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9. Air Quality

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Contents

9 Air Quality

9.1 Introduction

This Chapter provides a description of the existing air quality within the vicinity of the study area for the revised Project. It also identifies potential air quality impacts for the revised Project and the required mitigation measures proposed to avoid or minimise adverse air quality impacts.

9.2 Regulatory Framework

The *Environmental Protection Act 1994* provides for the management of the air environment in Queensland. Air quality guidelines are specified by the *Queensland Department of Environment and Heritage Protection* (DEHP) in the *Queensland Environmental Protection (Air) Policy 2008* (EPP (Air)). The purpose of the EPP (Air) is to protect the air quality environment for human health and wellbeing, the health and biodiversity of ecosystems, the aesthetics of the environment and for agricultural use.

The air quality objectives in the EPP (Air) considered relevant to the construction and operation of the revised Project are presented in **Table 9-1**. The key air emissions from the revised Project are particulate matter generated as dust from mining operations.

Table 9-1 Air quality objectives in the EPP (Air) relevant to the revised Project

Pollutant	Air Quality Objective	Averaging Period	Allowable Exceedances
Total Suspended Particulates (TSP)	90 µg/m^3	Annual	-
Particulates as PM_{10} (<10 µm)	50 µg/m^3	24 hours	5 per year
Particulates as $PM_{2.5}$ (<2.5 µm)	25 µg/m^3	24 hours	-
	8 µg/m^3	Annual	-
Nitrogen dioxide (NO_2)	250 µg/m^3	1 hour	1 day each year
	62 µg/m^3	1 year	-
	33 µg/m^3	1 year	-
Carbon monoxide (CO)	11,000 µg/m^3	8 hours	-
Sulphur dioxide SO_2	570	1 hour	1 day each year
	230	1 day	1 day each year
	57	1 year	-

The National Environment Protection Measure (NEPM) for Ambient Air Quality was released in 2003 by the National Environment Protection Council (NEPC, 2003). The NEPM sets national standards for the six key air pollutants, being, carbon monoxide, ozone, sulphur dioxide, nitrogen dioxide, lead and particles. The EPP (Air) has adopted the NEPM (Air) goals as air quality objectives.

The NEPM also provides advisory reporting standards for $PM_{2.5}$, only recommending an advisory reporting standard a maximum (ambient) concentration of for $PM_{2.5}$ of 25 µg/m^3 (24 hour averaging period) and 8 µg/m^3 (annual averaging period), which is consistent with the objectives for $PM_{2.5}$ set out in the EPP (Air).

Coarse particulates (>10 µm) have the greater potential to generate potential nuisance. The EPP (Air) does not provide specific objectives for nuisance impacts of particulates. The following objectives are adopted for the management of potential nuisance impacts for the revised Project:

- dust deposition rate of 120 mg/m^2/day averaged over one month (EPA, 2003); and
- TSP concentration of 80 µg/m^3 (24 hour average) (NZME, 2001).

9.3 Existing Environment

This section describes the existing air quality and dispersion meteorology within the study area for the revised Project.

9.3.1 Local Setting and Sensitive Receptors

The revised Project is located on the Darling Downs in Southern Queensland, approximately 12 km northwest of Oakey and 35 km northwest of Toowoomba.

The terrain of the study area is gently undulating. Large areas of land around the revised Project have been cleared for grazing or agriculture, while low scrub vegetation remains in some places. Land use is generally agricultural in the area surrounding the revised Project.

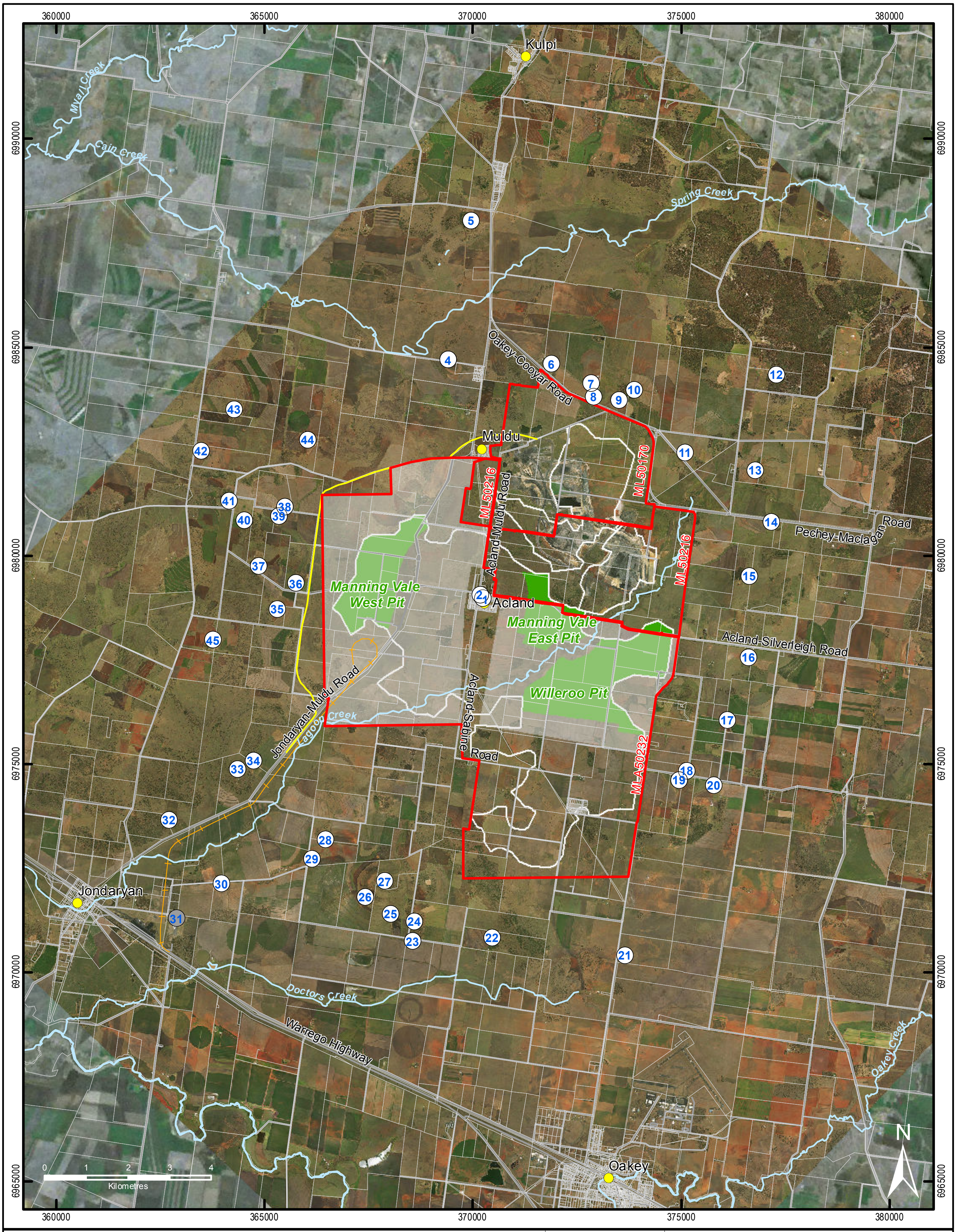
Sensitive receptors are locations which have the potential to be impacted by air emissions from a project. Air quality sensitive receptors include:

- residences;
- educational facilities (e.g. schools, kindergartens, child care centres and universities);
- medical institutions (e.g. hospitals and surgeries);
- public parks and recreational areas; and
- religious buildings.

The nearest sensitive receptors to the revised Project are presented in **Figure 9-1**. The sensitive receptors are generally residences based on properties surrounding the revised Project area. Receptor 31 is a commercial sensitive receptor. Sensitive receptor 3 (in Muldu) has been removed from **Figure 9-1** because NAC have reached agreement to relocate the current tenant and purchase this property.

The closest sensitive receptor (number 36) to an active mine pit is located approximately 1 km west of the MVW pit. Sensitive receptor 1 and 2 are also located approximately 1km west of the MVE pit.

There are four sensitive receptors (31, 32, 33 and 34) that are located within approximately 700 m of the rail line with receptor number 31 located approximately 400 m to the east of line.



LEGEND

- Towns and Localities
- Sensitive Receptor - Residential
- Sensitive Receptor - Commercial
- Rail Spur
- Jondaryan-Muldu Road Diversion
- Creeks
- Mining Tenements
- Proposed Extent of Surface Rights Area
- Stage 3 Pit Areas

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Figure 9-1 - Sensitive Receptors

Scale 1:120,000 on A4
Projection: Australian Geodetic Datum - Zone 56 (AGD84)

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Produced: 27/11/2013

9.3.2 Climate

Meteorological data recorded by the Bureau of Meteorology (BoM) at Oakey (station 041359) has been reviewed to describe the existing meteorological and climatological influences of the study area. The BoM station at Oakey is located approximately 10 km south-southwest of the revised Project and is considered representative of the study area for the air quality assessment. **Table 9-2** provides a summary of the temperature, humidity and rainfall data for the Oakey meteorological station.

Oakey typically has warm days during summer with average maximum daytime temperatures around 30°C falling to 19°C during the winter months. Overnight temperatures are generally cool all year round and cold during the winter months with average minimum daily temperatures of 3°C in July, rising to greater than 15°C between December and March.

Mean 9 am relative humidity is generally greatest during the months from February to July and least during September to December. Mean 3 pm relative humidity is generally lower than 9 am through the year, ranging from 35% in September up to 48% in February. The lowest 3 pm relative humidity is experienced between August and October.

Highest rainfall is generally recorded during summer months with monthly rain averages above 77 mm/month from November to February. Mean monthly rainfall generally drops off in late autumn and winter with average monthly rainfalls less than 48 mm from March until September.

Table 9-2 Climate summary statistics for BoM Oakey (041359)

Climate statistic	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Mean maximum temperature (°C)	30.8	29.9	28.6	25.8	22.3	19	18.5	20.3	23.8	26.6	28.5	30.2	25.4
Mean minimum temperature (°C)	17.8	17.6	15.6	11.8	7.8	4.1	2.8	3.6	7.2	11.3	14.4	16.6	10.9
Mean monthly rainfall (mm)	82.1	83.4	47.8	32.2	40.3	30.3	29.7	26.5	31.6	57.1	77.2	95	634.4
Mean no. of rain days	8.7	7.5	6.6	5.3	5.8	5.5	5.8	4.8	5.4	7.2	8.3	8.8	79.7
Mean 9am temperature (°C)	24.3	23.6	22.3	19.5	15.3	11	10.4	12.6	16.9	20.2	22.2	23.9	18.5
Mean 9am relative humidity (%)	63	67	66	67	74	79	76	67	59	56	58	59	66
Mean 3pm temperature (°C	29.3	28.3	27.3	24.5	21.1	18	17.4	19.2	22.6	25.2	26.9	28.5	24
Mean 3 pm relative humidity (%)	44	48	44	43	46	46	44	37	35	36	40	41	42

Table 9-2 indicates that the highest rainfall and the greatest number of rain days generally occur during the warmer months from November through to February. Driest times of the year are typically June through to September and it is during this period that dust emissions from excavation and wind erosion from exposed areas would be greatest.

9.3.3 Dispersion Meteorology

The seasonal wind roses for the hourly data recorded at the BoM station at Oakey (041359) from 2002 to 2013 are provided in **Figure 9-2**. The wind roses presented in **Figure 9-2** indicate that:

- the dominant winds are from the east, northeast and southeast;
- summer and autumn are representative of the yearly winds;
- winter has the highest percentage of calm conditions (6.4%); and
- the winter months have a significant proportion (12%) of westerly winds.

The local meteorology indicates that sensitive receptors to the west of the operating pits have the highest potential to be impacted from dust from mining activities.

9.3.4 Meteorology for Dispersion Modelling

Dispersion modelling requires hourly breakdown of wind speed and direction, and other meteorological parameters.

A one year (2011) meteorological dataset for wind speed and wind direction, air temperature, relative humidity, mixing height and other micro-meteorological variable has been prepared for the study area using the CALMET meteorological model. The dataset from 2011 was selected as it had the highest percentage of calm winds which can lead to poorer atmospheric dispersion. This approach is considered to be more conservative. The methodology for the meteorological modelling provided in **Appendix G.6.1**. The following outputs from the CALMET derived meteorological dataset for the revised Project site are presented below:

- wind speed and wind direction;
- mixing height; and
- stability class.

Wind speed and direction

The seasonal wind roses from the TAPM-CALMET derived meteorological data for the revised Project site for 2011 are provided in **Figure 9-3**.

The wind roses presented in Figure 9-3 indicate that:

- the dominant winds are from the east, northeast and southeast;
- summer and autumn are representative of the yearly winds;
- winter has the highest percentage of calm conditions (5%); and
- the winter months have a significant proportion (15%) of westerly winds.

These findings are similar to the long term data measured at the Oakey BoM station, indicating that the simulated meteorology for air dispersion modelling is consistent with observations.

Figure 9-2 Annual and seasonal windroses for the Oakey BoM station, 2002-2013

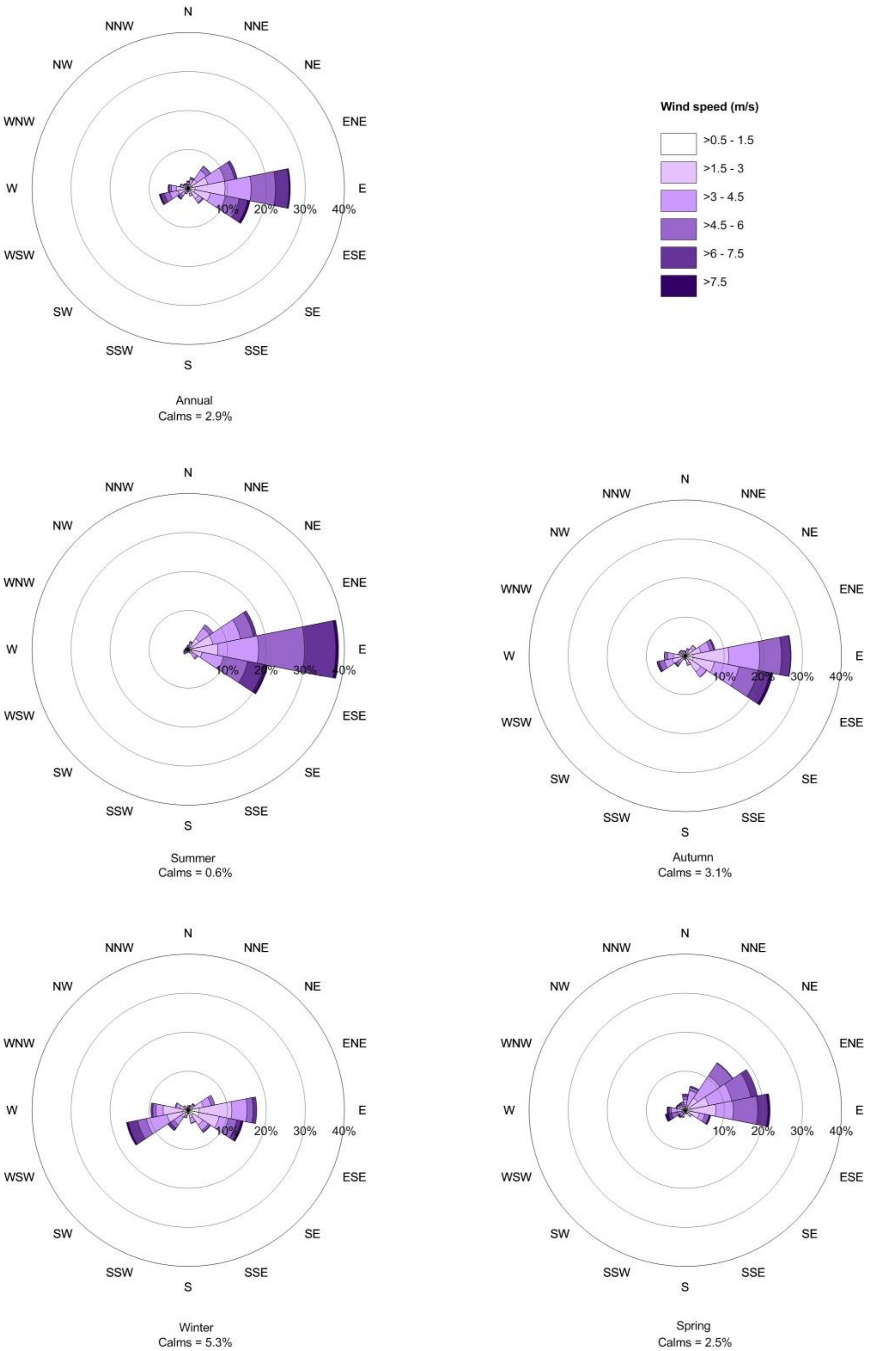


Figure 9-3 Annual and season windroses for the CALMET derived data

Mixing height

Mixing height is the depth of the atmospheric surface layer beneath an elevated temperature inversion. Vertical diffusion or mixing of a plume is generally limited by the mixing height, as the air above this layer tends to be stable, with restricted vertical motion.

The diurnal variation of mixing height is summarised in **Figure 9-4**. On average, mixing heights are lower during the night and early morning hours (<500 m), increasing after sunrise to a maximum of 2700 m by mid-afternoon and generally decreasing sharply with sunset. This pattern of a diurnal cycle is consistent with the inland location of the revised Project.

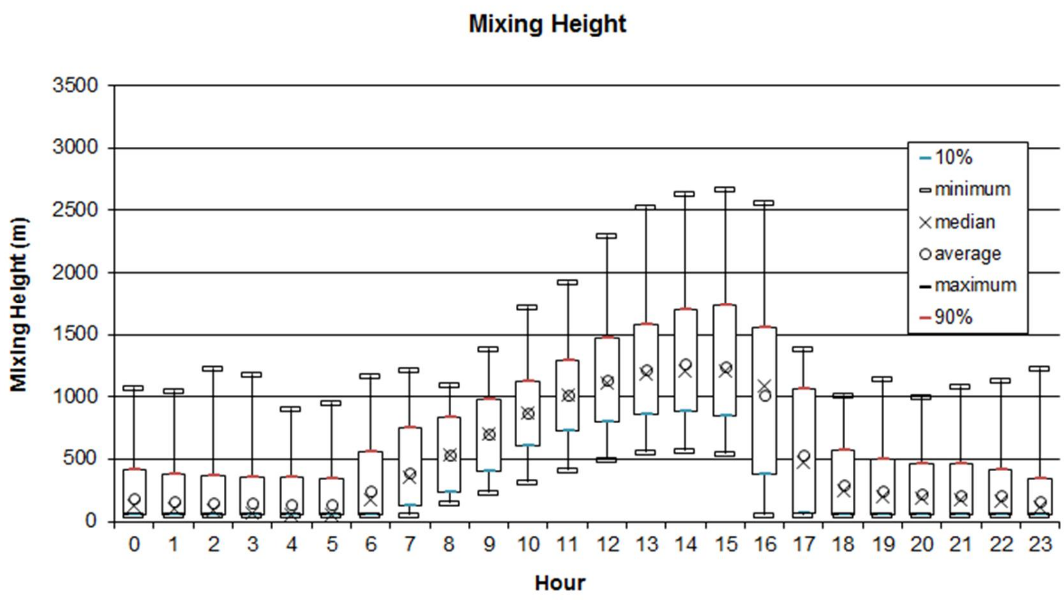


Figure 9-4 Diurnal variation in mixing height for the CALMET derived data

The diurnal mixing heights for each season have also been presented in **Figure 9-5**. During the cooler months of autumn and winter the mixing heights are shown to be lower in height demonstrating the potential for the formation of inversion layers, which can lead to poor atmospheric dispersion conditions.

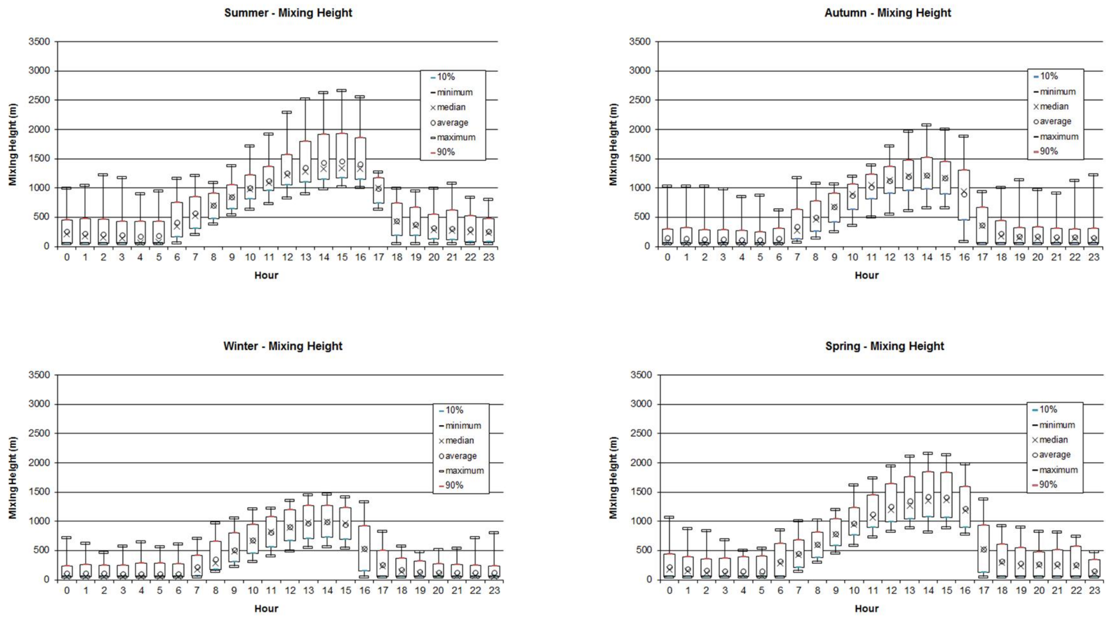


Figure 9-5 Seasonal diurnal variation in mixing height for the CALMET derived data

Stability Class

The Pasquill-Gifford stability classification scheme denotes stability classes from A to F. Class A is described as highly unstable and occurs in association with strong surface heating and light winds, leading to intense convective turbulence and much enhanced plume dilution. At the other extreme, class F denotes very stable conditions associated with strong temperature inversions and light winds, which commonly occur under clear skies at night and in the early morning. Intermediate stability classes grade from moderately unstable (B), through neutral (D) to slightly stable (E). Whilst classes A and F are strongly associated with clear skies, class D is linked to windy and/or cloudy weather, and short periods around sunset and sunrise when surface heating or cooling is small.

As a general rule, unstable (or convective) conditions dominate during the daytime and stable flows are dominant at night. This diurnal pattern is most pronounced when there is relatively little cloud cover and light to moderate winds.

Figure 9-6 shows the stability class percentages from the CALMET derived meteorological data for the revised Project. Neutral to stable atmospheric conditions associated with light to moderate winds are shown by the high percentage of D (21%) and F classes (32%).

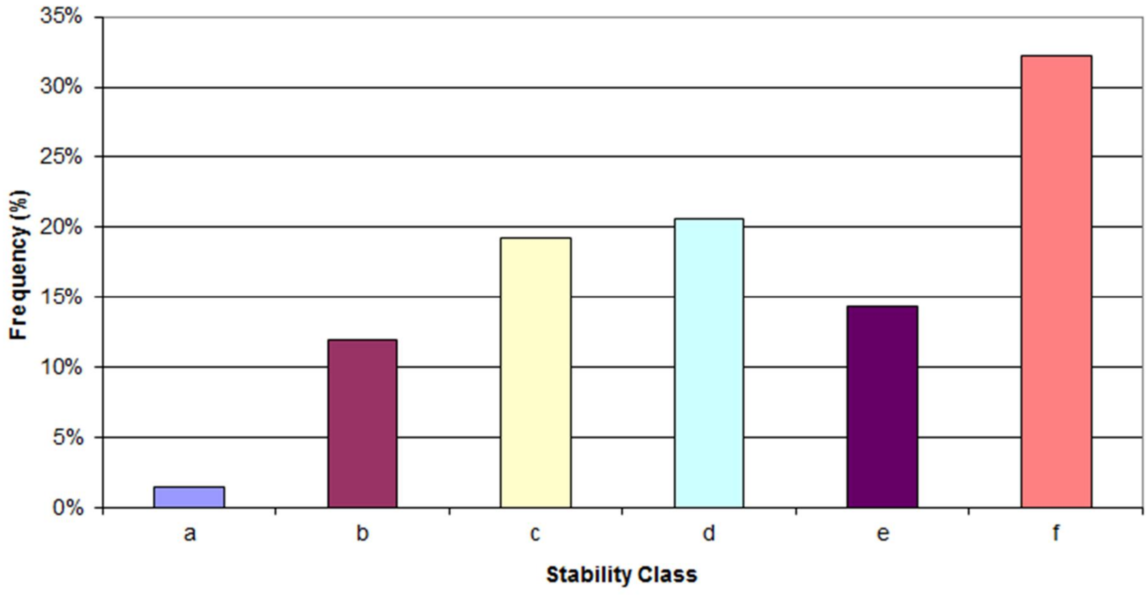


Figure 9-6 Stability class percentages for the CALMET derived data

The stability class percentages for each season have also been presented in **Figure 9-7.** During autumn and winter there is a higher percentage of F class stability (38% and 44% respectively) that is characterised by stable conditions associated with strong temperature inversions and light winds.

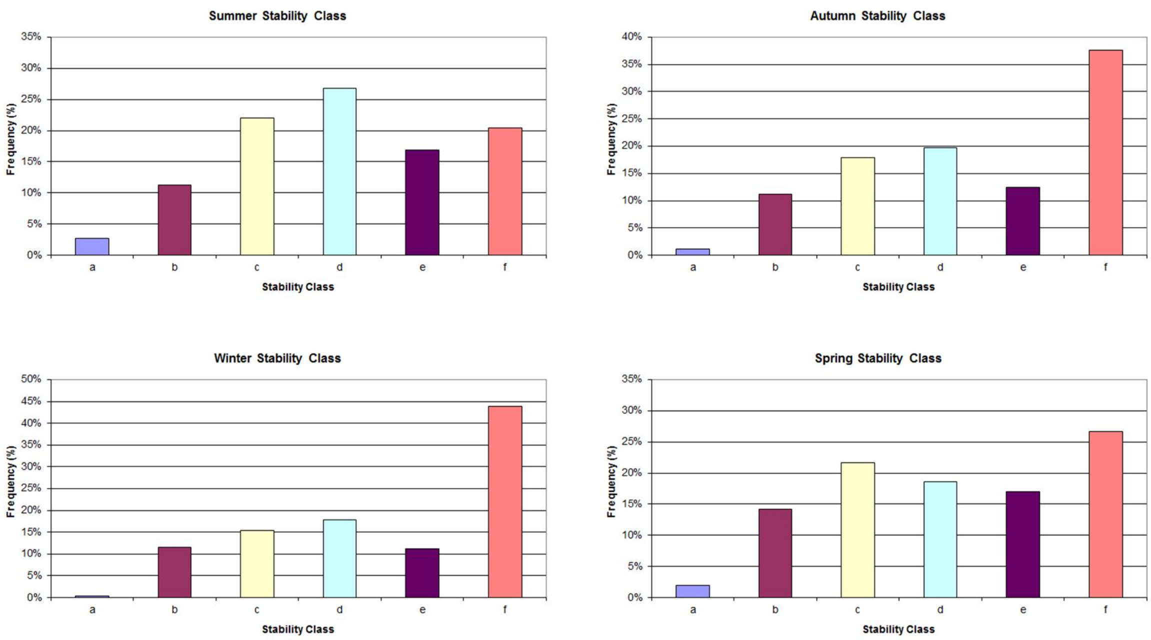


Figure 9-7 Seasonal stability class percentages for the CALMET derived data

9.3.5 Existing Air Quality

Existing air quality in the revised Project area is potentially influenced by local sources including:

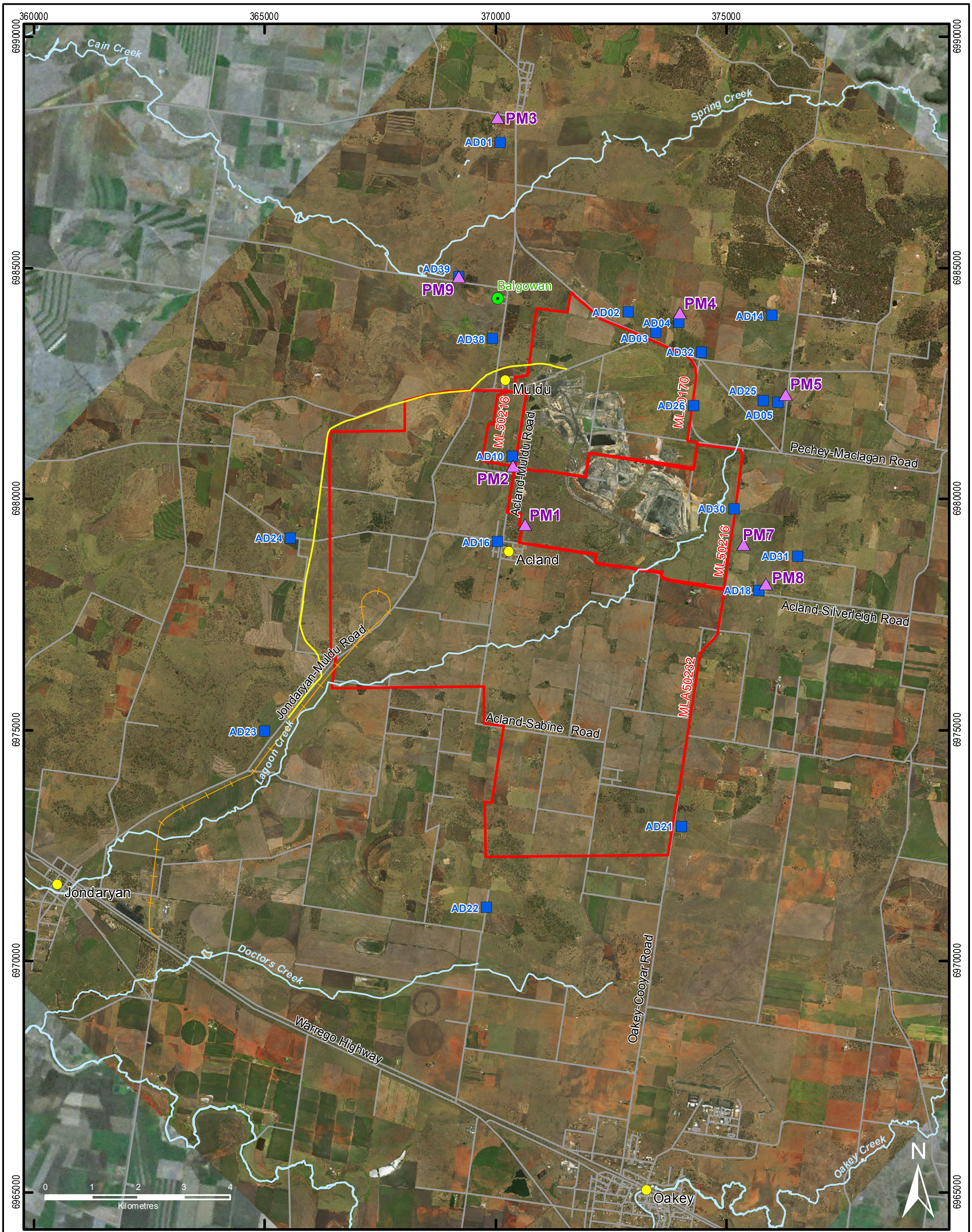
- mining activity from operations at the Mine;
- agricultural activity or dust from cultivation and harvesting;
- motor vehicle emissions from nearby roads;
- occasional bushfires and control burns; and
- windblown dust from dry inland areas.

Particulate monitoring

NAC has collected air quality data at various sensitive receptors around the Mine on a campaign measurement basis for approximately 11 years. The monitoring program consists of:

- quarterly monitoring of PM_{10} at various locations around the Mine since 2003 until the present;
- monthly dust deposition sampling at locations around the Mine; and
- simultaneous sampling of TSP, PM_{10} and $PM_{2.5}$ at Balgowan with compositional analysis to determine coal content.

The locations of the air quality monitoring program undertaken at the Mine are presented in **Figure 9-8**.



LEGEND

- Towns and Localities
- Quarterly PM_{10} Monitoring Locations
- TSP, TM_{10} + $PM_{2.5}$ Monitoring Campaign
- Dust Deposition guages
- Rail Spur
- Roads
- Jondaryan-Muldu Road Diversion
- Creeks
- Mining Tenements

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Figure 9-8 - Air Quality Monitoring Locations for the Mine

Scale 1:110,000 on A4

Projection: Australian Geodetic Datum – Zone 56 (AGD84)

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Produced: 22/11/2013

All 24 hour PM_{10} concentrations presented in **Figure 9-9** and **Table 9-3** were recorded between March 2003 and September 2012 are below the air quality goal of 50 µg/m^3 specified in the EPP (Air).

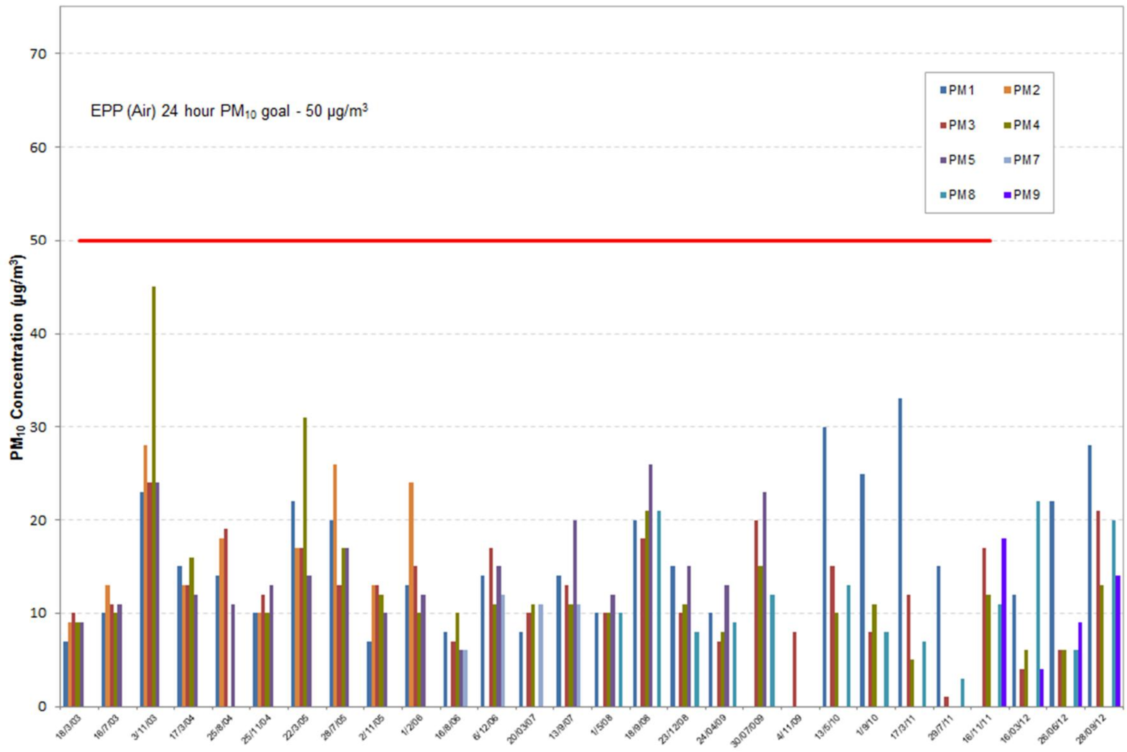


Figure 9-9 PM_{10} concentrations recorded at sensitive receptors around the Mine

Table 9-3 PM_{10} concentrations (24 hour average) recorded around the Mine from 2003 to 2012

Date	PM 1	PM 2	PM 3	PM 4	PM 5	PM 7	PM 8	PM 9
18/03/2003	7	9	10	9	9	-	-	-
16/07/2003	10	13	11	10	11	-	-	-
3/11/2003	23	28	24	45	24	-	-	-
17/03/2004	15	13	13	16	12	-	-	-
25/08/2004	14	18	19	-	11	-	-	-
25/11/2004	10	10	12	10	13	-	-	-
22/03/2005	22	17	17	31	14[1]	-	-	-
28/07/2005	20	26	13	17	17	-	-	-
2/11/2005	7	13	13	12	10	-	-	-
1/02/2006	13	24	15	10	12	-	-	-
16/08/2006	8	-	7	10	6	6	-	-
6/12/2006	14[2]	-	17	11[3]	15	12	-	-
20/03/2007	8	-	10	11[4]	-	11	-	-

Date	PM 1	PM 2	PM 3	PM 4	PM 5	PM 7	PM 8	PM 9
13/09/2007	14	-	13	11[5]	20	11	-	-
1/05/2008	10	-	10	10[5]	12	-	10	-
18/09/2008	20	-	18	21[5]	26	-	21	-
22/12/2008	15	-	10	11[5]	15	-	8	-
23/04/2009	10	-	-	8[5]	13	-	-	9
29/07/2009	-[6]	-	20	15[5]	23	-	12	-
13/05/2010	30[7]	-	15	10	-	-	13	-
1/09/2010	25[7]	-	8	11	-	-	8	-
17/03/2011	33[7]	-	12	5	-	-	7	-
29/07/2011	15[7]	-	1	-	-	-	3	-
16/11/2011	-	-	17	12	-	-	11	18
16/03/2012	12[8]	-	4	6	-	-	22[7]	4
26/06/2012	22[7]	-	6	6	-	-	6	9
28/09/2012	28[7]	-	21	13[9]	-	-	20	14
Minimum	7	9	1	5	6	6	3	4
Average	17	17	13	14	14	10	12	11
70^{th} percentile	21	20	15	12	15	11	15	14
Maximum	33	28	24	45	26	12	22	18

- No sampling undertaken

1 Sampling was for 12 instead of 24 hours

2 Calibration check could be performed at end of sampling run

3 Sample was run for 21.7 hours due to power problems

4 Sample was run for 19.5 hours due to power failure

5 Partisol low-volume sampler used

6 Power has been disconnected

7 Microvol low-volume sampler used in accordance with AS/NZS 3580.9.9:2006 as no mains power available

8 Sample was run for 12.6 hours only

9 Series 2000 high volume sampler was used.

In addition to the routine PM_{10} monitoring, NAC also conducted a 3 month monitoring program simultaneously measuring TSP, PM_{10} and $PM_{2.5}$ at Balgowan located approximately 2 km northwest of the Mine (Simtars, 2012; Simtars, 2013). The results of the monitoring program are presented in **Table 9-4**.

Table 9-4 TSP, PM_{10} and $PM_{2.5}$ concentrations (24 hour average) recorded at Balgowan

Sample Date	Concentration (µg/m^3)		
	TSP	PM_{10}	$PM_{2.5}$
10 December 2011*	5	6	4
16 December 2011*	12	13	6
20 December 2011*	14	14	6
24 December 2011	14	11	4
4 January 2012*	14	14	6
7 January 2012*	11	13	9
11 January 2012	25	14	5
19 January 2012*	8	8	5
22 January 2012	12	10	4
3 February 2012*	8	10	5
8 February 2012	10	11	5
10 February 2012*	17	16	5
14 February 2012*	9	10	5
16 February 2012	11	10	3
29 February 2012*	16	15	5
3 March 2012*	16	13	6
7 March 2012*	10	9	3
10 March 2012	14	10	4
13 March 2012*	14	13	4
18 March 2012*	8	8	3
20 March 2012	6	7	2
27 March 2012*	7	7	3
30 March 2012	11	9	2
3 April 2012	17	12	4
12 April 2012	14	9	2
14 April 2012*	6	7	2
20 April 2012*	8	10	4
Average	12	11	4
70th percentile	14	13	5
Maximum	25	16	9

* Note: the archived filters have been in storage in excess of 1 year. The filter weights may drift with time and consequently accuracy of the measurements may be degraded. This is particularly notable for PVC filters, which were used for total suspended particulate (Simtars, 2013).

The air quality data presented in **Table 9-4** indicates that all 24 hour average data for TSP, PM_{10} and $PM_{2.5}$ are below the air quality objectives described in **Table 9-1.**

Ten TSP samples were chosen by the measurement contractor from the 27 recorded (**Table 9-4**) and examined for particle identification by an external laboratory. The ten samples were selected as being typical for analysis with 5 considered upwind and 5 downwind of the mine (Simtars, 2012). Stereomicroscopy was used to check for particle distribution and general appearance. Portions of the filters were then excised for scanning electron microscope (SEM) mounting and examination. Generally the filters were sparsely covered with mineral-based dust (80–100% on an area basis) with traces of plant and insect materials. A single coal particle was identified in one filter (24–25 December 2011) (Simtars, 2012). The monitoring results at Balgowan comply with the air quality objectives in the EPP (Air) and indicate this location experiences minor impacts from coal dust.

Dust deposition sampling has also been conducted in the area surrounding the Mine. The results from 2009 until 2011 are presented in **Table 9-5**. The average dust deposition rate at most monitoring locations are below the dust nuisance goal recommended by the DEHP. Most monitoring locations exceed the DEHP nuisance goal on occasion. Three of the dust deposition gauges (AD22, AD23 and AD24) located between 8 and 10 km from existing mining operations consistently recorded dust deposition rates above the DEHP dust nuisance goal. Dust deposition at these sites is considered to be influenced by localised agricultural activities. Dust deposition monitoring results are highly variable with the potential to be influenced by:

- environmental factors – wind-blown dust and dust storms can generate significant quantities of dust which increase the recorded dust deposition results;
- biological influences – birds, insects and frogs can be attracted to the deposition gauges (particularly if rainwater is captured in the deposition gauges);
- human activity – agricultural activity, mining activity and vehicle movements near a dust deposition gauge will increase the recorded dust deposition levels; and
- sampling errors – dust deposition gauge can be contaminated or knocked over.

The background dust deposition rate has been for the study area is based on the average 70^{th} percentile dust deposition rates recorded near the Mine from 2009 to 2011 excluding sites that appear to be significantly affected by localised dust sources (such as cropping, bare paddocks or unsealed roads). Deposition gauges AD14, AD23, AD24 and AD26 were considered to be significantly affected by localised particulate sources and were excluded from statistical analysis.

Table 9-5 Dust Deposition Results ($mg/m^2/day$) near the Mine from 2009 to 2011

Location	Proximity to particulate sources	Maximum	70th percentile	Average
AD01	5.5 km north northwest of mine	265	90	72
AD02	1.5 km north of mine	522	75	83
AD03	1.5 km north of mine	40	21	21
AD04	1.5 km north of mine	66	42	31
AD05	2.5 km east of the mine	69	64	55
AD10	1 km west of the mine	220	86	84
AD14 #	4 km northeast of the mine	1,257	336	339
AD16	2 km southwest of the mine	246	76	61
AD18	2 km southeast of the mine	54	24	16
AD21	6 km south of the mine	334	100	72
AD22	9 km south of the mine cropping in nearby paddocks	486	122	121
AD23 #	8 km southwest of the mine, cropping in nearby paddocks	1,558	436	437
AD24 #	10 km south of mine, cropping in nearby paddocks	2,727	318	375
AD25	2.5 km east of the mine	43	37	32
AD26 #	1.5 km northeast of the mine	619	170	173
AD30	1 km east of the mine	153	56	49
AD31	2 km east southeast of the mine	180	50	46
AD32	2 km northeast of the mine	53	44	39
AD38	2 km northwest of the mine	-	-	55
AD39	3 km northwest of the mine	-	-	68
Average		223	63	57

Dust deposition data has been excluded from statistical analysis as these sites are considered to be significantly affected by localised particulate sources

Air quality at Toowoomba

Ambient air quality monitoring data recorded by DEHP at Toowoomba (NO_2 and CO) and Flinders View (SO_2 only) from 2003 to 2007 has been reviewed to provide an indication of the likely existing levels of air quality within the region. A summary of the data is presented in **Table 9-6**.

Table 9-6 Air quality data at Toowoomba (NO_2 and CO) and Flinders View (SO_2)

Pollutant	Averaging period	Air quality objective ($\mu g/m^3$)	Max	70^{th} Percentile	Average
Nitrogen dioxide (NO_2)	1 hour	250	104	11.5	-
	1 year	62	14 (2004)	-	12
Carbon Monoxide (CO)	8 hours	11,000	2,982	167	210
Sulphur dioxide (SO_2)	1 hour	570	119	2.9	-
	24 hours	230	19	3.6	3.1
	1 year	57	4 (2006)	-	3.1

Due to the rural nature of the land surrounding the revised Project, background air quality data is generally expected to be good. Typically, concentrations of all pollutants are expected to be lower at the Project than recorded at Toowoomba and Flinders View.

Adopted background air quality

In order to provide a thorough assessment of cumulative impacts, background pollutant data from the monitoring programs outlined above are included in the modelling (where available). A 70^{th} percentile pollutant concentration is accepted as an estimate of the 24 hour average background data to determine cumulative impacts (EPA Victoria, 2007). The adopted background concentrations are presented below in **Table 9-7**.

Table 9-7 Adopted background concentrations for the revised Project

Pollutant	Averaging period	Background concentration	Units
Total Suspended Particulates (TSP)	Annual	28	$\mu g/m^3$
Particulates as PM_{10}	24 hours	14	$\mu g/m^3$
Particulates as $PM_{2.5}$	24 hours	5	$\mu g/m^3$
	Annual	2.8	$\mu g/m^3$
Dust deposition	1 month	63	$mg/m^2/day$

9.4 Impact Assessment

The potential air quality impacts associated with the revised Project have been assessed by:

- identifying potential sources of air emissions from the revised Project and assessing the potential for these air emissions sources to have an impact at sensitive receptors (**Section 9.3.1**);
- preparing an air emissions inventory for key air emissions sources from the revised Project (**Section 9.4.2**);
- undertaking dispersion modelling on sources considered to have the potential to exceed the ambient air quality objectives (**Section 9.4.4**);
- comparison of predicted concentrations and cumulative impacts with ambient air quality objectives; and
- recommending appropriate mitigation measures for the revised Project to achieve compliance with the ambient air quality goals (**Section 9.5**).

9.4.1 Sources of air emissions and potential for impact

This section identifies potential sources of air emissions from the revised Project during construction, operation and closure.

Dust from mining

An overview of the mining process is presented through a process flow diagram in **Figure 9-10**. During operations, the main emissions to air are particulate matter generated by the onsite mining activities which primarily occur as a result of the following activities:

- excavation of coal and overburden;
- bulldozer and grader operations;
- loading/unloading of haul trucks;
- wheel generated dust from haul trucks and other vehicles;
- drilling and blasting activities;
- wind erosion from disturbed areas and stockpiles;
- operation of the conveyors/ transfer points at Coal Handling and Preparation Plan (CHPP);
- stacking and reclaiming at the Material Handling Facility (MHF); and
- operation of the Train Loadout Facility (TLF).

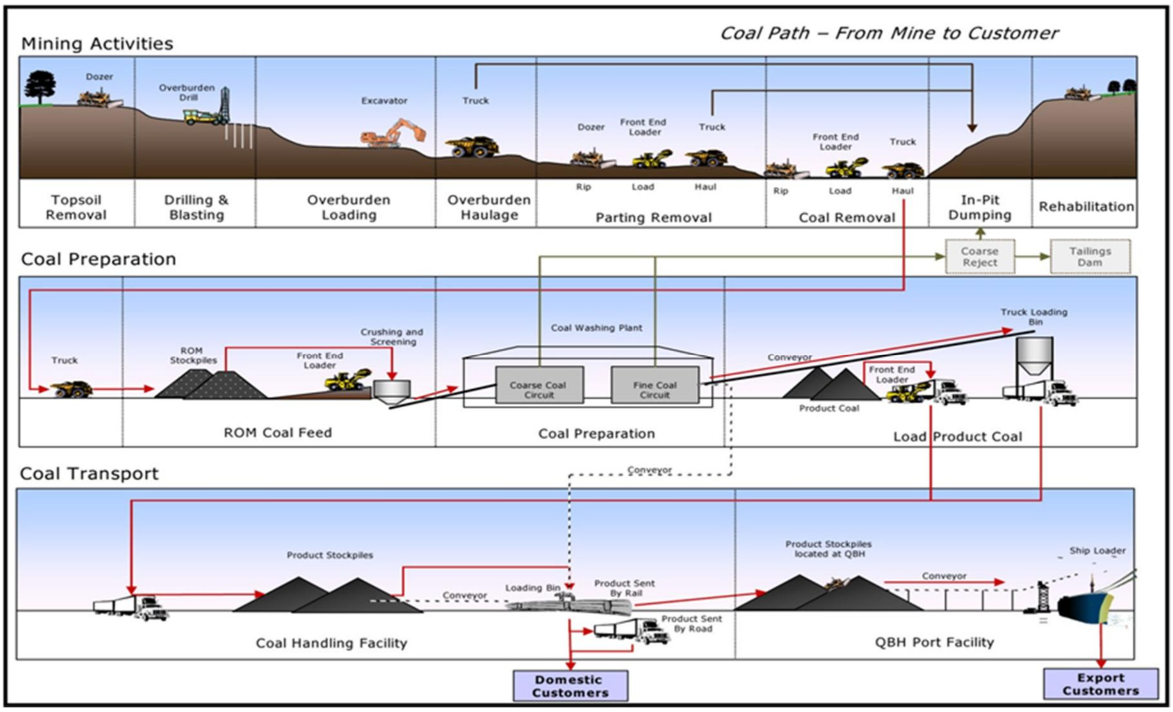


Figure 9-10 Process flow diagram for mining operations at the revised Project

Dust from coal transportation

Product coal will be transported from the CHPP precinct to the TLF via an internal sealed haul road. The existing Jondaryan – Muldu Road that traverses to the east of the Manning Vale West resource area will be closed to the public. Wheel generated dust from sealed roads is considered to be negligible and has not been modelled as part of this air quality assessment.

Dust from mine and mine infrastructure construction

The main construction requirements for the revised Project include construction of:

- supporting infrastructure comprising the upgrade of the existing CHPP precinct, the MHF, the TLF and upgrade of the Mine Industrial Area (MIA);
- water infrastructure (e.g. water dams, environmental dams); and
- the Jondaryan-Muldu Road realignment.

The potential sources of dust emissions include:

- wind erosion from exposed areas after vegetation clearing;
- dust from earthmoving equipment including bulldozers and excavators;
- vehicle emissions from mobile plant (forklifts, cranes);
- topsoil disturbance and removal; and
- wheel generated dust from vehicle movement delivery.

Construction is expected to take place over an 18 to 24 month period with activities expected to be 12 hours per day. While dust emissions can have impacts on local air quality they are of short duration and are typically not modelled. Given the distance from construction activities to sensitive receptors it is unlikely the air quality objectives for the revised Project will be exceeded during construction. Implementation of mitigation measures described in **Section 9.5** will assist in reducing the potential for air quality impacts.

Dust from rail spur and balloon loop construction

The potential sources of dust emissions include:

- wind erosion from exposed areas after vegetation clearing;
- dust from earthmoving equipment including bulldozers and excavators;
- vehicle emissions from mobile plant (cranes and earthmoving equipment);
- levelling and grading of disturbed soil;
- vehicle movement in the worksite and material laydown area; and
- topsoil removal and placement

Construction and commissioning is expected to take place over a two year period, with 15 months to construct the earthworks, a further 4 months to construct the track and 5 months to construct the TLF.

The dominant sources of dust emissions during the construction of the rail spur and balloon loop will be activities that cause large mechanical disturbances and various phases of the track laying process. The potential for air quality impact is greatest at receptors located closest to the rail spur and balloon loop. While dust emissions can have impacts on local air quality they are of short duration and the separation distance to the sensitive receptors is considered sufficient. It is unlikely the air quality objectives for the revised Project will be exceeded and mitigation measures described in **Section 9.5** will assist in reducing the potential for nuisance air quality impacts.

Dust from decommissioning mining areas and infrastructure

During decommissioning of mining areas and infrastructure for the revised Project, potential emissions to air include products of fuel combustion from vehicles and equipment and dust emissions from decommissioning activities. The potential sources of dust emissions include:

- wind erosion from exposed areas awaiting rehabilitation; and
- dust from earthmoving equipment undertaking rehabilitation activities.

Given the significant reduction in mobile equipment and coal preparation and processing activity and distances to sensitive receptors, the potential for air quality impacts during decommissioning is considered to be low. Progressive rehabilitation activities over the life of the revised Project will ensure that exposed areas are kept to an operational minimum. It is very unlikely the air quality objectives for the revised Project will be exceeded during decommissioning. Implementation of mitigation measures described in **Section 9.5** will assist in reducing the potential for air quality impacts.

Dust from decommissioning the JRLF

During decommissioning of the JRLF, potential emissions to air include products of fuel combustion from vehicles and equipment and dust emissions from decommissioning activities. The potential sources of dust emissions include:

- wind erosion from exposed areas awaiting rehabilitation;
- removal of the coal stockpiles and transport of the coal to the TLF;
- removal of concrete slabs and building materials from the workshops, sheds and crib huts;
- removal and surface ripping of the tracks, dirt roads and car parks;
- the shaping and spreading of the earthen bunds and topsoil for on-site rehabilitation purposes; and
- dust from earthmoving equipment undertaking rehabilitation activities.

The decommissioning of the JRLF has the potential to have impacts on local air quality. However the dust emissions are of short duration and are typically not modelled. It is unlikely the air quality objectives and nuisance dust guidelines in the EPP (Air) will be exceeded during decommissioning. Implementation of mitigation measures described in **Section 9.5** will assist in reducing the potential for air quality impacts. The on-site TEOM will remain (refer to **Figure 3-30**) and be used to monitor potential air quality impacts during decommissioning and post decommissioning.

Exhaust emissions from mining equipment and transportation

During construction, operation and decommissioning, mining/construction equipment, trucks, light vehicles and diesel locomotives will emit exhaust emissions. Air emissions from mining/construction equipment are primarily associated with the products of combustion of diesel and unleaded fuel. The operation of equipment during construction and operation will also generate gaseous and particulate combustion products (as PM_{10} and $PM_{2.5}$), nitrogen oxides, sulphur oxides and volatile organic compounds.

An emissions inventory for $PM_{2.5}$, CO, NO_2 and SO_2 from mining equipment and vehicles during the operation of the revised Project is presented in **Section 9.4.2 (Vehicle Emissions)**. An emissions inventory for $PM_{2.5}$, CO, NO_2 and SO_2 from locomotives on the rail spur and balloon loop is presented in **Section 9.4.2 (Locomotive Emissions)**. The quantities of exhaust emissions are relatively low and are not expected to not to exceed the ambient air quality goals. This conclusion is supported by roadside monitoring in Queensland (EPA, 2001). These emissions have not been modelled as part of this assessment.

The combustion process also generates small quantities of air pollutants referred to as air toxics. Air toxics included formaldehyde, toluene, xylene and polycyclic aromatic hydrocarbons (PAHs). Motor vehicles are one of the main sources of emissions of air toxics. DEHP measurements of concentrations of air toxics in South East Queensland indicate that levels are well below ambient air quality objectives in the EPP(Air). The quantities of these emissions from the operation of mining equipment, vehicles and locomotives will be much lower than in an urban area such as South East Queensland. The emissions of air toxics are not expected to exceed the ambient air quality goals in the EPP(Air) due to small quantities of emissions and distance from operations to the sensitive receptors.

NOx from Blasting

The blasting of overburden with ANFO (ammonium nitrate/fuel oil) results in the rapid release of particulate matter and gaseous emissions. The dust emissions as a result from blasting have been included in the dispersion modelling represented as a conservative daily one hour blast. The gaseous emissions have not been modelled however a qualitative discussion is presented.

Attalla et.al (2007) noted that under ideal conditions the only gaseous products from a typical ANFO mixture is carbon dioxide (CO_2), water (H_20) and nitrogen (N_2) as shown in the following reaction;

$$3NH_4NO_3 + CH_2 \rightarrow 3N_2 + CO_2 + 7\ H_2O$$

However under non ideal conditions the blast can lead to the formation of carbon monoxide (CO) and nitric oxide (NO) with further oxidation to NO_2.

Quantitative measurements of NO_2 at two mines in the Hunter Valley, NSW were made by Attalla *et al*. (2007). The report found that:

- the highest ground level concentration of NO_2 was approximately 17 ppm;
- the maximum predicted NO_2 concentrations occurred at approximately 8 minutes after the blast; and
- ambient monitoring did not detect NOx events that could be attributed to individual blasts.

The blast emissions in each of the three mining scenarios in the revised Project are expected to be similar to those presented in the Hunter Valley study. The highest instantaneous measured concentration of NO_2 was 17 ppm however the plume is expected to dissipate quickly (10 minutes after blast) and the 1 hour average ambient concentration is not predicted to exceed air quality objective in the EPP (Air). Given the plume dissipates quickly and blasting is only undertaken once per week, the annual NO_2 concentrations from blasting will be well below the annual objective in the EPP (Air).

Fume management procedures are detailed in **Section 9.5.2**.

9.4.2 Air Emissions Inventory

Particulates from Mining Operations

The three mine operating scenarios assessed for the revised Project are the years 2019, 2023 and 2029. These operating scenarios were considered to be representative of potential air quality impacts over the life of the revised Project from 2017 to 2029. The mining rates for these three scenarios are presented in **Table 9-8**.

Table 9-8 Mine information and activity data for the three mining scenarios

Parameter		2019	2023	2029
Overburden removal Total (x 1000 bcm)	Manning Vale East Pit	11,809	11,653	11,324
	Willeroo Pit	12,329	16,170	14,240
	Manning Vale West Pit	14,906	17,556	19,400
	TOTAL	41,063	47,402	46,993
Production rates ROM coal rate (kt)	Manning Vale East Pit	4,086	4,351	4,786
	Willeroo Pit	4,849	4,820	4,820
	Manning Vale West Pit	4,808	4,820	4,820
Coal production rate	Total for all pits (Mt)	7.5	7.5	7.5
Blasting overburden	Area	25,000	25,000	25,000
	Frequency	1 per week	1 per week	1 per week
Return haul distance – Coal from pit to CHPP (km)	Manning Vale East Pit	7 km	8.5 km	9.5 km
	Willeroo Pit	8.5 km	9.5 km	13 km
	Manning Vale West Pit	5.5 km	8.5 km	10.5 km
Estimate of diesel used (kL)	Excavator/shovels	7,731	8,509	6,875
	Haul trucks	20,856	22,955	18,548
	Track dozer	10,792	11,878	9,597
	Graders	1,201	1,322	1,068
	Wheeled loader	3,960	4,359	3,522
	Wheeled dozer	1,699	1,870	1,511

Emission rates for the sources outlined in **Section 9.4.1(Dust from mining)** were derived from industry-standard emission factors that have been collated by the National Pollutant Inventory (NPI) and United States Environmental Protection Agency (USEPA) AP-42 emissions estimation methodology. These factors are based on measurements of dust emissions from other operational coal mines in Australia and the United States.

The uncontrolled emission factors and estimation equations, where applicable, used in the assessment are summarised in **Table 9-9**. **Appendix G.6.2** provides the derivation of the uncontrolled emission rates in **Table 9-9** including any site specific parameters where applicable. The adopted techniques to minimise dust emissions are presented in **Table 9-9** and are consistent with typical air quality management practices in the mining industry. The dust emissions inventory from mining operations for the revised Project has been developed based on the controlled emission factors in **Table 9-9**.

Table 9-9 Uncontrolled and controlled emission factors used in the assessment

Mining Activity	Source and units	Units	Uncontrolled Emission factor		Control factor applied (%)	Controlled Emission factor	
			TSP	PM_{10}		TSP	PM_{10}
Pre-stripping	Dozer on topsoil	kg/h	16.7	4.1	NA	16.7	4.1
Overburden removal	Dozer on overburden	kg/h	16.7	4.1	NA	16.7	4.1
	Drilling	kg/hole	0.59	0.31	70% for water sprays	0.18	0.09
	Blasting overburden	kg/blast	870	452	NA	870	452
	Blasting interburden	kg/blast	220	114	NA	220	114
	Excavators on overburden	kg/t	0.0021	0.0010	NA	0.0021	0.0010
	Trucks dumping overburden	kg/t	0.012	0.0043	25% for controlled drop	0.009	0.003
	Wind erosion	kg/ha/hr	0.4	0.2	NA	0.4	0.2
Coal handling	Dozer on coal	kg/hr	21.9	7.0	NA	21.9	7.0
	Excavators on coal	kg/hr	0.052	0.007	NA	0.052	0.007
	Wind erosion	kg/ha/hr	0.4	0.2	NA	0.4	0.2
Haul roads	In-pit hauling	kg/VKT	4.42	1.31	85% for level 2 watering and reduced speed	0.66	0.19
	Hauling coal to CHPP	kg/VKT	4.42	1.31	75% for level 2 watering	1.1	0.33
	Grader	km/VKT	1.08	0.34	50% for level 1 water	0.54	0.17
ROM and CHPP	Loading ROM bins	kg/t	0.010	0.0042	70% for water sprays	0.003	0.0013
	Dozer on ROM pad	kg/hr	20	6.38	NA	20	6.38
	conveyor transfer points	kg/t	0.0003	0.00015	NA	0.0003	0.00015
MHF	Stacker / reclaimer	kg/t	0.0003	0.00015	kg/t	0.0003	0.00015
	Dozer on product coal	kg/hr	14.6	4.7	NA	14.6	4.7

Mining Activity	Source and units	Units	Uncontrolled Emission factor		Control factor applied (%)	Controlled Emission factor	
			TSP	PM_{10}		TSP	PM_{10}
	Truck loading	kg/t	0.0004	0.00017	NA	0.0004	0.00017
	Wind erosion	kg/ha/hr	0.4	0.2	NA	0.4	0.2
TLF	Side tipper	kg/t	0.0004	0.00017	70% enclosure	0.00012	0.000051
	Loading coal to trains	kg/t	0.0004	0.00017	70% enclosure	0.00012	0.000051

The estimated emission rates (kg/year) for TSP, PM_{10} and $PM_{2.5}$ (dust component) for the three mine operating scenarios are presented in **Table 9-10.** The following assumptions have been used to prepare the emissions inventory of particulates from mining operations.

- Emission rates for $PM_{2.5}$ are estimated to be 10% of the PM_{10} emissions based on particulate size distributions recorded around mining operations (Smith, 2004; Air Noise Environment, 1999).
- Application of a pit retention factor to dust sources operating in the pit due to proportion of particulate emissions remaining in the pit as a result of gravitational settling. The escape fractions for TSP and PM_{10} are 61% and 93% respectively.

Table 9-10 Summary of controlled emission rates modelled – Year 2019, 2023 and 2029

Source type	2019 (kg/yr)			2023 (kg/yr)			2029 kg/yr)		
	TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$	TSP	PM_{10}	$PM_{2.5}$
Striping topsoil	197,912	48,181	4,818	197,912	48,181	4,818	197,912	48,181	4,818
Excavator/truck loading	120,284	86,735	8,674	139,800	100,809	10,081	138,710	80,539	8,054
Dozer on overburden	798,245	245,723	24,572	878,729	275,595	27,559	798,499	245,857	24,586
Trucks dumping OB	503,726	275,191	27,519	585,457	319,842	31,984	580,893	317,531	31,753
Drilling	9,452	4,966	497	9,452	4,966	497	9,452	4,966	497
Blasting	169,982	88,390	8,839	169,982	88,390	8,839	169,982	88,390	8,839
Excavating coal	400,988	87,921	8,792	429,771	93,016	9,302	432,721	94,281	9,428
Dozer on coal	288,695	140,306	14,031	306,895	149,151	14,915	298,127	144,958	14,496
Trucks dumping coal	83,832	53,680	5,368	85,345	54,649	5,465	88,091	43,522	4,352
In pit hauling	365,344	113,146	11,315	412,849	127,649	12,765	412,862	93,515	9,352
Hauling ROM coal to CHPP	285,848	56,169	5,617	341,841	101,315	10,131	438,511	86,167	8,617
Road grading	58,866	18,615	1,862	58,866	18,615	1,862	58,866	18,615	1,862
Wind erosion	112,216	85,541	8,554	112,216	85,541	8,554	112,317	76,120	7,612
Stacker/reclaimer	9,731	4,603	460	9,731	4,603	460	9,731	4,603	460
TLF	900	3,773	377	900	383	38	900	383	38
ROM Pad	216,497	79,537	7,954	217,241	79,850	7,985	218,546	80,398	8,040
CHPP and MHF	84,279	40,360	4,036	84,279	32,249	3,225	77,972	29,095	2,910
TOTAL TSP	3,706,798			4,041,267			4,044,094		
TOTAL PM_{10}	1,432,838			1,584,803			1,457,121		
TOTAL $PM_{2.5}$	143,284			158,480			145,712		

Vehicle Emissions

Emission rates for the sources outlined in **Section 9.4.1 (Exhaust emissions from mining equipment and transportation)** were derived from industry-standard emission factors that have been collated by the National Pollutant Inventory (NPI) Emission Estimation manual for combustion engines (NPI, 2008). The emission rates are presented below in **Table 9-12** and are based on the uncontrolled emission factors in **Table 9-11** and the estimates of diesel usage in **Table 9-8**.

Table 9-11 Summary vehicle emission factors

Vehicle type	$PM_{2.5}$ (kg/kL)	NOx (kg/kL)	CO (kg/kL)	SO_2 (kg/kL)
Excavator/shovels	2.67	41.3	10.0	0.000025
Haul trucks	2.04	36.0	15.5	0.000024
Track dozer	2.82	34.7	9.5	0.000024
Graders	2.54	31.6	6.8	0.000024
Wheeled loader	3.28	38.9	12.0	0.000025
Wheeled dozer	1.67	36.0	15.5	0.000024

Table 9-12 Summary of vehicle emission for the three mining scenarios

Pollutant	2019 (kg/yr)	2023 (kg/yr)	2029 (kg/yr)
$PM_{2.5}$	112,520	123,843	100,065
NOx	1,688,135	1,867,004	1,508,533
CO	535,754	535,754	535,754
SO_2	1.1	1.1	1.1

Locomotive Emissions

Emission rates for the diesel powered locomotives were derived from industry accepted emission factors that have been described in Dieselnet (2008). The emission factors are presented below in **Table 9-13**.

Table 9-13 Locomotive emission factors

Vehicle type	Emission standard	$PM_{2.5}$ (g/bhp-h)	NOx (g/bhp-h)	CO (g/bhp-h)
Locomotives	Tier 2 (2005 – 2011) Line haul	0.10	5.5	1.5
	Tier 2 (2005 – 2011) Switching	0.13	8.1	2.4

An emissions inventory for $PM_{2.5}$, CO and NO_2 from the diesel powered locomotives for the revised Project has been calculated and presented in **Table 9-14**. The emission rates are a conservative estimate of the duration of line haulage, time spent idling at the TLF and an estimate of power output of the locomotives.

Table 9-14 Locomotive emission rates

Vehicle type	$PM_{2.5}$ (kg/yr)	NOx (kg/yr)	CO (kg/yr)
Locomotives	675	39,522	11,256

The quantities of exhaust emissions are relatively low and are not expected to exceed the ambient air quality goals. These emissions have not been modelled as part of this assessment.

9.4.3 Modelling Methodology

Dust concentrations due to mining activities were predicted using the air dispersion model known as CALPUFF (Version 6.42). CALPUFF is a Lagrangian dispersion model that simulates the dispersion of pollutants within a turbulent atmosphere by representing emissions as a series of puffs emitted sequentially. Provided the rate at which the puffs are emitted is sufficiently rapid, the puffs overlap and the serial release is representative of a continuous release.

The CALPUFF model differs from traditional Gaussian plume models in that it can model spatially varying wind and turbulence fields that are important in complex terrain, long-range transport and near calm conditions. It is the preferred model of the United States Environmental Protection Agency for the long-range transport of pollutants and for complex terrain (TRC, 2007). CALPUFF has the ability to model the effect of emissions entrained into the thermal internal boundary layer that forms over land, both through fumigation and plume trapping.

The dispersion modelling options include:

- emissions were volume sources with the source parameters in **Table 9-15**;
- 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;
- dust deposition rates were determined from the highest monthly average; and
- geometric mean diameter and geometric standard deviation for particle size fractions greater than 10 µm), between 2.5 µm and 10 µm and less than 2.5 µm is presented in **Table 9-16**.

Table 9-15 Volume source parameters

Source type	Height of release (m)	Vertical spread (m)	Horizontal spread (m)
Hauling coal/overburden	5	30	10
Dozer on coal/overburden	10	40	20
Trucks dumping coal/overburden	10	20	10
Grader	10	20	10
Drilling	10	20	10
Blasting	50	100	100
Loading	10	20	20
CHPP ROM bins	20	40	20
Conveying transfer points	20	20	10
Wind erosion	10	20	20

Table 9-16 Modelling parameters for different particle size fractions

Particle size	Mean particle diameter (µm)	Geometric standard deviation (µm)
>10 µm	17	2
2.5 µm - 10 µm	7	1
<2.5 µm	1	0

Wind dependency

Dust emissions for all sources have been considered to fit in one of three categories:

- wind insensitive sources, where emissions do not vary with wind speed (for example, trucks transporting overburden over unsealed roads);
- wind sensitive sources, where emissions vary with the hourly wind speed, raised to the power of 1.3 (for example, loading and unloading coal from trucks); and
- wind erosion sources, where emissions vary with the wind speed, raised to the power of 3 (for example, wind erosion from stockpiles, overburden dumps or active pits).

9.4.4 Modelling Results

Dispersion modelling results from CALPUFF are presented below for the following four scenarios.

- Year 2019 emissions (refer to **Table 9-9**) incorporating typical mining industry dust control measures (Section 9.4.4 Year 2019).
- Year 2023 emissions (refer to **Table 9-9**) incorporating typical mining industry dust control measures (Section 9.4.4 Year 2023).
- Year 2029 emissions (refer to **Table 9-9**) incorporating typical mining industry dust control measures (Section 9.4.4 Year 2029).
- Year 2029 emissions incorporating both typical mining industry dust control measures and adaptive air quality management measures (**Section 9.4.4 Operations with adaptive air quality management**).

Year 2019

The air dispersion modelling results for selected sensitive receptors in the year 2019 during the early stages of the revised Project are presented in **Table 9-17**. The sensitive receptors selected in **Table 9-17** are those with the greatest potential for air quality impacts based on the air dispersion modelling. The results for all 44 sensitive receptors are presented in **Appendix G.6.3**. The predicted TSP, PM_{10} and $PM_{2.5}$ concentrations in **Table 9-17** and **Appendix G.6.3** are cumulative concentrations and include the adopted background air quality levels in **Table 9-7**.

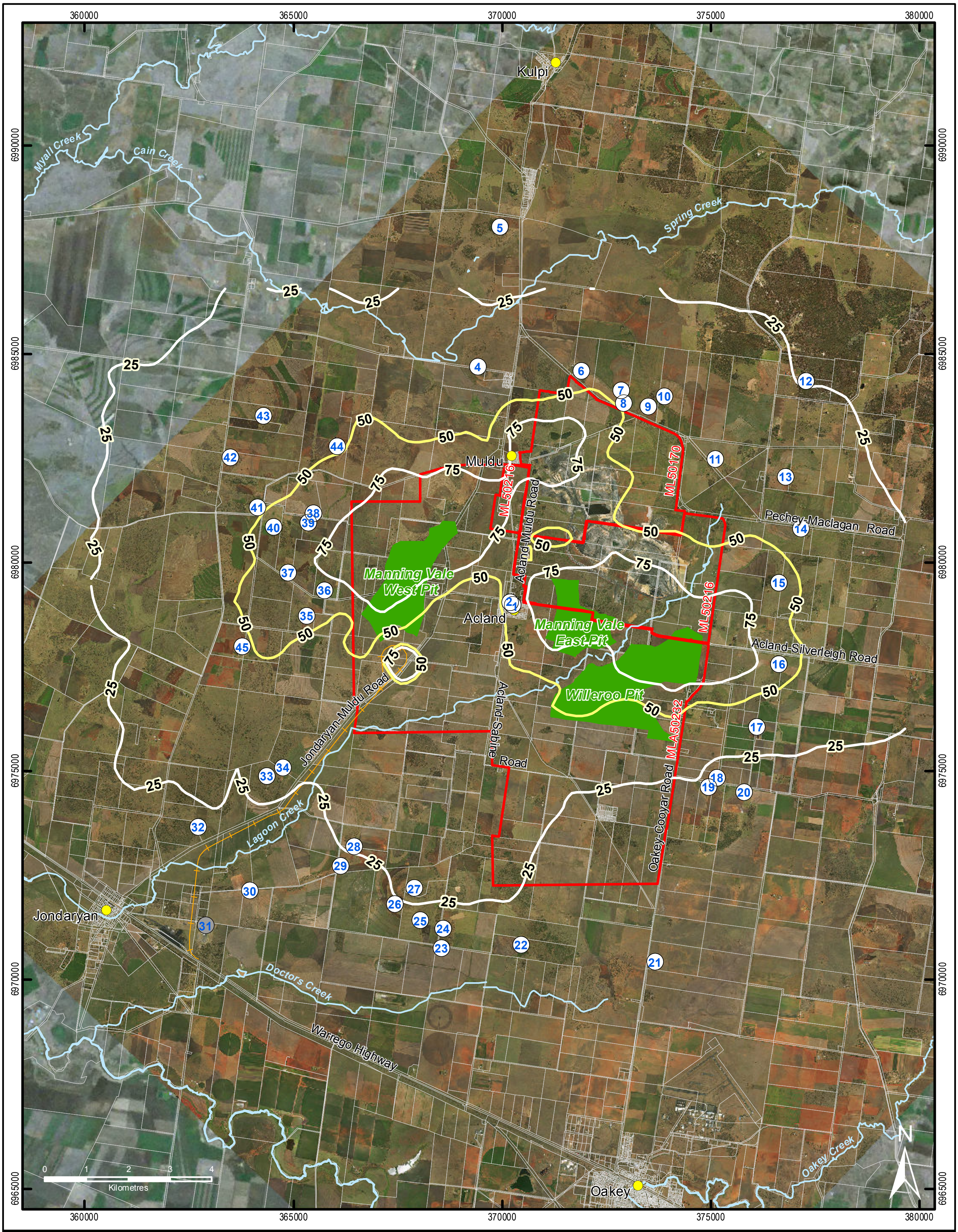
Table 9-17 Predicted cumulative TSP, PM_{10} and $PM_{2.5}$ concentrations and dust deposition rates for 2019

Sensitive Receptor	Maximum 24-hr PM_{10} (µg/m³)	5th Highest 24-hr PM_{10} (µg/m³)	Maximum 24-hr $PM_{2.5}$ (µg/m³)	Annual $PM_{2.5}$ (µg/m³)	Annual TSP (µg/m³)	Monthly Average Dust Deposition (mg/m²/day)	Maximum Dust Deposition (mg/m²/day)
1	52	50	15	3.2	59	137	190
2	48	43	14	3.0	53	122	162
35	65	54	17	4.8	44	87	101
36	77	61	19	4.9	49	96	116
37	65	53	17	4.5	46	91	110
38	61	56	16	4.2	48	101	135
39	66	57	17	3.7	49	101	134
Air Quality objective	NA	50	25	8	90	120	NA

Contour plots for the predicted cumulative air quality impacts (including adopted background air quality levels in **Table 9-7**) of the revised Project in year 2019 are presented below and in **Appendix G.6.4**:

- predicted maximum 24-hour PM_{10} concentration for 2019 - **Figure 9-11**;
- predicted 5th highest 24-hour PM_{10} concentration for 2019 - **Figure 9-12**;
- predicted maximum 24 hour average $PM_{2.5}$ concentrations for 2019 - **Figure 9-13**;
- predicted monthly maximum dust deposition rates for 2019 - **Figure 9-14**;
- predicted annual average $PM_{2.5}$ concentrations for 2019 - **Appendix G.6.4**; and
- predicted annual average TSP concentrations for 2019 - **Appendix G.6.4**.

Time series plots for the PM_{10} 24 hour concentrations at sensitive receptors with greatest potential for air quality impacts based on the air dispersion modelling are presented in **Figure 9-15** to **Figure 9-17**.



LEGEND

- Towns and Localities
- Sensitive Receptor - Residential
- Sensitive Receptor - Commercial
- Rail Spur
- Creeks
- Concentration Contour at air quality objective
- Concentration Contour
- Mining Tenements
- Stage 3 Pit Areas
- Cadastre

NEW HOPE GROUP

SKM

NEW ACLAND COAL MINE
STAGE 3 PROJECT

Figure 9-11 - Contour plot of predicted maximum 24 hour average PM_{10} concentrations (µg/m^3) for 2019

Scale 1:120,000 on A4

Projection: Australian Geodetic Datum – Zone 56 (AGD84)

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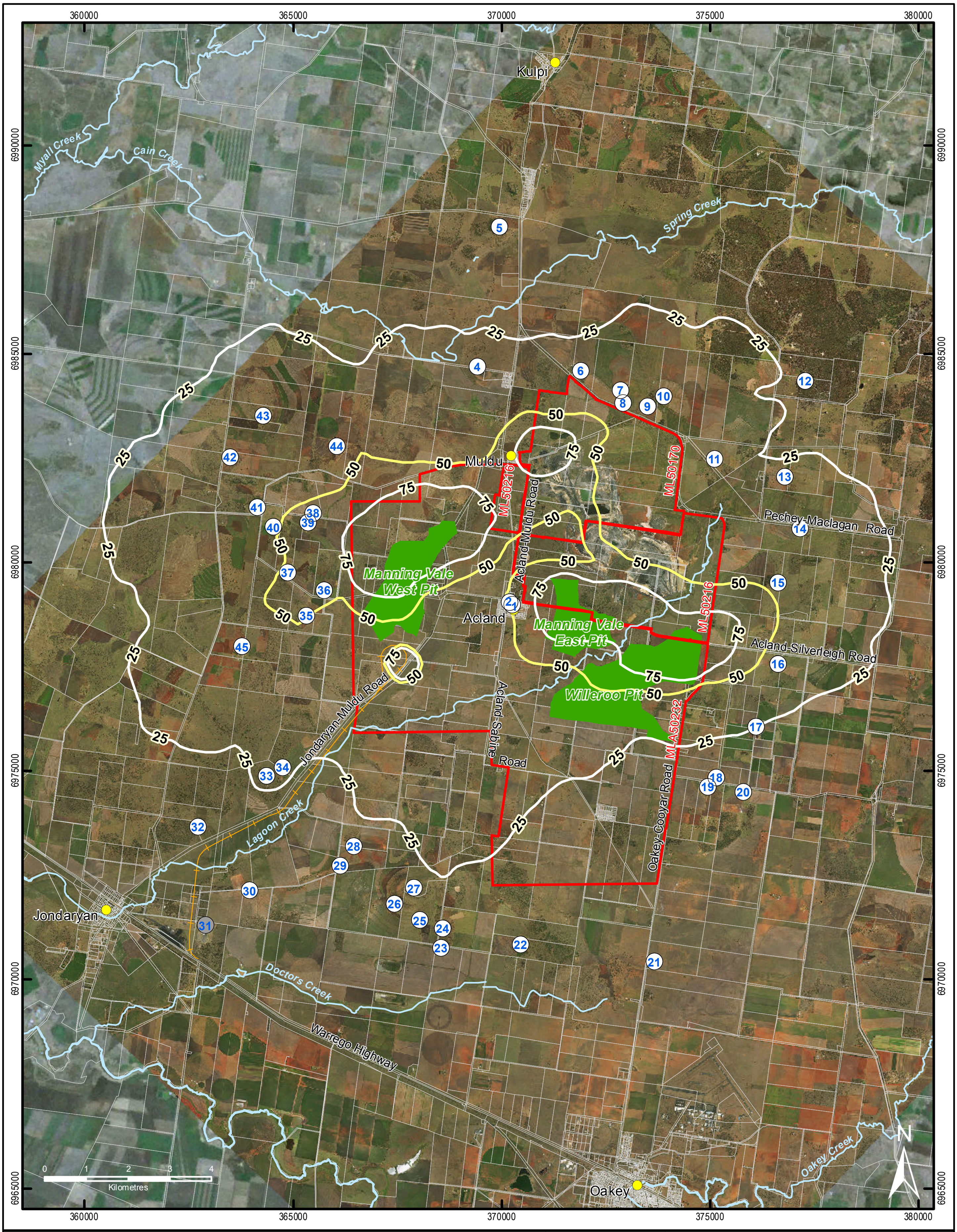

LEGEND

- Towns and Localities
- Sensitive Receptor - Residential
- Sensitive Receptor - Commercial
- Rail Spur
- Creeks
- Concentration Contour at air quality objective
- Concentration Contour
- Mining Tenements
- Stage 3 Pit Areas
- Cadastre

NEW HOPE GROUP

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NEW ACLAND COAL MINE STAGE 3 PROJECT

Figure 9-12 - Contour plot of predicted 5th highest 24 hour average PM_{10} concentrations ($\mu g/m^3$) for 2019

Scale 1:120,000 on A4

Projection: Australian Geodetic Datum – Zone 56 (AGD84)

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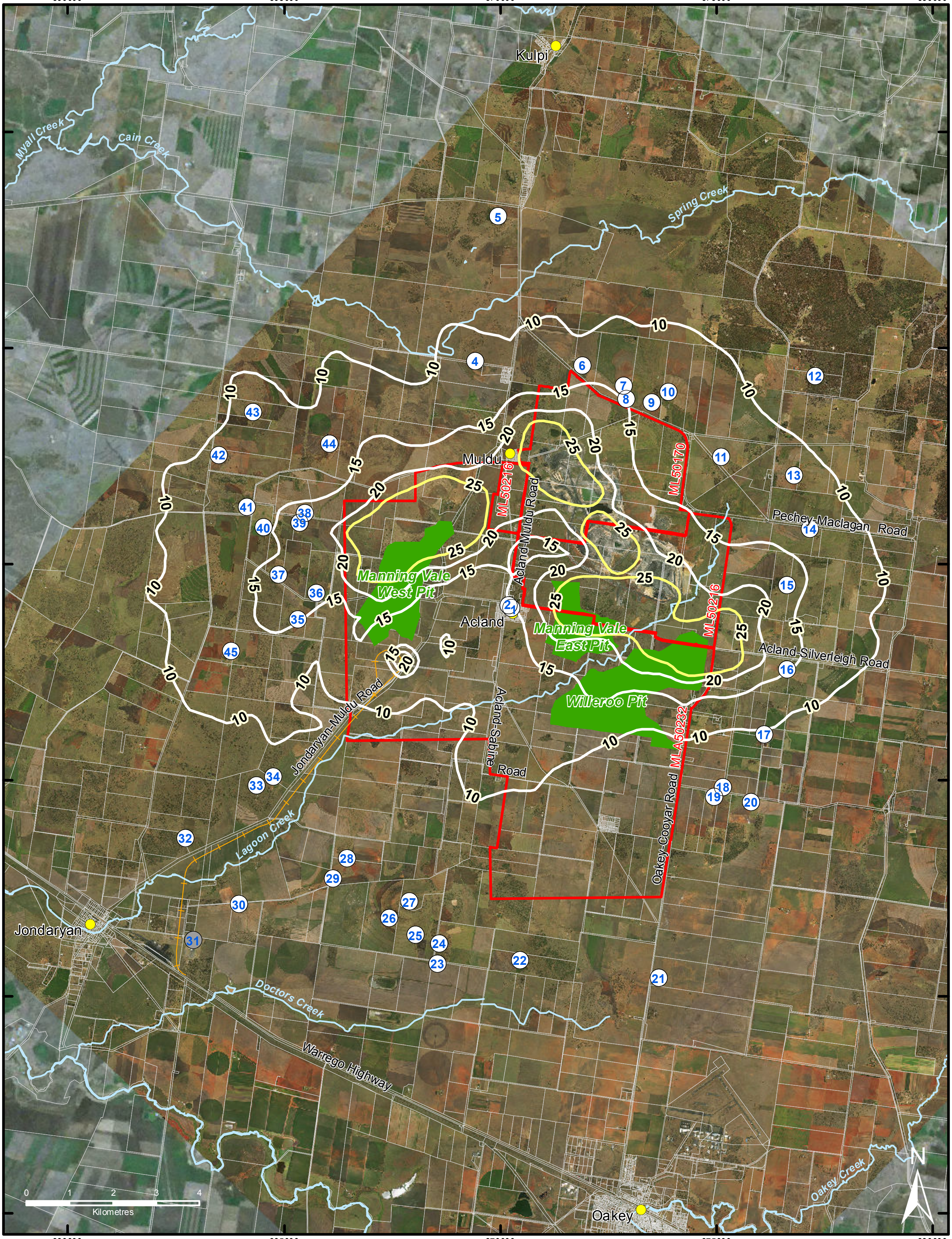

LEGEND

- Towns and Localities
- Sensitive Receptor - Residential
- Sensitive Receptor - Commercial
- Rail Spur
- Creeks
- Concentration Contour at air quality objective
- Concentration Contour
- Mining Tenements
- Stage 3 Pit Areas
- Cadastre

NEW HOPE GROUP

SKM

NEW ACLAND COAL MINE STAGE 3 PROJECT

Figure 9-13 - Contour plot of predicted maximum 24 hour average $PM_{2.5}$ concentrations ($\mu g/m^3$) for 2019

Scale 1:120,000 on A4

Projection: Australian Geodetic Datum – Zone 56 (AGD84)

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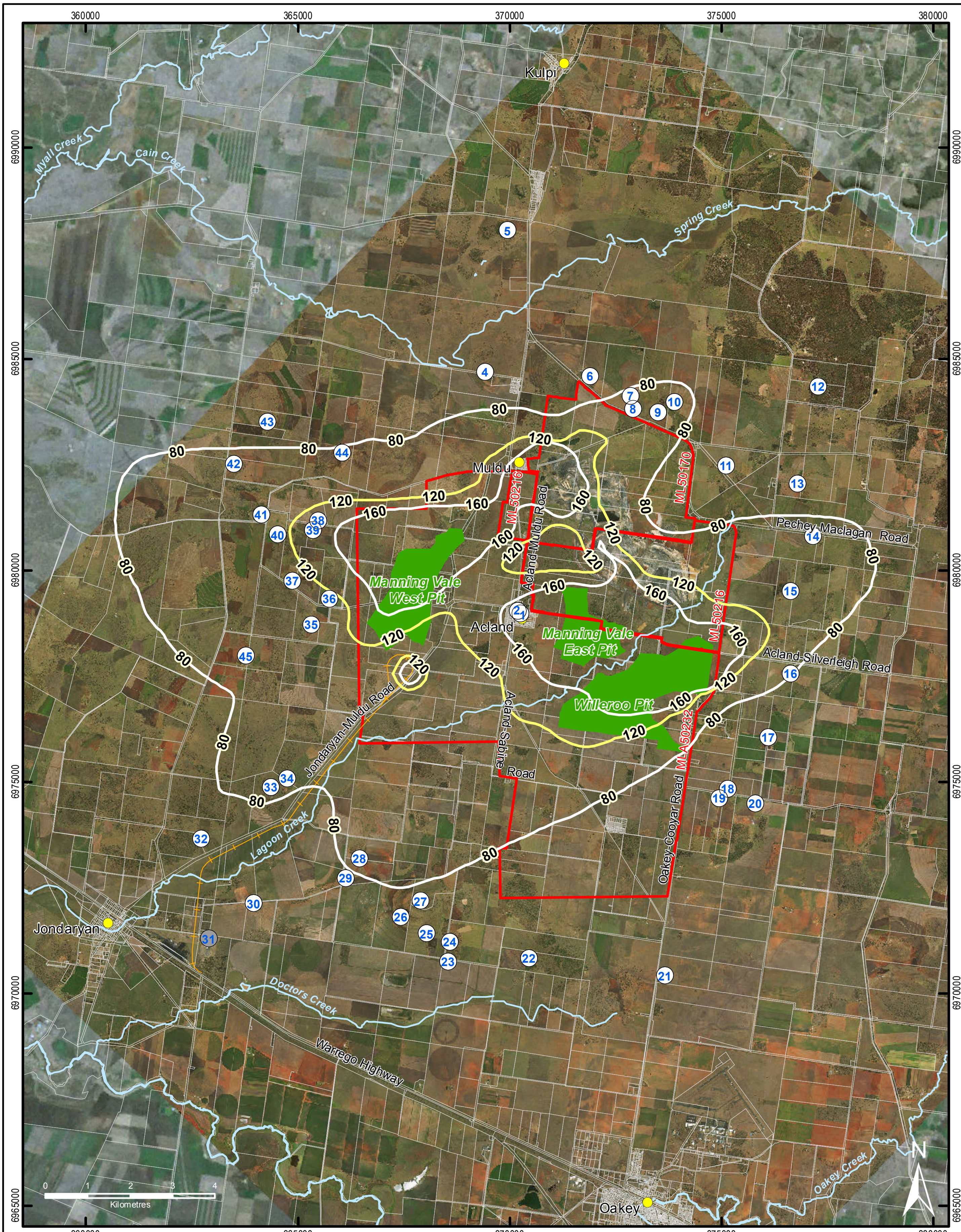

LEGEND

- Towns and Localities
- Sensitive Receptor - Residential
- Sensitive Receptor - Commercial
- Rail Spur
- Creeks
- Concentration Contour at air quality objective
- Concentration Contour
- Mining Tenements
- Stage 3 Pit Areas
- Cadastre

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Figure 9-14 - Contour plot of predicted monthly maximum dust deposition rates (mg/m²/day) for 2019

Scale 1:120,000 on A4

Projection: Australian Geodetic Datum – Zone 56 (AGD84)

Path: I:\QENV2\Projects\QE06644\Spatial\ArcGIS\01_Figures\01_SEIS\09_AirQuality\131122_NewHope_AirQuality_Figure9-14_Contour_predicted_monthly_maximum_dust_deposition_rates_2019.mxd

Produced: 27/11/2013

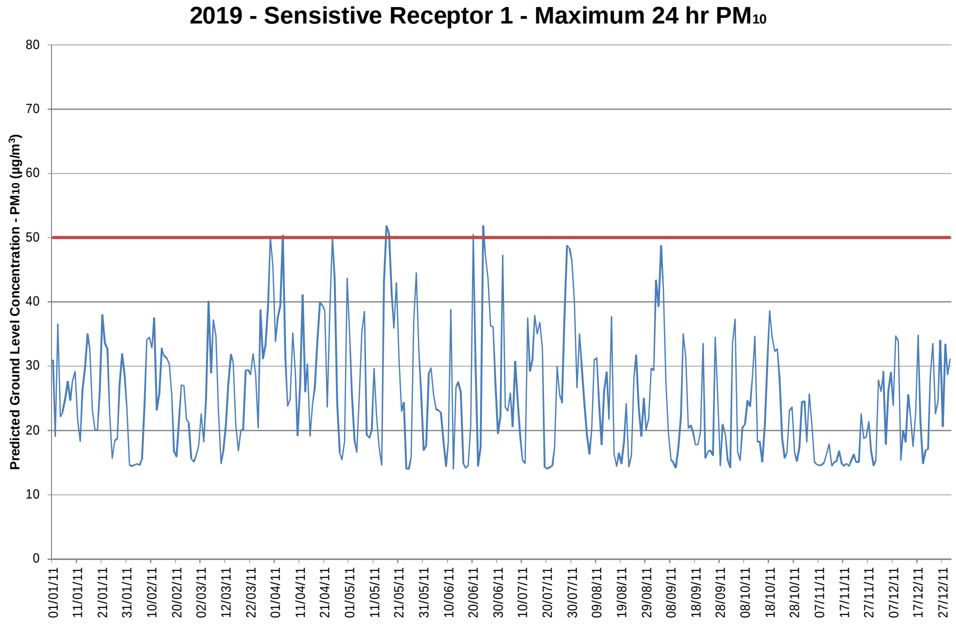


Figure 9-15 Time series of predicted 24 hour average PM_{10} concentrations ($\mu g/m^3$) at sensitive receptor 1 in 2019

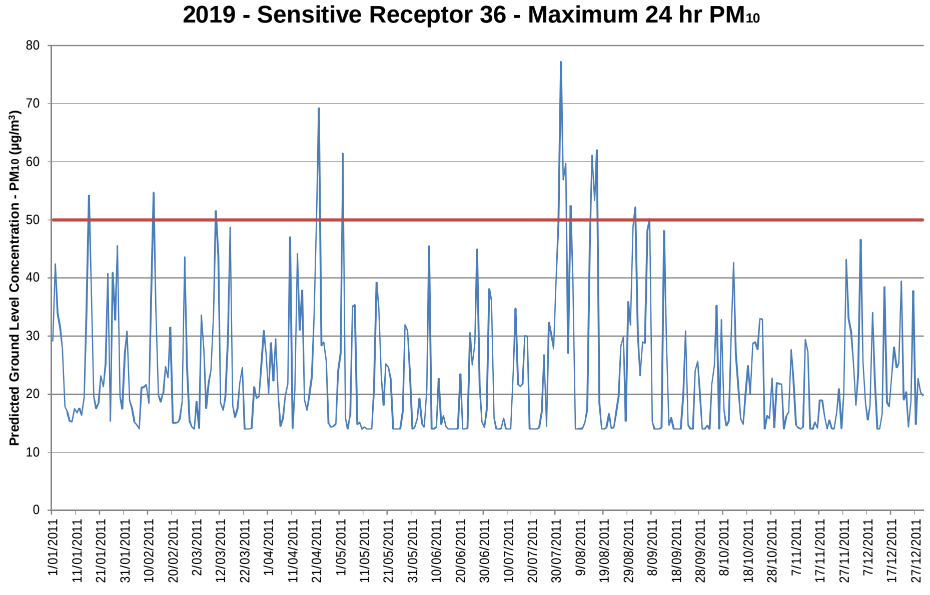


Figure 9-16 Time series of predicted 24 hour average PM_{10} concentrations ($\mu g/m^3$) at sensitive receptor 36 in 2019

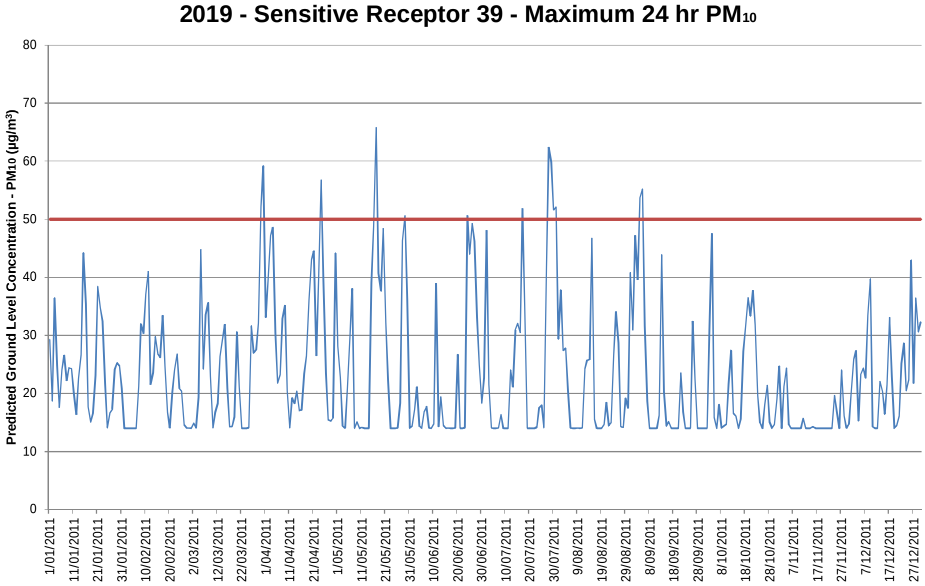


Figure 9-17 Time series of predicted 24 hour average PM_{10} concentrations (µg/m^3) at sensitive receptor 39 in 2019

The results of the modelling is summarised as follows.

- Exceedances of the EPP (Air) objective of 50 µg/m^3 for the 5th highest 24 hour average are predicted to occur at 6 of the 44 sensitive receptors (receptors 1, 35, 36, 37, 38, 39).
- Exceedances of the DEHP nuisance guideline of 120 mg/m^2/day for annual average dust deposition are predicted to occur at 2 sensitive receptors (receptor 1 and 2).
- No exceedances of the relevant EPP (Air) objective for the 24 hour and annual average $PM_{2.5}$ concentrations and the annual average TSP of 90 µg/m^3.
- The highest predicted PM_{10} ground level concentrations occur during the cooler months of autumn and winter which is dominated by poor atmospheric dispersion as discussed in **Section 9.3.4**.

The contour plots also generally show impacts from the particulate emissions are predicted to be greatest to the west of the revised Project mining activities which illustrates the effects of the prevailing easterly winds that carry the dust in the west direction. The proximity of the Manning Vale West Pit to the sensitive receptors combined with the level of overburden mining activity and the prevailing easterly winds has resulted in the amount of exceedances predicted.

The main dust sources that have the potential to impact on the sensitive receptors are overburden activities (dozer, hauling and dumping), dozers on the coal floor and wind erosion from exposed areas.

Year 2023

The air dispersion modelling results for mining operations in year 2023 of the revised Project are presented in **Table 9-18**. The sensitive receptors selected in **Table 9-18** are those with the greatest potential for air quality impacts based on the air dispersion modelling. The results for all 44 sensitive receptors are presented in **Table I.18.3-2**. The predicted TSP, PM_{10} and $PM_{2.5}$ concentrations in **Table 9-18** and **Appendix G.6.3** are cumulative concentrations and include the adopted background air quality levels in **Table 9-7**.

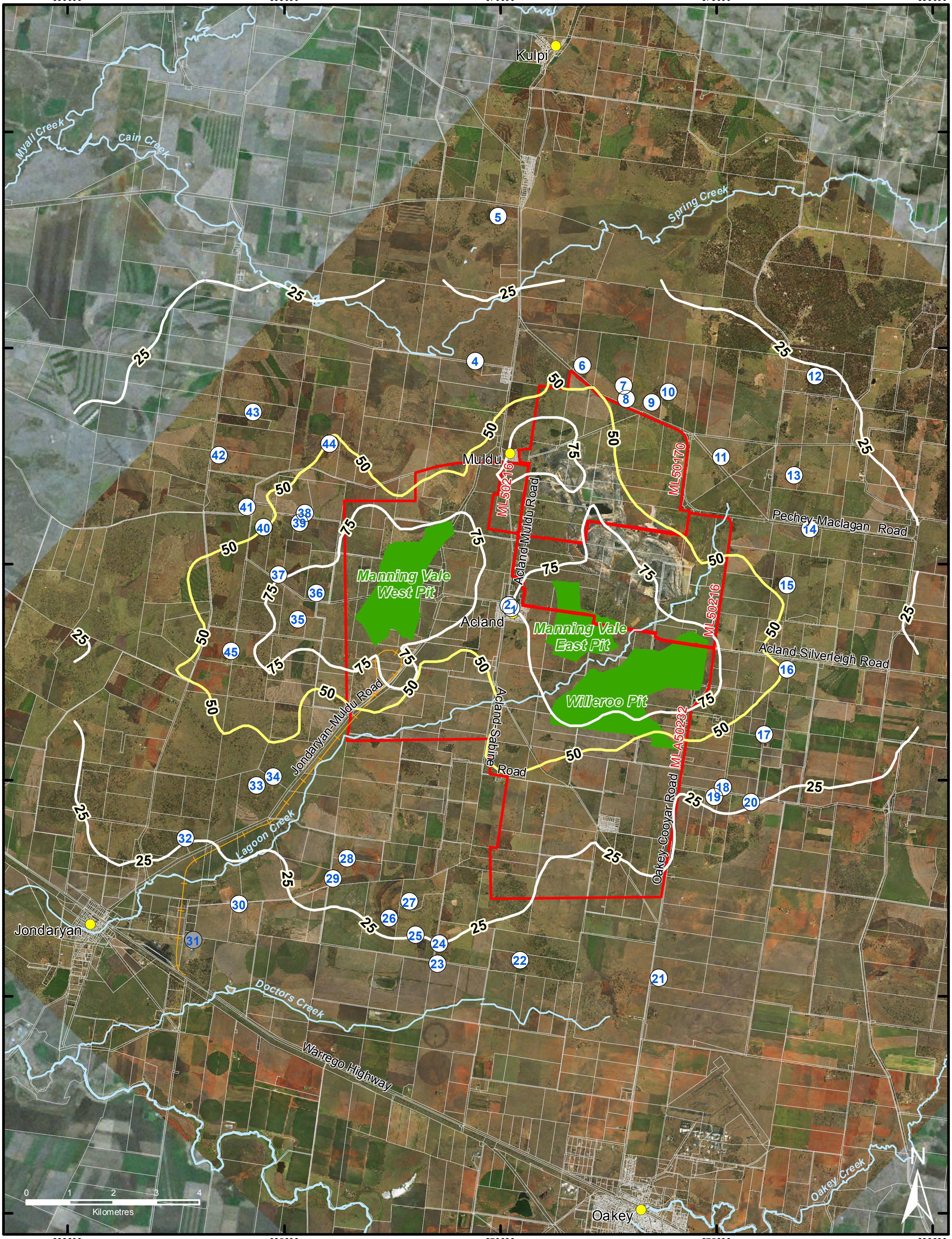
Table 9-18 Predicted cumulative TSP, PM_{10} and $PM_{2.5}$ concentrations and dust deposition rates for 2023

Sensitive Receptor	Maximum 24-hr PM_{10} (µg/m^3)	5th Highest 24-hr PM_{10} (µg/m^3)	Maximum 24-hr $PM_{2.5}$ (µg/m^3)	Annual $PM_{2.5}$ (µg/m^3)	Annual TSP (µg/m^3)	Monthly Average Dust Deposition (mg/m^2/day)	Maximum Dust Deposition (mg/m^2/day)
1	61	51	18	3	69	161	227
2	53	50	16	3	59	134	187
35	88	82	20	4	61	119	153
36	96	94	21	4	68	148	212
37	74	67	17	4	51	111	154
38	57	43	13	4	38	80	102
39	58	44	14	3	40	83	111
45	62	51	17	5	43	109	90
Air Quality objective	NA	50	25	8	90	120	NA

Contour plots for the predicted cumulative air quality impacts (including background air quality levels in **Table 9-7**) of the revised Project in year 2023 are presented below and in **Appendix G.6.4**:

- predicted maximum 24-hour PM_{10} concentration for 2023 - **Figure 9-18**;
- predicted 5th highest 24-hour PM_{10} concentration for 2023 - **Figure 9-19**;
- predicted maximum 24 hour average $PM_{2.5}$ concentrations for 2023 - **Figure 9-20**;
- predicted monthly maximum dust deposition rates for 2023 - **Figure 9-21**;
- predicted annual average $PM_{2.5}$ concentrations for 2023 - **Appendix G.6.4**; and
- predicted annual average TSP concentrations for 2023 - **Appendix G.6.4**.

Time series plots for the PM_{10} 24 hour concentrations at sensitive receptors with greatest potential for air quality impacts based on the air dispersion modelling are presented in **Figure 9-22** to **Figure 9-25**.



LEGEND

- Towns and Localities
- Sensitive Receptor - Residential
- Sensitive Receptor - Commercial
- Rail Spur
- Creeks
- Concentration Contour at air quality objective
- Concentration Contour
- Mining Tenements
- Stage 3 Pit Areas
- Cadastre

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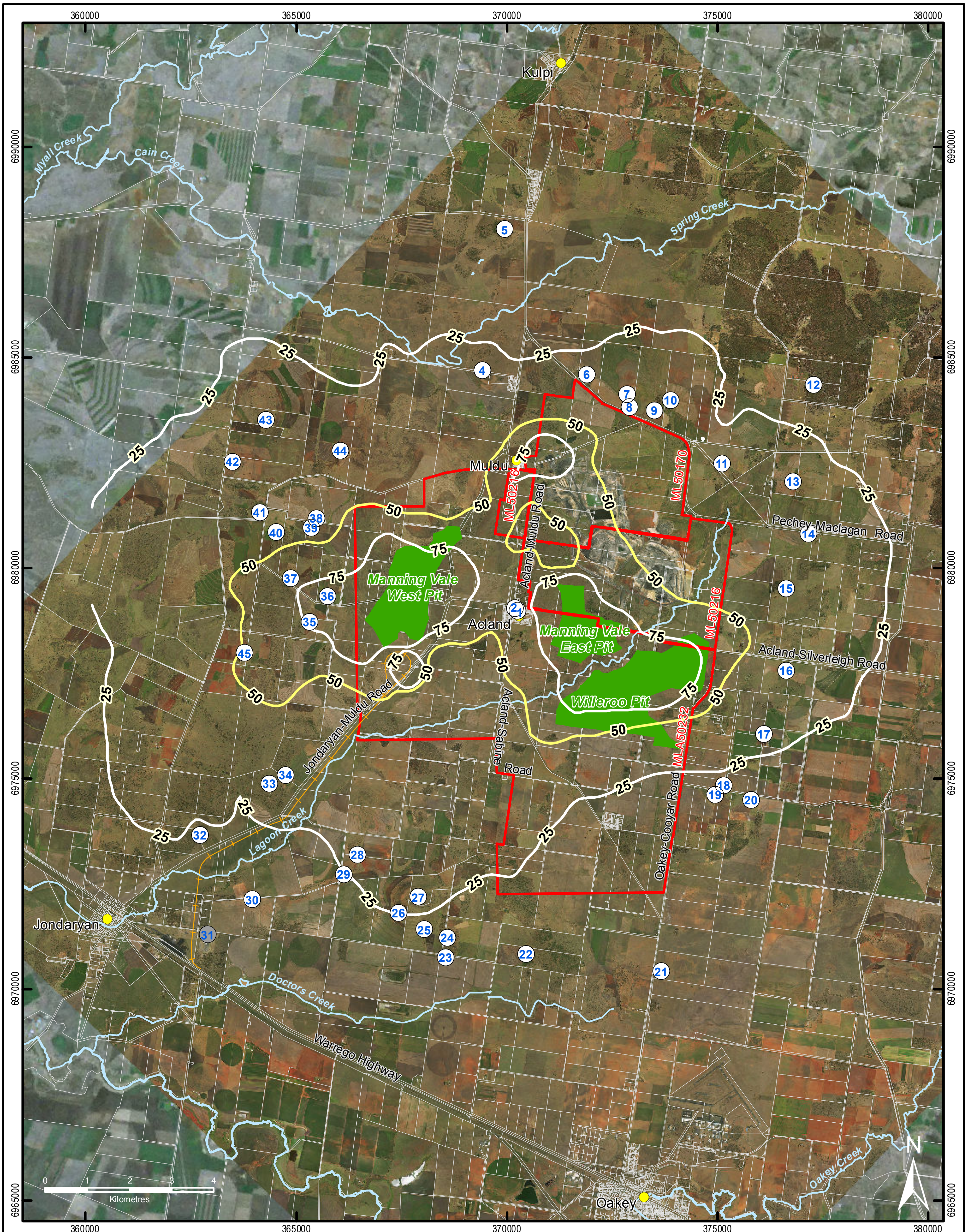
Figure 9-18 - Contour plot of predicted maximum 24 hour average PM_{10} concentrations ($\mu g/m^3$) for 2023

Scale 1:120,000 on A4

Projection: Australian Geodetic Datum – Zone 56 (AGD84)

Path: I:\QENV2\Projects\QE06644\Spatial\ArcGIS\01_Figures\01_SEIS\09_AirQuality\131122_NewHope_AirQuality_Figure9-18_Contours_PredictedMax24HrAvg_PM10Concentrations2023.mxd

Produced: 27/11/2013



LEGEND

- Towns and Localities
- Sensitive Receptor - Residential
- Sensitive Receptor - Commercial
- Rail Spur
- Creeks
- Concentration Contour at air quality objective
- Concentration Contour
- Mining Tenements
- Stage 3 Pit Areas
- Cadastre

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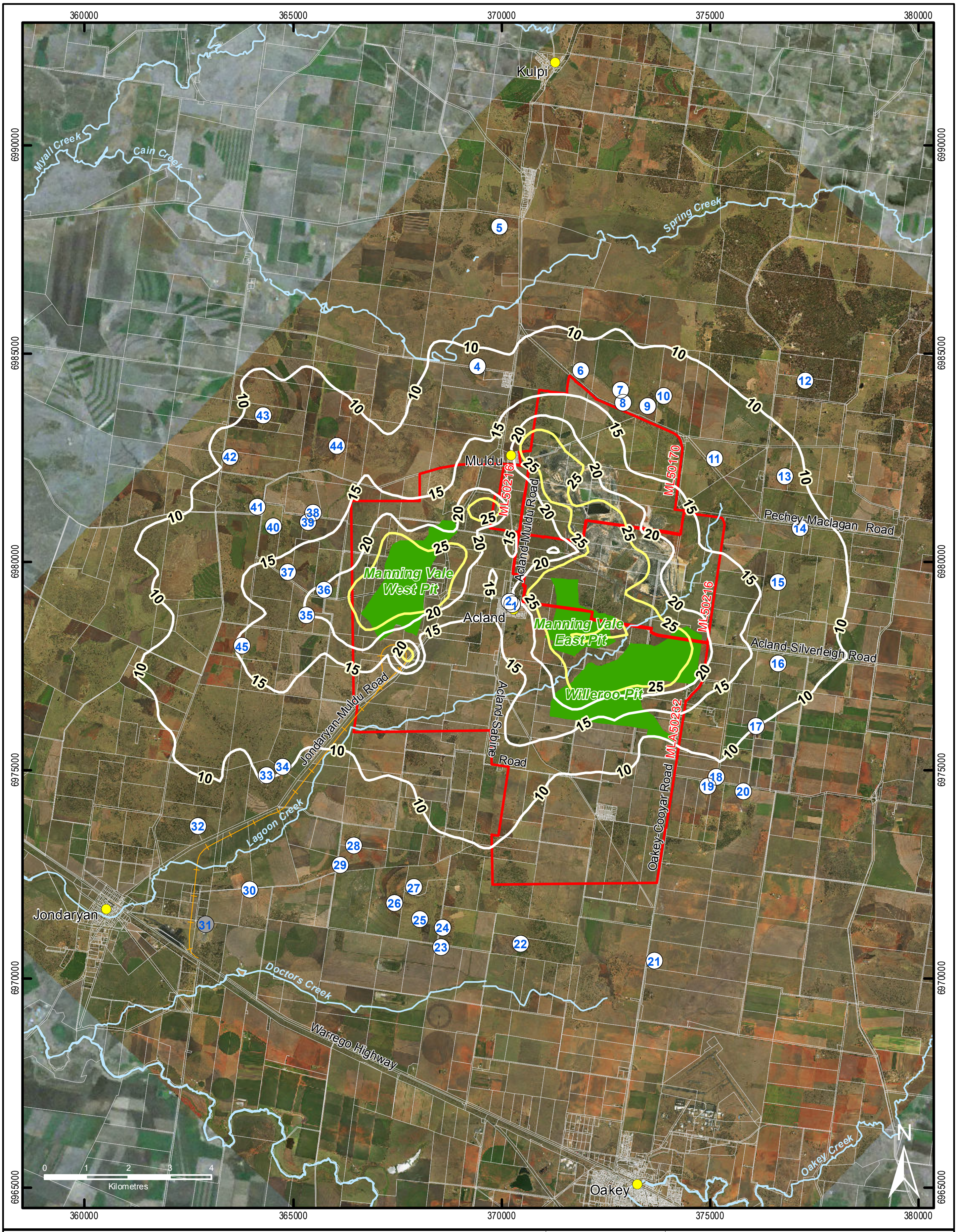
Figure 9-19 - Contour plot of predicted 5th highest 24 hour average PM_{10} concentrations (µg/m^3) for 2023

Scale 1:120,000 on A4
Projection: Australian Geodetic Datum – Zone 56 (AGD84)

Path: I:\QENV2\Projects\QE06644\Spatial\ArcGIS\01_Figures\01_SEIS\09_AirQuality\131122_NewHope_AirQuality_Figure9-19_Contours_Predicted5thHighest24HrAvg_PM10Concentrations2023.mxd

Produced: 27/11/2013



LEGEND

- Sensitive Receptor - Residential
- Sensitive Receptor - Commercial
- Towns and Localities
- Rail Spur
- Creeks
- Concentration Contour at air quality objective
- Concentration Contour
- Mining Tenements
- Stage 3 Pit Areas
- Cadastre

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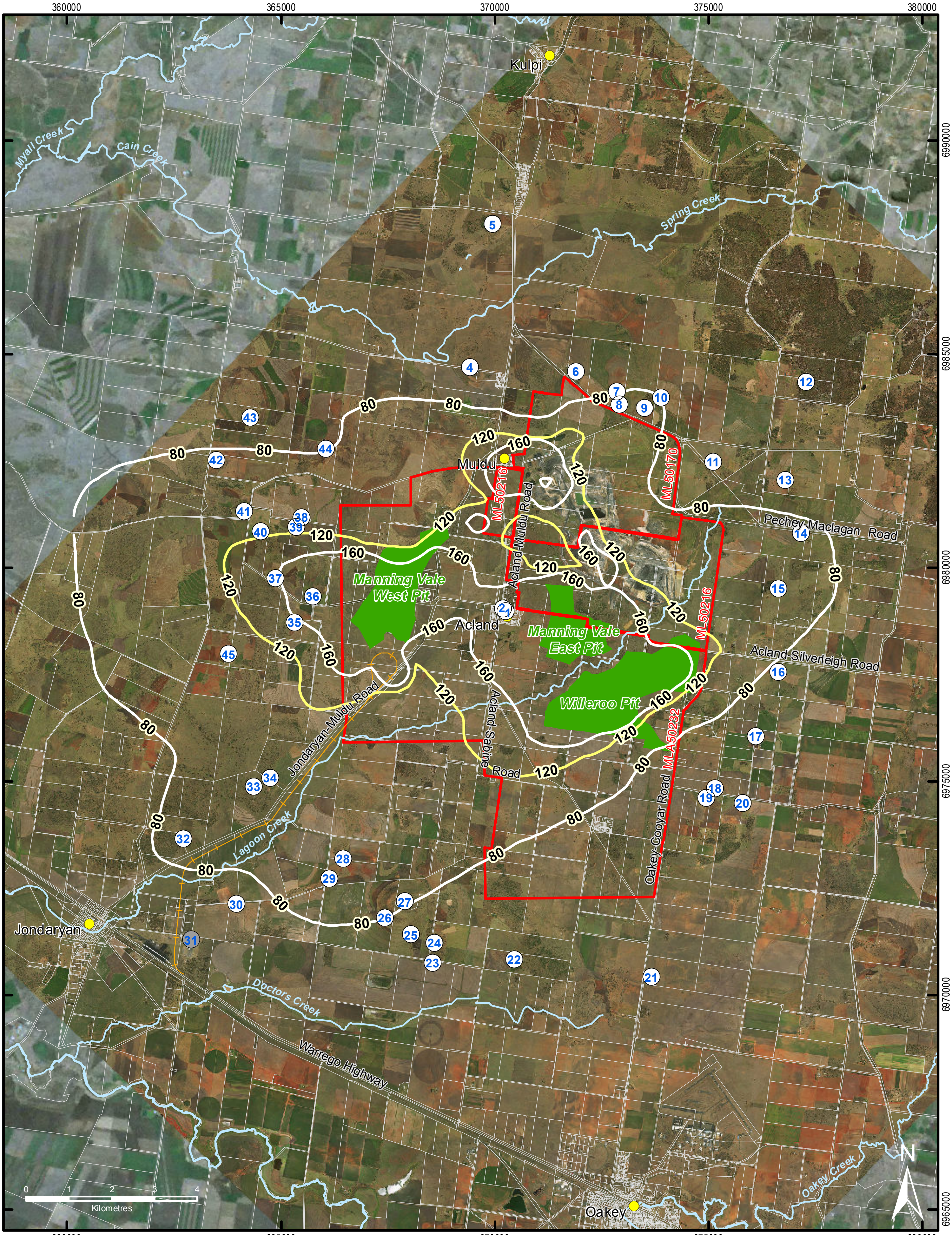
Figure 9-20 - Contour plot of predicted maximum 24 hour average $PM_{2.5}$ concentrations ($\mu g/m^3$) for 2023

Scale 1:120,000 on A4

Projection: Australian Geodetic Datum – Zone 56 (AGD84)

Path: \\skmconsulting.com\BNEProjects\QENV2\Projects\QE06644\Spatial\ArcGIS\01_Figures\01_SEIS\09_AirQuality\131122_NewHope_AirQuality_Figure9-20_Contours_PredictedMax24HrAvg_PM2_5Concentrations2023.mxd

Produced: 28/11/2013



LEGEND

- Towns and Localities
- Sensitive Receptor - Residential
- Sensitive Receptor - Commercial
- Rail Spur
- Creeks
- Concentration Contour at air quality objective
- Concentration Contour
- Mining Tenements
- Stage 3 Pit Areas
- Cadastre

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Figure 9-21 - Contour plot of predicted monthly maximum dust deposition rates (mg/m^2/day) for 2023

Scale 1:120,000 on A4

Projection: Australian Geodetic Datum – Zone 56 (AGD84)

Path: I:\QENV2\Projects\QE06644\Spatial\ArcGIS\01_Figures\01_SEIS\09_AirQuality\131122_NewHope_AirQuality_Figure9-21_Contour_predicted_monthly_maximum_dust_deposition_rates_2023.mxd

Produced: 27/11/2013

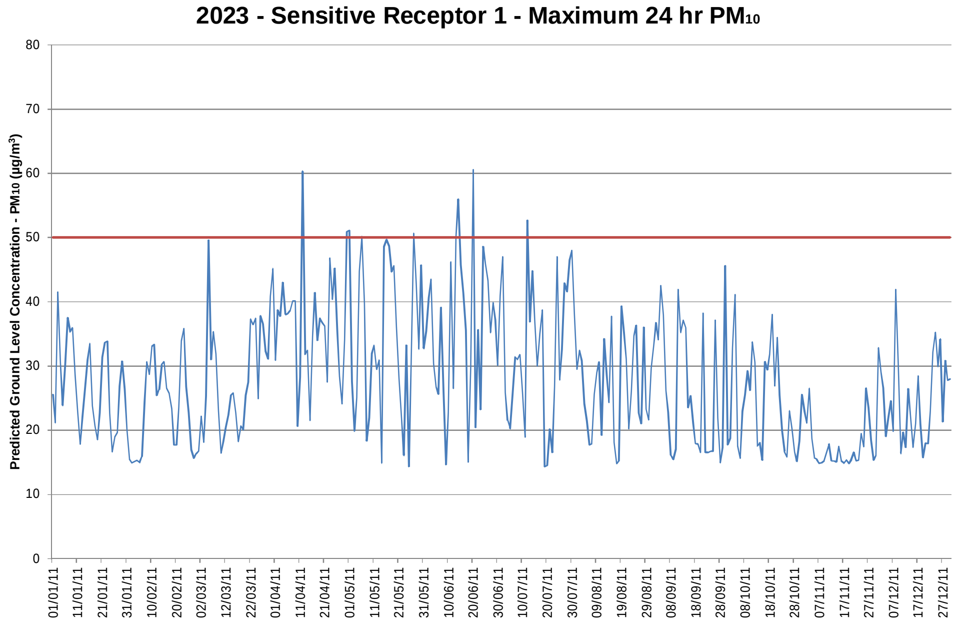


Figure 9-22 Time series of predicted 24 hour average PM_{10} concentrations (µg/m^3) at sensitive receptor 1 in 2023

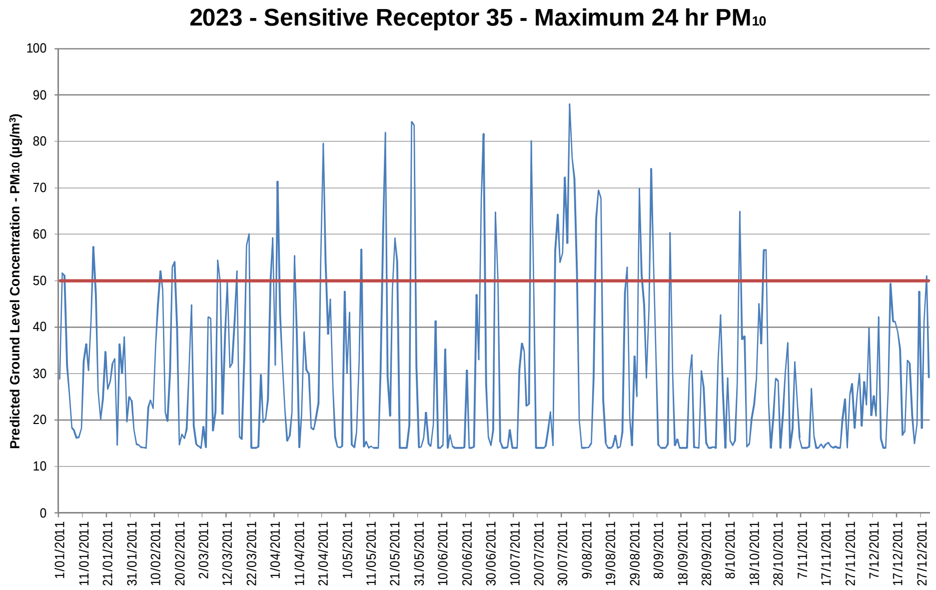


Figure 9-23 Time series of predicted 24 hour average PM10 concentrations (µg/m^3) at sensitive receptor 35 in 2023

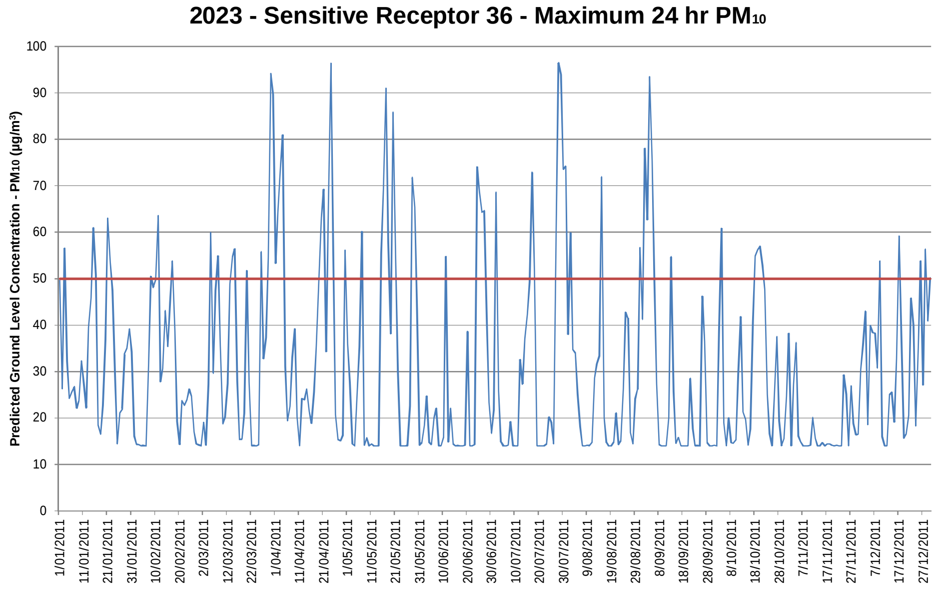


Figure 9-24 Time series of predicted 24 hour average PM_{10} concentrations (µg/m^3) at sensitive receptor 36 in 2023

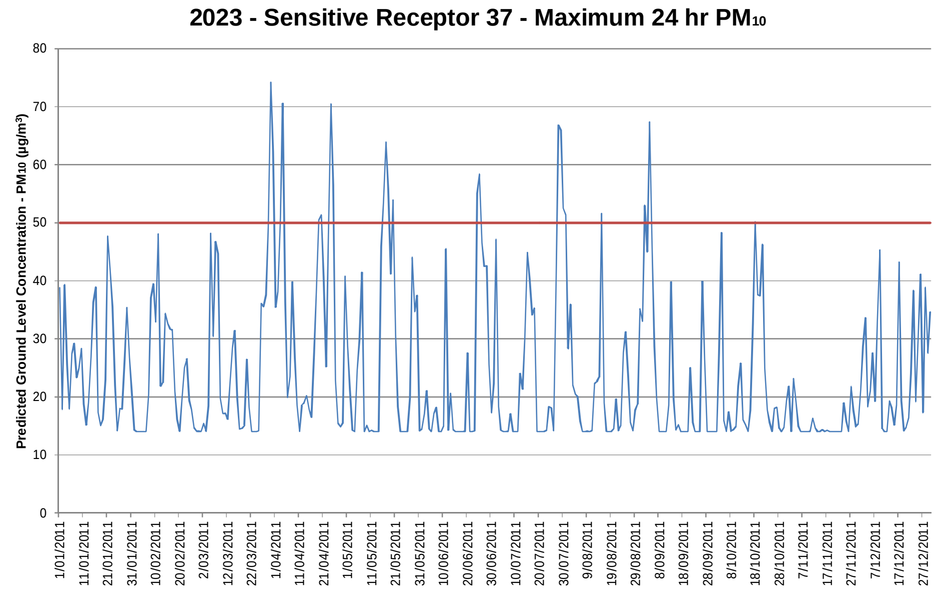


Figure 9-25 Time series of predicted 24 hour average PM_{10} concentrations (µg/m^3) at sensitive receptor 37 in 2023

The results of the modelling is summarised as follows.

- Exceedances of the EPP (Air) objective of 50 µg/m^3 for the 5th highest 24 hour average are predicted to occur at 6 of the 44 sensitive receptors (receptors 1, 2, 35, 36, 37 and 45).
- Exceedances of the DEHP nuisance guideline of 120 mg/m^2/day for annual average dust deposition are predicted to occur at 3 of the 44 sensitive receptors (receptors 1, 2 and 36).
- No exceedances of the relevant EPP (Air) objective for the 24 hour and annual average $PM_{2.5}$ concentrations, annual average TSP of 90 µg/m^3.
- The highest predicted PM_{10} ground level concentrations occur during the cooler months of autumn and winter which is dominated by poor atmospheric dispersion as discussed in **Section 9.3.4**.

The contour plots also generally show impacts from the particulate emissions are predicted to be greatest to the west of the revised Project activities which illustrates the effects of the prevailing easterly winds that carry the dust in the west direction.

The main dust sources that have the potential to impact on the sensitive receptors are overburden activities (dozer, hauling and dumping), dozers on the coal floor and wind erosion from exposed areas.

Year 2029

The air dispersion modelling results for mining operations in year 2029 of the revised Project are presented in **Table 9-19**. The sensitive receptors selected in **Table 9-19** are those with the greatest potential for air quality impacts based on the air dispersion modelling. The results for all 44 sensitive receptors are presented in **Table I.18.3-3**. The predicted TSP, PM_{10} and $PM_{2.5}$ concentrations in **Table 9-19** and **Appendix G.6.3** are cumulative concentrations and include the adopted background air quality levels in **Table 9-7**.

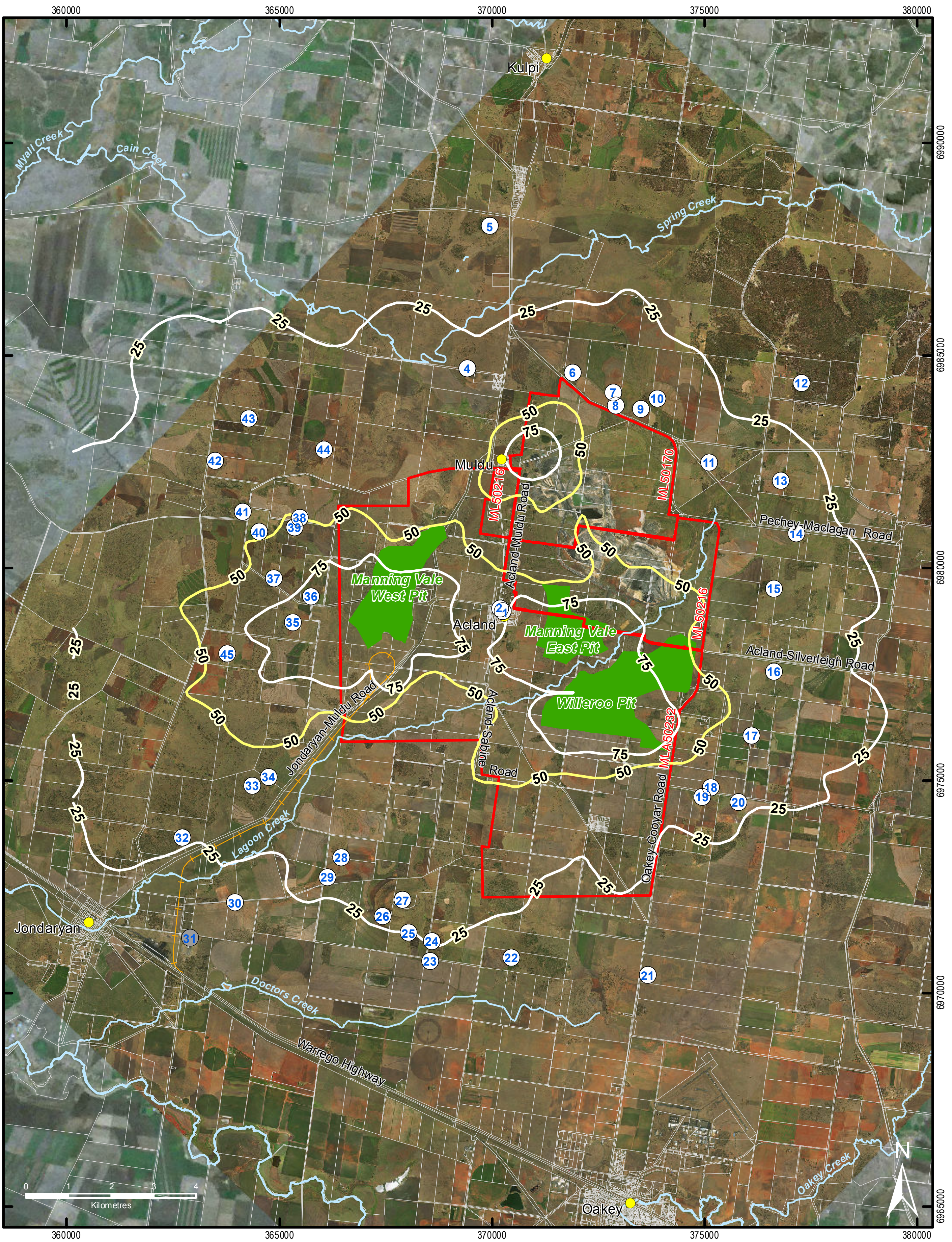
Table 9-19 Predicted cumulative TSP, PM_{10} and $PM_{2.5}$ concentrations and dust deposition rates for 2029

Sensitive Receptor	Maximum 24-hr PM_{10} (µg/m^3)	5th Highest 24-hr PM_{10} (µg/m^3)	Maximum 24-hr $PM_{2.5}$ (µg/m^3)	Annual $PM_{2.5}$ (µg/m^3)	Annual TSP (µg/m^3)	Monthly Average Dust Deposition (mg/m^2/day)	Maximum Dust Deposition (mg/m^2/day)
1	60	53	16	3	50	114	164
2	55	48	14	3	45	100	131
35	109	88	24	3	61	138	193
36	83	74	20	3	55	130	218
37	57	53	15	3	42	97	143
38	51	39	12	3	34	74	86
39	54	40	13	3	35	75	90
Air Quality objective	NA	50	25	8	90	120	NA

Contour plots for the predicted cumulative air quality impacts (including background air quality levels in **Table 9-7**) of the revised Project in year 2029 are presented below and in **Appendix G.6.4**:

- predicted maximum 24-hour PM_{10} concentration for 2029 - **Figure 9-26;**
- predicted 5^{th} highest 24-hour PM_{10} concentration for 2029 - **Figure 9-27** ;
- predicted maximum 24 hour average $PM_{2.5}$ concentrations for 2029 - **Figure 9-28**;
- predicted monthly maximum dust deposition rates for 2029 - **Figure 9-29**;
- predicted annual average $PM_{2.5}$ concentrations for 2029 - **Appendix G.6.4**; and
- predicted annual average TSP concentrations for 2029 - **Appendix G.6.4**.

Time series plots for the PM_{10} 24 hour concentrations at sensitive receptors with the greatest potential for air quality impacts based on the air dispersion modelling are presented in **Figure 9-32** to **Figure 9-35**.



LEGEND

- Towns and Localities
- Sensitive Receptor - Residential
- Sensitive Receptor - Commercial
- Rail Spur
- Creeks
- Concentration Contour at air quality objective
- Concentration Contour
- Mining Tenements
- Stage 3 Pit Areas
- Cadastre

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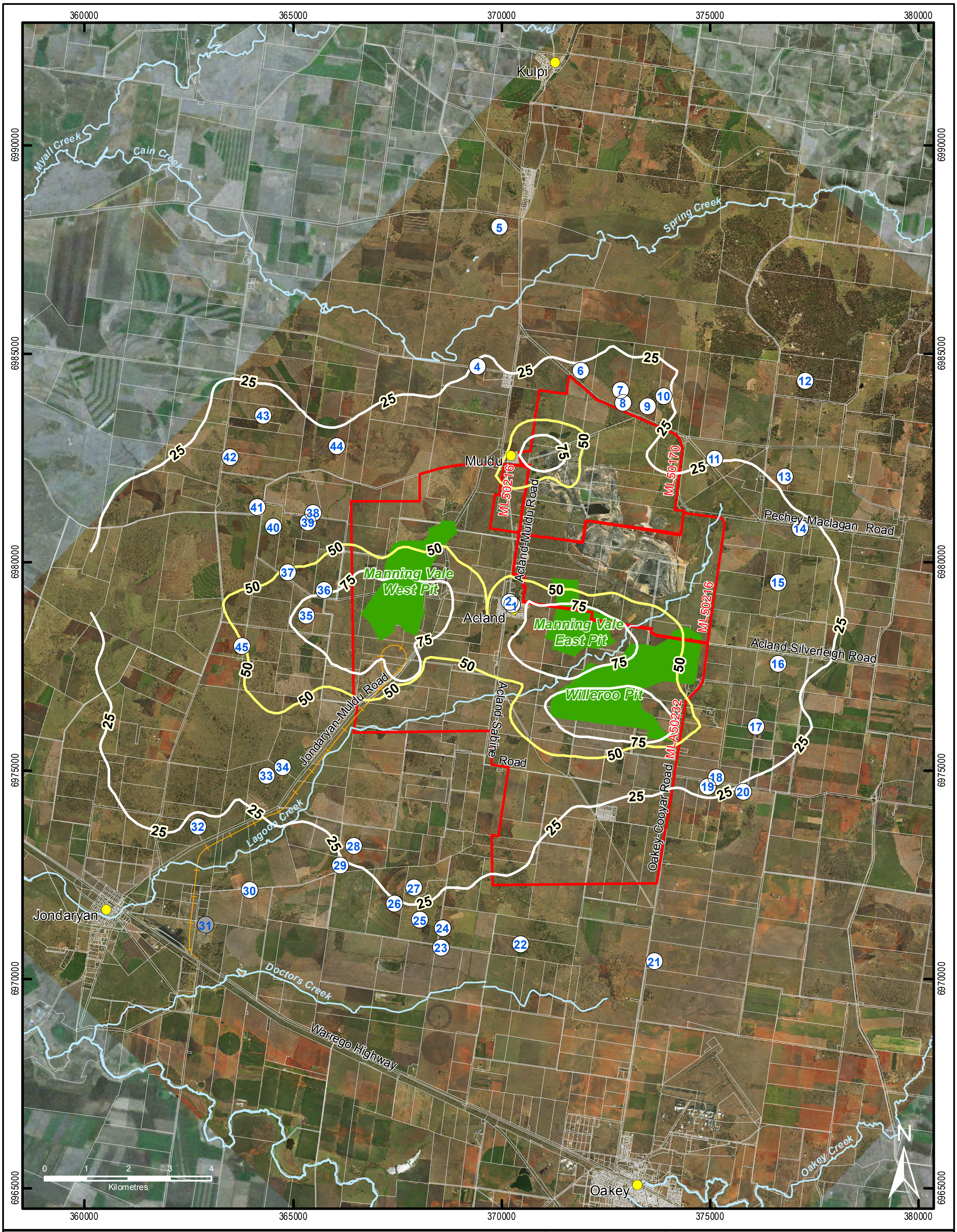
Figure 9-26 - Contour plot of predicted maximum 24 hour average PM_{10} concentrations (µg/m^3) for 2029

Scale 1:120,000 on A4

Projection: Australian Geodetic Datum – Zone 56 (AGD84)

Path: I:\QENV2\Projects\QE06644\Spatial\ArcGIS\01_Figures\01_SEIS\09_AirQuality\131122_NewHope_AirQuality_Figure9-26_Contours_PredictedMax24HrAvg_PM10Concentrations2029.mxd

Produced: 27/11/2013



LEGEND

- Towns and Localities
- Sensitive Receptor - Residential
- Sensitive Receptor - Commercial
- Rail Spur
- Creeks
- Concentration Contour at air quality objective
- Concentration Contour
- Mining Tenements
- Stage 3 Pit Areas
- Cadastre

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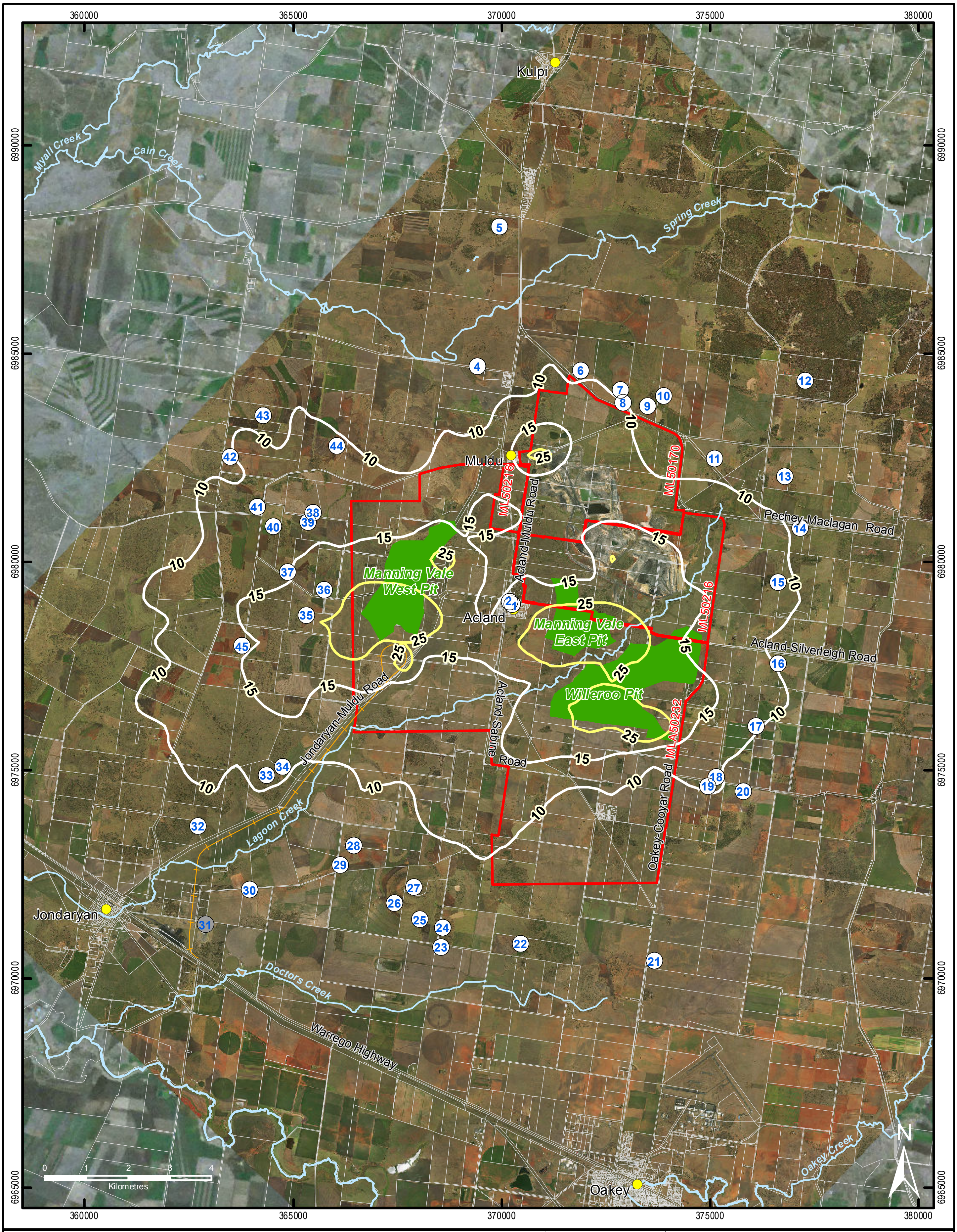
Figure 9-27 - Contour plot of predicted 5th highest 24 hour average PM_{10} concentrations (µg/m^3) for 2029

Scale 1:120,000 on A4
Projection: Australian Geodetic Datum – Zone 56 (AGD84)

Path: I:\QENV2\Projects\QE06644\Spatial\ArcGIS\01_Figures\01_SEIS\09_AirQuality\131122_NewHope_AirQuality_Figure9-27_Contours_Predicted5thHighest24HrAvg_PM10Concentrations2029.mxd

Produced: 27/11/2013



LEGEND

- Towns and Localities
- Sensitive Receptor - Residential
- Sensitive Receptor - Commercial
- Rail Spur
- Creeks
- Concentration Contour at air quality objective
- Concentration Contour
- Mining Tenements
- Stage 3 Pit Areas
- Cadastre

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Figure 9-28 - Contour plot of predicted maximum 24 hour average $PM_{2.5}$ concentrations ($\mu g/m^3$) for 2029

Scale 1:120,000 on A4
Projection: Australian Geodetic Datum – Zone 56 (AGD84)

Path: \\skmconsulting.com\BNEProjects\QENV2\Projects\QE06644\Spatial\ArcGIS\01_Figures\01_SEIS\09_AirQuality\131122_NewHope_AirQuality_Figure9-28_Contours_PredictedMax24HrAvg_PM2_5Concentrations2029.mxd

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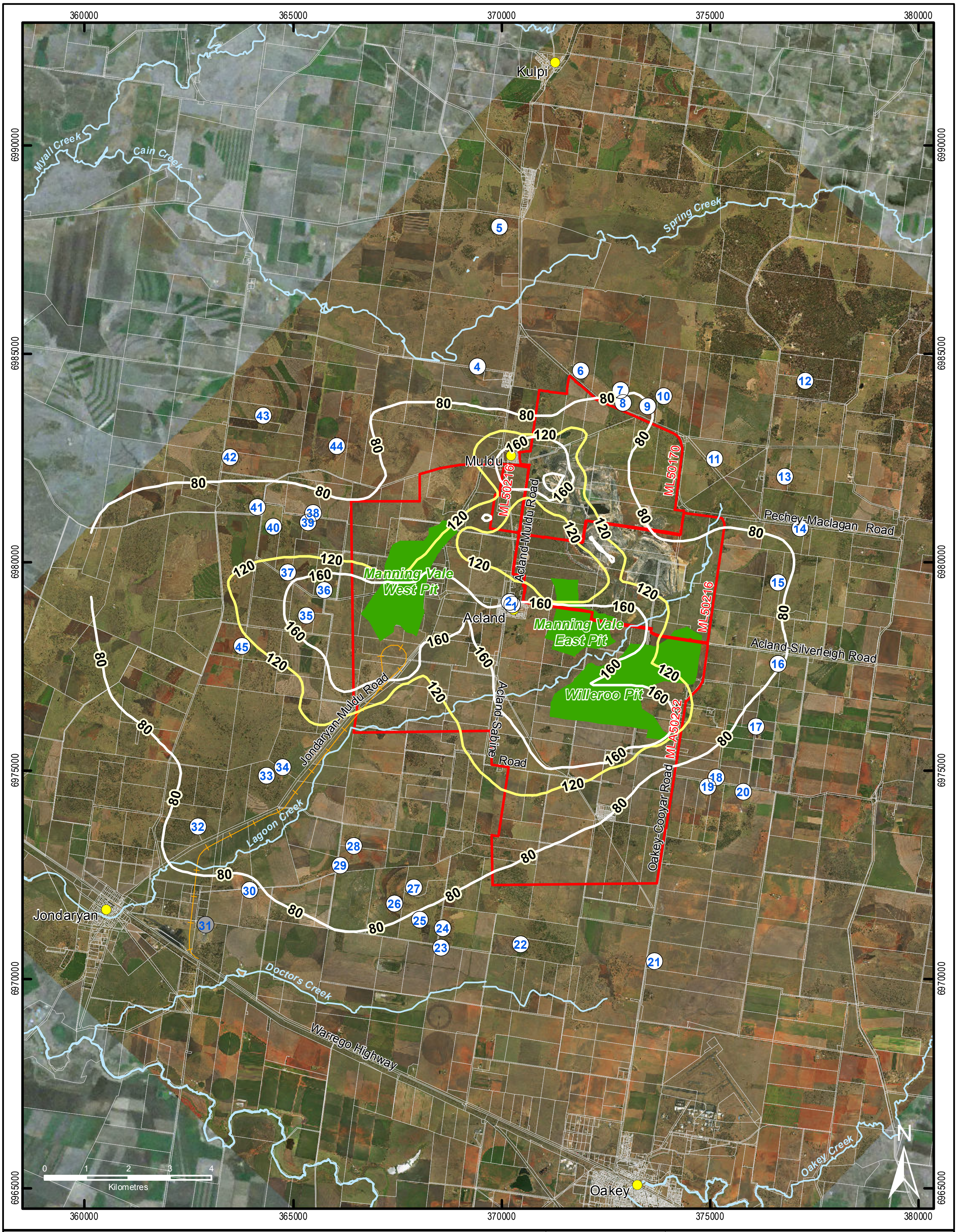

LEGEND

- Towns and Localities
- Sensitive Receptor - Residential
- Sensitive Receptor - Commercial
- Rail Spur
- Creeks
- Concentration Contour at air quality objective
- Concentration Contour
- Mining Tenements
- Stage 3 Pit Areas
- Cadastre

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Figure 9-29 - Contour plot of predicted monthly maximum dust deposition rates (mg/m^2/day) for 2029

Scale 1:120,000 on A4
Projection: Australian Geodetic Datum – Zone 56 (AGD84)

Path: I:\QENV2\Projects\QE06644\Spatial\ArcGIS\01_Figures\01_SEIS\09_AirQuality\131122_NewHope_AirQuality_Figure9-29_Contour_predicted_monthly_maximum_dust_deposition_rates_2029.mxd

Produced: 27/11/2013

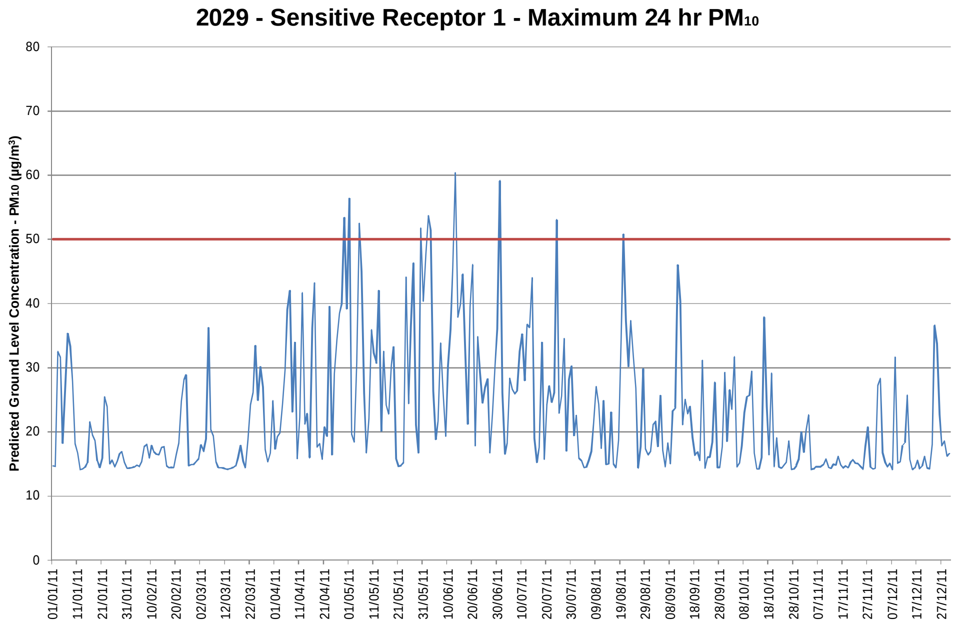


Figure 9-30 Time series of predicted 24 hour average PM_{10} concentrations ($\mu g/m^3$) at sensitive receptor 1 in 2029

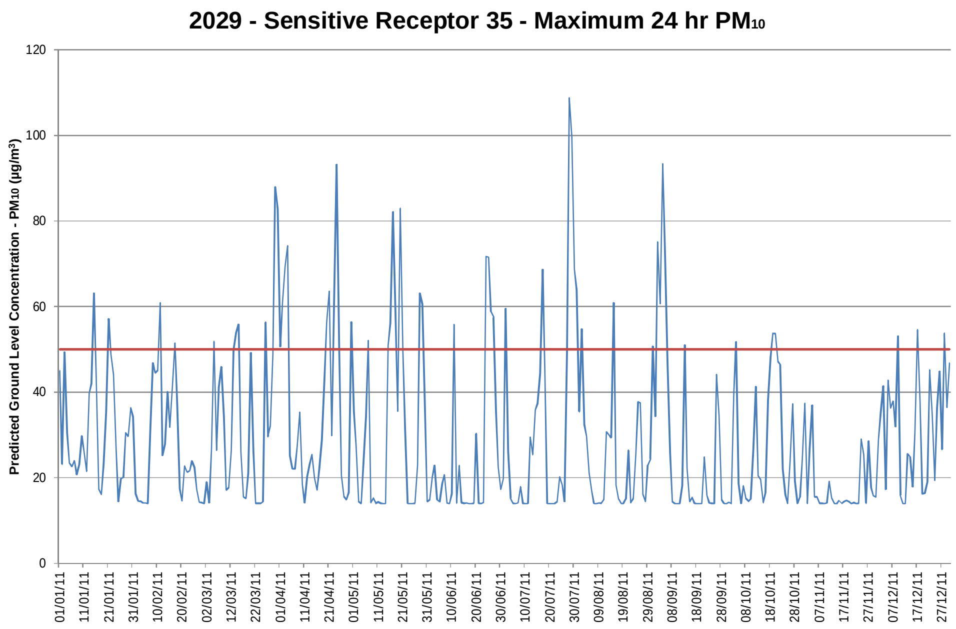


Figure 9-31 Time series of predicted 24 hour average PM_{10} concentrations at sensitive receptor 35 in 2029

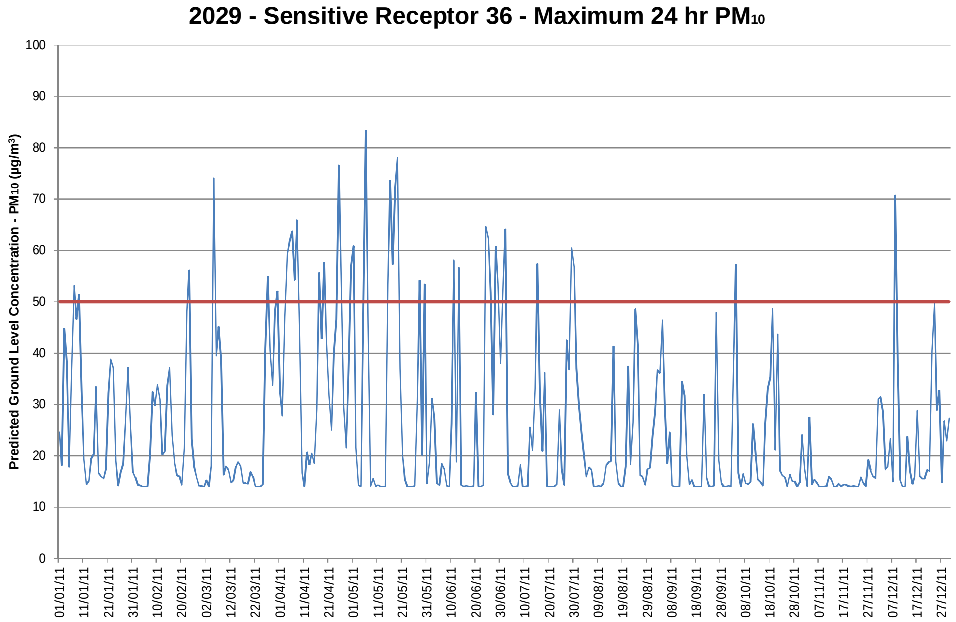


Figure 9-32 Time series of predicted 24 hour average PM_{10} concentrations at sensitive receptor 36 in 2029

The results of the modelling is summarised as follows.

- Exceedances of the EPP (Air) objective of 50 µg/m^3 for the 5th highest 24 hour average are predicted to occur at 4 of the 44 sensitive receptors (receptors 1, 35, 36, and 37).
- Exceedances of the DEHP nuisance guideline of 120 mg/m^2/day for monthly average dust deposition are predicted at 2 of the 44 sensitive receptors (35 and 36).
- No exceedances of the EPP (Air) objective for the 24 hour and annual average $PM_{2.5}$ concentrations or annual average TSP of 90 µg/m^3.
- The highest predicted PM_{10} ground level concentrations occur during the cooler months of autumn and winter which is dominated by poor atmospheric dispersion as discussed in **Section 9.3.4**.

As discussed for the 2019 and 2023 operating scenarios, the contour plots also generally show impacts from the particulate emissions are predicted to be greatest to the west of the revised Project activities which illustrates the effects of the prevailing easterly winds that carry the dust in the west direction and the distance from the Manning Vale West Pit to the sensitive receptors.

The main dust sources that have the potential to impact on the sensitive receptors are overburden activities (dozer, hauling and dumping), dozers on the coal floor and wind erosion from exposed areas.

Operations with Adaptive Air Quality Management

The 2029 mining scenario was re-modelled to assess the effectiveness of implementing adaptive air quality management for the revised Project as this scenario had the greatest potential for air quality impacts. The adaptive air quality management scenario assumes a dust forecasting system will enable operations to adapt by suspending dust activities likely to generate air quality impacts at sensitive receptors.

The adaptive air quality management approach for this scenario assumed the following parameters.

- Mining has been restricted to daytime hours (6 am – 6 pm) only in the Manning Vale East Pit when PM_{10} levels are predicted to exceed the air quality goals in the EPP (Air) at sensitive receptor 1.
- All overburden activities (including loading, dumping and hauling) have been suspended in the Manning Vale West Pit when PM_{10} levels are predicted to exceed the air quality goals in the EPP (Air) at any of sensitive receptors 35, 36, 37, 38 and 39.

The predicted cumulative PM_{10} and $PM_{2.5}$ concentrations for 2029 with and without adaptive air quality management are presented in **Table 9-20**. Time series of predicted 24 hour average PM_{10} concentrations with adaptive air quality management at sensitive receptors 1, 35, 36 and 37 are presented in **Figure 9-33**, **Figure 9-34**, **Figure 9-35** and **Figure 9-36** respectively. Days requiring adaptive air quality management are indicated by grey bars in the time series plots. The implementation of adaptive air quality management for the 2029 operating scenario indicates the following outcomes.

- No exceedances of the EPP (Air) objective of 50 µg/m^3 for the PM_{10} 5th highest 24 hour average and 25 µg/m^3 for the $PM_{2.5}$ 24 hour average.
- Adaptive air quality management is required for approximately 80 days in the Manning Vale East Pit and the Manning Vale West Pit.
- Successful implementation of adaptive air quality management will significantly reduce the potential for air quality impacts from the revised Project.

Table 9-20 Predicted cumulative PM_{10} and $PM_{2.5}$ concentrations for 2029 with and without adaptive air quality management

Sensitive Receptor	2029 Mining scenario			2029 Mitigated mining scenario		
	Maximum 24-hr PM_{10} (µg/m^3)	5th Highest 24-hr PM_{10} (µg/m^3)	Maximum 24-hr $PM_{2.5}$ (µg/m^3)	Maximum 24-hr PM_{10} (µg/m^3)	5th Highest 24-hr PM_{10} (µg/m^3)	Maximum 24-hr $PM_{2.5}$ (µg/m^3)
1	60	53	16	48	39	15
2	55	48	14	48	35	15
35	109	88	24	50	38	25
36	83	74	20	50	34	25
37	57	53	15	39	29	19
38	51	39	12	43	23	17
39	54	40	13	41	23	18
Air Quality objective	NA	50	25	NA	50	25

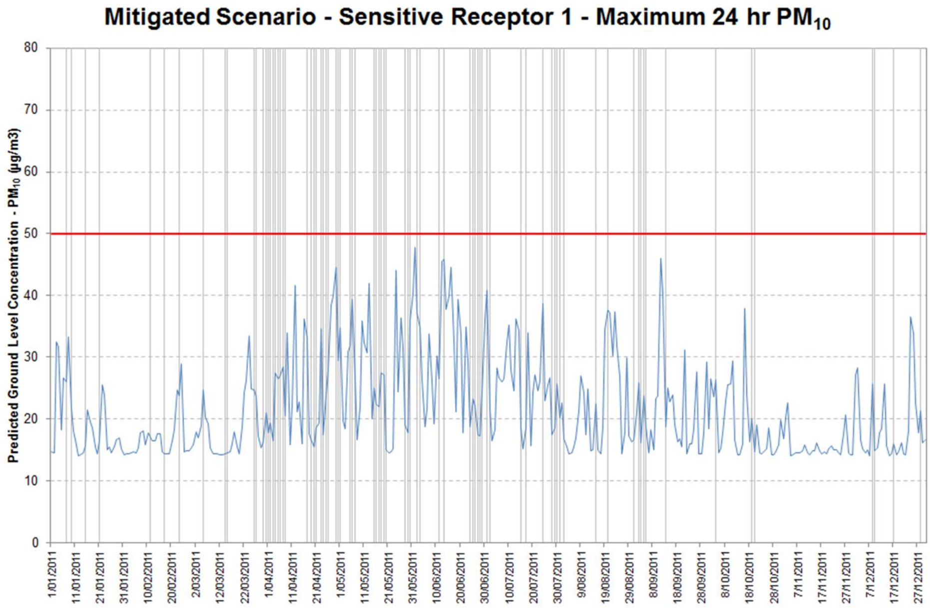


Figure 9-33 Time series of predicted 24 hour average PM_{10} concentrations ($\mu g/m^3$) at sensitive receptor 1 in 2029 implementing adaptive air quality management

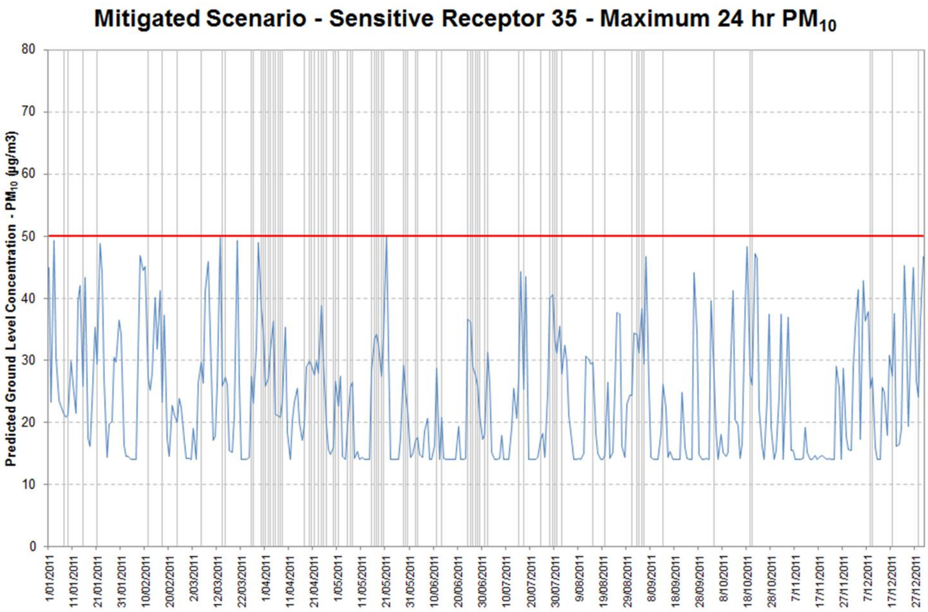


Figure 9-34 Time series of predicted 24 hour average PM_{10} concentrations ($\mu g/m^3$) at sensitive receptor 35 in 2029 implementing adaptive air quality management

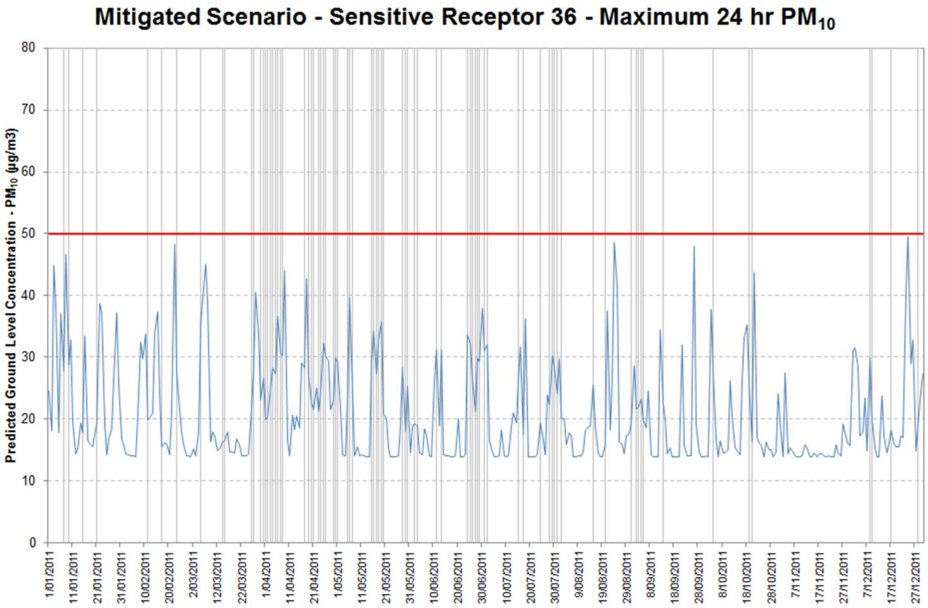


Figure 9-35 Time series of predicted 24 hour average PM_{10} concentrations (µg/m^3) at sensitive receptor 36 in 2029 implementing adaptive air quality management

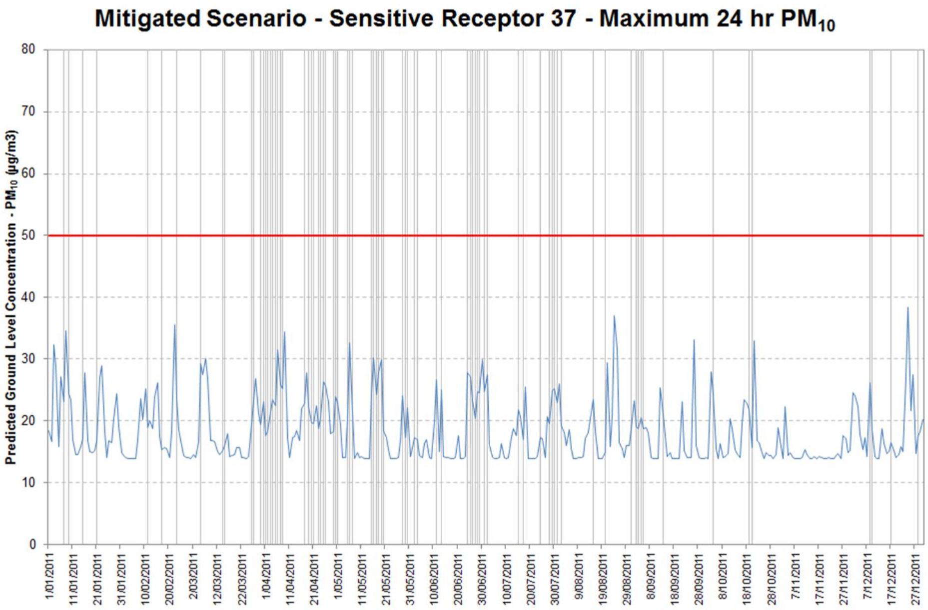


Figure 9-36 Time series of predicted 24 hour average PM_{10} concentrations (µg/m^3) at sensitive receptor 37 in 2029 implementing adaptive air quality management

9.4.5 Discussion

Impacts on animals and vegetation

Animals are expected to have a similar response to particulate emissions as humans. The air quality objectives for particulates in the EPP (Air) are considered appropriate guidelines to assess the potential health impacts on both humans and animals.

A dust load of 10 g/m^2 or a dust deposition rate of (1,000 mg/m^2/day) is predicted to result in measurable reductions in crop growth during overcast weather, but the effect may be more difficult to detect in sunny weather (Doley, 2003). The predicted dust deposition rates from the revised Project are not likely to have detectable adverse effects on pasture.

Most dust from coal mines is associated with windblown dust from overburden movements, wind erosion and wheel generated dust. Coal dust from a coal mine only makes up a small fraction of total dust emissions. Coal dust emissions represent approximately 15% of total dust emissions from the mine. Model calculations on a cotton crop suggest that dust loads of 5 g/m^2 or dust deposition rates of 500 mg/m^2/day are unlikely to have a detectable effect on vegetative growth (Doley, 2003). The predicted dust deposition rates from the revised Project should not have detectable adverse effects on crops.

Human health risk

There is a considerable body of international literature about the health effects of exposure to coal dust of respirable particle size. In almost every case the studies and associated reported health effects relate to coal miners and coal mine sites, either underground or open-cast. Health problems can result from the inhalation of high concentrations of respirable coal dust over extended periods (i.e. by underground coal mine workers), the most severe of which is Coal Worker's Pneumoconiosis (CWP), commonly known as Black Lung Disease. Respirable coal dust can also exacerbate asthma and chronic obstructive pulmonary disease.

Less well studied are the epidemiological effects of respirable coal dust in lower concentrations or exposure for shorter periods. A literature review by the Environment Canterbury Regional Council into the *Health Effects of Coal Dust in a Non-Occupational Context* summarises the outcomes of a study by the University of Newcastle-upon-Tyne's Department of Epidemiology and Public Health, published in December 1999, that looked into possible links between opencut coal mining, associated coal stockpiling and respiratory health. The key findings showed that opencut coal mining activity was:

- associated with a small increase in the mean PM_{10} particulate concentrations in areas close to opencut mines; and
- the respiratory health of children living close to the mine sites was very similar to that of children living in communities distant from such sites.

The review also discusses a study of public health records data for nearly 16,500 persons in West Virginia which investigated the relationships between health indicators and residential proximity to coal mining activities. The results are claimed to indicate that "high levels of coal production are associated with a worse adjusted health status" and with higher rates of cardiopulmonary disease, chronic obstructive pulmonary disease, hypertension, lung disease and kidney disease. No data are presented on relative proximity of residents to coal mining activity, whether the cohort contained actual coal miners, or about airborne dust concentrations to which persons were exposed.

In general, the vast majority of dust from mining activities comprises PM_{10} (around 40%) and particles larger than PM_{10} (around 60%), generated from natural activities such as mechanical disturbance of rock and soil materials by excavators, bulldozing, blasting, and vehicles on dirt roads. $PM_{2.5}$ (i.e. fine particles) are also produced at mine sites, though they only account for about 5% of the particles emitted during the mining process. Fine particles produced at mine sites are mainly from vehicle and mobile equipment exhausts (NSWMC, 2011).

Recent studies (Ono, 2007; Coward & Donaldson, 2005; USEPA, 2006) indicate that in susceptible sub-populations, fine particulate matter from combustion related sources are markedly more detrimental to health than coarse particulate fractions ($PM_{10-2.5}$). There is data associating PM_{10} from a combustion origin with health effects but this fraction also contains $PM_{2.5}$ (Drew, 2009), and hence, the specific cause cannot be delineated (Katestone Environmental, 2013).

Based on the available studies the air quality objectives in the EPP (Air) presented in **Table 9-1** are considered appropriate for the air quality assessment of the revised Project. Particulate emissions including TSP, PM_{10} and $PM_{2.5}$ have been modelled for the revised Project and compared with the air quality objectives in the EPP (Air). The modelling results show the revised Project with the adoption of adaptive air quality management will comply with the air quality objectives.

Impacts on water quality in rainwater tanks

Deposited dust from mining operations that is captured in rainwater tanks has the potential to affect rainwater quality through a potential increase in levels of suspended solids or concentrations of metals.

The Australian Drinking Water Guidelines (ADWG) (NHMRC & NRMMC, 2011) provides water quality levels considered safe for human consumption. NAC undertook water quality sampling of rainwater tanks around the Mine during 2007 and 2009. Results of water quality sampling from rainwater tanks are presented in **Appendix G.6.5**. The water quality sampling results for metals concentrations meet the recommended health and aesthetic guideline values in the ADWG.

Water quality in rainwater tanks is considered unlikely to exceed the water quality levels in the ADWG as a result of the revised Project. In consultation with affected landholders, NAC is committed to sampling of water quality sampling in rainwater tanks should air quality monitoring exceed the air quality objectives in the EPP (Air) or the dust nuisance goals. NSW Health (2007) Options to protect water quality in rainwater tanks include:

- use drinking water grade PVC for fittings;
- inlet and overflow of the tank should incorporate a mesh cover and a strainer to keep out materials such as leaves;
- cover the tank to prevent light reaching the water;
- discharge pipes from roof mounted appliances such as air conditioners should not be allowed to discharge onto the roof catchment;

- clean roof catchments and gutters of leaves and other debris every three or four months; and
- installation of first flush devices to prevent bird droppings and dust entering the rainwater tank after first rains.

Coal dust from rail transport

There have been some complaints from residents of Brisbane suburbs along the Metropolitan rail line to the Port of Brisbane concerning dust nuisance from the transport of coal (DSITIA, 2013).

In response to these complaints, air quality monitoring was undertaken during September 2012 (http://www.ehp.qld.gov.au/air/pdf/tennyson-dust-report.pdf). More comprehensive monitoring was undertaken during March and April 2013 and then again during May 2013 at six locations along the rail line of the South West System (SWS) (Oakey, Willowburn (Toowoomba), Dinmore, Tennyson, Fairfield and Coorparoo) and one background location on a section of the Metropolitan rail system not used by coal trains (Chelmer). The two-stage monitoring during 2013 was to assess air quality without and then with veneering of coal in rail wagons from the JRLF.

In all cases, ambient PM_{10} and $PM_{2.5}$ concentrations did not exceed the EPP (Air) 24-hour average air quality objectives of 50 µg/m^3 and 25 µg/m^3 respectively on any day. The PM_{10} and $PM_{2.5}$ concentrations measured at the monitoring sites located on the SWS differed little from those measured at DSITIA's ambient monitoring network sites in Brisbane. Furthermore, coal dust represented no more than 20% of dust deposited. The effect of veneering was not clear, masked by wet weather. Thorough coal washing appears to have limited coal dust emissions. The most recent report concluded a low risk of health impacts from coal dust, either within or outside the rail corridor, although there may be a potential for short term nuisance impacts from dust deposition (DSITIA 2013). The monitoring report is consistent with findings from a 2008 Queensland Rail study in Central Queensland (Connell Hatch, 2008).

The South West System Coal Dust Management Plan (CDMP) has been prepared to assist in mitigation and management of coal dust on the SWS rail corridor (SWS User Group 2013). This CDMP outlines the activities that are currently being undertaken by all members of the SWS User Group to minimise and manage coal dust emissions:

- **Moisture content management:** Washing or blending coal to achieve an optimum moisture level which reduces dust and achieves market qualities.
- **Improved loading practices:** Improved loading practices can reduce coal deposits on coal wagon ledges and wheel surfaces that are prone to spillage during transport. It also supports the ability to create a consistent surface of coal in each wagon.
- **Load profiling of coal surface:** The profile of the loaded coal wagon refers to the shape of the exposed surface of coal on the top of in the wagon. A flat surface with gradually sloping sides (referred to as a 'garden bed' type coal profiles) is has been demonstrated to reduce dust emissions.
- **Veneering:** Veneering is the application of a biodegradable polymer onto the surface of the loaded coal. The veneer forms a crust over the coal load reducing in coal dust lift-off from wagons.

- **Ongoing dust monitoring:** Commitment to a program of ongoing dust monitoring for a further 12 months to validate the effectiveness of mitigation measures and to confirm that dust levels, particularly coal dust levels, continue to meet environmental standards.

NAC proposes to construct a TLF as part of the revised Project. The TLF will replace the JRLF, which during April 2013 was upgraded to include a veneering system. The TLF's design expects to reduce potential coal dust emissions further, for example, through the use of a hopper feed to create 'garden bed' type coal profiles within the rail wagons.

The revised Project will result in up to an additional 27 weekly rail movements along the SWS to QBH. Additional rail movements from the revised Project are unlikely to increase fugitive coal dust emissions along the rail corridor due to the implementation of the CDMP and the advanced TLF. The revised Project is not expected to result in exceedances of the ambient air quality objectives in the EPP (Air). Ongoing rail coal dust monitoring of the SWS is planned (DSITIA 2013) including the collection of deposited dust samples over a 12 month period at one rail corridor monitoring site within Brisbane as part of the second phase of the Western – Metropolitan Rail Systems Coal Dust Monitoring Program will monitor this.

Overall, the cumulative dust impacts associated with the operation of the revised Project and its associated coal transport are unlikely to significantly affect the local or regional airshed.

Future regional sources

The potential cumulative impacts from other projects have been identified by reviewing current and proposed resource projects in the region. Details on current and future mining operations are presented in **Chapter 20 Cumulative Impacts** including the proximity to the revised Project, potential for cumulative environmental impacts, requirements for transport infrastructure and community services.

All other current and future mining operations are more than 60 km from the revised Project and therefore are unlikely to contribute to cumulative environmental impacts to air quality.

Accuracy of modelling

The USEPA (2003) has made the following statements on the accuracy and performance of air quality dispersion models.

- Models are more reliable for estimating longer time averaged concentrations than for estimating short-term concentrations at specific locations.
- Estimates of concentrations that occur at a specific time and site are poorly correlated with actual observed concentrations (paired in space and time) and are less reliable (mostly due to reducible uncertainty such as error in plume location due to a wind direction error).
- Models are reasonably reliable in estimating the highest concentrations occurring sometime, somewhere in an area. Model certainty is expected to be in the range of a factor of two.

It is recognised that all computer-based air dispersion models have inherent error and uncertainty, generally erring on the conservative (over-prediction) side. This is primarily because the complex meteorology, and its effect on air dispersion, cannot be characterised perfectly. The other key factor that contributes to error in the model predictions is emission estimation. For mining projects, and in particular dust-generating sources, the emission factors have been developed from a specific range of conditions (such as the moisture content or silt content of the soil at the time of the emission measurement), that may not necessarily be an accurate reflection of the conditions relating to the modelled activities.

Many dispersion model studies involving prediction of dust concentrations and comparison of predictions with monitored data (see for example, Holmes and Lakmaker, 2007; Bridgman *et al*., 2002) have shown that the current assessment procedures using dispersion modelling, local meteorological data and NPI emission estimation techniques can provide some confidence that predictions are accurate to within a factor of two.

The potential air quality impacts for current operations have been predicted using the methodology adopted for this assessment and compared air quality monitoring data to monitoring data record. The predicted ground level concentrations were predicted for the period from July 2011 to June 2012 and presented in **Section 9.3.5**. The predicted concentrations have been compared to air quality monitoring data recorded at monitoring locations Acland and Balgowan in **Appendix G.6.6**. The predicted 24 hour average PM_{10} concentrations for current operations were generally higher than recorded air quality monitoring data.

9.5 Mitigation Measures

This section outlines the proposed approach to minimise potential air quality impacts from the revised Project including:

- mitigation measures to minimise dust emissions;
- blast fume management procedures;
- dust forecasting system;
- air quality monitoring;
- adaptive management;
- local stakeholder engagement; and
- acquisition/relocation/treatment strategies.

9.5.1 Minimising Dust Emissions

Dust control measures for the operation of the revised Project are presented in **Table 9-21**.

Table 9-21 Dust control measures for operation of the revised Project

Mining Activity	Dust Control Measures
Material extraction and handling	Loading/dumping overburden The drop height of material from excavators will be minimised when loading trucks. Modification of operations will occur during adverse weather conditions (e.g. dust storms, gale force winds and storm conditions). Water carts will be employed to keep mine roads and work areas in a moist condition. Dozer operations on overburden dumps will be modified or suspended if dust generation is excessive.
Drilling and Blasting	Dust curtains will be installed on drill rigs (i.e. under the drill deck with fabric filters to collect dust). Water injector will be used on drill rigs to minimise dust emission. Local residents (neighbours) will be advised of blasting events (date and time). Blasting operations will be modified during adverse weather conditions (e.g. dust storms, gale force winds and storm conditions). Blasts will occur during daytime hours only and not on weekends or public holidays. Gravel/basalt stemming will be used in blast holes.
Haul roads	Water carts will maintain moisture conditions on haul roads. Road grading and maintenance will be undertaken on a regular basis. Key actions include: - Application of coarse rejects on haul roads to reduce dust generation. - Grading procedures to achieve constant spread of fines and coarser material. Speed on haul roads will be limited to 60km/h (20 km/h on selected corners). Where feasible, the volumes of trays on haul trucks will be maximised to increase carrying capacity and to reduce vehicle kilometres travelled on haul roads. Visual monitoring of haul roads and major work areas will be undertaken to identify noticeable dust generation for corrective actioning. Certain site roads will be sealed (near administration area – site access and employee car park). Efficient watering will be conducted during peak periods of activity and within areas of concentrated activity. Well defined and planned haul routes and internal roads will be developed to maximise efficiency of travel. Obsolete mine roads will be rehabilitated. The private haulage route from the Materials Handling Facility to Train Loading Facility will be a sealed road.

Mining Activity	Dust Control Measures
Exposed areas	The pre-strip areas will be planned to minimise the time of exposure following clearing in advance of mine development. Exposed areas/active areas will be watered if dust generation is observed. Where possible, topsoil will be stripped when its moisture content is elevated but not sodden. A vegetative cover will be established as soon as feasible on areas prepared for rehabilitation. Progressive rehabilitation will be conducted behind the active pit areas to minimise exposed areas. Unauthorised clearing of non-mine areas will be prevented using a 'permit to disturb' system.
ROM Pad	Water will be applied on a regular basis by a water cart on trafficked areas within the ROM Pad's operational area. Visual monitoring of ROM coal stockpiles will be undertaken to identify noticeable dust generation for corrective action. Water will be applied on the ROM coal stockpiles if significant dust levels are being generated.
CHPP and ROM Bin	ROM Bin Automatic water sprays will be installed at the ROM hopper bin to produce a fine mist to suppress dust generated when sensors are triggered. Surge Bin Dust curtains will be installed. Waters sprays will be used. Crushing Wet crushing will be employed. This activity will be fully enclosed. Conveyors Water sprays will be used on transfer points.
MHF	An automatic sprinkler system will be employed to moisten product coal stockpiles. Water sprays will operate at transfer points on conveyors. Coal spills will be removed regularly to minimise the potential for dust generation. A vacuum sweeper will operate on roads near the MHF. The washed coal will normally retain a moisture level of approximately 10%.
CHPP, MHF, TLF	No coal will be stored in open/exposed stockpiles. An enclosed overhead bin will deliver the coal to each rail wagon as part of the train loadout system. Coal will be loaded by side tipper into a hopper as part of the train loadout system. Veneering and profiling of the loaded coal will be conducted to minimise dust emissions during transport.

Dust control measures for the construction of the revised Project are presented in **Table 9-22**.

Table 9-22 Dust control measures for construction of the revised Project

Construction Activity	Dust Control Measures
Mine and Mine Infrastructure	The size of cleared areas will be kept to an operational minimum to limit exposed areas available for dust emissions by wind erosion. The speed of light vehicles on-site will be limited to reduce wheel-generated dust. A watering truck will be employed to control dust in dry and/or windy conditions. Cease works if excessive dust generation from construction activities occurs.
Rail Spur and Balloon Loop	The size of cleared areas will be kept to an operational minimum to limit exposed areas available for dust emissions by wind erosion. The speed of light vehicles on-site will be limited to reduce wheel-generated dust. A watering truck will be employed to control dust in dry and/or windy conditions. Cease works if excessive dust generation from construction activities occurs.

9.5.2 Fume Management

NAC have developed fume management procedures at the Mine which will be adopted for the revised Project. The fume management procedures form part of the **Air Quality Management Plan** in **Appendix J.10**. Key fume management actions include:

- review weather forecast;
- establish 300 m machine and 500 m personnel exclusion zones;
- establish Fume Management Zone based on expected meteorological conditions;
- notify neighbours on blast contact list of time and date of blast, and whether their residence is in the fume management zone;
- set up portable weather station to monitor field meteorological conditions;
- blast when meteorological conditions favourable; and
- capture, record and review relevant blast data.

In addition to general fume management practices, NAC continues to work closely with its explosive suppliers to minimise the potential for post blast fume. Recent developments to minimise potential impacts include innovation blasting methods and explosive products. These developments are likely to benefit the broader mining industry, particularly those mining operations operating in a fume sensitive environment.

9.5.3 Dust Forecasting System

NAC proposes to implement a dust forecasting system to provide daily predictions of upcoming meteorological conditions and potential risk of air quality impacts from mining operations from the revised Project.

The dust forecasting system predicts potential risk of air quality impacts using dispersion modelling tools for up to two days in advance. The dust forecasts will be updated on a daily basis, generating a daily automated email of forecast meteorological conditions and dust risk.

Predictions from the dust forecasting system will allow operators to identify locations and times of potentially increased risk, and to facilitate appropriate planning to minimise or avoid potential impacts. A proposed hierarchy of adaptive management measures for key sources of dust from mining operations is outlined in **Section 9.5.5**.

9.5.4 Air quality monitoring

An air quality monitoring program has been designed based on the dispersion modelling results presented in **Section 9.4.4.**

The air quality monitoring requirements for the revised Project are presented in **Table 9-23**. The locations of air quality monitoring equipment for the revised Project are presented in **Figure 9-37**.

Table 9-23 Summary of air quality monitoring requirements for the revised Project

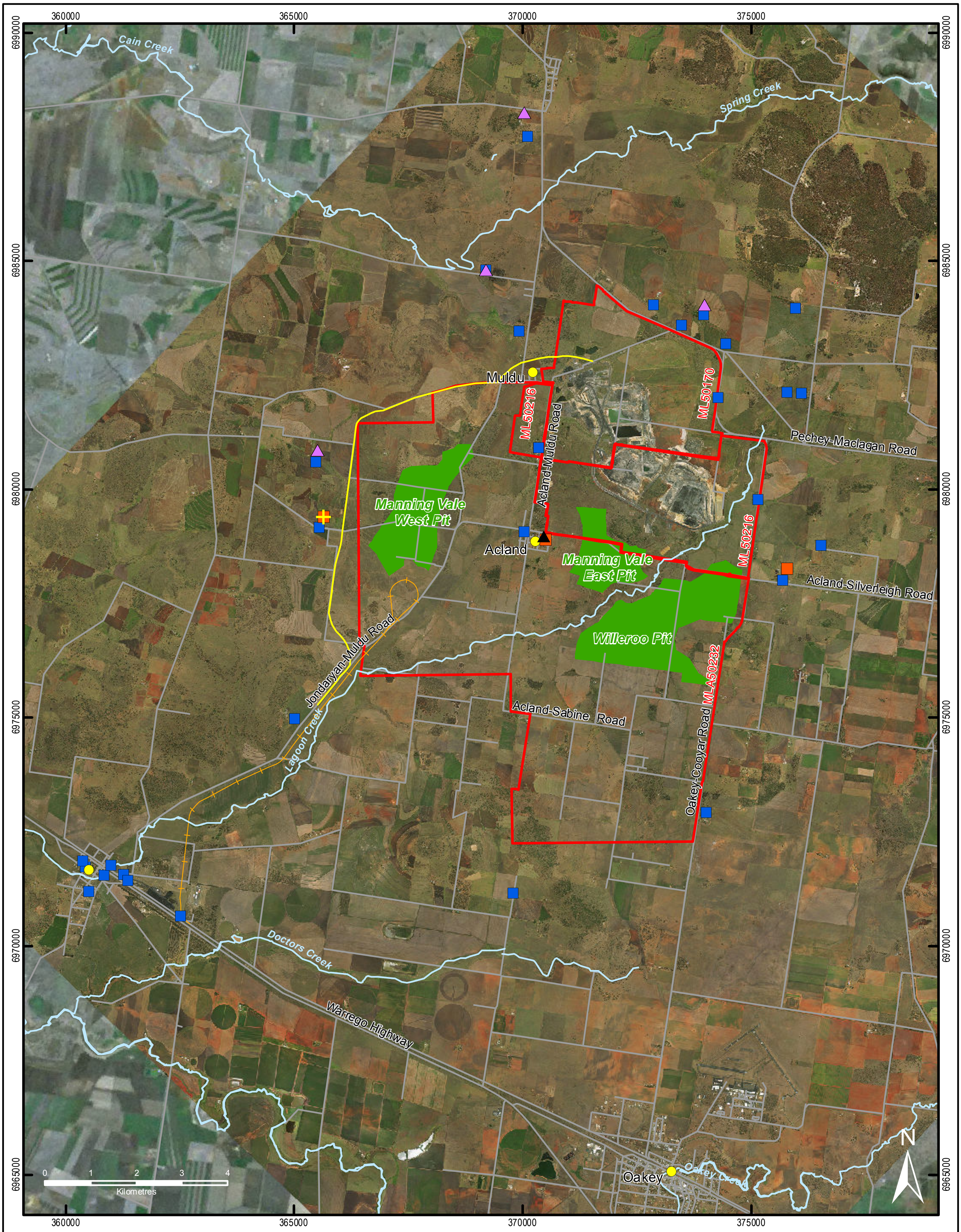
Instrument	Air Quality Indicator	Frequency	Air Quality Objective	Nuisance Goal	Methodology
TEOM	PM_{10}	Real-time	50 µg/m^3 (24 h avg)	-	AS/NZS 3580.9.8:2008
	TSP#	Real-time	90 µg/m^3 (annual)	80 µg/m^3 (24 h avg)	AS/NZS 3580.9.8:2008/ AS 3580.9.11:2009
High Volume Samplers	PM_{10}	Quarterly	50 µg/m^3 (24 h avg)	-	AS/NZS 3580.9.6:2003
Dust Deposition gauges	Insoluble solids	Monthly	-	120 mg/m^2/day (monthly average)	AS/NZS 3580.10.1:2003
Meteorological Station	-	Hourly	-	-	AS 3580.14:2011

there are no specific standards for measurement of real time TSP. The TEOM/BAM requires a suitable size-selective inlet to monitor TSP.

As required, compositional analysis of deposition samples or other localised dust fallout environments (e.g. exposed residential building surfaces or rainwater tank sludge of nearby sensitive receptors) may be undertaken periodically.

The rationale for each component of the air quality monitoring program is:

- Real time PM_{10} – determine compliance with EPP (Air) objective of 50 µg/m^3 and facilitate adaptive air quality management;
- Real time TSP – determine potential nuisance impacts to west of Manning Vale West Pit and determine compliance with EPP (Air) objective of 90 µg/m^3;
- Quarterly PM_{10} monitoring - continue historical monitoring and determine compliance with EPP (Air) objective of 50 µg/m^3;
- Dust deposition gauges – determine potential nuisance impacts and to continue historical monitoring; and
- Meteorological Station – analysis of data to will provide supporting data to assess potential for air quality impacts following any investigations of dust concerns raised.



LEGEND

- Towns and Localities
- Proposed rea time PM_{10} concentration
- Proposed real time TSP concentration
- Proposed Quarterly PM_{10} Monitoring Locations
- Proposed Dust Deposition guages
- Proposed Meteorological Station
- Rail Spur
- Roads
- Jondaryan-Muldu Road Diversion
- Creeks
- Mining Tenements
- Stage 3 Pit Areas

NEW HOPE GROUP

SKM

NEW ACLAND COAL MINE STAGE 3 PROJECT

Figure 9-37 - Proposed Air Quality Monitoring Locations for the revised Project

Scale 1:110,000 on A4

Projection: Australian Geodetic Datum – Zone 56 (AGD84)

Path: I:\QENV2\Projects\QE06644\Spatial\ArcGIS\01_Figures\01_SEIS\09_AirQuality\131122_NewHope_AirQuality_Figure9-37_ProposedMonitoring_Locations.mxd

Produced: 22/11/2013

9.5.5 Adaptive Air Quality Management

In addition to the dust controls identified in **Table 9-21**, a series of adaptive management measures are included in the **Air Quality Management Plan** for the revised Project in **Appendix J.10**. These adaptive management measures will include the suspension or modification of operations in response to the following triggers:

- potential dust risk predictions from the dust forecasting system;
- warning or exceedance alarms from the strategic real time air quality monitoring system; and
- observation(s) of significant dust generation during visual monitoring of mining activities.

An indicative hierarchy of controls in response to potential dust risk predictions from the dust forecasting system is presented in **Table 9-24**. The proposed hierarchy of adaptive management measures is ordered based on the reduction of dust emissions achievable. For example, suspension of night time operations will have the greatest reduction in dust emissions from the Manning Vale East Pit. Operators on-site will decide on the appropriate dust control based on the predicted dust risk, real time air quality monitoring data and visual monitoring of dust generating activities.

Table 9-24 Hierarchy of Dust Control Actions

Trigger	Possible Dust Control Actions
Dust risk predicted from the Manning Vale East Pit	1. Increase watering rate applied to haul roads in the Manning Vale East Pit 2. Suspension of overburden/interburden blasting if meteorological conditions are unfavourable 3. Suspension or modification of dozer operations on overburden dumps 4. Suspension of night-time operations (6am - 6pm) in the Manning Vale East Pit 5. Suspension or modification of all or selected overburden and/or coal handling activities (including excavation, loading, dumping and hauling)
Dust risk predicted from the Manning Vale West Pit	1. Increase watering rate applied to haul roads in the Manning Vale West Pit 2. Suspension of overburden/interburden blasting if meteorological conditions are unfavourable 3. Suspension or modification of dozer operations on overburden dumps 4. Suspension or modification of all or selected overburden and/or coal handling activities (including excavation, loading, dumping and hauling)
Dust risk predicted from the Willeroo Pit	1. Increase watering rate applied to haul roads in the Willeroo Pit 2. Suspension of overburden/interburden blasting if meteorological conditions are unfavourable 3. Suspension or modification of dozer operations on overburden dumps 4. Suspension or modification of all or selected overburden and/or coal handling activities (including excavation, loading, dumping and hauling)

9.5.6 Local Stakeholder Engagement

The potential for dust nuisance from the revised Project can be further reduced through:

- effective communications with local stakeholders on air quality issues associated with mining activities;
- a clearly identified point of contact should local stakeholders have comments or concerns;
- a well defined process to ensure that any issues are dealt with promptly and where possible to a satisfactory level; and
- a well defined system of recording any incidents or concerns.

NAC will undertake consultation with local stakeholders where dispersion modelling predicts there is a potential for dust nuisance from the revised Project. The processes for communicating with local stakeholders are provided in the Local Stakeholder Management Plan (refer to **Appendix J.18**).

All concerns about air quality will be investigated promptly and appropriate action will be taken to reduce legitimate dust nuisance. A register of dust concerns will be maintained. The processes for recording and investigating dust concerns are provided in the Air Quality Management Plan (refer to **Appendix J.10**).

9.5.7 Acquisition/relocation/treatment strategy

NAC will undertake a specific consultation approach for local landholders/neighbours that may be potentially affected by air quality impacts from the revised Project (i.e. based on the air quality modelling results). Depending on individual circumstances, NAC will seek to negotiate legal agreement with potentially affected local landholders/neighbours for either property acquisition, relocation of their living arrangements or physical treatment of their residence.

NAC proposes to acquire land or relocate sensitive receptors in the event that air quality impacts cannot be adequately managed by dust minimisation activities and adaptive air quality management. NAC will ensure all acquisition and relocation processes are managed in a fair and equitable manner and to the satisfaction of both parties.

NAC may treat affected local landholder/neighbour's residences if potential air quality impacts cannot be adequately managed by dust minimisation activities and adaptive air quality management. NAC will ensure all proposed treatment options are negotiated in a fair and equitable manner (e.g. air conditioning).

The predicted PM_{10} concentrations for the revised Project including adaptive air quality management measures comply with the air quality objectives in the EPP (Air).

9.6 Conclusion

This Chapter has assessed the air quality impacts of the revised Project at nearby surrounding sensitive receptors.

Air quality in the study area for the revised Project is influenced by current operations of the Mine and other localised sources including wind-blown dust and bushfires. NAC continues to undertake a range of air quality monitoring around the Mine (i.e. from 2001 to present). All recorded PM_{10} concentrations since commencement of monitoring are below the air quality goals in the EPP (Air).

Dust emissions for three operating scenarios of the revised Project were estimated using published emissions factors. Dust emissions estimates incorporated dust control factors in line with mining industry benchmarks for dust management.

CALPUFF was used to predict PM_{10} and TSP concentrations and dust deposition rates at sensitive receptors for three operating scenarios for the revised Project. Air dispersion modelling for the revised Project has predicted air quality will meet the EPP (Air) at 38 of the 43 sensitive receptors. The dispersion modelling indicates there is potential for air quality impacts at:

- sensitive receptor 1 due to mining operations in Manning Vale East Pit; and
- sensitive receptors 35, 36, 37, 38, 39 and 45 due to mining operations in Manning Vale West Pit.

NAC has proposed a comprehensive air quality management strategy to manage potential air quality impacts from the revised Project including the implementation of:

- mitigation measures to minimise dust emissions;
- blast fume management procedures;
- a dust forecasting system;
- a range of air quality monitoring techniques (real time and contemporary);
- adaptive air quality management;
- communication and concern management; and
- an acquisition/relocation/treatment strategy.

The implementation of adaptive air quality management measures will include the suspension or modification of operations in response to potential dust risk predictions from the dust forecasting system, real time air quality monitoring data and visual monitoring.

This assessment considered the potential residual air quality risk through dispersion modelling incorporating the adoption of adaptive air quality management. This assessment assumes mining is restricted to daytime hours (6 am – 6 pm) in the Manning Vale East Pit and suspension of overburden activities (including loading, dumping and hauling) in the Manning Vale West Pit for periods where there is potential for dust risk. The implementation of adaptive air quality management predicted no exceedances of the EPP (Air) objective. Successful implementation of adaptive air quality management will significantly reduce potential for air quality impacts from the revised Project.

The revised Project is expected to comply with the ambient air quality objectives in the EPP (Air) provided NAC successfully implement a comprehensive air quality management strategy including a dust forecasting system, real time air quality monitoring and adaptive air quality management through the suspension or modification of mining activities to reduce dust emissions.

9.7 Summary of Mitigation Measures and Commitments

Table 9-25 Summary of Mitigation Measures and Commitments

Mining Activity	Action
Minimising Dust Emissions	The drop height of material from excavators will be minimised when loading trucks. Modification of operations will occur during adverse weather conditions (e.g. dust storms, gale force winds and storm conditions). Water carts will be employed to keep mine roads and work areas in a moist condition. Dozer operations on overburden dumps will be modified or suspended if dust generation is excessive. Dust curtains will be installed on drill rigs (i.e. under the drill deck with fabric filters to collect dust). Water injector will be used on drill rigs to minimise dust emission. Local residents (neighbours) will be advised of blasting events (date and time). Blasting operations will be modified during adverse weather conditions (e.g. dust storms, gale force winds and storm conditions). Blasts will occur during daytime hours only and not on weekends or public holidays. Gravel/basalt stemming will be used in blast holes. Water carts will maintain moisture conditions on haul roads. Road grading and maintenance will be undertaken on a regular basis. Key actions include: ▪ Application of coarse rejects on haul roads to reduce dust generation. ▪ Grading procedures to achieve constant spread of fines and coarser material. Speed on haul roads will be limited to 60km/h (20 km/h on selected corners). Where feasible, the volumes of trays on haul trucks will be maximised to increase carrying capacity and to reduce vehicle kilometres travelled on haul roads. Visual monitoring of haul roads and major work areas will be undertaken to identify noticeable dust generation for corrective actioning. Certain site roads will be sealed (near administration area – site access and employee car park). Efficient watering will be conducted during peak periods of activity and within areas of concentrated activity. Well defined and planned haul routes and internal roads will be developed to maximise efficiency of travel. Obsolete mine roads will be rehabilitated. The private haulage route from the Materials Handling Facility to Train Loading Facility will be a sealed road. The pre-strip areas will be planned to minimise the time of exposure following clearing in advance of mine development. Exposed areas/active areas will be watered if dust generation is observed. Where possible, topsoil will be stripped when its moisture content is elevated but not sodden.

Mining Activity	Action
	A vegetative cover will be established as soon as feasible on areas prepared for rehabilitation. Progressive rehabilitation will be conducted behind the active pit areas to minimise exposed areas. Unauthorised clearing of non-mine areas will be prevented using a 'permit to disturb' system. Water will be applied on a regular basis by a water cart on trafficked areas within the ROM Pad's operational area. Visual monitoring of ROM coal stockpiles will be undertaken to identify noticeable dust generation for corrective action. Water will be applied on the ROM coal stockpiles if significant dust levels are being generated. ROM Bin Automatic water sprays will be installed at the ROM hopper bin to produce a fine mist to suppress dust generated when sensors are triggered. Surge Bin Dust curtains will be installed and waters sprays will be used at Surge Bin Wet crushing will be employed and will be fully enclosed. Water sprays will be used on transfer points along conveyors An automatic sprinkler system will be employed to moisten product coal stockpiles at MHF Water sprays will operate at transfer points on conveyors at MHF Coal spills will be removed regularly to minimise the potential for dust generation. A vacuum sweeper will operate on roads near the MHF. The washed coal will normally retain a moisture level of approximately 10%. No coal will be stored in open/exposed stockpiles. An enclosed overhead bin will deliver the coal to each rail wagon as part of the train loadout system. Coal will be loaded by side tipper into a hopper as part of the train loadout system. Veneering and profiling of the loaded coal will be conducted to minimise dust emissions during transport.
Blast fume management	Review weather forecast Establish 300 m machine and 500 m personnel exclusion zones Establish Fume Management Zone based on expected meteorological conditions Notify neighbours on blast contact list of time and date of blast, and whether their residence is in the fume management zone Set up portable weather station to monitor field meteorological conditions Blast when meteorological conditions favourable Capture, record and review relevant blast data
Dust Forecasting System	Implements a dust forecasting system to predict potential dust risk from the revised Project using dispersion modelling tools for up to two days in advance Dust forecasts will be updated on a daily basis, generating a daily automated email of forecast meteorological conditions and dust risk

Mining Activity	Action
Air Quality Monitoring	Real time monitoring for PM_{10} concentrations Real time monitoring for TSP concentrations Quarterly monitoring of PM_{10} concentrations Monthly dust deposition monitoring Meteorological monitoring
Adaptive Air Quality Management	Suspension or modification of operations in response to the following triggers: ▪ potential dust risk predictions from the dust forecasting system ▪ warning or exceedance alarms from the real time air quality monitoring system ▪ observation(s) of significant dust generation during visual monitoring
Local Stakeholder Engagement	Effective communications with local stakeholders All concerns about dust will be investigated promptly and appropriate action taken to reduce legitimate dust nuisance A register of dust concerns will be maintained for periodic review by the regulatory authority
Acquisition/relocation/ treatment strategy	Acquire/relocation sensitive receptors if air quality impacts cannot be adequately managed by dust minimisation and adaptive air quality management Physically treat sensitive receptor's residences if air quality impacts cannot be adequately managed by dust mitigation and adaptive air quality management (e.g. air conditioning)