APPENDIX 14

Air Quality Impact Assessment

Ulan Coal Complex Modification 5

Air Quality Impact Assessment

Final 0 | Revision 0

2 November 2022

Ulan Coal Mines Limited

Umwelt (Australia) Pty Ltd 20020

Ulan Coal Complex Modification 5

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Contents

Figures

Tables

Acronyms and definitions

Abbreviation	Definition
AEMR	Annual Environmental Management Report
BoM	Bureau of Meteorology
CALMET	Meteorological model for the CALPUFF air dispersion model
CALPUFF	Computer-based air dispersion model
CO	Carbon monoxide
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DA	Development Approval
DEC	Department of Environment and Conservation
DPIE	Department of Planning, Industry and Environment
EPA	NSW Environment Protection Authority
EPL	Environment Protection Licence
HVAS	High volume air sampler
Jacobs	Jacobs Group (Australia) Pty Limited
MIA	Mine Infrastructure Area
Mtpa	Million tonnes per annum
NEPM	National Environment Protection Measure
NEPC	National Environment Protection Council of Australia
NO_2	Nitrogen dioxide
NPI	National Pollutant Inventory
OEH	Office of Environment and Heritage, now part of the Department of Planning, Industry and Environment as Environment, Energy and Science
PA	Project Approval
$PM_{2.5}$	Particulate matter with equivalent aerodynamic diameters less than 2.5 microns
PM_{10}	Particulate matter with equivalent aerodynamic diameters less than 10 microns
POEO Act	*Protection of the Environment Operations (POEO) Act 1997*
ROM	Run-of-mine
SEE	Statement of Environmental Effects
SSD	State Significant Development
TAPM	The Air Pollution Model – a meteorological and air dispersion model developed by CSIRO
TEOM	Tapered Element Oscillating Microbalance
TSP	Total suspended particulate matter
UCMPL	Ulan Coal Mines Pty Limited

Executive Summary

Ulan Coal Mines Pty Limited (UCMPL) is seeking approval for a modification to the underground operations at the Ulan Coal Complex (UCC), hereafter referred to as the Proposed Modification. Approval is sought under Section 4.55(2) of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This report provides an assessment of the potential air quality impacts of the Proposed Modification.

The assessment involved identifying the key air quality issues, characterising the existing environment, quantifying emissions to air and modelling to predict the impact of the Proposed Modification on local air quality.

The key air quality issues were identified as mining dust and diesel exhaust, predominantly from proposed changes to underground operations and associated surface infrastructure. These issues were the focus of the assessment.

A detailed review of the existing environment was carried out including an analysis of historically measured concentrations of key quality indicators from representative monitoring stations. The following conclusions were made in relation to the existing environment:

- Meteorological conditions in 2017 were representative of the long term, local conditions around the UCC.
- There was a deterioration in air quality conditions between 2017 and 2019 (and early into 2020), heavily influenced by drought, dust storms and bushfires. These conditions were not unique to the Central Tablelands and have been observed across NSW.
- UCMPL has complied with the air quality criteria specified in its existing Project Approval in all of the past six years (from 2015 to 2020).

The key outcomes of the assessment are:

- The contribution of the UCC (as modified) to local air quality would be relatively minor, based on modelling that showed contributions well below the criteria set by the Environment Protection Authority (EPA).
- Dust concentrations and deposition levels due to the UCC (as modified) are unlikely to exceed relevant EPA assessment criteria at the sensitive receptors. The only potential for the UCC (as modified) to cause an exceedance of EPA criteria (specifically 24-hour average PM_{10}) would be when the background levels are already approaching the criteria. Under these conditions, the contribution from UCC would be very small and this risk can be managed through appropriate air quality management measures.
- Emissions from diesel exhausts associated with vehicles, plant and equipment are not expected to result in any adverse air quality impacts, based on modelling which showed contributions well below the EPA criteria.

Based on this assessment, it has been concluded that the Proposed Modification is unlikely to affect air quality beyond the range of historically measured fluctuations of key air quality indicators around Ulan. This conclusion has been informed by modelling which showed that the UCC (as modified) would not result in changes to air quality that would cause exceedances of air quality criteria at the sensitive receptors.

Important note about your report

The sole purpose of this report and the associated services performed by Jacobs is to quantify the potential air quality impacts of the UCC Proposed Modification in accordance with the scope of services set out in the contract between Jacobs and the Client. That scope of services, as described in this report, was developed with the Client.

In preparing this report, Jacobs has relied upon, and presumed accurate, any information (or confirmation of the absence thereof) provided by the Client and/or from other sources. Except as otherwise stated in the report, Jacobs has not attempted to verify the accuracy or completeness of any such information. If the information is subsequently determined to be false, inaccurate or incomplete then it is possible that our observations and conclusions as expressed in this report may change.

Jacobs derived the data in this report from information sourced from the Client (if any) and/or available in the public domain at the time or times outlined in this report. The passage of time, manifestation of latent conditions or impacts of future events may require further examination of the project and subsequent data analysis, and re-evaluation of the data, findings, observations and conclusions expressed in this report. Jacobs has prepared this report in accordance with the usual care and thoroughness of the consulting profession, for the sole purpose described above and by reference to applicable standards, guidelines, procedures and practices at the date of issue of this report. For the reasons outlined above, however, no other warranty or guarantee, whether expressed or implied, is made as to the data, observations and findings expressed in this report, to the extent permitted by law.

This report should be read in full and no excerpts are to be taken as representative of the findings. No responsibility is accepted by Jacobs for use of any part of this report in any other context.

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1. Introduction

1.1 Background

UCMPL is seeking approval for a modification to operations at the UCC. Specifically, UCMPL is seeking a modification to Project Approval (PA) 08_0184 to extend the life of the existing operations by two years and to allow for the extraction of additional coal through some changes to the underground mining area, extension and/or widening of select longwall panels (the Proposed Modification). Approval is sought under Section 4.55(2) of the *Environmental Planning and Assessment Act 1979* (EP&A Act). This report provides an assessment of the potential air quality impacts of the Proposed Modification.

1.2 Modification Description

The UCC is located approximately 38 kilometres north-north-east of Mudgee and 19 kilometres north-east of Gulgong in New South Wales. Operations at the UCC are located approximately 1.5 kilometres east of the village of Ulan and entirely within the Mid-Western Regional Council Local Government Area (LGA). Coal mining has been undertaken in the Ulan area since the 1920s.

UCMPL was granted PA 08_0184 under Part 3A of the EP&A Act on 15 November 2010 for the Ulan Coal Continued Operations Project (UCCO Project). Approved operations at the UCC consist of underground mining in the Ulan Underground and Ulan West areas as well as open cut mining, and associated coal handling, processing and transport through to August 2033. The open cut operations have been in care and maintenance since 2016.

UCMPL is proposing a modification to PA 08_0184 pursuant to section 4.55(2) of the EP&A Act to maximise resource recovery from the existing underground mining operations and within existing mining lease and exploration lease areas. In addition to identifying supplementary mineable resources within existing mining lease areas, UCMPL has determined that there is a valuable mineable resource within Exploration Lease (EL) 7542. UCMPL is seeking to modify PA 08_0184 to enable access to this coal resource by extending the currently approved longwall panels in these areas.

The Proposed Modification will extend the life of the existing operations by two years until 2035 and will allow for an additional approximately 25 million tonnes (Mt) of product coal. The Proposed Modification generally comprises of:

- extension of Ulan Underground longwall (LW) panels LWW9 to LWW11 to the west
- widening of Ulan Underground LWW11 by approximately 40 metres
- extension of Ulan West LW9 to LW12 to the north.

UCMPL is also proposing minor changes to surface infrastructure to support underground mining activities including provision of:

- three ventilation shafts and associated infrastructure corridors
- five dewatering bores and associated infrastructure corridors
- alternate access track
- an infrastructure corridor and service borehole (to deliver gravel and other construction materials and to provide access and power to the underground mine) to the south-west of Ulan West
- other associated infrastructure required to service the approved and proposed underground mining operations.

Table 1 provides a comparison between the approved development under PA 08_0184 and the Proposed Modification. A detailed description of the Proposed Modification is provided in the Modification Report.

Table 1 Proposed Modification

Component	Approved operations	Proposed modification
Mine life	Mining operations until 30 August 2033	Extension of life of mine until 30 August 2035 (an additional 2 years)
Limits of Extraction	20 million tonnes of coal per annum including a maximum of 4.1 million tonnes per annum (Mtpa) of run-of-mine (ROM) coal from the open cut	No change, with an additional 25 Mt from the Proposed Modification
Operating Hours	24 hours per day, 7 days per week	No change
Project boundary	As per PA 08_0184	Extension of Project Approval Boundary to include the northern part of EL 7542
Mine plan	As per PA 08_0184	Extension of Ulan Underground LWW9 to LWW11, and Ulan West LW9 to LW12. Widening of Ulan Underground LWW11.
Mining Method	Retreat longwall method	No change
Surface Infrastructure	As per PA 08_0184	Minor changes to infrastructure including dewatering bores, ventilation shafts and associated infrastructure to accommodate the proposed mine plan.
Coal Handling and Preparation Plant	As per PA 08_0184	No change
Coal Transportation	All coal transported from the site by rail. No more than 10 laden trains leave the site each day.	No change
Workforce	Approximately 930 people (Ulan Coal Complex)	No change

Figure 1 shows the location of the UCC, surrounding features and sensitive receptors.

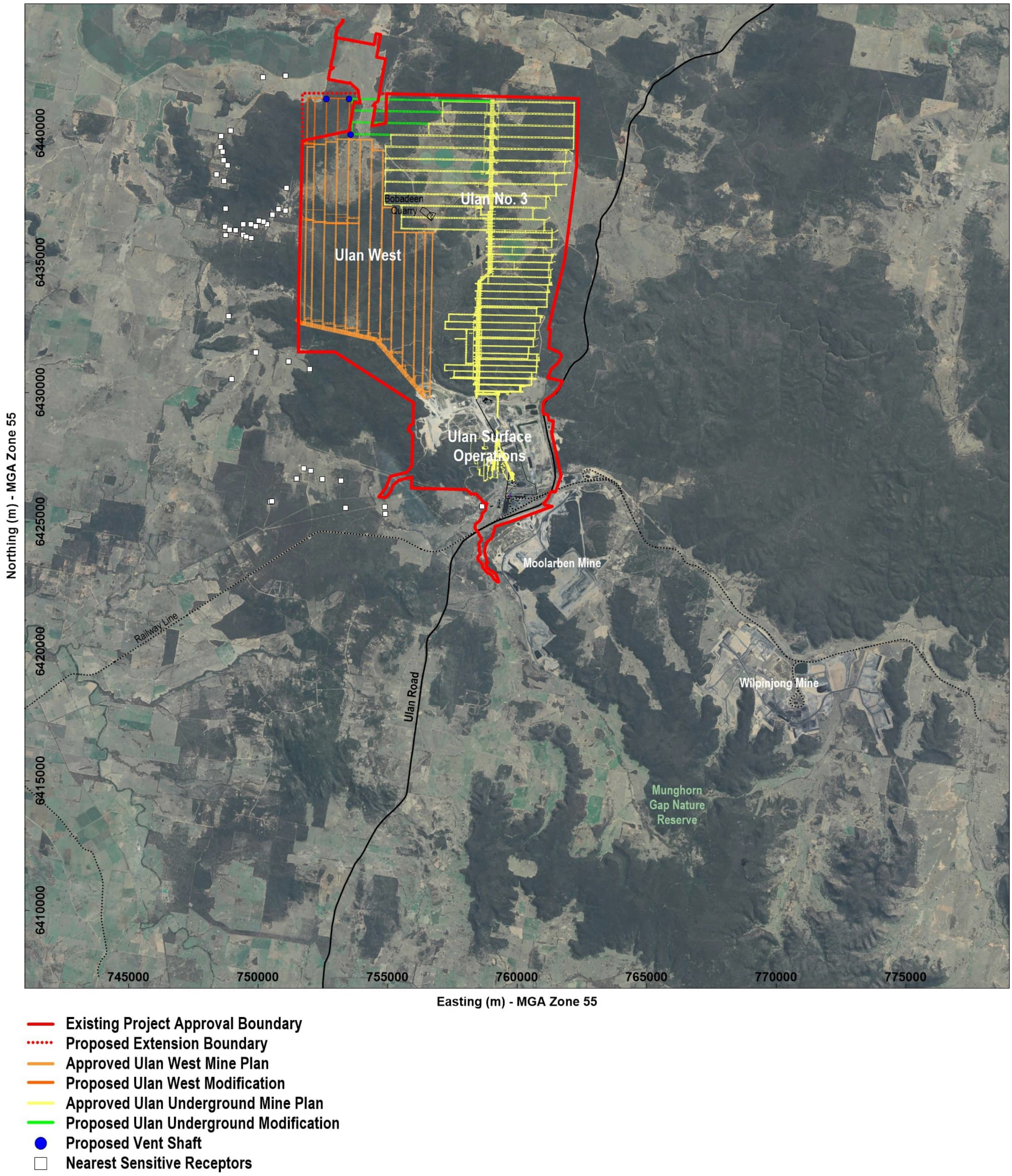

Figure 1 Location of the Ulan Coal Complex and surrounds

1.3 Performance Outcome

The desired performance outcome for the Proposed Modification relating to air quality is to comply with relevant criteria and minimise air quality impacts to reduce risks to human health and the environment to the greatest extent practicable through the design and operation of the Proposed Modification.

1.4 Report Structure

The report is structured as follows:

- Section 1 – Introduces the Proposed Modification with a summary of the background, description and performance outcomes
- Section 2 – Identifies the key air quality issues to be addressed
- Section 3 – Outlines the key legislative and policy assessment requirements for air quality
- Section 4 – Discusses key features of the existing environment including surrounding land uses, sensitive receptors, and local meteorological and air quality conditions
- Section 5 – Provides an overview of the methods used to assess the potential for air quality impacts
- Section 6 – Provides an assessment of the potential construction and operational air quality impacts including potential cumulative impacts
- Section 7 – Outlines the measures to mitigate or otherwise effectively manage and monitor potential impacts
- Section 8 – Provides the conclusions of the assessment.

2. Key Issues

Air quality issues can arise when emissions from an industry or activity lead to deterioration in the ambient air quality. Potential air quality issues have been identified from a review of the Proposed Modification and associated activities. This identification process has considered the types of emissions to air and proximity of these emission sources to sensitive receptors.

Emissions to air at the UCC may occur from a variety of activities including coal handling, coal processing, wind erosion from exposed areas and venting of air from the underground operations. The Proposed Modification will involve minor changes to surface infrastructure. In terms of the potential to affect current air quality outcomes, the most significant change will be the construction and operation of three ventilation shafts, and associated infrastructure corridors to the northwest of the existing project approval boundary (Figure 1). Potential emissions from these sources and activities will be predominantly dust, also referred to as particulate matter.

Key classifications of particulate matter include:

- Total suspended particulates (TSP)
- Particulate matter with equivalent aerodynamic diameter of 10 microns or less (PM_{10})
- Particulate matter with equivalent aerodynamic diameter of 2.5 microns or less ($PM_{2.5}$)
- Deposited dust.

Plant and equipment exhausts also have the potential to generate emissions that include, most significantly, oxides of nitrogen (NO_x) and particulate matter (as PM_{10} and $PM_{2.5}$). This issue has been assessed.

The area around the UCC contains various emission sources that will contribute to local air quality and cumulative impacts are addressed in the report.

The key issues for the Proposed Modification will be:

- Mining dust (that is, particulate matter in the form of TSP, PM_{10}, $PM_{2.5}$ and deposited dust) due to surface infrastructure changes
- Diesel exhaust (PM_{10}, $PM_{2.5}$ and NO_2) from plant and equipment at the UCC.

These issues are the focus of this assessment. Greenhouse gas emissions are the subject of a separate assessment.

3. Air Quality Policy Setting

Air quality is typically quantified by the concentrations of substances in the ambient air. Air pollution occurs when the concentration (or some other measure of intensity) of one or more substances known to cause health, nuisance and/or environmental effects, exceeds a certain level. With regard to human health and nuisance effects, the substances most relevant to the Proposed Modification have been identified, from Section 2, as particulate matter and NO_2.

The EPA has developed assessment criteria for a range of air quality indicators including particulate matter and NO_2. These criteria are outlined in the "Approved Methods for the Modelling and Assessment of Air Pollutants in NSW" (EPA, 2022), hereafter referred to as the Approved Methods. Most of the EPA criteria referred to in this report have been drawn from national standards for air quality set by the National Environmental Protection Council of Australia (NEPC) as part of the National Environment Protection Measures (NEPMs) (NEPC, 1998). To measure compliance with ambient air quality criteria, the Department of Planning, Industry and Environment (DPIE) has established a network of monitoring stations across NSW and up-to-date records are published on the DPIE website. Section 4 provides details of the data from relevant monitoring stations.

The Proposed Modification has been assessed in terms of its ability to comply with the air quality criteria set by the EPA as part of the Approved Methods. These criteria are outlined in Table 2 and apply to existing and potentially sensitive receptors, where the Approved Methods defines a sensitive receptor as *"a location where people are likely to work or reside; this may include a dwelling, school, hospital, office or public recreational area"*. This definition has also been interpreted as places of near-continuous occupation. Criteria applicable to the approved project are included in Table 2.

Table 2 EPA air quality assessment criteria

Air quality indicator	Averaging time	EPA criterion*	Criteria applicable to the Ulan Coal Approved Project**
Particulate matter (PM_{10})	24-hour	50 µg/m^3	50 µg/m^3
	Annual	25 µg/m^3	30 µg/m^3
Particulate matter ($PM_{2.5}$)	24-hour	25 µg/m^3	None
	Annual	8 µg/m^3	None
Particulate matter (TSP)	Annual	90 µg/m^3	90 µg/m^3
Deposited dust	Annual (maximum increase)	2 g/m^2/month	2 g/m^2/month
	Annual (maximum total)	4 g/m^2/month	4 g/m^2/month
Nitrogen dioxide (NO_2)	1-hour	164 µg/m^3	None
	Annual	31 µg/m^3	None

**Source: Table 7.1 of the Approved Methods.*
***Source: PA08_0184, Schedule 3, condition 19.*

The EPA air quality assessment criteria relate to the total concentration of pollutants in the air (that is, cumulative) and not just the contribution from project-specific sources. Therefore, some consideration of background levels needs to be made when using these criteria to assess the potential impacts. In situations where background levels are elevated the proponent must "*demonstrate that no additional exceedances of the impact assessment criteria will occur as a result of the proposed activity and that best management practices will be implemented to minimise emissions of air pollutants as far as is practical*" (EPA, 2016). Section 4 provides further discussion of background levels.

In December 2015 the Australian Government announced a National Clean Air Agreement (Agreement). This Agreement aims to reduce air pollution and improve air quality via the following main actions:

- The introduction of emission standards for new non-road spark ignition engines and equipment.

- Measures to reduce air pollution from wood heaters.
- Strengthened ambient air quality reporting standards for particle pollution.

The strengthening of ambient air quality reporting standards for particle pollution is relevant to the Proposed Modification. Specifically, and at the time, the following was agreed:

> *"Taking into account the latest scientific evidence of health impacts, Ministers agreed to strengthen national ambient air quality reporting standards for airborne fine particles. Ministers agreed to adopt reporting standards for annual average and 24-hour $PM_{2.5}$ particles of 8 µg/m^3 and 25 µg/m^3 respectively, aiming to move to 7 µg/m^3 and 20 µg/m^3 respectively by 2025. Ministers also agreed to establish an annual average standard for PM_{10} particles of 25 µg/m^3. Victoria and the Australian Capital Territory will set, and South Australia will consider setting, a more stringent annual average PM_{10} standard of 20 µg/m^3 in the state, while ensuring nationally consistent monitoring and reporting against the agreed National Environment Protection Measure standards. The decision was also taken to review PM_{10} standards in 2018. The review will be co-led by the NSW and Victorian governments, in discussion with other jurisdictions."*

On 25 February 2016, an amendment to the NEPM entered into force and introduced the new national air quality standards for PM_{10} and $PM_{2.5}$, as noted above. The EPA subsequently revised its PM_{10} and $PM_{2.5}$ assessment criteria as part of an update to the Approved Methods. These revised criteria are reflected in Table 2 and took effect from 20 January 2017 onwards. There is currently no State legislation regarding the aim to move to more stringent $PM_{2.5}$ criteria by 2025. Accordingly, the Proposed Modification is assessed against the current criteria detailed in the Approved Methods as these criteria would be applied by the consent authority in accordance with the provisions of Clause 12AB of the S*tate Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007* (Mining SEPP) (2018 amendment). Table 2 also reflects the April 2021 update to the NEPM, where the standards for ozone (O_3), sulfur dioxide (SO_2) and NO_2 were updated in-line with the latest scientific research around health impacts.

The NSW Voluntary Land Acquisition and Mitigation Policy (NSW Government, 2018) (VLAMP) includes the NSW Government's policy for voluntary mitigation and land acquisition to address dust (particulate matter) impacts from state significant mining, petroleum and extractive industry developments. The VLAMP brings the air quality criteria in line with the NEPM standards and EPA criteria.

From the VLAMP, voluntary mitigation rights may apply where, even with best practice management, the development contributes to exceedances of the criteria in Table 3 at any residence or workplace.

Table 3 VLAMP mitigation criteria for particulate matter

Air quality indicator	Averaging time	Mitigation criterion	Impact type
Particulate matter (PM_{10})	24-hour	50 µg/m^3 **	Human health
	Annual	25 µg/m^3 *	Human health
Particulate matter ($PM_{2.5}$)	24-hour	25 µg/m^3 **	Human health
	Annual	8 µg/m^3 *	Human health
Particulate matter (TSP)	Annual	90 µg/m^3 *	Amenity
Deposited dust	Annual (maximum increase)	2 g/m^2/month **	Amenity
	Annual (maximum total)	4 g/m^2/month *	Amenity

** Cumulative impact (i.e. increase in concentrations due to the development plus background concentrations due to all other sources).*
*** Incremental impact (i.e. increase in concentrations due to the development alone), with zero allowable exceedances of the criteria over the life of the development.*

Voluntary acquisition rights may apply where, even with best practice management, the development contributes to exceedances of the criteria in Table 4 at any residence or workplace on privately owned land, or on 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 VLAMP acquisition criteria for particulate matter

Air quality indicator	Averaging time	Acquisition criterion	Impact type	Acquisition criteria applicable to the Ulan Coal Approved Project***
Particulate matter (PM_{10})	24-hour	50 µg/m^3 **	Human health	50 µg/m^3 ** 150 µg/m^3 *
	Annual	25 µg/m^3 *	Human health	30 µg/m^3
Particulate matter ($PM_{2.5}$)	24-hour	25 µg/m^3 **	Human health	None
	Annual	8 µg/m^3 *	Human health	None
Particulate matter (TSP)	Annual	90 µg/m^3 *	Amenity	90 µg/m^3
Deposited dust	Annual (maximum increase)	2 g/m^2/month **	Amenity	2 g/m^2/month
	Annual (maximum total)	4 g/m^2/month *	Amenity	4 g/m^2/month

** Cumulative impact (i.e. increase in concentrations due to the development plus background concentrations due to all other sources).*
*** Incremental impact (i.e. increase in concentrations due to the development alone), with up to five allowable exceedances of the criteria over the life of the development.*
****Source: PA08_0184, Schedule 3, condition 20.*

The particulate matter levels for comparison with the criteria in Table 3 and Table 4 must be calculated in accordance with the Approved Methods.

4. Existing Environment

This section provides a description of the environmental characteristics in the area, including a review of recent and historical meteorological and ambient air quality conditions. One of the objectives for this review was to develop an understanding of any existing air quality issues and to identify the main factors that have influenced air quality conditions.

4.1 Local Setting

The UCC is located within the Cockabutta Creek and Mona Creek catchments at the headwaters of both the Goulburn River and the Talbragar River. Landforms consist of undulating valley floors to steeper slopes and rocky escarpments. Clearing within valleys has historically occurred for agriculture, mainly for grazing, with surrounding land also used for forestry and mining. Other land consists of conservation areas and private dwellings. Figure 2 shows a pseudo three dimension representation of the local terrain indicating elevations of between 400 and 800 m above mean sea level in a 20 km by 20 km domain.

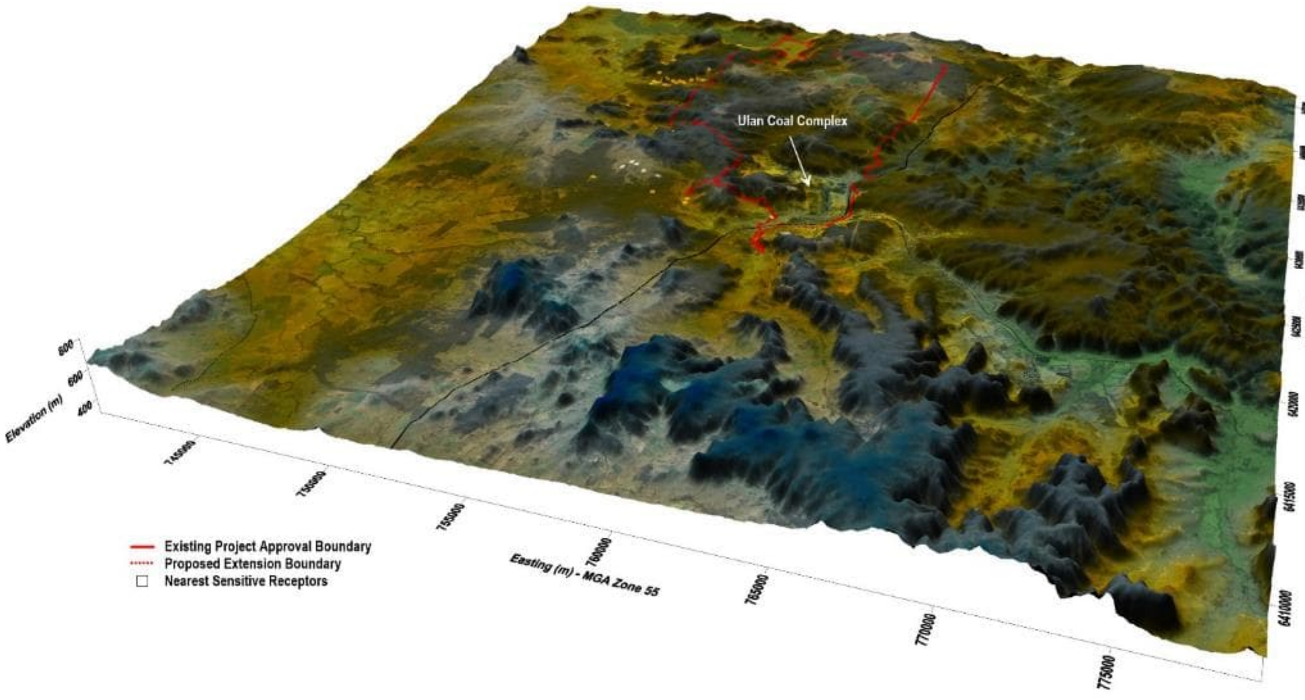

Figure 2 Pseudo three dimension representation of the local terrain

Characterisation of the existing environment has considered data from nearby meteorological and air quality monitoring stations, the locations of which are shown in Figure 3. One of the objectives for reviewing these data was to develop an understanding of any existing air quality issues as well as the meteorological conditions, which typically influence the local air quality. Figure 3 also shows the location of the sensitive receptors.

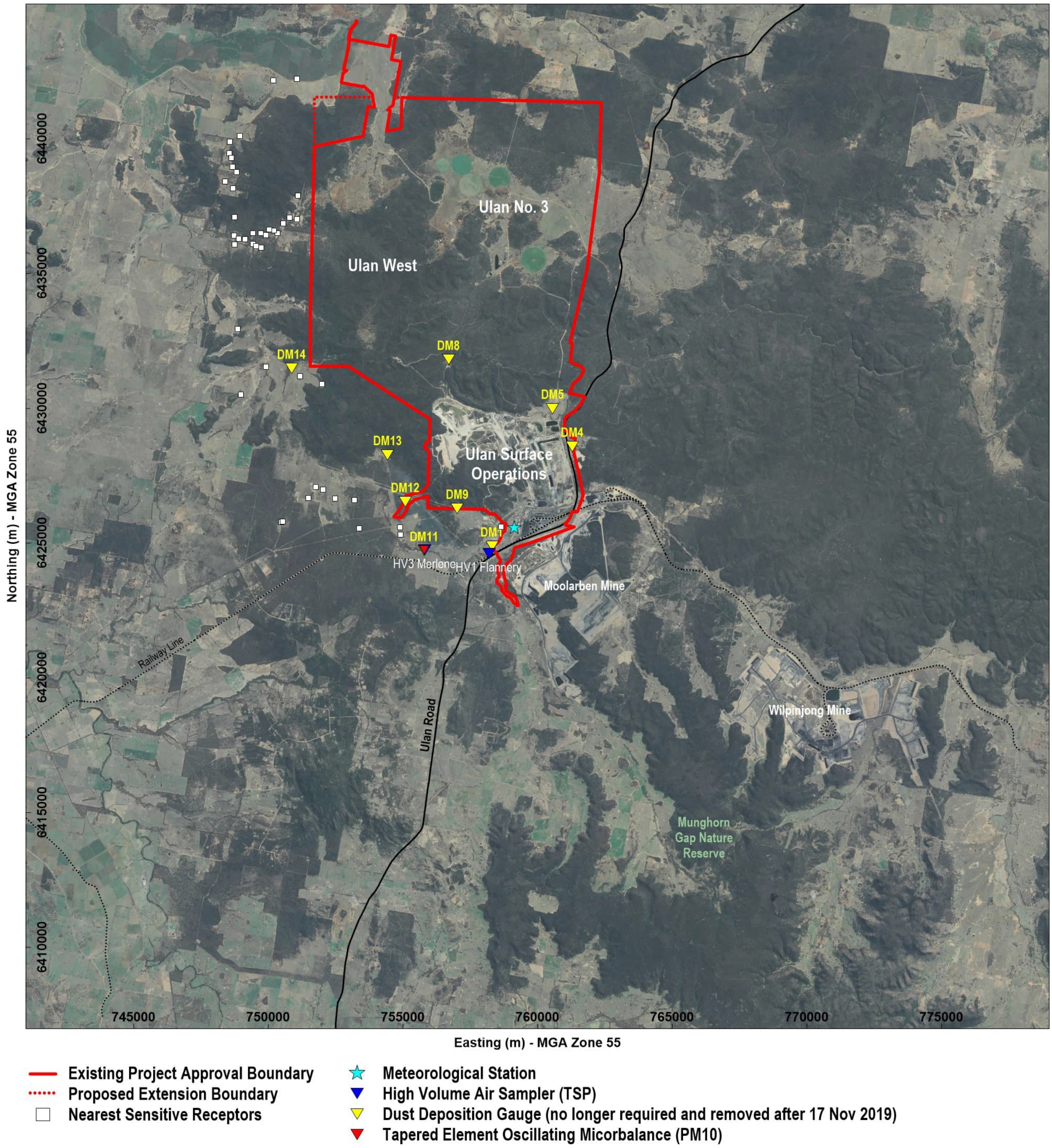

Figure 3 Location of air quality and meteorological monitoring sites

4.2 Meteorological Conditions

Meteorological conditions are important for determining the direction and rate at which emissions from a source will disperse. The key meteorological requirements of air dispersion models are, typically, hourly records of wind speed, wind direction, temperature and atmospheric stability. For air quality assessments, a minimum of one year of hourly data is usually required, which means that almost all possible meteorological conditions, including seasonal variations, are considered in the model simulations.

UCMPL conducts meteorological monitoring at the UCC in accordance with Schedule 3, Condition 23 of PA 08_0184. Figure 3 shows the location of the meteorological station and, based on the proximity of this station to the pit top facilities, the station would be classified as “site-specific” by the Approved Methods terminology.

This means that any modelling is to be conducted using a dataset that is of a minimum one year duration and at least 90% complete.

Meteorological data from six recent years (2015 to 2020 inclusive) have been analysed in order to identify a representative year for future operations modelling. Hourly records of wind speed and wind direction were examined. The procedure for identifying a representative meteorological year involved comparing wind patterns and statistics for each calendar year.

Figure 4 shows the annual wind patterns for each year from 2015 to 2020. It can be seen from these wind-roses that the most common winds in the area are from the east or west. This pattern of winds reflects the influences of the local topographical environment as illustrated by Figure 2.

It is also clear from Figure 4 that wind patterns were similar in all six years of data presented. This suggests that wind patterns do not vary significantly from year to year, and potentially the data from any of the years presented could be used as a representative year for future operations modelling purposes.

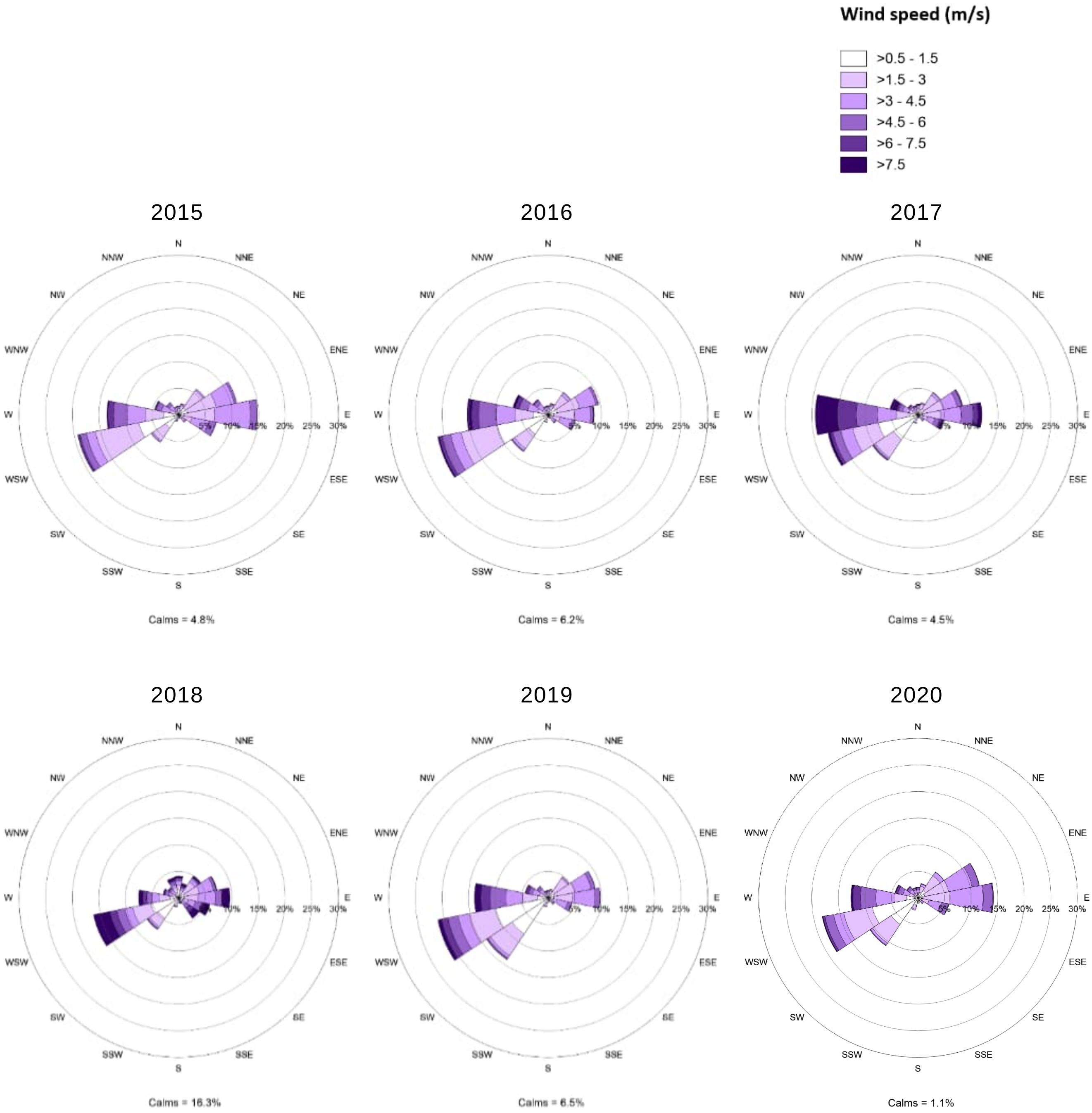

Figure 4 Annual wind-roses from data collected at the Ulan Coal Complex meteorological station

Figure 5 shows the wind speed data from the UCC meteorological station, as well as rainfall data from Ulan (Bureau of Meteorology station number 062036). In terms of wind conditions, the average and maximum wind speeds exhibited similar ranges across all six years except in 2018 when greater variability was observed. Maximum wind speeds reached around 18 metres per second (m/s) as an hourly average.

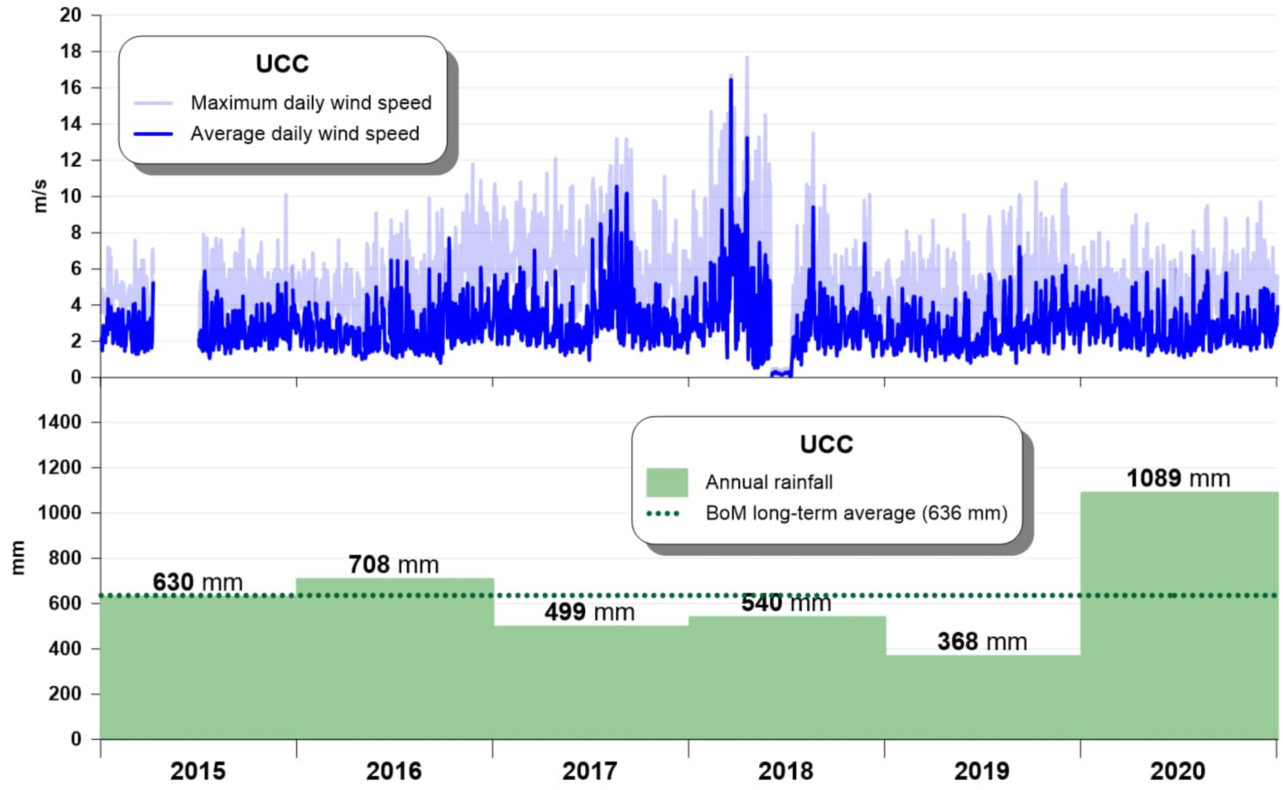

Figure 5 Wind speed and rainfall from data collected between 2015 and 2020

As can be seen from Figure 5 the annual rainfall (for 2015 to 2020) has ranged from 368 millimetres (mm) in 2019 to 1089 mm in 2020. These annual values can be compared to the longer-term record, which is as follows:

- Ulan, Water NSW (Bureau of Meteorology, 2020) 1906 to 2020 = 636 mm.

Figure 5 also shows that rainfall in 2019 was much lower than the long-term average. This suggests that 2019 was not a typical meteorological year, at least in terms of rainfall.

Finally, the annual data statistics for the 2015 to 2020 years have been examined to assist with identifying a representative meteorological year. Table 5 shows the statistics.

Table 5 Annual statistics from meteorological data collected between 2015 and 2020

Location	Statistic	2015	2016	2017	2018	2019	2020
UCC	Percent complete (%)	76	94	100	98	99	100
UCC	Mean wind speed (m/s)	2.6	2.7	3.3	3.1	2.7	2.8
UCC	99th percentile wind speed (m/s)	6.8	8.0	10.8	13.2	8.2	7.2
UCC	Percentage of calms (%)	4.8	6.2	4.5	16.3	6.5	1.1
UCC	Percentage of winds >6 m/s (%)	2.3	4.9	13.6	14.8	6.1	3.7
Ulan	Rainfall (mm)	630	708	499	540	368	1,089

Over these six years the mean annual wind speed has ranged from 2.6 to 3.3 m/s and the percentage of calms (that is, winds less than or equal to 0.5 m/s) has ranged from 1 to 16%. The 2015 and 2018 years have been discounted due to insufficient data capture (2015) and winds that were not consistent with other years (2018).

For future operations modelling the 2017 calendar year has been identified as a representative meteorological year based on:

- High data capture rate, meeting the EPA's requirement for a 90% complete dataset

- Similar wind patterns to other years
- Rainfall being slightly lower than the long-term average
- Air quality conditions that showed similarities to other years and were not adversely influenced by bushfire activity or extreme conditions (as seen in Section 4.3).

4.3 Air Quality Conditions

Air quality in the vicinity of the UCC is monitored by UCMPL and includes the measurement of:

- Particulate matter (as PM_{10})
- Particulate matter (as TSP)
- Deposited dust.

The DPIE also monitors air quality at a network of stations across NSW with the closest three monitoring stations to the UCC located at Orange, Bathurst and Merriwa.

It should be noted that the measurement data from all monitoring stations represent the contributions from all sources that have at some stage been upwind of each monitor. In the case of particulate matter (as PM_{10} and $PM_{2.5}$) for example, the background concentration may contain emissions from many sources such as from mining activities, construction works, bushfires and ‘burning off’, industry, vehicles, roads, wind-blown dust from nearby and remote areas, fragments of pollens, moulds, domestic wood fires and so on.

4.3.1 Extraordinary Events

Air quality in many parts of NSW, including the Central Tablelands, was adversely influenced by drought conditions between 2017 to 2019 and lower than average rainfall. A deterioration in air quality conditions in recent years was not unique to the Central Tablelands and extraordinary events, beyond normal conditions, have been identified as part of annual reviews of monitoring data.

In their “Annual Air Quality Statement 2018” the DPIE concluded that particle levels increased across NSW due to dust from the widespread, intense drought and smoke from bushfires and hazard reduction burning (OEH, 2019). The DPIE subsequently concluded, from their “Annual Air Quality Statement 2019”, that air quality in NSW was greatly affected by the continuing intense drought conditions and unprecedented extensive bushfires during 2019. In addition, the continued “intense drought has led to an increase in widespread dust events throughout the year” (DPIE, 2020).

The influence of drought conditions on air quality is evident in the DPIE’s monitoring data. Figure 6 shows the rolling annual average PM_{10} concentrations from data collected at various rural and urban air quality monitoring sites since 2011. These data clearly show an increase in PM_{10} concentrations at all rural and urban locations from 2017 onwards, reflecting the onset of drought conditions, and increased bushfire activity in 2019. The rolling annual average PM_{10} concentrations decreased rapidly in 2020 as rainfall increased.

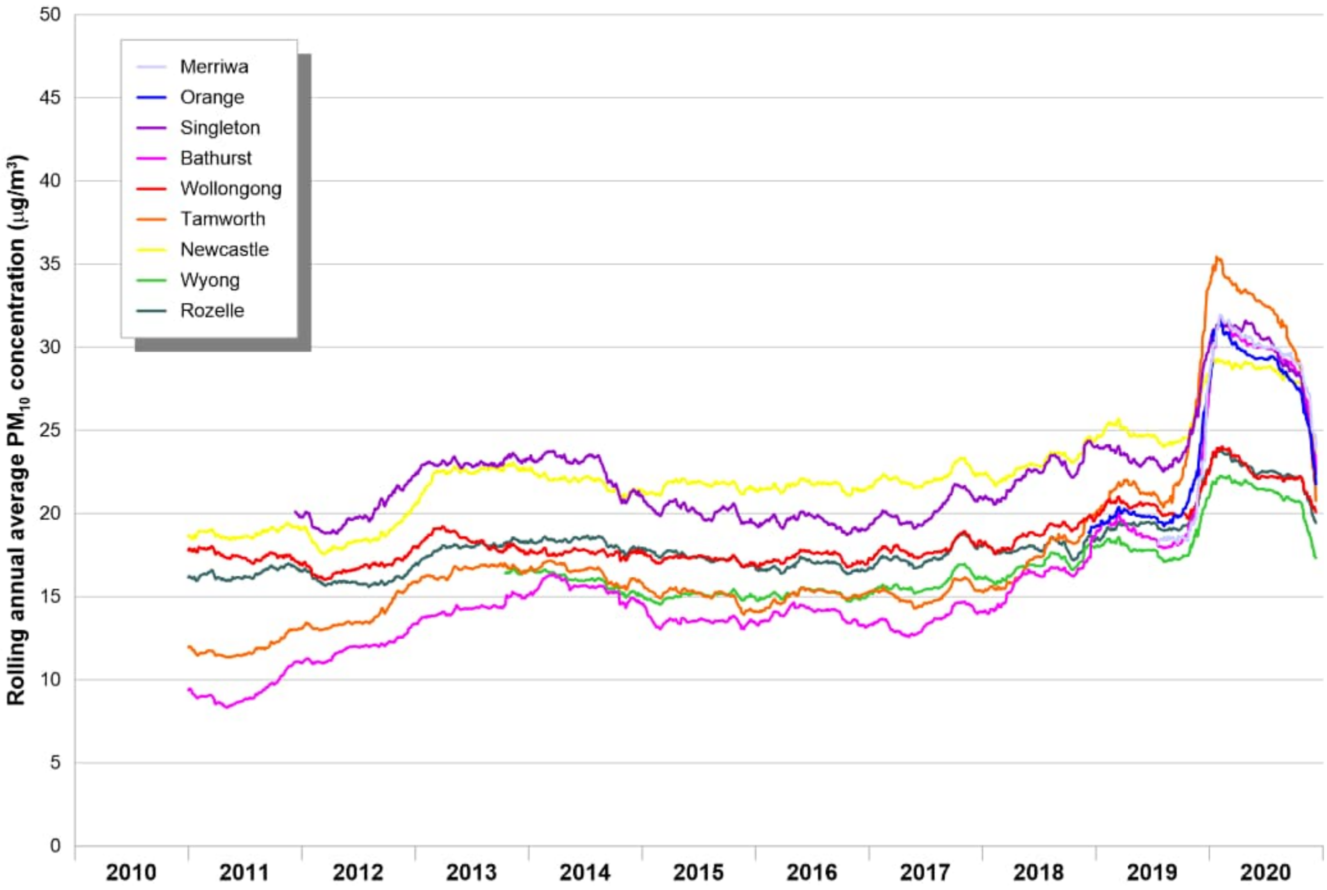

Figure 6 Annual average PM_{10} concentrations at various NSW air quality monitoring sites

The use of years with elevated air quality levels, largely driven by extraordinary events or extreme climatic conditions (or both) are avoided in modelling studies primarily because they do not address the definition of representative. In addition, extraordinary events cannot be reliably simulated in air dispersion models as it is not possible to identify all possible factors that led to these events, for example, the factors that influence the time, location and intensity of bushfires. This context has been considered in the analysis below.

4.3.2 Particulate Matter (as PM_{10})

PM_{10} concentrations are measured by a Tapered Element Oscillating Microbalance (TEOM) located to the west of Ulan Village (Figure 3). Figure 7 shows the measured 24-hour average PM_{10} concentrations from data collected each day between 2015 and 2020 inclusive. The EPA assessment criteria for PM_{10} (50 µg/m^3) is also shown on this figure.

The data from Figure 7 show that, between 2015 and 2017, there was only one day (6 May 2015) when PM_{10} concentrations exceeded the 50 µg/m^3 criterion. However, the incidents of PM_{10} concentrations above 50 µg/m^3 increased in 2018 and 2019, and early into 2020.

Dust storms were observed between 21 and 23 November 2018 and affected many parts of eastern Australia including the Central West of NSW. This particular event adversely impacted on air quality around the UCC, resulting in 24-hour average PM_{10} concentrations of up to 157 µg/m^3, as can be seen in Figure 7. Dust storms were also observed around 15 December 2018 and evident in the UCMPL data with 24-hour average PM_{10} concentrations reaching 265 µg/m^3.

As noted in Section 4.3.1, PM_{10} concentrations increased from 2017 to 2019 coinciding with drought conditions and lower than average rainfall. These conditions led to increases in the number of days when the 24-hour average PM_{10} concentration exceeded 50 µg/m^3 and increases in the annual average PM_{10} concentrations. The increases in PM_{10} concentrations were observed across many locations in NSW and were not unique to the Central Tablelands. These widespread conditions were reflected in the UCC data shown in Figure 7.

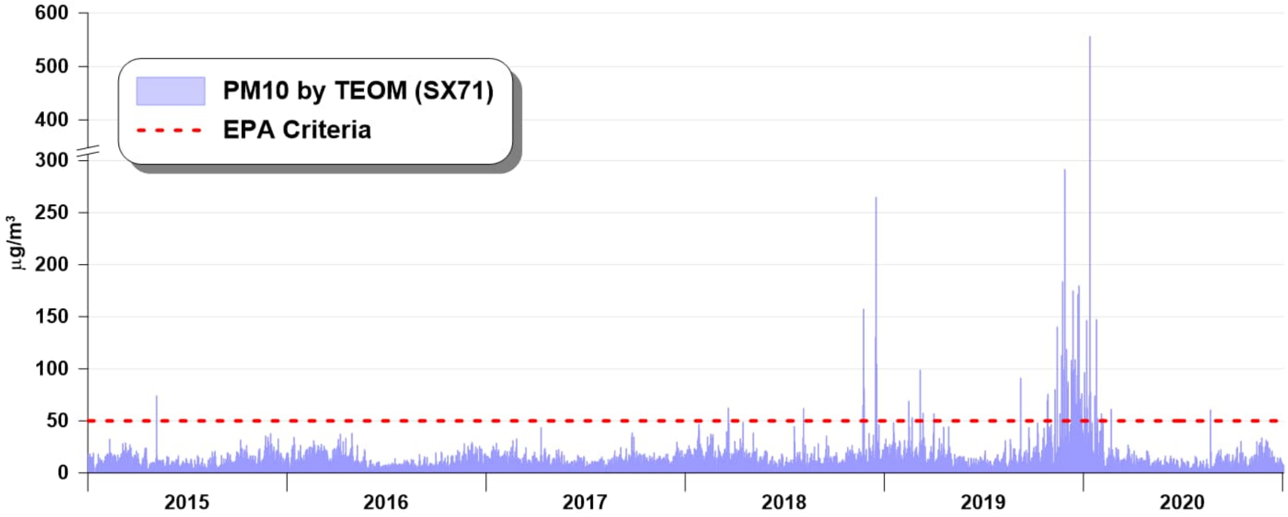

Figure 7 Measured 24-hour average PM_{10} concentrations near the UCC

Table 6 summarises the measured PM_{10} concentration data for 24-hour and annual average periods, for comparison with the respective EPA criteria. As noted above, drought conditions leading to an increased frequency of regional dust events and bushfires had adversely influenced air quality conditions in 2018, 2019 and early into 2020. Annual average PM_{10} concentrations were below the EPA's 25 µg/m^3 criterion in all years except for 2019 due to the influence of the drought and bushfires. This criterion was applicable from 2017 onwards and would be used to assess the Proposed Modification.

Compliance with the PM_{10} criteria in PA 08_0184 is evaluated by UCMPL as part of annual reviews. These reviews have shown that the UCC has not caused any exceedances of 24-hour or annual average PM_{10} criteria for the period between 2015 and 2020 inclusive (UCMPL, 2016-2021).

Table 6 Summary of measured PM_{10} concentrations

Year	SX71	EPA criterion
Maximum 24-hour average in µg/m^3		
2015	74	50
2016	38	
2017	44	
2018	265	
2019	291	
2020	556	
Number of days above 24-hour average criteria		
2015	1	-
2016	0	
2017	0	
2018	5	
2019	38	
2020	18[1]	
Annual average in µg/m^3		
2015	13	30
2016	13	
2017	14	25
2018	19	
2019	26	
2020	17	

Note: shaded cells represent those results above EPA criteria

4.3.3 Particulate Matter (as $PM_{2.5}$)

No known monitoring of $PM_{2.5}$ is conducted in the vicinity of the UCC. The closest air quality monitoring stations, which record concentrations of $PM_{2.5}$, and with publicly available data, are located at Bathurst, Orange and Muswellbrook. While all three stations are located over 100 km from the UCC, the data have been reviewed to gain an understanding of $PM_{2.5}$ concentrations in rural areas of NSW, albeit near population centres. These stations are operated by the DPIE and use Beta Attenuation Monitors for the measurement of $PM_{2.5}$.

Table 7 provides a summary of the measured $PM_{2.5}$ concentrations at Bathurst, Orange and Muswellbrook for the past six years. The data show that $PM_{2.5}$ concentrations at Muswellbrook have consistently exceeded the 24-hour criterion, both before and after the criterion was enacted. Domestic heating in winter has been identified (OEH, 2013) as one of the main causes for elevated levels. Annual averages have also exceeded the annual average criterion at Muswellbrook in all years.

Monitoring of $PM_{2.5}$ has not occurred for as long at Bathurst and Orange, but the available data do suggest that average $PM_{2.5}$ concentrations at Bathurst, and likely Orange, are lower than at Muswellbrook (excluding data from the “extraordinary” years of 2018 and 2019).

It has been inferred from the data in Table 7 that, in rural locations near population centres, $PM_{2.5}$ concentrations can approach and sometimes exceed the recently (i.e. 2017) introduced EPA assessment criteria

[1] All exceedances were determined ‘extraordinary’ events by the DPIE.

for $PM_{2.5}$. The Bathurst, Orange and Muswellbrook monitoring sites are located close to regional population centres and none of these sites would measure $PM_{2.5}$ concentrations that are representative of levels in the vicinity of the UCC. This is because the UCC is well removed from other industries and regional population centres. Consequently, the ambient $PM_{2.5}$ concentrations in the vicinity of the UCC would be expected to be lower than those measured at Bathurst, Orange and Muswellbrook.

Table 7 Summary of measured $PM_{2.5}$ concentrations

Year	Bathurst (DPIE)	Orange (DPIE)	Muswellbrook (DPIE)	EPA criterion
Maximum 24-hour average in µg/m³				
2015	NA	NA	31	-
2016	15	NA	29	
2017	18	NA	31	25
2018	41	NA	27	
2019	200	387	77	
2020	207	92	49	
Number of days above 24-hour average criteria				
2015	NA	NA	3	-
2016	0	NA	1	
2017	0	NA	2	
2018	2	NA	2	
2019	24	31	27	
2020	13	15	9	
Annual average in µg/m³				
2015	NA	NA	8.7	-
2016	5.9	NA	8.4	
2017	6.1	NA	9.4	8
2018	7.0	NA	9.4	
2019	11.3	15.8	12.2	
2020	7.6	9.1	9.3	

Note: shaded cells represent those results above EPA criteria

4.3.4 Particulate Matter (as TSP)

TSP concentrations have been measured at two locations by high volume air sampler (HVAS). Figure 3 shows the location of the monitoring sites and Table 8 shows the annual average concentrations from data collected in the past six years, for comparison with the EPA's annual average criterion of 90 µg/m³. Annual average TSP concentrations have not exceeded the EPA criterion at either monitoring site.

Table 8 Summary of measured TSP concentrations

Year	HV1	HV3	EPA criterion
Annual average in µg/m³			
2015	25	31	90
2016	23	40	
2017	24	31	
2018	35	44	
2019	49	57	

Year	HV1	HV3	EPA criterion
2020	33	27	

4.3.5 Deposited Dust

Table 9 shows the annual average deposited dust levels for each gauge from data collected between 2015 and 2019. Figure 3 shows the location of the monitoring sites. The results in Table 9 can be compared with the EPA's 4 g/m^2/month criterion. Annual average deposited dust levels have not exceeded the EPA criterion at any monitoring site. UCMPL is no longer required to measure deposited dust and ceased monitoring after 17 November 2019.

Table 9 Summary of measured deposited dust levels

Year	DM1	DM4	DM5	DM8	DM9	DM11	DM12	DM13	EPA criterion
Annual average in g/m^2/month									
2015	1.6	0.9	1.6	0.6	0.9	1.3	0.7	1.2	4
2016	1.3	0.8	1.1	0.6	1.0	0.9	0.9	1.0	
2017	1.0	0.9	1.8	0.8	0.8	0.8	0.7	0.9	
2018	2.0	1.2	3.3	1.2	0.9	1.6	1.3	1.0	
2019	1.6	1.3	3.2	1.4	1.5	2.4	1.8	1.2	

4.3.6 Nitrogen Dioxide (NO_2)

Table 10 provides a summary of the measured NO_2 concentrations from Muswellbrook, the closest known air quality monitoring site which records this air quality indicator. As expected for this rural location these data show that the maximum NO_2 concentrations have not exceeded the EPA's 1-hour average criterion of 164 µg/m^3. Annual averages have not exceeded the EPA's annual average criterion of 31 µg/m^3.

Table 10 Summary of measured NO_2 concentrations

Year	Muswellbrook	EPA criterion
Maximum 1-hour average in µg/m^3		
2015	86	164
2016	86	
2017	92	
2018	96	
2019	119	
2020	80	
Annual average in µg/m^3		
2015	18	31
2016	18	
2017	21	
2018	21	
2019	21	
2020	16	

Additional analysis of the typical fraction of NO_x that is NO_2 has been carried out. The NO_x monitoring data from Muswellbrook (2017 data) shows that percentage of NO_2 in the NO_x is inversely proportional to the total NO_x concentration, and when NO_x concentrations are high, the percentage of NO_2 in the NO_x is typically of the order of 20%. This is demonstrated by Figure 8 which shows that, for high NO_x concentrations (i.e. 200 µg/m^3 and above), the NO_2 to NO_x ratio reduces to 20%.

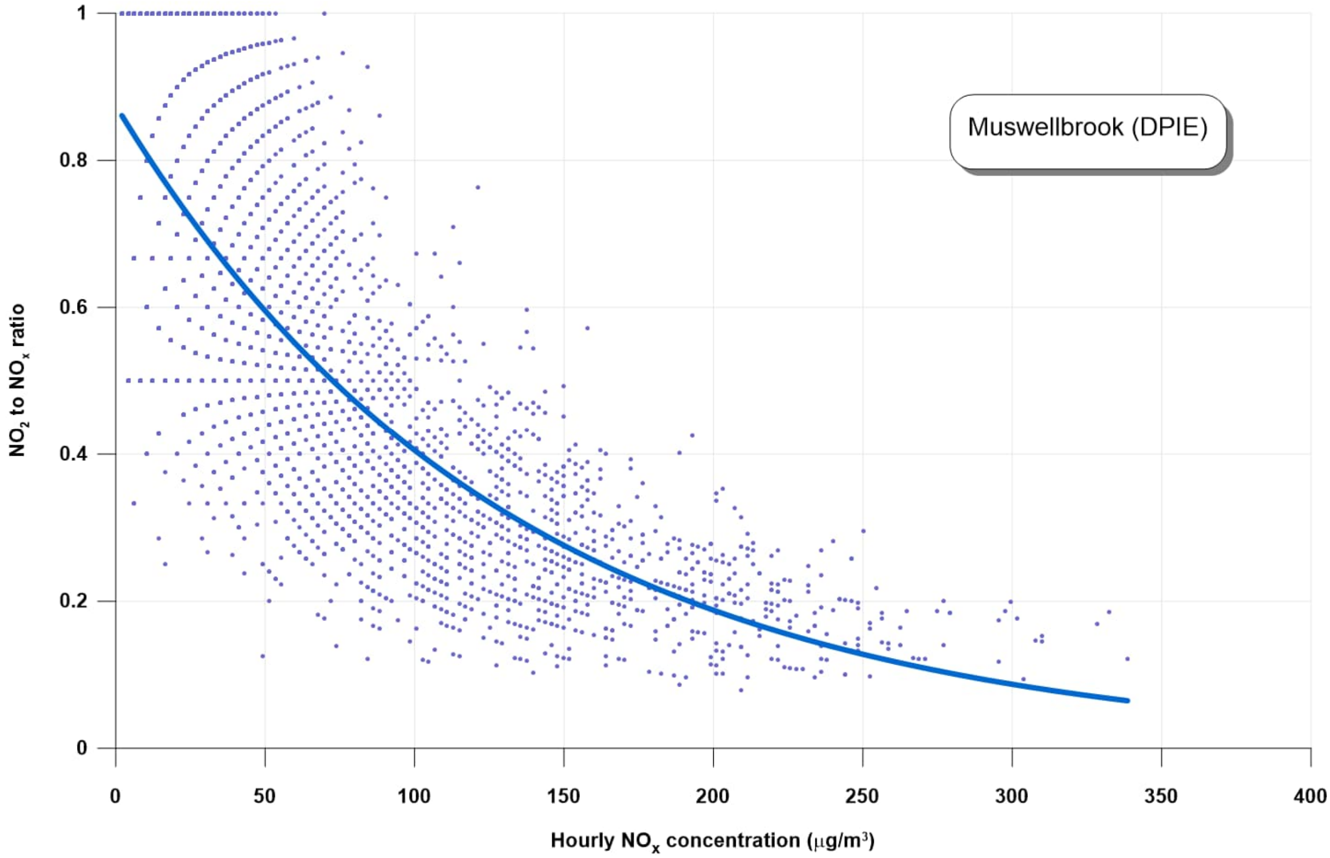

Figure 8 Measured NO_2 to NO_x ratios from hourly average data collected at Muswellbrook in 2017

4.4 Summary of Existing Environment

The review of the existing environment led to the following observations:

- Meteorological conditions in 2017 were representative of the long term, local conditions around the UCC.
- There was a deterioration in air quality conditions in the recent two to three years, heavily influenced by drought, dust storms and bushfires. These conditions were not unique to the Central Tablelands.
- UCMPL has complied with the air quality criteria specified in PA 08_0184 in all of the past six years (that is from 2015 to 2020).

One of the objectives for reviewing the air quality monitoring data was to determine appropriate background levels to be added to project contributions for the assessment of potential cumulative impacts. For this objective, it was important to identify the monitoring stations that are sufficiently close to the area of interest but not adversely influenced by those sources, which are proposed for modification, such as mining operations. Table 11 shows the assumed background levels that apply at sensitive receptors, taking into account this objective. These levels (or approach) have been added to project contributions to determine the potential cumulative impacts.

Table 11 Assumed background levels that apply at sensitive receptors

Air quality indicator	Averaging time	Assumed background level that applies at sensitive receptors	Notes
Particulate matter (PM_{10})	24-hour	44 µg/m^3	Maximum 24-hour average PM_{10} concentration that was measured in the representative year (2017) from SX71, near the UCC. This approach represents a "Level 1 assessment" from the Approved Methods whereby maximum background concentrations have been added to maximum model predictions.
	Annual	14 µg/m^3	Measured annual average PM_{10} concentrations in the representative year (2017) from SX71.
Particulate matter ($PM_{2.5}$)	24-hour	19 µg/m^3	Estimated maximum 24-hour average $PM_{2.5}$ concentrations in the representative year (2017), derived from the background PM_{10} concentrations on the assumption that 44% of the PM_{10} is $PM_{2.5}$. The DPIE data for Muswellbrook showed that $PM_{2.5}$ was on average 44% of the PM_{10}.
	Annual	6.2 µg/m^3	Estimated annual average $PM_{2.5}$ concentrations in the representative year (2017), derived from the background PM_{10} concentrations on the assumption that 44% of the PM_{10} is $PM_{2.5}$. The DPIE data for Muswellbrook showed that $PM_{2.5}$ was on average 44% of the PM_{10}.
Particulate matter (TSP)	Annual	31 µg/m^3	Annual average TSP concentration in the representative year (2017) from HV3.
Deposited dust	Annual	1.8 g/m^2/month	Annual average deposited dust level in the representative year (2017) from DM5.
Nitrogen dioxide (NO_2)	1-hour	92 µg/m^3	Maximum 1-hour average NO_2 concentration in the representative year (2017) from Muswellbrook.
	Annual	21 µg/m^3	Annual average NO_2 concentration in the representative year (2017) from Muswellbrook.

5. Assessment Methodology

This assessment has followed the procedures outlined in the Approved Methods (EPA, 2016). The Approved Methods include guidelines for the preparation of meteorological data, reporting requirements and air quality assessment criteria to assess the significance of expected impacts.

Specific methodologies for each of the identified key issues (from Section 2) are described below.

5.1 Mining Dust

Operational dust has been quantified by modelling. The choice of model has considered the expected transport distances for the emissions, as well as the potential for temporally and spatially varying flow fields due to influences of the locally complex terrain, non-uniform land use, and stagnation conditions characterised by calm or very low wind speeds with variable wind directions. The CALPUFF model has been selected. This model is specifically listed in the Approved Methods and has been used to predict ground-level particulate matter concentrations and deposition levels due to the Proposed Modification and other sources. Concentrations and deposition levels have been simulated for every hour of the representative year and results at sensitive receptors have then been compared to the relevant air quality assessment criteria.

Figure 9 shows and overview of the model and key inputs. Appendix B provides details of all model settings.

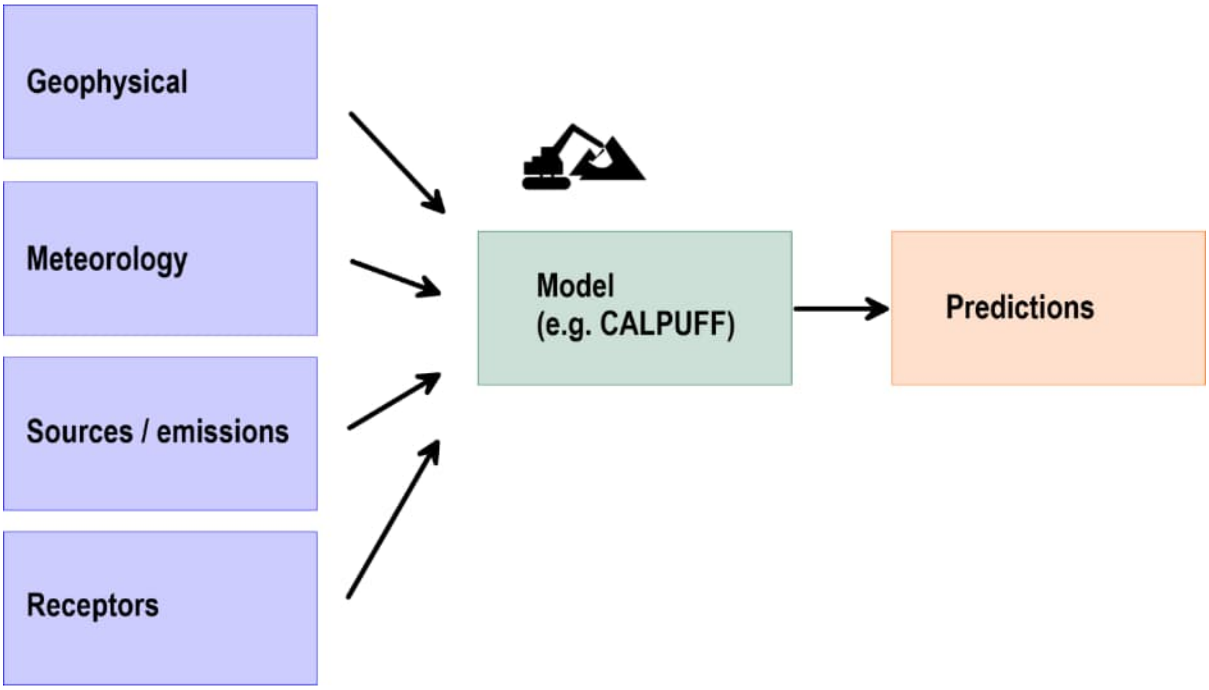

Figure 9 Overview of model inputs

Dust (particulate matter) is the most significant emission to air from the operations and estimates of these emissions are required by the dispersion model. Total dust emissions have been estimated for a worst-case operational scenario using the material handling schedule, equipment listing and mine plans combined with emission factors from:

- *Emission Estimation Technique Manual for Mining* (NPI, 2012); and
- AP 42 (US EPA 1985 and updates).

The future operational scenario has assumed that underground operations will be producing up to 20 Mtpa of ROM coal per year and that all proposed mine ventilation outlets will be operating concurrently and continuously. The modelling has considered contributions from the UCC. Contributions from other sources have been represented in the assumed background levels. It is noted that the approved operations at the UCC include open cut mining, and that the open cut operations have been in care and maintenance since 2016. The modelling does not simulate emissions from the open cut as no changes to these operations are proposed as part of the Proposed Modification.

Table 12 summarises the estimated annual TSP, PM_{10} and $PM_{2.5}$ emissions due to the UCC. It should be noted that the main intent of the inventories was to capture the most significant emission sources that may affect off-site air quality. Not every source will be captured. However, the contribution of emissions from sources not identified will be captured in the air quality monitoring data and these data have been added to the modelled mining contributions. Full details on the emission calculations, including assumptions, emission controls and allocation of emissions to modelled locations are provided in Appendix C.

Table 12 Estimated annual dust emissions from the UCC (as modified)

Activity	Annual emissions (kg/y)		
	TSP	PM_{10}	$PM_{2.5}$
Topsoil stripping	183	46	9
Topsoil spreading	126	76	4
ROM coal - loading ROM coal stockpile	1,654	782	118
ROM coal - dozers on ROM coal stockpiles	61,826	14,302	1,360
ROM coal - rotary breaker	3,375	1,500	169
ROM coal - dry screening	15,625	5,375	781
ROM coal - secondary bypass crushing	2,194	975	110
ROM coal - conveyor transfer (x4)	6,614	3,128	474
Product coal - loading bypass coal	651	308	47
Product coal - loading washed product coal	952	450	68
Product coal - conveyor transfer	2,672	1,264	191
Product coal - dozers on product coal stockpiles	61,826	14,302	1,360
Product coal - loading trains	8,000	3,400	400
Rejects - conveyor transfer (x2)	84	39	6
Rejects - loading rejects stockpile	50	24	4
Rejects - hauling rejects	7,500	2,216	225
Wind erosion - ROM coal stockpile	1,275	657	96
Wind erosion - product coal stockpile	3,824	1,971	287
Wind erosion - exposed areas around plant	25,492	13,140	1,912
Ventilation shaft(s)	35,478	17,739	1,774
Total	239,400	81,695	9,394

There will be operational controls in place at the UCC which will also have a direct effect on emissions to air. Specifically, UCMPL is committed to the continued implementation of operational controls during adverse weather conditions in order to minimise impacts. The operational controls will result in reduced levels of activity at the UCC relative to the capacity considered as part of the current air quality modelling. In practice these operational controls, which will vary on a daily basis, will lead to lower emissions to air than for unconstrained activities. Consequently, the estimated emissions in Table 12 should represent conservative estimates, as these further detailed operational controls are not included, and it follows that the modelled impacts of the Proposed

Modification will also be conservative. That is, the modelled impacts are likely to over-state actual impacts to some extent.

Mining operations were represented by a series of volume sources located according to the location of activities for each modelled scenario. Emissions from the dust generating activities at each operation were assigned to one or more of source location (refer to Appendix C for details of the allocations).

Dust emissions for all modelled mine-related sources have been considered to fit in one of three categories, as follows:

- Wind insensitive sources, where emissions are relatively insensitive to wind speed (for example, dozers).
- Wind sensitive sources, where emissions vary with the hourly wind speed, raised to the power of 1.3, a generic relationship published by the US EPA (1987). This relationship has been applied to sources such as loading and unloading stockpiles and results in increased emissions with increased wind speed.
- Wind sensitive sources, where emissions also vary with the hourly wind speed, but raised to the power of 3, a generic relationship published by Skidmore (1998). This relationship has been applied to sources including wind erosion from stockpiles and exposed areas and results in increased emissions with increased wind speed.

Emissions from each volume source were developed on an hourly time step, taking into account the level of activity at that location and, in some cases, the hourly wind speed. This approach ensured that light winds corresponded with lower dust generation and higher winds, with higher dust generation.

All activities have been modelled for 24 hours per day.

Finally, the model predictions at identified sensitive receptors were then compared with the EPA air quality criteria, previously discussed in Section 3. Contour plots have also been created to show the spatial distribution of model predictions. Section 6.2 provides the assessment of operational dust.

5.2 Diesel Exhaust

Emissions from diesel exhausts associated with off-road vehicles and equipment at mine sites are often deemed a lower air quality impact risk than dust emissions from the material handling activities. This is because of the relatively few emission sources involved, for example when compared to a busy motorway, and the large distances between the sources and sensitive receptors. Nevertheless, a review of the potential impacts has been carried out, including modelling to quantify the potential impacts.

The most significant emissions from diesel exhausts are products of combustion including CO, NO_x, PM_{10} and $PM_{2.5}$. It is the NO_x, or more specifically NO_2, and PM_{10} (including $PM_{2.5}$) which have been assessed as this indicator has the higher potential to approach air quality criteria. DPIE monitoring data have shown that CO concentrations have not exceeded relevant air quality criteria at rural or urban monitoring stations in NSW, indicating that this indictor represents a much lower air quality risk.

The modelling for mining dust (Section 5.1) has considered emission factors that represent the contribution from both wheel generated particulates and the exhaust particulates. These emission factors, including with control factors, are based on measured emissions, which included diesel particulates in the form of both PM_{10} and $PM_{2.5}$. The emission factors are also likely to include more diesel exhaust particulate than from a modern truck as the factors were developed on the basis of emissions from trucks measured in the 1980s (that is, older trucks). Todoroski Air Sciences has also reported (TAS, 2016) on several studies confirming that a control factor of 85% can be maintained, representing all components of the truck haulage emission. This information highlights that the potential impacts of diesel exhaust emissions (as PM_{10} and $PM_{2.5}$) are represented in the model results for operational dust (Section 6.2).

Table 13 provides the explicit estimates of PM_{10} and $PM_{2.5}$ emissions due only to diesel plant and equipment exhausts. Emission factors for “Industrial off-road vehicles and equipment” from the EPA’s 2008 Air Emissions

Inventory (EPA, 2012) were used for the calculations and it has been assumed that there will be no reduction to emissions in the future; a conservative approach. These factors relate to diesel exhaust and evaporative emissions.

Table 13 Estimated PM_{10} and $PM_{2.5}$ emissions from diesel engines

Parameter	Value
Estimated maximum fuel usage between 2021 and 2034 (kL) (source: UCMPL)	5,070
PM_{10} calculations	
Diesel exhaust emission factor (kg/kL)	2.84
Diesel exhaust emissions - all equipment (kg/y)	14,399
$PM_{2.5}$ calculations	
Diesel exhaust emission factor (kg/kL)	2.75
Diesel exhaust emissions - all equipment (kg/y)	13,967

Emissions of NO_x from diesel exhausts have been estimated using fuel consumption data, provided by UCMPL, and an emission factor from the EPA's Air Emissions Inventory for 2008 (EPA, 2012). Table 14 shows the calculations. Again, it has been assumed that there will be no reduction to emissions in the future; a conservative approach.

Table 14 Estimated NO_x emissions from diesel engines

Parameter	Value
Estimated maximum fuel usage between 2021 and 2034 (kL) (source: UCMPL)	5,070
NO_x calculations	
Diesel exhaust emission factor (kg/kL)	40.77
Diesel exhaust emissions - all equipment (kg/y)	206,704

The NO_x emission estimate from Table 14 has been explicitly modelled to provide an indication of the off-site NO_2 concentrations due to diesel exhaust emissions. Section 6.3 provides the assessment of operational diesel exhaust.

6. Air Quality Assessment

This section provides an assessment of the identified key air quality issues from Section 2.

6.1 Construction

Dust emissions from construction works have the potential to cause nuisance impacts if not properly managed. In practice, it is not possible to realistically quantify construction impacts for a project of this nature using modelling. To do so would require knowledge of weather conditions for the period in which work would be taking place in each location on the site. The potential significance and impacts of construction dust has therefore been determined from a qualitative review, taking into consideration the intensity, scale, location and duration of the proposed works.

Air quality impacts during construction would largely result from dust generated from work associated with additional infrastructure and upgrades to existing infrastructure that would be required to support the Proposed Modification. Construction and upgrades of infrastructure would occur in parallel with ongoing mining operations and, of relevance to air quality, would include:

- Development of services corridors and access tracks to surface infrastructure. Services corridors and access tracks would continue to be progressively developed to provide access from the pit top areas to surface infrastructure components.
- Development of mine ventilation infrastructure. The excavated material from the development of the shafts would be used as fill material for the development of other infrastructure construction activities.
- Development of dewatering and other boreholes.

Surface construction and development would generally occur 7.00 am to 7.00 pm seven days per week (except for the operation shaft excavation which may be 24 hours per day). The existing mobile equipment would generally be required for ongoing development activities including graders, bulldozers, gravel trucks and water carts. During periods of more intense development, additional mobile equipment may be required. The number and type of equipment would vary, depending on the development activity being undertaken.

The total amount of dust generated would depend on the quantities of material handled, silt and moisture content of the soil, the types of operations being carried out, exposed areas, frequency of water spraying and speed of machinery. The detailed approach to construction would depend on decisions made by UCMPL, in conjunction with contractor(s), and changes to the construction methods and sequences that are expected to take place during the construction phase.

The specific quantities of spoil to be handled during construction has not been quantified but is expected to be orders of magnitude lower than the 20 Mtpa of coal handled during operations. This means that emissions (as particulate matter) from construction works will also be orders of magnitude lower than the emissions that have been quantified and assessed for operations (Section 6.2 and 6.3). It follows that the potential air quality impacts of the construction works are likely to be well within the impacts of operations.

Nevertheless, it will be important that exposed areas be stabilised as quickly as possible and that appropriate dust suppression methods be used to keep dust impacts to a minimum. Dust management would require the use of water carts, the defining of trafficked areas, the imposition of site vehicle speed limits and constraints on work under unfavourable weather conditions, such as dry wind conditions. Monitoring would also continue to be carried out during the construction phase to assess compliance with Project Approval criteria.

6.2 Mining Dust

This section provides an assessment of the Proposed Modification in terms of mining dust, based on the methodology described in Section 5.1. Model results have been assessed for each of the key particulate matter classifications.

6.2.1 Particulate Matter (as PM_{10})

Figure 10 shows the modelled maximum 24-hour average PM_{10} concentrations due to the UCC (as modified) at maximum production. The EPA does not prescribe a project only criteria for 24-hour average PM_{10}, but the VLAMP refers to 50 µg/m^3 for the purposes of determining land acquisition and mitigation. The modelling shows that the 50 µg/m^3 criterion would not be exceeded at any sensitive receptor.

Compliance with the EPA's 24-hour average PM_{10} criterion of 50 µg/m^3 has also been assessed. This criterion relates to the total concentration in the air (that is, cumulative) and not just the contribution from the UCC (as modified). The 6 µg/m^3 contour on Figure 10 represents the extent of the EPA's 50 µg/m^3 criterion on the assumption that maximum background levels are in the order of 44 µg/m^3 (Section 4.4). The modelling indicates that the Proposed Modification will not cause exceedances of the EPA criterion for 24-hour average PM_{10} at any off-site sensitive receptor.

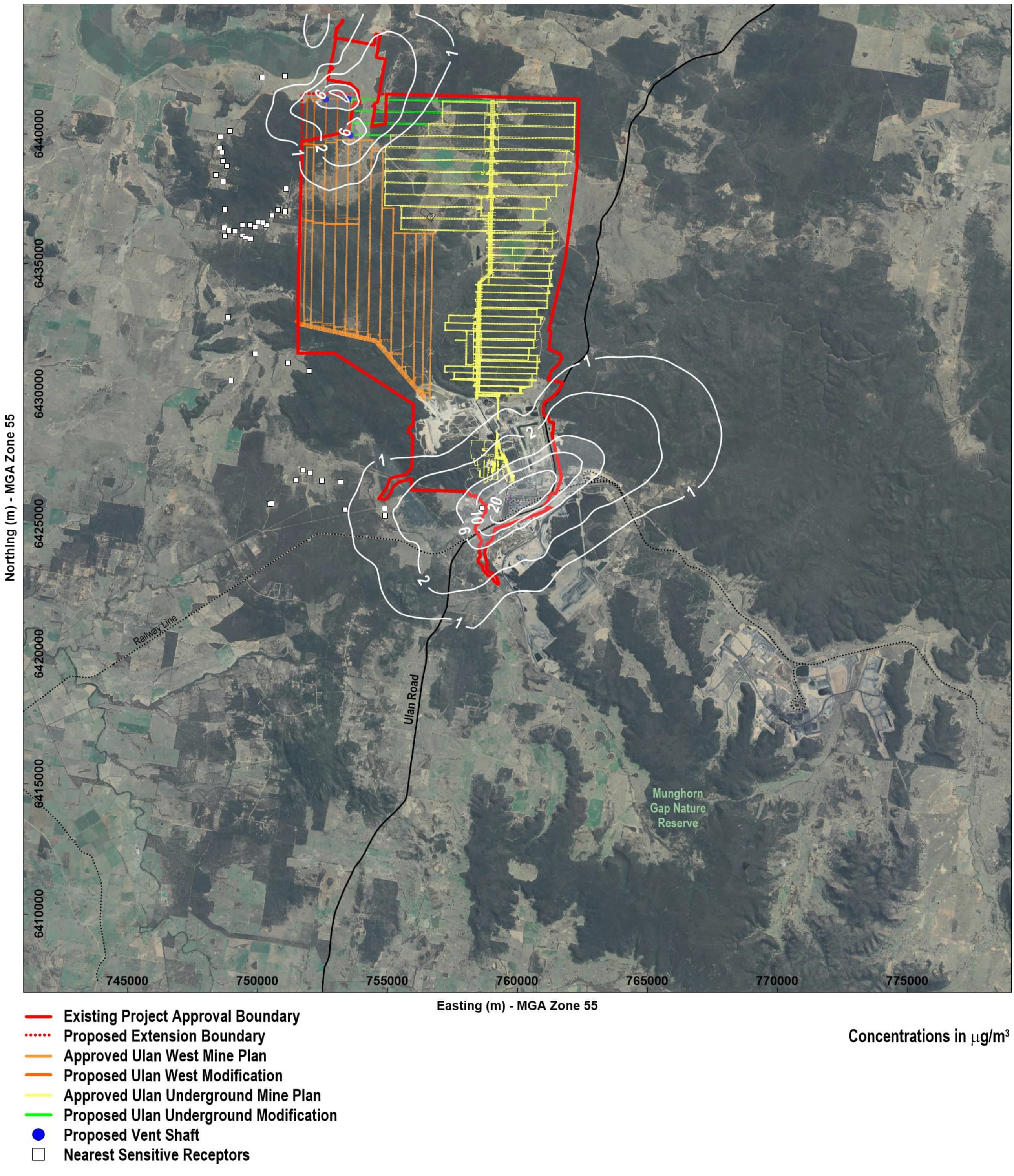

Figure 10 Modelled maximum 24-hour average PM_{10} due to UCC (as modified)

Figure 11 shows the modelled annual average PM_{10} concentrations due to the UCC (as modified). The EPA's criterion for annual average PM_{10} (25 µg/m^3) relates to the total concentration in the air and not just the contribution from the UCC (as modified). The 11 µg/m^3 contour on Figure 11 represents the extent of the EPA's 25 µg/m^3 criterion on the assumption that background levels are in the order of 14 µg/m^3 (Section 4.4). The modelling indicates that the Proposed Modification will not cause exceedances of the EPA criterion for annual average PM_{10} at any off-site sensitive receptor.

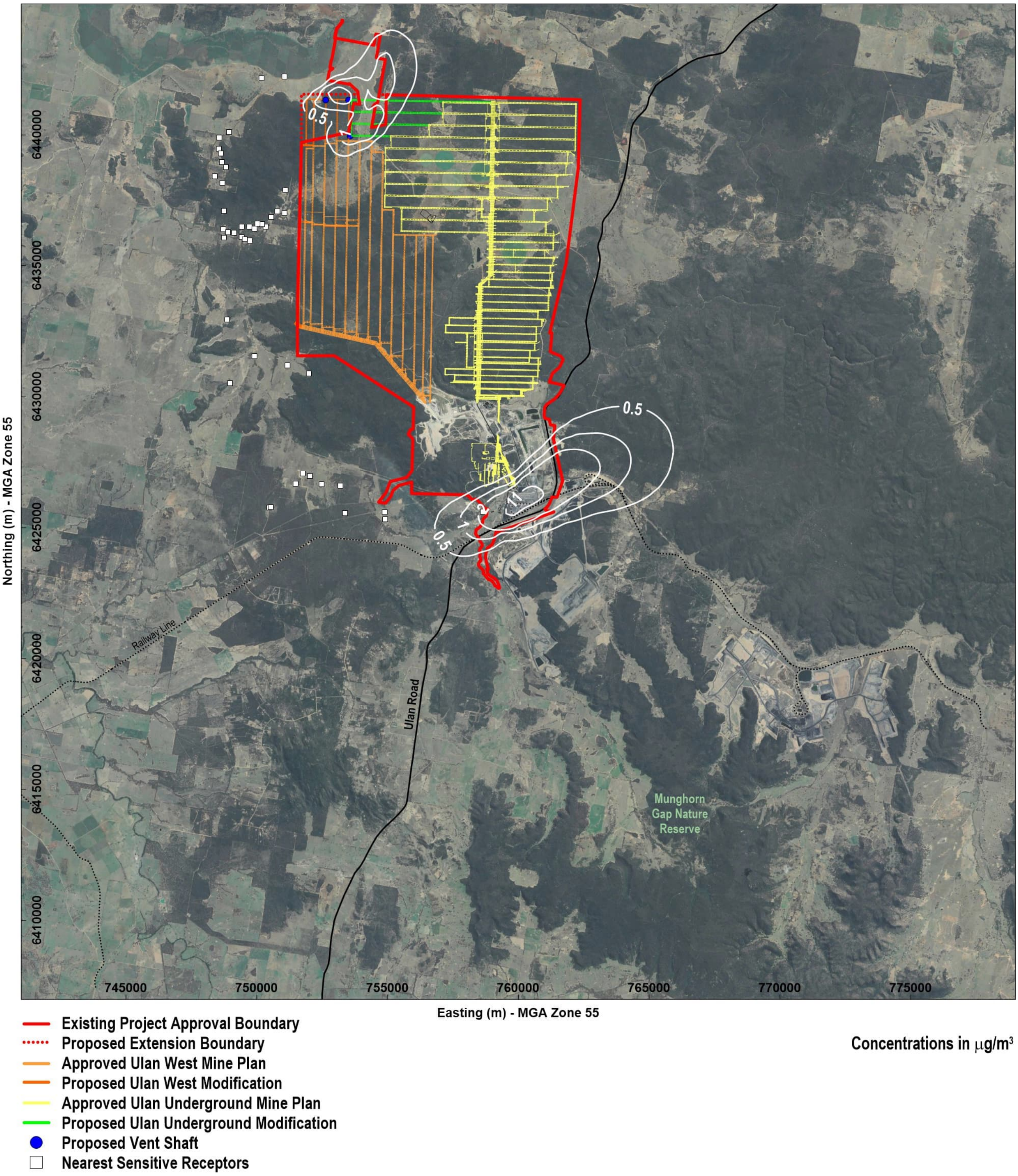

Figure 11 Modelled annual average PM_{10} due to UCC (as modified)

6.2.2 Particulate Matter (as $PM_{2.5}$)

Figure 12 shows the modelled maximum 24-hour average $PM_{2.5}$ concentrations due to the UCC (as modified) at maximum production. The EPA criterion relates to the total concentration in the air and not just the contribution from the UCC (as modified). A 6 µg/m^3 contour on Figure 12 would represent the extent of the EPA's 25 µg/m^3 criterion on the assumption that maximum background levels are in the order of 19 µg/m^3 (Section 4.4). The modelling indicates that the Proposed Modification will not cause exceedances of the EPA criterion for 24-hour average $PM_{2.5}$ at any sensitive receptor.

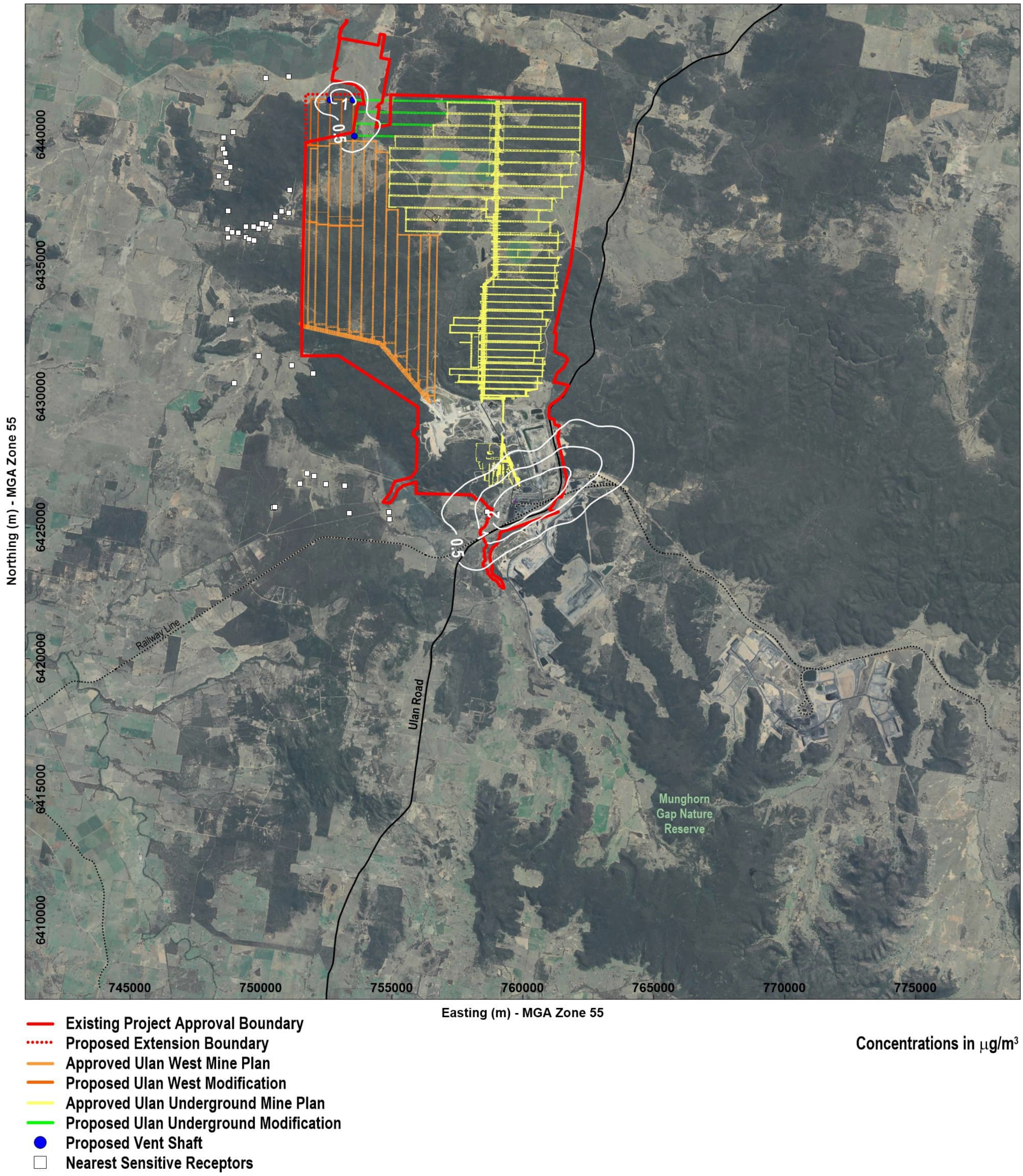

Figure 12 Modelled maximum 24-hour average $PM_{2.5}$ due to UCC (as modified)

Figure 13 shows the modelled annual average $PM_{2.5}$ concentrations due to the UCC (as modified). The EPA's criterion for annual average $PM_{2.5}$ (8 µg/m^3) relates to the total concentration in the air and not just the contribution from the UCC (as modified). A 1.8 µg/m^3 contour on Figure 13 would represent the extent of the EPA's 8 µg/m^3 criterion on the assumption that background levels are in the order of 6.2 µg/m^3 (Section 4.4). The modelling indicates that the Proposed Modification will not cause exceedances of the EPA criterion for annual average $PM_{2.5}$ at any off-site sensitive receptor.

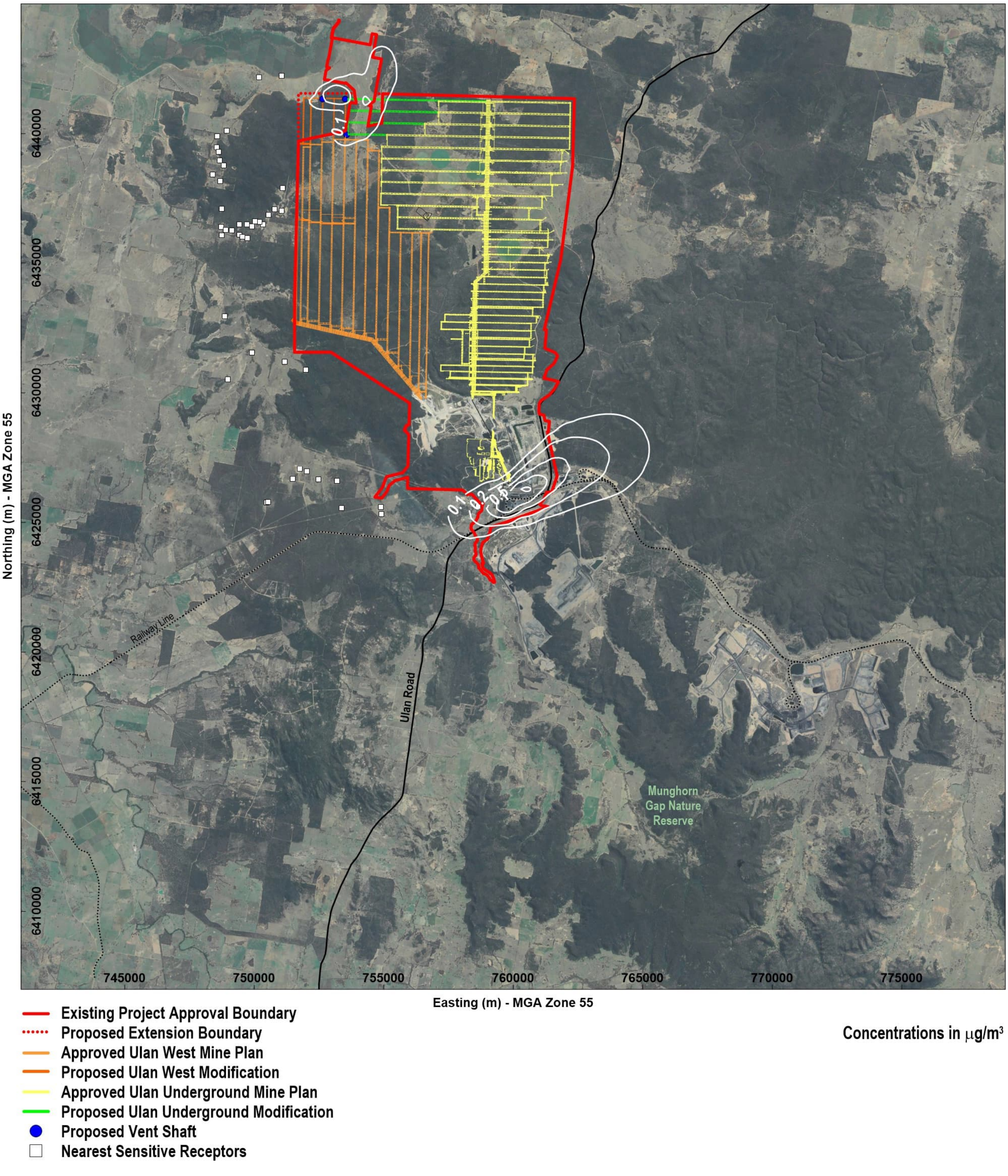

Figure 13 Modelled annual average $PM_{2.5}$ due to UCC (as modified)

6.2.3 Particulate Matter (as TSP)

Figure 14 shows the modelled annual average TSP concentrations due to the UCC (as modified). The EPA's criterion for annual average TSP (90 µg/m^3) relates to the total concentration in the air and not just the contribution from the UCC (as modified). A 59 µg/m^3 contour on Figure 14 would represent the extent of the EPA's 90 µg/m^3 criterion on the assumption that background levels are in the order of 31 µg/m^3 (Section 4.4). The modelling indicates that the Proposed Modification will not cause exceedances of the EPA criterion for annual average TSP at any off-site sensitive receptor.

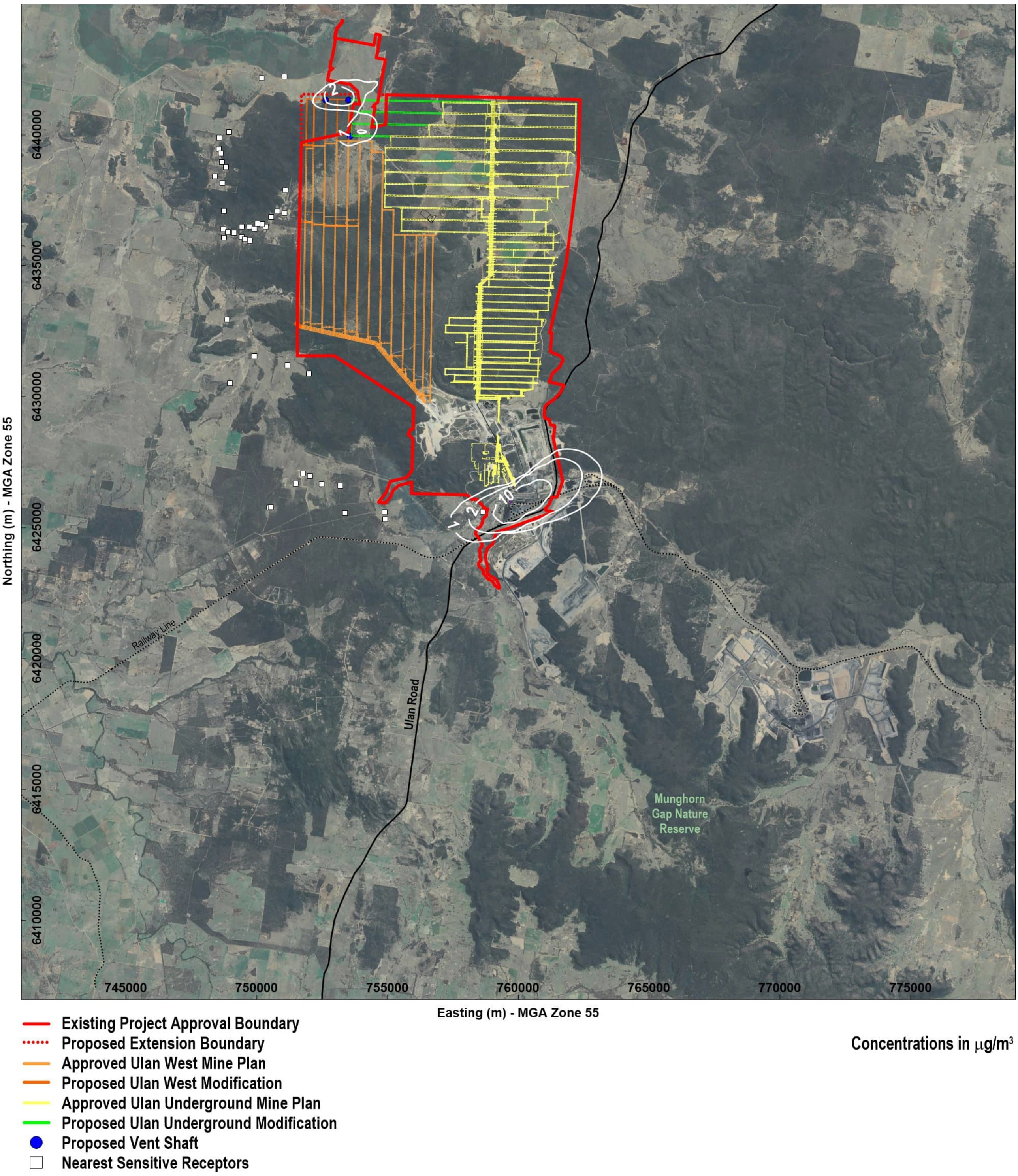

Figure 14 Modelled annual average TSP due to UCC (as modified)

6.2.4 Deposited Dust

Figure 15 shows the modelled annual average deposited dust levels due to the UCC (as modified). These results show that the EPA's assessment criterion for incremental deposited dust (2 g/m^2/month) will not be exceeded at sensitive receptors. In addition, a 2.2 µg/m^3 contour on Figure 15 would represent the extent of the EPA's 4 g/m^2/month criterion for total deposited dust on the assumption that background levels are in the order of 1.8 g/m^2/month (Section 4.4). These results show that the EPA's assessment criterion for total deposited dust (4 g/m^2/month) will not be exceeded at sensitive receptors.

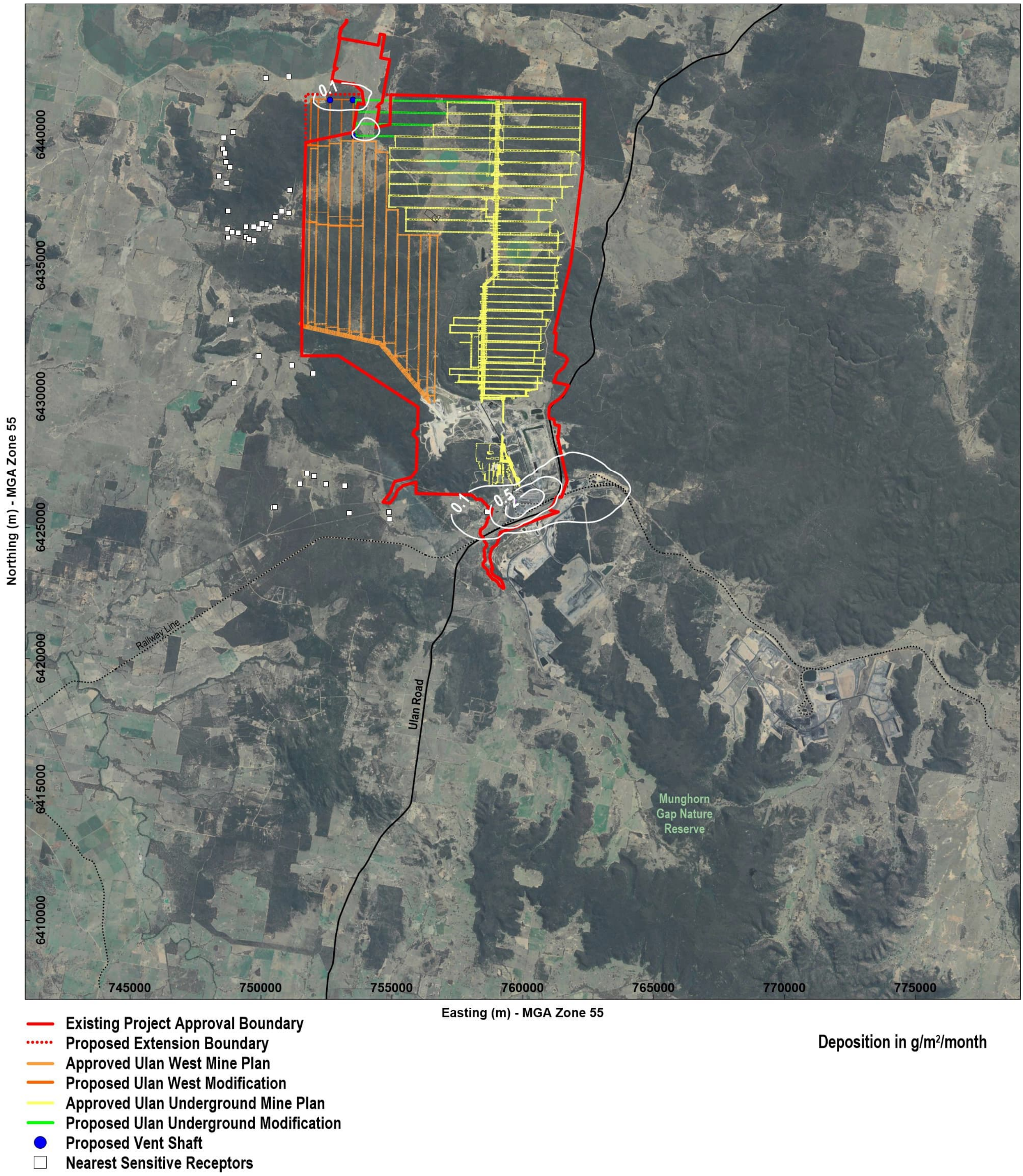

Figure 15 Modelled annual average deposited dust due to UCC (as modified)

6.3 Diesel Exhaust

Figure 16 shows the modelled maximum 1-hour average NO_2 concentrations due to diesel exhaust emissions at UCC, based on the methodology outlined in Section 5.2. The results assume that 20% of the NO_x is NO_2 at the locations of maximum ground-level concentrations. The EPA's criterion for maximum 1-hour average NO_2 (164 µg/m^3) relates to the total concentration in the air and not just the contribution from the UCC (as modified). A 72 µg/m^3 contour on Figure 16 would represent the extent of the EPA's 164 µg/m^3 criterion on the assumption that background levels are in the order of 92 µg/m³ (Section 4.4). The modelling indicates that the Proposed Modification will not cause exceedances of the EPA criterion for maximum 1-hour average NO_2.

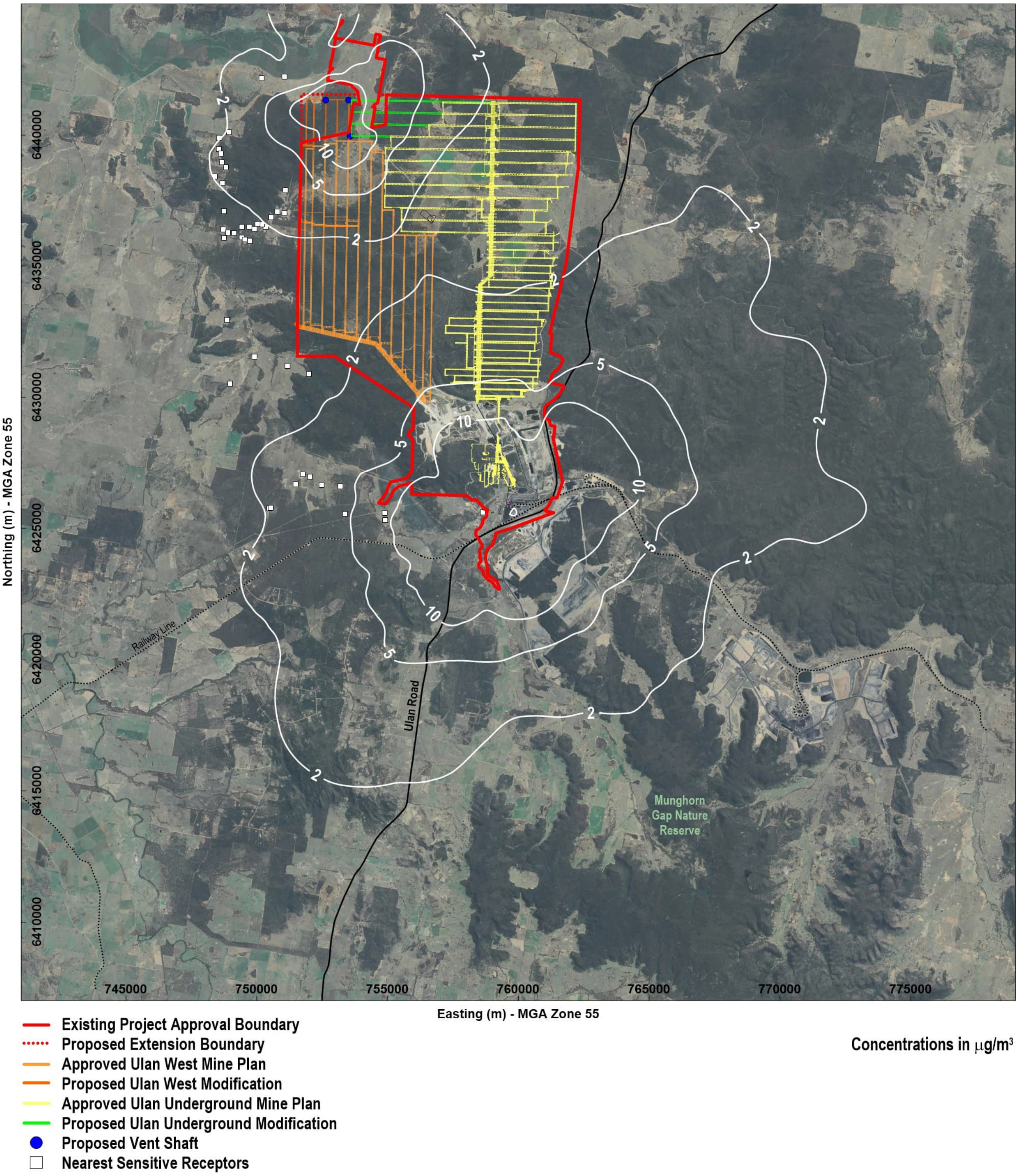

Figure 16 Modelled maximum 1-hour average NO_2 due to diesel exhausts

Figure 17 shows the modelled annual average NO_2 concentrations. These predictions assume that 100% of the NO_x is NO_2, a conservative approach. The EPA's criterion for annual average NO_2 (31 µg/m³) relates to the total concentration in the air and not just the contribution from the UCC (as modified). The 10 µg/m³ contour on Figure 17 represents the extent of the EPA's 31 µg/m³ criterion on the assumption that background levels are in the order of 21 µg/m^3 (Section 4.4). The modelling indicates that the Proposed Modification will not cause exceedances of the EPA criterion for maximum 1-hour average NO_2.

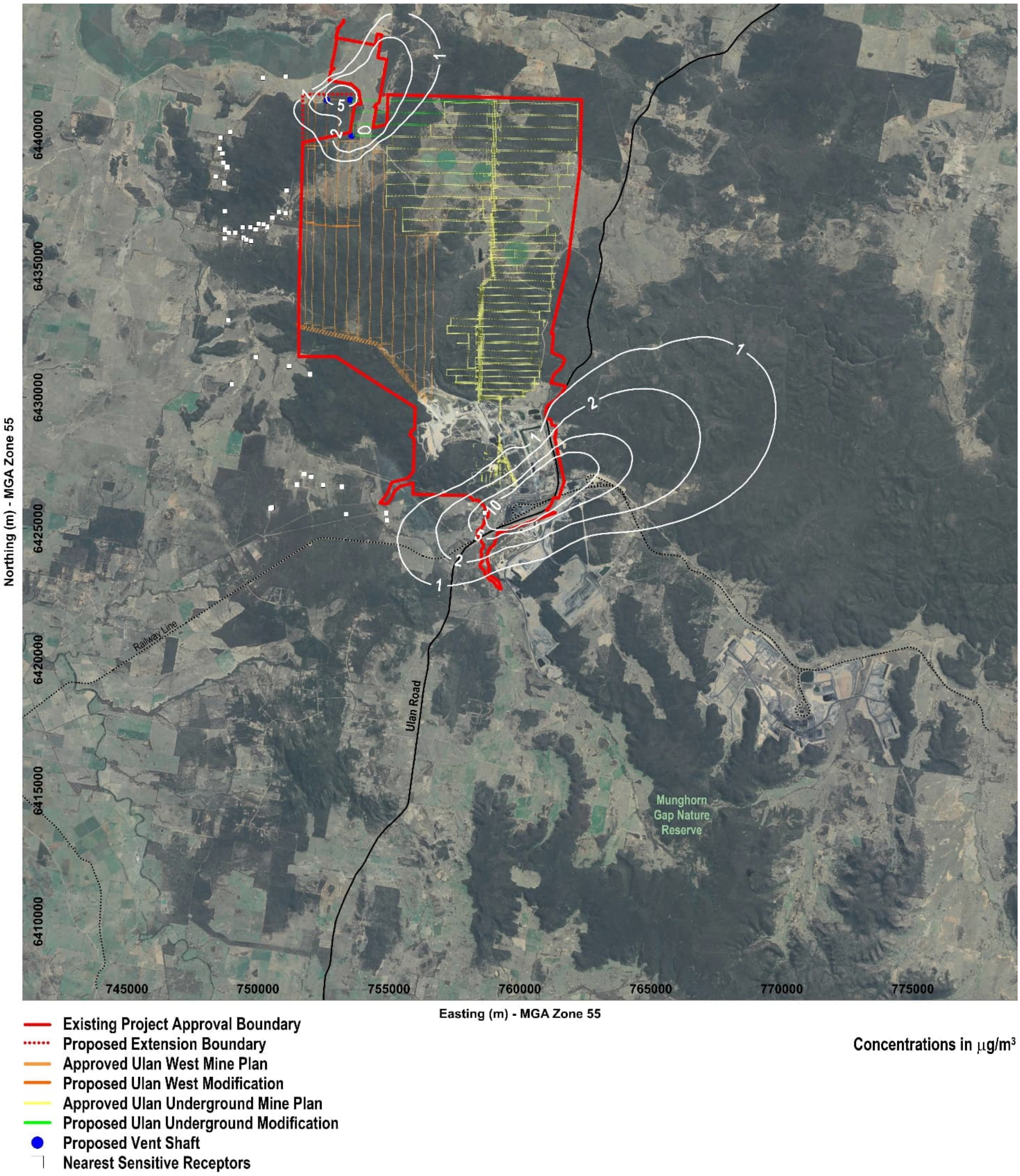

Figure 17 Modelled annual average NO_2 due to diesel exhausts

7. Monitoring and Management

UCMPL operates the UCC in accordance with the approved Air Quality and Greenhouse Gas Management Plan (UCMPL, 2021b). Table 15 outlines the existing dust management measures that are in place at the existing approved UCC, based on the operational details provided by UCMPL, and the assumed emission control factors that were applied for the modelling. These measures would continue to be adopted as part of the Proposed Modification. In addition, UCMPL currently implements, and would continue to implement, a Trigger Action Response Plan. This plan identifies specific meteorological conditions that, upon measurement, require action for managing dust.

Table 15 Emission management measures

Activity	Emission management measures	Assumed emission control (%) (NPI, 2012, Katestone, 2011)
Loading ROM stockpiles	Water sprays	70
Loading product stockpiles	Water sprays	70
Coal handling and preparation plant	Enclosure	90
Conveyors	Covered	70
Hauling rejects on unsealed roads	Watering of unsealed haul routes / roads Restricting vehicle speeds Clearly marked haul routes	85
Wind erosion from ROM stockpiles	Water sprays	50
Wind erosion from product stockpiles	Water sprays	50

The modelling showed that the concentrations of key air quality indicators due to the UCC (as modified) would be relatively minor and that levels would not exceed relevant EPA assessment criteria at sensitive receptors. Therefore, no additional dust emission mitigation would be warranted.

As noted in Section 4 the current monitoring consists of one TEOM, two HVASs and a meteorological station. As the modelling showed that the Proposed Modification is a relatively small contributor to local air quality and would not lead to exceedances of criteria at sensitive receptors, the current monitoring regime is appropriate and no additional monitoring is proposed.

8. Conclusions

This report has provided an assessment of the potential air quality impacts of the Proposed Modification. In summary the assessment has involved identifying the key air quality issues, characterising the existing environment, quantifying emissions to air and modelling to predict the impact of the Proposed Modification on local air quality.

The key air quality issues were identified as mining dust and diesel exhaust, predominantly from proposed changes to underground operations and associated surface infrastructure. These issues were the focus of the assessment.

A detailed review of the existing environment was carried out including an analysis of historically measured concentrations of key quality indicators from representative monitoring stations. The following conclusions were made in relation to the existing environment:

- Meteorological conditions in 2017 were representative of the long term, local conditions around the UCC.
- There was a deterioration in air quality conditions between 2017 and 2019 (and early into 2020), heavily influenced by drought, dust storms and bushfires. These conditions were not unique to the Central Tablelands and have been observed across NSW.
- UCMPL has complied with the air quality criteria specified in PA 08_0184 in all of the past six years (from 2015 to 2020).

The key outcomes of the assessment are:

- The contribution of the UCC (as modified) to local air quality would be relatively minor, based on modelling that showed contributions well below EPA criteria.
- Dust concentrations and deposition levels due to the UCC (as modified) are unlikely to exceed relevant EPA and VLAMP assessment criteria at the sensitive receptors. The only potential for the UCC (as modified) to cause an exceedance of EPA criteria (specifically 24-hour average PM_{10}) would be when the background levels are already approaching the criteria. Under these conditions, the contribution from UCC would be very small and this risk can be managed through appropriate air quality management measures.
- Emissions from diesel exhausts associated with vehicles, plant and equipment are not expected to result in any adverse air quality impacts, based on modelling which showed contributions well below the EPA criteria.

Based on this assessment, it has been concluded that the Proposed Modification is unlikely to affect air quality beyond the range of historically measured fluctuations of key air quality indicators around Ulan. This conclusion has been informed by modelling which showed that the UCC (as modified) would not result in changes to air quality that would cause exceedances of air quality criteria at the sensitive receptors.

These outcomes are consistent with the desired performance outcome for the Proposed Modification, which for air quality, is to minimise air quality impacts to reduce risks to human health and the environment to the greatest extent practicable through the design and operation of the Proposed Modification.

9. References

BoM (2020) Climatic Averages Australia, Bureau of Meteorology website, accessed December 2020. http://www.bom.gov.au/climate/averages/

DPIE (2020) "*Annual Air Quality Statement 2019*". Now a web-based document, available from https://www.environment.nsw.gov.au/

EPA (2012) *"Air Emissions Inventory for the Greater Metropolitan Region in New South Wales, 2008 Calendar Year, Off-Road Mobile Emissions"*. Technical Report No. 6. Prepared by the Environment Protection Authority. EPA 2012/0050. August 2012.

EPA (2022) *"Approved Methods for the Modelling and Assessment of Air Pollutants in NSW"*.

Katestone (2011) *"NSW Coal Mining Benchmarking Study: International Best Practice Measures to Prevent and / or Minimise Emissions of Particulate Matter from Coal Mining"*. Prepared by Katestone Environmental Pty Ltd for NSW Office of Environment and Heritage, December 2010.

NEPC (1998) *"Ambient Air – National Environment Protection Measure for Ambient Air Quality"*, National Environment Protection Council, Canberra.

NPI (2012) *"Emission Estimation Technique Manual for Mining"*. Version 3.1, January 2012. National Pollutant Inventory.

NSW Government (2018) *"Voluntary Land Acquisition and Mitigation Policy for State Significant Mining, Petroleum and Extractive Industry Developments"*. VLAMP, September 2018.

OEH (2013) *"Upper Hunter Fine Particle Characterisation Study"*. Final report, dated 17 September 2013. Prepared by the CSIRO on behalf of the Office of Environment and Heritage.

OEH (2019) *"Annual Air Quality Statement 2018"*. Prepared by the Office of Environment and Heritage.

Skidmore, E.L. (1998) *"Wind Erosion Processes"*. USDA-ARS Wind Erosion Research Unit, Kansas State University. Wind Erosion in Africa and West Asia: Problems and Control Strategies. Proceedings of the expert group meeting 22-25 April 1997, Cairo, Egypt.

Todoroski (2016) *"Review – Air Quality Impact Assessment – Mt Owen Continued Operations Project"*. Prepared by Todoroski Air Sciences for the NSW Department of Planning and Environment. Job number 15090470, report dated 29 April 2016.

TRC (2011) *"Generic Guidance and Optimum Model Settings for the CALPUFF Modelling System for Inclusion into the 'Approved Methods for the Modelling and Assessments of Air Pollutants in NSW'"*. Prepared for the Office of Environment and Heritage by TRC, March 2011.

UCMPL (2016) *"Annual Review 2015"*. Prepared by Ulan Coal Mines Pty Limited.

UCMPL (2017) *"Annual Review 2016"*. Prepared by Ulan Coal Mines Pty Limited.

UCMPL (2018) *"Annual Review 2017"*. Prepared by Ulan Coal Mines Pty Limited.

UCMPL (2019) *"Annual Review 2018"*. Prepared by Ulan Coal Mines Pty Limited.

UCMPL (2020) *"Annual Review 2019"*. Prepared by Ulan Coal Mines Pty Limited.

UCMPL (2021) *"Annual Review 2020"*. Prepared by Ulan Coal Mines Pty Limited.

UCMPL (2021b) *“Air Quality and Greenhouse Gas Management Plan”*. Prepared by Ulan Coal Mines Pty Limited. ULNCX-111515275-1653. Dated 11/01/2021.

US EPA (1985 and updates) *“Compilation of Air Pollutant Emission Factors”*, AP-42, Fourth Edition United States Environmental Protection Agency, Office of Air and Radiation Office of Air Quality Planning and Standards, Research Triangle Park, North Carolina 27711. Now a web-based document.

US EPA (1987) Update of fugitive dust emission factors in AP-42 Section 11.2, EPA Contract No. 68-02-3891, Midwest Research Institute, Kansas City, MO, July 1987.

Appendix A. Annual and seasonal wind-roses

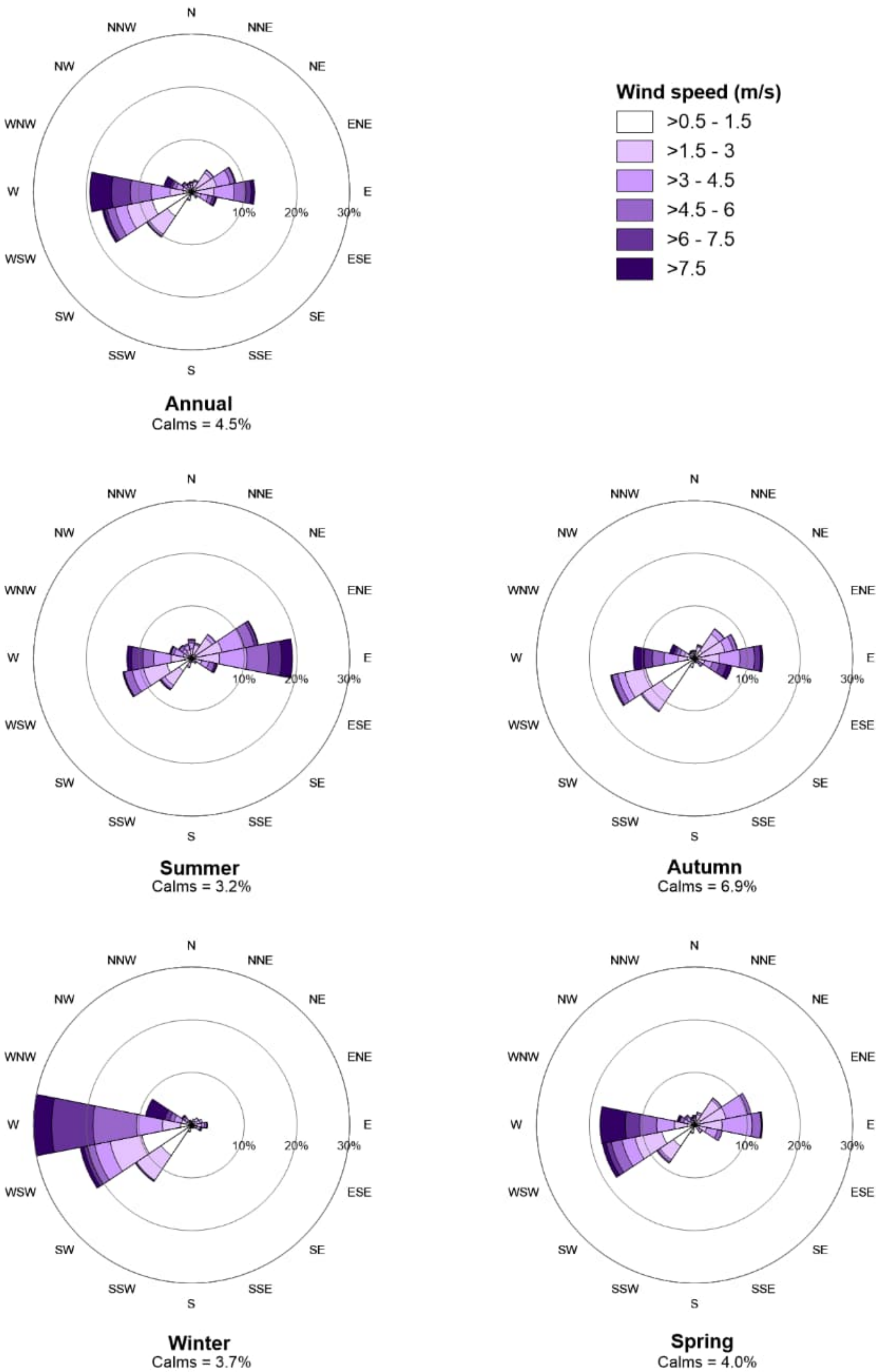

Figure A1 Annual and seasonal wind-roses for data collected at the UCC meteorological station in 2017

Appendix B. Model settings and setup

Model Geophysical

Figure B1 shows the model grid, land-use and terrain information, as used by CALMET.

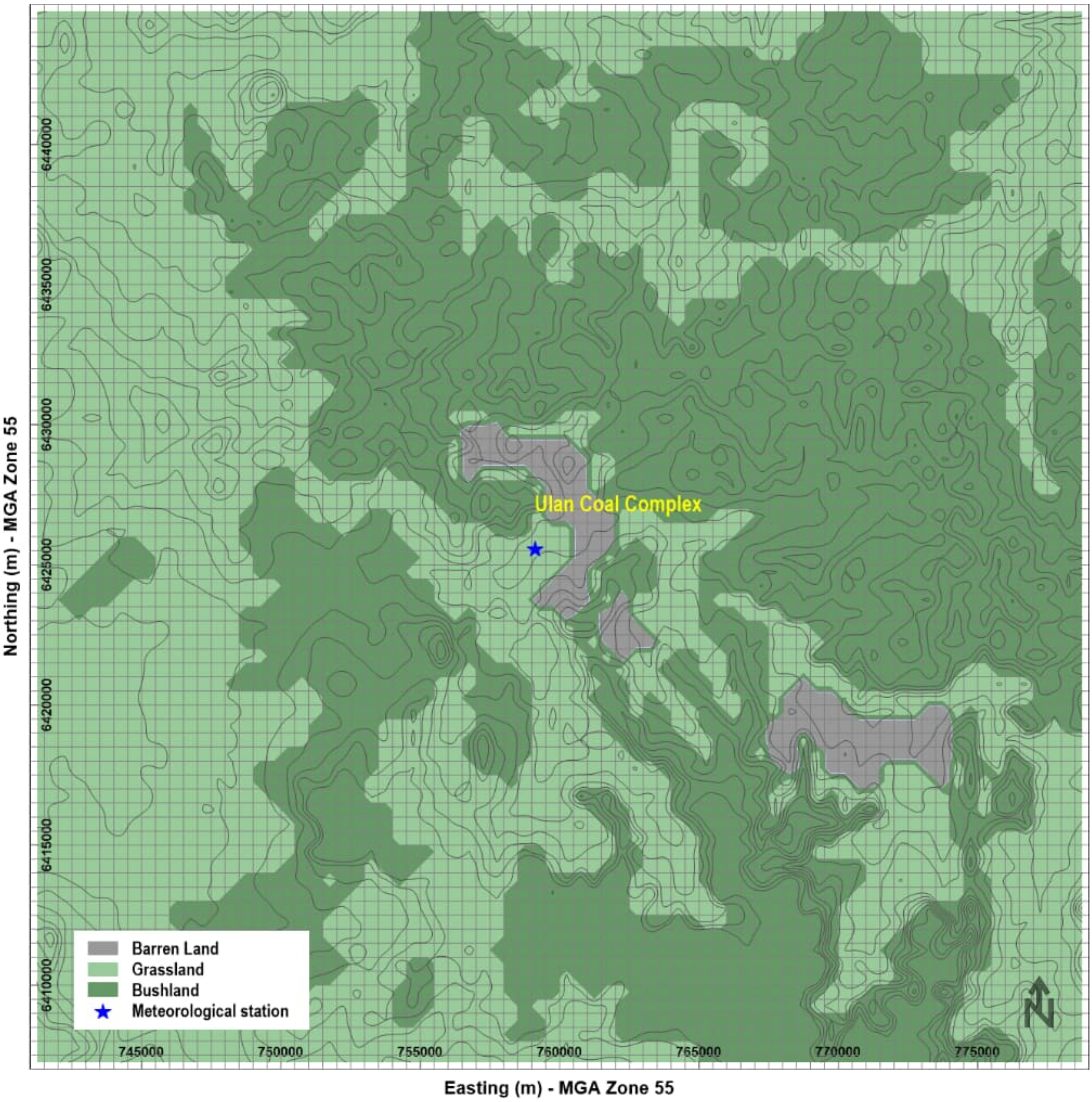

Figure B1 Model domain, grid, land use and terrain information

Figure B2 shows a snapshot of winds at 10 metres above ground-level as simulated by the CALMET model under stable conditions. This plot shows the effect of the topography on local winds, for this particular hour, and highlights the non-uniform wind patterns in the area, further supporting the use of a non-steady-state model such as CALPUFF.

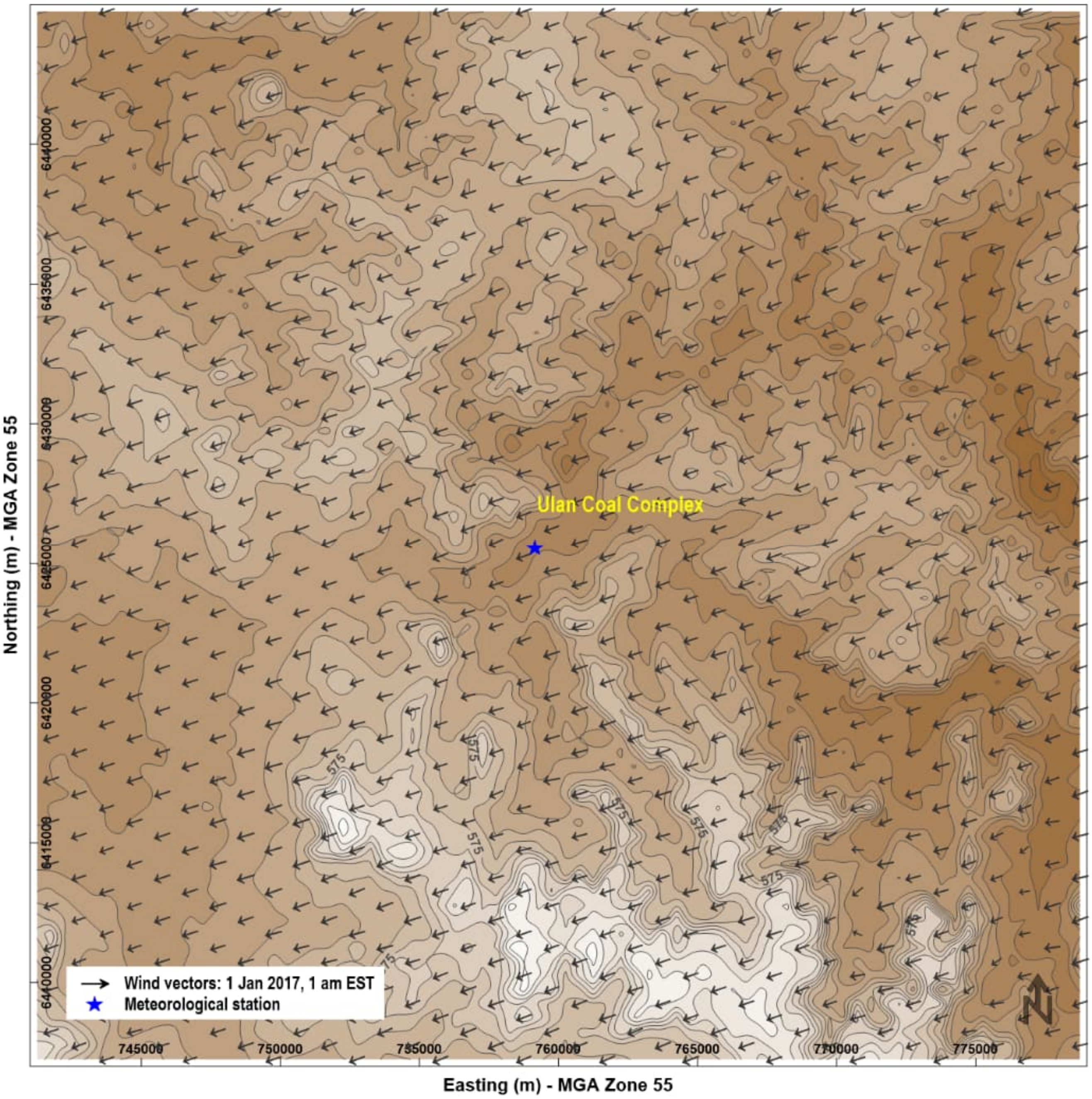

Figure B2 Example of CALMET simulated ground-level wind flows

Model Meteorology

The CALPUFF model, through the CALMET meteorological pre-processor, simulates complex meteorological patterns that exist in a particular region. The necessary upper air data for CALMET were generated by the CSIRO's prognostic model, TAPM, and the required surface observation data were sourced from local weather stations. CALMET was used to produce a year-long, three-dimensional output of meteorological conditions for input to the CALPUFF air dispersion model. The meteorological modelling followed the guidance of TRC (2011) and adopted the "observations" mode.

Table B1 Model settings and inputs for TAPM

Parameter	Value(s)
Model version	4.0.5
Number of grids (spacing)	4 (30 km, 10 km, 3 km, 1 km)
Number of grids point	35 x 35 x 25
Year(s) of analysis	2017
Centre of analysis	32º16' S, 149º46' E
Terrain data source	30 m Shuttle Research Topography Mission (SRTM)
Land use data source	Default
Meteorological data assimilation	UCC meteorological station. Radius of influence = 10 km. Number of vertical levels for assimilation = 4

Table B2 Model settings and inputs for CALMET

Parameter	Value(s)
Model version	6.334
Terrain data source(s)	30 m SRTM. Higher resolution topographical data were not necessary in order to develop wind fields that reflect the influence of terrain and effects that are important for dispersion of emissions from the project to the sensitive receptor areas.
Land use data source(s)	Digitised from aerial imagery
Meteorological grid domain	38 km x 38 km
Meteorological grid resolution	0.5 km
Meteorological grid dimensions	76 x 76 x 9 grid points
Meteorological grid origin	741000 mE, 6407000 mN. MGA Zone 55
Surface meteorological stations	UCC: wind speed, wind direction TAPM (at location of UCC): temperature, humidity, ceiling height, cloud cover and air pressure
Upper air meteorological stations	Upper air data file for the location of the UCC meteorological station, derived by TAPM. Biased towards surface observations (-1, -0.8, -0.6, -0.4, -0.2, 0, 0, 0, 0)
Simulation length	8760 hours (1 Jan 2017 to 31 Dec 2017)
R1, R2	0.5, 1
RMAX1, RMAX2	5, 20
TERRAD	5

Table B3 Model settings and inputs for CALPUFF

Parameter	Value(s)
Model version	6.42
Computational grid domain	76 x 76
Chemical transformation	None
Dry deposition	Yes
Wind speed profile	ISC rural
Puff element	Puff
Dispersion option	Turbulence from micrometeorology
Time step	3600 seconds (1 hour)
Terrain adjustment	Partial plume path
Number of volume sources	See below. Height = 5 m, SY = 20 m, SZ = 10 m.

Parameter	Value(s)
Number of discrete receptors	831. See below.

Model Sources

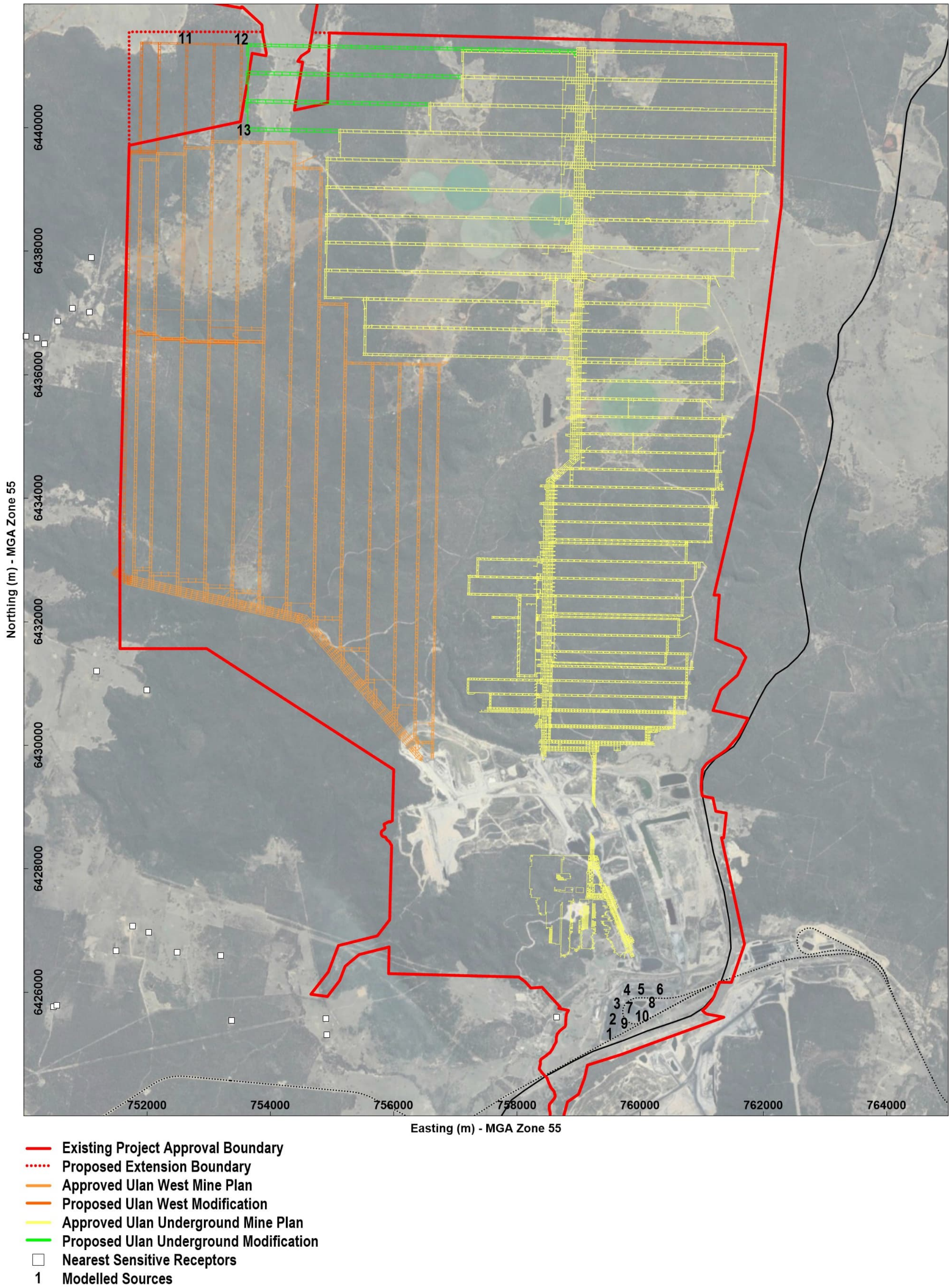

Figure B3 Modelled source locations

Model Receptors

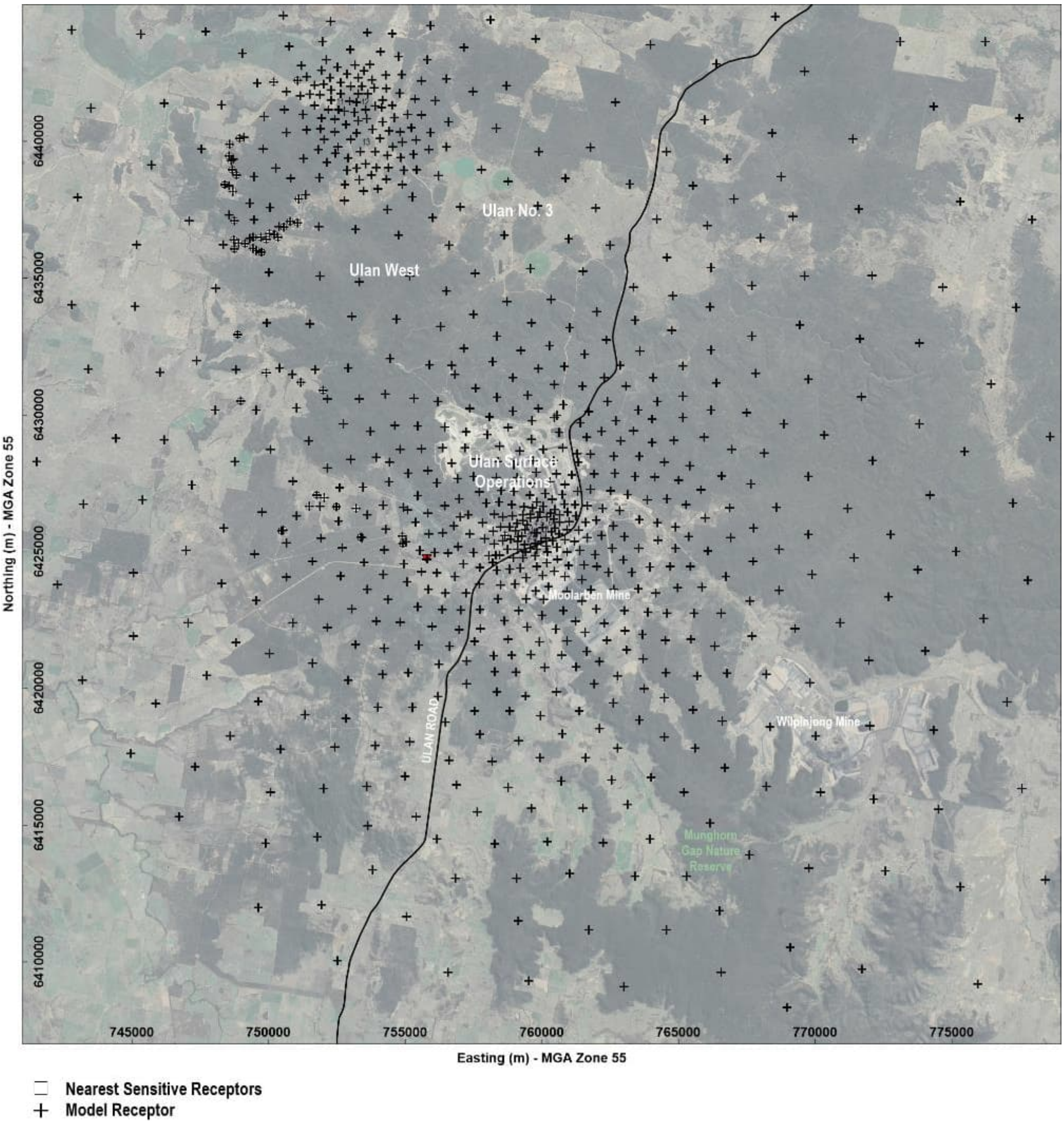

Figure B4 Model receptor locations

Appendix C. Emission calculations

Emission factors

Activity	Emission factor			Units	Source
	TSP	PM_{10}	$PM_{2.5}$		
Stripping topsoil	$E_{TSP} = 0.029$	$E_{PM10} = 0.0073 \times E_{TSP}$	$E_{PM2.5} = 0.05 \times E_{TSP}$	kg/t	US EPA / NPI
Topsoil spreading	$E_{TSP} = 0.02$	$E_{PM10} = 0.006 \times E_{TSP}$	$E_{PM2.5} = 0.031 \times E_{TSP}$	kg/t	US EPA / NPI
Loading stockpiles / conveyors	$E_{TSP} = 0.74 \times 0.0016 \times ((U/2.2)^{1.3}/(M/2)^{1.4})$	$E_{PM10} = 0.35 \times 0.0016 \times ((U/2.2)^{1.3}/(M/2)^{1.4})$	$E_{PM2.5} = 0.053 \times 0.0016 \times ((U/2.2)^{1.3}/(M/2)^{1.4})$	kg/t	US EPA / NPI
Dozers working on coal stockpiles	$E_{TSP} = 35.6 \times (S^{1.2}/M^{1.3})$	$E_{PM10} = 6.33 \times (S^{1.5}/M^{1.4})$	$E_{PM2.5} = 0.022 \times E_{TSP}$	kg/hour	US EPA / NPI
Rotary breaker / crushing	$E_{TSP} = 0.0027$	$E_{PM10} = 0.0012$	$E_{PM2.5} = 0.005 \times E_{TSP}$	kg/t	US EPA
Screening	$E_{TSP} = 0.0125$	$E_{PM10} = 0.0043$	$E_{PM2.5} = 0.005 \times E_{TSP}$	kg/t	US EPA
Loading product coal to trains	$E_{TSP} = 0.0004$	$E_{PM10} = 0.00017$	$E_{PM2.5} = 0.05 \times E_{TSP}$	kg/t	NPI
Hauling rejects on unsealed roads	$E_{TSP} = 4$	$E_{PM10} = 0.3 \times E_{TSP}$	$E_{PM2.5} = 0.03 \times E_{TSP}$	kg/VKT	SPCC
Miscellaneous transfer	$E_{TSP} = 0.74 \times 0.0016 \times ((U/2.2)^{1.3}/(M/2)^{1.4})$	$E_{PM10} = 0.35 \times 0.0016 \times ((U/2.2)^{1.3}/(M/2)^{1.4})$	$E_{PM2.5} = 0.053 \times 0.0016 \times ((U/2.2)^{1.3}/(M/2)^{1.4})$	kg/t	US EPA / NPI
Wind erosion from stockpiles	$E_{TSP} = 0.097$	$E_{PM10} = 0.5 \times E_{TSP}$	$E_{PM2.5} = 0.075 \times E_{TSP}$	kg/ha/h	US EPA
Grading roads	$E_{TSP} = 0.0034 \times s^{2.5}$	$E_{PM10} = 0.00336 \times s^{2}$	$E_{PM2.5} = 0.0001054 \times s^{2.5}$	kg/VKT	US EPA / NPI

U = wind speed (m/s)
M = moisture content (%)
S = silt content (%)
s = speed (km/h)

Emission inventory
Maximum production

	Annual emissions (kg/y)						TSP		PM10		PM2.5		Variables					
Activity	TSP	PM10	PM2.5	Control (%)	Intensity	Units	Factor	Units	Factor	Units	Factor	Units	(ws/2.2)^1.3	Moisture (%)	kg/VKT	t/truck	km/trip	Silt (%)
Topsoil stripping	183	46	9	50	12600	t/y	0.029	kg/t	0.0073	kg/t	0.001	kg/t	-	-	-	-	-	-
Topsoil spreading	126	76	4	50	12600	t/y	0.02	kg/t	0.012	kg/t	0.001	kg/t	-	-	-	-	-	-
ROM coal - loading ROM coal stockpile	1654	782	118	70	20625000	t/y	0.00027	kg/t	0.00013	kg/t	0.0000	kg/t	1.85	9	-	-	-	-
ROM coal - dozers on ROM coal stockpiles	61826	14302	1360	50	8760	h/y	14.1	kg/h	3.3	kg/h	0.311	kg/h	-	9	-	-	-	5
ROM coal - rotary breaker	3375	1500	169	90	12500000	t/y	0.00270	kg/t	0.0012	kg/t	0.0001	kg/t	-	-	-	-	-	-
ROM coal - dry screening	15625	5375	781	90	12500000	t/y	0.01250	kg/t	0.0043	kg/t	0.0006	kg/t	-	-	-	-	-	-
ROM coal - secondary bypass crushing	2194	975	110	90	8125000	t/y	0.00270	kg/t	0.0012	kg/t	0.0001	kg/t	-	-	-	-	-	-
ROM coal - conveyor transfer (x4)	6614	3128	474	70	20625000	t/y	0.00107	kg/t	0.00051	kg/t	0.0001	kg/t	1.85	9	-	-	-	-
Product coal - loading bypass coal	651	308	47	70	8125000	t/y	0.00027	kg/t	0.00013	kg/t	0.0000	kg/t	1.85	9	-	-	-	-
Product coal - loading washed product coal	952	450	68	70	11875000	t/y	0.00027	kg/t	0.00013	kg/t	0.0000	kg/t	1.85	9	-	-	-	-
Product coal - conveyor transfer	2672	1264	191	50	20000000	t/y	0.00027	kg/t	0.00013	kg/t	0.0000	kg/t	1.85	9	-	-	-	-
Product coal - dozers on product coal stockpiles	61826	14302	1360	50	8760	h/y	14.1	kg/h	3.3	kg/h	0.311	kg/h	-	9	-	-	-	5
Product coal - loading trains	8000	3400	400	0	20000000	t/y	0.00040	kg/t	0.00017	kg/t	0.0000	kg/t	-	-	-	-	-	-
Rejects - conveyor transfer (x2)	84	39	6	50	625000	t/y	0.00027	kg/t	0.00013	kg/t	0.0000	kg/t	1.85	9	-	-	-	-
Rejects - loading rejects stockpile	50	24	4	70	625000	t/y	0.00027	kg/t	0.00013	kg/t	0.0000	kg/t	1.85	9	-	-	-	-
Rejects - hauling rejects	7500	2216	225	85	625000	t/y	0.08000	kg/t	0.02364	kg/t	0.002	kg/t	-	-	4	50	1	-
Wind erosion - ROM coal stockpile	1275	657	96	50	3.0	ha	849.7	kg/ha/y	438.0	kg/ha/y	63.7	kg/ha/y	-	-	-	-	-	-
Wind erosion - product coal stockpile	3824	1971	287	50	9.0	ha	849.7	kg/ha/y	438.0	kg/ha/y	63.7	kg/ha/y	-	-	-	-	-	-
Wind erosion - exposed areas around plant	25492	13140	1912	0	30.0	ha	849.7	kg/ha/y	438.0	kg/ha/y	63.7	kg/ha/y	-	-	-	-	-	-
Ventilation shaft(s)	35478	17739	1774	0	26280	h/y	1.4	kg/h	0.7	kg/h	0.07	kg/h	-	-	-	-	-	-
Total	239400	81695	9394															

Source allocations
Maximum production

```
 --------------------------------      17-Dec-2020 10:36
  DUST EMISSION CALCULATIONS XL1
 --------------------------------

 Output emissions file  : emiss.vol
 Meteorological file    : NA
 Number of dust sources : 13
 Number of activities   : 22

  -----ACTIVITY SUMMARY-----
 ACTIVITY NAME : Topsoil stripping
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 183 kg/y TSP  46 kg/y PM10  9 kg/y PM2.5
 FROM SOURCES  : 10
1 2 3 4 5 6 7 8 9 10
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : Topsoil spreading
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 126 kg/y TSP  76 kg/y PM10  4 kg/y PM2.5
 FROM SOURCES  : 10
1 2 3 4 5 6 7 8 9 10
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : ROM coal - loading ROM coal stockpile
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 1654 kg/y TSP  782 kg/y PM10  118 kg/y PM2.5
 FROM SOURCES  : 3
4 5 6
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : ROM coal - dozers on ROM coal stockpiles
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 61826 kg/y TSP  14302 kg/y PM10  1360 kg/y PM2.5
 FROM SOURCES  : 3
4 5 6
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : ROM coal - rotary breaker
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 3375 kg/y TSP  1500 kg/y PM10  169 kg/y PM2.5
 FROM SOURCES  : 3
4 5 6
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : ROM coal - dry screening
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 15625 kg/y TSP  5375 kg/y PM10  781 kg/y PM2.5
 FROM SOURCES  : 3
4 5 6
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : ROM coal - secondary bypass crushing
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 2194 kg/y TSP  975 kg/y PM10  110 kg/y PM2.5
 FROM SOURCES  : 3
4 5 6
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : ROM coal - conveyor transfer (x4)
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 6614 kg/y TSP  3128 kg/y PM10  474 kg/y PM2.5
 FROM SOURCES  : 3
4 5 6
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : Product coal - loading bypass coal
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 651 kg/y TSP  308 kg/y PM10  47 kg/y PM2.5
 FROM SOURCES  : 3
1 2 3
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : Product coal - loading washed product coal
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 952 kg/y TSP  450 kg/y PM10  68 kg/y PM2.5
 FROM SOURCES  : 3
1 2 3
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : Product coal - conveyor transfer
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 2672 kg/y TSP  1264 kg/y PM10  191 kg/y PM2.5
 FROM SOURCES  : 3
1 2 3
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : Product coal - dozers on product coal stockpiles
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 61826 kg/y TSP  14302 kg/y PM10  1360 kg/y PM2.5
 FROM SOURCES  : 3
1 2 3
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : Product coal - loading trains
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 8000 kg/y TSP  3400 kg/y PM10  400 kg/y PM2.5
 FROM SOURCES  : 1
7
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : Rejects - conveyor transfer (x2)
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 84 kg/y TSP  39 kg/y PM10  6 kg/y PM2.5
 FROM SOURCES  : 3
4 5 6
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : Rejects - loading rejects stockpile
 ACTIVITY TYPE : Wind sensitive
 DUST EMISSION : 50 kg/y TSP  24 kg/y PM10  4 kg/y PM2.5
 FROM SOURCES  : 3
4 5 6
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : Rejects - hauling rejects
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 7500 kg/y TSP  2216 kg/y PM10  225 kg/y PM2.5
 FROM SOURCES  : 7
4 5 6 7 8 9 10
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : Wind erosion - ROM coal stockpile
 ACTIVITY TYPE : Wind erosion
 DUST EMISSION : 1275 kg/y TSP  657 kg/y PM10  96 kg/y PM2.5
 FROM SOURCES  : 3
4 5 6
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : Wind erosion - product coal stockpile
 ACTIVITY TYPE : Wind erosion
 DUST EMISSION : 3824 kg/y TSP  1971 kg/y PM10  287 kg/y PM2.5
 FROM SOURCES  : 3
1 2 3
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : Wind erosion - exposed areas around plant
 ACTIVITY TYPE : Wind erosion
 DUST EMISSION : 25492 kg/y TSP  13140 kg/y PM10  1912 kg/y PM2.5
 FROM SOURCES  : 10
1 2 3 4 5 6 7 8 9 10
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : Wind erosion - other areas
 ACTIVITY TYPE : Wind erosion
 DUST EMISSION : 0 kg/y TSP  0 kg/y PM10  0 kg/y PM2.5
 FROM SOURCES  : 10
1 2 3 4 5 6 7 8 9 10
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : Ventilation shaft(s)
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 35478 kg/y TSP  17739 kg/y PM10  1774 kg/y PM2.5
 FROM SOURCES  : 3
11 12 13
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 ACTIVITY NAME : Grading roads
 ACTIVITY TYPE : Wind insensitive
 DUST EMISSION : 0 kg/y TSP  0 kg/y PM10  0 kg/y PM2.5
 FROM SOURCES  : 10
1 2 3 4 5 6 7 8 9 10
 HOURS OF DAY  :
1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1

 Pit retention sources:
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