5 µg/m³
- 5 - 10 µg/m³
- 10 - 25 µg/m³
- 25 - 45 µg/m³
- 45 - 90 µg/m³
- > 90 µg/m³

Predicted annual average TSP concentrations (µg/m³) – Year 4 operations only

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure E.13

REGIS RESOURCES LTD

EMM creating opportunities



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km
GDA 1994 MGA Zone 55
N

KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 4

Existing environment
- Main road
- Local road
- Named watercourse
- Vittoria State Forest

Sensitive receptor
- Private
- Residences under option
- Project related (Regis-owned)

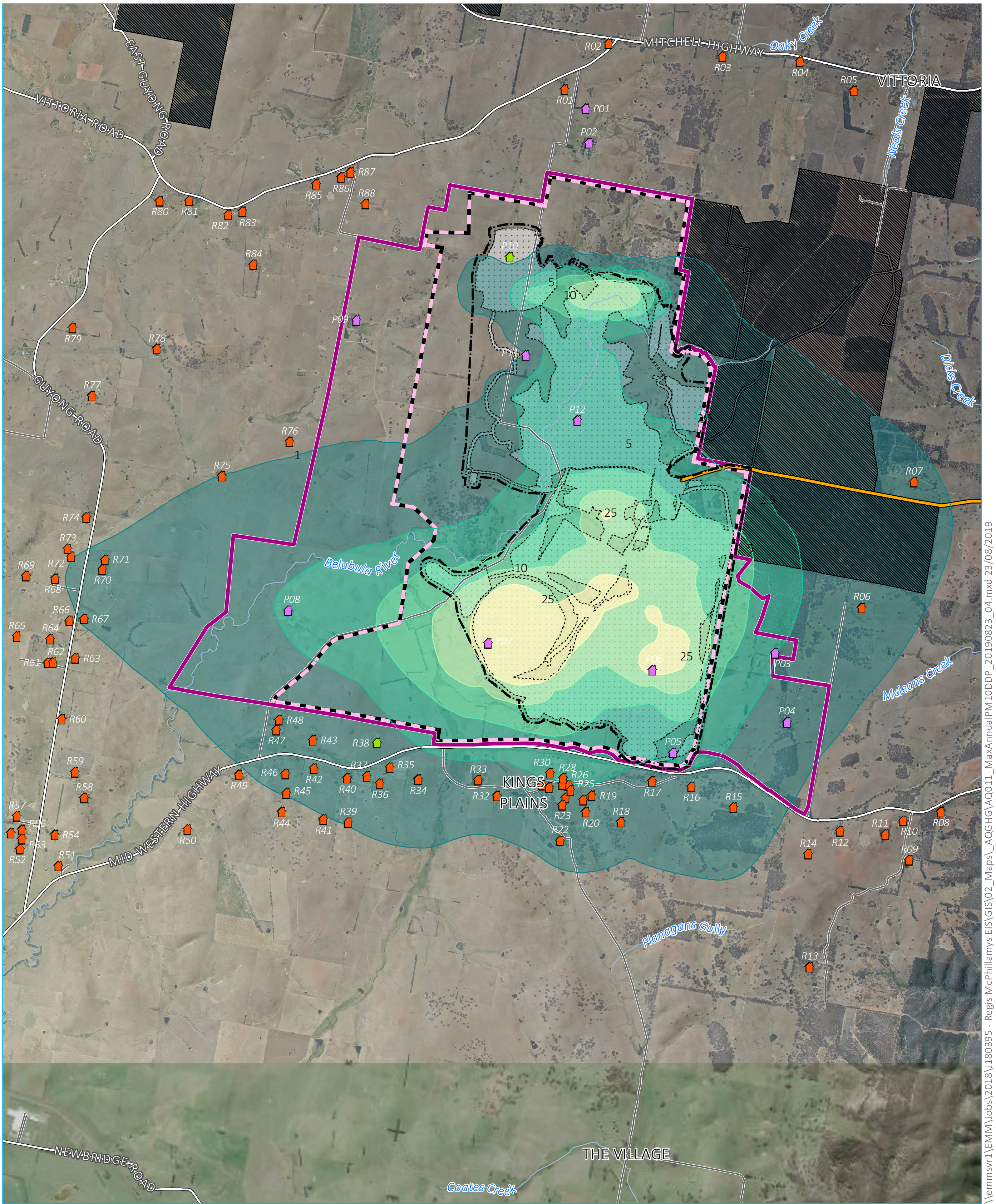
24-hour average PM_{10} concentrations
- 10 µg/m³
- 25 µg/m³
- 50 µg/m³ (incremental VLAMP mitigation criteria)
- 100 µg/m³

24-hour average PM_{10} concentration range
- 10 - 25 µg/m³
- 25 - 50 µg/m³
- 50 - 100 µg/m³
- > 100 µg/m³

Maximum predicted 24-hour average PM_{10} concentrations (µg/m³) – Year 4 operations only

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure E.14

REGIS RESOURCES LTD
EMM creating opportunities



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km

GDA 1994 MGA Zone 55

N

KEY

Project application area

- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 4

Existing environment

- Main road
- Local road
- Named watercourse
- Vittoria State Forest

Sensitive receptor

- Private
- Residences under option
- Project related (Regis-owned)

Annual average PM_{10} concentrations

- 1 µg/m³
- 2.5 µg/m³
- 5 µg/m³
- 10 µg/m³
- 25 µg/m³

Annual average PM_{10} concentration range

- 1 - 2.5 µg/m³
- 2.5 - 5 µg/m³
- 5 - 10 µg/m³
- 10 - 25 µg/m³
- > 25 µg/m³

Predicted annual average PM_{10} concentrations (µg/m³) – Year 4 operations only

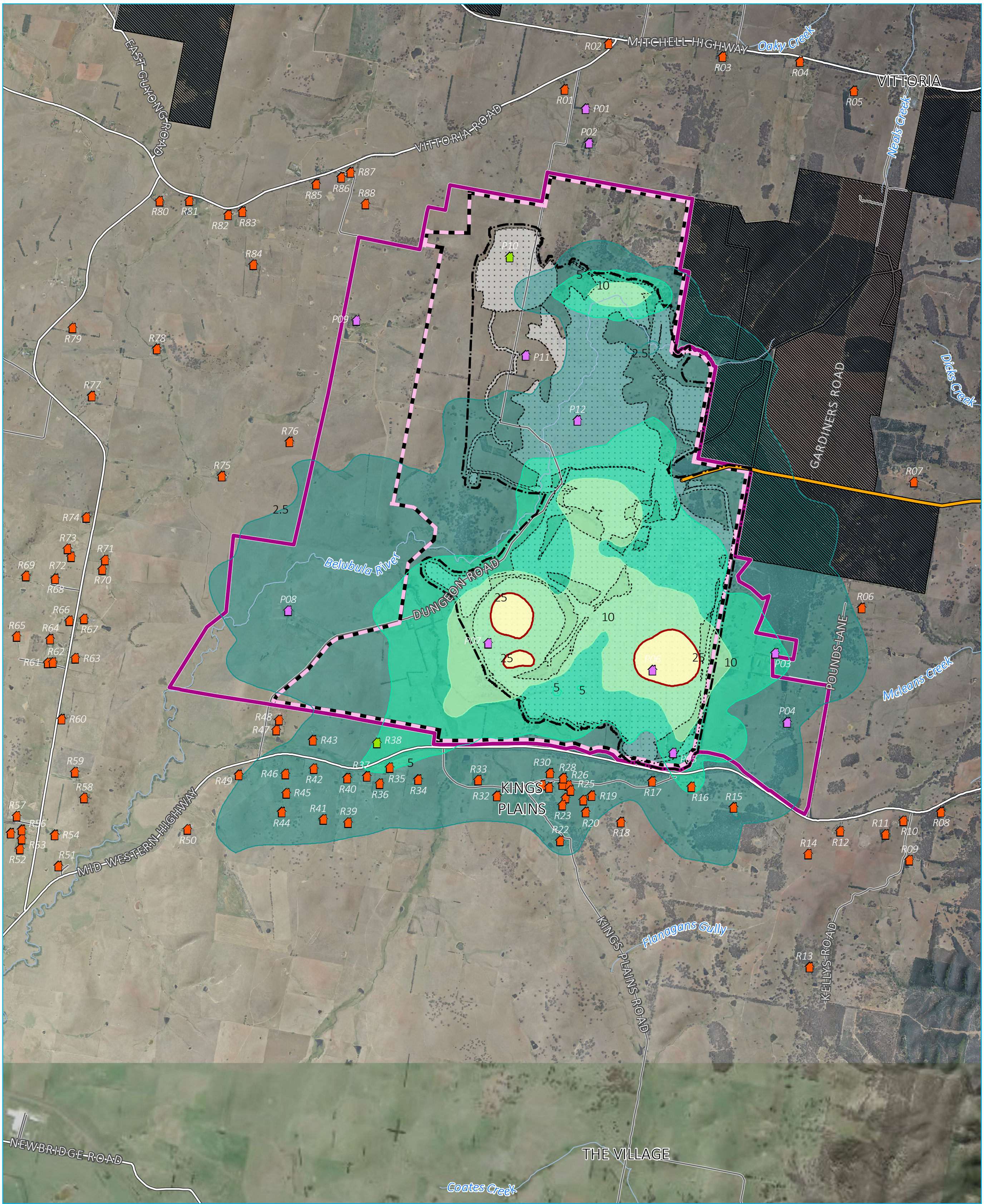
McPhillamys Gold Project

Air quality and greenhouse gas assessment

Figure E.15

REGIS RESOURCES LTD

EMM creating opportunities



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km
GDA 1994 MGA Zone 55
N

KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 4

Existing environment
- Main road
- Local road
- Named watercourse
- Vittoria State Forest

Sensitive receptor
- Private Residences
- Residences under option
- Project related (Regis-owned)

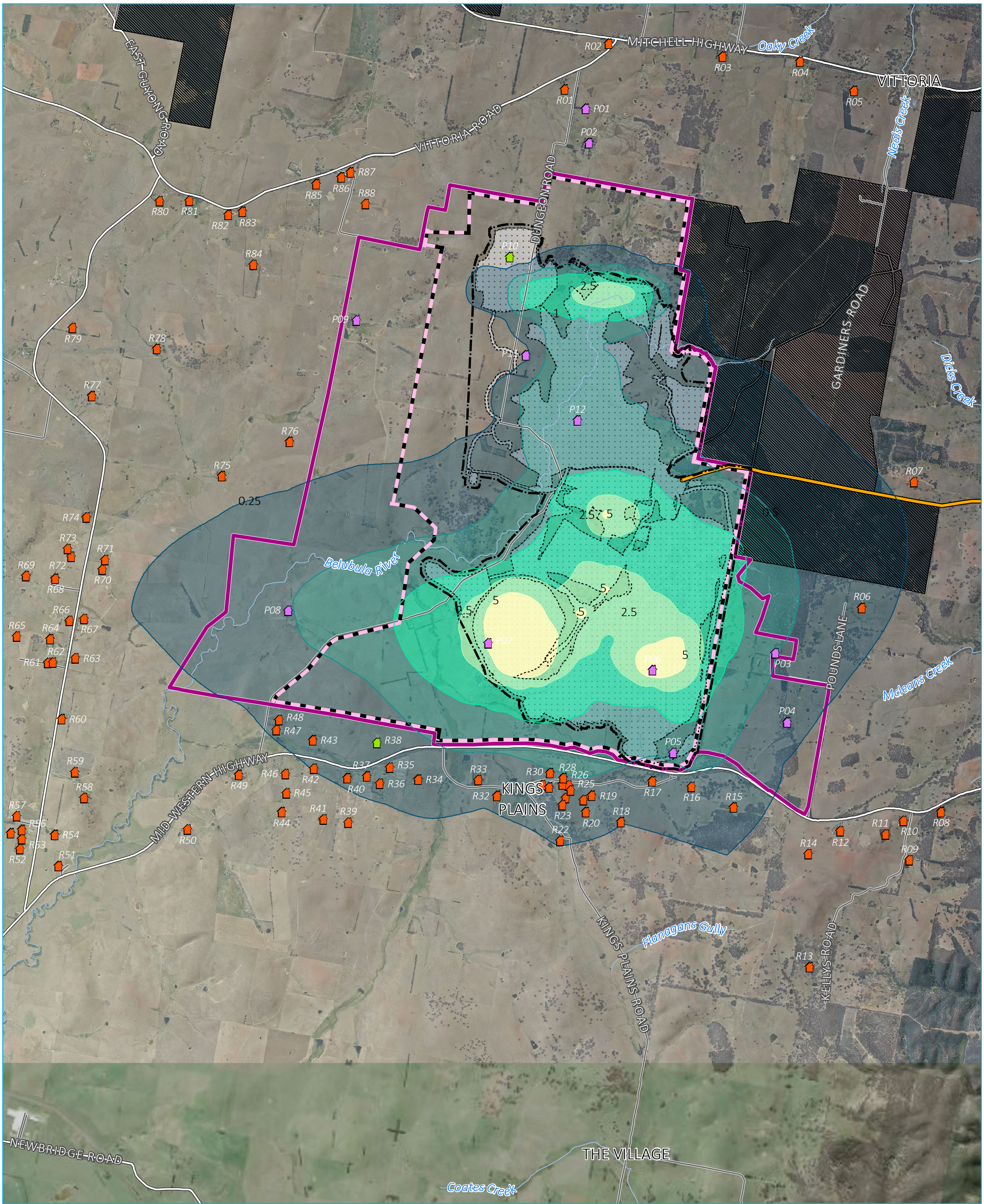
24-hour average $PM_{2.5}$ concentrations
- 2.5 µg/m³
- 5 µg/m³
- 10 µg/m³
- 25 µg/m³

24-hour average $PM_{2.5}$ concentration range
- 2.5 - 5 µg/m³
- 5 - 10 µg/m³
- 10 - 25 µg/m³
- > 25 µg/m³

Maximum predicted 24-hour average $PM_{2.5}$ concentrations (µg/m³) – Year 4 operations only

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure E.16

\\emmsvr1\EMM\Jobs\2018\J180395 - Regis McPhillamys EIS\GIS\02_Maps_AQGHG\AQ012_Max24hrPM25DDP_20190823_04.mxd 23/08/2019



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 4

Existing environment
- Main road
- Local road
- Named watercourse
- Vittoria State Forest

Sensitive receptor
- Private
- Residences under option
- Project related (Regis-owned)

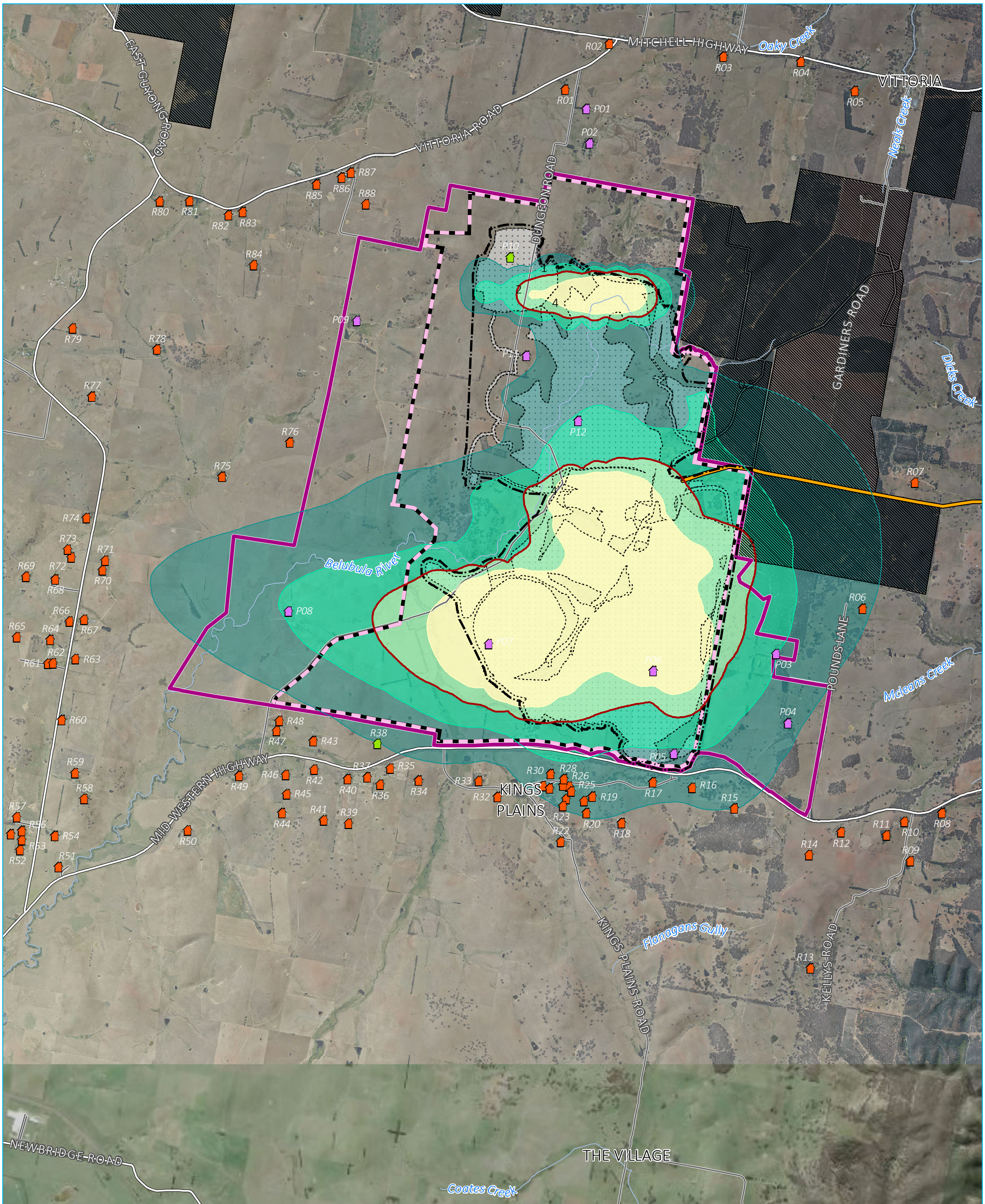
Annual average $PM_{2.5}$ concentrations
- 0.25 µg/m³
- 0.5 µg/m³
- 1 µg/m³
- 2.5 µg/m³
- 5 µg/m³

Annual average $PM_{2.5}$ concentration range
- 0.25 - 0.5 µg/m³
- 0.5 - 1 µg/m³
- 1 - 2.5 µg/m³
- 2.5 - 5 µg/m³
- > 5 µg/m³

Predicted annual average $PM_{2.5}$ concentrations (µg/m³) – Year 4 operations only

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure E.17

\\emmsvr1\EMM\Jobs\2018\J180395 - Regis McPhillamys EIS\GIS\02_Maps_AQGHG\AQ013_MaxAnnualPM25DDP_20190823_04.mxd 23/08/2019



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km

GDA 1994 MGA Zone 55

N

KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- pipeline corridor
- Mine development general arrangement - Year 4

Existing environment
- Main road
- Local road
- Named watercourse
- Vittoria State Forest

Sensitive receptor
- Private
- Residences under option
- Project related (Regis-owned)

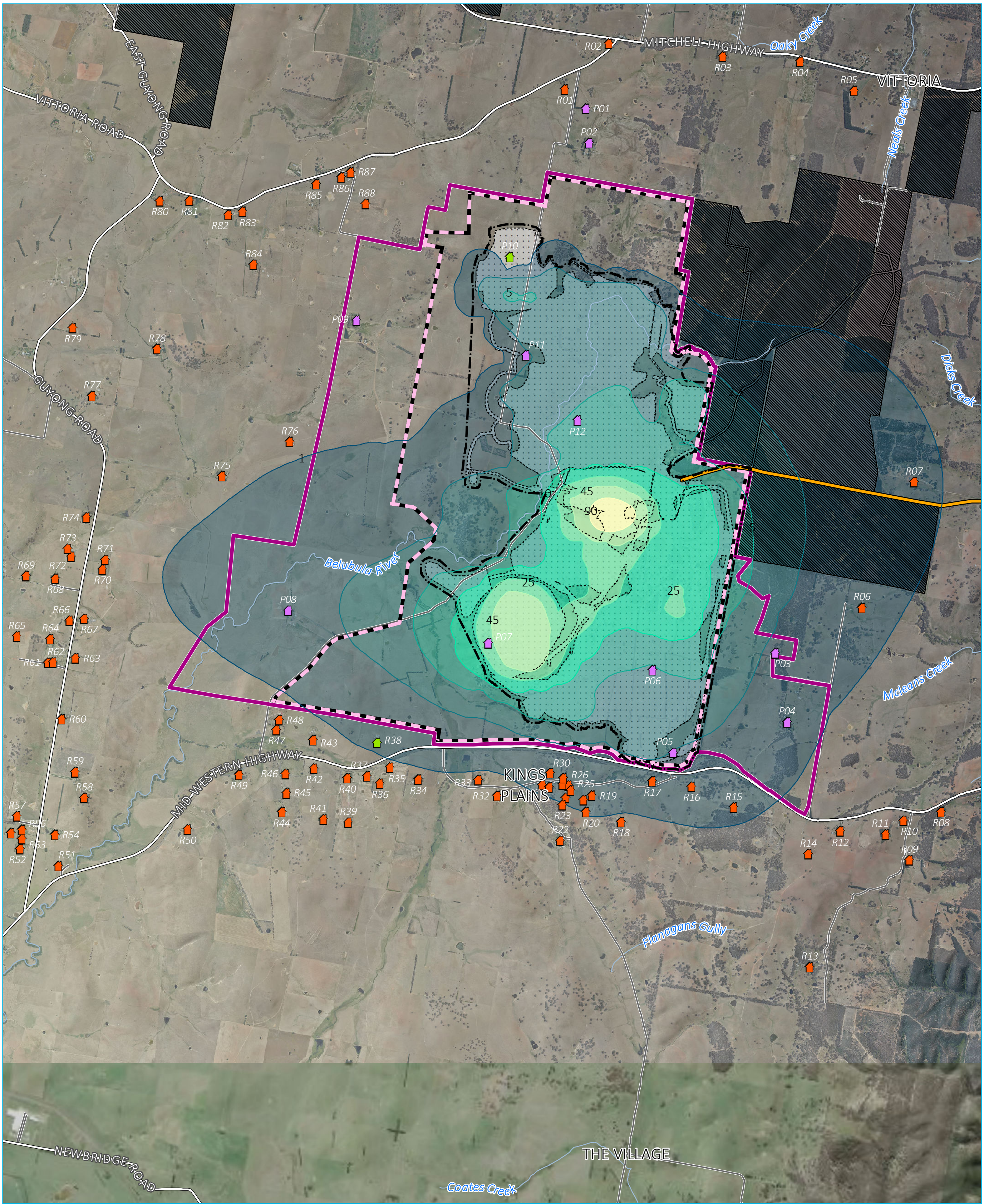
Average dust deposition levels
- 0.5 g/m²/month
- 1 g/m²/month
- 2 g/m²/month (incremental VLAMP mitigation criteria)
- 4 g/m²/month

Average dust deposition level range
- 0.5 - 1 g/m²/month
- 1 - 2 g/m²/month
- 2 - 4 g/m²/month
- > 4 g/m²/month

Predicted annual average dust deposition levels (g/m²/month) – Year 4 operations only

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure E.18

\\emmsvr1\EMM\Jobs\2018\J180395 - Regis McPhillamys EIS\GIS\02_Maps_AQGHG\AQ014_AnnualDustLevelsDDP_20190823_04.mxd 23/08/2019



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

\\emmsvr1\EMM\Jobs\2018\J180395 - Regis McPhillamys EIS\GIS\02_Maps_AQGHG\AQ009_AnnualTSPConcDDP_20190823_05.mxd 23/08/2019

KEY

Project application area

- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 8

Existing environment

- Main road
- Local road
- Named watercourse
- Vittoria State Forest

Sensitive receptor

- Private
- Residences under option
- Project related (Regis-owned)

Annual average TSP concentrations

- 1 µg/m³
- 2.5 µg/m³
- 5 µg/m³
- 10 µg/m³
- 25 µg/m³
- 45 µg/m³
- 90 µg/m³

Annual average TSP concentration range

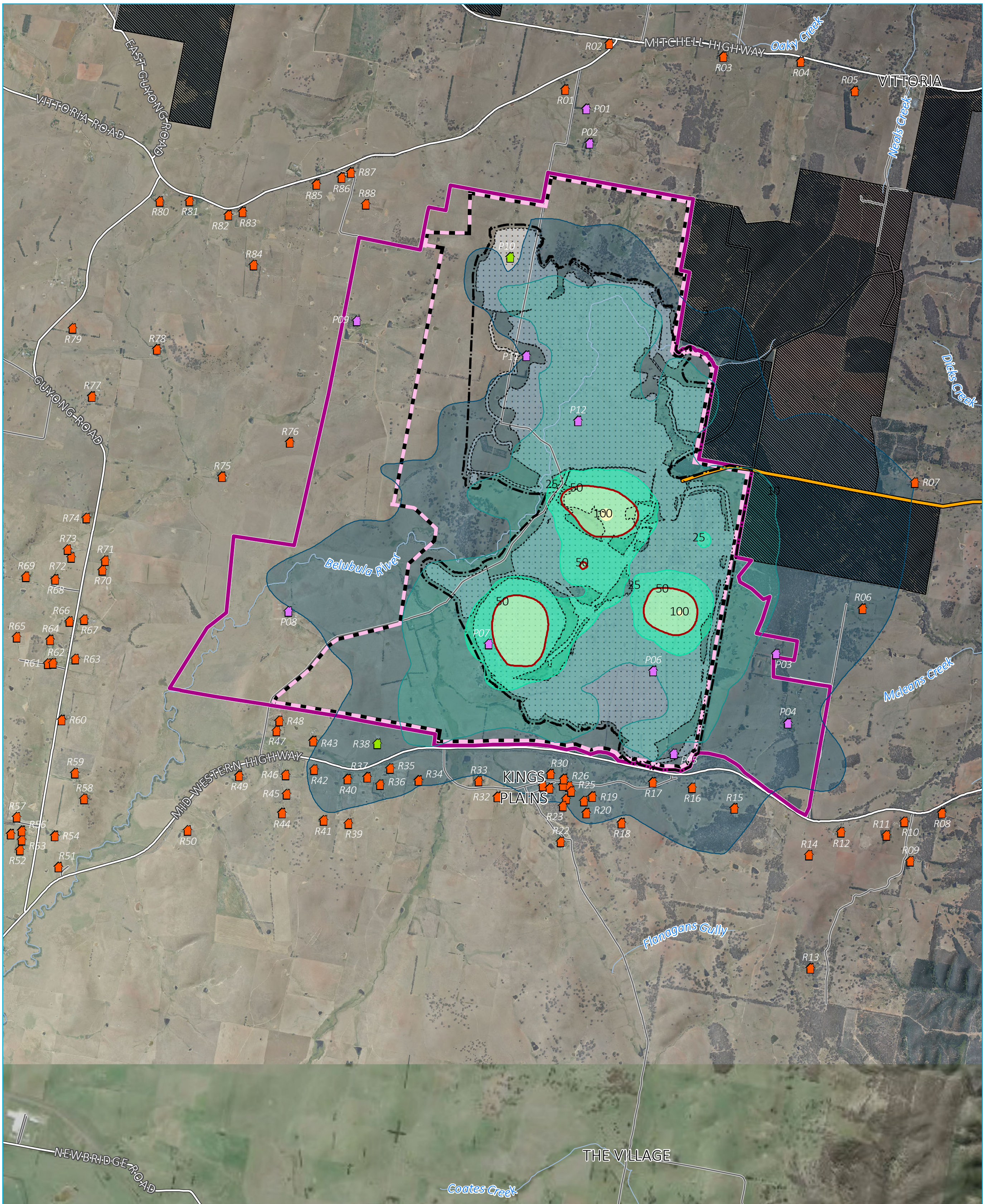
- 1 - 2.5 µg/m³
- 2.5 - 5 µg/m³
- 5 - 10 µg/m³
- 10 - 25 µg/m³
- 25 - 45 µg/m³
- 45 - 90 µg/m³
- > 90 µg/m³

Predicted annual average TSP concentrations (µg/m³) – Year 8 operations only

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure E.19

REGIS RESOURCES LTD

EMM creating opportunities



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km

GDA 1994 MGA Zone 55

N

KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 8

Existing environment
- Main road
- Local road
- Named watercourse
- Vittoria State Forest

Sensitive receptor
- Private
- Residences under option
- Project related (Regis-owned)

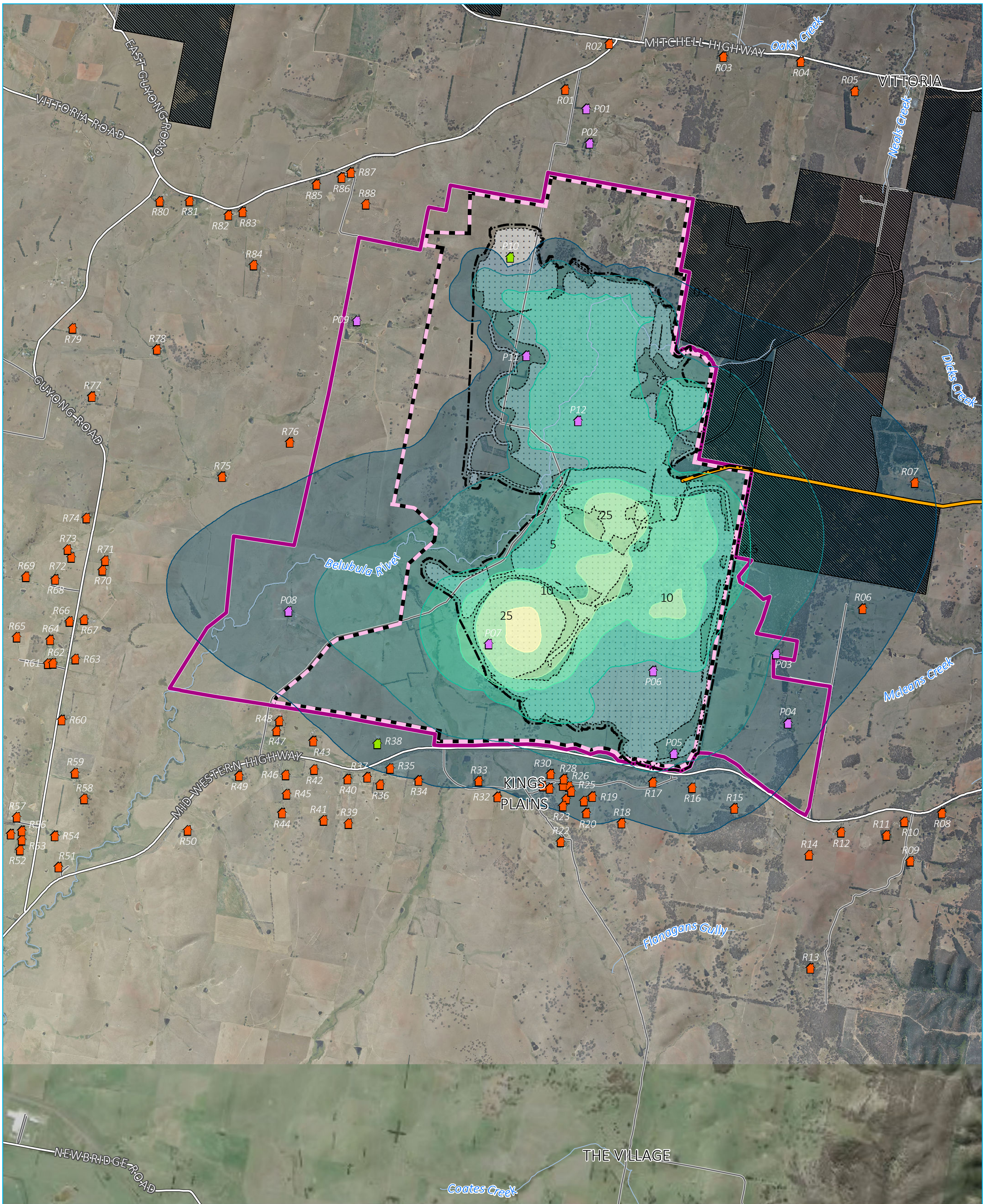
24-hour average PM_{10} concentrations
- 5 µg/m³
- 10 µg/m³
- 25 µg/m³
- 50 µg/m³ (incremental VLAMP mitigation criteria)
- 100 µg/m³

24-hour average PM_{10} concentration range
- 5 - 10 µg/m³
- 10 - 25 µg/m³
- 25 - 50 µg/m³
- 50 - 100 µg/m³
- > 100 µg/m³

Maximum predicted 24-hour average PM_{10} concentrations (µg/m³) – Year 8 operations only

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure E.20

\\emmsvr1\EMM\Jobs\2018\J180395 - Regis McPhillamys EIS\GIS\02_Maps_AQGHG\AQ010_Max24hrPM10DDP_20190823_05.mxd 23/08/2019



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km
GDA 1994 MGA Zone 55

\\emmsvr1\EMM\Jobs\2018\J180395 - Regis McPhillamys EIS\GIS\02_Maps_AQGHG\AQ011_MaxAnnualPM10DDP_20190823_04.mxd 23/08/2019

KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 8

Existing environment
- Main road
- Local road
- Named watercourse
- Vittoria State Forest

Sensitive receptor
- Private
- Residences under option
- Project related (Regis-owned)

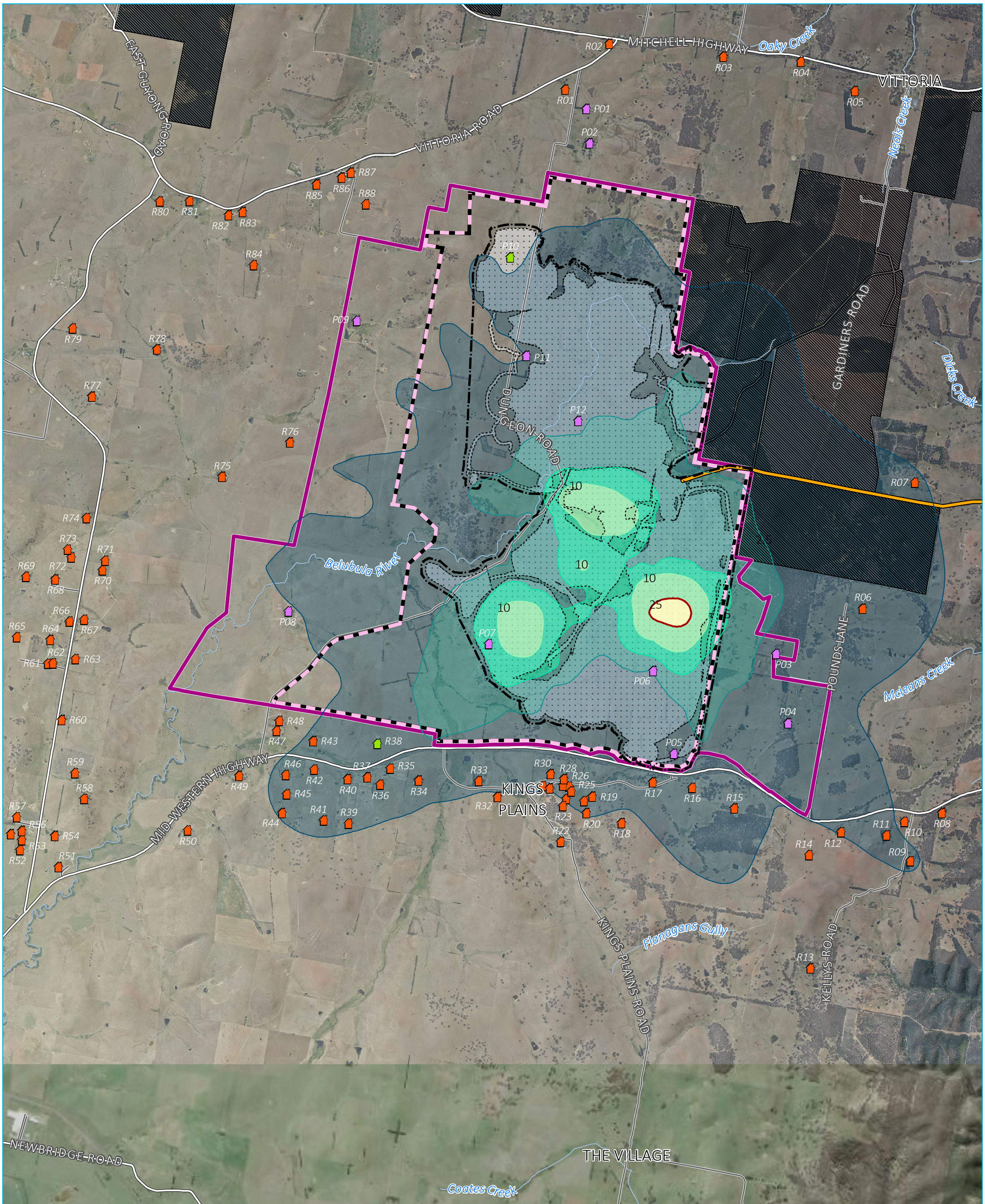
Annual average PM_{10} concentrations
- 0.5 µg/m³
- 1 µg/m³
- 2.5 µg/m³
- 5 µg/m³
- 10 µg/m³
- 25 µg/m³

Annual average PM_{10} concentration range
- 0.5 - 1 µg/m³
- 1 - 2.5 µg/m³
- 2.5 - 5 µg/m³
- 5 - 10 µg/m³
- 10 - 25 µg/m³
- > 25 µg/m³

Predicted annual average PM_{10} concentrations (µg/m³) – Year 8 operations only

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure E.21

REGIS RESOURCES LTD
EMM creating opportunities



\\emmsvr1\EMM\Jobs\2018\J180395 - Regis McPhillamys EIS\GIS\02_Maps_AQGHG\AQ012_Max24hrPM25DDP_20190823_04.mxd 23/08/2019

Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 8

Existing environment
- Main road
- Local road
- Named watercourse
- Vittoria State Forest

Sensitive receptor
- Private
- Residences under option
- Project related (Regis-owned)

24-hour average $PM_{2.5}$ concentrations
- 1 µg/m³
- 2.5 µg/m³
- 5 µg/m³
- 10 µg/m³
- 25 µg/m³

24-hour average $PM_{2.5}$ concentration range
- 1 - 2.5 µg/m³
- 2.5 - 5 µg/m³
- 5 - 10 µg/m³
- 10 - 25 µg/m³
- > 25 µg/m³

Maximum predicted 24-hour average $PM_{2.5}$ concentrations (µg/m³) – Year 8 operations only

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure E.22

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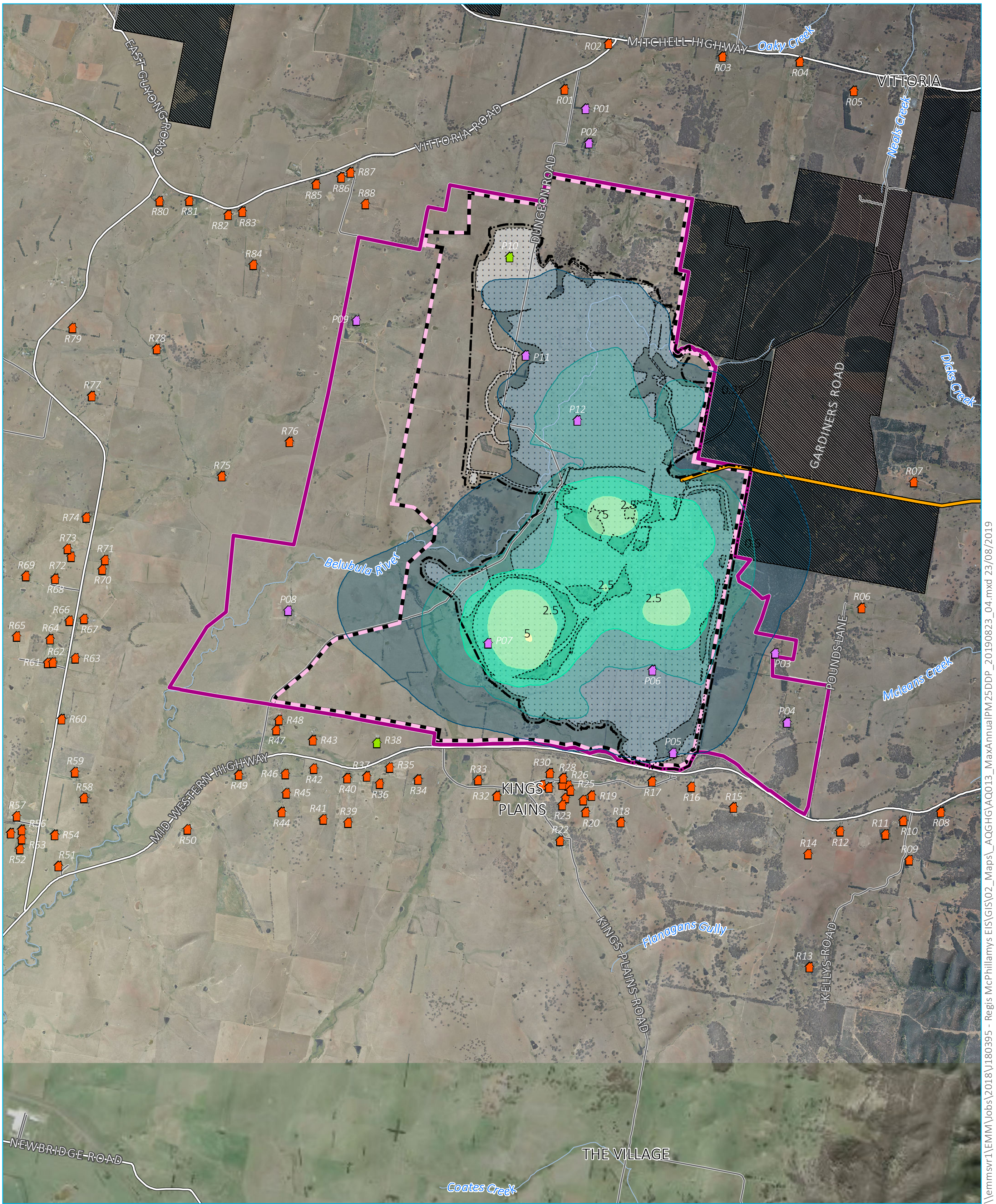


Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km
GDA 1994 MGA Zone 55

KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor
- Mine development general arrangement - Year 8

Existing environment
- Main road
- Local road
- Named watercourse
- Vittoria State Forest

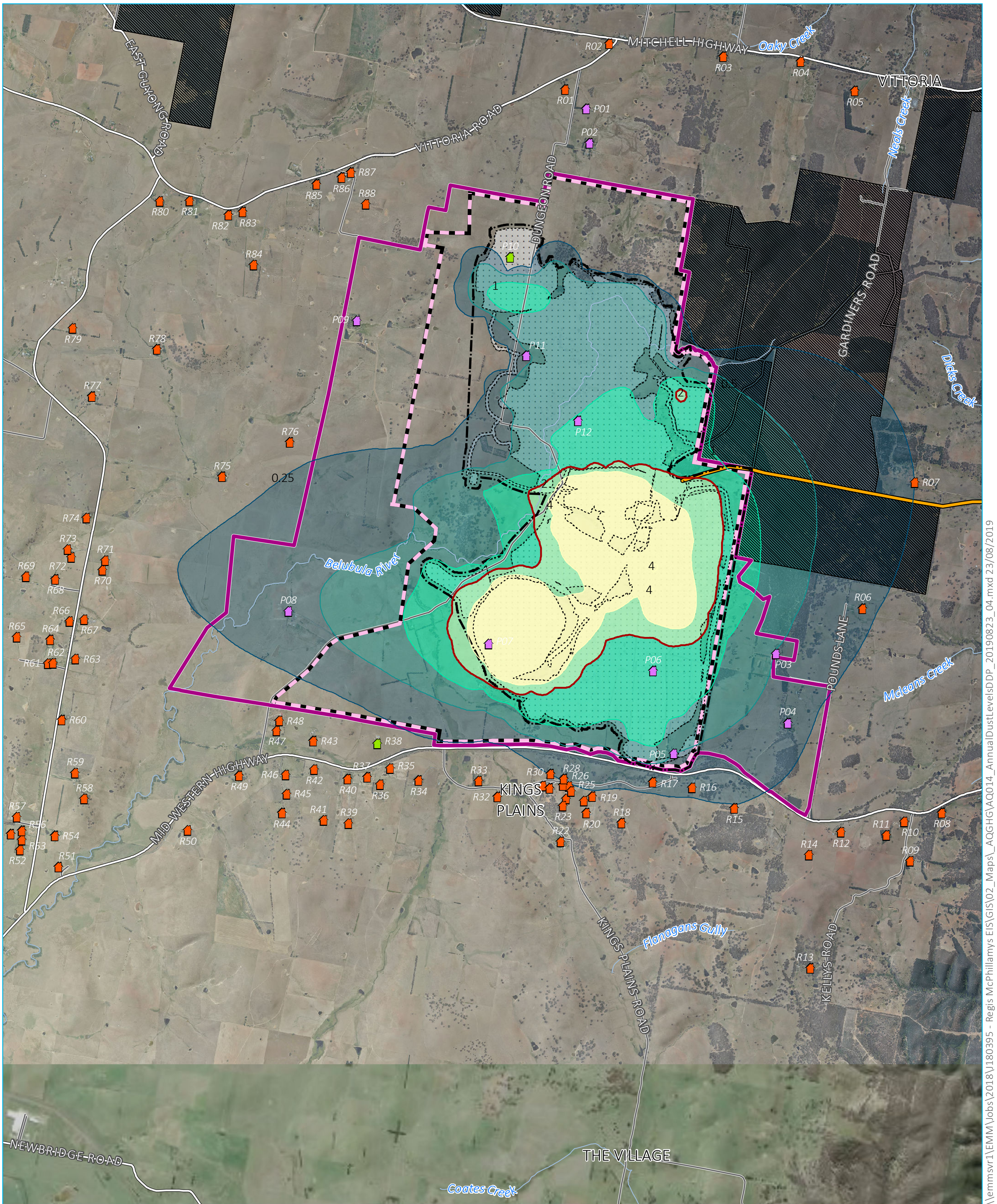
Sensitive receptor
- Private
- Residences under option
- Project related (Regis-owned)

Annual average $PM_{2.5}$ concentrations
- 0.25 µg/m³
- 0.5 µg/m³
- 1 µg/m³
- 2.5 µg/m³
- 5 µg/m³

Annual average $PM_{2.5}$ concentration range
- 0.25 - 0.5 µg/m³
- 0.5 - 1 µg/m³
- 1 - 2.5 µg/m³
- 2.5 - 5 µg/m³
- > 5 µg/m³

Predicted annual average $PM_{2.5}$ concentrations (µg/m³) – Year 8 operations only

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure E.23



Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km
GDA 1994 MGA Zone 55
N

KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- pipeline corridor
- Mine development general arrangement - Year 8

Existing environment
- Main road
- Local road
- Named watercourse
- Vittoria State Forest

Sensitive receptor
- Private
- Residences under option
- Project related (Regis-owned)

Average dust deposition levels
- 0.25 g/m²/month
- 0.5 g/m²/month
- 1 g/m²/month
- 2 g/m²/month (incremental VLAMP mitigation criteria)
- 4 g/m²/month

Average dust deposition level range
- 0.25 - 0.5 g/m²/month
- 0.5 - 1 g/m²/month
- 1 - 2 g/m²/month
- 2 - 4 g/m²/month
- > 4 g/m²/month

Predicted annual average dust deposition levels (g/m²/month) – Year 8 operations only

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Air quality and greenhouse gas assessment
Figure E.24

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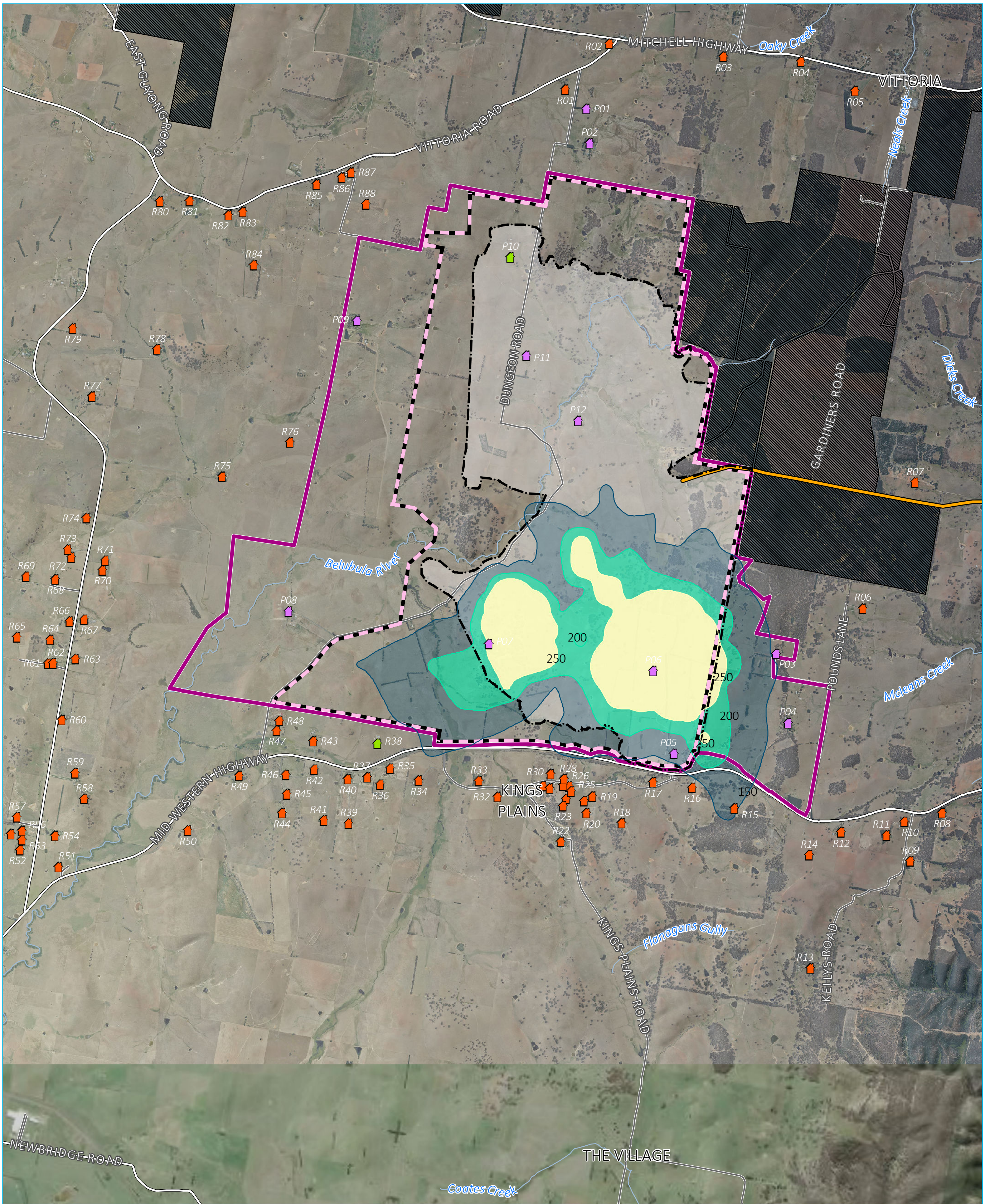

Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

0 1 2 km
GDA 1994 MGA Zone 55

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KEY

Project application area
- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor

Existing environment
- Main road
- Local road
- Named watercourse
- Vittoria State Forest

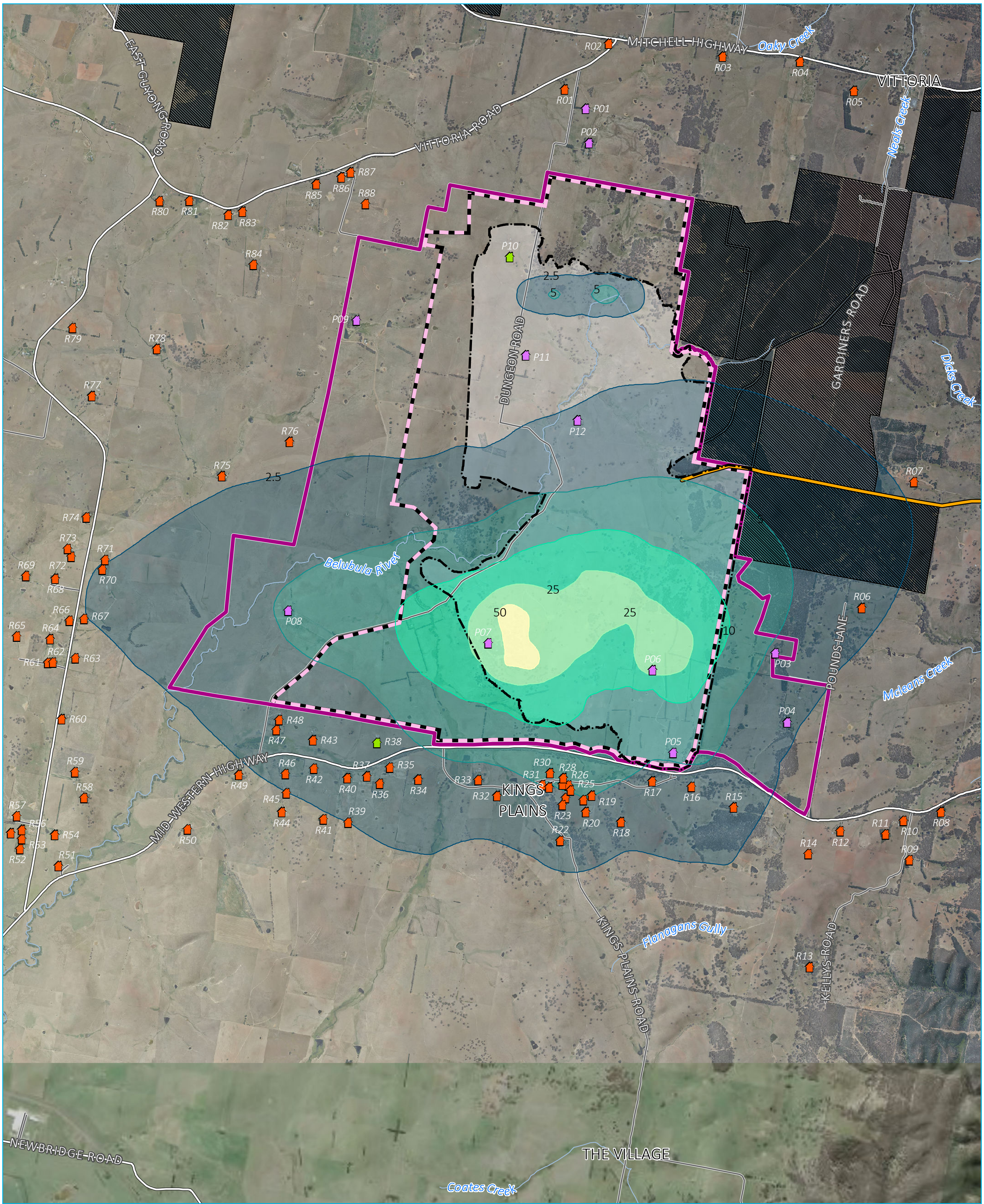
Sensitive receptor
- Private
- Residences under option
- Project related (Regis-owned)

1-hour average NO_2 concentrations
- 150 µg/m³
- 200 µg/m³
- 250 µg/m³

1-hour average NO_2 concentration range
- 150 - 200 µg/m³
- 200 - 250 µg/m³
- > 250 µg/m³

Maximum predicted 1-hour average NO_2 concentrations (µg/m³) – Maximum diesel combustion operations only

McPhillamys Gold Project
Air quality and greenhouse gas assessment
Figure E.25



\\emmsvr1\EMM\Jobs\2018\J180395 - Regis McPhillamys EIS\GIS\02_Maps_AQGHG\AQ016_AnnualNO2_20190823_04.mxd 23/08/2019

Source: EMM (2019); Regis Resources (2019); Survey Graphics (2019); DFSI (2017); ELVIS (2014)

KEY

Project application area

- Mine development project area (2,513.47 ha)
- Mining lease application area (1,812.99 ha) (Note: boundary offset for clarity)
- Disturbance footprint
- Pipeline corridor

Existing environment

- Main road
- Local road
- Named watercourse
- Vittoria State Forest

Sensitive receptor

- Private
- Residences under option
- Project related (Regis-owned)

Average NO_2 concentrations

- 2.5 µg/m³
- 5 µg/m³
- 10 µg/m³
- 25 µg/m³
- 50 µg/m³

Average NO_2 concentration range

- 2.5 - 5 µg/m³
- 5 - 10 µg/m³
- 10 - 25 µg/m³
- 25 - 50 µg/m³
- > 50 µg/m³

Predicted annual average NO_2 concentrations (µg/m³) – Maximum diesel combustion operations only

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Air quality and greenhouse gas assessment
Figure E.26